PARTICULATE EMISSIONS TEST REPORT FOR W. R. GRACE

AUGUST 1991

RTP ENVIRONMENTAL ASSOCIATES INC.

AIR • WATER • SOLID WASTE CONSULTANTS

PARTICULATE EMISSIONS
TEST REPORT
FOR
W. R. GRACE

AUGUST 1991

PREPARED BY:

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INTRODUCTION

INTRODUCTION

This report presents the final results of the emissions tests performed for W.R. Grace.

The purpose of the tests was to determine the particulate emissions of the unit. The results of the tests can be found in Section II of this report.

The emissions testing was performed by Total Source Analysis, Inc., whose main office is located at 139 W. Herrick, Wellington, Ohio.

The tests were performed on August 27/29, 1991. The testing was performed in accordance with EPA reference methods as published in the July 1, 1990 Federal Register, - "Standards of Performance for New Stationary Sources" and subsequent revisions.

The testing equipment and sampling procedures are described in Section III of this report. The raw field data and equations used in determining final results are presented in the Appendix.

SUMMARY OF TEST RESULTS

SUMMARY OF TEST RESULTS

The following charts present the results of the particulate emissions tests performed at W.R. Grace.

PARTICULATE

RUN #	DATE	LOCATION	DSCFM	LB/DSCF	LBS/HOUR
1	8-27-91	Dryer Stack	19,644	1.21E-05	14.30
2	8-27-91	Dryer Stack	19,461	1.49E-05	17.43
3	8-27-91	Dryer Stack	19,586	1.74E-05	20.48
AVG.			19,564	1.48E-05	17.40

RUN #	DATE	LOCATION	DSCFM	LB/DSCF	LBS/HOUR
4	8-28-91	West Stack	4,462	2.34E-05	6.27
5	8-28-91	West Stack	4,533	2.14E-05	5.83
6	8-28-91	West Stack	4,606	2.60E-05	7.19
AVG.			4,534	2.36E-05	6.43

RUN #	DATE	LOCATION	DSCFM	LB/DSCF	LBS/HOUR
7	8-28-91	East Stack	4,595	1.11E-05	3.06
8	8-28-91	East Stack	4,411	9.13E-06	2.41
9	8-28-91	East Stack	4,444	1.60E-05	4.29
AVG.			19,564	1.21E-05	3.25

RUN #	DATE	LOCATION	DSCFM	LB/DSCF	LBS/HOUR
10	8-29-91	Unit 4 Stack	1,860	9.21E-06	1.02
11	8-29-91	Unit 4 Stack	1,908	1.27E-05	1.45
12	8-29-91	Unit 4 Stack	1,928	1.82E-05	2.10
AVG.			1,899	1.34E-05	1.52

Total Source Analysis, Inc.
Particulate Test Analysis

RTP
W.R. GRACE

91-155

Run Number		1	2	3
Data set		(01)	(02)	(03)
Date		8-27-91	8-27-91	8-27-91
Location		DRYER STACK	DRYER STACK	DRYER STACK
Start time		10:40	13:00	14:35
End time		11:45	14:03	15:15
Barometric Pressure	In. Hg	29.65	29.65	29.65
Static Pressure	In. H2O	1.20	1.20	1.20
Volume of Condensate	Mls	275	290	309
Volume Sampled	DCF	50.847	50.809	55.231
Meter Correction Factor		1.02	1.02	1.02
Square Root of Delta P		1.306	1.308	1.315
Orifice Pressure	In. H2O	2.62	2.92	2.91
Meter Temperature	Deg. F	89	92	97
Flue Temperature	Deg. F	174	175	176
Percent CO2	%	0.00	0.00	0.00
Percent O2	%	20.90	20.90	20.90
Diameter of Nozzle	In	0.225	0.225	0.225
Area of Flue	Sq Ft	5.94	5.94	5.94
Sample Time	Min	60	60	60
Weight Gain	Grams	0.2737	0.3349	0.4212
Absolute Flue Pressure	In. Hg	29.74	29.74	29.74
Corrected Sample Volume	DSCF	49.73	49.46	53.28
Moisture in Flue Gas	%	20.7	21.6	21.4
Molecular Weight	Lb/LbMole	26.60	26.49	26.51
Velocity of Flue Gas	FpS	83.97	84.33	84.81
Volume of Flue Gas	ACFM	29,926	30,054	30,228
Volume of Flue Gas	DSCFM	19,644	19,461	19,586
Dust Concentration	Lb/DSCF	1.21E-05	1.49E-05	1.74E-05
Dust Concentration	Lbs/Hour	14.30	17.43	20.48
Dust Concentration	Grs/ACF	5.66E-02	6.89E-02	8.03E-02
Dust Concentration	Grs/DSCF	8.49E-02	.10	.12
Isokinetic Rate	%	90.6	91.0	97.4

Averages:

Stack Temperature		175.0	Percent O2		20.9
Vol Flue Gas	ACFM	30,069	DSCFM		19,564
Part Emis	Lb/DSCF	1.48E-05	Lb/Hour		17.40
	Grs/ACF	6.86E-02	Grs/DSCF		.10
	Lbs/MBtu	0			

Total Source Analysis, Inc.
Particulate Test Analysis

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		4	5	6
Run Number		(04)	(05)	(06)
Data set				
Date		8-28-91	8-28-91	8-28-91
Location		WEST STACK	WEST STACK	WEST STACK
Start time		08:15	09:45	11:05
End time		09:15	10:47	12:07
Barometric Pressure	In. Hg	30.24	30.24	30.24
Static Pressure	In. H20	0.80	0.80	0.80
Volume of Condensate	Mls	39	42	38
Volume Sampled	DCF	50.711	50.486	49.290
Meter Correction Factor		1.02	1.02	1.02
Square Root of Delta P		0.795	0.809	0.823
Orifice Pressure	In. H20	2.60	2.62	2.49
Meter Temperature	Deg. F	82	85	90
Flue Temperature	Deg. F	110	109	113
Percent CO2	%	0.00	0.00	0.00
Percent O2	%	20.90	20.90	20.90
Diameter of Nozzle	In	0.254	0.254	0.254
Area of Flue	Sq Ft	1.77	1.77	1.77
Sample Time	Min	60	60	60
Weight Gain	Grams	0.5444	0.4939	0.5794
Absolute Flue Pressure	In. Hg	30.30	30.30	30.30
Corrected Sample Volume	DSCF	51.23	50.72	49.06
Moisture in Flue Gas	%	3.5	3.8	3.5
Molecular Weight	Lb/LbMole	28.46	28.43	28.46
Velocity of Flue Gas	FpS	46.41	47.22	48.18
Volume of Flue Gas	ACFM	4,929	5,015	5,117
Volume of Flue Gas	DSCFM	4,462	4,533	4,606
Dust Concentration	Lb/DSCF	2.34E-05	2.14E-05	2.60E-05
Dust Concentration	Lbs/Hour	6.27	5.83	7.19
Dust Concentration	Grs/ACF	.15	.13	.16
Dust Concentration	Grs/DSCF	.16	.15	.18
Isokinetic Rate	%	96.1	93.7	89.2

Averages:

Stack Temperature		: 110.7			
Vol Flue Gas	ACFM	: 5,020	Percent O2	:	20.9
	DSCFM			:	4,534
Part Emis	Lb/DSCF	: 2.36E-05	Lb/Hour	:	6.43
	Grs/ACF	: .15	Grs/DSCF	:	.16
	Lbs/MBtu	: 0			

Total Source Analysis, Inc.
Particulate Test Analysis

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91-155

Run Number		7	8	9
Data set		(07)	(08)	(09)
Date		8-28-91	8-28-91	8-28-91
Location		EAST STACK	EAST STACK	EAST STACK
Start time		12:30	13:50	15:00
End time		13:34	14:51	16:02
Barometric Pressure	In. Hg	30.24	30.24	30.24
Static Pressure	In. H2O	0.70	0.70	0.70
Volume of Condensate	Mls	41	39	39
Volume Sampled	DCF	49.491	41.317	40.940
Meter Correction Factor		1.02	1.02	1.02
Square Root of Delta P		0.836	0.807	0.813
Orifice Pressure	In. H2O	2.49	1.72	1.70
Meter Temperature	Deg. F	93	95	100
Flue Temperature	Deg. F	131	132	131
Percent CO2	%	0.00	0.00	0.00
Percent O2	%	20.90	20.90	20.90
Diameter of Nozzle	In	0.232	0.232	0.232
Area of Flue	Sq Ft	1.77	1.77	1.77
Sample Time	Min	60	60	60
Weight Gain	Grams	0.2468	0.1686	0.2916
Absolute Flue Pressure	In. Hg	30.29	30.29	30.29
Corrected Sample Volume	DSCF	48.99	40.68	39.94
Moisture in Flue Gas	%	3.8	4.3	4.4
Molecular Weight	Lb/LbMole	28.43	28.37	28.36
Velocity of Flue Gas	FpS	49.74	48.10	48.43
Volume of Flue Gas	ACFM	5,282	5,108	5,143
Volume of Flue Gas	DSCFM	4,595	4,411	4,444
Dust Concentration	Lb/DSCF	1.11E-05	9.13E-06	1.60E-05
Dust Concentration	Lbs/Hour	3.06	2.41	4.29
Dust Concentration	Grs/ACF	6.85E-02	5.59E-02	9.84E-02
Dust Concentration	Grs/DSCF	7.77E-02	6.39E-02	.11
Isokinetic Rate	%	107.0	92.5	90.2

Averages:

Stack Temperature		131.3	Percent O2		20.9
Vol Flue Gas	ACFM	5,178		DSCFM	4,483
Part Emis	Lb/DSCF	1.21E-05		Lb/Hour	3.25
	Grs/ACF	7.43E-02		Grs/DSCF	8.48E-02
	Lbs/MBtu	0			

Total Source Analysis, Inc.
Particulate Test Analysis

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91-155

Run Number		10	11	12
Data set		(10)	(11)	(12)
Date		8-29-91	8-29-91	8-29-91
Location		UNIT 4 STACK	UNIT 4 STACK	UNIT 4 STACK
Start time		08:00	09:20	10:45
End time		09:02	10:22	11:50
Barometric Pressure	In. Hg	30.16	30.16	30.16
Static Pressure	In. H2O	0.05	0.05	0.05
Volume of Condensate	Mls	33	26	32
Volume Sampled	DCF	43.769	45.292	45.333
Meter Correction Factor		1.02	1.02	1.02
Square Root of Delta P		0.324	0.332	0.340
Orifice Pressure	In. H2O	1.93	2.09	2.21
Meter Temperature	Deg. F	83	90	96
Flue Temperature	Deg. F	83	88	98
Percent CO2	%	0.00	0.00	0.00
Percent O2	%	20.90	20.90	20.90
Diameter of Nozzle	In	0.365	0.365	0.365
Area of Flue	Sq Ft	1.77	1.77	1.77
Sample Time	Min	60	60	60
Weight Gain	Grams	0.1836	0.2595	0.3672
Absolute Flue Pressure	In. Hg	30.16	30.16	30.16
Corrected Sample Volume	DSCF	43.95	44.92	44.48
Moisture in Flue Gas	%	3.4	2.7	3.3
Molecular Weight	Lb/LbMole	28.47	28.54	28.48
Velocity of Flue Gas	FpS	18.50	19.02	19.68
Volume of Flue Gas	ACFM	1,965	2,020	2,090
Volume of Flue Gas	DSCFM	1.860	1,908	1.928
Dust Concentration	Lb/DSCF	9.21E-06	1.27E-05	1.82E-05
Dust Concentration	Lbs/Hour	1.02	1.45	2.10
Dust Concentration	Grs/ACF	6.18E-02	8.49E-02	.11
Dust Concentration	Grs/DSCF	6.44E-02	8.91E-02	.12
Isokinetic Rate	%	95.8	95.4	93.5

Averages:

Stack Temperature		: 89.7	Percent O2	:	20.9
Vol Flue Gas	ACFM	: 2,025	DSCFM	:	1,899
Part Emis	Lb/DSCF	: 1.33E-05	Lb/Hour	:	1.53
	Grs/ACF	: 8.85E-02	Grs/DSCF	:	9.36E-02
	Lbs/MBtu	: 0			

SAMPLING AND ANALYTICAL PROCEDURES

TESTING EQUIPMENT - EPA METHOD 5 SAMPLING TRAIN

A Nutech Corporation Stack Sampler was used at the sampling location(s). The particulate sampling train consisted basically of a glass or stainless steel probe; a variable-heat-controlled filter oven with a calibrated Type K (Chromel/Alumel) thermocouple located at the impinger outlet; a 1/2-hp shaft sealed carbon vane vacuum pump assembly with a vacuum gauge; a control unit with an elapse time indicator, a temperature selector switch, a temperature indicator (potentiometer), temperature controllers, gauges, a calibrated dry gas meter, and an umbilical and various interconnecting hoses, fitting and valves. An appropriately sized glass or stainless-steel nozzle, a calibrated Type K temperature sensor, a static pressure tube, a calibrated S type pitot tube and a variable-heat-controlled stainless-steel liner with a calibrated Type K (Chromel/Alumel) thermocouple are integral parts of the probe assembly.

The vacuum pump was used to control gas sampling rates. The control unit was used to control probe and oven temperatures. The control unit was also used to monitor elapsed sampling times, temperatures, velocities, static pressure, gas sampling rates and sampled gas volume.

Analyzer (Orsat)

Flue gas concentrations were determined with a Gas Analyzer (Orsat) which measures the percentage of carbon dioxide, percentage of oxygen and percentage of carbon monoxide to the nearest tenth of a percent.

Programmable Calculator

A Hewlett Packard, Model 32S, programmable calculator was used to determine the isokinetic sampling rate at each sampling point.

Prior to the field testing, the following procedures were performed: All instruments were checked and calibrated. Gelman Spectro Grade, glass-fiber-mat filters with 99.95 percent retention of 0.3-micron particles were individually numbered, placed in similarly numbered glass petri dishes, desiccated for 24 hours and weighed on a Sartorious analytical balance to the nearest 0.1-milligram, and weighed a minimum of every six hours until two consecutive weights within +0.5 milligram were obtained, or heated for two to three hours at 220 degrees F, cooled in a desiccator and weighed. Several 250 milliliter crucibles were desiccated for a minimum of 24 hours and weighed in the same manner as the filters and petri dishes. Also, several 200-gram quantities of Type 6-16 mesh indicating silica gel were weighed on an Ohaus beam balance and placed into separate airtight polypropylene storage bottles.

The number of sampling points and positions of the points in the flue at the sampling location(s), and the sampling time at each point were determined prior to the particulate testing. The sampling procedures were performed in accordance with the Environmental Protection Agency's Reference Method 5, "Determination of Particulate Emissions from Stationary Sources" in the July 1, 1990 Federal Register, "Standards of Performance for New Stationary Sources" and subsequent revisions.

Before each test run a particulate sampling train was prepared inpart at the sampling location(s) in the following manner: An appropriately sized sampling nozzle was installed onto the inlet of the sampling probe and capped. The probe was then dimensioned and marked with glass-cloth tape at increments that corresponded with the predetermined sampling positions in the flue. A standard impinger assembly was prepared by adding 100 milliliters of distilled water to each of the first two impingers. The third impinger was left dry and the fourth was filled with approximately 200 grams of type 6-16 mesh indicating silica gel. The entire impinger assembly was then placed in an ice bath. A disc filter was removed from its petri dish and placed inside of a filter holder. The filter holder was then placed inside of a filter oven and assembled to the sampling probe outlet and the impinger unit inlet. Next, an umbilical and sampling hoses were connected to the sampling probe, filter oven, impinger unit, a vacuum pump and the control unit, accordingly.

The probe and oven were then heated to and held at 248 degrees plus or minus 25 degrees.

As soon as the probe and oven temperatures had stabilized the entire sampling train assembly was leak-checked at a minimum of 15 inches of mercury vacuum for one minute and the leakage rate recorded. A leakage rate of less than .02 cfm and no vacuum loss was considered acceptable.

After the particulate sampling train had been assembled, the probe and oven heated, and the entire system leak-checked, as previously described, the particulate sampling was performed.

Three test runs were performed at the sampling location(s). The sampling data for each test run was recorded on a field test form during each of the sampling periods.

After the completion of a test run, the following procedures were performed: A final leak-check was performed at maximum vacuum or greater incurred during the test for one minute and the leakage rate recorded. The flue gas moisture collected in the first three impingers was measured and recorded. The moisture laden silica gel in the fourth impinger was transferred to an appropriately marked, airtight polypropylene bottle and retained for later weighing. The weight gain of the silica gel moisture collection was added to the measured moisture condensed for that test run. The sample nozzle, probe and filter holder were capped and taken to a clean area for sample recovery. At the recovery area, the disc filter was carefully removed from the filter holder and transferred to its petri dish for later weighing.

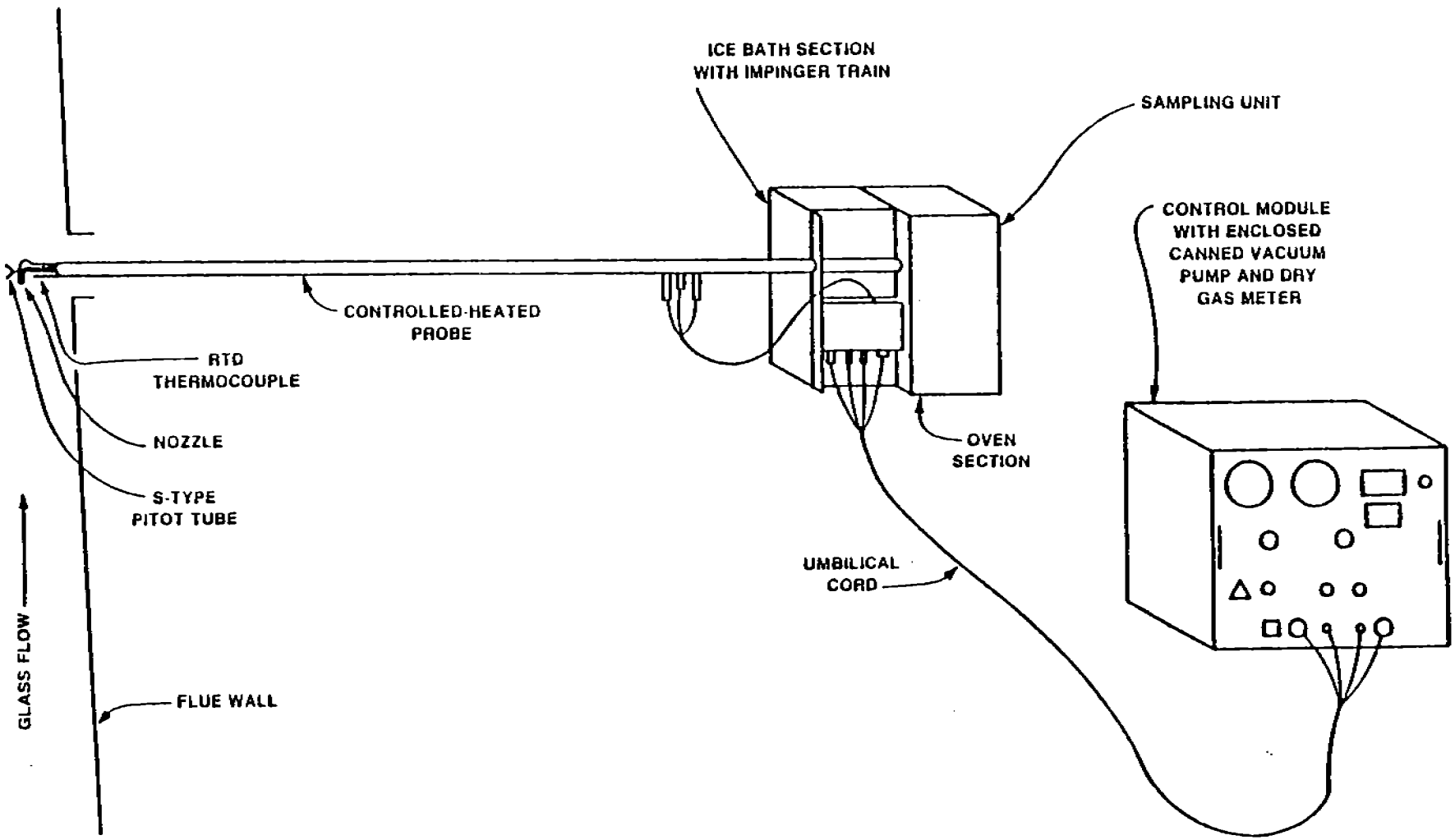
The sampling nozzle, probe and filter holder were washed with nanograde acetone, glass components were washed three times, stainless steel components were washed six times and visually inspected for cleanliness. The acetone washing and acetone blank were collected and labeled polypropylene sample bottles and retained for later evaporation, desiccation and weighing.

Flue gas concentrations (percentage of CO_2, percentage of O_2, and percentage of CO) were determined by taking several Orsat samples of the gas collected, simultaneously with the particulate sampling, throughout the test run, by an integrated gas sampling train. The integrated gas sample was collected from the discharge of the particulate control unit. The sampling train was set at a predetermined constant flow rate to obtain an adequate sample or by taking direct readings from the sampling points. The concentrations for each test run were recorded on a field test form.

ANALYTICAL PROCEDURES - EPA REFERENCE METHOD 5 (PARTICULATE)

After the field testing was completed, the following procedures were performed: Each silica gel moisture collection was weighed in it's storage bottle on an Ohaus beam balance with sensitivity of 0.1-gram. Each disc filter and petri dish was oven dried at 220 degrees Fahrenheit for two to three hours and cooled in a dessicator for two hours before weighing. Each acetone washing and acetone blank was transferred from its sample bottle to a preweighed crucible for evaporation. When the acetone in a crucible had completely evaporated, the crucible was transferred to a desiccator for further drying at room temperature. Each acetone blank collected was used to determine the amount of residual weight each crucible retained due to acetone impurities. Each disc filter and petri dish, acetone washing and acetone blank was weighed on a Sartorious analytical balance with a sensitivity of 0.1-milligram.

All test instruments were recalibrated to determine the deviation percentage.



Total Source Analysis, Inc.
Environmental Testing Consultants

TYPICAL SAMPLING TRAIN

Sample Calculations

APPENDIX

NOMENCLATURE

acf	= actual cubic feet
acfm	= actual cubic feet per minute
A	= effective area of flue in square feet
acm	= actual cubic meters
acmm	= actual cubic meters per minute
A_n	= inside area of sampling nozzle in square feet
B_{ws}	= water vapor in gas stream, proportion by volume
%C	= percent carbon by weight, dry basis
%CO	= percent carbon monoxide by volume, dry basis
$\%CO_2$	= percent carbon dioxide by volume, dry basis
C_p	= pitot tube coeffecient
D_I	= dust loading per heat input in pounds (grams) per million Btu (calories) per Fr constant
D_I'	= dust loading per heat input in pounds (grams) per million Btu (calories) per Fr calculated
dscf	= dry standard cubic feet
dscfh	= dry standard cubic feet per hour
dscm	= dry standard cubic meters
dscmh	= dry standard cubic meters per hour
fps	= feet per second
F_r	= ratio factor of dry flue gas volume to heat value of combusted fuel in dry standard cubic feet (meters) per million Btu (calories)
gms	= grams
gm-mole	= gram-mole
grs	= grains
ΔH	= orifice pressure drop in inches water, average
%H	= percent hydrogen by weight, dry basis
H_c	= heat of combustion in Btu per pound, dry basis
hr	= hour
%I	= percent isokinetic
in. Hg	= inches mercury
lbs	= pounds
lb-mole	= pound-mole
%M	= percent moisture by volume
mmBtu	= million Btu
mmcal	= million calories
mm Hg	= millimeters mercury
mps	= meters per second
M_s	= molecular weight in pounds (gram) per pound (gram) mole (wet basis)
%N	= percent nitrogen by weight, dry basis
$\%N_2$	= percent nitrogen by difference, dry basis
%O	= percent oxygen by difference, dry basis
$\%O_2$	= percent oxygen by volume, dry basis
P_b	= barometric pressure in inches mercury
P_{std}	= standard absolute pressure (29.92 in Hg)
P_s	= absolute pressure in flue in inches (millimeters) mercury
P_f	= static pressure in flue in inches water, average
$\sqrt{\Delta P}$	= square root of velocity head in inches water, average
%S	= percent sulfur by weight, dry basis
scf	= standard cubic feet
scm	= standard cubic meters
T_{std}	= absolute temperature of air in degrees Rankine at standard conditions (528 degrees)
T_S	= absolute temperature of flue gas in degrees Rankin, average
T_m	= absolute temperature at meter in degrees Rankine, average
V_S	= velocity of flue gas in feet (meters) per second
V_l	= volume of condensate through the impingers in milliliters
V_{lc}	= volume of liquid collected in condenser in milliliters plus weight of liquid absorbed in silica gel in grams indicated as milliliters
V_m	= volume of metered gas measured at meter conditions in cubic feet (meters)
V_{ms}	= volume of metered gas corrected to dry standard conditions in cubic feet (meters)
V_o	= volume of flue gas at actual conditions in cubic feet (meters) per minute
Q_{sd}	= volume of flue gas corrected to dry standard conditions in cubic feet (meters) per hour
V_t	= total volume of flue gas sampled at actual conditions in cubic feet (meters)
V_w	= volume of water vapor in metered gas corrected to standard conditions in cubic feet (meters)
V_{wc}	= volume of water condensed in impingers corrected to standard conditions
V_{wsg}	= volume of water collected in silica gel corrected to standard conditions
W_a	= total weight of dust collected per unit volume in grains (grams) per actual cubic feet (meters)
W_d	= total weight of dust collected per unit volume in pounds (grams) per dry standard cubic feet (meters)
W_g	= total weight of dust collected in grams
W_h	= total weight of dust collected per unit volume in pounds (grams) per hour, dry basis
W_p	= total weight of dust collected in pounds
W_s	= total weight of dust collected per unit volume in grains (grams) per dry standard cubic feet (meters)
W_{sg}	= impinger silica gel weight gain in grams
Y	= metered gas volume correction factor
Θ	= total elapsed sampling time in minutes

EPA DUST LOADING Formulas

(1) ABSOLUTE FLUE PRESSURE (in. Hg)

$$P_s = (\pm P_f \div 13.6) + P_b$$

(2) WATER VAPOR VOLUME IN METERED GAS CORRECTED TO STANDARD CONDITIONS (scf)

$$V_{wc} = .04707 \times V_l \qquad V_{wsg} = .04715 \times W_{sg}$$
$$V_w = V_{wc} + V_{wsg}$$

(3) METERED GAS VOLUME CORRECTED TO STANDARD CONDITIONS (scf)

$$V_{ms} = 17.64 \times Y \times V_m \frac{P_b + (\Delta H/13.6)}{T_m}$$

(4) PERCENT MOISTURE IN FLUE GAS

$$B_{ws} = \frac{V_w}{(V_{ms} + V_w)} \qquad \%M = B_{ws} \times 100$$

(5) AVERAGE RESULTS OF FLUE GAS ANALYSIS

$$\%N_2 \text{ dry} = 100 - (\%CO_2 + \%O_2 + \%CO)$$

(6) APPROXIMATE MOLECULAR WEIGHT OF FLUE GAS (WET BASIS) (lb/lb-mole)

$$M_s = (18 \times B_{ws}) + \Big((.440\ (\%CO_2) + .320\ (\%O_2) + .280\ (\%N_2 + \%CO)\Big) \times (1. - B_{ws})$$

(7) GAS VELOCITY IN FLUE (fps)

$$V_s = 85.49 \times C_p \times (\sqrt{\Delta P}\ )_{\text{avg.}} \sqrt{\frac{T_s}{P_s \times M_s}}$$

(8) FLUE GAS VOLUME AT ACTUAL CONDITIONS (acfm)

$$V_o = V_s \times A \times 60$$

(9) FLUE GAS VOLUME CORRECTED TO DRY STANDARD CONDITIONS (dscfh)

$$Q_{sd} = \frac{T_{std}}{29.92} \times \frac{P_s}{T_s} \times V_o \times (1 - B_{ws}) \times 60$$

(10) TOTAL FLUE GAS VOLUME SAMPLED AT ACTUAL CONDITIONS (acf)

$$V_t = \left[V_m \times Y \times \frac{T_s}{T_m} \times \left(\frac{P_b + (\Delta H/13.6)}{P_s} \right) \right] + \left(0.00267 \times V_{lc} \times \frac{T_s}{P_s} \right)$$

EPA DUST LOADING FORMULAS (Continued)

(11) DUST CONCENTRATION FOR INDIRECT HEATING UNIT ACTUAL CONDITIONS AND STANDARD CONDITIONS

W_g = gms

$W_p = 0.002205 \times W_g$ (lb)

$W_d = \frac{W_p}{V_{ms}}$ (lb/dscf)

$W_h = W_d \times Q_{sd}$ (lb/hr dry)

$W_a = \frac{7000 \times W_p}{V_t}$ (gr/acf)

$W_s = 7000 \times W_d$ (gr/dscf)

$D_l = \frac{9780 \times 20.9 \times W_d}{(20.9 - \%O_2)}$ (lb/mmBtu with constant 9780Fr)

$F_r = \frac{10^6 \times [(3.64 \times \%H) + (1.53 \times \%C) + (0.57 \times \%S) + (0.14 \times \%N) - (0.46 \times \%O)]}{H_c}$ (dscf/mmBtu)

$D_l' = \frac{20.9 \times W_d \times F_r}{(20.9 - \%O_2)}$ (lb/mmBtu with calculated F_r)

(12) PERCENT OF ISOKINETIC SAMPLING

$$\%I = \frac{1.667 \times T_s \times \left\{0.00267 \times V_{lc} + \left[\frac{V_m \times Y}{T_m} \times \left(P_b + \Delta H/13.6\right)\right]\right\}}{\Theta \times V_s \times P_s \times A_n}$$

Test Data Sheets

Particulate Field Data Sheet

Client: W.R. GRACE (ATP)			Date: 8-27-91 Page 1 Of 2
Project No.: 91-155	Operator: J. SUTTON		Orsat Analysis
Sampling Location: DRYER STACK		Run No.: 1	CO_2 / $+O_2$ / O_2 / CO
Filter No.: 91-127	Acetone No.:	Condensate: 284 ml	0 / — / 20.9 / —
Barometric Pressure: 29.65	Static Pressure: +1.2	Probe Number: 4-1	— / — / — / —
Nozzle Diameter: .228	Nozzle Number: 2-6	Pitot Coefficient: .84	Pitot Number: 4-1 — / — / — / —
Meter Corr. Factor: 1.02	Meter-Orifice: 10 (3.68)		— / — / — / —
Sample Pt. Time: 5 min	Assumed % Moisture: 25%	Leak Test: Before 0.008 @ 15"	After 0.005 @ 10"

Sample Point	ΔP	√ΔP	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr (in. HG)	Dry Gas Meter Reading in Cu. Ft.
	START	10:40				68					121.916
A 1	1.4	1.183	2.11	180	259		254	84		1	125.45
2	1.6	1.265	2.41	170	255		256	85		1	129.31
3	1.8	1.342	2.79	166	255		261	88		1	133.62
4	2.0	1.414	3.60	166	254		251	87		2	138.22
5	1.8	1.342	2.79	179	255		256	88		2	142.78
6	1.7	1.304	2.58	186	253		255	89		2	147.071
B 1	1.7	1.304	2.58	168	254		256	89		2	151.26
2	1.6	1.265	2.43	169	255		257	90		2	155.23
3	1.7	1.304	2.63	164	252		258	90		2	159.95
4	1.9	1.378	2.94	188	254		259	91		2	164.12
5	1.8	1.342	2.78	177	253		252	91		2	168.79
6	1.5	1.225	2.32	172	255		256	91		2	172.763
	STOP	11:45									
	AVG	1.306	2.62	174				89			50.847

Pitot Tube Leak Check: Before OK After OK

Integrated Bag Leak Check: Before OK After OK

Particulate Field Data Sheet

Client: W. R. GRACE				Date: 8-27-91	Page 1 Of 2
Project No.: 91-155	Operator: J. SCOTTON			Orsat Analysis	
Sampling Location: DRYER STACK			Run No.: 2	CO_2: 0	$+O_2$:	O_2: 20.9	CO:
Filter No.: 91-149	Acetone No.:	Condensate: 265					
Barometric Pressure: 29.65	Static Pressure: +1.2	Probe Number: 4-1					
Nozzle Diameter: .225	Nozzle Number: 2-6	Pitot Coefficient: .84	Pitot Number: 4-1				
Meter Corr. Factor: 1.02	Meter-Orifice: 10 (3.68						
Sample Pt. Time: 5 min	Assumed % Moisture: 22.9	Leak Test	Before: 006 @ 15"	After: 004 @ 10"			

Sample Point	ΔP	$\sqrt{\Delta P}$	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr (in. HG)	Dry Gas Meter Reading in Cu. Ft.
	START	1:00 pm				68					173.426
A 1	1.5	1.225	2.51	162	255		257	90		1	177.563
2	1.6	1.265	2.75	158	256		257	90		1	181.82
3	1.8	1.342	3.10	170	259		256	92		2	186.43
4	2.0	1.414	3.43	166	258		257	92		2	191.18
5	1.7	1.304	2.93	190	256		258	92		2	195.58
6	1.6	1.265	2.66	185	257		255	92		2	199.831
1	1.6	1.265	2.66	174	258		257	92		3	204.13
2	1.8	1.342	2.99	178	256		256	92		2	209.73
3	1.7	1.304	3.73	183	257		255	93		2	214.29
4	2.1	1.449	3.52	184	255		257	93		3	219.36
5	1.8	1.342	3.02	169	256		256	95		3	224.23
6	1.4	1.183	2.35	178	255		251	95		3	
	STOP	2:03 pm									
	AVG	1.308	2.92	175				92			50.809

Pitot Tube Leak Check: Before OK After OK

Integrated Bag Leak Check: Before OK After OK

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Particulate Field Data Sheet

Client: W. R. GRACE (RTP)				Date: 8-26-91	Page 1 Of 2
Project No.: 91-155	Operator: J. SUTTON			Orsat Analysis	
Sampling Location: Dryer STACK		Run No.: 3		CO_2	$+O_2$ / O_2 / CO
Filter No.: 91-097	Acetone No.:	Condensate: 285 ml		0	20.9
Barometric Pressure: 29.65	Static Pressure: 1.2	Probe Number: 4-1			
Nozzle Diameter: .225	Nozzle Number: 2-6	Pitot Coefficient: .84	Pitot Number: 4-1		
Meter Corr. Factor: 1.02	Meter-Orifice: 10 (3.68)				
Sample Pt. Time: 5 min	Assumed % Moisture: 25	Leak Test	Before: 0.004 @ 15"	After: 0.002"	

Sample Point	ΔP	$\sqrt{\Delta P}$	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr (in. HG)	Dry Gas Meter Reading in Cu. Ft.
	START	2.35				68					229.320
A 1	1.5	1.225	2.51	163	250		256	9	5	1	233.45
2	1.8	1.342	3.02	178	252		257	9	5	2	237.99
3	1.7	1.304	2.85	171	254		256	9	6	2	242.68
4	1.9	1.378	3.18	184	256		259	9	6	2	249.93
5	1.8	1.342	3.02	182	257		256	9	7	2	253.46
6	1.6	1.265	2.68	169	256		259	9	8	2	257.739
B 1	1.6	1.265	2.68	174	258		256	9	8	2	262.38
2	1.7	1.304	2.85	175	256		259	9	7	3	266.90
3	1.4	1.183	2.35	193	255		256	9	8	3	270.89
4	2.1	1.449	3.52	175	254		258	9	8	3	275.85
5	2.0	1.414	3.35	172	255		256	9	8	3	280.331
6	1.7	1.304	2.85	178	256		253	9	9	3	284.552
	STOP	3.45									
	AVG	1.315	2.91	176				47			55.231

Pitot Tube Leak Check: Before OK After OK

Integrated Bag Leak Check: Before OK After OK

TSA

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Particulate Field Data Sheet

Client: W. R. GRACE (RTP)				Date: 8-28-91	Page 1 Of 2
Project No.: 91-155	Operator: J. SUTTON			Orsat Analysis	
Sampling Location: ROOF CYCLONE WEST STACK	Run No.: 4			CO_2 / $+O_2$ / O_2 / CO	
Filter No.: 91-251	Acetone No.:	Condensate: 25mL		0 / — / 20.9 / —	
Barometric Pressure: 30.24	Static Pressure: .8	Probe Number: 4-1		— / — / — / —	
Nozzle Diameter: .254	Nozzle Number:	Pitot Coefficient: .84	Pitot Number: 4-1	— / — / — / —	
Meter Corr. Factor: 1.02	Meter-Orifice: 10 (3.68)			— / — / — / —	
Sample Pt. Time: 5min	Assumed % Moisture: 8%	Leak Test	Before: 003@15"	After: 004@12	

Sample Point	ΔP	$\sqrt{\Delta P}$	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr (in. HG)	Dry Gas Meter Reading in Cu. Ft.
	START	8:15				68					285.062
A 1	.65	.806	2.68	109	256		254	8	0	1	289.33
2	.75	.866	3.10	110	257		256	8	0	2	293.92
3	.73	.854	2.99	110	255		253	6	1	2	298.48
4	.66	.812	2.70	110	254		256	8	1	2	303.08
5	.59	.768	2.41	110	255		257	8	0	2	307.15
6	.53	.728	2.17	110	259		256	9	1	2	310.96
B 1	.70	.837	2.86	111	259		258	8	2	3	315.38
2	.72	.849	2.95	112	257		256	8	2	3	319.85
3	.70	.837	2.86	112	258		257	8	2	3	324.26
4	.62	.787	2.54	111	254		255	8	3	4	328.44
5	.55	.742	2.25	110	255		253	8	4	4	332.35
6	.42	.648	1.72	110	254		253	8	4	4	335.723
	STOP	9:15									
	AVG	.795	2.60	110				8	2		50.711
						6					

Pitot Tube Leak Check: Before OK After OK

Integrated Bag Leak Check: Before OK After OK

Particulate Field Data Sheet

Client: W. R. GRACE (RPT)				Date: 8-28-90	Page: 1 Of 2
Project No.: 91-155	Operator: J. SUTTON			Orsat Analysis	
Sampling Location: CYCLONE WEST STACK		Run No.: 5		CO_2 / $+O_2$ / O_2 / CO	
Filter No.: 91-138	Acetone No.:	Condensate: 25 ml		0 / — / 20.9 / —	
Barometric Pressure: 30.24	Static Pressure: +.8	Probe Number: 4-1		— / — / — / —	
Nozzle Diameter: .254	Nozzle Number:	Pitot Coefficient: .84	Pitot Number: 4-1	— / — / — / —	
Meter Corr. Factor: 1.02	Meter-Orifice: 10 (3.68)			— / — / — / —	
Sample Pt. Time: 5 MIN	Assumed % Moisture: 7%	Leak Test	Before: 0.006 @ 15"	After: 0.004 @ 12"	

Sample Point	ΔP	$\sqrt{\Delta P}$	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr (in. HG)	Dry Gas Meter Reading in Cu. Ft.
	START	9:45				68					336.553
A 1	.60	.775	2.45	108	254		259	83		1	340.63
2	.69	.831	2.82	110	256		258	83		1	345.02
3	.63	.794	2.58	111	258		256	84		2	349.23
4	.75	.866	3.07	109	259		257	84		2	353.82
5	.62	.787	2.54	108	255		253	85		2	357.93
6	.55	.742	2.25	109	255		256	85		2	361.821
B 1	.59	.768	2.41	108	251		256	86		3	365.83
2	.77	.877	3.15	109	255		254	86		3	370.48
3	.75	.866	3.07	108	254		251	86		3	375.05
4	.70	.837	2.56	109	257		256	87		3	379.22
5	.68	.825	2.49	109	256		253	87		3	383.34
6	.55	.742	2.01	107	255		251	87		3	387.039
	STOP	10:47									
	AVG	.809	2.62	109				85			5C.498

Pitot Tube Leak Check: Before OK After OK

Integrated Bag Leak Check: Before OK After OK

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Particulate Field Data Sheet

Client: W.R. GRACE (RFTA)											Date: 8-28-91	Page 1 Of 2	
Project No.: 91-155			Operator: J. SCATTOLA								Orsat Analysis		
Sampling Location: CYCLONE WEST STACK									Run No.: 6		CO_2	$+O_2$	O_2 / CO
Filter No.: 91-234			Acetone No.:				Condensate: 23 mL						20.9 /
Barometric Pressure: 30.24			Static Pressure: -1.8		Probe Number: 4-1								
Nozzle Diameter: .254		Nozzle Number:		Pitot Coefficient: .84		Pitot Number: 4-1							
Meter Corr. Factor: 1.02			Meter-Orifice: 10 (3.68)										
Sample Pt. Time: 5 min			Assumed % Moisture: 7%			Leak Test	Before: 006@15"		After: 005@15"				

Sample Point	ΔP	$\sqrt{\Delta P}$	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr (in. HG)	Dry Gas Meter Reading in Cu. Ft.
	START 11:05					C68					387.231
A 1	.63	.794	2.30	112	258		256	89		2	391.19
2	.71	.843	2.59	112	256		259	89		3	395.36
3	.75	.866	2.74	113	257		260	91		2	399.68
4	.78	.883	2.85	112	251		255	91		2	404.09
5	.64	.800	2.34	111	254		256	91		2	408.09
6	.52	.721	1.90	112	253		254	90		2	411.65
B 1	.60	.775	2.19	112	256		252	90		2	415.53
2	.70	.837	2.56	113	258		251	90		3	419.72
3	.73	.854	2.67	113	254		250	91		3	423.99
4	.85	.922	3.11	115	256		251	91		3	428.59
5	.65	.806	2.38	115	254		253	91		3	432.63
6	.60	.775	2.19	115	256		254	91		3	436.52
	STOP 12:07										
	AVG .823	2.44	113					air			441.290

Pitot Tube Leak Check: Before OK After OK

Integrated Bag Leak Check: Before OK After OK

Particulate Field Data Sheet

Client: W.R. GRACE ATP											Date: 5-28-91	Page 1 Of 2	
Project No.: 91-155				Operator: J. SATTON							Orsat Analysis		
Sampling Location: CYCLONE EAST STACK						Run No.: 7					CO_2	$+O_2$	O_2 / CO
Filter No.: 91-193			Acetone No.:			Condensate:					0		20.9
Barometric Pressure: 30.24				Static Pressure: .7		Probe Number: 4-1							
Nozzle Diameter: .254		Nozzle Number:		Pitot Coefficient: .84		Pitot Number: 4-1							
Meter Corr. Factor: 1.02				Meter-Orifice: 10 (3.68)									
Sample Pt. Time: 5m.N				Assumed % Moisture: 7%				Leak Test: Before 005@15"			After 003@7"		

Sample Point	ΔP	$\sqrt{\Delta P}$	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr (in. HG)	Dry Gas Meter Reading in Cu. Ft.
	START	12:30				68					437.081
AT 1	.68	.825	2.49	127	254		255	9	1	2	441.19
2	.59	.768	2.09	130	256		251	9	1	2	444.98
3	.75	.866	2.66	131	255		257	9	2	2	449.26
4	.78	.883	2.77	131	254		257	9	2	2	453.60
5	.73	.854	2.59	134	250		254	9	2	2	457.80
6	.76	.872	2.70	131	251		251	9	3	2	462.08
B 1	.65	.806	2.31	130	252		255	9	3	3	466.04
2	.70	.837	2.48	131	256		252	9	3	3	470.15
3	.75	.866	2.66	131	258		257	9	4	4	474.40
4	.68	.825	2.41	131	256		256	9	4	4	478.492
5	.70	.837	2.48	131	257		258	9	4	3	482.60
6	.60	.794	2.24	132	251		248	9	4	3	486.572
	STOP	1:34									
	DIG	.436	2.40	131				9	2		489.491

Pitot Tube Leak Check: Before OK After OK

Integrated Bag Leak Check: Before OK After OK

Particulate Field Data Sheet

Client: W.R. GRACE (RTP)				Date: 8-28-91	Page 1 of 2
Project No.: 91-155	Operator: J. SUTTON			Orsat Analysis	
Sampling Location: CYCLONE EAST STACK			Run No.: 8	CO_2: 0	$+O_2$:	O_2: 21.9	CO:
Filter No.: 91-275	Acetone No.:	Condensate:			
Barometric Pressure: 30.24	Static Pressure: +.7	Probe Number: 4-1			
Nozzle Diameter: .254	Nozzle Number:	Pitot Coefficient: .84	Pitot Number: 4-1		
Meter Corr. Factor: 1.02	Meter-Orifice: 10 (3.68)				
Sample Pt. Time: 5m.ν	Assumed % Moisture: 7%	Leak Test	Before: 0050@15"	After: 00X@2"	

Sample Point	ΔP	$\sqrt{\Delta P}$	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr (in. HG)	Dry Gas Meter Reading in Cu. Ft.
	START	1:50				68					489.075
A 1	.61	.781	2.16	131	258		263	9	3	1	492.87
2	.59	.768	1.51	132	254		257	9	3	2	496.08
3	.75	.866	1.92	133	256		253	9	4	2	499.72
4	.75	.866	1.92	133	251		248	9	5	2	503.36
5	.60	.775	1.53	133	256		251	9	5	3	506.53
6	.59	.768	1.51	131	254		253	9	5	3	509.73
B 1	.71	.843	1.81	129	256		254	9	5	2	513.38
2	.66	.812	1.68	129	257		256	9	5	2	516.78
3	.63	.794	1.61	131	252		253	9	5	3	520.08
4	.78	.883	1.99	130	251		252	9	6	3	523.75
5	.62	.787	1.58	131	252		254	9	6	3	527.23
C	.55	.742	1.41	131	253		252	9	5	2	530.39
	STOP	2:51									
	AVG	.807	1.72	132				9	5		21.317

Pitot Tube Leak Check: Before 0K After 0K

Integrated Bag Leak Check: Before 0K After 0K

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Particulate Field Data Sheet

Client: W.R. GRACE										Date: 8-25-91	Page 1 Of 2		
Project No.: 91-155			Operator: J. SUTTON							Orsat Analysis			
Sampling Location: CYCLONE EAST STACK					Run No.: 9					CO_2	$+O_2$	O_2	CO
Filter No.: 91-		Acetone No.:		Condensate:						0		20.9	
Barometric Pressure: 30.24			Static Pressure: .7		Probe Number: 4-1								
Nozzle Diameter: .254		Nozzle Number:	Pitot Coefficient: .84		Pitot Number: 4-1								
Meter Corr. Factor: 1.02			Meter-Orifice: 10 (3.68)										
Sample Pt. Time: 5 min			Assumed % Moisture: 7					Leak Test: Before 0.005@15" 4		After 4x6@10"			

Sample Point	ΔP	$\sqrt{\Delta P}$	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr (in. HG)	Dry Gas Meter Reading in Cu. Ft.
	START	300 pm				64					531.114
A 1	.62	.787	1.58	126	254		258	98		2	534.43
2	.69	.831	1.80	133	255		259	96		2	537.93
3	.75	.866	1.95	136	255		258	99		3	541.68
4	.74	.860	1.90	134	256		257	99		3	545.26
5	.61	.781	1.56	134	258		255	100		3	548.53
6	.53	.728	1.36	135	259		256	100		2	551.59
B 1	.63	.794	1.61	132	254		258	100		2	554.93
2	.75	.866	1.92	130	251		256	100		2	558.53
3	.71	.843	1.82	129	254		257	101		2	562.05
4	.68	.825	1.74	127	255		253	101		3	565.49
5	.65	.806	1.67	125	252		250	101		3	568.85
6	.59	.768	1.51	128	250		254	101		3	572.054
	STOP	4:02 pm									
	AVG	.813	1.70	131				100			4.054

Pitot Tube Leak Check: Before OK After OK

Integrated Bag Leak Check: Before OK After OK

Particulate Field Data Sheet

Client: W.R GRACE (ATP)										Date		Page 1 Of 2	
Project No.: 91-155			Operator: J. SUTTON							Orsat Analysis			
Sampling Location: UNIT 4 STACK					Run No.: 10					CO_2	$+O_2$	O_2	CO
Filter No.: 91-272		Acetone No.:		Condensate: 20mL						0		20.9	
Barometric Pressure: 30.16		Static Pressure: .05		Probe Number: 4-1									
Nozzle Diameter: .365	Nozzle Number:	Pitot Coefficient: .84		Pitot Number: 4-1									
Meter Corr. Factor: 1.02		Meter-Orifice: 10 (3.68)											
Sample Pt. Time: 5min)		Assumed % Moisture: 7%		Leak Test: Before 0060 @ 15"					After 0048 @ 11"				

Sample Point	ΔP	$\sqrt{\Delta P}$	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr (in. HG)	Dry Gas Meter Reading in Cu. Ft.
	START	8:00				68					573.213
A 1	.12	.346	2.17	79	252		258	7	8	1	577.23
2	.15	.387	2.71	82	256		261	7	9	1	581.53
3	.10	.316	1.81	84	257		260	7	9	2	585.06
4	.13	.360	2.35	84	256		258	8	0	2	589.09
5	.09	.300	1.63	86	257		256	8	0	3	592.46
6	.07	.265	1.27	85	257		257	8	1	2	595.424
B 1	.13	.361	2.36	82	254		257	8	4	2	599.43
2	.12	.346	2.17	82	256		255	8	4	2	603.26
3	.12	.346	2.17	84	256		259	8	5	3	607.10
4	.10	.316	1.81	82	256		257	8	6	2	610.62
5	.09	.283	1.45	83	255		256	8	6	3	613.77
6	.07	.265	1.27	83	256		258	8	7	2	616.983
	STOP	9:02									
	AVG	.320	1.93	83		✓		8	3		43.764

Pitot Tube Leak Check: Before OK After OK

Integrated Bag Leak Check: Before OK After OK

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Particulate Field Data Sheet

Client: W. R. GRACE (RTP)				Date: 8-29-91	Page: 1 Of 2
Project No.: 91-155	Operator: J. SUTTON			Orsat Analysis	
Sampling Location: 4 STACK			Run No.: 11	CO_2	$+O_2$ / O_2 / CO
Filter No.: 91-280	Acetone No.:		Condensate: 18 mL	0	20.9
Barometric Pressure: 30.16	Static Pressure: -.05	Probe Number: 4-1			
Nozzle Diameter: .365	Nozzle Number:	Pitot Coefficient: .84	Pitot Number: 4-1		
Meter Corr. Factor: 1.02	Meter-Orifice: 10 (3.68)				
Sample Pt. Time: 5 min	Assumed % Moisture: 7%	Leak Test: Before 0.05 @ 6"	After 0.05 @ 7"		

Sample Point	ΔP	$\sqrt{\Delta P}$	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr (in. HG)	Dry Gas Meter Reading in Cu. Ft.
	START 9:20					<68					617.931
B 1	.14	.374	2.53	88	254		256	8	7	3	622.09
2	.11	.332	1.99	88	256		258	8	8	3	625.73
3	.12	.346	2.17	89	256		255	8	8	2	629.58
4	.11	.332	1.99	89	257		256	9	0	2	633.29
5	.09	.300	1.72	89	256		254	9	0	2	636.74
6	.08	.283	1.53	90	251		252	9	0	2	639.98
A 1	.12	.346	2.29	87	256		259	9	1	3	643.52
2	.15	.387	2.87	88	257		256	9	1	3	648.39
3	.14	.374	2.68	88	255		256	9	1	3	652.68
4	.11	.332	2.10	88	256		258	9	2	3	656.58
5	.10	.316	1.91	88	254		252	9	2	4	660.19
6	.07	.265	1.34	89	248		250	9	1	3	663.22
	STOP 10:27										
	AVG	.322	2.09	88				9	0		45.392
						1					

Pitot Tube Leak Check: Before OK After OK

Integrated Bag Leak Check: Before OK After OK

Particulate Field Data Sheet

Client: W.R. GRACE (RTP)										Date: 8-29-91	Page 1 Of 2
Project No.: 91-155			Operator: J. SUTTON							Orsat Analysis	
Sampling Location: UNIT 4 STACK					Run No.: 12					CO_2 / $+O_2$ / O_2 / CO	
Filter No.: 91-276		Acetone No.:		Condensate: 22 ml						1 / — / 20.9 / —	
Barometric Pressure: 30.16			Static Pressure: .05		Probe Number: 4-1					—	
Nozzle Diameter: .365		Nozzle Number:	Pitot Coefficient: .84		Pitot Number: 4-1					—	
Meter Corr. Factor: 1.02			Meter-Orifice: 10 (3.68)							—	
Sample Pt. Time: 5m.n			Assumed % Moisture: 5%			Leak Test	Before: 005 @ 14"			After: 00 @ 13"	

Sample Point	ΔP	$\sqrt{\Delta P}$	ΔH	Temperature °F: Stack	Probe	Imp. Out	Oven	Meter In	Meter Out	Vac. Pr (in. HG)	Dry Gas Meter Reading in Cu. Ft.
	START	10:45				68					664.190
A 1	.13	.361	2.49	88	251		252	9	3	1	667.08
2	.15	.387	2.87	90	252		254	9	4	2	669.49
3	.15	.387	2.87	90	253		253	9	4	2	675.92
4	.12	.346	2.29	95	256		258	9	5	3	679.93
5	.10	.316	1.91	98	257		256	9	5	3	683.52
6	.09	.300	1.66	102	256		254	9	6	3	686.93
B 1	.14	.374	2.58	103	254		256	9	6	3	691.123
2	.12	.346	2.27	103	251		254	9	6	3	695.05
3	.11	.332	2.08	102	251		254	9	7	3	698.82
4	.11	.332	2.08	100	253		254	9	7	4	702.62
5	.10	.316	1.99	102	250		251	9	7	4	706.22
6	.08	.283	1.51	102	255		254	9	7	4	709.523
	STOP	11:50									
	AVG	.340	2.21	98				4	6		45.333

Pitot Tube Leak Check: Before OK After OK

Integrated Bag Leak Check: Before OK After OK

Calibration Sheets

Dry Gas Meter Calibration Sheet

Client W. R. Grace — Run By Tim Ramirez

Project No. 91-155-OH — Date 7-9-91

Module 10 — Barometric Press 29.43

Orifice

STD P = 3.68

ΔH in. H_2O	Vw initial	Vw final	Vw ft.³	Vd initial	Vd final	Vd ft.³	tw °F	tdi °F	tdo °F	Pw in H_2O	Time Θ min.
.5	262.020	265.940	3.920	708.353	712.258	3.905	79	86			10.0
1.0	266.167	271.635	5.468	712.483	717.942	5.459	79	87			10.0
2.0	271.765	279.305	7.540	718.070	725.584	7.514	79	89			10.0
4.0	279.589	290.195	10.606	725.860	736.422	10.562	79	91			10.0
6.0	290.452	303.431	12.976	736.673	749.522	12.849	79	92			10.0

ΔH	ΔH / 13.6	Mc (Y) Vw Pb (td + 460) / Vd (Pb + ΔH/13.6) (tw + 460)	ΔHa (For Small Orifice Only) 0.0317 ΔH / Pb (td + 460)	(tw + 460) Θ² / Vw
.5	.0368	1.02	1.81649	
1.0	.0737	1.01	1.9134	
2.0	.147	1.02	2.0052	
4.0	.294	1.02	2.0195	
6.0	.441	1.02	2.0201	
Average		1.02	1.96476	

ΔH = Orifice Setting
Vw = Volume of Gas of Wet Test Meter
Vd = Volume of Gas of Dry Gas Meter
Pw = Pressure of Wet Test Meter
tw = Temperature of Fluid in Wet Test Meter
tdi = Inlet Temperature of Dry Gas Meter
tdo = Outlet Temperature of Dry Gas Meter
td = Average Temperature of Dry Gas Meter
Θ = Time required to pull specified cubic feet
Mc = Dry Gas Meter Correction Factor
ΔHa = Orfice setting that would pull .75 cfm of air at standard conditions

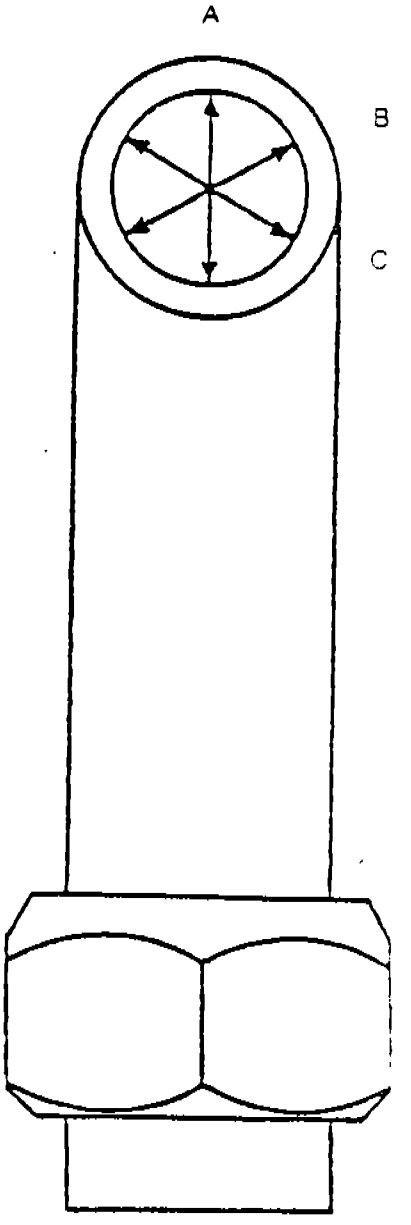
Nozzle Calibration

Sized By Bruce Woods

Nutech

Date	Nozzle	Dimension A	Dimension B	Dimension C	Difference	Avg. Diameter
7-9-91	Z-1	.188	.183	.187	.001	.189
	Z-2	.173	.173	.173	.000	.173
	Z-3	.175	.175	.175	.000	.175
	Z-4	.175	.175	.176	.001	.175
	Z-5	.175	.176	.176	.001	.176
	Z-6	.225	.226	.225	.001	.225
	Z-7	.254	.253	.254	.001	.254
	Z-8	.244	.245	.245	.001	.245
	Z-9	.248	.248	.248	.000	.248
	Z-10	.243	.244	.243	.001	.243
	Z-11	.282	.282	.283	.001	.282
	Z-12	.314	.314	.314	.000	.314
	Z-13	.312	.312	.313	.001	.313
	Z-14	.314	.314	.314	.000	.314
	Z-15	.320	.320	.320	.000	.320
	Z-16	.277	.278	.277	.001	.277
	Z-17	.369	.369	.370	.001	.369
	Z-18	.370	.371	.371	.001	.371
	Z-19	.365	.365	.365	.000	.365
	Z-20	.370	.370	.370	.000	.370
	Z-21	.364	.365	.365	.001	.365
	Z-22	.369	.370	.370	.001	.369
	Z-23	.485	4916	.485	.001	.485
	Z-24	.495	.495	.495	.000	.495
	Z-25	.494	.495	.495	.001	.495
	Z-26	.497	.498	.497	.001	.497
	Z-27	.594	.595	.595	.001	.595
	Z-28	.754	.755	.755	.001	.754
	Z-29	.759	.760	.761	.002	.760
	Z-30	.759	.760	.760	.001	.760
	Z-31	.495	.495	.495	.000	.495
	Z-32	.758	.759	.758	.001	.758
	Z-33	1.008	1.007	1.007	.001	1.007
	Z-34	1.024	1.025	1.025	.001	1.025
	Z-35	1.150	1.150	1.150	.000	1.150

All Dimensions are in inches.



Laboratory Reports

Analytical Data Sheet

Client W.R.GRACE Project No. 91-155-OH Date 9/3/91

Run No. 1 (Dryer Stack)
Filter No. 91-127
Acetone No. 1
Amount liquid lost during transport 0
Acetone blank volume, ml 100
Acetone wash volume, ml 200
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)** 0.6

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	0.4838	0.3491	0.1347
2	78.1106	77.9710	0.1396
3			
Less acetone blank			0.0006
Weight of particulate matter			0.2737

	Volume of Liquid Water Collected	
	Impinger Volume, ml	Silica Gel Weight, g
Final		271.2
Initial		250.0
Liquid collected		21.2
Total Volume Collected		g* ml

Run No. 2
Filter No. 91-149
Acetone No. 2
Amount liquid lost during transport 0
Acetone blank volume, ml 100
Acetone wash volume, ml 190
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)** 0.6

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	0.5352	0.3496	0.1856
2	49.4205	49.2706	0.1499
3			
Less acetone blank			0.0006
Weight of particulate matter			0.3349

	Volume of Liquid Water Collected	
	Impinger Volume, ml	Silica Gel Weight, g
Final		274.7
Initial		250.0
Liquid collected		24.7
Total Volume Collected		g* ml

Run No. 3
Filter No. 91-097
Acetone No. 3
Amount liquid lost during transport 0
Acetone blank volume, ml 100
Acetone wash volume, ml 225
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)** 0.7

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	0.5162	0.3387	0.1775
2	66.4059	66.1615	0.2444
3			
Less acetone blank			0.0007
Weight of particulate matter			0.4212

	Volume of Liquid Water Collected	
	Impinger Volume, ml	Silica Gel Weight, g
Final		273.9
Initial		250.0
Liquid collected		23.9
Total Volume Collected		g* ml

Run No. Blank Acetone
Filter No.
Acetone No.
Amount liquid lost during transport
Acetone blank volume, ml 100
Acetone wash volume, ml
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)**

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	67.4495	67.4492	0.0003
2			
3			
Less acetone blank			
Weight of particulate matter			0.0003

	Volume of Liquid Water Collected	
	Impinger Volume, ml	Silica Gel Weight, g
Final		
Initial		
Liquid collected		
Total Volume Collected		g* ml

*Convert weight of water to volume by dividing total weight increase by density of water (1g/ml): $\frac{\text{Increase, g}}{1\text{g/ml}}$ = Volume Water, ml

**See Federal Register, Method 5, 6.6, & 6.7.

Analytical Data Sheet

Client W.R. GRACE Project No. 91-155-0H Date 9/3/91

Run No. 4 (WEST STACK)
Filter No. 91-251
Acetone No. 4
Amount liquid lost during transport 0
Acetone blank volume, ml 100
Acetone wash volume, ml 185
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)** 0.6

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	0.5117	0.3487	0.1630
2	80.4745	80.0925	0.3820
3			
Less acetone blank			0.0006
Weight of particulate matter			0.5444

	Volume of Liquid Water Collected	
	Impinger Volume, ml.	Silica Gel Weight, g
Final		263.9
Initial		250.0
Liquid collected		13.9
Total Volume Collected		g* ml

Run No. 5
Filter No. 91-138
Acetone No. 5
Amount liquid lost during transport 0
Acetone blank volume, ml 100
Acetone wash volume, ml 175
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)** 0.5

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	0.4951	0.3487	0.1464
2	63.9789	63.6309	0.3480
3			
Less acetone blank			0.0005
Weight of particulate matter			0.4939

	Volume of Liquid Water Collected	
	Impinger Volume, ml.	Silica Gel Weight, g
Final		267.1
Initial		250.0
Liquid collected		17.1
Total Volume Collected		g* ml

Run No. 6
Filter No. 91-234
Acetone No. 6
Amount liquid lost during transport 0
Acetone blank volume, ml 100
Acetone wash volume, ml 170
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)** 0.5

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	0.5262	0.3452	0.1810
2	75.4075	75.0086	0.3989
3			
Less acetone blank			0.0005
Weight of particulate matter			0.5794

	Volume of Liquid Water Collected	
	Impinger Volume, ml.	Silica Gel Weight, g
Final		264.7
Initial		250.0
Liquid collected		14.7
Total Volume Collected		g* ml

Run No.
Filter No.
Acetone No.
Amount liquid lost during transport
Acetone blank volume, ml
Acetone wash volume, ml
Acetone blank concentration, mg/mg (equation 5-4)**
Acetone wash blank, mg (equation 5-5)**

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1			
2			
3			
Less acetone blank			
Weight of particulate matter			

	Volume of Liquid Water Collected	
	Impinger Volume, ml.	Silica Gel Weight, g
Final		
Initial		
Liquid collected		
Total Volume Collected		g* ml

*Convert weight of water to volume by dividing total weight increase by density of water (1g/ml): $\frac{\text{Increase, g}}{1\text{g/ml}}$ = Volume Water, ml

**See Federal Register, Method 5, 6.6, & 6.7.

Analytical Data Sheet

Client W. R. GRACE Project No. 91-155-0H Date 9/3/91

Run No. 10 (4 STACK)
Filter No. 91-272
Acetone No. 10
Amount liquid lost during transport 0
Acetone blank volume, ml 100
Acetone wash volume, ml 130
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)** 0.4

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	0.4123	0.3464	0.0659
2	109.9289	109.8108	0.1181
3			
Less acetone blank			0.0004
Weight of particulate matter			0.1836

	Volume of Liquid Water Collected	
	Impinger Volume, ml.	Silica Gel Weight, g
Final		262.8
Initial		250.0
Liquid collected		12.8
Total Volume Collected		g* ml

Run No. 11
Filter No. 91-280
Acetone No. 11
Amount liquid lost during transport 0
Acetone blank volume, ml 100
Acetone wash volume, ml 170
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)** 0.5

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	0.4165	0.3416	0.0749
2	106.5507	106.3657	0.1850
3			
Less acetone blank			0.0005
Weight of particulate matter			0.2595

	Volume of Liquid Water Collected	
	Impinger Volume, ml.	Silica Gel Weight, g
Final		258.4
Initial		250.0
Liquid collected		8.4
Total Volume Collected		g* ml

Run No. 12
Filter No. 91-276
Acetone No. 12
Amount liquid lost during transport 0
Acetone blank volume, ml 100
Acetone wash volume, ml 120
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)** 0.4

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	0.4702	0.3458	0.1244
2	106.3250	106.0818	0.2432
3			
Less acetone blank			0.0004
Weight of particulate matter			0.3672

	Volume of Liquid Water Collected	
	Impinger Volume, ml.	Silica Gel Weight, g
Final		259.9
Initial		250.0
Liquid collected		9.9
Total Volume Collected		g* ml

Run No.
Filter No.
Acetone No.
Amount liquid lost during transport
Acetone blank volume, ml
Acetone wash volume, ml
Acetone blank concentration, mg/mg (equation 5-4)**
Acetone wash blank, mg (equation 5-5)**

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1			
2			
3			
Less acetone blank			
Weight of particulate matter			

	Volume of Liquid Water Collected	
	Impinger Volume, ml.	Silica Gel Weight, g
Final		
Initial		
Liquid collected		
Total Volume Collected		g* ml

*Convert weight of water to volume by dividing total weight increase by density of water (1g/ml): $\frac{\text{Increase, g}}{1\text{g/ml}}$ = Volume Water, ml

**See Federal Register, Method 5, 6.6, & 6.7.

Analytical Data Sheet

Client W. R. GRACE Project No. 91-155-OH Date 9/3/91

Run No. 7 (Cyclone EAST STACK)
Filter No. 91-193
Acetone No. 7
Amount liquid lost during transport 0
Acetone blank volume, ml 100
Acetone wash volume, ml 125
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)** 0.4

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	0.4219	0.3481	0.0738
2	102.7272	102.5538	0.1734
3			
Less acetone blank			0.0004
Weight of particulate matter			0.2468

	Volume of Liquid Water Collected	
	Impinger Volume, ml	Silica Gel Weight, g
Final		264.9
Initial		250.0
Liquid collected		14.9
Total Volume Collected		g* ml

Run No. 8
Filter No. 91-275
Acetone No. 8
Amount liquid lost during transport 0
Acetone blank volume, ml 100
Acetone wash volume, ml 120
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)** 0.4

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	0.3764	0.3469	0.0295
2	102.7543	102.6148	0.1395
3			
Less acetone blank			0.0004
Weight of particulate matter			0.1686

	Volume of Liquid Water Collected	
	Impinger Volume, ml	Silica Gel Weight, g
Final		261.1
Initial		250.0
Liquid collected		11.1
Total Volume Collected		g* ml

Run No. 9
Filter No. 91-277
Acetone No. 9
Amount liquid lost during transport 0
Acetone blank volume, ml 100
Acetone wash volume, ml 150
Acetone blank concentration, mg/mg (equation 5-4)** 3.8×10^{-6}
Acetone wash blank, mg (equation 5-5)** 0.4

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1	0.4021	0.3459	0.0562
2	98.9974	98.7616	0.2358
3			
Less acetone blank			0.0004
Weight of particulate matter			0.2916

	Volume of Liquid Water Collected	
	Impinger Volume, ml	Silica Gel Weight, g
Final		259.2
Initial		250.0
Liquid collected		9.2
Total Volume Collected		g* ml

Run No.
Filter No.
Acetone No.
Amount liquid lost during transport
Acetone blank volume, ml
Acetone wash volume, ml
Acetone blank concentration, mg/mg (equation 5-4)**
Acetone wash blank, mg (equation 5-5)**

Container Number	Weight of Particulate Collected, g		
	Final Weight	Tare Weight	Weight Gain
1			
2			
3			
Less acetone blank			
Weight of particulate matter			

	Volume of Liquid Water Collected	
	Impinger Volume, ml	Silica Gel Weight, g
Final		
Initial		
Liquid collected		
Total Volume Collected		g* ml

*Convert weight of water to volume by dividing total weight increase by density of water (1 g/ml): $\frac{\text{Increase, g}}{1\ \text{g/ml}}$ = Volume Water, ml

**See Federal Register, Method 5, 6.6, & 6.7.