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REPORT ON COMPLIANCE AND RELATIVE ACCURACY TESTING

Carleton, Michigan

Line #1 (EU00079) & Line #2 (EU00080)

Guardian Industries, LLC
14600 Romine Road
Carleton, Michigan 48117
Client Reference No. G000430977

CleanAir Project No. 14903
A2LA ISO 17025 Certificate No. 4342.01
A2LA / STAC Certificate No. 4342.02
Revision 0, Final Report
July 18, 2023

COMMITMENT TO QUALITY

To the best of our knowledge, the data presented in this report are accurate, complete, error free and representative of the actual emissions during the test program. Clean Air Engineering operates in conformance with the requirements of ASTM D7036-04 Standard Practice for Competence of Air Emission Testing Bodies.

Report Submittal:

July 18, 2023

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I hereby certify that the information contained within the final test report has been reviewed and, to the best of my ability, verified as accurate.

Independent Report Review:

July 18, 2023

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REPORT REVISION HISTORY

Version	Revision	Date	Pages	Comments
Draft	D0a	07/07/23	All	Draft version of original document.
Final	0	07/18/23	All	Final version of original document.

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ACRONYMS & ABBREVIATIONS

AAS (atomic absorption spectrometry)
acfm (actual cubic feet per minute)
ACI (activated carbon injection)
ADL (above detection limit)
AIG (ammonia injection grid)
APC (air pollution control)
AQCS (air quality control system(s))
ASME (American Society of Mechanical Engineers)
ASTM (American Society for Testing and Materials)
BDL (below detection limit)
Btu (British thermal units)
CAM (compliance assurance monitoring)
CARB (California Air Resources Board)
CCM (Controlled Condensation Method)
CE (capture efficiency)
°C (degrees Celsius)
CEMS (continuous emissions monitoring system(s))
CFB (circulating fluidized bed)
CFR (Code of Federal Regulations)
cm (centimeter(s))
COMS (continuous opacity monitoring system(s))
CT (combustion turbine)
CTI (Cooling Technology Institute)
CTM (Conditional Test Method)
CVAAS (cold vapor atomic absorption spectroscopy)
CVAFS (cold vapor atomic fluorescence spectrometry)
DI H_2O (de-ionized water)
%dv (percent, dry volume)
DLL (detection level limited)
DE (destruction efficiency)
DCI (dry carbon injection)
DGM (dry gas meter)
dscf (dry standard cubic feet)
dscfm (dry standard cubic feet per minute)
dscm (dry standard cubic meter)
ESP (electrostatic precipitator)
FAMS (flue gas adsorbent mercury speciation)
°F (degrees Fahrenheit)
FB (field blank)
FCC (fluidized catalytic cracking)
FCCU (fluidized catalytic cracking unit)
FEGT (furnace exit gas temperatures)
FF (fabric filter)
FGD (flue gas desulfurization)
FIA (flame ionization analyzer)
FID (flame ionization detector)
FPD (flame photometric detection)
FRB (field reagent blank)
FSTM (flue gas sorbent total mercury)
ft (feet or foot)
ft^2 (square feet)
ft^3 (cubic feet)
ft/sec (feet per second)
FTIR (Fourier Transform Infrared Spectroscopy)
FTRB (field train reagent blank)
g (gram(s))
GC (gas chromatography)
GFAAS (graphite furnace atomic absorption spectroscopy)
GFC (gas filter correlation)
gr/dscf (grains per dry standard cubic feet)
> (greater than)/ ≥ (greater than or equal to)
g/s (grams per second)
H_2O (water)
HAP(s) (hazardous air pollutant(s))
HI (heat input)
hr (hour(s))
HR GC/MS (high-resolution gas chromatography and mass spectrometry)
HRVOC (highly reactive volatile organic compounds)
HSRG(s) (heat recovery steam generator(s))
HVT (high velocity thermocouple)
IC (ion chromatography)
IC/PCR (ion chromatography with post column reactor)
ICP/MS (inductively coupled argon plasma mass spectroscopy)
ID (induced draft)
in. (inch(es))
in. H_2O (inches water)
in. Hg (inches mercury)
IPA (isopropyl alcohol)
ISE (ion-specific electrode)
kg (kilogram(s))
kg/hr (kilogram(s) per hour)
< (less than)/ ≤ (less than or equal to)
L (liter(s))
lb (pound(s))
lb/hr (pound per hour)
lb/MMBtu (pound per million British thermal units)
lb/TBtu (pound per trillion British thermal units)
lb/lb-mole (pound per pound mole)
LR GC/MS (low-resolution gas chromatography and mass spectrometry)
m (meter)
m^3 (cubic meter)
MACT (maximum achievable control technology)
MASS® (Multi-Point Automated Sampling System)
MATS (Mercury and Air Toxics Standards)
MDL (method detection limit)
µg (microgram(s))
min. (minute(s))
mg (milligram(s))
ml (milliliter(s))
MMBtu (million British thermal units)
MW (megawatt(s))
NCASI (National Council for Air and Stream Improvement)
ND (non-detect)
NDIR (non-dispersive infrared)
NDO (natural draft opening)
NESHAP (National Emission Standards for Hazardous Air Pollutants)
ng (nanogram(s))
Nm^3 (Normal cubic meter)
% (percent)
PEMS (predictive emissions monitoring systems)
PFGC (pneumatic focusing gas chromatography)
pg (picogram(s))
PJFF (pulse jet fabric filter)
ppb (parts per billion)
PPE (personal protective equipment)
ppm (parts per million)
ppmdv (parts per million, dry volume)
ppmwv (parts per million, wet volume)
PSD (particle size distribution)
psi (pound(s) per square inch)
PTE (permanent total enclosure)
PTFE (polytetrafluoroethylene)
QA/QC (quality assurance/quality control)
QI (qualified individual)
QSTI (qualified source testing individual)
QSTO (qualified source testing observer)
RA (relative accuracy)
RATA (relative accuracy test audit)
RB (reagent blank)
RE (removal or reduction efficiency)
RM (reference method)
scf (standard cubic feet)
scfm (standard cubic feet per minute)
SCR (selective catalytic reduction)
SDA (spray dryer absorber)
SNCR (selective non-catalytic reduction)
STD (standard)
STMS (sorbent trap monitoring system)
TBtu (trillion British thermal units)
TEOM (Tapered Element Oscillating Microbalance)
TEQ (toxic equivalency quotient)
ton/hr (ton per hour)
ton/yr (ton per year)
TSS (third stage separator)
USEPA or EPA (United States Environmental Protection Agency)
UVA (ultraviolet absorption)
WFGD (wet flue gas desulfurization)
%wv (percent, wet volume)

1. PROJECT OVERVIEW

TEST PROGRAM SUMMARY

Guardian Industries, LLC contracted CleanAir Engineering (CleanAir) to complete testing on Line #1 (EU00079) and Line #2 (EU00080) at Guardian's facility located in Carleton, Michigan. The objective of the test program was complete testing obligations with respect to Michigan Renewable Operating Permit (MI ROP) Number MI-ROP-B1877-2021b.

A summary of the test program results is presented below. Section 2 Results provides a more detailed account of the test conditions and data analysis.

Table 1-1:
Summary of Results / Permit Limits

Source Constituent	Sampling Method	Average Emission	Permit Limit[1]
Line #1 Stack (EU00079)			
FPM (lb/ton of glass produced)	EPA 5	0.04	0.45
Line #1 Outlet (EU00079)			
Sulfuric Acid Mist (lb/hr)[2]	CTM-013	0.2	1.6
Line #2 Stack (EU00080)			
FPM (lb/ton of glass produced)	EPA 5	0.01	0.45
Line #2 Outlet (EU00080)			
Sulfuric Acid Mist (lb/hr)	CTM-013	0.3	1.6

[1] Permit limits obtained from Michigan ROP Number MI-ROP-B1877-2021b.

[2] Sulfuric Acid Mist results based on Ion Chromatography laboratory results.

Table 1-2:
Summary of Results / Performance Specification Limits

Source Constituent	Reference Method	Relative Accuracy (%)[1]	Applicable Specification	Specification Limit[2]
Line #1 (EU00079) Stack				
SO_2 (lb/hr)	EPA 1-4, 6C	4.7	PS6	≤20% RM
SO_2 (lb/ton of glass produced)	EPA 1-4, 6C	5.3	PS6	≤20% RM
NO_x (ppm @7% O_2)	EPA 1-4, 7E	9.3	PS2	≤20% RM
NO_x (lb/hr)	EPA 1-4, 7E	4.4	PS6	≤20% RM
Line #1 (EU00079) Inlet				
NO_x (ppm @7% O_2)	EPA 1-4, 7E	14.0	PS2	≤20% RM
Line #2 (EU00080) Stack				
SO_2 (lb/hr)	EPA 1-4, 6C	1.0	PS6	≤10% Std.
SO_2 (lb/ton of glass produced)	EPA 1-4, 6C	7.4	PS6	≤10% Std.
NO_x (ppm @7% O_2)	EPA 1-4, 7E	6.1	PS2	≤20% RM
NO_x (lb/hr)	EPA 1-4, 7E	5.4	PS6	≤20% RM
Line #2 (EU00080) Inlet				
NO_x (ppm @7% O_2)	EPA 1-4, 7E	3.9	PS2	≤20% RM

[1] Relative Accuracy is expressed in terms of comparison to the reference method (% RM) or applicable emission standard (% Std.) The specific expression used depends on the specification limit cited.

[2] Specification limits obtained from 40 CFR 60, Appendix B, Performance Specifications.

[3] Applicable Standards:
Line #2 (EU00080) Stack SO_2: 134.3 lb/hr and 1.2 lb/ton glass produced

TEST PROGRAM DETAILS

PARAMETERS

The test program included the following measurements:

- filterable particulate matter (FPM)
- sulfuric acid mist (H_2SO_4)
- sulfur dioxide (SO_2) – RATA Only
- nitrogen oxide (NO_x) – RATA Only
- flue gas composition (e.g., O_2, CO_2, H_2O)
- flue gas temperature
- flue gas flow rate

SCHEDULE

Testing was performed on June 6 through June 9, 2023. Tables 1-3 and 1-4 outline the on-site schedule followed during the test program.

Table 1-3:
Line #1 (EU00079) Test Schedule

Run Number	Location	Method	Analyte	Date	Start Time	End Time
2	Line #1 Stack	USEPA Method 5	FPM	06/08/23	13:35	14:57
3	Line #1 Stack	USEPA Method 5	FPM	06/08/23	16:00	17:13
4	Line #1 Stack	USEPA Method 5	FPM	06/09/23	07:16	08:27
2	Line #1 Outlet	CTM-013 (Mod.)	H_2SO_4, as Sulfuric Acid Mist	06/08/23	13:35	14:35
3	Line #1 Outlet	CTM-013 (Mod.)	H_2SO_4, as Sulfuric Acid Mist	06/08/23	16:00	17:00
4	Line #1 Outlet	CTM-013 (Mod.)	H_2SO_4, as Sulfuric Acid Mist	06/09/23	07:16	08:16
1	Line #1 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/09/23	14:54	15:15
2	Line #1 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/09/23	15:16	15:37
3	Line #1 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/09/23	15:37	15:58
4	Line #1 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/09/23	16:27	16:48
5	Line #1 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/09/23	16:49	17:10
6	Line #1 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/09/23	17:11	17:32
7	Line #1 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/09/23	17:55	18:16
8	Line #1 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/09/23	18:16	18:37
9	Line #1 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/09/23	18:38	18:59
10	Line #1 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/09/23	19:25	19:46
11	Line #1 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/09/23	19:46	20:07
12	Line #1 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/09/23	20:07	20:28
1	Line #1 Inlet	USEPA Method 7E	NO_x	06/09/23	14:54	15:15
2	Line #1 Inlet	USEPA Method 7E	NO_x	06/09/23	15:16	15:37
3	Line #1 Inlet	USEPA Method 7E	NO_x	06/09/23	15:37	15:58
4	Line #1 Inlet	USEPA Method 7E	NO_x	06/09/23	16:27	16:48
5	Line #1 Inlet	USEPA Method 7E	NO_x	06/09/23	16:49	17:10
6	Line #1 Inlet	USEPA Method 7E	NO_x	06/09/23	17:11	17:32
7	Line #1 Inlet	USEPA Method 7E	NO_x	06/09/23	17:55	18:16
8	Line #1 Inlet	USEPA Method 7E	NO_x	06/09/23	18:16	18:37
9	Line #1 Inlet	USEPA Method 7E	NO_x	06/09/23	18:38	18:59
10	Line #1 Inlet	USEPA Method 7E	NO_x	06/09/23	19:25	19:46
11	Line #1 Inlet	USEPA Method 7E	NO_x	06/09/23	19:46	20:07
12	Line #1 Inlet	USEPA Method 7E	NO_x	06/09/23	20:07	20:28
1	Line #1 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/09/23	14:54	15:07
2	Line #1 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/09/23	15:17	15:31
3	Line #1 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/09/23	15:35	15:48
4	Line #1 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/09/23	16:27	16:43
5	Line #1 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/09/23	16:49	17:00
6	Line #1 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/09/23	17:11	17:28
7	Line #1 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/09/23	17:55	18:06
8	Line #1 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/09/23	18:16	18:27
9	Line #1 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/09/23	18:38	18:48
10	Line #1 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/09/23	19:25	19:36
11	Line #1 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/09/23	19:46	19:56
12	Line #1 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/09/23	20:07	20:17
1	Line #1 Stack	USEPA Method 4	Moisture	06/09/23	14:54	15:54
2	Line #1 Stack	USEPA Method 4	Moisture	06/09/23	16:27	17:27
3	Line #1 Stack	USEPA Method 4	Moisture	06/09/23	17:55	18:55
4	Line #1 Stack	USEPA Method 4	Moisture	06/09/23	19:25	20:25

Table 1-4:
Line #2 (EU00080) Test Schedule

Run Number	Location	Method	Analyte	Date	Start Time	End Time
1	Line #2 Stack	USEPA Method 5	FPM	06/06/23	09:25	11:05
2	Line #2 Stack	USEPA Method 5	FPM	06/06/23	13:24	14:47
3	Line #2 Stack	USEPA Method 5	FPM	06/06/23	16:02	17:14
1	Line #2 Outlet	CTM-013 (Mod.)	H_2SO_4, as Sulfuric Acid Mist	06/06/23	09:25	10:25
2	Line #2 Outlet	CTM-013 (Mod.)	H_2SO_4, as Sulfuric Acid Mist	06/06/23	13:24	14:24
3	Line #2 Outlet	CTM-013 (Mod.)	H_2SO_4, as Sulfuric Acid Mist	06/06/23	16:02	17:02
1	Line #2 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/07/23	07:47	08:08
2	Line #2 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/07/23	08:08	08:29
3	Line #2 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/07/23	08:57	09:18
4	Line #2 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/07/23	09:56	10:17
5	Line #2 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/07/23	10:18	10:39
6	Line #2 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/07/23	10:39	11:00
7	Line #2 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/07/23	12:11	12:32
8	Line #2 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/07/23	12:33	12:54
9	Line #2 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/07/23	12:55	13:16
10	Line #2 Stack	USEPA Methods 6C, 7E	SO_2 and NO_x	06/07/23	13:59	14:20
1	Line #2 Inlet	USEPA Method 7E	NO_x	06/07/23	07:47	08:08
2	Line #2 Inlet	USEPA Method 7E	NO_x	06/07/23	08:08	08:29
3	Line #2 Inlet	USEPA Method 7E	NO_x	06/07/23	08:57	09:18
4	Line #2 Inlet	USEPA Method 7E	NO_x	06/07/23	09:56	10:17
5	Line #2 Inlet	USEPA Method 7E	NO_x	06/07/23	10:18	10:39
6	Line #2 Inlet	USEPA Method 7E	NO_x	06/07/23	10:39	11:00
7	Line #2 Inlet	USEPA Method 7E	NO_x	06/07/23	12:11	12:32
8	Line #2 Inlet	USEPA Method 7E	NO_x	06/07/23	12:33	12:54
9	Line #2 Inlet	USEPA Method 7E	NO_x	06/07/23	12:55	13:16
10	Line #2 Inlet	USEPA Method 7E	NO_x	06/07/23	13:59	14:20
1	Line #2 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/07/23	07:47	08:06
2	Line #2 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/07/23	08:10	08:49
3	Line #2 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/07/23	08:59	09:18
4	Line #2 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/07/23	09:50	10:10
5	Line #2 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/07/23	10:18	10:28
6	Line #2 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/07/23	10:39	10:47
7	Line #2 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/07/23	12:11	12:21
8	Line #2 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/07/23	12:33	12:43
9	Line #2 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/07/23	12:55	13:03
10	Line #2 Stack	USEPA Methods 2 & 4	Velocity, Flow Rate	06/07/23	14:04	14:17
1	Line #1 Stack	USEPA Method 4	Moisture	06/07/23	08:26	09:26
2	Line #1 Stack	USEPA Method 4	Moisture	06/07/23	09:50	10:50
3	Line #1 Stack	USEPA Method 4	Moisture	06/07/23	12:11	13:11
4	Line #1 Stack	USEPA Method 4	Moisture	06/07/23	14:04	14:39

DISCUSSION

EPA Method 5 Compliance

EPA Method 5, "Determination of Particulate Emissions from Stationary Sources", was followed for the filterable particulate matter (FPM) measurements. This method is contained in Appendix A of 40 CFR 60. Method 5 defines particulate matter as any material that is collected before or on the surface of a quartz fiber filter.

Stack gas was isokinetically withdrawn through a temperature-controlled probe and high-efficiency quartz fiber filter. A minimum of 30 dry standard cubic feet of sample gas was collected over a one-hour test period for each run. A set of impingers were connected to the outlet of the filter. They were gravimetrically measured before and after each test to determine flue gas moisture content. A slipstream of the dry-filtered flue gas exiting the dry gas meter was collected in a flexible bag. This gas sample was analyzed for oxygen and carbon dioxide following Method 3A for each tes1t.

The front-half of the sampling train consisted of a stainless-steel nozzle and probe liner on Line #1 (due to the large diameter of the stack) and a glass nozzle and probe liner on Line #2. These were followed by a filter holder heated to 120°C ±14°C (248°F ±25°F), and a quartz fiber filter.

After exiting the filter, the flue gas passed through a Teflon line into a series of glass impingers surrounded by ice. The purpose of the impingers was to determine the flue gas moisture concentration and thoroughly dry the gas. The sample gas then flowed into a calibrated dry gas meter where the collected sample gas volume was determined.

The front-half portion of the sample train (nozzle, probe, and heated filter) was recovered per Method 5 requirements, using acetone as the recovery solvent. The filters and front-half acetone rinses were sent to CleanAir's laboratory in Palatine, Illinois for gravimetric analysis.

Line #1, Run 1 was invalidated due to a sampling equipment problem. Compliance is based on Runs 2, 3, and 4. Because the CTM-013 testing was performed in tandem with the Method 5 testing, Run 1 was also invalidated for the CTM-013 testing.

Sulfuric Acid Mist – CTM-013

CleanAir followed EPA Conditional Test Method 013 (CTM-013). This method is applicable for the determination of sulfur trioxide (SO_3) and sulfuric acid vapor/mist (H_2SO_4) using a controlled condensation sampling system.

The key operating parameters for this method included:

- Probe was maintained at a temperature of >350°F.
- Quartz fiber filter was maintained at a temperature of >500°F.
- H_2SO_4 condenser - Modified Graham condenser, filled with water and temperatures were maintained between 75 and 85°C (167 to 185°F).

A second filter, referred to as the sulfuric acid mist (SAM) filter, was located at the condenser outlet for the collection of residual sulfuric acid aerosols not collected by the condenser. The condenser temperature was regulated by a water jacket and the SAM filter was regulated by a closed oven. Both the water jacket and oven were maintained between 167°F to 185°F. The condenser and SAM filter (glass frit) were maintained above the water dew point, which eliminated the problem of oxidation of dissolved SO_2.

The condenser collection media, including the coil condenser rinse and glass frit, were extracted with DI water.

CleanAir conducted three 1-hour CTM-013 tests for the determination of sulfuric acid mist. At the conclusion of each test, samples were recovered and sent to the on-site laboratory trailer for analysis. CleanAir analyzed the samples on-site with barium-thorin titration procedures on the day of sampling. CleanAir also analyzed the same samples the following day using ion chromatography (IC).

Moisture and flow data from the concurrent EPA Method 5 testing were used to calculate mass emission rates.

Relative Accuracy Testing

Relative accuracy testing consisted of concurrent pollutant emissions measurements using the facility CEMS and a RM monitoring system. The RATA consisted of 12 runs of gaseous measurements for Line #1 and 10 runs for Line #2. The best nine runs were used for the RATA calculations. Each test run was 21 minutes in length.

CleanAir performed a leak check of each sampling system in its entirety prior to performing the initial bias check. The acceptable leak rate for this check is zero liters per minute (lpm) for 30 seconds, as measured on the flow control panel.

In accordance with Performance Specification 2, Paragraph 8.1.3.2, three sample points were located along a measurement line that passed through the centroidal area. The three points were located at 83.3%, 50.0%, and 16.7%.

A calibration error check and an initial system bias were performed successfully. Copies of the RM calibration error and other RM QA/QC information are in Appendix G. Calibration gas certifications are in Appendix D. Additional data reduction and calculated result parameters are in Appendix C.

A passing converter efficiency check was performed on the RM NO_x analyzer according to Section 16.2 of Method 7E. The converter efficiency check is in Appendix D.

Oxygen (O_2) and carbon dioxide (CO_2) data used in the molecular weight calculation was determined using Method 3A and analyzed via a calibrated paramagnetic/IR instrument analyzer.

Twelve Method 2 velocity traverses were performed during the RATA. One Method 4 moisture run was conducted for every three RATA runs for a total of four moisture runs performed. The results from the Methods 2 and 4 testing were used to convert the compliance data concentration-based results into mass-based emission results in units of lb/hr and lb/ton glass produced.

End of Section

2. RESULTS

This section summarizes the test program results. Additional results are available in the report appendices.

Table 2-1:
Line #1 Stack (EU00079) – FPM

Run No.		2	3	4	Average
Date (2023)		Jun 8	Jun 8	Jun 9	
Start Time (approx.)		13:35	16:00	07:16	
Stop Time (approx.)		14:57	17:13	08:27	
Process Conditions					
R_P	Production rate (ton of glass produced/hr)	16.7	16.7	16.7	**16.7**
Gas Conditions					
O_2	Oxygen (dry volume %)	11.2	11.0	10.1	**10.8**
CO_2	Carbon dioxide (dry volume %)	8.1	8.4	7.8	**8.1**
T_s	Stack temperature (°F)	594	594	591	**593**
B_w	Actual water vapor in gas (% by volume)	11.6	12.4	12.0	**12.0**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	98,500	102,000	102,000	**101,000**
Q_s	Volumetric flow rate, standard (scfm)	47,900	49,700	49,700	**49,100**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	42,400	43,500	43,800	**43,200**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	39.19	40.71	41.57	**40.49**
%I	Isokinetic sampling (%)	100.7	101.9	103.4	**102.0**
Laboratory Data					
m_{filter}	Matter collected on filter(s) (g)	0.00204	0.00305	0.00191	
m_s	Matter collected in solvent rinse(s) (g)	0.00164	0.00321	0.00244	
m_n	Total FPM (g)	0.00368	0.00626	0.00435	
FPM Results					
C_{sd}	Particulate Concentration (lb/dscf)	2.07E-07	3.39E-07	2.31E-07	**2.59E-07**
$E_{lb/hr}$	Particulate Rate (lb/hr)	0.526	0.884	0.606	**0.672**
E_{Rp}	Particulate Rate - Production-based (lb/ton of glass produced)	0.0315	0.0529	0.0364	**0.0403**

Average includes 3 runs.

Table 2-2:
Line #1 Outlet (EU00079) – Sulfuric Acid Mist

Run No.[1]		2	3	4	Average
Date (2023)		Jun 8	Jun 8	Jun 9	
Start Time (approx.)		13:35	16:00	07:16	
Stop Time (approx.)		14:35	17:00	08:16	
Gas Conditions					
O_2	Oxygen (dry volume %)	11.2	11.0	10.1	**10.8**
CO_2	Carbon dioxide (dry volume %)	8.1	8.4	7.8	**8.1**
T_s	Stack temperature (°F)	632	623	612	**622**
B_w	Actual water vapor in gas (% by volume)	11.72	11.67	12.96	**12.12**
Gas Flow Rate[2]					
Q_a	Volumetric flow rate, actual (acfm)	98,500	102,000	102,000	**101,000**
Q_s	Volumetric flow rate, standard (scfm)	47,900	49,700	49,700	**49,100**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	42,400	43,500	43,800	**43,200**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	23.78	23.65	24.02	**23.82**
Laboratory Data (Ion Chromatography)					
m_n	Total H2SO4 collected (mg)	0.5580	0.6758	0.9514	
Laboratory Data (Titration)					
m_n	Total H2SO4 collected (mg)	0.9303	0.8908	1.0224	
Sulfuric Acid Mist (H2SO4) IC Results					
C_{sd}	H2SO4 Concentration (ppmdv)	0.203	0.248	0.343	**0.265**
$E_{lb/hr}$	H2SO4 Rate (lb/hr)	0.132	0.164	0.229	**0.175**
Sulfuric Acid Mist (H2SO4) Titration Results					
C_{sd}	H2SO4 Concentration (ppmdv)	0.339	0.326	0.369	**0.345**
$E_{lb/hr}$	H2SO4 Rate (lb/hr)	0.219	0.217	0.246	**0.227**

[1] Run 1 was invalidated due to a sampling train equipment problem during the concurrently run Method 5 test.

[2] Velocity and flow rate data obtained from USEPA Method 5 testing.

Table 2-3:
Line #1 Stack (EU00079) – SO_2 RATA (lb/hr)

Run No.	Start Time	Date (2023)	RM Data (lb/hr)	CEMS Data (lb/hr)	Difference (lb/hr)	Difference Percent
1 *	14:54	Jun 9	4.46	5.00	-0.54	-12.2%
2 *	15:16	Jun 9	2.68	4.50	-1.82	-67.9%
3 *	15:37	Jun 9	4.33	5.20	-0.87	-20.2%
4	16:27	Jun 9	4.89	5.10	-0.21	-4.3%
5	16:49	Jun 9	5.16	5.30	-0.14	-2.8%
6	17:11	Jun 9	5.09	5.30	-0.21	-4.2%
7	17:55	Jun 9	4.81	5.30	-0.49	-10.2%
8	18:16	Jun 9	4.96	5.40	-0.44	-8.9%
9	18:38	Jun 9	5.16	5.40	-0.24	-4.7%
10	19:25	Jun 9	4.61	4.90	-0.29	-6.3%
11	19:46	Jun 9	4.62	5.00	-0.38	-8.2%
12	20:07	Jun 9	4.66	5.20	-0.54	-11.5%
	Average		**4.88**	**5.21**	**-0.33**	**-6.7%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	0.138956	
Confidence Coefficient (CC)	0.106810	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of RM)	**8.89%**	**20.0%**

RM = Reference Method (CleanAir Data) 062323 160415
CEMS = Continuous Emissions Monitoring System (Guardian Industries, LLC Data)
RATA calculations are based on 9 of 12 runs. * indicates the excluded runs.

Table 2-4:
Line #1 Stack (EU00079) – SO_2 RATA (lb/ton of Glass Produced)

Run No.	Start Time	Date (2023)	RM Data (lb/ton of glass produced)	CEMS Data (lb/ton of glass produced)	Difference (lb/ton of glass produced)	Difference Percent
1 *	14:54	Jun 9	0.27	0.30	-0.03	-12.2%
2 *	15:16	Jun 9	0.16	0.27	-0.11	-67.9%
3 *	15:37	Jun 9	0.26	0.31	-0.05	-19.4%
4	16:27	Jun 9	0.29	0.31	-0.02	-5.6%
5	16:49	Jun 9	0.31	0.32	-0.01	-3.4%
6	17:11	Jun 9	0.31	0.32	-0.01	-4.8%
7	17:55	Jun 9	0.29	0.32	-0.03	-10.7%
8	18:16	Jun 9	0.30	0.33	-0.03	-10.8%
9	18:38	Jun 9	0.31	0.33	-0.02	-6.5%
10	19:25	Jun 9	0.28	0.30	-0.02	-8.4%
11	19:46	Jun 9	0.28	0.30	-0.02	-8.0%
12	20:07	Jun 9	0.28	0.31	-0.03	-10.6%
Average			**0.29**	**0.32**	**-0.02**	**-7.6%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	0.007576	
Confidence Coefficient (CC)	0.005823	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of RM)	**9.58%**	**20.0%**

RM = Reference Method (CleanAir Data) 062323 160415
CEMS = Continuous Emissions Monitoring System (Guardian Industries, LLC Data)
RATA calculations are based on 9 of 12 runs. * indicates the excluded runs.

Table 2-5:
Line #1 Stack (EU00079) – NO_x RATA (ppm @7% O_2)

Run No.	Start Time	Date (2023)	RM Data (ppm@7%O2)	CEMS Data (ppm@7%O2)	Difference (ppm@7%O2)	Difference Percent
1	14:54	Jun 9	166.9	156.2	10.7	6.4%
2	15:16	Jun 9	175.1	162.2	12.9	7.4%
3	15:37	Jun 9	148.8	138.7	10.1	6.8%
4	16:27	Jun 9	157.2	144.0	13.2	8.4%
5 *	16:49	Jun 9	167.7	151.6	16.1	9.6%
6 *	17:11	Jun 9	144.1	143.4	0.7	0.5%
7	17:55	Jun 9	164.3	152.8	11.5	7.0%
8	18:16	Jun 9	151.2	139.9	11.3	7.5%
9	18:38	Jun 9	174.9	161.6	13.3	7.6%
10	19:25	Jun 9	188.0	173.5	14.5	7.7%
11 *	19:46	Jun 9	163.1	148.3	14.8	9.0%
12	20:07	Jun 9	176.6	162.5	14.1	8.0%
	Average		**167.0**	**154.6**	**12.4**	**7.4%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	1.531915	
Confidence Coefficient (CC)	1.177532	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of RM)	**8.13%**	**20.0%**

RM = Reference Method (CleanAir Data) 062323 160415
CEMS = Continuous Emissions Monitoring System (Guardian Industries, LLC Data)
RATA calculations are based on 9 of 12 runs. * indicates the excluded runs.

Table 2-6:
Line #1 Stack (EU00079) – NO_x RATA (lb/hr)

Run No.	Start Time	Date (2023)	RM Data (lb/hr)	CEMS Data (lb/hr)	Difference (lb/hr)	Difference Percent
1	14:54	Jun 9	39.2	39.7	-0.5	-1.4%
2	15:16	Jun 9	39.1	39.0	0.1	0.1%
3	15:37	Jun 9	35.5	35.9	-0.4	-1.0%
4	16:27	Jun 9	39.5	37.9	1.6	4.1%
5 *	16:49	Jun 9	41.7	39.6	2.1	5.0%
6 *	17:11	Jun 9	35.8	37.5	-1.7	-4.7%
7	17:55	Jun 9	40.4	40.1	0.3	0.8%
8	18:16	Jun 9	37.6	36.9	0.7	1.8%
9	18:38	Jun 9	44.0	42.5	1.5	3.4%
10	19:25	Jun 9	45.9	44.1	1.8	4.0%
11 *	19:46	Jun 9	39.8	38.7	1.1	2.9%
12	20:07	Jun 9	44.0	43.4	0.6	1.3%
	Average		**40.6**	**39.9**	**0.6**	**1.6%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	0.868194	
Confidence Coefficient (CC)	0.667352	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of RM)	**3.21%**	**20.0%**

RM = Reference Method (CleanAir Data) 062323 160415
CEMS = Continuous Emissions Monitoring System (Guardian Industries, LLC Data)
RATA calculations are based on 9 of 12 runs. * indicates the excluded runs.

Table 2-7:
Line #1 Inlet (EU00079) – NO_x RATA (ppm @7% O_2)

Run No.	Start Time	Date (2023)	RM Data (ppm@7%O2)	CEMS Data (ppm@7%O2)	Difference (ppm@7%O2)	Difference Percent
1	14:54	Jun 9	1049.1	1179.8	-130.7	-12.5%
2 *	15:16	Jun 9	1097.0	1618.1	-521.1	-47.5%
3	15:37	Jun 9	1046.8	1160.9	-114.1	-10.9%
4	16:27	Jun 9	1062.8	1197.4	-134.6	-12.7%
5	16:49	Jun 9	1072.8	1187.0	-114.2	-10.6%
6	17:11	Jun 9	1079.4	1204.4	-125.0	-11.6%
7	17:55	Jun 9	1085.5	1215.2	-129.7	-12.0%
8 *	18:16	Jun 9	909.4	1194.2	-284.8	-31.3%
9 *	18:38	Jun 9	211.2	1240.5	-1029.3	-487.5%
10	19:25	Jun 9	1117.5	1259.8	-142.3	-12.7%
11	19:46	Jun 9	1072.1	1215.5	-143.4	-13.4%
12	20:07	Jun 9	1078.8	1263.1	-184.3	-17.1%
	Average		**1073.9**	**1209.2**	**-135.4**	**-12.6%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	21.119689	
Confidence Coefficient (CC)	16.234001	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of RM)	**14.12%**	**20.0%**

RM = Reference Method (CleanAir Data) 062323 160415
CEMS = Continuous Emissions Monitoring System (Guardian Industries, LLC Data)
RATA calculations are based on 9 of 12 runs. * indicates the excluded runs.

Table 2-8:
Line #2 Stack (EU00080) – FPM

Run No.		1	2	3	Average
Date (2023)		Jun 6	Jun 6	Jun 6	
Start Time (approx.)		09:25	13:24	16:02	
Stop Time (approx.)		11:05	14:47	17:14	
Process Conditions					
R_P	Production rate (ton of glass produced/hr)	17.8	17.8	17.8	**17.8**
Gas Conditions					
O_2	Oxygen (dry volume %)	14.2	14.1	14.1	**14.2**
CO_2	Carbon dioxide (dry volume %)	4.2	4.3	4.3	**4.3**
T_s	Stack temperature (°F)	457	461	456	**458**
B_w	Actual water vapor in gas (% by volume)	9.1	8.6	8.6	**8.8**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	88,200	93,300	92,800	**91,400**
Q_s	Volumetric flow rate, standard (scfm)	49,600	52,200	52,200	**51,400**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	45,100	47,700	47,700	**46,900**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	40.90	43.97	45.39	**43.42**
%I	Isokinetic sampling (%)	97.0	98.5	101.7	**99.1**
Laboratory Data					
m_{filter}	Matter collected on filter(s) (g)	0.00037	0.00082	0.00029	
m_s	Matter collected in solvent rinse(s) (g)	0.00120	0.00095	0.00130	
m_n	Total FPM (g)	0.00157	0.00177	0.00159	
FPM Results					
C_{sd}	Particulate Concentration (lb/dscf)	8.46E-08	8.88E-08	7.72E-08	**8.35E-08**
$E_{lb/hr}$	Particulate Rate (lb/hr)	0.229	0.254	0.221	**0.235**
E_{Rp}	Particulate Rate - Production-based (lb/ton of glass produced)	0.0129	0.0143	0.0125	**0.0132**

Average includes 3 runs.

Table 2-9:
Line #2 Outlet (EU00080) – Sulfuric Acid Mist

Run No.		1	2	3	Average
Date (2023)		Jun 6	Jun 6	Jun 6	
Start Time (approx.)		09:25	13:24	16:02	
Stop Time (approx.)		10:25	14:24	17:02	
Gas Conditions					
O_2	Oxygen (dry volume %)	14.2	14.1	14.1	**14.2**
CO_2	Carbon dioxide (dry volume %)	4.2	4.3	4.3	**4.3**
T_s	Stack temperature (°F)	482	489	483	**485**
B_w	Actual water vapor in gas (% by volume)	11.21	9.92	9.39	**10.17**
Gas Flow Rate[1]					
Q_a	Volumetric flow rate, actual (acfm)	88,200	93,300	92,800	**91,400**
Q_s	Volumetric flow rate, standard (scfm)	49,600	52,200	52,200	**51,400**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	45,100	47,700	47,700	**46,900**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	24.31	23.63	24.05	**24.00**
Laboratory Data (Ion Chromatography)					
m_n	Total H2SO4 collected (mg)	0.5987	0.8004	1.0171	
Laboratory Data (Titration)					
m_n	Total H2SO4 collected (mg)	0.83312	1.39382	1.39242	
Sulfuric Acid Mist (H2SO4) IC Results					
C_{sd}	H2SO4 Concentration (ppmdv)	0.213	0.294	0.366	**0.291**
$E_{lb/hr}$	H2SO4 Rate (lb/hr)	0.147	0.214	0.267	**0.209**
Sulfuric Acid Mist (H2SO4) Titration Results					
C_{sd}	H2SO4 Concentration (ppmdv)	0.29699	0.5113	0.5017	**0.437**
$E_{lb/hr}$	H2SO4 Rate (lb/hr)	0.20448	0.37264	0.36557	**0.314**

[1] Velocity and flow rate data obtained from USEPA Method 5 testing.

Table 2-10:
Line #2 Stack (EU00080) – SO_2 RATA (lb/hr)

Run No.	Start Time	Date (2023)	RM Data (lb/hr)	CEMS Data (lb/hr)	Difference (lb/hr)	Difference Percent
1	07:47	Jun 7	5.70	7.20	-1.50	-26.4%
2	08:08	Jun 7	7.99	9.20	-1.21	-15.1%
3	08:57	Jun 7	7.34	8.50	-1.16	-15.8%
4	09:56	Jun 7	5.85	6.90	-1.05	-17.9%
5	10:18	Jun 7	6.96	8.10	-1.14	-16.4%
6 *	10:39	Jun 7	5.26	6.60	-1.34	-25.4%
7	12:11	Jun 7	6.20	7.20	-1.00	-16.1%
8	12:33	Jun 7	4.77	6.00	-1.23	-25.8%
9	12:55	Jun 7	6.50	7.20	-0.70	-10.8%
10	13:59	Jun 7	5.30	6.70	-1.40	-26.4%
	Average		**6.29**	**7.44**	**-1.15**	**-18.3%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	0.231835	
Confidence Coefficient (CC)	0.178204	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of Appl. Std.)	**0.99%**	**10.0%**
Appl. Std. = 134.3 lb/hr		

RM = Reference Method (CleanAir Data) 062323 160549
CEMS = Continuous Emissions Monitoring System (Guardian Industries, LLC Data)
RATA calculations are based on 9 of 10 runs. * indicates the excluded run.

Table 2-11:
Line #2 Stack (EU00080) – SO_2 RATA (lb/ton of Glass Produced)

Run No.	Start Time	Date (2023)	RM Data (lb/ton of glass produced)	CEMS Data (lb/ton of glass produced)	Difference (lb/ton of glass produced)	Difference Percent
1	07:47	Jun 7	0.32	0.40	-0.08	-24.3%
2	08:08	Jun 7	0.45	0.50	-0.05	-10.8%
3	08:57	Jun 7	0.41	0.50	-0.09	-20.6%
4	09:56	Jun 7	0.33	0.40	-0.07	-21.0%
5	10:18	Jun 7	0.39	0.50	-0.11	-27.2%
6 *	10:39	Jun 7	0.30	0.40	-0.10	-34.5%
7	12:11	Jun 7	0.35	0.40	-0.05	-14.2%
8	12:33	Jun 7	0.27	0.30	-0.03	-11.4%
9	12:55	Jun 7	0.37	0.40	-0.03	-9.0%
10	13:59	Jun 7	0.30	0.40	-0.10	-33.6%
Average			**0.36**	**0.42**	**-0.07**	**-18.8%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	0.028091	
Confidence Coefficient (CC)	0.021593	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of Appl. Std.)	**7.38%**	**10.0%**
Appl. Std. = 1.2 lb/ton of glass produced		

RM = Reference Method (CleanAir Data) 062323 160549
CEMS = Continuous Emissions Monitoring System (Guardian Industries, LLC Data)
RATA calculations are based on 9 of 10 runs. * indicates the excluded run.

Table 2-12:
Line #2 Stack (EU00080) – NO_x RATA (ppm @7% O_2)

Run No.	Start Time	Date (2023)	RM Data (ppm@7%O2)	CEMS Data (ppm@7%O2)	Difference (ppm@7%O2)	Difference Percent
1	07:47	Jun 7	332.2	354.5	-22.3	-6.7%
2 *	08:08	Jun 7	372.3	392.7	-20.4	-5.5%
3	08:57	Jun 7	330.1	351.8	-21.7	-6.6%
4	09:56	Jun 7	370.0	383.0	-13.0	-3.5%
5	10:18	Jun 7	361.1	387.3	-26.2	-7.2%
6	10:39	Jun 7	369.3	388.1	-18.8	-5.1%
7	12:11	Jun 7	405.6	426.5	-20.9	-5.1%
8	12:33	Jun 7	371.6	391.4	-19.8	-5.3%
9	12:55	Jun 7	393.9	408.6	-14.7	-3.7%
10	13:59	Jun 7	370.5	385.5	-15.0	-4.1%
	Average		**367.2**	**386.3**	**-19.1**	**-5.2%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	4.234677	
Confidence Coefficient (CC)	3.255055	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of RM)	**6.10%**	**20.0%**

RM = Reference Method (CleanAir Data) 062323 160549
CEMS = Continuous Emissions Monitoring System (Guardian Industries, LLC Data)
RATA calculations are based on 9 of 10 runs. * indicates the excluded run.

Table 2-13:
Line #2 Stack (EU00080) – NO_x RATA (lb/hr)

Run No.	Start Time	Date (2023)	RM Data (lb/hr)	CEMS Data (lb/hr)	Difference (lb/hr)	Difference Percent
1	07:47	Jun 7	53.4	57.5	-4.1	-7.7%
2 *	08:08	Jun 7	59.6	64.6	-5.0	-8.4%
3	08:57	Jun 7	53.3	57.1	-3.8	-7.0%
4	09:56	Jun 7	62.8	62.6	0.2	0.3%
5	10:18	Jun 7	58.3	62.2	-3.9	-6.6%
6	10:39	Jun 7	60.3	62.4	-2.1	-3.6%
7	12:11	Jun 7	66.5	68.7	-2.2	-3.3%
8	12:33	Jun 7	60.8	61.7	-0.9	-1.5%
9	12:55	Jun 7	66.4	65.8	0.6	0.9%
10	13:59	Jun 7	61.7	62.1	-0.4	-0.7%
	Average		**60.4**	**62.2**	**-1.8**	**-3.1%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	1.805617	
Confidence Coefficient (CC)	1.387918	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of RM)	**5.36%**	**20.0%**

RM = Reference Method (CleanAir Data) 062323 160549
CEMS = Continuous Emissions Monitoring System (Guardian Industries, LLC Data)
RATA calculations are based on 9 of 10 runs. * indicates the excluded run.

Table 2-14:
Line #2 Inlet (EU00080) – NO_x RATA (ppm @7% O_2)

Run No.	Start Time	Date (2023)	RM Data (ppm@7%O2)	CEMS Data (ppm@7%O2)	Difference (ppm@7%O2)	Difference Percent
1	07:47	Jun 7	1915.5	1822.4	93.1	4.9%
2	08:08	Jun 7	1975.0	1941.1	33.9	1.7%
3	08:57	Jun 7	1933.9	1877.4	56.5	2.9%
4	09:56	Jun 7	2000.7	1999.5	1.2	0.1%
5 *	10:18	Jun 7	1994.0	1892.0	102.0	5.1%
6	10:39	Jun 7	2024.4	2031.2	-6.8	-0.3%
7	12:11	Jun 7	2111.6	2029.4	82.2	3.9%
8	12:33	Jun 7	2022.4	1932.7	89.7	4.4%
9	12:55	Jun 7	2084.7	2035.1	49.6	2.4%
10	13:59	Jun 7	2051.3	1987.1	64.2	3.1%
	Average		**2013.3**	**1961.8**	**51.5**	**2.6%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	36.336917	
Confidence Coefficient (CC)	27.930977	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of RM)	**3.95%**	**20.0%**

RM = Reference Method (CleanAir Data) 062323 160549
CEMS = Continuous Emissions Monitoring System (Guardian Industries, LLC Data)
RATA calculations are based on 9 of 10 runs. * indicates the excluded run.

End of Section

3. DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

Guardian's flat glass manufacturing Line #1 and Line #2 consist of a raw material melting Furnace, glass forming and finishing, and glass cutting. Line #1 and Line #2 produce flat glass using the float method. Materials are weighed and mixed with water in the batch house before entering the natural gas-fired Furnace. Glass then enters the tin bath to be formed and drawn. Next, it enters a lehr to reduce its temperature. The natural gas-fired Furnace portion of the emission unit is controlled by a control device consisting of a Dry Scrubber (DS), Particulate Filter (PF), and Selective Catalytic Reduction (SCR).

The emission unit includes a 4,000 cubic foot Dry Scrubber reagent storage silo equipped with a passive bin vent and a 20,000-gallon pressurized aqueous ammonia storage tank.

The testing reported in this document will be performed at the Stack locations (EU00079 and EU00080).

TEST LOCATIONS

The sample point placement was determined by EPA Method 1 and Performance Specification 2. Table 3-1 presents the sampling information for the test locations. The figures represent the layout of the test location.

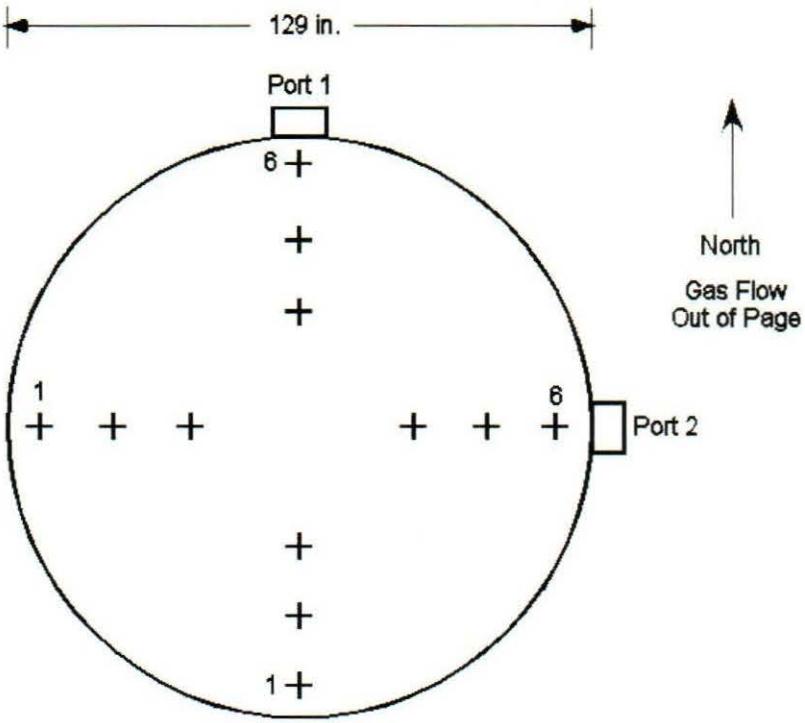
Table 3-1:
Sampling Information

Source Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
Line #1 Stack (EU00079)							
Flow Rate	EPA 2	1-12	2	6	Varied	Varied	3-1
Moisture	EPA 4	1-3	1	1	60	60	NA
FPM	EPA 5	2-4	2	6	5	60	3-1
Line #1 Outlet (EU00079)							
H_2SO_4, as Sulfuric Acid Mist	CTM-013	2-4	1	1	60	60	NA
SO_2, NO_x	EPA 6C, 7E	1-12	1	3	7	21	3-2
Line #1 Inlet (EU00079)							
NO_x	EPA 7E	1-12	1	3	7	21	3-3
Line #2 Stack (EU00080)							
Flow Rate	EPA 2	1-10	2	6	Varied	Varied	3-4
Moisture	EPA 4	1-3	1	1	60	60	NA
Moisture	EPA 4	4	1	1	35	35	NA
FPM	EPA 5	1-3	2	6	5	60	3-4
Line #2 Outlet (EU00080)							
H_2SO_4, as Sulfuric Acid Mist	CTM-013	1-3	1	1	60	60	NA
SO_2, NO_x	EPA 6C, 7E	1-10	1	3	7	21	3-5
Line #2 Inlet (EU00080)							
NO_x	EPA 7E	1-10	1	3	7	21	3-6

Note:

Moisture and H_2SO_4 were sampled at the approximate center of the duct. Readings were taken every five minutes.

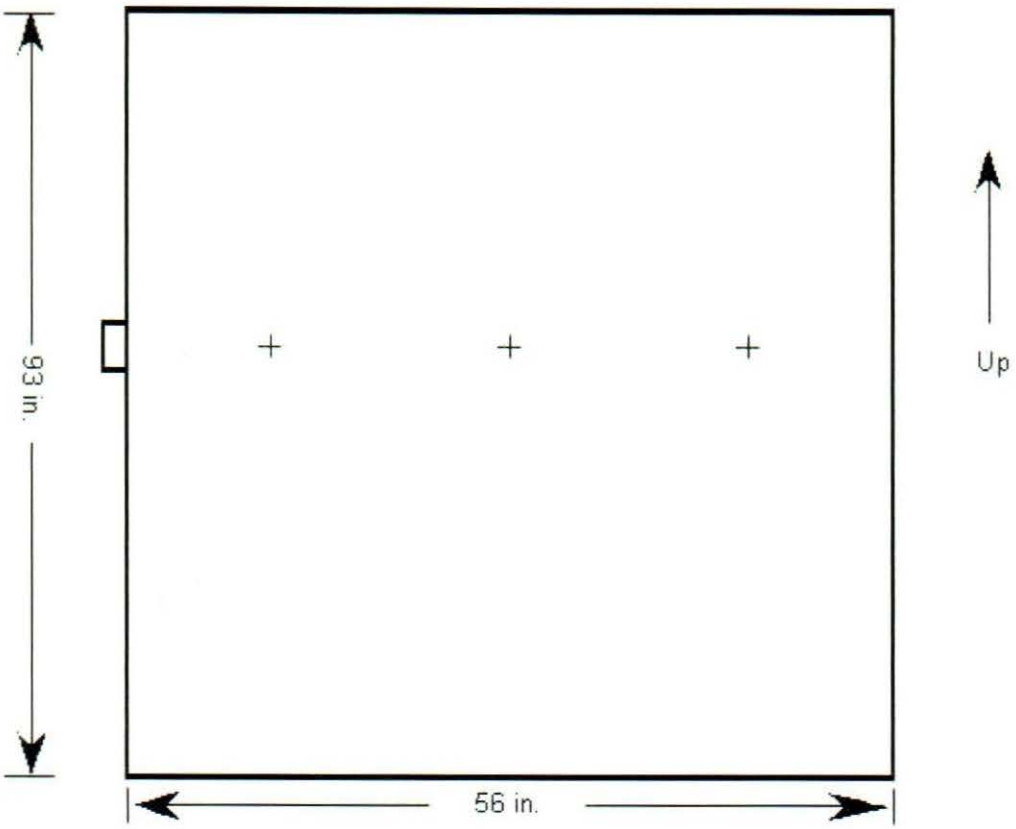
Figure 3-1:
EU00079 Stack Sample Point Layout (EPA Method 1)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	95.6	123.3
2	85.4	110.2
3	70.4	90.8
4	29.6	38.2
5	14.6	18.8
6	4.4	5.7

Duct diameters upstream from flow disturbance (A): 11.2 Limit: 0.5
Duct diameters downstream from flow disturbance (B): 7.0 Limit: 2.0

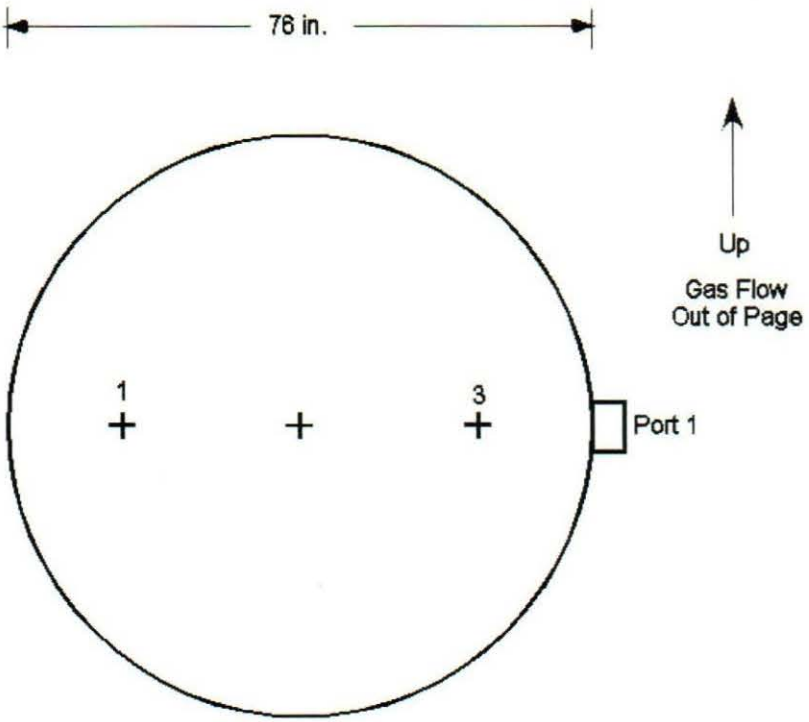
Figure 3-2:
EU00079 Outlet (Performance Specification 2)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	83.3	46.7
2	50.0	28.0
3	16.7	9.4

Equivalent duct diameters upstream from flow disturbance (A): 1.9 Limit: NA
Equivalent duct diameters downstream from flow disturbance (B): 5.7 Limit: NA

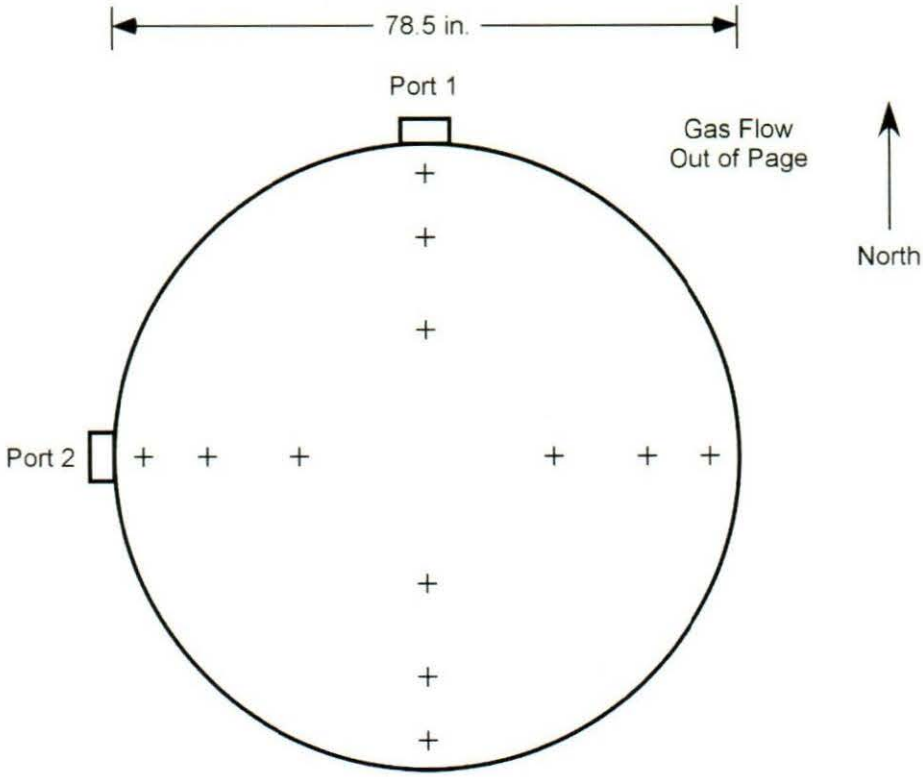
Figure 3-3:
EU00079 Inlet (Performance Specification 2)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	83.3	63.3
2	50.0	38.0
3	16.7	12.7

Duct diameters upstream from flow disturbance (A): ≈0.4 Limit: 0.5
Duct diameters downstream from flow disturbance (B): ≈1.9 Limit: 2.0

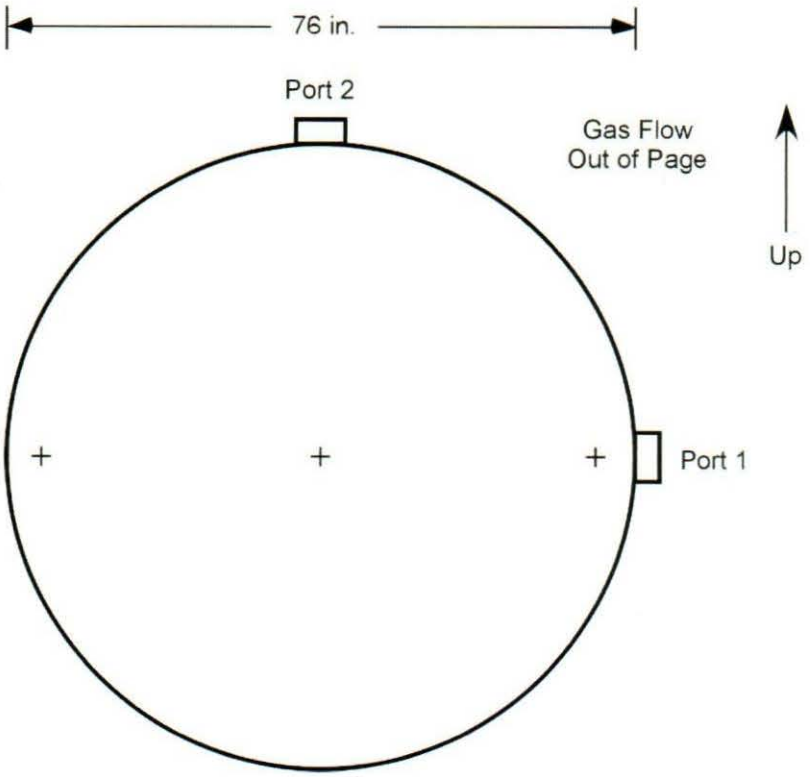
Figure 3-4:
EU00080 Stack Sample Point Layout (EPA Method 1)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	95.6	75.0
2	85.4	67.0
3	70.4	55.3
4	29.6	23.2
5	14.6	11.5
6	4.4	3.5

Duct diameters upstream from flow disturbance (A): ≈2.3 Limit: 0.5
Duct diameters downstream from flow disturbance (B): ≈13 Limit: 2.0

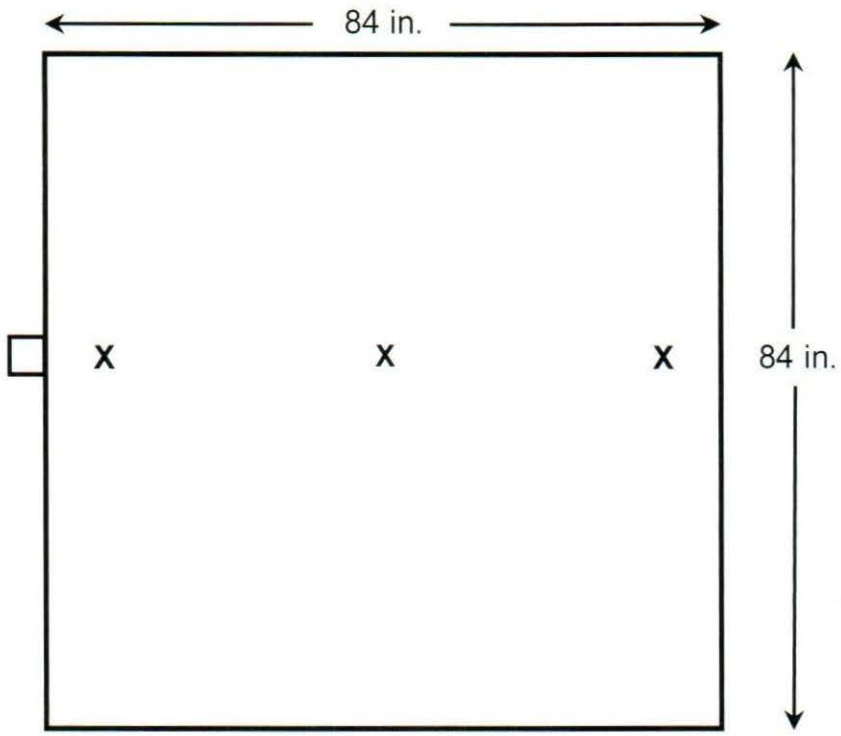
Figure 3-5:
EU00080 Outlet (Performance Specification 2)



Sampling Point	% of Duct Diameter	Port to Point Distance (inches)
1	83.3	63.3
2	50.0	38.0
3	16.7	12.7

Duct diameters upstream from flow disturbance (A): 1.9 Limit: 0.5
Duct diameters downstream from flow disturbance (B): 5.7 Limit: 2.0

Figure 3-6:
EU00080 Inlet (Performance Specification 2)



Sampling Point	% of Duct Width	Port to Point Distance (inches)
1	83.3	70.0
2	50.0	42.0
3	16.7	14.0

Equivalent duct diameters upstream from flow disturbance (A): ≈0.4 Limit: NA
Equivalent duct downstream from flow disturbance (B): ≈1.9 Limit: NA

End of Section

4. METHODOLOGY

PROCEDURES AND REGULATIONS

The test program sampling measurements followed procedures and regulations outlined by the USEPA and Michigan Department of Environment, Great Lakes, and Energy (EGLE). These methods appear in detail in Title 40 of the CFR and at https://www.epa.gov/emc.

Appendix A includes diagrams of the sampling apparatus, as well as specifications for sampling, recovery, and analytical procedures. Any modifications to standard test methods are explicitly indicated in this appendix. In accordance with ASTM D7036 requirements, CleanAir included a description of any such modifications along with the full context of the objectives and requirements of the test program in the test protocol submitted prior to the measurement portion of this project. Modifications to standard methods are not covered by the ISO 17025 and TNI portions of CleanAir's A2LA accreditation.

CleanAir follows specific QA/QC procedures outlined in the individual methods and in USEPA "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III Stationary Source-Specific Methods," EPA/600/R-94/038C. Appendix D contains additional QA/QC measures, as outlined in CleanAir's internal Quality Manual.

TITLE 40 CFR PART 60, APPENDIX A

Method 1	"Sample and Velocity Traverses for Stationary Sources"
Method 2	"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"
Method 3A	"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)"
Method 4	"Determination of Moisture Content in Stack Gases"
Method 5	"Determination of Particulate Matter Emissions from Stationary Sources"
Method 6C	"Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)"
Method 7E	"Determination of Nitrogen Oxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)"

TITLE 40 CFR PART 60, APPENDIX B PERFORMANCE SPECIFICATIONS

PS2	"Specifications and Test Procedures for SO_2 and NOx Continuous Emission Monitoring Systems in Stationary Sources"
PS3	"Specifications and Test Procedures for O_2 and CO_2 Continuous Emission Monitoring Systems in Stationary Sources"
PS6	"Specifications and Test Procedures for Continuous Emission Rate Monitoring Systems in Stationary Sources"

CTM-013 Controlled Condensation Method (CCM)

"Determination of Sulfur Oxides Including Sulfur Dioxide, Sulfur Trioxide and Sulfuric Acid Vapor and Mist from Stationary Sources Using a Controlled Condensation Sampling Apparatus"

End of Section

5. APPENDIX

Appendix A: Test Method Specifications

Appendix B: Sample Calculations

Appendix C: Parameters

Appendix D: QA/QC Data

Appendix E: Field Data

Appendix F: Field Data Printouts

Appendix G: Reference Method Monitor Data

Appendix H: Laboratory Data

Appendix I: Facility Operating Data

Appendix J: CleanAir Resumes and Certifications

APPENDIX A: TEST METHOD SPECIFICATIONS

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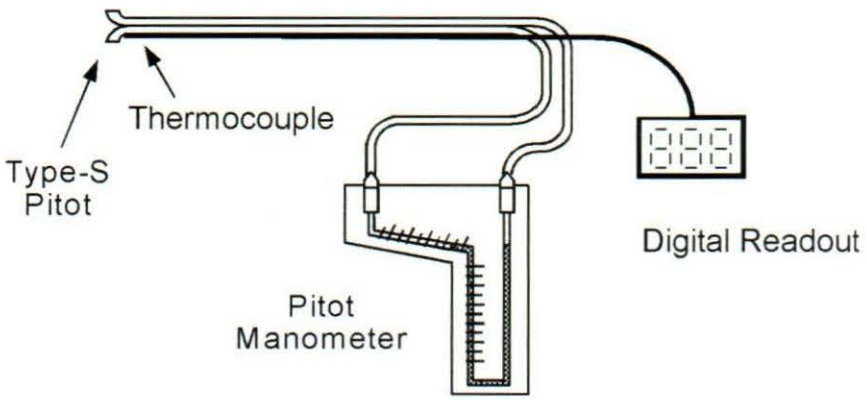
Specification Sheet for EPA Method 2

Source Location Name(s)	Line #1 and Line #2 Stacks
Pollutant(s) to be Determined	None
Other Parameters to be Determined from Train	Flow Rate

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	Varied
No. of Sample Traverse Points	N/A	12
Sample Time per Point	N/A	Varied
Sampling Rate	N/A	N/A
Sampling Probe		
Nozzle Material	N/A	N/A
Nozzle Design	N/A	N/A
Probe Liner Material	N/A	N/A
Effective Probe Length	Sufficient to Traverse Points	15 feet and 9 feet
Probe Temperature Set-Point	N/A	N/A
Velocity Measuring Equipment		
Pitot Tube Design	Type S	Type S
Pitot Tube Coefficient	N/A	0.84
Pitot Tube Calibration by	Geometric or Wind Tunnel	Geometric
Pitot Tube Attachment	Attached to Probe	Attached to Probe
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	N/A	N/A
Meter Resolution	N/A	N/A
Meter Size	N/A	N/A
Meter Calibrated Against	N/A	N/A
Pump Type	N/A	N/A
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4°F	1.0°F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	N/A	N/A
Filter Holder Material	N/A	N/A
Filter Support Material	N/A	N/A
Cyclone Material	N/A	N/A
Filter Heater Set-Point	N/A	N/A
Filter Material	N/A	N/A
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

EPA Method 2
Sampling Train Configuration



Specification Sheet for EPA Method 4

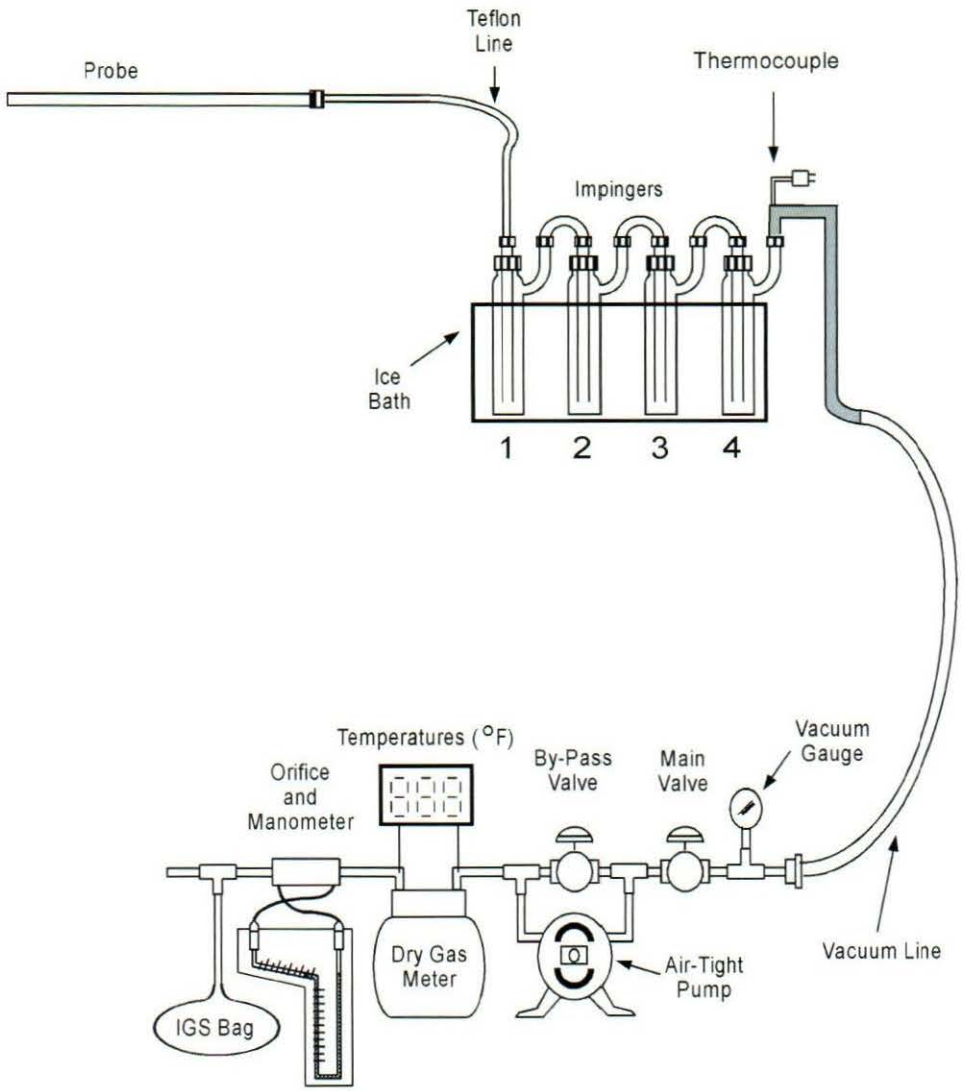
Source Location Name(s)	Line #1 and Line #2 Stacks
Pollutant(s) to be Determined	None
Other Parameters to be Determined from Train	Moisture

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	60 minutes
No. of Sample Traverse Points	N/A	1
Sample Time per Point	N/A	60 minutes
Sampling Rate	Within 10% of Constant Rate	Constant Rate (±10%)
Sampling Probe		
Nozzle Material	N/A	None
Nozzle Design	N/A	N/A
Probe Liner Material	Stainless Steel, Glass, Other Metals, Plastic Tubing	Stainless Steel
Effective Probe Length	N/A	10 feet and 8 feet
Probe Temperature Set-Point	Prevent water condensation	None
Velocity Measuring Equipment		
Pitot Tube Design	N/A	None
Pitot Tube Coefficient	N/A	N/A
Pitot Tube Calibration by	N/A	N/A
Pitot Tube Attachment	N/A	N/A
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	±2%	±1%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	Wet Test Meter or Standard DGM	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4˚F	1.0˚F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	In Stack or Exit of Probe	None
Filter Holder Material	Borosilicate Glass (for probe exit location)	N/A
Filter Support Material	Glass Frit	N/A
Cyclone Material	N/A	None
Filter Heater Set-Point	Prevent condensation	N/A
Filter Material	Glass Wool (in-stack) or Fiberglass Mat (out of stack)	None
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

Specification Sheet for EPA Method 4

	Standard Method Specification	Actual Specification Used
Impinger Train Description		
Type of Glassware Connections	Ground Glass or Equivalent	Screw Joint with Silicone Gasket
Connection to Probe or Filter by	Flexible Line	Flexible Teflon Line
Number of Impingers	4	4
Impinger Stem Types		
Impinger 1	Modified-Greenburg Smith	Modified Greenburg-Smith
Impinger 2	Greenburg-Smith	Greenburg-Smith
Impinger 3	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 4	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 5		
Impinger 6		
Impinger 7		
Impinger 8		
Gas Density Determination		
Sample Collection	N/A	N/A
Sample Collection Medium	N/A	N/A
Sample Analysis	N/A	N/A
Sample Recovery Information		
Probe Brush Material	N/A	N/A
Probe Rinse Reagent	N/A	N/A
Probe Rinse Wash Bottle Material	N/A	N/A
Probe Rinse Storage Container	N/A	N/A
Filter Recovered?	No	No
Filter Storage Container	N/A	N/A
Impinger Contents Recovered?	No	No
Impinger Rinse Reagent	N/A	N/A
Impinger Wash Bottle	N/A	N/A
Impinger Storage Container	N/A	N/A
Analytical Information		
Method 4 H_2O Determination by	Gravimetric	Gravimetric
Filter Preparation Conditions	N/A	N/A
Front-Half Rinse Preparation	N/A	N/A
Back-Half Analysis	N/A	N/A
Additional Analysis	N/A	None

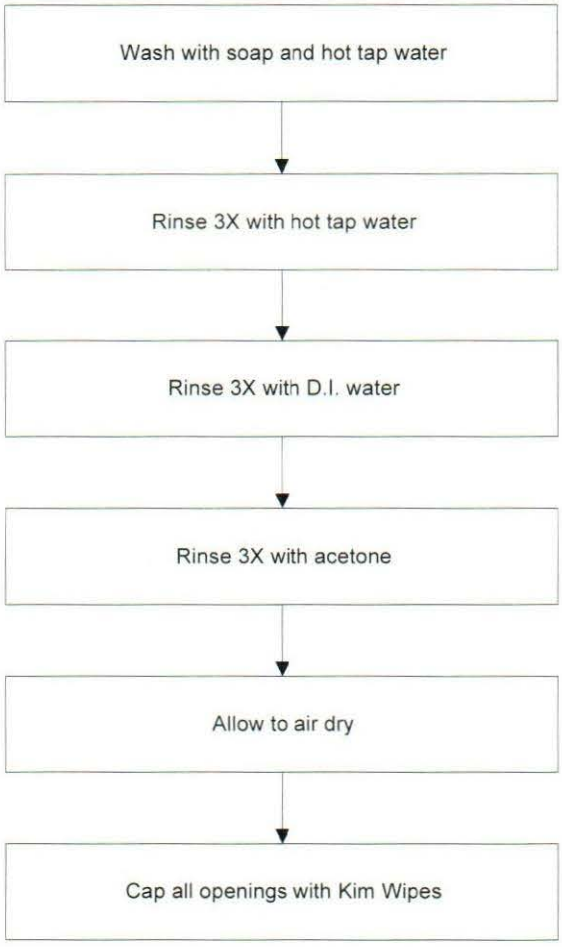
EPA Method 4
Sampling Train Configuration



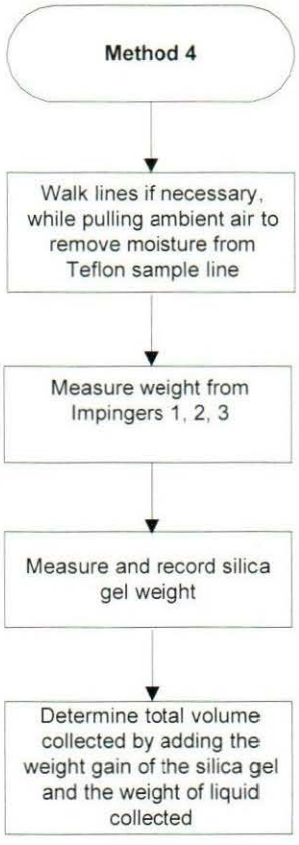
Impinger Contents

Impinger 1	DI H_2O
Impinger 2	DI H_2O
Impinger 3	Empty
Impinger 4	Silica gel

EPA Method 4
Glassware Preparation Procedures



EPA Method 4
Analytical Recovery Flowchart



Specification Sheet for EPA Method 5

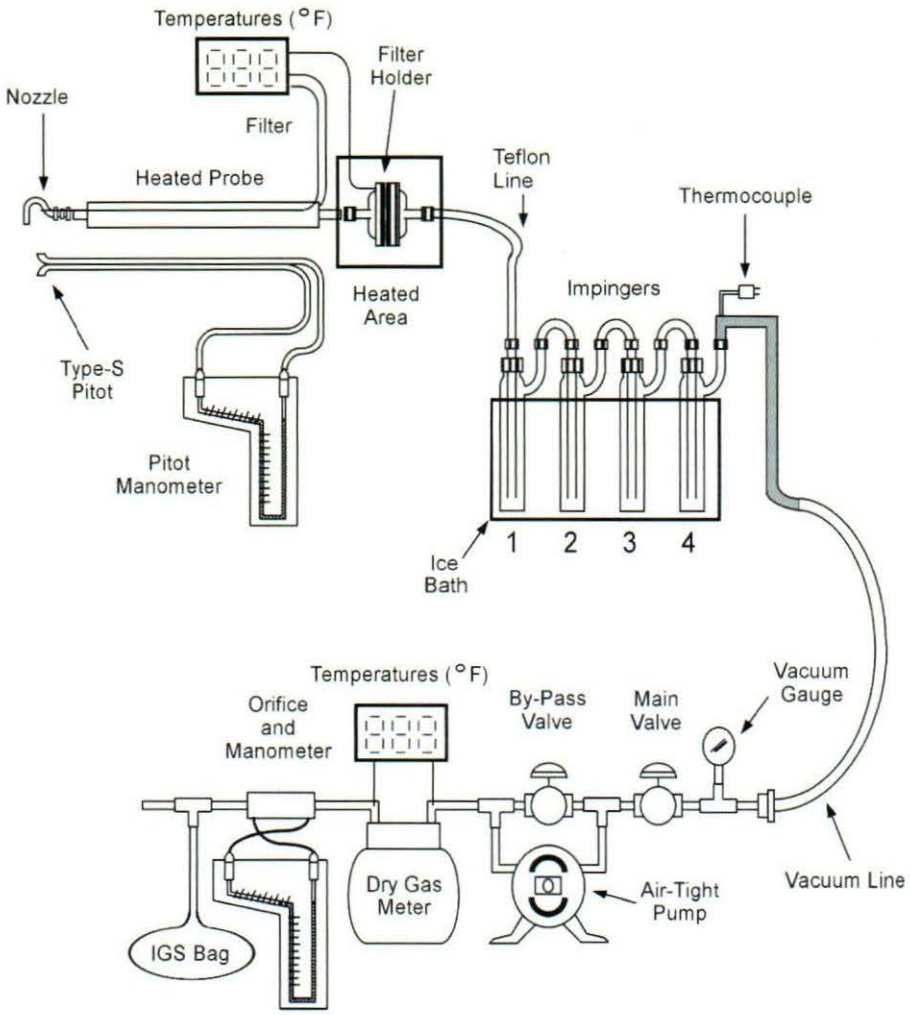
Source Location Name(s)	Line #1 and Line #2 Stacks
Pollutant(s) to be Determined	Filterable Particulate Matter (FPM)
Other Parameters to be Determined from Train	Gas Density, Moisture, Flow Rate

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	60 minutes
No. of Sample Traverse Points	N/A	12
Sample Time per Point	N/A	5 minutes
Sampling Rate	Isokinetic (90-110%)	Isokinetic (90-110%)
Sampling Probe		
Nozzle Material	Stainless Steel or Glass	Stainless Steel (Line 1); Borosilicate Glass (Line 2)
Nozzle Design	Button-Hook or Elbow	Button-Hook
Probe Liner Material	Borosilicate or Quartz Glass	Stainless Steel (Line 1); Borosilicate Glass (Line 2)
Effective Probe Length	N/A	15 feet and 9 feet
Probe Temperature Set-Point	248°F±25°F	248°F±25°F
Velocity Measuring Equipment		
Pitot Tube Design	Type S	Type S
Pitot Tube Coefficient	N/A	0.84
Pitot Tube Calibration by	Geometric or Wind Tunnel	Geometric
Pitot Tube Attachment	Attached to Probe	Attached to Probe
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	±2%	±1%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	Wet Test Meter or Standard DGM	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4°F	1.0°F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Digital Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	After Probe	Exit of Probe
Filter Holder Material	Quartz	Borosilicate Glass
Filter Support Material	Glass Frit	Teflon
Cyclone Material	N/A	None
Filter Heater Set-Point	248°F±25°F	248°F±25°F
Filter Material	Glass Fiber	Quartz Fiber
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

Specification Sheet for EPA Method 5

	Standard Method Specification	Actual Specification Used
Impinger Train Description		
Type of Glassware Connections	Ground Glass or Equivalent	Ground Glass with Silicone O-Ring
Connection to Probe or Filter by	Direct Glass Connection	Direct Glass Connection
Number of Impingers	4	4
Impinger Stem Types		
Impinger 1	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 2	Greenburg-Smith	Greenburg-Smith
Impinger 3	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 4	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 5		
Impinger 6		
Impinger 7		
Impinger 8		
Gas Density Determination		
Sample Collection	Multi-point integrated	Multi-Point Integrated
Sample Collection Medium	Flexible Gas Bag	Vinyl Bag
Sample Analysis	Orsat or Fyrite Analyzer	CEM
Sample Recovery Information		
Probe Brush Material	Nylon Bristle	Nylon Bristle
Probe Rinse Reagent	Acetone	Acetone
Probe Rinse Wash Bottle Material	Glass or Polyethylene	Teflon
Probe Rinse Storage Container	Glass or Polyethylene	Glass
Filter Recovered?	Yes	Yes
Filter Storage Container	N/A	Polystyrene
Impinger Contents Recovered?	Provision	Archived
Impinger Rinse Reagent	Deionized Distilled Water	N/A
Impinger Wash Bottle	Glass or Polyethylene	N/A
Impinger Storage Container	Glass or Polyethylene	N/A
Analytical Information		
Method 4 H_2O Determination by	Gravimetric	Gravimetric
Filter Preparation Conditions	Dessicate 24 hours minimum at ambient temperature	Dessicate 24 hours minimum at ambient temperature
Front-Half Rinse Preparation	Evaporate at ambient temperature and pressure	Evaporate at ambient temperature and pressure
Back-Half Analysis	N/A	N/A
Additional Analysis	N/A	None

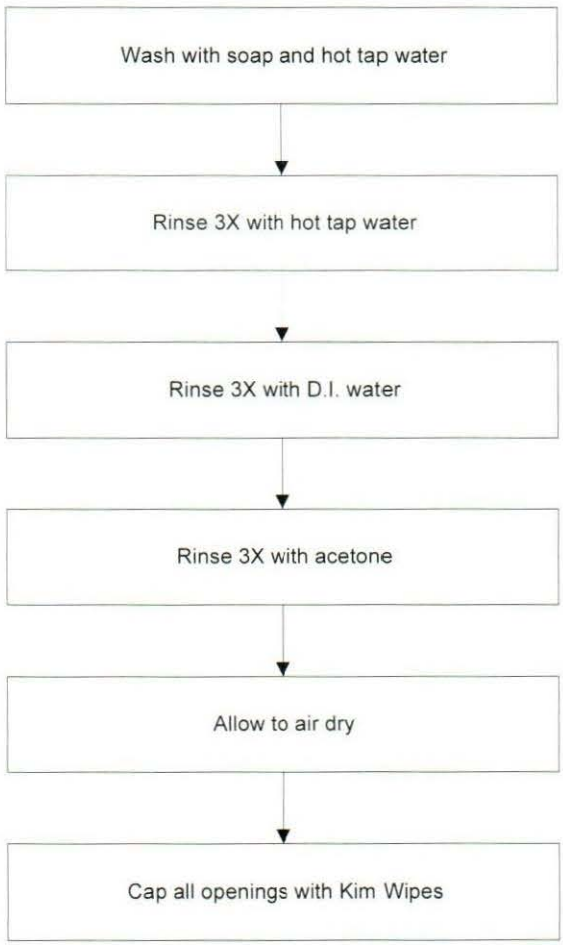
EPA Method 5
Sampling Train Configuration



Impinger Contents

Impinger 1	DI H_2O
Impinger 2	DI H_2O
Impinger 3	Empty
Impinger 4	Silica Gel

EPA Method 5
Glassware Preparation Procedures



EPA Method 5
Sample Recovery Flowchart

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degrees C)

Container 1
Quartz Filter
Petri Dish

↓

Remove with tweezers to original container. Brush any loose particulate or filter fibers into sample container

↓

If necessary fold in half and place into container

↓

Visual Inspection

Container 2
Front Half (FH) Rinse
500 ml Glass

↓

Probe liner, nozzle, cyclone or cyclone bypass and filter FH

↓

Brush/rinse 3X with acetone (6X for metal components)

↓

Visual Inspection

↓

Label container and measure volume by weight

Container 3
Silica Gel

↓

Measure volume by weight, note any color change

↓

Recycle silica gel

*Containers 4 and 7 are required when the testing includes a back half analysis

Container 4*
Back Half (BH) Rinse
500 ml Plastic

↓

BH filter housing, Z-piece, impingers 1, 2, 3 and U-Bends

↓

Measure volume by weight

↓

Empty contents into labeled container

↓

Rinse with water

↓

Visual Inspection

↓

Label container and measure volume by weight

Blanks

Container 5
Filter Blank
Plastic Petri Dish

↓

Clean, unused tared filter

Container 6
Acetone Blank
500 ml Glass

↓

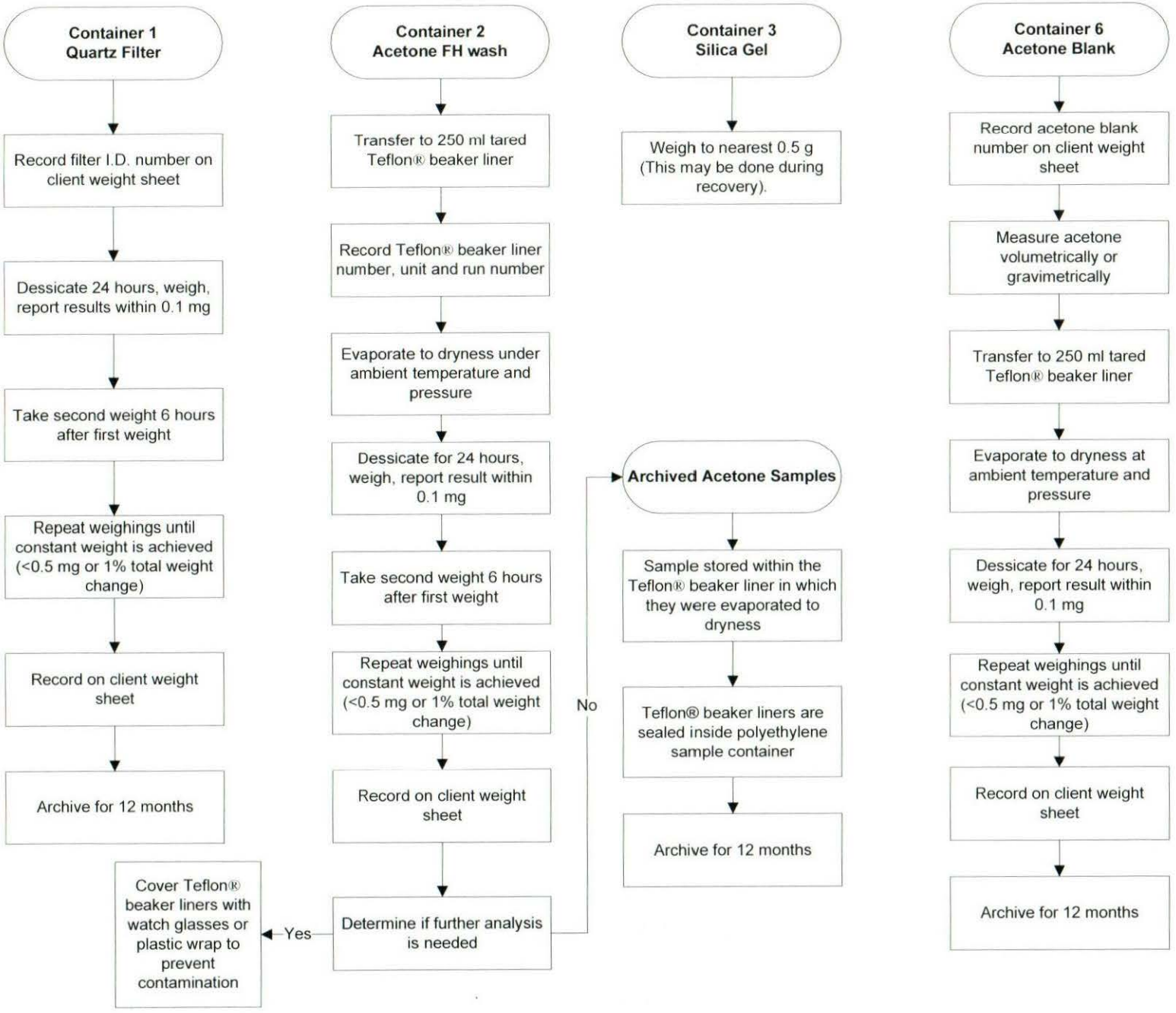
200 ml of acetone from rinse bottle. Record lot number

Container 7*
D.I. Water Blank
250 ml Plastic

↓

200 ml of water from rinse bottle

EPA Method 5
Analytical Flowchart



Specification Sheet for CTM-013

Source Location Name(s)	Outlet (EU00079 and EU00080)
Pollutant(s) to be Determined	Sulfuric Acid (H_2SO_4)
Other Parameters to be Determined from Train	None

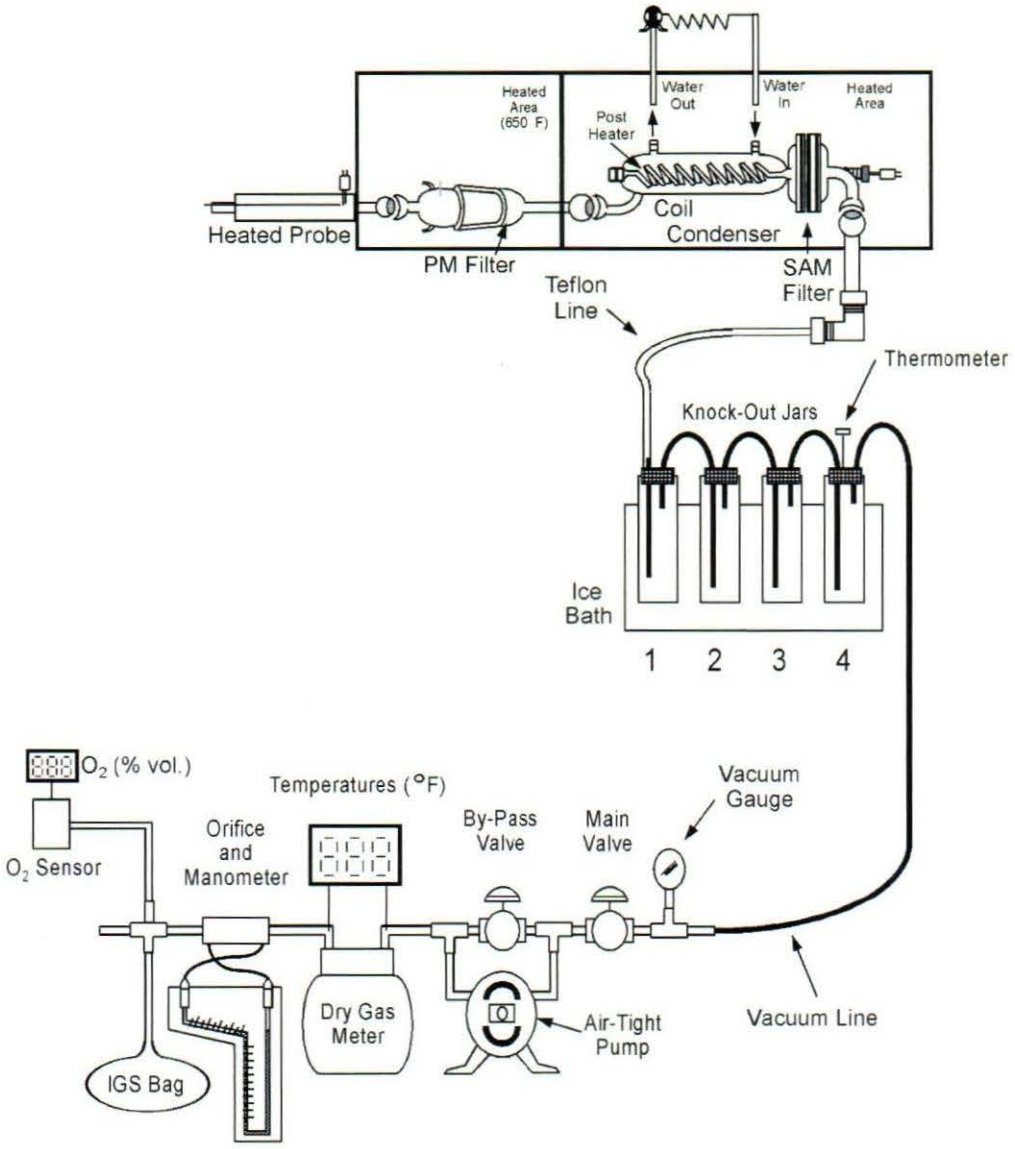
	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	60 minutes	60 minutes
No. of Sample Traverse Points	1	1
Sample Time per Point	60 minutes	60 minutes
Sampling Rate	Constant rate of 10.0 Lpm ±10%	Constant rate of 10.0 Lpm ±10%
Sampling Probe		
Nozzle Material	N/A	None
Nozzle Design	N/A	N/A
Probe Liner Material	Borosilcate Glass	Quartz
Effective Probe Length	N/A	10 feet
Probe Temperature Set-Point	>350°F	650°F
Velocity Measuring Equipment		
Pitot Tube Design	N/A	None
Pitot Tube Coefficient	N/A	N/A
Pitot Tube Calibration by	N/A	N/A
Pitot Tube Attachment	N/A	N/A
Metering System Console		
Meter Type	Dry gas meter or controlled orifice	Dry Gas Meter
Meter Accuracy	±2%	±1%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	N/A	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	±5°F	1.0°F
ΔP Differential Pressure Gauge	N/A	N/A
ΔH Differential Pressure Gauge	N/A	Inclined Manometer
Barometer	Capable of measurement within 0.1 in. Hg	Digital Barometer calibrated w/Mercury Aneroid
Particulate (PM) Filter		
Filter Location	Exit of Probe	Exit of Probe
Connection to probe liner by	Direct glass-to-glass	Direct Quartz-to-Quartz
Filter Holder Material	Quartz	Quartz
Filter Support Material	Glass frit	Quartz
Cyclone Material	N/A	None
Filter Heater Set-Point	>500°F	650°F
Filter Material	Tissuequartz	Quartz Fiber
Filter Conditioning	Pre-rinsed w 0.1N H_2SO_4; baked at 600°F	Pre-rinsed w/ 0.1N H_2SO_4; baked at 600°F
SO_3 Coil condenser and Filter		
Description	Condenser Coil (10 coils) with Type C glass frit	Condenser Coil (10 coils) with Type C glass frit
Location	After PM Filter	After PM filter
Connection to PM Filter by	Direct glass-to-glass	Ground Glass with Silicone O-Ring
Water Jacket	Temperature regulated water jacket surrounding coil condenser	Temperature regulated water jacket surrounding coil condenser
Operating Temperature	167 -185°F	167 -185°F

Specification Sheet for CTM-013

Source Location Name(s)	Outlet (EU00079 and EU00080)
Pollutant(s) to be Determined	Sulfuric Acid (H_2SO_4)
Other Parameters to be Determined from Train	None

	Standard Method Specification	Actual Specification Used
Impinger Train Description		
Type of Glassware Connections	Ground Glass	Flexible Rubber Line
Connection to SAM Filter by	Direct glass-to-glass	Flexible Teflon Line
Number of Impingers	4	4
Impinger Stem Types		
Impinger 1	Midget or Full size impinger	Knock-Out Jar
Impinger 2	Midget or Full size impinger	Knock-Out Jar
Impinger 3	Midget or Full size impinger	Knock-Out Jar
Impinger 4	Midget or Full size impinger	Knock-Out Jar
Impinger 5		
Impinger 6		
Impinger 7		
Gas Density Determination		
Sample Collection	N/A	Single Point Integrated
Sample Collection Medium	N/A	Vinyl Bag
Sample Analysis	N/A	CEM
Sample Recovery Information		
Probe Brush Material	N/A	N/A
Probe Rinse Reagent	N/A	N/A
Probe Rinse Wash Bottle Material	N/A	N/A
Probe Rinse Storage Container	N/A	N/A
PM Filter Recovered?	No	Yes
PM Filter Storage Container	N/A	Polyethylene
SO_3 Condenser Contents Recovered?	Yes	Yes
SO_3 Condenser Rinse Reagent	Sulfate-free water	DI Water
SO_3 Condenser Wash Bottle	Polyethylene	Polyethylene
SO_3 Condenser Storage Container	Polyethylene	Polyethylene
SAM Filter Recovered?	Yes	Yes, placed into SO_3 condenser storage container
SAM Filter Storage Container	Polyethylene	Polyethylene
Impinger Contents Recovered?	Optional	No
Impinger Rinse Reagent	Sulfate-free water	N/A
Impinger Wash Bottle	Polyethylene	N/A
Impinger Storage Container	Polyethylene	N/A
Analytical Information		
Method 4 H_2O Determination by	Gravimetric	Gravimetric
SO_3 Condenser/SAM Filter Analysis	Ion chromatography for sulfate	Ion chromatography and titration for sulfate
Impinger Analysis (SO_2)	Ion Chromatography or Titration for sulfate (optional)	N/A
PM Filter Analysis	PM Filter - Not recovered	Not analyzed

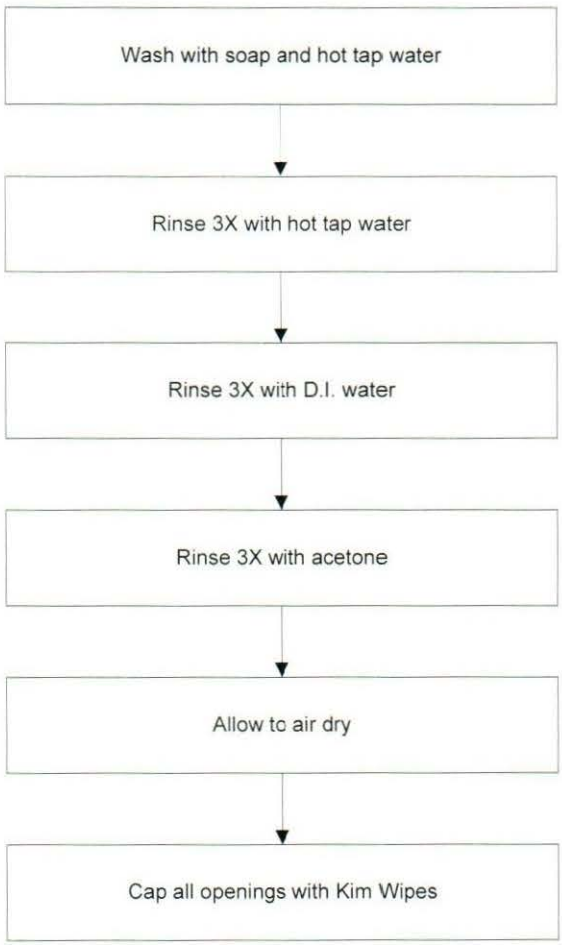
CTM-013
Sampling Train Configuration



Impinger Contents

Impinger 1	DI Water
Impinger 2	DI Water
Impinger 3	Empty
Impinger 4	Silica Gel

EPA CTM-013
Glassware Preparation Procedures



EPA CTM-013
Sample Recovery Flowchart

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degrees C)

Container 0
Condenser Rinse
Pre-Test Proof
125ml HDPE

Prior to Run 1, rinse condenser with approximately 75ml of DI water and collect in sample container

Label, seal and mark liquid level of container

Condition condenser with 50ml of 100% IPA

Container 2A
Particulate Catch
(Optional Ash Analysis)
Quartz Filter
125ml HDPE

Place PM filter in sample container and brush any loose particulate into sample container

Rinse filter holder with 75ml of DI water and collect in the container with the filter. Add water if necessary to cover the filter

Label, seal and mark liquid level of container

Container 1
Condenser Rinse
125ml HDPE

Rinse condenser a minimum of 3X with approximately 75ml DI water and collect rinse in sample container

Place SAM filter in container and brush any loose particulate into sample container

Label, seal and mark liquid level of container

Container 2B
Probe Rinse
(Optional Ash Analysis)
125 ml HDPE

Rinse 3x with DI water and collect in sample container

Label, seal and mark liquid level of container

Note: If the ash analysis is not to be done, then the filter and particulate catch may be discarded.

Container 3
Impingers Contents
(Optional Sulfur Dioxide Analysis)
500ml HDPE

Impingers 1, 2 and 3, teflon jumper and connecting glassware

Rinse teflon jumper into Impinger 1 with measured amount of DI water

Weigh all impingers to plus or minus 1ml or 0.5g

Quantitatively transfer impinger contents into sample container

Rinse impingers and connecting glassware with DI water and add to container

Label, seal and mark liquid level of container

Container 4
Silica Gel

Measure volume by weight to nearest 0.5g and note any color change

Recycle silica gel

Container 5
Final Condenser Rinse
Post-Test Proof
125ml HDPE

Rinse condenser a minimum of 3X with approximately 75ml DI water and collect rinse in sample container

Label, seal and mark liquid level of container

Condition condenser with 50ml of 100% IPA

Blanks

Container 6
DI Water Blank
250ml Plastic

200ml of DI water

Container 7
3% Hydrogen Peroxide Blank (Optional Sulfur Dioxide Analysis)
250ml HDPE

200ml of 3% H_2O_2

EPA CTM-013
Analytical Flowchart

- Log each sample in shipment and verify against chain-of-custody sheet
- Note liquid levels in the sample containers and confirm on the chain-of-custody sheet condition

Containers 0, 1 and 5

Quantitatively transfer each sample to a volumetric flask or graduated cylinder and bring to standard volume with D.I. water

Sample Blanks, Audits, Standards

Analyze by ion chromatography for sulfate

OPTIONAL

Container 2A PM Filter

Container 2B Probe Rinse

Combine contents and agitate vigorously

Filter solution through Whatman filter paper

Bring filtrate to standard volume with DI water

Analyze by ion chromatography for sulfate

Container 3 (Optional SO2 Analysis)

Quantitatively transfer each sample to a volumetric flask or graduated cylinder and bring to standard volume with D.I. water

Analyze by ion chromatography for sulfate

**Optional Titration Analysis: Refer to EPA Method 6 Analytical Flowchart*