Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

90 9:23 FROM ################

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

EPA

FACSIMILE REQUEST AND COVER SHEET

PLEASE PRINT IN BLACK INK ONLY

TO: Robin Barker

OFFICE/PHONE: 677 0249

REGION/LAB/LOCATION: MRI Cary

FROM: F. Clay

PH: 541-5236

MAIL CODE: MD-14

OFFICE: EMB

Date: MAY 90

NUMBER OF PAGES TO INCLUDE THIS COVER SHEET: 6

Please number all pages

INFORMATION FOR SENDING FACSIMILE MESSAGES

LOCATION	EQUIPMENT	FACSIMILE NUMBER	VERIFICATION NUMBER
10th Floor	PANAFAX PX-100	FTS: 629-5661 Comm: (919) 541-5661	FTS: 629-5660 Comm: (919) 541-[illegible]
9th Floor	PITNEY BOWES 8000	FTS: 629-5663 Comm: (919) 541-5663	FTS: 629-5641 Comm: (919) 541-[illegible]
8th Floor	PITNEY BOWES 8000	FTS: 629-0804 Comm: (919) 541-0804	FTS: 629-5665 Comm: (919) 541-5665

PAGE ____ OF ____ PAGES

TABLE 3-5. SUMMARY OF Cr^{+6} REMOVAL EFFICIENCIES

Run No.	Cr^{+6} Emission Rate lb/hr	Cr^{+6} Removal Efficiency
I-1	0.0454	98.7%
O-1	0.000569	
I-2	0.0498	99.0%
O-2	0.000485	
I-3	0.0642	98.9%
O-3	0.000697	
I-4	0.0146	97.0%
O-4	0.000438	
I-5	0.0090	95.7%
O-5	0.000389	
Polypropylene Ball Efficiency* (Average I-1 vs. I-4 and I-2 vs. I-5)		74.9%
Mist Eliminator Efficiency (Runs 1-3)		98.9%
Mist Eliminator Efficiency With Polypropylene Balls On Tank Surface (Runs 4-5)		96.4%

* The efficiency of the polypropylene balls was calculated based on these runs because identical parts were being plated and operating conditions were identical within each pair of tests.

Please sent this page as a replacement for the report & couldn't see any difference. Maybe there is.

SAMPLING SUMMARY SHEET

PLANT HARD CHROMIUM SPECIALISTS

LOCATION YORK, PENNSYLVANIA

SAMPLED SOURCE MESH AD INLET (BALLS)

Run	Date	N_p	3 Y_m	4 ΔH	5 P Bar.	6 V_m	7 T_m	8 V_m Std.	9 %	10 P_{st}	17 P_s	18 T_s	19 VP	20 V_w	21 $V_{w_{gas}}$	22 %M	23 M_d
I-4	Feb 89	24	1.006	1.91	29.37	154.000	105	142.796		-1.5	29.26	73		24.3	1.14	0.79	.992
I-5	Feb 89	24	1.006	1.87	29.37	95.061	105	88.136		-1.5	29.26	74		18.9	0.89	1.00	.990

Run	Date	25	26 CO_2	27 CO	28	29 MW_d	30 MW	31 C_p	32 $\sqrt{\Delta P_s (T_s + 460)}$	33 T_t	34 D_n	35 V_s	36 D_s	37 Area	38 ACFM	39 DSCFM	40 %I
I-4	6	21.0	78.3			28.95	28.86	.84	17.7972	192	.235	44.0	15.5	1.31	3458	3323	97.4
I-5	7	21.0	78.3			28.95	28.84	.84	17.5626	120	.235	43.4	15.5	1.31	3413	3267	97.9

$$V_{m\,Std.} = V_m \frac{17.64 \times V_m \left(P\ Bar. + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$V_{w_{gas}} = 0.0471\ V_w$$

$$M_d = 100_2 \times .44 + (O_2 \times .32) + (CO \times .28) + (N_2 \times .28) + (Other \times \frac{Mol.\ wt.}{100})$$

$$M = M_d \times M_d + 18(1 - M_d)$$

$$V_s = 85.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s + M}\right]^{1/2}$$

$$I = \frac{0.09450 \times (T_s + 460) \times V_m\ Std.}{V_s \times T_t \times P_s \times M_d \times A_n}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{Std. + V_{w_{gas}}}$$

$$M_d = \frac{100 - \%M}{100}$$

$$P_s = P\ Bar. \pm \frac{P_{st}}{13.6}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orifice Pressure Drop, inches H_2O

P Bar. = Barometric Pressure, Inches Hg, Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

T_m = Average Meter Temperature, °F.

V_m Std. = Volume of Dry Gas at STP, DSCF[a]

% = Per Cent other gas removed before Dry Gas Meter

P_{st} = Static Pressure of Stack Gas, inches H_2O

P_s = Stack Pressure, Inches Hg.

T_s = Average Stack Temperature °F.

VP = Vapor Pressure of H_2O At Stack Temperature

V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volume of water vapor collected at STP, SCF[b]

%M = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

CO_2 = Volume % Dry

O_2 = Volume % Dry

N_2 = Volume % Dry

CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P (T_s + 460)}$ is determined by averaging the square root of the product of the velocity head (P) and the absolute stack temperature from each sampling point.

T_t = Net time of test in minutes

D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft^2.

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, inches

Area = Area of duct in ft^2

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic Feet per minute

%I = Per Cent Isokinetic

[a] Dry Standard Cubic Feet @ 68°F, 29.92 in. Hg.

[b] Standard Conditions @ 68°F, 29.92 in. Hg.

MAY 21 '90 9:25 FROM ##########

SUMMARY OF EMISSIONS

PLANT: HARD CHROMIUM SPECIALISTS, INC.

LOCATION: YORK, PENNSYLVANIA

SAMPLED SOURCE: MESH PAD INLET (BALLS)

RUN	DATE	(1) V_m Std.	(2) DSCFM
I-4	1 Feb 89	142.796	3323
I-5	1 Feb 89	88.136	3267
I-4		142.796	3323
I-5		88.136	3267

FRONT HALF MILLIGRAMS				(4)	5
PROBE	CYCLONE	FILTER	(3) TOTAL	BACK HALF	FRONT + BACK TOTAL
			4.7289		
			1.8389		
			4.5638		
			3.7435		

CONCENTRATIONS

	FRONT HALF				BACK HALF				TOTAL			
RUN	Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr	Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr	Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr
I-4	.000511	1.16947	.019556	.00660								
I-5	.000322	.736809	.009016	.0040898								
✓ I-4	.0004952	1.128645	.0140481	.0063722								
✓ I-5	.0006555	1.491952	.0183549	.0083258								
	6		8	9	10	17	18	19	0	21	22	23

Ck:

DATA ZERO SUMMARY SHEET

PLANT HARD CHROMIUM SPECIALISTS LOCATION YORK, PENNSYLVANIA

SAMPLED SOURCE MESH PAD OUTLET (BALLS)

Run	Date	N_p	3 Y_m	4 ΔH	5 P Bar.	6 V_m	7 T_m	8 V_m Std.	9 %	10 P_{st}	17 P_s	18 T_s	19 VP	20 V_w	21 $V_{w_{gas}}$	22 %M	23 M_d
0-4	1 Feb 89	12	.985	6.62	29.32	293.623	117	263.655		.20	29.33	67		24.3	1.14	0.43	.996
0-5	1 Feb 89	12	.985	6.65	29.31	184.647	118	165.758		.20	29.32	68		21.0	0.99	0.59	.994

Run	24 CO_2	25 O_2	26 N_2	27 CO	28 —	29 MW_d	30 MW	31 C_p	32 $\sqrt{\Delta P_s (T_s + 460)}$	33 T_t	34 D_n	35 V_s	36 D_s	37 Area	38 ACFM	39 DSCFM	40 %I
0-4	0.7	21.0	78.3			28.95	28.90	.84	18.6446	192	.29467	46.0	15.8125	1.36	3762	3680	107.5
0-5	0.7	21.0	78.3			28.95	28.89	.84	18.6955	120	.29467	46.1	15.8125	1.36	3774	3677	108.2

$$V_m \text{ Std.} = Y_m \frac{17.64 \times V_m \left(P \text{ Bar.} + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$V_{w_{gas}} = 0.0471\ V_w$$

$$MW_d = CO_2 \times .44 + (O_2 \times .32) + (CO + N_2) \times .28 + \left(\text{Other} \times \frac{\text{Mol. wt.}}{100}\right)$$

$$MW = MW_d \times M_d + 18(1 - M_d)$$

$$V_s = 85.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{0.09450 \times (T_s + 460) \times V_m \text{ Std.}}{V_s \times T_t \times D_s^2 \times M_d \times A_n}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_m \text{ Std.} + V_{w_{gas}}}$$

$$M_d = \frac{100 - \%M}{100}$$

$$P_s = P \text{ Bar.} \pm \frac{P_{st}}{13.6}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orifice Pressure Drop, Inches H_2O

P Bar. = Barometric Pressure, Inches Hg, Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

T_m = Average Meter Temperature, °F.

V_m Std. = Volume of Dry Gas at STP, DSCF[a]

I = Per Cent other gas removed before Dry Gas Meter

P_{st} = Static Pressure of Stack Gas, Inches [illegible]

[illegible]

[illegible]

VP = Vapor Pressure of H_2O At Stack Temperature

V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volume of water vapor collected at STP, SCF[b]

%M = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

CO_2 = Volume % Dry

O_2 = Volume % Dry

N_2 = Volume % Dry

CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P (T_s + 460)}$ Is determined by averaging the square root of the product of the velocity head (ΔP_s) and the absolute stack temperature from each sampling point.

T_t = Net time of test in minutes

D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft^2.

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, Inches

Area = Area of duct in ft^2

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic [illegible] per minute

%I = Per Cent Isokinetic

[a]Dry Standard Cubic [illegible] °F, 29.92 in. Hg.

[b]Standard Condi[illegible] 92 in. Hg.

SUMMARY EMISSIONS

PLANT HARD CHROMIUM SPECIALISTS, INC. LOCATION YORK, PENNSYLVANIA

SAMPLED SOURCE MESH PAD OUTLET (BALLS)

RUN	DATE	(1) V_m Std.	(2) DSCFM
0-4	1 Feb 89	263.655	3680
0-5	1 Feb 89	165.758	3677

FRONT HALF MILLIGRAMS			
PROBE	CYCLONE	FILTER	(3) TOTAL
			.23704
			.13266

(4) BACK HALF	5 FRONT + BACK TOTAL

CONCENTRATIONS

FRONT HALF			
RUN	Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr
0-4	.0000139	.0317992	.0004376	.0001985
0-5	.0000124	.0283[illegible]	.0003893	.0001766
6	7	8	9

BACK HALF			
Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr
10	17	18	19

TOTAL			
Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr
20	21	22	23

Remarks:

TABLE 3-5. SUMMARY OF Cr^{+6} REMOVAL EFFICIENCIES

Run No.	Cr^{+6} Emission Rate lb/hr	Cr^{+6} Removal Efficiency
I-1 O-1	0.0454 0.000569	98.7%
I-2 O-2	0.0498 0.000485	99.0%
I-3 O-3	0.0642 0.000697	98.9%
I-4 O-4	0.0146 0.000438	97.0%
I-5 O-5	0.0090 0.000389	95.7%
Polypropylene Ball Efficiency* (Average I-1 vs. I-4 and I-2 vs. I-5)		74.9%
Mist Eliminator Efficiency (Runs 1-3)		98.9%
Mist Eliminator Efficiency With Polypropylene Balls On Tank Surface (Runs 4-5)		96.4%

* The efficiency of the polypropylene balls was calculated based on these runs because identical parts were being plated and operating conditions were identical within each pair of tests.

Pear sent this page as a replacement for the report & couldn't see any difference. Maybe there is.

SAMPLING SUMMARY SHEET

PLANT HARD CHROMIUM SPECIALISTS LOCATION YORK, PENNSYLVANIA

SAMPLED SOURCE MESH PAD INLET (BALLS)

Run	Date	N_p	3 Y_m	4 ΔH	5 P Bar.	6 V_m	7 T_m	8 V_m Std.	9 %	10 P_{st}	17 P_s	18 T_s	19 VP	20 V_w	21 $V_{w_{gas}}$	22 %M	23 M_d
I-4	1 Feb 89	24½	1.006	1.91	29.37	154.000	105	142.796		-1.5	29.26	73		24.3	1.14	0.79	.992
I-5	1 Feb 89	24	1.006	1.87	29.37	95.061	105	88.136		-1.5	29.26	74		18.9	0.89	1.00	.990

Run	24 CO_2	25 O_2	26 N_2	27 CO	28 —	29 MW_d	30 MW	31 C_p	32 $\sqrt{\Delta P_s (T_s + 460)}$	33 T_t	34 D_n	35 V_s	36 D_s	37 Area	38 ACFM	39 DSCFM	40 %I
I-4	0.7	21.0	78.3			28.95	28.86	.84	17.7972	192	.235	44.0	15.5	1.31	3458	3323	97.4
I-5	0.7	21.0	78.3			28.95	28.84	.84	17.5626	120	.235	43.4	15.5	1.31	3413	3267	97.9

$$\text{Std.} = V_m \frac{17.64 \times Y_m \left(P\ \text{Bar.} + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{\text{Std.} + V_{w_{gas}}}$$

$$V_w = 0.0471\ V_w$$

$$M_d = \frac{100 - \%M}{100}$$

$$MW = \%CO_2 \times .44 + (\%O_2 \times .32) + (\%CO \times .28) + (\%N_2) \times .28 + \left(\%\text{Other} \times \frac{\text{Mol. Wt.}}{100}\right)$$

$$MW_d = M_d + 18(1 - M_d)$$

$$P_s = P\ \text{Bar.} \pm \frac{P_{st}}{13.6}$$

$$15.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\frac{0.09450 \times (T_s + 460) \times V_m\ \text{Std.}}{V_s \times T_t \times P_s \times M_d \times A_n}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orifice Pressure Drop, inches H_2O

P Bar. = Barometric Pressure, Inches Hg, Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

T_m = Average Meter Temperature, °F

V_m Std. = Volume of Dry Gas at STP, DSCF[a]

% = Per Cent other gas removed before Dry Gas Meter

P_{st} = Static Pressure of Stack Gas, inches H_2O

P_s = Stack Gas Pressure, inches Hg.

T_s = Average Stack Temperature, °F

VP = Vapor Pressure of H_2O At Stack Temperature

V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volume of water vapor collected at STP, SCF[b]

%M = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

$\%CO_2$ = Volume % Dry

$\%O_2$ = Volume % Dry

$\%N_2$ = Volume % Dry

%CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P_s (T_s + 460)}$ Is determined by averaging the square root of the product of the velocity head (P_s) and the absolute stack temperature from each sampling point.

T_t = Net time of test in minutes

D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft^2.

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, inches

Area = Area of duct in ft^2

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic Feet per minute

%I = Per Cent Isokinetic

[a] Dry Standard Cubic Feet @ 68°F, 29.92 in. Hg.

[b] Standard Conditions @ 68°F, 29.92 in. Hg.

SUMMARY OF EMISSIONS

PLANT HARD CHROMIUM SPECIALISTS, INC. LOCATION YORK, PENNSYLVANIA

SAMPLED SOURCE MESH PAD INLET (BALLS)

RUN	DATE	(1) V_m Std.	(2) DSCFM	FRONT HALF MILLIGRAMS PROBE	CYCLONE	FILTER	(3) TOTAL	(4) BACK HALF	5 FRONT + BACK TOTAL
I-4	1 Feb 89	142.796	3323				4.7289		
I-5	1 Feb 89	88.136	3267				1.8389		
I-4		142.796	3323				4.5638		
I-5		88.136	3267				3.7455		

CONCENTRATIONS

RUN	FRONT HALF Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr	BACK HALF Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr	TOTAL Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr
I-4	.000511	1.16947	.019556	.00660	.000322	.7						
I-5	.000322	.736804	.009016	.0040898								
✓ I-4	.0004952	1.128645	.0140481	.0063722								
✓ I-5	.0006555	1.499952	.0183549	.0083258								
	6	7	8	9	10	17	18	19	20	21	22	23

Remarks:

DATA AND SUMMARY SHEET

PLANT HARD CHROMIUM SPECIALISTS

LOCATION YORK, PENNSYLVANIA

SAMPLED SOURCE MESH PAD OUTLET (BALLS)

Run	Date	N_p	(3) Y_m	(4) ΔH	(5) P Bar.	(6) V_m	(7) T_m	(8) V_m Std.	(9) %	(10) P_{st}	17 P_s	(18) T_s	(19) VP	(20) V_w	21 $V_{w_{gas}}$	22 %M	23 M_d
0-4	1 Feb 89	12	.985	6.62	29.32	293.623	117	263.655	/	.20	29.33	67	/	24.3	1.14	0.43	.996
0-5	1 Feb 89	12	.985	6.65	29.31	184.647	118	165.758	/	.20	29.32	68	/	21.0	0.99	0.59	.994

Run	(24) CO_2	(25) O_2	26 N_2	(27) CO	(28) —	29 MW_d	30 MW	(31) C_p	(32) $\sqrt{\Delta P_s (T_s + 460)}$	(33) T_c	(34) D_n	35 V_s	(36) D_s	(37) Area	38 ACFM	(39) DSCFM	40 %I
0-4	0.7	21.0	78.3	/	/	28.95	28.90	.84	18.6446	192	.29467	46.0	15.8125	1.36	3762	3680	107.5
0-5	0.7	21.0	78.3	/	/	28.95	28.89	.84	18.6955	120	.29467	46.1	15.8125	1.36	3774	3677	108.2

$$V_m \text{ Std.} = V_m \frac{17.64 \times V_m \left(P \text{ Bar.} + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_m \text{ Std.} + V_{w_{gas}}}$$

$$V_{w_{gas}} = 0.0471\ V_w$$

$$M_d = \frac{100 - \%M}{100}$$

$$MW_d = \%CO_2 \times .44 + (\%O_2 \times .32) + (\%CO + \%N_2) \times .28 + \left(\%Other \times \frac{Mol.\ wt.}{100}\right)$$

$$MW = MW_d \times M_d + 18(1 - M_d)$$

$$P_s = P \text{ Bar.} \pm \frac{P_{st}}{13.6}$$

$$V_s = 85.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{0.09450 \times (T_s + 460) \times V_m \text{ Std.}}{V_s \times T_s \times P_s \times M_d \times A_n}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orifice Pressure Drop, Inches H_2O

P Bar. = Barometric Pressure, Inches Hg. Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

T_m = Average Meter Temperature, °F.

V_m Std. = Volume of Dry Gas at STP, DSCF[a]

% = Per Cent other gas removed before Dry Gas Meter

P_{st} = Static Pressure of Stack Gas, Inches H_2O

P_s = Stack Gas Pressure, Inches Hg.

T_s = Average Stack Temperature, °F

VP = Vapor Pressure of H_2O At Stack Temperature

V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volume of water vapor collected at STP, SCF[b]

%M = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

$\%CO_2$ = Volume % Dry

$\%O_2$ = Volume % Dry

$\%N_2$ = Volume % Dry

%CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P (T_s + 460)}$ Is determined by averaging the square root of the product of the velocity head (P_s) and the absolute stack temperature from each sampling point.

T_c = Net time of test in minutes

D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft^2.

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, inches

Area = Area of duct in ft^2

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic Feet per minute

%I = Per Cent Isokinetic

[a] Dry Standard Cubic Feet @ 68°F, 29.92 In. Hg.

[b] Standard Condition .92 In. Hg.

MAY 21 '90 9:24 FROM ##########

SUMMARY OF EMISSIONS

PLANT HARD CHROMIUM SPECIALISTS, INC. LOCATION YORK, PENNSYLVANIA

SAMPLED SOURCE MESH PAD OUTLET (BALLS)

RUN	DATE	1 V_m Std.	2 DSCFM
0-4	1 Feb 89	263.655	3680
0-5	1 Feb 89	165.758	3677

FRONT HALF MILLIGRAMS			
PROBE	CYCLONE	FILTER	3 TOTAL
			.23704
			.13266

4 BACK HALF	5 FRONT + BACK TOTAL

CONCENTRATIONS

FRONT HALF			
RUN	Gr/DSCF	Mg/M^3	Lb/Hr
0-4	.0000139	.0317492	.0004376
0-5	.0000124	.0283[illegible]	.0003893
6	7	8	9

BACK HALF			
Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr
10	17	18	19

TOTAL			
Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr
20	21	22	23

Remarks:

MAY 21 '90 9:24 FROM ##########

EPA Contract No. 68-02-4346
Work Assignment 4

August 22, 1989

Determination of the Efficiency of a Mesh-Pad Mist Eliminator

Candidate Plant
Hard Chrome Specialists, Inc.
York, Pennsylvania

Prepared for

U.S. Environmental Protection Agency
Emissions Measurement Branch
Research Triangle Park, North Carolina 27711

Prepared by

PEER Consultants, P.C.
4134 Linden Ave., Suite 202
Dayton, Ohio 45432

CONTENTS

Section		Page
1.0	Introduction	1
2.0	Process Operation	4
3.0	Summary of Results	14
4.0	Sampling Locations and Test Methods	24
5.0	Quality Assurance	29

FIGURES

Figures		Page
1-1	Location of sample points	2
2-1	Hard Chrome Specialists, Inc., plant layout	5
2-2	Mesh-pad mist eliminator schematic	7
2-3	Air pollution control system	8

TABLES

Table		Page
2-1	Average Operating Parameters During Each Mass Emission Test Run	10
2-2	Total Current Supplied to Plating Tank During Each Mass Emission Test Run	12
3-1	Schedule of Activities	15
3-2	Summary of Flue Gas Conditions	17
3-3	Summary of Sample Volumes, Analytical Results and Emission Rates for the Mesh-Pad Mist Eliminator Inlet	18

CONTENTS (continued)

Table		Page
3-4	Summary of Sample Volumes, Analytical Results and Emission Rates for the Mesh-Pad Mist Eliminator Outlet	20
3-5	Summary of Cr^{+6} Removal Efficiencies	21
3-6	Summary of Plating Solution Analytical Results	22
4-1	Sample Traverse Point Locations for the Mesh-Pad Mist Eliminator Inlet and Outlet	25
5-1	Summary of Analytical Results for QA/QC Samples And Blanks	31

APPENDICES

A	Field Data Sheets	A-1
B	Draft Method for Chromium Analysis	B-1
C	Chain of Custody	C-1
D	Equipment Calibration Data	D-1
E	Process Data	E-1
F	Project Participants and Activity Log	F-1

SECTION 1.0
INTRODUCTION

During the week of January 30, 1989, an emission measurement program was conducted at Hard Chrome Specialists, Inc. in York, Pennsylvania. The purpose of this program was to collect data to determine the efficiency of a mesh-pad mist eliminator, and also to determine the effectiveness of polypropylene balls in controlling emissions from the surface of the plating bath. The data gathered will be used as a second data set to confirm the performance of an identical mesh-pad mist eliminator which was found to have achieved 99.7% control of hexavalent chromium (Cr^{+6}) emissions.

The principal reason for selecting Hard Chrome Specialists, Inc. was the plant's use of a mesh-pad mist eliminator containing two mesh pads to control chromic acid emissions from a plating tank. The capture and control system on the plating tank consists of a single-sided lateral hood ducted to the mesh-pad mist eliminator prior to ducting to the atmosphere. In order to assess the control efficiency of the system, hexavalent chromium emissions were measured at two locations along the duct. These locations are identified in Figure 1-1 as: 1) inlet sample site and 2) outlet sample site.

The emission samples were collected using a Modified Method 13B (MM13B) sample train. This method will be discussed in Section 4.0. The samples were analyzed for Cr^{+6} concentration using the diphenylcarbazide colorimetric method. This method will also be discussed in Section 4.0.

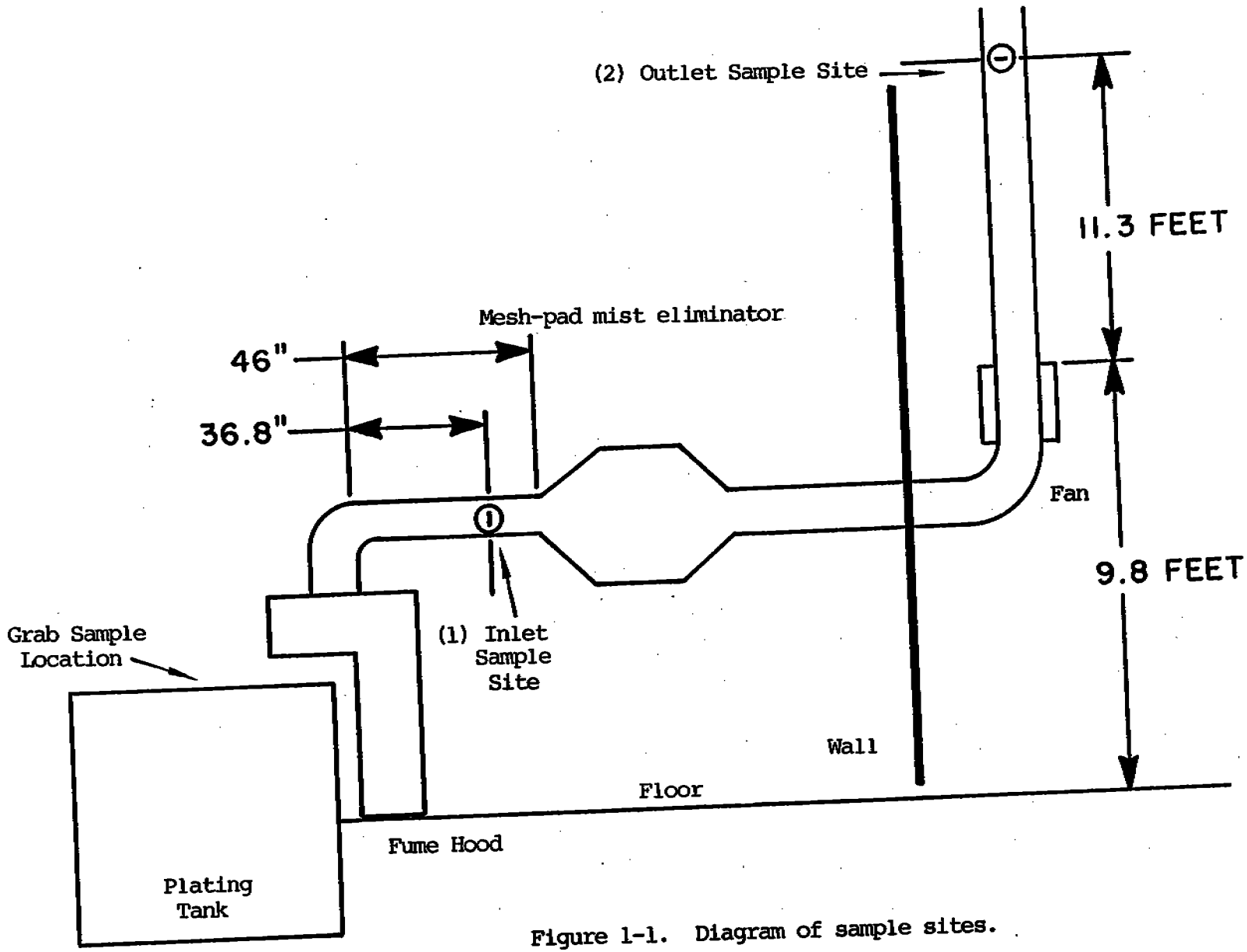


Figure 1-1. Diagram of sample sites.

PEER Consultants, P.C., located in Dayton, Ohio was responsible for developing the test protocol, conducting the field test, performing on-site analysis of samples and the preparation of draft and final reports. PEER was supported by its subcontractor, Pacific Environmental Services, Inc. located in Cincinnati, Ohio. Midwest Research Institute, located in Raleigh, North Carolina, was responsible for monitoring the process operation, and EPA personnel conducted Screening Method testing and monitored the implementation of the test protocol.

SECTION 2.0
PROCESS OPERATION

2.1 PROCESS DESCRIPTION

Hard Chrome Specialists, Inc., is a job shop that plates industrial rolls, hydraulic components, dies, and molds. The hard chromium plating line at this facility consists of an alkaline strip tank to clean the parts prior to plating, two alkaline rinse tanks, an alkaline scrub tank, and the hard chromium plating tank followed by a spray rinse tank and by three countercurrent rinse tanks. A floor plan of the facility is presented in Figure 2-1.

The hard chromium plating tank is 1.8 m (6.0 ft) long, 0.76 m (2.5 ft) wide, and 4.3 m (14.0 ft) deep and holds approximately 5,720 liters (ℓ) (1,510 gallons [gal]) of plating solution. The plating tank usually operates 8 hours per day, 5 days per week. Typical plating times for each part range from 0.5 to 20 hours. For parts that require a plating time in excess of 8 hours, the parts are plated over the course of 2 days. The plating solution contains chromic acid in a concentration of about 210 grams per liter (g/ℓ) (28 ounces per gallon [oz/gal]) of water. Sulfuric acid is used as a catalyst at a bath concentration of 2.1 g/ℓ (0.28 oz/gal). The temperature of the plating solution is maintained between 54° and 60°C (130° and 140°F). The plating tank is equipped with an air agitation system to maintain uniform bath temperature and chromic acid concentration. The maximum current and voltage of the rectifier is 8,000 amperes and 9 volts.

2.2 AIR POLLUTION CONTROL

The capture and control on the plating tank consist of a single-sided lateral hood ducted to a mesh-pad mist eliminator.

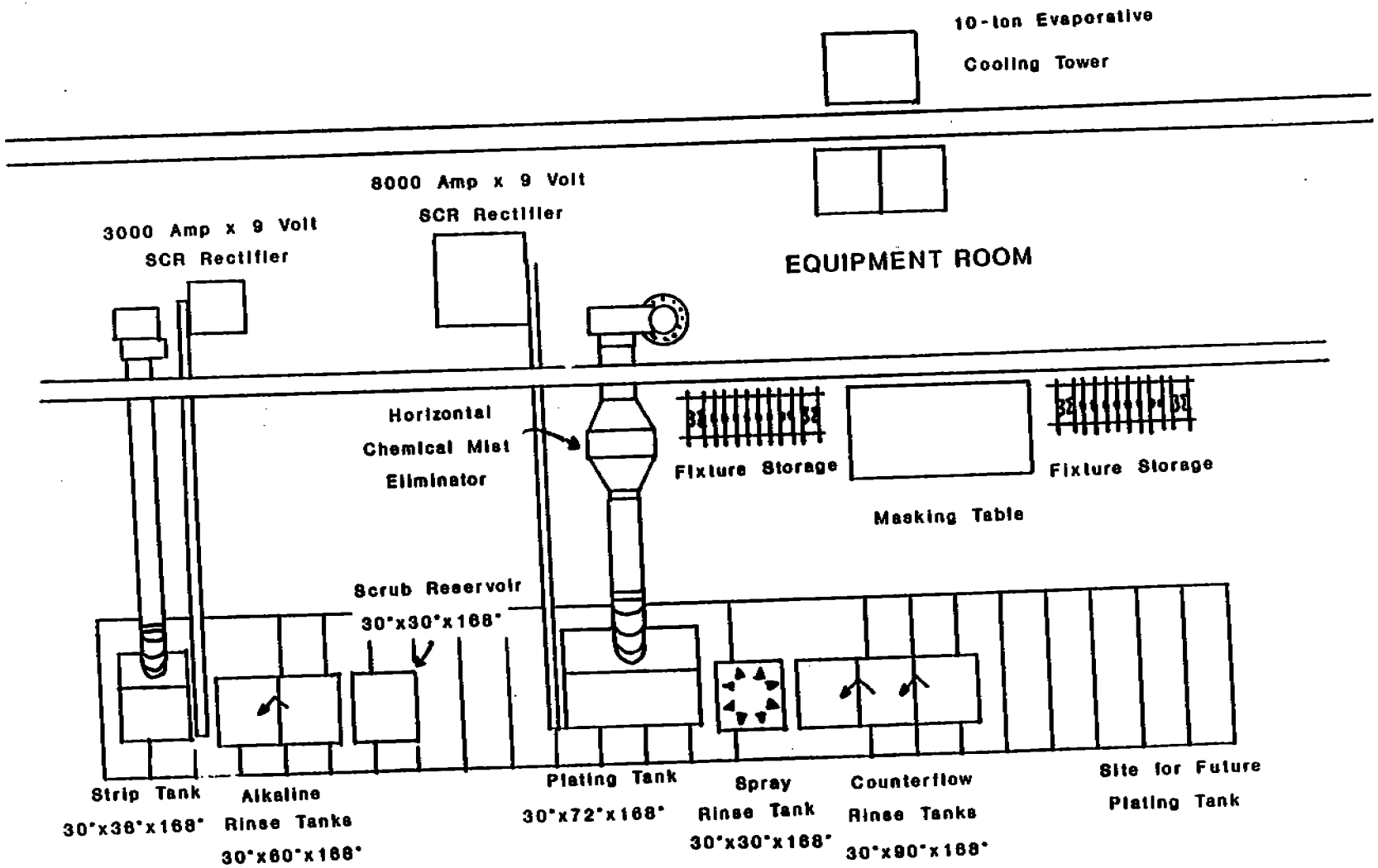


Figure 2-1. Hard Chromium Specialists, Inc., plant layout.

Figure 2-2 presents a schematic of the capture and control system on the hard chromium plating tank.

The mesh-pad mist eliminator was fabricated and installed in November 1988 by ChromeTech, Inc., Bedford, Ohio. Figure 2-3 presents a detailed schematic of the mesh-pad mist eliminator. The design airflow rate of the ventilation system is 110 dry standard cubic meters per minute (m^3/min) (3,800 dry standard cubic feet per minute [ft^3/min]. The mesh-pad mist eliminator unit has a pressure drop of 0.62 kilopsacal (kPa) (2.5 inches in water column [in. w.c.]) at a gas velocity of 150 to 210 meters per minute (500 to 700 feet per minute). The mist eliminator consists of two mesh pads spaced approximately 10 centimeters (cm) [4 in.] apart. Each mesh pad is 79 cm (31 in.) in diameter. The primary mesh pad at the inlet of the unit is 6.4 to 7.6 cm (2.5 to 3.0 in.) thick, and the secondary mesh pad is 3.2 to 3.8 cm (1.25 to 1.5 in.) thick. Each mesh pad consists of interlocked polypropylene filaments. Each thread is 0.051 cm (0.0200 in.) in diameter. The thread count is 4.3 by 3.3 per square centimeter (28 by 21 per square inch) and the weave type is honeycomb.

Removal of chromic acid mist is accomplished by direct interception of impaction of the chromic acid mist on the mesh pads. The collected droplets then coalesce along the fibers and drain down the pads into the drain pipe located at the bottom of the unit.

The mist eliminator unit is equipped with two spray nozzles to clean the pads. One spray nozzle is located at the inlet of the unit prior to the first mesh pad, and the other spray nozzle is located behind the second mesh pad. The first nozzle sprays intothe first mesh pad in the direction of the airflow, and the second nozzle sprays into the second mesh pad countercurrent to the airflow. The first spray nozzle uses rinse water from the first rinse tank following the plating tank, and the second spray nozzle uses clean tap water. At the end of each day, the ventilation system is shut off and the spray nozzles are

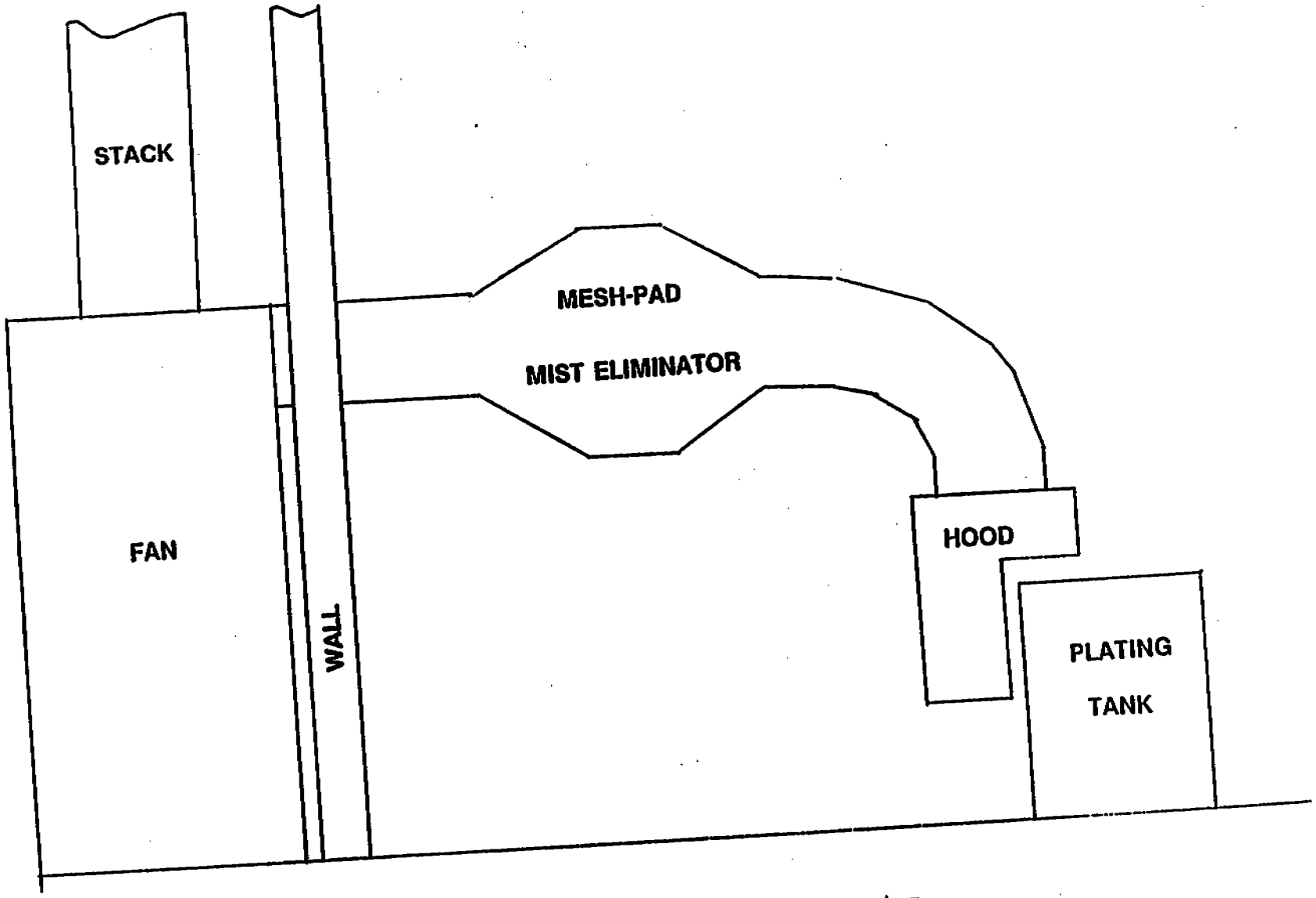


Figure 2-2. Air pollution control system.

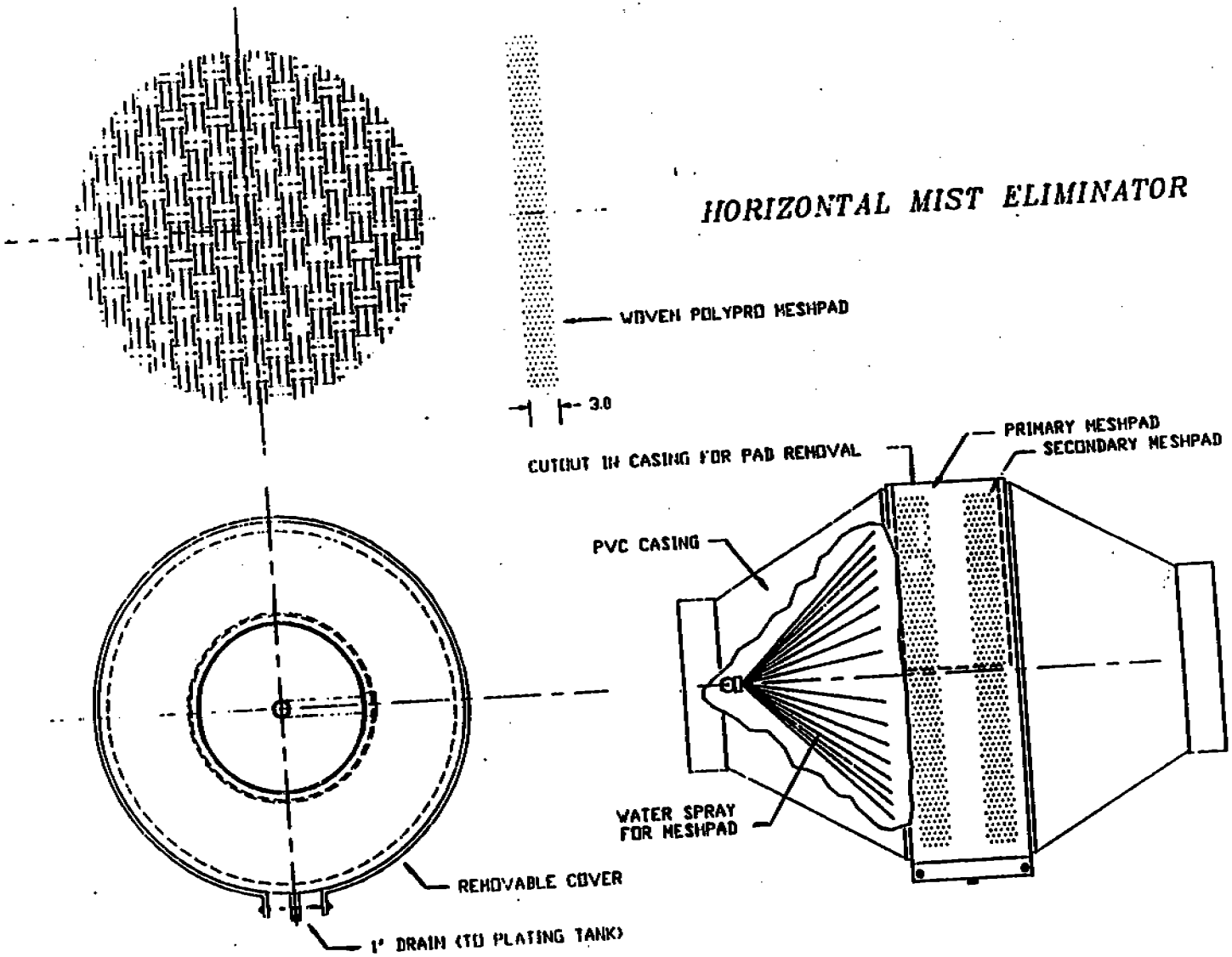


Figure 2-3. Mesh-pad mist eliminator schematic.

activated for approximately 30 seconds to wash down the mesh pads. Typically, 23 to 39 liters (6 to 10 gallons) of water are used each time the pads are cleaned. The washdown is drained to the plating tank. In addition, the unit is designed so that the mesh pads can be easily removed and cleaned by immersion in the plating bath. The immersion cleaning is performed once a month.

2.3 PROCESS CONDITIONS DURING TESTING

Five mass emission test runs were conducted at the inlet and outlet of the mesh-pad mist eliminator. During this source test program, the plating tank was operated with and without polypropylene balls covering the surface of the plating solution. The first three test runs were conducted on the system without any polypropylene balls on the plating tank surface to determine the effectiveness of the mesh-pad mist eliminator. The two subsequent test runs were conducted while polypropylene balls covered the surface of the plating solution to determine their effectiveness in controlling chromic acid mist at the surface of the plating solution. During test runs No. 4 and 5, polypropylene balls covered the entire surface of the plating solution. The ball coverage was two to three layers thick in most places. Each polypropylene ball was 3.8 cm (1.5 in.) in diameter. There was no observed dispersion of polypropylene balls away from the cathode area during plating due to the relatively thick coverage supplied by the balls. In typical industrial applications, coverage is not usually as complete as in the case tested.

Process parameters recorded during each test run were the operating current, the operating voltage, and the plating solution temperature. In addition, the pressure drop across the mesh-pad mist eliminator unit was recorded. Process data sheets documenting the process and control device parameters monitored during testing are presented in Appendix E. Data on the average operating parameters recorded for each test run are presented in Table 2-1. The plating tank was plating one or two hydraulic

TABLE 2-1. AVERAGE OPERATING PARAMETERS DURING EACH MASS EMISSION TEST RUN

Run No.	Operating current amperes	Operating voltage, volts	Temperature of plating solution °C (°F)
1	3,000	4.6	54 (130)
2	3,000	4.7	55 (131)
3	5,400	5.0	55 (131)
4	3,000	5.0	56 (132)
5	3,000	5.0	56 (132)

cylinders during each test run. A single, 18-cm (7 in.) diameter roll, 175 cm (69 in.) long, was plated during Runs No. 1, 2, 4, and 5. This cylinder and another hydraulic cylinder, with a diameter of 14 cm (5.5 in.) and a length of 173 cm (68 in.), were plated during test run No. 3. During plating, no visible misting was observed escaping the plating tank's ventilation system. During test runs No. 4 and 5, visible misting was observed above the polypropylene balls; however, the mist was captured by the ventilation system. The total current supplied to the tank during each test run was calculated in terms of ampere-hours and is reported in Appendix E. A summary of the total current values is presented in Table 2-2.

The fan speed was increased after test run No. 1, on the recommendation of the control system vendor, ChemTech, Inc. The vendor felt that increasing the air flow was necessary to operate closer to the design condition. The inlet gas flow rate during testing ranged from 88 to 93 dry standard m^3/min (3,100 to 3,300 dry standard ft^3/min). The outlet flow rates ranged from 99 to 108 dry standard m^3/min (3,500 to 3,800 dry standard ft^3/min). The outlet flow rate was 6 to 16 percent greater than the inlet flow rate. The larger outlet flow rate resulted from an inadequate seal around the mesh pads which allowed ambient air to be drawn into the system.

Grab samples from the plating tank were taken during each test run to determine the Cr^{+6} concentration of the plating solution during emission testing. The mist eliminator was washed down at the end of each day, and grab samples of the washdown water were collected. The Cr^{+6} concentrations of the grab samples are reported in Section 3 of this report.

Test runs No. 1 and 4 were 3 hours in duration, and the remaining test runs were 2 hours in duration. A slightly larger sampling nozzle was used during test runs No. 4 and 5, which resulted in a larger sample volume collected. The larger nozzle was used to ensure adequate sample

TABLE 2-2. TOTAL CURRENT SUPPLIED TO PLATING TANK DURING EACH MASS EMISSION TEST RUN

Run No.	Test time minutes (hours)		Total current, ampere-hours	
	Inlet	Outlet	Inlet	Outlet
1	192 (3.2)	192 (3.2)	9,600	9,600
2	120 (2.0)	120 (2.0)	6,000	6,000
3	120 (2.0)	120 (2.0)	10,800	10,800
4	192 (3.2)	192 (3.2)	9,600	9,600
5	120 (2.0)	120 (2.0)	6,000	6,000

collection for the test runs when polypropylene balls were in the tank. Each test run was interrupted for 5 to 15 minutes to change test ports.

SECTION 3.0
SUMMARY OF RESULTS

INTRODUCTION

Five Modified Method 13B (MM13B) samples were collected at each sample location. All of the emission samples were analyzed on site for Cr^{+6} concentrations using the procedures outlined in the method entitled "Draft Method - Determination of Hexavalent Chromium in Dry Particulate Emissions from Stationary Sources". This analytical method is presented in Appendix B.

In addition to the emission samples, grab samples of the plating bath and mist eliminator washdown water were composited during each MM13B run and analyzed using the same colorimetric procedures as for the emission samples. Table 3-1 presents a schedule of the activities during the test program. The results from the sampling program are presented in the remainder of this section.

HEXAVALENT CHROMIUM EMISSION RESULTS

Emission samples were collected isokinetically using a Method 13B sample train that had been modified by removing the glass fiber filter and placing 100 mℓ of 0.1N NaOH in each of the first two impingers. The impinger solutions were recovered into tared polyethylene sample bottles and the total volume of the recovered samples was determined gravimetrically. Following recovery of the samples, an aliquot of the solution was analyzed for Cr^{+6}. The following subsections present the flue gas data and analytical results for each sample location.

TABLE 3-1. SCHEDULE OF ACTIVITIES

Date (1989)	Sample Type	Run No.	Test Time (Minutes)	Parameter Measured
1/30	MM13B[a]	I-1, O-1	192	Cr^{+6}
1/30	SM[b]	1I series		Cr^{+6}
1/30	SM	10 series		Cr^{+6}
1/30	plating sol.	1		Cr^{+6}
1/31	MM13B	I-2, O-2	120	Cr^{+6}
1/31	SM	2I series		Cr^{+6}
1/31	SM	20 series		Cr^{+6}
1/31	plating sol.	2		Cr^{+6}
1/31	MM13B	I-3, O-3	120	Cr^{+6}
1/31	SM	3I series		Cr^{+6}
1/31	SM	30 series		Cr^{+6}
1/31	plating sol.	3		Cr^{+6}
2/1	MM13B	I-4, O-4	192	Cr^{+6}
2/1	SM	4I series		Cr^{+6}
2/1	SM	40 series		Cr^{+6}
2/1	plating sol.	4		Cr^{+6}
2/1	MM13B	I-5, O-5	120	Cr^{+6}
2/1	SM	5I series		Cr^{+6}
2/1	SM	50 series		Cr^{+6}
2/1	plating sol.	5		Cr^{+6}

a = modified method 13B

b = screening method

Inlet to the Mesh-Pad Mist Eliminator

Modified Method 13B--

Testing at this location was conducted under two conditions. During the first three runs, the emissions from the plating bath were uncontrolled. The fourth and fifth runs were conducted with two to three layers of hollow polypropylene balls on the surface of the plating bath to control emissions.

A summary of the flue gas conditions at this location are presented in Table 3-2. The volumetric flowrates were consistent and averaged 92 dry standard cubic meters per minute (dscmm), (3,240 dry standard cubic feet per minute, (dscfm)). The flue gas temperature averaged 23°C (74°F) and the moisture content averaged 0.93 percent. The flue gas was essentially ambient air and was assigned a dry molecular weight of 28.95 lb/lb mole. The isokinetic sampling rates were within the allowable limitations for these sample runs.

Prior to sampling, it was decided that the first and fourth MM13B runs should be run at 8 minutes per point for a total sample time of 192 minutes. This sample time ensured the collection of a detectable concentration of Cr^{+6}. Following the analysis of the sample, it was determined that the sample time per point could be reduced to 5 minutes. The uncontrolled emissions (Runs 1-3) for each MM13B run were consistent and averaged 4.42 mg/dscm (0.00193 gr/dscf). When polypropylene balls were placed on the surface of the plating bath, emissions were consistent and averaged 0.953 mg/dscm (0.000415 gr/dscf). A summary of the MM13B sample volumes, analytical results and emission rates for this location presented in Table 3-3.

Outlet from the Mist Eliminator

Modified Method 13B--

A summary of the flue gas conditions at this location are also presented in Table 3-2. The volumetric flowrates were consistent and

TABLE 3-2. SUMMARY OF FLUE GAS CONDITIONS

Run No.	Date	Volumetric Flowrate dscm/min	Volumetric Flowrate dscf/min	Temperature °C	Temperature °F	% Moisture	% Isokinetic
I-1	1/30/89	87	3,080	23	74	1.10	98.2
O-1	1/30/89	98	3,460	21	70	1.07	95.5
I-2	1/31/89	94	3,300	23	74	0.84	94.7
O-2	1/31/89	105	3,710	21	69	0.77	98.5
I-3	1/31/89	92	3,250	24	76	0.94	93.4
O-3	1/31/89	103	3,640	22	71	0.90	98.1
I-4	2/1/89	94	3,320	23	73	0.79	97.4
O-4	2/1/89	104	3,680	19	67	0.43	107.3
I-5	2/1/89	93	3,270	23	74	1.00	97.9
O-5	2/1/89	104	3,680	20	68	0.59	108.0

TABLE 3-3. SUMMARY OF SAMPLE VOLUMES, ANALYTICAL RESULTS AND EMISSION RATES FOR THE MESH-PAD MIST ELIMINATOR INLET

Run No.	Stack dscfm	Volume Metered dscf	Total Mass Cr+6, mg	Concentration mg/dscm	Concentration gr/dscf	Emission Rates kg/hr	Emission Rates lb/hr
Without Balls							
I-1	3,080	133.171	14.873	3.94	0.00172	0.0206	0.0454
I-2	3,300	86.183	9.820	4.02	0.00176	0.0226	0.0498
I-3	3,250	83.670	12.511	5.28	0.00231	0.0291	0.0642
With Balls							
I-4	3,320	142.796	4.729	1.17	0.00051	0.0066	0.0146
I-5	3,270	88.136	1.839	0.74	0.00032	0.0041	0.0090

averaged 103 dry standard cubic meters per minute (dscmm), (3,630 dry standard cubic feet per minute, (dscfm)). The flue gas temperature averaged 21°C (69°F) and the moisture content averaged 0.75 percent. The flue gas was essentially ambient air and was assigned a dry molecular weight of 28.95 lb/lb mole. The isokinetic sampling rates were within the allowable limitations for these sample runs.

Prior to sampling, it was decided that the first and fourth MM13B run should be run at 8 minutes per point for a total sample time of 192 minutes. This sample time ensured the collection of a detectable concentration of Cr^{+6}. In order to collect a larger sample and assure a detectable Cr^{+6} concentration, nozzle size was increased from 0.235 inches to 0.295 inches on outlet runs 4 and 5. Following the analysis of the sample, it was determined that the sample time per point could be reduced to 5 minutes, for a total sample time of 120 minutes. The emissions as measured in each MM13B run were consistent and averaged 0.0380 mg/dscm (0.00002 gr/dscf). A summary of the MM13B sample volumes, analytical results and emission rates for this location is presented in Table 3-4.

The Cr^{+6} control efficiency of the polypropylene balls on the surface of the plating tank averaged 74.9%. This value was determined by comparing the mass flowrates for runs I-1 vs. I-4 and run I-2 vs. I-5. The Cr^{+6} removal efficiency for the mist eliminator alone was 98.9% (no polypropylene balls on plating tank surface and based on runs 1-3). The efficiency of the mist eliminator operated in combination with the polypropylene balls (runs 4-5) was 96.3%. A summary of removal efficiencies for the system is presented in Table 3-5.

PLATING TANK SOLUTIONS

During each MM13 run, grab samples of the plating bath solution were collected and composited. The samples were analyzed for Cr^{+6} concentration. The results from these analyses are presented in Table 3-6.

TABLE 3-4. SUMMARY OF SAMPLE VOLUMES, ANALYTICAL RESULTS AND EMISSION RATES FOR THE MESH-PAD MIST ELIMINATOR OUTLET

Run No.	Stack dscfm	Volume Metered dscf	Total Mass Cr+6, mg	Concentration mg/dscm	Concentration gr/dscf	Emission Rates kg/hr	Emission Rates lb/hr
Without Balls							
0-1	3,460	139.880	0.1740	0.0439	0.00002	0.000258	0.000569
0-2	3,710	96.812	0.0957	0.0349	0.00002	0.000220	0.000485
0-3	3,640	94.613	0.1369	0.0511	0.00002	0.000316	0.000697
With Balls							
0-4	3,680	263.655	0.2370	0.0317	0.00001	0.000199	0.000438
0-5	3,680	165.758	0.1327	0.0283	0.00001	0.000177	0.000389

TABLE 3-5. SUMMARY OF Cr^{+6} REMOVAL EFFICIENCIES

Run No.	Cr^{+6} Emission Rate lb/hr	Cr^{+6} Removal Efficiency
I-1	0.0454	
0-1	0.000569	98.7%
I-2	0.498	
0-2	0.000485	99.0%
I-3	0.0642	
0-3	0.000297	98.9%
I-4	0.0146	
0-4	0.000438	96.9%
I-5	0.0090	
0-5	0.000389	95.7%
Polypropylene Ball Efficiency (Average I-1 vs. I-4 and I-2 vs. I-5)		74.9%
Mist Eliminator Efficiency (Runs 1-3)		98.9%
Mist Eliminator Efficiency With Polypropylene Balls On Tank Surface (Runs 4-5)		96.3%

TABLE 3-6. SUMMARY OF PLATING SOLUTION & WASHDOWN WATER ANALYTICAL RESULTS

Run No.	Cr^{+6} Concentration, µg/mℓ
Plating Solution	
I-1	106,745
I-2	111,620
I-3	111,620
I-4	108,277
I-5	106,627
Mist Eliminator Washdown Water	
1/30/89	48,369
1/31/89	31,228
2/1/89	15,520

MIST ELIMINATOR RINSE

Prior to the start of the sampling program, the mist eliminator was rinsed with fresh water. The mist eliminator was rinsed daily and a sample of washdown water was collected and analyzed for Cr^{+6} concentrations. The results of these analyses were presented in Table 3-6.

SECTION 4.0
SAMPLING LOCATIONS AND TEST METHODS

EMISSION SAMPLES

Location of Measurement Sites

EPA Reference Method 1, "Sample and Velocity Traverses for Stationary Sources" was used to select representative measurement sites. At the inlet, the measurement site was located in a 15.5 inch ID circular horizontal duct 36.8 inches (2.4 stack diameters) downstream of the nearest flow disturbance (90° elbow) and 9.2 inches (0.6 stack diameters) upstream of the nearest flow disturbance (mist eliminator inlet). According to EPA Method 1 criteria, this location required 24 sample traverse points, 12 along each of two perpendicular diameters. Table 4-1 shows the traverse point locations.

At the mist eliminator outlet, the measurement site was located in a 15.8 inch ID circular vertical stack 11.3 feet (8.6 stack diameters) downstream of the nearest flow disturbance (ID fan) and approximately 29 feet (22 stack diameters) upstream of the nearest flow disturbance (atmosphere). According to EPA Method 1 criteria, this location required 12 sample traverse points, 6 along each of two perpendicular diameters. Table 4-1 shows the traverse point locations.

Prior to sampling, verification of the absence of cyclonic flow at each sample traverse point was assessed based on procedures described in EPA Reference Method 1. In this method, the face openings of the Type-S pitot tube are aligned perpendicular to the duct cross-sectional plane, designated "0-degree reference." Null (zero) pitot readings obtained at 0-degree reference indicate an acceptable flow condition at a given

TABLE 4-1. SAMPLE TRAVERSE POINT LOCATIONS FOR THE MESH-PAD MIST ELIMINATOR INLET AND OUTLET

Traverse Point No.	Location (inches)	
	Mist Eliminator Inlet	Mist Eliminator Outlet
1	0.5	0.9
2	1.0	2.5
3	1.8	4.9
4	2.7	11.4
5	3.9	13.7
6	5.5	15.3
7	10.0	
8	11.6	
9	12.8	
10	13.7	
11	14.5	
12	15.0	

point. If the point reading was not zero at 0-degree reference, the pitot was rotated until a null reading was obtained. The value of the rotation angle (yaw) was recorded for each point and averaged across the duct. Method 1 criteria stipulate that average angular rotations greater than 20 degrees indicate cyclonic (nonaxial) flow conditions in the duct. Both of these sites indicated acceptable flow patterns so that extraction of representative samples from these sites was performed using normal sampling procedures.

Test Methods

Velocity and static pressures, moisture content, and temperature were measured prior to sampling, in order to define sampling rates and nozzle sizes as described in the EPA Reference Methods 1, 2 and 4.

An EPA MM13B sample train was used to collect the Cr^{+6} samples. The sample train consisted of a 316 stainless steel button-hook nozzle, an unheated Pyrex glass-lined probe, and a series of four impingers. The first, third and fourth impingers were Greenburg-Smith design, modified by replacing the tip with a 1/2-in. inside diameter glass tube extending to 1/2-in. from the bottom of the flask. The second impinger was a Greenburg-Smith impinger with the standard tip. The first and second impingers contained 100mℓ of 0.1N NaOH. The third impinger was empty and the fourth impinger contained approximately 200 grams of silica gel. The balance of the sampling system consisted of a vacuum pump, dry gas meter, calibrated orifice and related temperature and pressure indicating apparatus to determine dry gas sample volume, stack gas temperature, volumetric flow rate and isokinetic sampling rates. During sampling, stack gas temperature and the gas temperature exiting the last impinger were monitored with calibrated thermocouples.

The sampling time was initially set at 8 minutes per point (192 minute total sample time) and reduced to to 5 minutes per point (120 minute total sample time) since the concentration of Cr^{+6} was such that good analytical results could be obtained using the shorter time.

The impingers were weighed before and after each test to determine the moisture content of the flue gas stream. All connecting glassware, the nozzle and probe were rinsed with 0.1N NaOH and combined with the impinger solution into a tared polyethylene sample bottle. The total volume of the sample was determined gravimetrically. The liquid level was marked on each sample bottle and each bottle was marked indicating the run number and bottle contents.

Following the recovery of the samples, all samples, including blanks, were analyzed for Cr^{+6} concentration using the analytical methodology developed by the EPA.

EMISSION SAMPLE ANALYSIS

The MM13B samples and the plating solution were analyzed for Cr^{+6} concentration. The analyses were conducted on site in a clean area of the plant. Immediately following the sample recovery, the samples were submitted to the analyst and the analyses and calculations were performed the same day. The analytical results were calculated on the Hewlett Packard 41CV calculator. The calculations were also performed by the EPA Task Manager.

The analytical method entitled "Draft Method - Determination of Hexavalent Chromium in Dry Particulate Emissions from Stationary Sources" was used as a "guideline" in conducting the analyses. This method is currently under development by the EPA and is presented in Appendix B.

There were several variations between the draft method and the analytical method that was performed in the field. They are described as follows:

1. The collected samples were not digested in an alkaline solution. Aliquots of the recovered samples were pipeted directly from the sample bottle and prepared as in paragraph 5.7.1 of the Draft Method.

2. The pH of the sample aliquot was monitored with a pH meter while adjusting the pH of the aliquot to 2 ± .5.

3. The spectrophotometer was calibrated with standards containing 2 mℓ, 5 mℓ, 7 mℓ, 10 mℓ, 15 mℓ and 20 mℓ of the 5 μg/mℓ working standard. The spectrophotometer calibration factor, K_c, was calculated as follows:

$$K_c = 10 \frac{A_1 + 2.5A_2 + 3.5A_3 + 5A_4 + 7.5A_5 + 10A_6}{A_1^2 + A_2^2 + A_3^2 + A_4^2 + A_5^2 + A_6^2}$$

4. The value of this calibration factor was calculated using a computer program that was developed by the EPA Task Manager for the HP41 calculator.

SECTION 5.0
QUALITY ASSURANCE

INTRODUCTION

The goal of the quality assurance activities for this project is to ensure, to the highest degree possible, the accuracy of data collected. The procedures contained in the "Quality Assurance Handbook for Air Pollution Measurement Systems," Volume III, "Stationary Source Specific Methods," EPA-600/4-77-027B served as the basis for performance of all testing and related work activities that were undertaken in this testing program. In addition to the quality assurance measure guidelines presented above, specific quality assurance activities were conducted for several of the individual testing activities, as performed; these are presented in the paragraphs that follow.

FIELD QUALITY ASSURANCE PROCEDURES

In order to assure a high level of quality control while sampling to allow the comparison of data from these two methods, a field quality assurance program was followed during the test program. Methods used to obtain the required level of quality assurance are itemized below.

Sample Blanks

Reagent Blanks--

The 0.1N NaOH absorbing solution was transported to the field in its "as-purchased" container. When in the field, the 0.1N NaOH was transferred to a polyethylene wash bottle. From the wash bottle, the NaOH solution was used for sample train preparation and recovery.

A blank sample was collected from the solution in the wash bottle. This sample was given to the on-site laboratory personnel with the emission samples, and analyzed in the same manner. Results of the blank analyses are presented in Table 5-1.

H_2O Blanks--

A distilled water blank was obtained from the wash bottles and analyzed in the same manner as the emission samples.

Duplicate Samples

One sample for every 10 samples analyzed was a duplicate, e.g., if 24 samples were analyzed, 3 duplicate samples would be analyzed. The analytical results for the duplicated samples are presented in Table 5-1.

Standards

Daily, throughout the analysis of the samples, standards were set up as a spot check of the spectrophotometer calibration. The results of these checks are presented in Table 5-1.

Chain of Custody

In an effort to maintain the integrity of all samples taken at the test facility, a chain of custody procedure was followed. Once the samples were placed in custody of the analytical group, that group provided for safe storage and maintenance of records sufficient to maintain sample integrity. The "Chain of Custody" data sheets are presented in Appendix C.

Sample Transfer

All MM13B samples collected during testing remained in the custody of EPA personnel and were secured in the mobile laboratory while in the field.

TABLE 5-1. SUMMARY OF ANALYTICAL RESULTS FOR QA/QC SAMPLES AND BLANKS

Sample No.	Date (1989)	Type of Sample: Duplicate	Type of Sample: Standard	Total µg Cr^{+6}	
75 µ/100 mℓ	1/30		X	75.2	
0-1	1/31	X		177.6	
Plating Sol 1/30	1/31	X		106,745 µg/mℓ	*112,015 µg/mℓ
50 µg/mℓ	1/31		X	50.9	
I-3	1/31	X		12,510.9	*12,510.9
75 µg/100 mℓ	2/1		X	75.4	
0-4	2/1	X		227.6	*237.04
50 µg/100 mℓ	2/1		X	50.7	
I-2	2/1	X		9699.0	*9820.4
100 µg/100 mℓ	2/1		X	99.4	
100µg/100 mℓ	2/1		X	95.6	
0-2	2/1	X		101.4	*95.7
Blanks					
0.1N NaOH	1/30			0.00	

* Original values against which duplicate results are to be compared.

SAMPLING TRAIN COMPONENTS

The equipment used in this test program, including nozzles, pitot tubes, dry gas meters, orifices, and thermocouples were uniquely identified and were calibrated in accordance with calibration procedures specified in the applicable EPA Reference Method prior to, and at the completion of, the testing program. The calibration sheets are presented in Appendix D.

VERIFICATION OF CALCULATIONS

Emission Calculations

Dry gas volumes, percent moisture of the stack gas, gas flow rates, and Cr^{+6} emission rates were calculated using a Hewlett Packard 41CV programmable calculator. The programs used can be found in the document: "Source Test Calculation and Check Programs for Hewlett Packard 41 Calculators" (EPA-340/1-85-018). The results were checked and verified by the PEER Task Manager.

Chromium Concentration Calculations

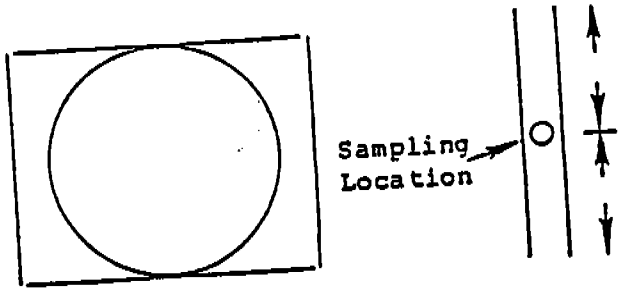
All absorbance data for blanks, standards, samples and QA/QC samples were documented in a notebook. The Cr^{+6} content and total mass of Cr^{+6} collected were calculated using a program developed by the EPA Task Manager for the HP41CV programmable calculator.

APPENDIX A

FIELD DATA SHEETS

PRELIMINARY VELOCITY TRAVERSE

Plant: Hard Chrome Spec. Job No. _____
Date: 1-30-89
Location: York, PA.
Stack I.D.: 15.8125
Barometric Pressure, in. Hg: 29.22
Stack Gauge Pressure, in. H_2O: +.15
Operators: Gerber, Hollins
Pitot Tube I.D. Number: S-34
Temperature Readout I.D.: T-2
Pitot Tube Leak Check: OK
Run Number 1 Time 11:00



Schematic of Traverse Point Layout

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
1	.50	68	—
2	.60	69	—
3	.67	70	—
4	.63	70	—
5	.62	70	—
6	.61	69	—
7	.51	69	—
8	.58	69	—
9	.62	69	—
10	.64	69	—
11	.65	69	—
12	.65	69	—
Average			

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
Average			

```
XROM "NOZZLE"
STATIC HOH ?
        .15     RUN
BAR PRESS ?
      29.22     RUN
STK TEMP ?
      69.00     RUN
% HOH ?
       2.00     RUN
STACK FPS ?
      44.40     RUN
ACT. DIA. = 0.2324
```

NOMOGRAPH DATA

Plant: Hard Chrome Spec. Date: 1-30-89

Sampling Location: Outlet

Calibrated Pressure Differential Across Orifice, in. H_2O	$\Delta H_@$	1.987
Average Meter Temperature (ambient + 20°F), °F	$T_{m_{avg}}$	85
Percent Moisture in Gas Stream by Volume	B_{wo}	2
Barometric Pressure at Meter, in. Hg.	P_m	29.18
Static Pressure in Stack, in. Hg. ($P_m \pm 0.073$ x stack gauge pressure in in. H_2O)	P_s	+.15
Ratio of Static Pressure to Meter Pressure	P_s/P_m	1.0
Average Stack Temperature, °F	$T_{s_{avg}}$	69
Average Velocity Head, in. H_2O	ΔP_{avg}	.61
Maximum Velocity Head, in. H_2O	ΔP_{max}	.68
C Factor		1.15
Calculated Nozzle Diameter, in.		.2324
Actual Nozzle Diameter, in.		.2353
Reference Δp, in. H_2O		.51

```
FROM "NOZZLE"
STATIC HOH ? -1.50      RUN
BAR PRESS ? 29.22       RUN
STK TEMP ? 70.00        RUN
% HOH ? 2.00            RUN
STACK FPS ? 42.00       RUN
ACT. DIA. = 0.2396
```

NOMOGRAPH DATA

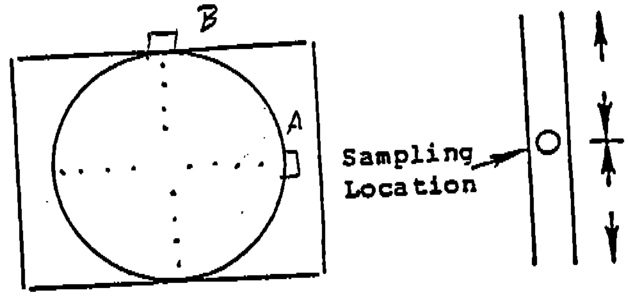
Plant: Hand Whone Specialists Date: 1/30/89

Sampling Location: Inlet

Calibrated Pressure Differential Across Orifice, in. H_2O	$\Delta H_@$	1.73
Average Meter Temperature (ambient + 20°F), °F	$T_{m_{avg}}$	85
Percent Moisture in Gas Stream by Volume	B_{wo}	2%
Barometric Pressure at Meter, in. Hg.	P_m	29.22
Static Pressure in Stack, in. Hg. ($P_m \pm 0.073$ x stack gauge pressure in in. H_2O)	P_s	-1.5
Ratio of Static Pressure to Meter Pressure	P_s/P_m	1.0
Average Stack Temperature, °F	$T_{s_{avg}}$	70
Average Velocity Head, in. H_2O	Δp_{avg}	42
Maximum Velocity Head, in. H_2O	Δp_{max}	
C Factor		
Calculated Nozzle Diameter, in.		.2396
Actual Nozzle Diameter, in.		.235
Reference Δp, in. H_2O		

PRELIMINARY VELOCITY TRAVERSE

Plant: Hard Chrome Job No. ______
Date: 1-31-8
Location: Filter Inlet
Stack I.D.: 15.5"
Barometric Pressure, in. Hg: 29.45
Stack Gauge Pressure, in. H_2O: -1.6
Operators: DW / BM
Pitot Tube I.D. Number: ______
Temperature Readout I.D.: ______
Pitot Tube Leak Check: OK



Schematic of Traverse Point Layout

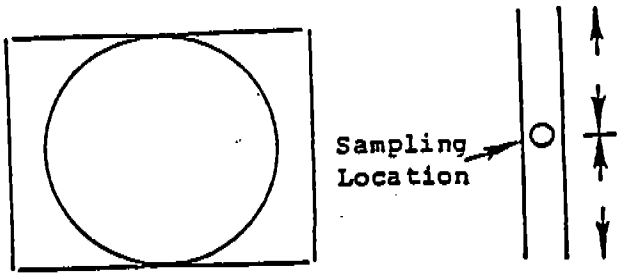
Run Number ______ Time ______

Traverse Point Number	Velocity Head (ΔP_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
B-1	.58	72	0 ± 5°
2	.6		
3	.58		
4	.57		
5	.54		
6	.54		
7	.57		
8	.57		
A-1	.55	73	0 ± 5°
2	.56		
3	.56		
4	.56		
5	.59		
6	.57		
7	.60		
8	.60		
Average	.57		

Traverse Point Number	Velocity Head (ΔP_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
Average			

PRELIMINARY VELOCITY TRAVERSE

Plant: Hard Chrome Spec. Job No. _____
Date: 1-31-89
Location: York, Pa.
Stack I.D.: 15.8125
Barometric Pressure, in. Hg: 29.45
Stack Gauge Pressure, in. H_2O: -.20
Operators: Gerber Hollins
Pitot Tube I.D. Number: S3-4
Temperature Readout I.D.: 1-2
Pitot Tube Leak Check: OK
Run Number 0-2 Time 8:30



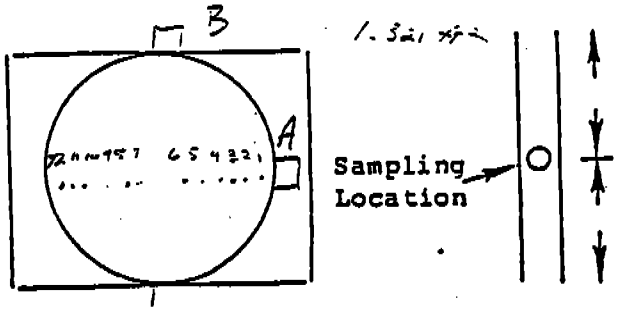
Schematic of Traverse Point Layout

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
1	.47	69	
2	.62	70	
3	.69	70	
4	.72	70	
5	.70	70	
6	.70	70	
7	.44	70	
8	.64	70	
9	.72	70	
10	.68	70	
11	.69	70	
12	.72	70	
Average			

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
Average			

PRELIMINARY VELOCITY TRAVERSE

Plant: Hex Chrome Job No. _____
Date: 1-27-89
Location: MIST ELIM. INLET
Stack I.D.: 15.5"
Barometric Pressure, in. Hg: 29.22
Stack Gauge Pressure, in. H_2O: -.5"
Operators: D. WETMORE, A. WELSMAN
Pitot Tube I.D. Number: S-3B
Temperature Readout I.D.: T-1
Pitot Tube Leak Check: O.K.
Run Number _____ Time _____



Schematic of Traverse Point Layout

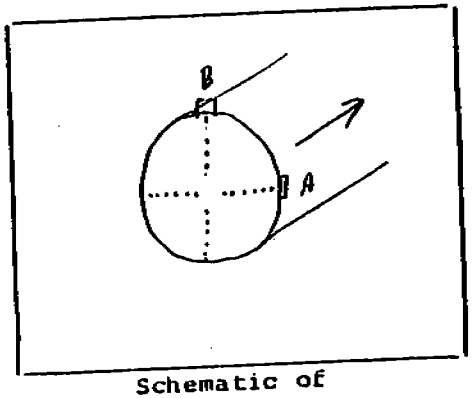
Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
A-12	~~.51~~ .63		0 ± 5°
11	.65		
10	.65		
9	.65		
8	.62		
7	.64		
6	.49		
5	.47		
4	.46		
3	.44		
2			
1			
Average			25° Notice

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
B-12	.50		0 ± 5°
B-11	.50	71	
B-10	.51	68	
B-9	.51	68	
B-8	0.50	68	
B-7	0.50	69	
B-6	0.49	70	
B-5	0.52	71	
B-4	0.51	71	
B-3	0.50	71	
B-2	0.51	71	
B-1	0.47	71	
Average			

I = 1.55

FIELD DATA

Plant: Hard Chrome
Date: 1-30-84 Job No.:
Sampling Location: Inlet
Sample Type: MM 13 B
Run Number: I-1
Operator: Dol / B Mentzer
Ambient Temperature: 75
Barometric Pressure: 29.15
Static Pressure (P_g): -1.5
Filter Number(s):
Pretest Leak Rate = ~~.001~~ .002 cfm @ ~~15~~ 23 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check:
Read and Record all Data Every 8 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 3' glass
Pitot Tube I.D. No.: S-3B Cp: .84
Nozzle I.D.: .238 | .236 | .236 | Avg. .235
Assumed Moisture, %: 2
Temp. Readout S/N: T-1
Meter Box Number: MB-1
Meter $\Delta H_@$: 1.73
C Factor:
Meter Gamma: 1.006
Heater Box Setting:
Reference Δp: I = 1.55
Post Test Leak Rate = .002 cfm @ 10 in. Hg
Post Test Pitot Leak Check:
Post Test Orsat Leak Check:

Page 1 of 2

Temp. Sensor ID No.

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 Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	ΔP-Filter ~~Sample Box Temp. Filter Temp. °F~~	Impinger Temp. °F	Probe Temp °F
	0	1326	100.600										
A-12	8	1334	107.1	.55	1.75	1.75	72	78	72	1	2.5	56	
11	16	1342	113.6	.6	1.85	1.85	72	98	76	1	2.4	51	
10	24	1350	119.8	.58	1.82	1.82	72	105	77	1	2.5	54	
9	32	1358	126.0	.55	1.72	1.72	72	108	82	1	2.5	56	
8	40	1406	132.0	.55	1.72	1.72	72	110	85	1	2.5	57	
7	48	1414	138.1	.51	1.6	1.6	73	110	85	1	2.5	57	
6	56	1422	143.8	.49	1.52	1.52	74	112	87	1	2.5	58	
5	64	1430	149.8	.45	1.4	1.4	74	112	88	1	2.5	58	
4	72	1438	156.0	.47	1.45	1.45	75	112	90	1	2.5	59	
3	80	1446	161.5	.5	1.55	1.55	74	113	92	1	2.5	60	
2	88	1454	167.1	.48	1.47	1.47	74	113	92	1	2.5	61	
1	96	1502	172.485	.40	1.25	1.25	74	114	94	1	2.4	62	
			71.885										
B 12	0	1517	172.920	.56	1.75	1.75	75	113	93	1	2.4	62	
	4	1521	175.9	.56	1.75	1.75	75	113	94	1	2.5	54	
11	8	1525	178.8	.56	1.75	1.75	75	118	94	1	2.4	54	
	12	1529	181.9	.56	1.75	1.75	75	120	95	1	2.4	56	
10	16	1533	185.1	.55	1.75	1.75	75	123	95	1	2.4	59	
	20	1537	188.2	.55	1.75	1.75	75	124	95	1	2.4	59	
9													

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Hard Chrome

Test Date: 1-30-89

Run Number:

Operator: Dwl Bob Mentzer

Page 2 of 2

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 Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Filter ΔP ~~Sample Box Temp. Filter Temp. °F~~	Impinger Temp. °F	Probe Temp °F
9	24	1541	191.3	.55	1.75	1.75	75	124	95	1	2.5	60	
	28		194.3	.55	1.75	1.75	75	124	95	1	2.5	61	
8	32	1549	197.5	.52	1.6	1.6	75	124	96	1	2.5	61	
	36		200.6	.52	1.6	1.6	75	125	96	1	2.5	62	
7	40	1557	203.7	.51	1.6	1.6	75	125	96	1	2.5	62	
	44		209.8	.51	1.6	1.6	75	125	96	1	2.5	62	
6	48	1605	209.8	.48	1.5	1.5	75	124	97	1	2.5	62	
	52		212.8	.48	1.5	1.5	75	123	95	1	2.5	62	
5	56	1613	215.7	.49	1.55	1.55	75	121	96	1	2.5	61	
	60		218.5	.49	1.55	1.55	75	121	97	1	2.5	61	
4	64	1621		.51	1.6	1.6	75	121	97	1	2.5	61	
	68		224.4	.51	1.6	1.6	75	121	97	1	2.5	60	
3	72	1629	227.2	.52	1.6	1.6	75	121	96	1	2.5	60	
	76			.52	1.6	1.6	75	121	97	1	2.5	61	
2	80	1637	233.5	.53	1.65	1.65	75	120	95	1	2.5	60	
	84		236.7	.53	1.65	1.65	75	120	96	1	2.5	61	
1	88	1645	239.5	.51	1.6	1.6	75	116	96	1	2.5	60	
	92		242.2	.51	1.6	1.6	75	119	96	1	2.5		
	96	~~1656~~	245.070										
		1653											
			72.15										
			+71.885										
			144.035										

PACIFIC ENVIRONMENTAL SERVICES, INC.

PES

SAMPLE RECOVERY DATA

Plant: Hard Chrome Specialists Run No.: I-1

Date: 1/30/89 Sample Box No.: RAC #1 Job No.: _____

Sample Location: Mesh Pad inlet

Sample Type: MM5B Filter No.: N/A

Sample Recovery Person: _____

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: _____ _____ _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	.1 N NaOH	100	561.4	556.9	-4.5
2	.1 N NaOH	100	571.9	580.7	8.8
3	MT	-	491.9	494.2	2.3
4	Silica Gel	-	716.1	740.9	24.8
5			2341.3	2372.7	31.4
6					
TOTAL					

Description of Impinger Catch: _____

```
                XROM "PRESS"
NO. OF POINTS ?
              12.00000
DELTA P ?
              .55000      RUN
STACK TEMP ?
              72.00000    RUN
DELTA P ?
              .60000      RUN
STACK TEMP ?
              72.00000    RUN
DELTA P ?
              .58000      RUN
STACK TEMP ?
              72.00000    RUN
DELTA P ?
              .55000      RUN
STACK TEMP ?
              72.00000    RUN
DELTA P ?
              .55000      RUN
STACK TEMP ?
              72.00000    RUN
DELTA P ?
              .51000      RUN
STACK TEMP ?
              73.00000    RUN
DELTA P ?
              .49000      RUN
STACK TEMP ?
              74.00000    RUN
DELTA P ?
              .45000      RUN
STACK TEMP ?
              74.00000    RUN
DELTA P ?
              .47000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .50000      RUN
STACK TEMP ?
              74.00000    RUN
DELTA P ?
              .48000      RUN
STACK TEMP ?
              74.00000    RUN
DELTA P ?
              .40000      RUN
STACK TEMP ?
              74.00000    RUN

SQRT PSTS = 16.47799
AVE STK TEMP = 73.16667
```

```
                XROM "PRESS"
NO. OF POINTS ?
              24.00000    RUN
DELTA P ?
              .56000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .56000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .56000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .56000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .55000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .55000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .55000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .55000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .52000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .52000      RUN
STACK TEMP ?
              75.00000    RUN
```

```
DELTA P ?
              .51000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .51000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .48000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .48000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .49000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .49000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .51000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .51000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .52000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .52000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .53000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .53000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .51000      RUN
STACK TEMP ?
              75.00000    RUN
DELTA P ?
              .51000      RUN

SQRT PSTS = 16.74112
AVE STK TEMP = 75.00000
```

```
                XROM "METH 5"
RUN NUMBER
I-1                       RUN
METER BOX Y?
              1.0060      RUN
DELTA H?
              1.6200      RUN
BAR PRESS ?
              29.1500     RUN
METER VOL ?
              144.0350    RUN
MTR TEMP F?
              102.0000    RUN
STATIC HOR IN ?
              -1.5000     RUN
STACK TEMP ?
              74.0000     RUN
ML. WATER ?
              31.4000     RUN

SAT % = 2.9

IMP. % H2O = 1.1
% H2OH=1.1

% CO2?
              .7000       RUN
% OXYGEN?
              21.0000     RUN
% CO ?                    RUN

MWd =28.95
MW WET=28.83

SQRT PSTS ?
              16.6096     RUN
COS SQRT PSTS ?           RUN
TIME MIN ?
              92.0000     RUN
NOZZLE DIA ?
              .2350       RUN
STK DIA INCH ?
              15.5000     RUN

* VOL MTR STD = 133.171
  STK PRES GAS = 29.04
  VOL H2O GAS = 1.48
  % MOISTURE = 1.10
  MOL DRY GAS = 0.989
  % NITROGEN = 78.30
  MOL WT DRY = 28.85
  MOL WT WET = 28.83
  VELOCITY FPS = 41.22
  STACK AREA = 1.31
  STACK ACFM = 3,241
* STACK DSCFM = 3,076
  % ISOKINETIC = 98.15
```

```
                XROM "MASSFLO"
RUN NUMBER
I-1                       RUN

VOL MTR STD ?
              133.171     RUN
STACK DSCFM ?
              3,076.00    RUN
FRONT 1/2 MG ?
              4.8727      RUN
BACK 1/2 MG ?             RUN

F  GR/DSCF = 1.72E-3
F  MG/MMM = 3.84
F  LB/HR = 0.05
F  KG/HR = 0.02
                          FIX 6
                          RUN
B  GR/DSCF = 0.000000
B  MG/MMM = 0.000000
B  LB/HR = 0.000000
B  KG/HR = 0.000000

T  GR/DSCF = 0.001723
T  MG/MMM = 3.928911
T  LB/HR = 0.045441
T  KG/HR = 0.020612
```

FIELD DATA

Plant Hard Chrome Spec.
Date 1-30-84 Job No.
Sampling Location Outlet
Sample Type Chrome MM13B
Run Number Outlet-1
Operator Gerber, Hollins
Ambient Temperature 69
Barometric Pressure 29.15.5
Static Pressure (P_s) -.15
Filter Number(s) N/A
Pretest Leak Rate = .002 cfm @ 15 in. Hg
Pretest Pitot Leak Check OK
Pretest Orsat Leak Check N/A
Read and Record all Data Every 4 Minutes

Schematic of Traverse Point Layout

Probe Length and Type 2' Glass
Pitot Tube I.D. No. S 34 Cp .84
Nozzle I.D. .236 | .236 | .234 | Avg. .2353
Assumed Moisture, % 2
Temp. Readout S/N T-2
Meter Box Number MB-3
Meter $\Delta H_@$ 1.987
C Factor 1.15 / 1.22
Meter Gamma 0.985
Heater Box Setting N/A
Reference Δp .51 / .48
Post Test Leak Rate = .004 cfm @ 5 in. Hg
Post Test Pitot Leak Check OK
Post Test Orsat Leak Check N/A

Page 1 of 2 Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_g) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
												40	
1	0	113:25	227.317	.43	1.6	1.6	68	71	71	1		40	
	4	113:29	230.034	.43	1.6	1.6	67	76	72	1		40	
	8	113:33	232.741	.44	1.62	1.62	68	82	72	1		43	
	12	113:37	235.428	.45	1.68	1.68	69	90	74	1		45	
	16	113:41	238.122	.60	2.21	2.21	68	97	76	1		46	
2	20	113:45	241.352	.62	2.26	2.26	68	104	79	1		47	
	24	113:49	244.523	.62	2.26	2.26	68	108	81	1		48	
	28	113:53	247.791	.62	2.26	2.26	68	114	83	1		48	
	32	113:57	250.969	.62	2.26	2.26	68	117	86	1		48	
3	36	114:01	254.158	.69	2.3	2.3	69	120	90	1		48	
*	40	114:05	257.418	.69	2.3	2.3	69	122	91	1		48	
	44	114:09	260.981	.69	2.3	2.3	70	125	94	1		48	
	48	114:13	264.036	.64	2.1	2.1	70	127	96	1		48	
4	52	114:17	267.198	.62	2.0	2.0	70	129	98	1		49	
	56	114:21	270.239	.63	2.05	2.05	70	129	100	1		49	
	60	114:25	273.349	.62	2.0	2.0	70	130	101	1		49	
	64	114:29	276.460	.62	2.0	2.0	70	130	103	1		49	
5	68	114:33	279.529	.62	2.0	2.0	70	131	103	1		49	
	72	114:37	282.691	.62	2.0	2.0	70	131	105	1		50	
	76	114:41	285.750	.61	1.98	1.98	70	132	106	1			

* Changed Nomograph to Higher Meter Temperature

PACIFIC ENVIRONMENTAL SERVICES INC

Plant Name: Hard Chrome Spec.

Run Number: Outlet - 1

Page 2 of 2

Test Date: 1-30-89

Operator: Gerber, Hollins

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 Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
		/										50	
6	80	14:45	288.839	.60	1.95	1.95	70	132	107	1		51	
	84	14:49	291.910	.60	1.95	1.95	70	132	108	1		51	
	88	14:53	295.041	.59	2.3	2.3	70	133	108	1		53	
*	92	14:57	298.248	.60	2.4	2.4	71	136	109	1		53	
	96	15:16	301.925	.42	1.71	1.71	68	112	103	1		47	
7	100	15:20	304.750	.40	1.61	1.61	69	113	103	1		47	
	104	15:24	307.541	.38	1.55	1.55	69	116	103	1		49	
	108	15:28	310.260	.38	1.55	1.55	69	120	102	1		50	
	112	15:32	312.972	.57	2.35	2.35	70	125	103	1		51	
8	116	15:36	316.588	.56	2.3	2.3	70	129	104	1		53	
	120	15:40	319.649	.57	2.35	2.35	70	131	105	1		53	
	124	15:44	322.999	.56	2.3	2.3	70	132	106	1		53	
	128	15:48	326.370	.61	2.51	2.51	71	134	107	1		53	
9	132	15:52	330.021	.63	2.58	2.58	71	135	108	1		53	
	136	15:56	333.372	.63	2.58	2.58	70	136	109	1		53	
	140	16:00	336.923	.63	2.58	2.58	71	138	110	1		53	
	144	16:04	340.486	.63	2.58	2.58	70	138	111	1		53	
10	148	16:08	344.052	.67	2.79	2.79	70	139	111	1		53	
	152	16:12	347.717	.68	2.82	2.82	70	140	112	1		53	
	156	16:16	351.361	.67	2.79	2.79	70	140	112	1		53	
	160	16:20	355.028	.69	2.84	2.84	70	141	113	1		54	
11	164	16:24	358.720	.69	2.84	2.84	70	141	114	1		54	
	168	16:28	362.385	.69	2.84	2.84	70	142	114	1		54	
	172	16:32	366.086	.69	2.84	2.84	70	142	114	1		54	
	176	16:36	369.777	.69	2.84	2.84	70	143	115	1		54	
12	180	16:40	373.471	.68	2.82	2.82	70	143	115	1		54	
	184	16:44	377.179	.69	2.84	2.84	70	143	115	1		54	
	188	16:48	380.870	.69	2.84	2.84	70	143	116	1			
OFF	192	16:52	384.544										
		/			Ave	2.27		Ave =	113				
		/											

PACIFIC ENVIRONMENTAL SERVICES, INC.

PES

SAMPLE RECOVERY DATA

Plant: Hard Chrome Specialties Run No.: C-1

Date: 1/30/89 Sample Box No.: RAC # 2 Job No.: _____

Sample Location: Mesh Pad / Fan outlet

Sample Type: MM13 B Filter No.: _____

Sample Recovery Person: _____

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: _____ _____ _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1			556.0	552.9	-3.1
2			580.2	587.0	6.8
3			490.8	493.3	2.5
4			761.4	787.4	26.0
5					
6			2388.4	2420.6	
TOTAL					32.2

Description of Impinger Catch: _____

XROM "PRESS"

NO. OF POINTS ? 48.0000
DELTA P ? .4300
STACK TEMP ? 68.0000
DELTA P ? .4300
STACK TEMP ? 67.0000
DELTA P ? .4400
STACK TEMP ? 68.0000
DELTA P ? .4500
STACK TEMP ? 67.0000
DELTA P ? .6000
STACK TEMP ? 69.0000
DELTA P ? .6200
STACK TEMP ? 68.0000
DELTA P ? .6200
STACK TEMP ? 68.0000
DELTA P ? .6200
STACK TEMP ? 68.0000
DELTA P ? .6200
STACK TEMP ? 68.0000
DELTA P ? .6900
STACK TEMP ? 69.0000
DELTA P ? .6900
STACK TEMP ? 69.0000
DELTA P ? .6900
STACK TEMP ? 70.0000
DELTA P ? .6400
STACK TEMP ? 70.0000
DELTA P ? .6200
STACK TEMP ? 70.0000
DELTA P ? .6300
STACK TEMP ? 70.0000
DELTA P ? .6200
STACK TEMP ? 70.0000
DELTA P ? .6200
STACK TEMP ? 70.0000
DELTA P ? .6200
STACK TEMP ? 70.0000
DELTA P ? .6200
STACK TEMP ? 70.0000
DELTA P ? .6100
STACK TEMP ? 70.0000
DELTA P ? .6000
STACK TEMP ? 70.0000
DELTA P ? .6000
STACK TEMP ? 70.0000
DELTA P ? .5900
STACK TEMP ? 70.0000
DELTA P ? .5300
STACK TEMP ? 71.0000
DELTA P ? .4200
STACK TEMP ? 68.0000 RUN

DELTA P ? .4000 RUN
STACK TEMP ? 69.0000 RUN
DELTA P ? .3800 RUN
STACK TEMP ? 69.0000 RUN
DELTA P ? .3800 RUN
STACK TEMP ? 69.0000 RUN
DELTA P ? .5700 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .5600 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .5700 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .5600 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .6100 RUN
STACK TEMP ? 71.0000 RUN
DELTA P ? .6300 RUN
STACK TEMP ? 71.0000 RUN
DELTA P ? .6300 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .6300 RUN
STACK TEMP ? 71.0000 RUN
DELTA P ? .6300 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .6700 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .6800 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .5700 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .6900 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .6900 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .6900 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .6900 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .6800 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .6900 RUN
STACK TEMP ? 70.0000 RUN
DELTA P ? .6900 RUN
STACK TEMP ? 70.0000 RUN

SQRT PSTS = 17.7589
AVE STK TEMP = 69.5208

XROM "METH 5"

RUN NUMBER
0-1 RUN
METER BOX Y? .9850 RUN
DELTA H? 2.2700 RUN
BAR PRESS ? 29.1600 RUN
METER VOL ? 157.2300 RUN
MTR TEMP F? 73.0000 RUN
STATIC HOH IN ? .1500 RUN
STACK TEMP. 1.0000 CLX
70.0000 RUN
ML. WATER ? 32.2000 RUN

SAT % = 2.5

IMP. % HOH = 1.1

% HOH=1.1

% CO2? .7000 RUN
% OXYGEN? 21.0000 RUN
% CO ? RUN

MWd =28.95
MW WET=28.83

SQRT PSTS ? 17.7599 RUN
COS SQRT PSTS ? RUN
TIME MIN ? 192.0000 RUN
NOZZLE DIA ? .2350 RUN
STK DIA INCH ? 4.0000 CLX
15.8125 RUN

* VOL MTR STD = [illegible]
STK PRES ABS = 29.17
VOL HOH GAS = 1.52
% MOISTURE = 1.07
MOL DRY GAS = .989
% NITROGEN = [illegible]
MOL WT DRY = [illegible]
MOL WT WET = 28.83
VELOCITY FPS = 43.97
STACK ACFM = [illegible]
STACK SCFM = 3,598.
* STACK DSCFM = 3,457.
% ISOKINETIC = 95.47

XROM "MASSFLO"

RUN NUMBER CHS
CLX
0-1 RUN

VOL MTR STD ? 139.8600 RUN
STACK DSCFM ? 3,457.2000 RUN
FRONT 1/2 MG ? [illegible] RUN
BACK 1/2 MG ? RUN

GR/DSCF = 1.9196E-5
MG/M3 = 0.0439
LB/HR = 0.0005
KG/HR = 0.0002

GR/DSCF = 0.00001920
MG/M3 = 0.04392792
LB/HR = 0.00056882
KG/HR = 0.00025801

FIELD DATA

Plant: Hart Chrome
Date: 1-31-89 Job No.:
Sampling Location: filter Inlet
Sample Type: M/M 13B
Run Number: I-2
Operator: Dw / BM
Ambient Temperature: 71
Barometric Pressure: 29.
Static Pressure (P_s): -1.6
Filter Number(s):
Pretest Leak Rate = .004 cfm @ 15 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check:
Read and Record all Data Every 5 Minutes

Schematic of Traverse Point Layout

Probe Length and Type: 3' glass
Pitot Tube I.D. No.: S-3B Cp: .84
Nozzle I.D.: .233 | .236 | .236 | Avg. .235
Assumed Moisture, %: 2
Temp. Readout S/N: T-1
Meter Box Number: MB-1
Meter $\Delta H_@$: 1.73
C Factor:
Meter Gamma: 1.006
Heater Box Setting:
Reference Δp: 1 - 2.85
Post Test Leak Rate = .002 cfm @ 10 in. Hg
Post Test Pitot Leak Check: OK
Post Test Orsat Leak Check:

Page 1 of 2 Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min) / Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Filter ΔP / ~~Sample Box Temp. Filter Temp. °F~~	Impinger Temp. °F	Probe Temp °F
	0 / 931	245.500										
A 12	5 / 936	249.3	.56	1.6	1.6	73	73	72	1	2.7	63	
11	10 / 941	253.0	.61	1.8	1.8	73	81	71	1	2.7	59	
10	15 / 946	256.8	.61	1.8	1.8	73	88	73	1	2.75	60	
9	20 / 951	260.7	.61	1.8	1.8	73	95	73	1	2.7	59	
8	25 / 956	264.5	.57	1.65	1.65	74	100	75	1	2.75	57	
7	30 / 1001	268.2	.56	1.62	1.62	74	103	78	1	2.75	56	
6	35 / 1006	272.3	.62	1.8	1.8	74	106	81	1	2.75	55	
5	40 / 1011	276.3	.6	1.75	1.75	74	108	82	1	2.65	55	
4	45 / 1016	280.1	.59	1.7	1.7	74	108	84	1	2.8	56	
3	50 / 1021	283.8	.58	1.68	1.68	74	110	85	1	2.8	56	
2	55 / 1026	287.7	.56	1.6	1.6	74	111	86	1	2.8	56	
1	60 / 1031	291.87	.59	1.7	1.7	74	111	87	1	2.65	56	
	/	(45.87)										
	0 / 1043	291.600	—	—	—	—	—	—	—	—	—	
B 12	5 / 1048	295.8	.72	2.1	2.1	74	104	90	1	2.75	56	
11	10 / 1053	300.0	.73	2.15	2.15	74	116	92	1	2.8	51	
10	15 / 1058	304.2	.73	2.15	2.15	75	123	93	1	2.75	53	
9	20 / 1103	308.5	.7	2.0	2.0	75	125	93	1	2.6	53	
8	25 / 1108	312.6	.68	1.95	1.95	75	126	95	1	2.6	53	
	/											

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Hard Chrome

Test Date: 1-31-89

Run Number: I-2

Operator: DW/BM

Page 2 of 2

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 Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Filter ΔP ~~Sample Box Temp. Filter Temp. °F~~	Im-pinger Temp. °F	Probe Temp °F
	30	7	316.4	.6	1.75	1.75	75	126	95	1	2.6	54	
	35	6	320.3	.55	1.57	1.57	75	125	95	1	2.6	54	
	40	5	323.9	.53	1.52	1.52	75	126	96	1	2.6	54	
	45	4	327.7	.5	1.45	1.45	75	126	96	1	2.6	54	
	50	3	331.0	.48	1.4	1.4	75	125	96	1	2.6	55	
	55	2	334.3	.44	1.28	1.28	75	122	98	1	2.55	54	
	60	1	337.480	.43	1.25	1.25	75	122	96	1	2.6	54	
			45.88										
			+45.87										
			91.75										

PACIFIC ENVIRONMENTAL SERVICES, INC

SAMPLE RECOVERY DATA

Plant: Hard Chrome Specialists Run No.: I-2

Date: 1- - Sample Box No.: _____ Job No.: _____

Sample Location: Mesh Filter Inlet

Sample Type: MM 13 B Filter No.: _____

Sample Recovery Person: _____

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: _____ _____ _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	.1 N NaOH	100	564.6	561.4	-3.2
2	.1 N NaOH	100	572.9	574.9	2.0
3	MT		492.5	492.1	-.4
4	SG		740.8	757.9	17.1
5					
6			2370.8		
TOTAL				15.50	15.5

Description of Impinger Catch: _____

```
XROM "PRESS"
NO. OF POINTS ?
24.0000
DELTA P ?
.5600
STACK TEMP ?
73.0000
DELTA P ?
.6100
STACK TEMP ?
72.0000
DELTA P ?
.6100
STACK TEMP ?
73.0000
DELTA P ?
.6100
STACK TEMP ?
73.0000      RUN
DELTA P ?
.5700        RUN
STACK TEMP ?
74.0000      RUN
DELTA P ?
.5600        RUN
STACK TEMP ?
74.0000      RUN
DELTA P ?
.6200        RUN
STACK TEMP ?
74.0000      RUN
DELTA P ?
.6000        RUN
STACK TEMP ?
74.0000      RUN
DELTA P ?
.5900        RUN
STACK TEMP ?
74.0000      RUN
DELTA P ?
.5800        RUN
STACK TEMP ?
74.0000      RUN
DELTA P ?
.5600        RUN
STACK TEMP ?
74.0000      RUN
DELTA P ?
.5900        RUN
STACK TEMP ?
74.0000      RUN
DELTA P ?
.7200        RUN
STACK TEMP ?
74.0000      RUN
DELTA P ?
.7300        RUN
STACK TEMP ?
74.0000      RUN
DELTA P ?
.7300        RUN
STACK TEMP ?
75.0000      RUN
DELTA P ?
.7000        RUN
STACK TEMP ?
75.0000      RUN
DELTA P ?
.6800        RUN
STACK TEMP ?
75.0000      RUN
DELTA P ?
.6000        RUN
STACK TEMP ?
75.0000      RUN
DELTA P ?
.5500        RUN
STACK TEMP ?
75.0000      RUN
DELTA P ?
.5300        RUN
STACK TEMP ?
75.0000      RUN
DELTA P ?
.5000        RUN
STACK TEMP ?
75.0000      RUN
DELTA P ?
.4800        RUN
STACK TEMP ?
75.0000      RUN
DELTA P ?
.4400        RUN
STACK TEMP ?
75.0000      RUN
DELTA P ?
.4300        RUN
STACK TEMP ?
75.0000      RUN

SQRT PSTS = 17.7057
AVE STK TEMP = 74.2500
```

```
XROM "METH 5"
RUN NUMBER
1-2                    RUN
METER BOX Y?
1.0060                 RUN
DELTA H?
1.7100                 RUN
BAR PRESS ?
29.4500                RUN
METER VOL ?
91.7500                RUN
MTR TEMP F?
99.0000                RUN
STATIC HOH IN ?
-1.6000                RUN
STACK TEMP ?
74.0000                RUN
ML. WATER ?
15.5000                RUN

SAT % = 2.9

IMP. % HOH = 0.8
% HOH=0.8

% CO2?
.7000                  RUN
% OXYGEN?
21.0000                RUN
% CO ?                 RUN

MWd =28.95
MW WET=28.86

SQRT PSTS ?
17.7057                RUN
COS SQRT PSTS ?        RUN
TIME MIN ?
120.0000               RUN
NOZZLE DIA ?
.2250                  RUN
STK DIA INCH ?
15.5000                RUN

* VOL MTR STD = 86.178
  STK PRES ABS = 29.83
  VOL H2O GAS = 0.73
  % MOISTURE = 0.84
  VOL DRY GAS = 0.992
  % NITROGEN = 78.30
  MOL WT DRY = 28.85
  MOL WT WET = 28.86
  VELOCITY FPS = 43.70
  STACK AREA = 1.31
  STACK ACFM = 3,436.
* STACK DSCFM = 3,303.
  % ISOKINETIC = 94.66

END OF FIELD DATA
```

```
                                    STK 7
XROM "MASS-LO"
RUN NUMBER
1-2                    RUN

VOL MTR STD ?
86.780000              RUN
STACK DSCFM ?
3,303.000000           RUN
FRONT 1/2 MG ?
0.0203500              RUN
BACK 1/2 MG ?          RUN

F  GR/DSCF = 0.0017586
F  KG/MMM = 4.0327806
F  LB/HR = 0.0497872
F  KG/HR = 0.0225835
```

FIELD DATA

Plant: Hard Chrome Spec.
Date: 1-31-89 Job No.:
Sampling Location: Outlet
Sample Type: M-13B
Run Number: Outlet-2
Operator: Gerber, Holling
Ambient Temperature: 68
Barometric Pressure: 29.45
Static Pressure (P_g): -1.20
Filter Number(s): N/A
Pretest Leak Rate = 0.000 cfm @ 10 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 5 Minutes

Schematic of Traverse Point Layout

Probe Length and Type: 2' Glass
Pitot Tube I.D. No. 5-34 Cp .84
Nozzle I.D. | | | Avg. .235
Assumed Moisture, % 2
Temp. Readout S/N T-2
Meter Box Number MB-3
Meter $\Delta H_@$ 1.987
C Factor 1.25
Meter Gamma 0.985
Heater Box Setting N/A
Reference Δp .46
Post Test Leak Rate = 0.000 cfm @ 6 in. Hg
Post Test Pitot Leak Check: OK
Post Test Orsat Leak Check: N/A

Page 1 of 2 Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_g) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
1	0	9:25	387.800	.55	2.28	2.28	69	72	72	1		56	
	5	9:30	388.720	.51	2.11	2.11	69	79	73	1		42	
2	10	9:35	392.513	.66	2.73	2.73	70	88	74	1		44	
	15	9:40	396.815	.67	2.79	2.79	69	97	77	1		46	
3	20	9:45	401.062	.74	3.08	3.08	69	105	80	1		46	
	25	9:50	405.622	.75	3.12	3.12	70	112	83	1		46	
4	30	9:55	410.269	.75	3.12	3.12	69	117	87	1		46	
	35	10:00	415.173	.69	2.82	2.82	69	121	91	1		46	
5	40	10:05	419.383	.71	2.95	2.95	69	124	94	1		46	
	45	10:10	423.872	.72	2.99	2.99	69	126	97	1		46	
6	50	10:15	428.431	.76	3.20	3.20	69	129	99	1		47	
	55	10:20	433.260	.77	3.22	3.22	69	133	102	1		51	
7	60	10:41	436.198	.47	1.93	1.93	69	108	100	1		43	
	65	10:46	441.885	.47	1.93	1.93	68	112	100	1		44	
8	70	10:51	445.618	.63	2.60	2.60	69	119	160	1		45	
	75	10:56	449.928	.63	2.60	2.60	69	124	101	1		45	
9	80	11:01	454.300	.70	2.92	2.92	69	130	103	1		45	
	85	11:06	459.191	.71	2.95	2.95	69	133	105	1		45	
10	90	11:11	463.432	.70	2.92	2.92	70	135	106	1		45	
	95	11:16	467.970	.73	3.02	3.02	69	137	107	1		45	

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Hard Chrome Specialties

Test Date: 1-31-89

Run Number: Outlet- 2

Operator: Gerber, Hollins

Page 2 of 2

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 Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
11	100	11:21	472.628	.73	3.02	3.02	69	138	109	1		45	
	105	11:26	477.225	.74	3.10	3.10	69	139	110	1		46	
12	110	11:31	481.948	.73	3.02	3.02	69	141	111	1		46	
	115	11:36	486.600	.73	3.02	3.02	69	141	113	1		46	
OFF	120	11:41	491.284										
			106.484										

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: Hard Chrome Specialists Run No.: 0-2

Date: 1- Sample Box No.: 2 Job No.:

Sample Location: Mesh Pad Outlet

Sample Type: MM 13 B Filter No.:

Sample Recovery Person:

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples stored and locked:

BACK HALF/MOISTURE

Container No:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	.1 N NaOH	100	560.4	555.1	-2.3
2	.1 N NaOH	100	580.4	581.5	1.1
3	MT		492.0	492.4	0.4
4	SG		787.3	804.1	16.8
5					
6					
TOTAL					16.0

Description of Impinger Catch:

F1

```
XROM "PRESS"
NO. OF POINTS ?
          24.000
DELTA P ?
            .550
STACK TEMP
              00
DELTA P ?
            .510
STACK TEMP ?
          69.000
DELTA P ?
            .660
STACK TEMP ?
          70.000
DELTA P ?
            .670
STACK TEMP ?
          69.000
DELTA P ?
            .740
STACK TEMP ?
          69.000
DELTA P ?
            .750      RUN
STACK TEMP ?
          70.000      RUN
DELTA P ?
            .750      RUN
STACK TEMP ?
          69.000      RUN
DELTA P ?
            .690      RUN
STACK TEMP ?
          69.000      RUN
DELTA P ?
            .710      RUN
STACK TEMP ?
          69.000      RUN
DELTA P ?
            .720      RUN
STACK TEMP ?
          69.000      RUN
DELTA P ?
            .760      RUN
STACK TEMP ?
          69.000      RUN
DELTA P ?
            .770      RUN
STACK TEMP ?
          69.000      RUN
DELTA P ?
            .470      RUN
STACK TEMP ?
          69.000      RUN
DELTA P ?
            .470      RUN
STACK TEMP ?
          69.000      RUN
DELTA P ?
            .630      RUN
STACK TEMP ?
          69.000      RUN
DELTA P ?
            .630      RUN
STACK TEMP ?
          69.000      RUN
DELTA P ?
            .700      RUN
STACK TEMP ?
          69.000      RUN
DELTA P ?
            .710      RUN
STACK TEMP ?
          69.000      RUN
DELTA P ?
            .700      RUN
STACK TEMP ?
          70.000      RUN
DELTA P ?
            .730      RUN
STACK TEMP ?
          69.000      RUN
```

```
DELTA P ?                 FIX 4
            .7300         RUN
STACK TEMP ?
          69.0000         RUN
DELTA P ?
            .7400         RUN
STACK TEMP ?
          69.0000         RUN
DELTA P ?
            .7300         RUN
STACK TEMP ?
          69.0000         RUN
DELTA P ?
            .7300         RUN
STACK TEMP ?
          69.0000         RUN

SQRT PSTS = 18.8831
AVE STK TEMP = 69.0833
```

```
                XROM "METH 5"
RUN NUMBER
F-2                       RUN
OF BOX Y?
            .9850         RUN
DELTA H?
          3.9100          RUN
TR PRESS ?
         29.4500          RUN
METER VOL ?
         106.4840         RUN
MTR TEMP F?
         107.0000         RUN
STATIC PRESSURE ?
           2.0000         CLX
           .2813          RUN
STACK TEMP.
          69.0000         RUN
ML. WATER ?
          16.0000         RUN

SET % = 2.4

IMP. % H2O = 0.5
% H2O=0.8

% CO2?
            .7000         RUN
% OXYGEN?
         21.0000          RUN
% CO ?                    RUN

MWd =28.95
MW WET=28.87

SQRT PSTS ?
          18.8831         RUN
COS SQRT PSTS ?           RUN
TIME MIN ?
         120.0000         RUN
NOZZLE DIA ?
            .2350         RUN
STK DIA INCH ?
          15.8125         RUN

* VOL MTR STD = 96.812
  STK PRES ABS = 29.46
  VOL H2O GAS = 0.75
  % MOISTURE = 0.77
  MOL DRY GAS = 0.992
  % NITROGEN = 78.30
  MW DRY = 28.95
  MW WET = 28.87
  VELOCITY FPS = 46.50
  STACK AREA = 1.36
  STACK ACFM = 3,894.
* STACK DSCFM = 3,711.
  % ISOKINETIC = 98.50
```

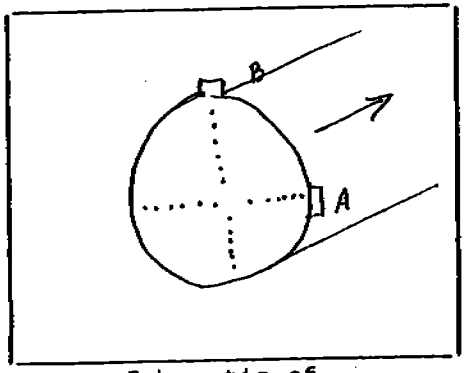
```
                XROM "MASSFLO"
RUN NUMBER
0-2                       RUN

VOL MTR STD ?
          96.812          RUN
STACK DSCFM ?
       3,711.000          RUN
FRONT 1/2 MG ?
            .0957         RUN
BACK 1/2 MG ?             RUN

T  GR/DSCF = 0.000015
T  MG/MMM = 0.034908
T  LB/HR = 0.000485
T  KG/HR = 0.000220
```

FIELD DATA

Plant: Hard Chrome
Date: 1-31-89 Job No.:
Sampling Location: Filter Inlet
Sample Type: MM 13 B
Run Number: I-3
Operator: DJ / BM
Ambient Temperature: 70
Barometric Pressure: 29.34
Static Pressure (P_g): -1.6
Filter Number(s):
Pretest Leak Rate = .005 cfm @ 15 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check:
Read and Record all Data Every 5 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 3' glass
Pitot Tube I.D. No.: S-3B Cp .84
Nozzle I.D.: 1 | 1 | Avg. .235
Assumed Moisture, %: 2
Temp. Readout S/N: T-1
Meter Box Number: MB-1
Meter $\Delta H_@$: 1.73
C Factor: ~~1.006~~
Meter Gamma: 1.006
Heater Box Setting:
Reference Δp: 1 = 2.85
Post Test Leak Rate = ___ cfm @ ___ in. Hg
Post Test Pitot Leak Check:
Post Test Orsat Leak Check:

Page 1 of 2

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	/ Clock Time / (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_g) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Filter ΔP ~~Sample Box Temp.~~ ~~Filter Temp. °F~~	Im-pinger Temp. °F	Probe Temp °F
	0	/ 1400	338.00										
B-12	5	/ 1405	342.0	.57	1.75	1.75	74	77	76	1	2.6	60	
11	10	/ 1410	345.9	.6	1.85	1.85	74	86	75	1	2.6	52	
10	15	/ 1415	349.7	.6	1.85	1.85	75	98	76	1	2.6	55	
9	20	/ 1420	353.6	.61	1.87	1.87	75	106	77	1	2.6	55	
8	25	/ 1425	~~361.5~~	.59	1.8	1.8	75	112	80	1	2.6	56	
7	30	/ 1430	361.5	.6	1.85	1.85	76	116	83	1	2.6	56	
6	35	/ 1435	365.5	.6	1.85	1.85	76	120	85	1	2.6	56	
5	40	/ 1440	369.6	.61	1.87	1.87	76	122	86	1	2.6	57	
4	45	/ 1445	373.5	.57	1.75	1.75	75	122	88	1	2.65	57	
3	50	/ 1450	377.2	.57	1.75	1.75	75	123	91	1	2.65	57	
2	55	/ 1455	381.2	.56	1.72	1.72	75	124	93	1	2.6	58	
1	60	/ 1500	384.908	.53	1.65	1.65	75	124	94	1	2.6	58	
		/	46.908										
	0	/ 1508	385.200	—	—	—	—	—	—	—	—	—	—
A-12	5	/ 1513	389.5	.70	2.15	2.15	77	115	94	1	2.6	56	
11	10	/ 1518	393.6	.7	2.15	2.15	77	121	95	1	2.6	55	
10	15	/ 1523	397.8	.69	2.12	2.12	77	123	95	1	2.6	56	
9	20	/ 1528	402.3	.67	2.05	2.05	77	124	96	1	2.65	56	
8	25	/ 1533	406.5	.67	2.05	2.05	77	124	96	1	2.60	56	
		/											

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Hard Chrome

Run Number: I-3

Page 2 of 2

Test Date: 1-31-89

Operator: DJ / BM

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 Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	~~Sample Box Temp. Filter Temp. °F~~ Filter ΔP	Impinger Temp. °F	Probe Temp °F
A-7	30	1538	410.2	.62	1.9	1.9	77	124	116	1	2.65	56	
6	35	1543	414.0	.52	1.6	1.6	77	124	96	1	2.6	57	
5	40	1548	417.6	.51	1.55	1.55	77	123	96	1	2.6	56	
4	45	1553	421.0	.43	1.3	1.3	76	122	97	1	2.6	57	
3	50	1558	424.5	.43	1.3	1.3	76	121	96	1	2.65	57	
2	55	1603	428.0	.43	1.3	1.3	76	120	97	1	2.65	57	
1	60	1608	431.330	.45	1.38	1.38	75	119	96	1	2.65	57	

~~46~~

46.13
+ 46.908
93.038

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: HARD CHROME Run No.: I-3

Date: 1-31-89 Sample Box No.: 1 Job No.:

Sample Location: MESH FILTER INLET

Sample Type: M M 13B Filter No.:

Sample Recovery Person:

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples stored and locked:

BACK HALF/MOISTURE

Container No:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	.1N NaOH	100	563.4	561.0	-2.4
2	.1N NaOH	100	573.4	574.6	1.2
3	MT		492.6	492.4	-.2
4	SG		668.1	686.3	18.2
5					
6			[illegible]	[illegible]	
TOTAL					16.3

Description of Impinger Catch:

```
XROM "PRESS"
NO. OF POINTS ?
        24.0000000    RUN
DELTA P ?
STACK TEMP ?
        .5700000
        74.0000000
DELTA P ?
STACK TEMP ?
        .6000000
        74.0000000
DELTA P ?
STACK TEMP ?
        .6000000
        75.0000000
DELTA P ?
STACK TEMP ?
        .6100000
        75.0000000
DELTA
STACK TEMP ?
        .5900000
        75.0000000    RUN
DELTA P ?
STACK TEMP ?
        .6000000    RUN
        75.0000000    RUN
DELTA P ?
        6.0000000    CLX
STACK TEMP ?
        .5800000    RUN
DELTA P ?
STACK TEMP ?
        76.0000000    RUN
DELTA P ?
STACK TEMP ?
        .5700000    RUN
        75.0000000    RUN
DELTA P ?
STACK TEMP ?
        .5700000    RUN
        75.0000000    RUN
DELTA P ?
STACK TEMP ?
        .5700000    RUN
        75.0000000    RUN
DELTA P ?
STACK TEMP ?
        .5800000    RUN
        75.0000000    RUN
DELTA P ?
STACK TEMP ?
        .5800000    RUN
        75.0000000    RUN
DELTA P ?
STACK TEMP ?
        .7000000    RUN
        77.0000000    RUN
DELTA P ?
STACK TEMP ?
        .7000000    RUN
        77.0000000    RUN
DELTA P ?
STACK TEMP ?
        .6900000    RUN
        77.0000000    RUN
DELTA P ?
STACK TEMP ?
        .5700000    RUN
        77.0000000    RUN
DELTA P ?
STACK TEMP ?
        .6700000    RUN
        77.0000000    RUN
DELTA P ?
STACK TEMP ?
        .6200000    RUN
        77.0000000    RUN
DELTA P ?
STACK TEMP ?
        .5200000    RUN
        77.0000000    RUN
DELTA P ?
STACK TEMP ?
        .5100000    RUN
        77.0000000    RUN
```

```
DELTA P ?
        .4300000    RUN
STACK TEMP ?
        76.0000000    RUN
DELTA P ?
STACK TEMP ?
        .4300000    RUN
        76.0000000    RUN
DELTA P ?
STACK TEMP ?
        .4300000    RUN
        76.0000000    RUN
DELTA P ?
STACK TEMP ?
        .4500000    RUN
        75.0000000    RUN
SQRT PSTS = 17.5268765
VE STK TEMP = 75.8333333
```

```
XROM "METH 5"
RUN NUMBER
I-3                    RUN
METER BOX Y?
        1.0060         RUN
DELTA H
        1.7700         RUN
BAR PRESS ?
        29.8400        RUN
METER VOL ?
        80.0380        RUN
MTR TEMP F?
        108.0000       RUN
STATIC HOP IN ?
        -1.6000        RUN
STACK TEMP ?
        76.0000        RUN
ML. WATER ?
        16.0000        RUN

SAT % = 2.1

IMP. % H2O = 0.9
% H2O=0.9

% CO2?
        .7000          RUN
% OXYGEN?
        21.0000        RUN
% CO ?                  RUN

MWd =28.95
MW WET=28.85

SQRT PSTS ?
        7.5269         RUN
COS SQRT PSTS ?        RUN
TIME MIN ?
        120.0000       RUN
NOZZLE DIA ?
        .2350          RUN
STK DIA INCH ?
        15.5000        RUN

* VOL MTR STD = 83.670
  STK PRES ASS = 29.22
  VOL H2O GAS = 0.79
  % MOISTURE = 0.94
  MOL DRY GAS = 0.991
  % NITROGEN = 78.30
  MOL WT DRY = 28.85
  MOL WT WET = 28.85
  VELOCITY FPS = 43.35
  STACK AREA = 1.31
  STACK ACFM = 3,408.
* STACK DSCFM = 3,248.
  % ISOKINETIC = 93.44

END OF FIELD DATA
```

```
XROM "MASSFLO"
RUN NUMBER
I-3                    COS
                       RUN
VOL MTR STD ?
        83.670000      RUN
STACK DSCFM ?
        3,248.000000   RUN
FRONT 1/2 MG ?
        12.510900      RUN
BACK 1/2 MG ?
                       RUN

F  GR/DSCF = 0.002308
F  MG/MMM = 5.280386
F  LB/HR = 0.064241
F  KG/HR = 0.029140
```

FIELD DATA

Plant Hard Chrome Specialties
Date 7-31-89 Job No.
Sampling Location Outlet
Sample Type MM5B
Run Number Outlet-3
Operator Gerber, Hollins
Ambient Temperature 67
Barometric Pressure 29.34
Static Pressure (P_g) +.20
Filter Number(s) N/A
Pretest Leak Rate = 0.008 cfm @ 10 in. Hg
Pretest Pitot Leak Check OK
Pretest Orsat Leak Check N/A
Read and Record all Data Every 5 Minutes

Schematic of Traverse Point Layout

Probe Length and Type 2' G/SS
Pitot Tube I.D. No. 5-34 Cp .84
Nozzle I.D. | | | Avg. .235
Assumed Moisture, % 1
Temp. Readout S/N T-2
Meter Box Number MB-3
Meter $\Delta H_@$ 1.987
C Factor 1.25
Meter Gamma .985
Heater Box Setting N/A
Reference Δp .46
Post Test Leak Rate = 0.001 cfm @ 6 in. Hg
Post Test Pitot Leak Check OK
Post Test Orsat Leak Check N/A

Page 1 of 2

Temp. Sensor ID No.

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 Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
1	0	14:00	491.509	.47	1.93	1.93	72	77	78	1		55	
	5	14:05	495.168	.44	1.83	1.83	71	85	79	1		41	
2	10	14:10	498.795	.69	2.85	2.85	72	97	80	1		43	
	15	14:15	503.111	.70	2.90	2.90	72	104	82	1		44	
3	20	14:20	507.548	.74	3.08	3.08	72	113	85	1		45	
	25	14:25	512.153	.75	3.15	3.15	72	118	89	2		45	
4	30	14:30	516.899	.68	2.83	2.83	71	122	93	1		45	
	35	14:35	521.103	.68	2.83	2.83	71	123	95	1		45	
5	40	14:40	525.264	.70	2.90	2.90	71	126	98	1		47	
	45	14:45	529.809	.68	2.83	2.83	71	129	100	1		45	
6	50	14:50	534.367	.70	2.90	2.90	71	131	102	2		45	
	55	14:55	538.949	.69	2.85	2.85	71	133	105	2		54	
7	60	15:00	543.484	.47	1.92	1.92	70	116	105	1		42	
	65	15:12	547.244	.47	1.92	1.92	70	122	105	1		42	
8	70	15:17	551.036	.62	2.52	2.52	71	128	106	1		43	
	75	15:22	555.541	.62	2.52	2.52	71	132	107	1		43	
9	80	15:27	559.749	.66	2.75	2.75	71	135	109	1		43	
	85	15:33	564.269	.69	2.85	2.85	71	137	110	1		44	
10	90	15:37	568.866	.72	2.95	2.95	71	140	112	2		47	
	95	15:42	573.514	.73	2.98	2.98	71	141	113	2			

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Hard Chrome Specialties

Test Date: 1-31-89

Run Number: Outlet-3

Operator: Gerber, Hollins

Page 2 of 2

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 Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
												44	
11	100	15:47	578.171	.73	2.98	2.98	71	142	114	2		44	
	105	15:52	582.843	.73	2.98	2.98	71	143	115	2		44	
12	110	15:57	587.514	.71	2.94	2.94	71	144	115	2		44	
	115	16:02	592.202	.73	2.98	2.98	70	145	116	2			
OFF	120	16:07	596.906										

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: Hard Chrome Specialists Run No.: 0-3

Date: 1-31-89 Sample Box No.: IA-2 Job No.:

Sample Location: Outlet

Sample Type: M.M. 13B Filter No.: 1A

Sample Recovery Person: Gerber, Hollins

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples stored and locked:

BACK HALF/MOISTURE

Container No:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	.1 N NaOH	100	591.8	589.9	-1.9
2	.1 N NaOH	100	560.8	562.5	1.7
3	M.T.	M.T.	492.7	492.6	-1
4	Silica Gel	300g	753.4	771.9	18.5
5					
6					
TOTAL					18.2

Description of Impinger Catch:

```
                XROM "PRESS"
NO. OF POINTS ?
              24.0000
DELTA P ?
              .4700
STACK TEMP ?
              72.0000
DELTA P ?
              .4400
STACK TEMP ?
              71.0000
DELTA P ?
              .6900
STACK TEMP ?
              72.0000
DELTA P ?
              .7000
STACK TEMP ?
              72.0000     RUN
DELTA P ?
              .7400       RUN
STACK TEMP ?
              72.0000     RUN
DELTA P ?
              .7500       RUN
STACK TEMP ?
              72.0000     RUN
DELTA P ?
              .6800       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .6800       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .7000       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .6800       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .7000       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .6900       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .4700       RUN
STACK TEMP ?
              70.0000     RUN
DELTA P ?
              .4700       RUN
STACK TEMP ?
              70.0000     RUN
DELTA P ?
              .5200       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .6200       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .6600       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .6900       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .7200       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .7300       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .7300       RUN
STACK TEMP ?
              71.0000     RUN
DELTA P ?
              .7300       RUN
STACK TEMP ?
              70.0000     RUN

SQRT PSTS = 18.6458
AVE STK TEMP = 71.0833
```

```
                XROM "METH 5"
RUN NUMBER
0-9                                RUN
METER BOX ?
              .9950                RUN
DELTA H?
              2.7200               RUN
BAR PRESS ?
              29.3400              RUN
METER VOL ?
              95.3970              RUN
MTR TEMP F?
              112.0000             RUN
STATIC HOH IN ?
              .2000                RUN
STACK TEMP,
              71.0000              RUN
ML. WATER ?
              18.0000              RUN

SAT % = 2.6

IMP. % HOH = 0.9
% HOH=0.9

% CO2?
              .7000                RUN
% OXYGEN?
              21.0000              RUN
% CO ?                             RUN

MWd =29.95
MW WET=28.85

SQRT PSTS ?
              18.6458              RUN
COS SQRT PSTS ?                    RUN
TIME MIN ?
              120.0000             RUN
NOZZLE DIA ?
              .2350                RUN
STK DIA INCH ?
              15.8125              RUN

* VOL MTR STD = 94.613
  STK PRES ABS = 29.35
  VOL HOH GAS = 0.86
  % MOISTURE = 0.90
  MOL DRY GAS = 0.991
  % NITROGEN = 78.00
  MOL WT DRY = 28.95
  MOL WT WET = 28.85
  VELOCITY FPS = 46.01
  STACK GPCF = 1.30
  STACK GPCM = 3.765
* STACK DSCFM = 3,640.
  % ISOKINETIC =  98.14

END OF FIELD DATA
```

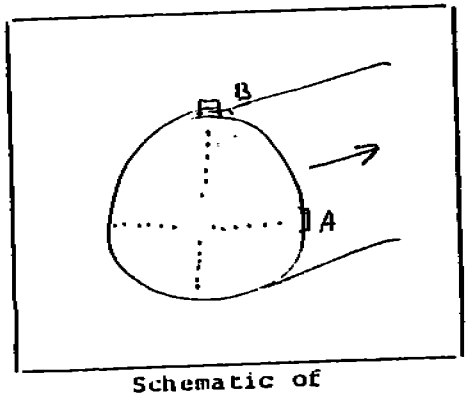
```
                XROM "MASSFLO"
RUN NUMBER
0-3                                RUN

VOL MTR STD ?
              92.6190000           RUN
STACK DSCFM ?
              3,640.000000         RUN
FRONT 1/2 MG ?
              .1869000             RUN
BACK 1/2 MG ?                      RUN

F  GR/DSCF = 0.0000223
F  MG/MMM = 0.0510975
F  LB/HR = 0.0000967
F  KG/HR = 0.0003160
```

FIELD DATA

Plant: Hard Chrome
Date: 2-1-89 Job No.:
Sampling Location: Filter Inlet
Sample Type: M 13B
Run Number: I-4
Operator: DJ TBM
Ambient Temperature: 71
Barometric Pressure: 29.37
Static Pressure (P_s): -1.5
Filter Number(s):
Pretest Leak Rate = .002 cfm @ 15 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check:
Read and Record all Data Every ___ Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 3' glass
Pitot Tube I.D. No.: S-5B Cp: .84
Nozzle I.D.: | | Avg. .235
Assumed Moisture, %: 1.5
Temp. Readout S/N: T-1
Meter Box Number: MB-1
Meter $\Delta H_@$: 1.73
C Factor:
Meter Gamma: 1.006
Heater Box Setting:
Reference Δp: 1= 3.25
Post Test Leak Rate = .006 cfm @ 13 in. Hg
Post Test Pitot Leak Check: OK
Post Test Orsat Leak Check:

Page ___ of ___ Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Filter ΔP Sample Box ~~Temp.~~ ~~Filter Temp.~~ °F	Impinger Temp. °F	Probe Temp °F
	0	0910	431.60										
B-12	4		434.9	.62	1.92	1.9	73	70	68	1	2.6	60	
	8	0918	438.0	.62	2.0	2.0	73	80	68	1	2.6	50	
11	12		441.3	.61	1.95	1.95	73	90	69	1	2.65	53	
	16	0926	444.5	.61	1.95	1.95	73	99	70	1	2.6	54	
10	20		447.8	.6	1.95	1.95	73	106	73	1	2.65	56	
	24	0934	451.0	.6	1.95	1.95	73	112	75	1	2.65	56	
9	28		454.5	.58	1.85	1.85	73	116	76	1	2.6	55	
	32	0942	457.3	.58	1.85	1.85	73	118	80	1	2.6	55	
8	36		460.7	.58	1.85	1.85	73	120	83	1	2.6	55	
	40	0950	463.5	.58	1.85	1.85	73	121	85	1	2.6	55	
7	44		467.0	.62	2.0	2.0	74	122	85	1	2.6	55	
	48	0958	470.3	.63	2.0	2.0	74	123	87	1	2.65	53	
6	52		473.0	.63	2.05	2.05	74	124	88	1	2.7	53	
	56	1006	476.8	.63	2.05	2.05	74	125	90	1	2.7	54	
5	60		479.9	.62	2.0	2.0	74	125	92	1	2.7	53	
	64	1014	483.4	.65	2.1	2.1	74	126	94	1	2.7	53	
4	68		486.8	.63	2.05	2.05	75	125	94	1	2.7	53	
	72	1022	489.8	.62	2.0	2.0	75	126	95	1	2.7	53	
3	76		492.4	.54	1.75	1.75	75	126	95	1	2.7	53	
	80	1030	496.3	.54	1.75	1.75	74						

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Hard Chrome

Test Date: 2-1-89

Run Number: I-4

Operator: DW / BM

Page 2 of 2

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 Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	~~Sample Box Temp.~~ Filter Temp. °F (Filter ΔP)	Impinger Temp. °F	Probe Temp °F
B-2	84		500.0	.61	1.95	1.95	74	123	95	1	2.65	55	
	88	1040	502.6	.61	1.95	1.95	74	124	95	1	2.65	53	
-1	92		505.8	.61	1.95	1.95	73	125	95	1	2.65	53	
	96	1048	509.00	.61	1.95	1.95	72	125	95	1	2.7	53	
			68.400										
		1057	509.400	—	—	—	—	—	—	—	—	—	
A-12	4		512.7	.63	2.05	2.05	71	112	95	1	2.7	58	
	8	1105	516.0	.63	2.05	2.05	71	120	95	1	2.6	48	
11	12		519.3	.63	2.05	2.05	71	123	95	1	2.6	49	
	16	1113	522.6	.63	2.05	2.05	72	124	95	1	2.6	49	
10	20		525.9	.64	2.05	2.05	72	126	95	1	2.6	49	
	24	1121	529.3	.64	2.05	2.05	71	126	95	1	2.65	50	
9	28		532.7	.61	1.95	1.95	71	126	95	1	2.65	50	
	32	1129	535.9	.61	1.95	1.95	71	126	95	1	2.6	50	
8	36		539.1	.62	2.0	2.0	72	126	95	1	2.6	50	
	40	1137	542.3	.62	2.0	2.0	72	126	96	1	2.6	50	
7	44		545.7	.57	1.8	1.8	72	125	95	1	2.6	50	
	48	1145	548.8	.57	1.8	1.8	72	126	95	1	2.6	50	
6	52		551.8	.57	1.8	1.8	71	125	95	1	2.6	50	
	56	1153	555.0	.57	1.8	1.8	72	126	96	1	2.65	50	
5	60		558.3	.59	1.9	1.9	72	126	96	1	2.6	50	
	64	1201	561.7	.55	1.75	1.75	72	125	95	1	2.6	50	
4	68		564.8	.55	1.75	1.75	72	124	95	1	2.6	50	
	72	1209	567.7	.52	1.65	1.65	73	120	95	1	2.65	50	
3	76		570.5	.52	1.65	1.65	72	122	95	1	2.6	49	
	80	1217	573.7	.61	1.95	1.95	73	123	95	1	2.6	49	
2	84		577.7	.61	1.95	1.95	73	124	96	1	2.6	50	
	88	1225	580.2	.6	1.92	1.92	73	124	96	1	2.6	50	
1	92		583.5	.5	1.6	1.6	73	124	96	1	2.6	50	
	96	1233	586.00	.46	1.45	1.45	73	124	96	1	2.7	51	
			76.60										
			145.00										

A-33

CHECK 3RD. IMPINGER

SAMPLE RECOVERY DATA

Plant: Hard Chrome Specialists Run No.: I-4

Date: _____ Sample Box No.: _____ Job No.: _____

Sample Location: Inlet

Sample Type: MM13B Filter No.: N/A

Sample Recovery Person: Wetmore, Metzer

Comments: BALLS

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: _____ _____ _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1			563.9	560.7	-3.2
2			575.0	581.0	6.0
3			492.5	592.9	0.4
4			686.2	707.3	21.1
5					
6					
TOTAL					24.3

Description of Impinger Catch: _____

```
XROM "PRESS"
NO. OF POINTS ?
          48.0000000
DELTA P ?
          .6200000
STACK TEMP ?
          72.0000000
DELTA P ?
          .6200000
STACK TEMP ?
          73.0000000
DELTA P ?
          .6100000
STACK TEMP ?
          73.0000000
DELTA P ?
          .6100000
STACK TEMP ?
          73.0000000
DELTA P ?
          .6000000
STACK TEMP ?
          73.0000000
DELTA P ?
          .6000000
STACK TEMP ?
          73.0000000
DELTA P ?
          .5800000
STACK TEMP ?
          73.0000000
DELTA P ?
          .5800000
STACK TEMP ?
          73.0000000
DELTA P ?
          .5800000
STACK TEMP ?
          73.0000000
DELTA P ?
          .5800000
STACK TEMP ?
          73.0000000
DELTA P ?
          .6200000
STACK TEMP ?
          74.0000000
DELTA P ?
          .6200000
STACK TEMP ?
          74.0000000
DELTA P ?
          .6300000
STACK TEMP ?
          74.0000000
DELTA P ?
          .6300000
STACK TEMP ?
          74.0000000
DELTA P ?
          .6300000
STACK TEMP ?
          74.0000000
DELTA P ?
          .6500000
STACK TEMP ?
          74.0000000
DELTA P ?
          .6300000
STACK TEMP ?
          75.0000000
DELTA P ?
          .6200000
STACK TEMP ?
          75.0000000
DELTA P ?
          .5400000
STACK TEMP ?
          75.0000000
DELTA P ?
          .5400000
STACK TEMP ?
          74.0000000
DELTA P ?
          .6100000
STACK TEMP ?
          74.0000000
DELTA P ?
          .6100000
STACK TEMP ?
          74.0000000
DELTA P ?
          .6100000
STACK TEMP ?
          73.0000000
DELTA P ?
          .6100000
STACK TEMP ?
          72.0000000
DELTA P ?
          .6300000
STACK TEMP ?
          71.0000000
DELTA P ?
          .6300000
STACK TEMP ?
          71.0000000
DELTA P ?
          .6300000
STACK TEMP ?
          71.0000000
DELTA P ?
          .6300000
STACK TEMP ?
          71.0000000
DELTA P ?
          .6300000
STACK TEMP ?
          72.0000000
DELTA P ?
          .6400000
STACK TEMP ?
          72.0000000
DELTA P ?
          .6400000
STACK TEMP ?
          71.0000000
DELTA P ?
          .6100000
STACK TEMP ?
          71.0000000
DELTA P ?
          .6100000
STACK TEMP ?
          71.0000000
DELTA P ?
          .6200000
STACK TEMP ?
          72.0000000
DELTA P ?
          .6200000
STACK TEMP ?
          72.0000000
DELTA P ?
          .5700000
STACK TEMP ?
          72.0000000
DELTA P ?
          .5700000
STACK TEMP ?
          72.0000000
DELTA P ?
          .5700000
STACK TEMP ?
          71.0000000
DELTA P ?
          .5700000
STACK TEMP ?
          72.0000000
DELTA P ?
          .5900000
STACK TEMP ?
          72.0000000
DELTA P ?
          .5500000
STACK TEMP ?
          72.0000000
DELTA P ?
          .5500000
STACK TEMP ?
          72.0000000
DELTA P ?
          .5200000
STACK TEMP ?
          73.0000000
DELTA P ?
          .5200000
STACK TEMP ?
          [illegible]
DELTA P ?
          .6100000
STACK TEMP ?
          73.0000000
DELTA P ?
          .6100000
STACK TEMP ?
          73.0000000
DELTA P ?
          .6000000
STACK TEMP ?
          73.0000000
DELTA P ?
          .5000000
STACK TEMP ?
          73.0000000
DELTA P ?
          .4600000
STACK TEMP ?
          73.0000000
SQRT PSTS = 17.7972274
VE STK TEMP = 72.7708333
```

```
XROM "METH 5"
RUN NUMBER
1-4
                    RUN
METER BOX Y?
          1.0060    RUN
DELTA H?
          1.9200    RUN
BAR PRESS ?
          29.3700   RUN
METER VOL ?
          154.0000  RUN
MTR TEMP ?
          105.0000  RUN
STATIC HOH IN ?
          -1.5000   RUN
STACK TEMP ?
          73.0000   RUN
ML. WATER ?
          24.3000   RUN

SAT % = 2.8

IMP. % HOH = 0.8

% HOH=0.8

% CO2?
          .7000     RUN
% OXYGEN?
          21.0000   RUN
% CO ?               RUN

MWd =28.95
MW WET=28.86

SQRT PSTS ?
          17.7972   RUN
COS SQRT PSTS ?     RUN
TIME MIN ?
          92.0000   RUN
NOZZLE DIA ?
          .2350     RUN
STK DIA INCH ?
          15.5000   RUN

* VOL MTR STD = 142.800
  STK PRES ABS = 29.26
  VOL HOH GAS = 1.14
  % MOISTURE = 0.76
  MOL DRY GAS = 0.992
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.86
  VELOCITY FPS = 43.98
  STACK AREA = 1.31
  STACK ACFM = 3,458.
* STACK DSCFM = 3,323.
  % ISOKINETIC = 97.43

END OF FIELD DATA
```

```
XROM "MASSFLO"
RUN NUMBER
1-4
                    RUN
VOL MTR STD ?
          142.8000  RUN
STACK DSCFM ?
          3,323.0000 RUN
FRONT 1/2 MG ?
          4.0000    FIX 7
          4.7259000 RUN
BACK 1/2 MG ?       RUN

* GR/DSCF = 0.0005110
* MG/MMM = 1.1692224
* LB/HR = 0.0145559
* KG/HR = 0.0066026
```

FIELD DATA

Plant: Hard Chrome Specialist
Date: 2-1-89 Job No.:
Sampling Location: Outlet
Sample Type: M.M.13B
Run Number: Outlet-4
Operator: Gerber, Hollins
Ambient Temperature: 67
Barometric Pressure: 29.32
Static Pressure (P_g): +.20
Filter Number(s): N/A
Pretest Leak Rate = 0.006 cfm @ 10 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 4 Minutes

Schematic of Traverse Point Layout

Probe Length and Type: 2' Glass
Pitot Tube I.D. No. S-3.4 Cp .84
Nozzle I.D. .294 | .294 | .296 | Avg. .2967
Assumed Moisture, %: 1
Temp. Readout S/N: T-2
Meter Box Number: MB-3
Meter $\Delta H_@$: 1.987
C Factor: 1.25
Meter Gamma: 0.985
Heater Box Setting: N/A
Reference Δp: .188
Post Test Leak Rate = 0.008 cfm @ 12 in. Hg
Post Test Pitot Leak Check: OK
Post Test Orsat Leak Check: N/A

Page 1 of 2

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_g) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
			597.804										
1	0	19:11	~~597.303~~	.45	4.45	4.45	68	70	70	4		48	
	4	19:15	602.911	.47	4.65	4.65	68	85	71	4		43	
	8	19:19	606.755	.47	4.65	4.65	68	88	72	4		47	
	12	19:23	611.418	.47	4.65	4.65	68	100	75	4		47	
2	16	19:27	616.030	.64	6.4	6.4	69	110	79	9		48	
	20	19:31	621.770	.64	6.4	6.4	68	118	82	9		49	
	24	19:35	627.752	.64	6.4	6.4	69	125	87	9		50	
	28	19:39	633.745	.64	6.4	6.4	69	130	90	9		49	
3	32	19:43	639.800	.68	6.8	6.8	69	135	96	10		49	
	36	19:47	645.999	.68	6.8	6.8	68	137	98	10		49	
	40	19:51	652.241	.68	6.8	6.8	69	141	101	10		49	
	44	19:55	658.591	.68	6.8	6.8	69	143	104	10		49	
4	48	19:59	664.928	.70	7.0	7.0	68	145	108	11		48	
	52	110:03	670.345	.73	7.3	7.3	69	146	109	11		49	
	56	110:07	677.850	.73	7.3	7.3	69	149	112	11		50	
	60	110:11	684.412	.73	7.3	7.3	69	151	114	11		50	
5	64	110:15	691.053	.75	7.5	7.5	69	152	116	12		50	
	68	110:19	697.969	.75	7.5	7.5	69	154	117	12		50	
	72	110:23	704.498	.75	7.5	7.5	68	153	117	12		50	
	76	110:27	711.333	.75	7.5	7.5	66	150	115			51	

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Hard Chrome Specialist

Run Number: Outlet-4

Page 2 of 2

Test Date: 2-1-89

Operator: Gerber, Hollins

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 Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
		/										50	
6	80	110:31	717.930	.74	7.4	7.4	67	146	112	12		50	
	84	110:35	724.595	.75	7.5	7.5	68	144	109	12		50	
	88	110:39	731.161	.76	7.6	7.6	69	143	107	13		51	
	92	110:43	737.809	.75	7.5	7.5	67	142	105	13		50	
7	96	110:55	744.472	.51	5.1	5.1	66	118	99	5		46	
	100	110:59	749.484	.49	4.9	4.9	66	118	96	5		48	
	104	111:03	754.379	.49	4.9	4.9	66	124	95	5		48	
	108	111:07	759.317	.50	5.0	5.0	66	127	95	5		48	
8	112	111:11	764.268	.64	6.4	6.4	67	131	96	10		49	
	116	111:15	770.273	.65	6.5	6.5	66	134	97	10		50	
	120	111:19	776.401	.64	6.4	6.4	66	136	97	10		50	
	124	111:23	782.563	.64	6.4	6.4	66	138	98	10		50	
9	128	111:27	788.642	.73	7.3	7.3	66	140	99	12		50	
	132	111:31	795.079	.72	7.2	7.2	66	141	100	12		50	
	136	111:35	801.574	.73	7.3	7.3	67	142	100	12		50	
	140	111:39	808.008	.72	7.2	7.2	67	142	101	12		50	
10	144	111:43	814.565	.69	6.9	6.9	66	143	102	12		50	
	148	111:47	820.981	.68	6.8	6.8	67	143	102	11		50	
	152	111:51	827.330	.69	6.9	6.9	67	142	102	12		50	
	156	111:55	833.674	.69	6.9	6.9	67	142	102	12		50	
11	160	111:59	840.069	.68	6.8	6.8	67	142	103	11		50	
	164	112:03	846.330	.68	6.8	6.8	67	142	103	11		50	
	168	112:07	852.792	.68	6.8	6.8	67	142	103	11		50	
	172	112:11	859.136	.68	6.8	6.8	67	142	103	12		49	
12	176	112:15	865.571	.72	7.2	7.2	67	142	103	12		50	
	180	112:19	871.998	.71	7.1	7.1	67	143	104	12		50	
	184	112:23	878.455	.70	7.0	7.0	67	143	104	12		50	
	188	112:27	884.929	.70	7.0	7.0	67	143	104	12		50	
OFF	192	112:31	891.427										
		/											
		/	2										

SAMPLE RECOVERY DATA

Plant: Hard Chrome Specialists Run No.: 0-4

Date: 2-1-89 Sample Box No.: IA-2 Job No.: _____

Sample Location: Outlet

Sample Type: MM13B Filter No.: N/A

Sample Recovery Person: Gerber, Hollins

Comments: BALLS

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: _____ _____ _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	.1N NaOH	100	594.1	558.7	-35.4
2	.1N NaOH	100	560.2	568.1	7.9
3	M.T	—	492.3	495.0	2.7
~~4~~ 5	Silica Gel	300g	771.9	817.7	45.8
~~5~~ 4	MT	—	475.3	478.6	3.3
6					
TOTAL					24.43

Description of Impinger Catch: _____

```
XROM "PRESS"
NO. OF POINTS ?
48.0000
DELTA P ?
.4500
STACK TEMP ?
[illegible]
DELTA P ?
.4700
STACK TEMP ?
68.0000
DELTA P ?
.4700
STACK TEMP ?
68.0000
DELTA P ?
.4700
STACK TEMP ?
68.0000
DELTA P ?
.4700
STACK TEMP ?
68.0000
DELTA P ?
.6400
STACK TEMP ?
69.0000
DELTA P ?
.6400
STACK TEMP ?
68.0000
DELTA P ?
.6400
STACK TEMP ?
69.0000
DELTA P ?
.6400
STACK TEMP ?
69.0000
DELTA P ?
.6800
STACK TEMP ?
69.0000
DELTA P ?
.6800
STACK TEMP ?
68.0000
DELTA P ?
.6800
STACK TEMP ?
69.0000
DELTA P ?
.6800
STACK TEMP ?
69.0000
DELTA P ?
.7000
STACK TEMP ?
68.0000
DELTA P ?
.7300
STACK TEMP ?
69.0000
DELTA P ?
.7300
STACK TEMP ?
69.0000
DELTA P ?
.7300
STACK TEMP ?
69.0000
DELTA P ?
.7500
STACK TEMP ?
69.0000
DELTA P ?
.7500
STACK TEMP ?
69.0000
DELTA P ?
.7500
STACK TEMP ?
68.0000
DELTA P ?
.7500
STACK TEMP ?
66.0000
DELTA P ?
.7400
STACK TEMP ?
67.0000
DELTA P ?
.7500
STACK TEMP ?
68.0000
DELTA P ?
.7600
STACK TEMP ?
69.0000
DELTA P ?
.7500
STACK TEMP ?
67.0000
```

```
DELTA P ?
.5100 RUN
STACK TEMP ?
66.0000 RUN
DELTA P ?
.4900 RUN
STACK TEMP ?
66.0000 RUN
DELTA P ?
.4900 RUN
STACK TEMP ?
66.0000 RUN
DELTA P ?
.5000 RUN
STACK TEMP ?
66.0000 RUN
DELTA P ?
.6400 RUN
STACK TEMP ?
67.0000 RUN
DELTA P ?
.6500 RUN
STACK TEMP ?
66.0000 RUN
DELTA P ?
.6400 RUN
STACK TEMP ?
66.0000 RUN
DELTA P ?
.6400 RUN
STACK TEMP ?
65.0000 RUN
DELTA P ?
.7300 RUN
STACK TEMP ?
66.0000 RUN
DELTA P ?
.7200 RUN
STACK TEMP ?
66.0000 RUN
DELTA P ?
.7300 RUN
STACK TEMP ?
67.0000 RUN
DELTA P ?
.7200 RUN
STACK TEMP ?
67.0000 RUN
DELTA P ?
.6900 RUN
STACK TEMP ?
66.0000 RUN
DELTA P ?
.6800 RUN
STACK TEMP ?
67.0000 RUN
DELTA P ?
.6900 RUN
STACK TEMP ?
67.0000 RUN
DELTA P ?
.6900 RUN
STACK TEMP ?
67.0000 RUN
DELTA P ?
.6800 RUN
STACK TEMP ?
67.0000 RUN
DELTA P ?
.6800 RUN
STACK TEMP ?
67.0000 RUN
DELTA P ?
.6800 RUN
STACK TEMP ?
67.0000 RUN
DELTA P ?
.7200 RUN
STACK TEMP ?
67.0000 RUN
DELTA P ?
.7100 RUN
STACK TEMP ?
67.0000 RUN
DELTA P ?
.7000 RUN
STACK TEMP ?
67.0000 RUN
DELTA P ?
.7000 RUN
STACK TEMP ?
67.0000 RUN

SQRT PSTS = 18.6446
AVE STK TEMP = 67.4583
```

```
XROM "METH 5"
RUN NUMBER
0-4
RUN
METER BOX Y?
.9850 RUN
DELTA H?
5.6200 RUN
BAR PRESS ?
29.3200 RUN
METER VOL ?
293.6230 RUN
MTR TEMP F?
117.0000 RUN
STATIC HOH IN ?
.2000 RUN
STACK TEMP.
67.0000 RUN
ML. WATER ?
24.3000 RUN

SAT % = 2.3

IMP. % HOH = 0.4

% HOH=0.4

% CO2?
.7000 RUN
% OXYGEN?
21.0000 RUN
% CO ?
RUN

MWd =28.95
MW WET=28.90

SQRT PSTS ?
18.6446 RUN
COS SQRT PSTS ?
RUN
TIME MIN ?
192.0000 RUN
NOZZLE DIA ?
.2950 RUN
STK DIA INCH ?
15.8125 RUN

* VOL MTR STD = 263.655
  STK PRES ABS = 29.33
  VOL HOH GAS = 1.14
  % MOISTURE = 0.43
  MOL DRY GAS = 0.996
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.90
  VELOCITY FPS = 45.98
  STACK AREA = 1.86
  STACK ACFM = 3,762.
* STACK DSCFM = 3,680.
  % ISOKINETIC = 107.28

END OF FIELD DATA
```

```
XROM "MASSFLO"
RUN NUMBER
0-4
RUN
VOL MTR STD ?
263.655 RUN
STACK DSCFM ?
3,680.00 RUN
FRONT 1/2 MG ?
.237 RUN
BACK 1/2 MG ?
FIX 7
RUN

F GR/DSCF = 0.0000139
F MG/MMM = 0.0317238
F LB/HR = 0.0004376
F KG/HR = 0.0001985
```

FIELD DATA

Plant: Hard Chrome
Date: 2-1-89 Job No.:
Sampling Location: Filter Inlet
Sample Type: MM 13B
Run Number: I-5
Operator: DW + BM
Ambient Temperature: 71
Barometric Pressure: 29.37
Static Pressure (P_s): -1.5
Filter Number(s):
Pretest Leak Rate = .002 cfm @ 15 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check:
Read and Record all Data Every ___ Minutes

Schematic of Traverse Point Layout

Probe Length and Type: 3' Glass
Pitot Tube I.D. No. S-3B Cp .84
Nozzle I.D. | | | Avg. .235
Assumed Moisture, % 1.5
Temp. Readout S/N T-1
Meter Box Number MB-1
Meter $\Delta H_@$ 1.73
C Factor
Meter Gamma 1.006
Heater Box Setting
Reference Δp 1 = 3.25
Post Test Leak Rate = .005 cfm @ 10 in. Hg
Post Test Pitot Leak Check
Post Test Orsat Leak Check

Page ___ of ___ Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Filter ΔP ~~Sample Box Temp. Filter Temp. °F~~	Impinger Temp. °F	Probe Temp °F
	0	1327	586.200										
A-12	5	1332	590.	.6	1.95	1.95	75	96	86	1	2.65	58	
				~~.62~~									
		1337	594.2	.63	2.05	2.05	75	102	86	1	2.65	59	
A-11	10	1342	598.4	.62	2.0	2.0	75	109	85	1	2.7	49	
-10	15	1347	602.5	.6	1.95	1.95	75	115	86	1	2.65	49	
A-19	20	1352	606.4	.6	1.95	1.95	75	117	88	1	2.6	49	
8	25	1357	610.3	.57	1.85	1.85	75	120	90	1	2.6	49	
7	30	1402	614.3	.55	1.75	1.75	75	122	91	1	2.65	49	
6	35	1407	618.2	.54	1.75	1.75	74	121	92	1	2.7	50	
5	40	1412	622.0	.53	1.7	1.7	75	120	93	1	2.7	50	
4	45	1417	625.7	.53	1.7	1.7	75	121	93	1	2.7	50	
3	50	1422	629.6	.54	1.72	1.72	74	120	94	1	2.7	50	
2	55	1427	633.173	.47	1.5	1.5	74	121	94	1	2.6	50	
1	60												
			46.973										
	0	1439	633.500	—	—	—	—	—	—	—	—	—	—
B 12	5	1444	637.6	.6	1.95	1.95	74	107	95	1	2.65	53	
11	10	1449	641.7	.61	1.97	1.97	74	115	94	1	2.65	48	
10	15	1454	645.7	.6	1.95	1.95	75	120	95	1	2.6	50	
9	20	1459	649.	.58	1.85	1.85	74	122	95	1	2.6	52	

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Hard Chrome

Test Date: 2-1-89

Run Number: I-5

Operator: DW / BM

Page 2 of 2

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 Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	~~Sample Box Temp. Filter Temp. °F~~ Filter ΔP	Impinger Temp. °F	Probe Temp °F
	/											
B-8	25 / 1504	653.9	.56	1.8	1.8	75	122	95	1	2.6	53	
7	30 / 1509	657.7	.54	1.75	1.75	74	122	95	1	2.65	54	
6	35 / 1514	662.0	.58	1.85	1.85	74	122	95	1	2.7	54	
5	40 / 1519	665.4	.6	1.9	1.9	74	121	96	1	2.6	54	
4	45 / 1524	669.5	.61	1.95	1.95	74	122	96	1	2.6	55	
3	50 / 1529	673.6	.64	2.05	2.05	74	122	96	1	2.7	56	
2	55 / 1534	677.7	.65	2.1	2.1	74	122	96	1	2.7	57	
1	60 / 1539	681.588	.52	1.8	1.8	74	123	96	1	2.7	57	
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											

SAMPLE RECOVERY DATA

Plant: HARDCHROME SPECIALISTS Run No.: I - 5

Date: 2-1-87 Sample Box No.: 1 Job No.:

Sample Location: INLET

Sample Type: MM13B Filter No.:

Sample Recovery Person: Wetmore Mentzer

Comments: BALS

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples stored and locked:

BACK HALF/MOISTURE

Container No:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	1N NaOH	100	564.3	563.3	~~[illegible]~~ -1
2	1N NaOH	100	573.2	576.0	2.8
3	MT		~~493.9~~	493.5	~~3~~.5
4	SG		693.7	710.3	16.6
5					
6					
TOTAL					~~17.9~~ 17.9

Description of Impinger Catch:

```
XROM "PRESS"
NO. OF POINTS ?
24.0000000
DELTA P ?
.6000000
STACK TEMP ?
75.0000000
DELTA P ?
.6300000
STACK TEMP ?
75.0000000
DELTA P ?
.6200000
STACK TEMP ?
75.0000000
DELTA P ?
.6000000
STACK TEMP ?
75.0000000
DELTA P ?
.6000000
STACK TEMP ?
75.0000000
DELTA P ?
.5700000
STACK TEMP ?
75.0000000 '  RUN
DELTA P ?
.5500000    RUN
STACK TEMP ?
75.0000000    RUN
DELTA P ?
.5400000    RUN
STACK TEMP ?
74.0000000    RUN
DELTA P ?
.5300000    RUN
STACK TEMP ?
75.0000000    RUN
DELTA P ?
.5300000    RUN
STACK TEMP ?
75.0000000    RUN
DELTA P ?
.5400000    RUN
STACK TEMP ?
74.0000000    RUN
DELTA P ?
.4700000    RUN
STACK TEMP ?
74.0000000    RUN
DELTA P ?
.6000000    RUN
STACK TEMP ?
74.0000000    RUN
DELTA P ?
.6100000    RUN
STACK TEMP ?
74.0000000    RUN
DELTA P ?
.6000000    RUN
STACK TEMP ?
75.0000000    RUN
DELTA P ?
.5800000    RUN
STACK TEMP ?
74.0000000    RUN
DELTA P ?
.5600000    RUN
STACK TEMP ?
75.0000000    RUN
DELTA P ?
.5400000    RUN
STACK TEMP ?
74.0000000    RUN
DELTA P ?
.5800000    RUN
STACK TEMP ?
74.0000000    RUN
DELTA P ?
.6000000    RUN
STACK TEMP ?
74.0000000    RUN
DELTA P ?
.6100000    RUN
STACK TEMP ?
74.0000000    RUN
DELTA P ?
.6000000    RUN
STACK TEMP ?
74.0000000    RUN

SQRT PSTS = 17.5625617
VE STK TEMP = 74.4583333
```

```
XROM "METH 5"
RUN NUMBER
I-5
                    RUN
METER BOX Y?
1.0060              RUN
DELTA H?
1.8700              RUN
BAR PRESS ?
29.3700             RUN
METER VOL ?
95.0610             RUN
MTR TEMP F?
105.0000            RUN
STATIC HOH IN ?
-1.5000             RUN
STACK TEMP.
74.0000             RUN
ML. WATER ?
18.9000             RUN

SAT % = 2.9

IMP. % HOH = 1.0
% HOH=1.0

% CO2?
.7000               RUN
% OXYGEN?
21.0000             RUN
% CO ?
                    RUN

MWd =28.95
MW WET=28.84

SQRT PSTS ?
17.5626             RUN
COS SQRT PSTS ?
                    RUN
TIME MIN ?
120.0000            RUN
NOZZLE DIA ?
.2350               RUN
STK DIA INCH ?
15.5000             RUN

* VOL MTR STD = 88.136
  STK PRES ABS = 29.26
  VOL HOH GAS = 0.89
  % MOISTURE = 1.00
  MOL DRY GAS = 0.990
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.84
  VELOCITY FPS = 43.41
  STACK AREA = 1.31
  STACK ACFM = 3,418.
* STACK DSCFM = 3,267.
  % ISOKINETIC =  97.85

END OF FIELD DATA
```

```
XROM "MASSFLO"
RUN NUMBER
I-5
                    RUN
VOL MTR STD ?
88.136              RUN
STACK DSCFM ?
3,267.00            RUN
FRONT 1/2 MG ?
1.8390000           RUN
BACK 1/2 MG ?
                    RUN

F  GR/DSCF = 0.0003220
F  MG/MMM = 0.7366436
F  LB/HR = 0.0090169
F  KG/HR = 0.0040901
```

FIELD DATA

Plant: Hard Chrome Specialists
Date: 2-1-89 Job No.:
Sampling Location: Outlet
Sample Type: MM13B
Run Number: 0-5
Operator: Gerber, Hollins
Ambient Temperature: 72
Barometric Pressure: 29.31
Static Pressure (P_g): +.20
Filter Number(s): N/A
Pretest Leak Rate = 0.003 cfm @ 15 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 5 Minutes

Schematic of Traverse Point Layout

Probe Length and Type: 2' Glass
Pitot Tube I.D. No. S-34 Cp .84
Nozzle I.D. .294 | .294 | .296 | Avg. .2944
Assumed Moisture, %: 1
Temp. Readout S/N: T-2
Meter Box Number: MB-3
Meter $\Delta H_@$: 1.987
C Factor: 1.25
Meter Gamma: 0.985
Heater Box Setting: N/A
Reference Δp: .188
Post Test Leak Rate = 0.004 cfm @ 15 in. Hg
Post Test Pitot Leak Check: OK
Post Test Orsat Leak Check: N/A

Page 1 of 2

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_g) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
1	0	13:27	892.203	.54	5.4	5.4	70	85	84	12		54	
	5	13:32	899.169	.54	5.4	5.4	69	106	85	12		50	
2	10	13:37	905.317	.68	6.8	6.8	70	119	88	16		55	
	15	13:42	913.400	.68	6.8	6.8	70	128	91	11		57	
3	20	13:47	921.131	.73	7.3	7.3	70	132	95	12		57	
	25	13:52	929.138	.75	7.5	7.5	69	135	97	13		56	
4	30	13:57	937.351	.72	7.2	7.2	69	138	99	13		55	
	35	14:02	946.079	.68	6.8	6.8	68	140	101	11		54	
5	40	14:07	953.462	.70	7.0	7.0	68	140	102	11		53	
	45	14:12	961.488	.70	7.0	7.0	68	140	103	11		51	
6	50	14:17	969.576	.70	7.0	7.0	68	141	103	11		51	
	55	14:22	977.615	.71	7.1	7.1	68	141	104	11		51	
7	60	14:31	985.761	.47	4.7	4.7	68	129	102	4		50	
	65	14:36	993.137	.47	4.7	4.7	67	130	100	4		47	
8	70	14:41	997.808	.48	4.8	4.8	68	132	100	4		47	
	75	14:46	1003.877	.62	6.2	6.2	68	135	101	8		48	
9	80	14:51	1011.262	.62	6.2	6.2	68	139	102	9		49	
	85	14:56	1018.809	.69	6.9	6.9	68	142	103	11		50	
10	90	15:01	1026.837	.74 ~~.68~~	~~6.8~~ 7.4	~~6.8~~ 7.4	68	145	104	12		50	
	95	15:06	1035.050	.74	7.4	7.4	68	146	105	12		49	

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Hard Chrome Specialists

Run Number: Outlet-5

Page 2 of 2

Test Date: 2-1-89

Operator: Gerber, Hollins

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 Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
11	100	15:11	1043.308	.74	7.4	7.4	68	147	106	12		49	
	105	15:16	1052.281	.75	7.5	7.5	68	148	107	12		50	
12	110	15:21	1059.950	.76	7.6	7.6	68	148	108	13		49	
	115	15:26	1068.400	.75	7.5	7.5	68	149	109	13		49	
OFF	120	15:31	1076.850										

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: Hard Chrome Specialists Run No.: 0-5

Date: 2-1-89 Sample Box No.: IA-2 Job No.:

Sample Location: Outlet

Sample Type: MM 13B Filter No.: N/A

Sample Recovery Person: Gerber, Hollins

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples stored and locked:

BACK HALF/MOISTURE

Container No:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	.1N NaOH	100	586.5	563.3	-23.2
2	.1N NaOH	100	567.6	574.7	7.1
3	M.T.	—	492.6	494.3	1.7
4	M.T.	—	476.3	478.4	2.1
5	Silica Gel	300g	734.1	767.4	33.3
6					
TOTAL					21.0

Description of Impinger Catch:

```
XROM "PRESS"
NO. OF POINTS ?
24.0000000
DELTA P ?
.5400000
STACK TEMP ?
70.0000000
DELTA P ?
.5400000
STACK TEMP ?
69.0000000
DELTA P ?
.6900000
STACK TEMP ?
70.0000000
DELTA P ?
.6900000
STACK TEMP ?
70.0000000
DELTA P ?
.7000000
STACK TEMP ?
70.0000000
DELTA P ?
.75  000
STACK TEMP ?
69.0000000
DELTA P ?
.7200000
STACK TEMP ?
69.0000000
DELTA P ?
.6800000
STACK TEMP ?
68.0000000
DELTA P ?
.7000000
STACK TEMP ?
68.0000000
DELTA P ?
.7000000
STACK TEMP ?
68.0000000
DELTA P ?
.7000000
STACK TEMP ?
68.0000000
DELTA P ?
.7100000
STACK TEMP ?
68.0000000
DELTA P ?
.4700000
STACK TEMP ?
68.0000000
DELTA P ?
.4700000
STACK TEMP ?
67.0000000
DELTA P ?
.4800000
STACK TEMP ?
68.0000000
DELTA P ?
.6200000
STACK TEMP ?
68.0000000
DELTA P ?
.6200000
STACK TEMP ?
68.0000000
DELTA P ?
.6900000
STACK TEMP ?
68.0000000
DELTA P ?
.7400000
STACK TEMP ?
68.0000000
DELTA P ?
.7400000
STACK TEMP ?
68.0000000
DELTA P ?
.7400000
STACK TEMP ?
68.0000000
```

```
DELTA P ?
.7500000
STACK TEMP ?
68.0000000
DELTA P ?
.7600000
STACK TEMP ?
68.0000000
DELTA P ?
.7500000
STACK TEMP ?
68.0000000
SQRT PSTS = 18.6955319
VE STK TEMP = 68.4166667
```

```
XROM "METH 5"
RUN NUMBER
0-5
.0
METER BOX Y?
.9850
DELTA -?
6.6500
BAR PRESS ?
29.3100
METER VOL ?
184.6470
MTR TEMP ?
117.0000
STATIC HOH IN ?
.2000
STACK TEMP,
68.0000
ML. WATER ?
21.0000

SAT % = 2.4

IMP. % HOH = 0.6

% HOH=0.6

% CO2?
.7000
% OXYGEN?
21.0000
% CO ?

MWd =28.95
MW WET=28.89

SQRT PSTS ?
18.6955
COS SQRT PSTS ?
TIME MIN ?
29.0000
NOZZLE DIA ?
.2950
STK DIA INCH ?
15.8125

* VOL MTR STD = 165.758
  STK PRES ABS = 29.32
  VOL HOH GAS = 0.99
  % MOISTURE = 0.59
  MOL DRY GAS = 0.994
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.89
  VELOCITY FPS = 46.13
  STACK AREA = 1.36
  STACK ACFM = 3,774.
* STACK DSCFM = 3,677.
  % ISOKINETIC = 107.99

END OF FIELD DATA
```

```
XROM "MASSFLO"
RUN NUMBER
0-5
VOL MTR STD ?
165.758
STACK DSCFM ?
3,677.00
FRONT 1/2 MG ?
.1327
BACK 1/2 MG ?

*  GR/DSCF = 0.0000124
*  MG/MMM = 0.0028211
*  G/HR = 0.0003894
*  LB/HR = 0.0001756
```

APPENDIX B

Draft Method - Determination of Hexavalent Chromium in Dry Particulate Emissions from Stationary Sources

DRAFT METHOD - DETERMINATION OF HEXAVALENT CHROMIUM IN DRY PARTICULATE EMISSIONS FROM STATIONARY SOURCES

1.0 APPLICABILITY AND PRINCIPLE

1.1 Applicability

This method applies to the determination of hexavalent chromium (Cr^{+6}) in dry particulate emissions only from specified stationary sources whose emissions do not contain acids or organics.

1.2 Principle

Particulate emissions are collected from the source by use of Method 5. (Appendix A, 40 CFR Part 60). The collected samples are digested in an alkaline solution and analyzed for Cr^{+6} by the diphenylcarbazide colorimetric method.

2.0 RANGE, SENSITIVITY, PRECISION, AND INTERFERENCES

2.1 Range

A straight-line response curve can be obtained in the range 5 μg Cr^{+6}/100 mℓ to 100 μg Cr^{+6}/100 mℓ. For a minimum analytical accuracy of ±10 percent, the lower limit of the range is 10 μg/100 mℓ. The upper limit can be extended by appropriate dilution.

2.2 Sensitivity

A minimum detection limit of 1 μg Cr^{+6}/100 mℓ has been observed.

2.3 Precision

The overall precision for sample collection and analysis for Cr^{+6} in dry particulate emissions was determined at a ferrochrome smelter, a chemical plant, and a refractory brick plant. Replicate Method 5 filters

with both high and low particulate loadings were analyzed. The relative standard deviations were less than 10 percent in all cases.

2.4 Interference

Molybdenum, mercury and vanadium react with diphenylcarbazide to form a color; however, approximately 20 mg of these elements can be present in a sample without creating a problem. Iron produces a yellow color, but this effect is not measured photometrically at 540 nm. No interference was observed at the sources listed in Section 2.3.

3.0 APPARATUS

3.1 Sampling Train

Same as Method 5, Section 2.1.

3.2 Sample Recovery

Same as Method 5, Section 2.2.

3.3 Analysis

The following equipment is needed.

3.3.1 Beakers--

Borosilicate, 250-mℓ, with watchglass covers.

3.3.2 Filtration Apparatus--

Vacuum unit constructed of plastic or glass, to accommodate 47-mm diameter, 3.0-μg size Teflon filters (NOTE: Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency).

3.3.3 Volumetric Flasks--

100-mℓ and other appropriate volumes.

3.3.4 Hot Plate

3.3.5 Pipettes--

Assorted sizes, as needed.

3.3.6 Spectrophotometer--

To measure absorbance at 540 nm.

4.0 REAGENTS

Unless otherwise indicated, all reagents shall conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society. Where such specifications are not available, use the best available grade.

4.1 Sampling

Same as Method 5, Section 3.1.

4.2 Sample Recovery

Same as Method 5, Section 3.2.

4.3 Analysis

The following reagents are required.

4.3.1 Water--

Deionized distilled, meeting American Society for Testing and Materials (ASTM) specifications for type 2 reagent - ASTM Test Method D 1193-77 (incorporated by reference - see Section 61.18).

4.3.2 Digestion Solution--

Dissolve 20.0 g NaOH and 30.0 g anhydrous Na_2CO_3 in water in a 1-liter volumetric flask, and dilute to the mark. Store the solution in a tightly capped polyethylene bottle. Prepare fresh monthly.

4.3.3 Potassium Dichromate Stock Solution--

Dissolve 141.4 mg of analytical reagent grade $K_2Cr_2O_7$ in water, and dilute to 1 liter (1 mℓ = 50 μg Cr^{+6}).

4.3.4 Potassium Dichromate Standard Solution--

Dilute 10.00 mℓ $K_2Cr_2O_7$ stock solution to 100 mℓ (1 mℓ = 5 μg Cr^{+6}) with water.

4.3.5 Sulfuric Acid, 10 percent (v/v)--

Dilute 10 mℓ H_2SO_4 to 100 mℓ in water.

4.3.6 Acetone--

Same as Method 5, Section 3.2.

4.3.7 Diphenylcarbazide Solution--

Dissolve 250 mg of 1, 5-diphenylcarbazide in 50 mℓ acetone. Store in a brown bottle. Discard when the solution becomes discolored.

5.0 PROCEDURE

5.1 Sampling

Same as Method 5, Section 4.1.

5.2 Sample Recovery

Same as Method 5, Section 4.2.

5.3 Preservation

Tests with dry particulate source samples from the sources described in Section 2.3 demonstrated that the Cr^{+6} content of the samples was stable. Nevertheless, all samples should be protected from extreme heat, kept dry and should be analyzed within 1 month of collection.

5.4 Sample Digestion and Preparation

Place the contents of Container Number 2 (the acetone probe rinse) in a 250-mℓ beaker. Evaporate to dryness. Place the contents of Container Number 1 in the same beaker (cut the filter into small pieces). Add 40 mℓ of digestion solution (Section 4.3.2). Cover the beaker with the watchglass, and heat to near boiling on a hot plate with constant stirring for 30 minutes. Do not allow the solution to evaporate to dryness.

Cool the solution, and transfer it quantitatively to the filtration apparatus with water. Filter the solution through the 47-mm Teflon filter. Transfer the filtrate from the filter flask quantitatively to a 100 mℓ volumetric flask. Fill to the mark with water.

5.5 Reagent Blank Preparation

Take a representative amount of acetone and a blank Method 5 filter and proceed as in Section 5.4.

5.6 Silica Gel Weighing

Weigh the spent silica gel (Container Number 3) or silica gel plum impinger to the nearest 0.5 g using a balance. This step may be conducted in the field.

5.7 Analysis

5.7.1 Color Development and Measurement--

Transfer a 50-mℓ or smaller aliquot of the prepared sample to a 100 mℓ volumetric flask and add sufficient water to bring the volume to approximately 80 mℓ. Adjust the pH to 2 ± 0.5 with 10 percent H_2SO_4, add 2.0 mℓ of diphenylcarbazide solution, and dilute to volume with water. Allow the solution to stand about 10 minutes for color development. For each set of samples analyzed, treat an identical aliquot of reagent blank solution in the same way. Transfer a portion of the sample to a 1-cm absorption cell and measure the absorbance a the optimum wavelength (Section 6.2.1). Measure and subtract the reagent blank absorbance reading, if any, to obtain a net reading. If the absorbance of the sample exceeds the absorbance of the 100 μg Cr^{+6} standard as determined in Section 6.2.2, dilute the sample and the reagent blank with equal volumes of water.

5.7.2 Check for Matrix Effects on the Cr^{+6} Results--

Since the analysis for Cr^{+6} by colorimetry is sensitive to the chemical composition of the sample (matrix effects), the analyst shall check

at least one sample from each source using the method of additions as follows:

Obtain two equal volume aliquots of the same sample solution. The aliquots should contain between 30 and 50 µg of Cr^{+6} (less is acceptable if not possible). Spike one of the aliquots with an aliquot of standard solution that contains between 30 and 50 µg of Cr^{+6}. Now treat both the spiked and unspiked sample aliquots as described in Section 5.7.1.

Next, calculate the Cr^{+6} mass (C_s), in µg in the aliquot of the unspiked sample solution by using the following equation.

$$C_s = C_a \frac{A_s}{A_t - A_s} \qquad \text{Eq. 1-1}$$

Where:

C_a = Cr^{+6} in the standard solution, µg.
A_s = Absorbance of the unspiked sample solution.
A_t = Absorbance of the spiked sample solution.

Volume corrections will not be required since the solutions as analyzed have been made to the same final volume. If the results of the method of additions procedure used on the single source sample do not agree to within 10 percent of the value obtained by the routine spectrophotometric analysis, then reanalyze all samples from the source using this method of additions procedure.

6.0 CALIBRATION

6.1 Sampling Train

Perform all of the calibrations described in Method 5, Section 5.

6.2 Spectrophotometer Calibration

6.2.1 Optimum Wavelength Determination--

Calibrate the wavelength scale of the spectrophotometer every 6 months. The calibration may be accomplished by using an energy source with an intense line emission such as a mercury lamp, or by using a series of glass filters spanning the measuring range of the spectrophotometer. Calibration materials are available commercially and from the National Bureau of Standards. Specific details on the use of such materials are normally supplied by the vendor; general information about calibration techniques can be obtained from general reference books on analytical chemistry. The wavelength scale of the spectrophotometer shall read correctly within ±5 nm, at all calibration points; otherwise, repair and recalibrate the spectrophotometer. Once the wavelength scale of the spectrophotometer is in proper calibration, use 540 nm as the optimum wavelength for the measurement of the absorbance of the standards and samples.

Alternatively, a scanning procedure may be employed to determine the proper measuring wavelength. If the instrument is a double-beam spectrophotometer, scan the spectrum between 530 and 550 nm using the 50 μg Cr^{+6} standard solution (Section 4.3.4) in the sample cell and a blank solution in the reference cell. If a peak does not occur, the spectrophotometer is malfunctioning. When a peak is obtained within the 530 to 550 nm range, record and use the wavelength at which this peak occurs as the optimum wavelength for the measurement of absorbance of both the standards and the samples. For a single-beam spectrophotometer, follow the scanning procedure described above, except scan the blank and standard solutions separately. For this instrument, the optimum wavelength is the wavelength at which the maximum difference in absorbance between the standard and the blank occurs.

6.2.2 Spectrophotometer Calibration--

Alternative calibration procedures are allowed provided acceptable accuracy and precision can be demonstrated. Add 0.0 mℓ, 1 mℓ, 2 mℓ,

5 mℓ, 10 mℓ, 15 mℓ, and 20 mℓ of the working standard solution (1 mℓ = 5 μg Cr^{+6}) to a series of seven 100-ml volumetric flasks. Dilute each to mark with water. Analyze these calibration standards as in Section 5.7.1. This calibration procedure must be repeated on each day that samples are analyzed. Calculate the spectrophotometer calibration factor K_C as follows:

$$K_C = 5 \frac{A_1 + 2A_2 + 5A_3 + 10A_4 + 15A_5 + 20A_6}{A_1^2 + A_2^2 + A_3^2 + A_4^2 + A_5^2 + A_6^2}$$

where:

K_C = Calibration factor.
A_1 = Absorbance of the 5 μg Cr^{+6}/100 mℓ standard.
A_2 = Absorbance of the 10 μg Cr^{+6}/100 mℓ standard.
A_3 = Absorbance of the 25 μg Cr^{+6}/100 mℓ standard.
A_4 = Absorbance of the 50 μg Cr^{+6}/100 mℓ standard.
A_5 = Absorbance of the 75 μg Cr^{+6}/100 mℓ standard.
A_6 = Absorbance of the 100 μg Cr^{+6}/100 mℓ standard.

6.2.2.1 Spectrophotometer Calibration Quality Control--Multiply the absorbance value obtained for each standard by the K_C factor (least squares slope) to determine the distance each calibration point lies from the theoretical calibration line. These calculated concentration values shall not differ from the actual concentrations (i.e., 5, 10, 25, 50, 75, and 100 μg Cr^{+6}/100 ℓ) by more than ___ percent (to be determined) for five of the six standards.

7.0 EMISSION CALCULATIONS

Carry out the calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculations.

7.1 Total Cr^{+6} in Sample.

Calculate m, the total μg Cr^{+6} in each sample, as follows:

$$m = \frac{100\ K_c\ AF}{v_a}$$

Where:

100 = Volume in mℓ of total sample.

A = Absorbance of sample.

F = Dilution factor (required only if sample dilution was needed to reduce the absorbance into the range of calibration).

v_a = Volume in mℓ of aliquot analyzed.

7.2 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop

Same as Method 5, Section 6.2.

7.3 Dry Gas Volume, Volume of Water Vapor, Moisture Content

Same as Method 5, Section 6.3, 6.4, and 6.5, respectively.

7.4 Cr^{+6} Emission Concentration

Calculate c_s (g/dscm), the Cr^{+6} concentration in the stack gas, dry basis, corrected to standard conditions, as follows:

$$c_s = 10^{-6} g/\mu g)(m/V_{m(std)})$$

7.5 Isokinetic Variation, Acceptable Results

Same as Method 5, Sections 6.11 and 6.12, respectively.

8.0 BIBLIOGRAPHY

1. Test Methods for Evaluating Solid Waste. U.S. Environmental Protection Agency. SW-846, 2nd Edition. July 1982.

2. Cox, X.B., R.W. Linton, and F.E. Butler. Determination of Chromium Speciation in Environmental Particles - A Multitechnique Study of Ferrochrome Smelter Dust. Accepted for publication in Environmental Science and Technology.

3. Same as in Bibliography of Method 5, Citations 2 to 5 and 7.

APPENDIX C

CHAIN OF CUSTODY

SAMPLE CHAIN OF CUSTODY

Plant: Hard Chrome Specialists Test Number: 2958

Date Sampled: 1-30-89 Run Number: 1

SAMPLE RECOVERY

Container Code	Description
I-1	Nozzle/probe + impinger rinse - Mesh pad inlet
O-1	" " " " - Mesh pad outlet
PS-1	Plating bath rinse
MP-1	Mesh pad rinse

Person Engaged in Sample Recovery

Signature: David K Wetmore

Title: Field Team Leader

Location at which Recovery was Done: @ plant

Date and Time of Recovery: 1/30/89 5:00p

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature: Helen Owens

Title: Analyst

Date and Time of Receipt: ~~3~~ 1/30/89 - 6.00pm

Sample Storage: clean-up room - building

Laboratory Person Receiving Sample

Signature Helen Owens

Title:

Date and Time of Receipt:

Sample Storage:

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
I-1	Cr^{+6}/colorimetric	1/30/89 - 6:30	Helen Owens
O-1	" "	" "	Helen Owens
PS-1	" "	" "	Helen Owens
MP-1	" "	" "	Helen Owens

SAMPLE CHAIN OF CUSTODY

Plant: Hard Chrome Specialists Test Number: 2958

Date Sampled: 1/31/89 Run Number: 2

SAMPLE RECOVERY

Container Code	Description
I-2	Nozzle/probe + impinger rinse - MM13B - Mesh pad inlet
O-2	" " " " " - Mesh pad outlet
PS-2	plating bath rinse

Person Engaged in Sample Recovery

Signature: David K Wetmore

Title: Field Team Leader

Location at which Recovery was Done: @plant

Date and Time of Recovery: 1/31/89 10:30a

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature: Helen Owens

Title: Analytical Supporter

Date and Time of Receipt: 1/31/89 11:00am

Sample Storage: clean up room - bldg

Laboratory Person Receiving Sample

Signature: Helen Owens

Title:

Date and Time of Receipt:

Sample Storage:

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
O-2	Cr^{+6}	1/31/89 12:00p	Helen Owens
I-2	"	" "	Helen Owens
PS-2	"	" "	Helen Owens

SAMPLE CHAIN OF CUSTODY

Plant: Hard Chrome Specialists Test Number: 2958

Date Sampled: 1/31/89 Run Number: 3

SAMPLE RECOVERY

Container Code	Description
I-3	Nozzle/probe + impinger rinse - MM13B - Mesh Pad inlet
O-3	" " " " " Mesh Pad outlet
PS-3	plating bath rinse

Person Engaged in Sample Recovery

Signature: David K Wetmore

Title: Field Team Leader

Location at which Recovery was Done: @ plant

Date and Time of Recovery: 1/31/89 4:00 p

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature: Helen Owens

Title: Analytical Supporter

Date and Time of Receipt: 1/31/89 5:00 pm

Sample Storage: clean-up room - bldg

Laboratory Person Receiving Sample

Signature: Helen Owens

Title:

Date and Time of Receipt:

Sample Storage:

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
I-3	Cr^{+6}	1/31/89 6:00pm	Helen Owens
O-3	"	" "	Helen Owens
PS-3	"	" "	Helen Owens

SAMPLE CHAIN OF CUSTODY

Plant: Hard Chrome Specialists Test Number: 2958

Date Sampled: 2/1/89 Run Number: 4

SAMPLE RECOVERY

Container Code	Description
I-4	nozzle/probe + impinger rinse - MM13B - Mesh pad inlet
O-4	" " " " " - Mesh pad outlet
PS-4	plating bath rinse

Person Engaged in Sample Recovery

Signature: David K Witmer

Title: Field Team Leader

Location at which Recovery was Done: @ plant

Date and Time of Recovery: 2/1/89 10:00 am

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature: Helen Owens

Title: Analytical Supporter

Date and Time of Receipt: 2/1/89 11:00 AM

Sample Storage: clean-up room - bldg

Laboratory Person Receiving Sample

Signature: Helen Owens

Title:

Date and Time of Receipt:

Sample Storage:

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
I-4	Cr^{+6}	2/1/89 1:00p	Helen Owens
O-4	Cr^{+6}	" 1:00p	Helen Owens
PS-4	"	"	Helen Owens

SAMPLE CHAIN OF CUSTODY

Plant: Hard Chrome Specialists Test Number: 2958

Date Sampled: 2/1/89 Run Number: 5

SAMPLE RECOVERY

Container Code	Description
I-5	nozzle/probe + impinger rinse - MM13B - mesh pad inlet
O-5	" " " " " mesh pad outlet
PS-5	plating bath rinse

Person Engaged in Sample Recovery

Signature: David K Wetmore

Title: Field Team Leader

Location at which Recovery was Done: @plant

Date and Time of Recovery: 2/1/89 5:00p

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature: Helen Owens

Title: Analytical Supporter

Date and Time of Receipt: 2/1/89 6:00p

Sample Storage: Clean-up room - bldg

Laboratory Person Receiving Sample

Signature: Helen Owens

Title:

Date and Time of Receipt:

Sample Storage:

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
I-5	Cr^{+6}	2/1/89 6:00p	Helen Owens
O-5	"	" "	Helen Owens
PS-5	"	" "	Helen Owens

APPENDIX D

EQUIPMENT CALIBRATION DATA

PES

PITOT TUBE CALIBRATION DATA SHEET

Calibrated By: T. MILLER

Date: 1-27-89

Pitot I.D. No.: S-3A

Effective Length: 3'

Pitot Tube Assembly Level? Yes ✓ No ____

Pitot Tube Openings Damaged? Yes (explain below) ____ No ✓

α_1 = 1 ° (<10°) α_2 = 1 ° (<10°)

β_1 = 0 ° (<5°) β_2 = 0 ° (<5°)

γ = 1 ° θ = 2 ° A = 0.927 °

z = A sin γ = 0.016 cm (in.) 0.32 cm (<1/8 in.)

w = A sin θ = 0.032 cm (in.) 0.08 cm (<1/32 in.)

P_A = 0.463 cm (in.)

P_B = 0.463 cm (in.)

D_t = 0.371 cm (in.)

Comments: ____

Calibration Required? Yes ____ No ✓

PES

PITOT TUBE CALIBRATION DATA SHEET

Calibrated By: T. MILLER

Date: 1-27-89

Pitot I.D. No.: S-3B

Effective Length: 3

Pitot Tube Assembly Level? Yes ✓ No ____

Pitot Tube Openings Damaged? Yes (explain below) ____ No ✓

α_1 = 1 ° (<10°) α_2 = 2 ° (<10°)

β_1 = 1 ° (<5°) β_2 = 0 ° (<5°)

γ = 1 ° θ = 2 ° A = 0.915 °

z = A sin γ = 0.016 cm (in.) 0.32 cm (<1/8 in.)

w = A sin θ = 0.032 cm (in.) 0.08 cm (<1/32 in.)

P_A = 0.458 cm (in.)

P_B = 0.458 cm (in.)

D_t = 0.380 cm (in.)

Comments: ____

Calibration Required? Yes ____ No ✓

TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 10-13-88 Thermocouple number SH-1

Ambient temperature 71 °F Barometric pressure 29.50 in. Hg

Calibrator T. Miller Reference: mercury-in-glass ASTM 3F 34078

Description SAMPLE HEAD other

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[c] %
1	ice bath	32	31	0.2
2	ambient	67	74	0.6
3	boiling water	212	210	0.3

[a]Every 30°C (50°F) for each reference point.

[b]Type of calibration system used.

[c] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%.$

TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 10-13-88 Thermocouple number SH-2

Ambient temperature 71 °F Barometric pressure 29.50 in. Hg

Calibrator T. Miller Reference: mercury-in-glass ASTM 3F 34073

Description SAMPLE HOLD other

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[c] %
1.	ice bath	32	32	0
2.	ambient	68	74	1.0
3.	boiling water	212	210	0.3

[a]Every 30°C (50°F) for each reference point.

[b]Type of calibration system used.

[c] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%.$

POSTTEST DRY GAS METER CALIBRATION DATA FORM

Test numbers I 1-5 Date 2/8/89 Meter box number MB-3 Plant Hard Chrome Specialist

Barometric pressure, P_b = 29.81 in. Hg Dry gas meter number 6804799 (ref.) Pretest Y 0.985

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average[a] (t_d), °F	Time (Θ), min	Vacuum setting, in. Hg	Y_i	Y_i $\frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
1.78	540.312	102.526	71	99	77	83		1.5	0.977	(11.084)(29.81)(543)
	529.228	90.977	71	84	73					(11.549)(29.94)(531)
1.78	552.086	114.884	72	103	81	90		1.5	0.980	(11.601)(29.81)(550)
	540.485	102.702	71	97	77					(12.182)(29.94)(532)
1.78	563.444	126.855	72	103	83	90		1.5	0.978	(11.032)(29.81)(550)
	552.416	115.238	72	94	80					(11.617)(29.94)(532)
									Y =	0.978

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y $\pm$0.05Y

P_b = Barometric pressure, in. Hg.

Θ = Time of calibration run, min.

PACIFIC ENVIRONMENTAL SERVICES, INC.

POSTTEST DRY GAS METER CALIBRATION DATA FORM

Test numbers 0 1-5 Date 2/6/89 Meter box number MB-1 Plant Hard Chrome Spec., York PA

Barometric pressure, P_b = 29.66 in. Hg Dry gas meter number 6804799 Pretest Y 1.006

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average[a] (t_d), °F	Time (θ), min	Vacuum setting, in. Hg	Y_i	$Y_i \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
4.21	482.880	738.670	70	116	86	95		12.5	0.999	(10.471)(29.66)(555) / (10.869)(29.97)(530)
	471.619	727.801	70	90	88					
4.21	493.064	750.088	70	126	90	103		12.0	1.011	(10.427)(29.66)(563) / (10.843)(29.97)(530)
	482.637	739.245	70	110	86					
4.21	505.527	763.110	71	127	93	108		12.5	1.013	(11.054)(29.66)(568) / (11.553)(29.97)(531)
	494.473	751.557	70	120	90					
									Y = 1.008	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ±0.05Y

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

PACIFIC ENVIRONMENTAL SERVICES, INC.

APPENDIX E

PROCESS DATA

HARD CHROMIUM SPECIALISTS
AMPERE-HOUR CALCULATIONS
TEST RUN NO.: 3

Time (24-h clock)		Time interval, min		Current, amperes	Ampere-hours	
Inlet	Outlet	Inlet	Outlet		Inlet	Outlet
14:00	14:00					
14:10	14:10	10	10	5,400	900	900
14:20	14:20	10	10	5,400	900	900
14:30	14:30	10	10	5,400	900	900
14:40	14:40	10	10	5,400	900	900
14:50	14:50	10	10	5,400	900	900
15:00	15:00	10	10	5,400	900	900
SUBTOTAL		60	60		5,400	5,400
15:08	15:07					
15:17	15:17	9	10	5,400	810	900
15:27	15:27	10	10	5,400	900	900
15:37	15:37	10	10	5,400	900	900
15:47	15:47	10	10	5,400	900	900
15:57	15:57	10	10	5,400	900	900
16:08	16:07	11	10	5,400	990	900
SUBTOTAL		60	60		5,400	5,400
TOTAL		120	120		10,800	10,800

HARD CHROMIUM SPECIALISTS
AMPERE-HOUR CALCULATIONS
TEST RUN NO.: 4

Time (24-h clock)		Time interval, min		Current, amperes	Ampere-hours	
Inlet	Outlet	Inlet	Outlet		Inlet	Outlet
09:10	09:11					
09:20	09:20	10	9	3,000	500	450
09:30	09:30	10	10	3,000	500	500
09:40	09:40	10	10	3,000	500	500
09:50	09:50	10	10	3,000	500	500
10:00	10:00	10	10	3,000	500	500
10:10	10:10	10	10	3,000	500	500
10:20	10:20	10	10	3,000	500	500
10:30	10:30	10	10	3,000	500	500
10:40	10:40	10	10	3,000	500	500
10:46	10:47	6	7	3,000	300	350
SUBTOTAL		96	96		4,800	4,800
10:57	10:55					
11:06	11:06	9	11	3,000	450	550
11:16	11:16	10	10	3,000	500	500
11:26	11:26	10	10	3,000	500	500
11:36	11:36	10	10	3,000	500	500
11:46	11:46	10	10	3,000	500	500
11:56	11:56	10	10	3,000	500	500
12:06	12:06	10	10	3,000	500	500
12:16	12:16	10	10	3,000	500	500
12:26	12:26	10	10	3,000	500	500
12:33	12:31	7	5	3,000	350	250
SUBTOTAL		96	96		4,800	4,800
TOTAL		192	192		9,600	9,600

HARD CHROMIUM SPECIALISTS
AMPERE-HOUR CALCULATIONS
TEST RUN NO.: 5

Time (24-h clock)		Time interval, min		Current, amperes	Ampere-hours	
Inlet	Outlet	Inlet	Outlet		Inlet	Outlet
13:27	13:27					
13:36	13:36	9	9	3,000	450	450
13:46	13:46	10	10	3,000	500	500
13:56	13:56	10	10	3,000	500	500
14:06	14:06	10	10	3,000	500	500
14:16	14:16	10	10	3,000	500	500
14:27	14:27	11	11	3,000	550	550
SUBTOTAL		60	60		3,000	3,000
14:39	14:31					
14:48	14:48	9	17	3,000	450	850
14:58	14:58	10	10	3,000	500	500
15:08	15:08	10	10	3,000	500	500
15:18	15:18	10	10	3,000	500	500
15:28	15:28	10	10	3,000	500	500
15:39	15:31	11	3	3,000	550	150
SUBTOTAL		60	60		3,000	3,000
TOTAL		120	120		6,000	6,000

SOURCE SAMPLING DATA SHEET

Plant: Hard Chromium Specialists, Inc.
Location: York, Pennsylvania
Tank No.: 1

Run No.	Description of parts plated	Dimensions of part, in. (d, ℓ)	Surface area of part, $in.^2$
1--1/30/89	1 hydraulic cylinder	7, 69	1,517
2--1/31/89	1 hydraulic cylinder	7, 69	1,517
3--1/31/89	2 hydraulic cylinders	5.5, 68 7, 69	1,175 1,517
4--2/1/89	1 hydraulic cylinder	7, 69	1,517
5--2/1/89	1 hydraulic cylinder	7, 69	1,517

SOURCE SAMPLING DATA SHEET

Plant: Hard Chromium Specialists, Inc.
Location: York, Pennsylvania
Date: 1/30/89
Run No.: 1--No polypropylene balls
Tank No.: 1

Inlet

Start time: 13:26
Stop time: 16:53

Outlet

Start time: 13:25
Stop time: 16:52

Time (24-h clock)	Voltage, volts	Current, amperes	Temperature of plating solution, °F	Control device ΔP, in. w.c.	Notes
13:25	4.6	3,000	131		Testing started: 13:25
13:35	4.6	3,000	131	2.5	
13:45	4.6	3,000	131	2.5	
13:55	4.6	3,000	131		
14:05	4.6	3,000	131		14:00 operator manually added some chrome from rinse tank
14:15	4.6	3,000	131		
14:25	4.6	3,000	131		No visible stack emissions
14:35	4.6	3,000	131		
14:45	4.6	3,000	130		Sampling stopped for outlet port change: 15:01
14:55	4.6	3,000	130		
15:02	4.6	3,000	130		Sampling stopped for inlet port change: 15:02
15:15	4.6	3,000	130		Resumed sampling at outlet: 15:16
15:25	4.6	3,000	130		
15:35	4.6	3,000	130		Resumed sampling at inlet: 15:17
15:45	4.6	3,000	130		
15:55	4.6	3,000	130		
16:05	4.6	3,000	130		
16:15	4.6	3,000	130	2.5	
16:25	4.6	3,000	130		
16:35	4.6	3,000	130	2.5	
16:45	4.6	3,000	130		
16:55	4.6	3,000	130		Testing stopped at outlet: 16:52
					Testing stopped at inlet: 16:53

SOURCE SAMPLING DATA SHEET

Plant: Hard Chromium Specialists, Inc.
Location: York, Pennsylvania
Date: 1/31/89
Run No.: 2--No polypropylene balls
Tank No.: 1

Inlet

Start time: 09:31
Stop time: 11:43

Outlet

Start time: 09:25
Stop time: 11:41

Time (24-h clock)	Voltage, volts	Current, amperes	Temperature of plating solution, °F	Control device ΔP, in. w.c.	Notes
09:30	4.7	3,000	131	2.7	Testing started at outlet: 09:25
09:40	4.7	3,000	131	2.7	
09:50	4.7	3,000	131	2.8	Testing started at inlet: 09:31
10:00	4.7	3,000	131	2.8	
10:10	4.7	3,000	131	2.8	
10:20	4.7	3,000	131	2.8	
10:30	4.7	3,000	131		Sampling stopped for outlet port change: 10:25
10:31	4.7	3,000	131		Sampling stopped for inlet port change: 10:31
10:42	4.7	3,000	130	2.8	Resumed sampling at outlet: 10:41
10:52	4.7	3,000	130	2.8	Resumed sampling at inlet: 10:43
11:02	4.7	3,000	130		
11:12	4.7	3,000	130	2.6	
11:22	4.7	3,000	130		
11:32	4.7	3,000	130	2.6	
11:42	4.7	3,000	130	2.6	Testing stopped at outlet: 11:41
					Testing stopped at inlet: 11:43

SOURCE SAMPLING DATA SHEET

Plant: Hard Chromium Specialists, Inc.
Location: York, Pennsylvania
Date: 1/31/89
Run No.: 3--No polypropylene balls
Tank No.: 1

Inlet

Start time: 14:00
Stop time: 16:08

Outlet

Start time: 14:00
Stop time: 16:07

Time (24-h clock)	Voltage, volts	Current, amperes	Temperature of plating solution, °F	Control device ΔP, in. w.c.	Notes
14:00	5	5,400	129	2.6	Testing started: 14:00
14:10	5	5,400	130	2.6	
14:20	5	5,400	130		
14:30	5	5,400	130	2.6	
14:40	5	5,400	131		
14:50	5	5,400	131	2.6	
15:00	5	5,400	131		Sampling stopped for port change: 15:00
15:07	5	5,400	132		Resumed sampling at outlet: 15:07
15:17	5	5,400	132		
15:27	5	5,400	132	2.6	Resumed sampling at inlet: 15:08
15:37	5	5,400	133		
15:47	5	5,400	132	2.6	
15:57	5	5,400	132		
16:07	5	5,400	132	2.6	Testing stopped at outlet: 16:07
					Testing stopped at inlet: 16:08

SOURCE SAMPLING DATA SHEET

Plant: Hard Chromium Specialists, Inc.
Location: York, Pennsylvania
Date: 2/1/89
Run No.: 4--With polypropylene balls
Tank No.: 1

Inlet

Start time: 09:10
Stop time: 12:34

Outlet

Start time: 09:11
Stop time: 12:34

Time (24-h clock)	Voltage, volts	Current, amperes	Temperature of plating solution, °F	Control device ΔP, in. w.c.	Notes
09:10	5	3,000	129	2.6	Testing started at inlet: 09:10
09:20	5	3,000	131	2.6	
09:30	5	3,000	131		Testing started at outlet: 09:11
09:40	5	3,000	131		
09:50	5	3,000	131	2.6	
10:00	5	3,000	132		
10:10	5	3,000	132		
10:20	5	3,000	132		
10:30	5	3,000	132	2.6	
10:40	5	3,000	132		
10:48	5	3,000	132		Sampling stopped for inlet port change: 10:46
					Sampling stopped for outlet port change: 10:47
10:56	5	3,000	132		Resumed sampling at outlet: 10:55
11:06	5	3,000	133		
11:16	5	3,000	132		Resumed sampling at inlet: 10:57
11:26	5	3,000	132		
11:36	5	3,000	132		
11:46	5	3,000	132	2.6	
11:56	5	3,000	132		
12:02	5	3,000	132		
12:06	5	3,000	132		
12:16	5	3,000	132	2.6	
12:26	5	3,000	133		
12:34	5	3,000	133		Testing stopped at outlet: 12:31
					Testing stopped at inlet: 12:33

SOURCE SAMPLING DATA SHEET

Plant: Hard Chromium Specialists, Inc.
Location: York, Pennsylvania
Date: 2/1/89
Run No.: 5--With polypropylene balls
Tank No.: 1

Inlet

Start time: 13:27
Stop time: 15:39

Outlet

Start time: 13:27
Stop time: 15:31

Time (24-h clock)	Voltage, volts	Current, amperes	Temperature of plating solution, °F	Control device ΔP, in. w.c.	Notes
13:26	5	3,000	132	2.6	Testing started: 13:27
13:36	5	3,000	132		
13:46	5	3,000	133		
13:56	5	3,000	132		
14:06	5	3,000	132		
14:16	5	3,000	132	2.6	
14:26	5	3,000	132		Sampling stopped for port change: 14:27
14:38	5	3,000	132		
14:48	5	3,000	132	2.6	Resumed sampling at outlet: 14:31
					Resumed sampling at inlet: 14:39
14:58	5	3,000	133		
15:08	5	3,000	132	2.6	
15:18	5	3,000	132		
15:28	5	3,000	132		Testing stopped outlet: 15:31
15:38	5	3,000	132		Testing stopped inlet: 15:39

APPENDIX F

PROJECT PARTICIPANTS AND ACTIVITY LOG

PROJECT PARTICIPANTS

Name	Title	Responsibility
Frank Clay	U.S. EPA Task Manager Computer Center Coordinator Test Observationist	Observed test activity and on-site data reduction and calculations
John Brown	U.S. EPA, Technician	Conducted Screening Methods tests
Andrew Weisman	PEER Consultants, P.C. Project Leader	Coordinated test activity with plant and contractors Data reduction and report preparation
Eric Hollins	PEER Consultants, P.C. Technician	Assisted in site set-up, sampling, sample recovery
Robert Mentzer	PEER Consultants, P.C. Technician	Assisted in site set-up, sampling, sample recovery
David Wetmore	Pacific Environmental Services	Conducted emission sampling, sample train set-up and recovery
Helen Owens	Pacific Environmental Services Project Leader	On site analysis
Bruce Gerber	Pacific Environmental Services Technician	Conducted emission sampling, sample train set-up and recovery
Mary-Jo Caldwell	MRI NESHAPS Contractor	Monitored process operation