United States
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Office of Air Quality
Planning and Standards
Research Triangle Park, NC 27711

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May 2000

AIR

EPA

Final Report

Hot Mix Asphalt Plants
Truck Loading and Silo Filling
Manual Methods Testing

Asphalt Plant C
Los Angeles, California

Volume 3 of 8

FINAL REPORT

HOT MIX ASPHALT PLANTS
TRUCK LOADING AND SILO FILLING
MANUAL METHODS TESTING
ASPHALT PLANT C, LOS ANGELES, CALIFORNIA

VOLUME 3 OF 8
APPENDICES C, D, E, AND F

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Prepared for:

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May 2000

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GLOSSARY OF TERMS

ASTM – American Society for Testing and Materials
CEMS – Continuous Emissions Monitoring System
CTS – Calibration Transfer Standard
EMC – Emissions Measurement Center
EMAD – Emission Monitoring and Analysis Division
ESP – Electrostatic Precipitator
FID – Flame Ionization Detector
FTIR – Fourier Transform Infrared Spectroscopy
HAP – Hazardous Air Pollutant
MCEM – Methylene Chloride Extractable Matter
MRI – Midwest Research Institute
PES – Pacific Environmental Services
PM – Particulate Matter
PTE – Permanent Total Enclosure
RAP – Recycled Asphalt
RTFOT – Rolling Thin Film Oven Test
SED – Silo Exhaust Duct

GLOSSARY OF TERMS (CONTINUED)

SMTG – Source Measurement Technology Group
SVOHAP – Semi-Volatile Organic Hazardous Air Pollutant
TED – Tunnel Emissions Duct
TFOT – Thin Film Oven Test
THC – Total Hydrocarbons
VOHAP – Volatile Organic Hazardous Air Pollutant
VOST – Volatile Organic Sampling Train

VOLUME 3

APPENDIX C

FIELD DATA

c.1 TED FIELD DATA
c.2 SED FIELD DATA
C.3 METEOROLOGICAL DATA
C.4 ON-SITE GC/MS REPORT AND DATA

APPENDIX C.1

TED FIELD DATA

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT [redacted] Asphalt Plt. C
DATE 7-22-98
SAMPLING LOCATION Tunnel Exhaust Duct (TED)
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE. (DISTANCE A) 35.5
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE. (DISTANCE B) 3.5
STACK I.D., (DISTANCE A - DISTANCE B) 32.0
NEAREST UPSTREAM DISTURBANCE
NEAREST DOWNSTREAM DISTURBANCE
CALCULATOR NN

SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	2.1	32.0	0.67	3.5	4.17
2	6.7		2.14		5.64
3	11.8		3.78		7.28
4	17.7		5.66		9.16
5	25.0		8.00		11.5
6	35.6		11.39		14.89
7	64.4		20.61		24.11
8	75.0		24.00		27.50
9	82.3		26.34		29.84
10	88.2		28.22		31.72
11	93.3		29.86		33.36
12	97.9		31.33		34.83

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant: Hot Mix Asphalt
Date: 7-22-98
Sampling Location: Tunnel Exhaust Duct
Clock Time: 1800-1815
Run #: T-M2-1
Operators: DDH,
Barometric Pressure, in. Hg: 29.50
Static Pressure, in. H_2O: -
Moisture, %: ~2
Molecular wt., Dry: ——
Pitot Tube, Cp: .84
Stack Dimension, in. Diameter or Side 1: 32
Side 2:
Wet Bulb, °F: ——
Dry Bulb, °F: ——

Cyclonic Flow check	Traverse Point Number	Velocity Head in. H_2O	Stack Temp. °F
1	A 1	.03	82
1	2	.03	82
1	3	.04	82
1	4	.04	82
0	5	.04	82
1	6	.04	83
0	7	.04	82
0	8	.04	28
0	9	.03	82
0	10	.04	83
1	11	.03	82
0	12	.03	82
5	B 1	.03	80
1	2	.03	80
1	3	.04	80
1	4	.04	80
1	5	.04	80
1	6	.04	80
1	7	.04	80
1	8	.04	80
1	9	.04	80
0	10	.04	80
1	11	.04	80
1	12	.04	80
AVG = 0.88°		$\overline{\sqrt{\Delta P}}$ = 0.19	$\overline{Ts}$ = 81.08

$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$

$Md = (0.44 \times \quad) + (0.32 \times \quad) + (0.28 \times \quad)$

$Md = 78.84$

$Ms = Md \times (1 - \frac{\%H_2O}{100}) + 18 (\frac{\%H_2O}{100})$

$Ms = (7 \quad) \times (1 - \frac{2}{100}) + 18 (\frac{2}{100})$

$Ms = 78.62$

$Ts = \quad$ °F = 541.08 °R (°F + 460)

$Ps = Pb + \frac{S.P.}{13.6} = (-0.5(?)) + \frac{\quad}{13.6}$

$Ps = 29.46$ in. Hg

$\overline{\sqrt{\Delta P}} = 0.19$

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{Ts\,(°R)}{Ps \times Ms}}$

$Vs = 85.49 \times (0.84) \times (0.19) \times \sqrt{\frac{541.}{(29.46)(78.62)}}$

$Vs = 10.93$ ft/s

$As = 5.59$ ft²

$Qs = Vs \times As \times 60$ s/m

$Qs = 10.93 \times 5.59 \times 60$

$Qs = 3666$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\%H_2O}{100})$

$Qs_{std} = 3666 \times 17.647 \times \frac{29.46}{541} \times (1 - \frac{2}{100})$

$Qs_{std} = 3452$ dscfm

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5

PACIFIC ENVIRONMENTAL SERVICES, INC.

# FIELD DATA
K = 4.9

Plant Hot Mix
Date 7-24-98
Sampling Location TED
Sample Type M315
Run Number 1 (CMC) T-M315-1
Operator NN
Barometric Pressure (P_b) 29.35
Static Pressure (P_s) -9.7
Filter Number(s)
Pretest Leak Rate = 0.012 cfm @ 15 in. Hg
Pretest Pitot Leak Check ✓
Pretest Orsat Leak Check N/A
Read and Record all Data Every 5 Minutes
Page 1 of

CO₂	
O₂	
CO	
N₂	

Condensers	
V_L: Silica gel	
Total H₂O	

Probe Length and Type 5 glass
Pitot Tube I.D. No.
Nozzle I.D. 0.258
Assumed Moisture, % 3
Meter Box Number 6A
Meter ΔH@ 1.95
Meter Gamma 1.001
Reference Δp 0.4
Post Test Leak Rate = 0.01 cfm @ 7.5 in. Hg
Post Test Pitot Leak Check ✓
Post Test Orsat Leak Check N/A

Schematic of Traverse Point Layout

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (Δ Ps) in. H₂O	Orifice Press. Differential (ΔH) in. H₂O		Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum in. Hg
					Desired	Actual				Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	
1	0	0720	254.171	0.32	1.57	1.6	80	250 / 246	57	74	74	5
	5	0725	257.6	0.39	1.91	1.9	78	250 / 252	46	80	75	6
2	10	0730	261.3	0.37	1.91	1.9	86	250 / 255	47	83	75	6
	15	0735	265.0	0.47	2.30	2.3	80	250 / 244	51	84	76	6
3	20	0740	269.3	0.33	1.62	1.6	90	251 / 241	54	85	76	5
	25	0745	272.7	0.33	1.62	1.6	93	249 / 250	55	85	77	5
4	30	0750	276.2	0.27	1.32	1.3	93	249 / 255	55	88	77	5
	35	0755	279.4	0.25	1.23	1.2	87	250 / 252	55	85	79	5
* 5	40	0800 / 0805	282.3	0.30	1.47	1.5	86	251 / 254	59	79	78	5
*	45	0810 / 0829	285.6	0.33	1.62	1.6	79	251 / 254	63	78	78	5
6	50	0834	289.1	0.33	1.6	1.6	84	250 / 252	51	83	79	5
	55	0839	292.7	0.32	1.57	1.6	81	250 / 248	54	86	79	5
7	60	0849	296.1	0.38	1.86	1.9	82	248 / 243	58	87	80	5
	65	0849	299.8	0.38	1.86	1.9	82	249 / 252	60	89	80	5
8	70	0854	303.7	0.27	1.32	1.3	87	249 / 256	61	89	80	4
	75	0859	306.8	0.28	1.37	1.4	85	250 / 294	63	88	80	5
9	80	0904	310.1	0.40	1.96	2.0	78	250 / 296	57	88	81	5
	85	0907	313.9	0.40	1.96	2.0	77	248 / 294	57	89	81	5
10	90	0914	318.3	0.26	1.27	1.3	95	248 / 253	58	89	81	5
	95	0919	321.9	0.26	1.27	1.3	80	249 / 255	60	89	81	5
11	100	0924	326.0	0.37	1.82	1.8	96	250 / 251	58	89	81	5
	105	0929	329.0	0.4	1.96	2.0	90	250 / 244	58	89	81	5
12	110	0994	333.7	0.49	2.16	2.2	79	249 / 251	58	85	81	5
	115	0939	337.7	0.34	1.67	1.7	90	250 254	58	90	82	5
	120	0944	341.094	—								

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Page 2 of 2

Plant Name: Hot Mix

Test Date: 7/24/98

Run Number: T-M315-1

Operator: NN

k = 4.9

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H₂O	Orifice Pres. Differential (ΔH) in. H₂O		Stack Temp. °F (T_s)	Probe Temp. / Filter Temp.° F	Impinger Temp. ° F	Dry Gas Meter Temp.		Pump Vacuum In. Hg
					Desired	Actual				Inlet ($T_{m_{in}}$)° F	Outlet ($T_{m_{out}}$) °F	
1	120	/ ~~1044~~ 1058	341.213	0.35	1.72	1.7	76	251 / 251	68	81	81	5
	125	/ 1103	344.9	0.35	1.72	1.7	76	251 / 256	46	86	81	5
2	130	/ 1108	348.5	0.35	1.72	1.7	89	252 / 255	46	90	82	5
	135	/ 1113	352.1	0.32	1.57	1.6	82	250 / 244	57	90	82	5
3	140	/ 1118	355.8	0.25	1.23	1.2	85	247 / 244	54	92	83	5
	145	/ 1123	358.8	0.31	1.52	1.5	84	252 / 257	55	92	89	5
4	150	/ 1128	362.2	0.31	1.52	1.5	83	250 / 255	55	92	84	5
	155	/ 1133	365.7	0.20	0.98	0.98	83	251 / 255	56	92	84	5
5	160	/ 1138	368.6	0.34	1.64	1.7	87	248 / 244	56	92	85	5
	165	/ 1142	371.9	0.36	1.76	1.8	86	250 / 246	56	93	86	5
6	170	/ 1148	375.5	6.31	1.52	1.5	87	250 / 246	58	94	86	5
	175	/ 1153	379.1	0.31	1.52	1.5	88	250 / 252	61	94	97	5
7	180	/ 1203	382.5	0.31	1.52	1.5	89	252 / 255	55	95	87	5
	185	/ 1208	386.0	0.28	0.98	0.98	85	250 / 251	55	95	87	5
8	190	/ 1213	389.5	0.31	1.52	1.5	87	252 / 249	54	95	88	5
	195	/ 1218	391.9	0.31	1.52	1.5	86	253 / 246	60	92	89	5
9	200	/ 1223	394.7	0.33	1.62	1.6	92	248 / 258	53	95	89	5
.	205	/ 1228	397.9	0.33	1.62	1.6	90	249 / 246	53	97	90	5
10	210	/ 1233	401.5	0.30	1.47	1.5	86	251 / 245	54	98	90	5
	215	/ 1238	405.0	0.35	1.72	1.7	87	248 / 248	54	98	91	5
11	220	/ ~~1343~~ 12:43	408.7	0.40	1.47	1.5	93	252 / 255	54	98	91	5
	225	/ ~~1348~~ 1248	412.9	0.35	1.92	1.7	87	250 / 254	55	98	91	5
12	230	/ ~~1353~~ 1253	416.0	0.35	1.72	1.7	89	251 / 249	55	99	92	5
	235	/ ~~1358~~ 1258	419.6	0.40	1.96	2.0	91	251 / 248	55	99	92	5
	240	/ 1303	423.320									

CMC 9/4/98

PACIFIC ENVIRONMENTAL SERVICES, INC

Central Park West
5001 South Miami Boulevard, P.O. Box 12077
Research Triangle Park, North Carolina 27709-2077
(919) 941-0333 FAX: (919) 941-0234

Sample Train Recovery Data

Plant: Hot Mix Asphalt Plant C
Date: 7/24/98
Sampling Location: Tunnel Exhaust Duct
Sample Recovery Person: Jairo Barreda
Field Team Leader: Frank Phoenix
Sampling Method Type: 315
Run Number: 1
Impinger Train ID: 3B
Job Number: 2012-001

Comments: Filters tared weight are the numbers 0.4491

Front Half Data

Filter No.: T-M315-1-F
Filter Media Type: Glass fiber
Filter Description:
Filter No.:
Filter Media Type:
Filter Description:

Back Half Data

Impinger Purge-
Start Time: Flow Rate: Stop Time: Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:	D.I. H_2O	D.I. H_2O	Empty
Final Volume: (mL)	798.2	744.7	531.9
Initial Volume: (mL)	764.2	697.2	5294
Net Volume: (mL)	34.0	47.5	2.5

	Impinger 4	Impinger 5	Final Impinger
Contents:	Silica Gel		
Final Volume: (mL)	763.0		(g):
Initial Volume: (mL)	7230		(g):
Net Volume: (mL)	40.0		(g):

Total Moisture Collected (mL): 124.0

Description of Impinger catch:

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1/2

FIELD DATA SHEET

Plant: Hot Mix
Sampling Location TED
Run Number: T-M315-2 **Date:** 7-25-98
Pretest Leak Rate: 0.01 **cfm @** 15 **in. Hg.**
Pretest Leak Check: Pitot: ✓ **Orsat:** N/A

Sample Type: M315 **Operator:** NN
Pbar: 29.33 **Ps:** -5.9
CO2: 0 **O2:** 20.9
Probe Length/Type: 5' glass **Pitot #:** RPH
Stack Diameter: 32" **As:** 5.585
K=5.0

Nozzle ID: 0.258 **Thermocouple #:**
Assumed Bws: 3 **Filter #:** 0.4985
Meter Box #: 6A **Y:** 1.001 **ΔH@:** 1.95
Post-Test Leak Rate: **cfm @** **in. Hg.**
Post-Test Leak Check: Pitot: **Orsat:**

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)	
1	0	0711	423.626	0.28	1.40	1.4	74	250	240	66	73	72	6
	5	0716	427.0	0.28	1.40	1.4	75	250	247	68	78	74	6
2	10	0721	430.2	0.43	2.15	2.2	88	249	247	60	83	74	7
	15	0726	434.3	0.40	2.0	20	84	249	259	56	84	75	7
3	20	0731	438.1	0.30	1.50	1.5	80	252	253	51	86	76	6
	25	0736	441.3	0.31	1.55	1.6	81	249	244	52	86	76	6
4	30	0741	446.0	0.26	1.30	1.3	79	250	245	52	86	77	5
	35	0746	448.1	0.28	1.40	1.4	91	250	251	54	86	77	5
5	40	0751	451.2	0.32	1.60	1.6	80	249	252	52	86	78	6
	45	0756	454.7	0.37	1.85	1.9	81	249	251	54	87	78	7
6	50	0801	458.6	0.32	1.60	1.6	87	250	246	55	87	78	7
	55	0806	461.6	0.37	1.85	1.9	81	250	249	57	87	79	7
7	60	0811	465.6	0.37	1.85	1.9	84	247	253	58	87	80	7
	65	0816	469.5	0.33	1.65	1.7	86	250	251	54	88	80	7
8	70	0821	473.4	0.38	1.90	1.9	90	251	252	52	88	80	7
	75	0826	476.8	0.40	2.00	2.0	83	249	250	52	89	81	7
9	80	0831	480.7	0.33	1.65	1.7	84	244	252	52	89	81	7
	85	0836	484.2	0.40	2.00	2.0	97	252	250	52	89	81	7
10	90	0841	488.1	0.42	2.1	2.1	84	252	250	52	90	82	7
	95	0846	492.1	0.42	2.1	2.1	88	249	247	53	91	83	7
11	100	0851	496.0	0.37	1.85	1.9	81	249	247	53	91	83	7
	105	0856	500.0	0.41	2.05	2.0	83	252	255	54	92	84	7
12	110	0901	503.9	0.38	1.90	1.9	83	250	249	54	92	84	7
	115	0906	507.9	0.40	2.00	2.0	89	250	244	55	92	84	7
	120	0911	512.097	–									

ΔVm=
$\overline{\sqrt{\Delta p}}$=
$\overline{\Delta H}$=
$\overline{Ts}$=
$\overline{Tm}$=

9

2/2

FIELD DATA SHEET

Plant: Hot Mix
Sampling Location TED
Run Number: T-M315-2 Date: 7/25/91
~~Pretest~~ mid-point Leak Rate: 0.01 cfm @ 7 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: N/A

Sample Type: M315 Operator: NN
Pbar: 29.33 Ps: -5.9
CO2: 0.0 O2: 20.9
Probe Length/Type: 5' glass Pitot #: R911
Stack Diameter: 32" As: 5.585

Nozzle ID: 0.258 Thermocouple #:
Assumed Bws: 3 Filter #: 0.4485
Meter Box #: GA Y: 1.001 ΔH@: 1.95
Post-Test Leak Rate: 0.008 cfm @ 7 in. Hg.
Post-Test Leak Check: Pitot: 0 Orsat:

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)	
1	120	0927	512.106	0.21	1.05	1.1	89	250	248	62	87	86	5
	125	0932	515.1	0.21	1.05	1.1	86	251	244	54	91	87	5
2	130	0937	518.0	0.17	0.85	0.85	83	257	250	52	94	88	4
	135	0942	520.6	0.17	0.85	0.85	83	253	251	50	95	88	4
3	140	0947	523.2	0.21	1.05	1.1	86	249	255	53	95	85	5
	145	0952	526.1	0.18	0.90	0.90	83	250	253	53	96	90	5
4	150	0957	529.5	0.21	1.05	1.1	87	251	254	53	96	90	5
	155	1002	531.8	0.21	1.05	1.1	86	250	243	52	98	91	5
5	160	1007	534.5	0.23	1.15	1.2	90	248	250	53	98	92	5
	165	1012	537.6	0.23	1.15	1.2	90	250	256	54	98	92	5
6	170	1017	540.6	0.32	1.60	1.6	92	248	254	53	99	93	5
	175	1022	544.2	0.32	1.60	1.6	89	251	244	53	100	93	5
7	180	1027	547.4	0.31	1.55	1.6	86	250	254	52	101	91	5
	185	1032	551.0	0.32	1.60	1.6	92	250	256	53	NM 94 102	NM 94	5
8	190	1037	554.6	0.26	1.30	1.3	104	248	246	54	102	94	5
	195	1042	558.0	0.42	2.1	2.1	102	250	249	54	102	95	5
9	200	1047	562.0	0.36	1.8	1.8	92	246	245	53	102	95	5
	205	1052	566.0	0.42	2.1	2.1	104	247	249	54	104	100	5
10	210	1057	570.2	0.45	2.25	2.3	96	250	244	55	109	96	5
	215	1102	574.2	0.47	2.35	2.4	108	251	253	56	104	97	5
11	220	1107	578.7	0.45	2.25	2.3	86	253	251	55	105	98	5
	225	1112	582.9	0.45	2.25	2.3	95	250	256	58	106	98	5
12	230	1117	587.7	0.47	2.35	2.4	86	251	255	58	106	98	5
	235	1122	591.5	0.47	2.35	2.4	93	250	251	58	107	91	5
	240	1127	595.845	—									

ΔVm= $\overline{\sqrt{\Delta p}}$= $\overline{\Delta H}$= $\overline{Ts}$= $\overline{Tm}$=

PACIFIC ENVIRONMENTAL SERVICES, INC

Central Park West
5001 South Miami Boulevard, P.O. Box 12077
Research Triangle Park, North Carolina 27709-2077
(919) 941-0333 FAX: (919) 941-0234

Sample Train Recovery Data

Plant: Hot Mix Asphalt Plant C Date: 7/25/98
Sampling Location: Tunnel
Sample Recovery Person: Jaime Parreda Field Team Leader: Frank Phoenix
Sampling Method Type: 315
Run Number: T-M315-2 Impinger Train ID: 3B
Job Number: 2012-001

Comments:

Front Half Data

Filter No.: T-M315-2-F Filter Media Type: Glass Fiber
Filter Description: 0.4489
Filter No.: Filter Media Type:
Filter Description:

Back Half Data

Impinger Purge-
Start Time: Flow Rate: Stop Time: Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:	DI H_2O	DI H_2O	Empty
Final Volume: (mL)	772.1	738.3	534.3
Initial Volume: (mL)	757.1	702.2	534.3
Net Volume: (mL)	15.0	36.1	0

	Impinger 4	Impinger 5	Final Impinger
Contents:	Silica Gel		
Final Volume: (mL)	734.1		(g):
Initial Volume: (mL)	700.4		(g):
Net Volume: (mL)	33.7		(g):

Total Moisture Collected (mL): 84.8
Description of Impinger catch:

FIELD DATA SHEET

Plant: Hot MIX
Sampling Location TED
Run Number: Blank Date: 7-25-98
Pretest Leak Rate: 0.018 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: – Orsat: –

Sample Type: M-315 Operator: NN
Pbar: 29.33 Ps: –
CO2: – O2: –
Probe Length/Type: 5' glass Pitot #: RP11
Stack Diameter: – As: –

Nozzle ID: .250 Thermocouple #: RT10
Assumed Bws: 3 Filter #:
Meter Box #: RMB15 Y: 1.000 ΔH@: 1.90
Post-Test Leak Rate: 0.018 cfm @ 15 in. Hg.
Post-Test Leak Check: Pitot: – Orsat: –

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)	
–	0	1304	819.672										
		1305	819.843										

ΔVm= $\overline{\sqrt{\Delta p}}$= $\overline{\Delta H}$= $\overline{Ts}$= $\overline{Tm}$=

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Sample Train Recovery Data

Plant: Hot Mix Asphalt Plant C Date: 7/25/98

Sampling Location: Tunel Exhaust

Sample Recovery Person: Jairo Barreda Field Team Leader: Frank Phoenix

Sampling Method Type: M315

Run Number: FB - Tunnel Impinger Train ID: 3B

Job Number: R012-001

Comments:

Front Half Data

Filter No.: 7-M315-FB-F Filter Media Type: Fiber Glass

Filter Description: 0.4463

Filter No.: Filter Media Type:

Filter Description:

Back Half Data

Impinger Purge-

Start Time: Flow Rate: Stop Time: Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:			
Final Volume: (mL)	770.5	689.4	527.7
Initial Volume: (mL)	770.4	689.0	527.7
Net Volume: (mL)	0.1	0.4	0

	Impinger 4	Impinger 5	Final Impinger
Contents:			
Final Volume: (mL)	749.9		(g):
Initial Volume: (mL)	749.7		(g):
Net Volume: (mL)	0.2		(g):

Total Moisture Collected (mL):

Description of Impinger catch:

12

13

1/2

FIELD DATA SHEET

Plant: Hot Mix
Sampling Location TED
Run Number: T-M315-4 **Date:** 7-26-98
Pretest Leak Rate: 0.005 **cfm @** 15 **in. Hg.**
Pretest Leak Check: Pitot: ✓ **Orsat:** N/A

Sample Type: 315 **Operator:** NN
Pbar: 29.31 **Ps:** -5.9
CO2: 0 **O2:** 20.9
Probe Length/Type: 3' glass **Pitot #:** RPII
Stack Diameter: 32" **As:** 5.585

Nozzle ID: 0.258 **Thermocouple #:**
Assumed Bws: 3 **Filter #:**
Meter Box #: 6A **Y:** 1.001 **ΔH@:** 1.55
Post-Test Leak Rate: **cfm @** **in. Hg.**
Post-Test Leak Check: Pitot: **Orsat:** N/A

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) In H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)	
—	–	–	—										
1	0	0926	597.132	0.21	1.02	1.0	79	249	249	60	84	84	4
	5	0931	599.9	0.19	0.92	0.92	79	250	257	51	86	84	4
2	10	0936	602.1	0.19	0.92	0.92	80	251	254	52	88	85	4
	15	0941	605.3	0.28	1.36	1.4	80	253	252	53	92	87	5
3	20	0946	608.7	0.24	1.16	1.2	81	250	246	57	94	87	5
	25	0951	611.7	0.22	1.07	1.1	83	250	257	60	96	89	4
4	30	0956	614.7	0.23	1.11	1.1	86	249	256	61	96	90	4
	35	1001	617.6	0.21	1.02	1.0	84	250	257	62	98	91	5
5	40	1006	620.5	0.29	1.41	1.4	83	249	251	63	99	92	5
	45	1011	623.9	0.31	1.50	1.5	84	250	254	63	101	93	5
6	50	1016	627.4	0.34	1.65	1.7	84	250	258	63	102	101	5
	55	1021	630.9	0.36	1.75	1.8	86	249	256	65	104	95	5
7	60	1026	634.7	0.36	1.75	1.8	85	257	251	66	104	86	5
	65	1031	638.7	0.47	2.28	2.3	88	250	244	66	105	98	5
8	70	1036	643.0	0.47	2.35	2.4	87	251	250	64	107	97	6
	75	1041	647.4	0.53	2.65	2.7	84	250	250	57	107	98	6
9	80	1046	652.0	0.47	2.35	2.4	87	250	247	57	107	100	6
	85	1051	656.3	0.58	2.90	2.5	88	250	253	58	107	101	7
10	90	1056	661.4	0.77	3.65	3.7	97	251	250	58	107	102	8
	95	1101	666.6	0.73	3.65	3.7	94	252	251	56	110	104	8
11	100	1106	672.4	0.82	4.10	4.1	92	253	250	61	107	100	9
	105	1111	677.9	0.82	4.10	4.1	93	252	251	60	107	100	9
12	110	1116	683.3	0.82	4.10	4.1	90	251	250	60	107	100	9
	115	1121	689.0	0.82	4.1	4.1	91	250	247	61	108	101	9
	120	1126	694.546	—	—	—	—	—	—	—	—	—	—

ΔVm= ______ $\overline{\sqrt{\Delta p}}$= ______ $\overline{\Delta H}$= ______ $\overline{Ts}$= ______ $\overline{Tm}$= ______

FIELD DATA SHEET

Plant: Hot Mix
Sampling Location TED
Run Number: T-M315-4 **Date:** 7/26/98
Pretest Leak Rate: 0.006 **cfm @** 10 **in. Hg.**
Pretest Leak Check: Pitot: ✓ **Orsat:** N/A

Sample Type: M315 **Operator:** NN
Pbar: 29.31 **Ps:** -5.9
CO2: 0 **O2:** 20.9
Probe Length/Type: 5' glass **Pitot #:** RP11
Stack Diameter: 32" **As:** 5.585

Nozzle ID: 0.258 **Thermocouple #:**
Assumed Bws: 3 **Filter #:**
Meter Box #: 6A **Y:** 1.001 **ΔH@:** 1.95
Post-Test Leak Rate: 0.004 **cfm @** 11 **in. Hg.**
Post-Test Leak Check: Pitot: ✓ **Orsat:** N/A

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)	
1	0	1140	694.643	0.26	1.30	1.3	90	249	251	63	101	101	5
	5	1145	697.8	0.23	1.15	1.2	93	250	252	61	103	101	5
2	10	1150	701.2	0.25	1.25	1.3	92	248	244	54	105	102	5
	15	1155	704.5	0.23	1.15	1.2	93	250	243	55	107	102	5
3	20	1200	707.5	0.26	1.30	1.3	97	251	246	56	107	102	5
	25	1205	710.7	0.23	1.15	1.2	96	252	249	57	108	104	5
4	30	1210	713.9	0.30	1.50	1.5	92	250	248	58	108	104	5
	35	1215	717.3	0.23	1.15	1.2	99	250	243	59	109	104	5
5	40	1220	720.6	0.30	1.5	1.5	95	249	246	61	110	105	5
	45	1225	723.7	0.30	1.5	1.5	100	251	254	62	110	105	5
6	50	1230	727.1	0.31	1.55	1.5	98	253	259	63	109	105	5
	55	1235	730.6	0.34	1.70	1.7	96	251	247	63	110	105	5
7	60	1240	734.2	0.34	1.7	1.7	101	252	251	63	98	86	5
	65	1245	737.0	0.36	1.80	1.8	101	253	250	63	99	87	5
8	70	1250	741.3	0.36	1.80	1.8	100	252	251	63	101	90	5
	75	1255	744.6	0.31	1.55	1.6	99	252	253	62	106	90	5
9	80	1300	748.3	0.36	1.80	1.8	99	251	251	62	105	92	5
	85	1305	751.9	0.36	1.80	1.8	99	252	253	62	105	94	5
10	90	1310	755.7	0.30	NT ~~1.75~~ 1.5	1.5	101	249	252	63	105	86	5
	95	1315	759.3	0.33	1.65	1.7	97	250	256	65	105	96	5
11	100	1320	762.9	0.32	1.60	1.6	96	251	257	65	105	98	5
	105	1325	766.4	0.36	1.80	1.8	98	250	246	65	105	98	5
12	110	1330	770.3	0.34	1.70	1.7	96	251	249	65	106	99	5
	115	1335	773.9	0.34	1.70	1.7	96	253	251	65	105	99	5
	120	1340	777.464	^	^	^	^	/	^	^	/	/	/

ΔVm= ______ $\overline{\sqrt{\Delta p}}$= ______ $\overline{\Delta H}$= ______ $\overline{Ts}$= ______ $\overline{Tm}$= ______

MOISTURE RECOVERY SHEET
PACIFIC ENVIRONMENTAL SERVICES, INC.

FACILITY: Hot mix

SOURCE: TED Filter # 0.4527

DATE: 7/26/98

RUN #: T-M315-4

METHOD #: 315

BOX #: 3B

IMPINGER	CONTENTS	FINAL GRAMS	INITIAL GRAMS	TOTAL GRAMS
1	D.I. WATER	736.2	754.7	18.5
2	D.I. WATER	743.9	693.0	50.9
3	EMPTY	534.6	526.3	8.3
4	SILICA GEL	789.7	751.7	38.0

TRANSPOSED EMC

TOTAL GRAMS COLLECTED	

INITALS: NN

16

1/1

FIELD DATA SHEET

Plant: Asphalt Plant C
Sampling Location Tunnel Exhaust
Run Number: T-315-3 **Date:** 7/27/98
Pretest Leak Rate: 0.003 **cfm @** 15 **in. Hg.**
Pretest Leak Check: Pitot: ✓ **Orsat:** N/A

Sample Type: 315 **Operator:** NN
Pbar: 29.27 **Ps:** -4.5
CO2: 0 **O2:** 20.9
Probe Length/Type: 5' glass **Pitot #:** ____
Stack Diameter: 32" **As:** ____

Nozzle ID: 0.257 **Thermocouple #:** ____
Assumed Bws: 3 **Filter #:** ____
Meter Box #: 6A **Y:** 1.001 **ΔH@:** 1.95
Post-Test Leak Rate: ____ **cfm @** ____ **in. Hg.**
Post-Test Leak Check: Pitot: ____ **Orsat:** N/A

stop 0741 *

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)
					Desired	Actual		Probe	Filter		Inlet (Tm in °F)	Outlet (Tm out °F)	
1	0	0711	777.594	NN 0.22	1.1	1.1	77	248	249	60	72	72	6
	5	0716	780.9	NN 0.22	1.1	1.1	77	250	247	49	77	72	6
2	10	0721/42	783.9	0.24	1.2	1.2	90	247	246	55	76	76	6
	15	0747	786.8	0.24	1.2	1.2	82	249	254	56	80	77	6
3	20	0752	789.7	0.27	1.35	1.4	87	250	246	56	85	78	6
	25	0757	793.0	0.24	1.2	1.2	88	249	247	57	86	78	6
4	30	0802	796.1	0.27	1.35	1.4	89	251	249	56	87	79	6
	35	0807	799.0	0.29	1.45	1.45	84	251	250	60	87	80	7
5	40	0812	802.9	.29	1.45	1.45	84	251	250	60	87	80	7
NN 6	45	0817	806.2	0.27	1.45	1.5	84	251	253	60	87	81	7
6	50	0822	809.9	0.30	1.50	1.5	83	249	251	62	89	81	7
	55	0827	813.100	.30	1.50	1.50	83	249	251	62	89	81	7
7	60	0832	817.2	.25	1.25	1.28	101	249	254	54	90	83	6
	65	0837	819.7	0.25	1.25	1.3	97	248	252	55	91	83	6
8	70	0842	822.5	0.31	1.55	1.6	94	250	248	57	91	84	7
	75	0847	826.2	0.31	1.55	1.6	98	250	256	57	92	85	7
9	80	0852	829.8	0.22	1.1	1.1	101	249	247	58	93	86	7
	85	0857	832.7	0.32	1.10	1.1	100	252	249	60	93	87	7
10	90	0902	835.6	0.29	1.45	1.5	100	254	253	62	94	87	7
	95	0907	838.9	0.29	1.45	1.5	100	255	256	63	85	88	7
11	100	0912	842.2	0.33	1.62	1.6	101	256	251	63	90	86	7
	105	0917	845.7	0.33	1.62	1.6	101	257	254	62	95	84	7
12	110	0922	849.4	0.32	1.60	1.6	100	251	252	61	94	86	7
	115	0927	852.8	0.32	1.60	1.6	101	252	256	61	96	85	7
	120	0932	856.3										
			FOP 9/21/98										

ΔVm= ____ $\overline{\sqrt{\Delta p}}$**=** ____ $\overline{\Delta H}$**=** ____ $\overline{Ts}$**=** ____ $\overline{Tm}$**=** ____

17

2/2

FIELD DATA SHEET

Plant: Asphalt Plant "C"
Sampling Location TED
Run Number: T-M315-3 Date: 7/27/98
Pretest Leak Rate: 0.003 cfm @ ___ in. Hg.
Pretest Leak Check: Pitot: ___ Orsat: ___

Sample Type: 315 Operator: NW
Pbar: 25.23 Ps: -4.5
CO2: 0 O2: 20.9
Probe Length/Type: 5' S/SS Pitot #: 7811
Stack Diameter: 32" As: ___

Nozzle ID: 0.257 Thermocouple #: ___
Assumed Bws: 3 Filter #: ___
Meter Box #: 6A Y: 1.001 ΔH@: 1.95
Post-Test Leak Rate: ___ cfm @ ___ in. Hg.
Post-Test Leak Check: Pitot: ___ Orsat: N/A

	Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Actual	Stack Temp. (Ts)	Temperature °F Probe	Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in°F)	Outlet (Tm out°F)	Pump Vacuum (in. Hg)
	1	120	0953	857.312	0.23	1.15	1.2	86	249	255	63	93	91	6
Stop 0958 ✱		125	0958	860.4	0.25	1.25	1.3	86	251	252	60	93	91	6
	2	130	NW ~~1005~~ 1009	863.7	0.26	1.25	1.3	90	247	249	51	96	92	6
		135	1015	866.4	0.23	1.1	1.1	93	246	252	52	98	94	6
	3	140	1020	869.7	0.23	1.1	1.1	94	249	253	52	95	95	6
		145	1025	872.0	0.22	1.00	1.0	95	250	260	52	100	95	6
	4	150	1030	875.8	0.21	1.00	1.0	95	253	251	53	100	95	6
		155	1035	878.9	0.23	1.10	1.1	95	250	254	55	101	96	6
	5	160	1040	882.0	0.23	1.1	1.1	95	249	252	55	100	98	6
45		165	1045	885.0	0.20	1.0	1.0	95	251	254	56	101	96	6
	6	170	1050	887.9	0.20	1.0	1.0	98	254	256	58	102	98	6
		175	1055	890.8	0.24	1.15	1.2	104	252	254	58	102	98	6
	7	180	1100	894.0	0.37	1.78	1.8	103	254	256	59	104	99	6
		185	1105	897.9	0.40	1.92	1.9	99	251	253	60	105	100	6
	8	190	1110	902.1	0.40	1.92	1.9	100	254	256	61	106	100	6
		195	1115	NW 909.6	0.42	2.02	2.0	99	256	252	62	107	101	6
	9	200	1120	913.3	0.41	1.97	2.0	95	251	254	64	107	102	6
		205	1125	917.0	0.44	2.2	2.2	96	248	252	58	107	102	6
90	10	210	1130	919.8	0.49	2.2	2.2	97	249	251	56	110	103	8
		215	1135	922.4	0.44	2.2	2.2	97	246	256	56	112	103	8
100	11	220	1140	925.3	0.40	2.2	2.2	96	248	255	57	113	107	8
		225	1145	926.4	0.34	1.63	1.6	96	251	261	57	113	104	8
110	12	230	1150		0.34	1.6	1.6							
		235	1155	937.5	0.34	1.6	1.6							
		240	1200	941.423	NW	NW	NW							

ΔVm= ___ $\overline{\sqrt{\Delta p}}$= ___ $\overline{\Delta H}$= ___ $\overline{Ts}$= ___ $\overline{Tm}$= ___

PACIFIC ENVIRONMENTAL SERVICES, INC

Central Park West
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Research Triangle Park, North Carolina 27709-2077
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Sample Train Recovery Data

Plant: Hot Mix Date: 7/27/98
Sampling Location: TED
Sample Recovery Person: N. Nielsen Field Team Leader: F. F.
Sampling Method Type: M315
Run Number: T-M315-3 Impinger Train ID: 3B
Job Number: 2012-001

Comments:

Front Half Data

Filter No.: T-M311-3-F Filter Media Type: Glass Fiber
Filter Description: 0.4530
Filter No.: Filter Media Type:
Filter Description:

Back Half Data

Impinger Purge-
Start Time: Flow Rate: Stop Time: Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:	D.I.	D.I.	MT
Final Volume: (mL)	749.9	745.0	528.1
Initial Volume: (mL)	766.2	697.3	527.3
Net Volume: (mL)	-16.3 ✓	47.7	0.80

	Impinger 4	Impinger 5	Final Impinger
Contents:	Silica		
Final Volume: (mL)	795.6		(g):
Initial Volume: (mL)	763.3		(g):
Net Volume: (mL)	32.3		(g):

Total Moisture Collected (mL): 64.5 ✓
Description of Impinger catch: Clear

18

19

FIELD DATA SHEET

Plant: Asphalt Plant C
Sampling Location: Tunnel Ex'
Run Number: T-MM5-1 Date: 7-24-98
Pretest Leak Rate: ~~.005~~ .002 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: N/A

Sample Type: MM5 Operator: DDH
Pbar: 29.35 Ps: -4.7
CO2: 0 O2: 20.9
Probe Length/Type: 3'/S Type Pitot #: RP-19 TCW RT-6
Stack Diameter: ______ As: ______
K-4.86

Nozzle ID: V-.252 Thermocouple #: TC-RT-06
Assumed Bws: 2 Filter #: DF
Meter Box #: RMB-15 Y: 1.006 ΔH@: 1.90
Post-Test Leak Rate: .002 cfm @ 15 in. Hg.
Post-Test Leak Check: Pitot: ✓ Orsat: N/A

Stopped at 0800 restart 0804

Stopped at 0809 restart at 0828

stop 1006

restart 1057

0919★

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)	XAD
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)		
A 1	0	0720	493.365											
	5	0725	496.415	.25	1.21	1.21	73	250	250	48	63	63	5	41
2	10	0730	499.325	.30	1.44	1.44	71	255	255	49	65	65	5	41
	15	0735	502.650	.30	1.44	1.44	69	254	250	49	66	66	5	41
3	20	0740	506.080	.30	1.49	1.44	69	250	245	50	68	64	5	40
	25	0745	509.130	.35	1.69	1.69	69	255	250	41	67	66	5	40
4	30	0750	512.340	.34	1.61	1.61	81	250	250	42	67	66	7	42
	35	0755	516.275	.38	1.81	1.81	77	252	251	45	67	69	7	42
5	40	0800	519.505	.33	1.57	1.57	83	255	250	46	70	70	7	42
	45	0809	522.896	.37	1.74	1.74	82	250	250	46	66	69	7	42
6	50	0833	525.896	.38	1.81	1.81	74	250	255	47	65	66	7	42
	55	0838	530.055	.38	1.77	1.77	90	255	255	47	70	68	7	45
7	60	0843	533.490	.33	1.55	1.55	85	250	255	44	70	69	7	40
	65	0848	537.150	.35	1.70	1.70	80	255	255	45	71	71	7	45
8	70	0853	540.620	.42	2.00	2.00	90	250	250	46	80	80	7	46
	75	0858	543.750	.25	1.19	1.19	82	260	250	47	72	67	7	46
9	80	0903	547.115	.37	1.76	1.76	82	260	250	48	72	70	7	46
	85	0908	550.700	.27	1.29	1.29	82	260	260	48	72	71	7	47
10	90	0913	554.140	.27	1.28	1.28	83	255	260	49	73	72	7	46
	95	0918	557.650	.29	1.38	1.38	83	254	249	50	73	72	7	46
11	100	0923	561.150	.35	1.67	1.67	82	247	250	50	73	72	7	47
	105	0928	564.700	.32	1.53	1.53	81	248	248	51	73	72	7	47
12	110	0933	567.915	.29	1.38	1.38	81	255	250	50	73	70	7	48
	115	0938	571.420	.30	1.43	1.43	80	250	250	50	73	71	7	49
1	120	0943	573.420	.30	1.43	1.43	80	250	250	51	73	71	7	49
	125	1000	577.540	.30	1.43	1.43	80	250	260	52	73	71	7	50
2	130	1106	581.115 ~~577.540~~	.30	1.43	1.43	80	250	250	51	73	71	7	50

ΔVm= ______ $\overline{\sqrt{\Delta p}}$= ______ $\overline{\Delta H}$= ______ $\overline{Ts}$= ______ $\overline{Tm}$= ______

573.420
574.470

★ Asphalt Spill

Page 2 of 2

Plant Name: Asphalt Plant C
Test Date: 7-24-98
Run Number: T-MMS-1
Operator: Dennis Holzschuh

Traverse Point Number	Sampling Time, (min.) / Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H₂O	Orifice Pres. Differential (ΔH) in. H₂O Desired	Orifice Pres. Differential (ΔH) in. H₂O Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp.° F	Impinger Temp. ° F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$)° F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum In. Hg	
	135 / 1106	584.080	.32	1.55	1.55	75	250 / 255	48	74	74	6	48
3	140 / 1116	587.250	.32	1.55	1.55	75	250 / 255	49	79	73	6	48
	145 / 1121	590.670	.38	1.84	1.84	74	260 / 255	50	76	73	6	49
4	150 / 1126	593.905	.31	1.47	1.47	88	260 / 250	50	76	73	6	48
	155 / 1131	597.300	.30	1.49	1.44	82	255 / 250	51	77	73	7	49
5	160 / 1136	600.512	.28	1.34	1.34	83	250 / 250	51	78	73	7	48
	165 / 1141	604.030	.34	1.61	1.61	90	255 / 250	50	78	73	7	48
6	170 / 1146	607.370	.25	1.19	1.19	90	255 / 250	50	79	75	7	49
	175 / 1151	610.440	.30	1.45	1.45	82	255 / 250	50	80	77	7	50
7	180 / 1156	613.800	.32	1.55	1.55	80	255 / 250	51	80	78	7	51
	185 / 1201	617.300	.33	1.60	1.60	82	260 / 255	48	81	81	7	51
8	190 / 1206	622.017	.43	2.09	2.09	79	260 / 255	49	81	81	9	52
	195 / 1211	625.430	.43	2.09	2.09	79	260 / 250	48	81	81	9	51
9	200 / 1216	629.040	.43	2.08	2.08	83	260 / 250	48	81	81	9	51
	205 / 1221	633.070	.48	2.33	2.33	80	260 / 250	49	84	81	9	51
10	210 / 1226	637.310	.46	2.23	2.23	84	255 / 250	51	84	82	8	48
	215 / 1231	642.650	.38	1.[illegible]	1.84	84	260 / 250	51	84	83	8	46
11	220 / 1236	645.6500	.38	1.84	1.84	84	260 / 250	50	84	83	8	45
	225 / 1241	648.830	.37	1.79	1.79	86	250 / 250	51	84	82	8	44
12	230 / 1246	652.530	.37	1.79	1.79	86	250 / 255	51	89	81	8	46
	235 / 1251	656.360	.34	1.64	1.64	84	250 / 255	52	84	81	8	
	240 / 1256	659.760	.33	1.59	1.59	88	250 / 250	51	84	83	8	
	/						/					
	/						/					

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Sample Train Recovery Data

Plant: Asphalt Plant C Date: 7-24-98
Sampling Location: Tunnel Exhaust Duct
Sample Recovery Person: DDH Field Team Leader: DDH
Sampling Method Type: MMS
Run Number: T-MMS-1 Impinger Train ID: 6D
Job Number: R012-001

Comments:

Front Half Data

Filter No.: Filter Media Type: DF
Filter Description: MMS Filter
Filter No.: Filter Media Type:
Filter Description:

Back Half Data

Impinger Purge-
Start Time: Flow Rate: Stop Time: Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:	MT	DI	DI
Final Volume: (mL)	513.5	805.7	772.9
Initial Volume: (mL)	473.4	734.6	741.6
Net Volume: (mL)	40.1	71.1	31.3

	Impinger 4	Impinger 5	Final Impinger
Contents:			
Final Volume: (mL)	615.9	754.8	(g): 344.5
Initial Volume: (mL)	614.3	682.5	(g): 306.5
Net Volume: (mL)	1.6	72.3	(g): 38.0

Total Moisture Collected (mL):
Description of Impinger catch:

22

FIELD DATA SHEET

Plant: Asphalt Plant C
Sampling Location Tunnel Exhaust Duct
Run Number: T-MMS-2 Date: 7-25-98
Pretest Leak Rate: 0.00 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: N/A
>3.0"

Sample Type: ________ Operator: DDH
Pbar: 29.33 Ps: -4.8
CO2: 0 O2: 20.9
Probe Length/Type: 3' Pitot #: RP-19
Stack Diameter: 32" As: ________
K- 4.86

Nozzle ID: IV- .252 Thermocouple #: ______
Assumed Bws: 2 Filter #: DF- Unnumbered
Meter Box #: ______ Y: 1.000 ΔH@: 1.90
Post-Test Leak Rate: ______ cfm @ __ in. Hg.
Post-Test Leak Check: Pitot: ✓ Orsat: N/A

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)	
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)		XAD
A 1	0	0710	660.664											
	5	0715	664.040	.28	1.33	1.33	74	255	249	47	65	65	6	48
2	10	0720	666.833	.28	1.33	1.33	74	250	260	49	68	67	6	49
	15	0725	670.430	.38	1.82	1.82	76	250	250	45	70	69	6	49
3	20	0730	673.320	.25	1.19	1.19	82	260	250	46	71	70	6	50
	25	0735	676.870	.38	1.83	1.83	75	255	250	46	72	71	6	50
4	30	0740	680.600	.37	1.79	1.79	74	250	250	46	72	71	6	47
	35	0745	683.930	.27	1.30	1.30	74	255	250	47	72	72	6	48
5	40	0750	687.017	.24	1.15	1.15	80	250	250	48	72	72	6	48
	45	0755	690.140	.35	1.66	1.66	82	260	256	47	72	72	6	45
6	50	0800	693.560	.39	1.68	1.68	78	255	250	47	72	71	6	46
	55	0805	696.340	.33	1.59	1.59	77	250	250	48	73	72	6	46
7	60	0810	699.713	.37	1.78	1.78	77	255	250	47	73	71	6	46
	65	0815	703.900	.34	1.62	1.62	81	250	255	47	71	71	6	46
8	70	0820	707.400	.35	1.68	1.68	79	260	250	46	74	72	6	46
	75	0825	710.800	.30	1.44	1.44	78	260	250	47	74	72	6	47
9	80	0830	714.010	.34	1.64	1.64	78	260	250	48	75	72	6	47
	85	0835	717.600	.40	1.90	1.90	85	250	255	48	75	72	6	47
10	90	0840	720.461	.32	1.54	1.54	79	250	250	47	75	74	6	48
	95	0845	724.160	.32	1.54	1.54	80	250	250	47	75	74	6	49
11	100	0850	728.400	.37	1.77	1.77	82	255	250	47	75	74	6	48
	105	0855	733.320	0.32	1.54	1.54	80	252	251	47	77	73	6	48
12	110	0900	735.320	.34	1.63	1.63	82	255	250	46	76	73	6	48
	115	0905	738.900	.34	1.63	1.63	82	255	250	46	76	73	6	47
B 1	120	0910	742.309	.34	1.63	1.63	82	255	250	46	76	73	6	47
	125	0926	746.220	.33	1.45	1.45	82	250	250	46	76	73	6	54
2	130	0931	749.7	.15	.73	.73	81	250	250	47	77	75	6	54

Stop- 0910
restart- 0926

ΔVm= ________ $\overline{\sqrt{\Delta p}}$= ________ $\overline{\Delta H}$= ________ Ts= ________ Tm= ________

(742.309
742.900)

23

FIELD DATA SHEET

Plant: Hot Mix — MMS (CMC)
Sampling Location: TEO
Run Number: T-MM5-2 Date: 7-25-98
Pretest Leak Rate: 0.00 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: N/A

Sample Type: MM5 Operator: NN
Pbar: 29.33 Ps: -4.8
CO2: 0.0 O2: 20.9
Probe Length/Type: 8' glass Pitot #: RP-19
Stack Diameter: 32" As:
K=4.86

Nozzle ID: D = 0.252 Thermocouple #:
Assumed Bws: 2 Filter #: DF
Meter Box #: Y: 1.000 ΔH@: 1.50
Post-Test Leak Rate: 0.002 cfm @ 8 in. Hg.
Post-Test Leak Check: Pitot: ✓ Orsat: N/A

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Orifice Pressure Differential (ΔH) in H2O Actual	Stack Temp. (Ts)	Temperature °F Probe	Temperature °F Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in°F)	Dry Gas Meter Temp. Outlet (Tm out°F)	Pump Vacuum (in. Hg)	
	135	0936	~~749.7~~ 751.1	0.24	1.17	1.2	82	258	294	46	82	79	7	56
3	140	0941	~~[illegible]~~ 754.9	0.24	1.17	1.2	81	256	295	46	82	79	7	56
	145	0946	~~755.7~~ 757.8	0.23	1.11	1.1	85	255	297	47	82	80	7	55
4	150	0951	761.0	0.26	1.27	1.3	79	254	255	55	81	80	7	54
	155	0956	764.3	0.23	1.25	1.3	78	255	254	48	87	80	7	55
5	160	1001	767.0	0.26	1.19	1.2	91	253	253	48	84	81	7	54
	165	1006	770.0	0.25	1.19	1.2	91	257	251	49	85	82	7	53
6	170	1011	773.2	0.26	1.26	1.3	83	251	252	49	84	85	7	52
	175	1016	776.3	0.27	1.31	1.3	84	251	252	50	84	85	7	53
7	180	1021	779.9	0.34	1.65	1.7	84	253	257	48	85	83	7	53
	185	1026	783.6	0.34	1.65	1.7	84	253	246	48	87	84	7	45
8	190	1031	787.2	0.29	1.41	1.4	88	255	249	48	86	85	7	52
	195	1036	790.6	0.29	1.41	1.4	87	255	253	47	87	85	7	52
9	200	1041	793.9	0.32	1.55	1.6	87	252	256	50	87	85	7	53
	205	1046	797.4	0.32	1.55	1.6	88	256	255	51	87	87	7	53
10	210	1051	800.6	0.25	1.21	1.2	89	255	254	51	88	87	7	52
	215	1056	803.5	0.23	1.12	1.1	84	250	250	51	88	86	7	52
11	220	1101	806.6	0.25	1.21	1.2	85	251	253	52	89	86	7	52
	225	1106	809.7	0.25	1.21	1.2	97	255	256	53	89	87	7	55
12	230	1111	812.6	0.25	1.21	1.2	97	256	257	53	90	87	7	56
	235	1116	815.7	0.25	1.21	1.2	82	253	245	54	91	88	7	57
	240	1121	818.905	6.25	1.21	1.2	82	251	248	55	89	88	7	54
		[illegible]		~~0.25~~	~~1.21~~	~~1.0~~	~~87~~	~~253~~	~~247~~	~~56~~	~~89~~	~~88~~	~~7~~	54

ΔVm=________ $\sqrt{\Delta p}$=________ $\overline{\Delta H}$=________ $\overline{Ts}$=________ $\overline{Tm}$=________

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Sample Train Recovery Data

Plant: Asphalt Plant C Date: 7-25-98

Sampling Location: Tunnel Exhaust Duct

Sample Recovery Person: DH Field Team Leader: DDH

Sampling Method Type: MMS

Run Number: ~~TED~~ T-MMS-2 Impinger Train ID:

Job Number: R012-001

Comments:

Front Half Data

Filter No.: Unnumbered Filter Media Type: DF Untared

Filter Description:

Filter No.: Filter Media Type:

Filter Description:

Back Half Data

Impinger Purge-
Start Time: Flow Rate: Stop Time: Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:			
Final Volume: (mL)	515.0	840.5	790.5
Initial Volume: (mL)	472.8	841.3	793.5
Net Volume: (mL)	42.2 ✓	-.8 ✓	-3.0 ✓

	Impinger 4	Impinger 5	Final Impinger
Contents:		SG	XAD
Final Volume: (mL)	622.2	763.1	(g): 376.4
Initial Volume: (mL)	620.4	731.9	(g): 331.4
Net Volume: (mL)	1.8 ✓	31.2 ✓	(g): 45.0 ✓

Total Moisture Collected (mL): ~~161.4~~ MC 116.4

Description of Impinger catch:

25

FIELD DATA SHEET

Plant: Hot Mix
Sampling Location TED
Run Number: Blank Date: 7-25-98
Pretest Leak Rate: 0.016 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: — Orsat: —

Sample Type: MM5 Operator: NN
Pbar: 29.53 Ps: —
CO2: — O2: —
Probe Length/Type: 5' glass Pitot #: RP-19
Stack Diameter: ______ As: ______

Nozzle ID: 0.252 Thermocouple #: RT6
Assumed Bws: — Filter #: ______
Meter Box #: RMB-15 Y: 1.000 ΔH@: 1.95
Post-Test Leak Rate: 0.016 cfm @ 15 in. Hg.
Post-Test Leak Check: Pitot: — Orsat: —

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)	
				▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
—	0	1245	819.137										
		1250	819.621										

ΔVm= ______ $\overline{\sqrt{\Delta p}}$= ______ $\overline{\Delta H}$= ______ $\overline{Ts}$= ______ $\overline{Tm}$= ______

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Sample Train Recovery Data

Plant: Asphalt Plant C Date: 9 8

Sampling Location: Tunnel Exhaust Duct

Sample Recovery Person: Dennis Holzschuh Field Team Leader: FJP

Sampling Method Type: MMS

Run Number: T-MMS-FB Impinger Train ID: 6D

Job Number: R012-001

Comments:

Front Half Data

Filter No.: Unnumbered Filter Media Type: DF

Filter Description: MMS

Filter No.: Filter Media Type:

Filter Description:

Back Half Data

Impinger Purge-
Start Time: Flow Rate: Stop Time: Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:	MT	DI	DI
Final Volume: (mL)	474.0	713.4	712.8
Initial Volume: (mL)	474.0	712.6	712.8
Net Volume: (mL)	-0-	0.8	0

	Impinger 4	Impinger 5	Final Impinger
Contents:	MT	SG	XAD
Final Volume: (mL)	622.8	764.0	(g): 318.0
Initial Volume: (mL)	622.8	764.0	(g): 317.8
Net Volume: (mL)	-0-	-0-	(g): .2

Total Moisture Collected (mL):

Description of Impinger catch:

26

FIELD DATA SHEET

Plant: Asphalt Plant C
Sampling Location Tunnel Ex
Run Number: I-MMS-4 **Date:** 7-26-98
Pretest Leak Rate: 0.000 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ✓ **Orsat:** N/A

Sample Type: MMS **Operator:** DDH
Pbar: 29.31 **Ps:** -5.8
CO2: 0 **O2:** 20.9
Probe Length/Type: 3'/S Type **Pitot #:** ____
Stack Diameter: 32" **As:** ____
K - 4.86

Nozzle ID: IV-.252 **Thermocouple #:** RT-6
Assumed Bws: 2 **Filter #:** DF
Meter Box #: RMB-15 **Y:** 1.006 **ΔH@:** 1.90
Post-Test Leak Rate: .000 cfm @ 15 in. Hg.
Post-Test Leak Check: Pitot: ✓ **Orsat:** ____

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)	
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)		
A1	0	0925	820.080											
	5	0930	823.180	.30	1.44	1.49	78	250	250	48	74	74	6	47
2	10	0935	826.400	.28	1.36	1.36	77	250	260	48	75	79	6	48
	15	0940	829.620	.31	1.49	1.49	78	255	250	48	75	74	6	49
3	20	0945	833.050	.33	1.60	1.60	79	260	260	48	78	76	6	48
	25	0950	837.121	.31	1.52	1.52	76	250	250	48	81	76	6	48
4	30	0955	840.490	.26	1.26	1.26	80	255	250	98	82	76	6	49
	35	1000	843.615	.38	1.85	1.85	80	260	250	47	83	77	6	48
5	40	1005	847.505	.31	1.51	1.51	80	255	250	48	83	77	6	49
	45	1010	850.706	.33	1.59	1.59	84	255	250	48	82	77	6	48
6	50	1015	854.340	.35	1.71	1.71	81	250	250	47	85	77	6	47
	55	1020	858.010	.30	1.46	1.46	81	260	250	47	85	77	6	46
7	60	1025	861.800	.38	1.87	1.87	80	250	250	49	88	85	6	49
	65	1030	865.525	.32	1.57	1.57	82	255	250	49	88	85	6	50
8	70	1035	869.000	.32	1.71	1.71	84	250	250	51	88	85	6	50
	75	1040	872.550	.37	1.81	1.81	84	255	250	50	90	89	6	50
9	80	1045	876.310	.37	1.81	1.81	84	250	250	51	90	84	6	51
	85	1050	880.540	.37	1.81	1.81	84	260	250	52	90	84	6	50
10	90	1055	884.140	.45	2.21	2.21	85	260	250	51	92	84	6	50
	95	1100	888.500	.52	2.55	2.55	88	250	250	51	93	84	6	50
11	100	1105	892.920	.48	2.34	2.34	91	255	250	52	95	84	6	51
	105	1110	897.210	.52	2.55	2.55	91	250	250	51	95	89	6	52
12	110	1115	901.510	.48	2.35	2.35	89	250	255	50	95	90	6	51
	115	1120	905.820	.47	2.32	2.32	85	250	250	50	94	90	6	50
B1	120	1125	910.055	.47	2.32	2.32	85	250	255	51	94	90	6	51
	125	1148	913.400	.38	1.73	1.73	94	250	250	52	85	90	6	51
2	130	1153	917.012	.40	1.97	1.97	85	255	250	51	94	90	6	

ΔVm= ______ √Δp= ______ ΔH= ______ Ts= ______ Tm= ______

910.055
910.120

FIELD DATA SHEET

Plant: Asphalt Plant C
Sampling Location Tunnel Exhaust Duct
Run Number: T-MMS 4 **Date:** 7-26 98
Pretest Leak Rate: 0.000 **cfm @** 15 **in. Hg.**
Pretest Leak Check: Pitot: ✓ **Orsat:** N/A

Sample Type: MMS **Operator:** DDH
Pbar: 29.31 **Ps:** -4.9
CO2: 0 **O2:** 20.9
Probe Length/Type: 3'/S Type **Pitot #:** RP-19
Stack Diameter: 32" **As:**
K = 4.86

Nozzle ID: V-.252 **Thermocouple #:** RT-6
Assumed Bws: 2 **Filter #:** DF
Meter Box #: RMB-15 **Y:** 1.00 **ΔH@:** 1.90
Post-Test Leak Rate: ____ **cfm @** __ **in. Hg.**
Post-Test Leak Check: Pitot: ✓ **Orsat:** —

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft^3	Velocity Head (Δp) In H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)	XA)
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)		
	135	1158	921.130											
3	140	1203	923.920	.37	1.83	1.83	85	260	250	48	97	95	6	44
	145	1208	927.700	.39	1.93	1.93	87	260	250	49	98	96	6	45
4	150	1213	931.217	.24	1.18	1.18	87	260	250	48	99	98	6	44
	155	1218	934.025	.32	1.57	1.57	93	250	255	48	99	97	6	50
5	160	1223	937.170	.25	1.22	1.22	93	~~255~~	250	49	99	98	6	49
	165	1228	940.123	.25	1.22	1.22	93	260	250	50	99	98	6	48
6	170	1233	943.617	.25	1.22	1.22	93	260	250	50	99	98	6	48
	175	1238	947.150	.29	1.42	1.42	94	260	250	51	100	98	6	47
7	180	1243	950.640	.34	1.67	1.67	94	260	250	51	101	99	6	48
	185	1248	954.410	.35	1.72	1.72	92	260	250	51	100	99	6	46
8	190	1253	957.900	.35	1.72	1.72	92	260	250	51	100	99	6	47
	195	1258	960.871	.32	1.57	1.57	94	260	250	51	102	100	6	48
9	200	1303	964.645	.32	1.57	1.57	94	260	250	51	102	100	6	47
	205	1308	970.750	.52	2.54	2.54	98	260	230	52	101	99	6	47
10	210	1313	974.400	.55	2.71	2.71	93	260	250	51	100	99	6	46
	215	1318	979.100	.55	2.70	2.70	94	260	250	51	100	99	6	46
11	220	1323	982.870	.50	2.46	2.46	91	260	250	51	100	99	7	46
	225	1328	987.250	.50	2.46	2.46	91	260	250	51	100	99	7	46
12	230	1333	991.520	.45	2.22	2.22	91	260	250	51	100	99	7	46
	235	1338	995.750	.45	2.22	2.22	91	260	250	51	100	99	7	46
	240	1343	999.817	.45	2.22	2.22	91	260	250	51	100	99	7	46

ΔVm= ________ $\overline{\sqrt{\Delta p}}$= ________ $\overline{\Delta H}$= ________ $\overline{Ts}$= ________ $\overline{Tm}$= ________

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Sample Train Recovery Data

Plant: Asphalt Plant C Date: 5-26-98
Sampling Location: Tunnel Exhaust Duct
Sample Recovery Person: DDH Field Team Leader: FJP
Sampling Method Type: MM5
Run Number: T-MM5-4 Impinger Train ID: 6D
Job Number: R012-001

Comments:

Front Half Data

Filter No.: Unnumbered Filter Media Type: DF
Filter Description: MM5
Filter No.: Filter Media Type:
Filter Description:

Back Half Data

Impinger Purge-
Start Time: Flow Rate: Stop Time: Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:	MT	DI	DI
Final Volume: (mL)	507.600	759.2	757.9
Initial Volume: (mL)	474.100	764.8	763.9
Net Volume: (mL)	33.5	(5.6)	(6.0)
	Impinger 4	Impinger 5	Final Impinger
Contents:	MT	SG	XAD
Final Volume: (mL)	616.2	852.2	(g): 326.8
Initial Volume: (mL)	611.5	764.0	(g): 308.7
Net Volume: (mL)	4.7	88.2	(g): 18.1

Total Moisture Collected (mL): 132.9
Description of Impinger catch:

1/2

FIELD DATA SHEET

Plant: Asphalt Plant C
Sampling Location: Tunnel Exhaust Duct
Run Number: T-MMS-3 Date: 7-27-98
Pretest Leak Rate: 0.000 cfm @ 15" in. Hg.
Pretest Leak Check: Pitol: ✓ Orsat: N/A

Sample Type: MMS Operator: DDH
Pbar: 29.23 Ps: -4.5
CO2: 0 O2: 20.9
Probe Length/Type: 3'/S Type Pitot #: RP-19
Stack Diameter: 32" As:
K - 4.86

Nozzle ID: V-.252 Thermocouple #: RT-6
Assumed Bws: 2 Filter #: DF
Meter Box #: RMB-15 Y: 1.000 ΔH@: 1.90
Post-Test Leak Rate: 0.010 cfm @ 9.5 ~~15~~" in. Hg.
Post-Test Leak Check: Pitol: ✓ Orsat: N/A

stop @ 0720 restart @ 0741

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)	XAD
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)		
A 1	0	0710	000.000											
	5	0715	2.985	.25	1.21	1.21	70	256	252	49	72	71	6	48
2	10	0720	6.015	.26	1.25	1.25	70	256	252	50	66	71	6	48
	15	0746 ~~0725~~	9.170	.39	1.88	1.88	71	255	250	51	67	70	6	49
3	20	0751 ~~0730~~	12.910	.39	1.88	1.88	71	255	250	52	68	68	6	51
	25	0756 ~~0735~~	16.325	.25	1.18	1.18	82	255	250	51	74	69	6	50
4	30	0801	19.383	.24	1.14	1.14	88	250	250	50	73	69	6	50
	35	0806	22.433	.26	1.25	1.25	80	260	250	51	78	69	6	51
5	40	0811	25.600	.27	1.30	1.30	80	260	250	52	78	74	6	52
	45	0816	28.765	.26	1.26	1.26	78	260	250	51	78	72	6	52
6	50	0821	31.925	.26	1.24	1.24	85	255	250	52	79	78	6	51
	55	0826	35.310	.24	1.15	1.15	86	255	250	51	79	78	6	48
7	60	0831	38.400	.30	1.44	1.44	88	260	250	50	79	79	6	49
	65	0836	42.031	.24	1.15	1.15	86	255	250	51	80	79	6	49
8	70	0841	45.015	.35	1.68	1.68	86	250	250	52	81	80	6	50
	75	0846	48.600	.35	1.68	1.68	86	250	250	52	81	80	6	50
9	80	0851	52.575	.46	2.20	2.20	90	260	250	51	83	80	8	50
	85	0856	56.500	.46	2.20	2.20	90	260	255	52	82	80	8	49
10	90	0901	60.975	.50	2.41	2.41	87	255	250	51	83	80	8	49
	95	0906	65.006	.65	3.15	3.15	86	250	250	51	85	80	8	50
11	100	0911	70.125	.41	1.97	1.97	91	250	250	52	86	84	8	51
	105	0916	73.160	.41	1.96	1.96	92	250	250	50	86	85	8	51
12	110	0921	76.470	.41	1.96	1.96	92	250	250	50	87	86	8	51
	115	0926	80.136	.41	1.96	1.96	92	250	250	51	87	86	8	51
B 1	120	0931	85 50	.41	1.96	1.96	92	260	250	51	87	86	8	51
	125	0958	89.920	.20	.97	.97	92	260	250	52	87	87	8	50
2	130	1005	91.270	.20	.97	.97	92	260	250	50	87	87	8	48

restart 0952
stop 0953

ΔVm=______ $\overline{\sqrt{\Delta p}}$=______ $\overline{\Delta H}$=______ $\overline{Ts}$=______ (85.500 85.625) $\overline{Tm}$=______

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2/2

Page 2 of 2

Plant Name: Asphalt Plant C

Run Number: T-MMS-3

Test Date: 7-27-98

Operator: DDH

Traverse Point Number	Sampling Time, (min.) / Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H₂O	Orifice Pres. Differential (ΔH) in. H₂O Desired	Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp.° F	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$)° F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum In. Hg	XAD
	135 / 1010	94.280	.25	1.21	1.21	86	250 / 260	48	88	87	6	49
3	140 / 1015	97.312	.25	1.21	1.21	86	250 / 250	48	88	87	6	48
	145 / 1020	99.880	.31	1.51	1.51	88	251 / 251	47	90	88	6	47
4	150 / 1025	.03.225	.31	1.51	1.51	88	251 / 251	48	90	88	6	48
	155 / 1030	106.700	.26	1.27	1.27	88	250 / 250	48	91	88	6	48
5	160 / 1035	110.340	.22	1.07	1.07	88	250 / 255	47	90	88	6	47
	165 / 1040	112.816	.25	1.22	1.22	88	250 / 250	47	93	89	6	47
6	170 / 1045	116.045	.25	1.22	1.22	88	250 / 252	46	92	89	6	46
	175 / 1050	118.900	.22	1.06	1.06	94	250 / 255	46	92	89	6	46
7	180 / 1055	122.170	.30	1.45	1.45	94	255 / 255	47	94	91	6	47
	185 / 1100	125.5	.33	1.59	1.59	1[illegible]	251 / 251	46	96	95	6	46
8	190 / 1105	128.9	0.33	1.59	1.59	94	254 / 256	47	96	95	6	47
	195 / 1110	131.4	0.35	1.59	1.59	94	252 / 248	50	97	95	6	47
9	200 / 1115	132.4	0.33	1.59	1.6	94	256 / 251	50	98	95	6	47
	205 / 1120	~~139.1~~ [illegible]	0.33	1.59	1.6	95	254 / 249	51	98	96	6	47
10	210 / 1125	139.1	0.32	1.5	1.5	98	253 / 252	52	98	95	6	47
	215 / 1130	142.5	0.38	1.59	1.6	103	288 / 256	52	97	95	7.5	49
11	220 / 1135	146.3	0.34	1.55	1.6	104	285 / 251	53	97	96	7.5	53
	225 / 1140	151.1	0.34	1.55	1.6	103	251 / 253	54	97	94	7.5	65
12	230 / 1145	~~155.39~~	0.39	1.9	1.9	96	254 / 251	56	98	96	8	59
	235 / 1150	160.8	0.39	1.9	1.9	96	256 / 246	57	98	96	8.5	61
	240 / 1155	164.031	0.39	1.9	1.9	96	251 / 249	58	99	96	8.5	62
	/						/					
	/						/					

60

90

xd 7/27/98

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Sample Train Recovery Data

Plant: Asphalt Plant C
Date: 7-27-98
Sampling Location: TED
Sample Recovery Person: DDH
Field Team Leader: FJP
Sampling Method Type: MMS
Run Number: R012-001
Impinger Train ID: 6D
Job Number: T-MMS-3

Comments:

Front Half Data

Filter No.: Unnumbered
Filter Media Type: DF
Filter Description: MMS Filter
Filter No.:
Filter Media Type:
Filter Description:

Back Half Data

Impinger Purge-
Start Time:
Flow Rate:
Stop Time:
Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:	MT	DI	DI
Final Volume: (mL)	517.6	760.4	816.8
Initial Volume: (mL)	470.6	759.5	814.8
Net Volume: (mL)	47.0	0.9	2.0

	Impinger 4	Impinger 5	Final Impinger
Contents:	MT	SG	XAD
Final Volume: (mL)	617.9	765.9	(g): 349.6
Initial Volume: (mL)	611.6	728.5	(g): 322.2
Net Volume: (mL)	6.3	37.4	(g): 27.4

Total Moisture Collected (mL): 121.0 ✓

Description of Impinger catch: Clear

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA Hot Mix
Facility: Hot Mix Asphalt Plant 'C'
Date: 7/24/98
Time: 0829
Meter Box No.: 6 - ~~Cinn.~~ (VB-6)
Barometric Pressure, in. Hg: 29.35
Ambient Temperature, °F: 70

Project No.: 2012-001
City: Los Angeles, CA
Sampling Location: Tunnel Exhaust.
Run Number: ~~4~~ T-V-1-1
Meter Gamma (γ) Pre: Post:
Operator: MDM
Purge Time: N/A
A-Side

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	~~[illegible]~~ 19.0	18.0	1.5
Post test	14.0	14.0	1.0

(Black Bull)

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft³)	Rotameter Setting ~~(Lpm)~~	Dry Gas Meter Temp. ~~°C~~ (°F)	Vacuum (in. Hg)	Meter Pressure (in H_2O)
0	0829	0033.930	~~120~~ 130	71	11.0	1.2
5	0834	37.45	133	71	11.0	1.2
10	0839	41.5	133	72	11.0	1.2
15	0844	45.6	133	73	11.0	1.2
20	0849	49.530				

33

240
190
180 ÷ 4

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC
Facility: Hot Mix Asphalt
Date: ~~7/23/98~~ 7/24/98
st. 0909 Time: 0910 - 0945
Meter Box No.: 6 (California)
Barometric Pressure, in. Hg: ~~29.65~~ 29.35 Dal
Ambient Temperature, °F: 70

Project No.: R012-001
City: Los Angeles, CA
Sampling Location: Tunnel Exhaust,
Run Number: T-V-1-2
Meter Gamma (γ) Pre:_____ Post:_____
Operator: MWM
Purge Time:
B-side.

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	11.0	11.0	1.0
Post	16.0	16.0	1.0

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft^3) Dal	Rotameter Setting	Dry Gas Meter Temp. ~~°C~~ (°F)	Vacuum (in. Hg)	Meter Pressure (in H_2O)
0	0910	49.721	~~135~~ 96	76	11.5	1.1
5	0915	52.0	96	76	12	1.1
10	0920	55.33	96	72	12.0	1.1
15	0925	58.2	96	77	12.0	1.1
20	0930	61.1	96	78	17.0	1.1
25	0935	64.1	95	79	11.5	1.1
30	0940	67.1	95	80	11.5	1.1
35	0945	69.840	END OF	TEST		

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC SCGA
Facility: Hot Mix Asphalt Plant C
Date: 7/24/98
Time: 1058
Meter Box No.: VB-1
Barometric Pressure, in. Hg: 29.35
Ambient Temperature, °F: ~72

Project No.: R012.001
City: Los Angeles, CA
Sampling Location: Tunnel Exhaust
Run Number: T-V-1-~~4~~ 3 CMC
Meter Gamma (γ) Pre: ______ Post: ______
Operator: MDM
Purge Time:

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	16.0	16.0	1.3
Post-test	12.5	12.5	1.5

Initial Vm: 994.341 BM

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, ~~liters~~ (ft³)	Rotameter Setting (Lpm)	Dry Gas Meter Temp. ~~°C~~ (°F)		Vacuum (in. Hg)	Meter Pressure (in H₂0)
0	1058	994.341	1.0	77	77	9.5	1.6
5	1103	949.5	1.0	79	79	11	1.8
30	1128	995.4	1.0	83	83	11	1.8
34.9	1133	996.357					
		move decimal place CMC					

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC SCGA
Facility: Hot Mix Asphalt Plant "C"
Date: 7/24/98 - [illegible]
Time: 1200
Meter Box No.: VB-L
Barometric Pressure, in. Hg: 29.35
Ambient Temperature, °F: ~70°

Project No.: 7202-001
City: Los Angeles, CA
Sampling Location: Tunnel Exhaust Duct
Run Number: ~~8~~ T-V-1-3 4 CMC
Meter Gamma (γ) Pre: ______ Post: ______
Operator: MDM
Purge Time: N/A

Leak Check Data

	Vacuum, inches Hg		Time, min
	Initial	Final	
Pre-test:	15.5	15.5	1.0
Post-test	19.0	19.0	1.0

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft³)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H₂0)
~~0~~	~~1144~~	~~996.337~~				
0	1219	996.732	0.85	85 91	20	1.6
5	1224	997.095	0.85	85 91	20	1.6
10	1229	997.465	0.85	87 92	20	1.6
15	1234	997.865	0.85	87 92	20	1.6
20	1239	~~998.823~~	0.85	88 92	20	1.6
25	1244	998.62	0.85	87 91	20	1.6
30	1249	999.014	~~0.85~~	~~88 93~~	~~20~~	~~1.6~~
		MOVE DECIMAL CMC				

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC SCGA
Facility: Hot Mix Asphalt Plant C
Date: 7/25/98
Time: 0800
Meter Box No.: VB-1
Barometric Pressure, in. Hg: 29.33
Ambient Temperature, °F: ~ 70°

Project No.: R012-001
City: Los Angeles, CA
Sampling Location: Tunnel Exhaust
Run Number: T-V-2-1
Meter Gamma (γ) Pre: _____ Post: _____
Operator: MDM
Purge Time: N/A
Side "A"

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	15.0	15.0	1.0
Post-test	19.0	19.0	1.0

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft³)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H_2O)
0	0802	999.957	1 lpm	70 70	18	1.6
5	0807	999.450	1 lpm	71 71	18	1.6
10	0812	999.870	1 lpm	73 73	18	1.6
15	0817	000.1	1 lpm	73 73	18	1.6
20	0822	000.7	1 lpm	74 75	18	1.6
25.3	0827	001.027	-	- -	-	-
		MOVE DECIMAL CMC				

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC SCGA
Facility: Hot Mix Asphalt Plant "C"
Date: 7/29/98
Time: 0859
Meter Box No.: VB + VB6 FOP
Barometric Pressure, in. Hg: 29.33
Ambient Temperature, °F: ~70°

Project No.: R017.001
City: Los Angeles, CA
Sampling Location: Tunnel Exhaust
Run Number: T-V-2-2
Meter Gamma (γ) Pre: ______ Post: ______
Operator: MDM
Purge Time: ______
SIDE "B" A

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	~~18.0~~ 20	20	1.0
Post-test	16.5	16.5	1.0

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters ~~(ft³)~~	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H_2O)
0	0859	1.236	0.9	77 78	16	1.6
5	0904	1.62	0.9	79 81	16	1.6
10	0909	2.5	0.9	82 83	16	1.6
15	0914	2.5	0.9	83 85	16	1.6
20	0919	.	-	-	-	-
25	0924	3.379	-	-	-	-

MWE DECIMAL
CMC

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC SCGA
Facility: Hot Mix Asphalt Plant C
Date: 7/25/98
Time: VB-1
Meter Box No.: ~~VB + VB6~~ FO
Barometric Pressure, in. Hg: 29.33
Ambient Temperature, °F: ~80

Project No.: 2017-001
City: Los Angeles CA
Sampling Location: Tunnel Ex.
Run Number: TV-2-3
Meter Gamma (γ) Pre: Post:
Operator: MM
Purge Time:

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	20.0	20.0	
Post-test	20.0	20.0	1.0

tenths = 1 l

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft³)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)		Vacuum (in. Hg)	Meter Pressure (in H₂0)
0	0951	3.396	0.9	90	94	~~93~~ 17.5	~~17.5~~ 1.6
5	0956	3.65	0.9	91	94	17.5	1.6
10	~~09~~1001	4.05	0.9	92	95	19.0	1.6
15	1006	4.45	0.9	96	93	19.	1.6
20	1011	4.84	0.9	94	94	19.	1.6
25	1016	5.25	0.9	96	98	19	1.6
32 end	1023	05.807					

MOVE DECIMAL
cmc

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA, EMC SCGA
Facility: Hot Mix Asphalt Plant C
Date: ~~4~~ 7/28/98
Time: 1102 VB-1
Meter Box No.: ~~VB-1~~ ~~VB6~~ FOP
Barometric Pressure, in. Hg: 29.33
Ambient Temperature, °F: 80

Project No.: R012.001
City: Los Angeles, CA
Sampling Location: Tunnel Exhaust
Run Number: T-V-24
Meter Gamma (γ) Pre: Post:
Operator: MDM
Purge Time:

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	20	20	2.0
Post-test	20	20	1.0

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft^3)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H_2O)
0	1102	5.997	0.9	96 100	16.0	1.8
5	1107	6.44	1.0	98 102	16.0	1.7
10	1112	6.97	1.0	98 101	16.0	1.9
15	1117	7.42	1.0	98 101	15.5	1.9
20	1122	7.836				
		✓				
		Move decimal				
		CMC				

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC
Facility: ASPHALT PLANT C
Date: 7/26/98
Time: ~~7/26/98~~ BW 0925 VB-1
Meter Box No.: ~~VB-1~~ ~~VB-6~~ FOP
Barometric Pressure, in. Hg: 29.31
Ambient Temperature, °F: ~75

Project No.: R012.001
City: LOS ANGELES, CA
Sampling Location: TUNNEL EXHAUST
Run Number: T-V-4-1
Meter Gamma (γ) Pre: ______ Post: ______
Operator: MDM
Purge Time: —
SIDE B

Leak Check Data

	Vacuum, inches Hg		Time, min
	Initial	Final	
Pre-test:	20.0	20.0	1.5
Post-test	~~17.0~~ 14.0 BW	~~2.0~~ 14.0 BW	1.5

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft^3)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H_2O)
0	0925	79.66	1.0	79 81	16.	1.7
5	0930	83.00	1.0	81 83	16	1.7
10	0935	87.65	1.0	83 85	16	1.7
15	0940	94.70	1.0	85 87	16	1.7
20	0945	97.0	1.0	86 87	16	1.7
25	0950	101.26				

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC
Facility: Hot Mix Asphalt Plant C
Date: 7/26/98
Time: 1025
Meter Box No.: ~~VB-1~~ ~~VB-6~~ VB-1 F08
Barometric Pressure, in. Hg: 29.31
Ambient Temperature, °F: ~75

Project No.: 2012-001
City: Los Angeles, CA
Sampling Location: Tunnel Exhaust
Run Number: T-V-4-2
Meter Gamma (γ) Pre: Post:
Operator: MVM
Purge Time: -
Side "A"

Leak Check Data

	Vacuum, inches Hg		
	Initial BW	Final BW	Time, min
Pre-test:	~~20.0~~ 17.0	~~20.0~~ 17.0	1.5
Post-test	21.0	21	1.5

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft^3)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H_2O)
0	1025	102.64	0.9	87 89	18	1.6
5	1030	105.7	0.9	89 91	18	1.6
10	1035	110.2	0.9	91 93	17.5	1.6
15	1040	114.4	0.9	93 94	17.5	1.6
20	1045	119.0	0.9	94 96	17.5	1.6
25	1050	123.33				

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA, EMC
Facility: Hot Mix Asphalt Plant C
Date: 7/20/98
Time: 1152
Meter Box No.: ~~VB-1~~ ~~VB-6~~ FOP VB-1
Barometric Pressure, in. Hg: ~~29.33~~ 29.31 EMC
Ambient Temperature, °F: ~80

Project No.: 8012.001
City: Los Angeles, CA
Sampling Location: Tunnel Exiting
Run Number: T-V-4-3
Meter Gamma (γ) Pre: ______ Post: ______
Operator: MOM
Purge Time: ______

SIDE "A"

Leak Check Data

	Vacuum, inches Hg		Time, min
	Initial	Final	
Pre-test:	20.0	20.0	1.2
Post-test	20.5	20.0	1.0

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft^3)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H_2O)
0	1152	124.57	0.85	101 104	~~16~~ 20	1.6
5	1157	-	-	- -	-	.
10	1202	132.50	0.85	101 105	20	1.6
15	1207	136.30	0.85	102 105	20	1.6
20	1212	141.5	0.85	102 105	20	1.6
25	1218	145.0	0.85	103 104	20	1.6
30	1222	148.24				

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC
Facility: Hot Mix Asphalt Plant C
Date: 7/20/98
Time:
Meter Box No.: ~~VB-1~~ ~~VB-6~~ FOP VB-1
Barometric Pressure, in. Hg: 29.31
Ambient Temperature, °F: ~80

Project No.: R012.001
City: Los Angeles CA
Sampling Location: Tunnel Exhaust, Side "B"
Run Number: T-V-4-4
Meter Gamma (γ) Pre: Post:
Operator: MPM
Purge Time:

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	20.0	20.0	1.0
Post-test	20.0	20.0	1.0

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, ℓ liters (~~ft³~~)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H_2O)
0	1255	148.46	1.0	102 105	16	1.7
5	1300	153.0	1.0	103 105	16	1.8
10	1305	154.6	1.0	104 105	16	1.8
15	1310	162.0	1.0	104 105	16	1.8
20	1315	166.6	1.0	104 106	16	1.8
25	1320	171.49	-2			

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC SCGA
Facility: Hot Mix Asphalt "C"
Date: 7/27/98
Time: 0915
Meter Box No.: VB-1
Barometric Pressure, in. Hg: 29.23
Ambient Temperature, °F: ~70

Project No.: 2012
City: Los Angeles, CA
Sampling Location: Tunnel Exhaust
Run Number: T-V-3-1
Meter Gamma (γ) Pre: ______ Post: ______
Operator: MDM
Purge Time: ______

Side "A"

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	17.5	17.5	1.0
Post-test	12	12	1.0

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, ℓ liters (~~ft^3~~)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)		Vacuum (in. Hg)	Meter Pressure (in H_2O)
0	0917	174.09	0.8	86	91	11	~~16~~ 1.6
5	0923	178.5	0.8	88	92	11	1.6
10	0927	181.5	0.8	89	93	11	1.6
15	0933	186.1	0.8	89	90	11	1.6
20	0940	191.25	0.8	91	94	10.5	1.6
25	0943	-	-	-	-	-	-
30	0947	196.47					

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC SCGA
Facility: Hot Mix Asphalt Plant C
Date: 7/27/98
Time: 1010
Meter Box No.: VB-1
Barometric Pressure, in. Hg: 29.73
Ambient Temperature, °F: ~ 75

Project No.: R012.001
City: Los Angeles, CA
Sampling Location: Tunnel Exhaust
Run Number: T-V-3-2
Meter Gamma (γ) Pre: ______ Post: ______
Operator: MDM
Purge Time: N/A

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	12.0	12.0	1.0
Post-test	10.0	10.0	1.0

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft^3)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H_2O)
0	1009	197.94	0.9	95 100	9.5	1.7
5	1014	201.2	0.9	97 101	9.5	1.7
10	1019	205.5	0.9	98 102	9.5	1.7
15	1024		–	– –	–	–
20	1029	215.2	0.9	101 105	9.5	1.7
25	1034	218.42				

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC SCGA
Facility: Hot Mix Asphalt Plant C
Date: 7/27/98
Time: 1055
Meter Box No.: VB-1
Barometric Pressure, in. Hg: 29.23
Ambient Temperature, °F: ~90

Project No.: R012.001
City: Los Angeles, CA
Sampling Location: Tunnel Exhaust
Run Number: T-V-3-3
Meter Gamma (γ) Pre: Post:
Operator: MDM
Purge Time: N/A

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	10.0	10.0	1.0
Post-test	10.5	10.5	1.2

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft^3)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H_2O)
0	1053	218.59	0.75	104 111	10.0	1.6
6	1058	222.80	0.75	106 112	10.0	1.6
10	1103	225.3	0.75	107 112	10.0	1.6
15						
20	1113	232.40	0.75	107 112	10.0	1.6
25	1118	235.6	0.75	107 112	10.0	1.6
30	1123	239.00				
		CMC 8/31	(BASED ON	0.68 L/min X 30 min.)		

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: US EPA EMC SCGA
Facility: Hot Mix Asphalt Plant C
Date: 7/25/98
Time:
Meter Box No.: U6.1
Barometric Pressure, in. Hg:
Ambient Temperature, °F:

Project No.: 8012.001
City: Los Angeles, CA
Sampling Location: Tunnel Exhaust
Run Number: 7-V-F6
Meter Gamma (γ) Pre: Post:
Operator:
Purge Time:

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	19.0	19.0	1.0
Post test.	19.0	19.0	1.0

Run Data

Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft^3)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in $H_2$0)

Pacific Environmental Services VOST Box Calibration

Date: 7/19-98
Vost Box Number: V-1

Flow Rate: **1.0 l/min**
Rotameter Setting: 1.08
Bubble Meter Temp. : 91

Run 1

Bubble Meter			Meter Box
1012	1007	Initial Volume	9829
1010	1007	Final Volume	9855
1010	1008	Initial Temp.	104
	1009	Final Temp.	104
		Average Temp.	101
Average:	**1009.00**	Time:	26.25
		QDGM=	972.821
		Y=	**1.0372**

Run 2

Bubble Meter			Meter Box
1008	1010	Initial Volume	9855.5
1010	1009	Final Volume	9881.5
1011	1007	Initial Temp.	104
	1003	Final Temp.	103
		Average Temp.	103.5
Average:	**1008.29**	Time:	26.25
		QDGM=	968.505
		Y=	**1.0411**

Run 3

1009	1005	Initial Volume	9882
1008	1003	Final Volume	9908
1006	1005	Initial Temp.	104
	1008	Final Temp.	103
		Average Temp.	103.5
Average:	**1006.29**	Time:	26.26
		QDGM=	968.1358553
		Y=	**1.0394**

Average Y= 1.0392

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EPA Method 18 Adsorbent Tube Data Sheet

Plant: Hot Mix Asphalt Plant C Date: 7/24/98
Sampling Location: Tunnel Exhaust Duct
Sampling Method Type: M18 Field Team Leader: BGL (M18)
Run Number: T-M18-1 Concurrent Train ID: MM5, M315

DESCRIPTION OF TRAIN

	Leg	Moisture Knockout (if used, indicate type)	Tube a Description	Tube b Description	Tube c Description
unspiked →	A	—	TED-M18-Run1 Aa	TED-M18-Run1 Ab	
Spiked →	B	—	TED-M18-Run1 Ba	TED-M18-Run1 Bb	

CALIBRATION - PRETEST

~~Various~~

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	993	—	—	~~20~~
B	998	—	—	~~20~~

RUN DATA

	Elapsed Time	Clock Time	Leg A Flow (L/min)	Leg A Vacuum (in Hg)	Leg B Flow (L/min)	Leg B Vacuum (in Hg)
	0	0720	71	6	71	7
	15		71	6	71	7
	30		71	6	71	7
	45		71	6	71	7
	60		71	6	71	7
	75		71	6	71	7
	90		71	6	71	7
	105		71	6	71	7
START 1057	120		71	6	71	7
	~~135~~ 130		71	6	71	7
	~~150~~ 140		71	6	71	7
BGL 7/27/98	~~165~~ 150		71	6	71	7
	~~180~~ 160		71	6	71	7
	~~195~~ 170		71	6	71	7
	~~210~~ 180		71	6	71	7
	~~225~~ 190		71	6	71	7
	~~240~~ 200		71	6	71	7
	210		71	6	71	7

CALIBRATION – POST-TEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	989			
B	995			

	LEAK CHECK	PRE-TEST	POST-TEST
50	A	OK 20 in Hg	OK 20 in Hg
	B	OK 20 in Hg	OK 20 in Hg

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EPA Method 18 Adsorbent Tube Data Sheet

Plant: Hot Mix Asphalt Plant C Date: 7/22/98

Sampling Location: Tunnel Exhaust Duct

Sampling Method Type: M18 Field Team Leader: BGP

Run Number: T-M18-1 Concurrent Train ID:

DESCRIPTION OF TRAIN

Leg	Moisture Knockout (if used, indicate type)	Tube a Description	Tube b Description	Tube c Description
A	—	—	—	—
B	—	—	—	—

CALIBRATION - PRETEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	—	—	—	—
B	—	—	—	—

RUN DATA

Elapsed Time	Clock Time	Leg A		Leg B	
		Flow (L/min)	Vacuum (in Hg)	Flow (L/min)	Vacuum (in Hg)
220		21	6	21	7
230		21	6	21	7
240	1256	21	6	21	7

CALIBRATION – POST-TEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	—	—	—	—
B	—	—	—	—

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EPA Method 18 Adsorbent Tube Data Sheet

Plant: Hot Mix Asphalt Plant C Date: 7/28/98
Sampling Location: Tunnel Exhaust Duct
Sampling Method Type: M18 (Anasorb 747) Field Team Leader: BGP
Run Number: 2 TED-M18-Run 2 Concurrent Train ID: MM5, M315

DESCRIPTION OF TRAIN

Leg	Moisture Knockout (if used, indicate type)	Tube a Description	Tube b Description	Tube c Description
A	—	TED-M18-Run2Aa	TED-M18-Run2Ab	—
B	—	TED-M18-Run2Ba	TED-M18-Run2Bb	—

CALIBRATION - PRETEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	1000 ml/min	—	—	—
B	997 ml/min	—	—	—

RUN DATA

Elapsed Time	Clock Time	Leg A		Leg B	
		Flow (L/min)	Vacuum (in Hg)	Flow (L/min)	Vacuum (in Hg)
0	0710	>1	8	>1	8
10	0720	>1	8	>1	8
20	0730	>1	8	>1	8
30	0740	>1	8	>1	8
40	0750	>1	8	>1	8
50	0800	>1	8	>1	8
60	0810	>1	8	>1	8
70	0820	>1	8	>1	8
80	0830	>1	8	>1	8
90	0840	>1	8	>1	8
100	0850	>1	8	>1	8
110	0900	>1	8	>1	8
120	0910/0926	>1	8	>1	8
130	0936	>1	8	>1	8
140	0946	>1	8	>1	8
150	0956	>1	8	>1	8
160	1006	>1	8	>1	8
170	1016 ~~1017~~	>1	8	>1	8

BGP 7/28/98

CALIBRATION – POST-TEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	987	—	—	—
B	985	—	—	—

LEAK CHECK	PRE-TEST	POST-TEST
A	OK 20 in Hg	OK 20 in Hg
B	OK 20 in Hg	OK 20 in Hg

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EPA Method 18 Adsorbent Tube Data Sheet

Plant: Hot Mix Asphalt Plant C
Date: 7/25/98
Sampling Location: Tunnel Exhaust Duct
Sampling Method Type: M18
Field Team Leader: BGP
Run Number: ~~2~~ TED-M18 Run 2
Concurrent Train ID: MM5, M315

DESCRIPTION OF TRAIN

Leg	Moisture Knockout (if used, indicate type)	Tube a Description	Tube b Description	Tube c Description
A	—	—	—	—
B	—	—	—	

CALIBRATION - PRETEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	—	—	—	—
B	—	—	—	—

RUN DATA

Elapsed Time	Clock Time	Leg A		Leg B	
		Flow (L/min)	Vacuum (in Hg)	Flow (L/min)	Vacuum (in Hg)
180	1026	72	8	72	8
190	1036	71	8	71	8
200	1046	71	8	71	8
210	1056	71	8	71	8
220	1106	71	8	71	8
230	1116	71	8	71	8
240	1126	71	8	71	8

CALIBRATION – POST-TEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	—	—	—	—
B	—	—	—	—

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1 of 2

Pbar 29.31

EPA Method 18 Adsorbent Tube Data Sheet

Plant: Hot Mix Asphalt Plant C Date: 7/26/98
Sampling Location: Tunnel Exhaust Duct
Sampling Method Type: M18 Field Team Leader: BLP
Run Number: TED-M18-Run 4 Concurrent Train ID: MM5, M315

DESCRIPTION OF TRAIN

Leg	Moisture Knockout (if used, indicate type)	Tube a Description	Tube b Description	Tube c Description
A	—	TED-M18-Run 4 Aa	TED-M18-Run 4 Ab	—
B	—	TED-M18-Run 4 Ba	TED-M18-Run 4 Bb	—

CALIBRATION - PRETEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	994	—	—	—
B	1011	—	—	—

RUN DATA

START/STOP

BLP 7/24/98

Elapsed Time	Clock Time	Leg A		Leg B	
		Flow (L/min)	Vacuum (in Hg)	Flow (L/min)	Vacuum (in Hg)
0	0925	71	8	71	8
10	0935	71	8	71	8
20	0945	71	8	71	8
30	0955	71	8	71	8
40	1005	71	8	71	8
50	1015	71	8	71	8
60	1025	71	8	71	8
70	1035	71	8	71	8
80	1045	71	8	71	8
90	1055	71	8	71	8
100	1105	71	8	71	8
110	1115	71	8	71	8
120	1125/~~1129~~ 1146	71	8	71	8
130	1156 ~~1145~~ ~~1135~~ 1139	71	8	71	8
140	1206 ~~1155~~ ~~1145~~ 1149	72	8	71	8
150	1216 ~~1205~~ ~~1155~~ 1159	71	8	71	8
160	1226 ~~1215~~ ~~1205~~ 1209	71	8	72	8
170	1236 ~~1225~~ ~~1215~~ 1219	71	8	72	8

CALIBRATION – POST-TEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	995	98	—	
B	1006	98	—	

LEAK CHECK	PRE-TEST	POST-TEST
A	OK 20 in Hg	OK 20 in Hg
B	OK 20 in Hg	OK 20 in Hg

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2D2

EPA Method 18 Adsorbent Tube Data Sheet

Plant: Hot Mix Asphalt Plant C Date: 7/26/98
Sampling Location: Tunnel Exhaust Duct
Sampling Method Type: M18 Field Team Leader: BGP
Run Number: TED-M18-Run 4 Concurrent Train ID: MM5, M315

DESCRIPTION OF TRAIN

Leg	Moisture Knockout (if used, indicate type)	Tube a Description	Tube b Description	Tube c Description
A	—	—	—	—
B	—	—	—	—

CALIBRATION - PRETEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	—	—	—	—
B	—	—	—	—

RUN DATA

Elapsed Time	Clock Time	Leg A		Leg B	
		Flow (L/min)	Vacuum (in Hg)	Flow (L/min)	Vacuum (in Hg)
180	1246	71	8	71	8
190	1256	71	8	71	8
200	1306	71	8	71	8
210	1316	71	8	71	8
220	1326	71	8	71	8
230	1336	71	8	71	8
240	1346	71	8	71	8

CALIBRATION – POST-TEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	—	—	—	—
B	—	—	—	—

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1 of 2

EPA Method 18 Adsorbent Tube Data Sheet

Plant: Hot Mix Asphalt Plant C Date: 7/27/98

Sampling Location: Tunnel Exhaust Duct

Sampling Method Type: M18 Field Team Leader: BCl

Run Number: TED-M18-Run 3 Concurrent Train ID: MMS, M315

DESCRIPTION OF TRAIN

Leg	Moisture Knockout (if used, indicate type)	Tube a Description	Tube b Description	Tube c Description
A	—	TED-M18-Run 3Aa	TED-M18-Run 3Ab	—
B	—	TED-M18-Run 3Ba	TED-M18-Run 3Bb	

CALIBRATION - PRETEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	1005 ml/min		—	29.23
B	1008 ml/min		—	29.23

RUN DATA

Elapsed Time	Clock Time	Leg A		Leg B	
		Flow (L/min)	Vacuum (in Hg)	Flow (L/min)	Vacuum (in Hg)
0	0710	71	8	71	8
10	0720	71	11	71	11
~~20~~ 24	0724/0741	STOP TRAIN	8	71	8
30		71	8	71	8
40		71	8	71	8
50		71	8	71	8
60		71	8	71	8
70		71	8	71	8
80		71	8	71	8
90		71	8	71	8
100		71	8	71	8
110		71	8	71	8
120	0931/0950	71	8	71	8
130	0950/~~1005~~	71	8	71	8
140	~~1015~~ 1005	71	8	71	8
150	~~1025~~ 1015	71	8	71	8
160	~~1035~~ 1025	71	8	71	8
170	~~1045~~ 1035	71	8	71	8

Stop @ 0950
Loading Silo
#1
Start @1000

CALIBRATION – POST-TEST

CMC 8/25 FROM MET. STATION DATA (@1200)

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	1010 ml/min	~~95~~ 92.8	—	
B	1003 ml/min	~~95~~ 92.8	—	

P:\r012.001\misc\m18sheet.doc

LEAK CHECK	PRE-TEST	POST-TEST
A	OK 20 in Hg	OK 20 in Hg
B	OK 20 in Hg	OK 20 in Hg

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2 of 2

EPA Method 18 Adsorbent Tube Data Sheet

Plant: Hot Mix Asphalt Plant C Date: 7/27/98
Sampling Location: Tunnel Exhaust Duct
Sampling Method Type: M18 (Anasorb 747) Field Team Leader: BGP
Run Number: TED – M18 – Run 3 Concurrent Train ID: MM5, M315

DESCRIPTION OF TRAIN

Leg	Moisture Knockout (if used, indicate type)	Tube a Description	Tube b Description	Tube c Description
A	—	—	—	—
B	—	—	—	—

CALIBRATION - PRETEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	—	—	—	—
B	—	—	—	—

RUN DATA

Elapsed Time	Clock Time	Leg A		Leg B	
		Flow (L/min)	Vacuum (in Hg)	Flow (L/min)	Vacuum (in Hg)
180	~~1055~~ 1045	71	8	71	8
190	~~1105~~ 1055	71	8	71	8
200	~~1115~~ 1105	71	8	71	8
200	~~1125~~ 1115	71	8	71	8
210	~~1135~~ 1125	71	8	71	8
220	~~1145~~ 1135	71	8	71	8
230	~~1155~~ 1145	71	8	71	8
240	~~1205~~ 1155	71	8	71	8

CALIBRATION – POST-TEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	—	—	—	—
B	—	—	—	—

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EPA Method 18 Adsorbent Tube Data Sheet

Plant: Hot Mix Asphalt Plant C Date: 7/25/98

Sampling Location: Tunnel Exhaust Duct

Sampling Method Type: M18 Field Team Leader: BGP

Run Number: TED-M18-Field Blank Concurrent Train ID: —

DESCRIPTION OF TRAIN

Leg	Moisture Knockout (if used, indicate type)	Tube a Description	Tube b Description	Tube c Description
A	—	TED-M18-FieldBlank Aa	TED-M18-Field Blank Ab	
B	—	TED-M18-Field Blank Ba	TED-M18-Field Blank Bb	

CALIBRATION - PRETEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	997	—	—	—
B	999	—	—	—

RUN DATA

	Elapsed Time	Clock Time	Leg A		Leg B	
			Flow (L/min)	Vacuum (in Hg)	Flow (L/min)	Vacuum (in Hg)
eak Check	0	1228	—	20 in Hg	—	20 in Hg
eak Check		1230	—	20 in Hg	—	20 in Hg

CALIBRATION – POST-TEST

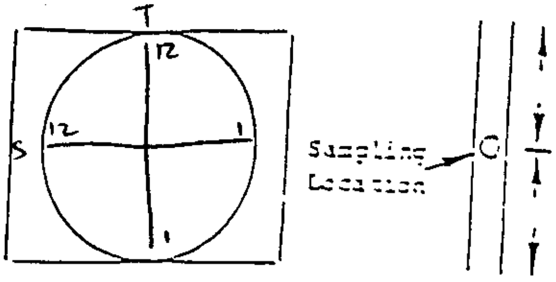
Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	991	—	—	—
B	999	—	—	—

APPENDIX C.2

SED FIELD DATA

PRELIMINARY VELOCITY TRAVERSE

Plant:
Date: 07-22-98
Location: SED
Stack I.D.: 10.0"
Barometric Pressure, in. Hg: 29.45
Stack Gauge Pressure, in. H2O: -0.002
Operators: J Barrera, Sprano
Pitot Tube I.D. Number: D-7 / TC 25
Temperature Readout I.D.: Box 3A
Pitot Tube Leak Check: OK



Schematic of Traverse Point Layout

@ 6.25 pm

Traverse Point Number	Velocity Head (Δp_s) in. H2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
S-1	0.17	137	0
2	0.17	139	0
3	0.18	140	0
4	0.18	141	1
5	0.20	143	0
6	0.20	147	0
7	0.20	147	1
8	0.21	146	0
9	0.20	148	0
10	0.18	146	0
11	0.17	145	0
12	0.15	146	0
	C=0		
Average			

Traverse Point Number	Velocity Head (Δp_s) in. H2O	Stack Temp. ↔ (T_s), °F	Cyclonic Flow Check ° from Null
T-1	0.15	0	139
2	0.16	0	140
3	0.17	1	142
4	0.18	0	143
5	0.19	0	145
6	0.20	0	146
7	0.20	0	148
8	0.19	0	145
9	0.20	0	147
10	0.18	1	148
11	0.17	0	145
12	0.16	0	145
Average of All 24pts	0.17°		

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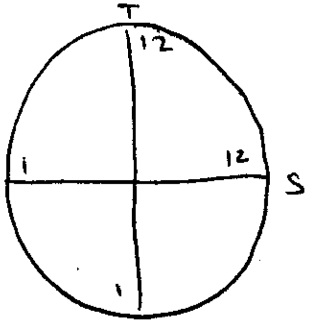
FIELD DATA

K= 14.31

Plant HOT MIX ASPALT PLANT C LA CA.
Date 07-24-98
Sampling Location SILO EXHAUST #2
Sample Type M315
Run Number ~~SED-315-1~~ S-M315-1 (EMC)
Operator J RUBIO
Barometric Pressure (P_b) ~~29.30~~ 29.28 (EMC)
Static Pressure (P_s) -0.25
Filter Number(s) —
Pretest Leak Rate = 0.013 cfm @ 15 in. Hg
Pretest Pitot Leak Check OK
Pretest Orsat Leak Check —
Read and Record all Data Every 2.5 Minutes
Page 1 of 1



Schematic of
Traverse Point Layout

Temp. Sensor ID No.

CO_2			
O_2			
CO			
N_2			

Condensers
V_L: Silica gel
Total H_2O

Probe Length and Type 38" GLASS
Pitot Tube I.D. No. 07
Nozzle I.D. (0.38) KX111
Assumed Moisture, % 25
Meter Box Number 3A
Meter ΔH@ 1.851
Meter Gamma 0.984
Reference Δp 1.5
Post Test Leak Rate = 0.010 cfm @ 13 in. Hg
Post Test Pitot Leak Check OK
Post Test Orsat Leak Check —

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (Δp_s) in. H_2O	Orifice Press. Differential (ΔH) in. H_2O		Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum in. Hg
					Desired	Actual				Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	
		/										
T- 1	0	/ 1140	255.361	0.13	1.86	1.9	262	238 / 236	63	86	85	7
2		/	257.3	0.13	1.86	1.9	265	244 / 243	56	88	86	7
3	5	/ 1146	259.2	0.15	2.19	2.2	269	249 / 250	55	92	86	9
4		/	261.2	0.15	2.15	2.2	269	248 / 248	54	96	87	9
5	10	/ 1151	263.2	0.16	2.29	2.3	269	253 / 248	57	98	88	10
6		/	265.4	0.14	2.00	2.0	266	251 / 246	61	99	88	9
7	15	/ 1156	267.2	0.11	1.57	1.6	267	250 / 248	62	99	88	7
8		/	269.1	0.13	1.57	1.6	267	248 / 250	62	99	88	7
9	20	/ 1201	270.6	0.08	1.15	1.2	268	248 / 248	63	99	89	5
10		/	272.4	0.08	1.15	1.2	264	248 / 248	63	100	90	5
11	25	/ 1206	273.9	0.08	1.15	1.2	270	250 / 243	63	100	91	5
12		/	275.5	0.07	1.00	1.0	272	244 / 240	63	100	91	5
S- 1	30	/ 1213	276.881	0.16	2.29	2.3	260	247 / 243	65	99	91	10
2		/	278.9	0.14	2.00	2.0	260	248 / 244	63	100	92	10
3	35	/ 1218	280.9	0.15	2.15	2.2	253	248 / 243	63	101	93	10
4		/	282.9	0.14	2.00	2.0	255	248 / 245	65	103	94	9
5	40	/ 1228	285.0	0.13	1.86	1.9	248	248 / 248	65	103	94	9
6		/	287.0	0.13	1.86	1.9	240	247 / 246	65	100	93	9
7	45	/ 1228	288.9	0.13	1.86	1.9	240	248 / 248	63	100	92	9
8		/	290.9	0.12	1.71	1.7	241	248 / 248	64	101	93	9
9	50	/ 1233	292.7	0.10	1.43	1.4	240	250 / 248	62	100	92	7
10		/	294.5	0.08	1.15	1.2	245	250 / 248	63	100	93	6
11	55	/ 1238	295.9	0.06	0.86	0.86	234	248 / 248	61	99	93	5
12			297.2	0.06	0.86	0.86	231	248 248	58	98	93	5
	60	1243	298.502									

STOP
1211
START
1213

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Sample Train Recovery Data

Plant: Hot Mix Asphalt Plant C Date: 7/24/98
Sampling Location: Silo No 2 Exhaust Duct
Sample Recovery Person: ______ Field Team Leader: Frank Phoenix
Sampling Method Type: 315
Run Number: 1 Impinger Train ID: 8B
Job Number: 2012-001

Comments: 0.4481 - #ZD

Front Half Data

Filter No.: 5-1035-1F Filter Media Type: Glass Fiber
Filter Description: ______
Filter No.: ______ Filter Media Type: ______
Filter Description: ______

Back Half Data

Impinger Purge-
Start Time: ______ Flow Rate: ______ Stop Time: ______ Purge Gas: ______

	Impinger 1	Impinger 2	Impinger 3
Contents:	DI H_2O	DI H_2O	Empty
Final Volume: (mL)	976.4	763.8	538.4
Initial Volume: (mL)	862.3	739.6	534.7
Net Volume: (mL)	114.1	24.2	3.7

	Impinger 4	Impinger 5	Final Impinger
Contents:	Silica Gel		
Final Volume: (mL)	854.8		(g):
Initial Volume: (mL)	839.1		(g):
Net Volume: (mL)	15.7		(g):

Total Moisture Collected (mL): 157.7
Description of Impinger catch: ______

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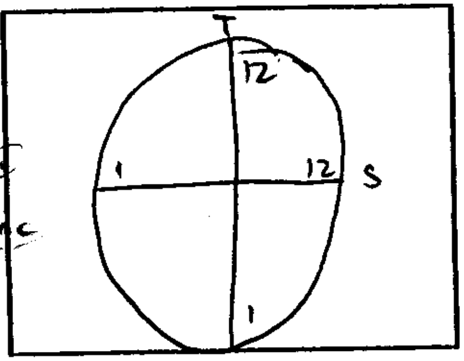
FIELD DATA

Plant HOT MIX ASPHALT PLANT C LA CA
Date 07-25-98
Sampling Location SED SILO # 2
Sample Type M315
Run Number ~~315-SED-2~~ S-M315-2
Operator JRUBIO
Barometric Pressure (P_b) ~~29.28~~ 29.26
Static Pressure (P_s) -0.25
Filter Number(s) —
Pretest Leak Rate = 0.002 cfm @ 15 in. Hg
Pretest Pitot Leak Check OK
Pretest Orsat Leak Check —
Read and Record all Data Every 2.5 Minutes
Page 1 of 1



Schematic of Traverse Point Layout

CO_2				
O_2				
CO				
N_2				

Condensers
V_{lc}: Silica gel
Total H_2O

Probe Length and Type 38" GLASS
Pitot Tube I.D. No. D-7/TC 25
Nozzle I.D. 0.380 XXIII
Assumed Moisture, % 15
Meter Box Number 3A
Meter Δ H@ 1.851
Meter Gamma 0.984
Reference Δ p 0.14
Post Test Leak Rate = .001 cfm @ 8 in. Hg
Post Test Pitot Leak Check Okay
Post Test Orsat Leak Check —

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (Δ P_s) in. H_2O	Orifice Press. Differential (ΔH) in. H_2O Desired	Orifice Press. Differential (ΔH) in. H_2O Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg
T-1	0	1015	387.829	0.16	2.38	2.4	255	240/335	66	95	95	6
2			390.1	0.16	2.38	2.4	263	246/240	62	97	95	5
3	5	1020	392.2	0.15	2.19	2.2	272	248/246	60	100	96	5
4			394.3	0.14	2.04	2.0	273	251/248	60	102	97	5
5	10	1025	396.2	0.14	2.04	2.0	268	249/248	61	101	95	5
6			398.2	0.14	2.04	2.0	271	248/248	61	105	98	5
7	15	1030	400.1	0.13	1.90	1.9	271	246/248	61	107	98	5
8			402.0	0.13	1.90	1.9	270	248/247	59	106	97	5
9	20	1035	403.8	0.12	1.75	1.8	272	248/248	60	106	97	5
10			405.6	0.13	1.90	1.9	273	245/248	61	107	97	5
11	25	1040	407.5	0.11	1.60	1.6	270	249/248	60	107	97	5
12			409.2	0.07	1.02	1.0	272	248/246	60	106	97	4
S-1	30	1000/47	410.935	0.15	2.17	2.2	271	246/248	65	104	97	6
2			412.7	0.14	2.04	2.0	276	249/251	60	106	98	5
3	35	1052	414.6	0.15	2.19	2.2	271	248/249	57	104	97	6
4			416.6	0.14	2.04	2.0	270	245/248	58	106	98	6
5	40	1057	418.6	0.13	1.90	1.9	270	244/248	57	105	97	6
6			420.9	0.13	1.90	1.9	271	248/248	57	105	97	6
7	45	1102	422.3	0.12	1.75	1.8	269	248/248	59	107	98	6
8			424.2	0.12	1.75	1.8	268	247/247	60	108	99	6
9	50	1107	425.9	0.10	1.46	1.5	270	248/248	60	108	99	5
10			427.7	0.08	1.02	1.0	272	246/248	61	109	100	5
11	55	1112	429.1	0.06	0.88	0.88	273	248/248	61	109	101	5
			430.4	0.06	0.88	0.88	270	248 248	62	109	101	5
	60	1117	431.711									

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Sample Train Recovery Data

Plant: Hot Mix Asphalt Plant C
Date: 7/25/98
Sampling Location: Silo Exhaust
Sample Recovery Person: Jairo Barreda
Field Team Leader: Frank Phoenix
Sampling Method Type: 315
Run Number: 2
Impinger Train ID: 8B
Job Number: 2012-001

Comments:

Front Half Data

Filter No.: S-M315-2-F
Filter Media Type: Glass Fiber
Filter Description: 0.4466
Filter No.:
Filter Media Type:
Filter Description:

Back Half Data

Impinger Purge-
Start Time:
Flow Rate:
Stop Time:
Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:	DI H2O	DI H2O	Empty
Final Volume: (mL)	999.3	861.3	537.9
Initial Volume: (mL)	855.6	740.5	536.9
Net Volume: (mL)	143.7	120.8	1.0

	Impinger 4	Impinger 5	Final Impinger
Contents:	Silica Gel		
Final Volume: (mL)	885.8		(g):
Initial Volume: (mL)	868.2		(g):
Net Volume: (mL)	17.6		(g):

Total Moisture Collected (mL): 283.1
Description of Impinger catch:

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FIELD DATA SHEET

Plant: Hot Mix
Sampling Location: Silo
Run Number: S-M315-4 Date: 7/28/98
Pretest Leak Rate: 0.002 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: N/A

Sample Type: 315 Operator: JK
Pbar: ~~29.15~~ 29.05 Emc Ps: -0.25
CO2: 0 O2: 20.9
Probe Length/Type: 5' g/ssl Pitot #: D-7
Stack Diameter: 10.0" As:

Nozzle ID: 0.433 Thermocouple #: Ta/25
Assumed Bws: 40 Filter #: —
Meter Box #: 34 Y: 0.984 ΔH@: 1.851
Post-Test Leak Rate: 0.001 cfm @ 10 in. Hg.
Post-Test Leak Check: Pitot: ✓ Orsat: —

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)	
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)		
1	0	0649	614.127	0.14	2.23	2.2	192	254	247	60	74	73	4	15.9
2			616.1	0.14	2.23	2.2	219	248	245	60	76	73	4	
3	5	0654	618.1	0.15	2.25	2.3	227	246	242	59	79	73	4	15.0
4			620.1	0.13	1.95	2.0	223	246	243	59	79	74	4	
5	10	0659	622.0	0.14	2.23	2.2	219	247	243	59	81	74	4	
6			623.5	0.14	2.23	2.2	222	248	243	61	82	73	4	
7	15	0704	625.9	0.15	2.25	2.3	224	249	243	63	84	74	5	
8			627.8	0.15	2.25	2.3	227	248	245	64	83	76	5	
9	20	0709	629.7	0.13	0.82	0.82	229	247	248	67	82	79	2	6.3
10			630.9	0.14	0.88	0.88	225	248	248	65	84	79	2	
11	25	0714	632.1	0.14	0.88	0.88	221	249	248	63	86	84	2	
12			633.4	0.13	0.82	0.82	226	248	248	62	89	85	2	
1	30	0719/0810	634.737	0.11	1.23	1.2	230	248	248	60	88	85	2	11.2
2			636.3	0.11	1.23	1.2	229	248	248	60	89	85	2	
3	35	0815	637.7	0.08	0.90	0.90	239	248	248	~~90~~60	~~85~~90	85	2	
4			639.0	0.08	0.86	0.86	240	248	248	62	92	87	2	10.8
5	40	0820	640.3	0.08	0.86	0.86	241	248	246	65	93	87	2	
6			641.6	0.08	0.86	0.86	240	248	248	67	93	87	2	
7	45	0825	642.8	0.06	0.65	0.65	231	247	247	65	94	88	2	
8			644.0	0.05	0.54	0.54	235	247	248	63	95	87	2	
9	50	0830	645.0	0.06	0.65	0.65	234	247	249	62	95	87	2	
10			646.1	0.06	0.65	0.65	233	249	248	64	95	90	2	
11	55	0835	647.3	0.06	0.65	0.65	234	248	248	64	98	90	2	
12			648.4	0.05	0.54	0.54	231	246						
	60	0840	649.830	~~0.05~~	~~0.54~~	~~0.54~~	~~230~~	247						

leak check
-0.300

ΔVm= ~~35.707~~ 35.403
√Δp= ~~[illegible]~~ .3212
ΔH= 1.22
Ts= 218
Tm=

PACIFIC ENVIRONMENTAL SERVICES, INC

Central Park West
5001 South Miami Boulevard, P.O. Box 12077
Research Triangle Park, North Carolina 27709-2077
(919) 941-0333 FAX: (919) 941-0234

Sample Train Recovery Data

Plant: Asphalt Plant C Date: 7-28-98
Sampling Location: Silo Exhaust Duct
Sample Recovery Person: DPH Field Team Leader: FJP
Sampling Method Type: M315
Run Number: 5-M315-4 Impinger Train ID: 6D
Job Number: R012-001

Comments:

Front Half Data

Filter No.: U 0.4494 (FOP) Filter Media Type:
Filter Description:
Filter No.: Filter Media Type:
Filter Description:

Back Half Data

Impinger Purge-
Start Time: Flow Rate: Stop Time: Purge Gas:

	Impinger	Impinger ~~2~~ 1	Impinger
Contents:			
Final Volume: (mL)	947.6	832.1	787.8
Initial Volume: (mL)	774.6 (3)	687.3 (2)	536.3 (1)
Net Volume: (mL)	173.0 ✓	144.8 ✓	251.5 ✓

	Impinger	Impinger	Final Impinger
Contents:			Si/Gel
Final Volume: (mL)	530.4	625.1	(g): 812.9
Initial Volume: (mL)	530.4 (4)	623.4 (5)	(g): 790.6
Net Volume: (mL)	0 ✓	1.7 ✓	(g): 22.3 ✓

Total Moisture Collected (mL): 643.3
Description of Impinger catch:

67

FIELD DATA SHEET

Plant: HOT MIX ASPHALT PLANT C LA CA
Sampling Location SILO # 2
Run Number: BLANK Date: 07-26-98
Pretest Leak Rate: 0.009 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: —

Sample Type: M315 Operator: J RUBIO
Pbar: 29.26 Ps: —
CO2: — O2: —
Probe Length/Type: 3' GLASS Pitot #: D-7
Stack Diameter: 10.0" As:

Nozzle ID: 0.380 Thermocouple #: TC25
Assumed Bws: – Filter #: –
Meter Box #: 3A Y: 0.984 ΔH@: 1.851
Post-Test Leak Rate: 0.007 cfm @ 15 in. Hg.
Post-Test Leak Check: Pitot: ✓ Orsat: —

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) In H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)
					Desired	Actual		Probe	Filter		Inlet (Tm in°F)	Outlet (Tm out°F)	
		917	518.895										
			518.982										15
		920	518.982										15
			519.148										

ΔVm= $\overline{\sqrt{\Delta p}}$= $\overline{\Delta H}$= $\overline{Ts}$= $\overline{Tm}$=

MOISTURE RECOVERY SHEET
PACIFIC ENVIRONMENTAL SERVICES, INC.

FACILITY: Hot Mix

SOURCE: SED

DATE: 7-26-98

RUN #: Blank

METHOD #: 315

BOX #: 8B

IMPINGER	CONTENTS	FINAL GRAMS	INITIAL GRAMS	TOTAL GRAMS
1	D.I. WATER	861.4	861.4	0
2	D.I. WATER	721.6	721.7	-0.1
3	EMPTY	532.7	532.5	0.2
4	SILICA GEL	906.3	906.3	0.
	FILTER		0.4500	

TOTAL GRAMS COLLECTED	0.1

INITALS: Nr

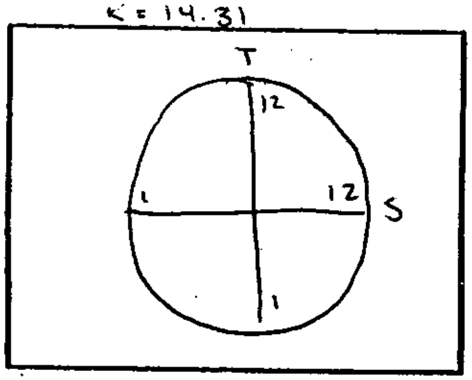
69

PACIFIC ENVIRONMENTAL SERVICES, INC.

FIELD DATA

Plant HOT MIX ASPHALT PLANT C LA. CA.
Date 07-24-98
Sampling Location SILO EXHAUST #2
Sample Type MMS
Run Number SED-MMS-1
Operator JRUBIO
Barometric Pressure (P̄) ~~29.30~~ 29.28
Static Pressure (P̄) -0.25
Filter Number(s) —
Pretest Leak Rate = 0.004 cfm @ 12 in. Hg
Pretest Pitot Leak Check OK
Pretest Orsat Leak Check —
Read and Record all Data Every 5 Minutes
Page 1 of 1

K = 14.31



Schematic of Traverse Point Layout

CO_2			
O_2			
CO			
N_2			

Condensers
V_{lc}: Silica gel
Total H_2O

Probe Length and Type 38" GLASS
Pitot Tube I.D. No. D-7
Nozzle I.D. 0.38 XXIII
Assumed Moisture, % 25
Meter Box Number 3A
Meter Δ H@ 1.851
Meter Gamma 0.984
Reference Δ p 0.17
Post Test Leak Rate = 0.002 cfm @ 10 in. Hg
Post Test Pitot Leak Check OK
Post Test Orsat Leak Check —

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (Δ P_s) in. H_2O	Orifice Press. Differential (ΔH) in. H_2O Desired	Orifice Press. Differential (ΔH) in. H_2O Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg
▨		/		▨	▨	▨	▨	▨	▨	▨	▨	▨
S-1	0	/ 0720	166.400	0.16	2.29	2.3	223	251 / 248	65	70	69	6
2	5	/ 0725	170.4	0.15	2.15	2.2	232	253 / 246	53	79	69	8
3	10	/ 0730	174.4	0.15	2.15	2.2	239	251 / 246	54	83	71	8
4	15	/ 0735	178.4	0.13	1.86	1.9	244	250 / 244	56	84	71	7
5	20	/ 0740	182.2	0.16	2.29	2.3	244	251 / 248	56	85	72	8
6	25	/ 0745	186.4	0.13	1.86	1.9	235	252 / 248	55	86	72	6
7	30	/ 0750	190.2	0.11	1.57	1.6	234	251 / 248	54	84	72	6
8	35	/ 0755	193.7	0.13	1.86	1.9	190	252 / 248	54	84	72	6
9	40	/ 0805	197.2	0.12	1.71	1.7	236	251 / 248	53	77	70	6
10	45	/ 0855	200.7	0.12	1.71	1.7	205	248 / 247	54	91	75	6
11	50	/ 0900	204.2	0.10	1.43	1.4	241	247 / 244	52	82	75	5
12	55	/ 0905	207.4	0.09	1.29	1.3	198	249 / 246	51	87	76	5
T-1	60	/ 0910/18	210.529	0.15	2.15	2.2	253	255 / 248	58	86	80	8
2	65	/ 0923	213.6	0.13	1.86	1.9	252	248 / 248	51	88	79	7
3	70	/ 0928	217.2	0.15	2.15	2.2	259	249 / 248	52	92	81	9
4	75	/ 0933	221.2	0.16	2.29	2.3	260	248 / 248	55	97	83	9
5	80	/ 0938	225.4	0.14	2.00	2.0	260	250 / 248	58	97	84	9
6	85	/ 0943	229.3	0.14	2.00	2.0	255	246 / 247	60	100	87	9
7	90	/ 0948	233.4	0.14	2.00	2.0	256	248 / 242	60	100	87	9
8	95	/ 0953	237.1	0.13	1.86	1.9	255	248 / 248	61	100	97	9
9	100	/ 0958	240.9	0.11	1.57	1.6	232	245 / 247	66	99	88	7
10	105	/ 1003	244.5	0.10	1.43	1.4	209	248 / 248	64	98	89	7
11	110	/ 1008	248.1	0.08	1.15	1.2	212	250 / 248	64	97	89	7
12	115	/ 1013	251.6	0.08	1.15	1.2	212	246 / 248	64	97	89	7
	120	/ 1018	254.650									

STOP – TEST *
STOP 8:10 *
FOP
START 8:55
STOP 9:10
START 9:18

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Sample Train Recovery Data

Plant: Asphalt Plant C
Date: 7-24-98
Sampling Location: Silo Exhaust Duct
Sample Recovery Person: DDH
Field Team Leader: DDH
Sampling Method Type: MMS
Run Number: S-MMS-1
Impinger Train ID:
Job Number: R012-001
Comments:

Front Half Data

Filter No.: Unnumbered
Filter Media Type: DF Filter
Filter Description:
Filter No.:
Filter Media Type:
Filter Description:

Back Half Data

Impinger Purge-
Start Time:
Flow Rate:
Stop Time:
Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:	KO	DI	
Final Volume: (mL)	704.8	812.2	776.6
Initial Volume: (mL)	474.5	812.2	776.6
Net Volume: (mL)	230.3 ✓	0	0

	Impinger 4	Impinger 5	Final Impinger
Contents:	MT	SG	XAD
Final Volume: (mL)	618.1	852.5	(g): 335.2
Initial Volume: (mL)	618.1	828.9	(g): 323.9
Net Volume: (mL)	0	24.1 ✓	(g): 11.3 ✓

Total Moisture Collected (mL): 265.7

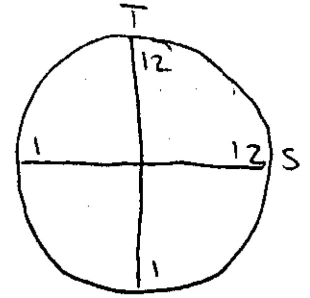
Description of Impinger catch:

PACIFIC ENVIRONMENTAL SERVICES, INC.

FIELD DATA

K: 14.96

Plant HOT MIX ASPHALT PLANT C LA CA
Date 07-25-98
Sampling Location SILO EXHAUST
Sample Type MMS
Run Number SED-MMS-2
Operator J RUBIO
Barometric Pressure (P_b) ~~29.25~~ 29.26 cm
Static Pressure (P_s) -0.25
Filter Number(s) —
Pretest Leak Rate = 0.008 cfm @ 15 in. Hg
Pretest Pitot Leak Check OK
Pretest Orsat Leak Check —
Read and Record all Data Every 5 Minutes
Page 1 of 1



Schematic of Traverse Point Layout

CO_2				
O_2				
CO				
N_2				

Condensers
V_L: Silica gel
Total H_2O

Probe Length and Type 38" GLASS
Pitot Tube I.D. No. D-7 / TQ 25
Nozzle I.D. 0.380 XXIII
Assumed Moisture, % 15
Meter Box Number 3A
Meter Δ H@ 1.851
Meter Gamma 0.984
Reference Δ p 0.16
Post Test Leak Rate = 0.007 cfm @ 13 in. Hg
Post Test Pitot Leak Check OK
Post Test Orsat Leak Check —

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δ Ps) in. H_2O	Orifice Press. Differential (ΔH) in. H_2O		Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum in. Hg
					Desired	Actual				Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	
S-1	0	710	298.684	0.17	2.53	2.5	230	248 / 245	50	78	76	7
2	5	715	302.8	0.15	2.24	2.3	233	248 / 239	50	85	77	8
3	10	720	307.0	0.15	2.24	2.3	234	247 / 241	54	89	78	8
4	15	725	311.1	0.14	2.09	2.1	242	248 / 241	57	90	79	8
5	20	730	315.1	0.14	2.09	2.1	236	247 / 243	57	89	80	8
6	25	735	319.1	0.13	1.94	1.9	244	248 / 245	53	89	80	7
7	30	740	322.9	0.10	1.49	1.5	250	247 / 240	50	89	80	7
8	35	745	326.8	0.09	1.34	1.3	253	247 / 241	47	89	81	5
9	40	750	329.8	0.08	1.19	1.2	251	248 / 237	49	88	82	5
10	45	755	332.8	0.08	1.19	1.2	245	248 / 241	50	87	82	5
11	50	0800	335.8	0.07	1.04	1.0	251	248 / 243	50	88	82	5
12	55	0805	338.5	0.07	1.04	1.0	250	248 / 243	53	88	82	5
T-1	60	0840	341.265	0.15	2.24	2.2	240	248 / 248	60	90	84	12
2	65	0845	345.4	0.15	2.24	2.2	244	248 / 242	59	94	85	12
3	70	0850	349.5	0.16	2.38	2.4	244	248 / 245	60	91	82	12
4	75	0855	353.8	0.16	2.38	2.4	242	249 / 247	63	96	84	12
5	80	0900	358.1	0.15	2.24	2.2	247	250 / 240	65	100	87	10
6	85	0905	362.1	0.15	2.24	2.2	238	249 / 243	63	101	88	10
7	90	0910	366.2	0.13	1.94	1.9	235	248 / 245	61	104	91	10
8	95	0915	370.1	0.12	1.79	1.8	248	248 / 243	61	106	92	9
9	100	0930	373.8	0.12	1.79	1.8	245	243 / 247	63	102	94	9
10	105	0935	377.6	0.12	1.79	1.8	247	247 / 248	57	103	94	9
11	110	0940	381.3	0.10	1.49	1.5	245	249 / 246	55	103	93	7
12	115	0945	384.6	0.08	1.19	1.2	187	248 / 248	56	102	93	6
	120	0950	387.697									

STOP 8:10
START 8:40

STOP 9:20
START 9:30

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Research Triangle Park, North Carolina 27709-2077
(919) 941-0333 FAX: (919) 941-0234

Sample Train Recovery Data

Plant: Hot mix Asphalt plant C LA, California Date: 7-25-98
Sampling Location: SED
Sample Recovery Person: DH Field Team Leader: FP
Sampling Method Type: MM5
Run Number: SED-MM5-2 Impinger Train ID: RTP-00
Job Number: R012.002

Comments:

Front Half Data

Filter No.: — Filter Media Type: Glass
Filter Description:
Filter No.: Filter Media Type:
Filter Description:

Back Half Data

Impinger Purge-
Start Time: — Flow Rate: — Stop Time: — Purge Gas: —

	Impinger 1	Impinger 2	Impinger 3
Contents:	MT	DI	DI
Final Volume: (mL)	982.7	677.2	718.0
Initial Volume: (mL)	475.3	718.3	716.6
Net Volume: (mL)	507.4	-41.10	~~14.0~~ 1.4 FDP 7/27/98

	Impinger 4	Impinger 5	~~Final Impinger~~ TRAP
Contents:	MT	SG	XAD
Final Volume: (mL)	619.5	873.9	(g): 379.4
Initial Volume: (mL)	614.9	847.7	(g): 355.0
Net Volume: (mL)	4.6	25.70	(g): 24.4

Total Moisture Collected (mL): 522.40 ✓
Description of Impinger catch:

73

FIELD DATA SHEET

Plant: HOT MIX ASPHALT PLANT C LA CA
Sampling Location SILO # 2 EXHAUST
Run Number: SEO-MMS-3 Date: 7-27-98
Pretest Leak Rate: 0.003 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: —

Sample Type: MMS Operator: J. RUBIO
Pbar: 29.16 corr ~~29.24~~ Ps: -0.26
CO2: — O2: —
Probe Length/Type: 38" GLASS Pitot #: 0-7
Stack Diameter: 10.0" As:

Nozzle ID: 0.431 Thermocouple #: TC25
Assumed Bws: 25 Filter #: —
Meter Box #: 3A Y: 0.984 ΔH@: 1.851
Post-Test Leak Rate: 0.006 cfm @ in. Hg.
Post-Test Leak Check: Pitot: Orsat:

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)
					Desired	Actual		Probe	Filter		Inlet (Tm in °F)	Outlet (Tm out °F)	
S-01	0	0800	521.010	0.16	3.26	3.3	205	248	247	64	94	88	12
2	5	0809	525.9	0.16	2.82	~~2.2~~ 2.3	251	248	248	54	103	90	9
3	10	0814	530.1	0.17	2.47	2.5	240	249	248	55	105	91	10
4	15	0819	534.4	0.16	2.42	2.4	225	249	249	58	107	92	10
5	20	0824	538.6	0.15	2.36	2.4	221	248	248	56	100	89	10
6	25	0829	542.7	0.13	2.07	2.1	180	249	248	53	100	88	9
7	30	0834	546.6	0.11	1.66	1.7	224	248	247	61	103	90	10
8	35	0839	550.2	0.09	1.61	1.6	238	247	249	63	103	92	8
9	40	0844	553.6	0.08	1.21	1.2	227	249	243	63	103	94	8
10	45	0849	556.6	0.08	1.21	1.2	228	248	248	64	103	94	8
11	50	0854	559.6	0.08	1.21	1.2	223	248	244	60	102	95	11
12	55	0859	562.6	0.06	0.91	0.91	228	250	240	57	104	99	15
T-1	60	0904	565.291	0.12	1.28 ~~1.41~~	~~1.3~~	228	253	248	60	104	98	15
2	65	0930	565.580 ~~568.915~~	0.10	1.07	1.1	260	248	248	62	102	99	13
3	70	0944	569.350	0.10	1.07	1.1	263	251	249	63	100	100	11
4	75	0955	572.3 ~~575.3~~	0.08	0.85	0.85	270	250	248	65	105	102	15
5	80	1010	577.8	0.10	1.11	1.1	225	248	248	65	107	103	15
6	85	1015	580.8	0.10	1.11	1.1	200	248	248	63	107	104	15
7	90	1020	583.6	0.08	0.88	0.88	226	248	247	61	107	105	14
8	95	1025	586.3	0.08	0.88	0.88	224	249	243	63	107	104	8
9	100	1030	588.9	0.08	0.88	0.88	225	247	249	65	109	105	7
10	105	1035	591.6	0.06	0.66	0.66	228	248	248	65	109	106	7
11	110	1040	593.8	0.06	0.66	0.66	233	249	248	65	108	106	6
12	115	1045	596.0	0.06	0.66	0.66	232	248	248	63	109	106	6
	120	1050	598.256										

STOP 9:04
START 9:25
STOP 9:35
START 9:48
STOP 9:55
START 10:07
STOP 10:50

-0.724

ΔVm= 76.957 √Δp= 0.3151 ΔH= 1.38 Ts= Tm=

* CHANGED OUT IMPINGERS 1 & 2 LEAK CHECK PRE 0.004 @ 16 POST 0.002 @ 15

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(919) 941-0333 FAX: (919) 941-0234

Sample Train Recovery Data

Plant: Asphalt Plant C Date: 7-27-98

Sampling Location: SED

Sample Recovery Person: DDH Field Team Leader: EJP

Sampling Method Type: MMS

Run Number: S-MMS-3 Impinger Train ID:

Job Number: R012-001

Comments:

Front Half Data

Filter No.: Unnumbered Filter Media Type: DF

Filter Description: MMS

Filter No.: Filter Media Type:

Filter Description:

Back Half Data

Impinger Purge-
Start Time: Flow Rate: Stop Time: Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:	MT	DI	DI
Final Volume: (mL)	[illegible]78.5+1156.9	965.7+991.8	812.6
Initial Volume: (mL)	(471.8x2)+106	(745.9x2)	716.8
Net Volume: (mL)	1997.8 ✓	465.7 ✓	95.8 ✓

	Impinger 4	Impinger 5	Final Impinger
Contents:	MT	SG	XAD
Final Volume: (mL)	694.4	912.2	(g): 339.4
Initial Volume: (mL)	613.2	874.4	(g): 310.7
Net Volume: (mL)	81.2	37.8	(g): 28.7

Total Moisture Collected (mL): 2207.0 ✓

Description of Impinger catch:

75

3

FIELD DATA SHEET

Plant: HOT MIX
Sampling Location SILO #2 EXHAUT
Run Number: 3EO-MMS-4 Date: 07-28-98
Pretest Leak Rate: 0.007 cfm @ 16 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: —

Sample Type: MMS Operator: JRUBIO
Pbar: ~~29.12~~ 29.05 CMC Ps: -0.25
CO2: — O2: —
Probe Length/Type: 38" GLASS Pitot #: 0-7
Stack Diameter: 10.0" As:

Nozzle ID: 0.433 Thermocouple #: TC-25
Assumed Bws: 50 Filter #: —
Meter Box #: 3A Y: 0.984 ΔH@: 1.851
Post-Test Leak Rate: 0.006 cfm @ 16 in. Hg.
Post-Test Leak Check: Pitot: ✓ Orsat: —

%H2O ↓	Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft3	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O Desired	Orifice Pressure Differential (ΔH) in H2O Actual	Stack Temp. (Ts)	Temperature °F Probe	Temperature °F Filter	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (Tm in °F)	Dry Gas Meter Temp. Outlet (Tm out °F)	Pump Vacuum (in. Hg)	
30	1	0	0913	649.779	0.12	1.37	1.4	265	249	243	49	96	95	16	11.4
50	2	9	0918	653.1	0.11	0.88	0.88	269	248	246	48	98	96	9	8.0
	3	10	0923	655.7	0.10	0.80	0.80	270	248	248	47	99	97	9	
75	4	15	0928	658.0	0.08	.16 ~~0.80~~	.16 ~~0.64~~	270	248	248	49	100	98	1	2.0
	5	20	0933	659.0	0.08	0.16	0.16	260	248	248	52	100	98	2	
50	6	25	0938/1026	660.2	0.08	0.62	0.62	252	248	248	55	105	104	4	7.7
35	7	30	1031	662.5	0.09	0.99	0.99	260	248	244	53	106	104	6	11.0
50	8	35	1036	665.3	0.07	0.54	0.54	248	248	249	56	107	104	7	~~4.9~~ 7.7
70	9	40	1041	667.4	0.08 ~~0.08~~	0.23 ~~0.62~~	.23 ~~0.62~~	234	244	251	58	107	104	6	2.9
	10	45	1046	668.85	0.08	0.23	0.23	269	249	248	61	109	105	5	
	11	50	1051	670.3	0.06	0.17	0.17	267	248	248	64	109	105	5	
*672.956	12	55	1056	671.6	0.06	0.17	0.17	269	248	248	65	109	106	5	
			1101	672.896*											
60	1	60	1139	673.018	0.11	0.53	0.53	278	250	248	62	107	102	6	4.8
	2	65	1144	675.1	0.11	0.53	0.53	279	248	248	60	107	106	6	
50 ~~55~~	3	70	1149/1233	677.1	0.10	0.75	0.75	259	248	249	67	103	102	6	5.5
50	4	75	1238	679.6	0.10	0.75	0.75	276	247	243	60	104	102	6	
30	5	80	1243	682.0	0.09	1.30	1.30	277	249	245	58	103	101	6	14.4
	6	85	1248	685.0	0.08	1.15	1.2	280	248	248	56	103	101	6	
45	7	90	1253	688.2	0.07	0.62	0.62	285	248	248	55	105	101	10	~~10.6~~ 8.9
	8	95	1258	690.5	0.06	0.53	0.53	284	246	247	59	104	101	10	
45	9	100	1303	692.7	0.06	0.53	0.53	287	247	245	61	104	100	6	8.9
	10	105	1308	696.8	0.06	0.53	0.53	286	248	248	62	104	100	7	
	11	110	1313	~~696.969~~	0.06	0.53	0.57	284	248	248	62	104	100	7	
	12	115	1318	699.0	0.06	0.53	0.53	290	248	248	63	100	99	6	
		120	1323	702.103	~~0.0~~										

~~Vm = 0.122~~

ΔVm= ______ $\overline{\sqrt{\Delta p}}$= ______ $\overline{\Delta H}$= ______ $\overline{Ts}$= ______ $\overline{Tm}$= ______

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Sample Train Recovery Data

Plant: Asphalt Plant C Date: 7-28-98
Sampling Location: Silo Exhaust Duct
Sample Recovery Person: DDH Field Team Leader: FJP
Sampling Method Type: MMS
Run Number: S-MMS-4 Impinger Train ID:
Job Number: R012-001

Comments:

Front Half Data

Filter No.: Filter Media Type:
Filter Description:
Filter No.: Filter Media Type:
Filter Description:

Back Half Data

Impinger Purge-
Start Time: Flow Rate: Stop Time: Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:	MT	DI	DI
Final Volume: (mL)	1,112.5+875.2	825.7	726.4
Initial Volume: (mL)	495.3x2	812.4	725.0
Net Volume: (mL)	997.1	13.3	1.4

	Impinger 4	Impinger 5	Final Impinger
Contents:	MT	SG	XAD
Final Volume: (mL)	700.6	796.0	(g): 352.0
Initial Volume: (mL)	618.9	780.2	(g): 327.7
Net Volume: (mL)	81.7 ✓	15.8 ✓	(g): 24.3 ✓

Total Moisture Collected (mL): 1133.6 ✓
Description of Impinger catch:

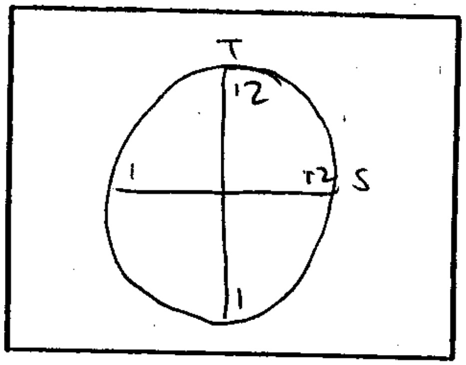
77

1119.9

PACIFIC ENVIRONMENTAL SERVICES, INC.

FIELD DATA

Plant HOT MIX ASPHALT PLANT C LA-CA
Date 07-28-98
Sampling Location SILO #2 EXHAUST
Sample Type ~~SE~~ MMS-0
Run Number SEO-MMS-5
Operator J RUBIO
Barometric Pressure (P_b) ~~29.15~~ 29.05 cmc
Static Pressure (P_s) -0.25
Filter Number(s) —
Pretest Leak Rate = 0.009 cfm @ 17 in. Hg
Pretest Pitot Leak Check ✓
Pretest Orsat Leak Check —
Read and Record all Data Every 5 Minutes
Page 1 of 1



Schematic of Traverse Point Layout

CO₂				
O₂				
CO				
N₂				

Condensers
V_lc: Silica gel
Total H₂O

Probe Length and Type 38" GLASS
Pitot Tube I.D. No. 0-7 / TC25
Nozzle I.D. 0.500
Assumed Moisture, % 40
Meter Box Number 3A
Meter Δ H@ 1.851
Meter Gamma 0.984
Reference Δ p 0.12
Post Test Leak Rate = 0.007 cfm @ 15 in. Hg
Post Test Pitot Leak Check ✓
Post Test Orsat Leak Check —

Temp. Sensor ID No.

	Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (Δ P_s) in. H₂O	Orifice Press. Differential (ΔH) in. H₂O Desired	Orifice Press. Differential (ΔH) in. H₂O Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp. Inlet (T_m in) °F	Dry Gas Meter Temp. Outlet (T_m out) °F	Pump Vacuum in. Hg	
40	S-1	0	1358	702.060	0.15	2.84	2.8	283	250 / 241	60	102.	98	13	
	2	5	1403	707.4	0.13	2.46	2.5	285	247 / 243	57	103	98	13	19.9
	3	10	1408	711.7	0.12	2.27	2.3	289	248 / 248	59	103	98	13	
	4	15	1413	716.0	0.09	1.70	1.7	283	248 / 249	57	103	97	10	
50	5	20	1418	719.5	0.09	1.17	1.2	283	247 / 248	60	103	99	7	
	6	25	1423	722.7	0.07	0.91	0.91	280	249 / 248	62	104	100	5	13.0
	7	30	1428	725.3	0.09	1.17	1.2	285	248 / 245	63	104	100	6	
	8	35	1813	728.8	0.09	1.74	1.7	257	254 / 241	53	90	89	7	19.3
	9	40	1818	733.0	0.07	1.35	1.4	277	249 / 245	48	92	90	6	
	10	45	1823	736.2	0.07	2.1	2.1	278	249 / 242	50	94	90	9	
	11	50	1828	740.2	0.06	2.52	2.5	265	249 / 241	53	96	91	11	30.0
	12	55	1833	744.6	0.06	2.52	2.5	273	248 / 249	53	97	91	11	42.7
	T-1	60	1838/40	*748.954	0.08	2.68	2.7	263	248 / 244	55	96	92	13	33.~~0~~5
21	2	65	1845	753.6	0.09	3.02	3.0	266	248 / 245	56	97	93	14	37.0
	3	70	1850	758.4	④ ~~0.09~~	3.02	3.0	254	248 / 241	56	98	94	13	33.0
22	4	75	1855	762.0	0.09	3.02	3.0	260	248 / 242	57	97	93	13	
	5	80	1900	767.8	0.08	2.72	2.7	267	248 / 244	58	97	94	12	34.0
	6	85	1905	772.4	0.08	2.72	2.7	265	248 / 246	57	97	94	13	
28	7	90	1910	776.9	0.08	2.72	2.7	262	248 / 243	59	97	94	13	
	8	95	1915	781.4	0.08	2.72	2.7 ~~3.07~~	259	248 / 249	59	97	94	13	
	9	100	1920	785.9	0.08	2.72	2.7	257	247 / 240	58	97	93	13	
	10	105	1925	790.4	0.07	2.38	2.4	267	248 / 246	57	96	93	12	
	11	110	1930	794.8	0.06	2.04	2.0	266	248 / 248	57	97	94	12	
	12	115	1935	798.6	0.07	2.38	2.4	265	247 / 246	57	97	94	12	
		120	1940	802.900										

~~728~~ * leak ck 40
729.670
(-1.059)
25.20

0.008 @ 15"
* 749.001 15
25
0.007 @ 12"
(-0.047)

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Sample Train Recovery Data

Plant: Asphalt Plant C Date: 7-28-98
Sampling Location: Silo Exhaust Duct
Sample Recovery Person: DAH Field Team Leader:
Sampling Method Type: MMS
Run Number: S-MMS-5 Impinger Train ID:
Job Number:

Comments:

Front Half Data

Filter No.: Filter Media Type:
Filter Description:
Filter No.: Filter Media Type:
Filter Description:

Back Half Data

Impinger Purge-
Start Time: Flow Rate: Stop Time: Purge Gas:

	Impinger 1	Impinger 2	Impinger 3
Contents:			
Final Volume: (mL)	1116.6+114	894.4	912.4
Initial Volume: (mL)	~~330.9~~ 496.2	720.4	778.2
Net Volume: (mL)	734.4 ✓	174.0 ✓	134.2 ✓

	Impinger 4	Impinger 5	Final Impinger
Contents:			
Final Volume: (mL)	613.6	835.7	(g): 367.9
Initial Volume: (mL)	602.9	806.1	(g): 330.9
Net Volume: (mL)	10.7 ✓	29.6 ✓	(g): 37.0 ✓

Total Moisture Collected (mL): 1119.9
Description of Impinger catch:

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FIELD DATA SHEET

Plant: HOT MIX ASPHALT PLANT C - LA CA
Sampling Location SILO # 2
Run Number: BLANK Date: 07-26-98
Pretest Leak Rate: 0.003 cfm @ 15 in. Hg.
Pretest Leak Check: Pitot: ✓ Orsat: —

Sample Type: MMS Operator: JRUBIO
Pbar: ~~29.26~~ 29.24 CMS Ps: —
CO2: — O2: —
Probe Length/Type: 3' GLASS Pitot #: D-7
Stack Diameter: 10.0" As:

Nozzle ID: 0.380 Thermocouple #: TC25
Assumed Bws: — Filter #: —
Meter Box #: 3A Y: 0.984 ΔH@: 1.851
Post-Test Leak Rate: 0.002 cfm @ 15 in. Hg.
Post-Test Leak Check: Pitot: ✓ Orsat: —

Traverse Point Number	Sampling Time (min)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δp) in H2O	Orifice Pressure Differential (ΔH) in H2O		Stack Temp. (Ts)	Temperature °F		Impinger Temp. °F	Dry Gas Meter Temp.		Pump Vacuum (in. Hg)
					Desired	Actual		Probe	Filter		Inlet (Tm in °F)	Outlet (Tm out °F)	
		900	518.659										
			518.777										
		903	518.777										15
			518.895										15

ΔVm= $\overline{\sqrt{\Delta p}}$= $\overline{\Delta H}$= $\overline{Ts}$= $\overline{Tm}$=

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Sample Train Recovery Data

Plant: Asphalt Plant C
Date: 7-26-98
Sampling Location: Silo Exhaust Duct
Sample Recovery Person: DDH
Field Team Leader: FJP
Sampling Method Type: MMS
Run Number: S-MMS-FB
Impinger Train ID: 104-1
Job Number: R012-001

Comments:

Front Half Data

Filter No.: Unnumbered
Filter Media Type: Glass
Filter Description: Clean
Filter No.: —
Filter Media Type: —
Filter Description: —

Back Half Data

Impinger Purge- Start Time: —
Flow Rate: —
Stop Time: —
Purge Gas: —

	Impinger 1	Impinger 2	Impinger 3
Contents:	MT	DI	DI
Final Volume: (mL)	473.4	643.5	623.9
Initial Volume: (mL)	473.4	643.5	623.9
Net Volume: (mL)	0	0	0

	Impinger 4	Impinger 5	Final Impinger
Contents:	MT	SG	XAD
Final Volume: (mL)	615.8	876.1	(g): 330.5
Initial Volume: (mL)	615.7	876.1	(g): 330.3
Net Volume: (mL)	0.1	0	(g): 0.2

Total Moisture Collected (mL): 0.3
Description of Impinger catch: Clear

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: Hot Mix Asphalt Plant C - LA, California
Project No.: R012.001
Facility: Plant C
City: Los Angeles, CA
Date: 7-24-98
Sampling Location: Silo #2
Time: 0920- 1014
Run Number: SED-V-1
Meter Box No.: V-2
Meter Gamma (γ) Pre: Post:
Barometric Pressure, in. Hg: ~~29.30~~ 29.28 cmc
Operator: TA
Ambient Temperature, °F: 69
Purge Time: —

Leak Check Data

	Vacuum, inches Hg		
	Initial	Final	Time, min
Pre-test:	10	7	1

Run Data

	Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft³)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H₂0)
Run 1	0	0726	8981.47	0.2	68	3	1
	10	0730	8983.45	0.2	69	3	1
	—	0859	7-24-98				
Run 2	0	~~8983.76~~	8983.76	0.2	79	5	1
	10	0909	8985.88	0.2	80	5	1
Run 3	0	0934	8986.06	0.2	79	3	1
	10	0944	8988.40	0.2	82	4	1
Run 4	0	1004	8988.53	0.2	78	4	1
	10	1014	8990.28	0.2	79	4	1

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: Hot Mix Asphalt Plant C LA, CA
Facility: Plant C
Date: 7-25-98
Time: 0710- 0920
Meter Box No.: V-2 FSP
Barometric Pressure, in. Hg: ~~29.28~~ 29.26 cmc
Ambient Temperature, °F: 70

Project No.: R012.001
City: LA, California
Sampling Location: SED - Silo #2
Run Number: S-V-2
Meter Gamma (γ) Pre: - Post: -
Operator: TA
Purge Time:

Leak Check Data

	Vacuum, inches Hg		Time, min
	Initial	Final	
Pre-test:	12	7	1

Run Data

	Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft³)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H_2O)
Set 1	0	0710	8990.53	0.2	69	6	1
	10	0720	8993.22	0.2	71	6	1
Set 2	0	0746	8993.45	0.2	71	2	0.8
	10	0756	8995.97	0.2	73	2	0.8
Set 3	0	0849	8996.21	0.2	74	5	0.8
	10	0859	8998.70	0.2	76	8	0.8
Set 4	0	0910	8998.73	0.2	76	2	0.8
	10	0920	9001.22	0.2	78	3	0.8

Pacific Environmental Services VOST Box Calibration

Date:	7-19-98	Flow Rate:	**0.25 l/min**
Vost Box Number:	V-2	Rotameter Setting:	0.2
		Bubble Meter Temp. :	91

Run 1

Bubble Meter	
238.5	240.9
239.4	241.0
240.1	240.5
	240.8
Average:	**240.17**

Meter Box	
Initial Volume	8815.5
Final Volume	8822
Initial Temp.	103
Final Temp.	102
Average Temp.	102.5
Time:	27.3
QDGM=	233.228
Y=	**1.0298**

Run 2

Bubble Meter	
238.0	240.1
239.5	240.4
239.6	240.4
	240.0
Average:	**239.71**

Meter Box	
Initial Volume	8822.5
Final Volume	8829
Initial Temp.	103
Final Temp.	103
Average Temp.	103
Time:	27.35
QDGM=	232.594
Y=	**1.0306**

Run 3

240.6	240.8
240.8	240.0
240.2	239.6
	239.0
Average:	**240.14**

Initial Volume	8829.5
Final Volume	8836
Initial Temp.	104
Final Temp.	104
Average Temp.	104
Time:	27.3
QDGM=	232.6072273
Y=	**1.0324**

Average Y= **1.0309**

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Volatile Organic Sampling Train (VOST) Data Sheet

Customer: Hot Mix Asphalt Plant C
Facility: LA, California
Date: 7-27-98
Time: 0816-
Meter Box No.: V-2 FOR
Barometric Pressure, in. Hg: ~~29.19~~ 29.16 cmc
Ambient Temperature, °F: 70

Project No.: R012.001
City: LA, California
Sampling Location: SED
Run Number: S-V-3
Meter Gamma (γ) Pre: — Post: —
Operator: TA
Purge Time: —

Leak Check Data

	Vacuum, inches Hg		Time, min
	Initial	Final	
Pre-test:	10 10 10 10 10 10	10 10 10 10 10 10 10	1 - 7
Post-test	10	10	

Run Data

	Sample Time (min)	Clock Time (24-hr)	Meter Volume, liters (ft³)	Rotameter Setting	Dry Gas Meter Temp. °C (°F)	Vacuum (in. Hg)	Meter Pressure (in H₂0)
set 1	0	0816	9001.60	0.5	77	8	1
	5	0821	9004.14	0.5	78	8	1
set 2	0	0831	9004.24	0.5	79	8	1
	5	0836	9006.50	0.5	80	8	1
set 3	0	0938	9006.63	0.5	81	8	1
	5	0943	9009.11	0.5	82	8	1
	—						
set 4	0	0955	9009.20	0.5	82	8	1
	7	1002	9013.71	0.5	83	8	1
set 5	0	1022	9013.80	0.5	84	8	1
	7	1029	9017.30	0.5	87	8	1
set 6	0	1035	9017.50	0.5	86	8	1
	7	1042	9021.11	0.5	88	8	1

Pacific Environmental Services VOST Box Calibration

Date: 7-19-98
Vost Box Number: V-2

Flow Rate: **0.5 l/min**
Rotameter Setting: 0.4
Bubble Meter Temp. : 91

Run 1

Bubble Meter		Meter Box	
499.9	498.7	Initial Volume	8837
500.9	501.3	Final Volume	8852
498.9	499.8	Initial Temp.	104
	500.2	Final Temp.	104
		Average Temp.	104
Average:	**499.96**	Time:	27.6
		QDGM=	530.951
		Y=	**0.9416**

Run 2

Bubble Meter		Meter Box	
500.2	500.0	Initial Volume	8852.25
501.0	499.8	Final Volume	8867.25
500.8	499.6	Initial Temp.	104
	499.8	Final Temp.	104
		Average Temp.	104
Average:	**500.17**	Time:	27.5
		QDGM=	532.882
		Y=	**0.9386**

Run 3

500.0	500.9	Initial Volume	8867.5
500.6	500.7	Final Volume	8882.75
501.0	500.1	Initial Temp.	105
	499.5	Final Temp.	104
		Average Temp.	104.5
Average:	**500.40**	Time:	27.6
		QDGM=	539.322345
		Y=	**0.9278**

Average Y= **0.9360**

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EPA Method 18 Adsorbent Tube Data Sheet

Plant: Hot Mix Asphalt Plant C Date: 7/24/98
Sampling Location: Silo Exhaust Duct
Sampling Method Type: M18 Field Team Leader: TA
Run Number: 1 S-M18-1 Concurrent Train ID: Run #1 SED

DESCRIPTION OF TRAIN

Leg	Moisture Knockout (if used, indicate type)	Tube a Description	Tube b Description	Tube c Description
A	Midget	SED-M18-Run1 Aa	SED-M18-Run1	Ab
B	Midget	SED-M18-Run 1Ba	SED-M18-Run1	Bb

CALIBRATION - PRETEST

Leg	Pre Volume (mL) Post	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	977/979	—	—	~~29.30~~ 29.28 CMC
B	1040/1054	—	—	~~29.30~~

RUN DATA

Elapsed Time	Clock Time	Leg A		Leg B	
		Flow (L/min)	Vacuum (in Hg)	Flow (L/min)	Vacuum (in Hg)
0 720	~~0920~~ 9/25/98	1	10	1	10
15 735	~~0935~~ [illegible]	1	10	1	10
30 756	~~0956~~	1	10	1	10
45	0810/0855	1	10	1	10
60	0900	1	10	1	10
70/75	0910/0923	1	10	1	10
90	0938	1	10	1	10
105	0953	1	10	1	10
120/END	1008	1	10	1	10
~~135~~					
~~150~~ TA					
~~165~~ 7-24-98					
~~180~~					
~~195~~					
~~210~~					
~~225~~					
~~240~~					

[illegible] 0414

CALIBRATION – POST-TEST

CMC 9/25 FROM MET. STATION DATA (@1013)

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	979	~~79~~ 68.4	60	~~29.30~~ 29.28 CMC
B	1054	~~79~~ 68.4	60	~~29.30~~

LEAK CHECK	PRETEST	POST-TEST
A	OK	OK
B	OK	OK

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PES
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EPA Method 18 Adsorbent Tube Data Sheet

Plant: Hot Mix Asphalt Plant C - LA, CA Date: 7/25/98
Sampling Location: Silo Exhaust Duct #2
Sampling Method Type: M18 (Anasorb 747) Field Team Leader: BGP - FP
Run Number: SED - M18 - Run 2 Concurrent Train ID: VOST

DESCRIPTION OF TRAIN

Leg	Moisture Knockout (if used, indicate type)	Tube a Description	Tube b Description	Tube c Description
A	midget	SED-M18-Run 2 Aa	SED-M18-Run 2 Ab	—
B	midget	SED-M18-Run 2 Ba	SED-M18-Run 2 Bb	—

8/25 CMC FROM MET. STATION DATA (@ 0705)

CALIBRATION - PRETEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	993	TM 7-25 cr ~~70~~ 67.8	~~+~~ 60	~~29.28~~ 29.26 cmc
B	993	~~70~~ 67.8	~~+~~ 60	~~29.28~~

RUN DATA

FP
Stop 8:06
start 0840
stop 9:20
start 0930

Elapsed Time	Clock Time	Leg A Flow (L/min)	Leg A Vacuum (in Hg)	Leg B Flow (L/min)	Leg B Vacuum (in Hg)
0	0710	1	15	1	15
10	0720	1	15	1	15
20	0730	1	15	1	15
30	0740	1	15	1	15
40	0750 FP	1	15	1	15
50/54	~~0800~~ ~~0804~~ 840	1	15	1	18
60	0844	1	18	1	18
70	0854	1	18	1	18
80	0904	1	18	1	18
90	0914/120	1	18	1	18
100	0934	1	18	1	18
110	0944	1	18	1	18
120	0954				
	CMC 8/25				
710 - 806	56				
840 - 920	40				
930 - 954	24 / 120				

FP

CMC 8/25 MET. STATION DATA @ 0959 = 75.2 °F

CALIBRATION – POST-TEST

Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
A	TM 7-25-98 ~~4~~ 1004	75.2	60	~~29.28~~ 29.26
B	994	75.2	60	~~29.28~~

P:\r012.001\misc\m18sheet.doc

LEAK CHECK PRE-TEST POST TEST
A OK 22 in Hg OK 20 in Hg
B OK 22 in Hg OK 20 in Hg

87

PES
PACIFIC ENVIRONMENTAL SERVICES, INC

Central Park West
5001 South Miami Boulevard, P.O. Box 12077
Research Triangle Park, North Carolina 27709-2077
(919) 941-0333 FAX: (919) 941-0234

EPA Method 18 Adsorbent Tube Data Sheet

Plant: Hot Mix Asphalt Plant C
Date: 7-27-98
Sampling Location: SED
Sampling Method Type: m-18
Field Team Leader: FP
Run Number: SED-M18-3
Concurrent Train ID: VOST

DESCRIPTION OF TRAIN

Leg	Moisture Knockout (if used, indicate type)	Tube a Description	Tube b Description	Tube c Description
A	midget	SED-M18-3 Aa	SED-M18-3 Ab	—
B	midget	SED-M18-3Ba	SED-M18-3Bb	—

CALIBRATION - PRETEST   CMC 8/05 FROM MET STATION DATA (@ 1018)

Leakcheck	Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
OK@20"	A	1020	~~75~~ 84.7	60	~~29.19~~ 29.16
OK@20"	B	1010	~~75~~ 84.7	60	~~29.19~~ CMC

RUN DATA

Elapsed Time	Clock Time	Leg A Flow (L/min)	Leg A Vacuum (in Hg)	Leg B Flow (L/min)	Leg B Vacuum (in Hg)
0	1023	1	15	1	15
10	1033	1	15	1	15
20	1043	1	15	1	15
30/stop	1053/1140	1	15	1	15
40	1150	1	15	1	15
45	1155 stop 1243	1	15	1	15
50	1248	1	15	1	15

CALIBRATION – POST-TEST   CMC 8/05 FROM MET STATION DATA (@ 1202)

	Leg	Volume (mL)	Temperature (°F)	Time (seconds)	Pbar (inches Hg)
OK@20"	A	992	~~75~~ 93.7	60	~~29.19~~ 29.16
OK@20"	B	920	~~75~~ 93.7	60	~~29.19~~ CMC

APPENDIX C.3

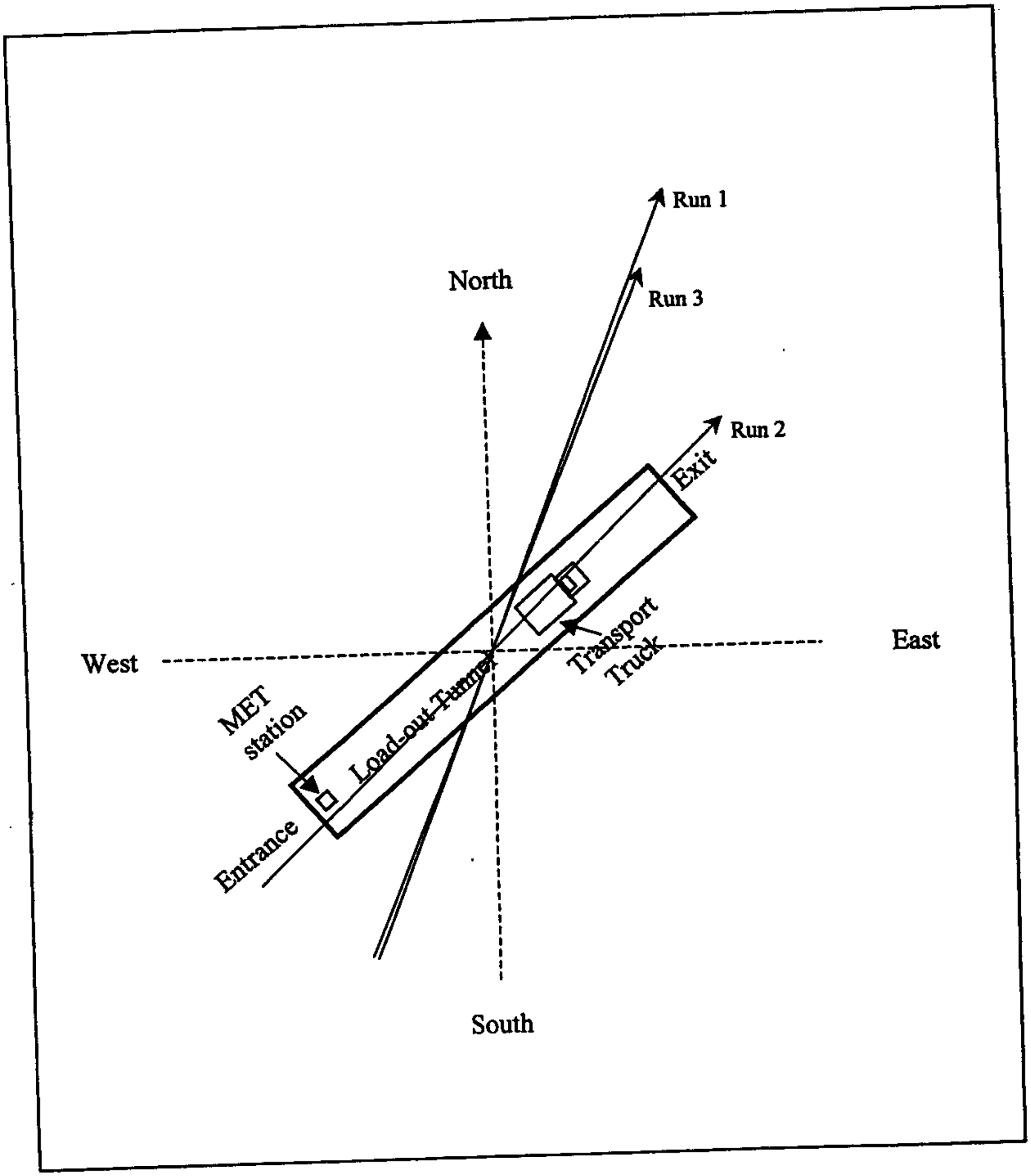
METEOROLOGICAL DATA

A meteorological (MET) monitoring station was positioned on top of the load-out tunnel, above the entrance. The station monitored the wind speed, wind direction, and ambient temperature. Readings from the MET station were recorded once per minute during the testing and downloaded to a data acquisition system. Due to hardware problems, no data were collected on 7/24/98 (background condition testing). Ambient humidity was measured manually using a sling psychrometer and recorded in field notebook. Table M.1 below summarizes the meteorological data collected. Figure M.1 shows the position of the load-out tunnel and the MET station and the average wind direction for each test day.

TABLE M.1
METEOROLOGICAL DATA SUMMARY
ASPHALT PLANT C, CALIFORNIA

Date	Time Periods	Wind Speed, MPH	Ambient Temperature Degrees C	Wind Direction, Degrees*	Ambient Relative Humidity, %
7/24/98	0646-0700	3.02	17.7	173	
	0701-0800	3.35	18.0	184	90
	0801-0812	3.98	18.1	151	
	0931-1000	3.71	22.6	228	
	1001-1100	4.05	21.3	224	
	1101-1200	6.12	23.0	233	
	1201-1300	7.63	25.2	219	60
	Average	**4.55**	**20.8**	**202**	**75**
7/25/98	0548-0559	3.23	19.1	281	
	0600-0659	2.91	19.8	218	
	0700-0759	4.12	20.1	262	77
	0800-0859	4.96	21.0	225	
	0900-0959	5.53	23.4	206	
	1000-1059	6.03	25.8	219	
	1100-1159	6.80	27.6	213	61
	1200-1259	7.74	29.3	206	
	1300-1327	9.01	29.5	204	
	Average	**5.59**	**23.9**	**226**	**69**
7/27/98	0722-0759	2.74	22.0	135	70
	0800-0859	4.27	22.7	213	
	0900-0959	6.33	26.9	231	
	1000-1059	6.13	29.1	223	
	1100-1159	6.63	31.9	219	
	1200-1202	8.00	33.9	198	
	Average	**5.68**	**27.7**	**203**	**70**

* Degrees clockwise from north (e.g. 180° = wind from the south)



Run 1 - Average wind direction on July 24, 1998 (202°)
Run 2 - Average wind direction on July 25, 1998 (226°)
Run 3 - Average wind direction on July 27, 1998 (203°)

Figure M.1 Load-out Tunnel and MET Station Location and Average Wind Direction.

HOT MIX ASPHALT
LOS ANGELES - PLANT C
7-24-98

Time	MPH	°C	Direction (°)
0646-0700	3.0	17.7	173
0701-0800	3.4	18.0	184
0801-0812	4.0	18.1	151
0931-1000	3.7	22.6	228
1001-1100	4.1	21.3	224
1101-1200	6.1	23.0	233
1201-1300	7.6	25.2	219

RAW Data

Time	MPH	°C	Direction (°)
6:46:00 AM	2.5	10.8	99
6:47:00 AM	4.5	18.0	139
6:48:00 AM	3.2	18.3	120
6:49:00 AM	2.5	18.4	130
6:50:00 AM	2.6	18.4	160
6:51:00 AM	3.3	18.3	191
6:52:00 AM	3.6	18.2	168
6:53:00 AM	4.1	18.2	158
6:54:00 AM	2.6	18.1	173
6:55:00 AM	2.0	18.2	142
6:56:00 AM	1.6	18.2	210
6:57:00 AM	2.4	18.3	221
6:58:00 AM	3.4	18.1	229
6:59:00 AM	3.3	18.2	232
7:00:00 AM	3.7	18.0	228
7:01:00 AM	2.9	18.1	206
7:02:00 AM	2.8	18.2	231
7:03:00 AM	3.5	18.1	229
7:04:00 AM	2.8	18.1	232
7:05:00 AM	3.0	18.2	226
7:06:00 AM	3.4	18.1	211
7:07:00 AM	3.5	18.1	207
7:08:00 AM	3.1	18.0	200
7:09:00 AM	2.5	18.0	161
7:10:00 AM	2.8	18.0	150
7:11:00 AM	3.0	18.0	151
7:12:00 AM	2.4	18.0	162
7:13:00 AM	3.1	18.0	158
7:14:00 AM	4.1	17.9	149
7:15:00 AM	4.1	17.9	129
7:16:00 AM	4.0	17.9	132
7:17:00 AM	2.6	17.9	171
7:18:00 AM	3.4	17.9	199
7:19:00 AM	3.3	17.9	206
7:20:00 AM	3.2	18.0	211
7:21:00 AM	2.8	18.1	220
7:22:00 AM	3.8	17.9	234
7:23:00 AM	3.1	18.0	216
7:24:00 AM	2.9	18.2	208
7:25:00 AM	4.0	18.1	205
7:26:00 AM	3.8	18.1	207
7:27:00 AM	3.2	18.1	226
7:28:00 AM	3.1	18.1	221
7:29:00 AM	2.5	18.3	206
7:30:00 AM	3.2	18.3	208
7:31:00 AM	2.7	18.1	200
7:32:00 AM	2.6	18.1	211

93

7:33:00 AM	3.2	18.1	231
7:34:00 AM	3.1	18.1	217
7:35:00 AM	3.3	18.1	219
7:36:00 AM	3.2	17.9	208
7:37:00 AM	3.8	18.0	207
7:38:00 AM	4.1	18.1	205
7:39:00 AM	3.3	18.0	207
7:40:00 AM	2.8	18.2	219
7:41:00 AM	2.6	18.3	209
7:42:00 AM	3.5	18.1	185
7:43:00 AM	3.0	18.0	175
7:44:00 AM	3.3	17.9	168
7:45:00 AM	2.5	18.0	193
7:46:00 AM	2.3	18.2	177
7:47:00 AM	3.4	18.0	140
7:48:00 AM	4.4	17.9	130
7:49:00 AM	3.3	18.0	134
7:50:00 AM	3.5	18.0	137
7:51:00 AM	4.1	18.1	130
7:52:00 AM	4.5	18.1	136
7:53:00 AM	4.2	18.0	148
7:54:00 AM	3.9	18.0	144
7:55:00 AM	5.1	17.9	142
7:56:00 AM	4.4	17.9	139
7:57:00 AM	3.7	17.9	141
7:58:00 AM	3.7	18.0	143
7:59:00 AM	4.1	18.0	141
8:00:00 AM	3.6	18.0	146
8:01:00 AM	3.5	18.1	149
8:02:00 AM	2.7	18.2	161
8:03:00 AM	3.2	18.1	163
8:04:00 AM	4.1	18.1	145
8:05:00 AM	4.3	18.0	142
8:06:00 AM	2.8	18.1	150
8:07:00 AM	4.3	18.1	172
8:08:00 AM	4.1	18.0	169
8:09:00 AM	4.3	18.0	161
8:10:00 AM	4.6	18.0	135
8:11:00 AM	4.9	18.1	126
8:12:00 AM	4.9	18.1	144
8:13:00 AM	0.5	-11.4	16
9:31:00 AM	2.0	81.1	250
9:32:00 AM	1.2	21.6	244
9:33:00 AM	1.4	21.6	113
9:34:00 AM	1.8	21.5	119
9:35:00 AM	2.3	21.7	156
9:36:00 AM	3.5	21.4	142
9:37:00 AM	3.2	21.0	188
9:38:00 AM	3.3	20.7	208

9:39:00 AM	3.0	20.6	191
9:40:00 AM	3.7	20.8	260
9:41:00 AM	4.5	20.9	271
9:42:00 AM	3.9	20.8	272
9:43:00 AM	4.2	20.5	240
9:44:00 AM	4.0	20.2	232
9:45:00 AM	3.6	20.2	297
9:46:00 AM	4.1	20.2	266
9:47:00 AM	4.4	20.3	255
9:48:00 AM	5.8	20.1	231
9:49:00 AM	3.7	20.3	251
9:50:00 AM	2.8	20.5	237
9:51:00 AM	4.4	20.0	204
9:52:00 AM	6.4	19.9	232
9:53:00 AM	5.6	19.8	245
9:54:00 AM	5.2	19.9	260
9:55:00 AM	5.2	20.0	268
9:56:00 AM	4.3	20.2	265
9:57:00 AM	3.6	20.5	281
9:58:00 AM	3.2	20.4	240
9:59:00 AM	3.6	19.9	222
10:00:00 AM	3.5	20.0	208
10:01:00 AM	5.9	19.7	202
10:02:00 AM	4.9	19.8	214
10:03:00 AM	4.9	20.1	236
10:04:00 AM	2.8	20.3	248
10:05:00 AM	4.3	20.1	219
10:06:00 AM	4.0	20.3	232
10:07:00 AM	4.9	20.2	228
10:08:00 AM	4.0	20.5	269
10:09:00 AM	3.3	20.6	223
10:10:00 AM	3.0	20.5	198
10:11:00 AM	1.8	20.8	209
10:12:00 AM	4.0	20.5	224
10:13:00 AM	4.8	20.2	215
10:14:00 AM	2.9	20.6	217
10:15:00 AM	3.9	20.8	252
10:16:00 AM	3.7	20.9	231
10:17:00 AM	1.9	21.2	221
10:18:00 AM	2.0	21.3	194
10:19:00 AM	1.7	21.7	141
10:20:00 AM	1.4	21.8	136
10:21:00 AM	3.8	21.1	197
10:22:00 AM	3.3	20.8	207
10:23:00 AM	2.2	21.3	220
10:24:00 AM	4.3	21.4	263
10:25:00 AM	4.1	21.4	316
10:26:00 AM	3.7	21.2	280
10:27:00 AM	6.4	20.9	326

10:28:00 AM	5.4	21.1	310
10:29:00 AM	2.0	21.5	165
10:30:00 AM	1.5	21.9	134
10:31:00 AM	2.7	22.0	220
10:32:00 AM	6.3	22.0	312
10:33:00 AM	5.3	22.0	315
10:34:00 AM	3.1	21.9	285
10:35:00 AM	3.1	22.0	312
10:36:00 AM	2.6	22.4	300
10:37:00 AM	3.3	22.4	258
10:38:00 AM	5.2	21.5	234
10:39:00 AM	6.3	21.1	211
10:40:00 AM	4.8	21.1	205
10:41:00 AM	6.0	21.1	152
10:42:00 AM	3.7	21.4	215
10:43:00 AM	5.5	21.5	255
10:44:00 AM	4.7	22.1	237
10:45:00 AM	5.4	21.6	224
10:46:00 AM	4.5	21.6	209
10:47:00 AM	5.1	21.4	186
10:48:00 AM	4.1	21.4	170
10:49:00 AM	4.3	21.6	213
10:50:00 AM	5.7	21.7	223
10:51:00 AM	3.1	22.6	274
10:52:00 AM	5.6	21.9	230
10:53:00 AM	5.4	21.7	198
10:54:00 AM	5.1	21.5	181
10:55:00 AM	3.8	21.5	192
10:56:00 AM	3.9	22.0	174
10:57:00 AM	3.3	22.7	144
10:58:00 AM	4.0	22.6	195
10:59:00 AM	6.6	21.8	187
11:00:00 AM	3.9	22.2	172
11:01:00 AM	6.0	22.0	204
11:02:00 AM	7.9	21.8	227
11:03:00 AM	6.7	22.2	270
11:04:00 AM	5.1	22.7	255
11:05:00 AM	4.0	22.4	192
11:06:00 AM	4.4	22.1	201
11:07:00 AM	4.7	22.2	189
11:08:00 AM	4.4	22.4	223
11:09:00 AM	6.4	22.5	244
11:10:00 AM	5.0	23.2	255
11:11:00 AM	6.1	23.1	256
11:12:00 AM	4.5	22.8	229
11:13:00 AM	3.9	23.3	206
11:14:00 AM	5.8	23.2	253
11:15:00 AM	4.2	23.5	212
11:16:00 AM	7.5	22.2	199

11:17:00 AM	6.6	22.1	232
11:18:00 AM	4.8	22.4	209
11:19:00 AM	5.8	23.0	232
11:20:00 AM	5.4	23.6	258
11:21:00 AM	6.4	22.8	206
11:22:00 AM	4.1	22.7	188
11:23:00 AM	5.9	22.5	209
11:24:00 AM	4.5	23.2	180
11:25:00 AM	4.4	24.0	185
11:26:00 AM	9.4	23.6	260
11:27:00 AM	7.3	23.5	260
11:28:00 AM	5.3	23.7	256
11:29:00 AM	7.7	23.2	238
11:30:00 AM	6.9	23.4	280
11:31:00 AM	5.5	23.6	251
11:32:00 AM	4.8	24.6	246
11:33:00 AM	7.6	23.9	244
11:34:00 AM	8.4	23.6	272
11:35:00 AM	5.5	23.8	270
11:36:00 AM	4.0	24.8	261
11:37:00 AM	5.6	23.4	215
11:38:00 AM	7.0	22.5	227
11:39:00 AM	9.2	21.1	221
11:40:00 AM	6.3	20.8	209
11:41:00 AM	5.4	20.9	211
11:42:00 AM	6.7	21.5	191
11:43:00 AM	6.4	21.8	190
11:44:00 AM	6.5	21.9	209
11:45:00 AM	6.4	21.8	227
11:46:00 AM	5.6	22.9	255
11:47:00 AM	7.9	22.3	260
11:48:00 AM	8.0	21.1	251
11:49:00 AM	5.7	22.6	298
11:50:00 AM	7.8	22.7	262
11:51:00 AM	6.9	23.7	253
11:52:00 AM	4.9	25.0	263
11:53:00 AM	6.8	24.6	290
11:54:00 AM	4.1	25.0	169
11:55:00 AM	8.1	23.8	207
11:56:00 AM	8.7	23.9	248
11:57:00 AM	7.7	24.8	261
11:58:00 AM	7.2	24.8	253
11:59:00 AM	5.7	24.2	228
12:00:00 PM	5.9	24.6	237
12:01:00 PM	7.4	24.0	200
12:02:00 PM	6.1	24.9	226
12:03:00 PM	5.8	24.8	259
12:04:00 PM	5.7	25.0	238
12:05:00 PM	8.2	23.9	191

12:06:00 PM	7.2	24.2	204
12:07:00 PM	9.5	24.6	256
12:08:00 PM	7.3	25.0	255
12:09:00 PM	8.0	25.3	270
12:10:00 PM	6.4	25.2	233
12:11:00 PM	8.2	23.9	212
12:12:00 PM	11.5	23.3	200
12:13:00 PM	8.0	23.6	190
12:14:00 PM	7.6	24.0	221
12:15:00 PM	6.9	24.0	202
12:16:00 PM	7.3	24.1	207
12:17:00 PM	9.9	23.6	199
12:18:00 PM	7.3	24.8	226
12:19:00 PM	10.8	24.4	244
12:20:00 PM	5.4	25.3	252
12:21:00 PM	6.4	24.7	195
12:22:00 PM	7.9	25.5	266
12:23:00 PM	8.9	25.4	301
12:24:00 PM	7.6	24.9	214
12:25:00 PM	7.8	24.9	277
12:26:00 PM	10.0	24.7	243
12:27:00 PM	7.3	25.4	246
12:28:00 PM	7.0	25.5	213
12:29:00 PM	6.8	25.4	191
12:30:00 PM	5.6	26.0	165
12:31:00 PM	6.9	25.4	197
12:32:00 PM	6.3	25.4	171
12:33:00 PM	9.1	24.8	200
12:34:00 PM	9.2	24.3	181
12:35:00 PM	7.2	25.5	158
12:36:00 PM	9.0	25.3	200
12:37:00 PM	7.6	25.0	186
12:38:00 PM	8.9	24.7	190
12:39:00 PM	5.6	25.4	230
12:40:00 PM	7.0	25.7	217
12:41:00 PM	5.6	25.9	171
12:42:00 PM	6.8	25.6	199
12:43:00 PM	6.9	25.7	224
12:44:00 PM	7.0	26.2	252
12:45:00 PM	6.0	26.2	213
12:46:00 PM	7.0	25.6	195
12:47:00 PM	5.7	25.6	204
12:48:00 PM	6.5	25.5	209
12:49:00 PM	9.9	25.0	208
12:50:00 PM	9.0	24.9	192
12:51:00 PM	6.3	25.9	182
12:52:00 PM	9.4	25.4	193
12:53:00 PM	12.4	24.8	217
12:54:00 PM	10.0	25.9	290

12:55:00 PM	5.5	26.6	268
12:56:00 PM	7.9	26.7	266
12:57:00 PM	8.5	27.1	262
12:58:00 PM	6.0	26.9	226
12:59:00 PM	5.0	26.9	234
1:00:00 PM	9.5	25.9	195
1:01:00 PM	9.6	25.7	202
1:02:00 PM	9.1	25.4	192
1:03:00 PM	8.1	26.1	232
1:04:00 PM	7.4	26.3	208
1:05:00 PM	8.1	25.6	194
1:06:00 PM	7.9	25.3	209
1:07:00 PM	7.4	26.4	253
1:08:00 PM	8.5	26.2	196
1:09:00 PM	7.2	26.6	242
1:10:00 PM	4.5	27.8	177
1:11:00 PM	8.1	26.3	211
1:12:00 PM	9.8	25.8	213
1:13:00 PM	10.9	25.8	238
1:14:00 PM	7.9	26.7	282
1:15:00 PM	9.0	26.9	261
1:16:00 PM	6.0	26.9	233
1:17:00 PM	6.6	26.3	200
1:18:00 PM	7.3	26.2	201
1:19:00 PM	3.6	129.2	110
1:20:00 PM	-0.1	211.9	-1
1:21:00 PM	0.0	192.6	-1
1:22:00 PM	0.0	201.8	0
1:23:00 PM	0.0	212.3	0
1:24:00 PM	0.0	217.1	0
1:24:12 PM	0.0	42.0	0

HOT MIX ASPHALT
LOS ANGELES - PLANT C
7-25-98

Time	MPH	°C	Direction (°)
0548-0559	3.2	19.1	280.8
0600-0659	2.9	19.8	218.0
0700-0759	4.1	20.1	261.9
0800-0859	5.0	21.0	225.4
0900-0959	5.5	23.4	205.7
1000-1059	6.0	25.8	218.6
1100-1159	6.8	27.6	212.8
1200-1259	7.7	29.3	206.1
1300-1327	9.0	29.5	204.3

Raw Data

Time	MPH	°C	Direction (°)
5:48:00 AM	4.6	18.3	321
5:49:00 AM	3.4	18.4	318
5:50:00 AM	3.2	18.6	312
5:51:00 AM	3.6	18.8	309
5:52:00 AM	3.7	18.9	323
5:53:00 AM	4.2	19	322
5:54:00 AM	5.1	19	321
5:55:00 AM	2.5	19.1	198
5:56:00 AM	1.9	19.4	260
5:57:00 AM	3	19.6	260
5:58:00 AM	2	19.8	227
5:59:00 AM	1.6	19.7	199
6:00:00 AM	1.6	19.7	175
6:01:00 AM	2.8	19.9	264
6:02:00 AM	2.7	20	264
6:03:00 AM	3.8	19.6	293
6:04:00 AM	2.5	19.6	231
6:05:00 AM	2.8	19.8	256
6:06:00 AM	2.3	19.9	178
6:07:00 AM	1.9	19.9	141
6:08:00 AM	2.3	19.9	171
6:09:00 AM	3.2	19.9	168
6:10:00 AM	2.5	19.9	278
6:11:00 AM	2.7	20	237
6:12:00 AM	2.6	20	274
6:13:00 AM	2.1	20	282
6:14:00 AM	2.5	19.9	253
6:15:00 AM	2.4	20	225
6:16:00 AM	2.4	20	243
6:17:00 AM	2.5	20.1	198
6:18:00 AM	3.7	20.1	206
6:19:00 AM	3.9	20.1	198
6:20:00 AM	3.1	20	240
6:21:00 AM	3	20.1	269
6:22:00 AM	3.1	19.9	279
6:23:00 AM	2.3	19.9	209
6:24:00 AM	2.5	19.9	232
6:25:00 AM	4	19.6	299
6:26:00 AM	4.4	19.3	320
6:27:00 AM	2.8	19.3	286
6:28:00 AM	3.1	19.2	291
6:29:00 AM	2.7	19.4	194
6:30:00 AM	4.1	19.5	165
6:31:00 AM	3.2	19.7	163
6:32:00 AM	5.5	19.7	140
6:33:00 AM	4.9	19.8	104
6:34:00 AM	5	19.6	64
6:35:00 AM	3.2	19.6	153

6:36:00 AM	2.6	19.8	172
6:37:00 AM	2.4	19.9	166
6:38:00 AM	2.2	19.9	236
6:39:00 AM	2.8	19.7	309
6:40:00 AM	2.3	19.9	248
6:41:00 AM	1.7	19.9	235
6:42:00 AM	2.3	19.9	289
6:43:00 AM	4	19.7	275
6:44:00 AM	3.7	19.7	188
6:45:00 AM	4.3	19.7	51
6:46:00 AM	2.5	19.8	301
6:47:00 AM	1.8	19.7	151
6:48:00 AM	2.3	19.6	85
6:49:00 AM	1.4	19.8	178
6:50:00 AM	2.5	19.8	265
6:51:00 AM	2.8	19.7	291
6:52:00 AM	1.9	19.8	114
6:53:00 AM	3.2	19.8	310
6:54:00 AM	3.9	19.7	321
6:55:00 AM	3.7	19.8	297
6:56:00 AM	2.6	19.9	138
6:57:00 AM	2.5	20	94
6:58:00 AM	2.4	20.1	155
6:59:00 AM	2.6	20.3	270
7:00:00 AM	3.4	20	287
7:01:00 AM	3.1	20	272
7:02:00 AM	3.5	19.9	272
7:03:00 AM	3.9	19.9	312
7:04:00 AM	2.8	19.9	280
7:05:00 AM	2.2	19.9	261
7:06:00 AM	3.3	19.7	241
7:07:00 AM	4.2	19.7	288
7:08:00 AM	3.3	19.7	296
7:09:00 AM	5.4	19.9	296
7:10:00 AM	5.2	19.8	272
7:11:00 AM	5.5	19.6	258
7:12:00 AM	5.6	19.6	281
7:13:00 AM	4.8	19.6	270
7:14:00 AM	5.7	19.7	284
7:15:00 AM	4.4	19.8	284
7:16:00 AM	5.4	19.9	282
7:17:00 AM	5.3	19.8	295
7:18:00 AM	4.6	19.9	290
7:19:00 AM	3.4	19.8	267
7:20:00 AM	4.7	19.9	261
7:21:00 AM	3.8	19.8	276
7:22:00 AM	4.1	20	300
7:23:00 AM	4.2	20	286
7:24:00 AM	3.7	19.9	259

102

7:25:00 AM	3	20	274
7:26:00 AM	3.2	20.1	260
7:27:00 AM	5.5	19.9	313
7:28:00 AM	3.5	19.8	314
7:29:00 AM	2.6	19.8	272
7:30:00 AM	5.5	19.6	237
7:31:00 AM	5.2	19.8	271
7:32:00 AM	4.8	19.9	289
7:33:00 AM	4.2	20.1	288
7:34:00 AM	3.9	20.1	266
7:35:00 AM	4.1	20	271
7:36:00 AM	3.2	20.1	280
7:37:00 AM	4.2	20.1	299
7:38:00 AM	3.8	20.1	311
7:39:00 AM	6.2	20.1	289
7:40:00 AM	4.8	20.2	282
7:41:00 AM	4.5	20.2	265
7:42:00 AM	4.2	20	230
7:43:00 AM	5.1	19.9	232
7:44:00 AM	3.4	20	238
7:45:00 AM	4	20	223
7:46:00 AM	5	20.1	234
7:47:00 AM	5.2	19.9	244
7:48:00 AM	4.2	20	230
7:49:00 AM	4.1	20.2	261
7:50:00 AM	4.2	20.3	234
7:51:00 AM	3.8	20.3	253
7:52:00 AM	2.3	20.6	195
7:53:00 AM	1.8	20.9	111
7:54:00 AM	3.4	20.8	57
7:55:00 AM	2.1	21	161
7:56:00 AM	3.5	21.2	310
7:57:00 AM	4.4	21	253
7:58:00 AM	4.3	20.8	249
7:59:00 AM	4.4	20.7	248
8:00:00 AM	3.4	20.6	250
8:01:00 AM	4.8	20.8	265
8:02:00 AM	3.1	20.7	258
8:03:00 AM	3.7	21	290
8:04:00 AM	4	21.1	261
8:05:00 AM	5.2	20.6	253
8:06:00 AM	3.4	20.8	242
8:07:00 AM	3.2	20.7	215
8:08:00 AM	5.4	20.7	242
8:09:00 AM	5.3	20.5	244
8:10:00 AM	5.2	20.8	231
8:11:00 AM	4.9	20.5	259
8:12:00 AM	6.9	20.6	249
8:13:00 AM	6.1	20.4	239

8:14:00 AM	6.3	20.4	243
8:15:00 AM	6.6	20	235
8:16:00 AM	6.1	20.2	249
8:17:00 AM	4.8	20.6	265
8:18:00 AM	3.4	20.9	263
8:19:00 AM	3.3	20.9	203
8:20:00 AM	4.8	20.6	212
8:21:00 AM	3.5	20.8	235
8:22:00 AM	4	21.1	236
8:23:00 AM	5.3	21.1	209
8:24:00 AM	4.3	21	198
8:25:00 AM	3.8	20.9	204
8:26:00 AM	4.5	20.8	218
8:27:00 AM	4.6	20.7	196
8:28:00 AM	5.8	20.5	200
8:29:00 AM	5.8	20.6	216
8:30:00 AM	6.6	20.7	265
8:31:00 AM	7.3	20.5	260
8:32:00 AM	6.5	20.5	249
8:33:00 AM	6.8	20.4	259
8:34:00 AM	5.6	20.5	232
8:35:00 AM	5.3	20.5	208
8:36:00 AM	5.8	20.2	230
8:37:00 AM	5.6	20.2	205
8:38:00 AM	5.6	20.3	218
8:39:00 AM	4.8	20.4	204
8:40:00 AM	5.2	20.2	184
8:41:00 AM	3.8	20.4	178
8:42:00 AM	5	20.4	181
8:43:00 AM	4	20.8	174
8:44:00 AM	5.5	21	192
8:45:00 AM	4.4	21.5	172
8:46:00 AM	6.5	21.9	128
8:47:00 AM	5	22.6	132
8:48:00 AM	3.9	22.6	161
8:49:00 AM	2.5	23.1	172
8:50:00 AM	4.1	22.6	250
8:51:00 AM	6.4	22.5	292
8:52:00 AM	5.3	22.1	239
8:53:00 AM	6.4	21.7	238
8:54:00 AM	5.9	21.8	253
8:55:00 AM	4.6	22.6	256
8:56:00 AM	2.5	22.7	222
8:57:00 AM	4.9	21.7	215
8:58:00 AM	5.8	21.5	235
8:59:00 AM	4.4	22.1	242
9:00:00 AM	3.8	22.4	237
9:01:00 AM	3.8	22	172
9:02:00 AM	3	22.4	186

9:03:00 AM	3	22.5	165
9:04:00 AM	2.7	22.9	137
9:05:00 AM	2	23.5	138
9:06:00 AM	1.5	24	143
9:07:00 AM	3	24.3	122
9:08:00 AM	4.2	23.7	147
9:09:00 AM	3.9	22.8	170
9:10:00 AM	3.7	23.7	141
9:11:00 AM	4.2	23.4	163
9:12:00 AM	5.6	23	271
9:13:00 AM	3.7	23.4	266
9:14:00 AM	5.8	22.4	234
9:15:00 AM	2.9	23.3	234
9:16:00 AM	4.8	23	234
9:17:00 AM	5.4	23	181
9:18:00 AM	7	22	198
9:19:00 AM	5.8	21.8	199
9:20:00 AM	6.9	21.9	206
9:21:00 AM	7.8	21.7	194
9:22:00 AM	7.5	21.7	205
9:23:00 AM	3.8	22.4	198
9:24:00 AM	4.3	23.1	204
9:25:00 AM	6.6	22.7	226
9:26:00 AM	7.5	22.2	195
9:27:00 AM	7.3	22	187
9:28:00 AM	6.1	22.3	187
9:29:00 AM	5.3	22.9	189
9:30:00 AM	7.3	22.6	189
9:31:00 AM	6.9	22.7	188
9:32:00 AM	8.4	22.6	201
9:33:00 AM	8	22.6	201
9:34:00 AM	9.1	22.3	204
9:35:00 AM	7	22.6	187
9:36:00 AM	6.5	23	215
9:37:00 AM	5.9	23.6	240
9:38:00 AM	4.7	24.1	243
9:39:00 AM	5.8	23.1	213
9:40:00 AM	6.5	23.1	209
9:41:00 AM	5.9	24.3	209
9:42:00 AM	6.5	25	262
9:43:00 AM	3.9	26.2	274
9:44:00 AM	6.3	26.2	255
9:45:00 AM	6.1	25.9	283
9:46:00 AM	6.3	25.3	232
9:47:00 AM	4.4	25.5	219
9:48:00 AM	5.8	24.9	197
9:49:00 AM	5	24.6	204
9:50:00 AM	5.6	24.8	225
9:51:00 AM	7.3	23.9	201

9:52:00 AM	6.7	24.5	221
9:53:00 AM	5.4	24.3	219
9:54:00 AM	6.9	24.2	236
9:55:00 AM	5.5	24.5	249
9:56:00 AM	6.8	24.5	217
9:57:00 AM	7.1	23.9	210
9:58:00 AM	5	23.9	209
9:59:00 AM	6.2	24	198
10:00:00 AM	4.5	24.7	224
10:01:00 AM	6.9	24.2	193
10:02:00 AM	6.7	24	221
10:03:00 AM	5.4	24.4	220
10:04:00 AM	4	24.9	257
10:05:00 AM	4	25.5	219
10:06:00 AM	6.8	24.2	189
10:07:00 AM	3.4	24.7	205
10:08:00 AM	7.4	24.5	215
10:09:00 AM	7.9	24.9	250
10:10:00 AM	6.8	24.7	244
10:11:00 AM	5.9	24.6	226
10:12:00 AM	6.1	25.1	253
10:13:00 AM	5.4	24.8	179
10:14:00 AM	4	25.4	212
10:15:00 AM	5.2	25.1	216
10:16:00 AM	6.1	25.6	277
10:17:00 AM	3.2	26.5	208
10:18:00 AM	4.2	26.2	186
10:19:00 AM	6.2	25	203
10:20:00 AM	5.9	24.8	204
10:21:00 AM	5.3	24.9	226
10:22:00 AM	4.5	25.8	228
10:23:00 AM	6.3	24.9	220
10:24:00 AM	8.5	25	218
10:25:00 AM	8.5	23.9	190
10:26:00 AM	5.8	25	173
10:27:00 AM	8.7	23.5	193
10:28:00 AM	5.8	24.8	180
10:29:00 AM	6.8	26	200
10:30:00 AM	7.5	26.1	199
10:31:00 AM	5.4	27	206
10:32:00 AM	8	26.6	207
10:33:00 AM	7.3	26.6	213
10:34:00 AM	5.6	26.6	198
10:35:00 AM	5.3	26.7	192
10:36:00 AM	6.5	26.5	206
10:37:00 AM	9	26.4	235
10:38:00 AM	7.6	27	265
10:39:00 AM	6.4	26.6	266
10:40:00 AM	4.2	26.8	244

10:41:00 AM	8.1	26.2	202
10:42:00 AM	6.2	25.8	207
10:43:00 AM	6.1	25.9	203
10:44:00 AM	6.7	25.8	204
10:45:00 AM	8.5	26.2	243
10:46:00 AM	4.1	27.4	274
10:47:00 AM	5.8	26.8	206
10:48:00 AM	7.3	25.6	187
10:49:00 AM	5	25.9	191
10:50:00 AM	5.8	26	205
10:51:00 AM	6.5	26	202
10:52:00 AM	7.4	25.7	191
10:53:00 AM	5.1	26.1	191
10:54:00 AM	2.7	27.9	178
10:55:00 AM	3.8	28.5	263
10:56:00 AM	7.2	27.4	306
10:57:00 AM	5.4	27.4	255
10:58:00 AM	5.6	27.8	275
10:59:00 AM	5.6	28.3	273
11:00:00 AM	3.6	27.8	282
11:01:00 AM	5.9	26.7	216
11:02:00 AM	6.7	26.1	206
11:03:00 AM	8.1	25.5	186
11:04:00 AM	6.2	26.8	161
11:05:00 AM	6.7	27.1	232
11:06:00 AM	5.8	27	232
11:07:00 AM	4.6	27.1	227
11:08:00 AM	6.4	26.8	229
11:09:00 AM	6.6	26.5	216
11:10:00 AM	4.2	26.7	198
11:11:00 AM	6.7	27.1	231
11:12:00 AM	6	26.8	199
11:13:00 AM	6.1	27	218
11:14:00 AM	8.4	26.3	204
11:15:00 AM	9.4	26.8	244
11:16:00 AM	7.5	27.2	239
11:17:00 AM	7.7	26.6	200
11:18:00 AM	6.1	26.6	198
11:19:00 AM	6.3	27.2	193
11:20:00 AM	8.2	26.5	191
11:21:00 AM	8.2	26.5	204
11:22:00 AM	5.7	27.4	221
11:23:00 AM	7.4	28	249
11:24:00 AM	5.2	28.5	231
11:25:00 AM	5.7	28.1	197
11:26:00 AM	7.7	27.7	212
11:27:00 AM	8.1	27.1	195
11:28:00 AM	9.6	27.2	230
11:29:00 AM	7.2	28.1	251

11:30:00 AM	6.2	28.2	265
11:31:00 AM	4.7	28.9	223
11:32:00 AM	7.8	27.5	210
11:33:00 AM	10.3	27.9	246
11:34:00 AM	5.9	28.4	259
11:35:00 AM	6.9	28.1	225
11:36:00 AM	6.1	27.7	211
11:37:00 AM	6.9	27.6	185
11:38:00 AM	10	27.1	185
11:39:00 AM	7.6	27.5	206
11:40:00 AM	5.9	28.2	222
11:41:00 AM	4.2	29.2	210
11:42:00 AM	7.3	27.9	194
11:43:00 AM	6.3	27.7	185
11:44:00 AM	5.6	28.6	186
11:45:00 AM	6.4	28.2	208
11:46:00 AM	5.4	28.4	196
11:47:00 AM	8.4	28.2	191
11:48:00 AM	7.1	27.9	235
11:49:00 AM	7.6	28.2	225
11:50:00 AM	8.1	28.5	233
11:51:00 AM	6.4	28.3	210
11:52:00 AM	6.3	28.6	206
11:53:00 AM	7.7	28.3	163
11:54:00 AM	7.7	27.8	197
11:55:00 AM	7.7	27.8	203
11:56:00 AM	5.4	28.4	211
11:57:00 AM	7.5	28.4	217
11:58:00 AM	7.8	28	185
11:59:00 AM	4.6	29.1	182
12:00:00 PM	4.5	29.4	236
12:01:00 PM	4	29.5	191
12:02:00 PM	8	28.6	205
12:03:00 PM	7	28.2	217
12:04:00 PM	4.9	29.1	187
12:05:00 PM	6.6	28.7	206
12:06:00 PM	6.8	28.6	193
12:07:00 PM	7.5	28.5	206
12:08:00 PM	6.1	28.8	203
12:09:00 PM	7.6	28.7	212
12:10:00 PM	6.5	28.8	195
12:11:00 PM	8.4	28.5	233
12:12:00 PM	6.9	28.4	193
12:13:00 PM	7.5	28.5	192
12:14:00 PM	5.5	28.8	216
12:15:00 PM	5.9	29.4	208
12:16:00 PM	8.3	29.2	219
12:17:00 PM	6.9	28.7	198
12:18:00 PM	7.3	29	206

12:19:00 PM	7.1	29	206
12:20:00 PM	7	29	194
12:21:00 PM	8.7	29.1	194
12:22:00 PM	7.3	29.4	246
12:23:00 PM	6.2	30.1	243
12:24:00 PM	8	29.7	221
12:25:00 PM	8.4	30.3	253
12:26:00 PM	7.8	30.5	252
12:27:00 PM	7.6	29.6	236
12:28:00 PM	5.4	30.1	244
12:29:00 PM	8.9	29.5	210
12:30:00 PM	7.6	29	210
12:31:00 PM	8.5	29.2	222
12:32:00 PM	9.6	28.6	199
12:33:00 PM	8.6	28.9	189
12:34:00 PM	8.3	28.7	196
12:35:00 PM	8.1	29.1	165
12:36:00 PM	7.6	29.6	188
12:37:00 PM	7.5	29.9	195
12:38:00 PM	10.2	29.6	165
12:39:00 PM	9.6	29	186
12:40:00 PM	9.8	29.3	209
12:41:00 PM	5.6	30.3	203
12:42:00 PM	9.2	29.7	195
12:43:00 PM	8.3	29.3	192
12:44:00 PM	7.8	29.5	191
12:45:00 PM	7.9	29.6	200
12:46:00 PM	7.2	30	180
12:47:00 PM	9.4	29.4	194
12:48:00 PM	7.9	29.8	182
12:49:00 PM	9.9	29.4	223
12:50:00 PM	9	29.8	213
12:51:00 PM	6.9	29.9	213
12:52:00 PM	8.9	29.3	195
12:53:00 PM	7.9	29.7	184
12:54:00 PM	8.6	29.8	195
12:55:00 PM	9.1	30	218
12:56:00 PM	8.6	29.9	231
12:57:00 PM	9.6	30.1	227
12:58:00 PM	8.7	29.8	201
12:59:00 PM	9.7	29.4	189
1:00:00 PM	8.1	29.8	222
1:01:00 PM	7.6	30	216
1:02:00 PM	9.1	29.3	207
1:03:00 PM	8.6	30.1	186
1:04:00 PM	9.4	29.3	200
1:05:00 PM	9.6	29.6	206
1:06:00 PM	11.8	29	198
1:07:00 PM	7.5	29.6	215

1:08:00 PM	8.9	29.4	211
1:09:00 PM	9.4	29.2	211
1:10:00 PM	7.9	29.2	190
1:11:00 PM	9.1	29.3	215
1:12:00 PM	10.7	29	194
1:13:00 PM	8.3	29.7	178
1:14:00 PM	9.5	29.6	216
1:15:00 PM	10.9	28.8	192
1:16:00 PM	6.8	29.7	172
1:17:00 PM	7	30	205
1:18:00 PM	7.7	30.1	236
1:19:00 PM	8.8	29.9	205
1:20:00 PM	10.2	29.6	192
1:21:00 PM	9.5	29.6	219
1:22:00 PM	10.8	29.3	235
1:23:00 PM	9.3	29.6	231
1:24:00 PM	9.3	28.8	193
1:25:00 PM	7.7	29.3	199
1:26:00 PM	8.5	29.4	198
1:27:00 PM	10.2	29.1	190
1:27:00 PM	9.2	29.1	192

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HOT MIX ASPHALT
LOS ANGELES - PLANT C
7-27-98

Time	MPH	°C	Direction (°)
0722-0759	2.7	22.0	135
0800-0859	4.3	22.7	213
0900-0959	6.3	26.9	231
1000-1059	6.1	29.1	223
1100-1159	6.6	31.9	219
1200-1202	8.0	33.9	198

///

Raw Data

Time	MPH	°C	Direction (°)
7:22:00 AM	2.0	20.3	128
7:23:00 AM	2.0	20.2	125
7:24:00 AM	2.0	20.3	196
7:25:00 AM	2.0	20.7	112
7:26:00 AM	2.0	20.9	181
7:27:00 AM	2.0	21.0	196
7:28:00 AM	3.0	20.5	187
7:29:00 AM	3.0	21.1	116
7:30:00 AM	3.0	21.7	116
7:31:00 AM	3.0	22.0	73
7:32:00 AM	2.0	22.2	135
7:33:00 AM	2.0	22.7	176
7:34:00 AM	2.0	22.9	117
7:35:00 AM	2.0	23.1	92
7:36:00 AM	3.0	23.3	121
7:37:00 AM	3.0	23.5	66
7:38:00 AM	2.0	24.0	79
7:39:00 AM	3.0	24.1	108
7:40:00 AM	3.0	24.2	79
7:41:00 AM	3.0	24.4	68
7:42:00 AM	3.0	24.1	80
7:43:00 AM	3.0	23.7	66
7:44:00 AM	3.0	22.6	59
7:45:00 AM	3.0	21.5	98
7:46:00 AM	3.0	21.0	71
7:47:00 AM	2.0	21.0	188
7:48:00 AM	2.0	20.9	155
7:49:00 AM	2.0	20.7	167
7:50:00 AM	2.0	20.4	135
7:51:00 AM	3.0	20.9	108
7:52:00 AM	4.0	21.2	142
7:53:00 AM	4.0	21.2	153
7:54:00 AM	3.0	21.5	170
7:55:00 AM	3.0	21.7	204
7:56:00 AM	3.0	22.1	219
7:57:00 AM	4.0	22.3	220
7:58:00 AM	4.0	22.3	211
7:59:00 AM	4.0	22.2	207
8:00:00 AM	4.0	22.5	210
8:01:00 AM	4.0	22.3	202
8:02:00 AM	4.0	22.4	204
8:03:00 AM	4.0	22.6	203
8:04:00 AM	4.0	22.6	204
8:05:00 AM	4.0	22.6	201
8:06:00 AM	4.0	23.0	205
8:07:00 AM	4.0	22.7	197
8:08:00 AM	4.0	23.0	195
8:09:00 AM	5.0	23.0	195

8:10:00 AM	5.0	23.0	201
8:11:00 AM	5.0	23.1	206
8:12:00 AM	4.0	23.3	217
8:13:00 AM	4.0	23.4	204
8:14:00 AM	5.0	23.1	202
8:15:00 AM	5.0	23.0	205
8:16:00 AM	5.0	22.9	214
8:17:00 AM	4.0	21.9	201
8:18:00 AM	5.0	21.0	203
8:19:00 AM	5.0	19.8	196
8:20:00 AM	4.0	19.7	198
8:21:00 AM	4.0	19.9	195
8:22:00 AM	4.0	19.7	198
8:23:00 AM	3.0	19.5	212
8:24:00 AM	3.0	19.8	205
8:25:00 AM	4.0	20.8	219
8:26:00 AM	4.0	21.6	204
8:27:00 AM	3.0	22.0	191
8:28:00 AM	4.0	22.1	188
8:29:00 AM	4.0	22.5	201
8:30:00 AM	4.0	22.7	199
8:31:00 AM	3.0	23.1	214
8:32:00 AM	3.0	23.9	218
8:33:00 AM	4.0	24.0	211
8:34:00 AM	4.0	24.1	227
8:35:00 AM	4.0	24.5	237
8:36:00 AM	4.0	24.4	217
8:37:00 AM	6.0	23.8	199
8:38:00 AM	4.0	24.0	207
8:39:00 AM	4.0	24.1	193
8:40:00 AM	4.0	24.5	206
8:41:00 AM	4.0	25.0	236
8:42:00 AM	5.0	25.0	257
8:43:00 AM	4.0	25.8	272
8:44:00 AM	4.0	25.4	213
8:45:00 AM	4.0	24.7	211
8:46:00 AM	4.0	23.7	232
8:47:00 AM	4.0	23.6	230
8:48:00 AM	4.0	23.0	224
8:49:00 AM	4.0	22.5	230
8:50:00 AM	5.0	21.7	218
8:51:00 AM	5.0	21.1	216
8:52:00 AM	4.0	21.7	251
8:53:00 AM	5.0	21.4	208
8:54:00 AM	4.0	21.5	219
8:55:00 AM	5.0	21.3	201
8:56:00 AM	5.0	21.1	227
8:57:00 AM	5.0	21.5	224
8:58:00 AM	6.0	23.1	244

Raw Data

8:59:00 AM	6.0	24.1	262
9:00:00 AM	4.0	25.1	255
9:01:00 AM	5.0	24.6	205
9:02:00 AM	6.0	24.9	199
9:03:00 AM	7.0	24.8	240
9:04:00 AM	7.0	25.1	258
9:05:00 AM	6.0	24.8	232
9:06:00 AM	6.0	24.9	251
9:07:00 AM	6.0	25.1	230
9:08:00 AM	7.0	25.2	183
9:09:00 AM	6.0	25.4	211
9:10:00 AM	5.0	25.6	261
9:11:00 AM	7.0	25.0	230
9:12:00 AM	7.0	25.3	247
9:13:00 AM	6.0	25.9	244
9:14:00 AM	6.0	25.9	231
9:15:00 AM	7.0	26.3	229
9:16:00 AM	7.0	26.9	261
9:17:00 AM	6.0	27.2	260
9:18:00 AM	5.0	27.1	217
9:19:00 AM	5.0	27.3	237
9:20:00 AM	5.0	27.3	235
9:21:00 AM	7.0	27.3	234
9:22:00 AM	6.0	27.3	237
9:23:00 AM	6.0	27.3	232
9:24:00 AM	6.0	27.4	236
9:25:00 AM	5.0	27.7	232
9:26:00 AM	6.0	27.6	240
9:27:00 AM	7.0	27.6	242
9:28:00 AM	7.0	27.4	247
9:29:00 AM	7.0	27.7	261
9:30:00 AM	7.0	27.7	243
9:31:00 AM	7.0	27.5	252
9:32:00 AM	6.0	27.4	254
9:33:00 AM	6.0	27.8	237
9:34:00 AM	7.0	27.3	225
9:35:00 AM	7.0	27.4	230
9:36:00 AM	7.0	27.5	235
9:37:00 AM	8.0	27.5	243
9:38:00 AM	6.0	27.9	254
9:39:00 AM	7.0	27.8	247
9:40:00 AM	6.0	27.4	240
9:41:00 AM	8.0	28.0	245
9:42:00 AM	6.0	27.6	239
9:43:00 AM	6.0	27.2	210
9:44:00 AM	7.0	27.1	208
9:45:00 AM	5.0	27.5	218
9:46:00 AM	8.0	27.1	200
9:47:00 AM	6.0	27.3	208

Raw Data

9:48:00 AM	7.0	27.2	204
9:49:00 AM	6.0	27.8	218
9:50:00 AM	7.0	27.5	200
9:51:00 AM	7.0	27.3	202
9:52:00 AM	5.0	28.2	212
9:53:00 AM	5.0	28.3	223
9:54:00 AM	7.0	27.7	214
9:55:00 AM	7.0	27.9	222
9:56:00 AM	6.0	28.4	234
9:57:00 AM	7.0	27.8	200
9:58:00 AM	7.0	27.9	227
9:59:00 AM	6.0	28.4	257
10:00:00 AM	8.0	28.5	259
10:01:00 AM	7.0	28.5	226
10:02:00 AM	6.0	27.6	209
10:03:00 AM	7.0	28.4	225
10:04:00 AM	7.0	28.6	245
10:05:00 AM	6.0	28.0	231
10:06:00 AM	6.0	27.9	237
10:07:00 AM	6.0	27.7	269
10:08:00 AM	7.0	27.6	255
10:09:00 AM	7.0	27.0	255
10:10:00 AM	8.0	27.4	262
10:11:00 AM	7.0	27.5	219
10:12:00 AM	7.0	28.5	258
10:13:00 AM	6.0	29.1	236
10:14:00 AM	6.0	29.0	232
10:15:00 AM	8.0	28.9	223
10:16:00 AM	6.0	29.3	229
10:17:00 AM	7.0	29.4	236
10:18:00 AM	7.0	29.3	239
10:19:00 AM	6.0	29.1	260
10:20:00 AM	6.0	30.4	221
10:21:00 AM	8.0	30.3	218
10:22:00 AM	9.0	29.7	211
10:23:00 AM	6.0	30.2	209
10:24:00 AM	7.0	30.3	229
10:25:00 AM	7.0	29.4	235
10:26:00 AM	6.0	28.9	240
10:27:00 AM	5.0	28.9	223
10:28:00 AM	6.0	28.8	239
10:29:00 AM	7.0	28.7	226
10:30:00 AM	7.0	29.0	235
10:31:00 AM	6.0	28.9	213
10:32:00 AM	4.0	29.3	210
10:33:00 AM	3.0	30.3	245
10:34:00 AM	4.0	30.9	255
10:35:00 AM	4.0	30.5	211
10:36:00 AM	6.0	29.5	146

10:37:00 AM	6.0	27.9	174
10:38:00 AM	6.0	26.9	207
10:39:00 AM	7.0	26.7	226
10:40:00 AM	7.0	27.0	229
10:41:00 AM	6.0	27.8	215
10:42:00 AM	7.0	27.7	196
10:43:00 AM	6.0	29.1	181
10:44:00 AM	6.0	29.7	214
10:45:00 AM	7.0	30.1	210
10:46:00 AM	8.0	29.5	197
10:47:00 AM	6.0	30.0	207
10:48:00 AM	5.0	29.6	188
10:49:00 AM	7.0	30.0	197
10:50:00 AM	4.0	30.9	242
10:51:00 AM	4.0	30.2	224
10:52:00 AM	4.0	30.7	222
10:53:00 AM	4.0	30.1	207
10:54:00 AM	7.0	28.7	196
10:55:00 AM	6.0	30.3	210
10:56:00 AM	5.0	31.4	231
10:57:00 AM	3.0	32.4	188
10:58:00 AM	6.0	30.3	232
10:59:00 AM	5.0	29.9	204
11:00:00 AM	7.0	30.0	201
11:01:00 AM	6.0	30.4	195
11:02:00 AM	6.0	31.4	211
11:03:00 AM	6.0	31.9	238
11:04:00 AM	5.0	32.0	265
11:05:00 AM	5.0	31.2	200
11:06:00 AM	6.0	31.5	153
11:07:00 AM	6.0	30.6	207
11:08:00 AM	7.0	30.4	228
11:09:00 AM	6.0	30.9	239
11:10:00 AM	5.0	30.9	215
11:11:00 AM	6.0	31.0	233
11:12:00 AM	7.0	30.9	244
11:13:00 AM	6.0	31.7	279
11:14:00 AM	6.0	31.0	190
11:15:00 AM	9.0	31.0	198
11:16:00 AM	8.0	31.8	205
11:17:00 AM	8.0	32.5	245
11:18:00 AM	7.0	31.6	208
11:19:00 AM	8.0	31.0	201
11:20:00 AM	5.0	32.5	244
11:21:00 AM	9.0	30.6	199
11:22:00 AM	7.0	31.1	192
11:23:00 AM	8.0	32.2	260
11:24:00 AM	6.0	32.3	250
11:25:00 AM	6.0	31.4	176

11:26:00 AM	8.0	30.8	201
11:27:00 AM	7.0	31.3	211
11:28:00 AM	7.0	31.8	231
11:29:00 AM	7.0	31.6	206
11:30:00 AM	8.0	31.6	205
11:31:00 AM	7.0	32.3	232
11:32:00 AM	6.0	32.7	256
11:33:00 AM	4.0	32.3	240
11:34:00 AM	7.0	31.4	242
11:35:00 AM	5.0	32.1	267
11:36:00 AM	6.0	31.4	241
11:37:00 AM	5.0	31.8	236
11:38:00 AM	5.0	32.0	258
11:39:00 AM	5.0	31.5	225
11:40:00 AM	7.0	31.9	231
11:41:00 AM	6.0	32.0	208
11:42:00 AM	5.0	32.8	189
11:43:00 AM	7.0	32.6	213
11:44:00 AM	8.0	31.7	210
11:45:00 AM	7.0	33.1	239
11:46:00 AM	7.0	32.7	195
11:47:00 AM	8.0	32.4	191
11:48:00 AM	9.0	32.5	195
11:49:00 AM	8.0	32.9	211
11:50:00 AM	7.0	33.0	211
11:51:00 AM	6.0	32.8	233
11:52:00 AM	5.0	32.5	208
11:53:00 AM	5.0	32.4	216
11:54:00 AM	6.0	32.7	195
11:55:00 AM	8.0	33.2	233
11:56:00 AM	9.0	33.0	210
11:57:00 AM	6.0	33.9	217
11:58:00 AM	7.0	33.8	226
11:59:00 AM	9.0	32.8	197
12:00:00 PM	7.0	33.8	205
12:01:00 PM	9.0	33.5	196
12:02:00 PM	8.0	34.3	194

APPENDIX C.4

ON-SITE GC/MS REPORT AND DATA

EMISSION MONITORING INC.
EFFECTIVE SOLUTIONS AND ADVANCED TECHNOLOGIES

DIRECT INTERFACE GCMS TESTING

TUNNEL EXHAUST DUCT
SILO EXHAUST DUCT

Prepared Under Subcontract to:

Pacific Environmental Services
Subcontract NO. 68-D-98-004-FP-002
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DISCLAIMER

This report presents the results of direct interface GCMS testing conducted at the "hot mix" load out tunnel exhaust duct, and asphalt silo storage exhaust duct [redacted]. Concentration results only are presented.

This document was prepared by Emission Monitoring Incorporated (EMI) under Pacific Environmental Services Incorporated (PES) Subcontract NO. 68-D-98-004-FP-002 and EPA Contract NO. 68-D-98-004. It has undergone the internal QA policies of EMI. The contents do not necessarily reflect the views and policies of the EPA, and mention of trade names does not constitute endorsement by the EPA or by EMI.

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1.0 INTRODUCTION

The United States Environmental Protection Agency (U.S. EPA) requested use of a portable gas chromatograph-mass spectrometer based analyzer (HAPSITE™) to identify and quantify volatile organic hazardous air pollutants from various emissions points at the [redacted]. The EPA requested specifically that the instrumentation be operated in the fully portable mode, without use of a heated extractive sampling system, so that the test locations could be accessed quickly and easily.

The GCMS instrumentation was developed by Leybold-Inficon, and has been evaluated extensively by Emission Monitoring Incorporated (EMI)[1]. Numerous industrial stationary sources have been tested using this instrumentation in accordance with the method entitled "Determination of Gaseous Organic Compounds by Direct Interface GCMS". This method was developed by EMI and Inficon and has been accepted by the U.S. EPA as an alternate test method for numerous stationary sources (ALT-017), and as a conditional test method (CTM-28). The method and documentation are available on-line from the EPA Website, and a copy of the method is provided in Appendix A.

Pacific Environmental Services (PES) subcontracted EMI to perform direct interface GCMS testing at the hot mix asphalt truck loading tunnel, and at the asphalt silo storage vent at [redacted] While on-site, EMI was asked to conduct additional testing at the aggregate dryer baghouse stack and at the exit of the load out tunnel. The results from testing performed at the aggregate dryer baghouse stack are presented in a separate report. The primary objective of the testing was to characterize and quantify nine specific volatile organic hazardous air pollutants (benzene, toluene, o,m,p-xylenes, styrene, ethyl benzene, 1,3-butadiene, and hexane) from each source tested. EMI focused the testing for these nine specific analytes in addition to those identified in Section 1 of the Method, because previous testing indicated these compounds to be present at measurable concentrations.

Two separate portable sampling systems were used during this testing effort. One sampling system employed an unheated stainless steel probe, 0.3 micron quartz fiber filter, Teflon-head diaphragm pump, and Teflon tubing to convey sample gas to the GCMS instrumentation. This was used for direct interface GCMS testing at the tunnel exhaust duct. This sampling system was used also to collect a Tedlar bag sample from the tunnel exhaust duct and one from above the truck beds during asphalt load out. This sampling system configuration was used to collect samples at essentially ambient air conditions where effluent moisture was not a concern.

The second sampling system used employed an unheated stainless steel probe and 0.3 micron quartz fiber filter, a stainless steel heat exchanger and two glass mini impingers for moisture removal, a Teflon-head diaphragm pump, and Teflon tubing to convey sample gas to the GCMS instrumentation. This configuration was used at the silo exhaust duct because the moisture content of the effluent exceeded that acceptable for the instrumentation. Use of these portable sampling systems allowed for direct measurement of volatile organic compounds at remote sources, and allowed for quicker set-up and sampling and analysis than could be achieved using conventional heated sample transport lines.

On-site analysis after each sample acquisition was performed to determine whether the method QA was achieved, and to inform the PES Project Manager of the concentration levels observed in the various effluent matrices. Numerous Representatives from the EPA and CAAP were on-site to observe the testing, the method QA/QC activities, and the on-site data analysis procedures and results. Representatives from Research Triangle Institute were present also to serve as test program auditors.

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[1] "Evaluation of HAPSITE and a Direct Interface GCMS Test Method for Measurement of Volatile Organic Compounds in Stationary Source Emissions," Vol. I &II. Prepared for Leybold Inficon Incorporated by Emission Monitoring Incorporated July 1997.

2.0 SUMMARY OF RESULTS

The sampling and analysis procedures used during this testing program followed those detailed in the direct interface GCMS Method (Appendix A). Some additional sampling was conducted using Tedlar bags with immediate on-site GCMS analysis. This section provides test results obtained from the tunnel exhaust duct and the silo exhaust duct. Volatile organic compounds are reported in concentration units of parts per billion at the effluent temperature and pressure. Results from the tunnel exhaust duct are presented at stack moisture conditions, and results from the silo exhaust duct are presented on a "dry" basis (approximately 2% moisture by volume).

The instrumentation utilizes a grab sample technique where effluent sample gas is co-mixed with the internal standard mixture (in a constant ratio of 10:1) in the GC sampling loop for approximately 1 minute before injection into the GCMS. The total sample equilibration time within the GC loop was varied for testing at the tunnel exhaust duct to obtain a sample representing the highest concentration from the truck load out operation. The GCMS run time was varied between 10 and 15 minutes depending upon the number of compounds observed in the effluent, and the potential for heavier compounds to be retained on the column during the relatively short isothermal GC run. For example, the GCMS run time at the silo exhaust duct was extended to 15 minutes in order to chromatograph all of the compounds present in the effluent. Extending the run time prevented "carry-over" of analytes from one GCMS run to the next.

2.1 Tunnel Exhaust Duct

Testing at the tunnel exhaust duct was conducted on 7-23 and 7-24. Testing on 7-23 consisted of collecting two samples only before a faulty damper in the exhaust duct interrupted the run. Testing was then focussed at the tunnel exit to determine what compounds escape the tunnel exhaust system when trucks are loaded and then travel through the tunnel with the fuming asphalt. No compounds were detected in the three samples acquired at the tunnel exit. An additional upwind sample was obtained at the tunnel entrance. No compounds were detected in the single sample acquired upwind of the hot mix load out tunnel.

Testing on 7-24 began after the damper was replaced. Numerous GCMS sample runs were conducted using various sample acquisition profiles to obtain results representing the highest concentration of analytes during the actual load out of the hot mix asphalt. The direct interface GCMS testing was concurrent with EPA Methods 18 and 315, and SW846-0010 and -0030.

The process of filling a truck with hot mix asphalt consists of a truck entering the tunnel and positioning under one of the five silo storage chutes. Hot asphalt concrete is loaded into the truck in an approximately 30 second dump. Fumes from the dumping of asphalt cause an immediate spike in the concentration of volatile organic compounds in the tunnel exhaust. In an effort to characterize the maximum emissions from this process, EMI attempted to coordinate the timing of the hot mix loading process with GCMS sample acquisition. This proved difficult because the residence time of the "spike" in the tunnel exhaust duct was unknown, and some trucks loaded different quantities hot mix asphalt.

Because the standard GCMS run employs a 60 second sample loop equilibration before GC introduction, the first few samples did not contain many of the target analytes. It was speculated that the maximum of the concentration peak was missed with the relatively long loop equilibration time. Next, the loop equilibration time was shortened to 30 seconds. For sample loop equilibration times of 30 seconds or less it was discovered that the internal standard mixture was not co-added with the effluent. (Internal standards are necessary to perform the sample quantitation and to assess instrument performance, so this time period was not acceptable.) The sample loop equilibration time was then extended to 45 seconds and the load out process monitoring personnel were instructed to give a 15 second notice before the dumping process began. The 45 second equilibration with the 15 second notice gave the most consistent and highest observed concentration results from run to run.

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Two separate Tedlar bag samples were collected at this location in order to verify that the sample timing issues had been resolved. One bag sample was collected from the same location that the direct interface GCMS testing was conducted. The bag was filled during three successive hot mix dumps while EMI personnel observed and visually coordinated the load out process. The four samples identified as TEDBAG01 (02,03,04) represent on-site analysis of this bag sample immediately following its collection.

The second Tedlar bag was filled by sampling directly above the truck bed, inside the tunnel while hot asphalt was loaded into the trucks. Samples identified as HMLOBAG1 (2, 3) represent on-site analysis of this bag sample immediately following its collection in the tunnel.

Tables 2.1 and 2.2 present the GCMS concentration results from testing conducted at the tunnel exhaust duct and the instrument specific detection limits based on the acquisition/calibration method used.

Concentration levels of the detected target analytes were generally below 20 ppb at the tunnel exhaust duct. It is important to note that the results from the direct interface testing and the results from collecting bag samples with subsequent immediate on-site analysis provided results at similar concentration levels. This verifies the timing sequence used during sample collection in the direct interface mode of operation. It is unclear if collecting bag samples with subsequent off-site analysis would provide similar results considering the very low concentration levels quantified in the effluent. It is likely that the time required to ship bag samples to an off-site laboratory would allow adsorption or reaction of the contained gases.

2.2 Asphalt Silo Exhaust Duct

Testing at the silo exhaust duct was conducted on 7-25. The GCMS and portable sampling system were hoisted to the top of the silo via a pulley system to sample directly from the vent. Four 15-minute GCMS sample runs were performed in succession. Because of the high moisture content of the effluent, the sampling system employing the heat exchanger and moisture removal apparatus were used to dry the sample before introduction into the instrumentation.

Numerous peaks were observed in the chromatography. Most of the target analytes were detected at concentrations of from 50 to 500 ppb. Methyl Ethyl Ketone was quantified also in all of the samples at concentrations of from 1.4 and 1.69 ppm. Carbon disulfide was detected also in this effluent stream. Although these compound were not identified as target analytes for this test program, they are contained in Section 1 of the Method and in the instrument specific calibration. It is likely that results reported for MEK are biased low because of the high moisture encountered at this location and because of the water soluble nature of MEK. Numerous additional analytes that are not contained in the instrument specific calibration were identified also in the silo exhaust.

Table 2.3 presents the GCMS concentration results for compounds contained in the instrument specific calibration and the instrument detection limits associated with the acquisition/calibration method used. Table 2.4 presents the estimated concentration results for those compounds identified in the silo exhaust duct that are <u>not contained</u> in the instrument specific calibration (the target analyte list of nine compounds or the analytes identified in Section 1 of the Method).

The specifically listed compounds in Table 2-4 were identified using first principals of mass spectroscopy and the NIST library contained in the instrument software. By tuning the mass spectrometer according to the criteria identified in the method, searches of the NIST Mass Spectral Library are made possible.

Tentatively identified compounds (TICs) in Table 2-4 are identified with a double asterisk (**). These TICs represent compounds whose peaks in both the GC and selected ion trace have a minimal signal-to-noise ratios (S:N). For S:N ratios of less than 5:1, complicated hydrocarbon spectra are very difficult to interpret accurately, particularly for those compounds having a molecular weight over 100 amu. Therefore, these compounds have been tentatively identified only. Their molecular weight and estimated concentration have been presented as "<" or ">" values.

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Table 2-1. Direct Interface GCMS Results [redacted] Tunnel Exhaust Duct

Sample Identification	Date	Acquisition Time	Compounds Detected	Concentration - PPB	GCMS Method1	Loop Equilibration	Load Silo #	Matrix Detection Limits - PPB
TED#1	7/23/98	10 30	m/p-Xylene	15	LFS	60 sec	4	7
TED#2	7/23/98	10 48	Benzene	17	LFS	60 sec	4	12
			Toluene	7				5
			m/p-Xylene	7				7

Remarks - Batch process asphalt loading operation, GCMS using 60 second sample loop equilibration not coordinated with dumps

Sample Identification	Date	Acquisition Time	Compounds Detected	Concentration - PPB	GCMS Method	Loop Equilibration	Load Silo #	Matrix Detection Limits - PPB
TED"2401	7/24/98	9:14	none	n/a	LFS	60 sec	3	n/a
TED"2402	7/24/98	9:29	Toluene	4	SIM2	60 sec	2	0.9
			m/p-Xylene	20				1
TED"2403**	7/24/98	9:41	Toluene	4	SIM2	60 sec	2	0.9
TED"2407	7/24/98	11:17	None	n/a	LFS - no trucks	40 sec	no trucks	present in tunnel during sampling
TED"2408	7/24/98	11.28	Toluene	3 - BDL	LFS	40 sec	2	5
TED"2409	7/24/98	11 46	Toluene	8	LFS	40 sec	2	5
			Ethyl Benzene	3		(15 sec notice)		3
			m/p-Xylene	15				7
TED"2410	7/24/98	12 03	Toluene	8	LFS	40 sec	2	5
			Ethyl Benzene	3		(15 sec notice)		3
			m/p-Xylene	18				7
TED"2411	7/24/98	12 17	Benzene	10	SIM2	40 sec	2	0.9
			Toluene	10		(15 sec notice)		0.9
			m/p-Xylene	40				1
TEDBAG01*	7/24/98	12 43	Toluene	10	LFS	Bag filled over	2	5
			Ethyl Benzene	9		three load outs		7
from 12 30 to 12 42			m/p-Xylene	17				
TEDBAG02*	7/24/98	12 54	Toluene	9	LFS	Bag filled over	2	5
Bag sample collected			Ethyl Benzene	9		three load outs		3
from 12 30 to 12 42			m/p-Xylene	10				7
TEDBAG03*	7/24/98	13 09	Benzene	10	SIM2	Bag filled over	2	0.9
Bag sample collected			Toluene	10		three load outs		0.9
from 12 30 to 12 42			m/p-Xylene	40				1
TEDBAG04*	7/24/98	13 20	Benzene	10	SIM1	Bag filled over	2	2
Bag sample collected			Toluene	20		three load outs		2
from 12 30 to 12 42			Ethyl Benzene	2				2
			m/p-Xylene	20				2

1 LFS = Limited full scan GCMS operation from 50-125 amu

SIM1 Specific for		SIM2 specific for:	
	1,3 butadiene		benzene
	hexane		toluene
	benzene		ethyl benzene
	toluene		o,m,p xylenes
	ethyl benzene		styrene
	o,m,p xylenes		
	styrene		

* TEDBAG01 thru 04 are analysis of single Tedlar bag immediately following collection of three separate asphalt load outs.

** TED[illegible]G0 thru 06 GCMS runs did not meet method QA/QC criteria and the results are not reported.

04 - no sample, pump not running

05 and 06 - pump repaired, no internal standards co-injected during 30 sec loop equilibration

Table 2-2. Direct Interface GCMS Results - [redacted] Hot Mix Load Out Bag Sample

Sample Identification[1]	Date	Acquisition Time	Compounds Detected	Concentration - PPB	GCMS Method[2]	Matrix Specific Detection Limit
HMLOBAG1	7/25/98	12:40	None	n/a	LFS	n/a
HMLOBAG2	7/25/98	12:50	Benzene	10	SIM2	0.9 ppb
			Toluene	9		0.9 ppb
			Ethyl Benzene	5		1 ppb
			m/p-Xylene	20		1 ppb
			o-Xylene	5		2 ppb
HMLOBAG3	7/25/98	13:00	Benzene	10	SIM1	2 ppb
			Toluene	5		2 ppb
			Ethyl Benzene	5		2 ppb
			m/p-Xylene	15		2 ppb
			o-Xylene	BDL*		5 ppb
HMLOBAG4	7/25/98	13:11	Benzene	10	SIM2	0.9 ppb
			Toluene	9		0.9 ppb
			Ethyl Benzene	3		1 ppb
			m/p-Xylene	25		1 ppb
			o-Xylene	BDL		2 ppb

1. Four separate analysis of single bag sample collected over three successive asphalt truck loadings from 12:20 to 12:35
Samples are replicate analysis of single bag sample using different GCMS methods. HMLOBAG2 and HMLOBAG3 are duplicates

2. LFS - limited full scan operation from 50-125 amu

SIM2 - selected ion method specific for:		SIM1 - selected ion method specific for:	
	benzene		1,3-butadiene
	toluene		hexane
	ethyl benzene		benzene
	o,m,p-xylenes		toluene
	styrene		ethyl benzene
			o,m,p-xylenes
			styrene

* BDL = Below Detectable Limit of Quantitation Method

Table 2-3 Direct Interface GCMS Results - [redacted] Silo Exhaust Duct

Sample ID	Date	Acquisition Time	Compounds Detected	Concentration - PPB	CMS Method[1]	Matrix Detection Limits - PPB
SED72501	7/25/98	8:59	Hexane	110	LFS	60
			Benzene	40		12
			Toluene	100		5
			Ethyl Benzene	50		12
			m/p-Xylene	250		7
			o-Xylene	90		15
			Carbon Disulfide	100		30
			MEK	1460		75
SED72502	7/25/98	9:20	Hexane	BDL*	Full Scan	100
			Benzene	50		10
			Toluene	170		10
			Ethyl Benzene	290		10
			m/p-Xylene	300		15
			o-Xylene	280		15
			Carbon Disulfide	80		10
			MEK	1400		75
SED72503	7/25/98	9:44	Hexane	BDL*	Full Scan	100
			Benzene	50		10
			Toluene	170		10
			Ethyl Benzene	290		10
			m/p-Xylene	360		15
			o-Xylene	280		15
			Carbon Disulfide	50		10
			MEK	1690		75
SED72504	7/25/98	10:03	Hexane	BDL*	Full Scan	100
			Benzene	30		10
			Toluene	140		10
			Ethyl Benzene	190		10
			m/p-Xylene	360		15
			o-Xylene	180		15
			Carbon Disulfide	20		10
			MEK	1090		75

1. LFS = Limited Full Scan Mass Spectrometer Operation from 50-125 amu
FS = Full Scan Mass Spectrometer Operation from 45-300 amu

* BDL = below detectable level

Table 2-4 Direct Interface GCMS Estimated Concentration Results - Silo Exhaust Duct

Compounds Not Contained in Instrument Specific Calibration

Sample ID	Date	Acquisition Time	Compounds Identified	MW	Compound RF Used	Estimated Concentration*	GCMS Method
SED72501	7/24/98	8:59	Cyclopentane	68	Benzene	53	LFS
			3-methyl Cyclopentane	82	Benzene	113	
			6 member ring alkyl substituted cyclic amine**	85	none	<50 ppb	
			5-hexenol	100	MEK	1567	
			2,4-dimethyl pentene	98	Hexane	604	
			Alkyl substituted cyclic alcohol**	>90	none	<50 ppb	
			Heptyne	96	Hexane	421	
			Alkyl substituted cyclohexanol**	>130	none	<100 ppb	
			Trimethyl pentane	114	Hexane	600	
			Trimethyl Cyclohexane	126	Ethyl Benzene	198	
			Alkyl multiply substituted pentanol**	>100	none	<50 ppb	
			Octahydro-Methyl-Pentalene	124	Ethyl Benzene	160	
			Ethyl Methyl Cyclopentane	112	Ethyl Benzene	200	
SED72502	7/24/98	9:20	Cyclopentane	68	Benzene	46	FS
			3-methyl Cyclopentane	82	Benzene	108	
			6 member ring cyclic amine**	85	none	<50 ppb	
			5-hexenol	100	MEK	463	
			2,4-dimethyl pentene	98	Hexane	231	
			Alkyl substituted cyclic alcohol**	>90	none	<50 ppb	
			Heptyne	96	Hexane	515	
			Alkyl substituted cyclohexanol**	>130	none	<100 ppb	
			Trimethyl pentane	114	Hexane	245	
			Trimethyl Cyclohexane	126	Ethyl Benzene	58	
			Alkyl multiply substituted pentanol**	>100	none	<50 ppb	
			Octahydro-Methyl-Pentalene	124	Ethyl Benzene	77	
			Ethyl Methyl Cyclopentane	112	Ethyl Benzene	58	
SED72503	7/24/98	9:44	Cyclopentane	68	Benzene	32	FS
			3-methyl Cyclopentane	82	Benzene	59	
			6 member ring cyclic amine**	85	none	<50 ppb	
			5-hexenol	100	MEK	444	
			2,4-dimethyl pentene	98	Hexane	208	
			Alkyl substituted cyclic alcohol**	>90	none	<50 ppb	
			Heptyne	96	Hexane	325	
			Alkyl substituted cyclohexanol**	>130	none	<100 ppb	
			Trimethyl pentane	114	Hexane	252	
			Trimethyl Cyclohexane	126	Ethyl Benzene	62	
			Alkyl multiply substituted pentanol**	>100	none	<50 ppb	
			Octahydro-Methyl-Pentalene	124	Ethyl Benzene	59	
			Ethyl Methyl Cyclopentane	112	Ethyl Benzene	65	
SED72504	7/24/98	10:03	Cyclopentane	68	Benzene	17	FS
			3-methyl Cyclopentane	82	Benzene	33	
			6 member ring cyclic amine**	85	none	<50 ppb	
			5-hexenol	100	MEK	288	
			2,4-dimethyl pentene	98	Hexane	337	
			Alkyl substituted cyclic alcohol**	>90	none	<50 ppb	
			Heptyne	96	Hexane	120	
			Alkyl substituted cyclohexanol**	>130	none	<100 ppb	
			Trimethyl pentane	114	Hexane	144	
			Trimethyl Cyclohexane	126	Ethyl Benzene	43	
			Alkyl multiply substituted pentanol**	>100	none	<50 ppb	
			Octahydro-Methyl-Pentalene	124	Ethyl Benzene	33	

* Estimated concentration results in PPB

** Tentatively Identified Compounds (TICs). Estimated concentration values presented "<" values because quantion signal to noise ratio less than 3:1

3.0 PROCESS DESCRIPTION

[redacted]. A simplified process schematic is shown in Figure 3-1. The plant was built in 1994 and has an asphalt production rate of 650 tons per hour. The plant produces five categories of asphalt concrete, 3/8 inch, ½ inch, ¾ inch fines, and recycled asphalt (RAP). The RAP production process adds small amounts of recycled asphalt to the hot aggregate mix.

The plant uses two varieties of liquid asphalt, each having a different content of volatile organic compounds. The percent of liquid asphalt added to the aggregate varies form 4.8 to 6 percent depending on the aggregate size.

Five 200 ton heated storage silos are situated on top of the truck load out tunnel. The storage silos hold the asphalt between the production time and the load out time. During normal operations, trucks load out approximately once every three minutes. Single bed trucks hold approximately 21 tons of asphalt, while dual bed trucks can hold up to 25 tons. It typically takes about 30 seconds to load a truck.

The load out tunnel is approximately 183 feet long by 16 feet wide by 16 feet high Attached to the ceiling of the tunnel and below each silo is an air plenum that draw vapors from the load out operations and directs them through a small electrostatic precipitator (the Smog Hog®), and to the stack.

Normal operations produce between 2000 and 6000 tons of asphalt per day. Load out starts at 4 am and continues for approximately 10 hours. On a typical day, the average load out rate matches the average production rate so that asphalt is not stored in the silos overnight.

4.0 SAMPLING LOCATIONS

4.1 Tunnel Exhaust Duct

The tunnel exhaust duct is a horizontal 32-inch diameter duct that leads from the load out tunnel to the Smog Hog®. Sampling ports and the physical dimensions of the tunnel exhaust duct are shown in Figure 4-1.

Single point constant rate (approximately 7 liters per minute) sampling was conducted from a point located approximately one foot within the duct.

4.2 Silo Exhaust Duct

Fumes from the silo exhaust duct exit through a 24 inch diameter duct, a 10 inch diameter duct, and finally a 12 inch common header before being directed to the Smog Hog®. For this testing, fumes from silo number 3 were tested. Sampling ports and the physical dimensions of the silo exhaust duct are shown in Figure 4-2.

Single point constant rate (approximately 7 liters per minute) sampling was conducted from a point approximately one foot within the duct.

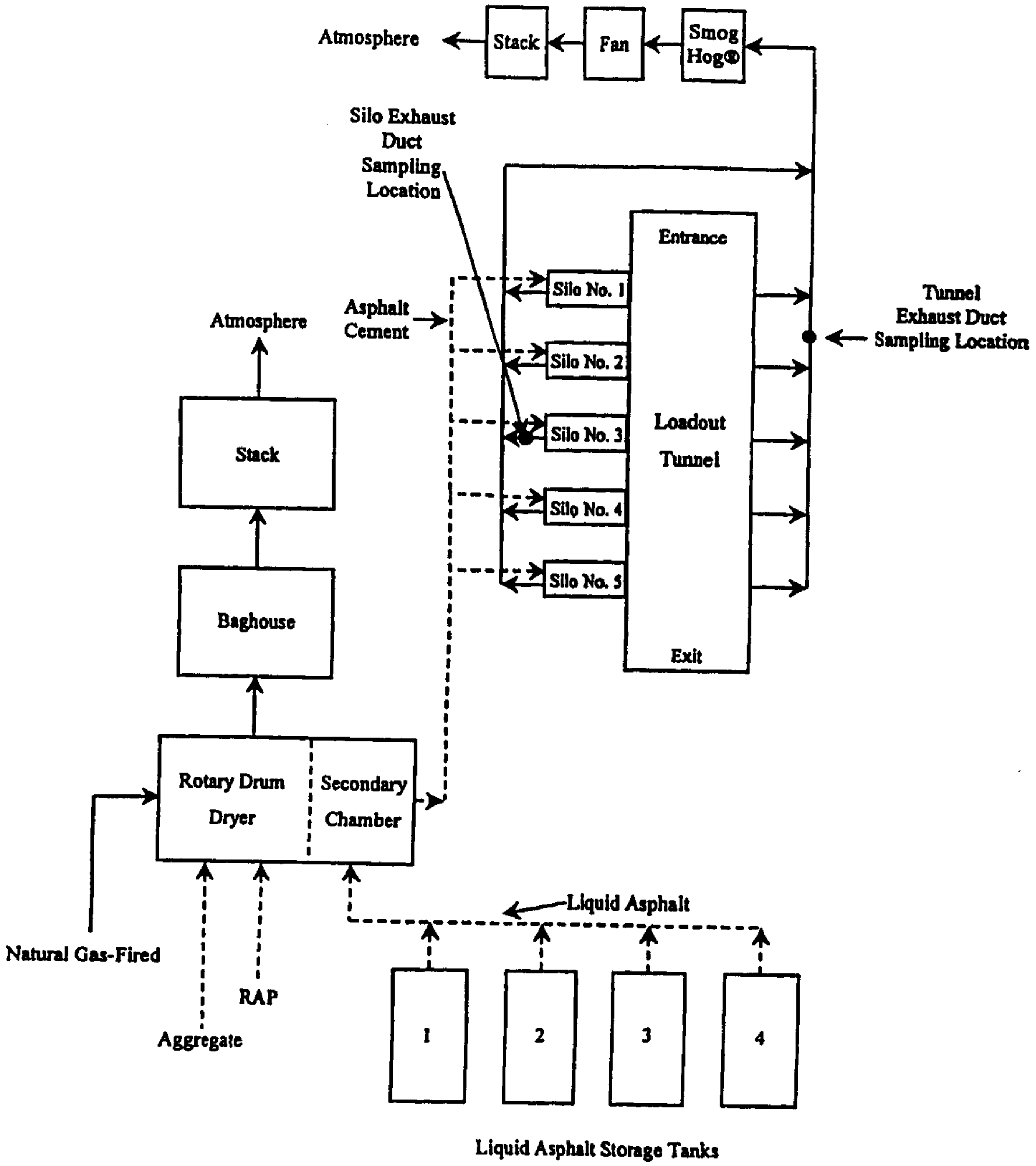

Figure 3.1 Process Flow Schematic, [redacted]

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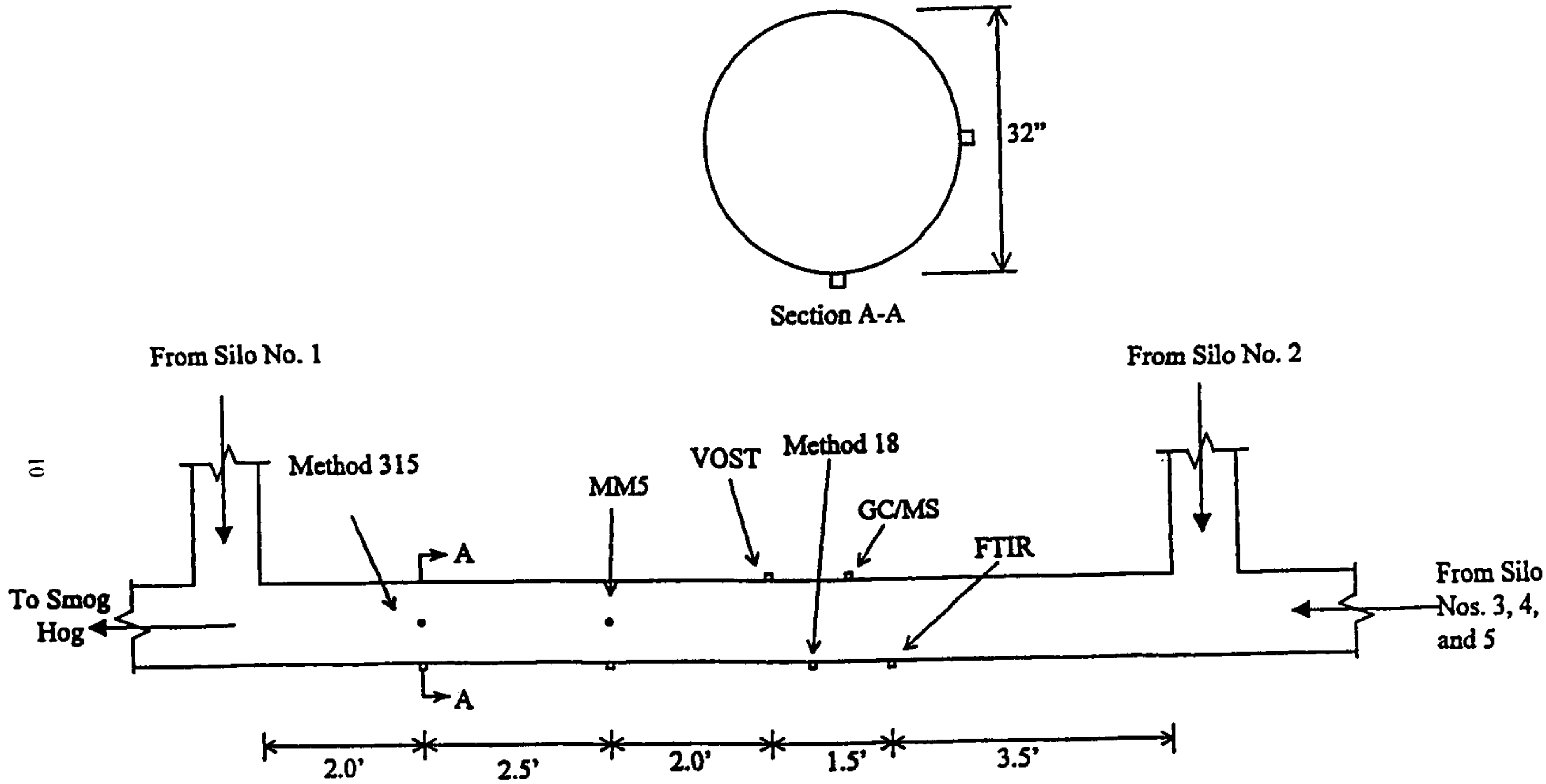

Figure 4.1 Tunnel Exhaust Duct Sampling Port Locations, [redacted]

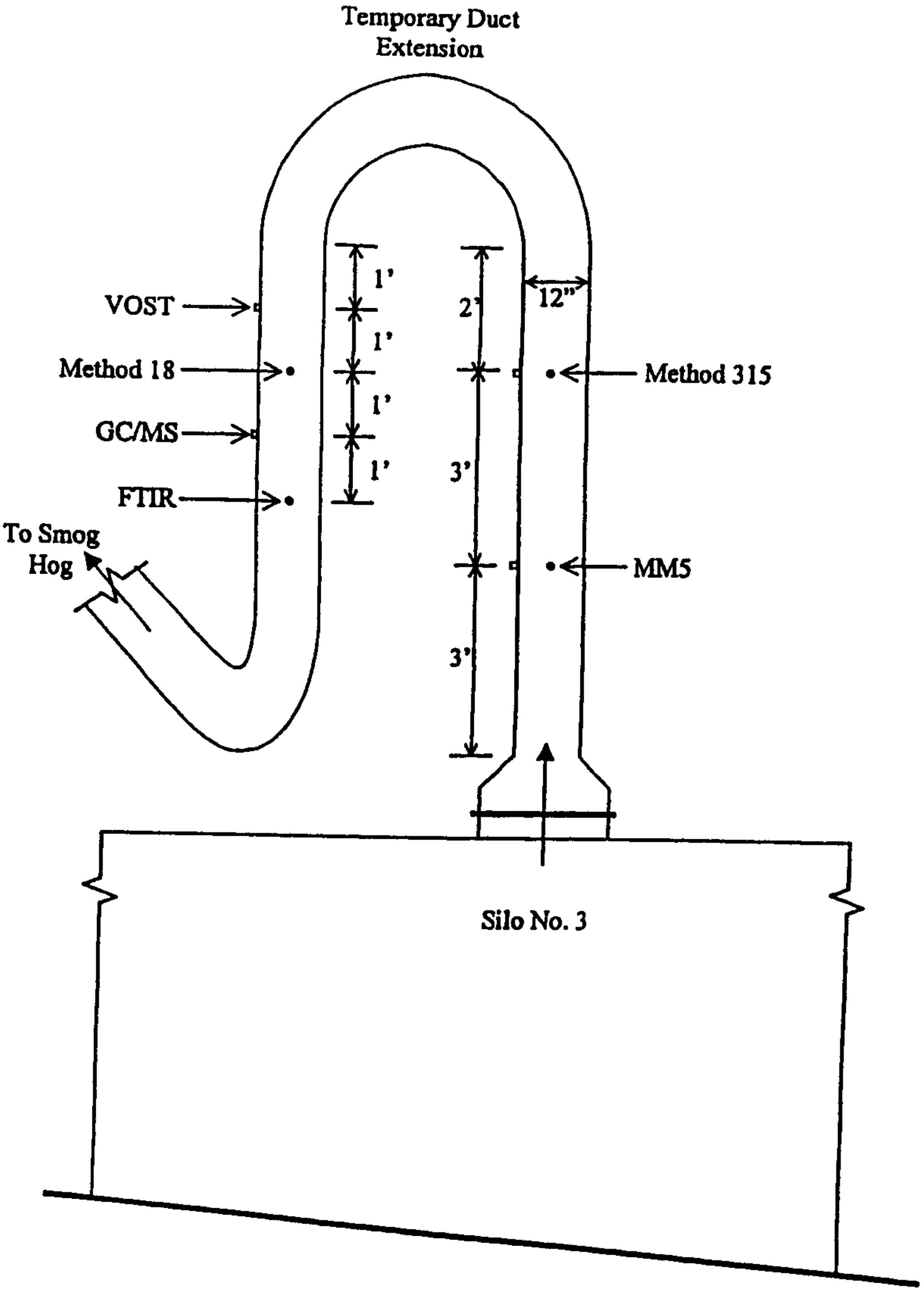

Figure 4.2 Temporary Exhaust Duct Sampling Port Locations,

[redacted]

5.0 SAMPLING AND ANALYTICAL PROCEDURES

The sampling and analytical procedures used during this testing program followed those detailed in the direct interface GCMS test method (Appendix A). The instrument was calibrated specifically for this test project using the nine of the target analytes. The instrument was calibrated also for all compounds identified in Section 1 of the method approximately one month before this test and this calibration was used also to identify any other potential analytes not specific to this test program (such as MEK and CS_2).

Instrument specific calibrations were conducted in the full scan mode (and limited full scan) of operation where all of the mass fragments in a compounds mass spectrum are generated in every run. Additional instrument calibrations were conducted for the nine test specific target analytes using a selected ion monitoring (SIM) mode of operation. In this mode, only a select few ions are measured in each compounds mass spectrum. Although this method of operation gives less information regarding the compounds true identity, it necessarily improves the instrument sensitivity because of the increased number of scans achieved per chromatographic peak. The combination of using the full scan, limited full scan, and SIM scan modes of operation gives positive identification of the individual analytes while increasing the instrument sensitivity.

System continuing calibration verification was conducted daily through the portable sampling system using all of the nine test specific target analytes. The system calibrations were performed in the rear compartment of a rental minivan. For testing conducted at the tunnel exhaust duct, the GCMS was calibrated and operated directly from the rear compartment the minivan. For testing conducted at the silo exhaust stack, the GCMS was disconnected from the sampling system, transported to the actual sampling location, and then reconnected to the sampling system after passing a leak check.

5.1 Sampling Procedures

5.1.1 Direct Interface GCMS Sampling

Effluent gas samples were withdrawn at a constant flow rate from a single point located approximately one foot inside of the each duct or stack using a Teflon head diaphragm pump. Effluent was withdrawn at approximately 3 liters per minute through the sampling system for no less than 5 minutes before sample acquisition in order to equilibrate fully all sampling system components. It is estimated that the gas residence time through the sampling system is less than 1 minute at this sampling rate.

Two sampling systems were used during this testing program depending on the effluent volumetric moisture content. Sampling system #1 is used primarily for ambient moisture applications and was used for testing at the tunnel exhaust duct. It is constructed out of stainless steel, and utilizes a 0.3μ quartz Balston filter for particulate removal. Sampling system #2 is used for applications where the volumetric moisture content of the effluent exceeds 8% (the instrumental operating limit). These conditions were encountered at the silo exhaust stack. Sampling system #2 is constructed out of stainless steel and utilizes a 0.3μ quartz Balston filter for particulate removal, followed by a heat exchanger and two mini impingers for moisture removal.

The gas flow through sampling system #1 is relatively simple. Sample gas is filtered and transported directly to the instrumentation at essentially stack conditions. The gas flow through sampling system #2 is unique in that after passing through the heat exchanger and mini impingers, the dried gas is directed back through the heat exchanger for reheating before introduction into the instrumentation. Figures 5-1 and 5-2 present simplified diagrams of both sampling systems used during this testing project.

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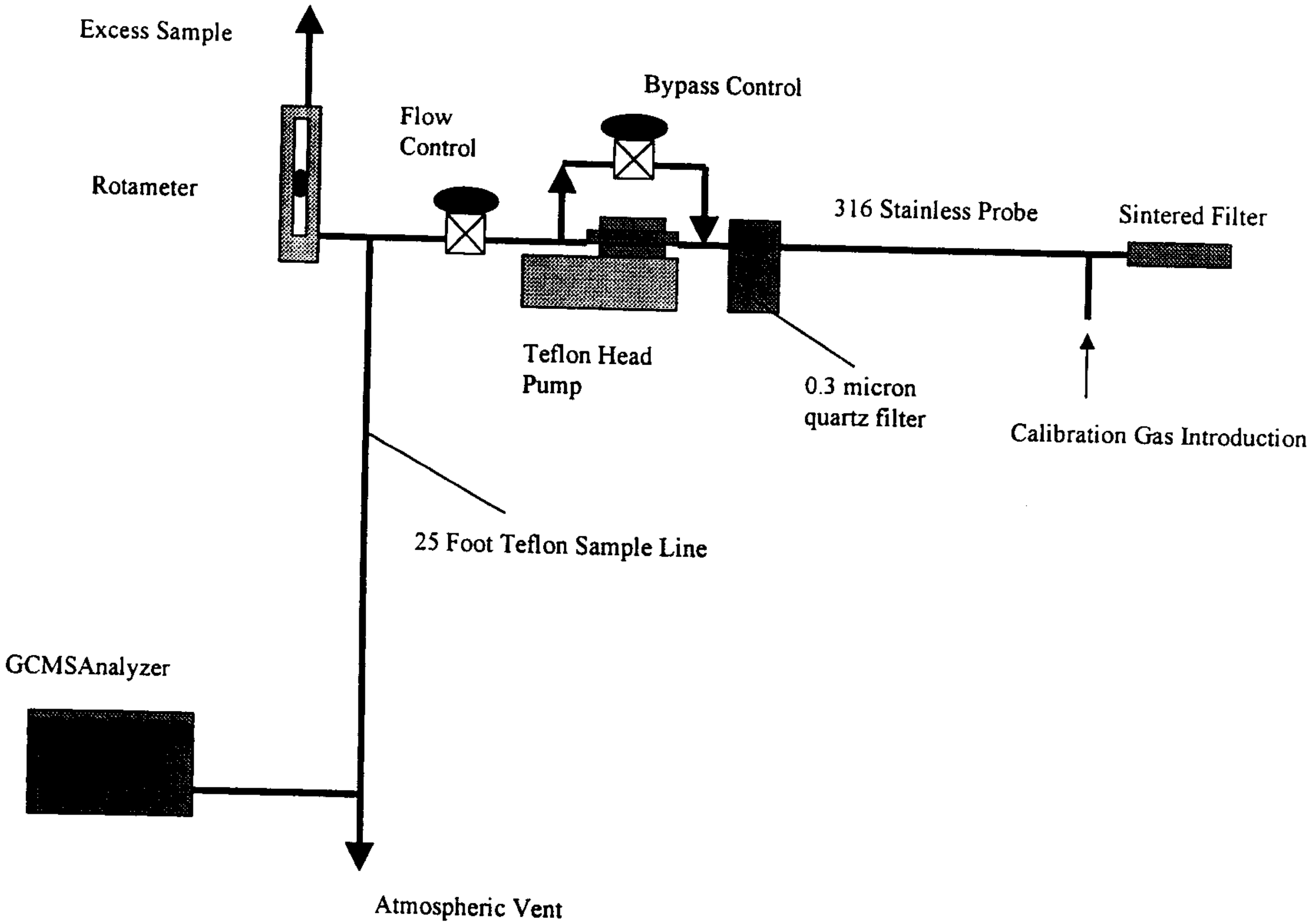

Figure 5-1 Low Moisture Portable Sampling System

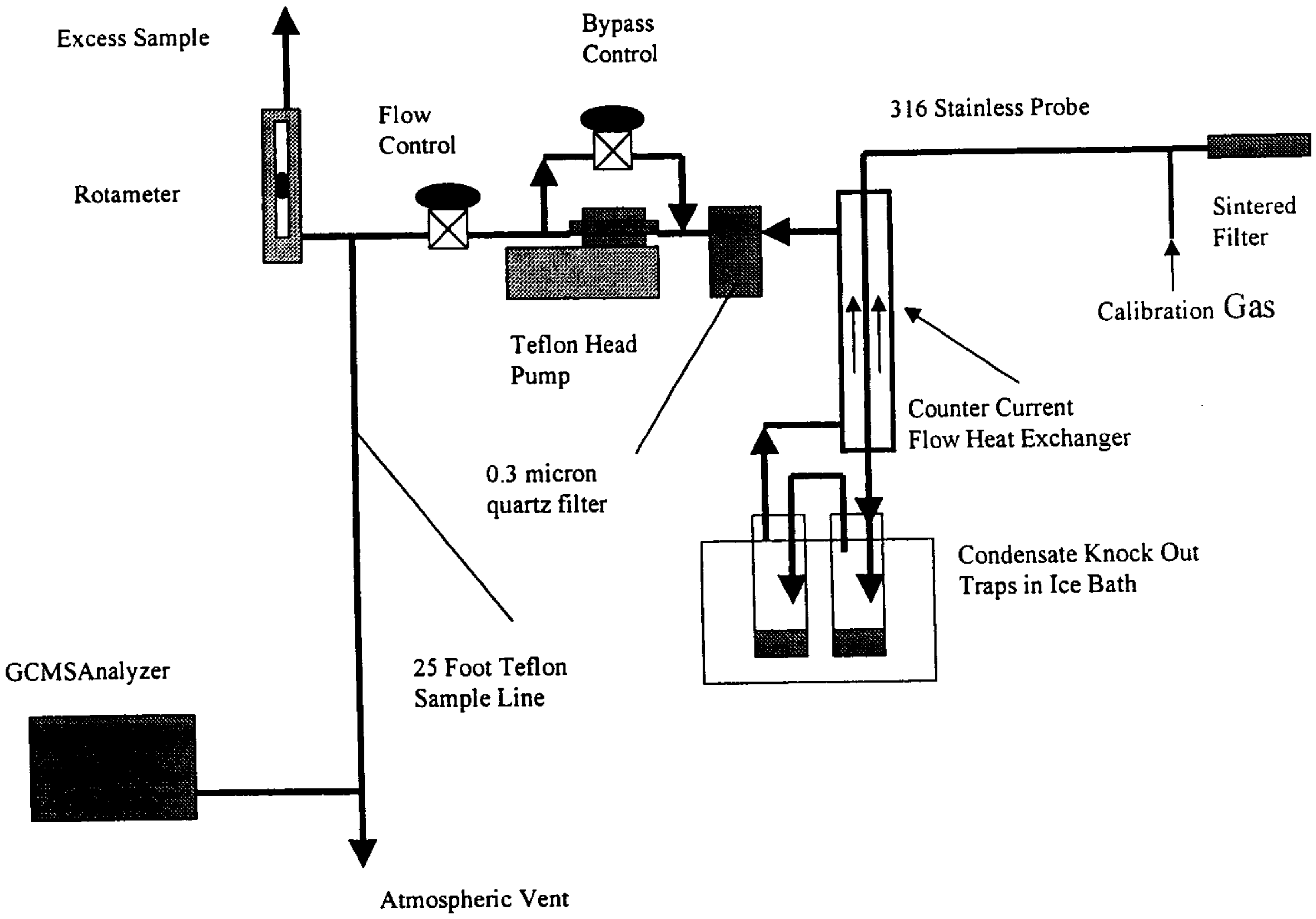

Figure 5-2 High Moisture Portable Sampling System

5.1.2 Tedlar Bag Sampling

A Tedlar bag was used to collect a composite sample from tunnel exhaust duct. Three truck load outs were monitored visually and coordinated with sample collection. Sample acquisition was performed using sampling system #1 to extract gas samples from the same point as that used for the direct interface testing. Before sampling, the Tedlar bag was filled twice with dry nitrogen and then the contained nitrogen was analyzed for the presence of any detectable analytes. No analytes were found in the blank bag sample. Samples identified as TEDBAG01, 02, 03 and 04 (Table 2-1) represent separate analysis of this single bag sample.

A Second Tedlar Bag sample was collected from inside the tunnel, above truck beds while loading asphalt. Sampling system #1 was used to collect a composite sample from three successive truck load outs. Before sampling, the Tedlar bag was filled twice with dry nitrogen and then the contained nitrogen was analyzed for the presence of any detectable analytes. No analytes were found in the blank bag sample. Samples identified as HMLOBAG1, 2, and 3 represent separate analysis of this single bag sample.

5.1.3 GCMS Operation

The GCMS instrumentation was operated using a non-evaporative getter (NEG) pump to maintain the requisite high internal vacuum needed to generate mass spectra. For some of the testing the GCMS used its own internal batteries for power if none was available.

Internal standards are co-added with every effluent sample in the GC sample loop before injection into the GC. The internal standards used are 1,3,5-trifluoromethyl benzene (TRIS) and bromopentafluoro benzene (BPFB). These compounds are not found in industrial processes. They are used to tune the mass spectrometer, to assess the stability and performance of the GCMS on each sample run, and to determine adherence to the method QA/QC.

The GC was operated isothermally at 60°C to separate and detect the target analytes. The mass spectrometer was operated in full scan (45-300 amu), limited full scan (50-125 amu), and selected ion monitoring modes of operation to optimize identification and quantification of the largest number of volatile organic compounds. All internal GCMS components were maintained at 60°C.

The GCMS internal sample pump withdrew sample from the sampling system (either #1 or #2) at atmospheric pressure for a period of approximately one minute for testing conducted at the silo and from 30 seconds to one minute for testing at the tunnel exhaust duct. For testing conducted at the tunnel exhaust duct, the sample timing was critical in obtaining the maximum in the concentration from the asphalt load out. Many parameters were tried, but the sample loop equilibration of 45 seconds with a 15 second notice from the process monitoring individual gas the most consistent results. (See Section 2.11 of this document for a complete description of the procedures leading to this conclusion.)

Daily QA/QC activities were conducted in the rear compartment of a rental minivan. GCMS operation was conducted from the minivan for testing at the tunnel exhaust duct. The GCMS was operated from on top of the silo for testing at the silo exhaust duct.

5.2 Analytical Procedures

The procedures detailed in the direct interface GCMS method (Appendix A) were followed for this testing program. See Figure 5-3 for a method operational flowchart.

The GCMS was calibrated at the EMI laboratory using duplicate injections at three concentration levels for each specific calibration curve. The calibration and internal standards used for this testing were certified by Spectra Gas, and by Scott Specialty Gases (manufacturer's certifications of analysis are included in Appendix A).

Two full scan calibrations were performed for the nine test specific target analytes and for all of the analytes listed in Section 1 of the method. Full scan operation is generally defined to be from 45-300 amu for the HAPSITE GCMS, and from 50-125 for the nine test specific analytes identified for this test. Therefore, compounds having a molecular weight of less than that identified are not detected, and compounds weighing greater than that identified will have resultant mass spectra in the scan range only. Full scan calibration curves were established at concentration levels of 10 ppm, 1 ppm and 300 ppb.

Two SIM scan calibrations were performed also at much lower concentration levels of 100 ppb, 50 ppb and 20 ppb. Ions specific to the nine target analytes were used to generate these curves (i.e., 78 for benzene, 91 for toluene etc..).

Sample acquisition was performed using one of the four acquisition methods that correspond to the individual calibration curves. All analytes contained in the instrument specific calibrations elute from the GC column during a ten-minute run. Sample quantification was performed using the internal standards and the selected three-point calibration curve that matched the GCMS acquisition profile. Section 10 of the method details the mathematical process by which the results are calculated (for those compounds contained in the calibration curve).

Results are reported also for compounds not contained in the calibration curve from testing conducted at the silo exhaust duct. Because the GC separates the individual compounds from each other, and the mass spectrometer fragments each compound in a virtually unique pattern, positive identification of compounds not contained in the instrument specific calibration is possible. Identification of compounds not contained in the instrument specific calibration was performed by mass spectral pattern recognition and by conducting searches of the NIST Mass Spectral Library that is contained in the instrument software. Response factors of chemically similar compounds contained in the instrument specific calibration were used to quantify these compounds based on the manually integrated area of a specific mass spectral quantification ion.

The following steps are used to identify and to quantify compounds not contained in the instrument specific calibration.

- Obtain the compounds mass spectrum
- Identify the compound using the NIST Library and first principals of mass spectrometry
- Determine the compounds molecular weight and assign a Quantification Ion (QI)
- Manually integrate the area contained under the peak of the QI
- Determine a chemically similar compound contained in the instrument specific calibration
- Use the chemically similar compounds instrument specific response factor (RF) as follows:

$$ppm = (QIarea / RF)(ISconc./ISarea)$$

Where:

ppm = Estimated concentration of compound
QI area = Manually integrated area of compound quantification ion
Rf = Response factor of most chemically similar compound from instrument specific calibration
IS conc. = Concentration of internal standard used
IS area = Area of internal standard quantification ion

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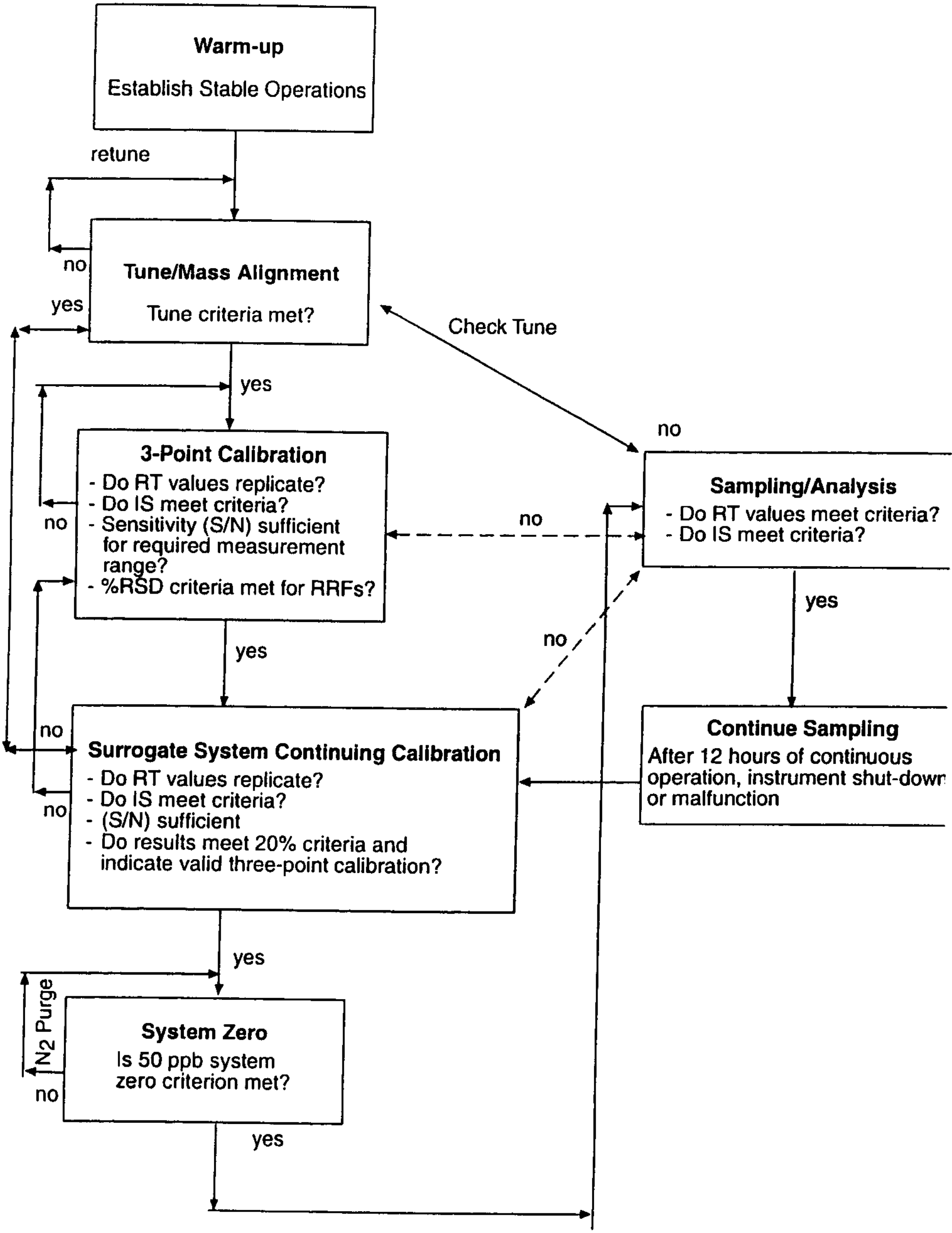

Figure 5-3 Direct Interface GCMS Method Operational Flowchart

6.0 QUALITY ASSURANCE/QUALITY CONTROL

6.1 Initial Calibration and Daily Calibration Check Procedures

Establishing a valid three-point calibration requires a 20 percent relative standard deviation (%RSD) for each individual analyte over the calibration range. Two calibration curves were generated in each of the full scan and SIM scan acquisition methods. Calibration was performed by conducting two successive GCMS runs at each of three concentration levels: 10 ppm, 1 ppm and 300 ppb for the full scan calibration curves, and 100 ppb, 50 ppb and 20 ppb for the SIM scan calibration curves. Section 10 of the method details the calculation procedures used to determine the %RSD for each of the analytes. Table 6-1 presents the target analytes, the results from the three-point calibration in terms of %RSD for each of the four calibration curves, and the estimated detection limits.

Daily system calibrations were conducted to check both the validity of the initial instrument three-point calibration and the effectiveness of the sampling system to transport the target analytes. Daily system calibration check procedures were conducted after accomplishing a successful instrument tune using the blended mixture of the internal standards. Immediately following the system continuing calibration, nitrogen was allowed to flow through the system and a system blank was acquired. No analytes were detected in any of the system blank analyses.

The direct interface GCMS test methods requires that continuing system calibrations be conducted using a blended mixture of six surrogate compounds at 1 ppm. (See Table 6 of the method.) Because this testing project had nine specific target analytes expected to be at much lower concentration levels than 1 ppm, continuing system calibrations were conducted using the nine target analytes themselves at a 300 ppb concentration level. This procedure gave a much better indication of the GCMS ability to quantify accurately the target analtyes at such low concentration levels.

Achieving the criteria for a valid mass spectral tune and achieving the internal standard relative mass abundances during each GCMS run (see Tables 3 and 4 of the method) verify the continuing instrument performance and ensure that the QA/QC of the method are achieved. Achieving the criteria for a valid tune also allows searches of the NIST Mass Spectral library for compounds that are not contained in the instrument specific calibration. Tables 6-2 through 6-4 present the daily system continuing calibration results.

Table 6-1. GCMS Three-Point Calibration Results and Estimated Detection Limits

Full Scan Calibration (45-300 amu)			Limited Full Scan Calibration (50-125 amu)			SIM1 (ions 57, 86, 78, 91, 104, 69 & 117)			SIM2 (ions 78, 91.104, 69 &117)		
Compounds FSM	3-Point Calibration[1] % RSDs *	Estimated DLs - PPB	Compounds LFS	3-Point Calibration[1] % RSDs *	Estimated DLs - PPB	Compounds SIM1	3-Point Calibration[2] % RSDs *	Estimated DLs - PPB	Compounds SIM2	3-Point Calibration[2] % RSDs	Estimated DLs - PPB
Chloromethane	6.5	30	1,3 Butadiene	7.5	300	1,3 Butadiene	1.6	50	Benzene	2.9	0.9
Chloroethane	6.1	30	Hexane	6.4	60	Hexane	10.1	20	Toluene	5.5	0.9
Methylene Chloride	6.3	30	Benzene	3.1	12	Benzene	8.5	2	Ethyl Benzene	6	1
1,1-dichloroethane	7.5	30	Toluene	3.3	5	Ethyl Benzene	11.1	2	m/p-Xylenes	5.3	1
c-1,3-dichloroethene	8.1	30	Ethyl Benzene	2.1	12	m/p-Xylenes	9.8	2	Styrene	7.2	2
1,1,1-trichloroethane	3.9	30	m/p-Xylenes	1.8	7.5	Styrene	8.1	5	o-Xylene	9.5	2
1,2-dichloropropane	7.9	15	Styrene	3.9	10	o-Xylene	7.3	5			
1,1,2-trichloroethane	5.9	15	o-Xylene	3.4	15						
Dibromochloromethane	6.3	15									
Ethylbenzene	4.6	12									
p-xylene	4.5	10									
1,1,2,2-tetrachloroethane	0.9	15									
Bromomethane	6.6	30									
1,1-dichloroethene	4.8	30									
t-1,2-dichloroethene	5.5	30									
MEK	3.9	75									
1,2-dichloroethane	7.8	30									
Carbon tetrachloride	6.6	15									
Trichloroethene	4.1	15									
c-1,2-dichloropropene	5.1	15									
t-1,2-dichloropropene	5.8	15									
2-hexanone	8.1	500									
Chlorobenzene	3.7	50									
m-xylene	4.8	10									
0-xylene	8.9	15									
Vinyl chloride	2.3	15									
Carbon disulfide	1.3	7									
Vinyl acetate	2.6	75									
Chloroform	2.6	15									
Benzene	1.6	15									
Bromodichloromethane	3.7	15									
MIBK	10.1	500									
Toluene	4.1	7									
TCE	1.6	15									
Bromoform	2.1	15									
Styrene	2.9	25									

1. Calibration conducted at 10 ppm, 1 ppm and 300 ppb
2. Calibration conducted at 100 ppb, 50 ppb, and 20 ppb

- GCMS method criteria for valid calibration is within 20% RSD

Table 6-2 System Continuing Calibration Check Results							
7/23/98			DF =0.03				
Cylinder #ICCR							
Compound	Area	RF	ARF*	ppm - tag	ppm-exp	ppm-obs	% Diff **
TRIS	3271835	3.29E+05	2.80E+05	NA	NA	NA	NA
BPFB	7014327	1.45E+06	1.50E+06	NA	NA	NA	NA
		RRF	ARRF				
1,3-Butadiene	nd	#VALUE!	0.31	10.00	0.30	nd	**#VALUE!**
Hexane	111798	1.12	1.45	10.10	0.30	0.29	**-4%**
Benzene	1537111	15.41	15.26	10.10	0.30	0.31	**2%**
Toluene	1305132	13.22	15.22	10.00	0.30	0.34	**13%**
Ethyl Benzene	1667974	3.81	4.02	10.10	0.30	0.38	**25%**
m/p-Xylene	2378401	2.71	3.39	20.20	0.61	0.69	**14%**
Styrene	679144	1.57	2.05	10.00	0.30	0.38	**27%**
o-Xylene	1291092	2.98	3.35	10.00	0.30	0.38	**27%**

* ARRF and ARF from Calibration Curve

** Valid System Continuing Calibration QA are within 20% for 1 ppm.

No criteria have been established for system continuing calibrations at 300 ppb.

Table 6-3 System Continuing Calibration Check Results

7/24/98			DF = 0.03				
Cylinder #ICCR							
Compound	Area	RF	ARF*	ppm - tag	ppm-exp	ppm-obs	% Diff **
TRIS	3745367	3.77E+05	2.80E+05	NA	NA	NA	NA
BPFB	8321812	1.72E+06	1.50E+06	NA	NA	NA	NA
		RRF	ARRF				
1.3-Butadiene	23687	0.21	0.31	10.00	0.30	0.3	**0%**
Hexane	122209	1.07	1.45	10.10	0.30	0.28	**-8%**
Benzene	1381665	12.10	15.26	10.10	0.30	0.25	**-17%**
Toluene	1132306	10.02	15.22	10.00	0.30	0.28	**-7%**
Ethyl Benzene	1287195	2.48	4.02	10.10	0.30	0.3	**-1%**
m/p-Xylene	1822517	1.75	3.39	20.20	0.61	0.55	**-9%**
Styrene	549654	1.07	2.05	10.00	0.30	0.33	**10%**
o-Xylene	1044418	2.03	3.35	10.00	0.30	0.31	**3%**

* ARRF and ARF from Calibration Curve

** Valid System Continuing Calibration QA are within 20% for 1 ppm.

No criteria have been established for system continuing calibrations at 300 ppb.

Table 6-4 System Continuing Calibration Check Results

7/25/98			DF = 0.03				
Cylinder #ICCR							
Compound	Area	RF	ARF*	ppm - tag	ppm-exp	ppm-obs	% Diff **
TRIS	3802228	3.83E+05	2.80E+05	NA	NA	NA	NA
BPFB	9090581	1.87E+06	1.50E+06	NA	NA	NA	NA
		RRF	ARRF				
1,3-Butadiene	29967	0.26	0.31	10.00	0.30	0.35	**17%**
Hexane	114860	0.99	1.45	10.10	0.30	0.26	**-14%**
Benzene	1178802	10.17	15.26	10.10	0.30	0.21	**-31%**
Toluene	920989	8.03	15.22	10.00	0.30	0.25	**-17%**
Ethyl Benzene	1321394	2.33	4.02	10.10	0.30	0.29	**-4%**
m/p-Xylene	1998716	1.76	3.39	20.20	0.61	0.55	**-9%**
Styrene	568219	1.01	2.05	10.00	0.30	0.32	**7%**
o-Xylene	954218	1.70	3.35	10.00	0.30	0.29	**-3%**

* ARRF and ARF from Calibration Curve

** Valid System Continuing Calibration QA are within 20% for 1 ppm.

No criteria have been established for system continuing calibrations at 300 ppb.

7.0 DISCUSSION OF TEST PROGRAM AND RESULTS

Concentration results from the tunnel exhaust duct were very low, generally less than 20 parts per billion for the compounds detected. Timing issues regarding how to sample the effluent effectively during the batch load out process were resolved using the 45 second GC sample loop equilibration combined with the 15 second notice from the process monitoring personnel. The validity of the sample timing in the direct interface mode of operation was verified using the secondary Tedlar bag sampling/analysis technique. Results from direct interface testing were generally in good agreement with the Tedlar bag samples.

Concentration results from the silo exhaust duct were higher that those observed from the tunnel load out operations. Numerous compounds were detected in the silo exhaust. Compounds that were test program specific (as well as those that were not) were identified and quantified from this location. One compound, methyl ethyl ketone (MEK), was quantified in two samples at much higher concentrations than the other compounds detected from this source. It is likely that results for MEK are biased low due to the relatively high water vapor content of the effluent and the water soluble nature of this compound.

Using the HAPSITE GCMS in the fully portable mode of operation combined with using the portable sampling systems allowed for collection and on-site data analysis from four separate locations over a three-day period. All sampling, QA/QC activities, and analytical procedures were conducted from the rear compartment of a rental mini-van or at the actual sampling location. Transporting the instrumentation to the actual test location eliminated much of the conventional sampling apparatus and electrical power requirements. Operation in this fully portable mode proved to be efficient while providing data that met the QA requirements of the test method and the data quality objectives of the test program.

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EMISSION MONITORING INC.
EFFECTIVE SOLUTIONS AND ADVANCED TECHNOLOGIES

DIRECT INTERFACE GCMS TESTING

AGGREGATE DRYER BAGHOUSE STACK

Prepared Under Subcontract to:

Pacific Environmental Services
Subcontract NO. 68-D-98-004-FP-002
U.S. EPA Contract NO. 68-D-98-004

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1.0 INTRODUCTION

The United States Environmental Protection Agency (U.S. EPA) requested use of a portable gas chromatograph-mass spectrometer based analyzer (HAPSITE™) to identify and quantify volatile organic hazardous air pollutants from various emissions points at [redacted] [redacted] The EPA requested specifically that the instrumentation be operated in the fully portable mode without use of a heated extractive sampling system so that the test locations could be accessed quickly and easily. The GCMS instrumentation was developed by Leybold-Inficon, and has been evaluated extensively by Emission Monitoring Incorporated (EMI)[1]. Numerous industrial stationary sources have been tested using this instrumentation in accordance with the method entitled "Determination of Gaseous Organic Compounds by Direct Interface GCMS". This method was developed by EMI and Inficon and has been accepted by the U.S. EPA as an alternate test method for numerous stationary sources (ALT-017), and as a conditional test method (CTM-28). The method and documentation are available on-line from the EPA Website, and a copy of the method is provided in Appendix A.

Pacific Environmental Services (PES) subcontracted EMI to perform direct interface GCMS testing at the hot mix asphalt load out tunnel, and at the asphalt silo storage vent. While on-site, EMI was asked to conduct additional testing at the aggregate dryer baghouse stack and at the exit of the load out tunnel. The results from testing performed at the aggregate dryer baghouse stack only are presented in this report. The primary objective of the testing was to characterize and quantify nine specific volatile organic hazardous air pollutants (benzene, toluene, o,m,p-xylenes, styrene, ethyl benzene, 1,3-butadiene, and hexane). EMI was asked to focus the testing for these specific analytes as a subset of the analytes identified in Section 1 of the Method.

The sampling system used employs an unheated stainless steel probe and 0.3 micron quartz fiber filter, a stainless steel heat exchanger and two glass mini impingers for moisture removal, a Teflon head diaphragm pump, and Teflon tubing to convey sample gas to the GCMS instrumentation. This configuration was used because the moisture content of the effluent exceeded that acceptable for the instrumentation. Use of this sampling methodology allows for direct measurement of volatile organic compounds at remote sources and allows for quicker set-up, and sampling and analysis than could be achieved using conventional heated sample transport lines.

On-site analysis after each sample acquisition was performed to determine whether the method QA was achieved, and to inform the PES Project Manager of the concentration levels observed in the effluent matrix. Numerous representatives from the EPA and CAAP were present to observe the testing, QA/QC activities and the on-site data analysis. Representatives from Research Triangle Institute were present also to serve as test program auditors.

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[1] "Evaluation of HAPSITE and a Direct Interface GCMS Test Method for Measurement of Volatile Organic Compounds in Stationary Source Emissions," Vol. I &II. Prepared for Leybold Inficon Incorporated by Emission Monitoring Incorporated July 1997.

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2.0 AGGREGATE DRYER BAGHOUSE STACK CONCENTRATION RESULTS

Testing at the dryer baghouse stack was conducted on 7-25. The GCMS and portable sampling system were pulled up on top of the baghouse to sample directly from the port. This location was very challenging for the instrumentation because of vibration and high ambient temperatures (approximately 95-100°F). Three 10-minute GCMS sample runs were performed in succession. Most of the target analytes were detected at concentrations of from 10 to 330 ppb. Immediately after acquiring the second sample, the dryer was observed visually to shut down, and then later observed to restart. It is unknown whether the second and third sample are representative of normal dryer operation. The measurement system passed the individual run criteria at this challenging location.

Table 2-1 presents the GCMS concentration results for the aggregate dryer baghouse stack, and the associated instrument detection limits.

3.0 PROCESS DESCRIPTION

No process specific information is available at this time.

4.0 SAMPLING LOCATION

No sampling location information is available at this time.

5.0 SAMPLING AND ANALYTICAL PROCEDURES

The sampling and analytical procedures used during this testing program followed those detailed in the direct interface GCMS test method (Appendix A). Figure 5-1 presents a method operational flow chart.

The instrument was calibrated specifically for this test project using nine of the target analytes identified in Section 1 of the method. Additionally, the instrument was calibrated for all compounds identified in Section 1 of the method approximately one month before this test. Both calibration curves were used to identify and to quantify the detected volatile organic compounds.

Instrument specific calibrations were conducted in the laboratory using the limited full scan mode of operation. In the limited full scan, all of the mass fragments in the nine-target analytes mass spectrum are generated in every run. Additional instrument calibrations were conducted for these nine analytes using a selected ion monitoring (SIM) mode of operation. In this mode, only a select few ions are measured in each compounds mass spectrum. Although this method of operation gives less information regarding the compounds true identity, it necessarily improves the instrument sensitivity because of the increased number of scans achieved per chromatographic peak. The combination of using limited full scan and SIM scan modes of operation give positive identification of the individual analytes while increasing the instrument sensitivity.

System continuing calibration verification was conducted daily through the portable sampling system using all of the test specific target analytes. The system calibrations were preformed in the rear compartment of a rental minivan. For testing conducted at the dryer baghouse stack, the GCMS was disconnected from the sampling system, transported to the actual sampling location, and then reconnected to the sampling system after passing a leak check.

5.1 Sampling Procedures

5.1.1 Direct Interface GCMS Sampling

Effluent gas samples were withdrawn at a constant flow rate from a single point located approximately one foot inside of the stack using a Teflon head diaphragm pump. Effluent was sampled at approximately 3 liters per minute for no less than 5 minutes before sample acquisition in order to equilibrate fully all sampling system components. It is estimated that the sample residence time through the sampling system is less than one-minute at this flow rate.

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The sampling system used for application is constructed out of stainless steel and utilizes a 0.3μ quartz Balston filter for particulate removal, followed by a heat exchanger and two mini impingers for moisture removal.

The gas flow through the sampling system is unique in that after passing through the heat exchanger and mini impingers, the dried gas is directed back through the heat exchanger for reheating before introduction into the instrumentation. Figure 5-2 presents a simplified diagram of the portable sampling system used at the aggregate dryer baghouse stack.

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Table 2-1. Direct Interface GCMS Results - [redacted] Aggregate Dryer Baghouse Stack

Sample Identification	Date	Acquisition Time	Compounds Detected	Concentration - PPB	GCMS Method[3]	Matrix Specific Detection Limit
Dryer01	7/25/98	13:53	Benzene	10	LFS	5 ppb
			Toluene	110		5 ppb
Dryer02[1]	7/25/98	14:05	Benzene	260	SIM2	0.9 ppb
			Toluene	80		0.9 ppb
			Ethyl Benzene	10		1 ppb
			m/p-Xylene	50		1 ppb
			Styrene	50		2 ppb
			o-Xylene	18		2 ppb
Dryer03[2]	7/25/98	14:17	Benzene	330	SIM2	0.9 ppb
			Toluene	110		0.9 ppb
			Ethyl Benzene	10		1 ppb
			m/p-Xylene	80		1 ppb
			Styrene	130		2 ppb

1. Plant upset condition - rotary dryer shuts down approximately 2 minutes after sample acquisition
2. Sample acquired approximately 15 minutes after rotary dryer re-start
3. LFS - limited full scan operation from 50-125 amu

SIM2 - selected ion method specific for:

- benzene
- toluene
- ethyl benzene
- o,m,p-xylenes
- styrene

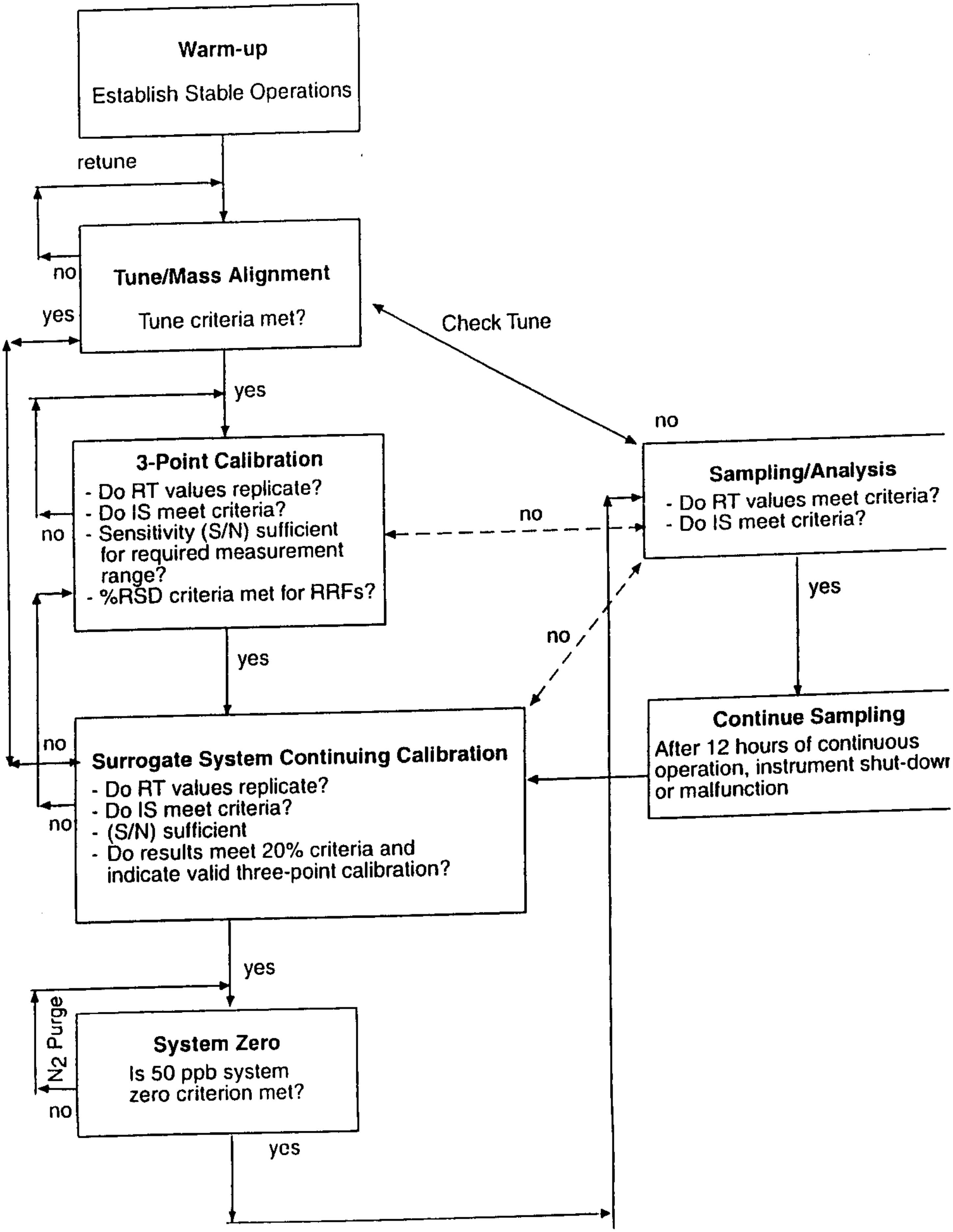

Figure 5-1 Direct Interface GCMS Method Operational Flowchart

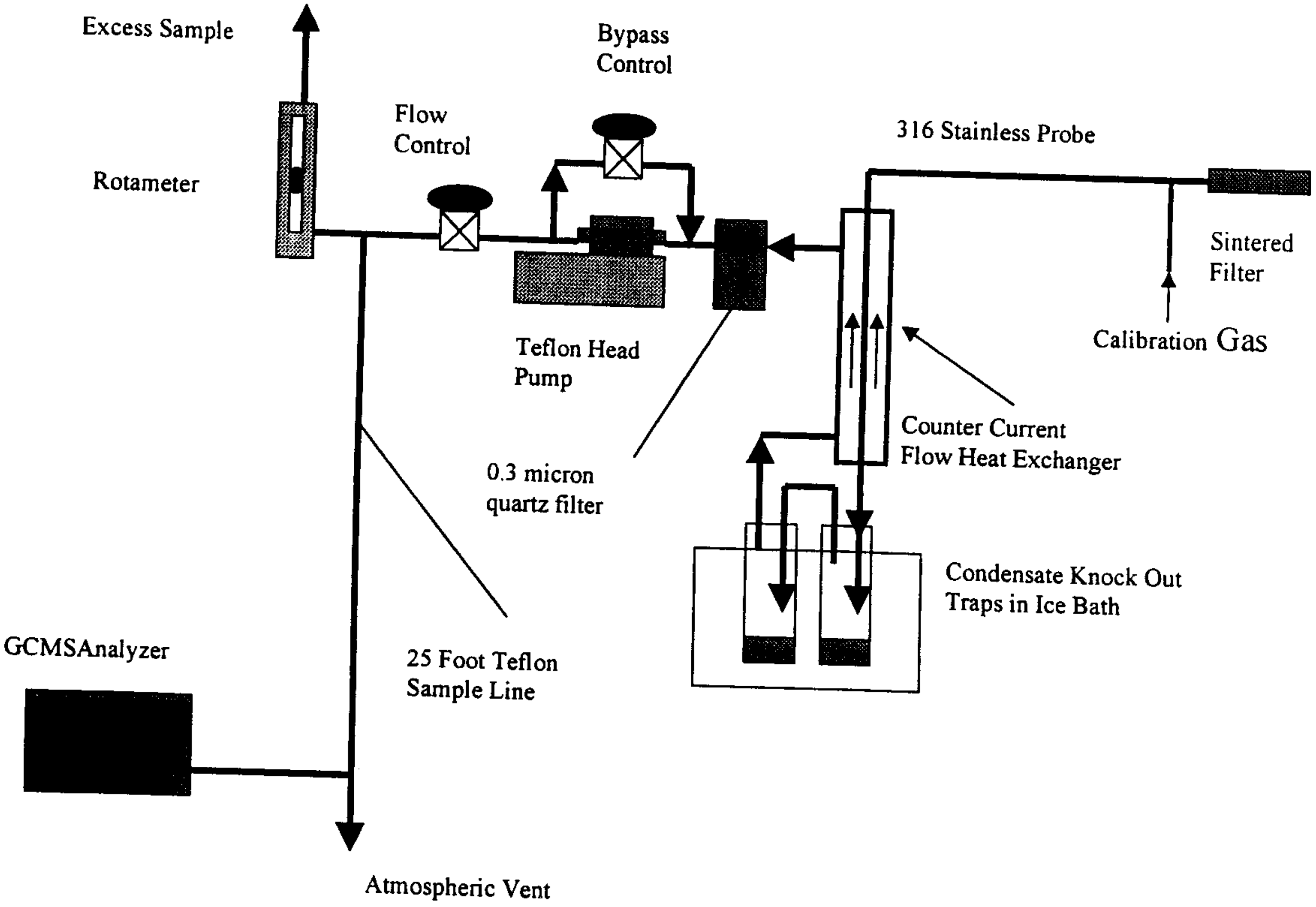

Figure 5-2 High Moisture Portable Sampling System

6.0 QUALITY ASSURANCE/QUALITY CONTROL

6.1 Initial Calibration and Daily Calibration Check Procedures

Establishing a valid three-point calibration requires a 20 percent relative standard deviation (%RSD) for each individual analyte over the calibration range. Two calibration curves were generated in each of the full scan and SIM scan acquisition methods in the EMI Laboratory. Calibration was performed by conducting two successive GCMS runs each at three concentration levels; 10 ppm, 1 ppm and 300 ppb for the full scan calibration curves, and 100 ppb, 50 ppb and 20 ppb for the SIM scan calibration curves. Section 10 of the method details the calculation procedures used to determine the %RSD for each of the analytes. Table 6-1 presents the target analytes, the results from the three-point calibration in terms of %RSD, and the estimated detection limits for each of the four calibration curves.

Daily system calibrations were conducted to check both the validity of the initial instrument three-point calibration and the effectiveness of the sampling system to transport the target analytes. Daily system calibration check procedures were conducted after accomplishing a successful instrument tune using the blended mixture of the internal standards. Immediately following the system continuing calibration, nitrogen was allowed to flow through the system and a system blank was acquired. No analytes were detected in the blank analysis.

The direct interface GCMS test methods requires that continuing system calibrations be conducted using a blended mixture of six surrogate compounds at 1 ppm. (See Table 6 of the method.) Because this testing project had nine specific target analytes expected to be at much lower concentration levels than 1 ppm, continuing system calibrations were conducted using the nine target analytes themselves at a 300 ppb concentration level. This procedure gives a much more realistic estimate of the ability of the GCMS to quantify accurately the target analytes at low concentration levels.

Achieving the criteria for a valid mass spectral tune and achieving the internal standard relative mass abundances during each GCMS run (see Tables 3 and 4 of the method) verify the continuing instrument performance and ensure that the QA/QC of the method are achieved. Table 6-2 presents the daily system continuing calibration results.

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Table 6-1. GCMS Three-Point Calibration Results and Estimated Detection Limits

Full Scan Calibration (45-300 amu)			Limited Full Scan Calibration (50-125 amu)			SIM1 (ions 57, 86, 78, 91, 104, 69 & 117)			SIM2 (ions 78, 91,104, 69 &117)		
Compounds	3-Point Calibration[1]	Estimated	Compounds	3-Point Calibration[1]	Estimated	Compounds	3-Point Calibration[2]	Estimated	Compounds	3-Point Calibration[2]	Estimated
FSM	% RSDs *	DLs - PPB	LFS	% RSDs *	DLs - PPB	SIM1	% RSDs *	DLs - PPB	SIM2	% RSDs	DLs - PPB
Chloromethane	6.5	30	1,3 Butadiene	7.5	300	1,3 Butadiene	1.6	50	Benzene	2.9	0.9
Chloroethane	6.1	30	Hexane	6.4	60	Hexane	10.1	20	Toluene	5.5	0.9
Methylene Chloride	6.3	30	Benzene	3.1	12	Benzene	8.5	2	Ethyl Benzene	6	1
1,1-dichloroethane	7.5	30	Toluene	3.3	5	Ethyl Benzene	11.1	2	m/p-Xylenes	5.3	1
c-1,3-dichloroethene	8.1	30	Ethyl Benzene	2.1	12	m/p-Xylenes	9.8	2	Styrene	7.2	2
1,1,1-trichloroethane	3.9	30	m/p-Xylenes	1.8	7.5	Styrene	8.1	5	o-Xylene	9.5	2
1,2-dichloropropane	7.9	15	Styrene	3.9	10	o-Xylene	7.3	5			
1,1,2-trichloroethane	5.9	15	o-Xylene	3.4	15						
Dibromochloromethane	6.3	15									
Ethylbenzene	4.6	12									
p-xylene	4.5	10									
1,1,2,2-tetrachloroethane	0.9	15									
Bromomethane	6.6	30									
1,1-dichloroethene	4.8	30									
t-1,2-dichloroethene	5.5	30									
MEK	3.9	75									
1,2-dichloroethane	7.8	30									
Carbon tetrachloride	6.6	15									
Trichloroethene	4.1	15									
c-1,2-dichloropropene	5.1	15									
t-1,2-dichloropropene	5.8	15									
2-hexanone	8.1	500									
Chlorobenzene	3.7	50									
m-xylene	4.8	10									
0-xylene	8.9	15									
Vinyl chloride	2.3	15									
Carbon disulfide	1.3	7									
Vinyl acetate	2.6	75									
Chloroform	2.6	15									
Benzene	1.6	15									
Bromodichloromethane	3.7	15									
MIBK	10.1	500									
Toluene	4.1	7									
TCE	1.6	15									
Bromoform	2.1	15									
Styrene	2.9	25									

1. Calibration conducted at 10 ppm, 1 ppm and 300 ppb
2. Calibration conducted at 100 ppb, 50 ppb, and 20 ppb

* GCMS method criteria for valid calibration is within 20% RSD

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Table 6-2 System Continuing Calibration Check Results

7/25/98			DF = 0.03				
Cylinder #ICCR							
Compound	Area	RF	ARF*	ppm - tag	ppm-exp	ppm-obs	% Diff **
TRIS	3802228	3.83E+05	2.80E+05	NA	NA	NA	NA
BPFB	9090581	1.87E+06	1.50E+06	NA	NA	NA	NA
		RRF	ARRF				
1.3-Butadiene	29967	0.26	0.31	10.00	0.30	0.35	17%
Hexane	114860	0.99	1.45	10.10	0.30	0.26	-14%
Benzene	1178802	10.17	15.26	10.10	0.30	0.21	-31%
Toluene	920989	8.03	15.22	10.00	0.30	0.25	-17%
Ethyl Benzene	1321394	2.33	4.02	10.10	0.30	0.29	-4%
m/p-Xylene	1998716	1.76	3.39	20.20	0.61	0.55	-9%
Styrene	568219	1.01	2.05	10.00	0.30	0.32	7%
o-Xylene	954218	1.70	3.35	10.00	0.30	0.29	-3%

* ARRF and ARF from Calibration Curve

** Valid System Continuing Calibration QA are within 20% for 1 ppm.

No criteria have been established for system continuing calibrations at 300 ppb.

APPENDIX A

DIRECT INTERFACE GCMS TEST METHOD

MANUFACTURERS CERTIFICATES OF ANALYSIS

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Also Available on Line @
http://www.epa.gov/ttn/emc/approalt.
(ALT-017) 3-17-98

DETERMINATION OF GASEOUS ORGANIC COMPOUNDS BY DIRECT INTERFACE GAS CHROMATOGRAPHY-MASS SPECTROMETRY

INTRODUCTION

This document describes the key elements of a sampling and analytical method for measurement of specific volatile organic hazardous air pollutants (VOHAPs) using a direct interface gas chromatograph/mass spectrometer (GCMS) for on-site analysis of emissions from stationary sources. The method provides concentration measurement results for the extracted gas samples. The performance-based approach validates each GCMS analysis by placing boundaries on the instrument response to internal standards and their specific mass spectral relative abundances.

1.0 SCOPE and APPLICATION

1.1 Analytes. This method employs a direct interface GCMS measurement system designed for the identification and quantification of the specific 36 volatile organic compounds listed below. The method has potential to be extended to many other compounds provided the performance criteria detailed in this method are met.

Benzene-71432
Bromodichloromethane-75274
Carbon Disulfide-75150
Cloroform-67663
Methyl iso-Butyl Ketone-108101
Styrene-100425
Tetrachloroethylene-127184
Toluene-108883
Bromoform-75252
Vinyl Acetate-108054
Vinyl Chloride-75014
Chloromethane-74873
cis-1,2-Dichloroethene-156592
Dibromochloromethane-124481
1,1-Dichloroethane-107062
1,2-Dichloropropane-78875
Ethyl benzene-100414
Ethyl chloride-75003
Methylene Chloride-75092
1,1,2,2-Tetrachloroethane-79349
1,1,1-Trichloroethane-71556
1,1,2-Trichloroethane-79005
p-Xylene-106423
Bromomethane-74839
Carbon Tetrachloride-56235
Chlorobenzene-108907
c-1,2-Dichloropropene-10061015
1,2,-Dichloroethane-156592
1,1-Dichloroethene-75354
t-1,2-Dichloroethene-156605
Methyl Ethyl Ketone-78933
2-Hexanone-591786
t-1,2-Dichloropropene-542756
Trichloroethene-79016
m-Xylene-108383
o-Xylene-95476

1.2 Applicability.

1.2.1 The method is applicable for the determination of the above listed compounds in emissions from stationary sources. Individual volatile hazardous air pollutants (VOHAPs) are detected and quantified by direct interface of a gas chromatograph/mass spectrometer (GCMS) measurement system to the source effluent. This method applies specifically to full scan operation (between 45 and 300 amu) of the mass spectrometer.

1.2.2 The method is applicable to direct measurement of unconditioned sample streams having moisture content less than the saturation value at applicable instrument operating limits. Sample streams having higher moisture content require conditioning before introduction into the analytical instrumentation that prevents moisture condensation within the instrument. Additional QA requirements are provided in the method for the analysis of polar, water-soluble compounds

1.3 Method Range and Sensitivity.

1.3.1 The instrument range shall be sufficient to measure from 150 ppbv to 100 ppmv. Measurement of concentrations outside of this range may be conducted provided that the specific performance requirements of the method are met and either a) the concentrations used to prepare the three-point and conduct the continuing calibration concentration are adjusted appropriately or b) the three-point calibration is extended to include additional concentrations. The sensitivity of the GCMS measurement system for the individual target analytes depends upon: a) the specific instrumental response for each target analyte, and the number of mass spectral quantification ions available, b) the amount of instrument noise, and c) the percent moisture content of the sample gas.

1.4 Data Quality Objectives

1.4.1 The overall data quality objectives are to achieve an accuracy of ±20% and precision of ±10% for each measurement value. Specific method performance criteria are detailed in Section 10 and listed in Tables 1, 2, 3, and 4. Achieving the method performance criteria enable meeting the data quality objectives.

1.4.2 The mass spectrometer tune should be established according to the manufacturers written instructions.

1.4.2.1 If NIST Library search able mass spectra are needed to identify compounds not included in the three-point calibration or to facilitate comparison with other mass spectral analyses, the mass spectrometer tune must be able to produce mass spectra for bromofluorobenzene (BFB) that meet the relative abundance criteria listed in Table 2. NIST Library search able spectra are not required for the quantification of target analytes.

1.4.2.2 Table 3 presents a specific example of applicable MS tune limits for the mixture of two recommended internal standards (1,3,5 (TRIS) trifluoromethylbenzene and bromopentafluorobenzene (BPFB)). These criteria have been demonstrated to produce an acceptable instrumental response for BFB. Table 4 presents a specific example of applicable ion abundance criteria for the two co-injected, GC separated, internal standards. Proper and consistent GCMS response is ensured in each run by meeting the Table 3 and Table 4 QA criteria.

1.4.3 An initial three-point calibration must be conducted to establish the instrument response for each target analyte over the measurement range. At a minimum, duplicate GCMS analyses at each of three calibration levels are required. The percent relative standard deviation (RSD) must be within 20% for these analyses. The signal to noise ratio also must be sufficient to establish the target analytes responses at the lowest concentration level in full scan operation. A signal to noise ratio of 10:1, and an average relative response factor >0.25 (Section 10. Equation 2) should be sufficient. The same MS tune conditions, GC operating conditions, and data quantification procedures that are used to establish the three-point calibration curve must be used also to acquire and quantify samples and to perform continuing calibrations.

1.4.4 A system continuing calibration check must be conducted each day before performing effluent measurements, before resuming sampling after each instrument shut down for maintenance or corrective action, and before analyzing additional samples after twelve hours of continuous operation. The six surrogate check compounds listed in Table 5 may be used to determine the validity of the three-point calibration curve for the 36 analytes listed in 1.1. Acceptable results are indicated if analysis of the continuing system calibration using the three-point calibration curve produces results within ±20% of the expected value (i.e., manufacturer's certified value for compressed gas standards). Acceptable continuing calibration results for each analyte or each surrogate allow use of the previously developed three-point calibration for analysis of effluent samples for those analytes or for those analytes that correspond to each surrogate (see Table 6).

1.4.5 A system continuing calibration check must be performed after each test run when analyzing for polar, water-soluble compounds when moisture removal is used. (The polar-water soluble compounds include methyl ethyl ketone, 2-hexanone, vinyl acetate, and methyl isobutyl ketone.) This continuing calibration check must be performed immediately after sampling the effluent (i.e., while the potential for residual moisture in the sample conditioning components is greatest). Unacceptable results for this continuing calibration check invalidate the run for polar, water-soluble compounds. Such results may indicate loss of water-soluble compounds in the sample conditioning components. Corrective action shall be taken before the next sample run. Specific sampling system designs that have been demonstrated to achieve adequate sample recoveries for water soluble compounds at higher moisture levels than encountered during the test are exempt from the requirement to conduct the post-test continuing calibration check. (Such demonstrations can be accomplished by performing analyte spiking at elevated moisture levels. The tester shall maintain documentation of such sampling system demonstrations.) For sampling systems that qualify for this exemption, the effluent shall be sampled for a period of at least 15 minutes prior to conducting the system continuing calibration check in 1.4.4.

2.0 METHOD SUMMARY

2.1 Analytical Principle. Gas chromatography (GC) is a means of separating gaseous mixtures of molecules by their affinity for the column's stationary and mobile phases. Sample gas is introduced into the GCMS via a pneumatic valve assembly or equivalent. In this application, an internal standard mixture must be quantitatively co-added to every sample.

2.1.1 As molecules elute from the GC column, they must be separated from the mobile phase carrier gas and enter the mass spectrometer. Because the GC operates at near ambient pressure and the MS operates at greatly reduced pressure (approximately 1×10^{-5} Torr), an interface is required. Upon entering the mass spectrometer, separated molecules are subjected to ionizing energy that causes an electron(s) to be ejected from the molecule. The result is a positively charged molecule (for electron ionization) that fragments while achieving a stable electronic configuration.

2.1.2 The mass spectrometer scans a defined mass range (from 45-300 amu in this application) enabling detection of the individually charged fragments, which are virtually unique for every molecule. Positive identification of target analytes is achieved by; 1) comparing eluting analyte GC peak retention times in the total ion chromatogram to those contained in the three-point calibration, and 2) by examining the mass spectral pattern of the eluted peaks.

2.1.3 The compounds listed in 1.1 and the internal standards can be separated and detected in a 10 to 15 minute isothermal GC run.

2.2 Sampling. The sample interface system must have a response time that provides a fully equilibrated sample to the GCMS analyzer within the GC sample analysis cycle time. The sample interface system should include provisions to facilitate direct calibrations of the GCMS instrument and system calibrations where calibration gases are introduced at the extractive probe outlet, upstream of the primary particulate filter. The sample interface system also must extract continuously effluent sample during the period between the consecutive GCMS sample acquisitions.

2.2.1 Sample Extraction. Sample is extracted from the stack or duct and passes through the entire sample interface system at a constant rate. The sample interface consists of a heated primary particulate filter, a heated pump, heated Teflon sample line, and sample conditioning unit. All sample extraction components must be maintained at temperatures sufficient to prevent moisture condensation within the measurement system components. (Other sampling techniques involving bags, canisters, adsorbents, etc. are not addressed by this method.)

2.2.2 Sample Conditioning. The conditioning unit is operated to protect the GCMS instrument from particulate and other condensable mater and remove excess sample moisture, if necessary. The following information is provided as an example of an acceptable arrangement. All components within the conditioning unit (except for the condenser, if applicable) must be maintained at, or above, the temperature of the GC introduction valve assembly. The secondary particulate filters should be maintained at a temperature approximating that of the GC introduction valve assembly. Sample gases that are free of condensable acids and that contain less than the saturated moisture at the highest dew point (i.e., lowest temperature, and highest pressure) within the instrument can be analyzed without moisture removal by allowing the entire sample stream to bypass the condenser. Sample streams containing higher moisture levels may be dried by directing the entire sample stream through the condenser to reduce the moisture content to an acceptable level. Alternatively, a portion of the sample stream may be directed through the condenser and a portion of the sample stream may bypass the condenser to reduce the loss of certain analytes. The flow of sample that bypasses the condenser and the condenser operating temperature must be carefully chosen based on knowledge of the unconditioned gas stream moisture content. The flow rate of sample gas through the condenser and the total sample flow rate must be monitored using calibrated precision rotometers and recorded.

2.2.3. Sample Transfer Line. A connection line that is heated to the temperature of the GC introduction valve conveys sample gas exiting the conditioning unit to the GCMS analyzer. An internal sample pump within the GCMS analyzer is required to draw sample gas through the connection line at a rate substantially less than the total sampling rate. The excess sample gas exiting the conditioning unit must be vented at atmospheric pressure so that the inlet on the connection line is not pressurized.

2.3 Operator Requirements. The operator should have rudimentary knowledge of the GCMS instrumental operating conditions that are sufficient to determine if the operation is consistent with the data quality objectives of the method.

3.0 DEFINITIONS

Refer to Appendix A of this document for a list of definitions.

4.0 INTERFERENCES

4.1 Analytical Interferences. Analytical interferences are defined as those interferences which result in chromatographic peak and quantion overlap to such an extent that quantification of specific target compounds is prohibited. The nature of the GCMS technique virtually eliminates analytical interferences.

4.2 Sampling System Interferences. Sampling system interferences prevent the transport of target analytes to the instrumentation or have the potential to damage the measurement system components. Water, reactive particulate matter, adsorptive sites within the sampling system components, and acid gases are examples of such potential sampling system interferences. Specific provisions and performance criteria are included in this method to detect the presence of sampling system interferences.

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5.0 SAFETY

5.1 Target Analytes. Many of the compounds listed in Section 1 are toxic and carcinogenic. Therefore, exposure to these chemicals should be limited. Compound mixtures are contained in compressed gas cylinders, and the appropriate safety precautions should be taken to avoid accidents in their transport and use.

5.2 Sampling Location. This method may involve sampling at locations having a high positive or negative pressure, or have a high temperature, elevated height, or high concentration of hazardous or toxic pollutants.

5.3 Mobile or Remote Laboratory. A leak check of the sampling system and an inspection of sample exhaust equipment should be performed before sampling the calibration standards or effluent to protect personnel in the laboratory.

6.0 EQUIPMENT AND SUPPLIES

The equipment and supplies are based on the generalized sampling system schematic shown in Figure 1.

6.1 Instrumentation

6.1.1 Gas Chromatograph/Mass Spectrometer. A GCMS system capable of separating the analyte mixture and detecting compounds having a 45-300 atomic mass unit (amu) range. This system must also include a means of co-injecting a gaseous internal standard mixture with sample gas at a precise and known ratio. A personal computer with compatible GCMS software is needed for data quantification.

6.1.2 Data Acquisition System. A data acquisition system and appropriate software that enables the analyst to acquire and quantify the target analytes and which allows for adequate storage of data.

6.2 Sampling System

6.2.1 Sampling Probe. Glass, stainless steel or other appropriate material of sufficient length and physical integrity to sustain heating, prevent adsorption of analytes and to reach the gas sampling point.

6.2.2 Pump. A leak-free, heated head pump (KNF Neuberger or equivalent) capable of maintaining an adequate sample flow rate (at least 1.5 lpm).

6.2.3 Calibration Assembly. Apparatus allowing the introduction of calibration gases into the sampling system at the probe outlet, upstream of the primary particulate filter. The apparatus shall be designed to ensure that calibration gases are introduced at the same pressure as effluent samples or shall include provisions for monitoring the sample pressure at the calibration introduction point both during calibrations and during effluent sampling. The calibration assembly shall ensure that the calibration gases are at the same temperature as the sample gases at the introduction point.

6.2.4 Sampling Line. Heated to a temperature sufficient to prevent sample condensation, and fabricated of stainless steel, Teflon™, or other material that minimizes adsorption of analytes and transports effluent to the GCMS. The length of heated transport line should be minimized.

6.2.5 Sample Condenser System. Peltier Cooler (or equivalent) capable of reducing the moisture of the sample gas to a level acceptable for sample injection.

6.2.6 Sample Flow Rotometers. Calibrated rotometers capable of withstanding sample gas conditions.

6.2.7 Sample Transfer Line. Sample line used to convey sample from the sample interface system to the inlet of the GCMS instrumentation. Heated to a temperature sufficient to prevent sample condensation and fabricated of stainless steel, Teflon™, PEEK™, or other material to minimize adsorption of analytes. The length of heated transport line should be minimized.

6.2.8 Particulate Filters. A filter (Balston™ or equivalent) rated at 0.3 micron for particulate removal is required, and should be placed immediately after the heated probe, and at any place in the sampling system where the physical conditions of the flue gas are changed (i.e. moisture removal).

6.3 Auxiliary Equipment

6.3.1 Calibration Gas Manifold. Gas manifold capable of delivering nitrogen or calibration gases through sampling system, or directly to the instrumentation. The calibration gas manifold should include provisions to provide for accurate dilution of the calibration gases as necessary.

6.3.2 Mass Flow Meters or Controllers. To measure accurately calibration gas flow rate. The meters/controllers should have a stated calibrated range and accuracy (e.g., ±2% of scale from 0-500 cc/min or 0-5 L/min).

6.3.3 Digital Bubble Meter (or equivalent). NIST traceable with an accuracy of ±2% of reading and with an adequate range to calibrate mass flow meters or controllers and rotometers at the specific flow rates ±10% required to perform the method.

6.3.4 Teflon Tubing. Diameter and length suitable to connect cylinder regulators.

6.3.5 Stainless Steel Tubing. 316, appropriate length and diameter for heated connections.

6.3.6 Gas Regulators. Appropriate for individual gas cylinders and constructed of materials that minimize adsorption of analytes.

7.0 REAGENTS AND STANDARDS

7.1 Calibration Gases. Compressed calibration gas standards having a manufacturer's certification of analysis (i.e., a certified analytical accuracy) must be used for the initial calibration and for the continuing calibrations. (Commercially available compressed gaseous standards typically carry manufacturer's certificates of analysis of ±5 to ±10% accuracy.)

7.2 Internal Standards. Gaseous internal standard mixtures for co-injection with sample gas having a manufacturers certification must be used.

7.3 High Purity (HP) Nitrogen or Zero Air. For purging sample lines, sampling system components and for performance of blank runs.

8.0 SAMPLE COLLECTION, PRESERVATION AND STORAGE

8.1 Initial Calibration. An initial three-point calibration for each target compound at nominal concentrations of 300 ppb, 1 ppm and 10 ppm must be prepared to quantify the GCMS data. There are two options available for generating the necessary gas concentrations. (Because of the incompatibility of some target compounds, several cylinders at each concentration are needed to construct a calibration for all of the 36 target analytes listed in 1.1.)

8.1.1 Option 1. Obtain calibration gas standards for the target compounds at the three specified concentration levels.

8.1.2 Option 2. Obtain 10 ppm calibration standards for the target analytes. Perform successive dilutions of the 10 ppm standard with nitrogen using mass flow meters that are calibrated against a NIST traceable digital bubble meter at the specific flow rates (±10%) necessary for dilutions. Dilute the 10 ppm standard to 1 ppm and 300 ppb. If Option 2 is used, analyze the surrogate continuing calibration check standard (see Table 5), or other independent manufacturer's certified gas standard, as a QA audit using the three-point calibration. The audit gas must be a separate gaseous standard. Audit results using the calibrated GCMS must be within ±20% of the manufacturer's certified value for each compound (or for each surrogate compound) to use the three-point calibration for analysis of those analytes (or those analytes for which the surrogates represent).

8.1.3 Perform duplicate GCMS analysis at each concentration level. Calculate relative response factors (RRF's) and average relative response factors (ARRF's) for each target compound at each concentration level (Section 10 Eq 1 and 2). The %RSDs from the three sets of duplicate analyses must be within 20%.

Tables 1-6 contain method QA/QC performance criteria for conducting initial three-point calibrations, and for continuing calibration checks.

8.2 Pretest Preparations and Evaluations.

8.2.1 Flow Rate and Moisture Determination. Perform EPA Methods 1 through 3 if effluent flow rates are required. Perform Method 4, or use wet-bulb dry-bulb measurements, saturation calculations or other applicable means that will afford a moisture determination within ±2%. (If the moisture content of the flue gas is greater than the applicable instrument operating limit, the sample gas must be conditioned before introduction into the GCMS.)

8.2.2 Sample Interface Preparation. Assemble the sampling system (Figure 1 is a generalized schematic of one possible sampling system configuration). Allow the sample interface system components to reach operating temperatures. Operate the sample interface system at a constant sampling rate during the entire test.

8.2.3 MS Tune. Perform the mass spectrometer instrumental tune according to the manufacturer's written instructions. See criteria for the recommended TRIS/BPFB blend listed in Table 3.

8.2.4 Calibration. Perform the surrogate system continuing calibration check (or other continuing calibration

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check). The continuing calibration check standards must be introduced into the sampling system at the extractive probe outlet, upstream of the particulate matter filter. The standards must flow through the sampling system for a period sufficient to ensure equilibration within the sampling system components but not longer than the GC run time. The calibration check responses must agree to within ±20% of the manufacturers certified value for the compressed gas standards. Tables 1, 3, and 4 contain calibration QA/QC criteria. Tables 5 and 6 provide surrogate compound calibration check information.

8.2.5 System Zero Analysis. After performing the surrogate system continuing calibration, perform a system zero by directing nitrogen or zero air through the entire sampling system including the particulate filter. Analyze nitrogen samples until the measurement system background levels are less than 50 ppb for the target analytes of interest.

8.3 Sampling

8.3.1 Sample Analysis. Extract effluent sample gas through the sampling system for a period equal to or greater than GC run time before acquisition of the first sample. Perform sample analysis according to manufacturers written procedures. Continuously extract the effluent between consecutive GCMS sample acquisitions to ensure constant sample equilibration within the sample interface system. Each sample analysis shall represent the emissions concentration over a period of approximately 15 minutes. The QA/QC criteria listed in Table 1 must be met for each run.

8.3.2 Run Duration. Each test run shall be composed of a minimum of three samples, unless otherwise specified in the applicable regulation. For sample run durations longer than 45 minutes, continue to acquire and analyze additional samples for each 15 minute period.

8.4 Data Storage and Reporting. Identify all samples with a unique file name. Store backup copies of data files. Report the results for the individual GCMS analyses, and the mean of all samples for each target analyte for each run. Include copies of the three-point calibration including %RSD, RRFs and ARRFs, surrogate continuing system calibration(s) results and other method QA/QC activities in the test report.

9.0 QUALITY CONTROL

9.1 Follow the manufacturer's written instructions for the set-up, tune, operation, and calibration of the GCMS instrument and any sample interface equipment. All hardware or software settings of temperatures, pressures, and other operational parameters used for sample acquisition and data quantification shall be the same as those used when constructing the three-point calibration.

9.2 Records of the manufacturer's certificates of analysis for calibration standards and internal standards must be stored and included in all test reports.

10 CALIBRATION AND STANDARDIZATION

10.1 Tune. Perform mass spectrometer tune according to the manufacturer's written instructions.

10.2 Initial Three-Point Calibration. Calibrate the GCMS with mixtures of the target analytes. The mixtures should be prepared at nominal concentrations of 300 ppb, and 1 and 10 ppm in a balance of ultra high purity nitrogen (the dilution technique described in Section 8.1.2 may be employed).

The internal standards must be coinjected with each external calibration standard. The flow mixture should approximate a ratio of 1:10 (one part internal standard to 9 parts sample gas).

Analyze the three levels of standards in duplicate. Calculate the mean of the six relative response factors (RRFs) for each target analyte and report as the average relative response factors (ARRFs). Table 1 contains the QA/QC criteria for valid initial and surrogate continuing system calibration checks. See the following equations for a complete explanation.

Equation 1: RRF = Relative Response Factor

$$\mathbf{RRF = (A_x/A_{is}) \times (C_{is}/C_x)}$$

A_x = Peak area of selected target VOHAP quantion.

A_{is} = Peak area of corresponding selected internal standard quantion.

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C_{is} = Concentration of corresponding selected internal standard.
C_x = Concentration of target VOHAP.

Equation 2: ARRF = Average Relative Response Factor

$$\mathbf{ARRF = (RRF_i) / n}$$

RRF_i = Individual RRFs calculated from calibration run.
n = 6

Equation 3: %RSD = Percent Relative Standard Deviation

$$\mathbf{\%RSD = (s \times 100)/ARRF}$$

s = Standard Deviation

The %RSD of the RRFs must be <20% for all target analytes to establish a valid calibration curve.

10.3 Surrogate Continuing (system) Calibration Check (CCC). A system continuing calibration check must be performed each day before performing effluent measurements, before resuming sampling after each instrument shut down for maintenance or corrective action, and before analyzing additional samples after twelve hours of continuous operation. The surrogate continuing calibration mixture is a manufacturer certified gas standard that is not from the same gas cylinder used to develop the initial three-point calibration. Alternatively, the continuing calibration check may be performed for all of the target analytes using the mid-range concentration level used to develop the three-point calibration. (Section 8.1.2 requires the use of an independent standard to audit the three-point calibration when developed by dilution techniques.) Direct the continuing system calibration standard through the entire measurement system including the particulate filters, and calculate the %D.

Equation 4: %D = Difference of Results from Expected Value

$$\mathbf{\%D = (Expected\ Value - Instrument\ Analysis\ Results)/Expected\ Value \times 100}$$

Expected Value = Certified Value of Cylinder
Instrument Analysis Results = Instrument output

The results from Equation 4 must be within ±20% of the manufacturers certified value for a successful continuing calibration for all target analytes, or for all surrogates that represent those target analytes. Additionally, the response factors of the internal standards must be within -50% to +100% of their average response factors obtained during the initial three-point calibration. If these criteria are not met, corrective action must be taken. If the corrective action does not result in a successful CCC, a new three-point calibration must be performed. Table 1 lists the acceptance criteria for calibrations and quantification.

11 ANALYTICAL PROCEDURE

11.1 Sampling and Instrumental Analysis. Refer to Figure 2 for method operation flowchart.

12 DATA ANALYSIS AND CALCULATIONS

12.1 Quantitation of Results. Use the following equation to quantify the concentration of VOHAPs in gas samples.

5) ppmv Target VOHAP = parts per million by volume of target VOHAP in sample

$$\textbf{ppmv Target VOHAP} = (A_x/ARRF)(C_{is}/A_{is})$$

A_x = Peak area of target VOHAP quantion.
A_{is} = Peak area of corresponding selected internal standard quantion.
C_{is} = Concentration of corresponding selected internal standard.
ARRF = Average Relative Response Factor of target VOHAP calculated from three-point calibration.

The internal standards used to quantify the results and the individual quantification ions used must be identified in the test report.

12.2 Alternative Quantification Calculations. Alternative quantification algorithms may be used in the development of calibration files and sample analysis quantification. For example, regression analyses may be performed to determine the "best fit line" for the three-point calibration responses for each analyte rather than relying on the average relative response factor. In some cases, calculation procedures allowing a non-zero y-axis intercept may improve the accuracy of measurement results. Such procedures may show improvement of the RSDs for the three-point calibration. For each analyte, a consistent numerical procedure must be applied in developing the three-point calibration and in performing all sample analysis for the test series.

13 METHOD PERFORMANCE

13.1 Instrument Performance. Gaseous internal standards must be co-injected with every sample. The internal standards are used to verify continuously the tune status and GC performance. Tables 1, 3 and 4 specify criteria to ensure meeting the overall method data quality objectives.

14 POLLUTION PREVENTION

Take appropriate measures to prevent excess venting of calibration standards to the atmosphere.

15 REFERENCES

1). Method 624 - Purgeables, U.S. EPA 40 CFR part 136, App. A, (49 FR 43234), October 26, 1984.

2). "EPA Method Study 29 EPA Method 624 - Purgeables," EPA 600/4-84-054, National Technical Information Service, PB84-209915, Springfield, Virginia 22161, June 1984.

3). Method 1624 - Volatile Organic Compounds by Isotope Dilution GCMS, U.S. EPA Office of Water Regulations and Standards, Industrial Technology Division, Office of Water, June 1989.

4). Peeler, J.W., Kinner, L.L., and DeLuca, S., "General Field Test Method Approval Process and Specific Application for a Direct Interface GCMS Source Test Method," Air and Waste Management Association, Nashville, TN, 96-RP132.01, June 23-28, 1996.

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16 TABLES, FIGURES AND FLOWCHARTS

16.1 Table 1. Table 1 outlines the method QA/QC criteria.
16.2 Table 2. Table 2 outlines the mass spectral relative abundance criteria for BFB.
16.3 Table 3. Table 3 outlines recommended tune criteria for a blended mixture of BPFB/TRIS
16.4 Table 4. Table 4 outlines recommended mass spectral relative abundance criteria for the GC separated BPFB and TRIS.
16.5 Table 5. Table 5 contains the surrogate continuing system calibration compounds.
16.6 Figure 1. Figure 1 illustrates a generalized sampling system diagram.
16.7 Figure 2. Figure 2 is a flowchart representing the GCMS operational method.

TABLE 1. Calibration and Sampling QA/QC Criteria

Operational Mode	IS Recommended Requirements	GC Retention Time Requirements	Extracted Ion Chromatographic Criteria	Accuracy and Sensitivity
Mass Spectrometer Tune	See Table 3			
Three-Point Calibration	See Table 4	RTs for individual VOHAPS must be within ±6% of each other from run to run.	% RSDs calculated from the individual RRFs at each calibration point must be ±20% for each target analyte. The RFs of the internal standards must be within -50 %- 100% of the mean for the initial three-point calibration.	ARRFs must be ^{3}0.25 to ensure proper instrumental response. A signal to noise of 10:1 is recommended for the low concentration level.
Surrogate Continuing Calibration Check (CCC)	See Table 4	RTs for individual VOHAPS must be within ±6% of the initial three-point calibration.	The RFs of the internal standards must be within -50 %- 100% of their ARFs from the initial three-point calibration.	Surrogate Continuing System Calibration results must be within ±20% of the manufacturers certified value from analysis by the three-point calibration for valid continuing calibration.
Sampling	See Table 4	RTs for detected VOHAPS must be within ±6% of those in the initial three-point calibration.	The RFs of the internal standards must be within -50 %- 100% of their ARFs from the initial three-point calibration.	Spectral ions of greater than 10% abundance in the identified compounds mass spectrum must also be contained in the reference calibration spectrum for that particular target analyte.

Table 2. Relative Ion Abundance Criteria for Bromofluorobenzene

Mass Fragment	ION ABUNDANCE CRITERIA
50	15-40%
75	30-60%
95	Base Peak
96	5-9% of mass 95
173	<2% of mass 174
174	>50% of mass 95
175	5-9% of mass 174
176	>95% but <101% of mass 174
177	5-9% of mass 174

Table 3. Instrument Performance for Blended TRIS/BPFB Internal Standard Mixture in Tune

Mass Fragment	Percent Relative Low Abundance	Percent Relative High Abundance
50	5	8
55	5	8
69	33	36
93	39	45
117	100	100
167	50	100
248	30	65
263	20	99
282	10	50

Table 4. Instrument Performance for Separated Internal Standard Mixture

Internal Standard	Mass	Ion Abundance Criteria
Tris	50	5-20% of mass 69
	69	Base Peak
	75	40-60% of mass 69
	213	50-90% of mass 69
	263	75-95% of mass 69
	282	30-70% of mass 69
BPFB	93	20-50% of mass 117
	117	Base Peak
	167	45-75% of mass 117
	245	< 2% of mass 246
	246	> 25% of mass 117
	247	5-9% of mass 246
	248	> 25% of mass 117
	249	5-9% of mass 248

Table 5 Surrogate System Continuing Calibration Compounds

COMPOUND	CLASS REPRESENTING	MOLECULAR WEIGHT	QUANT-ION	RETENTION TIME
Methylene Chloride	Chlorinated	84	84	2:41 mins
Methyl Ethyl Ketone (MEK)	Polar	72	72	2:57 mins
Carbon Tetrachloride	Chlorinated	152	117	3:35 mins
Toluene	Aromatic	92	91	5:08 mins
Chlorobenzene	Chlorinated Aromatic	112	112	7:22 mins
O-Xylene	Aromatic	91	91	9:44 min

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Table 6 Surrogates and Corresponding Analytes

Compound	Retention Time*	Suggested Quantion	Surrogate	Suggested Surrogate Quantion
Chloromethane	1:09	50	Methylene Chloride	49/84
vinyl chloride	1:11	62	Methylene Chloride	49/84
Bromomethane	1:13	94	Methylene Chloride	49/84
Chloroethane	1:15	64	Methylene Chloride	49/84
Methylene Chloride	1:25	49	Methylene Chloride	49/84
1,1-dichloroethene	1:25	61	Methylene Chloride	49/84
carbon disulfide	1:31	76	Toluene	91/92
t-1,2-dichloroethene	1:34	96	Methylene Chloride	49/84
1,1-dichloroethane	1:36	63	Methylene Chloride	49/84
vinyl acetate	1:36	86	MEK	72
Methyl Ethyl Ketone	1:40	72	MEK	72
c-1,2-dichloroethene	1:44	61	Methylene Chloride	49/84
chloroform	1:48	83	Methylene Chloride	49/84
1,2-dichloroethane	1:58	62	Methylene Chloride	49/84
1,1,1-trichloroethane	2:01	97	Methylene Chloride	49/84
benzene	2:10	78	Toluene	91/92
carbon tetrachloride	2:12	117	Carbon Tetrachloride	117
1,2-dichloropropane	2:25	63	Carbon Tetrachloride	117
bromodichloromethane	2:29	129	Carbon Tetrachloride	117
trichloroethene	2:30	95	Carbon Tetrachloride	117
c-1,2-dichloropropene	2:54	75	Carbon Tetrachloride	117
MIBK	2:56	85	MEK	72
t-1,2-dichloropropene	3:12	75	Carbon Tetrachloride	117
1,1,2-trichloroethane	3:17	83	Carbon Tetrachloride	117
Toluene	3:31	91	Toluene	91/92
2-hexanone	3:48	58	MEK	72
dibromochloromethane	3:49	129	Carbon Tetrachloride	117
Tetrachloroethylene	4:33	94	Carbon Tetrachloride	117
chlorobenzene	5:27	77	Chlorobenzene	112
ethylbenzene	6:07	91	Toluene	91/92
bromoform	6:28	173	Carbon Tetrachloride	152
p-xylene	6:30	91	o-xylene	91
m-xylene	6:30	91	o-xylene	91
styrene	7:17	104	o-xylene	91
1,1,2,2-tetrachloroethane	7:30	83	Carbon Tetrachloride	117/152
0-xylene	7:31	91	o-xylene	91

* Retention Time based on a 60 C isothermal separation on a SPB - 1 GC Column, 30 meters long, 0.32 mm ID, 1 micron film thickness

APPENDIX A - DEFINITIONS

AMU = Atomic Mass Unit, molecular weight of positively charged fragmented ions detected by mass spectrometer electron multiplier.

ARRF = Average Relative Response Factor (see Section 10.2, equation 2)

Blank Analysis = Injection of zero air or nitrogen into the GCMS to determine background levels of the target analytes.

BFB = Bromofluorobenzene, A standard mass spectrometer tuning compound.

BPFB = Bromopentafluorobenzene, one of the recommended internal standards.

CCC = Continuing calibration check. Performed before each testing day, before resuming sampling after instrument shutdown or malfunction, and before continuation of sampling after 12 hours of continuous instrument operation.

GC = Gas Chromatograph

GCMS = Analytical technique using a mass spectrometer as a GC detector.

Internal Standard (IS) = Compounds used as markers in the analysis of GCMS data. The purpose of the internal standards is to correct for hardware related error such as, different injection volumes, operational temperature fluctuations, and electron multiplier drift.

MS = Mass Spectrometer

ppbv = Parts per billion by volume

ppmv = Parts per million by volume

Quantion - Quantification ion, A specific ion in the analytes mass spectrum that is used for quantification.

RRF = Relative Response Factor (see Section 10.2, equation 1)

RT = Retention time, the time corresponding to the elution of a peak (scan number) from the chromatographic column measured from the injection point.

System Calibration = A means of injecting the calibration standard(s) through the entire sampling system. In a system calibration, the sample pump draws calibration gas only through the sampling system. See Figure 1.

System Zero = A means of injecting dry nitrogen or zero gas through the entire sampling system to determine the system background levels of the target analytes.

Three-point calibration = The initial instrument calibration using 300 ppb, 1 and 10 ppm VOHAP mixture standards.
TRIS = 1,3,5-trifluoromethylbenzene, One of the recommended internal standards

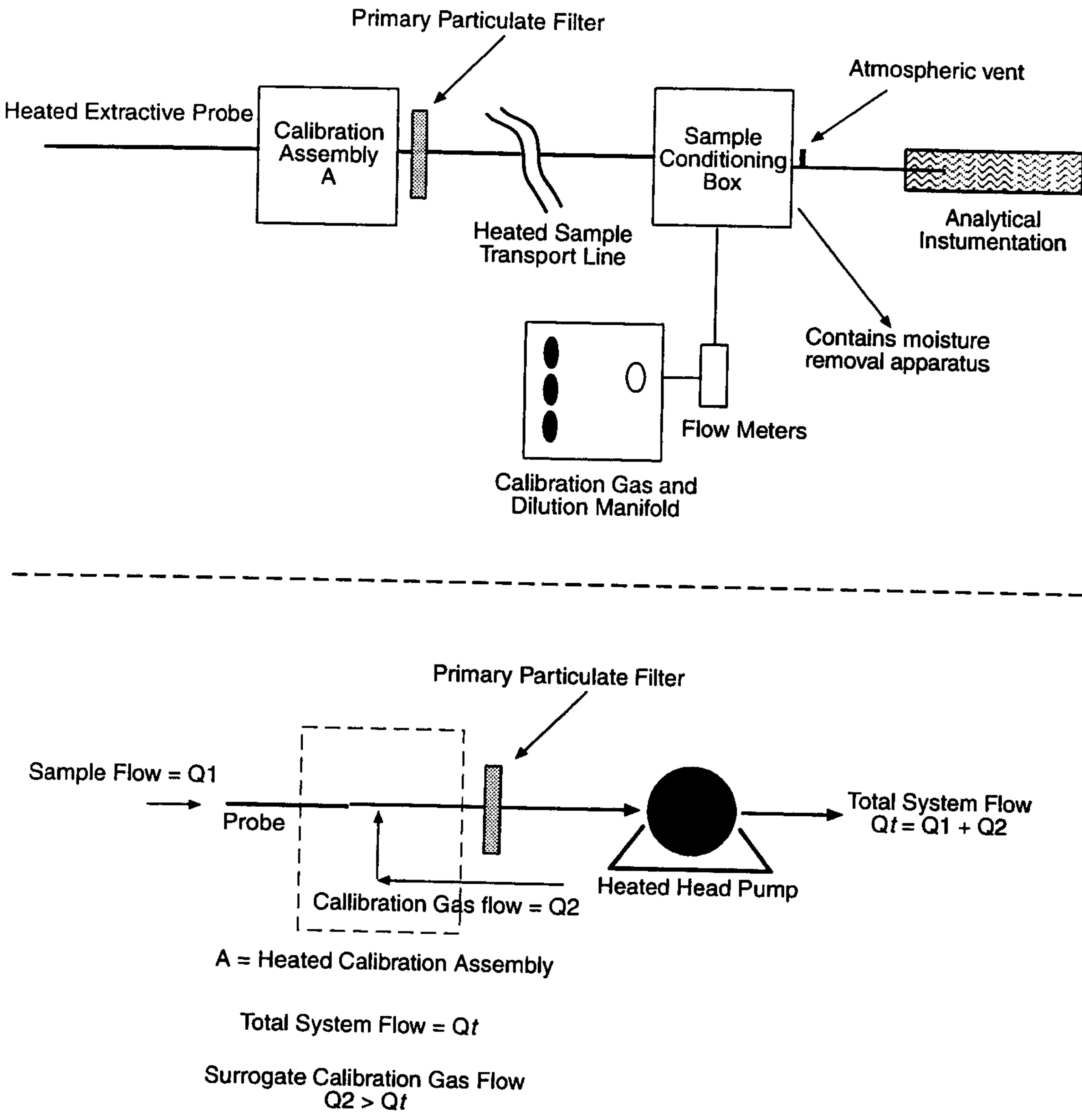

Figure 1. Example Sample Interface System and Plumbing Schematic for Surrogate System Continuing Calibratio

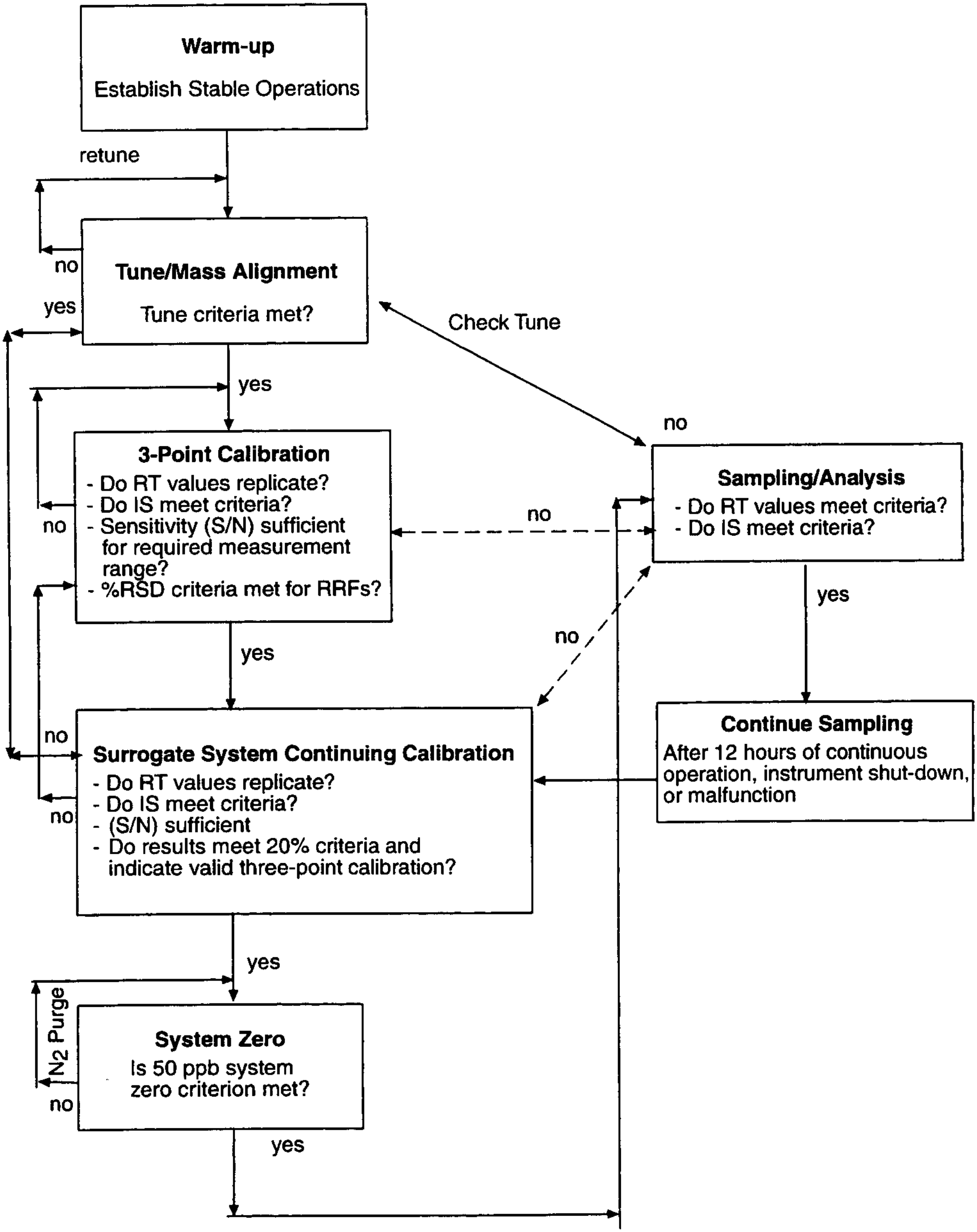

Figure 2. Method Operational Procedure

SPECTRA GASES

277 Coit Street • Irvington, NJ 07111 USA Tel: (973) 372-2060 • (800) 929-2427 • Fax: (973)

SHIPPED FROM: 80 INDUSTRIAL DRIVE ALPHA, NJ. 08865 TEL: (908) 454-7455

SHIPPED TO:

Emission Monitoring Inc.
416 Emery Wood Drive
Raleigh , NC 27615

used To generate
LFS method
Sim 1 method
Sim 2 method by
successive Dilutions

CERTIFICATE OF ANALYSIS

SGI ORDER # :	133913
ITEM# :	1
CERTIFICATION DATE:	6/18/98
P.O.# :	Verbal - Laura
BLEND TYPE:	CERTIFIED

CYLINDER # : CC91245
CYLINDER PRES: 2000 psig
CYLINDER VALVE: CGA 350

ANALYTICAL ACCURACY: + / - 2%

COMPONENT	REQUESTED GAS CONC	ANALYSIS
1,3-Butadiene	10.0 ppm	10.0 ppm
Hexane	10.0 ppm	10.1 ppm
Benzene	10.0 ppm	10.1 ppm
Toluene	10.0 ppm	10.0 ppm
Ethylbenzene	10.0 ppm	10.1 ppm
P-Xylene	10.0 ppm	10.1 ppm
M-Xylene	10.0 ppm	10.1 ppm
Styrene	10.0 ppm	10.0 ppm
O-Xylene	10.0 ppm	10.0 ppm
Nitrogen	Balance	Balance

ANALYST: ____________
Ted Neeme

DATE: 6/18/98

175

Scott Specialty Gases

Shipped From:
6141 EASTON ROAD
PLUMSTEADVILLE PA 18949-0310
Phone: 215-766-8861
PO BOX 310
Fax: 215-766-2070

CERTIFICATE OF ANALYSIS

LEYBOLD INFICON INC
DR.LAURA KINNER
C/O EMMISSIONS MONITORING
301 EAST DURHAM RD.
CARY NC 27513

PROJECT #: 01-65495-001
PO#: P61339
ITEM #: 0102AE004204AL
DATE: 3/08/95

CYLINDER #: ALM057596 ANALYTICAL ACCURACY: +/-5%

BLEND TYPE : CERTIFIED MASTER GAS

COMPONENT	REQUESTED GAS CONC MOLES		ANALYSIS (MOLES)	
ACETONE	1.	PPM	.938	PPM
BENZENE	1.	PPM	1.04	PPM
BROMODICHLOROMETHANE	1.	PPM	1.01	PPM
CARBON DISULFIDE	1.	PPM	.924	PPM
CHLOROFORM	1.	PPM	1.07	PPM
ETHYLENE	100.	PPM	100.	PPM
METHYL ISOBUTYL KETONE	1.	PPM	1.01	PPM
STYRENE	1.	PPM	1.06	PPM
SULFUR HEXAFLUORIDE	1.	PPM	1.00	PPM
TETRACHLOROETHYLENE	1.	PPM	1.04	PPM
TOLUENE	1.	PPM	1.05	PPM
TRIBROMOMETHANE	1.	PPM	.995	PPM
VINYL ACETATE	1.	PPM	.921	PPM
VINYL CHLORIDE	1.	PPM	1.01	PPM
NITROGEN		BALANCE		BALANCE

Following 6 used to
generate full scan
method.

used only @ Silo
exhaust Duct.

ANALYTICAL METHOD: GC-FID/GC-FPD

ANALYST: ____________________
JAMES T. KRAUS

176

Scott Specialty Gases, Inc.

Shipped From:
6141 EASTON ROAD PO BOX 310
PLUMSTEADVILLE PA 18949-0310
Phone: 215-766-8861 Fax: 215-766-2070

CERTIFICATE OF ANALYSIS

LEYBOLD INFICON INC

C/O ENTROPY ENVRNMNTLSTS
8724 GLENWOOD AVENUE
RALEIGH NC 27612

PROJECT #: 01-60491-002
PO#: P56873
ITEM #: 0102AE004104AL
DATE: 9/28/94

CYLINDER #: ALM034607 ANALYTICAL ACCURACY: +/- 2% 6

BLEND TYPE : CERTIFIED MASTER GAS

COMPONENT	REQUESTED GAS CONC MOLES		ANALYSIS (MOLES)	
ACETONE	10.	PPM	10.1	PPM
BENZENE	10.	PPM	9.97	PPM
BROMODICHLOROMETHANE	10.	PPM	9.97	PPM
CARBON DISULFIDE	10.	PPM	9.27	PPM
CHLOROFORM	10.	PPM	9.98	PPM
ETHYLENE	100.	PPM	100.	PPM
METHYL ISOBUTYL KETONE	10.	PPM	10.1	PPM
STYRENE	10.	PPM	9.99	PPM
SULFUR HEXAFLUORIDE	1.	PPM	1.01	PPM
TETRACHLOROETHYLENE	10.	PPM	10.2	PPM
TOLUENE	10.	PPM	9.99	PPM
TRIBROMOMETHANE	5.	PPM	5.38	PPM
VINYL ACETATE	10.	PPM	10.	PPM
VINYL CHLORIDE	10.	PPM	10.	PPM
NITROGEN		BALANCE		BALANCE

ANALYTICAL METHOD: GC - FID

ANALYST: ____________
JAMES T. KRAUS

177

Scott Specialty Gases, Inc.

Shipped From:
6141 EASTON ROAD
PLUMSTEADVILLE PA 18949-0310
Phone: 215-766-8861
PO BOX 310
Fax: 215-766-2070

CERTIFICATE OF ANALYSIS

LEYBOLD INFICON INC

C/O ENTROPY ENVRNMNTLSTS
8724 GLENWOOD AVENUE
RALEIGH NC 27612

PROJECT #: 01-60729-008
PO#: P56873
ITEM #: 0102BF004504AL
DATE: 9/26/94

CYLINDER #: ALM050124

ANALYTICAL ACCURACY: +/- 5%

BLEND TYPE : CERTIFIED MASTER GAS

COMPONENT	REQUESTED GAS CONC MOLES	ANALYSIS (MOLES)
BROMOMETHANE	1. PPM	.918 PPM
CARBON TETRACHLORIDE	1. PPM	.901 PPM
CHLOROBENZENE	1. PPM	.999 PPM
CIS 1,3-DICHLOROPROPENE	1.2 PPM	1.31 PPM
1,2-DICHLOROETHANE	1. PPM	1.91 PPM
1,1-DICHLOROETHENE	1. PPM	.975 PPM
ETHYLENE	100. PPM	93.9 PPM
ETHYLENE 1,2 DICHLORO (TRANS)	1. PPM	.936 PPM
METHYL ETHYL KETONE	1. PPM	1.04 PPM
METHYL N-BUTYL KETONE	1. PPM	1.05 PPM
SULFUR HEXAFLUORIDE	1. PPM	.978 PPM
TRANS 1,3-DICHLOROPROPENE	.8 PPM	.936 PPM
TRICHLOROETHYLENE	1. PPM	.954 PPM
M-XYLENE	1. PPM	1.06 PPM
O-XYLENE	1. PPM	1.09 PPM
NITROGEN	BALANCE	BALANCE

ANALYTICAL METHOD: GC - FID

ANALYST:
JAMES T. KRAUS

178

Scott Specialty Gases, Inc.

Shipped From:
6141 EASTON ROAD
PLUMSTEADVILLE PA 18949-0310
Phone: 215-766-8861
PO BOX 310
Fax: 215-766-2070

CERTIFICATE OF ANALYSIS

LEYBOLD INFICON INC

C/O ENTROPY ENVRNMNTLSTS
8724 GLENWOOD AVENUE
RALEIGH NC 27612

PROJECT #: 01-60729-007
PO#: P56873
ITEM #: 0102BF004404AL
DATE: 9/27/94

CYLINDER #: ALM050128

ANALYTICAL ACCURACY: +/- 2%

BLEND TYPE : CERTIFIED MASTER GAS

COMPONENT	REQUESTED GAS CONC MOLES		ANALYSIS (MOLES)	
BROMOMETHANE	10.	PPM	9.04	PPM
CARBON TETRACHLORIDE	10.	PPM	9.20	PPM
CHLOROBENZENE	10.	PPM	9.86	PPM
CIS 1,3-DICHLOROPROPENE	12.	PPM	12.1	PPM
1,2-DICHLOROETHANE	10.	PPM	18.4	PPM
1,1-DICHLOROETHENE	10.	PPM	10.0	PPM
ETHYLENE	100.	PPM	98.3	PPM
ETHYLENE 1,2 DICHLORO (TRANS)	10.	PPM	9.62	PPM
METHYL ETHYL KETONE	10.	PPM	9.57	PPM
METHYL N-BUTYL KETONE	5.	PPM	5.11	PPM
SULFUR HEXAFLUORIDE	1.	PPM	.983	PPM
TRANS 1,3-DICHLOROPROPENE	8.	PPM	8.36	PPM
TRICHLOROETHYLENE	10.	PPM	9.56	PPM
M-XYLENE	10.	PPM	9.18	PPM
O-XYLENE	10.	PPM	9.18	PPM
NITROGEN		BALANCE		BALANCE

ANALYTICAL METHOD: GC - FID

ANALYST:
JAMES T. KRAUS

179

Scott Specialty Gases, Inc.

Shipped From:
6141 EASTON ROAD
PLUMSTEADVILLE PA 18949-0310
Phone: 215-766-8861
PO BOX 310
Fax: 215-766-2070

CERTIFICATE OF ANALYSIS

LEYBOLD INFICON INC

C/O ENTROPY ENVRNMNTLSTS
8724 GLENWOOD AVENUE
RALEIGH NC 27612

PROJECT #: 01-60491-015
PO#: P56873
ITEM #: 0102CE000504AL
DATE: 9/27/94

CYLINDER #: ALM050069

ANALYTICAL ACCURACY: +/- 5%

BLEND TYPE : CERTIFIED MASTER GAS

COMPONENT	REQUESTED GAS CONC MOLES		ANALYSIS (MOLES)	
CHLOROMETHANE	1.	PPM	1.00	PPM
CIS 1,2-DICHLOROETHYLENE	1.	PPM	1.01	PPM
DIBROMOCHLOROMETHANE	1.	PPM	.982	PPM
1,1-DICHLOROETHANE	1.	PPM	1.02	PPM
1,2-DICHLOROPROPANE	1.	PPM	1.01	PPM
ETHYLBENZENE	1.	PPM	.992	PPM
ETHYL CHLORIDE	1.	PPM	.986	PPM
ETHYLENE	100.	PPM	100.	PPM
METHYLENE CHLORIDE	1.	PPM	1.01	PPM
SULFUR HEXAFLUORIDE	1.	PPM	1.00	PPM
1,1,2,2-TETRACHLOROETHANE	1.	PPM	1.03	PPM
1,1,1-TRICHLOROETHANE	1.	PPM	1.03	PPM
1,1,2-TRICHLOROETHANE	1.	PPM	1.00	PPM
P-XYLENE	1.	PPM	.983	PPM
NITROGEN		BALANCE		BALANCE

ANALYTICAL METHOD: MICROGRAV

ANALYST:
T. H. RICHARDS

180

Scott Specialty Gases, Inc.

Shipped From:
6141 EASTON ROAD
PLUMSTEADVILLE PA 18949-0310
Phone: 215-766-8861
PO BOX 310
Fax: 215-766-2070

CERTIFICATE OF ANALYSIS

LEYBOLD INFICON INC

C/O ENTROPY ENVRNMNTLSTS
8724 GLENWOOD AVENUE
RALEIGH NC 27612

PROJECT #: 01-60491-012
PO#: P56873
ITEM #: 0102CE000404AL
DATE: 9/30/94

CYLINDER #: ALM050123

ANALYTICAL ACCURACY: +/- 2%

BLEND TYPE : CERTIFIED MASTER GAS

COMPONENT	REQUESTED GAS CONC MOLES		ANALYSIS (MOLES)	
CHLOROMETHANE	10.	PPM	9.99	PPM
CIS 1,2-DICHLOROETHYLENE	10.	PPM	10.0	PPM
DIBROMOCHLOROMETHANE	10.	PPM	9.97	PPM
1,1-DICHLOROETHANE	10.	PPM	9.96	PPM
1,2-DICHLOROPROPANE	10.	PPM	9.98	PPM
ETHYLBENZENE	10.	PPM	10.0	PPM
ETHYL CHLORIDE	10.	PPM	9.98	PPM
ETHYLENE	100.	PPM	101.	PPM
METHYLENE CHLORIDE	10.	PPM	9.99	PPM
SULFUR HEXAFLUORIDE	1.	PPM	1.	PPM
1,1,2,2-TETRACHLOROETHANE	5.	PPM	5.09	PPM
1,1,1-TRICHLOROETHANE	10.	PPM	9.98	PPM
1,1,2-TRICHLOROETHANE	10.	PPM	9.99	PPM
P-XYLENE	10.	PPM	10.	PPM
NITROGEN		BALANCE		BALANCE

ANALYTICAL METHOD: GC - FID

ANALYST:
JAMES T. KRAUS

181

Scott Specialty Gases

Shipped From: 6141 EASTON ROAD
PLUMSTEADVILLE PA 18949-0310
Phone: 215-766-8861
PO BOX 310
Fax: 215-766-2070

CERTIFICATE OF ANALYSIS

SCOTT SPECIALTY GASES

C/O EMISSION MONITORING
301 EAST DURHAM ROAD
CARY NC 27513

PROJECT #: 01-69630-001
PO#: 6/26/95
ITEM #: 0102B3012914AL
DATE: 7/12/95

CYLINDER #: ALM035013

ANALYTICAL ACCURACY: +/-1%

BLEND TYPE : CERTIFIED MASTER GAS

COMPONENT	REQUESTED GAS CONC	VOLUME	ANALYSIS (VOLUME)	
BROMOPENTAFLUOROBENZENE	50.	PPM	51.5	PPM
135TRIS(TRIFLUOROMETHYL)BENZEN	100.	PPM	102.5	PPM
NITROGEN		BALANCE		BALANCE

ANALYST: KEN WONG

APPROVED BY: PAUL PAINTER

182

APPENDIX B

THREE-POINT CALIBRATION RAW DATA

```
FULL SCAN Calibration Response Table

Title:
FULL SCAN DATA :  C:\PROGRA~1\HAPSRUN\DATA\AAA\LFSCALS\ICCR300C
Acquired          07/09/~~95~~ at 14:59:36
                        98 JJK

Peak Search Method :  C:\PROGRA~1\HAPSRUN\METHOD\AAA.LSM
PQUAN Library      :  C:\PROGRA~1\HAPSRUN\METHOD\AAA
Last Calibration      07/10/98 at 09:04:28

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\LLKLFS.FSM
Tune/Cal File      :
Datafile title:
ICCR - New Gas
10 ppm diluted to 0.3 ppm
Can E

W = RT +- ( 0:45.00 / 2 + RT * 0.010 )
Min Fit=0.650; Min Pur=0.650; Min Area=5000
Width= 5-100 scans; Res= 6 scans; NLM=2.0


Linear calibration curve

Internal Standards:

I.S. #1 -- TRIS
Concentration = 9.940 ppm; 6 calib points

    pt.  File     Man.          Area Resp. Factor
      1  ICCR10A             2932843  295054.61191
      2  ICCR10B             2980580  299857.12675
      3  ICCR001A            2687084  270330.36777
      4  ICCR001B            2851831  286904.51175
      5  ICCR300A            2577534  259309.24160
      6  ICCR300C            2657386  267342.64157
                        Average RF = 2.79800e+05

I.S. #2 -- BPFB
Concentration = 4.850 ppm; 6 calib points

    pt.  File     Man.          Area Resp. Factor
      1  ICCR10A             7776438  1603389.30988
      2  ICCR10B             8196344  1689967.86828
      3  ICCR001A            7124059  1468878.17321
      4  ICCR001B            7288881  1502862.09141
      5  ICCR300A            6679921  1377303.32605
      6  ICCR300C            6691100  1379608.27455
                        Average RF = 1.50367e+06

Analytes:

Analyte #1 -- 1,3-butadiene
5 calib points
 pt.  File     M |     Conc.     Cratio |        Area      Aratio | Resp. Factor
   1  ICCR10A    |     10.00  1.006e+00 |      933824   3.184e-01 |  3.16492e-01
   2  ICCR10B    |     10.00  1.006e+00 |     1041395   3.494e-01 |  3.47297e-01
```

Calibration
1st CAN E

AAA quant method

LFS method
50-125 Amu

1,3 But
Hex
BTEXS

```
   3   ICCR001A    |        1.00  1.006e-01 |       70864  2.637e-02 |  2.62139e-01
   4   ICCR001B    |        1.00  1.006e-01 |       90859  3.186e-02 |  3.16687e-01
   5   ICCR300C    |        0.30  3.018e-02 |       24371  9.171e-03 |  3.03867e-01
                                                         Average RF = 3.09296e-0
                                                          Deviation = 7.45103%

 Analyte #2 -- Hexane
 6 calib points
  pt.  File       M |      Conc.     Cratio |          Area     Aratio | Resp. Factor
    1  ICCR10A      |      10.10  1.016e+00 |       4530171  1.545e+00 |  1.52017e+00
    2  ICCR10B      |      10.10  1.016e+00 |       4970370  1.668e+00 |  1.64117e+00
    3  ICCR001A     |       1.01  1.016e-01 |        391153  1.456e-01 |  1.43262e+00
    4  ICCR001B     |       1.01  1.016e-01 |        435586  1.527e-01 |  1.50319e+00
    5  ICCR300A     |       0.30  3.048e-02 |        106016  4.113e-02 |  1.34931e+00
    6  ICCR300C     |       0.30  3.048e-02 |        100366  3.777e-02 |  1.23901e+00
                                                         Average RF = 1.44758e+00
                                                          Deviation = 6.39510%

 Analyte #3 -- Benzene
 6 calib points
  pt.  File       M |      Conc.     Cratio |          Area     Aratio | Resp. Factor
    1  ICCR10A      |      10.10  1.016e+00 |      45438832  1.549e+01 |  1.52477e+01
    2  ICCR10B      |      10.10  1.016e+00 |      47933000  1.608e+01 |  1.58270e+01
    3  ICCR001A     |       1.01  1.016e-01 |       4294511  1.598e+00 |  1.57289e+01
    4  ICCR001B     |       1.01  1.016e-01 |       4451729  1.561e+00 |  1.53628e+01
    5  ICCR300A     |       0.30  3.048e-02 |       1190114  4.617e-01 |  1.51470e+01
    6  ICCR300C     |       0.30  3.048e-02 |       1157577  4.356e-01 |  1.42902e+01
                                                         Average RF = 1.52673e+01
                                                          Deviation = 3.14150%

 Analyte #4 -- Toluene
 6 calib points
  pt.  File       M |      Conc.     Cratio |          Area     Aratio | Resp. Factor
    1  ICCR10A      |      10.00  1.006e+00 |      50571376  1.724e+01 |  1.71397e+01
    2  ICCR10B      |      10.00  1.006e+00 |      53416740  1.792e+01 |  1.78141e+01
    3  ICCR001A     |       1.00  1.006e-01 |       4199091  1.563e+00 |  1.55332e+01
    4  ICCR001B     |       1.00  1.006e-01 |       4247383  1.489e+00 |  1.48042e+01
    5  ICCR300A     |       0.30  3.018e-02 |       1036666  4.022e-01 |  1.33260e+01
    6  ICCR300C     |       0.30  3.018e-02 |       1019161  3.835e-01 |  1.27073e+01
                                                         Average RF = 1.52207e+01
                                                          Deviation = 3.30817%

 Analyte #5 -- Ethyl Benzene
 6 calib points
  pt.  File       M |      Conc.     Cratio |          Area     Aratio | Resp. Factor
    1  ICCR10A      |      10.10  2.082e+00 |      79391136  1.021e+01 |  4.90243e+00
    2  ICCR10B      |      10.10  2.082e+00 |      81925928  9.995e+00 |  4.79978e+00
    3  ICCR001A     |       1.01  2.082e-01 |       5884071  8.259e-01 |  3.96616e+00
    4  ICCR001B     |       1.01  2.082e-01 |       6047727  8.297e-01 |  3.98430e+00
    5  ICCR300A     |       0.30  6.247e-02 |       1419815  2.125e-01 |  3.40220e+00
    6  ICCR300C     |       0.30  6.247e-02 |       1288873  1.926e-01 |  3.08327e+00
                                                         Average RF = 4.02302e+00
                                                          Deviation = 2.05843%

 Analyte #6 -- m/p-Xylene
 6 calib points
  pt.  File       M |      Conc.     Cratio |          Area     Aratio | Resp. Factor
```

```
   1   ICCR10A      |      20.20  4.165e+00 |  136964640  1.761e+01 |  4.22881e+00
   2   ICCR10B      |      20.20  4.165e+00 |  141405296  1.725e+01 |  4.14225e+00
   3   ICCR001A     |       2.02  4.165e-01 |   10346079  1.452e+00 |  3.48689e+00
   4   ICCR001B     |       2.02  4.165e-01 |   10648626  1.461e+00 |  3.50770e+00
   5   ICCR300A     |       0.61  1.249e-01 |    2194581  3.285e-01 |  2.62936e+00
   6   ICCR300C     |       0.61  1.249e-01 |    1982834  2.963e-01 |  2.37169e+00
                                                        Average RF = 3.39445e+0
                                                         Deviation = 1.83123%

Analyte #7 -- Styrene
6 calib points
 pt.   File      M |     Conc.      Cratio |       Area      Aratio | Resp. Factor
   1   ICCR10A     |     10.00  2.062e+00 |   42591352  5.477e+00 |  2.65633e+00
   2   ICCR10B     |     10.00  2.062e+00 |   46812688  5.711e+00 |  2.77003e+00
   3   ICCR001A    |      1.00  2.062e-01 |    2877482  4.039e-01 |  1.95897e+00
   4   ICCR001B    |      1.00  2.062e-01 |    2972343  4.078e-01 |  1.97779e+00
   5   ICCR300A    |      0.30  6.186e-02 |     604688  9.052e-02 |  1.46346e+00
   6   ICCR300C    |      0.30  6.186e-02 |     624207  9.329e-02 |  1.50817e+00
                                                       Average RF = 2.05579e+00
                                                        Deviation = 3.88139%

Analyte #8 -- O-Xylene
6 calib points
 pt.   File      M |     Conc.      Cratio |       Area      Aratio | Resp. Factor
   1   ICCR10A     |     10.00  2.062e+00 |   67677544  8.703e+00 |  4.22091e+00
   2   ICCR10B     |     10.00  2.062e+00 |   68584080  8.368e+00 |  4.05831e+00
   3   ICCR001A    |      1.00  2.062e-01 |    4886995  6.860e-01 |  3.32703e+00
   4   ICCR001B    |      1.00  2.062e-01 |    4965403  6.812e-01 |  3.30396e+00
   5   ICCR300A    |      0.30  6.186e-02 |    1074403  1.608e-01 |  2.60026e+00
   6   ICCR300C    |      0.30  6.186e-02 |    1071390  1.601e-01 |  2.58863e+00
                                                       Average RF = 3.34985e+00
                                                        Deviation = 3.44283%
```

```
FULL SCAN Quantitation Report

Title:
FULL SCAN DATA :   C:\PROGRA~1\HAPSRUN\DATA\AAA\LFSCALS\ICCR300B
Acquired            07/09/~~95~~98 at 14:42:27
This Quantitation   07/10/98 at 09:12:10

Peak Search Method :   C:\PROGRA~1\HAPSRUN\METHOD\AAA.LSM
PQUAN Library      :   C:\PROGRA~1\HAPSRUN\METHOD\AAA
Last Calibration       07/10/98 at 09:04:28

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\LLKLFS.FSM
Tune/Cal File      :
Datafile title:
ICCR - New Gas
10 ppm diluted to 0.3 ppm
Can E
Total FS

W = RT +- ( 0:45.00 / 2 + RT * 0.010 )
Min Fit=0.650; Min Pur=0.650; Min Area=5000
Width= 5-100 scans; Res= 6 scans; NLM=2.0


REC NO.   Target    Pred. RT.   Internal Standard Name
   1         69      1:54.79    TRIS
   2        117      5:45.43    BPFB

 Rec#   Target   ret.tm. TS  fit  purity  MS        area            ppm   man.   %RFC
   1       69    1:54.14    0.996  0.714          2689308           9.94          -3.4
   2      117    5:41.04    0.999  0.844          6410456           4.85         -12.9

REC NO.   Target    Pred. RT.   Analyte Name
   1         53      1:11.79    1,3-butadiene
   2         57      1:46.45    Hexane
   3         78      2:09.07    Benzene
   4         91      3:28.22    Toluene
   5         91      5:59.71    Ethyl Benzene
   6         91      6:21.57    m/p-Xylene
   7        104      7:06.06    Styrene
   8         91      7:18.85    O-Xylene

 Rec#  Target   ret.tm. TS  fit  purity  MS        area            ppm   man.  EXP
*  1      53    Not Found                          BDL
   2      57    1:46.89    0.968  0.946           110989           0.33         .3
   3      78    2:08.58    0.997  0.983          1336144           0.33         .3
   4      91    3:25.92    0.998  0.992          1060263           0.33         .3
   5      91    5:54.77    0.996  0.979          1540299           0.38         .3
   6      91    6:15.69    0.991  0.979          2366199           0.72         .3
   7     104    6:59.03    0.995  0.933           591206           0.38         .6
   8      91    7:13.53    0.987  0.974          1046399           0.35         .3
                                                                                .3
```

audit

acquired full scan

187

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FULL SCAN Quantitation Report

Title:
FULL SCAN DATA :   C:\PROGRA~1\HAPSRUN\DATA\AAA\LFSCALS\ICCR300C
Acquired            07/09/~~95~~98 at 14:59:36
This Quantitation   07/10/98 at 09:11:35

Peak Search Method :   C:\PROGRA~1\HAPSRUN\METHOD\AAA.LSM
PQUAN Library      :   C:\PROGRA~1\HAPSRUN\METHOD\AAA
Last Calibration       07/10/98 at 09:04:28

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\LLKLFS.FSM
Tune/Cal File      :
Datafile title:
ICCR - New Gas
10 ppm diluted to 0.3 ppm
Can E

W = RT +- ( 0:45.00 / 2 + RT * 0.010 )
Min Fit=0.650; Min Pur=0.650; Min Area=5000
Width= 5-100 scans; Res= 6 scans; NLM=2.0


REC NO.   Target    Pred. RT.   Internal Standard Name
   1         69      1:54.79    TRIS
   2        117      5:45.43    BPFB

Rec#  Target   ret.tm. TS  fit  purity  MS        area           ppm   man.   %RFC
  1       69   1:55.57   0.995  0.986           2657386          9.94           -4.6
  2      117   5:46.97   1.000  0.997           6691100          4.85           -8.6

REC NO.   Target    Pred. RT.   Analyte Name
   1         53      1:11.79    1,3-butadiene
   2         57      1:46.45    Hexane
   3         78      2:09.07    Benzene
   4         91      3:28.22    Toluene
   5         91      5:59.71    Ethyl Benzene
   6         91      6:21.57    m/p-Xylene
   7        104      7:06.06    Styrene
   8         91      7:18.85    O-Xylene

Rec#  Target   ret.tm. TS  fit  purity  MS       area            ppm   man.   EKP
  1       53   1:11.08   0.887  0.722            24371           0.39          .3
  2       57   1:46.50   0.968  0.963           100366           0.31          .3
  3       78   2:09.13   0.999  0.999          1157577           0.29          .3
  4       91   3:28.28   0.999  0.998          1019161           0.33          .3
  5       91   6:02.02   0.998  0.994          1288873           0.34          .3
  6       91   6:23.16   1.000  0.993          1982834           0.64          .6
  7      104   7:08.37   0.985  0.963           624207           0.38          .3
  8       91   7:21.16   0.983  0.979          1071390           0.35          .3
```

audit / LFS acquired

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audit

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FULL SCAN Quantitation Report

Title:
FULL SCAN DATA :  C:\PROGRA~1\HAPSRUN\DATA\AAA\LFSCALS\ICCR001B
Acquired           07/09/~~95~~98 at 15:20:56
This Quantitation  07/10/98 at 09:10:11

Peak Search Method :  C:\PROGRA~1\HAPSRUN\METHOD\AAA.LSM
PQUAN Library      :  C:\PROGRA~1\HAPSRUN\METHOD\AAA
Last Calibration      07/10/98 at 09:04:28

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\LLKLFS.FSM
Tune/Cal File      :
Datafile title:
ICCR - New Gas
10 ppm diluted to 1 ppm
Can E

W = RT +- ( 0:45.00 / 2 + RT * 0.010 )
Min Fit=0.650; Min Pur=0.650; Min Area=5000
Width= 5-100 scans; Res= 6 scans; NLM=2.0


REC NO.   Target    Pred. RT.
   1          69     1:54.79   Internal Standard Name
   2         117     5:45.43   TRIS
                               BPFB

Rec#  Target   ret.tm. TS  fit purity  MS       area
  1      69    1:54.80    0.997  0.989         2851831        ppm   man.  %RFC
  2     117    5:46.20    0.999  0.995         7288881        9.94           2.5
                                                              4.85          -0.1

REC NO.   Target    Pred. RT.
   1          53     1:11.79   Analyte Name
   2          57     1:46.45   1,3-butadiene
   3          78     2:09.07   Hexane
   4          91     3:28.22   Benzene
   5          91     5:59.71   Toluene
   6          91     6:21.57   Ethyl Benzene
   7         104     7:06.06   m/p-Xylene
   8          91     7:18.85   Styrene
                               O-Xylene

Rec#  Target   ret.tm. TS  fit purity  MS       area                      EXP
  1      53    1:11.85    0.960  0.944          90859         ppm   man.
  2      57    1:46.51    0.997  0.994         435586         1.06        1.0
  3      78    2:09.14    0.998  0.998        4451729         1.03        1.0
  4      91    3:28.29    1.000  0.999        4247383         1.01        1.0
  5      91    6:00.54    0.999  0.996        6047727         0.95        1.0
  6      91    6:21.63    0.997  0.995       10648626         0.97        1.0
  7     104    7:06.83    0.999  0.982        2972343         1.97        1.0
  8      91    7:19.69    0.985  0.984        4965403         0.93        2.0
                                                              0.95        1.0
                                                                          1.0
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FULL SCAN Quantitation Report

 Title:
 FULL SCAN DATA :  C:\PROGRA~1\HAPSRUN\DATA\AAA\LFSCALS\ICCR10B
 Acquired           07/09/~~95~~98 at 15:42:26
 This Quantitation  07/10/98 at 09:10:55

 Peak Search Method :  C:\PROGRA~1\HAPSRUN\METHOD\AAA.LSM
 PQUAN Library      :  C:\PROGRA~1\HAPSRUN\METHOD\AAA
 Last Calibration      07/10/98 at 09:04:28

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\LLKLFS.FSM
Tune/Cal File      :
Datafile title:
ICCR - New Gas
10 ppm straight shot
Can E

W = RT +- ( 0:45.00 / 2 + RT * 0.010 )
Min Fit=0.650; Min Pur=0.650; Min Area=5000
Width= 5-100 scans; Res= 6 scans; NLM=2.0


REC NO.   Target    Pred. RT.   Internal Standard Name
    1        69       1:54.79   TRIS
    2       117       5:45.43   BPFB

 Rec#  Target   ret.tm. TS  fit  purity  MS       area          ppm  man.  %RFC
   1      69   1:54.79    0.998  0.990         2980580          9.94          6.9
   2     117   5:45.43    1.000  0.998         8196344          4.85         11.7

REC NO.   Target    Pred. RT.   Analyte Name
    1        53      1:11.79    1,3-butadiene
    2        57      1:46.45    Hexane
    3        78      2:09.07    Benzene
    4        91      3:28.22    Toluene
    5        91      5:59.71    Ethyl Benzene
    6        91      6:21.57    m/p-Xylene
    7       104      7:06.06    Styrene
    8        91      7:18.85    O-Xylene
                                                                        exp
Rec#  Target   ret.tm. TS  fit  purity  MS       area          ppm   man.
  1       53  1:12.56    0.994  0.993         1041395        10.44        10
  2       57  1:46.45    1.000  0.999         4970370        10.47        10
  3       78  2:09.07    1.000  1.000        47933000        10.28        10
  4       91  3:28.22    1.000  1.000        53416740        10.19        10
  5       91  6:00.48    1.000  0.998        81925928        10.00        10
  6       91  6:21.57    1.000  0.998       141405296        20.00        20
  7      104  7:06.06    1.000  0.998        46812688        10.20        10
  8       91  7:18.85    0.986  0.985        68584080         9.81        10
```

audit

190

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MID SCAN Calibration Response Table

Title:
 MID SCAN DATA :  C:\PROGRA~1\HAPSRUN\DATA\AAA\SIM002B
Acquired           07/13/98 at 10:58:38

Peak Search Method :  C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA.LSM
PQUAN Library      :  C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA
Last Calibration      07/14/98 at 14:57:18

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\AAA.MIM
Tune/Cal File      :
Datafile title:
iccr gas DF = 0.002
iccr gas diluted to 21 ppb
can E

W = RT +- ( 0:15.00 / 2 + RT * 0.010 )
Min Fit=0.500; Min Pur=0.000; Min Area=2000
Width= 10-200 scans; Res= 6 scans; NLM=2.0


Linear calibration curve

Internal Standards:

I.S. #1 -- TRIS
Concentration = 9.940 ppm; 6 calib points

    pt.   File     Man.         Area Resp. Factor
      1   SIM01A               7502923  754821.18681
      2   SIM01B               8096245  814511.52565
      3   SIM005A              8229477  827915.14666
      4   SIM005B              7931064  797893.71971
      5   SIM002A    *         5711226  574569.98925
      6   SIM002B              8127841  817690.19752
                          Average RF = 7.64567e+05

I.S. #2 -- BPFB
Concentration = 4.850 ppm; 6 calib points

    pt.   File     Man.         Area Resp. Factor
      1   SIM01A              22737388  4688121.32930
      2   SIM01B              23432816  4831508.54861
      3   SIM005A             23605052  4867021.12663
      4   SIM005B             21918912  4519363.38784
      5   SIM002A             23517340  4848936.17782
      6   SIM002B             23633006  4872784.83808
                          Average RF = 4.77129e+06

Analytes:

Analyte #1 -- 1,3-butadiene
4 calib points
 pt.  File     M |    Conc.    Cratio |       Area     Aratio | Resp. Factor
  1   SIM01A     |    0.10  1.006e-02 |      23668  3.155e-03 |  3.13558e-01
  2   SIM01B     |    0.10  1.006e-02 |      26138  3.228e-03 |  3.20904e-01
```

SimAAA quant method

Sum method

3 sets.

1,3 But.

Hex

B E X S

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  3  SIM005A     |       0.05  5.030e-03 |          12954  1.574e-03 |  3.12931e-01
  4  SIM005B     |       0.05  5.030e-03 |          11993  1.512e-03 |  3.00617e-01
                                                         Average RF = 3.12002e-01
                                                          Deviation = 1.59087%


Analyte #2 -- Hexane
5 calib points
 pt.  File     M |      Conc.      Cratio |           Area      Aratio | Resp. Factor
   1  SIM01A     |       0.10  1.016e-02 |          72602  9.676e-03 |  9.52320e-01
   2  SIM01B     |       0.10  1.016e-02 |          93759  1.158e-02 |  1.13971e+00
   3  SIM005A    |       0.05  5.080e-03 |          37273  4.529e-03 |  8.91491e-01
   4  SIM005B  * |       0.05  5.080e-03 |          36813  4.642e-03 |  9.13618e-01
   5  SIM002B  * |       0.02  2.032e-03 |          15619  1.922e-03 |  9.45612e-01
                                                         Average RF = 9.68550e-01
                                                          Deviation = 10.13368%


Analyte #3 -- Benzene
6 calib points
 pt.  File     M |      Conc.      Cratio |           Area      Aratio | Resp. Factor
   1  SIM01A     |       0.10  1.016e-02 |        1072065  1.429e-01 |  1.40623e+01
   2  SIM01B     |       0.10  1.016e-02 |        1075874  1.329e-01 |  1.30780e+01
   3  SIM005A    |       0.05  5.080e-03 |         503815  6.122e-02 |  1.20502e+01
   4  SIM005B    |       0.05  5.080e-03 |         453725  5.721e-02 |  1.12605e+01
   5  SIM002A    |       0.02  2.032e-03 |         185948  3.256e-02 |  1.60213e+01
   6  SIM002B    |       0.02  2.032e-03 |         192551  2.369e-02 |  1.16575e+01
                                                         Average RF = 1.30216e+01
                                                          Deviation = 8.51472%


Analyte #4 -- Toluene
0 calib points

Analyte #5 -- Ethyl Benzene
6 calib points
 pt.  File     M |      Conc.      Cratio |           Area      Aratio | Resp. Factor
   1  SIM01A   * |       0.10  2.082e-02 |         436796  1.921e-02 |  9.22483e-01
   2  SIM01B     |       0.10  2.082e-02 |        1878925  8.018e-02 |  3.85040e+00
   3  SIM005A    |       0.05  1.041e-02 |         613597  2.599e-02 |  2.49648e+00
   4  SIM005B    |       0.05  1.041e-02 |         628430  2.867e-02 |  2.75352e+00
   5  SIM002A    |       0.02  4.165e-03 |         241033  1.025e-02 |  2.46081e+00
   6  SIM002B  * |       0.02  4.165e-03 |         215464  9.117e-03 |  2.18900e+00
                                                         Average RF = 2.44545e+00
                                                          Deviation = 46.84543%
```

delete #1
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gives
11 9
Rc

```
Analyte #6 -- m/p-Xylene
6 calib points
 pt.  File     M |      Conc.      Cratio |           Area      Aratio | Resp. Factor
   1  SIM01A     |       0.20  4.165e-02 |        2809694  1.236e-01 |  2.96694e+00
   2  SIM01B     |       0.20  4.165e-02 |        2680206  1.144e-01 |  2.74621e+00
   3  SIM005A    |       0.10  2.082e-02 |         900517  3.815e-02 |  1.83192e+00
   4  SIM005B    |       0.10  2.082e-02 |         831158  3.792e-02 |  1.82090e+00
   5  SIM002A    |       0.04  8.330e-03 |         270068  1.148e-02 |  1.37862e+00
   6  SIM002B    |       0.04  8.330e-03 |         285057  1.206e-02 |  1.44802e+00
                                                         Average RF = 2.03210e+00
                                                          Deviation = 9.80775%


Analyte #7 -- Styrene
6 calib points
```

```
 pt.  File      M |       Conc.      Cratio |        Area      Aratio | Resp. Factor
   1  SIM01A      |        0.10  2.062e-02 |      658985  2.898e-02 |  1.40565e+00
   2  SIM01B      |        0.10  2.062e-02 |      663986  2.834e-02 |  1.37428e+00
   3  SIM005A     |        0.05  1.031e-02 |      191696  8.121e-03 |  7.87734e-01
   4  SIM005B     |        0.05  1.031e-02 |      189592  8.650e-03 |  8.39021e-01
   5  SIM002A     |        0.02  4.124e-03 |       12712  5.405e-04 |  1.31080e-01
   6  SIM002B     |        0.02  4.124e-03 |       38506  1.629e-03 |  3.95113e-01
                                                        Average RF = 8.22147e-0
                                                         Deviation = 8.04836%

Analyte #8 -- o-Xylene
6 calib points
 pt.  File      M |       Conc.      Cratio |        Area      Aratio | Resp. Factor
   1  SIM01A      |        0.10  2.062e-02 |     1241802  5.461e-02 |  2.64883e+00
   2  SIM01B      |        0.10  2.062e-02 |     1189744  5.077e-02 |  2.46247e+00
   3  SIM005A     |        0.05  1.031e-02 |      383434  1.624e-02 |  1.57564e+00
   4  SIM005B     |        0.05  1.031e-02 |      415801  1.897e-02 |  1.84009e+00
   5  SIM002A     |        0.02  4.124e-03 |       65816  2.799e-03 |  6.78664e-01
   6  SIM002B     |        0.02  4.124e-03 |       88112  3.728e-03 |  9.04124e-01
                                                        Average RF = 1.68497e+0
                                                         Deviation = 7.34985%
```

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MID SCAN Calibration Response Table

Title:
 MID SCAN DATA :  C:\PROGRA~1\HAPSRUN\DATA\AAA\AAA002B
Acquired            07/14/98 at 13:27:06

Peak Search Method :  C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA2.LSM
PQUAN Library      :  C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA2
Last Calibration      07/14/98 at 15:06:10

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\AAA2.MIM
Tune/Cal File      :
Datafile title:
Sim Cals ICCR gas DF = .002
Can D

W = RT +- ( 0:45.00 / 2 + RT * 0.010 )
Min Fit=0.500; Min Pur=0.000; Min Area=2000
Width= 5-150 scans; Res= 6 scans; NLM=2.0


Linear calibration curve

Internal Standards:

I.S. #1 -- Tris
Concentration = 9.940 ppm; 6 calib points

    pt.  File     Man.          Area  Resp. Factor
      1  AAA010A             7667186   771346.63864
      2  AAA010B             7622166   766817.46383
      3  AAA005A             7819453   786665.24948
      4  AAA005B             7725098   777172.79527
      5  AAA002A             7890010   793763.53884
      6  AAA002B             7979764   802793.11582
                        Average RF = 7.83093e+05

I.S. #2 -- BPFB
Concentration = 4.850 ppm; 6 calib points

    pt.  File     Man.          Area  Resp. Factor
      1  AAA010A            16369912  3375239.65400
      2  AAA010B            16086901  3316886.86934
      3  AAA005A            16103032  3320212.84879
      4  AAA005B            16431683  3387975.94291
      5  AAA002A            16493355  3400691.81945
      6  AAA002B            16836116  3471364.19197
                        Average RF = 3.37873e+06

Analytes:

Analyte #1 -- Benzene
6 calib points
 pt.  File     M |    Conc.     Cratio |       Area     Aratio | Resp. Factor
   1  AAA010A    |     0.10  1.016e-02 |    1195389  1.559e-01 |  1.53440e+01
   2  AAA010B    |     0.10  1.016e-02 |    1159839  1.522e-01 |  1.49756e+01
   3  AAA005A    |     0.05  5.080e-03 |     588034  7.520e-02 |  1.48020e+01
```

SimAAA2
quant method
Sim for
BTEXS

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   4  AAA005B     |       0.05  5.080e-03 |       584426  7.565e-02 |  1.48909e+01
   5  AAA002A     |       0.02  2.032e-03 |       194609  2.467e-02 |  1.21373e+01
   6  AAA002B     |       0.02  2.032e-03 |       255073  3.196e-02 |  1.57293e+01
                                                       Average RF = 1.46465e+0
                                                        Deviation = 2.91434%

Analyte #2 -- Toluene
6 calib points
 pt.  File      M |      Conc.      Cratio |        Area     Aratio | Resp. Factor
   1  AAA010A     |       0.10  1.006e-02 |     1055384  1.376e-01 |  1.36824e+01
   2  AAA010B     |       0.10  1.006e-02 |     1021144  1.340e-01 |  1.33167e+01
   3  AAA005A     |       0.05  5.030e-03 |      586991  7.507e-02 |  1.49235e+01
   4  AAA005B     |       0.05  5.030e-03 |      505124  6.539e-02 |  1.29990e+01
   5  AAA002A     |       0.02  2.012e-03 |      164738  2.088e-02 |  1.03770e+01
   6  AAA002B     |       0.02  2.012e-03 |      210069  2.633e-02 |  1.30836e+01
                                                       Average RF = 1.30637e+0
                                                        Deviation = 5.51358%

Analyte #3 -- Ethyl benzene
6 calib points
 pt.  File      M |      Conc.      Cratio |        Area     Aratio | Resp. Factor
   1  AAA010A     |       0.10  2.082e-02 |     1059879  6.475e-02 |  3.10907e+00
   2  AAA010B     |       0.10  2.082e-02 |     1044530  6.493e-02 |  3.11795e+00
   3  AAA005A     |       0.05  1.041e-02 |      468581  2.910e-02 |  2.79465e+00
   4  AAA005B     |       0.05  1.041e-02 |      571365  3.477e-02 |  3.33950e+00
   5  AAA002A     |       0.02  4.165e-03 |      140214  8.501e-03 |  2.04114e+00
   6  AAA002B     |       0.02  4.165e-03 |      215662  1.281e-02 |  3.07554e+00
                                                       Average RF = 2.91298e+0
                                                        Deviation = 6.00032%

Analyte #4 -- m/p-Xylene
6 calib points
 pt.  File      M |      Conc.      Cratio |        Area     Aratio | Resp. Factor
   1  AAA010A     |       0.20  4.165e-02 |     1404183  8.578e-02 |  2.05953e+00
   2  AAA010B     |       0.20  4.165e-02 |     1484753  9.230e-02 |  2.21601e+00
   3  AAA005A     |       0.10  2.082e-02 |      616493  3.828e-02 |  1.83840e+00
   4  AAA005B     |       0.10  2.082e-02 |      691130  4.206e-02 |  2.01975e+00
   5  AAA002A     |       0.04  8.330e-03 |      162938  9.879e-03 |  1.18597e+00
   6  AAA002B     |       0.04  8.330e-03 |      249387  1.481e-02 |  1.77825e+00
                                                       Average RF = 1.84965e+0
                                                        Deviation = 5.28587%

Analyte #5 -- Styrene
6 calib points
 pt.  File      M |      Conc.      Cratio |        Area     Aratio | Resp. Factor
   1  AAA010A     |       0.10  2.062e-02 |      393875  2.406e-02 |  1.16695e+00
   2  AAA010B     |       0.10  2.062e-02 |      371736  2.311e-02 |  1.12074e+00
   3  AAA005A     |       0.05  1.031e-02 |      170978  1.062e-02 |  1.02992e+00
   4  AAA005B     |       0.05  1.031e-02 |      199072  1.212e-02 |  1.17517e+00
   5  AAA002A     |       0.02  4.124e-03 |       29485  1.788e-03 |  4.33515e-01
   6  AAA002B   * |       0.02  4.124e-03 |       60920  3.618e-03 |  8.77465e-01
                                                       Average RF = 9.67294e-0
                                                        Deviation = 6.17581%

Analyte #6 -- o-Xylene
6 calib points
 pt.  File      M |      Conc.      Cratio |        Area     Aratio | Resp. Factor
```

```
1  AAA010A    |      0.10  2.062e-02 |      725983  4.435e-02 |  2.15091e+00
2  AAA010B    |      0.10  2.062e-02 |      681613  4.237e-02 |  2.05498e+00
3  AAA005A    |      0.05  1.031e-02 |      373294  2.318e-02 |  2.24862e+00
4  AAA005B    |      0.05  1.031e-02 |      386564  2.353e-02 |  2.28198e+00
5  AAA002A    |      0.02  4.124e-03 |       57744  3.501e-03 |  8.49004e-01
6  AAA002B    |      0.02  4.124e-03 |      152918  9.083e-03 |  2.20256e+00
                                                  Average RF = 1.96467e+00
                                                   Deviation = 9.45649%
```

```
MID SCAN Quantitation Report

Title:
 MID SCAN DATA :   C:\PROGRA~1\HAPSRUN\DATA\AAA\AAA005A
Acquired             07/14/98 at 13:39:42
This Quantitation    07/14/98 at 15:12:33

Peak Search Method :   C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA2.LSM
PQUAN Library      :   C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA2
Last Calibration       07/14/98 at 15:06:10

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\AAA2.MIM
Tune/Cal File      :
Datafile title:
Sim Cals ICCR gas DF = .005
Can D

W = RT +- ( 0:45.00 / 2 + RT * 0.010 )
Min Fit=0.500; Min Pur=0.000; Min Area=2000
Width= 5-150 scans; Res= 6 scans; NLM=2.0


REC NO.    Target     Pred. RT.    Internal Standard Name
     1        69       1:54.65     Tris
     2       117       5:39.99     BPFB

 Rec#   Target    ret.tm. TS   fit  purity  MS        area             ppm   man.   %RFC
   1       69    1:53.94     1.000   *N/A*          7819453            9.94           0.5
   2      117    5:39.32     1.000   *N/A*         16103032            4.85          -1.7


REC NO.    Target     Pred. RT.    Analyte Name
     1        78       2:08.22     Benzene
     2        91       3:26.10     Toluene
     3        91       5:54.98     Ethyl benzene
     4        91       6:15.47     m/p-Xylene
     5       104       6:58.97     Styrene
     6        91       7:11.82     o-Xylene

 Rec#   Target    ret.tm. TS   fit  purity  MS        area             ppm   man.
   1       78    2:07.51     1.000   *N/A*           588034            0.05
   2       91    3:24.73     1.000   *N/A*           586991            0.06
   3       91    5:54.65     1.000   *N/A*           468581            0.05
   4       91    6:14.80     1.000   *N/A*           616493            0.10
   5      104    6:58.96     1.000   *N/A*           170978            0.05
   6       91    7:12.92     1.000   *N/A*           373294            0.05
```

audit

Dilution Audits

should be
.05
↓
.1
.05
↓

197

audit

```
MID SCAN Quantitation Report

Title:
 MID SCAN DATA :  C:\PROGRA~1\HAPSRUN\DATA\AAA\AAA010A
Acquired              07/14/98 at 14:07:35
This Quantitation     07/14/98 at 15:12:01

Peak Search Method :  C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA2.LSM
PQUAN Library      :  C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA2
Last Calibration      07/14/98 at 15:06:10

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\AAA2.MIM
Tune/Cal File      :
Datafile title:
Sim Cals ICCR gas DF = .01
Can D

W = RT +- ( 0:45.00 / 2 + RT * 0.010 )
Min Fit=0.500; Min Pur=0.000; Min Area=2000
Width= 5-150 scans; Res= 6 scans; NLM=2.0


REC NO.    Target     Pred. RT.   Internal Standard Name
    1          69       1:54.65   Tris
    2         117       5:39.99   BPFB

 Rec#  Target    ret.tm. TS  fit  purity  MS        area             ppm   man.   %RFC
   1      69    1:54.65    1.000   *N/A*         7667186             9.94          -1.5
   2     117    5:39.66    1.000   *N/A*        16369912             4.85          -0.1


REC NO.    Target     Pred. RT.   Analyte Name
    1          78       2:08.22   Benzene
    2          91       3:26.10   Toluene
    3          91       5:54.98   Ethyl benzene
    4          91       6:15.47   m/p-Xylene
    5         104       6:58.97   Styrene
    6          91       7:11.82   o-Xylene
                                                                               Should
                                                                                 be
 Rec#  Target    ret.tm. TS  fit  purity  MS        area             ppm    man.
   1      78    2:08.22    1.000   *N/A*         1195389             0.10       .1
   2      91    3:26.10    1.000   *N/A*         1055384             0.10        ↓
   3      91    5:54.60    1.000   *N/A*         1059879             0.10        ↓
   4      91    6:15.14    1.000   *N/A*         1404183             0.20       .2
   5     104    6:58.97    1.000   *N/A*          393875             0.10       .1
   6      91    7:11.82    1.000   *N/A*          725983             0.10        ↓
```

```
MID SCAN Quantitation Report

Title:
 MID SCAN DATA :    C:\PROGRA~1\HAPSRUN\DATA\AAA\AAA002A
Acquired            07/14/98 at 13:15:06
This Quantitation   07/14/98 at 15:13:11

Peak Search Method :   C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA2.LSM
PQUAN Library      :   C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA2
Last Calibration       07/14/98 at 15:06:10

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\AAA2.MIM
Tune/Cal File      :
Datafile title:
Sim Cals ICCR gas DF = .002
Can D

W = RT +- ( 0:45.00 / 2 + RT * 0.010 )
Min Fit=0.500; Min Pur=0.000; Min Area=2000
Width= 5-150 scans; Res= 6 scans; NLM=2.0


REC NO.   Target    Pred. RT.   Internal Standard Name
    1        69       1:54.65   Tris
    2       117       5:39.99   BPFB

 Rec#  Target   ret.tm. TS  fit  purity  MS        area          ppm   man.   %RFC
   1      69    1:53.94   1.000  *N/A*          7890010          9.94           1.4
   2     117    5:39.65   1.000  *N/A*         16493355          4.85           0.6

REC NO.   Target    Pred. RT.   Analyte Name
    1        78       2:08.22   Benzene
    2        91       3:26.10   Toluene
    3        91       5:54.98   Ethyl benzene
    4        91       6:15.47   m/p-Xylene
    5       104       6:58.97   Styrene
    6        91       7:11.82   o-Xylene

 Rec#  Target   ret.tm. TS  fit  purity  MS        area          ppm    man.
   1      78    2:07.83   1.000  *N/A*           194609         0.02
   2      91    3:25.44   1.000  *N/A*           164738         0.02
   3      91    5:54.59   1.000  *N/A*           140214         0.02
   4      91    6:14.42   0.999  *N/A*           162938         0.04
   5     104    7:00.72   0.997  *N/A*            29485         0.02
   6      91    7:11.82   1.000  *N/A*            57744         0.01
```

audit

Should be
.02
↓
.04
.02
.02

199

```
MID SCAN Quantitation Report

Title:
 MID SCAN DATA :  C:\PROGRA~1\HAPSRUN\DATA\AAA\SIM01A
Acquired             07/13/98 at 11:51:39
This Quantitation    07/14/98 at 15:19:25

Peak Search Method :  C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA.LSM
PQUAN Library      :  C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA
Last Calibration      07/14/98 at 14:57:18

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\AAA.MIM
Tune/Cal File      :
Datafile title:
iccr gas DF = 0.01
iccr gas diluted to 100 ppb
can E

W = RT +- ( 0:15.00 / 2 + RT * 0.010 )
Min Fit=0.500; Min Pur=0.000; Min Area=2000
Width= 10-200 scans; Res= 6 scans; NLM=2.0


REC NO.   Target    Pred. RT.   Internal Standard Name
     1        69     1:54.48    TRIS
     2       117     4:51.32    BPFB

 Rec#  Target   ret.tm. TS  fit  purity  MS       area          ppm  man.  %RFC
    1      69   1:54.48    1.000  *N/A*         7502923        9.94         -1.3
    2     117   4:52.63    1.000  *N/A*        22737388        4.85         -1.8


REC NO.   Target    Pred. RT.   Analyte Name
     1        53     1:12.25    1,3-butadiene
     2        57     1:46.25    Hexane
     3        78     2:08.00    Benzene
     4        91     2:37.24    Toluene
     5        91     5:06.75    Ethyl Benzene
     6        91     5:27.24    m/p-Xylene
     7       104     6:10.93    Styrene
     8        91     6:24.23    o-Xylene

 Rec#  Target   ret.tm. TS  fit  purity  MS       area          ppm   man.
    1      53   1:12.69    1.000  *N/A*           23668        0.10
    2      57   1:46.68    1.000  *N/A*           72602        0.09
    3      78   2:08.43    1.000  *N/A*         1072065        0.11
*   4      91  Not Found
    5      91   5:07.41    1.000  *N/A*         1815518        0.11
    6      91   5:28.12    1.000  *N/A*         2809694        0.21
    7     104   6:11.98    1.000  *N/A*          658985        0.10
    8      91   6:25.76    1.000  *N/A*         1241802        0.10
```

audit

Should be

.1

.2

200

```
MID SCAN Calibration Report

Title:
 MID SCAN DATA :   C:\PROGRA~1\HAPSRUN\DATA\AAA\SIM002A
Acquired            07/13/98 at 10:44:04
This Calibration    07/14/98 at 14:57:17

Peak Search Method :  C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA.LSM
PQUAN Library      :  C:\PROGRA~1\HAPSRUN\METHOD\SIMAAA

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\AAA.MIM
Tune/Cal File      :
Datafile title:
iccr gas DF = 0.002
iccr gas diluted to 21 ppb
can E

W = RT +- ( 0:15.00 / 2 + RT * 0.010 )
Min Fit=0.500; Min Pur=0.000; Min Area=2000
Width= 10-200 scans; Res= 6 scans; NLM=2.0


REC NO.   Target    Pred. RT.   Internal Standard Name
     1       69      1:54.48    TRIS
     2      117      4:51.32    BPFB

 Rec#  Target    ret.tm. TS  fit purity  MS       area          ppm  man.
   1      69    1:53.93    1.000  *N/A*          5711226         9.94    *
   2     117    4:50.82    1.000  *N/A*         23517340         4.85


REC NO.    Target    Pred. RT.   Analyte Name
     1         53      1:12.25   1,3-butadiene
     2         57      1:46.25   Hexane
     3         78      2:08.00   Benzene
     4         91      2:37.24   Toluene
     5         91      5:06.75   Ethyl Benzene
     6         91      5:27.24   m/p-Xylene
     7        104      6:10.93   Styrene
     8         91      6:24.23   o-Xylene

  Rec#  Target    ret.tm. TS  fit purity  MS       area          ppm   man.
*    1      53   1:23.01   1.000  *N/A*            2489 Short peak.
*    2      57   1:44.65   1.000  *N/A*            8042 Short peak.
     3      78   2:07.61   1.000  *N/A*          185948           0.02
*    4      91  Not Found
     5      91   5:06.31   1.000  *N/A*          241033           0.02
     6      91   5:26.80   1.000  *N/A*          270068           0.04
     7     104   6:10.16   1.000  *N/A*           12712           0.02
     8      91   6:24.72   1.000  *N/A*           65816           0.02
```

audit

ooc Should b

.02

.04

↓

201

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FULL SCAN Calibration Response Table

Title: trona
FULL SCAN DATA :  C:\PROGRA~1\HAPSRUN\DATA\CAECALS\CAE1300B
Acquired           05/12/98 at 17:00:02

Peak Search Method :  C:\PROGRA~1\HAPSRUN\METHOD\CAE1.LSM
PQUAN Library      :  C:\PROGRA~1\HAPSRUN\METHOD\TGPC1
Last Calibration      05/13/98 at 11:23:40

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\LLK.FSM
Tune/Cal File      :
Datafile title:
Cylinder #3 - 300 ppb
CAE/EMI OCI-TG Test
5-12-98

W = RT +- ( 0:45.00 / 2 + RT * 0.010 )
Min Fit=0.650; Min Pur=0.650; Min Area=5000
Width= 5-100 scans; Res= 6 scans; NLM=2.0


Linear calibration curve

Internal Standards:

I.S. #1 -- TRIS
Concentration = 9.940 ppm; 6 calib points

    pt.  File     Man.          Area  Resp. Factor
      1  CAE1010A            1531445  154068.90520
      2  CAE1010B            1450186  145893.95594
      3  CAE1001A            1613940  162368.20053
      4  CAE1001B            1615176  162492.54660
      5  CAE1300A            1682897  169305.52410
      6  CAE1300B            1659603  166962.06346
                         Average RF = 1.60182e+05

I.S. #2 -- BPFB
Concentration = 4.850 ppm; 6 calib points

    pt.  File     Man.          Area  Resp. Factor
      1  CAE1010A            2876444  593081.24878
      2  CAE1010B            2790694  575400.83606
      3  CAE1001A            2941213  606435.68203
      4  CAE1001B            2921814  602435.88813
      5  CAE1300A            3076968  634426.40423
      6  CAE1300B            3042285  627275.27007
                         Average RF = 6.06509e+05

Analytes:

Analyte #1 -- Chloromethane
6 calib points
 pt.  File       M |    Conc.      Cratio |      Area      Aratio | Resp. Factor
   1  CAE1010A     |     9.99  1.005e+00 |    859035  5.609e-01 |  5.58124e-01
   2  CAE1010B     |     9.99  1.005e+00 |    878564  6.058e-01 |  6.02796e-01
```

Linear

Full scan
Calibration
curve

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  3  CAE1001A    |       1.00  1.005e-01 |       93327  5.783e-02 |  5.75362e-01
  4  CAE1001B    |       1.00  1.005e-01 |       86273  5.341e-02 |  5.31467e-01
  5  CAE1300A    |       0.30  3.015e-02 |       21403  1.272e-02 |  4.21810e-01
  6  CAE1300B    |       0.30  3.015e-02 |       32808  1.977e-02 |  6.55655e-01
                                                     Average RF = 5.57535e-0
                                                      Deviation = 6.54791%


Analyte #2 -- Chloroethane
6 calib points
 pt.  File      M |       Conc.      Cratio |        Area    Aratio | Resp. Factor
   1  CAE1010A    |       9.98  1.004e+00 |     2546828  1.663e+00 |  1.65636e+00
   2  CAE1010B    |       9.98  1.004e+00 |     2593230  1.788e+00 |  1.78104e+00
   3  CAE1001A    |       1.00  1.004e-01 |      236929  1.468e-01 |  1.46213e+00
   4  CAE1001B    |       1.00  1.004e-01 |      248772  1.540e-01 |  1.53404e+00
   5  CAE1300A    |       0.30  3.012e-02 |       71831  4.268e-02 |  1.41706e+00
   6  CAE1300B    |       0.30  3.012e-02 |       80993  4.880e-02 |  1.62023e+00
                                                     Average RF = 1.57848e+0
                                                      Deviation = 6.16326%


Analyte #3 -- Methylene Chloride
6 calib points
 pt.  File      M |       Conc.      Cratio |        Area    Aratio | Resp. Factor
   1  CAE1010A    |       9.99  1.005e+00 |     6503620  4.247e+00 |  4.22547e+00
   2  CAE1010B    |       9.99  1.005e+00 |     6640100  4.579e+00 |  4.55588e+00
   3  CAE1001A    |       1.00  1.005e-01 |      653535  4.049e-01 |  4.02905e+00
   4  CAE1001B    |       1.00  1.005e-01 |      664074  4.111e-01 |  4.09089e+00
   5  CAE1300A    |       0.30  3.015e-02 |      173766  1.033e-01 |  3.42458e+00
   6  CAE1300B    |       0.30  3.015e-02 |      186268  1.122e-01 |  3.72249e+00
                                                     Average RF = 4.00806e+0
                                                      Deviation = 6.27712%


Analyte #4 -- 1,1-dichloroethane
6 calib points
 pt.  File      M |       Conc.      Cratio |        Area    Aratio | Resp. Factor
   1  CAE1010A    |       9.96  1.002e+00 |     7941977  5.186e+00 |  5.17552e+00
   2  CAE1010B    |       9.96  1.002e+00 |     8228796  5.674e+00 |  5.66291e+00
   3  CAE1001A    |       1.00  1.002e-01 |      787538  4.880e-01 |  4.86980e+00
   4  CAE1001B    |       1.00  1.002e-01 |      792629  4.907e-01 |  4.89753e+00
   5  CAE1300A    |       0.30  3.006e-02 |      242718  1.442e-01 |  4.79789e+00
   6  CAE1300B    |       0.30  3.006e-02 |      242543  1.461e-01 |  4.86172e+00
                                                     Average RF = 5.04423e+0
                                                      Deviation = 7.53477%


Analyte #5 -- c-1,2-dichloroethene
6 calib points
 pt.  File      M |       Conc.      Cratio |        Area    Aratio | Resp. Factor
   1  CAE1010A    |      10.00  1.006e+00 |     6149913  4.016e+00 |  3.99166e+00
   2  CAE1010B    |      10.00  1.006e+00 |     6408859  4.419e+00 |  4.39282e+00
   3  CAE1001A    |       1.00  1.006e-01 |      502310  3.112e-01 |  3.09365e+00
   4  CAE1001B    |       1.00  1.006e-01 |      557686  3.453e-01 |  3.43207e+00
   5  CAE1300A    |       0.30  3.018e-02 |      167332  9.943e-02 |  3.29448e+00
   6  CAE1300B    |       0.30  3.018e-02 |      148603  8.954e-02 |  2.96680e+00
                                                     Average RF = 3.52858e+00
                                                      Deviation = 8.13740%


Analyte #6 -- 1,1,1-trichloroethane
6 calib points
```

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 pt.   File      M |       Conc.     Cratio |       Area     Aratio | Resp. Factor
   1   CAE1010A    |        9.98  1.004e+00 |    7941901  5.186e+00 |  5.16510e+00
   2   CAE1010B    |        9.98  1.004e+00 |    7872220  5.428e+00 |  5.40666e+00
   3   CAE1001A    |        1.00  1.004e-01 |     772968  4.789e-01 |  4.77013e+00
   4   CAE1001B    |        1.00  1.004e-01 |     781629  4.839e-01 |  4.81988e+00
   5   CAE1300A    |        0.30  3.012e-02 |     233874  1.390e-01 |  4.61380e+00
   6   CAE1300B    |        0.30  3.012e-02 |     221625  1.335e-01 |  4.43353e+00
                                                        Average RF = 4.86818e+0
                                                         Deviation = 3.86414%

Analyte #7 -- 1,2-dichloropropane
6 calib points
 pt.   File      M |       Conc.     Cratio |       Area     Aratio | Resp. Factor
   1   CAE1010A    |        9.98  1.004e+00 |    7148643  4.668e+00 |  4.64920e+00
   2   CAE1010B    |        9.98  1.004e+00 |    7442873  5.132e+00 |  5.11179e+00
   3   CAE1001A    |        1.00  1.004e-01 |     655377  4.061e-01 |  4.04445e+00
   4   CAE1001B    |        1.00  1.004e-01 |     693076  4.291e-01 |  4.27383e+00
   5   CAE1300A    |        0.30  3.012e-02 |     202418  1.203e-01 |  3.99325e+00
   6   CAE1300B    |        0.30  3.012e-02 |     213647  1.287e-01 |  4.27393e+00
                                                        Average RF = 4.39107e+00
                                                         Deviation = 7.97975%

Analyte #8 -- 1,1,2-trichloroethane
6 calib points
 pt.   File      M |       Conc.     Cratio |       Area     Aratio | Resp. Factor
   1   CAE1010A    |        9.99  1.005e+00 |   12254564  8.002e+00 |  7.96191e+00
   2   CAE1010B    |        9.99  1.005e+00 |   12449066  8.584e+00 |  8.54150e+00
   3   CAE1001A    |        1.00  1.005e-01 |    1153711  7.148e-01 |  7.11264e+00
   4   CAE1001B    |        1.00  1.005e-01 |    1123639  6.957e-01 |  6.92194e+00
   5   CAE1300A    |        0.30  3.015e-02 |     315623  1.875e-01 |  6.22029e+00
   6   CAE1300B    |        0.30  3.015e-02 |     319910  1.928e-01 |  6.39327e+00
                                                        Average RF = 7.19193e+00
                                                         Deviation = 5.91686%

Analyte #9 -- Dibromochloromethane
6 calib points
 pt.   File      M |       Conc.     Cratio |       Area     Aratio | Resp. Factor
   1   CAE1010A    |        9.97  2.056e+00 |    7064662  2.456e+00 |  1.19476e+00
   2   CAE1010B    |        9.97  2.056e+00 |    7386689  2.647e+00 |  1.28761e+00
   3   CAE1001A    |        1.00  2.056e-01 |     626688  2.131e-01 |  1.03651e+00
   4   CAE1001B    |        1.00  2.056e-01 |     638013  2.184e-01 |  1.06224e+00
   5   CAE1300A    |        0.30  6.167e-02 |     157000  5.102e-02 |  8.27374e-01
   6   CAE1300B    |        0.30  6.167e-02 |     168594  5.542e-02 |  8.98602e-01
                                                        Average RF = 1.05118e+00
                                                         Deviation = 6.25527%

Analyte #10 -- Ethyl Benzene
6 calib points
 pt.   File      M |       Conc.     Cratio |       Area     Aratio | Resp. Factor
   1   CAE1010A    |       10.00  2.062e+00 |   45610096  1.586e+01 |  7.69036e+00
   2   CAE1010B    |       10.00  2.062e+00 |   46299072  1.659e+01 |  8.04640e+00
   3   CAE1001A    |        1.00  2.062e-01 |    2946939  1.002e+00 |  4.85944e+00
   4   CAE1001B    |        1.00  2.062e-01 |    2976477  1.019e+00 |  4.94074e+00
   5   CAE1300A    |        0.30  6.186e-02 |     622158  2.022e-01 |  3.26887e+00
   6   CAE1300B    |        0.30  6.186e-02 |     758907  2.495e-01 |  4.03282e+00
                                                        Average RF = 5.47311e+00
                                                         Deviation = 4.59934%
```

```
Analyte #11 -- p-Xylene
6 calib points
 pt.  File      M |      Conc.      Cratio |        Area     Aratio | Resp. Factor
  1   CAE1010A    |      10.00  2.062e+00 |    35860888  1.247e+01 |  6.04654e+00
  2   CAE1010B    |      10.00  2.062e+00 |    36158800  1.296e+01 |  6.28411e+00
  3   CAE1001A    |       1.00  2.062e-01 |     2132630  7.251e-01 |  3.51666e+00
  4   CAE1001B    |       1.00  2.062e-01 |     2145611  7.343e-01 |  3.56156e+00
  5   CAE1300A    |       0.30  6.186e-02 |      522128  1.697e-01 |  2.74331e+00
  6   CAE1300B    |       0.30  6.186e-02 |      523291  1.720e-01 |  2.78076e+00
                                                      Average RF = 4.15549e+00
                                                       Deviation = 4.51725%

Analyte #12 -- 1,1,2,2-tetrachloroethane
6 calib points
 pt.  File      M |      Conc.      Cratio |        Area     Aratio | Resp. Factor
  1   CAE1010A    |       5.09  1.049e+00 |    20311168  7.061e+00 |  6.72826e+00
  2   CAE1010B    |       5.09  1.049e+00 |    19883932  7.125e+00 |  6.78913e+00
  3   CAE1001A    |       0.51  1.049e-01 |     1831837  6.228e-01 |  5.93450e+00
  4   CAE1001B    |       0.51  1.049e-01 |     1795553  6.145e-01 |  5.85558e+00
  5   CAE1300A    |       0.15  3.148e-02 |      453519  1.474e-01 |  4.68139e+00
  6   CAE1300B    |       0.15  3.148e-02 |      477855  1.571e-01 |  4.98883e+00
                                                      Average RF = 5.82962e+00
                                                       Deviation = 0.96430%
```

```
FULL SCAN Calibration Response Table

Title: trona
FULL SCAN DATA :  C:\PROGRA~1\HAPSRUN\DATA\CAECALS\CAE3300B
Acquired           05/12/98 at 15:39:16

Peak Search Method :  C:\PROGRA~1\HAPSRUN\METHOD\CAE3.LSM
PQUAN Library      :  C:\PROGRA~1\HAPSRUN\METHOD\TGPC3
Last Calibration      05/13/98 at 11:03:00

Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\LLK.FSM
Tune/Cal File      :
Datafile title:
Cylinder #3 - 300 ppb
CAE/EMI OCI-TG Test
5-12-98

W = RT +- ( 0:45.00 / 2 + RT * 0.010 )
Min Fit=0.650; Min Pur=0.650; Min Area=5000
Width= 5-100 scans; Res= 6 scans; NLM=2.0


Linear calibration curve

Internal Standards:

I.S. #1 -- TRIS
Concentration = 9.940 ppm; 6 calib points

    pt.  File     Man.          Area  Resp. Factor
     1   CAE3010A            1443182  145189.32822
     2   CAE3010B            1582543  159209.54879
     3   CAE3001A            1685525  169569.91041
     4   CAE3001B            1647299  165724.23657
     5   CAE3300A            1629043  163887.61695
     6   CAE3300B            1674469  168457.63682
                        Average RF = 1.62006e+05

I.S. #2 -- BPFB
Concentration = 4.850 ppm; 6 calib points

    pt.  File     Man.          Area  Resp. Factor
     1   CAE3010A            3251967  670508.67298
     2   CAE3010B            3192356  658217.74490
     3   CAE3001A            3081741  635410.52796
     4   CAE3001B            3181594  655998.77579
     5   CAE3300A            3254150  670958.77608
     6   CAE3300B            2872759  592321.45495
                        Average RF = 6.47236e+05

Analytes:

Analyte #1 -- Bromomethane
6 calib points
 pt.  File      M |     Conc.     Cratio |       Area      Aratio | Resp. Factor
  1   CAE3010A    |     10.00  1.006e+00 |    3429096   2.376e+00 |  2.36181e+00
  2   CAE3010B    |     10.00  1.006e+00 |    3474695   2.196e+00 |  2.18247e+00
```

✓ linear

206

```
   2  CAE3001A    |      1.00  1.006e-01 |     344130  2.042e-01 |  [illegible]
   3  CAE3001A    |      1.00  1.006e-01 |     348719  2.069e-01 |  2.05649e+00
   4  CAE3001B    |      1.00  1.006e-01 |     333992  2.028e-01 |  2.01535e+00
   5  CAE3300A    |      0.30  3.018e-02 |      93222  5.723e-02 |  1.89606e+00
   6  CAE3300B    |      0.30  3.018e-02 |     101310  6.050e-02 |  2.00466e+00
                                                  Average RF = 2.08614e+(
                                                   Deviation = 6.61873%

Analyte #2 -- 1,1-dichloroethene
6 calib points
 pt.  File      M |      Conc.      Cratio |       Area      Aratio | Resp. Factor
   1  CAE3010A    |     10.20  1.026e+00 |    3893971  2.698e+00 |  2.62941e+00
   2  CAE3010B    |     10.20  1.026e+00 |    4040971  2.553e+00 |  2.48838e+00
   3  CAE3001A    |      1.02  1.026e-01 |     361871  2.147e-01 |  2.09221e+00
   4  CAE3001B    |      1.02  1.026e-01 |     360731  2.190e-01 |  2.13401e+00
   5  CAE3300A    |      0.31  3.078e-02 |     105111  6.452e-02 |  2.09595e+00
   6  CAE3300B    |      0.31  3.078e-02 |     104990  6.270e-02 |  2.03674e+00
                                                  Average RF = 2.24612e+0
                                                   Deviation = 4.80168%

Analyte #3 -- t-1,2-dichloroethene
6 calib points
 pt.  File      M |      Conc.      Cratio |       Area      Aratio | Resp. Factor
   1  CAE3010A    |     10.50  1.056e+00 |    6294969  4.362e+00 |  4.12924e+00
   2  CAE3010B    |     10.50  1.056e+00 |    6470831  4.089e+00 |  3.87081e+00
   3  CAE3001A    |      1.05  1.056e-01 |     591593  3.510e-01 |  3.32265e+00
   4  CAE3001B    |      1.05  1.056e-01 |     586701  3.562e-01 |  3.37164e+00
   5  CAE3300A    |      0.31  3.169e-02 |     170717  1.048e-01 |  3.30689e+00
   6  CAE3300B    |      0.31  3.169e-02 |     172445  1.030e-01 |  3.24975e+00
                                                  Average RF = 3.54183e+0(
                                                   Deviation = 5.53441%

Analyte #4 -- MEK
5 calib points
 pt.  File      M |      Conc.      Cratio |       Area      Aratio | Resp. Factor
   1  CAE3010A    |     10.20  1.026e+00 |    2542307  1.762e+00 |  1.71669e+00
   2  CAE3010B    |     10.20  1.026e+00 |    2684464  1.696e+00 |  1.65306e+00
   3  CAE3001A    |      1.02  1.026e-01 |     135561  8.043e-02 |  7.83765e-01
   4  CAE3001B    |      1.02  1.026e-01 |     159584  9.688e-02 |  9.44068e-01
   5  CAE3300A    |      0.31  3.078e-02 |      18676  1.146e-02 |  3.72406e-01
                                                  Average RF = 1.09400e+0(
                                                   Deviation = 3.86804%

Analyte #5 -- 1,2-dichloroehane
4 calib points
 pt.  File      M |      Conc.      Cratio |       Area      Aratio | Resp. Factor
   1  CAE3010A    |     10.50  1.056e+00 |   10346109  7.169e+00 |  6.78661e+00
   2  CAE3010B    |     10.50  1.056e+00 |   10193005  6.441e+00 |  6.09739e+00
   3  CAE3001A    |      1.05  1.056e-01 |    1008668  5.984e-01 |  5.66513e+00
   4  CAE3001B    |      1.05  1.056e-01 |    1027144  6.235e-01 |  5.90277e+00
```

300ppbs split out from this

```
                                                  Average RF = 6.11298e+0(
                                                   Deviation = 7.83000%

Analyte #6 -- Carbon Tetrachloride
6 calib points
 pt.  File      M |      Conc.      Cratio |       Area      Aratio | Resp. Factor
   1  CAE3010A    |     10.00  1.006e+00 |    3696945  2.562e+00 |  2.54629e+00
   2  CAE3010B    |     10.00  1.006e+00 |    3747467  2.368e+00 |  2.35380e+00
```

```
      CAE3001A     |       1.00  1.006e-01 |
  4   CAE3001B     |       1.00  1.006e-01 |      352687  2.141e-01 |  2.12816e+00
  5   CAE3300A     |       0.30  3.018e-02 |       76911  4.721e-02 |  1.56430e+00
  6   CAE3300B     |       0.30  3.018e-02 |       96624  5.770e-02 |  1.91193e+00
                                                       Average RF = 2.08899e+0
                                                        Deviation = 6.58137%


Analyte #7 -- Trichloroethene
6 calib points
 pt.  File      M  |       Conc.     Cratio |        Area     Aratio | Resp. Factor
   1  CAE3010A     |      10.00  1.006e+00 |    10395648  7.203e+00 |  7.16006e+00
   2  CAE3010B     |      10.00  1.006e+00 |    10883738  6.877e+00 |  6.83611e+00
   3  CAE3001A     |       1.00  1.006e-01 |      949865  5.635e-01 |  5.60161e+00
   4  CAE3001B     |       1.00  1.006e-01 |      970459  5.891e-01 |  5.85587e+00
   5  CAE3300A     |       0.30  3.018e-02 |      248561  1.526e-01 |  5.05552e+00
   6  CAE3300B     |       0.30  3.018e-02 |      267033  1.595e-01 |  5.28388e+00
                                                       Average RF = 5.96551e+0
                                                        Deviation = 4.06582%


Analyte #8 -- c-1,2-dichloropropene
6 calib points
 pt.  File      M  |       Conc.     Cratio |        Area     Aratio | Resp. Factor
   1  CAE3010A     |      12.50  1.258e+00 |    30013118  2.080e+01 |  1.65374e+01
   2  CAE3010B     |      12.50  1.258e+00 |    31121156  1.967e+01 |  1.56378e+01
   3  CAE3001A     |       1.25  1.258e-01 |     2388666  1.417e+00 |  1.12693e+01
   4  CAE3001B     |       1.25  1.258e-01 |     2437939  1.480e+00 |  1.17687e+01
   5  CAE3300A     |       0.38  3.773e-02 |      680521  4.177e-01 |  1.10730e+01
   6  CAE3300B     |       0.38  3.773e-02 |      657748  3.928e-01 |  1.04121e+01
                                                       Average RF = 1.27830e+01
                                                        Deviation = 5.15498%


Analyte #9 -- t-1,2-dichloropropene
6 calib points
 pt.  File      M  |       Conc.     Cratio |        Area     Aratio | Resp. Factor
   1  CAE3010A     |       8.10  8.149e-01 |    19640928  1.361e+01 |  1.67010e+01
   2  CAE3010B     |       8.10  8.149e-01 |    20223152  1.278e+01 |  1.56818e+01
   3  CAE3001A     |       0.81  8.149e-02 |     1450673  8.607e-01 |  1.05617e+01
   4  CAE3001B     |       0.81  8.149e-02 |     1512153  9.180e-01 |  1.12648e+01
   5  CAE3300A     |       0.24  2.445e-02 |      417885  2.565e-01 |  1.04931e+01
   6  CAE3300B     |       0.24  2.445e-02 |      394180  2.354e-01 |  9.62936e+00
                                                       Average RF = 1.23886e+01
                                                        Deviation = 5.81765%


Analyte #10 -- 2-Hexanone
2 calib points
 pt.  File      M  |       Conc.     Cratio |        Area     Aratio | Resp. Factor
   1  CAE3010A     |       5.00  5.030e-01 |      728897  5.051e-01 |  1.00406e+00
   2  CAE3010B     |       5.00  5.030e-01 |      713493  4.509e-01 |  8.96294e-01
                                                       Average RF = 9.50179e-01
                                                        Deviation = 8.02004%


Analyte #11 -- Chlorobenzene
6 calib points
 pt.  File      M  |       Conc.     Cratio |        Area     Aratio | Resp. Factor
   1  CAE3010A     |      10.00  2.062e+00 |    29124048  8.956e+00 |  4.34358e+00
   2  CAE3010B     |      10.00  2.062e+00 |    29607180  9.274e+00 |  4.49808e+00
   3  CAE3001A     |       1.00  2.062e-01 |     1967362  6.384e-01 |  3.09621e+00
```

```
   5  CAE3300A          0.30  6.186e-02 |      557983  1.715e-01 |  2.77207e+00
   6  CAE3300B    |     0.30  6.186e-02 |      533478  1.857e-01 |  3.00219e+00
                                                   Average RF = 3.48755e+0(
                                                    Deviation = 3.68364%

Analyte #12 -- m-Xylene
6 calib points
 pt.  File      M |      Conc.     Cratio |        Area     Aratio | Resp. Factor
   1  CAE3010A    |     10.00  2.062e+00 |    39678100  1.220e+01 |  5.91761e+00
   2  CAE3010B    |     10.00  2.062e+00 |    40909728  1.281e+01 |  6.21523e+00
   3  CAE3001A    |      1.00  2.062e-01 |     2587431  8.396e-01 |  4.07206e+00
   4  CAE3001B    |      1.00  2.062e-01 |     2675522  8.409e-01 |  4.07855e+00
   5  CAE3300A    |      0.30  6.186e-02 |      639796  1.966e-01 |  3.17852e+00
   6  CAE3300B    |      0.30  6.186e-02 |      677163  2.357e-01 |  3.81079e+00
                                                   Average RF = 4.54546e+0(
                                                    Deviation = 4.75628%

Analyte #13 -- o-Xylene
6 calib points
 pt.  File      M |      Conc.     Cratio |        Area     Aratio | Resp. Factor
   1  CAE3010A    |     10.00  2.062e+00 |    40901988  1.258e+01 |  6.10014e+00
   2  CAE3010B    |     10.00  2.062e+00 |    44594104  1.397e+01 |  6.77498e+00
   3  CAE3001A    |      1.00  2.062e-01 |     2654372  8.613e-01 |  4.17741e+00
   4  CAE3001B    |      1.00  2.062e-01 |     2781677  8.743e-01 |  4.24037e+00
   5  CAE3300A    |      0.30  6.186e-02 |      690180  2.121e-01 |  3.42882e+00
   6  CAE3300B    |      0.30  6.186e-02 |      692750  2.411e-01 |  3.89850e+00
                                                   Average RF = 4.77004e+0(
                                                    Deviation = 8.99319%
```

```
FULL SCAN Calibration Response Table

Title: trona
FULL SCAN DATA :  C:\PROGRA~1\HAPSRUN\DATA\CAECALS\CAE5300B
Acquired           05/12/98 at 14:08:55

Peak Search Method :  C:\PROGRA~1\HAPSRUN\METHOD\CAE5.LSM
PQUAN Library      :  C:\PROGRA~1\HAPSRUN\METHOD\TGPC5
Last Calibration      05/13/98 at 15:04:40
```

Linear

```
Acquisition Method : C:\PROGRA~1\HAPSRUN\METHOD\LLK.FSM
Tune/Cal File      :
Datafile title:
Cylinder #5 - 300 ppb
CAE/EMI OCI-TG Test
5-12-98

W = RT +- ( 0:45.00 / 2 + RT * 0.010 )
Min Fit=0.650; Min Pur=0.650; Min Area=5000
Width= 5-100 scans; Res= 6 scans; NLM=2.0


Linear calibration curve

Internal Standards:

I.S. #1 -- TRIS
Concentration = 9.940 ppm; 6 calib points

    pt.  File      Man.           Area  Resp. Factor
      1  CAE5010A              1582120  159166.99346
      2  CAE5010B              1621917  163170.71558
      3  CAE5001A              1723046  173344.65869
      4  CAE5001B              1587595  159717.79826
      5  CAE5300A              1586445  159602.10410
      6  CAE5300B              1679727  168986.61064
                       Average RF = 1.63998e+05
```

new field Cal

2.8e+5

```
I.S. #2 -- BPFB
Concentration = 4.850 ppm; 6 calib points

    pt.  File      Man.           Area  Resp. Factor
      1  CAE5010A              3358073  692386.19918
      2  CAE5010B              3410616  703219.80764
      3  CAE5001A              3539976  729891.97312
      4  CAE5001B              3509273  723561.45753
      5  CAE5300A              3236082  667233.41518
      6  CAE5300B              3314609  683424.54952
                       Average RF = 6.99953e+05
```

9.4 e+5

```
Analytes:

Analyte #1 -- Vinyl Chloride
6 calib points
 pt.  File      M |    Conc.      Cratio |      Area      Aratio | Resp. Factor
  1   CAE5010A    |    10.00  1.006e+00 |   2165622  1.369e+00 |  1.36060e+00
  2   CAE5010B    |    10.00  1.006e+00 |   2160957  1.332e+00 |  1.32435e+00
```

210

```
  3  CAE5001A    |     1.00  1.006e-01 |     227305  1.319e-01 |  1.31129e+00
  4  CAE5001B    |     1.00  1.006e-01 |     206588  1.301e-01 |  1.29346e+00
  5  CAE5300A    |     0.30  3.018e-02 |      58750  3.703e-02 |  1.22701e+00
  6  CAE5300B    |     0.30  3.018e-02 |      63814  3.799e-02 |  1.25876e+00
                                                     Average RF = 1.29591e+0
                                                      Deviation = 2.26639%
```

4.01

```
Analyte #2 -- Carbon Disulfide
6 calib points
 pt.  File      M |      Conc.      Cratio |        Area      Aratio | Resp. Factor
   1  CAE5010A    |     9.27  9.326e-01 |   27700628  1.751e+01 |  1.87740e+01
   2  CAE5010B    |     9.27  9.326e-01 |   28016282  1.727e+01 |  1.85220e+01
   3  CAE5001A    |     0.93  9.326e-02 |    2757646  1.600e+00 |  1.71612e+01
   4  CAE5001B    |     0.93  9.326e-02 |    2750234  1.732e+00 |  1.85753e+01
   5  CAE5300A    |     0.28  2.798e-02 |     780285  4.918e-01 |  1.75798e+01
   6  CAE5300B    |     0.28  2.798e-02 |     793336  4.723e-01 |  1.68812e+01
                                                     Average RF = 1.79156e+0
                                                      Deviation = 1.32425%
```

2.64

```
Analyte #3 -- Vinyl Acetate
6 calib points
 pt.  File      M |      Conc.      Cratio |        Area      Aratio | Resp. Factor
   1  CAE5010A    |    10.00  1.006e+00 |   15574405  9.844e+00 |  9.78495e+00
   2  CAE5010B    |    10.00  1.006e+00 |   15489580  9.550e+00 |  9.49287e+00
   3  CAE5001A    |     1.00  1.006e-01 |    1586515  9.208e-01 |  9.15237e+00
   4  CAE5001B    |     1.00  1.006e-01 |    1581212  9.960e-01 |  9.90004e+00
   5  CAE5300A    |     0.30  3.018e-02 |     442870  2.792e-01 |  9.24946e+00
   6  CAE5300B    |     0.30  3.018e-02 |     446005  2.655e-01 |  8.79764e+00
                                                     Average RF = 9.39622e+0
                                                      Deviation = 2.62476%
```

2.98

```
Analyte #4 -- Chloroform
6 calib points
 pt.  File      M |      Conc.      Cratio |        Area      Aratio | Resp. Factor
   1  CAE5010A    |     9.98  1.004e+00 |   15574405  9.844e+00 |  9.80456e+00
   2  CAE5010B    |     9.98  1.004e+00 |   15489580  9.550e+00 |  9.51189e+00
   3  CAE5001A    |     1.00  1.004e-01 |    1586515  9.208e-01 |  9.17071e+00
   4  CAE5001B    |     1.00  1.004e-01 |    1581212  9.960e-01 |  9.91988e+00
   5  CAE5300A    |     0.30  3.012e-02 |     442870  2.792e-01 |  9.26800e+00
   6  CAE5300B    |     0.30  3.012e-02 |     446005  2.655e-01 |  8.81527e+00
                                                     Average RF = 9.41505e+0
                                                      Deviation = 2.62476%
```

2.98

```
Analyte #5 -- Benzene
6 calib points
 pt.  File      M |      Conc.      Cratio |        Area      Aratio | Resp. Factor
   1  CAE5010A    |     9.97  1.003e+00 |   29162668  1.843e+01 |  1.83772e+01
   2  CAE5010B    |     9.97  1.003e+00 |   29444264  1.815e+01 |  1.80994e+01
   3  CAE5001A    |     1.00  1.003e-01 |    2654030  1.540e+00 |  1.53568e+01
   4  CAE5001B    |     1.00  1.003e-01 |    2625366  1.654e+00 |  1.64870e+01
   5  CAE5300A    |     0.30  3.009e-02 |     707165  4.458e-01 |  1.48138e+01
   6  CAE5300B    |     0.30  3.009e-02 |     652889  3.887e-01 |  1.29173e+01
                                                     Average RF = 1.60086e+01
                                                      Deviation = 1.57232%
```

3.45

```
Analyte #6 -- Bromodichloromethane
6 calib points
```

```
 pt.  File      M |      Conc.      Cratio |       Area      Aratio | Resp. Factor
   1  CAE5010A    |      9.97   1.003e+00 |   22718664  1.436e+01 |  1.43164e+01
   2  CAE5010B    |      9.97   1.003e+00 |   22289668  1.374e+01 |  1.37014e+01
   3  CAE5001A    |      1.00   1.003e-01 |    2241200  1.301e+00 |  1.29681e+01
   4  CAE5001B    |      1.00   1.003e-01 |    2257115  1.422e+00 |  1.41744e+01
   5  CAE5300A    |      0.30   3.009e-02 |     625526  3.943e-01 |  1.31036e+01
   6  CAE5300B    |      0.30   3.009e-02 |     607161  3.615e-01 |  1.20125e+01
                                                   Average RF = 1.33794e+0
                                                    Deviation = 3.74700%
                                                                  3.14
Analyte #7 -- MIBK
3 calib points
 pt.  File      M |      Conc.      Cratio |       Area      Aratio | Resp. Factor
   1  CAE5010A    |     10.10   1.016e+00 |     978934  6.187e-01 |  6.08946e-01
   2  CAE5010B    |     10.10   1.016e+00 |    1152249  7.104e-01 |  6.99170e-01
   3  CAE5300A    |      0.30   3.048e-02 |      25106  1.583e-02 |  5.19154e-01
                                                   Average RF = 6.09090e-0
                                                    Deviation = 10.05332%
                                                                  1.26
Analyte #8 -- Toluene
6 calib points
 pt.  File      M |      Conc.      Cratio |       Area      Aratio | Resp. Factor
   1  CAE5010A    |      9.99   1.005e+00 |   32334980  2.044e+01 |  2.03355e+01
   2  CAE5010B    |      9.99   1.005e+00 |   31693392  1.954e+01 |  1.94429e+01
   3  CAE5001A    |      1.00   1.005e-01 |    2554943  1.483e+00 |  1.47538e+01
   4  CAE5001B    |      1.00   1.005e-01 |    2469059  1.555e+00 |  1.54744e+01
   5  CAE5300A    |      0.30   3.015e-02 |     639063  4.028e-01 |  1.33604e+01
   6  CAE5300B    |      0.30   3.015e-02 |     673848  4.012e-01 |  1.33052e+01
                                                   Average RF = 1.61120e+0
                                                    Deviation = 4.12348%
                                                                  3.74
Analyte #9 -- Tetrachloroethene
6 calib points
 pt.  File      M |      Conc.      Cratio |       Area      Aratio | Resp. Factor
   1  CAE5010A    |     10.22   2.107e+00 |    8034173  2.392e+00 |  1.13538e+00
   2  CAE5010B    |     10.22   2.107e+00 |    8030984  2.355e+00 |  1.11745e+00
   3  CAE5001A    |      1.02   2.107e-01 |     689925  1.949e-01 |  9.24895e-01
   4  CAE5001B    |      1.02   2.107e-01 |     704770  2.008e-01 |  9.53062e-01
   5  CAE5300A    |      0.31   6.322e-02 |     148601  4.592e-02 |  7.26393e-01
   6  CAE5300B    |      0.31   6.322e-02 |     150283  4.534e-02 |  7.17211e-01
                                                   Average RF = 9.29065e-0
                                                    Deviation = 1.55813%
                                                                  1.12
Analyte #10 -- Bromoform
6 calib points
 pt.  File      M |      Conc.      Cratio |       Area      Aratio | Resp. Factor
   1  CAE5010A    |      5.38   1.109e+00 |    4634349  1.380e+00 |  1.24411e+00
   2  CAE5010B    |      5.38   1.109e+00 |    4629078  1.357e+00 |  1.22355e+00
   3  CAE5001A    |      0.54   1.109e-01 |     358207  1.012e-01 |  9.12207e-01
   4  CAE5001B    |      0.54   1.109e-01 |     376628  1.073e-01 |  9.67509e-01
   5  CAE5300A    |      0.16   3.328e-02 |      81094  2.506e-02 !  7.53022e-01
   6  CAE5300B    |      0.16   3.328e-02 |      88169  2.660e-02 |  7.99322e-01
                                                   Average RF = 9.83286e-0
                                                    Deviation = 2.16591%
                                                                  1.73
Analyte #11 -- Styrene
6 calib points
```

```
Pt.  File      M |    Conc.      Cratio  |       Area      Aratio  |  Resp. factor
 1   CAE5010A    |     9.99  2.060e+00   |   24430152  7.275e+00   |  3.53193e+00
 2   CAE5010B    |     9.99  2.060e+00   |   24705562  7.244e+00   |  3.51672e+00
 3   CAE5001A    |     1.00  2.060e-01   |    1474013  4.164e-01   |  2.02152e+00
 4   CAE5001B    |     1.00  2.060e-01   |    1543280  4.398e-01   |  2.13503e+00
 5   CAE5300A    |     0.30  6.179e-02   |     299676  9.260e-02   |  1.49861e+00
 6   CAE5300B    |     0.30  6.179e-02   |     293701  8.861e-02   |  1.43393e+00
                                                  Average RF = 2.35629e+00
                                                   Deviation = 2.98926%
```

3.27

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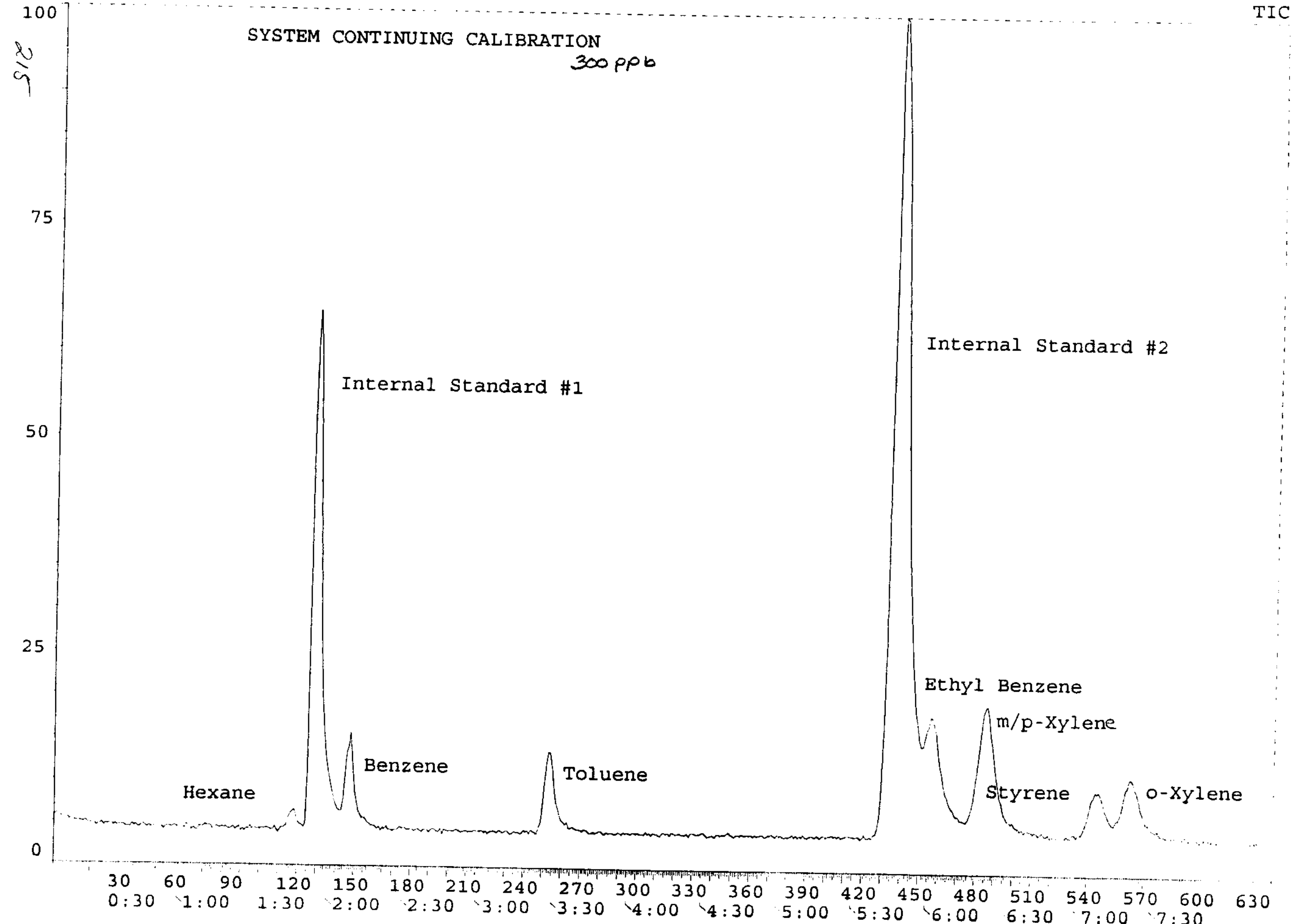
APPENDIX C

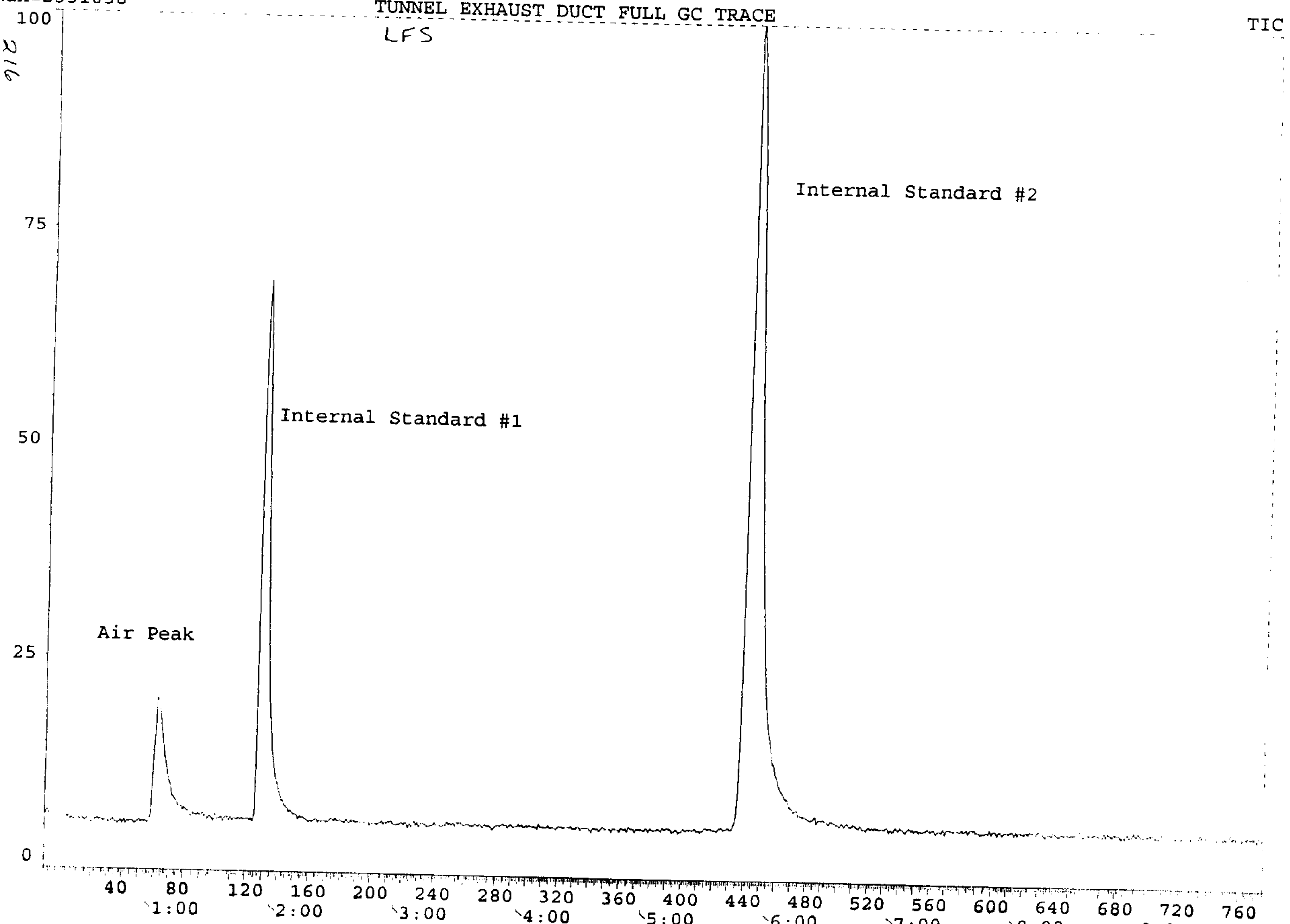
SELECTED EXAMPLE FIELD DATA

```
Chromatogram: c:\progra~1\hapsrun\data\aaa\7-25\725cc#5    Scans      1 to 649
Run: 07/25/98 at 07:39:13                                  RTime 0:10.77 to 8:19.16
              ccc 300ppb   lfs
Max=3337600
```



```
Chromatogram: c:\progra~1\hapsrun\data\aaa\7-24\ted72401   Scans     1 to 786
Run: 07/24/98 at 09:14:20                                    RTime 0:10.82 to 10:02.48
         Tunnel Exhaust Duct
Max=2551038
```

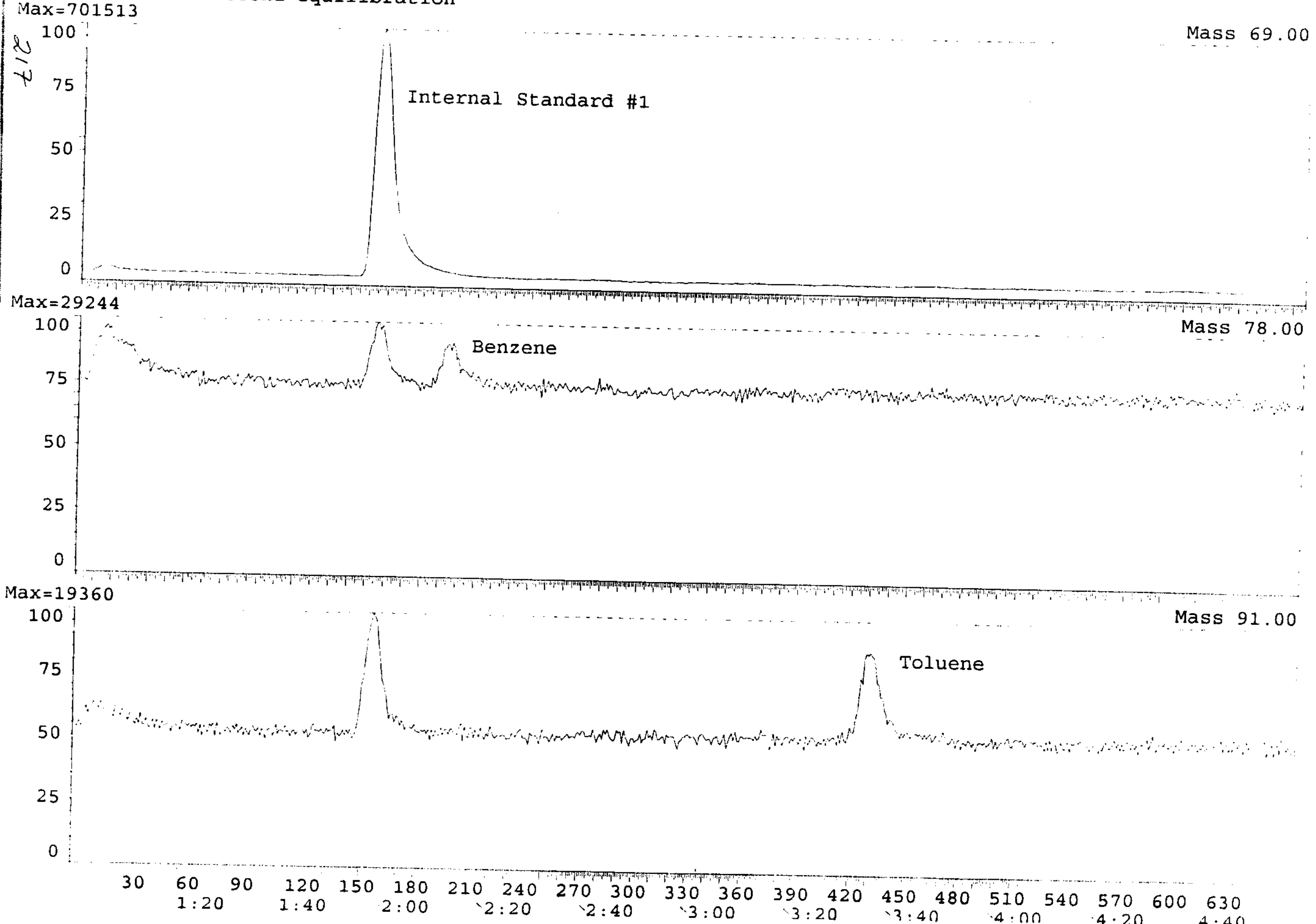
216


TUNNEL EXHAUST DUCT FULL GC TRACE

LFS

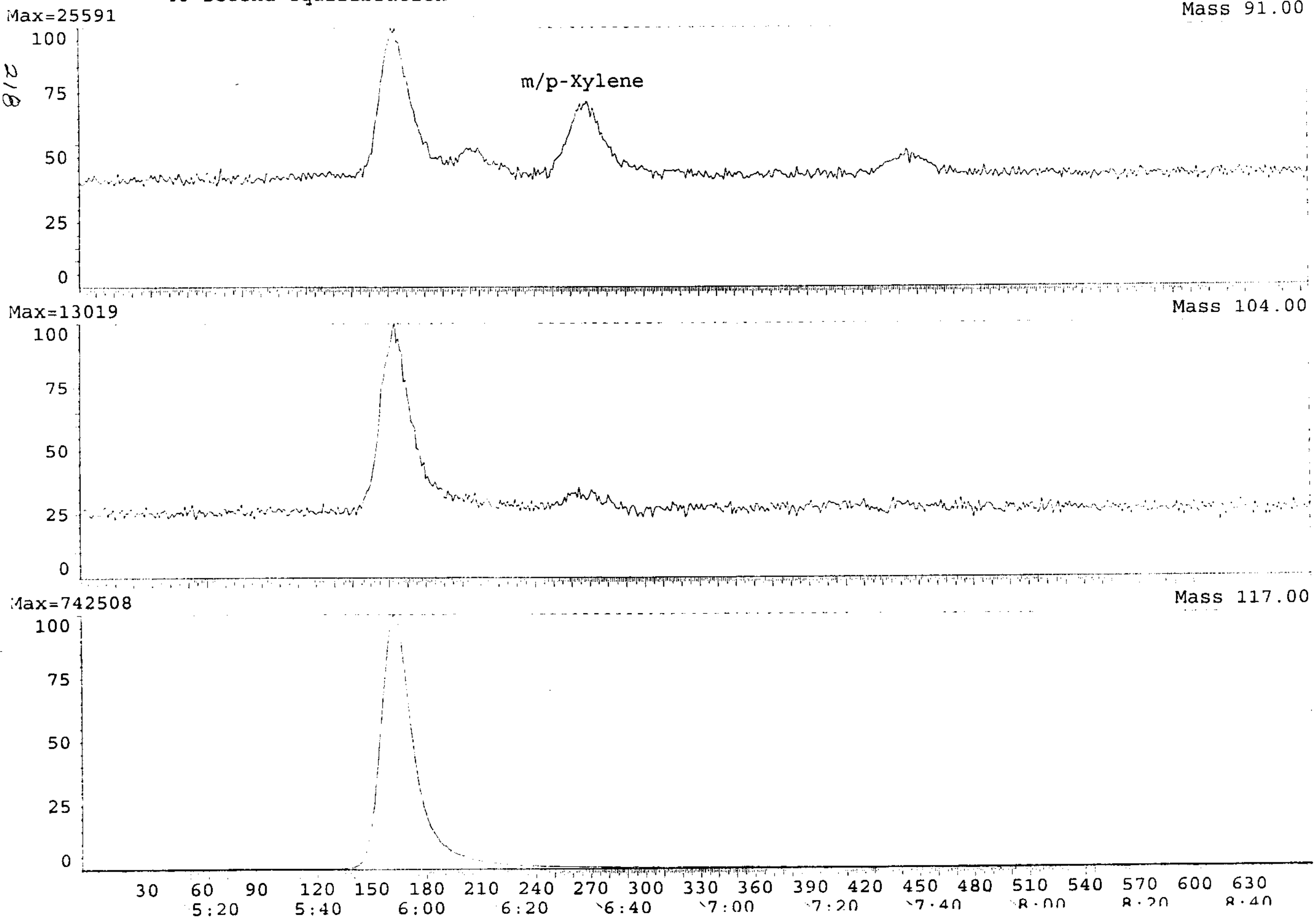
SIM Set #1   c:\progra~1\hapsrun\data\aaa\7-24\ted72411   Scans 1 to 677
Run: 07/24/98 at 12:17:50   RTime 1:00.38 to 4:59.58
Tunnel Exhaust Duct sim2
40 second equilibration

217



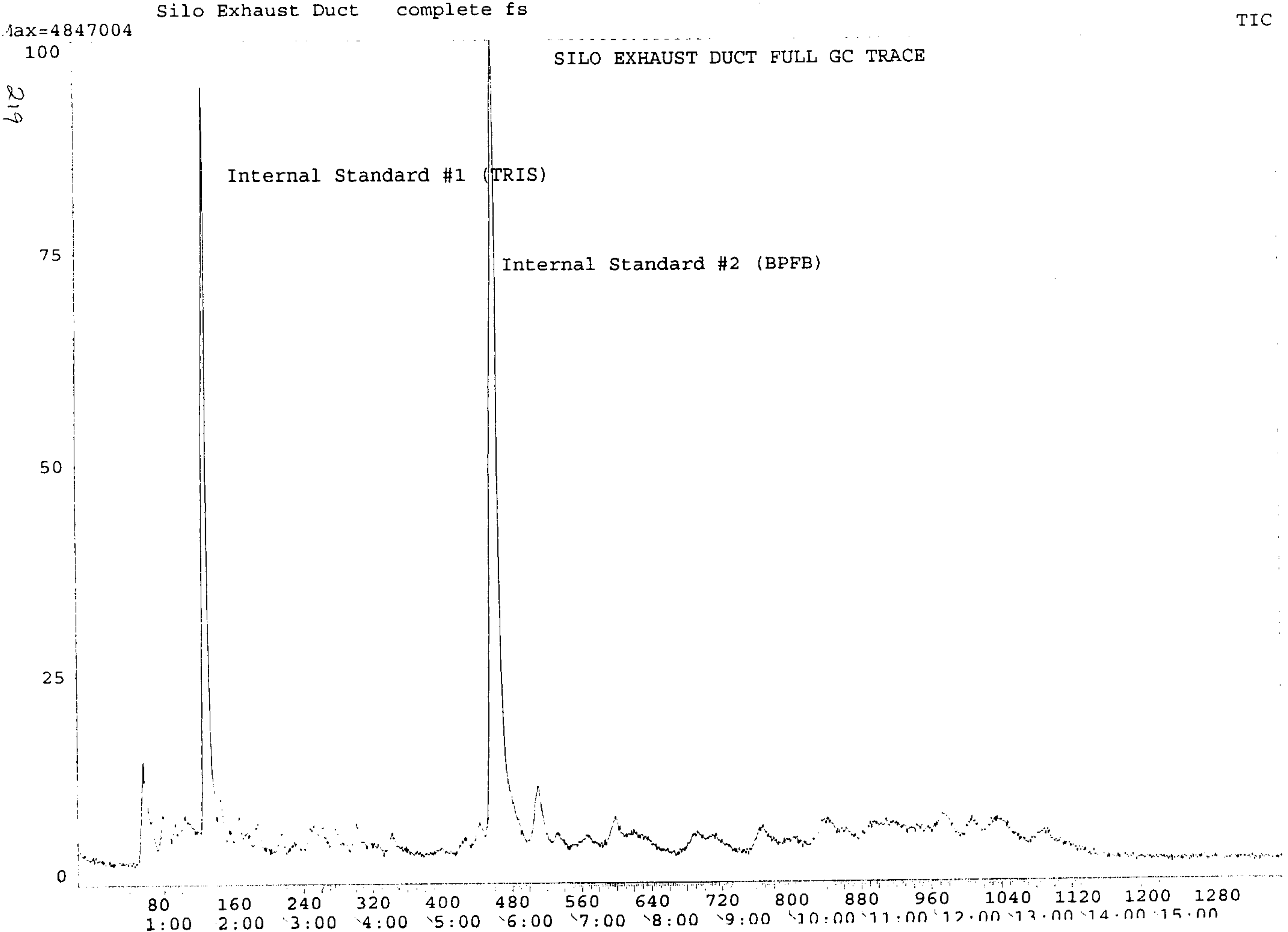
SIM Set #2   c:\progra~1\hapsrun\data\aaa\7-24\ted72411   Scans   1 to 674
Run: 07/24/98 at 12:17:50   RTime 5:00.39 to 8:58.49
Tunnel Exhaust Duct   sim2
40 second equilibration

218



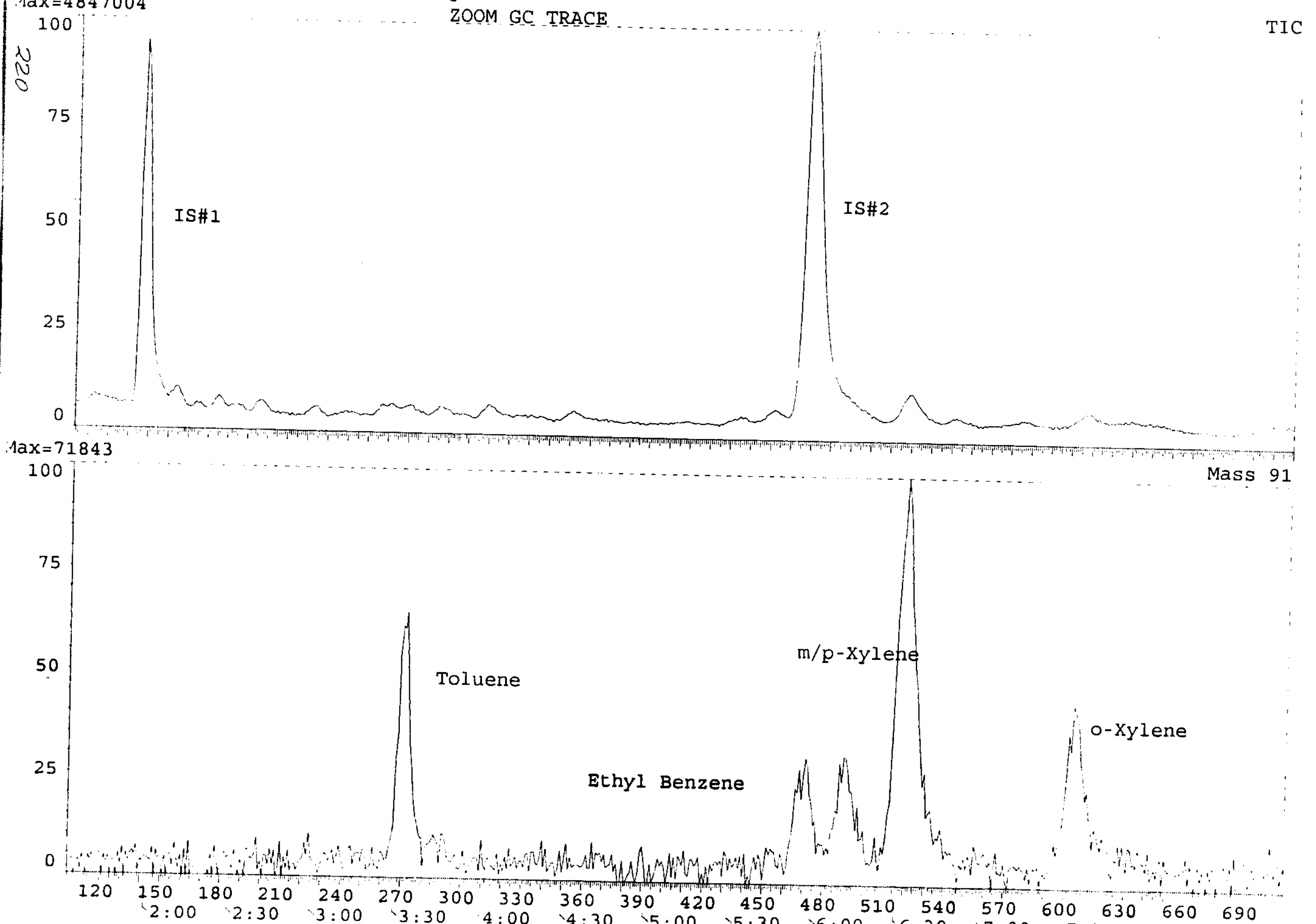
hromatogram: c:\progra~1\hapsrun\data\aaa\7-25\sed72502 Scans 1 to 1380
un: 07/25/98 at 09:20:01 RTime 0:10.82 to 16:47.22
Silo Exhaust Duct complete fs
ax=4847004

219

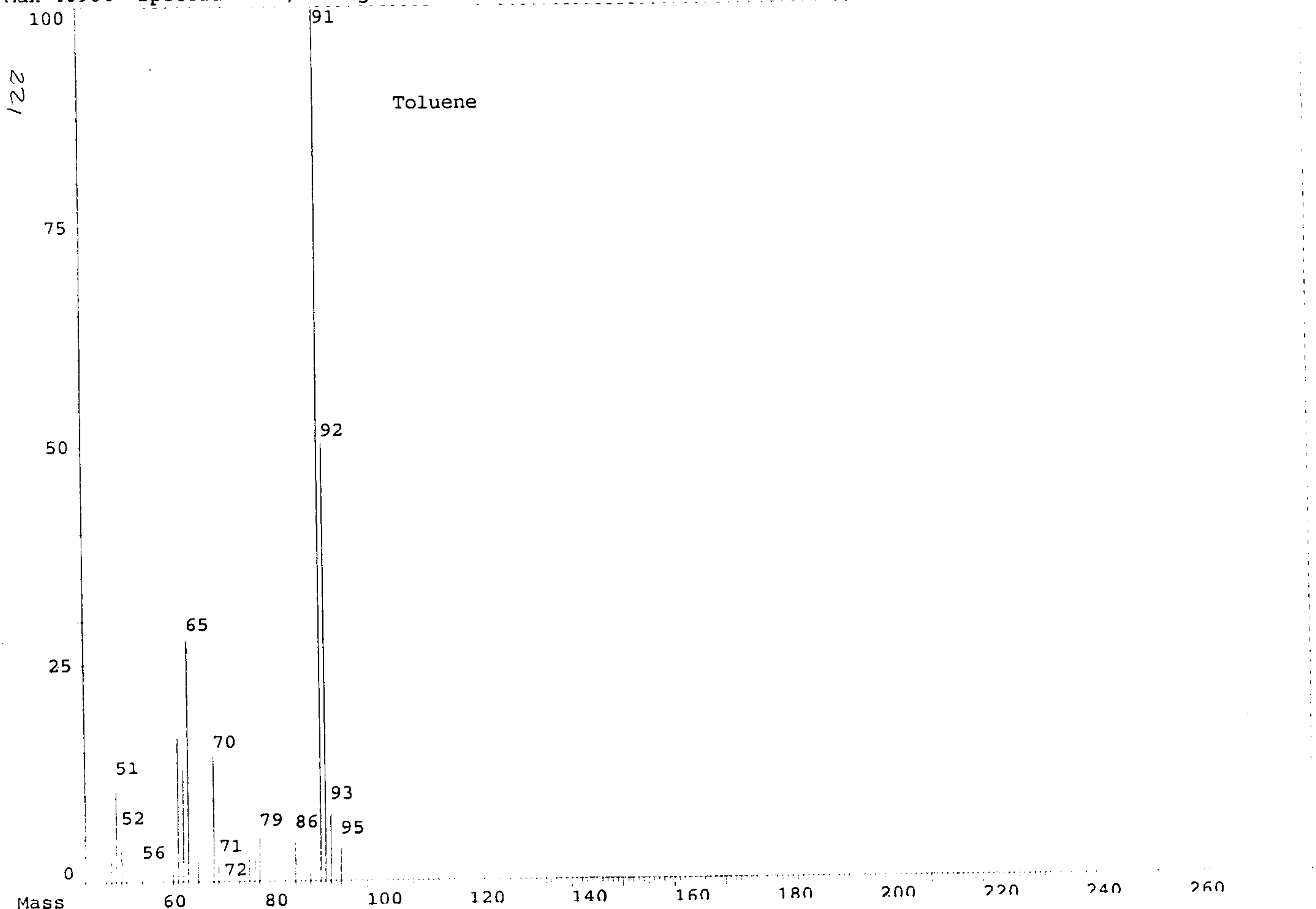


Chromatogram: c:\progra~1\hapsrun\data\aaa\7-25\sed72502 Scans 114 to 720
Run: 07/25/98 at 09:20:01 RTime 1:32.44 to 8:50.36
Silo Exhaust Duct complete fs

220

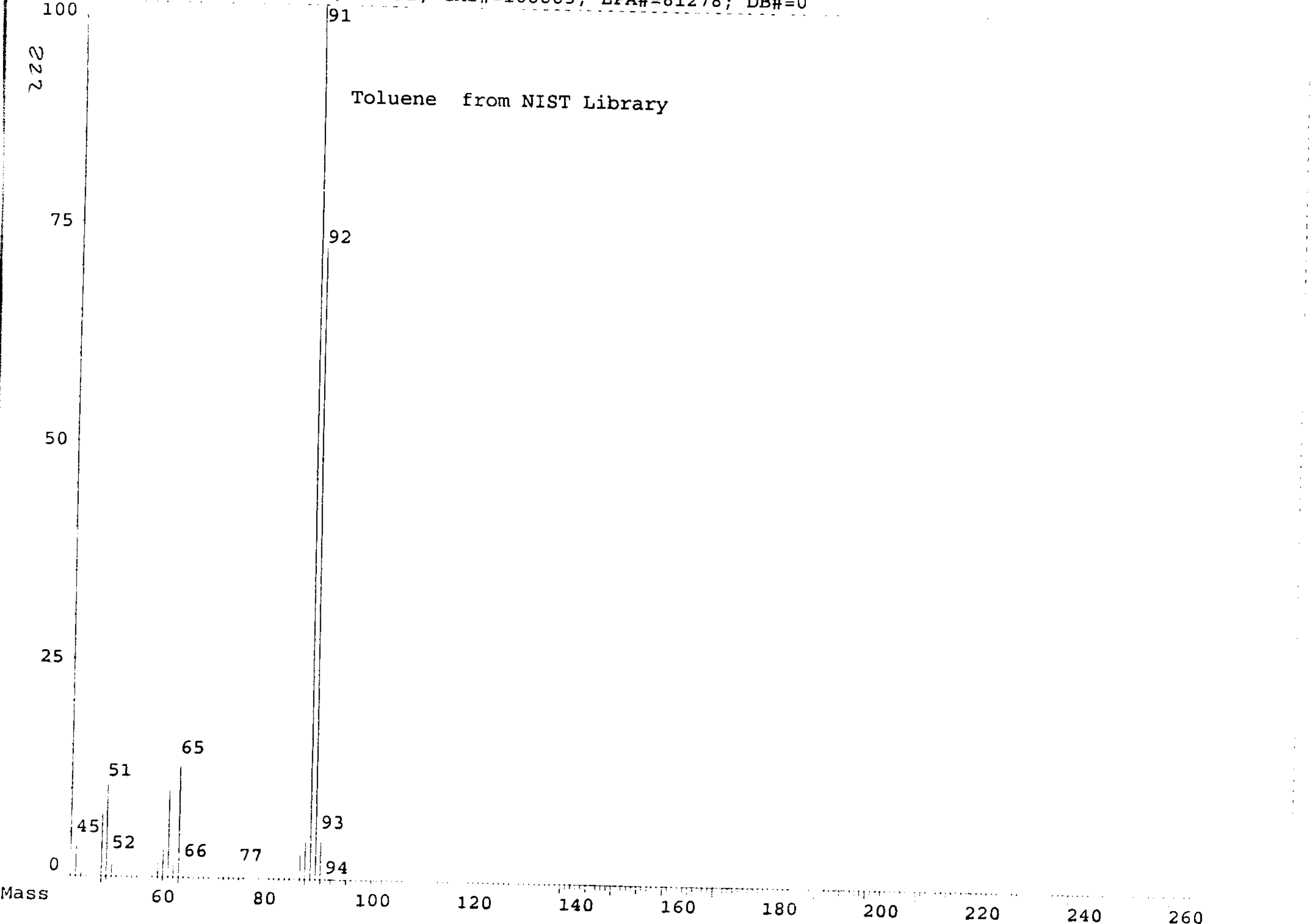


Full Scan   c:\progra~1\hapsrun\data\aaa\7-25\sed72502   1.0 m/z;   RTime 3:32.40
Normalization Mass: 91;   Run: 07/25/98 at 09:20:01
Silo Exhaust Duct   complete fs
Max=40904 Spectrum 280; Background 196-267, 294-340



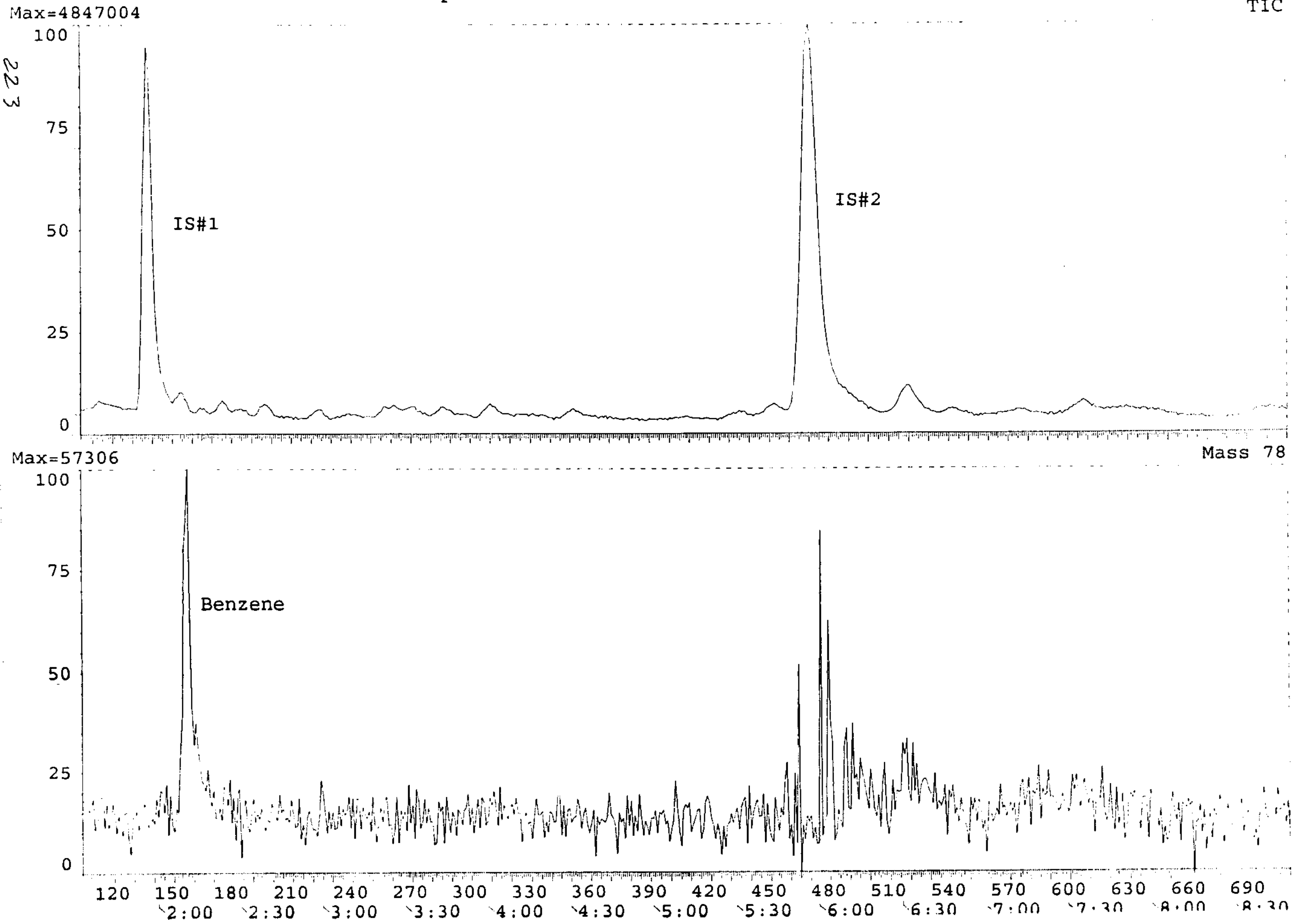
221

NIST hit #2 of 100; 1.0 m/z; Toluene
NIST hits of S[280]B[196-267,294-340] SED72502 Run: 07/25/98 at 09:20:01
Silo Exhaust Duct complete fs
SI=790; Formula=C7H8; MW=92; CAS#=108883; EPA#=61278; DB#=0

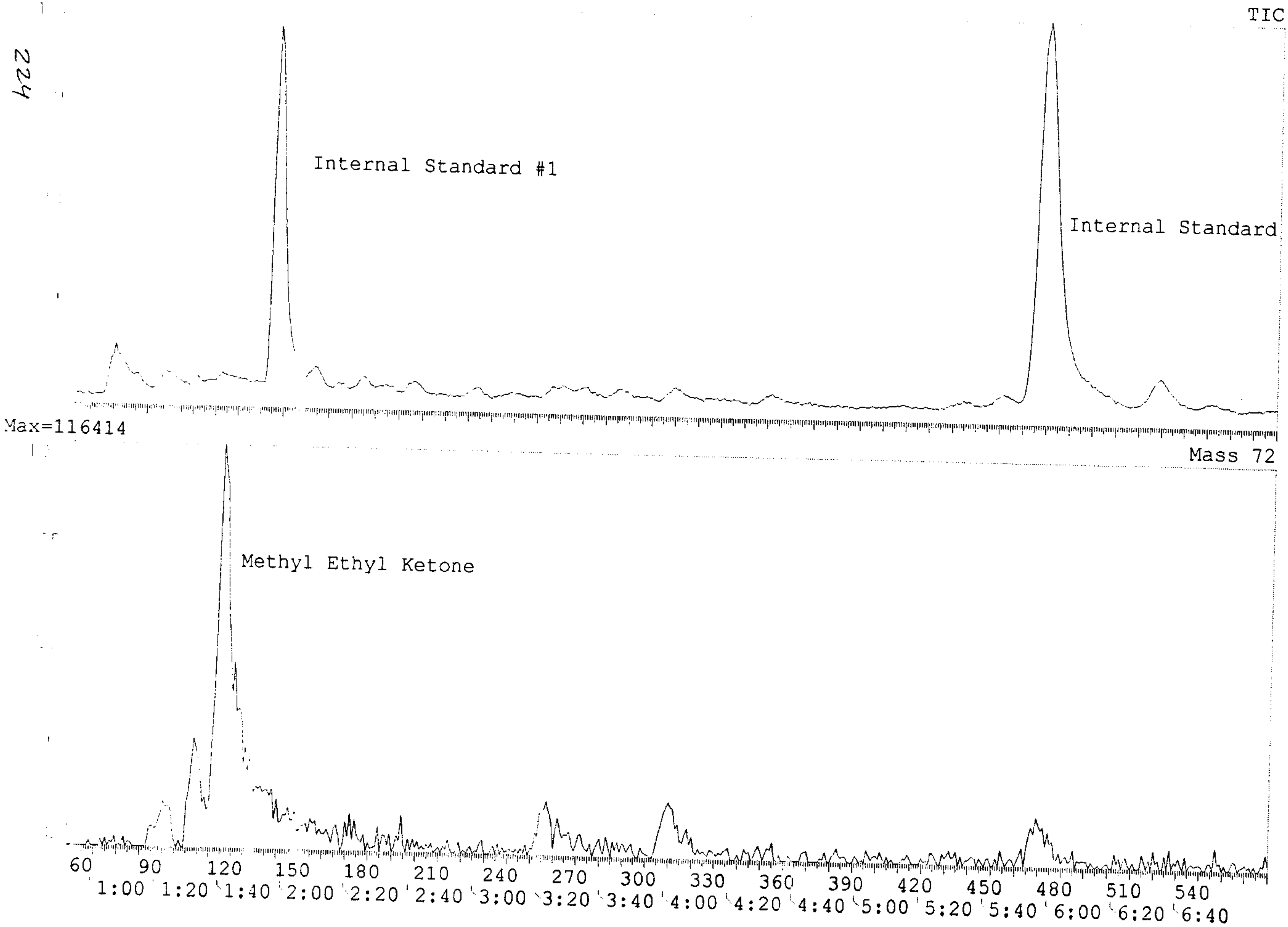


Chromatogram: c:\progra~1\hapsrun\data\aaa\7-25\sed72502 Scans 114 to 720
Run: 07/25/98 at 09:20:01 RTime 1:32.44 to 8:50.36
Silo Exhaust Duct complete fs

223

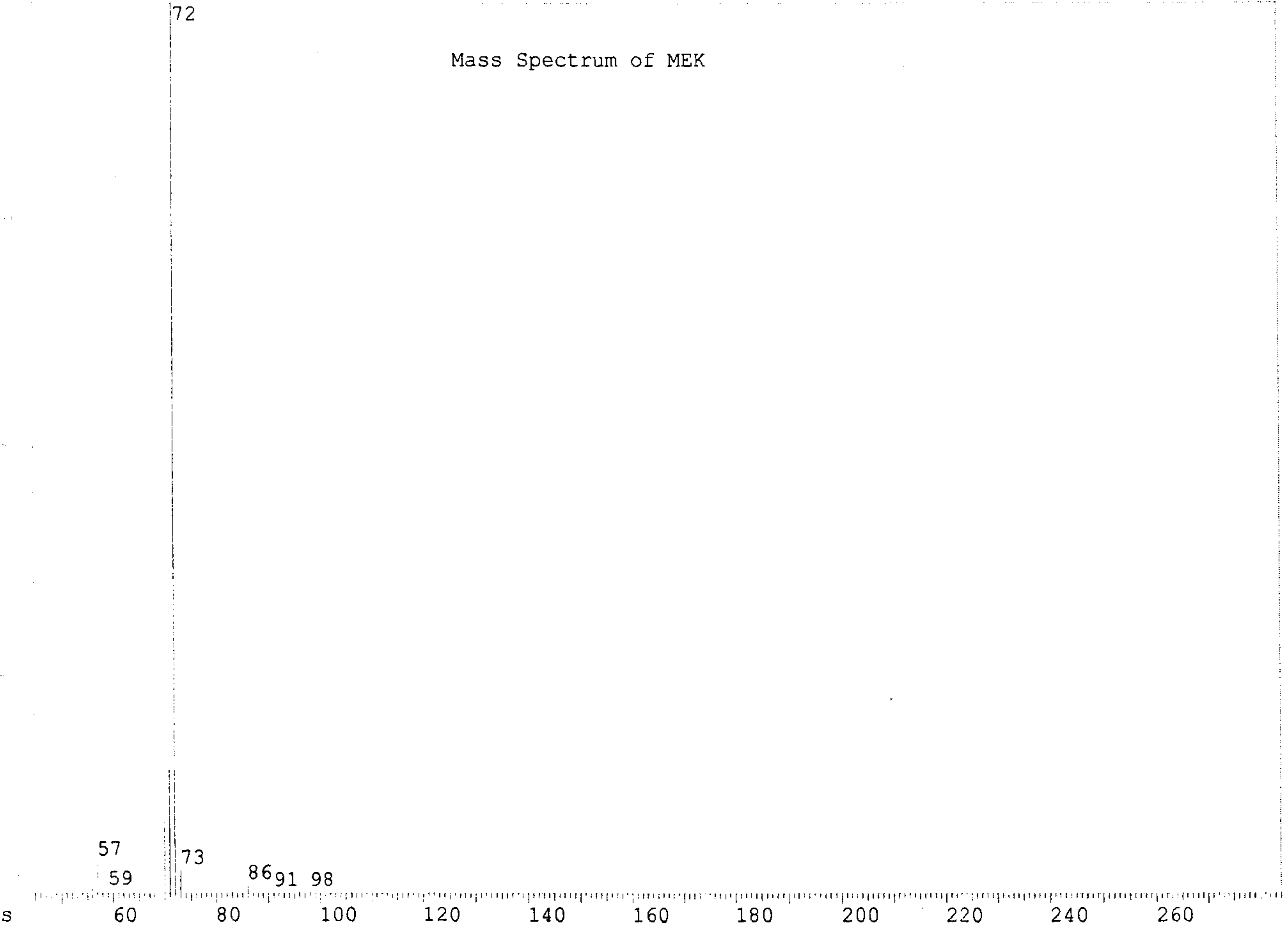


Chromatogram: c:\progra~1\hapsrun\data\aaa\7-25\sed72502 Scans 59 to 580
Run: 07/25/98 at 09:20:01 RTime 0:52.73 to 7:09.19
Silo Exhaust Duct complete fs
Max=4847004



```
Full Scan    c:\progra~1\hapsrun\data\aaa\7-25\sed72502      1.0 m/z;        RTime 1:40.41
Normalization Mass: 72;      Run: 07/25/98 at 09:20:01
             Silo Exhaust Duct    complete fs
Max=103404  Spectrum 125; Background 83-118, 132-149
```

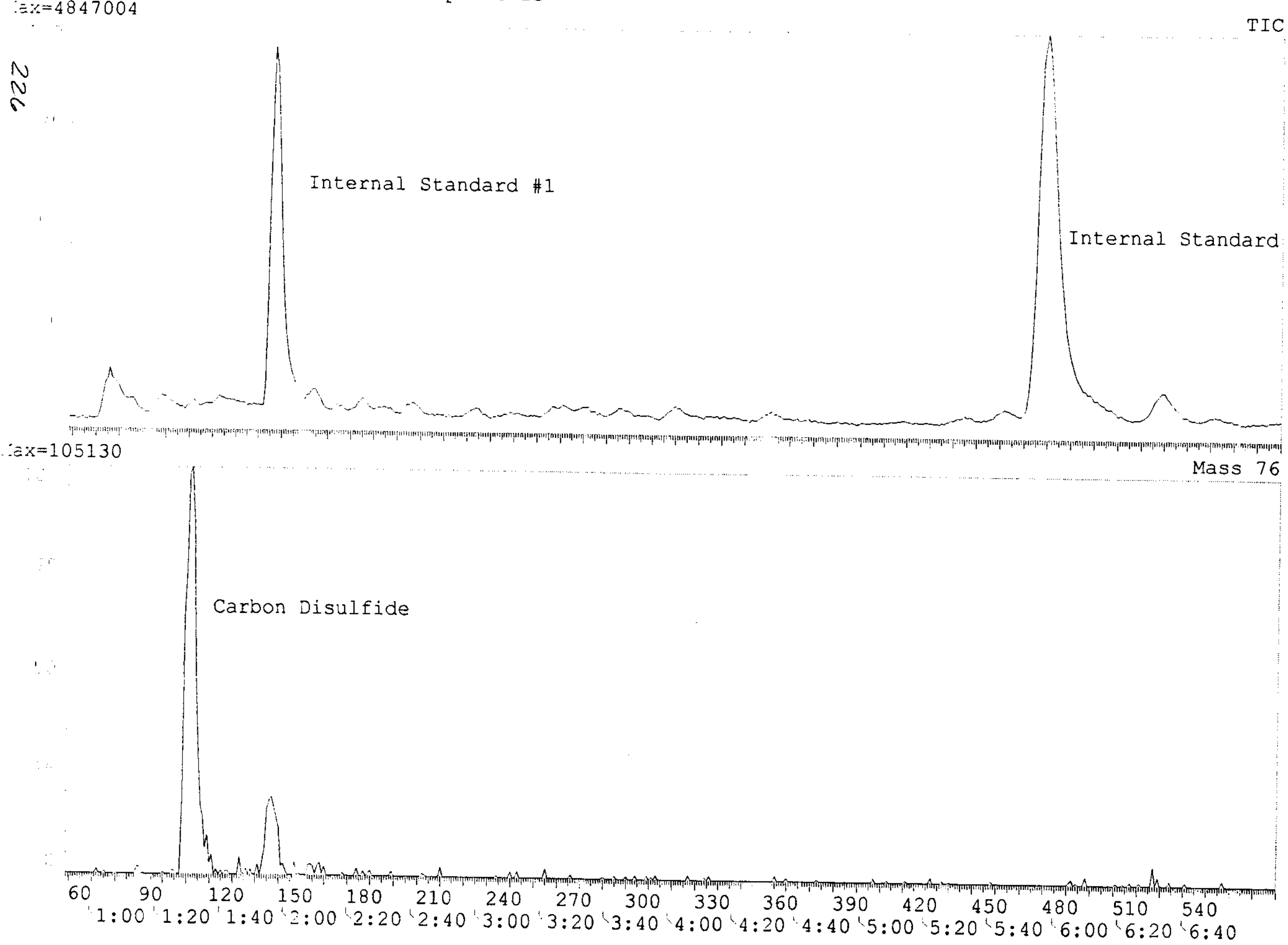
225



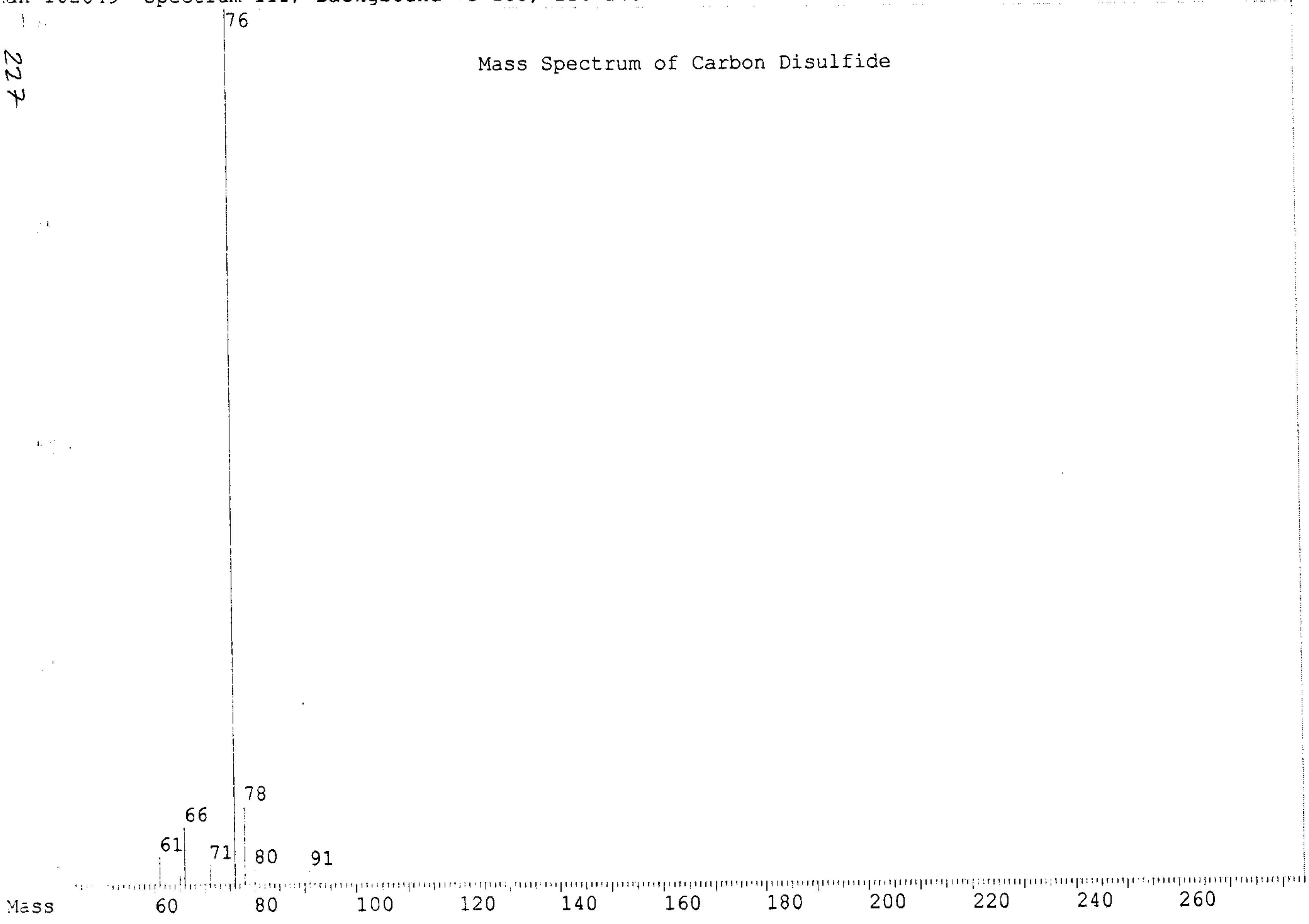
Mass Spectrum of MEK

romatogram: c:\progra~1\hapsrun\data\aaa\7-25\sed72502 Scans 59 to 580
n: 07/25/98 at 09:20:01 RTime 0:52.73 to 7:09.19
Silo Exhaust Duct complete fs

226

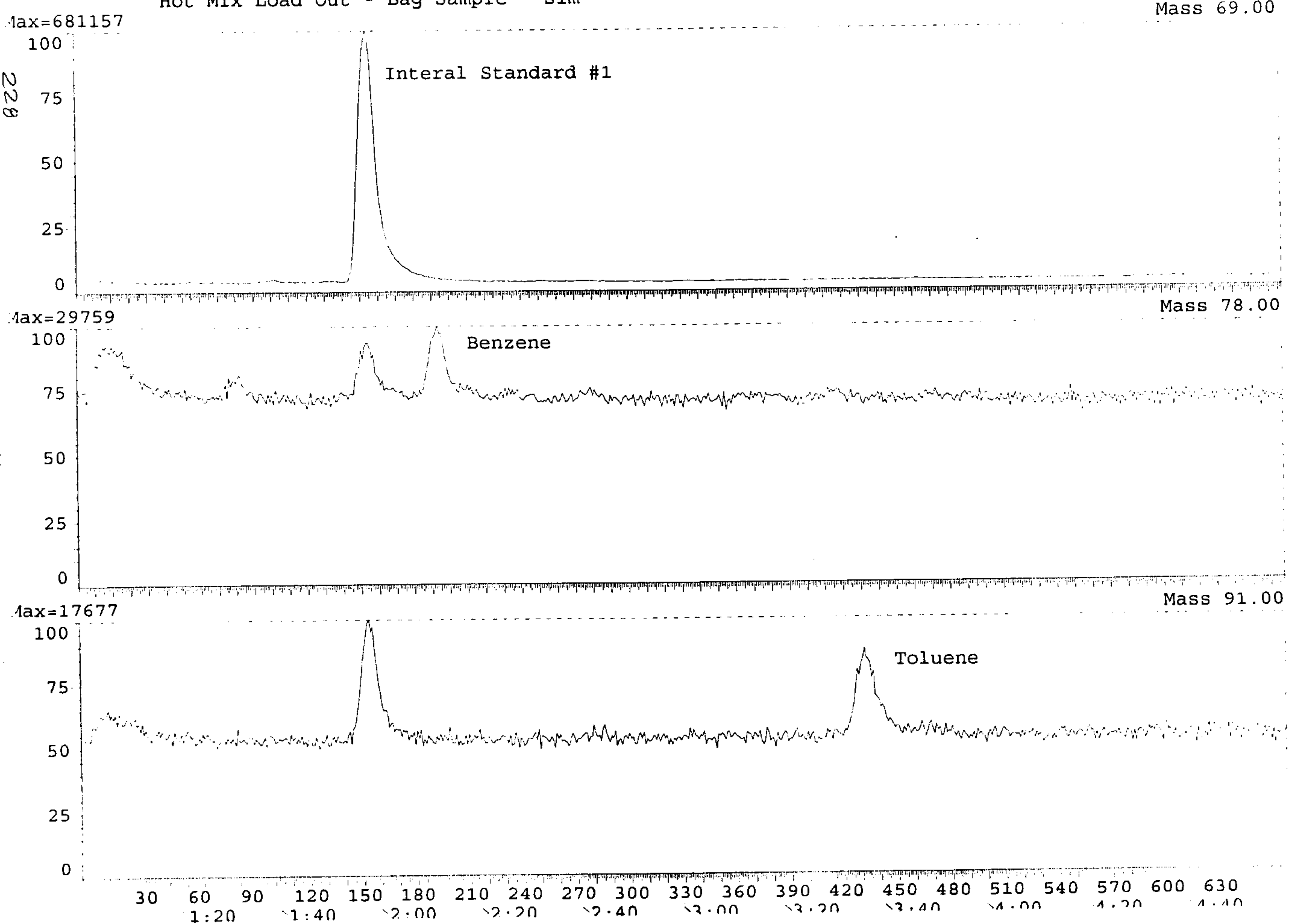


```
ull Scan    c:\progra~1\hapsrun\data\aaa\7-25\sed72502      1.0 m/z;           RTime 1:30.30
ormalization Mass: 76;       Run: 07/25/98 at 09:20:01
            Silo Exhaust Duct    complete fs
ax=102049  Spectrum 111; Background 73-103, 124-146
```



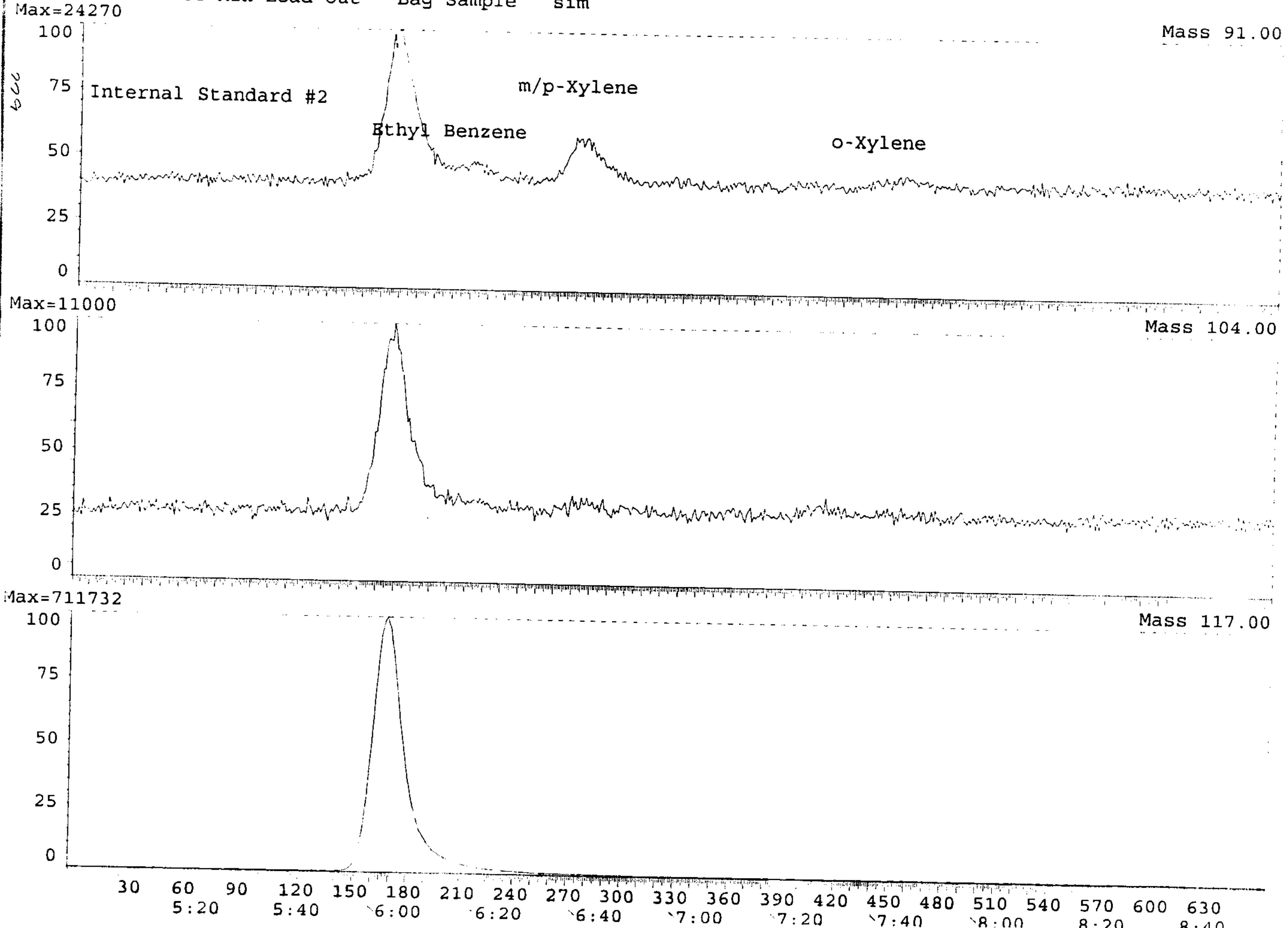
Mass Spectrum of Carbon Disulfide

SIM Set #1 c:\progra~1\hapsrun\data\aaa\7-25\hmlobag2 Scans 1 to 677
Run: 07/25/98 at 12:50:27 RTime 1:00.39 to 4:59.64
Hot Mix Load Out - Bag Sample sim



228

```
SIM Set #2   c:\progra~1\hapsrun\data\aaa\7-25\hmlobag2   Scans     1 to 674
Run: 07/25/98 at 12:50:27                                  RTime 5:00.39 to 8:58.55
          Hot Mix Load Out - Bag Sample   sim
```



VOLUME 3

APPENDIX D

QA/QC DATA

TED RUN 1

All American Asphalt Plant
Irvine, California
Tunnel Exhaust Duct (TED)
for M 315 & MMS

Date July 24, 1998
Page 1 of 2

Quality Control Check	**Observation**
Prior to Start of Tests	
Keep all cleaned glassware sealed until train assembly	done
Assemble trains in dust free environment	done
Visually inspect each train for proper assembly	done
Level and zero manometer	done
Calculate proper sampling nozzle size	done .258 & .252
Visually inspect sampling nozzle for chips	done
Visually inspect Type S Pitot tube	done
Leak check each leg of Type S Pitot tube	done
Leak check entire sampling train	done
During Testing	
Read temperatures and differential pressures at each traverse point	done
Sample data and calculations recorded on preformatted data sheets	done
Unusual occurrences noted in test log	if any, there will be an attachment
Properly maintain the roll and pitch of axis of Type S Pitots and sampling nozzle	done
Leak check train before and after any component changes during test	Done
Maintain the probe and filter temperature	done
Maintain ice in ice water bath and maintain impinger exit temperature	done
Calibration forms reviewed for completeness and accuracy	done
Data sheets reviewed by PM daily during testing	done

Method 315 MB# 6.A
Y = ~~1.04~~ 1.001 CMC
ΔH = 1.95

MMS MB# 15
Y = 1.00
ΔH = 1.90

Date July 24, 1998
Page 2 of 2

Quality Control Check	**Observation**
After Testing	
Visually inspect sampling nozzle	Done
Visually inspect Type S Pitot tube	Done
Leak check each leg of the Type S Pitot tube	Done
Leak check the entire sampling train	Done
Record observations if any	yes
Field Log	
Project name/ID and location	~~Hot Mix Asphalt Load Out~~ Asphalt Plant C Los Angeles, Calif.
Sampling personnel (names/position)	Dennis D Holzschuh - Nick Nelson
Geological observations including map	Plant is located inbetween hills & Mountains
Sample run times and dates	(MM5) 7:20 to 12:56 (240 MIN) 7/24/98 (M315 240 min)
Sample descriptions	Particulate M315 Organic MM5
Description of QC samples	N/A
Deviations from QAPP	If any, there will be an attachment
Difficulties in sampling or unusual conditions	Main difficulties is the Process. (Batch operation)
Sample Labels	yes
Sample ID	yes
Date and time of collection	7-24-98 (7:20 Am to 1:00 PM)
Lab technician initials	~~HB~~ & NN M315 DH & BP MM5
Analytical parameter	PAH's, EOM, Particulate
Preservative required	Keep samples cool

All American Asphalt Plant
Irvine, California
Tunnel Exhaust Duct (TED)
for M 315 & MMS

TED RUN 1

July 24, 1998
Page 1 of 5

I. Test Run Observations R = Recommended M = Mandatory	Date	TED Test Run 1 MMS	TED Test Run 2 M-315	Test Run 3	Test Run 4
1. Train set up	filter ID	N/A	TED1		
	filter weight	N/A	.4491		
	filter checked for holes	✓	✓		
	filter centered	✓	✓		
	nozzle clean	✓	✓		
	nozzle undamaged	✓	✓		
	nozzle diameter (in.)	.258	.258		
	probe liner clean	yes	yes		
	probe markings correct	yes	yes		
	probe heated along entire length	yes	yes		
	impingers charged	yes	yes		
	impingers iced	yes	yes		
	meter box leveled	yes	yes		
	pitot manometer zeroed	yes	yes		
	orifice manometer zeroed	yes	yes		
	filter box or holder at temp.	yes	yes		
	all ball joints lightly greased	N/A	N/A		
	all openings capped	yes	yes		
2. Train leak check at nozzle: (<0.02 cfm @ 15 in. Hg initial. Intermediate and final at highest Vacuum during test run.)	initial (R) LC	.005	.012		
	initial (R) VAC	15"Hg	15"Hg		
	intermediate (R) LC				
	intermediate (R) VAC				
	intermediate (R) LC				
	intermediate (R) VAC				
	intermediate (R) LC				
	intermediate (R) VAC				
	final (M) LC	.002	.01		
	final (M) VAC	8"Hg	7.5"Hg		
3. Pitot lines leak check: (hold 3 in. H_2O) on manometer for (15 sec.)	initial positive line (R)	23 ok	23 ok		
	initial negative line (R)	23 ok	23 ok		
	final positive line (M)	6.3" ok	4.3" ok		
	final negative line (R)	3.8" ok	8.4" ok		
	pitot tube undamaged	yes	yes		
M-3 bag initial leak check (M) Tedlar bag:	Should hold 2 to 4 in. H_2O pressure for 10 minutes or zero flow meter reading on continuous evacuation or Completely fill bag and let stand overnight—no deflation.	N/A	N/A		

Method ~~MMS~~ ~~MB #6A~~ ~~Method 315 MB #15~~

~~Y = 1.00~~ ~~Y = 1.04~~

233 ~~ΔH = 1.90~~ ~~ΔH = 1.95~~

CMC

R = Recommended
M = Mandatory

		Test Run 1	Test Run 2	Test Run 3	Test Run 4
	Date	TED	TED		
		M-345	M315		
4. M-3 sampling train check:	initial (M)	N/A	N/A		
(should hold 10 in. vacuum for 1/2 min.)	final (M)				
Purge sample train with stack gas					
Constant rate sampling 1 pm					
5. Time test started		7:20	7:20		
Time test ended		12:56	12:57		
6. Dry gas meter volume:	( ) port initial	493.365	254.175		
	final				
	( ) port initial				
	final				
	( ) port initial				
	final				
	( ) port initial				
	final	659.760	423.178		
7. Train operation during run	Nozzle changed during run - NOT ALLOWED	NO	NO		
pitch and yaw of probe o.k.		yes	yes		
nozzle not scraped on nipple		No	NO		
effective seal around probe		yes	yes		
probe moved at proper time		yes	yes		
probe heated		yes	yes		
calculator constants or nomograph changed when TS and/or TM changes significantly		N/A	N/A		
average time to set isokenetics after probe moved to next point		10 Sec	10 Sec		
Average values: impinger temperature should be ≤ 70°F		OK	OK		
Post filter gas streamer or Filter box temperature [✓ 250°F + 25], ≤320°F, °F circle one		OK	OK		
stack temperature		81°F	85°F		
barometric P taken and value		29.35	29.35		
was probe ever disconnected from filter holder while in stack?		NO	NO		
was filter changed during run?		No	NO		

Date	TED	TED		
R = Recommended M = Mandatory	Test Run 1 MM5	Test Run 2 M315	Test Run 3	Test Run 4
Check on filter holder loosening of clamping device holder	Done	Done		
was silica gel changed during run?	NO	NO		
was any particulate lost?	NO	NO		
Accurate reading of: ΔP Average Sq Rt ΔP (in H2O)½	.5968	.5968		
ΔH Average Meter orifice Pressure in H2O	1.62	1.62		
meter temperature	84°F	84°F		
stack temperature	81°F	85°F		
meter vacuum	9"Hg	6"Hg		
time per point	10 Min	10 Min		
impinger temperature	<58°F	<61°F		
filter box temperature	250±10	250°F ±10		
Minimum sample time of 240 min met Minimum sample volume of 165.345 dscf collected	yes	yes		
8. Post test: - All openings sealed	yes	yes		
- recovery area clean sheltered	yes	yes		
- filter handled with gloves, forceps	yes	yes		
- petri dish sealed, labeled	yes	yes		
- any sample lost	no	no		
water measured mL gms (grad cyl. weighed)	254.4	124.0		
- silica gel weighed, net gms	38.0	40.0		
- condition - color	—	—		
% spent	—	—		
- probe cooled sufficiently	yes	yes		
- nozzle removed and brushed	yes	yes		
- probe brushed 6 times	yes	yes		
- nozzle brushes clean	yes	yes		
- wash bottles clean	yes	yes		
- acetone clean	yes	yes		
- M-8 15 minute purge	N/A	N/A		
- water/solution clean	yes	yes		
- blank taken: acetone, water, other	yes	yes		
Probe brush and extension clean.	yes	yes		
Sample container: Clean	yes	yes		
Capped	yes	yes		
Labeled	yes	yes		
Sealed	yes	yes		
Liquid level marked	yes	yes		

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R = Recommended M = Mandatory	Date	TED	TED		
		Test Run 1 MMS	Test Run 2 M315	Test Run 3	Test Run 4
9. Post test Orsat Analysis of integrated bag sample Orsat analyzer - Analyzer leak check (levels should not fall below cap. tubing and not more than 0.2 mL in burrette for 2 min.)	Initial (M)	N/A			
	Final (M)				
Orsat samples:	Each bag analyzed 3 times	N/A			
	% CO_2 agrees within 0.2%				
	% O_2 agrees within 0.2%				
	% CO agrees within 0.2%				
Analysis at end of test. Orsat analyzer checked against air (20.9 ± 0.3)					
Orsat Analysis:					
	CO_2%				
	O_2%				
	CO%				
	$Fo = \frac{20.9 - \% O_2}{\% CO_2}$	N/A			
	Fuel				
	F_o range for fuel				
	Orsat analysis valid				
	Orsat solutions changed when calculated F_o exceeds fuel type range				
10. All samples locked up		yes	yes		
All sampling components clean and sealed		yes	yes		
All data sheets submitted to ~~observer~~*		✓	✓		
- Orsat		N/A	N/A		
- Run isokenetic	Team/Observer	yes	yes		
- Particulate recovery		yes	yes		
- Process data		yes	yes		
- Charts		yes	yes		
- Calibration sheets		yes	yes		

* Data Custodian Mike Marct.

J. NOTES: Care should be taken, when sampling for organic compounds, to follow stringent quality control guidelines to avoid contamination of the sample and sampling train. Take note of any occurences which could bias the sample in any manner. So noted

Include: (1) General comments; (2) Changes to pretest agreement with justification; (3) Identify (manufacturer) and describe condition of sampling equipment; (4) any abnormal occurrences during test program. (Additional page(s) attached: Yes ✓, No ____.)

Dennis P Holzschuh
Signature of Observer

PES
Affiliation of Observer

7-24-98
Date

TED Run 2

All American Asphalt Plant
Irvine, California
Tunnel Exhaust Duct (TED)
for M23 (mms) & M-315

Date July 25, 1998
Page 1 of 2

Quality Control Check	**Observation**
Prior to Start of Tests	
Keep all cleaned glassware sealed until train assembly	done
Assemble trains in dust free environment	done
Visually inspect each train for proper assembly	done
Level and zero manometer	done
Calculate proper sampling nozzle size	done (.252 & .258)
Visually inspect sampling nozzle for chips	done
Visually inspect Type S Pitot tube	done
Leak check each leg of Type S Pitot tube	done
Leak check entire sampling train	done
During Testing	
Read temperatures and differential pressures at each traverse point	done
Sample data and calculations recorded on preformatted data sheets	done
Unusual occurrences noted in test log	yes
Properly maintain the roll and pitch of axis of Type S Pitots and sampling nozzle	yes N/A
Leak check train before and after any component changes during test	yes
Maintain the probe and filter temperature	yes
Maintain ice in ice water bath and maintain impinger exit temperature	yes
Calibration forms reviewed for completeness and accuracy	yes
Data sheets reviewed by PM daily during testing	yes

M-23 (MMS) MB#15
$Y = 1.00$
$\Delta H = 1.90$

Method 315
MB #6A
$Y = 1.04$
$\Delta H = 1.95$

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Date July 25, 1998
Page 2 of 2

Quality Control Check	**Observation**
After Testing	
Visually inspect sampling nozzle	Done
Visually inspect Type S Pitot tube	Done
Leak check each leg of the Type S Pitot tube	Done
Leak check the entire sampling train	Done
Record observations if any	yes
Field Log	
Project name/ID and location	Hot Mix Asphalt Loadout Asphalt Plant C / Irvine Calif.
Sampling personnel (names/position)	D. Holzschuh – Nick Nielsen
Geological observations including map	Plant located between Hills & Mts.
Sample run times and dates	Organic (M-23) Particulate M-315
Sample descriptions	Semi Volatile Organics / Particulate & EOM
Description of QC samples	N/A
Deviations from QAPP	yes
Difficulties in sampling or unusual conditions	Batch Operation
Sample Labels	yes
Sample ID	yes
Date and time of collection	7-25-98 7:10 AM – 11:27 Am
Lab technician initials	HB & NN (M-315) & DH &
Analytical parameter	organics & Particulate
Preservative required	Keep Sample cool

All American Asphalt Plant

Irvine, California

Tunnel Exhaust Duct (TED) for MMS & M315

TED RUN2 July 25, 1998

Page 1 of 5

I. Test Run Observations R = Recommended M = Mandatory	Date	TED Test Run ~~#~~2 MMS	TED Test Run 2 M-315	Test Run 3	Test Run 4
1. Train set up	filter ID	N/A	TED#2		
	filter weight	N/A	.4489		
	filter checked for holes	Done	Done		
	filter centered	✓	✓		
	nozzle clean	✓	✓		
	nozzle undamaged	✓	✓		
	nozzle diameter (in.)	.252	.258		
	probe liner clean	yes	yes		
	probe markings correct	yes	yes		
	probe heated along entire length	yes	yes		
	impingers charged	yes	yes		
	impingers iced	yes	yes		
	meter box leveled	yes	yes		
	pitot manometer zeroed	yes	yes		
	orifice manometer zeroed	yes	yes		
	filter box or holder at temp.	yes	yes		
	all ball joints lightly greased	N/A	N/A		
	all openings capped	yes	yes		
2. Train leak check at nozzle: (<0.02 cfm @ 15 in. Hg initial. Intermediate and final at highest Vacuum during test run.)	initial (R) LC	.000	.01		
	initial (R) VAC	15"Hg	15"Hg		
	intermediate (R) LC				
	intermediate (R) VAC				
	intermediate (R) LC	.004	.01		
	intermediate (R) VAC	6"Hg	10"Hg		
	intermediate (R) LC				
	intermediate (R) VAC				
	final (M) LC	.002	.008		
	final (M) VAC	8"Hg	7"Hg		
3. Pitot lines leak check: (hold 3 in. H_2O) on manometer for (15 sec.)	initial positive line (R)	> 3 OK	> 3 OK		
	initial negative line (R)	> 3 OK	> 3 OK		
	final positive line (M)	> 3 OK	> 3 OK		
	final negative line (R)	> 3 OK	> 3 OK		
	pitot tube undamaged	✓	✓		
M-3 bag initial leak check (M) Tedlar bag:	Should hold 2 to 4 in. H_2O pressure for 10 minutes or zero flow meter reading on continuous evacuation or Completely fill bag and let stand overnight—no deflation.	N/A	N/A		

MMS MB #15
Y = 1.00
ΔH = 1.90

M-315 MB # 6.A
Y = 1.04
ΔH = 1.95

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		Test Run 1	Test Run 2	Test Run 3	Test Run 4
Date		TED	TED		
R = Recommended M = Mandatory		MM5	M315		
4. M-3 sampling train check:	initial (M)	N/A	N/A		
(should hold 10 in. vacuum for 1/2 min.)	final (M)	↓	↓		
Purge sample train with stack gas		↓	↓		
Constant rate sampling 1 pm		↓	↓		
5. Time test started		7:10 AM	7:11 AM		
Time test ended		11:21 AM	11:27 AM		
6. Dry gas meter volume:	( ) port initial	422.626			
	final				
	( ) port initial	660.664	423.626		
	final				
Port change	( ) port initial	751.800	512.106		
	final				
	( ) port initial				
	final	819.901	591.847		
7. Train operation during run	Nozzle changed during run - NOT ALLOWED	NO	NO		
pitch and yaw of probe o.k.		N/A ✓	N/A ✓		
nozzle not scraped on nipple		NO	NO DP18		
effective seal around probe		yes	yes		
probe moved at proper time		yes	yes		
probe heated		yes	yes		
calculator constants or nomograph changed when TS and/or TM changes significantly		N/A	N/A		
average time to set isokenetics after probe moved to next point		10 sec	10 Sec		
Average values: impinger temperature should be ≤ 70°F		o.k	o.k		
Post filter gas streamer or Filter box temperature [✓ 250°F + 25], ≤320°F, °F circle one		o.k	o.k		
	stack temperature	88°F	88°F		
	barometric P taken and value	29.33	29.33		
	was probe ever disconnected from filter holder while in stack?	NO	NO		
	was filter changed during run?	NO	NO		

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July 25, 1998

Page 3 of 5

R = Recommended M = Mandatory	Test Run 1	Test Run 2	Test Run 3	Test Run 4
Date	TED	TED		
	MM5	M-315		
Check on filter holder loosening of clamping device holder	done	done		
was silica gel changed during run?	NO	NO		
was any particulate lost?	no	no		
Accurate reading of: Δp	.5442	.5729		
ΔH	1.44	1.69		
meter temperature	78°F	90°F		
stack temperature	82°F	88°F		
meter vacuum	6.5"Hg	4"Hg		
time per point	5 MIN	5 MIN		
impinger temperature	<55°F	<66°F		
filter box temperature	>250°F	>250°F		
Minimum sample time of 120 min met Minimum sample volume of ✓ dscf collected	152.087	160.986		
8. Post test: - All openings sealed	yes	yes		
- recovery area clean sheltered	yes	yes		
- filter handled with gloves, forceps	yes	yes		
- petri dish sealed, labeled	yes	yes		
- any sample lost	NO	NO		
water measured mL (grad cyl.) gms (weighed)	116.4	84.8		
- silica gel weighed, net gms	31.2	33.7		
- condition - color				
% spent				
- probe cooled sufficiently	yes	yes		
- nozzle removed and brushed	yes	yes		
- probe brushed 6 times	yes	yes		
- nozzle brushes clean	yes	yes		
- wash bottles clean	yes	yes		
- acetone clean	yes	yes		
- M-8 15 minute purge	N/A	N/A		
- water/solution clean	yes	yes		
- blank taken: acetone, water, other	yes	yes		
Probe brush and extension clean	yes	yes		
Sample container: Clean	yes	yes		
Capped	yes	yes		
Labeled	yes	yes		
Sealed	yes	yes		
Liquid level marked	yes	yes		

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July 25, 1998

Page 4 of 5

R = Recommended M = Mandatory		Date	TED	TED		
			Test Run 1 M5	Test Run 2 M315	Test Run 3	Test Run 4
9.	Post test Orsat Analysis of integrated bag sample Orsat analyzer - Analyzer leak check (levels should not fall below cap. tubing and not more than 0.2 mL in burrette for 2 min.)	Initial (M)	↑	↑		
		Final (M)	N/A	N/A		
	Orsat samples: Each bag analyzed 3 times					
	% CO_2 agrees within 0.2%		N/A	N/A		
	% O_2 agrees within 0.2%					
	% CO agrees within 0.2%					
	Analysis at end of test. Orsat analyzer checked against air (20.9 ± 0.3)					
	Orsat Analysis: CO_2%		N/A	N/A		
	O_2%					
	CO%					
	$F_o = \frac{20.9 - \% O_2}{\% CO_2}$					
	Fuel					
	F_o range for fuel					
	Orsat analysis valid					
	Orsat solutions changed when calculated F_o exceeds fuel type range		↓	↓		
10.	All samples locked up		yes	yes		
	All sampling components clean and sealed		yes	yes		
	All data sheets submitted to ~~observer~~ *		yes	yes		
	- Orsat		N/A	N/A		
	- Run isokenetic	Team/Observer	yes	yes		
	- Particulate recovery		yes	yes		
	- Process data		yes	yes		
	- Charts		yes	yes		
	- Calibration sheets		yes	yes		

* Sample Custodian

243

J. NOTES: Care should be taken, when sampling for organic compounds, to follow stringent quality control guidelines to avoid contamination of the sample and sampling train. Take note of any occurences which could bias the sample in any manner. So noted

Include: (1) General comments; (2) Changes to pretest agreement with justification; (3) Identify (manufacturer) and describe condition of sampling equipment; (4) any abnormal occurrences during test program. (Additional page(s) attached: Yes ✓, No ____.)

Dennis P Holzschuh
Signature of Observer

PES
Affiliation of Observer

7-21-98
Date

SED Run 1

All American Asphalt Plant
Irvine, California
Silo Exhaust Duct (SED)
For M315 & MM5

Date July 29, 1998
Page 1 of 2

Quality Control Check	**Observation**
Prior to Start of Tests	
Keep all cleaned glassware sealed until train assembly	done
Assemble trains in dust free environment	done
Visually inspect each train for proper assembly	done
Level and zero manometer	done
Calculate proper sampling nozzle size	MM5 (.38)
Visually inspect sampling nozzle for chips	done
Visually inspect Type S Pitot tube	done
Leak check each leg of Type S Pitot tube	done
Leak check entire sampling train	done
During Testing	
Read temperatures and differential pressures at each traverse point	done
Sample data and calculations recorded on preformatted data sheets	done
Unusual occurrences noted in test log	done
Properly maintain the roll and pitch of axis of Type S Pitots and sampling nozzle	done N/A
Leak check train before and after any component changes during test	done
Maintain the probe and filter temperature	done
Maintain ice in ice water bath and maintain impinger exit temperature	done
Calibration forms reviewed for completeness and accuracy	done
Data sheets reviewed by PM daily during testing	done

Method 315 MB # 3A
$y =$ ~~.984~~ 1.007 cmc
ΔH 1.851

Method MM5 – MB # 3A
$y = .984$
$\Delta H = 1.851$

Date July 24, 1998
Page 2 of 2

Quality Control Check	**Observation**
After Testing	
Visually inspect sampling nozzle	done
Visually inspect Type S Pitot tube	done
Leak check each leg of the Type S Pitot tube	done
Leak check the entire sampling train	done
Record observations if any	yes
Field Log	
Project name/ID and location	Hot Mix Asphalt Load Out Los Angeles, Calif- Asphalt Plant C
Sampling personnel (names/position)	Joe Rubio Console operator for M-315 & MM5
Geological observations including map	Plant located between hills & Mts
Sample run times and dates	M 315 (60 MIN) MM5 (120 MIN)
Sample descriptions	Particulate (M-315) Organics (MM-5) 7-24-
Description of QC samples	N/A
Deviations from QAPP	If any, there will be an attachment
Difficulties in sampling or unusual conditions	Main Difficulty (Process is Batch operation
Sample Labels	yes
Sample ID	yes
Date and time of collection	7-24-98 (7:20 AM to 1:00 PM)
Lab technician initials	NB & NN (M-315) DH & BP (MM-5)
Analytical parameter	Particulate & Organic
Preservative required	Keep cool

246

All American Asphalt Plant
Irvine, California
DH ~~Tunnel Exhaust Duct~~ (SED) Silo Exhaust
For M315 & MM5

July 24, 1998
Page 1 of 5

I. Test Run Observations R = Recommended M = Mandatory		Date	SED Test Run 1 MM5	SED Test Run 2 M315	Test Run 3	Test Run 4
1. Train set up	filter ID		N/A	SED1		
	filter weight		N/A	.4481		
	filter checked for holes		✓	✓		
	filter centered		✓	✓		
	nozzle clean		✓	✓		
	nozzle undamaged		✓	✓		
	nozzle diameter (in.)		.38	.380		
	probe liner clean		yes	yes		
	probe markings correct		yes	yes		
	probe heated along entire length		yes	yes		
	impingers charged		yes	yes		
	impingers iced		yes	yes		
	meter box leveled		yes	yes		
	pitot manometer zeroed		yes	yes		
	orifice manometer zeroed		yes	yes		
	filter box or holder at temp.		yes	yes		
	all ball joints lightly greased					
	all openings capped		yes	yes		
2. Train leak check at nozzle: (≤0.02 cfm @ 15 in. Hg initial. Intermediate and final at highest Vacuum during test run.)	initial (R)	LC	.004	.013		
		VAC	12" Hg	15		
	intermediate (R)	LC				
		VAC				
	intermediate (R)	LC				
		VAC				
	intermediate (R)	LC				
		VAC				
	final (M)	LC	.01	.01		
		VAC	13" Hg	13" Hg		
3. Pitot lines leak check: (hold 3 in. H_2O) on manometer for (15 sec.)	initial positive line (R)		>3 ✓	>3 ✓		
	negative line (R)					
	final positive line (M)		>3 ok	>3 ✓		
	negative line (R)		ok	ok		
	pitot tube undamaged		✓	✓		
M-3 bag initial leak check (M) Tedlar bag:	Should hold 2 to 4 in. H_2O pressure for 10 minutes or		N/A	N/A		
	zero flow meter reading on continuous evacuation or					
	Completely fill bag and let stand overnight—no deflation.					

Method MM5 - MB# 3A
247
Y = ~~.984~~ 1.007 (cmc)
ΔH = 1.851 (same console

Method 315 MB# 3~~8~~A
y = ~~.984~~ 1.007 cmc
ΔH 1.851

R = Recommended M = Mandatory	Test Run 1	Test Run 2	Test Run 3	Test Run 4
Date	MM5	M315		
	SED	SED		
4. M-3 sampling train check: initial (M)	N/A	N/A		
(should hold 10 in. vacuum for 1/2 min.) final (M)				
Purge sample train with stack gas				
Constant rate sampling 1 pm				
5. Time test started	7:20AM	11:[illegible]AM		
Time test ended	10:18	12:43		
6. Dry gas meter volume: ( ) port initial	166.400	255.360		
final				
( ) port initial				
final				
( ) port initial				
final				
( ) port initial				
final	254.68	298.500		
7. Train operation during run — Nozzle changed during run – NOT ALLOWED	NO	NO		
pitch and yaw of probe o.k.	yes	yes		
nozzle not scraped on nipple	no	no		
effective seal around probe	yes	yes		
probe moved at proper time	yes	yes		
probe heated	yes	yes		
calculator constants or nomograph changed when TS and/or TM changes significantly	N/A	N/A		
average time to set isokenetics after probe moved to next point	approx. 10 sec	approx. 10 sec		
Average values: impinger temperature should be ≤ 70°F	ok	ok		
Post filter gas streamer or Filter box temperature [✓ 250°F + 25], ≤320°F, °F circle one	ok	ok		
stack temperature	233	256		
barometric P taken and value	29.38	29.35		
was probe ever disconnected from filter holder while in stack?	NO	NO		
was filter changed during run?	NO	NO		

248

Date	SED	SED		
R = Recommended M = Mandatory	Test Run 1 MM5	Test Run 2 M315	Test Run 3	Test Run 4
Check on filter holder loosening of clamping device holder	Done	Done		
was silica gel changed during run?	NO	NO		
was any particulate lost?	NO	NO		
Accurate reading of: ΔP Average Sq. Rt. ΔP (in. H₂O)½	.3548	.4972		
ΔH Average Meter orifice P in. H₂O	1.86	1.70		
meter temperature	84°F	84°F		
stack temperature	235°F	256°F		
meter vacuum	9" Hg	10" Hg		
time per point	5 MIN	5 MIN		
impinger temperature	<65°F	<65°F		
filter box temperature	250± 10	250±10		
Minimum sample time of 120 min met				
Minimum sample volume of ____ dscf collected				
8. Post test: - All openings sealed	yes	yes		
- recovery area clean sheltered	yes	yes		
- filter handled with gloves, forceps	yes	yes		
- petri dish sealed, labeled	yes	yes		
- any sample lost	NO	NO		
water measured 265.7 mL grad cyl. weighed gms	265.7 mL	157.7		
- silica gel weighed, net gms	19.2	15.7		
- condition - color	—	—		
% spent	—	—		
- probe cooled sufficiently	yes	yes		
- nozzle removed and brushed	yes	yes		
- probe brushed 6 times	yes	yes		
- nozzle brushes clean	yes	yes		
- wash bottles clean	yes	yes		
- acetone clean	yes	yes		
- M-8 15 minute purge	N/A	N/A		
- water/solution clean	yes	yes		
- blank taken: acetone, water, other	yes	yes		
Probe brush and extension clean.	yes	yes		
Sample container: Clean	yes	yes		
Capped	yes	yes		
Labeled	yes	yes		
Sealed	yes	yes		
Liquid level marked	yes	yes		

R = Recommended
M = Mandatory

		Date	SEP	SEP		
			Test Run 1 MM5	Test Run 2 M315	Test Run 3	Test Run 4
9.	Post test Orsat Analysis of integrated bag sample Orsat analyzer - Analyzer leak check (levels should not fall below cap. tubing and not more than 0.2 mL in burrette for 2 min.)	Initial (M)	N/A	N/A		
		Final (M)				
	Orsat samples:	Each bag analyzed 3 times	N/A	N/A		
		% CO₂ agrees within 0.2%				
		% O₂ agrees within 0.2%				
		% CO agrees within 0.2%				
	Analysis at end of test. Orsat analyzer checked against air (20.9 ± 0.3)					
	Orsat Analysis:	* CO_2%	N/A	N/A		
		O_2%				
		CO%				
		$F_o = \frac{20.9 - \% O_2}{\% CO_2}$				
		Fuel				
		F_o range for fuel				
		Orsat analysis valid				
		Orsat solutions changed when calculated F_o exceeds fuel type range				
10.	All samples locked up		Yes	Yes		
	All sampling components clean and sealed		Yes	Yes		
M.M Data Custodian	All data sheets submitted to ~~observer~~		Yes	Yes		
	- Orsat		N/A	N/A		
	- Run isokenetic	Team/Observer	95.9 VA	100.3 VA		
	- Particulate recovery		yes	yes		
	- Process data		yes	yes		
	- Charts		yes	yes		
	- Calibration sheets		yes	yes		

97.4 (cmc) 102.3 (cmc)

* AMBIENT AIR $CO_2 = 0$ $O_2 = 20.9$

250

J. NOTES: Care should be taken, when sampling for organic compounds, to follow stringent quality control guidelines to avoid contamination of the sample and sampling train. Take note of any occurences which could bias the sample in any manner. So noted

Include: (1) General comments; (2) Changes to pretest agreement with justification; (3) Identify (manufacturer) and describe condition of sampling equipment; (4) any abnormal occurrences during test program. (Additional page(s) attached: Yes ✓, No ____.)

Dennis P Holzschuh
Signature of Observer

PES
Affiliation of Observer

7-24-98
Date

SED RUN 2

All American Asphalt Plant
Irvine, California
Silo Exhaust Duct (SED)
For MM5 & M315

Date July 25, 1998
Page 1 of 2

Quality Control Check	Observation
Prior to Start of Tests	
Keep all cleaned glassware sealed until train assembly	done
Assemble trains in dust free environment	done
Visually inspect each train for proper assembly	done
Level and zero manometer	done
Calculate proper sampling nozzle size	done (Both location's .380)
Visually inspect sampling nozzle for chips	done
Visually inspect Type S Pitot tube	done
Leak check each leg of Type S Pitot tube	done
Leak check entire sampling train	done
During Testing	
Read temperatures and differential pressures at each traverse point	yes
Sample data and calculations recorded on preformatted data sheets	yes
Unusual occurrences noted in test log	yes
Properly maintain the roll and pitch of axis of Type S Pitots and sampling nozzle	yes (N/A)
Leak check train before and after any component changes during test	yes
Maintain the probe and filter temperature	yes
Maintain ice in ice water bath and maintain impinger exit temperature	yes
Calibration forms reviewed for completeness and accuracy	yes
Data sheets reviewed by PM daily during testing	yes

Method 23 MM5-MB#3A
y = ~~984~~ 1.007 cmc
ΔH = 1.851

Method 315 MB#3A
y = ~~984~~ .1.007 cmc
ΔH 1.851

252

Same console

Date July 25, 1998
Page 2 of 2

Quality Control Check	Observation
After Testing	
Visually inspect sampling nozzle	done
Visually inspect Type S Pitot tube	done
Leak check each leg of the Type S Pitot tube	done
Leak check the entire sampling train	done
Record observations if any	yes
Field Log	
Project name/ID and location	Hot Mix Asphalt, hood out Asphalt Plant C Irvine Calif.
Sampling personnel (names/position)	Joe Rubio Console operator M-23 & M-315
Geological observations including map	Plant located between hills & Mts.
Sample run times and dates	(MM5 - 120 min) (M-315 - 60 min) 7-25-98
Sample descriptions	Organics (MM5) Particulate (M-315)
Description of QC samples	N/A
Deviations from QAPP	If any - will be noted in attachment
Difficulties in sampling or unusual conditions	Main Difficulty (Process Batch operation)
Sample Labels	yes
Sample ID	yes
Date and time of collection	7-25-98 (7:00 - 10:15)
Lab technician initials	HB & AN (M-315) DH & BP (MM5)
Analytical parameter	Particulate & Organic
Preservative required	Keep cool

All American Asphalt Plant

Irvine, California

Silo Exhaust Duct (SED)

For MM5 & M 315

SED Run 2

July 25, 1998

Page 1 of 5

I. Test Run Observations R = Recommended M = Mandatory	Date	SED	SED		
		Test Run 2 MM5	Test Run 2 M315	Test Run 3	Test Run 4
1. Train set up	filter ID	N/A	SED-2		
	filter weight	N/A	.4466		
	filter checked for holes	✓	✓		
	filter centered	✓	✓		
	nozzle clean	✓	✓		
	nozzle undamaged	✓	✓		
	nozzle diameter (in.)	.380	.380		
	probe liner clean	yes			
	probe markings correct	yes			
	probe heated along entire length	yes	yes		
	impingers charged	yes	yes		
	impingers iced	yes	yes		
	meter box leveled	yes	yes		
	pitot manometer zeroed	yes	yes		
	orifice manometer zeroed	yes	yes		
	filter box or holder at temp.	yes	yes		
	all ball joints lightly greased	N/A	N/A		
	all openings capped	yes	yes		
2. Train leak check at nozzle: (<0.02 cfm @ 15 in. Hg initial. Intermediate and final at highest Vacuum during test run.)	initial (R) LC	.008	.002		
	initial (R) VAC	15"Hg	15"Hg		
	intermediate (R) LC				
	intermediate (R) VAC				
	intermediate (R) LC				
	intermediate (R) VAC				
	intermediate (R) LC				
	intermediate (R) VAC				
	final (M) LC	.007	.002		
	final (M) VAC	13"Hg	8"Hg		
3. Pitot lines leak check: (hold 3 in. H_2O on manometer for (15 sec.)	initial positive line (R)	>3 ok	>3 ok		
	initial negative line (R)	>3 ok	>3 ok		
	final positive line (M)	>3 ok	>3 ok		
	final negative line (R)	>3 ok	>3 ok		
	pitot tube undamaged	✓	✓		
M-3 bag initial leak check (M) Tedlar bag:	Should hold 2 to 4 in. H_2O pressure for 10 minutes or zero flow meter reading on continuous evacuation or Completely fill bag and let stand overnight—no deflation.	N/A	N/A		

MM-5 MB# 3A

Y = ~~.984~~ 1.007 (CMC)

ΔH = 1.851

M-315 MB# 3A

Same console as MM5

254

R = Recommended
M = Mandatory

		Test Run 1	Test Run 2	Test Run 3	Test Run 4
	Date	SED	SED		
		MM5	M-315		
4.	M-3 sampling train check: initial (M)	N/A	N/A		
	(should hold 10 in. vacuum for 1/2 min.) final (M)				
	Purge sample train with stack gas				
	Constant rate sampling 1 pm				
5.	Time test started	7:10 AM	10:15 AM		
	Time test ended				
6.	Dry gas meter volume: ( ) port initial	298.681	382.829		
	final				
	( ) port initial				
	final				
	( ) port initial				
	final				
	( ) port initial				
	final	387.682	431.711		
7.	Train operation during run — Nozzle changed during run – NOT ALLOWED	NO	NO		
	pitch and yaw of probe o.k.	yes	yes		
	nozzle not scraped on nipple	yes	yes		
	effective seal around probe	yes	yes		
	probe moved at proper time	yes	yes		
	probe heated	yes	yes		
	calculator constants or nomograph changed when TS and/or TM changes significantly	NO	NO.		
	average time to set isokenetics after probe moved to next point	approx 10 Sec.	approx 10 Sec		
	Average values: impinger temperature should be ≤ 70°F	ok	oK		
Post filter gas streamer or Filter box temperature	250°F [✓ ± 25], ≤320°F, °F circle one	OK	OK		
	stack temperature	272°F	270°F		
	barometric P taken and value	29.26	29.26		
	was probe ever disconnected from filter holder while in stack?	NO	NO		
	was filter changed during run?	NO	NO		

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July 25, 1993

Page 3 of 5

R = Recommended
M = Mandatory

		Test Run 1	Test Run 2	Test Run 3	Test Run 4
	Date	SED	SED		
		M-5	S-315		
Check on filter holder loosening of clamping device holder		Done	Done		
	was silica gel changed during run?	NO	NO		
	was any particulate lost?	NO	NO		
Accurate reading of:	ΔP Averag Sq Rt ΔP (in H2O)½	.4472	.3483		
	ΔH Average Meter orifice Pressure	1.83	1.80		
	meter temperature	89	89		
	stack temperature	253°F	270		
	meter vacuum	12"Hg	6"Hg		
	time per point	5 MIN	5 MIN		
	impinger temperature	<67	<65		
	filter box temperature	250±10	250±10		
Minimum sample time of ______ min met		120 min	120 min		
Minimum sample volume of ______ dscf collected		89.0	74.982		
8. Post test:	- All openings sealed	yes	yes		
	- recovery area clean sheltered	yes	yes		
	- filter handled with gloves, forceps	yes	yes		
	- petri dish sealed, labeled	yes	yes		
	- any sample lost	no	no		
	water measured grad cyl. mL weighed gms	522.4 mL	283.4 mL		
	- silica gel weighed, net gms	24.1	17.6		
	- condition - color	✓	✓		
	% spent	✓	✓		
	- probe cooled sufficiently	yes	yes		
	- nozzle removed and brushed	yes	yes		
	- probe brushed 6 times	yes	yes		
	- nozzle brushes clean	yes	yes		
	- wash bottles clean	yes	yes		
	- acetone clean	yes	yes		
	- M-8 15 minute purge	N/A	N/A		
	- water/solution clean	yes	yes		
	- blank taken: acetone, water, other	yes	yes		
Probe brush and extension clean.		yes	yes		
Sample container:	Clean	yes	yes		
	Capped	yes	yes		
	Labeled	yes	yes		
	Sealed	yes	yes		
	Liquid level marked	yes	yes		

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		Date	SED	SED		
	R = Recommended M = Mandatory		Test Run 1 MM5	Test Run 2 M-315	Test Run 3	Test Run 4
9.	Post test Orsat Analysis of integrated bag sample Orsat analyzer - Analyzer leak check (levels should not fall below cap. tubing and not more than 0.2 mL in burrette for 2 min.)	Initial (M)	N/A	N/A		
		Final (M)				
	Orsat samples:	Each bag analyzed 3 times	N/A	N/A		
		% CO_2 agrees within 0.2%				
		% O_2 agrees within 0.2%				
		% CO agrees within 0.2%				
	Analysis at end of test. Orsat analyzer checked against air (20.9 ± 0.3)					
	Orsat Analysis:					
		CO_2%	N/A	N/A		
		O_2%				
		CO%				
	Fo =	$\frac{20.9 - \% O_2}{\% CO_2}$				
		Fuel				
		F_o range for fuel				
		Orsat analysis valid				
		Orsat solutions changed when calculated F_o exceeds fuel type range				
10.	All samples locked up		yes	yes		
	All sampling components clean and sealed		yes	yes		
	All data sheets submitted to observer		✓	✓		
	- Orsat		N/A	N/A		
	- Run isokenetic	Team/Observer	*NO	~~yes~~ ←	NO CMC	
	- Particulate recovery		yes	yes		
	- Process data		yes	yes		
	- Charts		yes	yes		
	- Calibration sheets		yes	yes		

* Had to repeat this run

J. **NOTES:** Care should be taken, when sampling for organic compounds, to follow stringent quality control guidelines to avoid contamination of the sample and sampling train. Take note of any occurences which could bias the sample in any manner. So noted

Include: (1) General comments; (2) Changes to pretest agreement with justification; (3) Identify (manufacturer) and describe condition of sampling equipment; (4) any abnormal occurrences during test program. (Additional page(s) attached: Yes ✓, No ____.)

Run 2 @ Silo for MM5 did not meet EPA criteria for ISO-Kinetic 100% ±10%

Solution to redo this run.

Dennis P Holzschuh
Signature of Observer

PEI
Affiliation of Observer

2-25-98
Date

THERMOCOUPLE CALIBRATION

CALIBRATED BY: J. RUBIO

DATE: 6-17-98

Thermocouple number	Thermocouple reading (°C)			Thermometer reading (°C)		
S-3A	0	22	100	0	22	100
S-4A	0	21	100	0	21	100
S-14A	0	21	99	0	21	100
S-15A	0	21	99	0	21	100
S-16A	1	22	100	0	21	100
S-17A	1	21	100	0	21	100
S-19A	0	22	100	0	22	100
ES 78	1	22	99	0	22	100
ES 87	1	22	100	0	22	100
P-14	0	22	100	0	22	100
TC 20	0	22	99	0	22	100
TC 21	1	21	99	0	22	100
TC 22	0	21	100	0	22	100
TC 23	0	22	99	0	22	100
TC 24	-1	22	100	0	22	100
TC 25	2	24	101	2	24	100

Thermometer Serial Number: A98-289
Certification Date: 03/19/98
Test Number: 157797
Thermometer Standard Serial Number: 128239
NIST I.D. Number: 88024

TEMPERATURE SENSOR CALIBRATION FORM

Temperature Sensor No. RT-11 **Sensor Type** K-TC **Length** ______
Ambient Temp. °F 73 **Barometric Pressure, "Hg** 30.21
Reference Temp. Sensor: ____________

Date	Ref. Point No.	Temp. Source	Temp. °F		Temp. Diff. %	Within Limits Y/N	Calibrated By
			Ref. Sensor	Test Sensor			
1-22-98	1	ICE H2O	32	36	.813	Y	JWB
"	2	AMB. AIR	73	73	0	Y	JWB
"	3	BOIL, H2O	206	206	0	Y	JWB
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						

$$\%\ \text{Temp. Diff} = \frac{(\text{Ref. Temp} + 460) - (\text{Test Temp.} + 460)}{(\text{Ref. Temp.} + 460)} \times 100 \leq 1.5\ \%$$

TEMPERATURE SENSOR CALIBRATION FORM

Temperature Sensor No. RT-10 **Sensor Type** K-TC **Length** 4'
Ambient Temp. °F 73 **Barometric Pressure, "Hg** 30.20
Reference Temp. Sensor:

Date	Ref. Point No.	Temp. Source	Temp. °F		Temp. Diff. %	Within Limits Y/N	Calibrated By
			Ref. Sensor	Test Sensor			
1-22-98	1	ICE H2O	32	32	0	Y	JWB
"	2	AMB. AIR	73	68	-.938	Y	JWB
"	3	BOIL. H2O	208	210	.299	Y	JWB
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						

$$\%\ \text{Temp. Diff} = \frac{(\text{Ref. Temp} + 460) - (\text{Test Temp.} + 460)}{(\text{Ref. Temp.} + 460)} \times 100 \leq 1.5\ \%$$

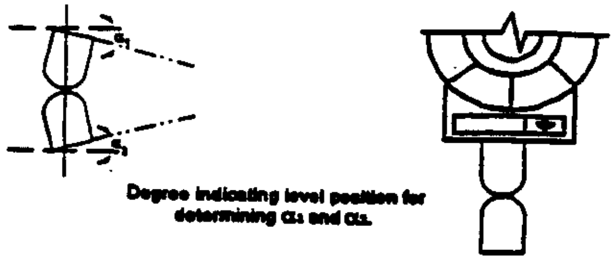
TEMPERATURE SENSOR CALIBRATION FORM

Temperature Sensor No. RT-6 Sensor Type K-TC Length ______
Ambient Temp. °F 72 Barometric Pressure, "Hg 30.21
Reference Temp. Sensor: ______

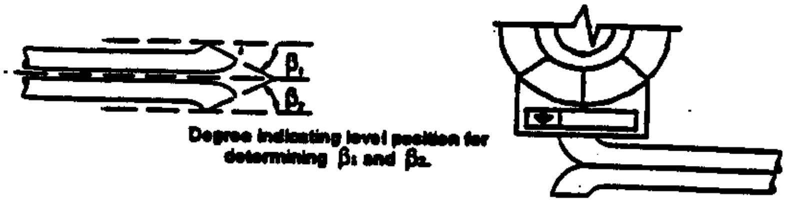
Date	Ref. Point No.	Temp. Source	Temp. °F		Temp. Diff. %	Within Limits Y/N	Calibrated By
			Ref. Sensor	Test Sensor			
1-22-98	1	ICE H2O	32	32	0	Y	JWB
"	2	AMB. AIR	72	69	-0.56 cmc ~~-.65~~	Y	JWB
"	3	BOIL. H2O	210	210	0	Y	JWB
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						

$$\% \text{ Temp. Diff} = \frac{(\text{Ref. Temp} + 460) - (\text{Test Temp.} + 460)}{(\text{Ref. Temp.} + 460)} \times 100 \leq 1.5\,\%$$

CALIBRATION DATA SHEET 2
Type S Pitot Tube Inspection

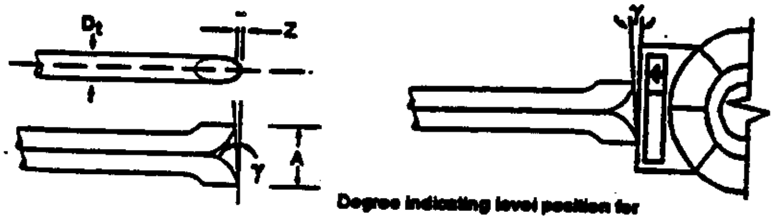


Degree indicating level position for determining α_1 and α_2.



Degree indicating level position for determining β_1 and β_2.

Degree indicating level position for determining Θ.



Degree indicating level position for detemining γ then calculate Z.

Level and Perpendicular?	YES
Obstruction?	NO
Damaged?	NO
α_1 $(-10° \le \alpha_1 \le +10°)$	0
α_2 $(-10° \le \alpha_2 \le +10°)$	1
β_1 $(-5° \le \beta_1 \le +5°)$	0
β_2 $(-5° \le \beta_2 \le +5°)$	1
γ	0
Θ	0
$z = A \tan\gamma$ $(\le 0.125")$	0
$w = A \tan\Theta$ $(\le 0.03125")$	0
D_t $(3/16" \le D_t \le 3/8")$	3/8
A	.938
$A/2D_t$ $(1.05 \le P_A/D_t \le 1.5)$	1.25

QA/QC Check

Completeness ____ Legibility ____ Accuracy ____ Specifications ____ Reasonableness ____

Certification

I certify that the Type S pitot tube/probe ID# RP-19 meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube calibration factor C_p of 0.84.

Certified by: 7-14-98

Personnel (Signature/Date)

Team Leader (Signature/Date)

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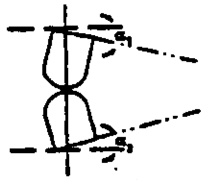
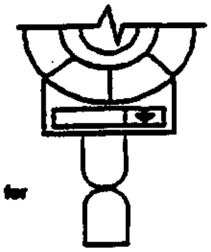
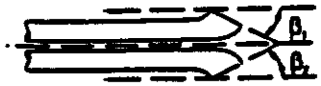
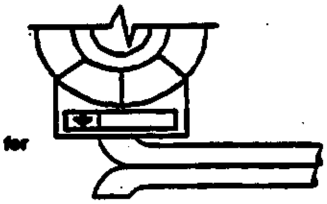
CALIBRATION DATA SHEET 2
Type S Pitot Tube Inspection



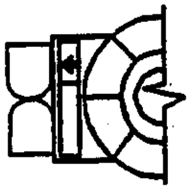


Degree indicating level position for determining α_1 and α_2.

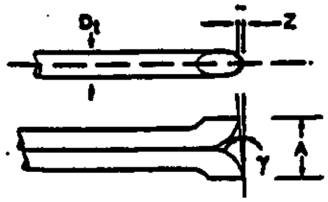


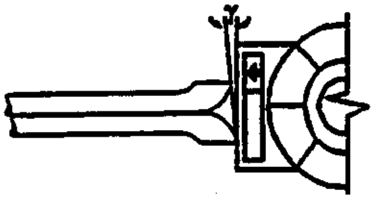


Degree indicating level position for determining β_1 and β_2.



Degree indicating level position for determining Θ





Degree indicating level position for determining γ then calculate Z.

Level and Perpendicular?	YES
Obstruction?	NO
Damaged?	NO
α_1 $(-10° \le \alpha_1 \le +10°)$	0
α_2 $(-10° \le \alpha_2 \le +10°)$	0
β_1 $(-5° \le \beta_1 \le +5°)$	0
β_2 $(-5° \le \beta_2 \le +5°)$	1
γ	0
Θ	1
$z = A \tan \gamma$ $(\le 0.125")$	0
$w = A \tan \Theta$ $(\le 0.03125")$	.0178
D_t $(3/16" \le D_t \le 3/8")$	3/8
A	1.022
$A/2D_t$ $(1.05 \le P_A/D_t \le 1.5)$	1.36

QA/QC Check
Completeness ____ Legibility ____ Accuracy ____ Specifications ____ Reasonableness ____

Certification
I certify that the Type S pitot tube/probe ID# RP-11 meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube calibration factor C_p of 0.84.

Certified by: 7-14-98

Personnel (Signature/Date)

Team Leader (Signature/Date)

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TEMPERATURE SENSOR CALIBRATION FORM

Temperature Sensor No. RMB-15 DCM-OUT **Sensor Type** K-TC **Length** 2'

Ambient Temp. °F 74 **Barometric Pressure, "Hg** 30.24"

Reference Temp. Sensor:

Date	Ref. Point No.	Temp. Source	Temp. °F		Temp. Diff. %	Within Limits Y/N	Calibrated By
			Ref. Sensor	Test Sensor			
3-18-98	1	ICE H2O	33	33	0	Y	JWB
"	2	AMB AIR	74	75	.187	Y	JWB
"	3	BOIL. H2O	208	208	0	Y	JWB
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						

$$\% \text{ Temp. Diff} = \frac{(\text{Ref. Temp} + 460) - (\text{Test Temp.} + 460)}{(\text{Ref. Temp.} + 460)} \times 100 \leq 1.5\,\%$$

TEMPERATURE SENSOR CALIBRATION FORM

Temperature Sensor No. RMB-15 DGM-1D **Sensor Type** K-TC **Length** 1'
Ambient Temp. °F 74 **Barometric Pressure, "Hg** 30.24"
Reference Temp. Sensor:

Date	Ref. Point No.	Temp. Source	Temp. °F		Temp. Diff. %	Within Limits Y/N	Calibrated By
			Ref. Sensor	Test Sensor			
3-18-98	1	ICE H2O	33	35	.406	Y	JWB
"	2	AMB. AIR	74	74	0	Y	JWB
"	3	BOIL. H2O	208	210	.299	Y	JWB
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						
	1						
	2						
	3						

$$\%\ Temp.\ Diff = \frac{(Ref.\ Temp + 460) - (Test\ Temp. + 460)}{(Ref.\ Temp. + 460)} \times 100 \leq 1.5\ \%$$

REFERENCE METER CALIBRATION
ENGLISH REFERENCE METER UNITS

DGM Serial # 6841495
Date 10/5/97

Barometric Pressure 29.82
Meter Yw 1.00000
K (deg R/inches Hg) 17.64

Filename: F:\DATAFILE\CALIBRAT\CAL_MENU.DSK\DGM_REF.
Revised: 06/08/95

Time (min)	Pressure (in. H20)	Dry Gas Meter (DGM) Meter Readings Initial	Dry Gas Meter (DGM) Meter Readings Final	Volume (cubic feet)	Temperature Initial (deg F)	Temperature Final (deg F)	Wet Test Meter (WTM) Meter Readings Initial	Wet Test Meter (WTM) Meter Readings Final	Volume (cubic feet)	Temp (deg F)	DGM Coefficient Yds	Coefficient Variation Yds-(Avg.Yds)	Flow Rate (CFM)
20.50	-8.000	742.719	768.193	25.474	78.0	79.0	671.890	697.180	25.290	77.0	1.016	0.002	1.208
5.00	-8.000	768.193	774.402	6.209	79.0	79.0	697.180	703.325	6.145	77.0	1.013	0.000	1.204
13.00	-8.000	774.402	790.575	16.173	79.0	79.0	703.325	719.309	15.984	77.0	1.012	-0.002	1.204
									Max Yds - Min Yds		=0.003626886	Must be no greater than 0.030	
									Average Yds		=1.013636253	Must be between 0.95 to 1.05	
8.50	-5.400	790.575	798.821	8.246	79.0	79.0	719.309	727.485	8.176	77.0	1.009	0.001	0.942
27.50	-5.400	798.821	825.423	26.602	79.0	80.0	727.485	753.809	26.324	77.0	1.008	0.000	0.938
26.50	-5.400	825.423	850.983	25.560	80.0	81.0	753.809	779.025	25.216	77.0	1.006	-0.001	0.932
									Max Yds - Min Yds		=0.002262496	Must be no greater than 0.030	
									Average Yds		=1.007525980	Must be between 0.95 to 1.05	
14.00	-3.800	850.983	861.899	10.916	81.0	81.0	779.025	789.820	10.795	77.0	1.006	0.001	0.755
15.50	-3.800	861.899	873.960	12.061	81.0	82.0	789.820	801.740	11.920	77.0	1.006	0.001	0.753
12.50	-3.800	953.219	962.970	9.751	86.0	86.0	879.651	889.205	9.554	78.0	1.004	-0.001	0.747
									Max Yds - Min Yds		=0.002245979	Must be no greater than 0.030	
									Average Yds		=1.005164785	Must be between 0.95 to 1.05	
23.50	-2.400	962.970	976.611	13.641	86.0	87.0	889.205	902.599	13.394	78.0	1.003	-0.001	0.557
17.50	-2.400	976.611	986.740	10.129	87.0	87.0	902.599	912.545	9.946	78.0	1.004	0.000	0.556
15.00	-2.400	986.740	995.413	8.673	87.0	88.0	912.545	921.069	8.524	78.0	1.006	0.002	0.556
									Max Yds - Min Yds		=0.002785363	Must be no greater than 0.030	
									Average Yds		=1.004591811	Must be between 0.95 to 1.05	
32.00	-1.600	995.413	1008.596	13.183	88.0	89.0	921.069	934.025	12.956	78.0	1.006	-0.002	0.396
35.00	-1.600	1008.596	1022.986	14.390	89.0	89.0	934.025	948.175	14.150	78.0	1.007	0.000	0.395
15.00	-1.600	1022.986	1029.158	6.172	89.0	90.0	948.175	954.255	6.080	78.0	1.010	0.002	0.396
									Max Yds - Min Yds		=0.004205886	Must be no greater than 0.030	
									Average Yds		=1.007822494	Must be between 0.95 to 1.05	

Overall Average Yds =1.007748265

I certify that the above Dry Gas Meter was calibrated in accordance with E.P.A. Method 5 , paragraph 7.1 ;CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature ____________ Date 10-5-97

PACIFIC ENVIRONMENTAL SERVICES, INC.

Central Park West
5001 South Miami Boulevard, P.O. Box 12077
Research Triangle Park, North Carolina 27709-2077
(919) 941-0333 FAX: (919) 941-0234

Initial Dry Gas Meter Calibration Form (English Units)

Date: 10/13/97
P_{bar}, in Hg 29.86
Calibrator: MMD
Meter Box No.: RMB-15
Reference Meter Correction Factor: 1.0077 (10/5/97)

ΔH = 0.5

		Dry Gas Meter RMB-15								
		Gas Volume			Meter Temperatures					
Trial	Trial Duration (min)	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial, Inlet (°F)	Final, Inlet (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	inal, Outle (°F)	Avg. Outlet (°F)
1	15	48.833	54.722	5.889	73	77	75	72	75	73.5
2	13	54.722	59.821	5.099	78	80	79	74	75	74.5
3	12	59.821	64.544	4.723	80	83	81.5	76	77	76.5

	Reference Meter						Meter Box Correction Factor	Reference Orifice Press $\Delta H_@$
	Gas Volume			Meter Temperature				
Trial	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial (°F)	Final (°F)	Avg. (°F)	γ	(in. H_2O)
1	34.044	39.829	5.785	70	70	70	0.997	1.86
2	39.829	44.843	5.014	71	70	70.5	1.001	1.86
3	44.843	49.463	4.620	71	71	71	0.999	1.86

ΔH = 0.75

		Dry Gas Meter RMB-15								
		Gas Volume			Meter Temperatures					
Trial	Trial Duration (min)	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial, Inlet (°F)	Final, Inlet (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	inal, Outle (°F)	Avg. Outlet (°F)
1	8	69.524	73.327	3.803	74	74	74	77	75	76
2	21	73.327	83.322	9.995	77	83	80	76	77	76.5
3	13	83.322	89.571	6.249	78	82	80	78	74	76

	Reference Meter						Meter Box Correction Factor	Reference Orifice Press $\Delta H_@$
	Gas Volume			Meter Temperature				
Trial	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial (°F)	Final (°F)	Avg. (°F)	γ	(in. H_2O)
1	54.365	58.108	3.743	72	72	72	0.996	1.91
2	58.108	67.912	9.804	72	73	72.5	0.997	1.91
3	67.912	74.036	6.124	73	73	73	0.995	1.88

ΔH = 1.0

		Dry Gas Meter RMB-15								
		Gas Volume			Meter Temperatures					
Trial	Trial Duration (min)	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial, Inlet (°F)	Final, Inlet (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	inal, Outle (°F)	Avg. Outlet (°F)
1	19	89.777	100.214	10.437	82	86	84	79	80	79.5
2	8	100.214	104.614	4.400	85	87	86	81	81	81
3	16	104.614	113.404	8.790	85	88	86.5	82	83	82.5

	Reference Meter						Meter Box Correction Factor	Reference Orifice Press $\Delta H_@$
	Gas Volume			Meter Temperature				
Trial	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial (°F)	Final (°F)	Avg. (°F)	γ	(in. H_2O)
1	74.254	84.44	10.186	73	73	73	0.997	1.92
2	84.440	88.743	4.303	73	73	73	1.002	1.91
3	88.743	97.302	8.559	73	73	73	1.000	1.92

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ΔH = 2.0

		Dry Gas Meter RMB-15								
	Trial Duration	Gas Volume			Meter Temperatures					
Trial	(min)	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial, Inlet (°F)	Final, Inlet (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	inal, Outle (°F)	Avg. Outlet (°F)
1	9	13.863	20.884	7.021	87	91	89	83	83	83
2	7	20.884	26.372	5.488	90	92	91	84	84	84
3	7	26.372	31.871	5.499	90	93	91.5	84	84	84

	Reference Meter						Meter Box Correction Factor	Reference Orifice Press $\Delta H_@$
	Gas Volume			Meter Temperature				
Trial	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial (°F)	Final (°F)	Avg. (°F)	γ	(in. H$_2$O)
1	97.749	104.591	6.842	73	73	73	1.001	1.90
2	104.591	109.929	5.338	73	73	73	1.002	1.89
3	109.929	115.281	5.352	73	74	73.5	1.002	1.88

ΔH = 4.0

		Dry Gas Meter RMB-15								
	Trial Duration	Gas Volume			Meter Temperatures					
Trial	(min)	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial, Inlet (°F)	Final, Inlet (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	inal, Outle (°F)	Avg. Outlet (°F)
1	6.5	32.371	39.484	7.113	92	94	93	85	85	85
2	15.5	39.484	56.484	17.000	93	97	95	87	87	87

	Reference Meter						Meter Box Correction Factor	Reference Orifice Press $\Delta H_@$
	Gas Volume			Meter Temperature				
Trial	Initial (ft^3)	Final (ft^3)	Net (ft^3)	Initial (°F)	Final (°F)	Avg. (°F)	γ	(in. H$_2$O)
1	15.775	22.732	6.957	73	74	73.5	1.004	1.92
2	22.732	39.287	16.555	73	73	73	1.005	1.92

Calibration Results

ΔH	γ	$\Delta H_@$	
0.50	0.999	1.86	
0.75	0.996	1.90	
1.0	1.000	1.92	
2.0	1.002	1.89	
4.0	1.004	1.92	<--- Two Trial Average

Dry Gas Meter RMB-15 on 10/13/97

Meter Box Calibration Factor	**1.000**
Meter Box Reference Orifice Pressure	**1.90**

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PACIFIC ENVIRONMENTAL SERVICES, INC.

Central Park West
5001 South Miami Boulevard, P.O. Box 12077
Research Triangle Park, North Carolina 27709-2077
(919) 941-0333 FAX: (919) 941-0234

Posttest Dry Gas Meter Calibration Form (English Units)

Pretest Calibration Factor 1.000
System Vacuum Setting, (in Hg) 18.6
Reference Meter Correction Factor 1.008
Date: 8/5/98 P_{bar}, in Hg 30.20 Calibrator: JB Meter Box No. RMB-15

ΔH = 1.41

		Dry Gas Meter								
Trial	Duration (min)	Initial (ft³)	Final (ft³)	Net (ft³)	Initial, Inlet (°F)	Final, Inle (°F)	Avg. Inlet (°F)	Initial, Outlet (°F)	Final, Outlet (°F)	Avg. Outlet (°F)
1	10	187.547	194.69	7.143	72	73	72.5	70	71	70.5
2	10.5	194.69	202.214	7.524	73	73	73	71	72	71.5
3	10	202.214	209.383	7.169	73	74	73.5	72	72	72

	Reference Meter						Meter Box Correction Factor	Reference Orifice Press
	Gas Volume			Meter Temperature				
Trial	Initial (ft³)	Final (ft³)	Net (ft³)	Initial (°F)	Final (°F)	Avg. (°F)	γ	$\Delta H_@$ (in. H2O)
1	496.874	503.931	7.057	68	68	68	0.999	1.55
2	503.931	511.377	7.446	68	68	68	1.002	1.53
3	511.377	518.444	7.067	69	69	69	0.997	1.55

[redacted]

DICK MUNNS COMPANY

Liquid and Gas - Flowmeter Calibration Service
10571 Calle Lee - 133 • Los Alamitos, California 90720
Telephone (562) 596-1559 • Telefax (714) 827-0823

CERTIFICATE OF CALIBRATION

Client Name: PES INC.
Reference Number:
Instrument Manufacturer: ROCKWELL
Instrument Description: P.D.METER
Model Number: S-190
Serial Number: 25507
Mfg.Rated Accuracy: +/-.5%
Accuracy Given: AS RECEIVED

Calibration Date: 03-27-1998
Calibration Due: 03-27-1999
Calibration Fluid: AIR @ 14.7 PSIA 70
Test Unit(s): A-4 DUE 4-5-98
NIST Traceability Per: M-0122
Ambient Conditions: 29.90"HGA 70F RH/4
CERT NUMBER: PES25507
PROCEDURE#: NAVAIR-17-20MG

	IND.SCFM	ACT.SCFM
1	0.100	0.100
2	0.200	0.200
3	0.300	0.300
4	0.400	0.400
5	0.604	0.605
6	0.802	0.803
7	1.002	1.003
8	1.522	1.523
9	2.551	2.553
10	3.002	3.004

Comments:

All instruments used in the performance of the above calibration are traceabile to • N.I.S.T. • Calibration has been performed in accordance with MIL-STD-45662A, ISO 10012-1 and ANSI/NCSL-Z-540-1.(X)IN TOLERANCE( )OUT OF TOLERANCE( )USE WITH CALIBRATION CURVE

TECHNICIAN :

Approved By: Michael Munns

MICHAEL MUNNS

MM,NAVAIR17-20MG-06

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DRY GAS METER AND ORIFICE CALIBRATION

Dry Gas Meter No.: 8804737
Barometric Pressure: 29.63
Meter Box No.: 6A
Calibration Date: 8/7/98
Reference Dry Gas Meter No.: 25507 Rockwell
Calibration Performed By: Joe Rubio

Orifice Manometer Setting	Initial Reference DGM Reading	Final Reference DGM Reading	Reference Gas Volume	Initial DGM Reading	Final DGM Reading	Test DGM Volume	Temperature				Run Time	Flow Rate	Meter Gamma	Delta H @
							Reference DGM	DGM Inlet	DGM Outlet	DGM Average				
H = "H2O	V = ft3	V = ft3	Vr = ft3	V = ft3	V = ft3	Vd = ft3	tr = F	t = F	t = F	td	minutes	Q = cfm		
0.5	596.775	608.320	11.545	150.300	161.767	11.467	73	77	75	76	30.5	0.37	1.011	1.979
1.0	635.803	647.985	12.182	189.100	201.246	12.146	75	89	83	86	23.0	0.52	1.021	1.999
2.0	648.332	658.455	10.123	201.600	211.712	10.112	76	92	84	88	13.5	0.73	1.018	1.995
4.0	658.857	669.842	10.985	212.100	223.052	10.952	76	95	86	91	10.0	1.07	1.020	1.851

Average	1.018	1.956

DRY GAS METER AND ORIFICE CALIBRATION

Dry Gas Meter No.: 8804737
Meter Box No.: 6A
Reference Dry Gas Meter No.: 25507 Rockwell

Barometric Pressure: 29.56
Calibration Date: 6/30/98
Calibration Performed By: Joe Rubio

Orifice Manometer Setting H = "H2O	Initial Reference DGM Reading V = ft3	Final Reference DGM Reading V = ft3	Reference Gas Volume Vr = ft3	Initial DGM Reading V = ft3	Final DGM Reading V = ft3	Test DGM Volume Vd = ft3	Temperature Reference DGM tr = F	 DGM Inlet t = F	 DGM Outlet t = F	 DGM Average td	Run Time minutes	Flow Rate Q = cfm	Meter Gamma	Delta H @
0.5	447.200	457.372	10.172	158.000	168.258	10.258	74	78	75	77	27.0	0.37	0.995	2.008
1.0	457.703	467.948	10.245	168.600	178.917	10.317	77	83	78	81	19.0	0.52	0.997	1.968
2.0	468.213	478.925	10.712	179.200	189.971	10.771	76	88	84	86	14.0	0.74	1.008	1.928
4.0	479.460	490.396	10.936	190.500	201.433	10.933	75	82	81	82	10.0	1.07	1.002	1.896

Average 1.001 1.950

DRY GAS METER AND ORIFICE CALIBRATION

Dry Gas Meter No.: 6846739

Meter Box No.: 3A

Reference Dry Gas Meter No.: 25507 (Rockwell)

Barometric Pressure: 29.65

Calibration Date: 8/6/98

Calibration Performed By: J.Rubio

Orifice Manometer Setting H = "H2O	Initial Reference DGM Reading V = ft3	Final Reference DGM Reading V = ft3	Reference Gas Volume Vr = ft3	Initial DGM Reading V = ft3	Final DGM Reading V = ft3	Test DGM Volume Vd = ft3	Temperature				Run Time minutes	Flow Rate Q = cfm	Meter Gamma	Delta H @
							Reference DGM tr = F	DGM Inlet t = F	DGM Outlet t = F	DGM Average td				
0.5	548.190	558.822	10.632	806.000	816.600	10.600	75	76	71	74	26.5	0.39	0.999	1.782
1.0	559.243	569.638	10.395	817.000	827.375	10.375	76	79	72	76	18.0	0.56	0.999	1.720
2.0	570.059	580.761	10.702	827.800	838.482	10.682	77	82	75	79	13.5	0.77	1.000	1.822
4.0	581.690	595.765	14.075	839.400	853.475	14.075	78	87	80	84	13.5	1.01	1.000	2.095
												Average	0.999	1.855

DRY GAS METER AND ORIFICE CALIBRATION

Dry Gas Meter No.: 6846739
Meter Box No.: 3A
Reference Dry Gas Meter No.: 25507 (Rockwell)

Barometric Pressure: 29.60
Calibration Date: 4/15/98
Calibration Performed By: J.Rubio

Orifice Manometer Setting H = "H2O	Initial Reference DGM Reading V = ft3	Final Reference DGM Reading V = ft3	Reference Gas Volume Vr = ft3	Initial DGM Reading V = ft3	Final DGM Reading V = ft3	Test DGM Volume Vd = ft3	Temperature Reference DGM tr = F	Temperature DGM Inlet t = F	Temperature DGM Outlet t = F	Temperature DGM Average td	Run Time minutes	Flow Rate Q = cfm	Meter Gamma	Delta H @
0.5	251.776	262.166	10.390	369.841	380.265	10.424	68	71	66	69	26.0	0.40	0.996	1.769
1.0	262.662	272.751	10.089	380.766	390.952	10.186	70	84	73	79	18.0	0.55	1.004	1.778
2.0	273.310	283.679	10.369	391.500	401.942	10.442	71	91	77	84	13.0	0.78	1.012	1.745
4.0	284.997	295.231	10.234	402.247	412.527	10.280	72	96	80	88	10.0	1.00	1.015	2.112
												Average	1.007	1.851

SENSIDYNE, INC.

CALIBRATION CERTIFICATE

CELL S/N: 16899-S

DATE: 05 - 18 - 1998

This is to certify that the above referenced Gilibrator Flow Cell was calibrated using film flowmeter MCS-102-A, which has been calibrated by instruments directly traceable to the National Institute of Standards and Technology. NIST Report 8361604.

Results:

REFERENCE MCS-102-A cc/min	S/N 16899-S cc/min	RELATIVE DIFF. cc/min	PERCENT DIFF.
2009	2011	2	0.1
2012	2012	0	0.0
2011	2013	2	0.1
2011	2013	2	0.1
2012	2013	1	0.05
2015	2015	0	0.0
2013	2016	3	0.15
2009	2009	0	0.0
2016	2017	1	0.05
2019	2021	2	0.1
MAX		3	0.15
MEAN 2012.7	2014		

CALIBRATED BY Rafael Torres 208

DATE: 05 - 18 - 1998

CODE 300

DRY GAS METER AND ORIFICE CALIBRATION

Dry Gas Meter No.: J169391

Meter Box No.: VB-6

Reference Dry Gas Meter No.: 25507 Rockwell

Barometric Pressure: 29.54

Calibration Date: 7/14/98

Calibration Performed By: J Rubio

Orifice Manometer Setting	Initial Reference DGM Reading	Final Reference DGM Reading	Reference Gas Volume	Initial DGM Reading	Final DGM Reading	Test DGM Volume	Temperature				Run Time	Flow Rate	Meter Gamma
							Reference DGM	DGM Inlet	DGM Outlet	DGM Average			
H = "H2O	V = ft3	V = ft3	Vr = ft3	V = ft3	V = ft3	Vd = ft3	tr = F	t = F	t = F	td	minutes	Q = cfm	
1.7	544.354	544.695	0.341	0.000	0.356	0.356	69	77	79	78	10.0	0.03	0.970
1.7	544.695	545.377	0.682	0.356	1.075	0.719	70	79	83	81	20.0	0.03	0.964

Average 0.967

EVER READY THERMOMETER CO., INC.
228 LACKAWANNA AVENUE
WEST PATTERSON, NJ 07424
(973) 812-7474

REPORT OF CALIBRATION

LIQUID-IN-GLASS-THERMOMETER

CALIBRATED BY EVER READY THERMOMETER CO.

MARKED: ERTCO CAT 611-3FC S/N-A98-289
RANGE: -20 TO +110 DEGREES C IN 1 DEGREE GRADUATIONS.

THERMOMETER READING	CORRECTION (ITS-90)**
0.0 C	0.0 C
37.0	0.0
56.0	-0.1

** ALL TEMPERATURES IN THIS REPORT ARE BASED ON THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90) PUBLISHED IN THE METROLGIA 27, NO. 1, 3/10/90.

THIS THERMOMETER WAS CALIBRATED AGAINST A STANDARD CALIBRATED AT THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) FORMERLY THE NATIONAL BUREAU OF STANDARDS (NBS) IN ACCORDANCE WITH ASTM METHOD E 77, AND NBS MONOGRAPH 174.

FOR A DISCUSSION OF ACCURACIES ATTAINABLE WITH SUCH THERMOMETERS SEE NBS MONOGRAPH 250-23.

IF NO SIGN IS GIVEN ON THE CORRECTION, THE TRUE TEMPERATURE IS HIGHER THAN THE INDICATED TEMPERATURE; IF THE SIGN GIVEN IS NEGATIVE, THE TRUE TEMPERATURE IS LOWER THAN THE INDICATED TEMPERATURE. TO USE THE CORRECTIONS PROPERLY, REFERENCE SHOULD BE MADE TO THE NOTES GIVEN BELOW.

THE THERMOMETER WAS TESTED IN A LARGE, CLOSED-TOP, ELECTRICALLY HEATED, LIQUID BATH, BEING "IMMERSED" 76MM. THE TEMPERATURE OF THE ROOM WAS ABOUT 25 DEGREES C (77 DEGREES F). IF THE THERMOMETER IS USED UNDER CONDITIONS WHICH WOULD CAUSE THE AVERAGE TEMPERATURE OF THE EMERGENT LIQUID COLUMN TO DIFFER MARKEDLY FROM THAT PREVAILING IN THE TEST, APPRECIABLE DIFFERENCES IN THE INDICATIONS OF THE THERMOMETER WOULD RESULT.

THE TABULATED CORRECTIONS APPLY PROVIDED THE ICE POINT READING IS 0.0 DEGREES C. IF THE ICE-POINT READING IS FOUND TO BE HIGHER (OR LOWER) THAN STATED, ALL OTHER READINGS WILL BE HIGHER (OR LOWER) TO THE SAME EXTENT.

TEST NUMBER: 157797
DATE: 03/19/98
STANDARD SERIAL NO. 128239
NIST IDENTIFICATION NO. 88024

S. Windesbaum for
Charles Tang-Nian
QUALITY CONTROL MANAGER

Pitot Tube Calibration Data Sheet

Calibrated by: J. RUBIO

Date: 06-17-98

Pitot Tube I.D. D-7

Effective Length: 24"

Pitot Tube Assembly Level ? ☒ Yes ☐ No

Pitot Tube Openings Damaged ? ☐ Yes ☒ No

If Yes, Explain

α_1 = <1 °(<10°) α_2 = <1 °(<10°)

β_1 = <1 °(<10°) β_2 = <1 °(<10°)

γ = <1 ° θ = <1 ° A = 0.8850 °

Z = A sin γ = 0.015 cm (in.) 0.32 cm (<1/8 in.)

W = A sin θ = 0.015 cm (in.) 0.08 cm (<1/32 in.)

P_A = 0.4425 cm (in.)

P_B = 0.4425 cm (in.)

D_t = 0.3150 cm (in.)

Comments:

Calibration Required ? ☐ Yes ☒ No

VOLUME 3

APPENDIX E

PROJECT PARTICIPANTS

PROJECT PARTICIPANTS

Affiliation	Name	Responsibility
USEPA	Michael L. Toney, EMC	Work Assignment Manager
Pacific Environmental Services, Inc.	John Chehaske	Program Manager
	Frank Phoenix	Project Manager and Field Team Leader
	Dennis P. Holzschuh	QA Coordinator
	Michael Maret	Site Leader/Console Operator
	Dennis D. Holzschuh	Site Leader/Console Operator
	Nick Nielson	Site Leader/Console Operator
	Troy Abernathy	Site Leader/Console Operator
	Joe Rubio	Site Leader/Console Operator
	Josh Letorneau	Process Monitor
	Jessica Swift	Process Sample and Met. Station Coordinator
	Jairo Barreda	Sample Recovery Coordinator
Emission Monitoring, Inc. (PES Subcontractor)	Laura Kinner, Ph.D	GC/MS Operator
	James Peeler	GC/MS Operator
Enthalpy Analytical, Inc. (PES Subcontractor)	Brian Purser	EPA Method 18 Console Operator

VOLUME 3

APPENDIX F

TEST METHODS

F.1	EPA METHOD 1
F.2	EPA METHOD 1A
F.3	EPA METHOD 2
F.4	EPA METHOD 4
F.5	EPA METHOD 18
F.6	EPA METHOD 315
F.7	SW-846 METHOD 0010
F.8	SW-846 METHOD 0030

APPENDIX F.1

EPA METHOD 1

Method 1 - Sample and Velocity Traverses for Stationary Sources

1. PRINCIPLE AND APPLICABILITY

1.1 Principle. To aid in the representative measurement of pollutant emissions and/or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into a number of equal areas. A traverse point is then located within each of these equal areas.

1.2 Applicability. This method is applicable to flowing gas streams in ducts, stacks, and flues. The method cannot be used when: (1) flow is cyclonic or swirling (see Section 2.4), (2) a stack is smaller than about 0.30 meter (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) in cross-sectional area, or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

The requirements of this method must be considered before construction of a new facility from which emissions will be measured; failure to do so may require subsequent alterations to the stack or deviation from the standard procedure. Cases involving variants are subject to approval by the Administrator, U.S. Environmental Protection Agency.

2. PROCEDURE

2.1 Selection of Measurement Site. Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may from the chosen measurement site to the nearest upstream and downstream disturbances, and divide each distance by the stack diameter or equivalent diameter, to determine the distance in terms of the number of duct diameters. Then, determine from Figure 1-1 the minimum number of traverse points that corresponds: (1) to the number of duct diameters upstream; and (2) to the number of diameters downstream. Select the higher of the two minimum numbers of traverse points, or a greater value, so that for circular stacks the number is a multiple of 4, and for rectangular stacks, the number is one of those shown in Table 1-1.

2.2.2 Velocity (Non-Particulate) Traverses. When velocity or volumetric flow rate is to be determined (but not particulate matter), the same procedure as that used for particulate traverses (Section 2.2.1) is followed, except that Figure 1-2 may be used instead of Figure 1-1.

2.3 Cross-Sectional Layout and Location of Traverse Points.

2.3.1 Circular Stacks. Locate the traverse points on two perpendicular diameters according to Table 1-2 and the example shown in Figure 1-3. Any equation (for examples, see Citations 2 and 3 in the Bibliography) that gives the same values as those in Table 1-2 may be used in lieu of Table 1-2.

For particulate traverses, one of the diameters must be in a plane containing the greatest expected concentration variation, e.g., after bends, one diameter shall be in the plane of the bend. This requirement becomes less critical as the distance from the disturbance increases; therefore, other diameter locations may be used, subject to the approval of the Administrator.

In addition, for stacks having diameters greater than 0.61 m (24 in.), no traverse points shall be within 2.5 centimeters (1.00 in.) of the stack walls; and for stack diameters equal to or less than 0.61 m (24 in.), no traverse points shall be located within 1.3 cm (0.50 in.) of the stack walls. To meet these criteria, observe the procedures given below.

2.3.1.1 Stacks With Diameters Greater Than 0.61 m (24 in.). When

2.4 Verification of Absence of Cyclonic Flow. In most stationary sources, the direction of stack gas flow is essentially parallel to the stack walls. However, cyclonic flow may exist (1) after such devices as cyclones and inertial demisters following venturi scrubbers, or (2) in stacks having tangential inlets or other duct configurations which tend to induce swirling; in these instances, the presence or absence of cyclonic flow at the sampling location must be determined. The following techniques are acceptable for this determination. Level and zero the manometer. Connect a Type S pitot tube to the manometer. Position the Type S pitot tube at each traverse point, in succession, so that the planes of the face openings of the pitot tube are perpendicular to the stack cross-sectional plane; when the Type S pitot tube is in this position, it is at "0° reference." Note the differential pressure (Δp) reading at each traverse point. If a null (zero) pitot reading is obtained at 0° reference at a given traverse point, an acceptable flow condition exists at that point. If the pitot reading is not zero at 0° reference, rotate the pitot tube (up to ±90° yaw angle), until a null reading is obtained. Carefully determine and record the value of the rotation angle (α) to the nearest degree. After the null technique
has been applied at each traverse point, calculate the average of the absolute values of α; assign α values of 0° to those points for which no rotation was required, and include these in the overall average. If the average value of α is greater than 20°, the overall flow condition in the stack is unacceptable, and alternative methodology, subject to the approval of the Administrator, must be used to perform accurate sample and velocity traverses. The alternative procedure described in Section 2.5 may be used to determine the rotation angles in lieu of the procedure described above.

2.5 Alternative Measurement Site Selection Procedure. This alternative applies to sources where measurement locations are less than 2 equivalent or duct diameters downstream or less than one-half duct diameter upstream from a flow disturbance. The alternative should be limited to ducts larger than 24 in. in diameter where blockage and wall effects are minimal. A directional flow-sensing probe is used to measure pitch and yaw angles of the gas flow at 40 or more traverse points; the resultant the location and layout of the traverse points. If the measurement location is determined to be acceptable according to the criteria in this alternative procedure, use the same traverse point number and locations for sampling and velocity measurements.

2.5.3 Measurement Procedure.

2.5.3.1 Prepare the directional probe and differential pressure gauges as recommended by the manufacturer. Capillary tubing or surge tanks may be used to dampen pressure fluctuations. It is recommended, but not required, that a pretest leak check be conducted. To perform a leak check, pressurize or use suction on the impact opening until a reading of at least 7.6 cm (3 in.) H_2O registers on the differential pressure gauge, then plug the impact opening. The pressure of a leak-free system will remain stable for at least 15 seconds.

2.5.3.2 Level and zero the manometers. Since the manometer level and zero may drift because of vibrations and temperature changes, periodically check the level and zero during the traverse.

2.5.3.3 Position the probe at the appropriate locations in the gas stream, and rotate until zero deflection is indicated for the yaw angle pressure gauge. Determine and record the yaw angle. Record the pressure gauge readings for the pitch angle, and determine the pitch angle from the calibration curve. Repeat this procedure for each traverse point. Complete a "back-purge" of the pressure lines and the impact openings prior to measurements of each traverse point.

A post-test check as described in Section 2.5.3.1 is required. If the criteria for a leak-free system are not met, repair the equipment, and repeat the flow angle measurements.

2.5.4 Calculate the resultant angle at each traverse point, the average resultant angle, and the standard deviation using the following equations. Complete the calculations retaining at least one extra significant figure beyond that of the acquired data.

2.5.6 **Calibration.** Use a flow system as described in Sections 4.1.2.1 and 4.1.2.2 of Method 2. In addition, the flow system shall have the capacity to generate two test-section velocities: one between 365 and 730 m/min (1200 and 2400 ft/min) and one between 730 and 1100 m/min (2400 and 3600 ft/min).

2.5.6.1 Cut two entry ports in the test section. The axes through the entry ports shall be perpendicular to each other and intersect in the centroid of the test section. The ports should be elongated slots parallel to the axis of the test section and of sufficient length to allow measurement of pitch angles while maintaining the pitot head position at the test-section centroid. To facilitate alignment of the directional probe during calibration, the test section should be constructed of plexiglass or some other transparent material. All calibration measurements should be made at the same point in the test section, preferably at the centroid of the test section.

2.5.6.2 To ensure that the gas flow is parallel to the central axis of the test section, follow the procedure in Section 2.4 for cyclonic flow determination to measure the gas flow angles at the centroid of the test section from two test ports located 90° apart. The gas flow angle measured in each port must be ±2° of 0°. Straightening vanes should be installed, if necessary, to meet this criterion.

2.5.6.3 **Pitch Angle Calibration.** Perform a calibration traverse according to the manufacturer's recommended protocol in 5° increments for angles from -60° to +60° at one velocity in each of the two ranges specified above. Average the pressure ratio values obtained for each angle in the two flow ranges, and plot a calibration curve with the average values of the pressure ratio (or other suitable measurement factor as recommended by the manufacturer) versus the pitch angle. Draw a smooth line through the data points. Plot also the data values for each traverse point. Determine the differences between the measured datavalues and the angle from the calibration curve at the same pressure ratio. The difference at each comparison must be within 2° for angles between 0° and 40° and within 3° for angles between 40° and

Number of Sampling Points: An Analysis of Method 1 Criteria. Environmental Protection Agency. Research Triangle Park, NC. EPA Contract No. 68-01-3172, Task 7.

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8. Brooks, E.F., and R.L. Williams. Flow and Gas Sampling Manual. U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA-600/2-76-203. July 1976. 93 p.

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10. Brown, J. and K. Yu. Test Report: Particulate Sampling Strategy in Circular Ducts. Emission Measurement Branch. Emission Standards and Engineering Division. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. July 31, 1980. 12 p.

11. Hawksley, P.G.W., S. Badzioch, and J.H. Blackett. Measurement of Solids in Flue Gases. Leatherhead, England, The British Coal Utilisation Research Association. 1961. p. 129-133.

12. Knapp, K.T. The Number of Sampling Points Needed for Representative Source Sampling. In: Proceedings of the Fourth National Conference on Energy and Environment. Theodore, L. et al. (ed). Dayton, Dayton Section of the American Institute of Chemical Engineers. October 3-7, 1976. p. 563-568.

13. Smith, W.S. and D.J. Grove. A Proposed Extension of EPA Method 1 Criteria. Pollution Engineering. XV (8):36-37. August 1983.

14. Gerhart, P.M. and M.J. Dorsey. Investigation of Field Test Procedures for Large Fans. University of Akron. Akron, OH.

Table 1-1. CROSS-SECTION LAYOUT FOR RECTANGULAR STACKS

Number of traverse points	Matrix layout
9	3x3
12	4x3
16	4x4
20	5x4
25	5x5
30	6x5
36	6x6
42	7x6
49	7x7

12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

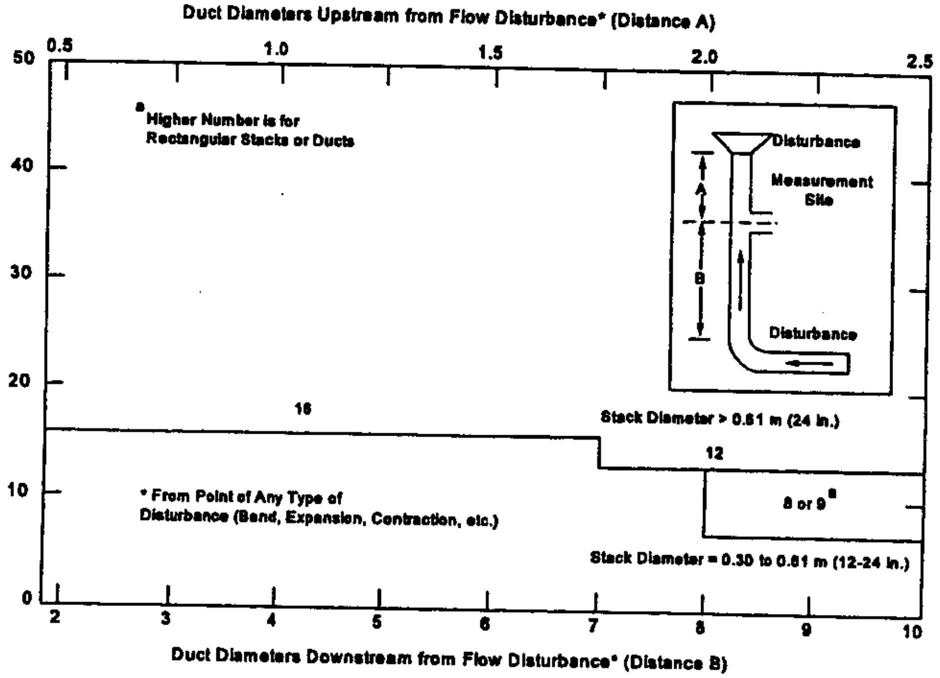

Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

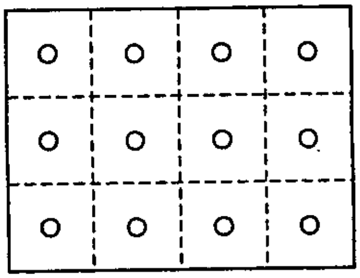

Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

APPENDIX F.2

EPA METHOD 1A

METHOD 1A - SAMPLE AND VELOCITY TRAVERSES FOR STATIONARY SOURCES WITH SMALL STACKS OR DUCTS

NOTE: This method does not include all of the specifications (*e.g.*, equipment and supplies) and procedures (*e.g.*, sampling) essential to its performance. Some material is incorporated by reference from other methods in this part. Therefore, to obtain reliable results, persons using this method should have a thorough knowledge of at least the following additional test method: Method 1.

1.0 Scope and Application.

1.1 Measured Parameters. The purpose of the method is to guide the selection of sampling ports and traverse points at which sampling for air pollutants will be performed pursuant to regulations set forth in this part.

1.2 Applicability. The applicability and principle of this method are identical to Method 1, except its applicability is limited to stacks or ducts. This method is applicable to flowing gas streams in ducts, stacks, and flues of less than about 0.30 meter (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) in cross-sectional area, but equal to or greater than about 0.10 meter (4 in.) in diameter, or 0.0081 m^2 (12.57 $in.^2$) in cross-sectional area. This method cannot be used when the flow is cyclonic or swirling.

1.3 Data Quality Objectives. Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sampling methods.

2.0 Summary of Method.

2.1 To aid in the representative measurement of pollutant emissions and/or total volumetric flow rate from a stationary source, a measurement site or a pair of measurement sites where the effluent stream is flowing in a known direction is (are) selected. The cross-section of the stack is divided into a number of equal areas. A traverse point is then located within each of these equal areas.

2.2 In these small diameter stacks or ducts, the conventional Method 5 stack assembly (consisting of a Type S pitot tube attached to a sampling probe, equipped with a nozzle and thermocouple) blocks a significant portion of the cross-section of the duct and causes inaccurate measurements. Therefore, for particulate matter (PM) sampling in small stacks or ducts, the gas velocity is measured using a standard pitot tube downstream of the actual emission sampling site. The straight run of duct between the PM sampling and velocity measurement sites allows the flow profile, temporarily disturbed by the presence of the sampling probe, to redevelop and stabilize.

3.0 Definitions. [Reserved]

4.0 Interferences. [Reserved]

5.0 Safety.

5.1 Disclaimer. This method may involve hazardous materials, operations, and equipment. This test method does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to performing this test method.

6.0 Equipment and Supplies. [Reserved]

7.0 Reagents and Standards. [Reserved]

8.0 Sample Collection, Preservation, Storage, and Transport. [Reserved]

9.0 Quality Control. [Reserved]

10.0 Calibration and Standardization. [Reserved]

11.0 Procedure.

11.1 Selection of Measurement Site.

11.1.1 Particulate Measurements - Steady or Unsteady Flow. Select a particulate measurement site located preferably at least eight equivalent stack or duct diameters downstream and 10 equivalent diameters upstream from any flow disturbances such as bends, expansions, or contractions in the stack, or from a visible flame. Next, locate the velocity measurement site eight equivalent diameters downstream of the particulate measurement site (see Figure 1A-1). If such locations are not available, select an alternative particulate measurement location at least two equivalent stack or duct diameters downstream and two and one-half diameters upstream from any flow disturbance. Then, locate the velocity measurement site two equivalent diameters downstream from the particulate measurement site. (See Section 12.2 of Method 1 for calculating equivalent diameters for a rectangular cross-section.)

11.1.2 PM Sampling (Steady Flow) or Velocity (Steady or Unsteady Flow) Measurements. For PM sampling when the volumetric flow rate in a duct is constant with respect to time, Section 11.1.1 of Method 1 may be followed, with the PM sampling and velocity measurement performed at one location. To demonstrate that the flow rate is constant (within 10 percent) when PM measurements are made, perform complete velocity traverses before and after the PM sampling run, and calculate the deviation of the flow rate derived after the PM sampling run from the one derived before the PM sampling run. The PM sampling run is acceptable if the deviation does not exceed 10 percent.

11.2 Determining the Number of Traverse Points.

11.2.1 Particulate Measurements (Steady or Unsteady Flow). Use Figure 1-1 of Method 1 to determine the number of traverse points to use at both the velocity measurement and PM sampling locations. Before referring to the figure, however, determine the distances between both the velocity measurement and PM sampling sites to the nearest upstream and downstream disturbances. Then divide each distance by the stack diameter or equivalent diameter to express the distances in terms of the number of duct diameters. Then, determine the number of traverse points from Figure 1-1 of Method 1 corresponding to each of these four distances. Choose the highest of the four numbers of traverse points (or a greater number) so that, for circular ducts the number is a multiple of four; and for rectangular ducts, the number is one of those shown in Table 1-1 of Method 1. When the optimum duct diameter location criteria can be satisfied, the minimum number of traverse points required is eight for circular ducts and nine for rectangular ducts.

11.2.2 PM Sampling (Steady Flow) or only Velocity (Non-Particulate) Measurements. Use Figure 1-2 of Method 1 to determine number of traverse points, following the same procedure used for PM sampling as described in Section 11.2.1 of Method 1. When the optimum duct diameter location criteria can be satisfied, the minimum number of traverse points required is eight for circular ducts and nine for rectangular ducts.

11.3 Cross-sectional Layout, Location of Traverse Points, and Verification of the Absence of Cyclonic Flow. Same as Method 1, Sections 11.3 and 11.4, respectively.

12.0 Data Analysis and Calculations. [Reserved]

13.0 Method Performance. [Reserved]

14.0 Pollution Prevention. [Reserved]

15.0 Waste Management. [Reserved]

16.0 References. Same as Method 1, Section 16.0,

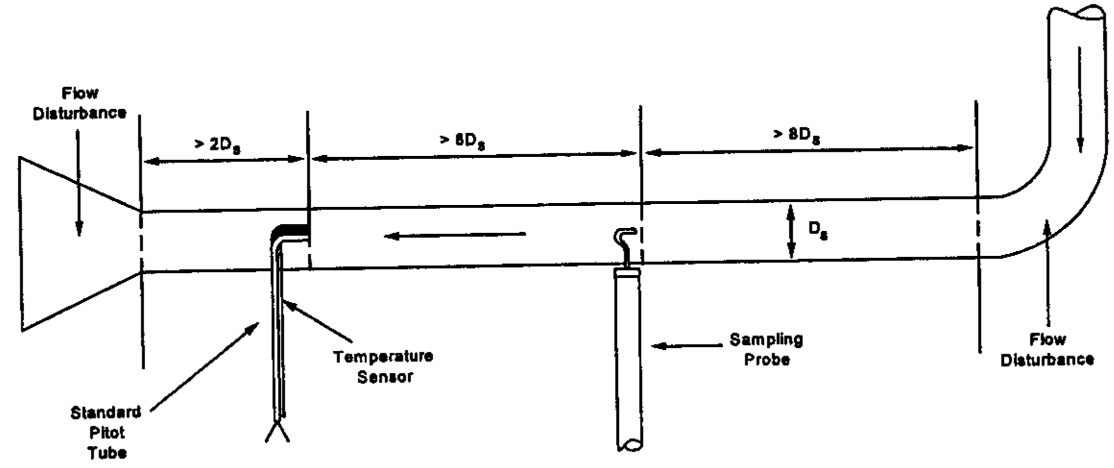

Figure 1A-1. Recommended sampling arrangement for small ducts

References 1 through 6, with the addition of the following:

1. Vollaro, Robert F. Recommended Procedure for Sample Traverses in Ducts Smaller Than 12 Inches in Diameter. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, North Carolina. January 1977.

17.0 Tables, Diagrams, Flowcharts, and Validation Data.

APPENDIX F.3

EPA METHOD 2

Method 2 - Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

1. PRINCIPLE AND APPLICABILITY

1.1 Principle. The average gas velocity in a stack is determined from the gas density and from measurement of the average velocity head with a Type S (Stausscheibe or reverse type) pitot tube.

1.2 Applicability. This method is applicable for measurement of the average velocity of a gas stream and for quantifying gas flow.

This procedure is not applicable at measurement sites that fail to meet the criteria of Method 1, Section 2.1. Also, the method cannot be used for direct measurement in cyclonic or swirling gas streams; Section 2.4 of Method 1 shows how to determine cyclonic or swirling flow conditions. When unacceptable conditions exist, alternative procedures, subject to the approval of the Administrator, U.S. Environmental Protection Agency, must be employed to make accurate flow rate determinations; examples of such alternative procedures are: (1) to install straightening vanes; (2) to calculate the total volumetric flow rate stoichiometrically, or (3) to move to another measurement site at which the flow is acceptable.

2. APPARATUS

Specifications for the apparatus are given below. Any other apparatus that has been demonstrated (subject to approval of the Administrator) to be capable of meeting the specifications will be considered acceptable.

2.1 Type S Pitot Tube. Pitot tube made of metal tubing (e.g., stainless steel) as shown in Figure 2-1. It is recommended that the external tubing diameter (dimension D_t, Figure 2-2b) be between 0.48 and 0.95 cm (3/16 and 3/8 inch). There shall be an equal distance from the base of each leg of the pitot tube to its face-opening plane (dimensions P_A and P_B, Figure 2-2b); it is recommended that this distance be between 1.05 and 1.50 times the external tubing diameter. The face openings of the pitot tube shall, preferably, be aligned as shown in Figure 2-2; however, slight misalignments of the openings are permissible (see Figure 2-3).

The Type S pitot tube shall have a known coefficient, determined as outlined in Section 4. An identification number shall be assigned to the pitot tube; this number shall be permanently marked or engraved on the body of the tube. A standard pitot tube may be used instead of a Type S, provided that it meets the specifications of Sections 2.7 and 4.2; note, however, that the static and impact pressure holes of standard pitot tubes are susceptible to plugging in particulate-laden gas streams. Therefore, whenever a standard pitot tube is used to perform a traverse, adequate proof must be furnished that the openings of the pitot tube have not plugged up during the traverse period; this can be done by taking a velocity head (Δp) reading at the final traverse point, cleaning out the impact and static holes of the standard pitot tube by "back-purging" with pressurized air, and then taking another Δp reading. If the Δp readings made before and after the air purge are the same (±5 percent), the traverse is acceptable. Otherwise, reject the run. Note that if Δp at the final traverse point is unsuitably low, another point may be selected. If "back-purging" at regular intervals is part of the procedure, then comparative Δp readings shall be taken, as above, for the last two back purges at which suitably high Δp readings are observed.

2.2 Differential Pressure Gauge. An inclined manometer or equivalent device. Most sampling trains are equipped with a 10-in. (water column) inclined-vertical manometer, having 0.01-in. H_2O divisions on the 0- to 1-in. inclined scale, and 0.1-in. H_2O divisions on the 1- to 10-in. vertical scale. This type of manometer (or other gauge of equivalent sensitivity) is satisfactory for the measurement of Δp values as low as 1.3 mm (0.05 in.) H_2O. However, a differential pressure gauge of greater sensitivity shall be used (subject to the approval of the Administrator), if any of the following is found to be true: (1) the arithmetic average of all Δp readings at the traverse points in the stack is less than 1.3 mm (0.05 in.) H_2O; (2) for traverses of 12 or more points, more than 10 percent of the individual Δp readings are below 1.3 mm (0.05 in.) H_2O; (3) for traverses of fewer than 12 points, more than one Δp reading is below 1.3 mm (0.05 in.) H_2O. Citation 18 in the Bibliography describes commercially available instrumentation for the measurement of low-range gas velocities.

As an alternative to criteria (1) through (3) above, the following calculation may be performed to determine the necessity of using a more sensitive differential pressure gauge:

$$T = \frac{\sum_{i=1}^{n} \sqrt{\Delta p_i + K}}{\sum_{i=1}^{n} \sqrt{\Delta p_i}}$$

Where:

Δp_i = Individual velocity head reading at a traverse point, mm (in.) H_2O.

n = Total number of traverse points.

K = 0.13 mm H_2O when metric units are used and 0.005 in. H_2O when English units are used.

If T is greater than 1.05, the velocity head data are unacceptable and a more sensitive differential pressure gauge must be used.

NOTE: If differential pressure gauges other than inclined manometers are used (e.g., magnehelic gauges), their calibration must be checked after each test series. To check the calibration of a differential pressure gauge, compare Δp readings of the gauge with those of a gauge-oil manometer at a minimum of three points, approximately representing the range of Δp values in the stack. If, at each point, the values of Δp as read by the differential pressure gauge and gauge-oil manometer agree to within 5 percent, the differential pressure gauge shall be considered to be in proper calibration. Otherwise, the test series shall either be voided, or procedures to adjust the measured Δp values and final results shall be used, subject to the approval of the Administrator.

2.3 Temperature Gauge. A thermocouple, liquid-filled bulb thermometer, bimetallic thermometer, mercury-in-glass thermometer, or other gauge capable of measuring temperature to within 1.5 percent of the minimum absolute stack temperature. The temperature gauge shall be attached to the pitot tube such that the sensor tip does not touch any metal; the gauge shall be in an interference-free arrangement with respect to the pitot tube face openings (see Figure 2-1 and also Figure 2-7 in Section 4). Alternative positions may be used if the pitot tube-temperature gauge system is calibrated according to the procedure of Section 4. Provided that a difference of not more than 1 percent in the average velocity measurement is introduced, the temperature gauge need not be attached to the pitot tube; this alternative is subject to the approval of the Administrator.

2.4 Pressure Probe and Gauge. A piezometer tube and mercury- or water-filled U-tube manometer capable of measuring stack pressure to within 2.5 mm (0.1 in.) Hg. The static tap of a standard type pitot tube or one leg of a Type S pitot tube with the face opening planes positioned parallel to the gas flow may also be used as the pressure probe.

2.5 **Barometer.** A mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm (0.1 in.) Hg. See **NOTE** in Method 5, Section 2.1.9.

2.6 **Gas Density Determination Equipment.** Method 3 equipment, if needed (see Section 3.6), to determine the stack gas dry molecular weight, and Reference Method 4 or Method 5 equipment for moisture content determination; other methods may be used subject to approval of the Administrator.

2.7 **Calibration Pitot Tube.** When calibration of the Type S pitot tube is necessary (see Section 4), a standard pitot tube for a reference. The standard pitot tube shall, preferably, have a known coefficient, obtained either (1) directly from the National Bureau of Standards, Route 70 S, Quince Orchard Road, Gaithersburg, Maryland, or (2) by calibration against another standard pitot tube with an NBS-traceable coefficient. Alternatively, a standard pitot tube designed according to the criteria given in Sections 2.7.1 through 2.7.5 below and illustrated in Figure 2-4 (see also Citations 7, 8, and 17 in the Bibliography) may be used. Pitot tubes designed according to these specifications will have baseline coefficients of about 0.99 ± 0.01.

2.7.1 Hemispherical (shown in Figure 2-4) ellipsoidal, or conical tip.

2.7.2 A minimum of six diameters straight run (based upon D, the external diameter of the tube) between the tip and the static pressure holes.

2.7.3 A minimum of eight diameters straight run between the static pressure holes and the centerline of the external tube, following the 90-degree bend.

2.7.4 Static pressure holes of equal size (approximately 0.1 D), equally spaced in a piezometer ring configuration.

2.7.5 Ninety-degree bend, with curved or mitered junction.

2.8 **Differential Pressure Gauge for Type S Pitot Tube Calibration.** An inclined manometer or equivalent. If the single-velocity calibration technique is employed (see Section 4.1.2.3), the calibration differential pressure gauge shall be readable to the nearest 0.13 mm (0.005 in.) H_2O. For multivelocity calibrations, the gauge shall be readable to the nearest 0.13 mm (0.005 in.) H_2O for Δp values between 1.3 and 25 mm (0.05 and 1.0 in.) H_2O, and to the nearest 1.3 mm (0.05 in.) H_2O for Δp values above 25 mm (1.0 in.) H_2O. A special, more sensitive gauge will be required to read Δp values below 1.3 mm (0.05 in.) H_2O (see Citation 18 in the Bibliography).

3. PROCEDURE

3.1 Set up the apparatus as shown in Figure 2-1. Capillary tubing or surge tanks installed between the manometer and pitot tube may be used to dampen Δp fluctuations. It is recommended, but not required, that a pretest leak-check be conducted as follows: (1) blow through the pitot impact opening until at least

7.6 cm (3 in.) H_2O velocity pressure registers on the manometer; then, close off the impact opening. The pressure shall remain stable for at least 15 seconds; (2) do the same for the static pressure side, except using suction to obtain the minimum of 7.6 cm (3 in.) H_2O. Other leak-check procedures, subject to the approval of the Administrator, may be used.

3.2 Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse. Record all necessary data as shown in the example data sheet (Figure 2-5).

3.3 Measure the velocity head and temperature at the traverse points specified by Method 1. Ensure that the proper differential pressure gauge is being used for the range of Δp values encountered (see Section 2.2). If it is necessary to change to a more sensitive gauge, do so, and remeasure the Δp and temperature readings at each traverse point. Conduct a post-test leak-check (mandatory), as described in Section 3.1 above, to validate the traverse run.

3.4 Measure the static pressure in the stack. One reading is usually adequate.

3.5 Determine the atmospheric pressure.

3.6 Determine the stack gas dry molecular weight. For combustion processes or processes that emit essentially CO_2, O_2, CO, and N_2, use Method 3. For processes emitting essentially air, an analysis need not be conducted; use a dry molecular weight of 29.0. For other processes, other methods, subject to the approval of the Administrator, must be used.

3.7 Obtain the moisture content from Reference Method 4 (or equivalent) or from Method 5.

3.8 Determine the cross-sectional area of the stack or duct at the sampling location. Whenever possible, physically measure the stack dimensions rather than using blueprints.

4. CALIBRATION

4.1 **Type S Pitot Tube.** Before its initial use, carefully examine the Type S pitot tube in top, side, and end views to verify that the face openings of the tube are aligned within the specifications illustrated in Figure 2-2 or 2-3. The pitot tube shall not be used if it fails to meet these alignment specifications.

After verifying the face opening alignment, measure and record the following dimensions of the pitot tube: (a) the external tubing diameter (dimension D_t, Figure 2-2b); and (b) the base-to-opening plane distances (dimensions P_A and P_B, Figure 2-2b). If D_t is between 0.48 and 0.95 cm (3/16 and 3/8 in.), and if P_A and P_B are equal and between 1.05 and 1.50 D_t, there are two possible options: (1) the pitot tube may be calibrated according to the procedure outlined in Sections 4.1.2 through 4.1.5 below, or (2) a baseline (isolated tube) coefficient value of 0.84 may be assigned to the pitot tube. Note, however, that if the pitot tube is part of an assembly, calibration may still be required, despite knowledge of the baseline coefficient value (see Section 4.1.1).

If D_t, P_A, and P_B are outside the specified limits, the pitot tube must be calibrated as outlined in Sections 4.1.2 through 4.1.5 below.

4.1.1 Type S Pitot Tube Assemblies. During sample and velocity traverses, the isolated Type S pitot tube is not always used; in many instances, the pitot tube is used in combination with other source-sampling components (thermocouple, sampling probe, nozzle) as part of an "assembly." The presence of other sampling components can sometimes affect the baseline value of the Type S pitot tube coefficient (Citation 9 in the Bibliography); therefore an assigned (or otherwise known) baseline coefficient value may or may not be valid for a given assembly. The baseline and assembly coefficient values will be identical only when the relative placement of the components in the assembly is such that aerodynamic interference effects are eliminated. Figures 2-6 through 2-8 illustrate interference-free component arrangements for Type S pitot tubes having external tubing diameters between 0.48 and 0.95 cm (3/16 and 3/8 in.). Type S pitot tube assemblies that fail to meet any or all of the specifications of Figures 2-6 through 2-8 shall be calibrated according to the procedure outlined in Sections 4.1.2 through 4.1.5 below, and prior to calibration, the values of the intercomponent spacings (pitot-nozzle, pitot-thermocouple, pitot-probe sheath) shall be measured and recorded.

NOTE: Do not use any Type S pitot tube assembly which is constructed such that the impact pressure opening plane of the pitot tube is below the entry plane of the nozzle (see Figure 2-6B).

4.1.2 Calibration Setup. If the Type S pitot tube is to be calibrated, one leg of the tube shall be permanently marked A, and the other, B. Calibration shall be done in a flow system having the following essential design features:

4.1.2.1 The flowing gas stream must be confined to a duct of definite cross-sectional area, either circular or rectangular. For circular cross sections, the minimum duct diameter shall be 30.5 cm (12 in.); for rectangular cross sections, the width (shorter side) shall be at least 25.4 cm (10 in.).

4.1.2.2 The cross-sectional area of the calibration duct must be constant over a distance of 10 or more duct diameters. For a rectangular cross section, use an equivalent diameter, calculated from the following equation, to determine the number of duct diameters:

$$D_e = \frac{2LW}{(L + W)}$$

Eq. 2-1

Where:

D_e = Equivalent diameter.
L = Length.
W = Width.

To ensure the presence of stable, fully developed flow patterns at the calibration site, or "test section," the site must be located at least eight diameters downstream and two diameters upstream from the nearest disturbances.

NOTE: The eight- and two-diameter criteria are not absolute; other test section locations may be used (subject to approval of the Administrator), provided that the flow at the test site is stable and demonstrably parallel to the duct axis.

4.1.2.3 The flow system shall have the capacity to generate a test-section velocity around 915 m/min (3,000 ft/min). This velocity must be constant with time to guarantee steady flow during calibration. Note that Type S pitot tube coefficients obtained by single-velocity calibration at 915 m/min (3,000 ft/min) will generally be valid to ±3 percent for the measurement of velocities above 305 m/min (1,000 ft/min) and to ±5 to 6 percent for the measurement of velocities between 180 and 305 m/min (600 and 1,000 ft/min). If a more precise correlation between C_p and velocity is desired, the flow system shall have the capacity to generate at least four distinct, time-invariant test-section velocities covering the velocity range from 180 to 1,525 m/min (600 to 5,000 ft/min), and calibration data shall be taken at regular velocity intervals over this range (see Citations 9 and 14 in the Bibliography for details).

4.1.2.4 Two entry ports, one each for the standard and Type S pitot tubes, shall be cut in the test section; the standard pitot entry port shall be located slightly downstream of the Type S port, so that the standard and Type S impact openings will lie in the same cross-sectional plane during calibration. To facilitate alignment of the pitot tubes during calibration, it is advisable that the test section be constructed of plexiglas or some other transparent material.

4.1.3 Calibration Procedure. Note that this procedure is a general one and must not be used without first referring to the special considerations presented in Section 4.1.5. Note also that this procedure applies only to single-velocity calibration. To obtain calibration data for the A and B sides of the Type S pitot tube, proceed as follows:

4.1.3.1 Make sure that the manometer is properly filled and that the oil is free from contamination and is of the proper density. Inspect and leak-check all pitot lines; repair or replace if necessary.

4.1.3.2 Level and zero the manometer. Turn on the fan, and allow the flow to stabilize. Seal the Type S entry port.

4.1.3.3 Ensure that the manometer is level and zeroed. Position the standard pitot tube at the calibration point (determined as outlined in Section 4.1.5.1), and align the tube so that its tip is pointed directly into the flow. Particular care should be taken in aligning the tube to avoid yaw and pitch angles. Make sure that the entry port surrounding the tube is properly sealed.

4.1.3.4 Read Δp_{std}, and record its value in a data table similar to the one shown in Figure 2-9. Remove the standard pitot tube from the duct, and disconnect it from the manometer. Seal the standard entry port.

4.1.3.5 Connect the Type S pitot tube to the manometer. Open the Type S entry port. Check the manometer level and zero. Insert and align the Type S pitot tube so that its A side impact opening is at the same point as was the standard pitot tube and is pointed directly into the flow. Make sure that the entry port surrounding the tube is properly sealed.

4.1.3.6 Read Δp_s, and enter its value in the data table. Remove the Type S pitot tube from the duct, and disconnect it from the manometer.

4.1.3.7 Repeat Steps 4.1.3.3 through 4.1.3.6 above until three pairs of Δp readings have been obtained.

4.1.3.8 Repeat Steps 4.1.3.3 through 4.1.3.7 above for the B side of the Type S pitot tube.

4.1.3.9 Perform calculations, as described in Section 4.1.4 below.

4.1.4 Calculations.

4.1.4.1 For each of the six pairs of Δp readings (i.e., three from side A and three from side B) obtained in Section 4.1.3 above, calculate the value of the Type S pitot tube coefficient as follows:

$$C_{p(s)} = C_{p(std)} \sqrt{\frac{\Delta p_{std}}{\Delta p_s}}$$

Eq. 2-2

Where:

$C_{p(s)}$ = Type S pitot tube coefficient.

$C_{p(std)}$ = Standard pitot tube coefficient; use 0.99 if the coefficient is unknown and the tube is designed according to the criteria of Sections 2.7.1 to 2.7.5 of this method.

Δp_{std} = Velocity head measured by the standard pitot tube, cm (in.) H_2O.

Δp_s = Velocity head measured by the Type S pitot tube, cm (in.) H_2O.

4.1.4.2 Calculate $\overline{C}_p$ (side A), the mean A-side coefficient, and $\overline{C}_p$ (side B), the mean B-side coefficient; calculate the difference between these two average values.

4.1.4.3 Calculate the deviation of each of the three A-side values of $C_{p(s)}$ from $\bar{C}_p$ (side A), and the deviation of each B-side values of $C_{p(s)}$ from $\bar{C}_p$ (side B). Use the following equation:

$$\text{Deviation} = C_{p_{(s)}} - \overline{C}_p(\text{A or B})$$

Eq. 2-3

4.1.4.4 Calculate σ, the average deviation from the mean, for both the A and B sides of the pitot tube. Use the following equation:

$$\sigma(\text{side A or B}) = \frac{\sum_{1}^{3} \left| C_{p(s)} - \overline{C}_p(\text{A or B}) \right|}{3}$$

Eq. 2-4

4.1.4.5 Use the Type S pitot tube only if the values of σ (side A) and σ (side B) are less than or equal to 0.01 and if the absolute value of the difference between $\bar{C}_p$ (A) and $\bar{C}_p$ (B) is 0.01 or less.

4.1.5 Special Considerations.

4.1.5.1 Selection of Calibration Point.

4.1.5.1.1 When an isolated Type S pitot tube is calibrated, select a calibration point at or near the center of the duct, and follow the procedures outlined in Sections 4.1.3 and 4.1.4 above. The Type S pitot coefficients so obtained, i.e., $\bar{C}_p$ (side A) and $\bar{C}_p$ (side B), will be valid, so long as either: (1) the isolated pitot tube is used; or (2) the pitot tube is used with other components (nozzle, thermocouple, sample probe) in an arrangement that is free from aerodynamic interference effects (see Figures 2-6 through 2-8).

4.1.5.1.2 For Type S pitot tube-thermocouple combinations (without sample probe), select a calibration point at or near the center of the duct, and follow the procedures outlined in Sections 4.1.3 and 4.1.4 above. The coefficients so obtained will be valid so long as the pitot tube-thermocouple combination is used by itself or with other components in an interference-free arrangement (Figures 2-6 and 2-8).

4.1.5.1.3 For assemblies with sample probes, the calibration point should be located at or near the center of the duct; however, insertion of a probe sheath into a small duct may cause significant cross-sectional area blockage and yield incorrect coefficient values (Citation 9 in the Bibliography). Therefore, to minimize the blockage effect, the calibration point may be a few inches off-center if necessary. The actual blockage effect will be negligible when the theoretical blockage, as determined by a projected-area model of the probe sheath, is 2 percent or less of the duct cross-sectional area for assemblies without external sheaths (Figure 2-10a), and 3 percent or less for assemblies with external sheaths (Figure 2-10b).

4.1.5.2 For those probe assemblies in which pitot tube-nozzle interference is a factor (i.e., those in which the pitot-nozzle separation distance fails to meet the specification illustrated in Figure 2-6A), the value of $C_{p(s)}$ depends upon the amount of free-space between the tube and nozzle, and therefore is a function of nozzle size. In these instances, separate calibrations shall be performed with each of the commonly used nozzle sizes in place. Note that the single-velocity calibration technique is acceptable for this purpose, even though the larger nozzle sizes (>0.635 cm or 1/4 in.) are not ordinarily used for isokinetic sampling at velocities around 915 m/min (3,000 ft/min), which is the calibration velocity; note also that it is not necessary to draw an isokinetic sample during calibration (see Citation 19 in the Bibliography).

4.1.5.3 For a probe assembly constructed such that its pitot tube is always used in the same orientation, only one side of the pitot tube need be calibrated (the side which will face the flow). The pitot tube must still meet the alignment specifications of Figure 2-2 or 2-3, however, and must have an average deviation (σ) value of 0.01 or less (see Section 4.1.4.4.)

4.1.6 Field Use and Recalibration.

4.1.6.1 Field Use.

4.1.6.1.1 When a Type S pitot tube (isolated or in an assembly) is used in the field, the appropriate coefficient value (whether assigned or obtained by calibration) shall be used to perform velocity calculations. For calibrated Type S pitot tubes, the A side coefficient shall be used when the A side of the tube faces the flow, and the B side coefficient shall be used when the B side faces the flow; alternatively, the arithmetic average of the A and B side coefficient values may be used, irrespective of which side faces the flow.

4.1.6.1.2 When a probe assembly is used to sample a small duct, 30.5 to 91.4 cm (12 to 36 in.) in diameter, the probe sheath sometimes blocks a significant part of the duct cross-section, causing a reduction in the effective value of $C_{p(s)}$. Consult Citation 9 in the Bibliography for details. Conventional pitot-sampling probe assemblies are not recommended for use in ducts having inside diameters smaller than 30.5 cm (12 in.) (see Citation 16 in the Bibliography).

4.1.6.2 Recalibration.

4.1.6.2.1 Isolated Pitot Tubes. After each field use, the pitot tube shall be carefully reexamined in top, side, and end views. If the pitot face openings are still aligned within the specifications illustrated in Figure 2-2 or 2-3, it can be assumed that the baseline coefficient of the pitot tube has not changed. If, however, the tube has been damaged to the extent that it no longer meets the specifications of the Figure 2-2 or 2-3, the damage shall either be repaired to restore proper alignment of the face openings, or the tube shall be discarded.

4.1.6.2.2 Pitot Tube Assemblies. After each field use, check the face opening alignment of the pitot tube, as in Section 4.1.6.2.1; also, remeasure the intercomponent spacings of the assembly. If the intercomponent spacings have not changed and the face opening alignment is acceptable, it can be assumed that the coefficient of the assembly has not changed. If the face opening alignment is no longer within the specifications of Figure 2-2 or 2-3, either repair the damage or replace the pitot tube (calibrating the new assembly, if necessary). If the intercomponent spacings have changed, restore the original spacings, or recalibrate the assembly.

4.2 Standard Pitot Tube (if applicable). If a standard pitot tube is used for the velocity traverse, the tube shall be constructed according to the criteria of Section 2.7 and shall be assigned a baseline coefficient value of 0.99. If the standard pitot tube is used as part of an assembly, the tube shall be in an interference-free arrangement (subject to the approval of the Administrator).

4.3 Temperature Gauges. After each field use, calibrate dial thermometers, liquid-filled bulb thermometers, thermocouple-potentiometer systems, and other gauges at a temperature within 10 percent of the average absolute stack temperature. For temperatures up to 405°C (761°F), use an ASTM mercury-in-glass reference thermometer, or equivalent, as a reference; alternatively, either a reference thermocouple and potentiometer (calibrated by NBS) or thermometric fixed points, e.g., ice bath and boiling water (corrected for barometric pressure) may be used. For temperatures above 405°C (761°F), use an NBS-calibrated reference thermocouple-potentiometer system or an alternative reference, subject to the approval of the Administrator.

If, during calibration, the absolute temperature measured with the gauge being calibrated and the reference gauge agree within 1.5 percent, the temperature data taken in the field shall be considered valid. Otherwise, the pollutant emission test shall either be considered invalid or adjustments (if appropriate) of the test results shall be made, subject to the approval of the Administrator.

4.4 Barometer. Calibrate the barometer used against a mercury barometer.

5. CALCULATIONS

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

5.1 Nomenclature.

A = Cross-sectional area of stack, m^2 (ft^2).

B_{ws} = Water vapor in the gas stream (from Method 5 or Reference Method 4), proportion by volume.

C_p = Pitot tube coefficient, dimensionless.

K_p = Pitot tube constant,

$$34.97 \frac{m}{sec}\left[\frac{(g/g\text{-}mole)(mmHg)}{(^{\circ}K)\ (mmH_2O)}\right]^{1/2}$$

for the metric system.

$$85.49 \frac{ft}{sec}\left[\frac{lb/lb\text{-}mole)\ (in.Hg)}{(^{\circ}R)\ (in.H_2O)}\right]^{1/2}$$

for the English system.

M_d = Molecular weight of stack gas, dry basis (see Section 3.6), g/g-mole (lb/lb-mole).

M_s = Molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole).

$$= M_d(1-B_{ws}) + 18.0B_{ws}$$

Eq. 2-5

P_{bar} = Barometric pressure at measurement site, mm Hg (in. Hg).

P_g = Stack static pressure, mm Hg (in. Hg).

P_s = Absolute stack pressure, mm Hg (in. Hg),

$$= P_{bar} + P_g$$

Eq. 2-6

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

Q_{sd} = Dry volumetric stack gas flow rate corrected to standard conditions, dsm^3/hr (dscf/hr).

t_s = Stack temperature, °C (°F).

T_s = Absolute stack temperature, °K (°R).

$$= 273 + t_s$$

for metric. Eq. 2-7

$$= 460 + t_s$$

for English. Eq. 2-8

T_{std} = Standard absolute temperature, 293°K (528°R).

v_s = Average stack gas velocity, m/sec (ft/sec).

Δp = Velocity head of stack gas, mm H_2O (in. H_2O).

3,600= Conversion factor, sec/hr.

18.0 = Molecular weight of water, g/g-mole (lb/lb-mole).

5.2 Average Stack Gas Velocity.

$$v_s = K_p C_p \left(\sqrt{\Delta p}\right)_{avg} \sqrt{\frac{T_{s(avg)}}{P_s M_s}}$$

Eq. 2-9

5.3 Average Stack Gas Dry Volumetric Flow Rate.

$$Q_{sd} = 3,600(1 - B_{ws}) v_s A \frac{T_{std}}{T_{s(avg)}} \frac{P_s}{P_{std}}$$

Eq. 2-10

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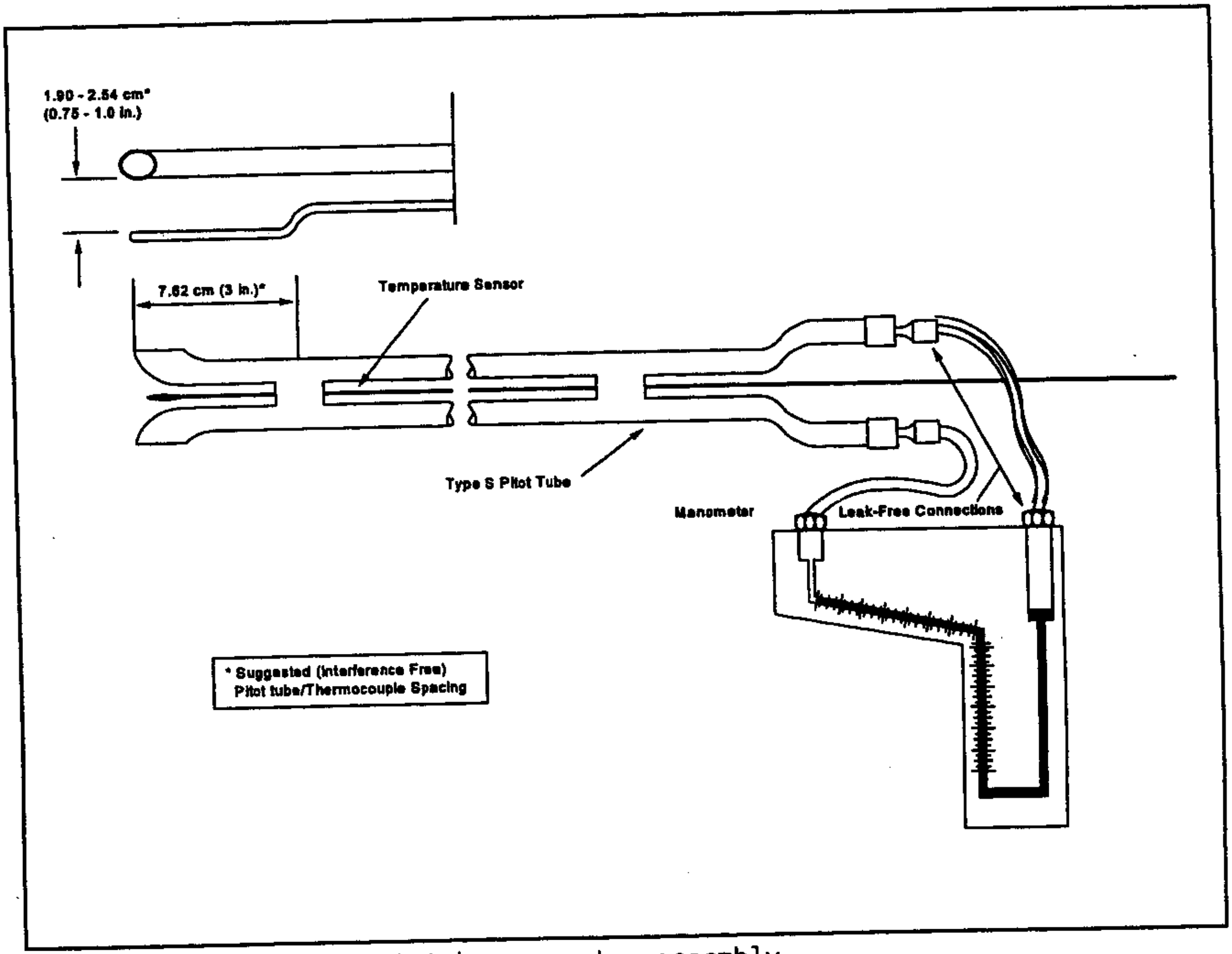
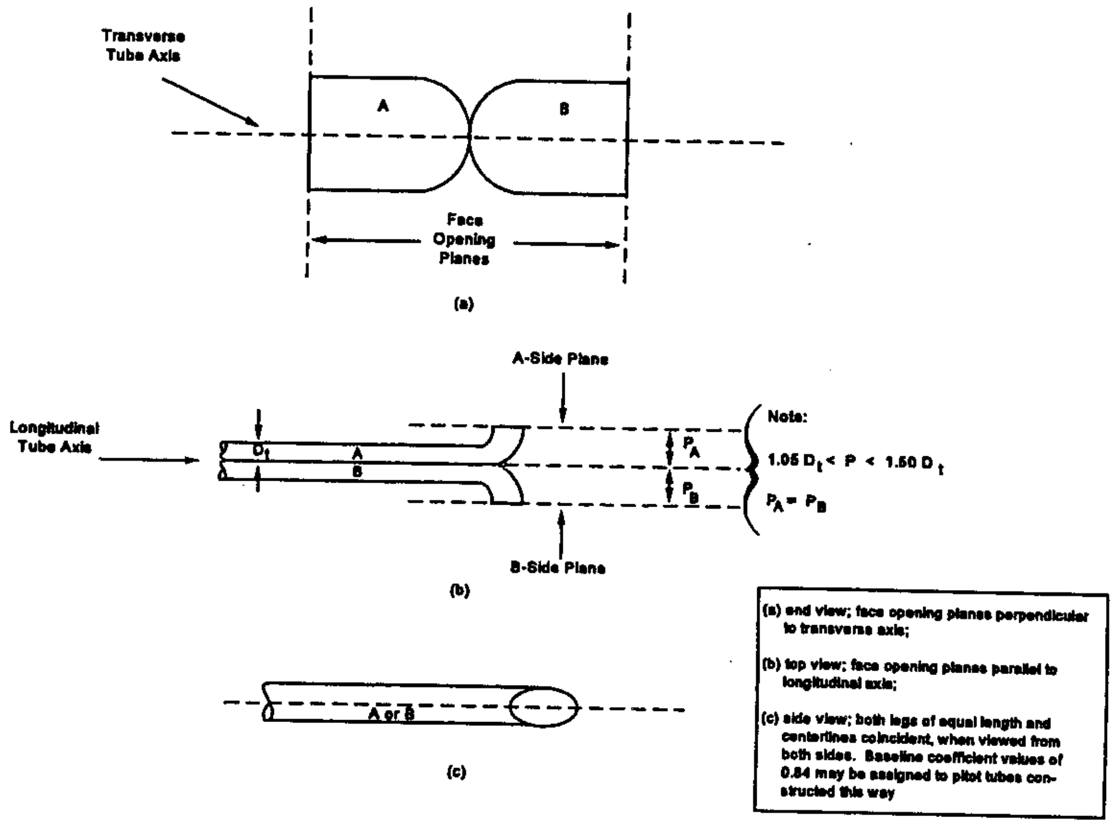


Figure 2-1. Type S pitot tube manometer assembly.



(a) end view; face opening planes perpendicular to transverse axis;

(b) top view; face opening planes parallel to longitudinal axis;

(c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Baseline coefficient values of 0.84 may be assigned to pitot tubes constructed this way

Figure 2-2. Properly constructed Type S pitot tube.

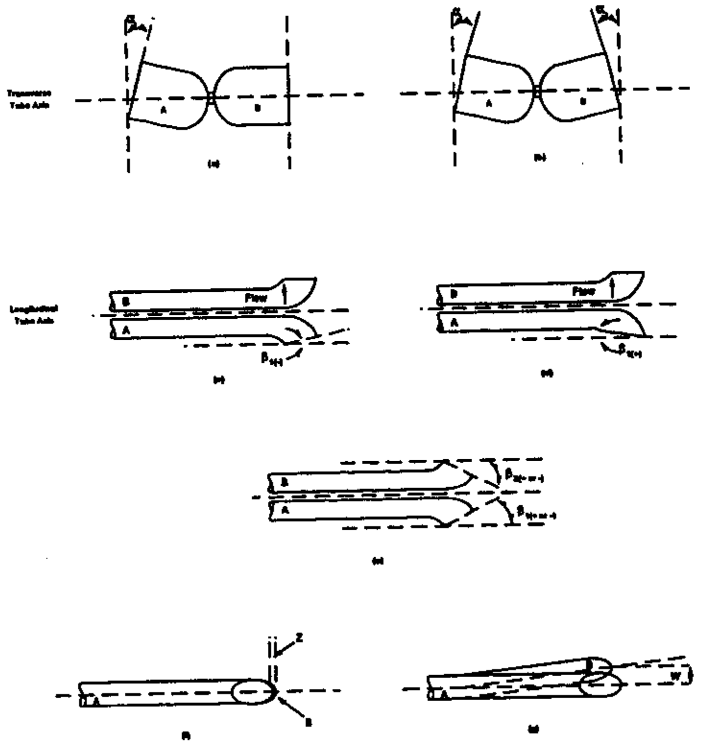


Figure 2-3. Types of face-opening misalignment that can result from field use or improper construction of Type S pitot tubes. These will not affect the baseline value of Cp(s) so long as α^1 and $\alpha^2 \leq 10°$, β^1 and $\beta^2 \leq 5°$, $z \leq 0.32$ cm (1/8 in.) and $w \leq 0.08$ cm (1/32 in.) (citation 11 in Bibliography).

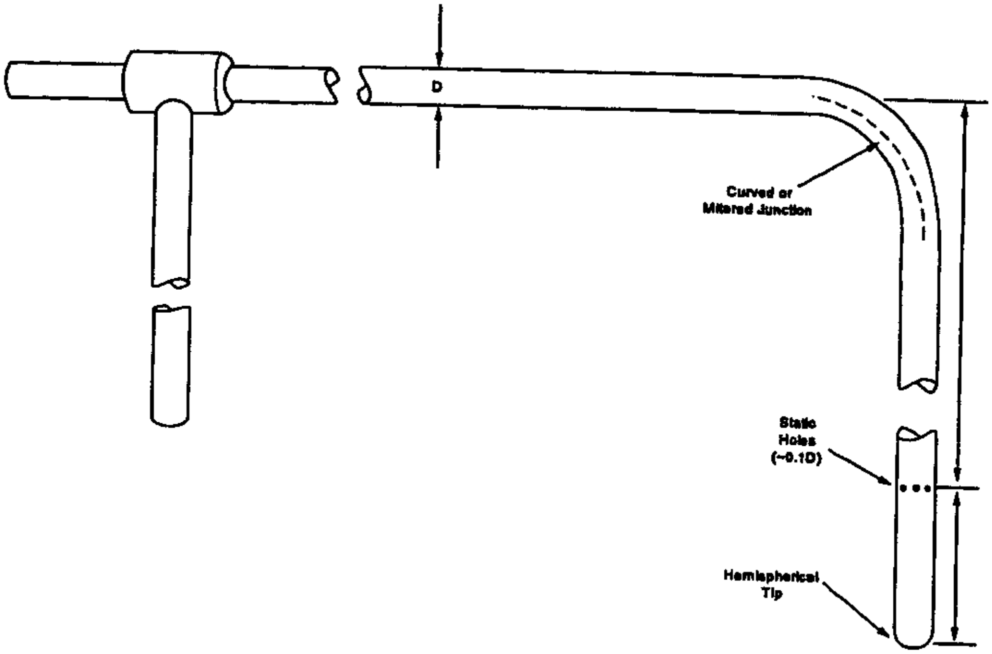


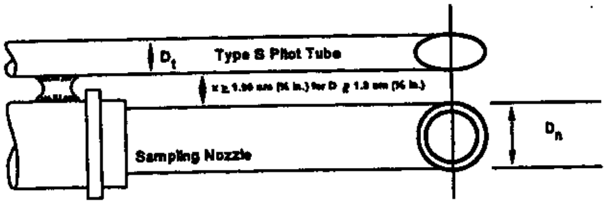
Figure 2-4. Standard pitot tube design specifications.

PLANT ______________________________
DATE __________ RUN NO. ______________STACK DIA. OR
DIMENSIONS, m (in.) _____ BAROMETRIC PRESS., mm Hg
(in. Hg) _____CROSS SECTIONAL AREA, m^2 (ft^2)________
OPERATORS ______________________________
PITOT TUBE I.D. NO. ________________
AVG. COEFFICIENT, Cp = ______________
LAST DATE CALIBRATED ________________

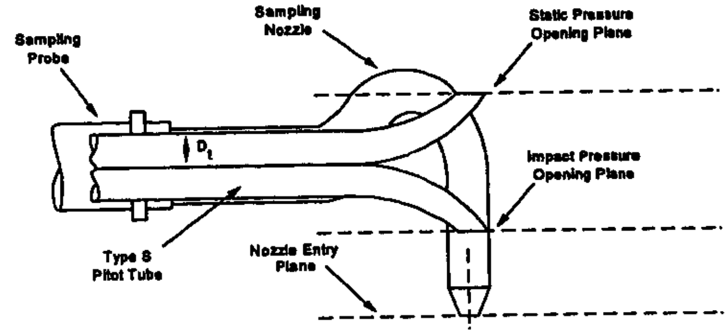
SCHEMATIC OF STACK
CROSS SECTION

Traverse Pt. No.	Vel. Hd., Δp mm (in.) H_2O	Stack Temperature		P_g mm Hg (in.Hg)	$(\Delta p)^{1/2}$
		T_s, °C (°F)	T_s, °K (°R)		
		Average			

Figure 2-5. Velocity traverse data.



A. Bottom View; showing minimum pitot tube-nozzle separation.



B. Side View; to prevent pitot tube from interfering with gas flow streamlines approaching the nozzle, the impact pressure opening plane of the pitot tube shall be even with or above the nozzle entry plane.

Figure 2-6. Proper pitot tube-sampling nozzle configuration to prevent aerodynamic interference; button-hook type nozzle; centers of nozzle and pitot opening aligned; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

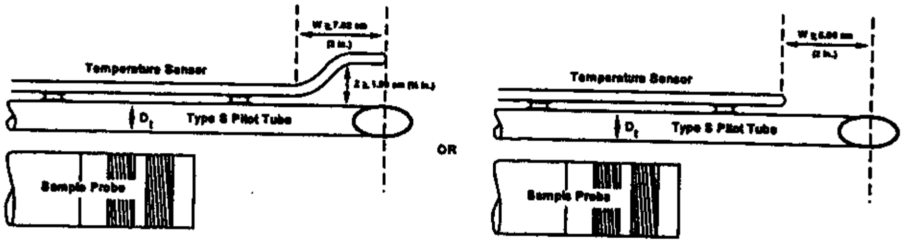


Figure 2-7. Proper thermocouple placement to prevent interference; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

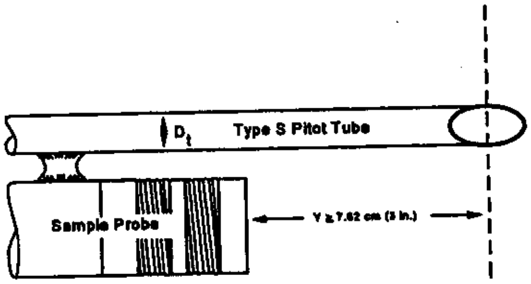


Figure 2-8. Minimum pitot-sample probe separation needed to prevent interference; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

PITOT TUBE IDENTIFICATION NUMBER: ________ DATE: ____________CALIBRATED BY: ____________

	"A" SIDE CALIBRATION			
RUN NO.	ΔP_{std} cm H_2O (in H_2O)	$\Delta P_{(s)}$ cm H_2O (in H_2O)	$C_{p(s)}$	Deviation $C_{p(s)} - C_p(A)$
1				
2				
3				
		$C_{p,avg}$ (SIDE A)		

	"B" SIDE CALIBRATION			
RUN NO.	ΔP_{std} cm H_2O (in H_2O)	$\Delta P_{(s)}$ cm H_2O (in H_2O)	$C_{p(s)}$	Deviation $C_{p(s)} - C_p(B)$
1				
2				
3				
		$C_{p,avg}$ (SIDE B)		

$$\text{Average Deviation} = \sigma_{(A\,or\,B)} = \frac{\sum_{i=1}^{3} \left| C_{p(s)} - \bar{C}_{p(A\,or\,B)} \right|}{3} \leftarrow \text{Must Be} \le 0.01$$

$$\left| \bar{C}_p(\text{Side A}) - \bar{C}_p(\text{Side B}) \right| \leftarrow \text{Must Be} \le 0.01$$

Figure 2-9. Pitot tube calibration data.

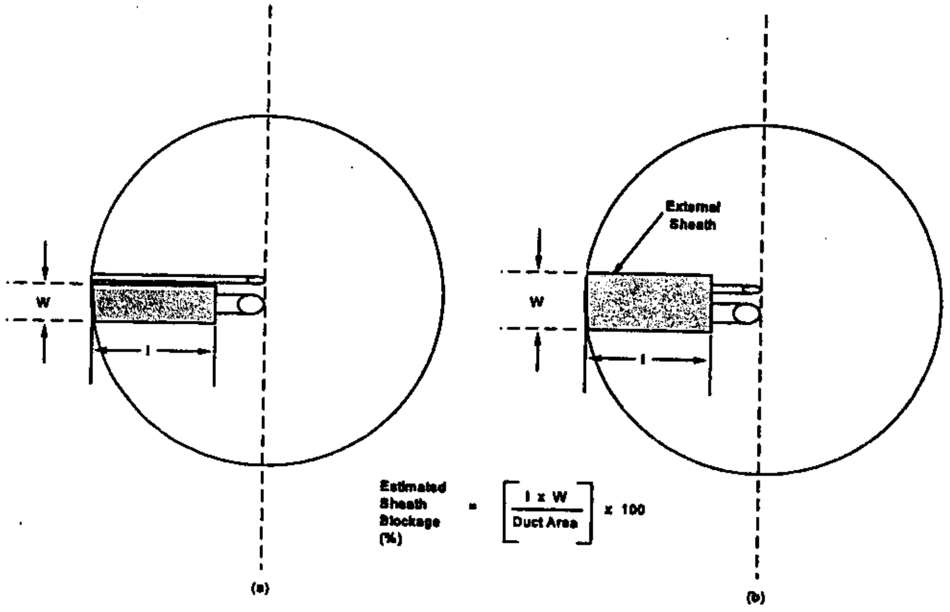


Figure 2-10. Projected-area models for typical pitot tube assemblies.

APPENDIX F.4

EPA METHOD 4

Method 4 - Determination of Moisture Content in Stack Gases

1. PRINCIPLE AND APPLICABILITY

1.1 **Principle.** A gas sample is extracted at a constant rate from the source; moisture is removed from the sample stream and determined either volumetrically or gravimetrically.

1.2 **Applicability.** This method is applicable for determining the moisture content of stack gas.

1.2.1 Two procedures are given. The first is a reference method, for accurate determinations of moisture content (such as are needed to calculate emission data). The second is an approximation method, which provides estimates of percent moisture to aid in setting isokinetic sampling rates prior to a pollutant emission measurement run. The approximation method described herein is only a suggested approach; alternative means for approximating the moisture content, e.g., drying tubes, wet bulb-dry bulb techniques, condensation techniques, stoichiometric calculations, previous experience, etc., are also acceptable.

1.2.2 The reference method is often conducted simultaneously with a pollutant emission measurement run; when it is, calculation of percent isokinetic, pollutant emission rate, etc., for the run shall be based upon the results of the reference method or its equivalent; these calculations shall not be based upon the results of the approximation method, unless the approximation method is shown, to the satisfaction of the Administrator, U.S. Environmental Protection Agency, to be capable of yielding results within 1 percent H_2O of the reference method.

1.2.3 Note: The reference method may yield questionable results when applied to saturated gas streams or to streams that contain water droplets. Therefore, when these conditions exist or are suspected, a second determination of the moisture content shall be made simultaneously with the reference method, as follows: Assume that the gas stream is saturated. Attach a temperature sensor [capable of measuring to within 1°C (2°F)] to the reference method probe. Measure the stack gas temperature at each traverse point (see Section 2.2.1) during the reference method traverse; calculate the average stack gas temperature. Next, determine the moisture percentage, either by: (1) using a psychrometric chart and making appropriate corrections if stack pressure is different from that of the chart, or (2) using saturation vapor pressure tables. In cases where the psychrometric chart or the saturation vapor pressure tables are not applicable (based on evaluation of the process), alternative methods, subject to the approval of the Administrator, shall be used.

2. REFERENCE METHOD

The procedure described in Method 5 for determining moisture content is acceptable as a reference method.

2.1 Apparatus. A schematic of the sampling train used in this reference method is shown in Figure 4-1. All components shall be maintained and calibrated according to the procedures in Method 5.

2.1.1 Probe. Stainless steel or glass tubing, sufficiently heated to prevent water condensation, and equipped with a filter, either in-stack (e.g., a plug of glass wool inserted into the end of the probe) or heated out-stack (e.g., as described in Method 5), to remove particulate matter. When stack conditions permit, other metals or plastic tubing may be used for the probe, subject to the approval of the Administrator.

2.1.2 Condenser. See Method 5, Section 2.1.7, for a description of an acceptable type of condenser and for alternative measurement systems.

2.1.3 Cooling System. An ice bath container and crushed ice (or equivalent), to aid in condensing moisture.

2.1.4 Metering System. Same as in Method 5, Section 2.1.8, except do not use sampling systems designed for flow rates higher than 0.0283 m^3/min (1.0 cfm). Other metering systems, capable of maintaining a constant sampling rate to within 10 percent and determining sample gas volume to within 2 percent, may be used, subject to the approval of the Administrator.

2.1.5 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm (0.1 in.) Hg. See **NOTE** in Method 5, Section 2.1.9.

2.1.6 Graduated Cylinder and/or Balance. To measure condensed water and moisture caught in the silica gel to within 1 ml or 0.5 g. Graduated cylinders shall have subdivisions no greater than 2 ml. Most laboratory balances are capable of weighing to the nearest 0.5 g or less. These balances are suitable for use here.

2.2 Procedure. The following procedure is written for a condenser system (such as the impinger system described in Section 2.1.7 of Method 5) incorporating volumetric analysis to measure the condensed moisture, and silica gel and gravimetric analysis to measure the moisture leaving the condenser.

2.2.1 Unless otherwise specified by the Administrator, a minimum of eight traverse points shall be used for circular stacks having diameters less than 0.61 m (24 in.), a minimum of nine points shall be used for rectangular stacks having equivalent diameters less than 0.61 m (24 in.), and a minimum of twelve traverse points shall be used in all other cases. The traverse points shall be located according to Method 1. The use of fewer points is subject to the approval of the

Administrator. Select a suitable probe and probe length such that all traverse points can be sampled. Consider sampling from opposite sides
of the stack (four total sampling ports) for large stacks, to permit use of shorter probe lengths. Mark the probe with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point. Place known volumes of water in the first two impingers. Weigh and record the weight of the silica gel to the nearest 0.5 g, and transfer the silica gel to the fourth impinger; alternatively, the silica gel may first be transferred to the impinger, and the weight of the silica gel plus impinger recorded.

2.2.2 Select a total sampling time such that a minimum total gas volume of 0.60 scm (21 scf) will be collected, at a rate no greater than 0.021 m^3/min (0.75 cfm). When both moisture content and pollutant emission rate are to be determined, the moisture determination shall be simultaneous with, and for the same total length of time as, the pollutant emission rate run, unless otherwise specified in an applicable subpart of the standards.

2.2.3 Set up the sampling train as shown in Figure 4-1. Turn on the probe heater and (if applicable) the filter heating system to temperatures of about 120°C (248°F), to prevent water condensation ahead of the condenser; allow time for the temperatures to stabilize. Place crushed ice in the ice bath container. It is recommended, but not required, that a leak check be done, as follows: Disconnect the probe from the first impinger or (if applicable) from the filter holder. Plug the inlet to the first impinger (or filter holder), and pull a 380 mm (15 in.) Hg vacuum; a lower vacuum may be used, provided that it is not exceeded during the test. A leakage rate in excess of 4 percent of the average sampling rate or 0.00057 m^3/min (0.02 cfm), whichever is less, is unacceptable. Following the leak check, reconnect the probe to the sampling train.

2.2.4 During the sampling run, maintain a sampling rate within 10 percent of constant rate, or as specified by the Administrator. For each run, record the data required on the example data sheet shown in Figure 4-2. Be sure to record the dry gas meter reading at the beginning and end of each sampling time increment and whenever sampling is halted. Take other appropriate readings at each sample point, at least once during each time increment.

2.2.5 To begin sampling, position the probe tip at the first traverse point. Immediately start the pump, and adjust the flow to the desired rate. Traverse the cross section, sampling at each traverse point for an equal length of time. Add more ice and, if necessary, salt to maintain a temperature of less than 20°C (68°F) at the silica gel outlet.

2.2.6 After collecting the sample, disconnect the probe from the filter holder (or from the first impinger), and conduct a leak check (mandatory) as described in Section 2.2.3. Record the leak rate. If the leakage rate exceeds the allowable rate, the tester shall either reject the test results or shall correct the sample volume as in Section 6.3 of Method 5. Next, measure the volume of the moisture condensed to the nearest ml. Determine the increase in weight of the silica gel (or silica gel plus impinger) to the nearest 0.5 g. Record this information (see example data sheet, Figure 4-3), and calculate the moisture percentage, as described in 2.3 below.

2.2.7 A quality control check of the volume metering system at the field site is suggested before collecting the sample following the procedure in Method 5, Section 4.4.

2.3 Calculations. Carry out the following calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

2.3.1 Nomenclature.

B_{ws} = Proportion of water vapor, by volume, in the gas stream.

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

P_m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 (mm Hg)(m^3)/(g-mole)(°K) for metric units and 21.85 (in. Hg)(ft^3)/(lb-mole)(°R) for English units.

T_m = Absolute temperature at meter, °K (°R).

T_{std} = Standard absolute temperature, 293°K (528°R).

V_m = Dry gas volume measured by dry gas meter, dcm (dcf).

ΔV_m = Incremental dry gas volume measured by dry gas meter at each traverse point, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{wc(std)}$ = Volume of water vapor condensed, corrected to standard conditions, scm (scf).

$V_{wsg(std)}$ = Volume of water vapor collected in silica gel, corrected to standard conditions, scm (scf).

V_f = Final volume of condenser water, ml.

V_i = Initial volume, if any, of condenser water, ml.

W_f = Final weight of silica gel or silica gel plus impinger, g.

W_i = Initial weight of silica gel or silica gel plus impinger, g.

Y = Dry gas meter calibration factor.

ρ_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

2.3.2 Volume of Water Vapor Condensed.

$$V_{wc(std)} = (V_f - V_i)\rho_w \frac{RT_{std}}{P_{std}M_w} = K_1(V_f - V_i) \qquad \text{Eq. 4-1}$$

Where:

K_1 = 0.001333 m^3/ml for metric units,

= 0.04707 ft^3/ml for English units.

2.3.3 Volume of Water Collected in Silica Gel.

$$V_{wsg(std)} = \frac{(W_f - W_i)\ RT_{std}}{P_{std}M_w} = K_2(W_f - W_i) \qquad \text{Eq. 4-2}$$

Where:

K_2 = 0.001335 m^3/g for metric units,

= 0.04715 ft^3/g for English units.

2.3.4 Sample Gas Volume.

$$V_{m(std)} = V_m Y \frac{(P_m)(T_{std})}{(P_{std})(T_m)} = K_3 Y \frac{V_m P_m}{T_m} \qquad \text{Eq. 4-3}$$

Where:

K_3 = 0.3858 °K/mm Hg for metric units,

= 17.64 °R/in. Hg for English units.

NOTE: If the post-test leak rate (Section 2.2.6) exceeds the allowable rate, correct the value of V_m in Equation 4-3, as described in Section 6.3 of Method 5.

2.3.5 Moisture Content.

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}} \qquad \text{Eq. 4-4}$$

NOTE: In saturated or moisture droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one using a value based upon the saturated conditions (see Section 1.2), and another based upon the results of the impinger analysis. The lower of these two values of B_{ws} shall be considered correct.

2.3.6 Verification of Constant Sampling Rate. For each time increment, determine the ΔV_m. Calculate the average. If the value for any time increment differs from the average by more than 10 percent, reject the results, and repeat the run.

3. APPROXIMATION METHOD

The approximation method described below is presented only as a suggested method (see Section 1.2).

3.1 Apparatus. See Figure 4-4.

3.1.1 Probe. Stainless steel or glass tubing, sufficiently heated to prevent water condensation and equipped with a filter (either in-stack or heated out-stack) to remove particulate matter. A plug of glass wool, inserted into the end of the probe, is a satisfactory filter.

3.1.2 **Impingers.** Two midget impingers, each with 30-ml capacity, or equivalent.

3.1.3 **Ice Bath.** Container and ice, to aid in condensing moisture in impingers.

3.1.4 **Drying Tube.** Tube packed with new or regenerated 6- to 16-mesh indicating-type silica gel (or equivalent desiccant), to dry the sample gas and to protect the meter and pump.

3.1.5 **Valve.** Needle valve, to regulate the sample gas flow rate.

3.1.6 **Pump.** Leak-free, diaphragm type, or equivalent, to pull the gas sample through the train.

3.1.7 **Volume Meter.** Dry gas meter, sufficiently accurate to measure the sample volume to within 2 percent, and calibrated over the range of flow rates and conditions actually encountered during sampling.

3.1.8 **Rate Meter.** Rotameter, to measure the flow range from 0 to 3 liters/min (0 to 0.11 cfm).

3.1.9 **Graduated Cylinder.** 25-ml.

3.1.10 **Barometer.** Mercury, aneroid, or other barometer, as described in Section 2.1.5 above.

3.1.11 **Vacuum Gauge.** At least 760-mm (30-in.) Hg gauge, to be used for the sampling leak check.

3.2 Procedure.

3.2.1 Place exactly 5 ml water in each impinger. Leak check the sampling train as follows: Temporarily insert a vacuum gauge at or near the probe inlet; then, plug the probe inlet, and pull a vacuum of at least 250 mm (10 in.) Hg. Note the time rate of change of the dry gas meter dial; alternatively, a rotameter (0 to 40 cc/min) may be temporarily attached to the dry gas meter outlet to determine the leakage rate. A leak rate not in excess of 2 percent of the average sampling rate is acceptable. **NOTE:** Carefully release the probe inlet plug before turning off the pump.

3.2.2 Connect the probe, insert it into the stack, and sample at a constant rate of 2 liters/min (0.071 cfm). Continue sampling until the dry gas meter registers about 30 liters (1.1 ft^3) or until visible liquid droplets are carried over from the first impinger to the second. Record temperature, pressure, and dry gas meter readings as required by Figure 4-5.

3.2.3 After collecting the sample, combine the contents of the two impingers, and measure the volume to the nearest 0.5 ml.

3.3 **Calculations.** The calculation method presented is designed to estimate the moisture in the stack gas; therefore, other data, which are only necessary for accurate moisture determinations, are not collected. The following equations adequately estimate the moisture content, for the purpose of determining isokinetic sampling rate settings.

3.3.1 Nomenclature.

B_{wm} = Approximate proportion by volume of water vapor in the gas stream leaving the second impinger, 0.025.

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

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

P_m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 [(mm Hg)(m^3)]/[(g-mole)(°K)] for metric units and 21.85 [(in. Hg)(ft^3)]/[(lb-mole)(°R)] for English units.

T_m = Absolute temperature at meter, °K (°R).

T_{std} = Standard absolute temperature, 293°R (528°R).

V_f = Final volume of impinger contents, ml.

V_i = Initial volume of impinger contents, ml.

V_m = Dry gas volume measured by dry gas meter, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by dry gas meter, corrected to standard conditions, dscm (dscf).

Y = Dry gas meter calibration factor.

ρ_w = Density of water,0.9982 g/ml (0.002201 lb/ml).

3.3.2 Volume of Water Vapor Collected.

$$V_{wc} = \frac{(V_f - V_i)\rho_w R T_{std}}{P_{std} M_w} = K_1 (V_f - V_i) \qquad \text{Eq. 4-5}$$

Where:

K_1 = 0.001333 m^3/ml for metric units,

= 0.04707 ft^3/ml for English units.

3.3.3 Gas Volume.

$$V_{m(std)} = V_m\left(\frac{P_m}{P_{std}}\right)\left(\frac{T_{std}}{T_m}\right) = K_2 \ V_m \frac{P_m}{T_m} \qquad \text{Eq. 4-6}$$

Where:

K_2 = 0.03858 °K/mm Hg for metric units,

= 17.64 °R/in. Hg for English units.

3.3.4 Approximate Moisture Content.

$$B_{ws} = \frac{V_{wc}}{V_{wc}+V_{m(std)}} + B_{wm} = \frac{V_{wc}}{V_{wc}+V_{m(std)}} + (0.025) \qquad \text{Eq. 4-7}$$

4. CALIBRATION

4.1 For the reference method, calibrate the metering system, temperature gauges, and barometer according to Sections 5.3, 5.5, and 5.7, respectively, of Method 5. The recommended leak check of the metering system (Section 5.6 of Method 5) also applies to the reference method. For the approximation method, use the procedures outlined in Section 5.1.1 of Method 6 to calibrate the metering system, and the procedure of Method 5, Section 5.7, to calibrate the barometer.

5. BIBLIOGRAPHY

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APPENDIX F.5

EPA METHOD 18

METHOD 18 - MEASUREMENT OF GASEOUS ORGANIC COMPOUND EMISSIONS BY GAS CHROMATOGRAPHY

NOTE: This method is not inclusive with respect to specifications (e.g., equipment and supplies) and procedures (e.g., sampling and analytical) essential to its performance. Some material is incorporated by reference from other methods in this part. Therefore, to obtain reliable results, persons using this method should have a thorough knowledge of at least the following additional test methods: Method 1, Method 2, Method 3.

NOTE: This method should not be attempted by persons unfamiliar with the performance characteristics of gas chromatography, nor by those persons who are unfamiliar with source sampling. Particular care should be exercised in the area of safety concerning choice of equipment and operation in potentially explosive atmospheres.

1.0 Scope and Application.

1.1 Analyte. Total gaseous organic compounds.

1.2 Applicability.

1.2.1 This method applies to the analysis of approximately 90 percent of the total gaseous organics emitted from an industrial source. It does not include techniques to identify and measure trace amounts of organic compounds, such as those found in building air and fugitive emission sources.

1.2.2 This method will not determine compounds that (1) are polymeric (high molecular weight), (2) can polymerize before analysis, or (3) have very low vapor pressures at stack or instrument conditions.

1.3 Range. The lower range of this method is determined by the sampling system; adsorbents may be used to concentrate the sample, thus lowering the limit of detection below the 1 part per million (ppm) typically achievable with direct interface or bag sampling. The upper limit is governed by GC detector saturation or column overloading; the upper range can be extended by dilution of sample with an inert gas or by using smaller volume gas sampling loops.

The upper limit can also be governed by condensation of higher boiling compounds.

1.4 Sensitivity. The sensitivity limit for a compound is defined as the minimum detectable concentration of that compound, or the concentration that produces a signal-to-noise ratio of three to one. The minimum detectable concentration is determined during the presurvey calibration for each compound.

2.0 Summary of Method. The major organic components of a gas mixture are separated by gas chromatography (GC) and individually quantified by flame ionization, photoionization, electron capture, or other appropriate detection principles. The retention times of each separated component are compared with those of known compounds under identical conditions. Therefore, the analyst confirms the identity and approximate concentrations of the organic emission components beforehand. With this information, the analyst then prepares or purchases commercially available standard mixtures to calibrate the GC under conditions identical to those of the samples. The analyst also determines the need for sample dilution to avoid detector saturation, gas stream filtration to eliminate particulate matter, and prevention of moisture condensation.

3.0 Definitions. [Reserved]

4.0 Interferences.

4.1 Resolution interferences that may occur can be eliminated by appropriate GC column and detector choice or by shifting the retention times through changes in the column flow rate and the use of temperature programming.

4.2 The analytical system is demonstrated to be essentially free from contaminants by periodically analyzing blanks that consist of hydrocarbon-free air or nitrogen.

4.3 Sample cross-contamination that occurs when high-level and low-level samples or standards are analyzed alternately, is best dealt with by thorough purging of the GC sample loop between samples.

4.4 To assure consistent detector response, calibration gases are contained in dry air. To adjust gaseous organic concentrations when water vapor is present in the sample, water vapor concentrations are determined for those samples, and a correction factor is applied.

5.0 Safety.

5.1 Disclaimer. This method amy involve hazardous materials, operations, and equipment. This test method does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to performing this test method. The analyzer users manual should be consulted for specific precautions to be taken with regard to the analytical procedure.

6.0 Equipment and Supplies.

6.1 Equipment needed for the presurvey sampling procedure can be found in Section 8.1.1.

6.2 Equipment needed for the evacuated container sampling procedure can be found in Section 8.2.1.1.1.

6.3 Equipment needed for the analysis of bag samples can be found in Section 8.2.1.5.1.

6.4 Equipment needed for the direct interface sampling and analysis can be found in Section 8.2.2.1.

7.0 Reagents and Standards.

7.1 Reagents needed for the presurvey sampling procedure can be found in Section 8.1.2.

8.0 Sample Collection, Preservation, Storage, and Transport.

8.1 Presurvey and Presurvey Sampling. Perform a presurvey for each source to be tested. Refer to Figure 18-1. Some of the information can be collected from literature surveys and source personnel. Collect gas samples that can be analyzed to confirm the identities and approximate concentrations of the organic emissions.

8.1.1 Apparatus. This apparatus list also applies to Sections 8.2 and 11.

8.1.1.1 Teflon® Tubing. (Mention of trade names or specific products does not constitute endorsement by the U.S. Environmental Protection Agency.) Diameter and length determined by connection requirements of cylinder regulators and the GC. Additional tubing is necessary to connect the GC sample loop to the sample.

8.1.1.2 Gas Chromatograph. GC with suitable detector, columns, temperature-controlled sample loop and valve assembly, and temperature programmable oven, if necessary. The GC shall achieve sensitivity requirements for the compounds under study.

8.1.1.3 Pump. Capable of pumping 100 ml/min. For flushing sample loop.

8.1.1.4 Flow Meter. To measure flow rates.

8.1.1.5 Regulators. Used on gas cylinders for GC and for cylinder standards.

8.1.1.6 Recorder. Recorder with linear strip chart is minimum acceptable. Integrator (optional) is recommended.

8.1.1.7 Syringes. 0.5-ml, 1.0- and 10-microliter size, calibrated, maximum accuracy (gas tight) for preparing calibration standards. Other appropriate sizes can be used.

8.1.1.8 Tubing Fittings. To plumb GC and gas cylinders.

8.1.1.9 Septums. For syringe injections.

8.1.1.10 Glass Jars. If necessary, clean, colored glass jars with Teflon®-lined lids for condensate sample collection. Size depends on volume of condensate.

8.1.1.11 Soap Film Flowmeter. To determine flow rates.

8.1.1.12 Tedlar Bags. 10- and 50-liter capacity, for preparation of standards.

8.1.1.13 Dry Gas Meter with Temperature and Pressure Gauges. Accurate to ± 2 percent, for preparation of gas standards.

8.1.1.14 Midget Impinger/Hot Plate Assembly. For preparation of gas standards.

8.1.1.15 Sample Flasks. For presurvey samples, must have gas-tight seals.

8.1.1.16 Adsorption Tubes. If necessary, blank tubes filled with necessary adsorbent (charcoal, Tenax, XAD-2, etc.) for presurvey samples.

8.1.1.17 Personnel Sampling Pump. Calibrated, for collecting adsorbent tube presurvey samples.

8.1.1.18 Dilution System. Calibrated, the dilution system is to be constructed following the specifications of an acceptable method.

8.1.1.19 Sample Probes. Pyrex or stainless steel, of sufficient length to reach centroid of stack, or a point no closer to the walls than 1 m.

8.1.1.20 Barometer. To measure barometric pressure.

8.1.2 Reagents.

8.1.2.1 Water. Deionized distilled.

8.1.2.2 Methylene Dichloride.

8.1.2.3 Calibration Gases. A series of standards prepared for every compound of interest.

8.1.2.4 Organic Compound Solutions. Pure (99.9 percent), or a s pure as can reasonably be obtained, liquid samples of all the organic compounds needed to prepare calibration standards.

8.1.2.5 Extraction Solvents. For extraction of adsorbent tube samples in preparation for analysis.

8.1.2.6 Fuel. As recommended by the manufacturer for operation of the GC.

8.1.2.7 Carrier Gas. Hydrocarbon free, as recommended by the manufacturer for operation of the detector and compatibility with the column.

8.1.2.8 Zero Gas. Hydrocarbon free air or nitrogen, to be used for dilutions, blank preparation, and standard preparation.

8.1.3 Sampling.

8.1.3.1 Collection of Samples with Glass Sampling Flasks. Presurvey samples can be collected in precleaned 250-ml double-ended glass sampling flasks. Teflon® stopcocks, without grease, are preferred. Flasks should be cleaned as follows: Remove the stopcocks from both ends of the flasks, and wipe the parts to remove any grease. Clean the stopcocks, barrels, and receivers with methylene dichloride. Clean all glass ports with a soap solution, then rinse with tap and deionized distilled water. Place the flask in a cool glass annealing furnace, and apply heat up to 500°C. Maintain at this temperature for 1 hours. After this time period, shut off and open the furnace to allow the flask to cool. Grease the stopcocks with stopcock grease, and return them to the flask receivers. Purge the assembly with high- purity nitrogen for 2 to 5 minutes. Close off the stopcocks after purging to maintain a slight positive nitrogen pressure. Secure the stopcocks with tape. Presurvey samples can be obtained either by drawing the gases into the previously evacuated flask or by drawing the gases into and purging the flask with a rubber suction bulb.

8.1.3.1.1 Evacuated Flask Procedure. Use a high-vacuum pump to evacuate the flask to the capacity of the pump; then close off the stopcock leading to the pump. Attach a 6-mm outside diameter (OD) glass tee to the flask inlet with a short piece of Teflon® tubing. Select a 6-mm OD borosilicate sampling probe, enlarged at one end to a 12-mm OD and of sufficient length to reach the centroid of the duct to be sampled. Insert a glass wool plug in the enlarged end of the probe to remove particulate matter. Attach the other end of the probe to the tee with a short piece of Teflon® tubing. Connect a rubber suction bulb to the third leg of the tee. Place the filter end of the probe at the centroid of the duct, and purge the probe with the rubber suction bulb. After the probe is completely purged and filled with duct gases, open the stopcock to the grab flask until the pressure in the flask reaches duct pressure. Close off the stopcock, and remove the probe from the duct. Remove the tee from the flask and tape the stopcocks to prevent leaks during shipment. Measure and record the duct temperature and pressure.

8.1.3.1.2 Purged Flask Procedure. Attach one end of the sampling flask to a rubber suction bulb. Attach the other end to a 6-mm OD glass probe as described in Section 8.3.3.1.1. Place the filter end of the probe at the centroid of the duct, or at a point no closer to the walls than 1 m, and apply suction with the bulb to completely purge the probe and flask. After the flask has been purged, close off the stopcock near the suction bulb, and then close off the stopcock near the probe. Remove the probe from the duct, and disconnect both the probe and suction bulb. Tape the stopcocks to prevent leakage during shipment. Measure and record the duct temperature and pressure.

8.1.3.2 Flexible Bag Procedure. Tedlar or aluminized Mylar bags can also be used to obtain the presurvey sample. Use new bags, and leak check them before field use. In addition, check the bag before use for contamination by filling it with nitrogen or air, and analyzing the gas by GC at high sensitivity. Experience indicates that it is desirable to allow the inert gas to remain in the bag about 24 hours or longer to check for desorption of organics from the bag. Follow the leak-check and sample collection procedures given in Section 8.2.1.

8.1.3.3 Determination of Moisture Content. For combustion or water- controlled processes, obtain the moisture content from plant personnel or by measurement during the presurvey. If the source is below 59°C, measure the wet bulb and dry bulb temperatures, and calculate the moisture content using a psychrometric chart. At higher temperatures, use Method 4 to determine the moisture content.

8.1.4 Determination of Static Pressure. Obtain the static pressure from the plant personnel or measurement. If a type S pitot tube and an inclined manometer are used, take care to align the pitot tube 90° from the direction of the flow. Disconnect one of the tubes to the manometer, and read the static pressure; note whether the reading is positive or negative.

8.1.5 Collection of Presurvey Samples with Adsorption Tube. Follow Section 16.1 for presurvey sampling.

8.2 Final Sampling and Analysis Procedure. Considering safety (flame hazards) and the source conditions, select an appropriate sampling and analysis procedure (Section 8.2.1, 8.2.2, 8.2.3 or 16.1). In situations where a hydrogen flame is a hazard and no intrinsically safe GC is suitable, use the flexible bag collection technique or an adsorption technique. If the source temperature is below 100°C, and the organic concentrations are suitable for the detector to be used, use the direct interface method. If the source gases require dilution, use a dilution interface and either the bag sample or adsorption tubes. The choice between these two techniques will depend on the physical layout of the site, the source temperature, and the storage stability of the compounds if collected in the bag. Sample polar compounds by direct interfacing or dilution interfacing to prevent sample loss by adsorption on the bag.

8.2.1 Integrated Bag Sampling and Analysis.

8.2.1.1 Evacuated Container Sampling Procedure. In this procedure, the bags are filled by evacuating the rigid air-tight container holding the bags. Use a field sample data sheet as shown in Figure 18-10. Collect triplicate sample from each sample location.

8.2.1.1.1 Apparatus.

8.2.1.1.1.1 Probe. Stainless steel, Pyrex glass, or Teflon® tubing probe, according to the duct temperature, with 6.4-mm OD Teflon® tubing of sufficient length to connect to the sample bag. Use stainless steel or Teflon® unions to connect probe and sample line.

8.2.1.1.1.2 Quick Connects. Male (2) and female (2) of stainless steel construction.

8.2.1.1.1.3 Needle Valve. To control gas flow.

8.2.1.1.1.4 Pump. Leakless Teflon®-coated diaphragm-type pump or equivalent. To deliver at least 1 liter/min.

8.2.1.1.1.5 Charcoal Adsorption Tube. Tube filled with activated charcoal, with glass wool plugs at each end, to adsorb organic vapors.

8.2.1.1.1.6 Flowmeter. 0 to 500-ml flow range; with manufacturer's calibration curve.

8.2.1.1.2 Sampling Procedure. To obtain a sample, assemble the sample train as shown in Figure 18-9. Leak check both the bag and the container. Connect the vacuum line from the needle valve to the Teflon® sample line from the probe. Place the end of the probe at the centroid of the stack or at a point no closer to the walls than 1 m, and start the pump with the needle valve adjusted to yield a flow of 0.5 liter/minute. After allowing sufficient time to purge the line several times, connect the vacuum line to the bag, and evacuate until the rotameter indicates no flow. Then position the sample and vacuum lines for sampling, and begin the actual sampling, keeping the rate proportional to the stack velocity. As a precaution, direct the gas exiting the rotameter away from sampling personnel. At the end of the sample period, shut off the pump, disconnect the sample line from the bag, and disconnect the vacuum line from the bag container. Record the source temperature, barometric pressure, ambient temperature, sampling flow rate, and initial and final sampling time on the data sheet shown in Figure 18-10. Protect the Tedlar bag and its container from sunlight. When possible, perform the analysis within 2 hours of sample collection.

8.2.1.2 Direct Pump Sampling Procedure. Follow 8.2.1.1, except place the pump and needle valve between the probe and the bag. Use a pump and needle valve constructed of stainless steel or some other material not affected by the stack gas. Leak-check the system, and then purge with stack gas before connecting to the previously evacuated bag.

8.2.1.3 Explosion Risk Area Bag Sampling Procedure. Follow 8.2.1.1 except replace the pump with another evacuated can (see Figure 18-9a). Use this method whenever there is a possibility of an explosion due to pumps, heated probes, or other flame producing equipment.

8.2.1.4 Other Modified Bag Sampling Procedures. In the event that condensation is observed in the bag while collecting the sample and a direct interface system cannot be used, heat the bag during collection, and maintain it at a suitably elevated temperature during all subsequent operations. (NOTE: Take care to leak-check the system prior to the dilutions so as not to create a potentially explosive atmosphere.) As an alternative, collect the sample gas, and simultaneously dilute it in the Tedlar bag.

8.2.1.4.1 In the first procedure, heat the box containing the sample bag to the source temperature, provided the components of the bag and the surrounding box can withstand this temperature. Then transport the bag as rapidly as possible to the analytical area while maintaining the heating, or cover the box with an insulating blanket. In the analytical area, keep the box heated to source temperature until analysis. Be sure that the method of heating the box and the control for the heating circuit are compatible with the safety restrictions required in each area.

8.2.1.4.2 To use the second procedure, prefill the Tedlar bag with a known quantity of inert gas. Meter the inert gas into the bag according to the procedure for the preparation of gas concentration standards of volatile liquid materials (Section 10.1.2.2), but eliminate the midget impinger section. Take the partly filled bag to the source, and meter the source gas into the bag through heated sampling lines and a heated flowmeter, or Teflon® positive displacement pump. Verify the dilution factors periodically through dilution and analysis of gases of known concentration.

8.2.1.5 Analysis of Bag Samples.

8.2.1.5.1 Apparatus. Same as Section 8.1. A minimum of three gas standards are required.

8.2.1.5.2 Procedure.

8.2.1.5.2.1 Establish proper GC operating conditions as described in Section 10.2, and record all data listed in Figure 18-7. Prepare the GC so that gas can be drawn through the sample valve. Flush the sample loop with gas from one of the three Tedlar bags containing a calibration mixture, and activate the valve. Obtain at least two chromatograms for the mixture. The results are acceptable when the peak areas from two consecutive injections agree to within 5 percent of their average. If they do not agree, run additional samples or correct the analytical techniques until this requirement is met. Then analyze the other two calibration mixtures in the same manner. Prepare a calibration curve as described in the same manner. Prepare a calibration curve as described in Section 10.2. If the results are acceptable, analyze the other two calibration gas mixtures in the same manner. Prepare the calibration curve by using the least squares method.

8.2.1.5.2.2 Analyze the two field audit samples as described in Section 9.2 by connecting each Tedlar bag containing an audit gas mixture to the sampling valve.

Calculate the results; record and report the data to the audit supervisor. If the results are acceptable, proceed with the analysis of the source samples.

8.2.1.5.2.3 Analyze the source gas samples by connecting each bag to the sampling valve with a piece of Teflon® tubing identified with that bag. Follow the restrictions on replicate samples specified for the calibration gases. Record the data in Figure 18-11. If certain items do not apply, use the notation "N.A.". If the bag has been maintained at an elevated temperature as described in Section 8.2.1.4, determine the stack gas water content by Method 4. After all samples have been analyzed, repeat the analysis of the calibration gas mixtures, and generate a second calibration curve. Use an average of the two curves to determine the sample second calibration curve gas concentrations. If the two calibration curves differ by more than 5 percent from their mean value, then report the final results by comparison to both calibration curves.

8.2.1.6 Determination of Bag Water Vapor Content. Measure the ambient temperature and barometric pressure near the bag. From a water saturation vapor pressure table, determine and record the water vapor content of the bag as a decimal figure. (Assume the relative humidity to be 100 percent unless a lesser value is known.) If the bag has been maintained at an elevated temperature as described in Section 8.2.1.4, determine the stack gas water content by Method 4.

8.2.1.7 Quality Assurance. Immediately prior to the analysis of the stack gas samples, perform audit analyses as described in Section 9.2. The audit analyses must agree with the audit concentrations within 10 percent. If the results are acceptable, proceed with the analyses of the source samples. If they do not agree within 10 percent, then determine the reason for the discrepancy, and take corrective action before proceeding.

8.2.1.8 Emission Calculations. From the average calibration curve described in Section 8.2.1.5, select the value of C_s that corresponds to the peak area. Calculate the concentration C_c in ppm, dry basis, of each organic in the sample using Equation 18-5 in Section 12.6.

8.2.2 Direct Interface Sampling and Analysis Procedure. The direct interface procedure can be used provided that the moisture content of the gas does not interfere with the analysis procedure, the physical requirements of the equipment can be met at the site, and the source gas concentration is low enough that detector saturation is not a problem. Adhere to all safety requirements with this method.

8.2.2.1 Apparatus.

8.2.2.1.1 Probe. Constructed of stainless steel, Pyrex glass, or Teflon® tubing as required by duct temperature, 6.4-mm OD. enlarged at duct end to contain glass wool plug. If necessary, heat the probe with heating tape or a special heating unit capable of maintaining duct temperature.

8.2.2.1.2 Sample Lines. 6.4-mm OD Teflon® lines, heat-traced to prevent condensation of material.

8.2.2.1.3 Quick Connects. To connect sample line to gas sampling valve on GC instrument and to pump unit used to withdraw source gas. Use a quick connect or equivalent on the cylinder or bag containing calibration gas to allow connection of the calibration gas to the gas sampling valve.

8.2.2.1.4 Thermocouple Readout Device. Potentiometer or digital thermometer, to measure source temperature and probe temperature.

8.2.2.1.5 Heated Gas Sampling Valve. Of two-position, six-port design, to allow sample loop to be purged with source gas or to direct source gas into the GC instrument.

8.2.2.1.6 Needle Valve. To control gas sampling rate from the source.

8.2.2.1.7 Pump. Leakless Teflon®-coated diaphragm-type pump or equivalent, capable of at least 1 liter/minute sampling rate.

8.2.2.1.8 Flowmeter. Of suitable range to measure sampling rate.

8.2.2.1.9 Charcoal Adsorber. To adsorb organic vapor collected from the source to prevent exposure of personnel to source gas.

8.2.2.1.10 Gas Cylinders. Carrier gas (helium or nitrogen), and oxygen and hydrogen for a flame ionization detector (FID) if one is used.

8.2.2.1.11 Gas Chromatograph. Capable of being moved into the field, with detector, heated gas sampling valve, column required to complete separation of desired components, and option for temperature programming.

8.2.2.1.12 Recorder/Integrator. To record results.

8.2.2.2 Procedure. To obtain a sample, assemble the sampling system as shown in Figure 18-12. Make sure all connections are tight. Turn on the probe and sample line heaters. As the temperature of the probe and heated line approaches the source temperature as indicated on the thermocouple readout device, control the heating to maintain a temperature of 0 to 3°C above the source temperature. While the probe and heated line are being heated, disconnect the sample line from the gas sampling valve, and attach the line from the calibration gas mixture. Flush the sample loop with calibration gas and analyze a portion of that gas. Record the results. After the calibration gas sample has been flushed into the GC instrument, turn the gas sampling valve to flush position, then reconnect the probe sample line to the valve. Place the inlet of the probe at the centroid of the duct, or at a point no closer to the walls than 1 m, and draw source gas into the probe, heated line, and sample loop. After thorough flushing, analyze the sample using the same conditions as for the calibration gas mixture. Repeat the analysis on an additional sample. Measure the peak areas for the two samples, and if they do not agree to within 5 percent of their mean value, analyze additional samples until two consecutive analyses meet this criteria. Record the data. After consistent results are obtained, remove the probe from the source and analyze a second calibration gas mixture. Record this calibration data and the other required data on the data sheet shown in Figure 18-11, deleting the dilution gas information.

(NOTE: Take care to draw all samples, calibration mixtures, and audits through the sample loop at the same pressure.)

8.2.2.3 Determination of Stack Gas Moisture Content. Use Method 4 to measure the stack gas moisture content.

8.2.2.4 Quality Assurance. Same as Section 8.2.1.7. Introduce the audit gases in the sample line immediately following the probe.

8.2.2.5 Emission Calculations. Same as Section 8.2.1.8.

8.2.3 Dilution Interface Sampling and Analysis Procedure. Source samples that contain a high concentration of organic materials may require dilution prior to analysis to prevent saturating the GC detector. The apparatus required for this direct interface procedure is basically the same as that described in the Section 8.2.2, except a dilution system is added between the heated sample line and the gas sampling valve. The apparatus is arranged so that either a 10:1 or 100:1 dilution of the source gas can be directed to the chromatograph. A pump of larger capacity is also required, and this pump must be heated and placed in the system between the sample line and the dilution apparatus.

8.2.3.1 Apparatus. The equipment required in addition to that specified for the direct interface system is as follows:

8.2.3.1.1 Sample Pump. Leakless Teflon®-coated diaphragm-type that can withstand being heated to 120°C and deliver 1.5 liters/minute.

8.2.3.1.2 Dilution Pumps. Two Model A-150 Komhyr Teflon® positive displacement type delivering 150 cc/minute, or equivalent. As an option, calibrated flowmeters can be used in conjunction with Teflon®-coated diaphragm pumps.

8.2.3.1.3 Valves. Two Teflon® three-way valves, suitable for connecting to 6.4-mm OD Teflon® tubing.

8.2.3.1.4 Flowmeters. Two, for measurement of diluent gas, expected delivery flow rate to be 1,350 cc/min.

8.2.3.1.5 Diluent Gas with Cylinders and Regulators. Gas can be nitrogen or clean dry air, depending on the nature of the source gases.

8.2.3.1.6 Heated Box. Suitable for being heated to 120°C, to contain the three pumps, three-way valves, and associated connections. The box should be equipped with quick connect fittings to facilitate connection of: (1) the heated sample line from the probe, (2) the gas sampling valve, (3) the calibration gas mixtures, and (4) diluent gas lines. A schematic diagram of the components and connections is shown in Figure 18-13. The heated box shown in Figure 18-13 is designed to receive a heated line from the probe. An optional design is to build a probe unit that attaches directly to the heated box. In this way, the heated box contains the controls for the probe heaters, or, if the box is placed against the duct being sampled, it may be possible to eliminate the probe heaters. In either case, a heated Teflon® line is used to connect the heated box to the gas sampling valve on the chromatograph.

NOTE: Care must be taken to leak-check the system prior to the dilutions so as not to create a potentially explosive atmosphere.

8.2.3.2 Procedure.

8.2.3.2.1 Assemble the apparatus by connecting the heated box, shown in Figure 18-13, between the heated sample line from the probe and the gas sampling valve on the chromatograph. Vent the source gas from the gas sampling valve directly to the charcoal filter, eliminating the pump and rotameter. Heat the sample probe, sample line, and heated box. Insert the probe and source thermocouple at the centroid of the duct, or to a point no closer to the walls than 1 m. Measure the source temperature, and adjust all heating units to a temperature 0 to 3°C above this temperature. If this temperature is above the safe operating temperature of the Teflon® components, adjust the heating to maintain a temperature high enough to prevent condensation of water and organic compounds. Verify the operation of the dilution system by analyzing a high concentration gas of known composition through either the 10:1 or 100:1 dilution stages, as appropriate. (If necessary, vary the flow of the diluent gas to obtain other dilution ratios.) Determine the concentration of the diluted calibration gas using the dilution factor and the calibration curves prepared in the laboratory. Record the pertinent data on the data sheet shown in Figure 18-11. If the data on the diluted calibration gas are not within 10 percent of the expected values, determine whether the chromatograph or the dilution system is in error, and correct it. Verify the GC operation using a low concentration standard by diverting the gas into the sample loop, bypassing the dilution system. If these analyses are not within acceptable limits, correct the dilution system to provide the desired dilution factors. Make this correction by diluting a high-concentration standard gas mixture to adjust the dilution ratio as required.

8.2.3.2.2 Once the dilution system and GC operations are satisfactory, proceed with the analysis of source gas, maintaining the same dilution settings as used for the standards. Repeat the analyses until two consecutive values do not vary by more than 5 percent from their mean value are obtained.

8.2.3.2.3 Repeat the analysis of the calibration gas mixtures to verify equipment operation. Analyze the two field audit samples using either the dilution system, or directly connect to the gas sampling valve as required. Record all data and report the results to the audit supervisor.

8.2.3.3 Determination of Stack Gas Moisture Content. Same as Section 8.2.2.3.

8.2.3.4 Quality Assurance. Same as Section 8.2.2.4.

8.2.3.5 Emission Calculations. Same as section 8.2.2.5, with the dilution factor applied.

8.3 Reporting of Results. At the completion of the field analysis portion of the study, ensure that the data sheets shown in Figure 18-11 have been completed. Summarize this data on the data sheets shown in Figure 18-15.

8.4 Recovery Study. After conducting the presurvey and identifying all of the pollutants of interest, conduct the appropriate recovery study during the test based on the sampling system chosen for the compounds of interest.

8.4.1 Recovery Study for Direct Interface or Dilution Interface Sampling. If the procedures in Section 8.2.2 or 8.2.3 are to be used to analyze the stack gas, conduct the calibration procedure as stated in Section 8.2.2.2 or 8.2.3.2, as appropriate. Upon successful completion of the appropriate calibration procedure, attach the mid-level calibration gas for at least one target compound to the inlet of the probe or as close as possible to the inlet of the probe, but before the filter. Repeat the calibration procedure by sampling and analyzing the mid-level calibration gas through the entire sampling and analytical system until two consecutive samples are within 5 percent of their mean value. The mean of the calibration gas response directly to the analyzer and the mean of the calibration gas response sampled through the probe shall be within 10 percent of each other. If the difference in the two means is greater than 10 percent, check for leaks throughout the sampling system and repeat the analysis of the standard through the sampling system until this criterion is met.

8.4.2 Recovery Study for Bag Sampling.

8.4.2.1 Follow the procedures for the bag sampling and analysis in Section 8.2.1. After analyzing all three bag samples, choose one of the bag samples and analyze twice more (this bag will become the spiked bag). Spike the chosen bag sample with a known mixture (gaseous or liquid) of all of the target pollutants. Follow a procedure similar to the calibration standard preparation procedure listed in Section 10.1, as appropriate. The theoretical concentration, in ppm, of each spiked compound in the bag shall be 40 to 60 percent of the average concentration measured in the three bag samples. If a target compound was not detected in the bag samples, the concentration of that compound to be spiked shall be 5 times the limit of detection for that compound. Analyze the bag three times after spiking. Calculate the average fraction recovered (R) of each spiked target compound with the equation in Section 12.7.

8.4.2.2 For the bag sampling technique to be considered valid for a compound, $0.70 \leq R \leq 1.30$. If the R value does not meet this criterion for a target compound, the sampling technique is not acceptable for that compound, and therefore another sampling technique shall be evaluated for acceptance (by repeating the recovery study with another sampling technique). Report the R value in the test report and correct all field measurements with the calculated R value for that compound by using the equation in Section 12.8.

8.4.3 Recovery Study for Adsorption Tube Sampling. If following the adsorption tube procedure in Section 16.1, conduct a recovery study of the compounds of interest during the actual field test. Set up two identical sampling trains. Collocate the two sampling probes in the stack. The probes shall be placed in the same horizontal plane, where the first probe tip is 2.5 cm from the outside edge of the other and with a pitot tube on the outside of each probe. One of the sampling trains shall be designated the spiked train and the other the unspiked train. Spike all of the compounds of interest (in gaseous or liquid form) onto the adsorbent tube(s) in the spiked train before sampling. The mass of each spiked compound shall be 40 to 60 percent of the mass expected to be collected with the unspiked train. Sample the stack gas into the two trains simultaneously. Analyze the adsorbents from the two trains utilizing the same analytical procedure and instrumentation. Determine the fraction of spiked compound recovered (R) using the equations in Section 12.9.

8.4.3.1 Repeat the procedure in Section 8.4.3 twice more, for a total of three runs. In order for the adsorbent tube sampling and analytical procedure to be acceptable for a compound, $0.70 \le R \le 1.30$ (R in this case is the average of three runs). If the average R value does not meet this criterion for a target compound, the sampling technique is not acceptable for that compound, and therefore another sampling technique shall be evaluated for acceptance (by repeating the recovery study with another sampling technique). Report the R value in the test report and correct all field measurements with the calculated R value for that compound by using the equation in Section 12.8.

9.0 Quality Control.

9.1

Section	Quality Control Measure	Effect
8.4.1	Recovery study for direct interface or dilution interface sampling.	Ensure that there are no significant leaks in the sampling system.
8.4.2	Recovery study for bag sampling.	Ensure that there are no significant leaks in the sampling system.
8.4.3	Recovery study for adsorption tube sampling.	Ensure that there are no significant leaks in the sampling system.

9.2 Quality Assurance for Laboratory Procedures. Immediately after the preparation of the calibration curves and prior to the presurvey sample analysis, the analysis audit described in 40 CFR Part 61, Appendix C, Procedure 2: "Procedure for Field Auditing GC Analysis," should be performed. The information required to document the analysis of the audit samples has been included on the example data sheets shown in Figures 18-3 and 18-7. The audit analyses should agree with the audit concentrations within 10 percent. When available, the tester may obtain audit cylinders by contacting: U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Quality Assurance Division (MD-77), Research Triangle Park, North Carolina 27711. Audit cylinders obtained from a commercial gas manufacturer may be used provided that (a) the gas manufacturer certifies the audit cylinder in a manner similar to the procedure described in 40 CFR Part 61, Appendix B, Method 106, Section 7.2.3.1, and (b) the gas manufacturer obtains an independent analysis of the audit cylinders to verify this analysis. Independent analysis is defined as an analysis performed by an individual other than the individual who performs the gas manufacturer's analysis, while using calibration standards and analysis equipment different from those used for the gas manufacturer's analysis. Verification is complete and acceptable when the independent analysis concentration is within 5 percent of the gas manufacturer's concentration.

10.0 Calibration and Standardization.

10.1 Calibration Standards. Prepare or obtain enough calibration standards so that there are three different concentrations of each organic compound expected to be measured in the source sample. For each organic compound, select those concentrations that bracket the concentrations expected in the source samples. A calibration standard may contain more than one organic compound. If available, commercial cylinder gases may be used if their concentrations have been certified by direct analysis. If samples are collected in adsorbent tubes (charcoal, XAD-2, Tenax, etc.), prepare or obtain standards in the same solvent used for the sample extraction procedure. Refer to Section 16.1. Verify the stability of all standards for the time periods they are used. If gas standards are prepared in the laboratory, use one or more of the following procedures.

10.1.1 Preparation of Standards from High Concentration Cylinder Standards.

10.1.1.1 Obtain enough high concentration cylinder standards to represent all the organic compounds expected in the source samples.

10.1.1.2 Use these high concentration standards to prepare lower concentration standards by dilution, as shown by Figures 18-5 and 18-6.

10.1.1.3 To prepare the diluted calibration samples, calibrated rotameters are normally used to meter both the high concentration calibration gas and the diluent gas. Other types of flowmeters and commercially available dilution systems can also be used.

10.1.1.4 Calibrate each flowmeter before use by placing it between the diluent gas supply and suitably sized bubble meter, spirometer, or wet test meter. Record all data shown on Figure 18-4. While it is desirable to calibrate the cylinder gas flowmeter with cylinder gas, the available quantity and cost may preclude it. The error introduced by using the diluent gas for calibration is insignificant for gas mixtures of up to 1,000 to 2,000 ppm of each organic component.

10.1.1.5 Once the flowmeters are calibrated, connect the flowmeters to the calibration and diluent gas supplies using 6-mm Teflon® tubing. Connect the outlet side of the flowmeters through a connector to a leak-free Tedlar bag as shown in Figure 18-5. (See Section 8.2.1 for bag leak-check procedures.) Adjust the gas flow to provide the desired dilution, and fill the bag with sufficient gas for GC calibration. Be careful not to overfill and cause the bag to apply additional pressure on the dilution system. Record the flow rates of both flowmeters, and the laboratory temperature and atmospheric pressure. Calculate the concentration C_s in ppm of each organic in the diluted gas using Equation 18-1 in Section 12.2.

10.1.1.6 Single-stage dilutions should be used to prepare calibration mixtures up to about 1:20 dilution factor.

10.1.1.7 For greater dilutions, a double dilution system is recommended, as shown in Figure 18-6. Fill the Tedlar bag with the dilute gas from the second stage. Record the laboratory temperature, barometric pressure, and static pressure readings. Correct the flow reading for temperature and pressure. Calculate the concentration C_s in ppm of the organic in the final gas mixture using Equation 18-2 in Section 12.3.

10.1.1.8 Further details of the calibration methods for flowmeters and the dilution system can be found in Reference 21 in the Section 17.

10.1.2 Preparation of Standards from Volatile Materials. Record all data shown on Figure 18-3.

10.1.2.1 Gas Injection Technique. This procedure is applicable to organic compounds that exist entirely as a gas at ambient conditions. Evacuate a 10-liter Tedlar bag that has passed a leak-check (see Section 8.2.1), and meter in 5.0 liters of air or nitrogen through a dry gas meter that has been calibrated in a manner consistent with the procedure described in Section 10.3.1 of Method 5. While the bag is filling use a 0.5-ml syringe to inject a known quantity of "pure" gas of the organic compound through the wall of the bag, or through a septum-capped tee at the bag inlet. Withdraw the syringe needle, and immediately cover the resulting hole with a piece of masking tape. In a like manner, prepare dilutions having other concentrations. Prepare a minimum of three concentrations. Prepare a minimum of three concentrations. Place each bag on a smooth surface, and alternately depress opposite sides of the bag 50 times to mix the gases. Record the average meter temperature and pressure, the gas volume and the barometric pressure. Record the syringe temperature and pressure before injection. Calculate each organic standard concentration C_s in ppm using Equation 18-3 in Section 12.4.

10.1.2.2 Liquid Injection Technique.

10.1.2.2.1 Use the equipment shown in Figure 18-8. Calibrate the dry gas meter as described in Section 10.1.2.1 with a set test meter or a spirometer. Use a water manometer for the pressure gauge and glass, Teflon®, brass, or stainless steel for all connections. Connect a valve to the inlet of the 50-liter Tedlar bag.

10.1.2.2.2 To prepare the standards, assemble the equipment as shown in Figure 18-8, and leak-check the system. Completely evacuate the bag. Fill the bag with hydrocarbon-free air, and evacuate the bag again. Close the inlet valve.

10.1.2.2.3 Turn on the hot plate, and allow the water to reach boiling. Connect the bag to the impinger outlet. Record the initial meter reading, open the bag inlet valve, and open the cylinder. Adjust the rate so that the bag will be completely filled in approximately 15 minutes. Record meter pressure and temperature, and local barometric pressure.

10.1.2.2.4 Allow the liquid organic to equilibrate to room temperature. Fill the 1.0- or 10-microliter syringe to the desired liquid volume with the organic. Place the syringe needle into the impinger inlet using the septum provided, and inject the liquid into the flowing air stream. Use a needle of sufficient length to permit injection of the liquid below the air inlet branch of the tee. Remove the syringe.

10.1.2.2.5 When the bag is filled, stop the pump, and close the bag inlet valve. Record the final meter reading, temperature, and pressure.

10.1.2.2.6 Disconnect the bag from the impinger outlet, and either set it aside for at least 1 hour, or massage the bag to insure complete mixing.

10.1.2.2.7 Measure the solvent liquid density at room temperature by accurately weighing a known volume of the material on an analytical balance to the nearest 1.0 milligram. A ground-glass stoppered 25-ml volumetric flask or a glass-stoppered specific gravity bottle is suitable for weighing. Calculate the result in terms of g/ml. As an alternative, literature values of the density of the liquid at 20°C may be used.

10.1.2.2.8 Calculate each organic standard concentration, C_s in ppm using Equation 18-4 in Section 12.5.

10.2 Preparation of Calibration Curves.

10.2.1 Establish proper GC conditions, then flush the sampling loop for 30 seconds at a rate of 100 ml/min. Allow the sample loop pressure to equilibrate to atmospheric pressure, and activate the injection valve. Record the standard concentration, attenuator factor, injection time, chart speed, retention time, peak area, sample loop temperature, column temperature, and carrier gas flow rate. Repeat the standard injection until two consecutive injections give area counts within 5 percent of their average. The average value multiplied by the attenuator factor is then the calibration area value for the concentration.

10.2.2 Repeat this procedure for each standard. Prepare a graphical plot of concentration (C_s) versus the calibration area values. Perform a regression analysis, and draw the least square line.

10.3 Relative Response Factors. The calibration curve generated from the standards for a single organic can usually be related to each of the individual GC response curves that are developed in the laboratory for all the compounds in the source. In the field, standards for that single organic can then be used to "calibrate" the GC for all the organics present. This procedure should first be confirmed in the laboratory by preparing and analyzing calibration standards containing multiple organic compounds.

11.0 Analytical Procedures.

11.1 Analysis Development.

11.1.1 Selection of GC Parameters.

11.1.1.1 Column Choice. Based on the initial contact with plant personnel concerning the plant process and the anticipated emissions, choose a column that provides good resolution and rapid analysis time. The choice of an appropriate column can be aided by a literature search, contact with manufacturers of GC columns, and discussion with personnel at the emission source.

NOTE: Most column manufacturers keep excellent records on their products. Their technical service departments may be able to recommend appropriate columns and detector type for separating the anticipated compounds, and they may be able to provide information on interferences, optimum operating conditions, and column limitations. Plants with analytical laboratories may be able to provide information on their analytical procedures.

11.1.1.2 Preliminary GC Adjustment. Using the standards and column obtained in Section 11.1.1.1, perform initial tests to determine appropriate GC conditions that provide good resolution and minimum analysis time for the compounds of interest.

11.1.1.3 Preparation of Presurvey Samples. If the samples were collected on an adsorbent, extract the sample as recommended by the manufacturer for removal of the compounds with a solvent suitable to the type of GC analysis. Prepare other samples in an appropriate manner.

11.1.1.4 Presurvey Sample Analysis.

11.1.1.4.1 Before analysis, heat the presurvey sample to the duct temperature to vaporize any condensed material. Analyze the samples by the GC procedure, and compare the retention times against those of the calibration samples that contain the components expected to be in the stream. If any compounds cannot be identified with certainty by this procedure, identify them by other means such as GC/mass spectroscopy (GC/MS) or GC/infrared techniques. A GC/MS system is recommended.

11.1.1.4.2 Use the GC conditions determined by the procedure of Section 11.1.1.2 for the first injection. Vary the GC parameters during subsequent injections to determine the optimum settings. Once the optimum settings have been determined, perform repeat injections of the sample to determine the retention time of each compound. To inject a sample, draw sample through the loop at a constant rate (100 ml/min for 30 seconds). Be careful not to pressurize the gas in the loop. Turn off the pump and allow the gas in the sample loop to come to ambient pressure. Activate the sample valve, and record injection time, loop temperature, column temperature, carrier flow rate, chart speed, and attenuator setting. Calculate the retention time of each peak using the distance from injection to the peak maximum divided by the chart speed. Retention times should be repeatable within 0.5 seconds.

11.1.1.4.3 If the concentrations are too high for appropriate detector response, a smaller sample loop or dilutions may be used for gas samples, and, for liquid samples, dilution with solvent is appropriate. Use the standard curves (Section 10.2) to obtain an estimate of the concentrations.

11.1.1.4.4 Identify all peaks by comparing the known retention times of compounds expected to be in the retention times of peaks in the sample. Identify any remaining unidentified peaks which have areas larger than 5 percent of the total using a GC/MS, or estimation of possible compounds by their retention times compared to known compounds, with confirmation by further GC analysis.

12.0 Data Analysis and Calculations.

12.1 Nomenclature.

B_{ws} = Water vapor content of the bag sample or stack gas, proportion by volume.

C_s = Concentration of the organic from the calibration curve, ppm.

F_r = Relative response factor (if applicable, see Section 10.3)

G_v = Gas volume or organic compound injected, ml.

L_v = Liquid volume of organic injected, μl.

M = Molecular weight of organic, g/g-mole.

m_s = Total mass of compound measured on adsorbent with spiked train (μg).

m_u = Total mass of compound measured on adsorbent with unspiked train (μg).

m_v = Mass per volume of spiked compound measured (μg/L).

P_i = Barometric or absolute sample loop pressure at time of sample analysis, mm Hg.

P_m = Absolute pressure of dry gas meter, mm Hg.

P_r = Reference pressure, the barometric pressure or absolute sample loop pressure recorded during calibration, mm Hg.

P_s = Absolute pressure of syringe before injection, mm Hg.

q_c = Flow rate of the calibration gas to be diluted.

q_{c1} = Flow rate of the calibration gas to be diluted in stage 1.

q_{c2} = Flow rate of the calibration gas to be diluted in stage 2.

q_d = Diluent gas flow rate.

q_{d1} = Flow rate of diluent gas in stage 1.

q_{d2} = Flow rate of diluent gas in stage 2.

s = Theoretical concentration (ppm) of spiked target compound in the bag.

S = Theoretical mass of compound spiked onto adsorbent in spiked train (μg).

t = Measured average concentration (ppm) of target compound and source sample (analysis results subsequent to bag spiking)

T_i = Sample loop temperature at the time of sample analysis, °K.

T_m = Absolute temperature of dry gas meter, °K.

T_s = Absolute temperature of syringe before injection, °K.

u = Source sample average concentration (ppm) of target compound in the bag (analysis results before bag spiking).

V_m = Gas volume indicated by dry gas meter, liters.

v_s = volume of stack gas sampled with spiked train (L).

v_u = volume of stack gas sampled with unspiked train (L).

X = Mole or volume fraction of the organic in the calibration gas to be diluted.

Y = Dry gas meter calibration factor, dimensionless.

μl = Liquid organic density as determined, g/ml.

24.055 = Ideal gas molar volume at 293 °K and 760 mm Hg, liters/g-mole.

1000 = Conversion factor, ml/liter.

10^6 = Conversion to ppm.

12.2 Calculate the concentration, C_s, in ppm using the following equation:

$$C_s = \frac{10^6 \, (\bar{X} \, q_c)}{q_c + q_d} \qquad \text{Eq. 18-1}$$

12.3 Calculate the concentration, C_s, in ppm of the organic in the final gas mixture using the following equation:

$$C_s = 10^6 \bar{X} \left(\frac{q_{c1}}{q_{c1} + q_{d1}} \right) \left(\frac{q_{c2}}{q_{c2} + q_{d2}} \right) \qquad \text{Eq. 18-2}$$

12.4 Calculate each organic standard concentration, C_s, in ppm using the following equation:

$$C_s = \frac{G_v \times 10^6 \, \frac{293}{T_s} \, \frac{P_s}{760}}{V_m \, Y \, \frac{293}{T_m} \, \frac{P_m}{760} \, 1000} = \frac{G_v \times 10^3 \, \frac{P_s}{T_s} \, \frac{T_m}{P_m}}{V_m \, Y} \qquad \text{Eq. 18-3}$$

12.5 Calculate each organic standard concentration, C_s, in ppm using the following equation:

$$C_s = \frac{\frac{L_v}{M}\rho(24.055\times10^6)}{V_m Y \frac{293}{T_m}\frac{P_m}{760}1000} = 6.24\times10^4 \frac{L_v \rho T_m}{M V_m Y P_m} \qquad \text{Eq. 18-4}$$

12.6 Calculate the concentration, C_c, in ppm, dry basis, of each organic is the sample using the following equation:

$$C_c = \frac{C_s P_r T_i F_r}{P_i T_r (1-B_{ws})} \qquad \text{Eq. 18-5}$$

12.7 Calculate the average fraction recovered (R) of each spiked target compound using the following equation:

$$R = \frac{t-u}{s} \qquad \text{Eq. 18-6}$$

12.8 Correct all field measurements with the calculated R value for that compound using the following equation:

$$\text{Reported Result} = \frac{\text{Measured Concentration (ppm)}}{R} \qquad \text{Eq. 18-7}$$

12.9 Determine the mass per volume of spiked compound measured using the following equation:

$$m_v = \frac{m_s}{v_s} - \frac{m_u}{v_u} \qquad \text{Eq. 18-8}$$

12.10 Calculate the fraction of spiked compound recovered, R, using the following equation:

$$R = \frac{m_v \times v_s}{S} \qquad \text{Eq. 18-9}$$

13.0 Method Performance.

13.1 Gas chromatographic techniques typically provide a precision of 5 to 10 percent relative standard deviation (RSD), but an experienced GC operator with a reliable instrument can readily achieve 5 percent RSD. For this method, the following combined GC/operator values are required.

(a) Precision. Duplicate analyses are within 5 percent of their mean value.

(b) Accuracy. Analysis results of prepared audit samples are within 10 percent of preparation values.

(c) Recovery. After developing an appropriate sampling and analytical system for the pollutants of interest, conduct the procedure in Section 8.4. Conduct the appropriate recovery study in Section 8.4 at each sampling point where the method is being applied. Submit the data and results of the recovery procedure with the reporting of results under Section 8.3.

14.0 Pollution Prevention. [Reserved]

15.0 Waste Management. [Reserved]

16.0 Alternative Procedures.

16.1 Adsorption Tube Procedure (Alternative Procedure). It is suggested that the tester refer to the National Institute for Occupational Safety and Health (NIOSH) method for the particular organics to be sampled. The principal interferent will be water vapor. If water vapor is present at concentrations above 3 percent, silica gel should be used in front of the charcoal. Where more than one compound is present in the emissions, then develop relative adsorptive capacity information.

16.1.1 Additional Apparatus. In addition to the equipment listed in the NIOSH method for the particular organic(s) to be sampled, the following items (or equivalent) are suggested.

16.1.1.1 Probe (Optional). Borosilicate glass or stainless steel, approximately 6-mm ID, with a heating system if water condensation is a problem, and a filter (either in-stack or out-stack heated to stack temperature) to remove particulate matter. In most instances, a plug of glass wool is a satisfactory filter.

16.1.1.2 Flexible Tubing. To connect probe to adsorption tubes. Use a material that exhibits minimal sample adsorption.

16.1.1.3 Leakless Sample Pump. Flow controlled, constant rate pump, with a set of limiting (sonic) orifices to provide pumping rates from approximately 10 to 100 cc/min.

16.1.1.4 Bubble-Tube Flowmeter. Volume accuracy within 1 percent, to calibrate pump.

16.1.1.5 Stopwatch. To time sampling and pump rate calibration.

16.1.1.6 Adsorption Tubes. Similar to ones specified by NIOSH, except the amounts of adsorbent per primary/backup sections are 800/200 mg for charcoal tubes and 1040/260 mg for silica gel tubes. As an alternative, the tubes may contain a porous polymer adsorbent such as Tenax GC or XAD-2.

16.1.1.7 Barometer. Accurate to 5 mm Hg, to measure atmospheric pressure during sampling and pump calibration.

16.1.1.8 Rotameter. 0 to 100 cc/min, to detect changes in flow rate during sampling.

16.1.2 Sampling and Analysis.

16.1.2.1 It is suggested that the tester follow the sampling and analysis portion of the respective NIOSH method section entitled "Procedure." Calibrate the pump and limiting orifice flow rate through adsorption tubes with the bubble tube flowmeter before sampling. The sample system can be operated as a "recirculating loop" for this operation. Record the ambient temperature and barometric pressure. Then, during sampling, use the rotameter to verify that the pump and orifice sampling rate remains constant.

16.1.2.2 Use a sample probe, if required, to obtain the sample at the centroid of the duct, or at a point no closer to the walls than 1 m. Minimize the length of flexible tubing between the probe and adsorption tubes. Several adsorption tubes can be connected in series, if the extra adsorptive capacity is needed. Provide the gas sample to the sample system at a pressure sufficient for the limiting orifice to function as a sonic orifice. Record the total time and sample flow rate (or the number of pump strokes), the barometric pressure, and ambient temperature. Obtain a total sample volume commensurate with the expected concentration(s) of the volatile organic(s) present, and recommended sample loading factors (weight sample per weight adsorption media). Laboratory tests prior to actual sampling may be necessary to predetermine this volume. When more than one organic is present in the emissions, then develop relative adsorptive capacity information. If water vapor is present in the sample at concentrations above 2 to 3 percent, the adsorptive capacity may be severely reduced. Operate the gas chromatograph according to the manufacturer's instructions. After establishing optimum conditions, verify and document these conditions during all operations. Analyze the audit samples (see Section 16.1.4.3), then the emission samples. Repeat the analysis of each sample until the relative deviation of two consecutive injections does not exceed 5 percent.

16.1.3 Standards and Calibration. The standards can be prepared according to the respective NIOSH method. Use a minimum of three different standards; select the concentrations to bracket the expected average sample concentration. Perform the calibration before and after each day's sample analyses. Prepare the calibration curve by using the least squares method.

16.1.4 Quality Assurance.

16.1.4.1 Determine the recovery efficiency of the pollutants of interest according to Section 8.4.

16.1.4.2 Determination of Sample Collection Efficiency. For the source samples, analyze the primary and backup portions of the adsorption tubes separately. If the backup portion exceeds 10 percent of the total amount (primary and back-up), repeat the sampling with a larger sampling portion.

16.1.4.3 Analysis Audit. Immediately before the sample analyses, analyze the two audits in accordance with Section 16.1.2. The analysis audit shall agree with the audit concentration within 10 percent.

16.1.4.4 Pump Leak Checks and Volume Flow Rate Checks. Perform both of these checks immediately after sampling with all sampling train components in place. Perform all leak-checks according to the manufacturer's instructions, and record the results. Use the bubble-tube flowmeter to measure the pump volume flow rate with the orifice used in the test sampling, and record the result. If it has changed by more than 5 but less than 20 percent, calculate an average flow rate for the test. If the flow rate has changed by more than 20 percent, recalibrate the pump and repeat the sampling.

16.1.4.5 Calculations. All calculations can be performed according to the respective NIOSH method. Correct all sample volumes to standard conditions. If a sample dilution system has been used, multiply the results by the appropriate dilution ratio. Correct all results according to the applicable procedure in Section 8.4. Report results as ppm by volume, dry basis.

17.0 References.

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Columbia Parkway, Cincinnati, Ohio 45226. April 1977 - August 1981. May be available from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Stock Number/Price:

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Volume 6 - 017-033-00369-6/$9,
Volume 7 - 017-033-00396-5/$7.

Prices subject to change. Foreign orders add 25 percent.

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18.0 Tables, Diagrams, Flowcharts, and Validation Data.

I. Name of company ____________________ Date __________

Address ______________________________

____

Contacts ____________________ Phone __________

Process to be sampled ______________________________

____

____

Duct or vent to be sampled ______________________________

____

II. Process description ______________________________

____

____

____

____

Raw material ______________________________

____

____

Products ______________________________

____

____

Operating cycle

Check: Batch ________ Continuous ________ Cyclic ________

Timing of batch or cycle ______________________________

Best time to test ___________________________________

Figure 18-1. Preliminary survey data sheet.

III. Sampling site

A. Description

Site description ______________________________
Duct shape and size ______________________________
Material ______________________________
Wall thickness ______________________________ inches
Upstream distance __________ inches __________ diameter
Downstream distance __________ inches __________ diameter
Size of port ______________________________
Size of access area ______________________________
Hazards ____________________ Ambient temp. __________ °F

B. Properties of gas stream

Temperature __________ °C __________ °F, Date source __________
Velocity ____________________, Data source __________
Static pressure __________ inches H_2O, Data source __________
Moisture content ____________________ %, Data source __________
Particulate content ____________________, Data source __________
Gaseous components
N_2 __________ % Hydrocarbons __________ ppm
O_2 __________ % __________ __________
CO __________ % __________ __________
CO_2 __________ % __________ __________
SO_2 __________ % __________ __________

Hydrocarbon components
__________ __________ ppm
__________ __________ ppm
__________ __________ ppm
__________ __________ ppm
__________ __________ ppm
__________ __________ ppm

Figure 18-1 (continued). Preliminary survey data sheet.

C. Sampling considerations

Location to set up GC ______________________________

Special hazards to be considered ______________________________

Power available at duct ______________________________

Power available for GC ______________________________

Plant safety requirements ______________________________

Vehicle traffic rules ______________________________

Plant entry requirements ______________________________

Security agreements ______________________________

Potential problems ______________________________

D. Site diagrams. (Attach additional sheets if required).

Figure 18-1 (continued). Preliminary survey data sheet.

Components_to_be_analyzed	Expected_concentration
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________

Suggested chromatographic column ______________________________
____

Column flow rate ________ ml/min   Head pressure ________ mm Hg

Column temperature:

Isothermal ____________ °C

Programmed from ________ °C to ________ °C at ________ °C/min

Injection port/sample loop temperature ________ °C

Detector temperature ________ °C

Detector flow rates: Hydrogen ________ ml/min.

head pressure ________ mm Hg

Air/Oxygen ________ ml/min.

head pressure ________ mm Hg

Chart speed ____________ inches/minute

Compound data:

Compound	Retention_time	Attenuation
________	______________	___________
________	______________	___________
________	______________	___________
________	______________	___________

Figure 18-2. Chromatographic conditions data sheet.

Figure 18-3. **Preparation of Standards in Tedlar Bags and Calibration Curve.**

	Standards		
Standards Preparation Data:	Mixture #1	Mixture #2	Mixture #3
Organic:			
Bag number or identification			
Dry gas meter calibration factor			
Final meter reading (liters)			
Initial meter reading (liters)			
Metered volume (liters)			
Average meter temperature(°K)			
Average meter pressure, gauge (mm Hg)			
Average atmospheric pressure (mm Hg)			
Average meter pressure, absolute (mm Hg)			
Syringe temperature (°K) (see Section 10.1.2.1)			
Syringe pressure, absolute (mm Hg) (see Section 10.1.2.1)			
Volume of gas in syringe (ml) (Section 10.1.2.1)			
Density of liquid organic (g/ml) (Section 10.1.2.2)			
Volume of liquid in syringe (ml) (Section 10.1.2.2)			

GC Operating Conditions:

Sample loop volume (ml)			
Sample loop temperature (°C)			
Carrier gas flow rate (ml/min)			
Column temperature			
Initial (°C)			
Rate change (°C/min)			
Final (°C)			

Organic Peak Identification and Calculated Concentrations:

Injection time (24 hour clock)			
Distance to peak (cm)			
Chart speed (cm/min)			
Organic retention time (min)			
Attenuation factor			
Peak height (mm)			
Peak area (mm$_2$)			
Peak area * attenuation factor (mm$_2$)			
Calculated concentration (ppm) (Equation 18-3 or 18-4)			

Plot peak area * attenuation factor against calculated concentration to obtain calibration curve.

Figure 18-3 (continued). Standards prepared in Tedlar bags and calibration curve.

Figure 18-4. Flowmeter Calibration.

Flowmeter number or identification ____________________

Flowmeter Type ____________________

Method: Bubble meter _____ Spirometer _____ Wet test meter _____

Readings at laboratory conditions:

Laboratory temperature (T_{lab}) _______ °K

Laboratory barometric pressure (P_{lab}) _______ mm Hg

Flow data:

	Flowmeter	
reading (as marked)	temp. (°K)	pressure (absolute)

	Calibration device	
Time (min)	Gas Volume[a]	Flow Rate[b]

[a] Vol. of gas may be measured in milliliters, liters or cubic feet.

[b] Convert to standard conditions (20°C and 760 mm Hg).

Plot flowmeter reading against flow rate (standard conditions), and draw a smooth curve. If the flowmeter being calibrated is a rotameter or other flow device that is viscosity dependent, it may be necessary to generate a "family" of calibration curves that cover the operating pressure and temperature ranges of the flowmeter.

While the following technique should be verified before application, it may be possible to calculate flow rate reading for rotameters at standard conditions Q_{std} as follows:

$$Q_{std} = Q_{lab}\left(\frac{760 \times T_{lab}}{P_{lab} \times 293}\right)^{1/2}$$

Flow rate (laboratory conditions)	Flow rate (STD_conditions)

Figure 18-4 (continued). Flowmeter calibration.

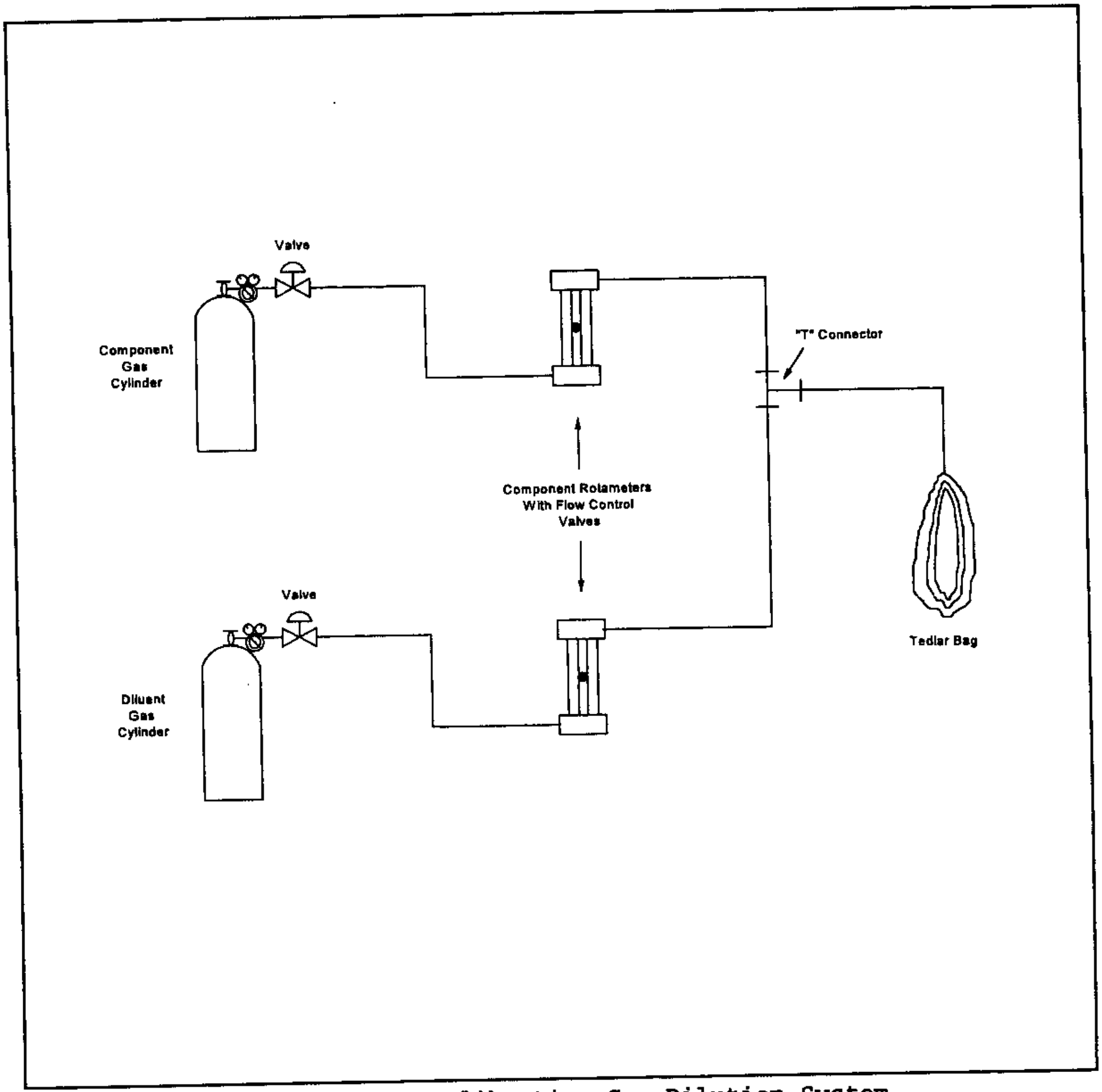

Figure 18-5. Single-Stage Calibration Gas Dilution System.

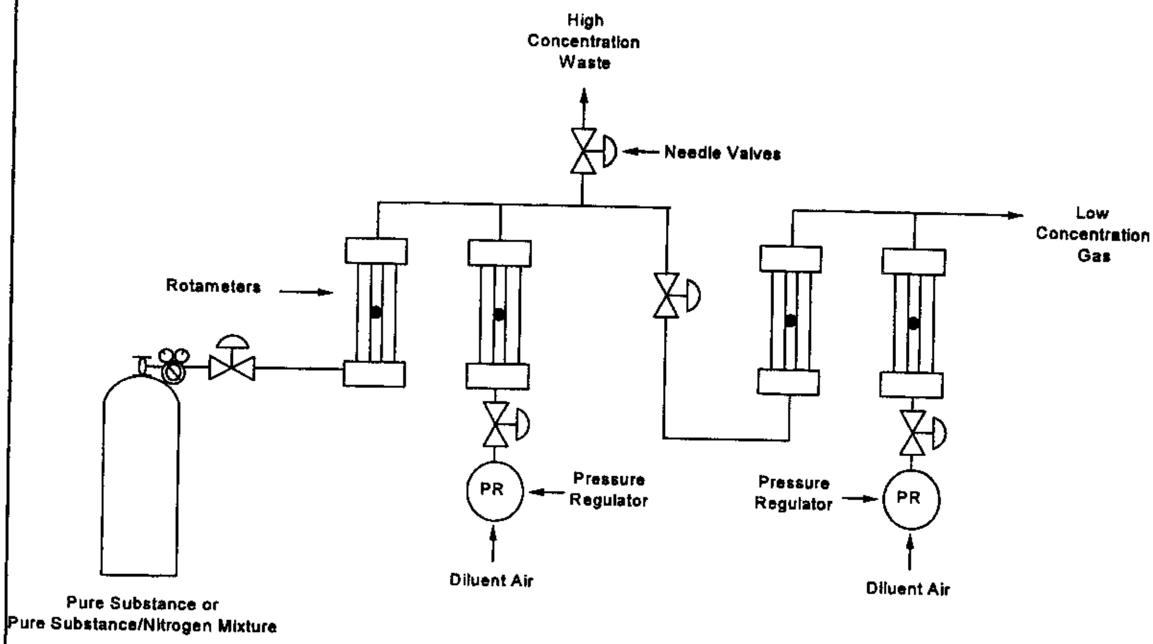

Figure 18-6. Two-Stage Dilution Apparatus.

Preparation of Standards by Dilution of Cylinder Standard

Cylinder Standard: Organic __________ Certified Concentration _____ ppm

Standards Preparation Data: Date:

Stage 1	Mixture 1	Mixture 2	Mixture 3
Standard gas flowmeter reading			
Diluent gas flowmeter reading			
Laboratory temperature (°K)			
Barometric pressure (mm Hg)			
Flowmeter gage pressure (mm Hg)			
Flow rate cylinder gas at standard conditions (ml/min)			
Flow rate diluent gas at standard conditions (ml/min)			
Calculated concentration (ppm)			
Stage 2 (if used)			
Standard gas flowmeter reading			
Diluent gas flowmeter reading			
Flow rate Stage 1 gas at standard conditions (ml/min)			
Flow rate diluent gas at standard conditions			
Calculated concentration (ppm)			
GC Operating Conditions:			

Sample loop volume (ml)			
Sample loop temperature (°C)			
Carrier gas flow rate (ml/min)			
Column temperature:			
Initial (°C)			
Program rate (°C/min)			
Final (°C)			

Organic Peak Identification and Calculated Concentrations:			
Injection time (24-hour clock)			
Distance to peak (cm)			
Chart speed (cm/min)			
Retention time (min)			
Attenuation factor			
Peak area (mm^2)			
Peak area * attenuation factor			

Plot peak area * attenuation factor against calculated concentration to obtain calibration curve.

Figure 18-7. Standards prepared by dilution of cylinder standard.

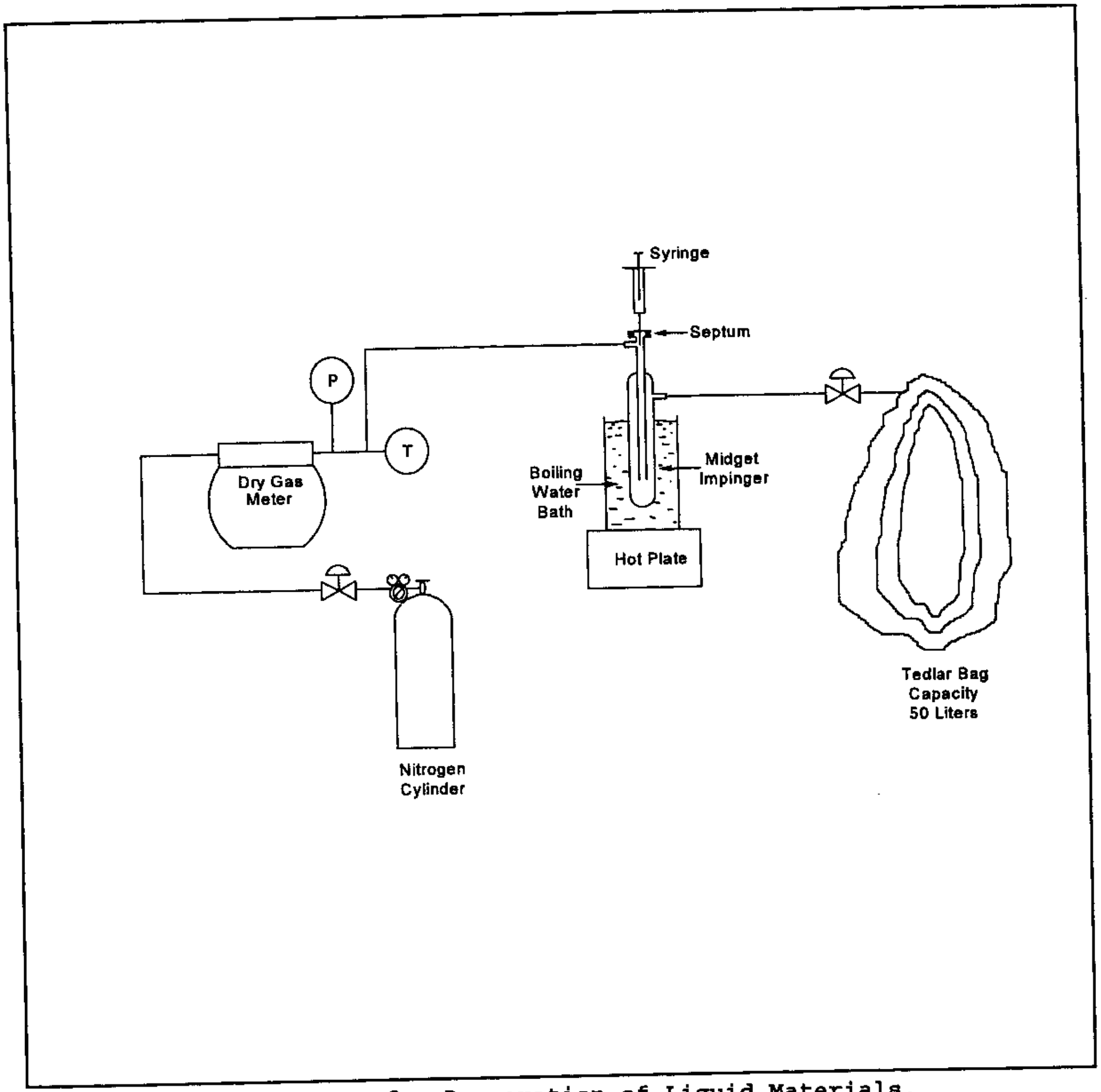

Figure 18-8. Apparatus for Preparation of Liquid Materials.

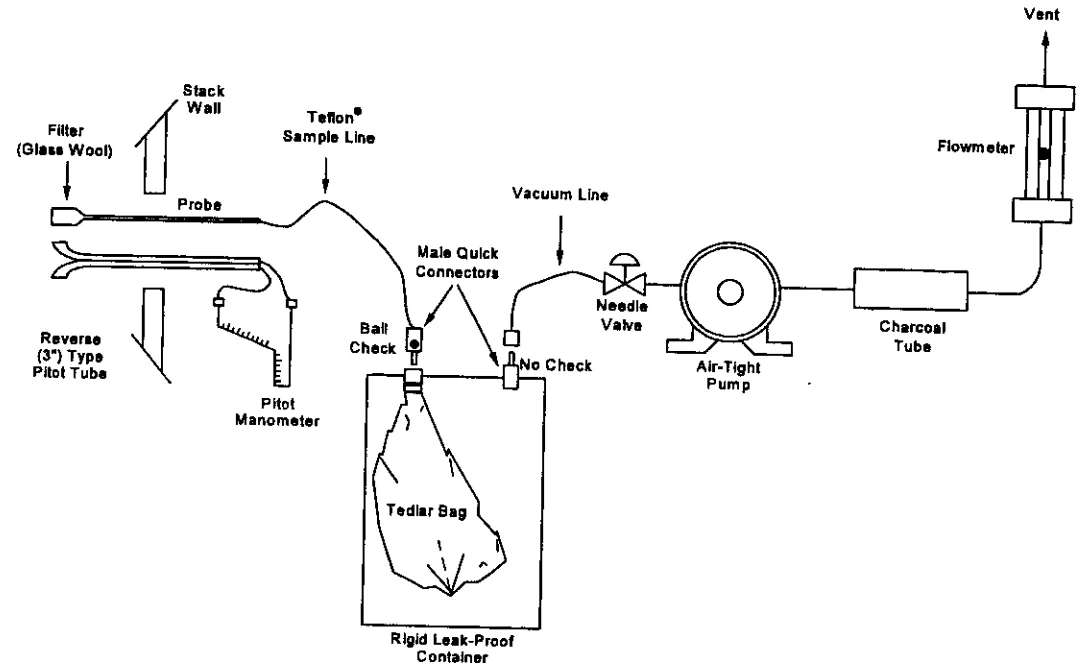

Figure 18-9. Integrated Bag Sampling Train.

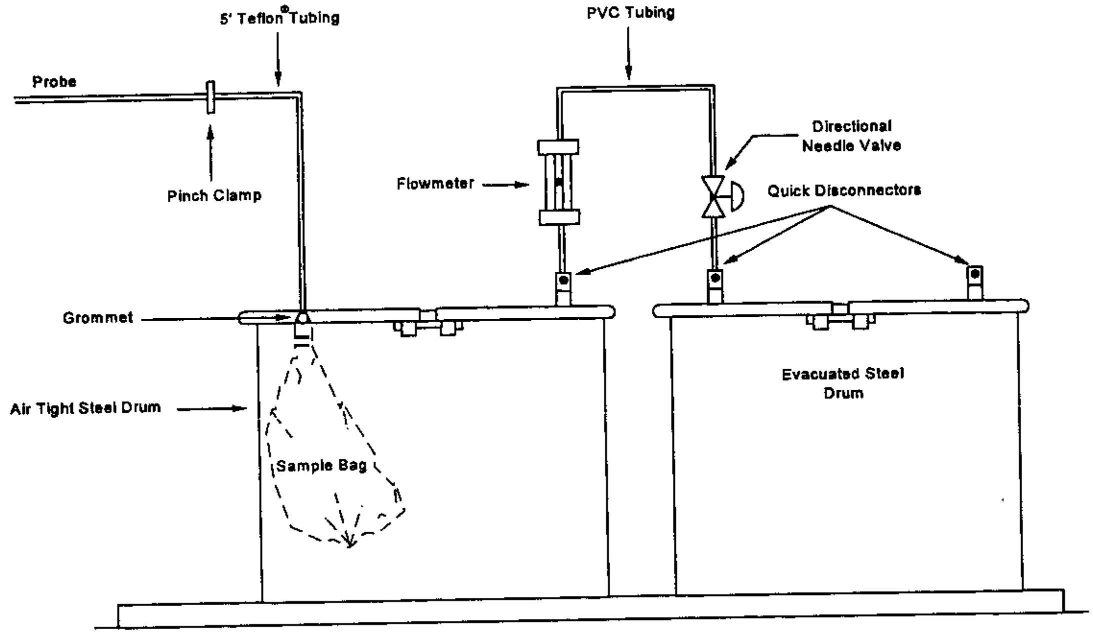

Figure 18-9a. Explosion Risk Gas Sampling Method.

Plant ______________________ Date ______________

Site ____

	Sample_1	Sample_2	Sample_3
Source temperature (°C)	______	______	______
Barometric pressure (mm Hg)	______	______	______
Ambient temperature (°C)	______	______	______
Sample flow rate (appr.)	______	______	______
Bag number	______	______	______
Start time	______	______	______
Finish time	______	______	______

Figure 18-10. Field sample data sheet - Tedlar bag collection method.

Plant ______________________ Date ______________________

Location ____

1. General information

Source temperature (°C)	________
Probe temperature (°C)	________
Ambient temperature (°C)	________
Atmospheric pressure (mm)	________
Source pressure ("Hg)	________
Absolute source pressure (mm)	________
Sampling rate (liter/min)	________
Sample loop volume (ml)	________
Sample loop temperature (°C)	________
Columnar temperature:	
Initial (°C) time (min)	________
Program rate (°C/min)	________
Final (°C)/time (min)	________
Carrier gas flow rate (ml/min)	________
Detector temperature (°C)	________
Injection time (24-hour basis)	________
Chart speed (mm/min)	________
Dilution gas flow rate (ml/min)	________
Dilution gas used (symbol)	________
Dilution ratio	________

Figure 18-11. Field analysis data sheets.

2. Field Analysis Data - Calibration Gas

Run No. ____________ Time ____________

Components	Area	Attenuation	A_x_A_Factor	Conc._(ppm)

Run No. ____________ Time ____________

Components	Area	Attenuation	A_x_A_Factor	Conc._(ppm)

Run No. ____________ Time ____________

Components	Area	Attenuation	A_x_A_Factor	Conc._(ppm)

Figure 18-11 (continued). Field analysis data sheets.

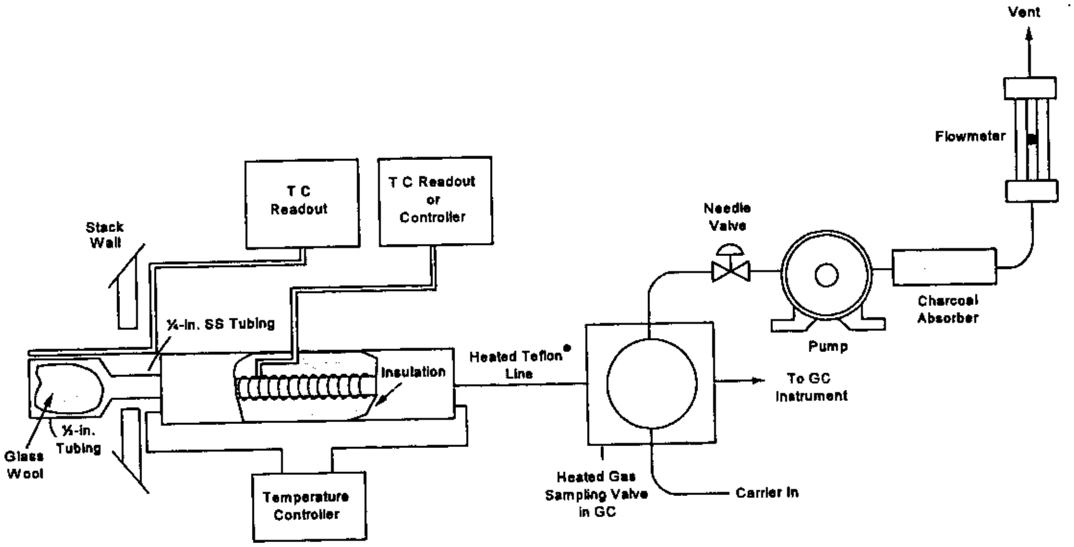

Figure 18-12. Direct Interface Sampling System.

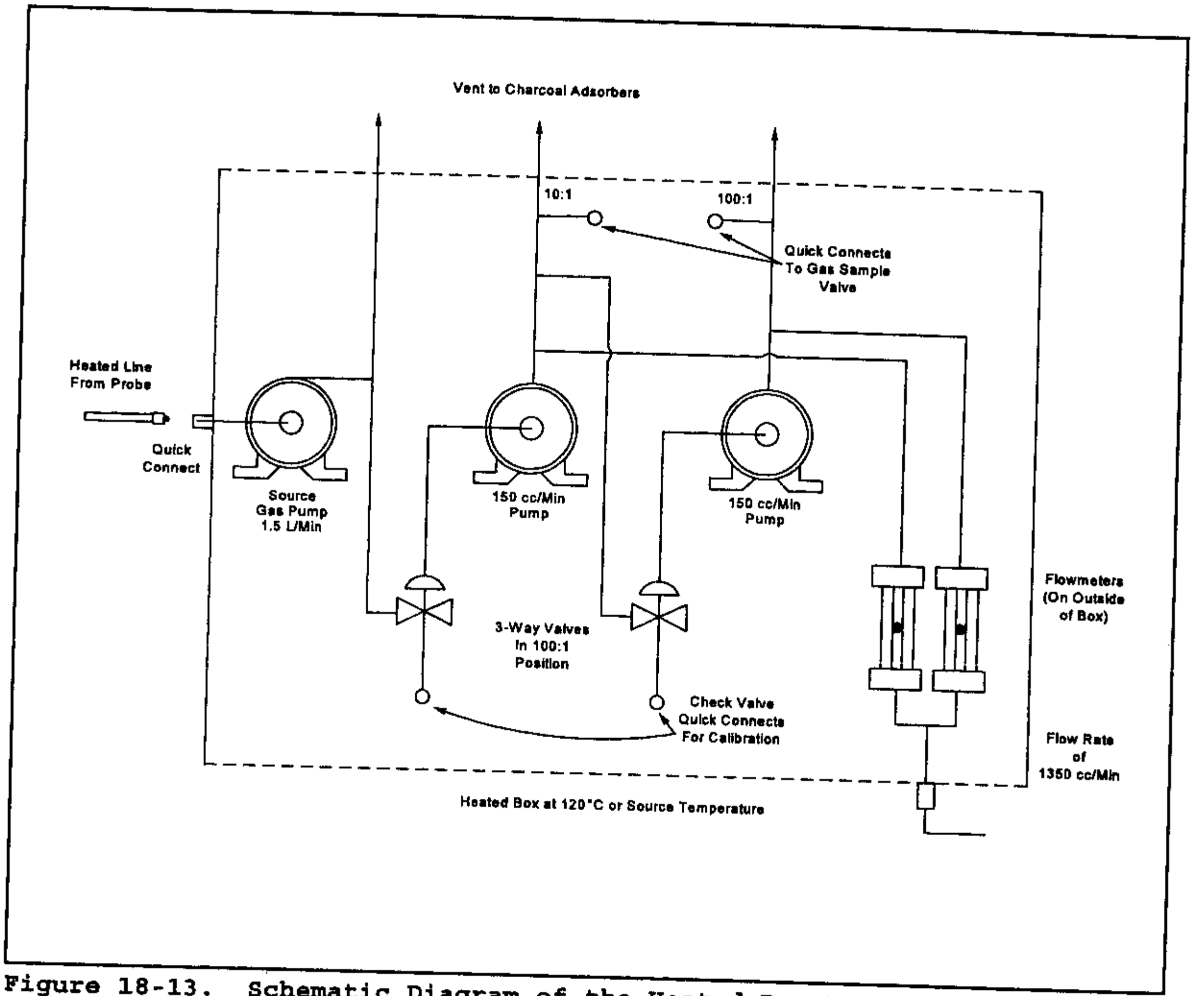

Figure 18-13. Schematic Diagram of the Heated Box Required for Dilution of Sample Gas.

Gaseous Organic Sampling and Analysis Check List

(Respond with initials or number as appropriate)

Date

1. Presurvey data
   - A. Grab sample collected ☐ ______
   - B. Grab sample analyzed for composition ☐ ______
     - Method GC ☐
     - GC/MS ☐
     - Other ______________ ☐
   - C. GC-FID analysis performed ☐ ______
2. Laboratory calibration data
   - A. Calibration curves prepared ☐ ______
     - Number of components ☐
     - Number of concentrations/ component (3 required) ☐
   - B. Audit samples (optional)
     - Analysis completed ☐ ______
     - Verified for concentration ☐ ______
     - OK obtained for field work ☐ ______
3. Sampling procedures
   - A. Method
     - Bag sample ☐
     - Direct interface ☐
     - Dilution interface ☐
   - B. Number of samples collected ☐ ______
4. Field Analysis
   - A. Total hydrocarbon analysis performed ☐ ______

B. Calibration curve prepared ☐ ______

Number of components ☐

Number of concentrations per component (3 required) ☐

Gaseous Organic Sampling and Analysis Data

Plant ______________________________
Date ______________
Location ______________________________

	Source sample_1	Source sample_2	Source sample_3
1. General information			
Source temperature (°C)			
Probe temperature (°C)			
Ambient temperature (°C)			
Atmospheric pressure (mm Hg)			
Source pressure (mm Hg)			
Sampling rate (ml/min)			
Sample loop volume (ml)			
Sample loop temperature (°C)			
Sample collection time (24-hr basis)			
Column temperature			
Initial (°C)			
Program rate (°C/min)			
Final (°C)			
Carrier gas flow rate (ml/min)			
Detector temperature (°C)			
Chart speed (cm/min)			
Dilution gas flow rate (ml/min)			
Diluent gas used (symbol)			
Dilution ratio			

Performed by:
(signature): ______________________ Date: ______________

Figure 18-14. Sampling and analysis sheet.

APPENDIX F.6

EPA METHOD 315

APPENDIX A TO PART 63--TEST METHODS

* * * * *

METHOD 315 - DETERMINATION OF PARTICULATE AND METHYLENE CHLORIDE EXTRACTABLE MATTER (MCEM) FROM SELECTED SOURCES AT PRIMARY ALUMINUM PRODUCTION FACILITIES

NOTE: This method does not include all of the specifications (e.g., equipment and supplies) and procedures (e.g., sampling and analytical) essential to its performance. Some material is incorporated by reference from other methods in this part. Therefore, to obtain reliable results, persons using this method should have a thorough knowledge of at least the following additional test methods: Method 1, Method 2, Method 3, and Method 5 of 40 CFR part 60, appendix A.

1.0 Scope and Application.

1.1 Analytes. Particulate matter (PM). No CAS number assigned. Methylene chloride extractable matter (MCEM). No CAS number assigned.

1.2 Applicability. This method is applicable for the simultaneous determination of PM and MCEM when specified in an applicable regulation. This method was developed by consensus with the Aluminum Association and the U.S. Environmental Protection Agency (EPA) and has limited precision estimates for MCEM; it should have similar precision to Method 5 for PM in 40 CFR part 60, appendix A since the procedures are similar for PM.

1.3 Data quality objectives. Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sampling methods.

2.0 Summary of Method.

Particulate matter and MCEM are withdrawn isokinetically from the source. PM is collected on a glass fiber filter maintained at a temperature in the range of 120 ± 14°C (248 ± 25°F) or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator for a particular application. The PM mass, which includes any material that condenses on the probe and is subsequently removed in an acetone rinse or on the filter at or above the filtration temperature, is determined gravimetrically after removal of uncombined water. MCEM is then determined by adding a methylene chloride rinse of the probe and filter holder, extracting the condensable hydrocarbons collected in the impinger water, adding an acetone rinse followed by a methylene chloride rinse of the sampling train components after the filter and before the silica gel impinger, and determining residue gravimetrically after evaporating the solvents.

3.0 Definitions. [Reserved]

4.0 Interferences. [Reserved]

5.0 Safety.

This method may involve hazardous materials, operations, and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to performing this test method.

6.0 Equipment and Supplies.

NOTE: Mention of trade names or specific products does not constitute endorsement by the EPA.

6.1 Sample collection. The following items are required for sample collection:

6.1.1 Sampling train. A schematic of the sampling train used in this method is shown in Figure 5-1, Method 5, 40 CFR part 60, appendix A. Complete construction details are given in APTD-0581 (Reference 2 in section 17.0 of this method); commercial models of this train are also available. For changes from APTD-0581 and for allowable modifications of the train shown in Figure 5-1, Method 5, 40 CFR part 60, appendix, A see the following subsections.

NOTE: The operating and maintenance procedures for the sampling train are described in APTD-0576 (Reference 3 in section 17.0 of this method). Since correct usage is important in obtaining valid results, all users should read APTD-0576 and adopt the operating and maintenance procedures outlined in it, unless otherwise specified herein. The use of grease for sealing sampling train components is not recommended because many greases are soluble in methylene chloride. The sampling train consists of the following components:

6.1.1.1 Probe nozzle. Glass or glass lined with sharp, tapered leading edge. The angle of taper shall be ≤30°, and the taper shall be on the outside to preserve a constant internal diameter. The probe nozzle shall be of the button-hook or elbow design, unless otherwise specified by the Administrator. Other materials of construction may be used, subject to the approval of the Administrator. A range of nozzle sizes suitable for isokinetic sampling should be available. Typical nozzle sizes range from 0.32 to 1.27 cm (1/8 to 1/2 in.) inside diameter (ID) in increments of 0.16 cm (1/16 in.). Larger nozzle sizes are also available if higher volume sampling trains are used. Each nozzle shall be calibrated according to the procedures outlined in section 10.0 of this method.

6.1.1.2 Probe liner. Borosilicate or quartz glass tubing with a heating system capable of maintaining a probe gas temperature at the exit end during sampling of 120 ± 14°C (248 ± 25°F), or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator for a particular application. Because the actual temperature at the outlet of the probe is not usually monitored during sampling, probes constructed according to APTD-0581 and using the calibration curves of APTD-0576 (or calibrated according to the procedure outlined in APTD-0576) will be considered acceptable. Either borosilicate or quartz glass probe liners may be used for stack temperatures up to about 480°C (900°F); quartz liners shall be used for temperatures between 480 and 900°C (900 and 1,650°F). Both types of liners may be used at higher temperatures than specified for short periods of time, subject to the approval of the Administrator. The softening temperature for borosilicate glass is 820°C (1,500°F) and for quartz glass it is 1,500°C (2,700°F).

6.1.1.3 Pitot tube. Type S, as described in section 6.1 of Method 2, 40 CFR part 60, appendix A, or other device approved by the Administrator. The pitot tube shall be attached to the probe (as shown in Figure 5-1 of Method 5, 40 CFR part 60, appendix A) to allow constant monitoring of the stack gas velocity. The impact (high pressure) opening plane of the pitot tube shall be even with or above the nozzle entry plane (see Method 2, Figure 2-6b, 40 CFR part 60, appendix A) during sampling. The Type S pitot tube assembly shall have a known coefficient, determined as outlined in section 10.0 of Method 2, 40 CFR part 60, appendix A.

6.1.1.4 Differential pressure gauge. Inclined manometer or equivalent device (two), as described in section 6.2 of Method 2, 40 CFR part 60, appendix A. One manometer shall be used for velocity head (Dp) readings, and the other, for orifice differential pressure readings.

6.1.1.5 Filter holder. Borosilicate glass, with a glass frit filter support and a silicone rubber gasket. The holder design shall provide a positive seal against leakage from the outside or around the filter. The holder shall be attached immediately at the outlet of the probe (or cyclone, if used).

6.1.1.6 Filter heating system. Any heating system capable of maintaining a temperature around the filter holder of 120 ± 14°C (248 ± 25°F) during sampling, or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator for a particular application. Alternatively, the tester may opt to operate the equipment at a temperature lower than that specified. A temperature gauge capable of measuring temperature to within 3°C (5.4°F) shall be installed so that the temperature around the filter holder can be regulated and monitored during sampling. Heating systems other than the one shown in APTD-0581 may be used.

6.1.1.7 Temperature sensor. A temperature sensor capable of measuring temperature to within ±3°C (5.4°F) shall be installed so that the sensing tip of the temperature sensor is in direct contact with the sample gas, and the temperature around the filter holder can be regulated and monitored during sampling.

6.1.1.8 Condenser. The following system shall be used to determine the stack gas moisture content: four glass impingers connected in series with leak-free ground glass fittings. The first, third, and fourth impingers shall be of the Greenburg-Smith design, modified by replacing the tip with a 1.3 cm (1/2 in.) ID glass tube extending to about 1.3 cm (1/2 in.) from the bottom of the flask. The second impinger shall be of the Greenburg-Smith design with the standard tip. The first and second impingers shall contain known quantities of water (section 8.3.1 of this method), the third shall be empty, and the fourth shall contain a known weight of silica gel or equivalent desiccant. A temperature sensor capable of measuring temperature to within 1°C (2°F) shall be placed at the outlet of the fourth impinger for monitoring.

6.1.1.9 Metering system. Vacuum gauge, leak-free pump, temperature sensors capable of measuring temperature to within 3°C (5.4°F), dry gas meter (DGM) capable of measuring volume to within 2 percent, and related equipment, as shown in Figure 5-1 of Method 5, 40 CFR part 60, appendix A. Other metering systems capable of maintaining sampling rates within 10 percent of isokinetic and of determining sample volumes to within 2 percent may be used, subject to the approval of the Administrator. When the metering system is used in conjunction with a pitot tube, the system shall allow periodic checks of isokinetic rates.

6.1.1.10 Sampling trains using metering systems designed for higher flow rates than that described in APTD-0581 or APTD-0576 may be used provided that the specifications of this method are met.

6.1.2 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm (0.1 in.) Hg.

NOTE: The barometric reading may be obtained from a nearby National Weather Service station. In this case, the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be made at a rate of minus 2.5 mm (0.1 in) Hg per 30 m (100 ft) elevation increase or plus 2.5 mm (0.1 in) Hg per 30 m (100 ft) elevation decrease.

6.1.3 Gas density determination equipment. Temperature sensor and pressure gauge, as described in sections 6.3 and 6.4 of Method 2, 40 CFR part 60, appendix A, and gas analyzer, if necessary, as described in Method 3, 40 CFR part 60, appendix A. The temperature sensor shall, preferably, be permanently attached to the pitot tube or sampling probe in a fixed configuration, such that the tip of the sensor extends beyond the leading edge of the probe sheath and does not touch any metal. Alternatively, the sensor may be attached just prior to use in the field. Note, however, that if the temperature sensor is attached in the field, the sensor must be placed in an interference-free arrangement with respect to the Type S pitot tube openings (see Method 2, Figure 2-4, 40 CFR part 60, appendix A). As a second alternative, if a difference of not more than 1 percent in the average velocity measurement is to be introduced, the temperature sensor need not be attached to the probe or pitot tube. (This alternative is subject to the approval of the Administrator.)

6.2 Sample recovery. The following items are required for sample recovery:

6.2.1 Probe-liner and probe-nozzle brushes. Nylon or Teflon® bristle brushes with stainless steel wire handles. The probe brush shall have extensions (at least as long as the probe) constructed of stainless steel, nylon, Teflon®, or similarly inert material. The brushes shall be properly sized and shaped to brush out the probe liner and nozzle.

6.2.2 Wash bottles. Glass wash bottles are recommended. Polyethylene or tetrafluoroethylene (TFE) wash bottles may be used, but they may introduce a positive bias due to contamination from the bottle. It is recommended that acetone not be stored in polyethylene or TFE bottles for longer than a month.

6.2.3 Glass sample storage containers. Chemically resistant, borosilicate glass bottles, for acetone and methylene chloride washes and impinger water, 500 ml or 1,000 ml. Screw-cap liners shall either be rubber-backed Teflon® or shall be constructed so as to be leak-free and resistant to chemical attack by acetone or methylene chloride. (Narrow-mouth glass bottles have been found to be less prone to leakage.) Alternatively, polyethylene bottles may be used.

6.2.4 Petri dishes. For filter samples, glass, unless otherwise specified by the Administrator.

6.2.5 Graduated cylinder and/or balance. To measure condensed water, acetone wash and methylene chloride wash used during field recovery of the samples, to within 1 ml or 1 g. Graduated cylinders shall have subdivisions no greater than 2 ml. Most laboratory balances are capable of weighing to the nearest 0.5 g or less. Any such balance is suitable for use here and in section 6.3.4 of this method.

6.2.6 Plastic storage containers. Air-tight containers to store silica gel.

6.2.7 Funnel and rubber policeman. To aid in transfer of silica gel to container; not necessary if silica gel is weighed in the field.

6.2.8 Funnel. Glass or polyethylene, to aid in sample recovery.

6.3 Sample analysis. The following equipment is required for sample analysis:

6.3.1 Glass or Teflon® weighing dishes.

6.3.2 Desiccator. It is recommended that fresh desiccant be used to minimize the chance for positive bias due to absorption of organic material during drying.

6.3.3 Analytical balance. To measure to within 0.1 mg.

6.3.4 Balance. To measure to within 0.5 g.

6.3.5 Beakers. 250 ml.

6.3.6 Hygrometer. To measure the relative humidity of the laboratory environment.

6.3.7 Temperature sensor. To measure the temperature of the laboratory environment.

6.3.8 Buchner fritted funnel. 30 ml size, fine (<50 micron)-porosity fritted glass.

6.3.9 Pressure filtration apparatus.

6.3.10 Aluminum dish. Flat bottom, smooth sides, and flanged top, 18 mm deep and with an inside diameter of approximately 60 mm.

7.0 Reagents and Standards.

7.1 Sample collection. The following reagents are required for sample collection:

7.1.1 Filters. Glass fiber filters, without organic binder, exhibiting at least 99.95 percent efficiency (<0.05 percent penetration) on 0.3 micron dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM Method D 2986-95A (incorporated by reference in § 63.841 of this part). Test data from the supplier's quality control program are sufficient for this purpose. In sources containing $S0_2$ or $S0_3$, the filter material must be of a type that is unreactive to $S0_2$ or $S0_3$. Reference 10 in section 17.0 of this method may be used to select the appropriate filter.

7.1.2 Silica gel. Indicating type, 6 to 16 mesh. If previously used, dry at 175°C (350°F) for 2 hours. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to the approval of the Administrator.

7.1.3 Water. When analysis of the material caught in the impingers is required, deionized distilled water shall be used. Run blanks prior to field use to eliminate a high blank on test samples.

7.1.4 Crushed ice.

7.1.5 Stopcock grease. Acetone-insoluble, heat-stable silicone grease. This is not necessary if screw-on connectors with Teflon® sleeves, or similar, are used. Alternatively, other types of stopcock grease may be used, subject to the approval of the Administrator. [Caution: Many stopcock greases are methylene chloride-soluble. Use sparingly and carefully remove prior to recovery to prevent contamination of the MCEM analysis.]

7.2 Sample recovery. The following reagents are required for sample recovery:

7.2.1 Acetone. Acetone with blank values < 1 ppm, by weight residue, is required. Acetone blanks may be run prior to field use, and only acetone with low blank values may be used. In no case shall a blank value of greater than 1E-06 of the weight of acetone used be subtracted from the sample weight.

NOTE: This is more restrictive than Method 5, 40 CFR part 60, appendix A. At least one vendor (Supelco Incorporated located in Bellefonte, Pennsylvania) lists <1 mg/l as residue for its Environmental Analysis Solvents.

7.2.2 Methylene chloride. Methylene chloride with a blank value <1.5 ppm, by weight, residue. Methylene chloride blanks may be run prior to field use, and only methylene chloride with low blank values may be used. In no case shall a blank value of greater than 1.6E-06 of the weight of methylene chloride used be subtracted from the sample weight.

NOTE: A least one vendor quotes <1 mg/l for Environmental Analysis Solvents-grade methylene chloride.

7.3 Sample analysis. The following reagents are required for sample analysis:

7.3.1 Acetone. Same as in section 7.2.1 of this method.

7.3.2 Desiccant. Anhydrous calcium sulfate, indicating type. Alternatively, other types of desiccants may be used, subject to the approval of the Administrator.

7.3.3 Methylene chloride. Same as in section 7.2.2 of this method.

8.0 Sample Collection, Preservation, Storage, and Transport.

NOTE: The complexity of this method is such that, in order to obtain reliable results, testers should be trained and experienced with the test procedures.

8.1 Pretest preparation. It is suggested that sampling equipment be maintained according to the procedures described in APTD-0576.

8.1.1 Weigh several 200 g to 300 g portions of silica gel in airtight containers to the nearest 0.5 g. Record on each container the total weight of the silica gel plus container. As an alternative, the silica gel need not be preweighed but may be weighed directly in its impinger or sampling holder just prior to train assembly.

8.1.2 A batch of glass fiber filters, no more than 50 at a time, should placed in a soxhlet extraction apparatus and extracted using methylene chloride for at least 16 hours. After extraction, check filters visually against light for irregularities, flaws, or pinhole leaks. Label the shipping containers (glass or plastic petri dishes), and keep the filters in these containers at all times except during sampling and weighing.

8.1.3 Desiccate the filters at 20 ± 5.6°C (68 ± 10°F) and ambient pressure for at least 24 hours and weigh at intervals of at least 6 hours to a constant weight, i.e., <0.5 mg change from previous weighing; record results to the nearest 0.1 mg. During each weighing the filter must not be exposed to the laboratory atmosphere for longer than 2 minutes and a relative humidity above 50 percent. Alternatively (unless otherwise specified by the Administrator), the filters may be oven-dried at 104°C (220°F) for 2 to 3 hours, desiccated for 2 hours, and weighed. Procedures other than those described, which account for relative humidity effects, may be used, subject to the approval of the Administrator.

8.2 Preliminary determinations.

8.2.1 Select the sampling site and the minimum number of sampling points according to Method 1, 40 CFR part 60, appendix A or as specified by the Administrator. Determine the stack pressure, temperature, and the range of velocity heads using Method 2, 40 CFR part 60, appendix A; it is recommended that a leak check of the pitot lines (see section 8.1 of Method 2, 40 CFR part 60, appendix A) be performed. Determine the moisture content using Approximation Method 4 (section 1.2 of Method 4, 40 CFR part 60, appendix A) or its alternatives to make isokinetic sampling rate settings. Determine the stack gas dry molecular weight, as described in section 8.6 of Method 2, 40 CFR part 60, appendix A; if integrated Method 3 sampling is used for molecular weight determination, the integrated bag sample shall be taken simultaneously with, and for the same total length of time as, the particulate sample run.

8.2.2 Select a nozzle size based on the range of velocity heads such that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates. During the run, do not change the nozzle size. Ensure that the proper differential pressure gauge is chosen for the range of velocity heads encountered (see section 8.2 of Method 2, 40 CFR part 60, appendix A).

8.2.3 Select a suitable probe liner and probe length such that all traverse points can be sampled. For large stacks, consider sampling from opposite sides of the stack to reduce the required probe length.

8.2.4 Select a total sampling time greater than or equal to the minimum total sampling time specified in the test procedures for the specific industry such that: (l) The sampling time per point is not less than 2 minutes (or some greater time interval as specified by the Administrator); and (2) the sample volume taken (corrected to standard conditions) will exceed the required minimum total gas sample volume. The latter is based on an approximate average sampling rate.

8.2.5 The sampling time at each point shall be the same. It is recommended that the number of minutes sampled at each point be an integer or an integer plus one-half minute, in order to eliminate timekeeping errors.

8.2.6 In some circumstances (e.g., batch cycles), it may be necessary to sample for shorter times at the traverse points and to obtain smaller gas sample volumes. In these cases, the Administrator's approval must first be obtained.

8.3 Preparation of sampling train.

8.3.1 During preparation and assembly of the sampling train, keep all openings where contamination can occur covered until just prior to assembly or until sampling is about to begin. Place 100 ml of water in each of the first two impingers, leave the third impinger empty, and transfer approximately 200 to 300 g of preweighed silica gel from its container to the fourth impinger. More silica gel may be used, but care should be taken to ensure that it is not entrained and carried out from the impinger during sampling. Place the container in a clean place for later use in the sample recovery. Alternatively, the weight of the silica gel plus impinger may be determined to the nearest 0.5 g and recorded.

8.3.2 Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is properly centered and the gasket properly placed so as to prevent the sample gas stream from circumventing the filter. Check the filter for tears after assembly is completed.

8.3.3 When glass liners are used, install the selected nozzle using a Viton A 0-ring when stack temperatures are less than 260°C (500°F) and an asbestos string gasket when temperatures are higher. See APTD-0576 for details. Mark the probe with heat-resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point.

8.3.4 Set up the train as in Figure 5-l of Method 5, 40 CFR part 60, appendix A, using (if necessary) a very light coat of silicone grease on all ground glass joints, greasing only the outer portion (see APTD-0576) to avoid possibility of contamination by the silicone grease. Subject to the approval of the Administrator, a glass cyclone may be used between the probe and filter holder when the total particulate catch is expected to exceed 100 mg or when water droplets are present in the stack gas.

8.3.5 Place crushed ice around the impingers.

8.4 Leak-check procedures.

8.4.1 Leak check of metering system shown in Figure 5-l of Method 5, 40 CFR part 60, appendix A. That portion of the sampling train from the pump to the orifice meter should be leak-checked prior to initial use and after each shipment. Leakage after the pump will result in less volume being recorded than is actually sampled. The following procedure is suggested (see Figure 5-2 of Method 5, 40 CFR part 60, appendix A): Close the main valve on the meter box. Insert a one-hole rubber stopper with rubber tubing attached into the orifice exhaust pipe. Disconnect and vent the low side of the orifice manometer. Close off the low side orifice tap. Pressurize the system to l3 to l8 cm (5 to 7 in.) water column by blowing into the rubber tubing. Pinch off the tubing, and observe the manometer for 1 minute. A loss of pressure on the manometer indicates a leak in the meter box; leaks, if present, must be corrected.

8.4.2 Pretest leak check. A pretest leak-check is recommended but not required. If the pretest leak-check is conducted, the following procedure should be used.

8.4.2.1 After the sampling train has been assembled, turn on and set the filter and probe heating systems to the desired operating temperatures. Allow time for the temperatures to stabilize. If a Viton A 0-ring or other leak-free connection is used in assembling the probe nozzle to the probe liner, leak-check the train at the sampling site by plugging the nozzle and pulling a 380 mm (l5 in.) Hg vacuum.

<u>NOTE</u>: A lower vacuum may be used, provided that it is not exceeded during the test.

8.4.2.2 If an asbestos string is used, do not connect the probe to the train during the leak check. Instead, leak-check the train by first plugging the inlet to the filter holder (cyclone, if applicable) and pulling a 380 mm (l5 in.) Hg vacuum. (See NOTE in section 8.4.2.1 of this method). Then connect the probe to the train and perform the leak check at approximately 25 mm (l in.) Hg vacuum; alternatively, the probe may be leak-checked with the rest of the sampling train, in one step, at 380 mm (l5 in.) Hg vacuum. Leakage rates in excess of 4 percent of the average sampling rate or 0.00057 m³/min (0.02 cfm), whichever is less, are unacceptable.

8.4.2.3 The following leak check instructions for the sampling train described in APTD-0576 and APTD-0581 may be helpful. Start the pump with the bypass valve fully open and the coarse adjust valve completely closed. Partially open the coarse adjust valve and slowly close the bypass valve until the desired vacuum is reached. Do not reverse the direction of the bypass valve, as this will cause water to back up into the filter holder. If the desired vacuum is exceeded, either leak-check at this higher vacuum or end the leak check as shown below and start over.

8.4.2.4 When the leak check is completed, first slowly remove the plug from the inlet to the probe, filter holder, or cyclone (if applicable) and immediately turn off the vacuum pump. This prevents the water in the impingers from being forced backward into the filter holder and the silica gel from being entrained backward into the third impinger.

8.4.3 Leak checks during sample run. If, during the sampling run, a component (e.g., filter assembly or impinger) change becomes necessary, a leak check shall be conducted immediately before the change is made. The leak check shall be done according to the procedure outlined in section 8.4.2 of this method, except that it shall be done at a vacuum equal to or greater than the maximum value recorded up to that point in the test. If the leakage rate is found to be no greater than 0.00057 m³/min (0.02 cfm) or 4 percent of the average sampling rate (whichever is less), the results are acceptable, and no correction will need to be applied to the total volume of dry gas metered; if, however, a higher leakage rate is obtained, either record the leakage rate and plan to correct the sample volume as shown in section 12.3 of this method or void the sample run.

NOTE: Immediately after component changes, leak checks are optional; if such leak checks are done, the procedure outlined in section 8.4.2 of this method should be used.

8.4.4 Post-test leak check. A leak check is mandatory at the conclusion of each sampling run. The leak check shall be performed in accordance with the procedures outlined in section 8.4.2 of this method, except that it shall be conducted at a vacuum equal to or greater than the maximum value reached during the sampling run. If the leakage rate is found to be no greater than 0.00057 m³/min (0.02 cfm) or 4 percent of the average sampling rate (whichever is less), the results are acceptable, and no correction need be applied to the total volume of dry gas metered. If, however, a higher leakage rate is obtained, either record the leakage rate and correct the sample volume, as shown in section 12.4 of this method, or void the sampling run.

8.5 Sampling train operation. During the sampling run, maintain an isokinetic sampling rate (within 10 percent of true isokinetic unless otherwise specified by the Administrator) and a temperature around the filter of 120 ± 14°C (248 ± 25°F), or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator.

8.5.1 For each run, record the data required on a data sheet such as the one shown in Figure 5-2 of Method 5, 40 CFR part 60, appendix A. Be sure to record the initial reading. Record the DGM readings at the beginning and end of each sampling time increment, when changes in flow rates are made, before and after each leak-check, and when sampling is halted. Take other readings indicated by Figure 5-2 of Method 5, 40 CFR part 60, appendix A at least once at each sample point during each time increment and additional readings when significant changes (20 percent variation in velocity head readings) necessitate additional adjustments in flow rate. Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse.

8.5.2 Clean the portholes prior to the test run to minimize the chance of sampling deposited material. To begin sampling, remove the nozzle cap and verify that the filter and probe heating systems are up to temperature and that the pitot tube and probe are properly positioned. Position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Nomographs are available, which aid in the rapid adjustment of the isokinetic sampling rate without excessive computations. These nomographs are designed for use when the Type S pitot tube coefficient (C_p) is 0.85 ± 0.02 and the stack gas equivalent density (dry molecular weight) is 29 ± 4. APTD-0576 details the procedure for using the nomographs. If C_p and M_d are outside the above-stated ranges, do not use the nomographs unless appropriate steps (see Reference 7 in section 17.0 of this method) are taken to compensate for the deviations.

8.5.3 When the stack is under significant negative pressure (height of impinger stem), close the coarse adjust valve before inserting the probe into the stack to prevent water from backing into the filter holder. If necessary, the pump may be turned on with the coarse adjust valve closed.

8.5.4 When the probe is in position, block off the openings around the probe and porthole to prevent unrepresentative dilution of the gas stream.

8.5.5 Traverse the stack cross-section, as required by Method l, 40 CFR part 60, appendix A or as specified by the Administrator, being careful not to bump the probe nozzle into the stack walls when sampling near the walls or when removing or inserting the probe through the portholes; this minimizes the chance of extracting deposited material.

8.5.6 During the test run, make periodic adjustments to keep the temperature around the filter holder at the proper level; add more ice and, if necessary, salt to maintain a temperature of less than 20°C (68°F) at the condenser/silica gel outlet. Also, periodically check the level and zero of the manometer.

8.5.7 If the pressure drop across the filter becomes too high, making isokinetic sampling difficult to maintain, the filter may be replaced in the midst of the sample run. It is recommended that another complete filter assembly be used rather than attempting to change the filter itself. Before a new filter assembly is installed, conduct a leak check (see section 8.4.3 of this method). The total PM weight shall include the summation of the filter assembly catches.

8.5.8 A single train shall be used for the entire sample run, except in cases where simultaneous sampling is required in two or more separate ducts or at two or more different locations within the same duct, or in cases where equipment failure necessitates a change of trains. In all other situations, the use of two or more trains will be subject to the approval of the Administrator.

NOTE: When two or more trains are used, separate analyses of the front-half and (if applicable) impinger catches from each train shall be performed, unless identical nozzle sizes were used in all trains, in which case the front-half catches from the individual trains may be combined (as may the impinger catches) and one analysis of the front-half catch and one analysis of the impinger catch may be performed.

8.5.9 At the end of the sample run, turn off the coarse adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final DGM reading, and then conduct a post-test leak check, as outlined in section 8.4.4 of this method. Also leak-check the pitot lines as described in section 8.1 of Method 2, 40 CFR part 60, appendix A. The lines must pass this leak check in order to validate the velocity head data.

8.6 Calculation of percent isokinetic. Calculate percent isokinetic (see Calculations, section 12.12 of this method) to determine whether a run was valid or another test run should be made. If there was difficulty in maintaining isokinetic rates because of source conditions, consult the Administrator for possible variance on the isokinetic rates.

8.7 Sample recovery.

8.7.1 Proper cleanup procedure begins as soon as the probe is removed from the stack at the end of the sampling period. Allow the probe to cool.

8.7.2 When the probe can be safely handled, wipe off all external PM near the tip of the probe nozzle and place a cap over it to prevent losing or gaining PM. Do not cap off the probe tip tightly while the sampling train is cooling down. This would create a vacuum in the filter holder, thus drawing water from the impingers into the filter holder.

8.7.3 Before moving the sample train to the cleanup site, remove the probe from the sample train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the filter inlet where the probe was fastened and cap it. Remove the umbilical cord from the last impinger and cap the impinger. If a flexible line is used between the first impinger or condenser and the filter holder, disconnect the line at the filter holder and let any condensed water or liquid drain into the impingers or condenser. After wiping off the silicone grease, cap off the filter holder outlet and impinger inlet. Ground-glass stoppers, plastic caps, or serum caps may be used to close these openings.

8.7.4 Transfer the probe and filter-impinger assembly to the cleanup area. This area should be clean and protected from the wind so that the chances of contaminating or losing the sample will be minimized.

8.7.5 Save a portion of the acetone and methylene chloride used for cleanup as blanks. Take 200 ml of each solvent directly from the wash bottle being used and place it in glass sample containers labeled "acetone blank" and "methylene chloride blank," respectively.

8.7.6 Inspect the train prior to and during disassembly and note any abnormal conditions. Treat the samples as follows:

8.7.6.1 Container No. 1. Carefully remove the filter from the filter holder, and place it in its identified petri dish container. Use a pair of tweezers and/or clean disposable surgical gloves to handle the filter. If it is necessary to fold the filter, do so such that the PM cake is inside the fold. Using a dry nylon bristle brush and/or a sharp-edged blade, carefully transfer to the petri dish any PM and/or filter fibers that adhere to the filter holder gasket. Seal the container.

8.7.6.2 Container No. 2. Taking care to see that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover PM or any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing these components with acetone and placing the wash in a glass container. Perform the acetone rinse as follows:

8.7.6.2.1 Carefully remove the probe nozzle and clean the inside surface by rinsing with acetone from a wash bottle and brushing with a nylon bristle brush. Brush until the acetone rinse shows no visible particles, after which make a final rinse of the inside surface with acetone.

8.7.6.2.2 Brush and rinse the inside parts of the Swagelok fitting with acetone in a similar way until no visible particles remain.

8.7.6.2.3 Rinse the probe liner with acetone by tilting and rotating the probe while squirting acetone into its upper end so that all inside surfaces are wetted with acetone. Let the acetone drain from the lower end into the sample container. A funnel (glass or polyethylene) may be used to aid in transferring liquid washes to the container. Follow the acetone rinse with a probe brush. Hold the probe in an inclined position, squirt acetone into the upper end as the probe brush is being pushed with a twisting action through the probe, hold a sample container under the lower end of the probe, and catch any acetone and PM that is brushed from the probe. Run the brush through the probe three times or more until no visible PM is carried out with the acetone or until none remains in the probe liner on visual inspection. With stainless steel or other metal probes, run the brush through in the above-described manner at least six times, since metal probes have small crevices in which PM can be entrapped. Rinse the brush with acetone and quantitatively collect these washings in the sample container. After the brushing, make a final acetone rinse of the probe as described above.

8.7.6.2.4 It is recommended that two people clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contamination.

8.7.6.2.5 After ensuring that all joints have been wiped clean of silicone grease, clean the inside of the front half of the filter holder by rubbing the surfaces with a nylon bristle brush and rinsing with acetone. Rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush and filter holder. Carefully rinse out the glass cyclone also (if applicable).

8.7.6.2.6 After rinsing the nozzle, probe, and front half of the filter holder with acetone, repeat the entire procedure with methylene chloride and save in a separate No. 2M container.

8.7.6.2.7 After acetone and methylene chloride washings and PM have been collected in the proper sample containers, tighten the lid on the sample containers so that acetone and methylene chloride will not leak out when it is shipped to the laboratory. Mark the height of the fluid level to determine whether leakage occurs during transport. Label each container to identify clearly its contents.

8.7.6.3 Container No. 3. Note the color of the indicating silica gel to determine whether it has been completely spent, and make a notation of its condition. Transfer the silica gel from the fourth impinger to its original container and seal the container. A funnel may make it easier to pour the silica gel without spilling. A rubber policeman may be used as an aid in removing the silica gel from the impinger. It is not necessary to remove the small amount of dust particles that may adhere to the impinger wall and are difficult to remove. Since the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, follow the procedure for Container No. 3 in section 11.2.3 of this method.

8.7.6.4 Impinger water. Treat the impingers as follows:

8.7.6.4.1 Make a notation of any color or film in the liquid catch. Measure the liquid that is in the first three impingers to within 1 ml by using a graduated cylinder or by weighing it to within 0.5 g by using a balance (if one is available). Record the volume or weight of liquid present. This information is required to calculate the moisture content of the effluent gas.

8.7.6.4.2 Following the determination of the volume of liquid present, rinse the back half of the train with water, add it to the impinger catch, and store it in a container labeled 3W (water).

8.7.6.4.3 Following the water rinse, rinse the back half of the train with acetone to remove the excess water to enhance subsequent organic recovery with methylene chloride and quantitatively recover to a container labeled 3S (solvent) followed by at least three sequential rinsings with aliquots of methylene chloride. Quantitatively recover to the same container labeled 3S. Record separately the amount of both acetone and methylene chloride used to the nearest 1 ml or 0.5g.

NOTE: Because the subsequent analytical finish is gravimetric, it is okay to recover both solvents to the same container. This would not be recommended if other analytical finishes were required.

8.8 Sample transport. Whenever possible, containers should be shipped in such a way that they remain upright at all times.

9.0 Quality Control.

9.1 Miscellaneous quality control measures.

Section	Quality Control Measure	Effect
8.4, 10.1-10.6	Sampling and equipment leak check and calibration	Ensure accurate measurement of stack gas flow rate, sample volume

9.2 Volume metering system checks. The following quality control procedures are suggested to check the volume metering system calibration values at the field test site prior to sample collection. These procedures are optional.

9.2.1 Meter orifice check. Using the calibration data obtained during the calibration procedure described in section 10.3 of this method, determine the $\Delta H_@$ for the metering system orifice. The $\Delta H_@$ is the orifice pressure differential in units of in. H_20 that correlates to 0.75 cfm of air at 528°R and 29.92 in. Hg. The $\Delta H_@$ is calculated as follows:

$$\Delta H_@ = 0.0319\ \Delta H\ \frac{T_m\ \Theta^2}{P_{bar}\ Y^2\ V_m^2}$$

where

$0.0319 = (0.0567\ \text{in. Hg/°R})(0.75\ \text{cfm})^2$;

ΔH = Average pressure differential across the orifice meter, in. H_20;

T_m = Absolute average DGM temperature, °R;

Θ = Total sampling time, min;

P_{bar} = Barometric pressure, in. Hg;

Y = DGM calibration factor, dimensionless;
V_m = Volume of gas sample as measured by DGM, dcf.

9.2.1.1 Before beginning the field test (a set of three runs usually constitutes a field test), operate the metering system (i.e., pump, volume meter, and orifice) at the $\Delta H_@$ pressure differential for 10 minutes. Record the volume collected, the DGM temperature, and the barometric pressure. Calculate a DGM calibration check value, Y_c, as follows:

$$Y_c = \frac{10}{V_m}\left[\frac{0.0319\ T_m}{P_{bar}}\right]^{\frac{1}{2}}$$

where

Y_c = DGM calibration check value, dimensionless;
10 = Run time, min.

9.2.1.2 Compare the Y_c value with the dry gas meter calibration factor Y to determine that: $0.97Y < Y_c < 1.03Y$. If the Y_c value is not within this range, the volume metering system should be investigated before beginning the test.

9.2.2 Calibrated critical orifice. A calibrated critical orifice, calibrated against a wet test meter or spirometer and designed to be inserted at the inlet of the sampling meter box, may be used as a quality control check by following the procedure of section 16.2 of this method.

10.0 Calibration and Standardization.

NOTE: Maintain a laboratory log of all calibrations.

10.1 Probe nozzle. Probe nozzles shall be calibrated before their initial use in the field. Using a micrometer, measure the ID of the nozzle to the nearest 0.025 mm (0.001 in.). Make three separate measurements using different diameters each time, and obtain the average of the measurements. The difference between the high and low numbers shall not exceed 0.1 mm (0.004 in.). When nozzles become nicked, dented, or corroded, they shall be reshaped, sharpened, and recalibrated before use. Each nozzle shall be permanently and uniquely identified.

10.2 Pitot tube assembly. The Type S pitot tube assembly shall be calibrated according to the procedure outlined in section 10.1 of Method 2, 40 CFR part 60, appendix A.

10.3 Metering system.

10.3.1 Calibration prior to use. Before its initial use in the field, the metering system shall be calibrated as follows: Connect the metering system inlet to the outlet of a wet test meter that is accurate to within 1 percent. Refer to Figure 5-5 of Method 5, 40 CFR part 60, appendix A. The wet test meter should have a capacity of 30 liters/revolution (1 ft^3/rev). A spirometer of 400 liters (14 ft^3) or more capacity, or equivalent, may be used for this calibration, although a wet test meter is usually more practical. The wet test meter should be periodically calibrated with a spirometer or a liquid displacement meter to ensure the accuracy of the wet test meter. Spirometers or wet test meters of other sizes may be used, provided that the specified accuracies of the procedure are maintained. Run the metering system pump for about 15 minutes with the orifice manometer indicating a median reading, as expected in field use, to allow the pump to warm up and to permit the interior surface of the wet test meter to be thoroughly wetted. Then, at each of a minimum of three orifice manometer settings, pass an exact quantity of gas through the wet test meter and note the gas volume indicated by the DGM. Also note the barometric pressure and the temperatures of the wet test meter, the inlet of the DGM, and the outlet of the DGM. Select the highest and lowest orifice settings to bracket the expected field operating range of the orifice. Use a minimum volume of 0.15 m^3 (5 cf) at all orifice settings. Record all the data on a form similar to Figure 5-6 of Method 5, 40 CFR part 60, appendix A, and calculate Y (the DGM calibration factor) and $\Delta H_@$ (the orifice calibration factor) at each orifice setting, as shown on Figure 5-6 of Method 5, 40 CFR part 60, appendix A. Allowable tolerances for individual Y and $\Delta H_@$ values are given in

Figure 5-6 of Method 5, 40 CFR part 60, appendix A. Use the average of the Y values in the calculations in section 12 of this method.

10.3.1.1. Before calibrating the metering system, it is suggested that a leak check be conducted. For metering systems having diaphragm pumps, the normal leak check procedure will not detect leakages within the pump. For these cases the following leak check procedure is suggested: make a 10-minute calibration run at 0.00057 m^3/min (0.02 cfm); at the end of the run, take the difference of the measured wet test meter and DGM volumes; divide the difference by 10 to get the leak rate. The leak rate should not exceed 0.00057 m^3/min (0.02 cfm).

10.3.2 Calibration after use. After each field use, the calibration of the metering system shall be checked by performing three calibration runs at a single, intermediate orifice setting (based on the previous field test) with the vacuum set at the maximum value reached during the test series. To adjust the vacuum, insert a valve between the wet test meter and the inlet of the metering system. Calculate the average value of the DGM calibration factor. If the value has changed by more than 5 percent, recalibrate the meter over the full range of orifice settings, as previously detailed.

NOTE: Alternative procedures, e.g., rechecking the orifice meter coefficient, may be used, subject to the approval of the Administrator.

10.3.3 Acceptable variation in calibration. If the DGM coefficient values obtained before and after a test series differ by more than 5 percent, either the test series shall be voided or calculations for the test series shall be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

10.4 Probe heater calibration. Use a heat source to generate air heated to selected temperatures that approximate those expected to occur in the sources to be sampled. Pass this air through the probe at a typical sample flow rate while measuring the probe inlet and outlet temperatures at various probe heater settings. For each air temperature generated, construct a graph of probe heating system setting versus probe outlet temperature. The procedure outlined in APTD-0576 can also be used. Probes constructed according to APTD-0581 need not be calibrated if the calibration curves in APTD-0576 are used. Also, probes with outlet temperature monitoring capabilities do not require calibration.

NOTE: The probe heating system shall be calibrated before its initial use in the field.

10.5 Temperature sensors. Use the procedure in section 10.3 of Method 2, 40 CFR part 60, appendix A to calibrate in-stack temperature sensors. Dial thermometers, such as are used for the DGM and condenser outlet, shall be calibrated against mercury-in-glass thermometers.

10.6 Barometer. Calibrate against a mercury barometer.

11.0 Analytical Procedure.

11.1 Record the data required on a sheet such as the one shown in Figure 315-1 of this method.

11.2 Handle each sample container as follows:

11.2.1 Container No. 1.

11.2.1.1 PM analysis. Leave the contents in the shipping container or transfer the filter and any loose PM from the sample container to a tared glass weighing dish. Desiccate for 24 hours in a desiccator containing anhydrous calcium sulfate. Weigh to a constant weight and report the results to the nearest 0.1 mg. For purposes of this section, the term "constant weight" means a difference of no more than 0.5 mg or 1 percent of total weight less tare weight, whichever is greater, between two consecutive weighings, with no less than 6 hours of desiccation time between weighings (overnight desiccation is a common practice). If a third weighing is required and it agrees within ±0.5 mg, then the results of the second weighing should be used. For quality assurance purposes, record and report each individual weighing; if more than three weighings are required, note this in the results for the subsequent MCEM results.

11.2.1.2 MCEM analysis. Transfer the filter and contents quantitatively into a beaker. Add 100 ml of methylene chloride and cover with aluminum foil. Sonicate for 3 minutes then allow to stand for 20 minutes. Set up the filtration apparatus. Decant the solution into a clean Buchner fritted funnel. Immediately pressure filter the solution through the tube into another clean, dry beaker. Continue decanting and pressure filtration until all the solvent is transferred. Rinse the beaker and filter with 10 to

20 ml methylene chloride, decant into the Buchner fritted funnel and pressure filter. Place the beaker on a low-temperature hot plate (maximum 40°C) and slowly evaporate almost to dryness. Transfer the remaining last few milliliters of solution quantitatively from the beaker (using at least three aliquots of methylene chloride rinse) to a tared clean dry aluminum dish and evaporate to complete dryness. Remove from heat once solvent is evaporated. Reweigh the dish after a 30-minute equilibrium in the balance room and determine the weight to the nearest 0.1 mg. Conduct a methylene chloride blank run in an identical fashion.

11.2.2 Container No. 2.

11.2.2.1 PM analysis. Note the level of liquid in the container, and confirm on the analysis sheet whether leakage occurred during transport. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results. Measure the liquid in this container either volumetrically to ±l ml or gravimetrically to ±0.5 g. Transfer the contents to a tared 250 ml beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours, and weigh to a constant weight. Report the results to the nearest 0.1 mg.

11.2.2.2 MCEM analysis. Add 25 ml methylene chloride to the beaker and cover with aluminum foil. Sonicate for 3 minutes then allow to stand for 20 minutes; combine with contents of Container No. 2M and pressure filter and evaporate as described for Container 1 in section 11.2.1.2 of this method.

NOTES FOR MCEM ANALYSIS:

1. Light finger pressure only is necessary on 24/40 adaptor. A Chemplast adapter #15055-240 has been found satisfactory.

2. Avoid aluminum dishes made with fluted sides, as these may promote solvent "creep," resulting in possible sample loss.

3. If multiple samples are being run, rinse the Buchner fritted funnel twice between samples with 5 ml solvent using pressure filtration. After the second rinse, continue the flow of air until the glass frit is completely dry. Clean the Buchner fritted funnels thoroughly after filtering five or six samples.

11.2.3 Container No. 3. Weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g using a balance. This step may be conducted in the field.

11.2.4 Container 3W (impinger water).

11.2.4.1 MCEM analysis. Transfer the solution into a 1,000 ml separatory funnel quantitatively with methylene chloride washes. Add enough solvent to total approximately 50 ml, if necessary. Shake the funnel for 1 minute, allow the phases to separate, and drain the solvent layer into a 250 ml beaker. Repeat the extraction twice. Evaporate with low heat (less than 40°C) until near dryness. Transfer the remaining few milliliters of solvent quantitatively with small solvent washes into a clean, dry, tared aluminum dish and evaporate to dryness. Remove from heat once solvent is evaporated. Reweigh the dish after a 30-minute equilibration in the balance room and determine the weight to the nearest 0.1 mg.

11.2.5 Container 3S (solvent).

11.2.5.1 MCEM analysis. Transfer the mixed solvent to 250 ml beaker(s). Evaporate and weigh following the procedures detailed for container 3W in section 11.2.4 of this method.

11.2.6 Blank containers. Measure the distilled water, acetone, or methylene chloride in each container either volumetrically or gravimetrically. Transfer the "solvent" to a tared 250 ml beaker, and evaporate to dryness at ambient temperature and pressure. (Conduct a solvent blank on the distilled deionized water blank in an identical fashion to that described in section 11.2.4.1 of this method.) Desiccate for 24 hours, and weigh to a constant weight. Report the results to the nearest 0.1 mg.

NOTE: The contents of Containers No. 2, 3W, and 3M as well as the blank containers may be evaporated at temperatures higher than ambient. If evaporation is done at an elevated temperature, the temperature must be below the boiling point of the solvent; also, to prevent "bumping," the evaporation process must be closely supervised, and the contents of the beaker must be swirled occasionally to maintain an even temperature. Use extreme care, as acetone and methylene chloride are highly flammable and have a low flash point.

12.0 Data Analysis and Calculations.

12.1 Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after the final calculation. Other forms of the equations may be used as long as they give equivalent results.

12.2 Nomenclature.

A_n = Cross-sectional area of nozzle, m^3 (ft^3).
B_{ws} = Water vapor in the gas stream, proportion by volume.
C_a = Acetone blank residue concentration, mg/g.
C_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscm (g/dscf).
I = Percent of isokinetic sampling.
L_a = Maximum acceptable leakage rate for either a pretest leak check or for a leak check following a component change; equal to 0.00057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate, whichever is less.
L_i = Individual leakage rate observed during the leak check conducted prior to the "i^{th}" component change (I = 1, 2, 3...n), m^3/min (cfm).
L_p = Leakage rate observed during the post-test leak check, m^3/min (cfm).
m_a = Mass of residue of acetone after evaporation, mg.
m_n = Total amount of particulate matter collected, mg.
M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).
P_{bar} = Barometric pressure at the sampling site, mm Hg (in Hg).
P_s = Absolute stack gas pressure, mm Hg (in. Hg).
P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
R = Ideal gas constant, 0.06236 [(mm Hg)(m^3)]/[(°K)(g-mole)] {21.85 [(in. Hg)(ft^3)]/[(°R)(lb-mole)]}.
T_m = Absolute average dry gas meter (DGM) temperature (see Figure 5-2 of Method 5, 40 CFR part 60, appendix A), °K (°R).
T_s = Absolute average stack gas temperature (see Figure 5-2 of Method 5, 40 CFR part 60, appendix A), °K(°R).
T_{std} = Standard absolute temperature, 293°K (528°R).
V_a = Volume of acetone blank, ml.
V_{aw} = Volume of acetone used in wash, ml.
V_t = Volume of methylene chloride blank, ml.
V_{tw} = Volume of methylene chloride used in wash, ml.
V_{lc} = Total volume liquid collected in impingers and silica gel (see Figure 5-3 of Method 5, 40 CFR part 60, appendix A), ml.
V_m = Volume of gas sample as measured by dry gas meter, dcm (dcf).
$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf).
$V_{w(std)}$ = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf).
V_s = Stack gas velocity, calculated by Equation 2-9 in Method 2, 40 CFR part 60, appendix A, using data obtained from Method 5, 40 CFR part 60, appendix A, m/sec (ft/sec).
W_a = Weight of residue in acetone wash, mg.
Y = Dry gas meter calibration factor.
ΔH = Average pressure differential across the orifice meter (see Figure 5-2 of Method 5, 40 CFR part 60, appendix A), mm H$_2$0 (in H$_2$0).
ρ_a = Density of acetone, 785.1 mg/ml (or see label on bottle).
ρ_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).
ρ_t = Density of methylene chloride, 1316.8 mg/ml (or see label on bottle).
Θ = Total sampling time, min.
Θ_1 = Sampling time interval, from the beginning of a run until the first component change,

min.

Θ_i = Sampling time interval, between two successive component changes, beginning with the interval between the first and second changes, min.

Θ_p = Sampling time interval, from the final (nth) component change until the end of the sampling run, min.

13.6 = Specific gravity of mercury.

60 = Sec/min.

100 = Conversion to percent.

12.3 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 5-2 of Method 5, 40 CFR part 60, appendix A).

12.4 Dry gas volume. Correct the sample volume measured by the dry gas meter to standard conditions (20°C, 760 mm Hg or 68°F, 29.92 in Hg) by using Equation 315-1.

$$V = V_m Y \frac{T_{std}\left(P_{bar} + \frac{\Delta H}{13.6}\right)}{T_m P_{std}} \qquad \underline{\text{Eq. 315-1}}$$

$$= V = K_1 V_m Y \frac{P_{bar} + \left(\frac{\Delta H}{13.6}\right)}{T_m}$$

where

K_1 = 0.3858 °K/mm Hg for metric units,

= 17.64 °R/in Hg for English units.

<u>NOTE</u>: Equation 315-1 can be used as written unless the leakage rate observed during any of the mandatory leak checks (i.e., the post-test leak check or leak checks conducted prior to component changes) exceeds L_a. If L_p or L_i exceeds L_a, Equation 315-1 must be modified as follows:

(a) Case I. No component changes made during sampling run. In this case, replace V_m in Equation 315-1 with the expression:

$$[V_m - (L_p - L_a)\,\Theta]$$

(b) Case II. One or more component changes made during the sampling run. In this case, replace V_m in Equation 315-1 by the expression:

$$[V_m - (L_1 - L_a)\,\Theta_1 - \sum_{i=2}^{n} (L_i - L_a)\,\Theta_i - (L_p - L_a)\,\Theta_p]$$

and substitute only for those leakage rates (L_i or L_p) which exceed L_a.

12.5 Volume of water vapor condensed.

$$V_{w(std)} = V_{lc} \frac{\rho_w \ R \ T_{std}}{M_w \ P_{std}} = K_2 \ V_{lc}$$

Eq. 315-2

where

K_2 = 0.001333 m^3/ml for metric units;

= 0.04706 ft^3/ml for English units.

12.6 Moisture content.

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

Eq. 315-3

NOTE: In saturated or water droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one from the impinger analysis (Equation 315-3), and a second from the assumption of saturated conditions. The lower of the two values of B_{ws} shall be considered correct. The procedure for determining the moisture content based upon assumption of saturated conditions is given in section 4.0 of Method 4, 40 CFR part 60, appendix A. For the purposes of this method, the average stack gas temperature from Figure 5-2 of Method 5, 40 CFR part 60, appendix A may be used to make this determination, provided that the accuracy of the in-stack temperature sensor is ±1°C (2°F).

12.7 Acetone blank concentration.

$$C_a = \frac{M_a}{V_a \ \rho_a}$$

Eq. 315-4

12.8 Acetone wash blank.

$$W_a = C_a \ V_{aw} \ \rho_a$$

Eq. 315-5

12.9 Total particulate weight. Determine the total PM catch from the sum of the weights obtained from Containers 1 and 2 less the acetone blank associated with these two containers (see Figure 315-1).

NOTE: Refer to section 8.5.8 of this method to assist in calculation of results involving two or more filter assemblies or two or more sampling trains.

12.10 Particulate concentration.

$$c_s = K_3 \ m_n / V_{m(std)}$$

Eq. 315-6

where

K = 0.001 g/mg for metric units;

= 0.0154 gr/mg for English units.

12.11 Conversion factors.

From	To	Multiply by
ft^3	m^3	0.02832
gr	mg	64.80004
gr/ft^3	mg/m3	2288.4
mg	g	0.001
gr	lb	1.429×10^{-4}

12.12 Isokinetic variation.

12.12.1 Calculation from raw data.

$$I = \frac{100\ T_s \left[K_4\ V_{lc} + \left(\frac{V_m\ Y}{T_m}\right)\left(P_{bar} + \frac{\Delta H}{13.6}\right)\right]}{60\ \Theta\ v_s\ P_s\ A_n} \qquad \text{Eq. 315-7}$$

where

K_4 = 0.003454 [(mm Hg)(m^3)]/[(ml)(°K)] for metric units;

= 0.002669 [(in Hg)(ft^3)]/[(ml)(°R)] for English units.

12.12.2 Calculation from intermediate values.

$$I = \frac{T_s\ V_{m(std)}\ P_{std}\ 100}{T_{std}\ v_s\ \Theta\ A_n\ P_s\ 60\ (1-B_{ws})} \qquad \text{Eq. 315-8}$$

$$= K_5 \frac{T_s\ V_{m(std)}}{P_s\ v_s\ A_n\ \Theta\ (1-B_{ws})}$$

where

K_5 = 4.320 for metric units;

= 0.09450 for English units.

12.12.3 Acceptable results. If 90 percent ≤ I ≤ 110 percent, the results are acceptable. If the PM or MCEM results are low in comparison to the standard, and "I" is over 110 percent or less than 90 percent, the Administrator may opt to accept the results. Reference 4 in the Bibliography may be used to make acceptability judgments. If "I" is judged to be unacceptable, reject the results, and repeat the test.

12.13 Stack gas velocity and volumetric flow rate. Calculate the average stack gas velocity and volumetric flow rate, if needed, using data obtained in this method and the equations in sections 5.2 and 5.3 of Method 2, 40 CFR part 60, appendix A.

12.14 MCEM results. Determine the MCEM concentration from the results from Containers 1, 2, 2M, 3W, and 3S less the acetone, methylene chloride, and filter blanks value as determined in the following equation:

$$m_{mcem} = \Sigma m_{total} - w_a - w_t - f_b$$

13.0 Method Performance. [Reserved]

14.0 Pollution Prevention. [Reserved]

15.0 Waste Management. [Reserved]

16.0 Alternative Procedures.

16.1 Dry gas meter as a calibration standard. A DGM may be used as a calibration standard for volume measurements in place of the wet test meter specified in section 16.1 of this method, provided that it is calibrated initially and recalibrated periodically as follows:

16.1.1 Standard dry gas meter calibration.

16.1.1.1. The DGM to be calibrated and used as a secondary reference meter should be of high quality and have an appropriately sized capacity, e.g., 3 liters/rev (0.1 ft^3/rev). A spirometer (400 liters or more capacity), or equivalent, may be used for this calibration, although a wet test meter is usually more practical. The wet test meter should have a capacity of 30 liters/rev (1 ft^3/rev) and be capable of measuring volume to within 1.0 percent; wet test meters should be checked against a spirometer or a liquid displacement meter to ensure the accuracy of the wet test meter. Spirometers or wet test meters of other sizes may be used, provided that the specified accuracies of the procedure are maintained.

16.1.1.2 Set up the components as shown in Figure 5-7 of Method 5, 40 CFR part 60, appendix A. A spirometer, or equivalent, may be used in place of the wet test meter in the system. Run the pump for at least 5 minutes at a flow rate of about 10 liters/min (0.35 cfm) to condition the interior surface of the wet test meter. The pressure drop indicated by the manometer at the inlet side of the DGM should be minimized (no greater than 100 mm H_2O [4 in. H_2O] at a flow rate of 30 liters/min [1 cfm]). This can be accomplished by using large- diameter tubing connections and straight pipe fittings.

16.1.1.3 Collect the data as shown in the example data sheet (see Figure 5-8 of Method 5, 40 CFR part 60, appendix A). Make triplicate runs at each of the flow rates and at no less than five different flow rates. The range of flow rates should be between 10 and 34 liters/min (0.35 and 1.2 cfm) or over the expected operating range.

16.1.1.4 Calculate flow rate, Q, for each run using the wet test meter volume, V_w, and the run time, q. Calculate the DGM coefficient, Y_{ds}, for each run. These calculations are as follows:

$$Q = K_1 \frac{P_{bar} V_w}{(t_w + t_{std})\,\Theta} \qquad \text{Eq. 315-9}$$

$$Y_{ds} = \frac{V_w (T_{ds} + T_{std}) P_{bar}}{V_{ds} (T_w + T_{std})(P_{bar} + \frac{\Delta p}{13.6})} \qquad \text{Eq. 315-10}$$

where

K_1 = 0.3858 for international system of units (SI);
17.64 for English units;
P_{bar} = Barometric pressure, mm Hg (in Hg);
V_w = Wet test meter volume, liter (ft^3);
t_w = Average wet test meter temperature, °C (°F);
t_{std} = 273°C for SI units; 460°F for English units;
Θ = Run time, min;
t_{ds} = Average dry gas meter temperature, °C (°F);
V_{ds} = Dry gas meter volume, liter (ft^3);
Δp = Dry gas meter inlet differential pressure, mm H_2O (in H_2O).

16.1.1.5 Compare the three Y_{ds} values at each of the flow rates and determine the maximum and minimum values. The difference between the maximum and minimum values at each flow rate should be no greater than 0.030. Extra sets of triplicate runs may be made in order to complete this requirement. In addition, the meter coefficients should be between 0.95 and 1.05. If these specifications cannot be met in three sets of successive triplicate runs, the meter is not suitable as a calibration standard and should not be used as such. If these specifications are met, average the three Y_{ds} values at each flow rate resulting in five average meter coefficients, Y_{ds}.

16.1.1.6 Prepare a curve of meter coefficient, Y_{ds}, versus flow rate, Q, for the DGM. This curve shall be used as a reference when the meter is used to calibrate other DGMs and to determine whether recalibration is required.

16.1.2 Standard dry gas meter recalibration.

16.1.2.1 Recalibrate the standard DGM against a wet test meter or spirometer annually or after every 200 hours of operation, whichever comes first. This requirement is valid provided the standard DGM is kept in a laboratory and, if transported, cared for as any other laboratory instrument. Abuse to the standard meter may cause a change in the calibration and will require more frequent recalibrations.

16.1.2.2 As an alternative to full recalibration, a two-point calibration check may be made. Follow the same procedure and equipment arrangement as for a full recalibration, but run the meter at only two flow rates (suggested rates are 14 and 28 liters/min [0.5 and 1.0 cfm]). Calculate the meter coefficients for these two points, and compare the values with the meter calibration curve. If the two coefficients are within 1.5 percent of the calibration curve values at the same flow rates, the meter need not be recalibrated until the next date for a recalibration check.

16.2 Critical orifices as calibration standards. Critical orifices may be used as calibration standards in place of the wet test meter specified in section 10.3 of this method, provided that they are selected, calibrated, and used as follows:

16.2.1 Selection of critical orifices.

16.2.1.1 The procedure that follows describes the use of hypodermic needles or stainless steel needle tubing that has been found suitable for use as critical orifices. Other materials and critical orifice designs may be used provided the orifices act as true critical orifices; i.e., a critical vacuum can be obtained, as described in section 7.2.2.2.3 of Method 5, 40 CFR part 60, appendix A. Select five critical orifices that are appropriately sized to cover the range of flow rates between 10 and 34 liters/min or the expected operating range. Two of the critical orifices should bracket the expected operating range. A minimum of three critical orifices will be needed to calibrate a Method 5 DGM; the other two critical orifices can serve as spares and provide better selection for bracketing the range of operating flow rates. The needle sizes and tubing lengths shown in Table 315-1 give the approximate flow rates indicated in the table.

16.2.1.2 These needles can be adapted to a Method 5 type sampling train as follows: Insert a serum bottle stopper, 13 x 20 mm sleeve type, into a 0.5 in Swagelok quick connect. Insert the needle into the stopper as shown in Figure 5-9 of Method 5, 40 CFR part 60, appendix A.

16.2.2 Critical orifice calibration. The procedure described in this section uses the Method 5 meter box configuration with a DGM as described in section 6.1.1.9 of this method to calibrate the critical orifices. Other schemes may be used, subject to the approval of the Administrator.

16.2.2.1 Calibration of meter box. The critical orifices must be calibrated in the same configuration as they will be used; i.e., there should be no connections to the inlet of the orifice.

16.2.2.1.1 Before calibrating the meter box, leak-check the system as follows: Fully open the coarse adjust valve and completely close the bypass valve. Plug the inlet. Then turn on the pump and determine whether there is any leakage. The leakage rate shall be zero; i.e., no detectable movement of the DGM dial shall be seen for 1 minute.

16.2.2.1.2 Check also for leakages in that portion of the sampling train between the pump and the orifice meter. See section 5.6 of Method 5, 40 CFR part 60, appendix A for the procedure; make any corrections, if necessary. If leakage is detected, check for cracked gaskets, loose fittings, worn 0-rings, etc. and make the necessary repairs.

16.2.2.1.3 After determining that the meter box is leakless, calibrate the meter box according to the procedure given in section 5.3 of Method 5, 40 CFR part 60, appendix A. Make sure that the wet test meter meets the requirements stated in section 7.1.1.1 of Method 5, 40 CFR part 60, appendix A. Check the water level in the wet test meter. Record the DGM calibration factor, Y.

16.2.2.2 Calibration of critical orifices. Set up the apparatus as shown in Figure 5-10 of Method 5, 40 CFR part 60, appendix A.

16.2.2.2.1 Allow a warm-up time of 15 minutes. This step is important to equilibrate the temperature conditions through the DGM.

16.2.2.2.2 Leak-check the system as in section 7.2.2.1.1 of Method 5, 40 CFR part 60, appendix A. The leakage rate shall be zero.

16.2.2.2.3 Before calibrating the critical orifice, determine its suitability and the appropriate operating vacuum as follows: turn on the pump, fully open the coarse adjust valve, and adjust the bypass valve to give a vacuum reading corresponding to about half of atmospheric pressure. Observe the meter box orifice manometer reading, DH. Slowly increase the vacuum reading until a stable reading is obtained on the meter box orifice manometer. Record the critical vacuum for each orifice. Orifices that do not reach a critical value shall not be used.

16.2.2.2.4 Obtain the barometric pressure using a barometer as described in section 6.1.2 of this method. Record the barometric pressure, P_{bar}, in mm Hg (in. Hg).

16.2.2.2.5 Conduct duplicate runs at a vacuum of 25 to 50 mm Hg (1 to 2 in. Hg) above the critical vacuum. The runs shall be at least 5 minutes each. The DGM volume readings shall be in increments of complete revolutions of the DGM. As a guideline, the times should not differ by more than 3.0 seconds (this includes allowance for changes in the DGM temperatures) to achieve ±0.5 percent in K'. Record the information listed in Figure 5-11 of Method 5, 40 CFR part 60, appendix A.

16.2.2.2.6 Calculate K' using Equation 315-11.

$$K' = \frac{K_1 \, V_m \, Y \, (P_{bar} + \frac{\Delta H}{13.6}) \, T_{amb}^{\frac{1}{2}}}{P_{bar} \, T_m \, \Theta}$$

<u>Eq. 315-11</u>

where

K' = Critical orifice coefficient, $[m^3)(°K)^{1/2}]/$ $[(mm\ Hg)(min)]$ $\{[(ft^3)(°R)^{1/2})]/[(in.\ Hg)(min)]\}$;

T_{amb} = Absolute ambient temperature, °K (°R).

16.2.2.2.7 Average the K' values. The individual K' values should not differ by more than ±0.5 percent from the average.

16.2.3 Using the critical orifices as calibration standards.

16.2.3.1 Record the barometric pressure.

16.2.3.2 Calibrate the metering system according to the procedure outlined in sections 7.2.2.2.1 to 7.2.2.2.5 of Method 5, 40 CFR part 60, appendix A. Record the information listed in Figure 5-12 of Method 5, 40 CFR part 60, appendix A.

16.2.3.3 Calculate the standard volumes of air passed through the DGM and the critical orifices, and calculate the DGM calibration factor, Y, using the equations below:

$V_{m(std)} = K_1 V_m [P_{bar} + (\Delta H/13.6)]/T_m$ <u>Eq. 315-12</u>

$V_{cr(std)} = K' (P_{bar} \Theta)/T_{amb}^{1/2}$ <u>Eq. 315-13</u>

$Y = V_{cr(std)}/V_{m(std)}$ <u>Eq. 315-14</u>

where

$V_{cr(std)}$ = Volume of gas sample passed through the critical orifice, corrected to standard conditions, dscm (dscf).

K' = 0.3858 °K/mm Hg for metric units

= 17.64 °R/in Hg for English units.

16.2.3.4 Average the DGM calibration values for each of the flow rates. The calibration factor, Y, at each of the flow rates should not differ by more than ±2 percent from the average.

16.2.3.5 To determine the need for recalibrating the critical orifices, compare the DGM Y factors obtained from two adjacent orifices each time a DGM is calibrated; for example, when checking orifice 13/2.5, use orifices 12/10.2 and 13/5.1. If any critical orifice yields a DGM Y factor differing by more than 2 percent from the others, recalibrate the critical orifice according to section 7.2.2.2 of Method 5, 40 CFR part 60, appendix A.

17.0 References.

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18.0 Tables, Diagrams, Flowcharts, and Validation Data

TABLE 315-1. Flow Rates for Various Needle Sizes and Tube Lengths.

Gauge/length (cm)	Flow rate (liters/min)	Gauge/length (cm)	Flow rate (liters/min)
12/7.6	32.56	14/2.5	19.54
12/10.2	30.02	14/5.1	17.27
13/2.5	25.77	14/7.6	16.14
13/5.1	23.50	15/3.2	14.16
13/7.6	22.37	15/7.6	11.61
13/10.2	20.67	15/10.2	10.48

Particulate analysis			
Plant			
Date			
Run No.			
Filter No.			
Amount liquid lost during transport			
Acetone blank volume (ml)			
Acetone blank concentration (Eq.315-4) (mg/mg)			
Acetone wash blank (Eq.315-5) (mg)			
	Final weight (mg)	Tare weight (mg)	Weight gain (mg)
Container No. 1			
Container No. 2			
Total			
Less Acetone blank			
Weight of particulate matter			
Moisture analysis			
	Final volume (mg)	Initial volume (mg)	Liquid collected (mg)
Impingers	Note 1	Note 1	
Silica gel			
Total			

FIGURE 315-1. Particulate and MCEM Analyses

Note 1: Convert volume of water to weight by multiplying by the density of water (1 g/ml).

MCEM analysis					
Container No.	Final weight (mg)	Tare of aluminum dish (mg)	Weight gain	Acetone wash volume (ml)	Methylene chloride wash volume (ml)
1					
2+2M					
3W					
3S					
Total			$\sum m_{total}$	$\sum v_{aw}$	$\sum v_{tw}$
Less acetone wash blank (mg) (not to exceed 1 mg/l of acetone used)			$w_a = c_a \rho_a \sum v_{aw}$		
Less methylene chloride wash blank (mg) (not to exceed 1.5 mg/l of methylene chloride used)			$w_t = c_t \rho_t \sum v_{tw}$		
Less filter blank (mg) (not to exceed.... (mg/filter)			F_b		
MCEM weight (mg)			$m_{MCEOM} = \sum m_{total} - w_a - w_t - f_b$		

FIGURE 315-1 (Continued). Particulate And MCEM Analyses

* * * * *

APPENDIX F.7

SW-846 METHOD 0010

METHOD 0010

MODIFIED METHOD 5 SAMPLING TRAIN

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to the determination of Destruction and Removal Efficiency (DRE) of semivolatile Principal Organic Hazardous Compounds (POHCs) from incineration systems (PHS, 1967). This method also may be used to determine particulate emission rates from stationary sources as per EPA Method 5 (see References at end of this method).

2.0 SUMMARY OF METHOD

2.1 Gaseous and particulate pollutants are withdrawn from an emission source at an isokinetic sampling rate and are collected in a multicomponent sampling train. Principal components of the train include a high-efficiency glass- or quartz-fiber filter and a packed bed of porous polymeric adsorbent resin. The filter is used to collect organic-laden particulate materials and the porous polymeric resin to adsorb semivolatile organic species. Semivolatile species are defined as compounds with boiling points $>100°C$.

2.2 Comprehensive chemical analyses of the collected sample are conducted to determine the concentration and identity of the organic materials.

3.0 INTERFERENCES

3.1 Oxides of nitrogen (NO_x) are possible interferents in the determination of certain water-soluble compounds such as dioxane, phenol, and urethane; reaction of these compounds with NO_x in the presence of moisture will reduce their concentration. Other possibilities that could result in positive or negative bias are (1) stability of the compounds in methylene chloride, (2) the formation of water-soluble organic salts on the resin in the presence of moisture, and (3) the solvent extraction efficiency of water-soluble compounds from aqueous media. Use of two or more ions per compound for qualitative and quantitative analysis can overcome interference at one mass. These concerns should be addressed on a compound-by-compound basis before using this method.

4.0 APPARATUS AND MATERIALS

4.1 Sampling train:

4.1.1 A schematic of the sampling train used in this method is shown in Figure 1. This sampling train configuration is adapted from EPA Method 5 procedures, and, as such, the majority of the required equipment

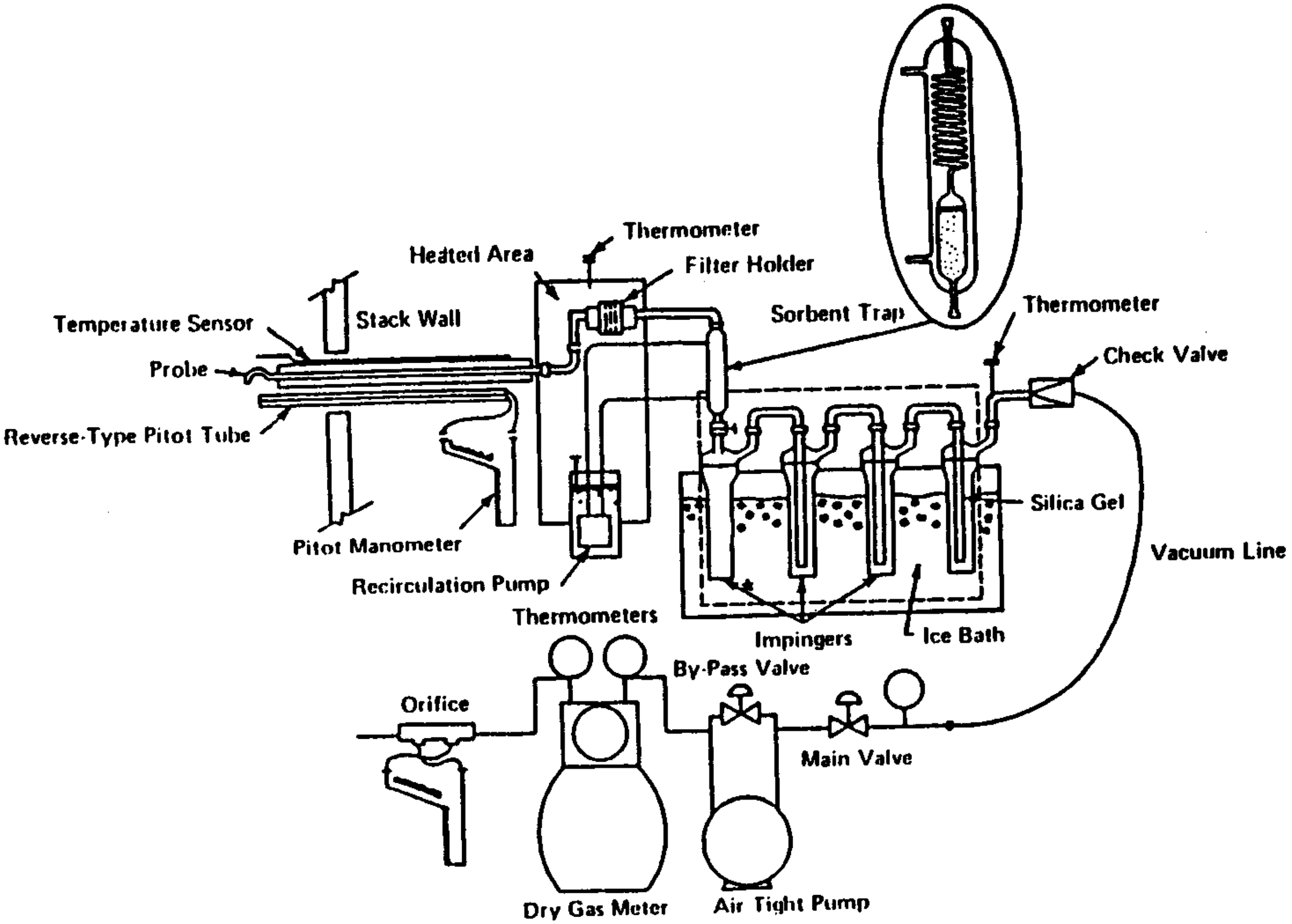
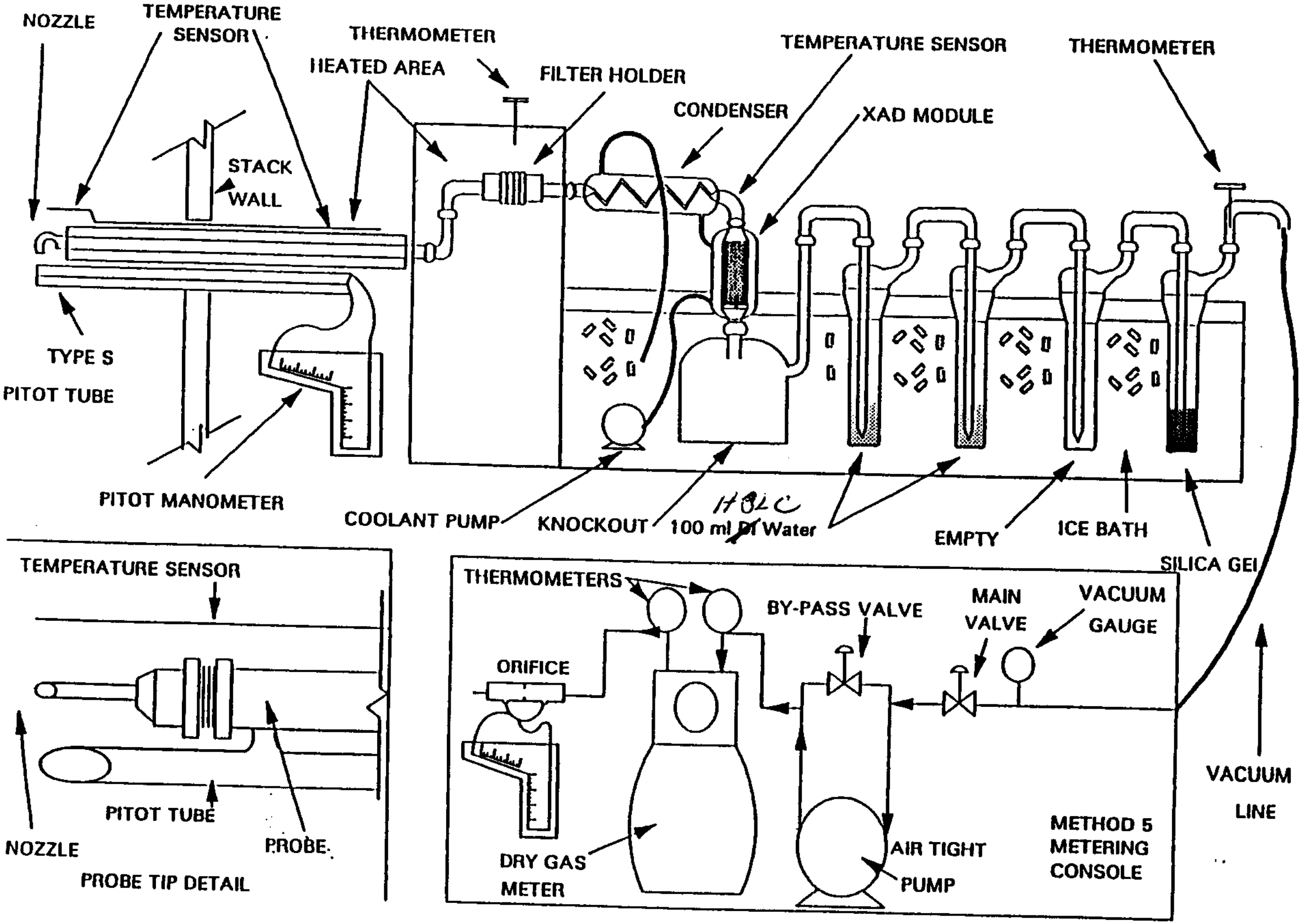


Figure 1. Modified Method 5 Sampling Train.



Semi Volatiles

Figure 4.2. Schematic of the EPA Method 0010 sampling train.

is identical to that used in EPA Method 5 determinations. The new components required are a condenser coil and a sorbent module, which are used to collect semivolatile organic materials that pass through the glass- or quartz-fiber filter in the gas phase.

4.1.2 Construction details for the basic train components are given in APTD-0581 (see Martin, 1971, in Section 13.0, References); commercial models of this equipment are also available. Specifications for the sorbent module are provided in the following subsections. Additionally, the following subsections list changes to APTD-0581 and identify allowable train configuration modifications.

4.1.3 Basic operating and maintenance procedures for the sampling train are described in APTD-0576 (see Rom, 1972, in Section 13.0, References). As correct usage is important in obtaining valid results, all users should refer to APTD-0576 and adopt the operating and maintenance procedures outlined therein unless otherwise specified. The sampling train consists of the components detailed below.

4.1.3.1 Probe nozzle: Stainless steel (316) or glass with sharp, tapered (30° angle) leading edge. The taper shall be on the outside to preserve a constant I.D. The nozzle shall be buttonhook or elbow design and constructed from seamless tubing (if made of stainless steel). Other construction materials may be considered for particular applications. A range of nozzle sizes suitable for isokinetic sampling should be available in increments of 0.16 cm (1/16 in.), e.g., 0.32-1.27 cm (1/8-1/2 in.), or larger if higher volume sampling trains are used. Each nozzle shall be calibrated according to the procedures outlined in Paragraph 9.1.

4.1.3.2 Probe liner: Borosilicate or quartz-glass tubing with a heating system capable of maintaining a gas temperature of 120 ± 14°C (248 ± 25°F) at the exit end during sampling. (The tester may opt to operate the equipment at a temperature lower than that specified.) Because the actual temperature at the outlet of the probe is not usually monitored during sampling, probes constructed according to APTD-0581 and utilizing the calibration curves of APTD-0576 (or calibrated according to the procedure outlined in APTD-0576) are considered acceptable. Either borosilicate or quartz-glass probe liners may be used for stack temperatures up to about 480°C (900°F). Quartz liners shall be used for temperatures between 480 and 900°C (900 and 1650°F). (The softening temperature for borosilicate is 820°C (1508°F), and for quartz 1500°C (2732°F).) Water-cooling of the stainless steel sheath will be necessary at temperatures approaching and exceeding 500°C.

4.1.3.3 Pitot tube: Type S, as described in Section 2.1 of EPA Method 2, or other appropriate devices (Vollaro, 1976). The pitot tube shall be attached to the probe to allow constant monitoring of the stack-gas velocity. The impact (high-pressure) opening plane of the pitot tube shall be even with or above the nozzle entry plane (see EPA Method 2, Figure 2-6b) during sampling. The Type S pitot tube assembly shall have a known coefficient, determined as outlined in Section 4 of EPA Method 2.

4.1.3.4 Differential pressure gauge: Inclined manometer or equivalent device as described in Section 2.2 of EPA Method 2. One manometer shall be used for velocity-head (ΔP) readings and the other for orifice differential pressure (ΔH) readings.

4.1.3.5 Filter holder: Borosilicate glass, with a glass frit filter support and a sealing gasket. The sealing gasket should be made of materials that will not introduce organic material into the gas stream at the temperature at which the filter holder will be maintained. The gasket shall be constructed of Teflon or materials of equal or better characteristics. The holder design shall provide a positive seal against leakage at any point along the filter circumference. The holder shall be attached immediately to the outlet of the cyclone or cyclone bypass.

4.1.3.6 Filter heating system: Any heating system capable of maintaining a temperature of 120 ± 14°C (248 ± 25°F) around the filter holder during sampling. Other temperatures may be appropriate for particular applications. Alternatively, the tester may opt to operate the equipment at temperatures other than that specified. A temperature gauge capable of measuring temperature to within 3°C (5.4°F) shall be installed so that the temperature around the filter holder can be regulated and monitored during sampling. Heating systems other than the one shown in APTD-0581 may be used.

4.1.3.7 Organic sampling module: This unit consists of three sections, including a gas-conditioning section, a sorbent trap, and a condensate knockout trap. The gas-conditioning system shall be capable of conditioning the gas leaving the back half of the filter holder to a temperature not exceeding 20°C (68°F). The sorbent trap shall be sized to contain approximately 20 g of porous polymeric resin (Rohm and Haas XAD-2 or equivalent) and shall be jacketed to maintain the internal gas temperature at 17 ± 3°C (62.5 ± 5.4°F). The most commonly used coolant is ice water from the impinger ice-water bath, constantly circulated through the outer jacket, using rubber or plastic tubing and a peristaltic pump. The sorbent trap should be outfitted with a glass well or depression, appropriately sized to accommodate a small thermocouple in the trap for monitoring the gas entry temperature. The condensate knockout trap shall be of sufficient size to collect the condensate following gas conditioning. The organic module components shall be oriented to direct the flow of condensate formed vertically downward from the conditioning section, through the adsorbent media, and into the condensate knockout trap. The knockout trap is usually similar in appearance to an empty impinger directly underneath the sorbent module; it may be oversized but should have a shortened center stem (at a minimum, one-half the length of the normal impinger stems) to collect a large volume of condensate without bubbling and overflowing into the impinger train. All surfaces of the organic module wetted by the gas sample shall be fabricated of borosilicate glass, Teflon, or other inert materials. Commercial versions of the complete organic module are not currently available, but may be assembled from commercially available laboratory glassware and a custom-fabricated sorbent trap. Details of two acceptable designs are shown in Figures 2 and 3 (the thermocouple well is shown in Figure 2).

4.1.3.8 Impinger train: To determine the stack-gas moisture content, four 500-mL impingers, connected in series with leak-free ground-glass joints, follow the knockout trap. The first, third, and fourth impingers shall be of the Greenburg-Smith design, modified by replacing the tip with a 1.3-cm (1/2-in.) I.D. glass tube extending about 1.3 cm (1/2 in.) from the bottom of the outer cylinder. The second impinger shall be of the Greenburg-Smith design with the standard tip. The first and second impingers shall contain known quantities of water or appropriate trapping solution. The third shall be empty or charged with a caustic solution, should the stack gas contain hydrochloric acid (HCl). The fourth shall contain a known weight of silica gel or equivalent desiccant.

4.1.3.9 Metering system: The necessary components are a vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3°C (5.4°F), dry-gas meter capable of measuring volume to within 1%, and related equipment, as shown in Figure 1. At a minimum, the pump should be capable of 4 cfm free flow, and the dry-gas meter should have a recording capacity of 0-999.9 cu ft with a resolution of 0.005 cu ft. Other metering systems capable of maintaining sampling rates within 10% of isokineticity and of determining sample volumes to within 2% may be used. The metering system must be used in conjunction with a pitot tube to enable checks of isokinetic sampling rates. Sampling trains using metering systems designed for flow rates higher than those described in APTD-0581 and APTD-0576 may be used, provided that the specifications of this method are met.

4.1.3.10 Barometer: Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases the barometric reading may be obtained from a nearby National Weather Service station, in which case the station value (which is the absolute barometric pressure) is requested and an adjustment for elevation differences between the weather station and sampling point is applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30-m (100 ft) elevation increase (vice versa for elevation decrease).

4.1.3.11 Gas density determination equipment: Temperature sensor and pressure gauge (as described in Sections 2.3 and 2.4 of EPA Method 2), and gas analyzer, if necessary (as described in EPA Method 3). The temperature sensor ideally should be permanently attached to the pitot tube or sampling probe in a fixed configuration such that the tip of the sensor extends beyond the leading edge of the probe sheath and does not touch any metal.

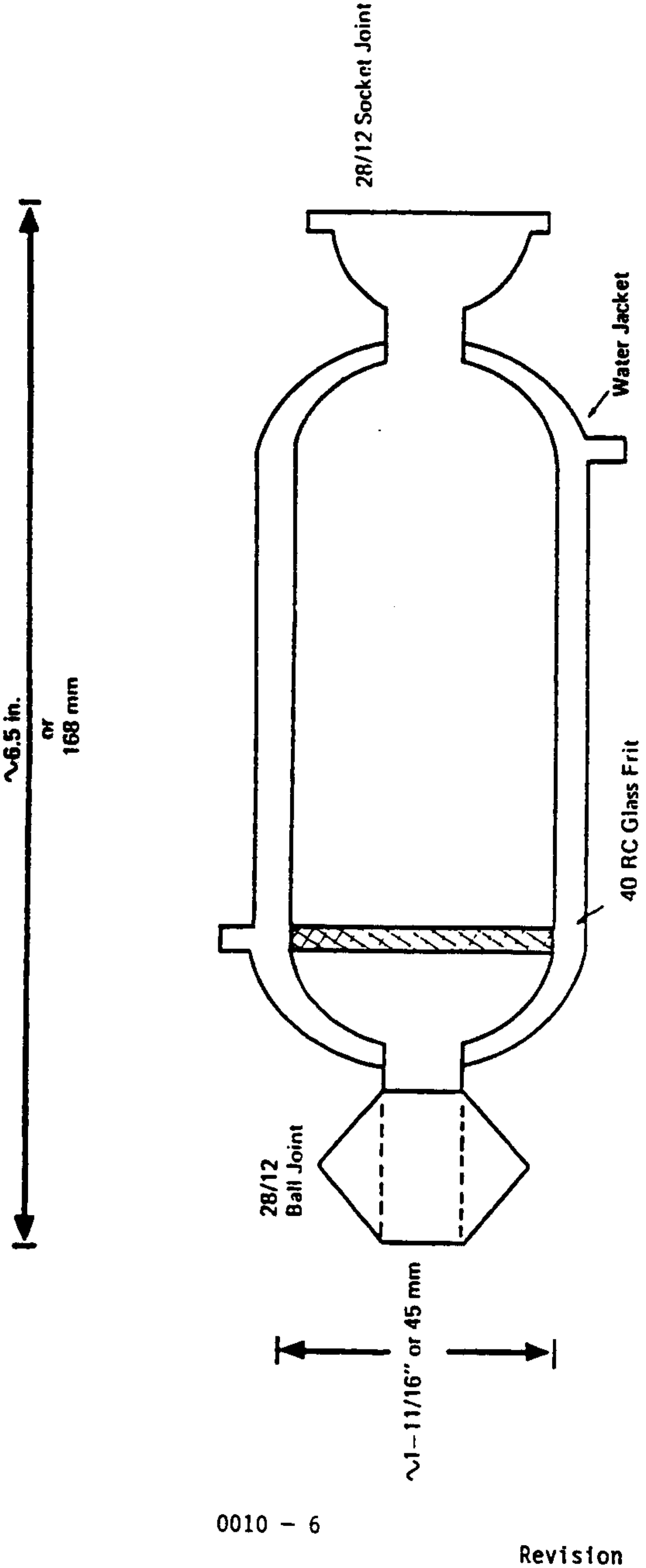
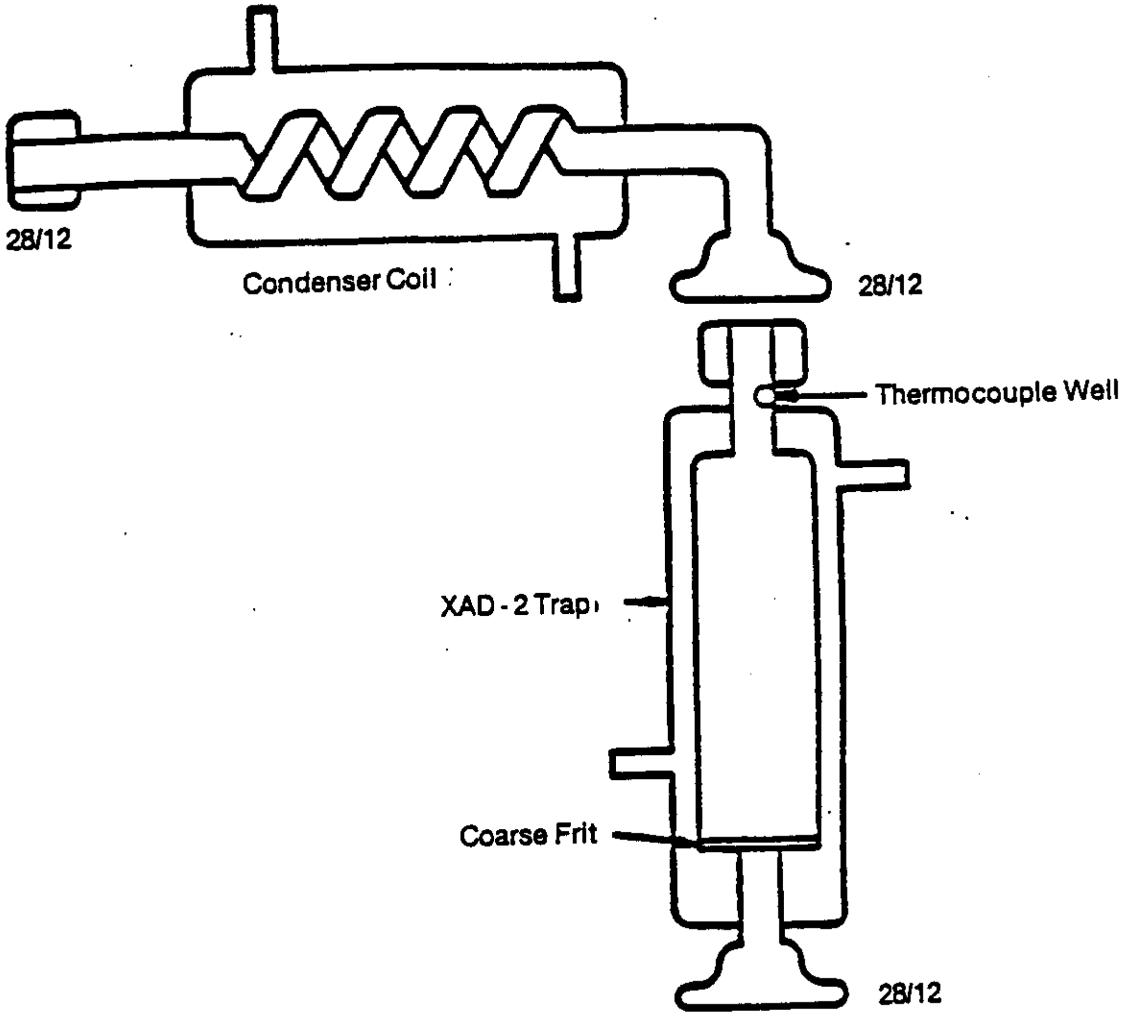


Figure 2. Adsorbent Sampling System.



XAD - 2 Trap and Condenser Coil

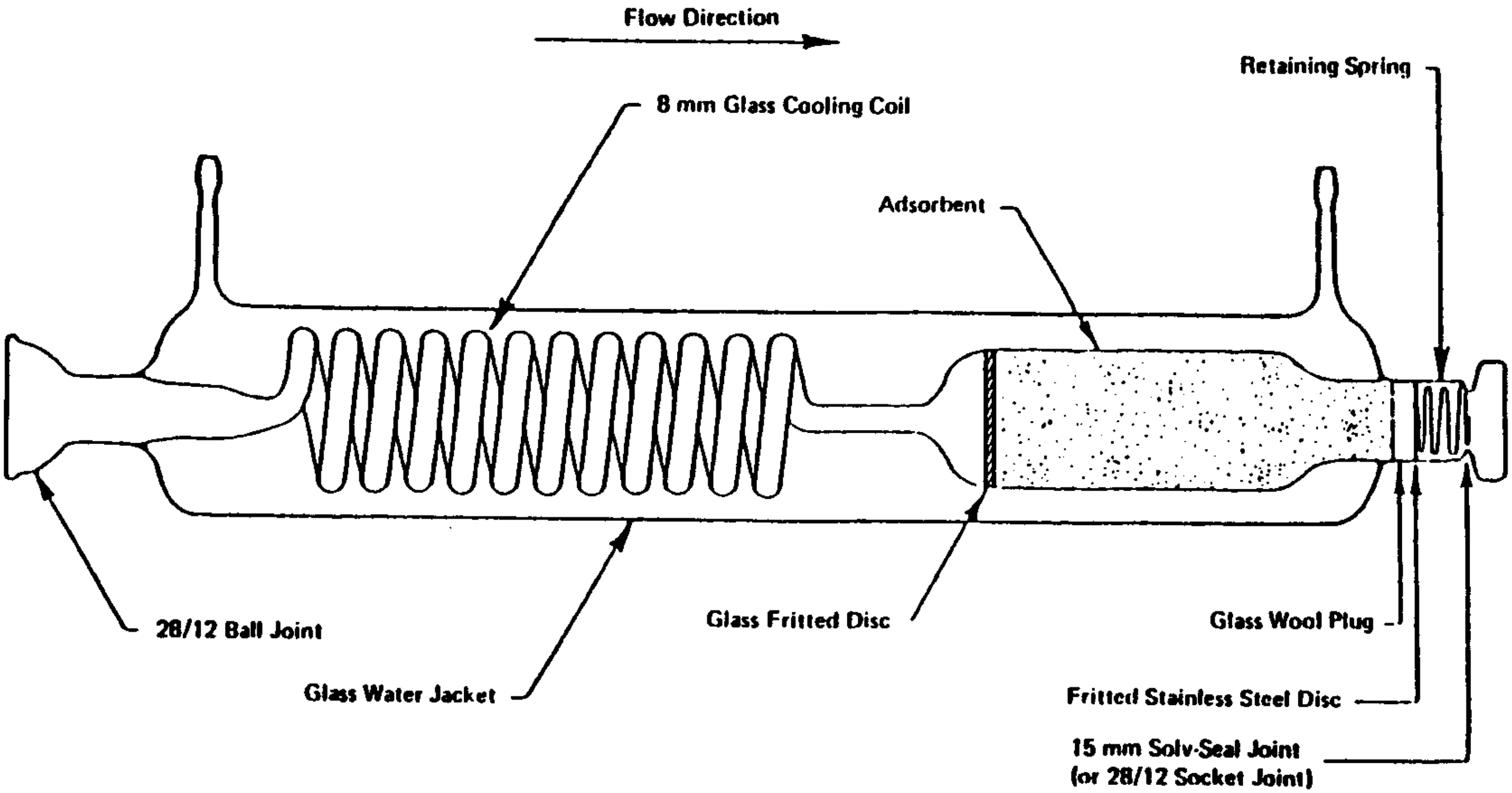


Figure 3. Adsorbent Sampling System.

Alternatively, the sensor may be attached just prior to use in the field. Note, however, that if the temperature sensor is attached in the field, the sensor must be placed in an interference-free arrangement with respect to the Type S pitot tube openings (see EPA Method 2, Figure 2-7). As a second alternative, if a difference of no more than 1% in the average velocity measurement is to be introduced, the temperature gauge need not be attached to the probe or pitot tube.

4.1.3.12 Calibration/field-preparation record: A permanently bound laboratory notebook, in which duplicate copies of data may be made as they are being recorded, is required for documenting and recording calibrations and preparation procedures (i.e., filter and silica gel tare weights, clean XAD-2, quality assurance/quality control check results, dry-gas meter, and thermocouple calibrations, etc.). The duplicate copies should be detachable and should be stored separately in the test program archives.

4.2 Sample Recovery:

4.2.1 **Probe liner:** Probe nozzle and organic module conditioning section brushes; nylon bristle brushes with stainless steel wire handles are required. The probe brush shall have extensions of stainless steel, Teflon, or inert material at least as long as the probe. The brushes shall be properly sized and shaped to brush out the probe liner, the probe nozzle, and the organic module conditioning section.

4.2.2 **Wash bottles:** Three. Teflon or glass wash bottles are recommended; polyethylene wash bottles should not be used because organic contaminants may be extracted by exposure to organic solvents used for sample recovery.

4.2.3 **Glass sample storage containers:** Chemically resistant, borosilicate amber and clear glass bottles, 500-mL or 1,000-mL. Bottles should be tinted to prevent action of light on sample. Screw-cap liners shall be either Teflon or constructed so as to be leak-free and resistant to chemical attack by organic recovery solvents. Narrow-mouth glass bottles have been found to exhibit less tendency toward leakage.

4.2.4 **Petri dishes:** Glass, sealed around the circumference with wide (1-in.) Teflon tape, for storage and transport of filter samples.

4.2.5 **Graduated cylinder and/or balances:** To measure condensed water to the nearest 1 mL or 1 g. Graduated cylinders shall have subdivisions not >2 mL. Laboratory triple-beam balances capable of weighing to ±0.5 g or better are required.

4.2.6 **Plastic storage containers:** Screw-cap polypropylene or polyethylene containers to store silica gel.

4.2.7 **Funnel and rubber policeman:** To aid in transfer of silica gel to container (not necessary if silica gel is weighed in field).

4.2.8 Funnels: Glass, to aid in sample recovery.

4.3 Filters: Glass- or quartz-fiber filters, without organic binder, exhibiting at least 99.95% efficiency (<0.05% penetration) on 0.3-um dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM standard method D2986-71. Test data from the supplier's quality control program are sufficient for this purpose. In sources containing SO_2 or SO_3, the filter material must be of a type that is unreactive to SO_2 or SO_3. Reeve Angel 934 AH or Schleicher and Schwell #3 filters work well under these conditions.

4.4 Crushed ice: Quantities ranging from 10-50 lb may be necessary during a sampling run, depending on ambient air temperature.

4.5 Stopcock grease: Solvent-insoluble, heat-stable silicone grease. Use of silicone grease upstream of the module is not permitted, and amounts used on components located downstream of the organic module shall be minimized. Silicone grease usage is not necessary if screw-on connectors and Teflon sleeves or ground-glass joints are used.

4.6 Glass wool: Used to plug the unfritted end of the sorbent module. The glass-wool fiber should be solvent-extracted with methylene chloride in a Soxhlet extractor for 12 hr and air-dried prior to use.

5.0 REAGENTS

5.1 Adsorbent resin: Porous polymeric resin (XAD-2 or equivalent) is recommended. These resins shall be cleaned prior to their use for sample collection. Appendix A of this method should be consulted to determine appropriate precleaning procedure. For best results, resin used should not exhibit a blank of higher than 4 mg/kg of total chromatographable organics (TCO) (see Appendix B) prior to use. Once cleaned, resin should be stored in an airtight, wide-mouth amber glass container with a Teflon-lined cap or placed in one of the glass sorbent modules tightly sealed with Teflon film and elastic bands. The resin should be used within 4 wk of the preparation.

5.2 Silica gel: Indicating type, 6-16 mesh. If previously used, dry at 175°C (350°F) for 2 hr before using. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to the approval of the Administrator.

5.3 Impinger solutions: Distilled organic-free water (Type II) shall be used, unless sampling is intended to quantify a particular inorganic gaseous species. If sampling is intended to quantify the concentration of additional species, the impinger solution of choice shall be subject to Administrator approval. This water should be prescreened for any compounds of interest. One hundred mL will be added to the specified impinger; the third impinger in the train may be charged with a basic solution (1 N sodium hydroxide or sodium acetate) to protect the sampling pump from acidic gases. Sodium acetate should be used when large sample volumes are anticipated because sodium hydroxide will react with carbon dioxide in aqueous media to form sodium carbonate, which may possibly plug the impinger.

5.4 Sample recovery reagents:

5.4.1 **Methylene chloride:** Distilled-in-glass grade is required for sample recovery and cleanup (see Note to 5.4.2 below).

5.4.2 **Methyl alcohol:** Distilled-in-glass grade is required for sample recovery and cleanup.

NOTE: Organic solvents from metal containers may have a high residue blank and should not be used. Sometimes suppliers transfer solvents from metal to glass bottles; thus blanks shall be run prior to field use and only solvents with low blank value (<0.001%) shall be used.

5.4.3 **Water:** Water (Type II) shall be used for rinsing the organic module and condenser component.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 Because of complexity of this method, field personnel should be trained in and experienced with the test procedures in order to obtain reliable results.

6.2 Laboratory preparation:

6.2.1 All the components shall be maintained and calibrated according to the procedure described in APTD-0576, unless otherwise specified.

6.2.2 Weigh several 200- to 300-g portions of silica gel in airtight containers to the nearest 0.5 g. Record on each container the total weight of the silica gel plus containers. As an alternative to preweighing the silica gel, it may instead be weighed directly in the impinger or sampling holder just prior to train assembly.

6.2.3 Check filters visually against light for irregularities and flaws or pinhole leaks. Label the shipping containers (glass Petri dishes) and keep the filters in these containers at all times except during sampling and weighing.

6.2.4 Desiccate the filters at 20 ± 5.6°C (68 ± 10°F) and ambient pressure for at least 24 hr, and weigh at intervals of at least 6 hr to a constant weight (i.e., <0.5-mg change from previous weighing), recording results to the nearest 0.1 mg. During each weighing the filter must not be exposed for more than a 2-min period to the laboratory atmosphere and relative humidity above 50%. Alternatively (unless otherwise specified by the Administrator), the filters may be oven-dried at 105°C (220°F) for 2-3 hr, desiccated for 2 hr, and weighed.

6.3 Preliminary field determinations:

6.3.1 Select the sampling site and the minimum number of sampling points according to EPA Method 1 or as specified by the Administrator. Determine the stack pressure, temperature, and range of velocity heads using EPA Method 2. It is recommended that a leak-check of the pitot lines (see EPA Method 2, Section 3.1) be performed. Determine the stack-gas moisture content using EPA Approximation Method 4 or its alternatives to establish estimates of isokinetic sampling-rate settings. Determine the stack-gas dry molecular weight, as described in EPA Method 2, Section 3.6. If integrated EPA Method 3 sampling is used for molecular weight determination, the integrated bag sample shall be taken simultaneously with, and for the same total length of time as, the sample run.

6.3.2 Select a nozzle size based on the range of velocity heads so that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates. During the run, do not change the nozzle. Ensure that the proper differential pressure gauge is chosen for the range of velocity heads encountered (see Section 2.2 of EPA Method 2).

6.3.3 Select a suitable probe liner and probe length so that all traverse points can be sampled. For large stacks, to reduce the length of the probe, consider sampling from opposite sides of the stack.

6.3.4 A minimum of 3 dscm (105.9 dscf) of sample volume is required for the determination of the Destruction and Removal Efficiency (DRE) of POHCs from incineration systems. Additional sample volume shall be collected as necessitated by analytical detection limit constraints. To determine the minimum sample volume required, refer to sample calculations in Section 10.0.

6.3.5 Determine the total length of sampling time needed to obtain the identified minimum volume by comparing the anticipated average sampling rate with the volume requirement. Allocate the same time to all traverse points defined by EPA Method 1. To avoid timekeeping errors, the length of time sampled at each traverse point should be an integer or an integer plus one-half min.

6.3.6 In some circumstances (e.g., batch cycles) it may be necessary to sample for shorter times at the traverse points and to obtain smaller gas-sample volumes. In these cases, the Administrator's approval must first be obtained.

6.4 Preparation of collection train:

6.4.1 During preparation and assembly of the sampling train, keep all openings where contamination can occur covered with Teflon film or aluminum foil until just prior to assembly or until sampling is about to begin.

6.4.2 Fill the sorbent trap section of the organic module with approximately 20 g of clean adsorbent resin. While filling, ensure that the trap packs uniformly, to eliminate the possibility of channeling. When freshly cleaned, many adsorbent resins carry a static charge, which will cause clinging to trap walls. This may be minimized by filling the trap in the presence of an antistatic device. Commercial antistatic devices include Model-204 and Model-210 manufactured by the 3M Company, St. Paul, Minnesota.

6.4.3 If an impinger train is used to collect moisture, place 100 mL of water in each of the first two impingers, leave the third impinger empty (or charge with caustic solution, as necessary), and transfer approximately 200-300 g of preweighed silica gel from its container to the fourth impinger. More silica gel may be used, but care should be taken to ensure that it is not entrained and carried out from the impinger during sampling. Place the container in a clean place for later use in the sample recovery. Alternatively, the weight of the silica gel plus impinger may be determined to the nearest 0.5 g and recorded.

6.4.4 Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is properly centered and the gasket properly placed to prevent the sample gas stream from circumventing the filter. Check the filter for tears after assembly is completed.

6.4.5 When glass liners are used, install the selected nozzle using a Viton-A O-ring when stack temperatures are <260°C (500°F) and a woven glass-fiber gasket when temperatures are higher. See APTD-0576 (Rom, 1972) for details. Other connecting systems utilizing either 316 stainless steel or Teflon ferrules may be used. When metal liners are used, install the nozzle as above, or by a leak-free direct mechanical connection. Mark the probe with heat-resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point.

6.4.6 Set up the train as in Figure 1. During assembly, do not use any silicone grease on ground-glass joints that are located upstream of the organic module. A very light coating of silicone grease may be used on all ground-glass joints that are located downstream of the organic module, but it should be limited to the outer portion (see APTD-0576) of the ground-glass joints to minimize silicone-grease contamination. Subject to the approval of the Administrator, a glass cyclone may be used between the probe and the filter holder when the total particulate catch is expected to exceed 100 mg or when water droplets are present in the stack. The organic module condenser must be maintained at a temperature of 17 ± 3°C. Connect all temperature sensors to an appropriate potentiometer/display unit. Check all temperature sensors at ambient temperature.

6.4.7 Place crushed ice around the impingers and the organic module condensate knockout.

6.4.8 Turn on the sorbent module and condenser coil coolant recirculating pump and begin monitoring the sorbent module gas entry temperature. Ensure proper sorbent module gas entry temperature before proceeding and again before any sampling is initiated. It is extremely important that the XAD-2 resin temperature never exceed 50°C (122°F), because thermal decomposition will occur. During testing, the XAD-2 temperature must not exceed 20°C (68°F) for efficient capture of the semivolatile species of interest.

6.4.9 Turn on and set the filter and probe heating systems at the desired operating temperatures. Allow time for the temperatures to stabilize.

6.5 Leak-check procedures

6.5.1 Pre-test leak-check:

6.5.1.1 Because the number of additional intercomponent connections in the Semi-VOST train (over the M5 Train) increases the possibility of leakage, a pre-test leak-check is required.

6.5.1.2 After the sampling train has been assembled, turn on and set the filter and probe heating systems at the desired operating temperatures. Allow time for the temperatures to stabilize. If a Viton A O-ring or other leak-free connection is used in assembling the probe nozzle to the probe liner, leak-check the train at the sampling site by plugging the nozzle and pulling a 381-mm Hg (15-in. Hg) vacuum.
(NOTE: A lower vacuum may be used, provided that it is not exceeded during the test.)

6.5.1.3 If an asbestos string is used, do not connect the probe to the train during the leak-check. Instead, leak-check the train by first attaching a carbon-filled leak-check impinger (shown in Figure 4) to the inlet of the filter holder (cyclone, if applicable) and then plugging the inlet and pulling a 381-mm Hg (15-in. Hg) vacuum. (Again, a lower vacuum may be used, provided that it is not exceeded during the test.) Then, connect the probe to the train and leak-check at about 25-mm Hg (1-in. Hg) vacuum; alternatively, leak-check the probe with the rest of the sampling train in one step at 381-mm Hg (15-in. Hg) vacuum. Leakage rates in excess of 4% of the average sampling rate or >0.00057 m^3/min (0.02 cfm), whichever is less, are unacceptable.

6.5.1.4 The following leak-check instructions for the sampling train described in APTD-0576 and APTD-0581 may be helpful. Start the pump with fine-adjust valve fully open and coarse-adjust valve completely closed. Partially open the coarse-adjust valve and slowly close the fine-adjust valve until the desired vacuum is reached. Do not reverse direction of the fine-adjust valve; this will cause water to back up into the organic module. If the desired vacuum is exceeded, either leak-check at this higher vacuum or end the leak-check, as shown below, and start over.

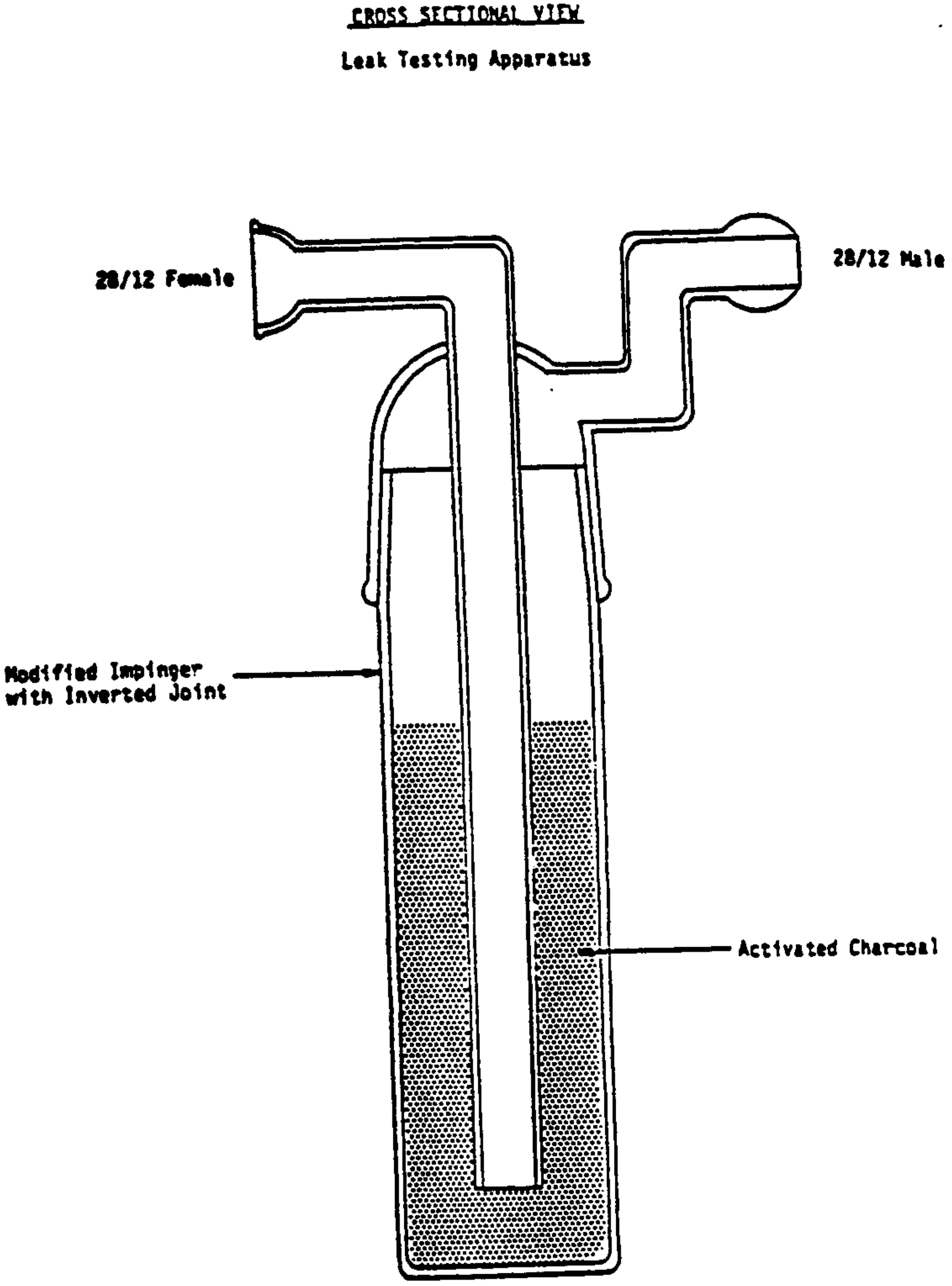


Figure 4. Leak-check impinger.

6.5.1.5 When the leak-check is completed, first slowly remove the plug from the inlet to the probe, filter holder, or cyclone (if applicable). When the vacuum drops to 127 mm (5 in.) Hg or less, immediately close the coarse-adjust valve. Switch off the pumping system and reopen the fine-adjust valve. Do not reopen the fine-adjust valve until the coarse-adjust valve has been closed. This prevents the water in the impingers from being forced backward into the organic module and silica gel from being entrained backward into the third impinger.

6.5.2 Leak-checks during sampling run:

6.5.2.1 If, during the sampling run, a component (e.g., filter assembly, impinger, or sorbent trap) change becomes necessary, a leak-check shall be conducted immediately after the interruption of sampling and before the change is made. The leak-check shall be done according to the procedure outlined in Paragraph 6.5.1, except that it shall be done at a vacuum greater than or equal to the maximum value recorded up to that point in the test. If the leakage rate is found to be no greater than 0.00057 m^3/min (0.02 cfm) or 4% of the average sampling rate (whichever is less), the results are acceptable, and no correction will need to be applied to the total volume of dry gas metered. If a higher leakage rate is obtained, the tester shall void the sampling run. (It should be noted that any "correction" of the sample volume by calculation by calculation reduces the integrity of the pollutant concentrations data generated and must be avoided.)

6.5.2.2 Immediately after a component change, and before sampling is reinitiated, a leak-check similar to a pre-test leak-check must also be conducted.

6.5.3 Post-test leak-check:

6.5.3.1 A leak-check is mandatory at the conclusion of each sampling run. The leak-check shall be done with the same procedures as those with the pre-test leak-check, except that it shall be conducted at a vacuum greater than or equal to the maximum value reached during the sampling run. If the leakage rate is found to be no greater than 0.00057 m^3/min (0.02 cfm) or 4% of the average sampling rate (whichever is less), the results are acceptable, and no correction need be applied to the total volume of dry gas metered. If, however, a higher leakage rate is obtained, the tester shall either record the leakage rate, correct the sample volume (as shown in the calculation section of this method), and consider the data obtained of questionable reliability, or void the sampling run.

6.6 Sampling-train operation:

6.6.1 During the sampling run, maintain an isokinetic sampling rate to within 10% of true isokinetic, unless otherwise specified by the Administrator. Maintain a temperature around the filter of 120 ± 14°C (248 ± 25°F) and a gas temperature entering the sorbent trap at a maximum of 20°C (68°F).

6.6.2 For each run, record the data required on a data sheet such as the one shown in Figure 5. Be sure to record the initial dry-gas meter reading. Record the dry-gas meter readings at the beginning and end of each sampling time increment, when changes in flow rates are made before and after each leak-check, and when sampling is halted. Take other readings required by Figure 5 at least once at each sample point during each time increment and additional readings when significant changes (20% variation in velocity-head readings) necessitate additional adjustments in flow rate. Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse.

6.6.3 Clean the stack access ports prior to the test run to eliminate the chance of sampling deposited material. To begin sampling, remove the nozzle cap, verify that the filter and probe heating systems are at the specified temperature, and verify that the pitot tube and probe are properly positioned. Position the nozzle at the first traverse point, with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Nomographs, which aid in the rapid adjustment of the isokinetic sampling rate without excessive computations, are available. These nomographs are designed for use when the Type S pitot-tube coefficient is 0.84 ± 0.02 and the stack-gas equivalent density (dry molecular weight) is equal to 29 ± 4. APTD-0576 details the procedure for using the nomographs. If the stack-gas molecular weight and the pitot-tube coefficient are outside the above ranges, do not use the nomographs unless appropriate steps (Shigehara, 1974) are taken to compensate for the deviations.

6.6.4 When the stack is under significant negative pressure (equivalent to the height of the impinger stem), take care to close the coarse-adjust valve before inserting the probe into the stack, to prevent water from backing into the organic module. If necessary, the pump may be turned on with the coarse-adjust valve closed.

6.6.5 When the probe is in position, block off the openings around the probe and stack access port to prevent unrepresentative dilution of the gas stream.

6.6.6 Traverse the stack cross section, as required by EPA Method 1 or as specified by the Administrator, being careful not to bump the probe nozzle into the stack walls when sampling near the walls or when removing or inserting the probe through the access port, in order to minimize the chance of extracting deposited material.

6.6.7 During the test run, make periodic adjustments to keep the temperature around the filter holder and the organic module at the proper levels; add more ice and, if necessary, salt to maintain a temperature of <20°C (68°F) at the condenser/silica gel outlet. Also, periodically check the level and zero of the manometer.

Plant ____________________
Location ____________________
Operator ____________________
Date ____________________
Run No. ____________________
Sample Box No. ____________________
Meter Box No. ____________________
Meter H@ ____________________
C Factor ____________________
Pitot Tube Coefficient C_p ____________________

Schematic of Stack Cross Section

Ambient Temperature ____________________
Barometric Pressure ____________________
Assumed Moisture % ____________________
Probe Length, m (ft) ____________________
Nozzle Identification No. ____________________
Average Calibrated Nozzle Diameter, cm (in) __________
Probe Heater Setting ____________________
Leak Rate, m^3/min, (cfm) ____________________
Probe Liner Material ____________________
Static Pressure, mm Hg (in. Hg) ____________________
Filter No. ____________________

Traverse Point Number	Sampling Time (8) min.	Vacuum mm Hg (in. Hg)	Stack Temperature (T_s) °C(°F)	Velocity Head (P_s) mm (in) H_2O	Pressure Differential Across Orifice Meter mm (H_2O) (in H_2O)	Gas Sample Volume m3 (ft3)	Gas Sample Temp. at Dry Gas Meter		Filter Holder Temperature °C(°F)	Temperature of Gas Entering Sorbet Trap °C(°F)	Temperature of Gas Leaving Condenser or Last Impinger
							Inlet °C(°F)	Outlet °C(°F)			
Total											
Average							Avg.	Avg.			

Figure 5. Particulate field data.

6.6.8 If the pressure drop across the filter or sorbent trap becomes too high, making isokinetic sampling difficult to maintain, the filter/sorbent trap may be replaced in the midst of a sample run. Using another complete filter holder/sorbent trap assembly is recommended, rather than attempting to change the filter and resin themselves. After a new filter/sorbent trap assembly is installed, conduct a leak-check. The total particulate weight shall include the summation of all filter assembly catches.

6.6.9 A single train shall be used for the entire sample run, except in cases where simultaneous sampling is required in two or more separate ducts or at two or more different locations within the same duct, or in cases where equipment failure necessitates a change of trains. In all other situations, the use of two or more trains will be subject to the approval of the Administrator.

6.6.10 Note that when two or more trains are used, separate analysis of the front-half (if applicable) organic-module and impinger (if applicable) catches from each train shall be performed, unless identical nozzle sizes were used on all trains. In that case, the front-half catches from the individual trains may be combined (as may the impinger catches), and one analysis of front-half catch and one analysis of impinger catch may be performed.

6.6.11 At the end of the sample run, turn off the coarse-adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final dry-gas meter reading, and conduct a post-test leak-check. Also, leak-check the pitot lines as described in EPA Method 2. The lines must pass this leak-check in order to validate the velocity-head data.

6.6.12 Calculate percent isokineticity (see Section 10.8) to determine whether the run was valid or another test run should be made.

7.0 SAMPLE RECOVERY

7.1 Preparation:

7.1.1 Proper cleanup procedure begins as soon as the probe is removed from the stack at the end of the sampling period. Allow the probe to cool. When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over the tip to prevent losing or gaining particulate matter. Do not cap the probe tip tightly while the sampling train is cooling down because this will create a vacuum in the filter holder, drawing water from the impingers into the sorbent module.

7.1.2 Before moving the sample train to the cleanup site, remove the probe from the sample train and cap the open outlet, being careful not to lose any condensate that might be present. Cap the filter inlet.

Remove the umbilical cord from the last impinger and cap the impinger. If a flexible line is used between the organic module and the filter holder, disconnect the line at the filter holder and let any condensed water or liquid drain into the organic module.

7.1.3 Cap the filter-holder outlet and the inlet to the organic module. Separate the sorbent trap section of the organic module from the condensate knockout trap and the gas-conditioning section. Cap all organic module openings. Disconnect the organic-module knockout trap from the impinger train inlet and cap both of these openings. Ground-glass stoppers, Teflon caps, or caps of other inert materials may be used to seal all openings.

7.1.4 Transfer the probe, the filter, the organic-module components, and the impinger/condenser assembly to the cleanup area. This area should be clean and protected from the weather to minimize sample contamination or loss.

7.1.5 Save a portion of all washing solutions (methanol/methylene chloride, Type II water) used for cleanup as a blank. Transfer 200 mL of each solution directly from the wash bottle being used and place each in a separate, prelabeled glass sample container.

7.1.6 Inspect the train prior to and during disassembly and note any abnormal conditions.

7.2 Sample containers:

7.2.1 **Container no. 1:** Carefully remove the filter from the filter holder and place it in its identified Petri dish container. Use a pair or pairs of tweezers to handle the filter. If it is necessary to fold the filter, ensure that the particulate cake is inside the fold. Carefully transfer to the Petri dish any particulate matter or filter fibers that adhere to the filter-holder gasket, using a dry nylon bristle brush or sharp-edged blade, or both. Label the container and seal with 1-in.-wide Teflon tape around the circumference of the lid.

7.2.2 **Container no. 2:** Taking care that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover particulate matter or any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing these components first with methanol/methylene chloride (1:1 v/v) into a glass container. Distilled water may also be used. Retain a water and solvent blank and analyze in the same manner as with the samples. Perform rinses as follows:

7.2.2.1 Carefully remove the probe nozzle and clean the inside surface by rinsing with the solvent mixture (1:1 v/v methanol/-methylene chloride) from a wash bottle and brushing with a nylon bristle brush. Brush until the rinse shows no visible particles; then make a final rinse of the inside surface with the solvent mix. Brush and rinse the inside parts of the Swagelok fitting with the solvent mix in a similar way until no visible particles remain.

7.2.2.2 Have two people rinse the probe liner with the solvent mix by tilting and rotating the probe while squirting solvent into its upper end so that all inside surfaces will be wetted with solvent. Let the solvent drain from the lower end into the sample container. A glass funnel may be used to aid in transferring liquid washes to the container.

7.2.2.3 Follow the solvent rinse with a probe brush. Hold the probe in an inclined position and squirt solvent into the upper end while pushing the probe brush through the probe with a twisting action; place a sample container underneath the lower end of the probe and catch any solvent and particulate matter that is brushed from the probe. Run the brush through the probe three times or more until no visible particulate matter is carried out with the solvent or until none remains in the probe liner on visual inspection. With stainless steel or other metal probes, run the brush through in the above-prescribed manner at least six times (metal probes have small crevices in which particulate matter can be entrapped). Rinse the brush with solvent and quantitatively collect these washings in the sample container. After the brushing, make a final solvent rinse of the probe as described above.

7.2.2.4 It is recommended that two people work together to clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contamination.

7.2.2.5 Clean the inside of the front half of the filter holder and cyclone/cyclone flask, if used, by rubbing the surfaces with a nylon bristle brush and rinsing with methanol/methylene chloride (1:1 v/v) mixture. Rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush and filter holder. Carefully rinse out the glass cyclone and cyclone flask (if applicable). Brush and rinse any particulate material adhering to the inner surfaces of these components into the front-half rinse sample. After all solvent washings and particulate matter have been collected in the sample container, tighten the lid on the sample container so that solvent will not leak out when it is shipped to the laboratory. Mark the height of the fluid level to determine whether leakage occurs during transport. Label the container to identify its contents.

7.2.3 **Container no. 3:** The sorbent trap section of the organic module may be used as a sample transport container, or the spent resin may be transferred to a separate glass bottle for shipment. If the sorbent trap itself is used as the transport container, both ends should be sealed with tightly fitting caps or plugs. Ground-glass stoppers or Teflon caps may be used. The sorbent trap should then be labeled, covered with aluminum foil, and packaged on ice for transport to the laboratory. If a separate bottle is used, the spent resin should be quantitatively transferred from the trap into the clean bottle. Resin that adheres to the walls of the trap should be recovered using a rubber policeman or spatula and added to this bottle.

7.2.4 **Container no. 4:** Measure the volume of condensate collected in the condensate knockout section of the organic module to within ±1 mL by using a graduated cylinder or by weighing to within ±0.5 g using a triple-beam balance. Record the volume or weight of liquid present and note any discoloration or film in the liquid catch. Transfer this liquid to a prelabeled glass sample container. Inspect the back half of the filter housing and the gas-conditioning section of the organic module. If condensate is observed, transfer it to a graduated or weighing bottle and measure the volume, as described above. Add this material to the condensate knockout-trap catch.

7.2.5 **Container no. 5:** All sampling train components located between the high-efficiency glass- or quartz-fiber filter and the first wet impinger or the final condenser system (including the heated Teflon line connecting the filter outlet to the condenser) should be thoroughly rinsed with methanol/methylene chloride (1:1 v/v) and the rinsings combined. This rinse shall be separated from the condensate. If the spent resin is transferred from the sorbent trap to a separate sample container for transport, the sorbent trap shall be thoroughly rinsed until all sample-wetted surfaces appear clean. Visible films should be removed by brushing. Whenever train components are brushed, the brush should be subsequently rinsed with solvent mixture and the rinsings added to this container.

7.2.6 **Container no. 6:** Note the color of the indicating silica gel to determine if it has been completely spent and make a notation of its condition. Transfer the silica gel from the fourth impinger to its original container and seal. A funnel may make it easier to pour the silica gel without spilling. A rubber policeman may be used as an aid in removing the silica gel from the impinger. It is not necessary to remove the small amount of dust particles that may adhere strongly to the impinger wall. Because the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, weigh the container and its contents to 0.5 g or better.

7.3 Impinger water:

7.3.1 Make a notation of any color or film in the liquid catch. Measure the liquid in the first three impingers to within ±1 mL by using a graduated cylinder or by weighing it to within ±0.5 g by using a balance (if one is available). Record the volume or weight of liquid present. This information is required to calculate the moisture content of the effluent gas.

7.3.2 Discard the liquid after measuring and recording the volume or weight, unless analysis of the impinger catch is required (see Paragraph 4.1.3.7). Amber glass containers should be used for storage of impinger catch, if required.

7.3.3 If a different type of condenser is used, measure the amount of moisture condensed either volumetrically or gravimetrically.

7.4 Sample preparation for shipment: Prior to shipment, recheck all sample containers to ensure that the caps are well secured. Seal the lids of all containers around the circumference with Teflon tape. Ship all liquid samples upright on ice and all particulate filters with the particulate catch facing upward. The particulate filters should be shipped unrefrigerated.

8.0 ANALYSIS

8.1 Sample preparation:

8.1.1 General: The preparation steps for all samples will result in a finite volume of concentrated solvent. The final sample volume (usually in the 1- to 10-mL range) is then subjected to analysis by GC/MS. All samples should be inspected and the appearance documented. All samples are to be spiked with surrogate standards as received from the field prior to any sample manipulations. The spike should be at a level equivalent to 10 times the MDL when the solvent is reduced in volume to the desired level (i.e., 10 mL). The spiking compounds should be the stable isotopically labeled analog of the compounds of interest or a compound that would exhibit properties similar to the compounds of interest, be easily chromatographed, and not interfere with the analysis of the compounds of interest. Suggested surrogate spiking compounds are: deuterated naphthalene, chrysene, phenol, nitrobenzene, chlorobenzene, toluene, and carbon-13-labeled pentachlorophenol.

8.1.2 Condensate: The "condensate" is the moisture collected in the first impinger following the XAD-2 module. Spike the condensate with the surrogate standards. The volume is measured and recorded and then transferred to a separatory funnel. The pH is to be adjusted to pH 2 with 6 N sulfuric acid, if necessary. The sample container and graduated cylinder are sequentially rinsed with three successive 10-mL aliquots of the extraction solvent and added to the separatory funnel. The ratio of solvent to aqueous sample should be maintained at 1:3. Extract the sample by vigorously shaking the separatory funnel for 5 min. After complete separation of the phases, remove the solvent and transfer to a Kuderna-Danish concentrator (K-D), filtering through a bed of precleaned, dry sodium sulfate. Repeat the extraction step two additional times. Adjust the pH to 11 with 6 N sodium hydroxide and reextract combining the acid and base extracts. Rinse the sodium sulfate into the K-D with fresh solvent and discard the desiccant. Add Teflon boiling chips and concentrate to 10 mL by reducing the volume to slightly less than 10 mL and then bringing to volume with fresh solvent. In order to achieve the necessary detection limit, the sample volume can be further reduced to 1 mL by using a micro column K-D or nitrogen blow-down. Should the sample start to exhibit precipitation, the concentration step should be stopped and the sample redissolved with fresh solvent taking the volume to some finite amount. After adding a standard (for the purpose of quantitation by GC/MS), the sample is ready for analysis, as discussed in Paragraph 8.2.

8.1.3 **Impinger:** Spike the sample with the surrogate standards; measure and record the volume and transfer to a separatory funnel. Proceed as described in Paragraph 8.1.2.

8.1.4 **XAD-2:** Spike the resin directly with the surrogate standards. Transfer the resin to the all-glass thimbles by the following procedure (care should be taken so as not to contaminate the thimble by touching it with anything other than tweezers or other solvent-rinsed mechanical holding devices). Suspend the XAD-2 module directly over the thimble. The glass frit of the module (see Figure 2) should be in the up position. The thimble is contained in a clean beaker, which will serve to catch the solvent rinses. Using a Teflon squeeze bottle, flush the XAD-2 into the thimble. Thoroughly rinse the glass module with solvent into the beaker containing the thimble. Add the XAD-2 glass-wool plug to the thimble. Cover the XAD-2 in the thimble with a precleaned glass-wool plug sufficient to prevent the resin from floating into the solvent reservoir of the extractor. If the resin is wet, effective extraction can be accomplished by loosely packing the resin in the thimble. If a question arises concerning the completeness of the extraction, a second extraction, without a spike, is advised. The thimble is placed in the extractor and the rinse solvent contained in the beaker is added to the solvent reservoir. Additional solvent is added to make the reservoir approximately two-thirds full. Add Teflon boiling chips and assemble the apparatus. Adjust the heat source to cause the extractor to cycle 5-6 times per hr. Extract the resin for 16 hr. Transfer the solvent and three 10-mL rinses of the reservoir to a K-D and concentrate as described in Paragraph 8.1.2.

8.1.5 **Particulate filter (and cyclone catch):** If particulate loading is to be determined, weigh the filter (and cyclone catch, if applicable). The particulate filter (and cyclone catch, if applicable) is transferred to the glass thimble and extracted simultaneously with the XAD-2 resin.

8.1.6 **Train solvent rinses:** All train rinses (i.e., probe, impinger, filter housing) using the extraction solvent and methanol are returned to the laboratory as a single sample. If the rinses are contained in more than one container, the intended spike is divided equally among the containers proportioned from a single syringe volume. Transfer the rinse to a separatory funnel and add a sufficient amount of organic-free water so that the methylene chloride becomes immiscible and its volume no longer increases with the addition of more water. The extraction and concentration steps are then performed as described in Paragraph 8.1.2.

8.2 Sample analysis:

8.2.1 The primary analytical tool for the measurement of emissions from hazardous waste incinerators is GC/MS using fused-silica capillary GC columns, as described in Method 8270 in Chapter Four of this manual. Because of the nature of GC/MS instrumentation and the cost associated with sample analysis, prescreening of the sample extracts by gas chromatography/flame ionization detection (GC/FID) or with electron capture (GC/ECD) is encouraged. Information regarding the complexity and concentration level of a sample prior to GC/MS analysis can be of enormous help. This information can be obtained by using either capillary columns or less expensive packed columns. However, the FID screen should be performed with a column similar to that used with the GC/MS. Keep in mind that GC/FID has a slightly lower detection limit than GC/MS and, therefore, that the concentration of the sample can be adjusted either up or down prior to analysis by GC/MS.

8.2.2 The mass spectrometer will be operated in a full scan (40-450) mode for most of the analyses. The range for which data are acquired in a GC/MS run will be sufficiently broad to encompass the major ions, as listed in Chapter Four, Method 8270, for each of the designated POHCs in an incinerator effluent analysis.

8.2.3 For most purposes, electron ionization (EI) spectra will be collected because a majority of the POHCs give reasonable EI spectra. Also, EI spectra are compatible with the NBS Library of Mass Spectra and other mass spectral references, which aid in the identification process for other components in the incinerator process streams.

8.2.4 To clarify some identifications, chemical ionization (CI) spectra using either positive ions or negative ions will be used to elucidate molecular-weight information and simplify the fragmentation patterns of some compounds. In no case, however, should CI spectra alone be used for compound identification. Refer to Chapter Four, Method 8270, for complete descriptions of GC conditions, MS conditions, and quantitative and quantitative identification.

9.0 CALIBRATION

9.1 Probe nozzle: Probe nozzles shall be calibrated before their initial use in the field. Using a micrometer, measure the inside diameter of the nozzle to the nearest 0.025 mm (0.001 in.). Make measurements at three separate places across the diameter and obtain the average of the measurements. The difference between the high and low numbers shall not exceed 0.1 mm (0.004 in.). When nozzles become nicked, dented, or corroded, they shall be reshaped, sharpened, and recalibrated before use. Each nozzle shall be permanently and uniquely identified.

9.2 Pitot tube: The Type S pitot tube assembly shall be calibrated according to the procedure outlined in Section 4 of EPA Method 2, or assigned a nominal coefficient of 0.84 if it is not visibly nicked, dented, or corroded and if it meets design and intercomponent spacing specifications.

9.3 Metering system:

9.3.1 Before its initial use in the field, the metering system shall be calibrated according to the procedure outlined in APTD-0576. Instead of physically adjusting the dry-gas meter dial readings to correspond to the wet-test meter readings, calibration factors may be used to correct the gas meter dial readings mathematically to the proper values. Before calibrating the metering system, it is suggested that a leak-check be conducted. For metering systems having diaphragm pumps, the normal leak-check procedure will not detect leakages within the pump. For these cases the following leak-check procedure is suggested: Make a 10-min calibration run at 0.00057 m^3/min (0.02 cfm); at the end of the run, take the difference of the measured wet-test and dry-gas meter volumes and divide the difference by 10 to get the leak rate. The leak rate should not exceed 0.00057 m^3/min (0.02 cfm).

9.3.2 After each field use, the calibration of the metering system shall be checked by performing three calibration runs at a single intermediate orifice setting (based on the previous field test). The vacuum shall be set at the maximum value reached during the test series. To adjust the vacuum, insert a valve between the wet-test meter and the inlet of the metering system. Calculate the average value of the calibration factor. If the calibration has changed by more than 5%, recalibrate the meter over the full range of orifice settings, as outlined in APTD-0576.

9.3.3 **Leak-check of metering system:** That portion of the sampling train from the pump to the orifice meter (see Figure 1) should be leak-checked prior to initial use and after each shipment. Leakage after the pump will result in less volume being recorded than is actually sampled. The following procedure is suggested (see Figure 6): Close the main valve on the meter box. Insert a one-hole rubber stopper with rubber tubing attached into the orifice exhaust pipe. Disconnect and vent the low side of the orifice manometer. Close off the low side orifice tap. Pressurize the system to 13-18 cm (5-7 in.) water column by blowing into the rubber tubing. Pinch off the tubing and observe the manometer for 1 min. A loss of pressure on the manometer indicates a leak in the meter box. Leaks, if present, must be corrected.

NOTE: If the dry-gas-meter coefficient values obtained before and after a test series differ by >5%, either the test series shall be voided or calculations for test series shall be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

9.4 Probe heater:

The probe-heating system shall be calibrated before its initial use in the field according to the procedure outlined in APTD-0576. Probes constructed according to APTD-0581 need not be calibrated if the calibration curves in APTD-0576 are used.

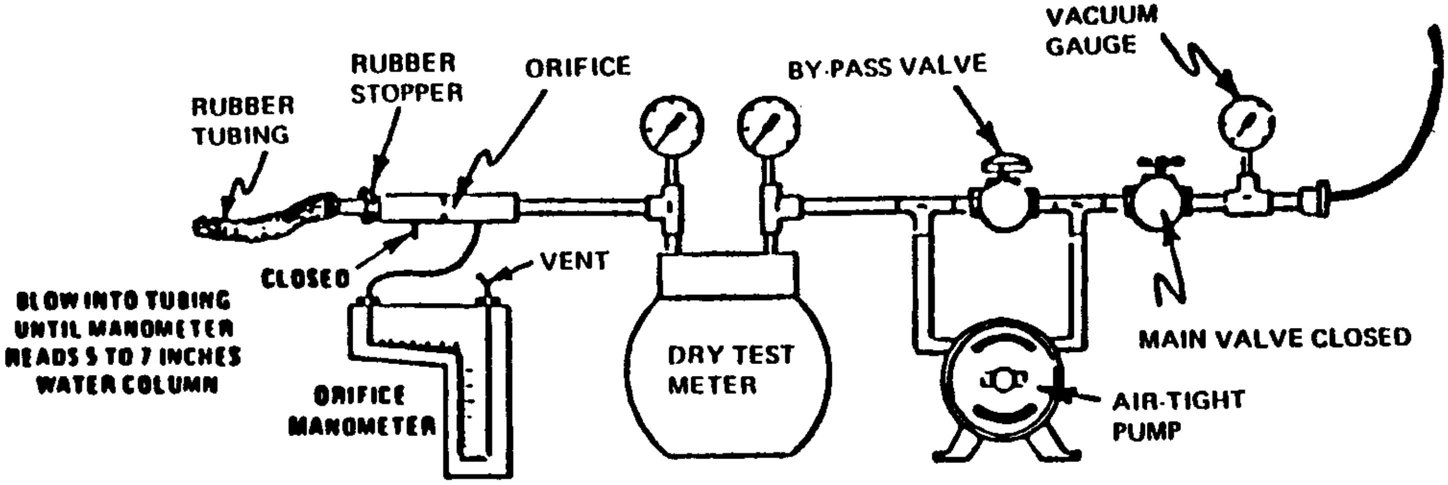


Figure 6. Leak-check of meter box.

9.5 Temperature gauges: Each thermocouple must be permanently and uniquely marked on the casting; all mercury-in-glass reference thermometers must conform to ASTM E-1 63C or 63F specifications. Thermocouples should be calibrated in the laboratory with and without the use of extension leads. If extension leads are used in the field, the thermocouple readings at ambient air temperatures, with and without the extension lead, must be noted and recorded. Correction is necessary if the use of an extension lead produces a change >1.5%.

9.5.1 **Impinger, organic module, and dry-gas meter thermocouples:** For the thermocouples used to measure the temperature of the gas leaving the impinger train and the XAD-2 resin bed, three-point calibration at ice-water, room-air, and boiling-water temperatures is necessary. Accept the thermocouples only if the readings at all three temperatures agree to ±2°C (3.6°F) with those of the absolute value of the reference thermometer.

9.5.2 **Probe and stack thermocouple:** For the thermocouples used to indicate the probe and stack temperatures, a three-point calibration at ice-water, boiling-water, and hot-oil-bath temperatures must be performed; it is recommended that room-air temperature be added, and that the thermometer and the thermocouple agree to within 1.5% at each of the calibration points. A calibration curve (equation) may be constructed (calculated) and the data extrapolated to cover the entire temperature range suggested by the manufacturer.

9.6 Barometer: Adjust the barometer initially and before each test series to agree to within ±25 mm Hg (0.1 in. Hg) of the mercury barometer or the corrected barometric pressure value reported by a nearby National Weather Service Station (same altitude above sea level).

9.7 Triple-beam balance: Calibrate the triple-beam balance before each test series, using Class-S standard weights; the weights must be within ±0.5% of the standards, or the balance must be adjusted to meet these limits.

10.0 CALCULATIONS

10.1 Carry out calculations. Round off figures after the final calculation to the correct number of significant figures.

10.2 Nomenclature:

A_n = Cross-sectional area of nozzle, m^2 (ft^2).

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

C_d = Type S pitot tube coefficient (nominally 0.84 ± 0.02), dimensionless.

I = Percent of isokinetic sampling.

L_a = Maximum acceptable leakage rate for a leak-check, either pre-test or following a component change; equal to 0.00057 m^3/min (0.02 cfm) or 4% of the average sampling rate, whichever is less.

L_i = Individual leakage rate observed during the leak-check conducted prior to the "i^{th}" component change (i = 1, 2, 3...n) m^3/min (cfm).

L_p = Leakage rate observed during the post-test leak-check, m^3/min (cfm).

M_d = Stack-gas dry molecular weight, g/g-mole (lb/lb-mole).

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

P_{bar} = Barometric pressure at the sampling site, mm Hg (in. Hg).

P_s = Absolute stack-gas pressure, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 mm Hg-m^3/K-g-mole (21.85 in. Hg-ft^3/°R-lb-mole).

T_m = Absolute average dry-gas meter temperature (see Figure 6), K (°R).

T_s = Absolute average stack-gas temperature (see Figure 6), K (°R).

T_{std} = Standard absolute temperature, 293K (528°R).

V_{lc} = Total volume of liquid collected in the organic module condensate knockout trap, the impingers, and silica gel, mL.

V_m = Volume of gas sample as measured by dry-gas meter, dscm (dscf).

$V_{m(std)}$ = Volume of gas sample measured by the dry-gas meter, corrected to standard conditions, dscm (dscf).

$V_{w(std)}$ = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf).

V_s = Stack-gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 5, m/sec (ft/sec).

W_a = Weight of residue in acetone wash, mg.

γ = Dry-gas-meter calibration factor, dimensionless.

ΔH = Average pressure differential across the orifice meter (see Figure 2), mm H_2O (in. H_2O).

ρ_w = Density of water, 0.9982 g/mL (0.002201 lb/mL).

θ = Total sampling time, min.

θ_1 = Sampling time interval from the beginning of a run until the first component change, min.

θ_i = Sampling time interval between two successive component changes, beginning with the interval between the first and second changes, min.

θ_p = Sampling time interval from the final (nth) component change until the end of the sampling run, min.

13.6 = Specific gravity of mercury.

60 = sec/min.

100 = Conversion to percent.

10.3 Average dry-gas-meter temperature and average orifice pressure drop: See data sheet (Figure 5, above).

10.4 Dry-gas volume: Correct the sample measured by the dry-gas meter to standard conditions (20°C, 760 mm Hg [68°F, 29.92 in. Hg]) by using Equation 1:

$$V_{m(std)} = V_m \gamma \frac{T_{std}}{T_m} \frac{P_{bar} + \Delta H/13.6}{P_{std}} = K_1 V_m \gamma \frac{P_{bar} + \Delta H/13.6}{T_m} \qquad (1)$$

where:

K_1 = 0.3858 K/mm Hg for metric units, or
K_1 = 17.64°R/in. Hg for English units.

It should be noted that Equation 1 can be used as written, unless the leakage rate observed during any of the mandatory leak-checks (i.e., the post-test leak-check or leak-checks conducted prior to component changes) exceeds L_a. If L_p or L_i exceeds L_a, Equation 1 must be modified as follows:

a. Case I (no component changes made during sampling run): Replace V_m in Equation 1 with the expression:

$$V_m - (L_p - L_a)$$

b. Case II (one or more component changes made during the sampling run): Replace V_m in Equation 1 by the expression:

$$V_m - (L_1 - L_a)\theta_1 - \sum_{i=2}^{n} (L_i - L_a)\theta_i - (L_p - L_a)\theta_p$$

and substitute only for those leakage rates (L_1 or L_p) that exceed L_a.

10.5 Volume of water vapor:

$$V_{w(std)} = V_{1c} \frac{P_w}{M_w} \frac{RT_{std}}{P_{std}} = K_2 V_{1c} \qquad (2)$$

where:

K_2 = 0.001333 m^3/mL for metric units, or
K_2 = 0.04707 ft^3/mL for English units.

10.6 Moisture content:

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}} \qquad (3)$$

NOTE: In saturated or water-droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one from the impinger analysis (Equation 3) and a second from the assumption of saturated conditions. The lower of the two values of B_w shall be considered correct. The procedure for determining the moisture content based upon assumption of saturated conditions is given in the Note to Section 1.2 of Method 4. For the purposes of this method, the average stack-gas temperature from Figure 6 may be used to make this determination, provided that the accuracy of the in-stack temperature sensor is ±1°C (2°F).

10.7 Conversion factors:

From	To	Multiply by
scf	m^3	0.02832
g/ft^3	gr/ft^3	15.43
g/ft^3	lb/ft^3	2.205×10^{-3}
g/ft^3	g/m^3	35.31

10.8 Isokinetic variation:

10.8.1 **Calculation from raw data:**

$$I = \frac{100\ T_s[K_3F_{lc} + (V_m/T_m)\ (P_{bar} + \Delta H/13.6)]}{60\theta V_s P_s A_n} \qquad (4)$$

where:

K_3 = 0.003454 mm Hg-m^3/mL-K for metric units, or
K_3 = 0.002669 in. Hg-ft^3/mL-°R for English units.

10.8.2 Calculation for intermediate values:

$$I = \frac{T_s V_{m(std)} P_{std} 100}{T_{std} V_s \theta A_n P_s 60 (1-B_{ws})}$$

$$= K_4 \frac{T_s V_{m(std)}}{P_s V_s A_n \theta (1-B_{ws})} \qquad (5)$$

where:

K_4 = 4.320 for metric units, or
K_4 = 0.09450 for English units.

10.8.3 Acceptable results: If 90% $\leq$ I $\leq$ 110%, the results are acceptable. If the results are low in comparison with the standard and I is beyond the acceptable range, or if I is less than 90%, the Administrator may opt to accept the results.

10.9 To determine the minimum sample volume that shall be collected, the following sequence of calculations shall be used.

10.9.1 From prior analysis of the waste feed, the concentration of POHCs introduced into the combustion system can be calculated. The degree of destruction and removal efficiency that is required is used to determine the maximum amount of POHC allowed to be present in the effluent. This may be expressed as:

$$\frac{(WF)\ (POHC_i\ conc)}{100}\ \frac{(100\text{-}\%DRE)}{100} = \text{Max } POHC_i \text{ Mass} \qquad (6)$$

where:

WF = mass flow rate of waste feed per hr, g/hr (lb/hr).

$POHC_i$ = concentration of Principal Organic Hazardous Compound (wt %) introduced into the combustion process.

DRE = percent Destruction and Removal Efficiency required.

Max POHC = mass flow rate (g/hr [lb/hr]) of POHC emitted from the combustion source.

10.9.2 The average discharge concentration of the POHC in the effluent gas is determined by comparing the Max POHC with the volumetric flow rate being exhausted from the source. Volumetric flow rate data are available as a result of preliminary Method 1-4 determinations:

$$\frac{\text{Max POHC}_i \text{ Mass}}{DV_{eff(std)}} = \text{Max POHC}_i \text{ conc} \qquad (7)$$

where:

$DV_{eff(std)}$ = volumetric flow rate of exhaust gas, dscm (dscf).

$POHC_i$ conc = anticipated concentration of the POHC in the exhaust gas stream, g/dscm (lb/dscf).

10.9.3 In making this calculation, it is recommended that a safety margin of at least ten be included:

$$\frac{LDL_{POHC} \times 10}{POHC_{i \text{ conc}}} = V_{TBC} \qquad (8)$$

where:

LDL_{POHC} = detectable amount of POHC in entire sampling train.
NOTE: The whole extract from an XAD-2 cartridge is seldom if ever, injected at once. Therefore, if aliquoting factors are involved, the LDL_{POHC} is not the same as the analytical (or column) detection limit.

V_{TBC} = minimum dry standard volume to be collected at dry-gas meter.

10.10 <u>Concentration of any given POHC in the gaseous emissions of a combustion process</u>:

1) Multiply the concentration of the POHC as determined in Method 8270 by the final concentration volume, typically 10 mL.

C_{POHC} (ug/mL) x sample volume (mL) = amount (ug) of POHC in sample (9)

where:

C_{POHC} = concentration of POHC as analyzed by Method 8270.

2) Sum the amount of POHC found in all samples associated with a single train.

Total (ug) = XAD-2 (ug) + condensate (ug) + rinses (ug) + impinger (ug) (10)

3) Divide the total ug found by the volume of stack gas sampled (m^3).

(Total ug)/(train sample volume) = concentration of POHC (ug/m^3) (11)

11.0 QUALITY CONTROL

11.1 Sampling: See EPA Manual 600/4-77-027b for Method 5 quality control.

11.2 Analysis: The quality assurance program required for this study includes the analysis of field and method blanks, procedure validations, incorporation of stable labeled surrogate compounds, quantitation versus stable labeled internal standards, capillary column performance checks, and external performance tests. The surrogate spiking compounds selected for a particular analysis are used as primary indicators of the quality of the analytical data for a wide range of compounds and a variety of sample matrices. The assessment of combustion data, positive identification, and quantitation of the selected compounds are dependent on the integrity of the samples received and the precision and accuracy of the analytical methods employed. The quality assurance procedures for this method are designed to monitor the performance of the analytical method and to provide the required information to take corrective action if problems are observed in laboratory operations or in field sampling activities.

11.2.1 **Field Blanks:** Field blanks must be submitted with the samples collected at each sampling site. The field blanks include the sample bottles containing aliquots of sample recovery solvents, unused filters, and resin cartridges. At a minimum, one complete sampling train will be assembled in the field staging area, taken to the sampling area, and leak-checked at the beginning and end of the testing (or for the same total number of times as the actual test train). The filter housing and probe of the blank train will be heated during the sample test. The train will be recovered as if it were an actual test sample. No gaseous sample will be passed through the sampling train.

11.2.2 **Method blanks:** A method blank must be prepared for each set of analytical operations, to evaluate contamination and artifacts that can be derived from glassware, reagents, and sample handling in the laboratory.

11.2.3 Refer to Method 8270 for additional quality control considerations.

12.0 METHOD PERFORMANCE

12.1 Method performance evaluation: Evaluation of analytical procedures for a selected series of compounds must include the sample-preparation procedures and each associated analytical determination. The analytical procedures should be challenged by the test compounds spiked at appropriate levels and carried through the procedures.

12.2 Method detection limit: The overall method detection limits (lower and upper) must be determined on a compound-by-compound basis because different compounds may exhibit different collection, retention, and extraction efficiencies as well as instrumental minimum detection limit (MDL). The method detection limit must be quoted relative to a given sample volume. The upper limits for the method must be determined relative to compound retention volumes (breakthrough).

12.3 Method precision and bias: The overall method precision and bias must be determined on a compound-by-compound basis at a given concentration level. The method precision value would include a combined variability due to sampling, sample preparation, and instrumental analysis. The method bias would be dependent upon the collection, retention, and extraction efficiency of the train components. From evaluation studies to date using a dynamic spiking system, method biases of -13% and -16% have been determined for toluene and 1,1,2,2-tetrachloroethane, respectively. A precision of 19.9% was calculated from a field test data set representing seven degrees of freedom which resulted from a series of paired, unspiked Semivolatile Organic Sampling trains (Semi-VOST) sampling emissions from a hazardous waste incinerator.

13.0 REFERENCES

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METHOD 0010, APPENDIX A

PREPARATION OF XAD-2 SORBENT RESIN

1.0 SCOPE AND APPLICATION

1.1 XAD-2 resin as supplied by the manufacturer is impregnated with a bicarbonate solution to inhibit microbial growth during storage. Both the salt solution and any residual extractable monomer and polymer species must be removed before use. The resin is prepared by a series of water and organic extractions, followed by careful drying.

2.0 EXTRACTION

2.1 Method 1: The procedure may be carried out in a giant Soxhlet extractor. An all-glass thimble containing an extra-coarse frit is used for extraction of XAD-2. The frit is recessed 10-15 mm above a crenellated ring at the bottom of the thimble to facilitate drainage. The resin must be carefully retained in the extractor cup with a glass-wool plug and stainless steel screen because it floats on methylene chloride. This process involves sequential extraction in the following order.

Solvent	Procedure
Water	Initial rinse: Place resin in a beaker, rinse once with Type II water, and discard. Fill with water a second time, let stand overnight, and discard.
Water	Extract with H_2O for 8 hr.
Methyl alcohol	Extract for 22 hr.
Methylene chloride	Extract for 22 hr.
Methylene chloride (fresh)	Extract for 22 hr.

2.2 Method 2:

2.2.1 As an alternative to Soxhlet extraction, a continuous extractor has been fabricated for the extraction sequence. This extractor has been found to be acceptable. The particular canister used for the apparatus shown in Figure A-1 contains about 500 g of finished XAD-2. Any size may be constructed; the choice is dependent on the needs of the sampling programs. The XAD-2 is held under light spring tension between a pair of coarse and fine screens. Spacers under the bottom screen allow for even distribution of clean solvent. The three-necked flask should be of sufficient size (3-liter in this case) to hold solvent

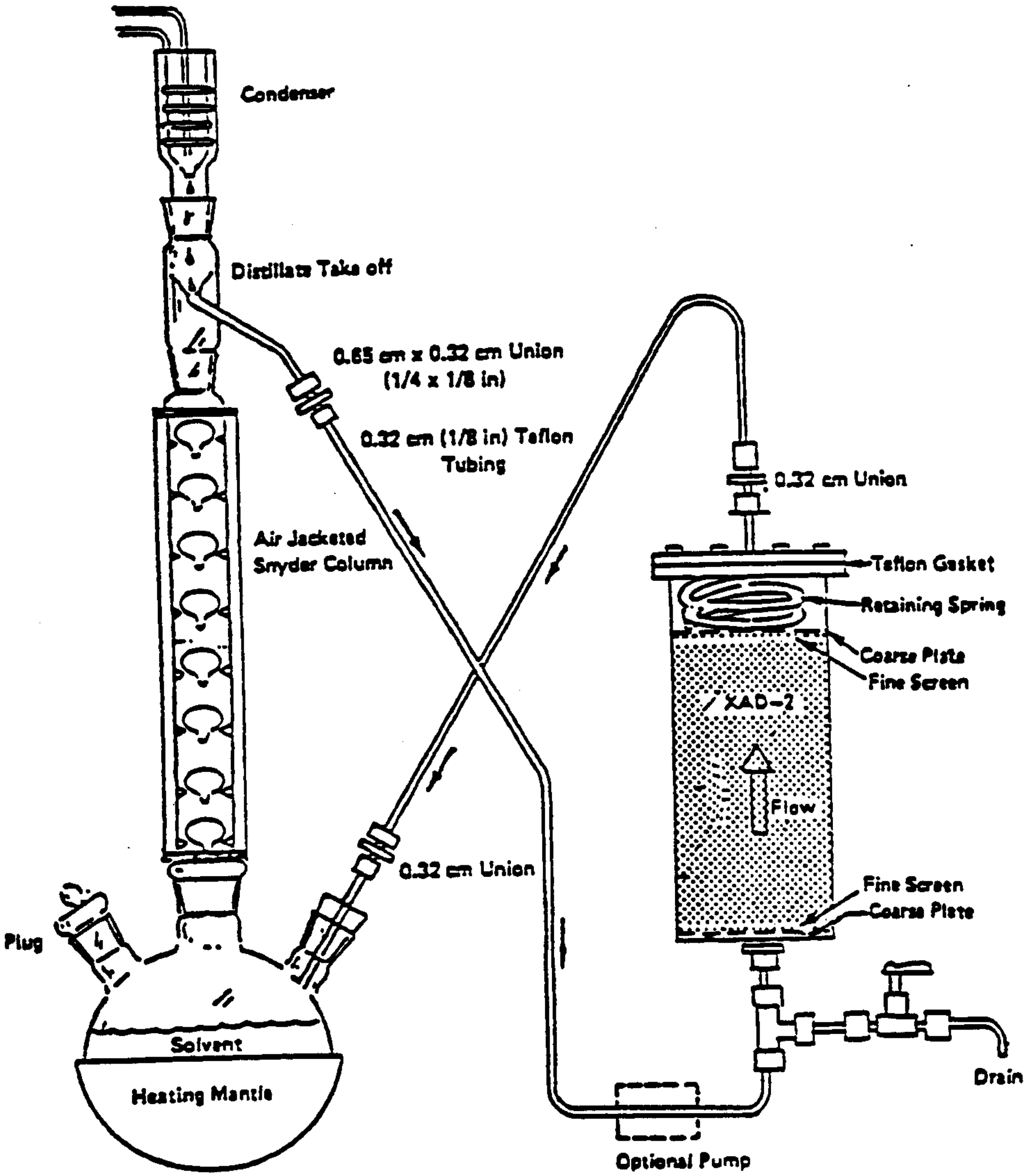


Figure A-1. XAD-2 cleanup extraction apparatus.

equal to twice the dead volume of the XAD-2 canister. Solvent is refluxed through the Snyder column, and the distillate is continuously cycled up through the XAD-2 for extraction and returned to the flask. The flow is maintained upward through the XAD-2 to allow maximum solvent contact and prevent channeling. A valve at the bottom of the canister allows removal of solvent from the canister between changes.

2.2.2 Experience has shown that it is very difficult to cycle sufficient water in this mode. Therefore the aqueous rinse is accomplished by simply flushing the canister with about 20 liters of distilled water. A small pump may be useful for pumping the water through the canister. The water extraction should be carried out at the rate of about 20-40 mL/min.

2.2.3 After draining the water, subsequent methyl alcohol and methylene chloride extractions are carried out using the refluxing apparatus. An overnight or 10- to 20-hr period is normally sufficient for each extraction.

2.2.4 All materials of construction are glass, Teflon, or stainless steel. Pumps, if used, should not contain extractable materials. Pumps are not used with methanol and methylene chloride.

3.0 DRYING

3.1 After evaluation of several methods of removing residual solvent, a fluidized-bed technique has proved to be the fastest and most reliable drying method.

3.2 A simple column with suitable retainers, as shown in Figure A-2, will serve as a satisfactory column. A 10.2-cm (4-in.) Pyrex pipe 0.6 m (2 ft) long will hold all of the XAD-2 from the extractor shown in Figure A-1 or the Soxhlet extractor, with sufficient space for fluidizing the bed while generating a minimum resin load at the exit of the column.

3.3 Method 1: The gas used to remove the solvent is the key to preserving the cleanliness of the XAD-2. Liquid nitrogen from a standard commercial liquid nitrogen cylinder has routinely proved to be a reliable source of large volumes of gas free from organic contaminants. The liquid nitrogen cylinder is connected to the column by a length of precleaned 0.95-cm (3/8-in.) copper tubing, coiled to pass through a heat source. As nitrogen is bled from the cylinder, it is vaporized in the heat source and passes through the column. A convenient heat source is a water bath heated from a steam line. The final nitrogen temperature should only be warm to the touch and not over 40°C. Experience has shown that about 500 g of XAD-2 may be dried overnight by consuming a full 160-liter cylinder of liquid nitrogen.

3.4 Method 2: As a second choice, high-purity tank nitrogen may be used to dry the XAD-2. The high-purity nitrogen must first be passed through a bed

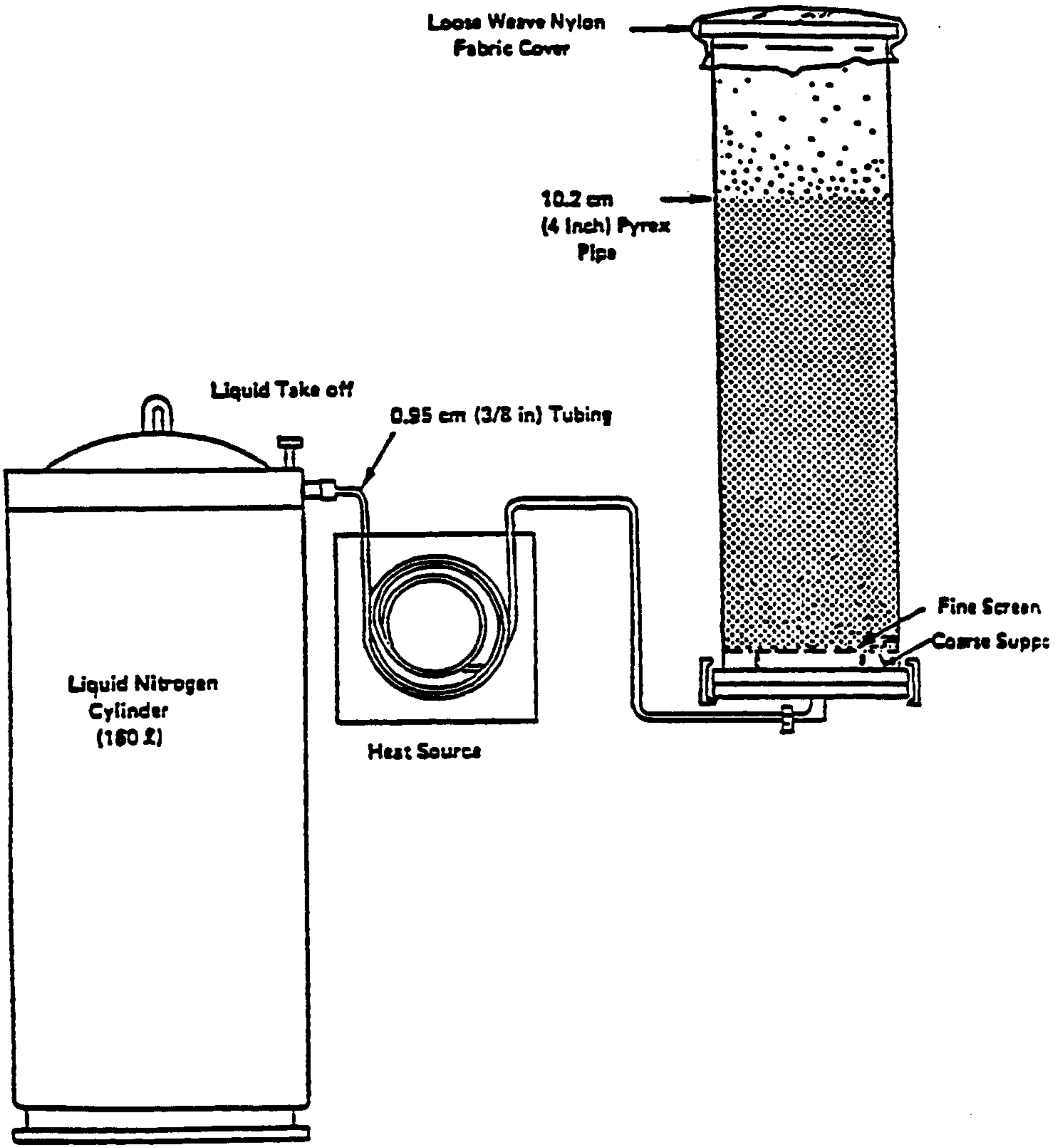


Figure A-2. XAD-2 fluidized-bed drying apparatus.

of activated charcoal approximately 150 mL in volume. With either type of drying method, the rate of flow should gently agitate the bed. Excessive fluidization may cause the particles to break up.

4.0 QUALITY CONTROL PROCEDURES

4.1 For both Methods 1 and 2, the quality control results <u>must</u> be reported for the batch. The batch must be reextracted if the residual extractable organics are >20 ug/mL by TCO analysis or the gravimetric residue is >0.5 mg/20 g XAD-2 extracted. (See also section 5.1, Method 0010.)

4.2 Four control procedures are used with the final XAD-2 to check for (1) residual methylene chloride, (2) extractable organics (TCO), (3) specific compounds of interest as determined by GC/MS, as described in Section 4.5 below, and (4) residue (GRAV).

4.3 <u>Procedure for residual methylene chloride</u>:

4.3.1 Description: A 1±0.1-g sample of dried resin is weighed into a small vial, 3 mL of toluene are added, and the vial is capped and well shaken. Five uL of toluene (now containing extracted methylene chloride) are injected into a gas chromatograph, and the resulting integrated area is compared with a reference standard. The reference solution consists of 2.5 uL of methylene chloride in 100 mL of toluene, simulating 100 ug of residual methylene chloride on the resin. The acceptable maximum content is 1,000 ug/g resin.

4.3.2 Experimental: The gas chromatograph conditions are as follows:

6-ft x 1/8-in. stainless steel column containing 10% OV-101 on 100/120 Supelcoport;

Helium carrier at 30 mL/min;

FID operated on 4 x 10^{-11} A/mV;

Injection port temperature: 250°C;

Detector temperature: 305°C;

Program: 30°C(4 min) <u>40°C/min</u> 250°C (hold); and

Program terminated at 1,000 sec.

4.4 <u>Procedure for residual extractable organics</u>:

4.4.1 Description: A 20±0.1-g sample of cleaned, dried resin is weighed into a precleaned alundum or cellulose thimble which is plugged with cleaned glass wool. (Note that 20 g of resin will fill a thimble, and the resin will float out unless well plugged.) The thimble containing the resin is extracted for 24 hr with 200-mL of pesticide- grade methylene chloride (Burdick and Jackson pesticide-grade or equivalent purity). The 200-mL extract is reduced in volume to 10-mL using a Kuderna-Danish concentrator and/or a nitrogen evaporation stream. Five uL of that solution are analyzed by gas chromatography using the TCO analysis procedure. The concentrated solution should not contain >20 ug/mL of TCO extracted from the XAD-2. This is equivalent to 10 ug/g of TCO in the XAD-2 and would correspond to 1.3 mg of TCO in the extract of the 130-g XAD-2 module. Care should be taken to correct the TCO data for a solvent blank prepared (200 mL reduced to 10 mL) in a similar manner.

4.4.2 **Experimental:** Use the TCO analysis conditions described in the revised Level 1 manual (EPA 600/7-78-201).

4.5 GC/MS Screen: The extract, as prepared in paragraph 4.4.1, is subjected to GC/MS analysis for each of the individual compounds of interest. The GC/MS procedure is described in Chapter Four, Method 8270. The extract is screened at the MDL of each compound. The presence of any compound at a concentration >25 ug/mL in the concentrated extract will require the XAD-2 to be recleaned by repeating the methylene chloride step.

4.6 Methodology for residual gravimetric determination: After the TCO value and GC/MS data are obtained for the resin batch by the above procedures, dry the remainder of the extract in a tared vessel. There must be <0.5 mg residue registered or the batch of resin will have to be extracted with fresh methylene chloride again until it meets this criterion. This level corresponds to 25 ug/g in the XAD-2, or about 3.25 mg in a resin charge of 130 g.

METHOD 0010, APPENDIX B

TOTAL CHROMATOGRAPHABLE ORGANIC MATERIAL ANALYSIS

1.0 SCOPE AND APPLICATION

1.1 In this procedure, gas chromatography is used to determine the quantity of lower boiling hydrocarbons (boiling points between 90° and 300°C) in the concentrates of all organic solvent rinses, XAD-2 resin and LC fractions - when Method 1 is used (see References, Method 0010) - encountered in Level 1 environmental sample analyses. Data obtained using this procedure serve a twofold purpose. First, the total quantity of the lower boiling hydrocarbons in the sample is determined. Then whenever the hydrocarbon concentrations in the original concentrates exceed 75 ug/m^3, the chromatography results are reexamined to determine the amounts of individual species.

The extent of compound identification is limited to representing all materials as normal alkanes based upon comparison of boiling points. Thus the method is not qualitative. In a similar manner, the analysis is semiquantitative; calibrations are prepared using only one hydrocarbon. They are replicated but samples routinely are not.

1.2 Application: This procedure applies solely to the Level 1 C7-C16 gas chromatographic analysis of concentrates of organic extracts, neat liquids, and of LC fractions. Throughout the procedure, it is assumed the analyst has been given a properly prepared sample.

1.3 Sensitivity: The sensitivity of this procedure, defined as the slope of a plot of response versus concentration, is dependent on the instrument and must be verified regularly. TRW experience indicates the nominal range is of the order of 77 uV·V·sec·uL/ng of n-heptane and 79 uV·sec·ul/ng of n-hexadecane. The instrument is capable of perhaps one hundredfold greater sensitivity. The level specified here is sufficient for Level 1 analysis.

1.4 Detection limit: The detection limit of this procedure as written is 1.3 ng/uL for a 1 uL injection of n-decane. This limit is arbitrarily based on defining the minimum detectable response as 100 uv·sec. This is an easier operational definition than defining the minimum detection limit to be that amount of material which yields a signal twice the noise level.

1.5 Range: The range of the procedure will be concentrations of 1.3 ng/uL and greater.

1.6 Limitations

1.6.1 Reporting limitations: It should be noted that a typical environmental sample will contain compounds which: (a) will not elute in the specified boiling ranges and thus will not be reported, and/or (b) will not elute from the column at all and thus will not be reported. Consequently, the organic content of the sample as reported is a lower bound and should be regarded as such.

1.6.2 **Calibration limitations:** Quantitation is based on calibration with n-decane. Data should therefore be reported as, e.g., mg C8/m^3 as n-decane. Since response varies linearly with carbon number (over a wide range the assumption may involve a 20% error), it is clear that heptane (C7) detected in a sample and quantitated as decane will be overestimated. Likewise, hexadecane (C16) quantitated as decane will be underestimated. From previous data, it is estimated the error involved is on the order of 6-7%.

1.6.3 **Detection limitations:** The sensitivity of the flame ionization detector varies from compound to compound. However, n-alkanes have a greater response than other classes. Consequently, using an n-alkane as a calibrant and assuming equal responses of all other compounds tends to give low reported values.

2.0 SUMMARY OF METHOD

2.1 A mL aliquot of all 10-mL concentrates is disbursed for GC-TCO analysis. With boiling point-retention time and response-amount calibration curves, the data (peak retention times and peak areas) are interpreted by first summing peak areas in the ranges obtained from the boiling point-retention time calibration. Then, with the response-amount calibration curve, the area sums are converted to amounts of material in the reported boiling point ranges.

2.2 After the instrument is set up, the boiling point-retention time calibration is effected by injecting a mixture of n-C7 through n-C16 hydrocarbons and operating the standard temperature program. Response-quantity calibrations are accomplished by injecting n-decane in n-pentane standards and performing the standard temperature program.

2.3 <u>Definitions</u>

2.3.1 **GC:** Gas chromatography or gas chromatograph.

2.3.2 **C7-C16 n-alkanes:** Heptane through hexadecane.

2.3.3 **GCA temperature program:** 4 min isothermal at 60°C, 10°C/min from 60° to 220°C.

2.3.4 **TRW temperature program:** 5 min isothermal at room temperature, then program from 30°C to 250°C at 15°C/min.

3.0 INTERFERENCES

Not applicable.

4.0 APPARATUS AND MATERIALS

4.1 Gas chromatograph: This procedure is intended for use on a Varian 1860 gas chromatograph, equipped with dual flame ionization detectors and a linear temperature programmer. Any equivalent instrument can be used provided that electrometer settings, etc., be changed appropriately.

4.2 Gases:

4.2.1 **Helium:** Minimum quality is reactor grade. A 4A or 13X molecular sieve drying tube is required. A filter must be placed between the trap and the instrument. The trap should be recharged after every third tank of helium.

4.2.2 **Air:** Zero grade is satisfactory.

4.2.3 **Hydrogen:** Zero grade.

4.3 Syringe: Syringes are Hamilton 701N, 10 uL, or equivalent.

4.4 Septa: Septa will be of such quality as to produce very low bleed during the temperature program. An appropriate septum is Supelco Microsep 138, which is Teflon-backed. If septum bleed cannot be reduced to a negligible level, it will be necessary to install septum swingers on the instrument.

4.5 Recorder: The recorder of this procedure must be capable of not less than 1 mV full-scale display, a 1-sec time constant and 0.5 in. per min chart rate.

4.6 Integrator: An integrator is required. Peak area measurement by hand is satisfactory but too time-consuming. If manual integration is required, the method of "height times width at half height" is used.

4.7 Columns:

4.7.1 **Preferred column:** 6 ft x 1/8 in. O.D. stainless steel column of 10% OV-101 on 100/120 mesh Supelcoport.

4.7.2 **Alternate column:** 6 ft x 1/8 in. O.D. stainless steel column of 10% OV-1 (or other silicon phase) on 100/120 mesh Supelcoport.

4.8 Syringe cleaner: Hamilton syringe cleaner or equivalent connected to a suitable vacuum source.

5.0 REAGENTS

5.1 Pentane: "Distilled-in-Glass" (reg. trademark) or "Nanograde" (reg. trademark) for standards and for syringe cleaning.

5.2 Methylene chloride: "Distilled-in-Glass" (reg. trademark) or "Nanograde" (reg. trademark) for syringe cleaning.

6.0 SAMPLING HANDLING AND PRESERVATION

6.1 The extracts are concentrated in a Kuderna-Danish evaporator to a volume less than 10 mL. The concentrate is then quantitatively transferred to a 10-mL volumetric flask and diluted to volume. A 1-mL aliquot is taken for both this analysis and possible subsequent GC/MS analysis and set aside in the sample bank. For each GC-TCO analysis, obtain the sample sufficiently in advance to allow it to warm to room temperature. For example, after one analysis is started, return that sample to the sample bank and take the next sample.

7.0 PROCEDURES

7.1 Setup and checkout: Each day, the operator will verify the following:

7.1.1 That supplies of carrier gas, air and hydrogen are sufficient, i.e., that each tank contains > 100 psig.

7.1.2 That, after replacement of any gas cylinder, all connections leading to the chromatograph have been leak-checked.

7.1.3 That the carrier gas flow rate is 30 ± 2 mL/min, the hydrogen flow rate is 30 ± 2 mL/min, and the air flow rate is 300 ± 20 mL/min.

7.1.4 That the electrometer is functioning properly.

7.1.5 That the recorder and integrator are functioning properly.

7.1.6 That the septa have been leak-checked (leak-checking is effected by placing the soap bubble flow meter inlet tube over the injection port adaptors), and that no septum will be used for more than 20 injections.

7.1.7 That the list of samples to be run is ready.

7.2 Retention time calibration:

7.2.1 To obtain the temperature ranges for reporting the results of the analyses, the chromatograph is given a normal boiling point-retention time calibration. The n-alkanes, their boiling points, and data reporting ranges are given in the table below:

	NBP,°C	Reporting Range,°C	Report As
n-heptane	98	90-110	C7
n-octane	126	110-140	C8
n-nonane	151	140-160	C9
n-decane	174	160-180	C10
n-undecane	194	180-200	C11
n-dodecane	214	200-220	C12
n-tridecane	234	220-240	C13
n-tetradecane	252	240-260	C14
n-pentadecane	270	260-280	C15
n-hexadecane	288	280-300	C16

7.2.2 **Preparation of standards:** Preparing a mixture of the C7-C16 alkanes is required. There are two approaches: (1) use of a standards kit (e.g., Polyscience Kit) containing bottles of mixtures of selected n-alkanes which may be combined to produce a C7-C16 standard; or (2) use of bottles of the individual C7-C16 alkanes from which accurately known volumes may be taken and combined to give a C7-C16 mixture.

7.2.3 **Procedure for retention time calibration:** This calibration is performed at the start of an analytical program; the mixture is chromatographed at the start of each day. To attain the required retention time precision, both the carrier gas flow rate and the temperature program specifications must be observed. Details of the procedure depend on the instrument being used. The general procedure is as follows:

7.2.3.1 Set the programmer upper limit at 250°C. If this setting does not produce a column temperature of 250°C, find the correct setting.

7.2.3.2 Set the programmer lower limit at 30°C.

7.2.3.3 Verify that the instrument and samples are at room temperature.

7.2.3.4 Inject 1 uL of the n-alkane mixture.

7.2.3.5 Start the integrator and recorder.

7.2.3.6 Allow the instrument to run isothermally at room temperature for five min.

7.2.3.7 Shut the oven door.

7.2.3.8 Change the mode to Automatic and start the temperature program.

7.2.3.9 Repeat Steps 1-9 a sufficient number of times so that the relative standard deviation of the retention times for each peak is <5%.

7.3 Response calibration:

7.3.1 For the purposes of a Level 1 analysis, response-quantity calibration with n-decane is adequate. A 10-uL volume of n-decane is injected into a tared 10 mL volumetric flask. The weight injected is obtained and the flask is diluted to the mark with n-pentane. This standard contains about 730 ng n-decane per uL n-pentane. The exact concentration depends on temperature, so that a weight is required. Two serial tenfold dilutions are made from this standard, giving standards at about 730, 73, and 7.3 ng n-decane per uL n-pentane, respectively.

7.3.2 Procedure for response calibration: This calibration is performed at the start of an analytical program and monthly thereafter. The most concentrated standard is injected once each day. Any change in calibration necessitates a full calibration with new standards. Standards are stored in the refrigerator locker and are made up monthly.

7.3.2.1 Verify that the instrument is set up properly.

7.3.2.2 Set electrometer at 1×10^{-10} A/mV.

7.3.2.3 Inject 1 uL of the highest concentration standard.

7.3.2.4 Run standard temperature program as specified above.

7.3.2.5 Clean syringe.

7.3.2.6 Make repeated injections of all three standards until the relative standard deviations of the areas of each standard are ≤5%.

7.4 Sample analysis procedure:

7.4.1 The following apparatus is required:

7.4.1.1 Gas chromatograph set up and working.

7.4.1.2 Recorder, integrator working.

7.4.1.3 Syringe and syringe cleaning apparatus.

7.4.1.4 Parameters: Electrometer setting is 1×10^{-10} A/mV; recorder is set at 0.5 in./min and 1 mV full-scale.

7.4.2 Steps in the procedure are:

7.4.2.1 Label chromatogram with the data, sample number, etc.

7.4.2.2 Inject sample.

7.4.2.3 Start integrator and recorder.

7.4.2.4 After isothermal operation for 5 min, begin temperature program.

7.4.2.5 Clean syringe.

7.4.2.6 Return sample; obtain new sample.

7.4.2.7 When analysis is finished, allow instrument to cool. Turn chromatogram and integrator output and data sheet over to data analyst.

7.5 Syringe cleaning procedure:

7.5.1 Remove plunger from syringe.

7.5.2 Insert syringe into cleaner; turn on aspirator.

7.5.3 Fill pipet with pentane; run pentane through syringe.

7.5.4 Repeat with methylene chloride from a separate pipet.

7.5.5 Flush plunger with pentane followed by methylene chloride.

7.5.6 Repeat with methylene chloride.

7.6 Sample analysis decision criterion: The data from the TCO analyses of organic extract and rinse concentrates are first used to calculate the total concentration of C7-C16 hydrocarbon-equivalents (Paragraph 7.7.3) in the sample with respect to the volume of air actually sampled, i.e., ug/m^3. On this basis, a decision is made both on whether to calculate the quantity of each n-alkane equivalent present and on which analytical procedural pathway will be followed. If the total organic content is great enough to warrant continuing the analysis -- >500 ug/m^3 -- a TCO of less than 75 ug/m^3 will require only LC fractionation and gravimetric determinations and IR spectra to be obtained on each fraction. If the TCO is greater than 75 ug/m^3, then the first seven LC fractions of each sample will be reanalyzed using this same gas chromatographic technique.

7.7 Calculations:

7.7.1 Boiling Point - Retention Time Calibration: The required data for this calibration are on the chromatogram and on the data sheet. The data reduction is performed as follows:

7.7.1.1 Average the retention times and calculate relative standard deviations for each n-hydrocarbon.

7.7.1.2 Plot average retention times as abscissae versus normal boiling points as ordinates.

7.7.1.3 Draw in calibration curve.

7.7.1.4 Locate and record retention times corresonding to boiling ranges 90-100, 110-140, 140-160, 160-180, 180-200, 200-220, 220-240, 240-260, 260-280, 280-300°C.

7.7.2 **Response-amount calibration:** The required data for this calibration are on the chromatogram and on the data sheet. The data reduction is performed as follows:

7.7.2.1 Average the area responses of each standard and calculate relative standard deviations.

7.7.2.2 Plot response (uv·sec) as ordinate versus ng/uL as abscissa.

7.7.2.3 Draw in the curve. Perform least squares regression and obtain slope (uV·sec·uL/ng).

7.7.3 **Total C7-C16 hydrocarbons analysis:** The required data for this calculation are on the chromatogram and on the data sheet. The data reduction is performed as follows:

7.7.3.1 Sum the areas of all peaks within the retention time range of interest.

7.7.3.2 Convert this area (uV·sec) to ng/uL by dividing by the weight response for n-decane (uV·sec.uL/ng).

7.7.3.3 Multiply this weight by the total concentrate volume (10 mL) to get the weight of the C7-C16 hydrocarbons in the sample.

7.7.3.4 Using the volume of gas sampled or the total weight of sample acquired, convert the result of Step 7.7.3.3 above to ug/m^3.

7.7.3.5 If the value of total C7-C16 hydrocarbons from Step 7.7.3.4 above exceeds 75 ug/m^3, calculate individual hydrocarbon concentrations in accordance with the instructions in Paragraph 7.7.5.5 below.

7.7.4 **Individual C7-C16 n-Alkane Equivalent Analysis:** The required data from the analyses are on the chromatogram and on the data sheet. The data reduction is performed as follows:

7.7.4.1 Sum the areas of peaks in the proper retention time ranges.

7.7.4.2 Convert areas (uV·sec) to ng/uL by dividing by the proper weight response (uV·sec·uL/ng).

7.7.4.3 Multiply each weight by total concentrate volume (10 mL) to get weight of species in each range of the sample.

7.7.4.4 Using the volume of gas sampled on the total weight of sample acquired, convert the result of Step 7.7.4.3 above to ug/m^3.

8.0 QUALITY CONTROL

8.1 Appropriate QC is found in the pertinent procedures throughout the method.

9.0 METHOD PERFORMANCE

9.1 Even relatively comprehensive error propagation analysis is beyond the scope of this procedure. With reasonable care, peak area reproducibility of a standard should be of the order of 1% RSD. The relative standard deviation of the sum of all peaks in a fairly complex waste might be of the order of 5-10%. Accuracy is more difficult to assess. With good analytical technique, accuracy and precision should be of the order of 10-20%.

10.0 REFERENCES

1. Emissions Assessment of Conventional Stationary Combustion Systems: Methods and Procedure Manual for Sampling and Analysis, Interagency Energy/Environmental R&D Program, Industrial Environmental Research Laboratory, Research Triangle Park, NC 27711, EPA-600/7-79-029a, January 1979.

APPENDIX F.8

SW-846 METHOD 0030

METHOD 0030

VOLATILE ORGANIC SAMPLING TRAIN

1.0 PRINCIPLE AND APPLICATION

1.1 Principle

1.1.1 This method describes the collection of volatile principal organic hazardous constituents (POHCs) from the stack gas effluents of hazardous waste incinerators. For the purpose of definition, volatile POHCs are those POHCs with boiling points less than 100°C. If the boiling point of a POHC of interest is less than 30°C, the POHC may break through the sorbent under the conditions of the sample collection procedure.

1.1.2 Field application for POHCs of this type should be supported by laboratory data which demonstrate the efficiency of a volatile organic sampling train (VOST) to collect POHCs with boiling points less than 30°C. This may require using reduced sample volumes collected at flow rates between 250 and 500 mL/min. Many compounds which boil above 100°C (e.g., chlorobenzene) may also be efficiently collected and analyzed using this method. VOST collection efficiency for these compounds should be demonstrated, where necessary, by laboratory data of the type described above.

1.1.3 This method employs a 20-liter sample of effluent gas containing volatile POHCs which is withdrawn from a gaseous effluent source at a flow rate of 1 L/min, using a glass-lined probe and a volatile organic sampling train (VOST). (Operation of the VOST under these conditions has been called FAST-VOST.) The gas stream is cooled to 20°C by passage through a water-cooled condenser and volatile POHCs are collected on a pair of sorbent resin traps. Liquid condensate is collected in an impinger placed between the two resin traps. The first resin trap (front trap) contains approximately 1.6 g Tenax and the second trap (back trap) contains approximately 1 g each of Tenax and petroleum-based charcoal (SKC Lot 104 or equivalent), 3:1 by volume. A total of six pairs of sorbent traps may be used to collect volatile POHCs from the effluent gas stream.

1.1.4 An alternative set of conditions for sample collection has been used. This method involves collecting sample volume of 20 liters or less at reduced flow rate. (Operation of the VOST under these conditions has been referred to as SLO-VOST.) This method has been used to collect 5 liters of sample (0.25 L/min for 20 min) or 20 liters of sample (0.5 L/min for 40 min) on each pair of sorbent cartridges. Smaller sample volumes collected at lower flow rates should be considered when the boiling points of the POHCs of interest are below 35°C. A total of six pairs of sorbent traps may be used to collect volatile POHCs from the effluent gas stream.

1.1.5 Analysis of the traps is carried out by thermal desorption purge-and-trap by gas chromatography/mass spectrometry (see Method 5040). The VOST is designed to be operated at 1 L/min with traps being replaced every 20 min for a total sampling time of 2 hr. Traps may be analyzed separately or combined onto one trap to improve detection limit. However, additional flow rates and sampling times are acceptable. Recent experience has shown that when less than maximum detection ability is required, it is acceptable and probably preferable to operate the VOST at 0.5 L/min for a total of three 40-min periods. This preserves the 2-hr sampling period, but reduces the number of cartridge changes in the field as well as the number of analyses required.

1.2 Application

1.2.1 This method is applicable to the determination of volatile POHCs in the stack gas effluent of hazardous waste incinerators. This method is designed for use in calculating destruction and removal efficiency (DRE) for the volatile POHCs and to enable a determination that DRE values for removal of the volatile POHCs are equal to or greater than 99.99%.

1.2.2 The sensitivity of this method is dependent upon the level of interferences in the sample and the presence of detectable levels of volatile POHCs in blanks. The target detection limit of this method is 0.1 ug/m^3 (ng/L) of flue gas, to permit calculation of a DRE equal to or greater than 99.99% for volatile POHCs which may be present in the waste stream at 100 ppm. The upper end of the range of applicability of this method is limited by breakthrough of the volatile POHCs on the sorbent traps used to collect the sample. Laboratory development data have demonstrated a range of 0.1 to 100 ug/m^3 (ng/L) for selected volatile POHCs collected on a pair of sorbent traps using a total sample volume of 20 liters or less (see Paragraph 1.1.4).

1.2.3 This method is recommended for use only by experienced sampling personnel and analytical chemists or under close supervision by such qualified persons.

1.2.4 Interferences arise primarily from background contamination of sorbent traps prior to or after use in sample collection. Many potential interferences can be due to exposure of the sorbent materials to solvent vapors prior to assembly and exposure to significant concentrations of volatile POHCs in the ambient air at hazardous waste incinerator sites.

1.2.5 To avoid or minimize the low-level contamination of train components with volatile POHCs, care should be taken to avoid contact of all interior surface or train components with synthetic organic materials (e.g., organic solvents, lubricating and sealing greases), and train components should be carefully cleaned and conditioned according to the procedures described in this protocol.

2.0 APPARATUS

2.1 Volatile Organic Sampling Train: A schematic diagram of the principal components of the VOST is shown in Figure 1 and a diagram of one acceptable version of the VOST is shown in Figure 2. The VOST consists of a glass-lined probe followed by an isolation valve, a water-cooled glass condenser, a sorbent cartridge containing Tenax (1.6 g), an empty impinger for condensate removal, a second water-cooled glass condenser, a second sorbent cartridge containing Tenax and petroleum-based charcoal (3:1 by volume; approximately 1 g of each), a silica gel drying tube, a calibrated rotameter, a sampling pump, and a dry gas meter. The gas pressure during sampling and for leak-checking is monitored by pressure gauges which are in line and downstream of the silica gel drying tube. The components of the sampling train are described below.

2.1.1 **Probe:** The probe should be made of stainless steel with a borosilicate or quartz glass liner. The temperature of the probe is to be maintained above 130°C but low enough to ensure a resin temperature of 20°C. A water-cooled probe may be required at elevated stack temperatures to protect the probe and meet the above requirements. Isokinetic sample collection is not a requirement for the use of VOST since the compounds of interest are in the vapor phase at the point of sample collection.

2.1.2 **Isolation valve:** The isolation valve should be a greaseless stopcock with a glass bore and sliding Teflon plug with Teflon wipers (Ace 8193 or equivalent).

2.1.3 **Condensers:** The condensers (Ace 5979-14 or equivalent) should be of sufficient capacity to cool the gas stream to 20°C or less prior to passage through the first sorbent cartridge. The top connection of the condenser should be able to form a leak-free, vacuum-tight seal without using sealing greases.

2.1.4 **Sorbent cartridges:**

2.1.4.1 The sorbent cartridges used for the VOST may be used in either of two configurations: the inside-outside (I/O) configuration in which the cartridge is held within an outer glass tube and in a metal carrier, and the inside-inside (I/I) configuration in which only a single glass tube is used, with or without a metal carrier. In either case, the sorbent packing will be the same.

2.1.4.1.1 The first of a pair of sorbent cartridges shall be packed with approximately 1.6 g Tenax GC resin and the second cartridge of a pair shall be packed with Tenax GC and petroleum-based charcoal (3:1 by volume; approximately 1 g of each).

2.1.4.1.2 The second sorbent cartridge shall be packed so that the sample gas stream passes through the Tenax layer first and then through the charcoal layer.

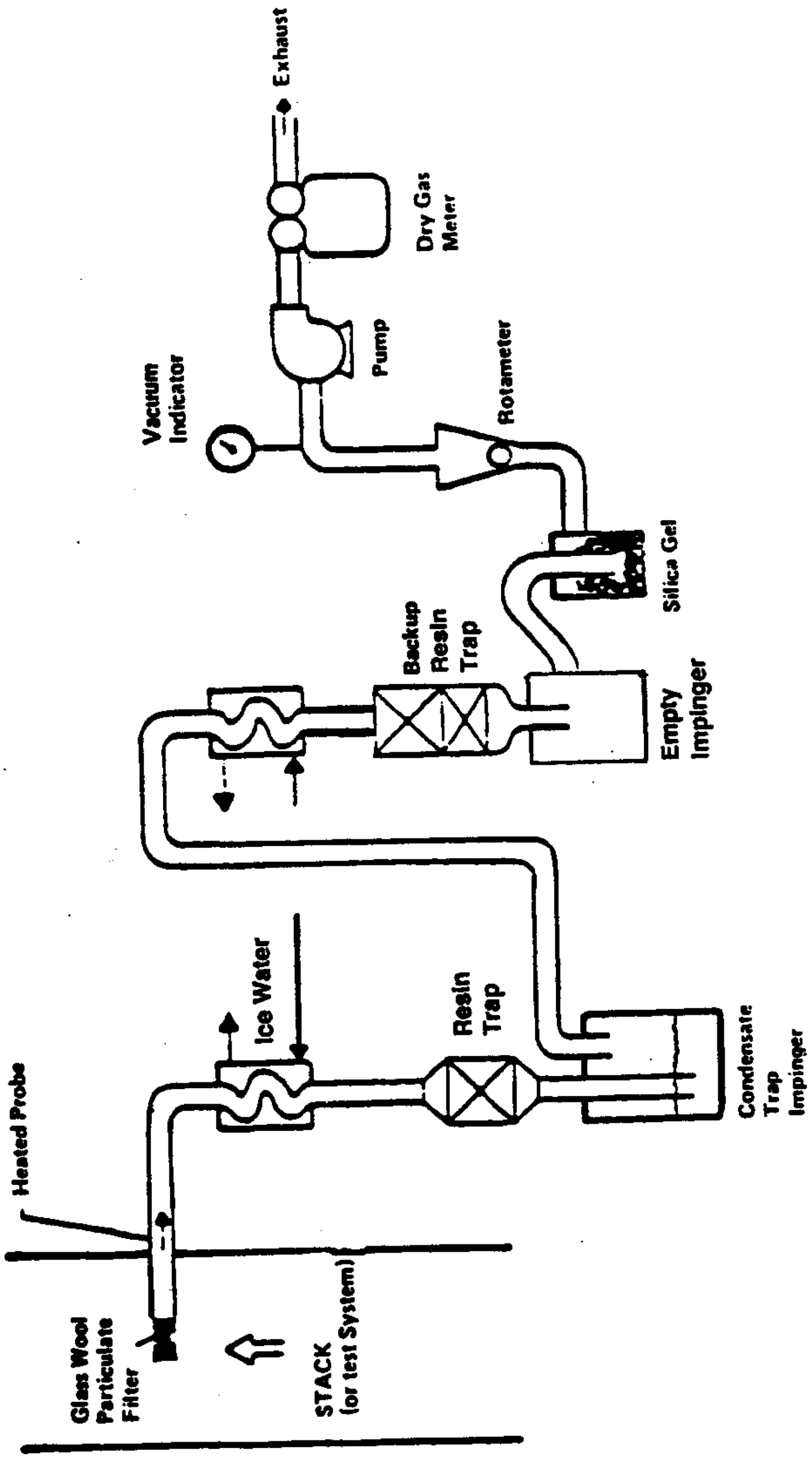


Figure 1. Schematic of Volatile Organic Sampling Train (VOST).

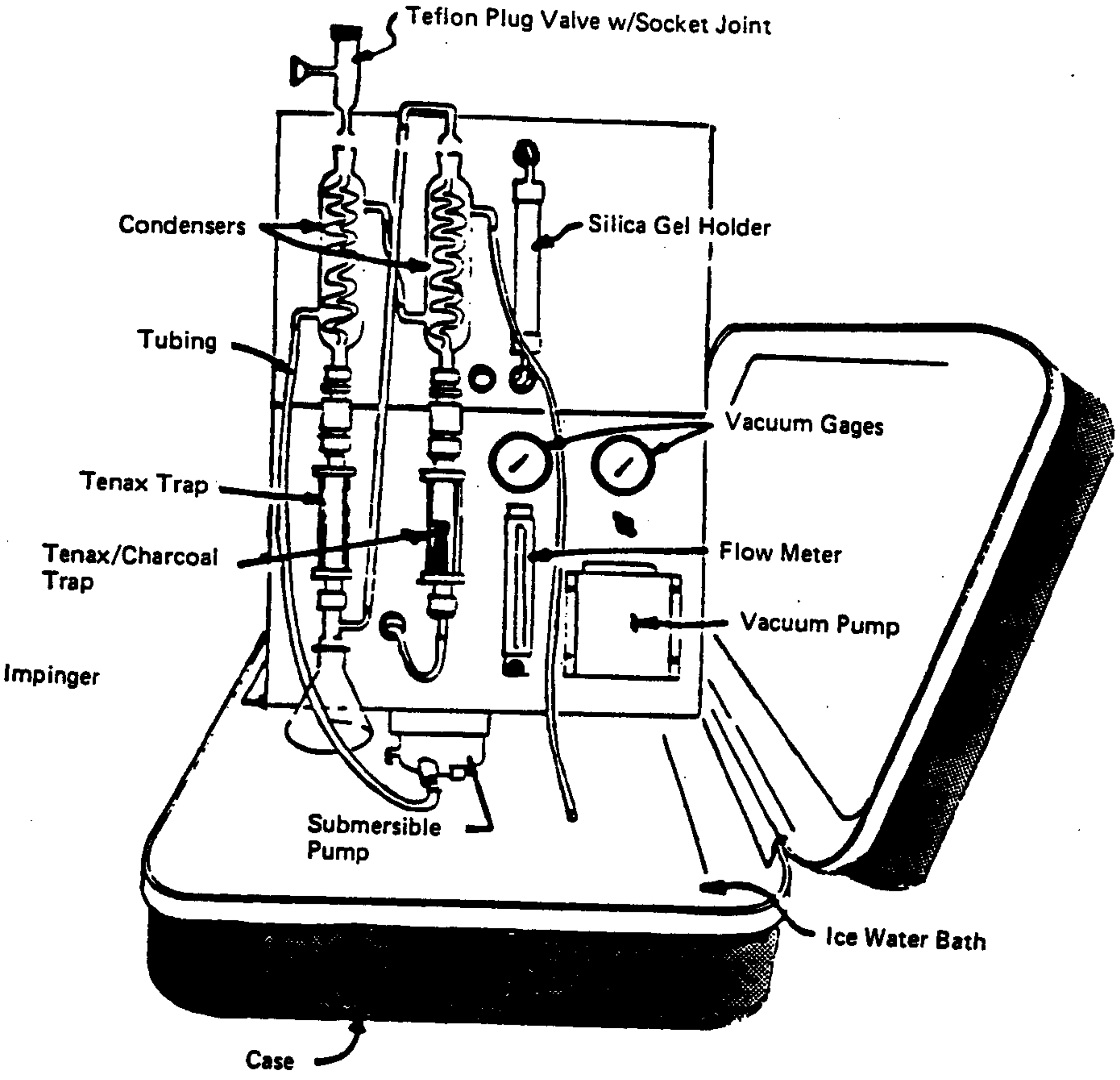


Figure 2. Volatile Organic Sampling Train (VOST).

2.1.4.2 The sorbent cartridges shall be glass tubes with approximate dimensions of 10 cm by 1.6 cm I.D. The two acceptable designs (I/O, I/I) for the sorbent cartridge are described in further detail below.

2.1.4.2.1 **Inside/Inside sorbent cartridge:** A diagram of an I/I sorbent cartridge is shown in Figure 3. This cartridge is a single glass tube (10 cm by 1.6 cm I.D.) which has the ends reduced in size to accommodate a 1/4- or 3/8-in. Swagelok or Cajon gas fitting. The resin is held in place by glass wool at each end of the resin layer. The amounts of each type of sorbent material used in the I/I design are the same as for the I/O design. Threaded end caps are placed on the sorbent cartridge after packing with sorbent to protect the sorbent from contamination during storage and transport.

2.1.4.2.2 **Inside/Outside type sorbent cartridge:** A diagram of an I/O sorbent cartridge is shown in Figure 4. In this design the sorbent materials are held in the glass tube with a fine mesh stainless steel screen and a C-clip. The glass tube is then placed within a larger diameter glass tube and held in place using Viton O-rings. The purpose of the outer glass tube is to protect the exterior of the resin-containing tube from contamination. The two glass tubes are held in a stainless steel cartridge holder, where the ends of the glass tubes are held in place by Viton O-rings placed in machine grooves in each metal end piece. The three cylindrical rods are secured in one of the metal end pieces and fastened to the other end piece using knurled nuts, thus sealing the glass tubes into the cartridge holder. The end pieces are fitted with a threaded nut onto which a threaded end cap is fitted with a Viton O-ring seal, to protect the resin from contamination during transport and storage.

2.1.5 **Metering system:** The metering system for VOST shall consist of vacuum gauges, a leak-free pump (Thomas Model 107 or equivalent, Thomas Industries, Sheboygan, Wisconsin), a calibrated rotameter (Linde Model 150, Linde Division of Union Carbide, Keasbey, New Jersey) for monitoring the gas flow rate, a dry gas meter with 2% accuracy at the required sampling rate, and related valves and equipment. Provisions should be made for monitoring the temperature of the sample gas stream between the first condenser and first sorbent cartridge. This can be done by placing a thermocouple on the exterior glass surface of the outlet from the first condenser. The temperature at that point should be less than 20°C. If it is not, an alternative condenser providing the required cooling capacity must be used.

2.1.6 **Sample transfer lines:** All sample transfer lines to connect the probe to the VOST shall be less than 5 ft in length, and shall be heat-traced Teflon with connecting fittings which are capable of forming leak-free, vacuum-tight connections without the use of sealing grease.

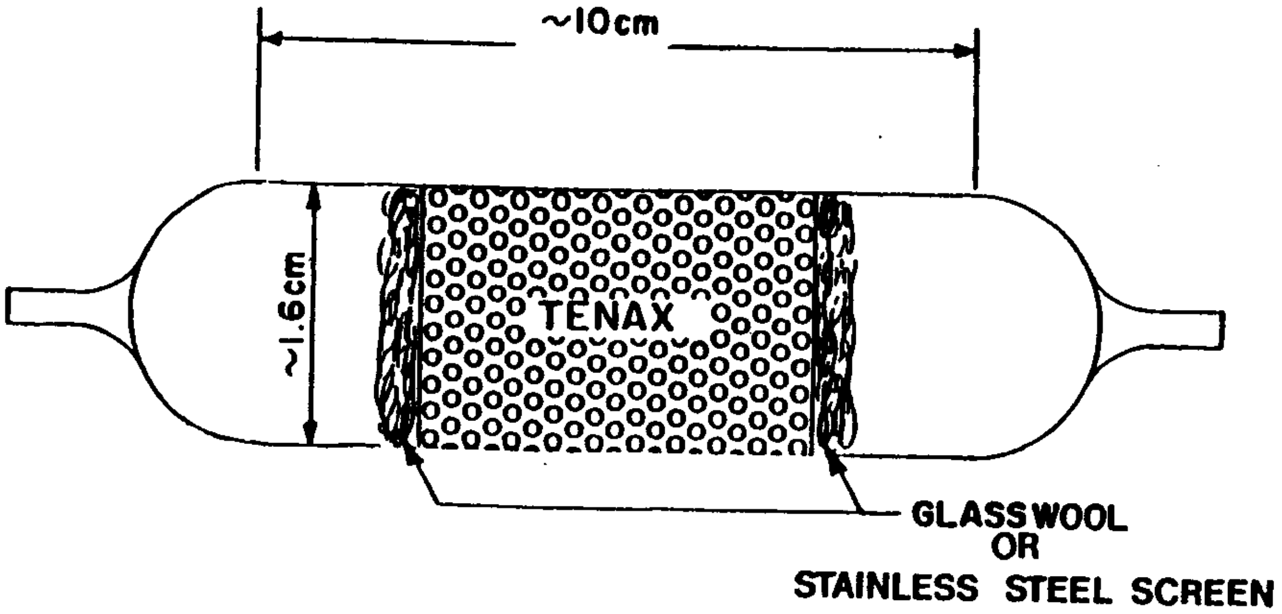
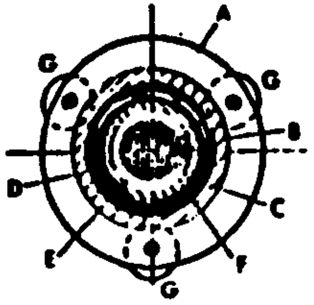


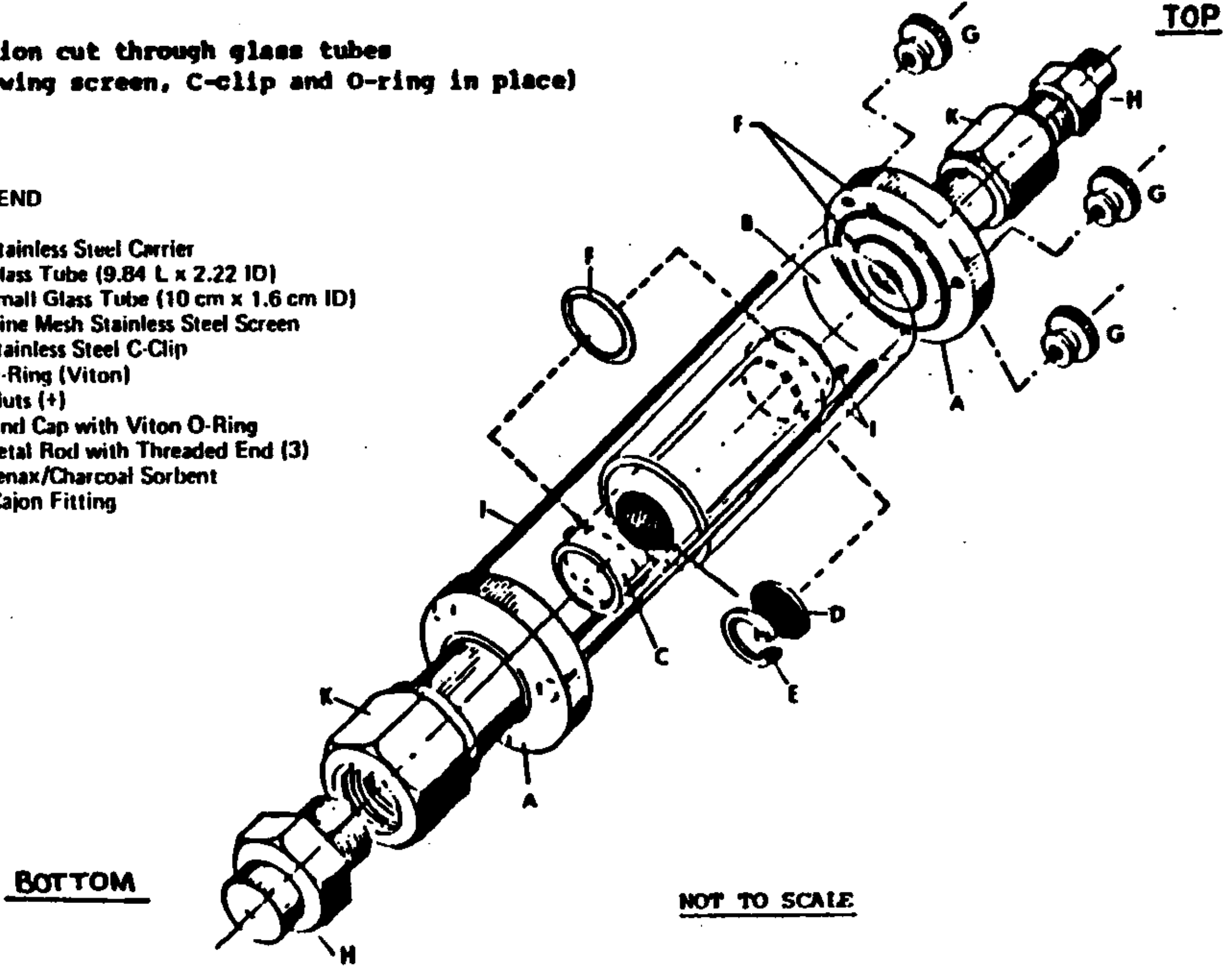
Figure 3. Inside-inside vost cartridge

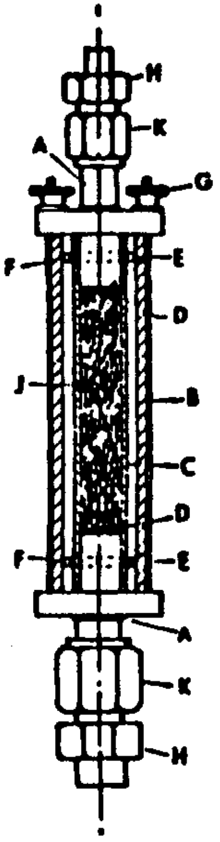


Section cut through glass tubes
(showing screen, C-clip and O-ring in place)

LEGEND

A - Stainless Steel Carrier
B - Glass Tube (9.84 L x 2.22 ID)
C - Small Glass Tube (10 cm x 1.6 cm ID)
D - Fine Mesh Stainless Steel Screen
E - Stainless Steel C-Clip
F - O-Ring (Viton)
G - Nuts (+)
H - End Cap with Viton O-Ring
I - Metal Rod with Threaded End (3)
J - Tenax/Charcoal Sorbent
K - Cajon Fitting





Assembled Trap
NTS

Figure 4. Sorbent Trap Assembly (I/O)
Volatile Organic Sampling Train (VOST)

All other sample transfer lines used with the VOST shall be Teflon with connecting fittings that are capable of forming leak-free, vacuum-tight connections without the use of sealing grease.

3.0 REAGENTS AND MATERIALS

3.1 2,6-Diphenylene oxide polymer (Tenax, 35/60 mesh):

3.1.1 The new Tenax is Soxhlet extracted for 24 hr with methanol (Burdick & Jackson, pesticide grade or equivalent). The Tenax is dried for 6 hr in a vacuum oven at 50°C before use. Users of I/O and I/I sorbent cartridges have used slightly different thermal conditioning procedures. I/O sorbent cartridges packed with Tenax are thermally conditioned by flowing organic-free nitrogen (30 mL/min) through the resin while heating to 190°C. Some users have extracted new Tenax and charcoal with pentane to remove nonpolar impurities. However, these users have experienced problems with residual pentane in the sorbents during analysis.

3.1.2 If very high concentrations of volatile POHCs have been collected on the resin (e.g., micrograms of analytes), the sorbent may require Soxhlet extraction as described above. Previously used Tenax cartridges are thermally reconditioned by the method described above.

3.2 Charcoal (SKC petroleum-base or equivalent): New charcoal is prepared and charcoal is reconditioned as described in Paragraph 4.4. New charcoal does not require treatment prior to assembly into sorbent cartridges. Users of VOST have restricted the types of charcoal used in sorbent cartridges to only petroleum-based types. Criteria for other types of charcoal are acceptable if recovery of POHC in laboratory evaluations meet the criteria of 50 to 150%.

3.3 Viton-O-Ring: All O-rings used in VOST shall be Viton. Prior to use, these O-rings should be thermally conditioned at 200°C for 48 hr. O-rings should be stored in clean, screw-capped glass containers prior to use.

3.4 Glass tubes/Condensers: The glass resin tubes and condensers should be cleaned with a nonionic detergent in an ultrasonic bath, rinsed well with organic-free water, and dried at 110°C. Resin tubes of the I/O design should be assembled prior to storage as described in Paragraph 4.1. Resin tubes of the I/I design can be stored in glass culture tube containers with cotton cushioning and Teflon-lined screw caps. Condensers can be capped with appropriate end caps prior to use.

3.5 Metal parts: The stainless steel carriers, C-clips, end plugs, and screens used in the I/O VOST design are cleaned by ultrasonication in a warm nonionic detergent solution, rinsed with distilled water, air-dried, and heated in a muffle furnace for 2 hr at 400°C. Resin tubes of the I/I design require Swagelok or equivalent end caps with Supelco M-1 ferrules. These should be heated at 190°C along with the assembled cartridges.

3.6 Silica gel (Indicating type, 6-16 mesh): New silica gel may be used as received. Silica gel which has been previously used should be dried for 2 hr at 175°C (350°F).

3.7 Cold packs: Any commercially available reusable liquids or gels that can be repeatedly frozen are acceptable. They are typically sold in plastic containers as "Blue Ice" or "Ice-Packs." Enough should be used to keep cartridges at or near 4°C.

3.8 Water: Water used for cooling train components in the field may be tap water; and water used for rinsing glassware should be organic-free.

3.9 Glass wool: Glass wool should be Soxhlet extracted for 8 to 16 hr, using methanol, and oven dried at 110°C before use.

4.0 SAMPLE HANDLING AND PROCEDURE

4.1 Assembly:

4.1.1 The assembly and packing of the sorbent cartridges should be carried out in an area free of volatile organic material, preferably a laboratory in which no organic solvents are handled or stored and in which the laboratory air is charcoal filtered. Alternatively, the assembly procedures can be conducted in a glove box which can be purged with organic-free nitrogen.

4.2 Tenax cartridges:

4.2.1 The Tenax, glass tubes, and metal cartridge parts are cleaned and stored (see Section 3.0). Approximately 1.6 g of Tenax is weighed and packed into the sorbent tube which has a stainless steel screen and C-clip (I/O design) or glass wool (I/I design) in the downstream end. The Tenax is held in place by inserting a stainless steel screen and C-clips in the upstream end (I/O design) or glass wool (I/I design). Each cartridge should be marked, using an engraving tool, with an arrow to indicate the direction of sample flow, and a serial number.

4.2.2 Conditioned resin tubes of the I/O design are then assembled into the metal carriers according to the previously described inside/inside or inside/outside procedures (with end caps) and are placed on cold packs for storage and transport. Conditioned resin tubes of the I/I design are capped and placed on cold packs for storage and transport.

4.3 Tenax/Charcoal tubes

4.3.1 The Tenax, charcoal, and metal cartridge parts are cleaned and stored as previously described (see Section 3.0). The tubes are packed with approximately a 3:1 volume ratio of Tenax and charcoal (approximately 1 g each). The Tenax and charcoal are held in place by the stainless steel screens and C-clips (I/O design) or by glass wool (I/I design). The glass tubes containing the Tenax and charcoal are then conditioned as described below (see Paragraph 4.4). Place the I/O glass tubes in the metal carriers (see Paragraph 2.1.4.2.2), put end caps on the assembled cartridges, mark direction of sample flow and serial number, and place the assembled cartridges on cold packs for storage and transport.

4.3.2 Glass tubes of the I/I design are conditioned, and stored in the same manner as the I/O tubes.

4.4 Trap Conditioning - QC

4.4.1 Following assembly and leak-checking, the traps are connected in reverse direction to sampling to a source of organic-free nitrogen, and nitrogen is passed through each trap at a flow rate of 40 mL/min, while the traps are heated to 190°C for 12-28 hr. The actual conditioning period may be determined based on adequacy of the resulting blank checks.

4.4.2 The following procedure is used to blank check each set of sampling cartridges prior to sampling to ensure cleanliness. The procedure provides semi-quantitative data for organic compounds with boiling points below 110°C on Tenax and Tenax/Charcoal cartridges. It is not intended as a substitute for Method 5040.

4.4.2.1 The procedure is based on thermal desorption of each set of two cartridges, cryofocusing with liquid nitrogen onto a trap packed with glass beads, followed by thermal desorption from the trap and analysis by GC/FID.

4.4.2.2 The detection limit is based on the analysis of Tenax cartridges spiked with benzene and toluene and is around 2 ng for each compound.

4.4.2.3 The results of analyzing spiked cartridges on a daily basis should not vary by more than 20 percent. If the results are outside this range, the analytical system must be evaluated for the probable cause and a second spiked cartridge analyzed.

4.4.2.4 The GC operating conditions are as follows:

GC Operating Conditions

Column: Packed column 6 ft x 1/8" stainless steel 1.0 percent SP-1000 on Carbopack B 60/80, or equivalent.
Temperature program: 50°C for 5 min, 20°C/min increase to 190°C, hold 13 min.
Injector: 200°C.
Detector: F.I.D. 250°C.
Carrier Gas: Helium at 25 mL/min.
Sample valve: Valco 6-port with 40" x 1/16" stainless steel trap packed with 60/80 mesh glass beads.
Cryogen: Liquid nitrogen.
Trap heater: Boiling water, hot oil, or electrically heated.

Desorption heater: Supelco "clam shell" (high capacity carrier gas purifier) heater and Variac, adjusted to 180°C to 200°C.

4.4.2.5 Calibration is accomplished by preparing a spiked Tenax cartridge with benzene and toluene and analyzing according to the standard operating procedure. A standard of benzene, toluene and bromofluorobenzene (BFB) is prepared by injecting 2.0 uL of benzene and toluene and 1.0 uL of BFB into 10 mL of methanol. The concentration of this stock is 175 ng/uL of benzene and toluene, and 150 ng/uL BFB. One microliter of the stock standard is injected onto a Tenax cartridge through a heated injection port set at 150°C. A GC oven can be used for this with the oven at room temperature. Helium carrier gas is set at 50 mL/min. The solvent flush technique should be used. After two min, remove the Tenax cartridge and place in the desorption heater for analysis. BFB is also used as an internal standard spike for GC/MS analysis which provides a good comparison between GC/FID and GC/MS. The results of this spike analysis should not vary more than 20 percent day to day. Initially and then periodically this spiked Tenax should be reanalyzed a second time to verify that the 10 min desorption time and 180-200°C temperature are adequate to remove all of the spiked components. It should be noted that only one spiked Tenax cartridge need be prepared and analyzed daily unless otherwise needed to ensure proper instrument operation.

An acceptable blank level is left to the discretion of the method analyst. An acceptable level is one that allows adequate determination of expected components emitted from the waste being burned.

4.4.3 After conditioning, traps are sealed and placed on cold packs until sampling is accomplished. Conditioned traps should be held for a minimum amount of time to prevent the possibility of contamination.

4.4.4 It may be useful to spike the Tenax and Tenax/charcoal traps with the compounds of interest to ensure that they can be thermally desorbed under laboratory conditions. After spiked traps are analyzed they may be reconditioned and packed for sampling.

4.5 Pretest preparation:

4.5.1 All train components shall be cleaned and assembled as previously described. A dry gas meter shall have been calibrated within 30 days prior to use, using an EPA-supplied standard orifice.

4.5.2 The VOST is assembled according to the schematic diagram in Figure 1. The cartridges should be positioned so that sample flow is through the Tenax first and then the Tenax/charcoal. Cooling water should be circulated to the condensers and the temperature of the cooling water should be maintained near 0°C. The end caps of the sorbent cartridges should be placed in a clean screw-capped glass container during sample collection.

4.6 Leak-checking:

4.6.1 The train is leak-checked by closing the valve at the inlet to the first condenser and pulling a vacuum of 250 mm (10 in. Hg) above the normal operating pressure. The traps and condensers are isolated from the pump and the leak rate noted. The leak rate should be less than 2.5 mm Hg after 1 min. The train is then returned to atmospheric pressure by attaching a charcoal-filled tube to the train inlet and admitting ambient air filtered through the charcoal. This procedure will minimize contamination of the VOST components by excessive exposure to the fugitive emissions at hazardous waste incinerator sites.

4.7 Sample Collection

4.7.1 After leak-checking, sample collection is accomplished by opening the valve at the inlet to the first condenser, turning on the pump, and sampling at a rate of 1 liter/min for 20 min. The volume of sample for any pair of traps should not exceed 20 liters.

4.7.2 Following collection of 20 liters of sample, the train is leak-checked a second time at the highest pressure drop encountered during the run to minimize the chance of vacuum desorption of organics from the Tenax. The train is returned to atmospheric pressure, using the method discussed in Paragraph 4.1 and the two sorbent cartridges are removed. The end caps are replaced and the cartridges shall be placed in a suitable environment for storage and transport until analysis. The sample is considered invalid if the leak test does not meet specification.

4.7.3 A new pair of cartridges is placed in the VOST, the VOST leak-checked, and the sample collection process repeated as described above. Sample collection continues until six pairs of traps have been used.

4.7.4 All sample cartridges should be kept on cold packs until they are ready for analysis.

4.8 Blanks

4.8.1 Field blanks/trip blanks: Blank Tenax and Tenax/charcoal cartridges are taken to the sampling site and the end caps removed for the period of time required to exchange two pairs of traps on VOST. After the two VOST traps have been exchanged, the end caps are replaced on the blank Tenax and Tenax/charcoal tubes and these are returned to the cold packs and analyzed with the sample traps. At least one pair of field blanks (one Tenax, one Tenax/charcoal) shall be included with each six pairs of sample cartridges collected (or for each field trial using VOST to collect volatile POHCs).

4.8.2 **Trip blanks:** At least one pair of blank cartridges (one Tenax, one Tenax/charcoal) shall be included with shipment of cartridges to a hazardous waste incinerator site. These "field blanks" will be treated like any other cartridges except that the end caps will not be removed during storage at the site. This pair of traps will be analyzed to monitor potential contamination which may occur during storage and shipment.

4.8.3 **Laboratory blanks:** One pair of blank cartridges (one Tenax, one Tenax/charcoal) will remain in the laboratory using the method of storage which is used for field samples. If the field and trip blanks contain high concentrations of contaminants (e.g., greater than 2 ng of a particular POHC), the laboratory blank shall be analyzed in order to identify the source of contamination.

5.0 CALCULATIONS (for sample volume)

5.1 The following nomenclature are used in the calculation of sample volume:

P_{bar} = Barometric pressure at the exit orifice of the dry gas meter, mm (in.) Hg.

P_{std} = Standard absolute pressure, 760 mm (29.92 in.) Hg.

T_m = Dry gas meter average absolute temperature, K (°R).

T_{std} = Standard absolute temperature, 293K (528°R).

V_m = Dry gas volume measured by dry gas meter, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by dry gas meter, corrected to standard conditions, dscm (dscf).

γ = Dry gas meter calibration factor.

5.2 The volume of gas sampled is calculated as follows:

$$V_{m(std)} = V_m \gamma \frac{T_{std}\ P_{bar}}{T_m\ P_{std}} = K_1 \gamma \frac{V_m\ P_{bar}}{T_m}$$

where:

K_1 = 0.3858 K/mm Hg for metric units, or

K_1 = 17.64 °R/in. Hg for English units.

6.0 ANALYTICAL PROCEDURE

See Method 5040.

7.0 PRECISION AND ACCURACY REQUIREMENTS

7.1 Method Performance Check

Prior to field operation of the VOST at a hazardous waste incinerator, a method performance check should be conducted using either selected volatile POHCs of interest or two or more of the volatile POHCs for which data are available. This check may be conducted on the entire system (VOST/GC/MS) by analysis of a gas cylinder containing POHCs of interest or on only the analytical system by spiking of the POHCs onto the traps. The results of this check for replicate pairs of traps should demonstrate that recovery of the analytes fall within 50% to 150% of the expected values.

7.2 Performance Audit

During a trial burn a performance audit must be completed. The audit results should agree within 50% to 150% of the expected value for each specific target compound. This audit consists of collecting a gas sample containing one or more POHCs in the VOST from an EPA ppb gas cylinder. Collection of the audit sample in the VOST may be conducted either in the laboratory or at the trial burn site. Anaysis of the VOST audit sample must be by the same person, at the same time, and with the same analytical procedure as used for the regular VOST trail burn samples. EPA ppb gas cylinders currently available for VOST Audit are shown in Table 1 below.

The audit procedure, audit equipment and audit cylinder may be obtained by writing:

Audit Cylinder Gas Coordinator (MD-77B)
Quality Assurance Division
Environmental Monitoring Systems Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

or by calling the Audit Cylinder Gas Coordinator at (919) 541-4531.

The request for the audit must be made at least 30 days prior to the scheduled trial burn. If a POHC is selected for which EPA does not have an audit cylinder, this audit is not required.

8.0 REFERENCES

1. Protocol for the Collection and Analysis of Volatile POHCs Using VOST. EPA/600/8-84/007, March 1984.

2. Sykes, A.L., Standard Operating Procedure for Blanking Tenax and Tenax/Charcoal Sampling Cartridges for Volatile Organic Sampling Train (VOST), Radion Corporation, P.O. Box 13000, Research Triangle Park, NC 27709.

3. Validation of the Volatile Organic Sampling Train (VOST) Protocol, Vols. I and II, EPA/600/4-86/014a, January 1986.

TABLE 1: Organic Gases in the ppb Audit Repository

Group I	Ranges of cylinders currently available:
5 Organics in N_2:	7 - 90 ppb
Carbon tetrachloride	90 - 430 ppb
Chloroform	430 - 10,000 ppb
Perchloroethylene	
Vinyl chloride	
Benzene	

Group II	Ranges of cylinders currently available:
9 Organics in N_2	7 - 90 ppb
Trichloroethylene	90 - 430 ppb
1,2-Dichloroethane	
1,2-Dibromoethane	
F-12	
F-11	
Bromomethane	
Methyl ethyl ketone	
1,1,1-Trichloroethane	
Acetronitrile	

TABLE 1: Organic Gases in the ppb Audit Repository (Continued)

Group III	Ranges of cylinders currently available:
7 Organics in N_2:	7 - 90 ppb
Vinylidene chloride	90 - 430 ppb
F-113	
F-114	
Acetone	
1,4-Dioxane	
Toluene	
Chlorobenzene	

Group IV	Ranges of cylinders currently available:
6 Organics in N_2:	7 - 90 ppb
Acrylonitrile	430 - 10,000
1,3-Butadiene	
Ethylene oxide	
Methylene chloride	
Propylene oxide	
Ortho-xylene	

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15. SUPPLEMENTARY NOTES

16. ABSTRACT

The United States Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards (OAQPS) is investigating hot mix asphalt plants to identify and quantify particulate matter (PM), methylene chloride extractable matter (MCEM), and organic hazardous air pollutant (HAP) emissions during asphalt concrete loading operations. In support of this investigation, the OAQPS issued Pacific Environmental Services, Inc. (PES) a series of work assignments to conduct emissions testing at a hot mix asphalt plant during load-out operations.

The primary objective of the emissions testing was to characterize the uncontrolled emissions of PM, MCEM, polynuclear aromatic hydrocarbons (PAHs), semi-volatile organic hazardous air pollutants (SVOHAPS), and volatile organic hazardous air pollutants (VOHAPS) from a hox mix production plant during loading operations. An asphalt plant south of Los Angeles, California was selected by EPA as the host facility. Testing was performed over five consecutive days beginning on July 24, 1998. Testing was performed under two conditions. Under normal operations, testing was performed to characterize load-out emissions from the tunnel exhaust and load-in emissions from the asphalt concrete storage silo. Under background conditions, testing was performed to characterize emissions from the combustion of diesel fuel in transport trucks.

The entire report consists of eight volumes totaling 4,234 pages, Vol. 1 (388 pages), Vol. 2 (308 pages), Vol. 3 (573 pages), Vol. 4 (694 pages), Vol. 5 (606 pages), Vol. 6 (564 pages), Vol. 7 (570 pages), and Vol. 8 (531 pages).

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTIONS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COASTI Field/Group
Hazardous Air Pollutants Methylene Chloride Extractable Matter Particulate Matter Polynuclear Aromatic Hydrocarbons Semi-volatile Organic Hazardous Air Pollutants Volatile Organic Hazardous Air Pollutants		

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