1. PROJECT OVERVIEW

TEST PROGRAM SUMMARY

EES Coke Battery, LLC contracted CleanAir Engineering (CleanAir) to complete compliance testing on the Underfire Combustion Stack at the Zug Island facility located in River Rouge, Michigan.

The test program objective was to perform total particulate matter (TPM), non-sulfate filterable particulate matter (NSFPM), and volatile organic compound (VOC) testing to demonstrate compliance with Michigan Permit to Install (MI-PTI) No. 51-08C. Emissions were sampled while the process operated at ≥ 90% operating capacity.

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]
Underfire Combustion Stack			
NSFPM (lb/hr)	EPA 5F (Modified)	2.1	25.7
NSFPM (gr/dscf)	EPA 5F (Modified)	0.0018	0.012
FPM (lb/1000 lb exhaust gas @50% EA)	EPA 5	0.031	0.095
TPM, as PM_{10} (lb/hr)	EPA 5/202	30.0	73.3
TPM, as $PM_{2.5}$ (lb/hr)	EPA 5/202	30.0	73.0
VOC (lb/hr)	EPA 25A	30.6	43.1
VOC (lb/MMBtu, heat input)	EPA 25A	0.0589	0.0956

[1] Permit limits obtained from MI-PTI No. 51-08C.

TEST PROGRAM DETAILS

PARAMETERS

The test program included the following measurements:

- total particulate matter (TPM), filterable and condensable particulate matter (FPM and CPM), reported as:
  - particulate matter less than 10 microns in diameter (PM_{10})
  - particulate matter less than 2.5 microns in diameter ($PM_{2.5}$)
- non-sulfate filterable particulate matter (NSFPM)
- volatile organic compounds (VOC), measured as non-methane hydrocarbons (NMHC)
- flue gas composition (e.g., O_2, CO_2, H_2O)
- flue gas temperature
- flue gas flow rate

SCHEDULE

Testing was performed on September 14 and 15, 2021. Table 1-2 outlines the on-site schedule followed during the test program.

Table 1-2:
Test Schedule

Run Number[1]	Location	Method	Analyte	Date	Start Time	End Time
1	Underfire Combustion Stack	USEPA Method 5F	Nonsulfate FPM	09/14/21	08:55	11:18
2	Underfire Combustion Stack	USEPA Method 5F	Nonsulfate FPM	09/14/21	12:20	15:25
3	Underfire Combustion Stack	USEPA Method 5F	Nonsulfate FPM	09/14/21	16:11	18:30
4	Underfire Combustion Stack	USEPA Method 5F	Nonsulfate FPM	09/15/21	08:22	10:43
1	Underfire Combustion Stack	USEPA Method 5/202	FPM/CPM	09/14/21	08:55	11:18
2	Underfire Combustion Stack	USEPA Method 5/202	FPM/CPM	09/14/21	12:20	15:25
3	Underfire Combustion Stack	USEPA Method 5/202	FPM/CPM	09/14/21	16:11	18:30
1	Underfire Combustion Stack	USEPA Methods 3A, 25A	O_2/CO_2, VOC	09/14/21	09:37	10:37
2	Underfire Combustion Stack	USEPA Methods 3A, 25A	O_2/CO_2, VOC	09/14/21	12:28	13:28
3	Underfire Combustion Stack	USEPA Methods 3A, 25A	O_2/CO_2, VOC	09/14/21	13:47	14:47

[1] Run 1 was invalidated due to a failed post-test leak check and not included in any averages.

DISCUSSION

Test Program Details

A failed final leak check during USEPA Method 5F Run 1 caused CleanAir to perform a fourth run the following morning. Oxygen readings on the meter console were steady during the entire run and the final moisture content closely agreed with Runs 2 through 4. It is possible that something occurred during the removal of the probe from the stack at the conclusion of Run 1, such as a line coming loose. To err on the side of caution, both CleanAir and EGLE representatives agreed to perform a fourth run. Run 1 is not included in any results averages.

$PM_{10}/PM_{2.5}$

Appendix A of MI-PTI No. 51-08C states that testing for PM_{10} and $PM_{2.5}$ follow EPA Methods 201A and 202. The test duration is listed as 120 minutes, with a minimum sample volume requirement of 60 dscf, respectively. The appendix states that any changes to the test methodology must be approved by the EGLE Air Quality Division (AQD) District Supervisor.

Modifications to $PM_{10}/PM_{2.5}$ Testing

The test ports at the sample location are not an adequate size to accommodate the Method 201A $PM_{10}/PM_{2.5}$ cyclone head. Numerous issues with broken glass due to the narrow and long test ports occurred during the 2015 test campaign. CleanAir used EPA Method 5 in lieu of Method 201A.

CleanAir has performed a results comparison between Method 201A/202 versus Method 5/202. Test data from the 2015 compliance program highlight a similarity between the readings with the Method 5/202 results being biased slightly higher than the Method 201A/202 results. For example, the three-run average (gr/dscf) of TPM for Methods 201A/202 and 5/202 were 0.0466 and 0.0484, respectively. The Method 5/202 results were approximately 3.7% higher than the 201A/202 results.

TPM is defined as the sum of filterable and condensable particulate matter. Method 5/202 does not provide unique values for PM_{10} and $PM_{2.5}$ and TPM was instead used to determine PM_{10} and $PM_{2.5}$ emissions. The use of Method 5 rather than Method 201A was approved during the 2017, 2019, and 2021 test programs.

In addition, this location experiences high winds that increase the likelihood of broken glassware during port changes. CleanAir requested approval to use stainless steel-lined probes and nozzles in lieu of borosilicate glass or quartz liners during the 2019 compliance campaign. This was approved during the 2017, 2019, and 2021 test program.

An excerpt from Section 6.1.1.2 of EPA Method 5 reads:

> *"Alternatively, metal liners (e.g., 316 stainless steel, Incoloy 825 or other corrosion resistant metals) made of seamless tubing may be used, subject to the approval of the Administrator."*

NSFPM

Appendix A of MI-PTI No. 51-08C states that requirements for particulate matter determinations (excluding sulfates) must be conducted per EPA Method 5, corrected for sulfate. The permit also requires a sample time of 60 minutes, with a minimum sample volume of 30 dscf. Any changes to the testing methods must be approved by the AQD District Supervisor.

Invalidated Test Run

EPA Method 5F Run 1 failed the final leak check resulting in CleanAir invalidating the test and collecting a total of four samples. The leak was found to have occurred at the back half of the particulate filter on a Teflon line connection (outside of the stack). Upon further analysis of the results, CleanAir believes this leak occurred when the probe was being removed from the final test port and prior to conducting the last leak check.

Run 1 moisture content was 14.79% while the 3-run average of Runs 2 through 4 averaged 14.72%. If a leak outside of the stack would have occurred during any test, the moisture content of ambient air would have driven down the moisture content to as low as 11.5% if this leak occurred during the final port change to impact the final 15-minutes of testing.

Modifications to NSFPM Testing

CleanAir sampled particulate matter isokinetically and collected on a filter maintained at a temperature in the range of 320 ±25°F, with a minimum of 60 dscf of sample gas collected over a 120-minute test period for each run. The modification was followed during compliance testing in 2015, 2017, 2019, and 2021 based on the conversation documented below.

A conference call between EES, EGLE, and CleanAir representatives was held on Monday, January 26, 2015, to discuss the best methodology for the determination of sulfate free particulate emissions at the Underfire Combustion Stack. It was agreed upon to perform EPA Method 5F for the sulfate-free filterable particulate matter measurements. This method is contained in Appendix A of 40 CFR 60.

Concern was raised by EGLE that the recovery of the probe with a water rinse would not be adequate and requested a change to acetone. The following deviations to the method were agreed upon during the conference call and were performed on-site:

1. The sample train nozzle, probe liner, and front-half filter holder were rinsed and recovered with acetone (Method 5F outlines the use of deionized distilled water; ASTM D1193–77 or 91 Type 3).
2. Due to the use of acetone, additional analytical steps were taken by the CleanAir Analytical laboratory, located in Palatine Illinois, during the first analytical step:
    a. The acetone was evaporated in a tared FEP beaker liner while the filter was digested.
    b. The acetone residue was combined with the filter digestate and brought to volume in a 500 mL flask.
    c. The flask was settled, and an aliquot was removed for sulfate determinations.
    d. The solution was re-evaporated in the original tared FEP beaker liner and the normal analytical steps, as outlined in Method 5F, were followed.

In addition, CleanAir requested approval to use stainless steel-lined probes and nozzles in lieu of borosilicate glass or quartz liners during the 2019 compliance campaign as mentioned in the $PM_{10}/PM_{2.5}$ discussion above. This was approved during the 2017, 2019, and 2021 test program.

VOC

VOC emission rates from the Underfire Combustion Stack were measured following EPA Method 25A. A total of three 60-minute tests were performed at a single point following a stratification check performed during Run 1. Results of the stratification check are in Appendix D. VOC results were reported on a propane-basis.

CleanAir directly measured the NMHC using a Thermo Model 55i Non-Methane Hydrocarbon Analyzer. The 55i analyzer utilizes a back-flush GC/FID system to cut the methane (GC) and measure non-methane hydrocarbons (FID) directly. It has lower detection limits of 20 ppb methane and 50 ppb NMHC. The proprietary column design is unaffected by the oxygen content of the sample and provides complete recovery of low volatility compounds while achieving absolute separation of methane from all carbon (C_2) compounds. Each measurement cycle takes approximately 70 seconds.

The NMHC measurement is reported as VOC. The NMHC measurements were made on a wet volumetric basis and corrected to a dry basis using concurrent flue gas moisture measurements. Mass emission rates were calculated using the heat value of the fuel in conjunction with relative EPA Method 19 calculations.

EGLE Site Feedback

Following the completion of testing, but prior to departing the facility, CleanAir received feedback from EGLE regarding low flow rates and future implementation of a micro manometer for flow rate determinations. The arithmetic average of all ΔP readings for each test was 0.05 or greater. While a micro manometer was not available on this project or discussed until its conclusion, CleanAir re-analyzed the raw data to replace all sub-0.05 readings with 0.05. Below are notes of the results:

- % Isokinetics go from 104.2% to 100.7%
- FPM (lb/1,000 lb Exhaust Gas @ 50% EA) & NSFPM (gr/dscf) remain unchanged
- Volumetric flow rate (dscfm) increases by 3.4%
- TPM as $PM_{10}/PM_{2.5}$ (lb/hr) & NSFPM (lb/hr) increase by 3.4%
    - EPA Method 5/202 TPM as $PM_{10}/PM_{2.5}$ average of 31.0 lb/hr vs. permit limit of 73 lb/hr
    - EPA Method 5F NSFPM average of 2.15 lb/hr vs. permit limit of 25.7 lb/hr

While the re-analysis does not have a significant impact on the results, the best approach is to implement a micro manometer on future projects at the Underfire Combustion Stack due to provide increased flow rate sensitivity and measurements. This will be included in the 2023 test program.

End of Section

2. RESULTS

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

Table 2-1:
Underfire Combustion Stack – NSFPM, Method 5F (Modified)

Run No.		2	3	4	Average
Date (2021)		Sep 14	Sep 14	Sep 15	
Start Time (approx.)		12:20	16:11	08:22	
Stop Time (approx.)		15:25	18:30	10:43	
Process Conditions					
P_1	No. of ovens charged per run	14	11	10	
P_2	Coal charged (dry tons/run)	447	350	319	**372**
P_3	COG used for Underfire combustion (kscf/run)	2,948	2,265	2,219	**2,477**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	**8,760**
Gas Conditions					
O_2	Oxygen (dry volume %)	10.5	10.3	10.4	**10.4**
CO_2	Carbon dioxide (dry volume %)	5.3	5.4	5.3	**5.4**
T_s	Stack temperature (°F)	515	514	511	**513**
B_w	Actual water vapor in gas (% by volume)	14.6	15.1	14.5	**14.7**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	296,000	290,000	285,000	**290,000**
Q_s	Volumetric flow rate, standard (scfm)	156,000	153,000	151,000	**153,000**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	133,000	130,000	129,000	**131,000**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	79.01	77.77	76.28	**77.68**
%I	Isokinetic sampling (%)	104.3	105.4	103.9	**104.5**
Laboratory Data					
m_n	Total NSFPM (g)	0.01428	0.00649	0.00720	
NSFPM Results					
C_{sd}	Particulate Concentration (lb/dscf)	3.99E-07	1.84E-07	2.08E-07	**2.64E-07**
C_{sd}	Particulate Concentration (gr/dscf)	2.79E-03	1.29E-03	1.46E-03	**1.84E-03**
$E_{lb/hr}$	Particulate Rate (lb/hr)	3.19	1.43	1.61	**2.08**
$E_{T/yr}$	Particulate Rate (Ton/yr)	14.0	6.28	7.06	**9.10**

Average includes 3 runs.

[1] Run 1 was invalidated due to a failed post-test leak check.

Table 2-2:
Underfire Combustion Stack – TPM, Method 5/202

Run No.		1	2	3	Average
Date (2021)		Sep 14	Sep 14	Sep 14	
Start Time (approx.)		08:55	12:20	16:11	
Stop Time (approx.)		11:18	15:25	18:30	
Process Conditions					
R_P	Excess Air (%)	84	90	86	**87**
P_1	No. of ovens charged per run	10	14	11	
P_2	Coal charged (dry tons/run)	313	447	350	**370**
P_3	COG used for Underfire combustion (kscf/run)	2,281	2,948	2,265	**2,498**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	**8,760**
Gas Conditions					
O_2	Oxygen (dry volume %)	10.2	10.5	10.3	**10.3**
CO_2	Carbon dioxide (dry volume %)	5.5	5.3	5.4	**5.4**
T_s	Stack temperature (°F)	511	513	518	**514**
B_w	Actual water vapor in gas (% by volume)	15.8	14.8	15.5	**15.4**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	292,000	308,000	289,000	**296,000**
Q_s	Volumetric flow rate, standard (scfm)	155,000	163,000	152,000	**156,000**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	130,000	138,000	129,000	**132,000**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	78.10	81.03	75.13	**78.08**
%I	Isokinetic sampling (%)	105.6	103.0	102.9	**103.8**
Laboratory Data					
m_n	Total FPM (g)	0.07318	0.02194	0.12747	
m_{CPM}	Total CPM (g)	0.05726	0.08567	0.03570	
m_{Part}	Total particulate matter (g)	0.13044	0.10761	0.16317	
FPM Results (Method 5) = PM					
C_{sd}	Particulate Concentration (lb/dscf)	2.07E-06	5.97E-07	3.74E-06	**2.13E-06**
C_{sd}	Particulate Concentration (gr/dscf)	0.0145	0.00418	0.0262	**0.0149**
$E_{lb/hr}$	Particulate Rate (lb/hr)	16.1	4.96	28.9	**16.6**
$E_{T/yr}$	Particulate Rate (Ton/yr)	70.7	21.7	126	**72.9**
$E_{EA50\%}$	Particulate Rate (lb/1000 lb Exhaust Gas at 50% EA)	0.0299	0.00898	0.0548	**0.0312**
CPM Results (Method 202)					
C_{sd}	Particulate Concentration (lb/dscf)	1.62E-06	2.33E-06	1.05E-06	**1.67E-06**
C_{sd}	Particulate Concentration (gr/dscf)	0.0113	0.0163	0.00733	**0.0117**
$E_{lb/hr}$	Particulate Rate (lb/hr)	12.6	19.4	8.08	**13.4**
$E_{T/yr}$	Particulate Rate (Ton/yr)	55.3	84.8	35.4	**58.5**
Total Particulate Matter Results (Method 5/202) = PM_{10} = $PM_{2.5}$					
C_{sd}	Particulate Concentration (lb/dscf)	3.68E-06	2.93E-06	4.79E-06	**3.80E-06**
C_{sd}	Particulate Concentration (gr/dscf)	0.0258	0.0205	0.0335	**0.0266**
$E_{lb/hr}$	Particulate Rate (lb/hr)	28.8	24.3	36.9	**30.0**
$E_{T/yr}$	Particulate Rate (Ton/yr)	126	107	162	**131**

Average includes 3 runs.

Table 2-3:
Underfire Combustion Stack – VOC, Method 25A

Run No.		1	2	3	Average
Date (2021)		Sep 14	Sep 14	Sep 14	
Start Time (approx.)		09:37	12:28	13:47	
Stop Time (approx.)		10:37	13:28	14:47	
Process Conditions					
P_1	No. of ovens charged per run	5	5	4	
P_2	Coal charged (dry tons/run)	156	158	129	**148**
P_3	COG used for Underfire combustion (ksfc/run)	976	969	981	**975**
F_d	Oxygen-based F-factor (dscf/MMBtu)	8,020	8,020	8,020	**8,020**
H_i	Actual heat input (MMBtu/hr)	519	516	522	**519**
Gas Conditions					
O_2	Oxygen (dry volume %)	10.2	10.5	10.6	**10.4**
CO_2	Carbon dioxide (dry volume %)	5.5	5.4	5.3	**5.4**
T_s	Sample temperature (°F)	511	513	513	**513**
B_w	Actual water vapor in gas (% by volume)	15.8	14.8	14.8	**15.2**
Gas Flow Rate					
Q_{std}	Volumetric flow rate, dry standard (dscfm)	130,000	138,000	138,000	**136,000**
Volatile Organic Compounds (VOC), measured as NMHC					
	Concentration (ppmwv)	28.7	27.8	27.1	**27.9**
	Concentration (ppmdv)	34.0	32.7	31.8	**32.8**
	Mass Rate (lb/hr)	30.4	31.1	30.2	**30.6**
	Mass Rate (lb/MMBtu) - Heat Input	0.0586	0.0602	0.0579	**0.0589**

Average includes 3 runs.

Flow rate, moisture, and sample temperature data obtained from USEPA Method 5/202 testing, Runs 1 and 2.

End of Section

3. DESCRIPTION OF INSTALLATION

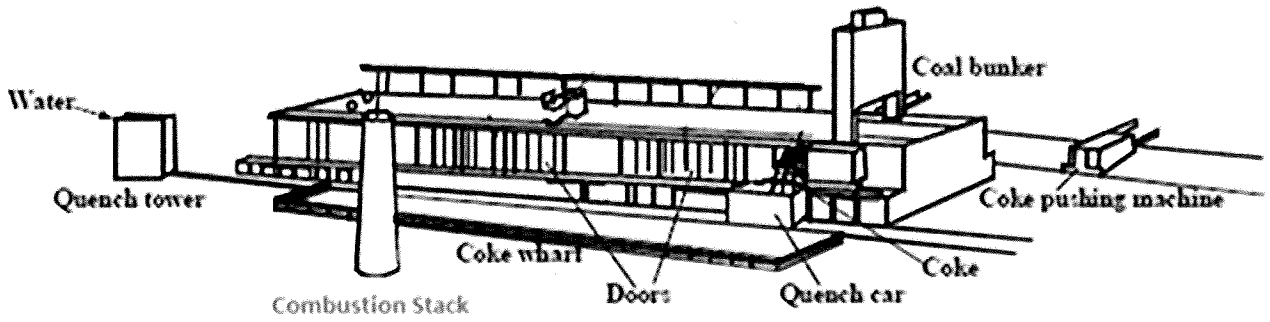
PROCESS DESCRIPTION

EES Coke Battery, LLC is a facility located on Zug Island in River Rouge, Michigan. The testing described in this document was performed at the Combustion Stack.

The No. 5 Coke Battery consists of 85 six-meter-high ovens producing furnace coke. A coal blend is used to charge each oven on timed intervals depending on the current production of the battery. Coking of the coal occurs in an oxygen free environment for 17 to 30 hours and the gases produced are collected, cleaned, and used to under fire the battery, supply fuel for other site sources, and sold to permitted off-site utilities.

The current permit limits allow for the charging of up to 1.420 million dry tons of coal. The design capacity heating requirement of the battery is approximately 375 MMBtu per hour. Also, the heating requirements of the battery at the current production rate are approximately 325 MMBtu per hour. Process source description information above was taken directly from written information provided by EES Coke. A schematic of the process indicating sampling locations is shown in Figure 3-1.

Figure 3-1:
Process Schematic



Note: The EES Coke Battery Underfire Combustion Stack is located on the other side of the battery.

TEST LOCATION

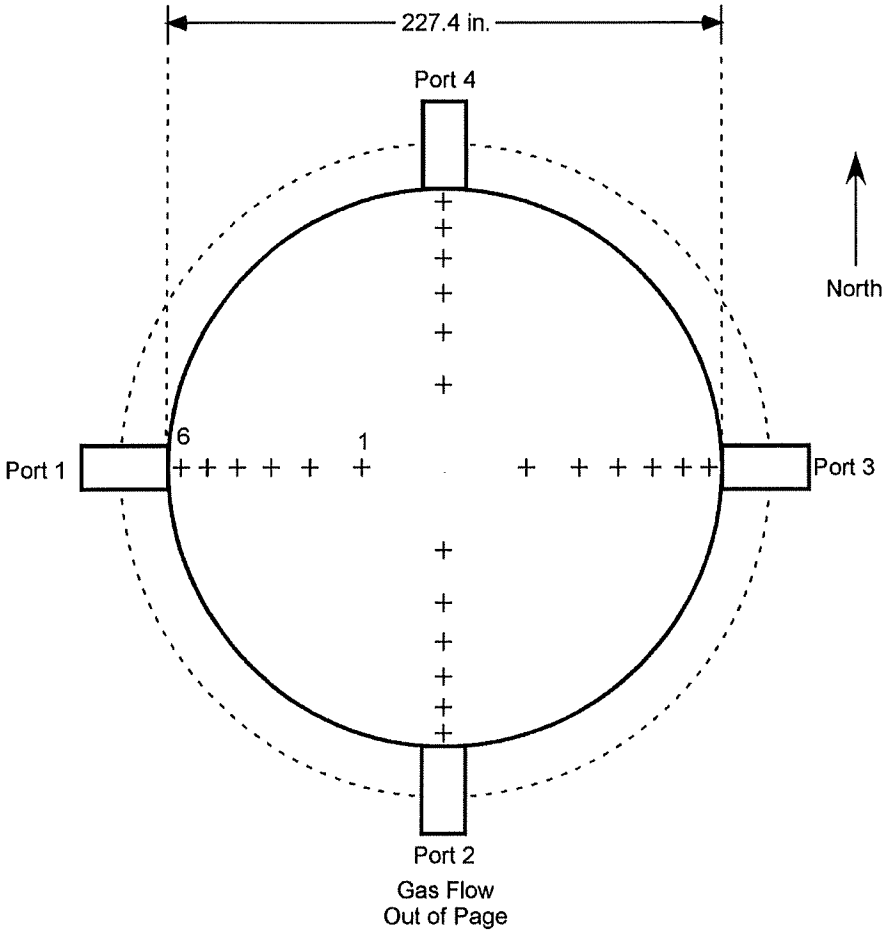
EPA Methods 1 and 7E specifications determined the sample point locations. Table 3-1 presents the sampling information for the test location. The figures shown represent the layout of the test location.

Table 3-1:
Sampling Information

Source Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
Underfire Combustion Stack							
NSFPM	EPA 5F (Modified)	1-4	4	6	5	120	3-2
TPM	EPA 5/202	1-3	4	6	5	120	3-2
VOC[1]	EPA 25A	1	1	3	20	60	3-3
VOC	EPA 25A	2-3	1	1	60	60	NA

[1] A stratification check was conducted during Run 1. The location was unstratified and testing for Runs 2 and 3 were conducted a single point that most closely matched the mean calculated during the stratification check.

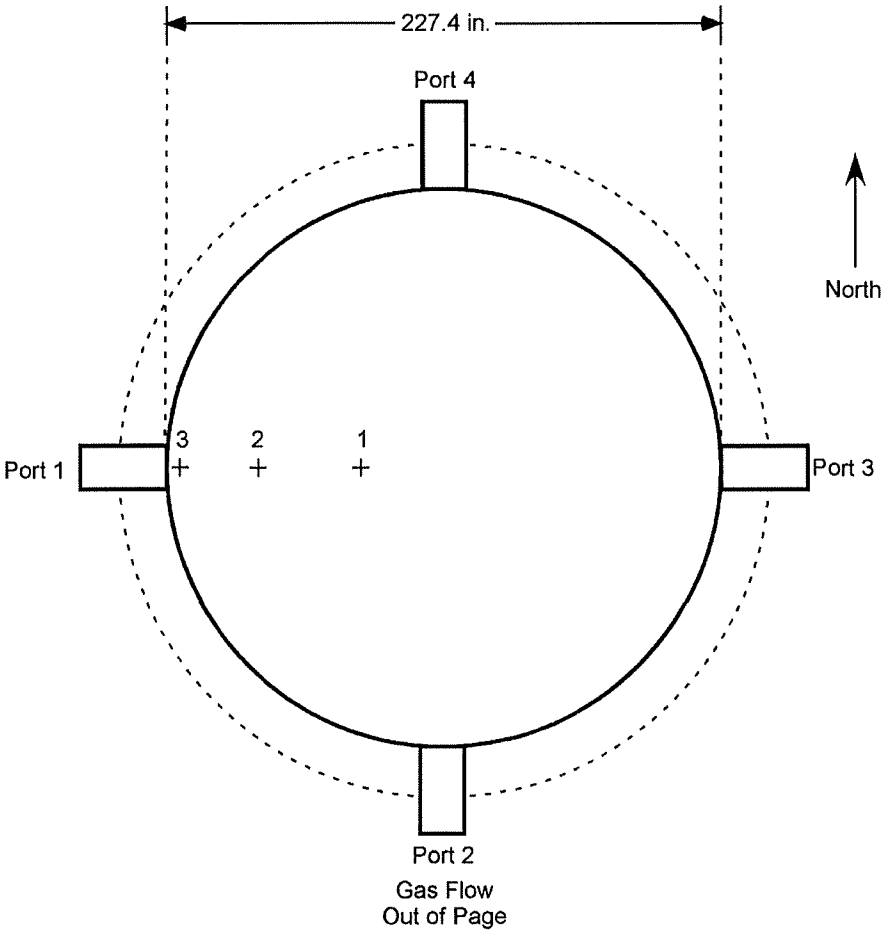
Figure 3-2:
Underfire Combustion Stack Sample Point Layout (EPA Method 1)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	35.6	81.0
2	25.0	56.9
3	17.7	40.2
4	11.8	26.8
5	6.7	15.2
6	2.1	4.8

Duct diameters upstream from flow disturbance (A): 10.9 Limit: 0.5
Duct diameters downstream from flow disturbance (B): 2.7 Limit: 2.0

Figure 3-3:
Underfire Combustion Stack EPA Method 25A Stratification Check (EPA Method 7E)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	2.0	78.7
2	1.2	47.2
3	0.4	15.7

Duct diameters upstream from flow disturbance (A): 10.9 Limit: 0.5
Duct diameters downstream from flow disturbance (B): 2.7 Limit: 2.0

Note: Stratification Check performed during Run 1.

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 5F	"Determination of Nonsulfate Particulate Matter Emissions from Stationary Sources"
Method 19	"Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide and Nitrogen Oxide Emission Rates"
Method 25A	"Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"

TITLE 40 CFR PART 51, APPENDIX M

Method 202	"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"

METHODOLOGY DISCUSSION

VERIFICATION OF THE ABSENCE OF CYCLONIC FLOW – EPA METHOD 1

The cyclonic flow check procedure is referred to as the "nulling" technique. An S-type pitot tube connected to an inclined manometer is used in this method. This is the same apparatus as referenced in EPA Method 2.

Note: A cyclonic flow check per EPA Method 1, Section 2.4 was completed during the compliance test program in 2015. The results of that test indicated an absence of cyclonic flow. This test was not repeated, and results are available in Appendix E of this report.

DETERMINATION OF FLUE GAS COMPOSITION – METHODS 1-4

CleanAir measured flow rates using S-type pitot tubes following sampling point requirements of EPA Methods 1 and 2. The testing occurred in four test ports at six points per port for a total of 24 points. The pitot tube measurements were used to determine the stack gas velocity and volumetric flow rate. EPA Method 3A was followed to determine the oxygen and carbon dioxide content of the flue gas. Values were obtained via continuous extraction of CleanAir CEMS or via grab samples. EPA Method 4 was followed to determine the moisture content of the sample.

The methods mentioned above were utilized to determine the flue gas volumetric flow rate and composition.

NON-SULFATE FILTERABLE PARTICULATE MATTER – METHOD 5F (MODIFIED)

Particulate matter was withdrawn isokinetically and collected on a quartz fiber filter maintained at a temperature of 160°C ± 14°C (320°F ± 25°F). A minimum of 60 dry standard cubic feet of sample gas was collected over a two-hour test period for each run. Flue gas volumetric flow rate, moisture concentration and flue gas molecular weight were also determined as part of the sample method.

TOTAL PARTICULATE MATTER DETERMINATION – METHOD 5/202

The front-half (Method 5 portion) of the sampling train consisted of a stainless-steel nozzle and liner, and glass filter holder heated to 250°F, and a quartz fiber filter. Flue gas samples was extracted isokinetically, per Method 5 requirements.

Flue gas exiting the front-half heated filter passed through a coiled condenser and dry impinger system jacketed by water continually circulated at ambient temperature. Moisture was removed from the flue gas without bubbling through the condensed water. Flue gas then passed through a Teflon membrane filter at ambient temperature. The temperature of the flue gas at the exit of the filter was directly measured with an in-line thermocouple and maintained in the temperature range of 65°F to 85°F.

After exiting the ambient filter, the flue gas passed through two additional impingers surrounded by ice in a "cold" section of the impinger bucket. The moisture collected in these impingers was not analyzed for CPM and was only collected to determine the flue gas moisture and thoroughly dry the gas prior to the metering device.

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 back-half of the sample train (heated filter outlet, condenser, dry impingers and TFE membrane filter) were recovered per Method 202 requirements. The impinger train was purged with N_2 at a rate of 14 liters per minute (lpm) for one hour following each test run and prior to recovery.

A field train blank was assembled, purged, leak checked, and recovered as if it were an actual test sample. Analysis of the field train blank was used to blank-correct the test run results. Reagent blanks were also collected to quantify background contamination. All samples and blanks were returned to CleanAir Analytical Services for gravimetric analysis. Method 202 samples were maintained at a temperature < 85°F during transport to the laboratory.

Three 120-minute Method 5/202 test runs were performed. The results are expressed as the average of three valid runs.

VOLATILE ORGANIC COMPOUNDS – METHOD 25A

Monitoring of O_2, CO_2, and NMHC emissions was performed using a combination of EPA Methods 3A and 25A. A gas sample was continuously extracted and delivered to a series of gas analyzers, which measured the pollutant or diluent concentrations in the gas. The analyzers were calibrated on-site using certified mixtures of EPA Protocol 1 propane calibration gases.

The system utilized a heated stainless-steel probe for gas withdrawal. The heated stainless-steel probe tip was equipped with a sintered stainless-steel filter for particulate removal. The end of the probe was connected to a heated Teflon sample line that delivered the sample gases from the stack to the CEM system. The heated sample line is designed to maintain the gas temperature above 250°F, to prevent condensation of stack gas moisture within the line.

A stratification check was performed during Run 1 as described in 40 CFR 60, Appendix A, Method 7E, §8.1.2. The stack measurement line was traversed at 2.0m, 1.2m, and 0.4m of the stack diameter to verify the absence of a stratified flue gas.

The concentration at each traverse point differed from the mean concentration for all traverse points by no more than ± 5.0% of the mean concentration. The gas stream was considered unstratified and a single point that most closely matched the mean was used for Runs 2 and 3.

Calibration error checks were performed by introducing zero nitrogen (N_2), high range and mid-range calibration gases to the inlet of each analyzer during calibration error checks. Bias checks were performed before and after each sampling run by introducing calibration gas to the inlet of the sampling system's heated filter.

Minute-average data points for O_2, CO_2, (dry basis), and NMHC (wet basis) were collected over a period of 60 minutes for each run.

End of Section

APPENDIX A: TEST METHOD SPECIFICATIONS

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Specification Sheet for EPA Method 5F

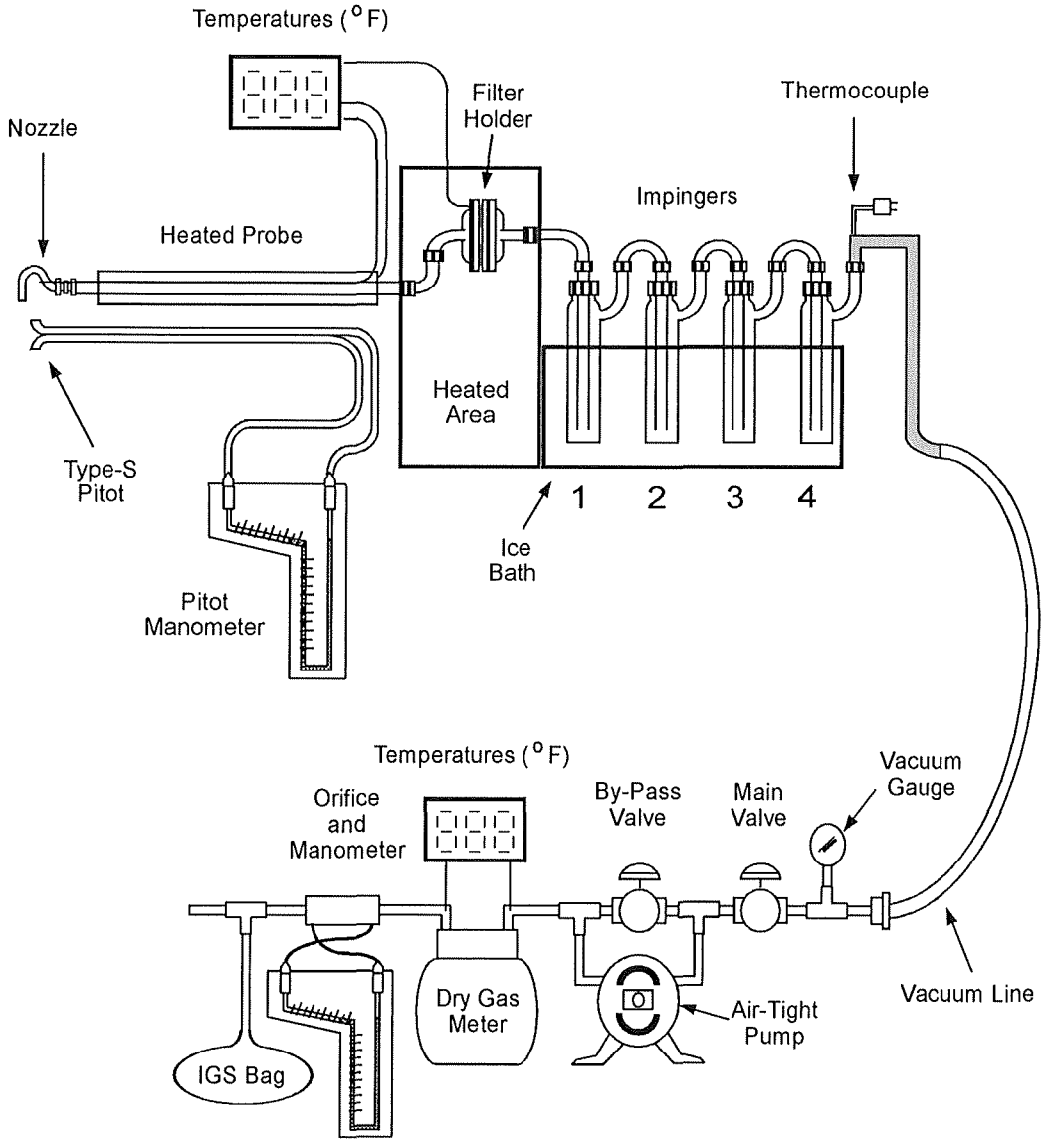
Source Location Name(s)	Underfire Combustion Stack
Pollutant(s) to be Determined	Non-Sulfate Filterable Particulate Matter (NSFPM)
Other Parameters to be Determined from Train	Gas Density, Moisture, Flow Rate

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	120 minutes
No. of Sample Traverse Points	N/A	24
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
Nozzle Design	Button-Hook or Elbow	Button-Hook
Probe Liner Material	Borosilicate or Quartz Glass	Stainless Steel
Effective Probe Length	N/A	12 feet
Probe Temperature Set-Point	320°F±25°F	320°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	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	After Probe	Exit of Probe
Filter Holder Material	Borosilicate Glass	Borosilicate Glass
Filter Support Material	Glass Frit	Teflon
Cyclone Material	N/A	None
Filter Heater Set-Point	320°F±25°F	320°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 5F

	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	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		
Nozzle and Probe Brush Material	Nylon Bristle	Nylon Bristle
Nozzle and Probe Rinse Reagent	Deionized Distilled Water	Deionized Distilled Water
Nozzle and Probe Rinse Wash Bottle Material	Glass or Polyethylene	Polyethylene
Nozzle and Probe Rinse Storage Container	Glass or Polyethylene	Polyethylene
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	Gravimetric per Analytical Flow Chart	See Analytical Flow Chart
Front-Half Rinse Preparation	Gravimetric per Analytical Flow Chart	See Analytical Flow Chart
Back-Half Analysis	N/A	N/A
Additional Analysis	None	None

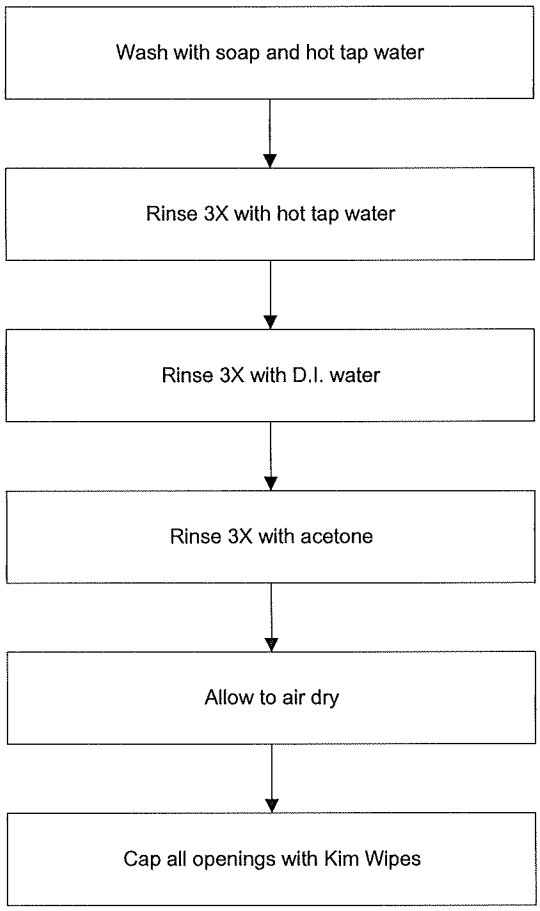
EPA Method 5F (Modified)
Sampling Train Configuration



Impinger Contents

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

EPA Method 5F
Glassware Preparation Procedures



EPA Method 5F (Modified)
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
Tared oven-dried Quartz Filter Petri Dish

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

Visual Inspection

Container 2
500 ml Clear Glass

Probe liner, nozzle, cyclone bypass and filter front half (FH)

Brush/rinse 3 times with DI water

Visual Inspection

Label container and measure volume by weight

Container 3
Silica Gel

Measure volume by weight, note any color change

Recycle silica gel

*Container 4 is required when the testing includes a back-half analysis

Container 4*
500 ml Plastic

Back half (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

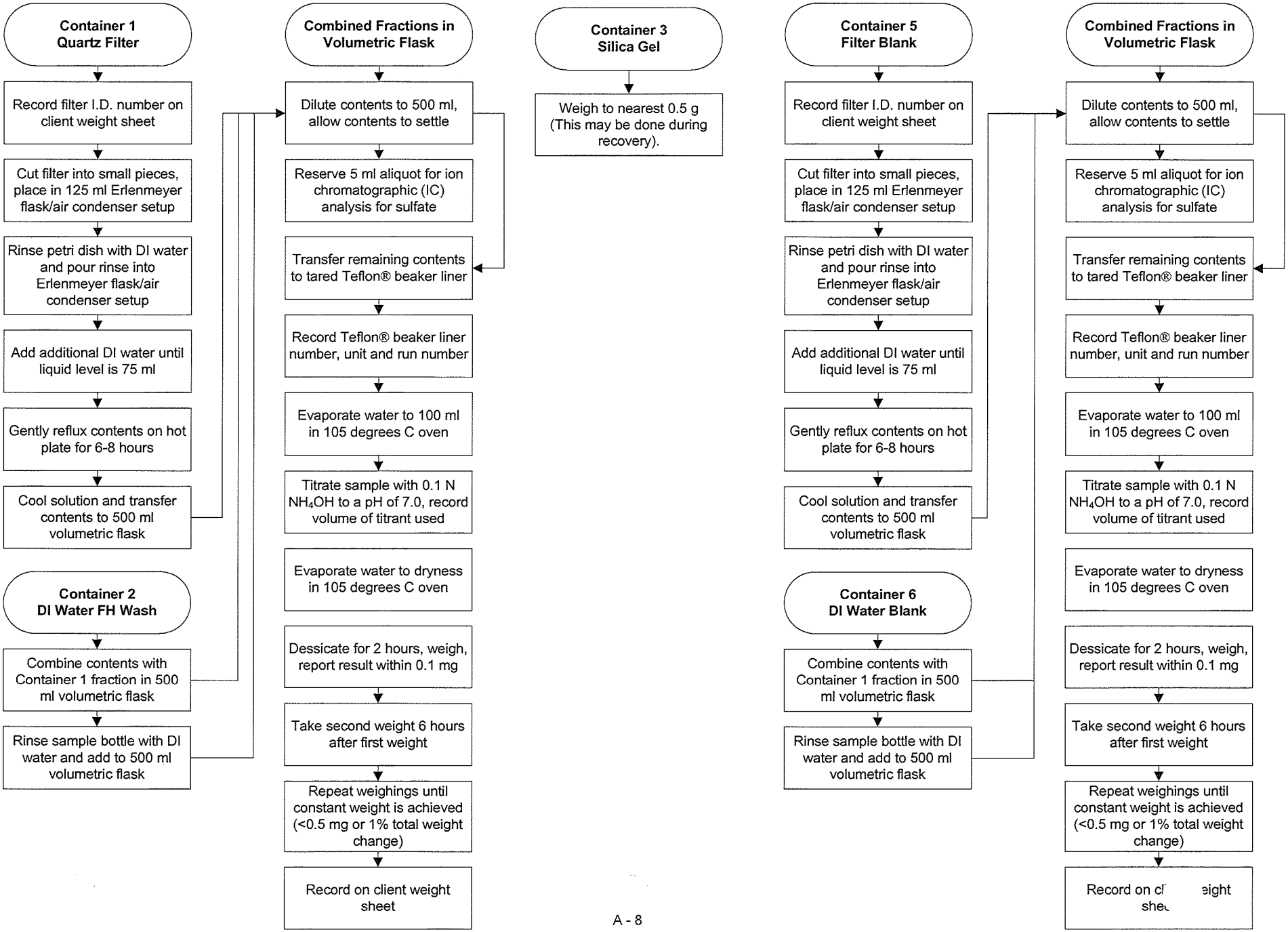
Clean, unused, oven-baked and tared filter

Container 6
DI Water Blank
500 ml Clear Glass

200 ml of DI water from rinse bottle

* Note: Sample recovery was modified to allow acetone as the recovery rinse agent rather than DI water. The probe liners and nozzles were brushed and rinsed a minimum of six times.

EPA Method 5F
Analytical Flowchart



Specification Sheet for EPA Method 5/202

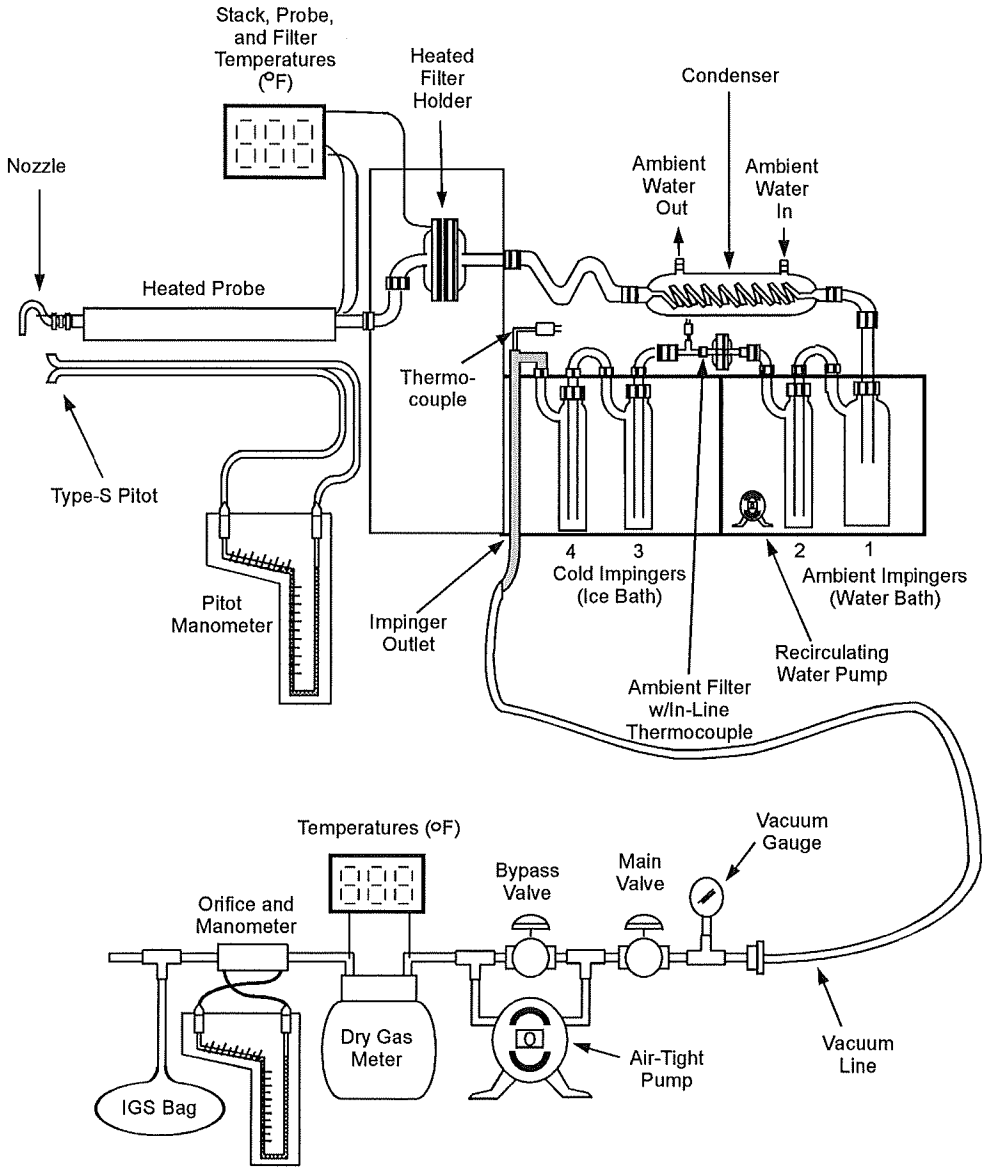
Source Location Name(s)	Underfire Combustion Stack
Pollutant(s) to be Determined	Filterable Particulate Matter (FPM) and Condensable Particulate Matter (CPM)
Other Parameters to be Determined from Train	Gas Density, Moisture, Flow Rate

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	120 minutes
No. of Sample Traverse Points	N/A	24
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
Nozzle Design	Button-Hook or Elbow	Button-Hook
Probe Liner Material	Glass or Teflon	Stainless Steel
Effective Probe Length	N/A	12 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	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
FPM 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	Condenser	Condenser
Location	Before Impinger 1	Before 1st Impinger
Operating Temperature	≤85°F	≤85°F

Specification Sheet for EPA Method 5/202

	Standard Method Specification	Actual Specification Used
Impinger Train Description		
Type of Glassware Connections	Leak-Free Glass Connectors	Screw Joint with Silicone Gasket
Connection to Probe or Filter by	Direct or Flexible Connection	Direct Glass Connection
Number of Impingers	4	4
Impinger Stem Types		
Impinger 1	Shortened Stem (open tip)	Shortened Stem (open tip)
Impinger 2	Modified Greenburg-Smith	Modified 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		
CPM Filter Description		
Filter Location	Between 2nd and 3rd Impingers	Between 2nd and 3rd Impingers
Filter Holder Material	Glass, Stainless Steel or Teflon	Borosilicate Glass
Filter Support Material	Teflon	Teflon
Cyclone Material	None	None
Filter Heater Set-Point	>65°F but ≤85°F	>65°F but ≤85°F
Filter Material	Teflon Membrane	Teflon Membrane
Gas Density Determination		
Sample Collection	Multi-point integrated	Multi-Point Integrated
Sample Collection Medium	Flexible Gas Bag	Vinyl Bag
Sample Analysis	Orsat or CEM Analyzer	CEM
Sample Recovery Information		
Nozzle Brush Material	Nylon Bristle or Teflon	Nylon Bristle
Nozzle Rinse Reagent	Acetone	Acetone
Nozzle Rinse Wash Bottle Material	Glass or Polyethylene	Inorganic in polyethylene, organic in Teflon
Nozzle Rinse Storage Container	Glass or Polyethylene	Glass
Filter Recovered?	Yes	Yes
Filter Storage Container	FH filter in petri dish, CPM filter in petri dish	FH filter in petri dish, CPM filter in petri dish
Impinger Contents Recovered?	Yes	Yes
Impinger Rinse Reagent	DI Water/Acetone/Hexane	DI Water/Acetone/Hexane
Impinger Wash Bottle	Inorganic in polyethylene, organic in Teflon	Inorganic in polyethylene, organic in Teflon
Impinger Storage Container	Inorganic in polyethylene, organic in glass	Inorganic in amber glass, organic in amber glass
Analytical Information		
Method 4 H_2O Determination by	Gravimetric	Gravimetric
Filter Preparation Conditions	Dessicate 24 Hours or Filter Extraction	See Analytical Flow Chart
Front-Half Rinse Preparation	Evaporate at ambient temperature and pressure	Evaporate at ambient temperature and pressure
Back-Half Analysis	Sonication and Extraction	See Analytical Flow Chart
Additional Analysis	N/A	None

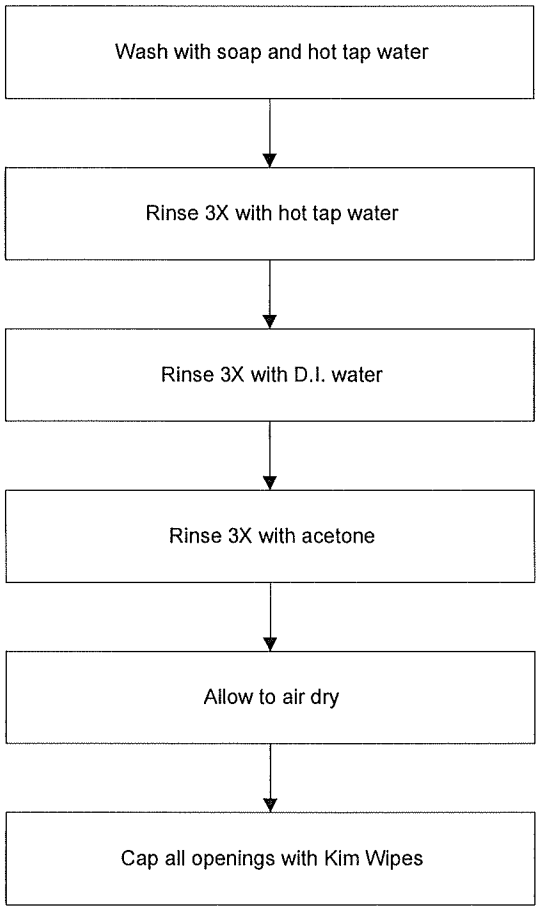
EPA Method 5/202
Sampling Train Configuration



Impinger Contents

Impinger 1	Empty
Impinger 2	Empty
Impinger 3	DI H_2O
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

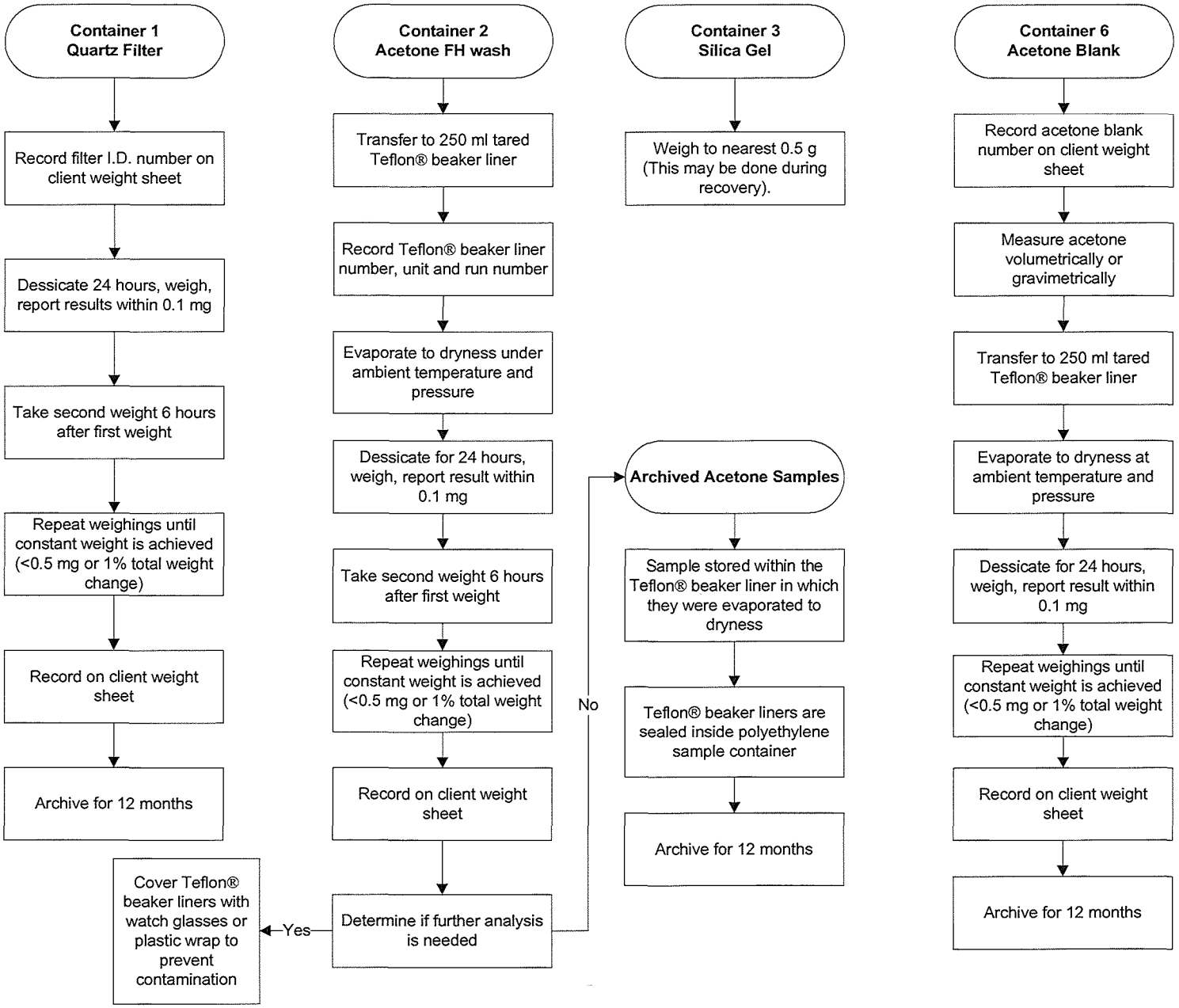
Container 6
Acetone Blank
500 ml Glass

200 ml of acetone from rinse bottle. Record lot number

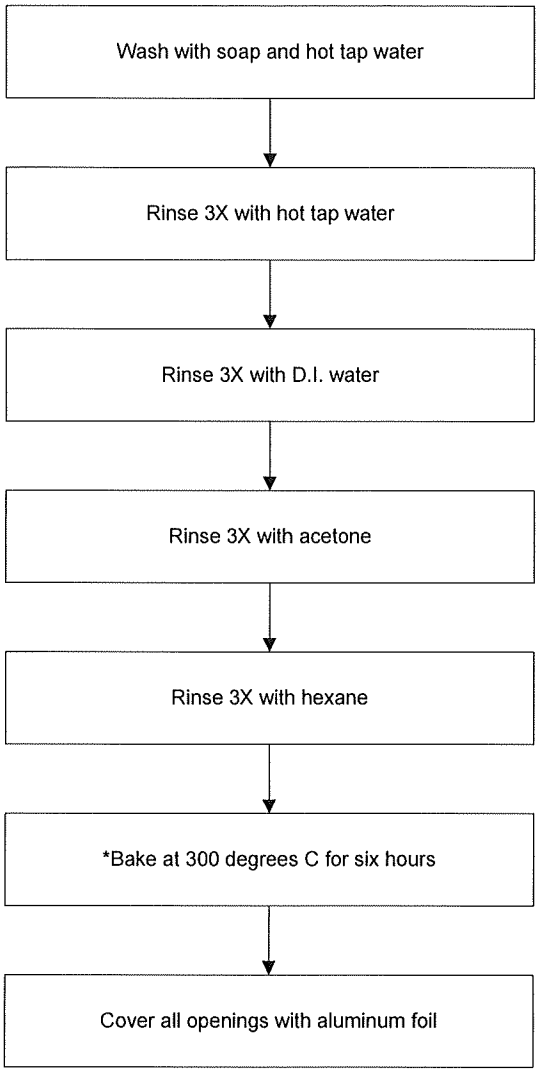
Container 7*
D.I. Water Blank
250 ml Plastic

200 ml of water from rinse bottle

EPA Method 5
Analytical Flowchart



EPA Method 202
Glassware Preparation Procedures



Before each run, rinse the train glassware with deionized, distilled, ultra-filtered water containing 1 ppmwv residual mass or less.

*As an alternative to baking glassware, a field train proof blank can be performed on the sampling train glassware.

EPA Method 202
Sample Recovery Flowchart (1 of 2)

- 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 degreesC)
- Samples must be maintained at or below 85 degrees F (30 degrees C) during shipping.

Post-Test N2 Purge*

Transfer water collected in condenser and water dropout impinger to back-up impinger; measure and record volume or weight

Conduct purge on condenser, back-up impinger and CPM filter with N2 at 14 LPM for one hour

Purge Notes:

- *Continue operating condenser recirculation pump and maintain gas temperature at exit of CPM filter >65°F but ≤85°F.*
- *If volume of water in moisture traps was not determined prior to purge, maintain trap temperature and keep gas temperature at exit of silica gel impinger below 68°F.*
- *At conclusion of purge, simultaneously turn off delivery and pumping systems.*
- *For high moisture sampling, weigh and change out silica gel prior to purging.*

CPM Container 1
Inorganic Rinse
950 ml Amber Glass

Back-half FPM filter holder, probe extension, condenser, dropout and back-up impingers, connecting glassware, front-half CPM filter holder

Measure and record impinger volume by weight

Empty contents into labeled container

Rinse 2X with deionized, distilled, ultra-filtered water and add to sample container

Visual Inspection

Mark liquid level and label container

CPM Container 2
Organic Rinses
950 ml Amber Glass

Back-half FPM filter holder, probe extension, condenser, dropout and back-up impingers, connecting glassware, front-half CPM filter holder

Rinse 1X with acetone and add to sample container

Rinse 2X with hexane and add to sample container

Visual Inspection

Mark liquid level and label container

CPM Container 3
Filter Sample
Petri Dish

CPM filter

Use tweezers and/or disposable surgical gloves to remove CPM filter and place in Petri dish

Visual Inspection

Label container

CPM Container 4**
Cold Impinger Water
500 ml Plastic

Cold impinger that follows the CPM filter

Quantitatively transfer liquid into sample container

Visual Inspection

Mark liquid level and label container

**If the water has been weighed in the field, it can be discarded.

CPM Container 5
Silica Gel

Measure volume by weight, note any color change

Recycle silica gel

EPA Method 202
Sample Recovery Flowchart (2 of 2)

- 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)
- Samples must be maintained at or below 85 degrees F (30 degrees C) during shipping.

CPM Container 6 Acetone Field Reagent Blank

Collect 200 ml of acetone from wash bottle into amber glass container

Visual inspection

Mark liquid level and label container

Collect one acetone blank for each lot of solvent used

CPM Container 7 Water Field Reagent Blank

Collect 200 ml of water from wash bottle into amber glass container

Visual inspection

Mark liquid level and label container

Collect one water blank for each lot used

CPM Container 8 Hexane Field Reagent Blank

Collect 200 ml of hexane from wash bottle into amber glass container

Visual inspection

Mark liquid level and label container

Collect one hexane blank for each lot of solvent used

CPM Container 9 Field Train Proof Blank* Inorganic Rinses

Prior to testing, rinse probe extension, condenser, impingers, connecting glassware and front-half CPM filter housing 2X with water

Collect rinses in plastic sample container

Visual inspection

Mark liquid level and label container

If glass ware was not baked a field train proof blank must be performed to demonstrate the cleanliness of the glassware. Baking the glassware is a CleanAir SOP

CPM Container 10 Field Train Proof Blank* Organic Rinses

After rinsing with water, rinse probe extension, condenser, impingers, connecting glassware and front-half CPM filter housing with acetone

Repeat procedure by rinsing 2X with hexane

Collect both rinses in amber glass container

Visual inspection

Mark liquid level and label container

Field Train Blank (required)

A minimum of one field train blank for each source category tested at facility is required.

Recover field blank after first or second run

Assemble sampling train as it would be used for testing.

Prior to purge, add 100 ml water to first impinger and record data

Purge train and recover blank samples as described on Page 1 of 2

From field sample weight, subtract condensable particulate mass determined from blank train or 0.002 g, whichever is less.

EPA Method 202
Analytical Flowchart (1 of 2)

- 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

CPM Container 1 Inorganic Rinse

Measure liquid volumetrically or gravimetrically

Transfer inorganic contents into separatory funnel and add 30 ml of hexane

Drain off lower inorganic phase into a clean sample container or beaker

Drain off organic phase into a separate clean sample container or beaker, leaving a small amount of hexane in funnel

Repeat procedure twice with 30 ml hexane, combining the organic phase with each extraction

Inorganic Extraction

Transfer inorganic fraction from extraction into 250 ml tared Teflon® beaker liner

Evaporate to no less than 10 ml on a hot plate or in 105 degree C oven

Allow to dry at room temperature (not to exceed 85 degrees F). Ensure the water and volatile acids have completely evaporated before neutralizing nonvolatile acids in sample

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

No constant weight

Redissolve residue in 100 ml of deionized, distilled ultra-filtered water

Titrate sample with 0.1 N NH_4OH to a pH of 7.0, record volume of titrant used.

Evaporate to no less than 10 ml using hot plate or 105 degree C oven

Allow to dry at room temperature (not to exceed 85 degrees F)

Organic Extraction

The extraction should yield around 90 ml of organic extract

Combine the organic extract of Container 1 with the organic train rinse in Container 2

CPM Container 2 Organic Rinses

Measure liquid volumetrically or gravimetrically

Transfer contents into 250 ml tared Teflon® beaker liner

Evaporate to dryness at room temperature (not to exceed 85 degrees F)

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

CPM Container 3 Filter Sample

Was sample collected by Method 17 or 201A with a stack temp < 85°F? Can the filter be brought to constant weight?

Yes

Transfer filter and loose PM from sample container to tared glass weighing dish

Dessicate for 24 hours

Weigh to constant weight and report results to nearest 0.1 mg

No

Extract the filter

Inorganic Extraction

Fold filter into quarters and place in 50 ml extraction tube

Add 10 ml deionized, distilled ultra-filtered water to extraction tube (or sufficient to cover the filter)

Extract for at least 2 minutes in sonication bath; add to separate inorganic fraction Container 1

Repeat extraction twice more for a total of three extractions; add to Container 1

Organic Extraction

Add 10 ml hexane to extraction tube (or sufficient to cover the filter)

Extract for at least 2 minutes in sonication bath; add to separate organic fraction Container 2

Repeat extraction twice more for a total of three extractions; add to Container 2

EPA Method 202
Analytical Flowchart (2 of 2)

- 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

CPM Container 4*
Cold Impinger Water

Measure liquid volumetrically or gravimetrically

CPM Container 5*
Silica Gel

Weigh to nearest 0.5 g

*May have been performed in the field during sample recovery

CPM Container 6
Acetone Field Reagent Blank

Transfer 150 ml of acetone to 250 ml tared Teflon® beaker liner and evaporate to dryness at room temperature (not to exceed 85 degrees F)

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

CPM Container 7
Water Field Reagent Blank

Transfer 150 ml of water to 250 ml tared Teflon® beaker liner and evaporate to dryness at room temperature (not to exceed 85 degrees F)

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

CPM Container 8
Hexane Field Reagent Blank

Transfer 150 ml of hexane to 250 ml tared Teflon® beaker liner and evaporate to dryness at room temperature (not to exceed 85 degrees F)

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

Specification Sheet for EPA Method 25A

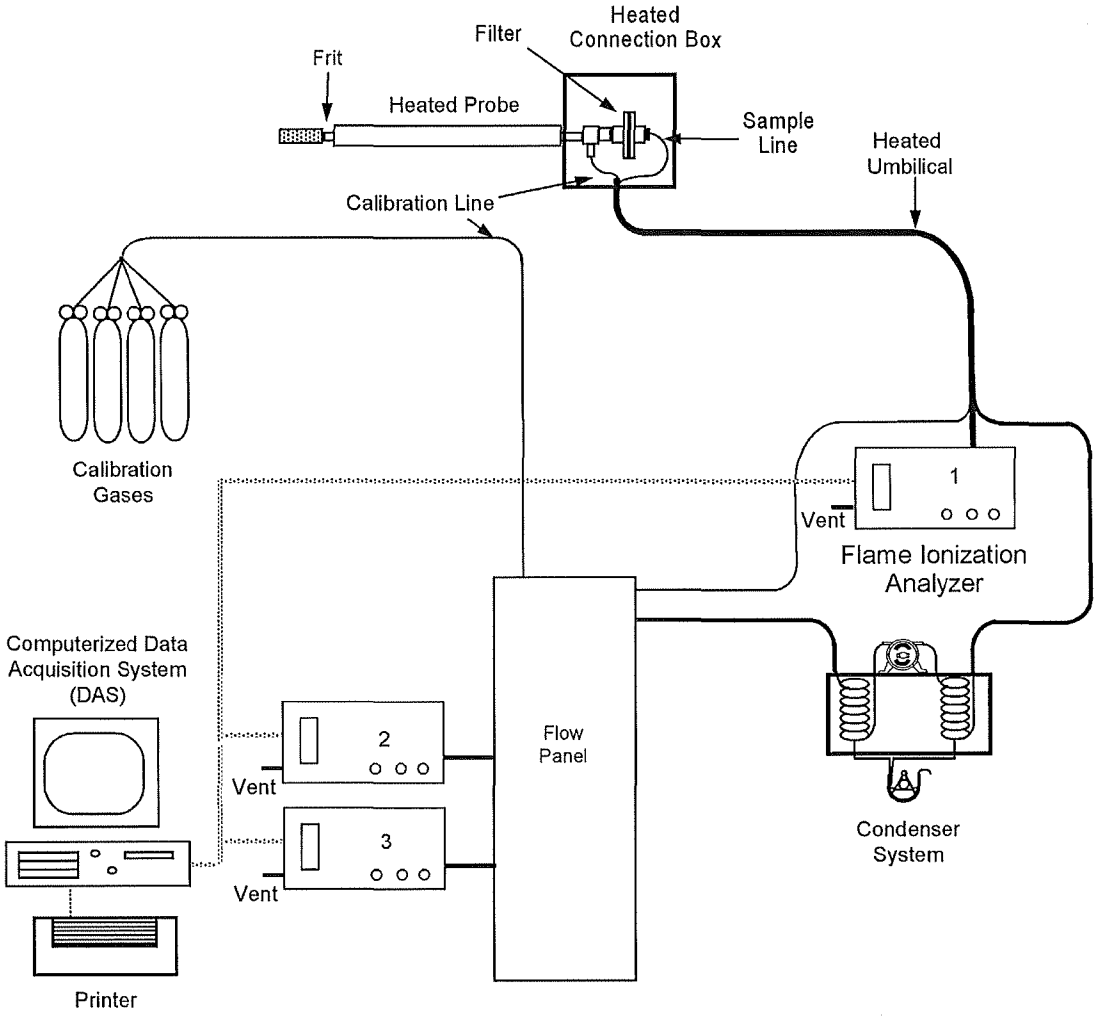
Source Location Name(s)	Underfire Combustion Stack
Pollutant(s) to be Determined	Total Gaseous Organic Concentration
Other Parameters to be Determined from Train	Diluents (O2 and CO2) - USEPA Method 3A

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	60 minutes
No. of Sample Traverse Points	N/A	Run 1 = 3, Runs 2-3 = 1
Sample Time per Point	N/A	Run 1 = 20 minutes, Runs 2-3 = 60 minutes
Sampling Rate	Constant Rate	Constant Rate
Sampling Probe		
Nozzle Material	N/A	None
Nozzle Design	N/A	N/A
Probe Liner Material	Stainless Steel or Equivalent	Stainless Steel
Effective Probe Length	Sufficient to Traverse Points	11 feet
Probe Temperature Set-Point	Prevent Condensation (>230°F)	248°F±25°F
Particulate Filter		
In-Stack Filter	Optional	Yes
In-Stack Filter Material	N/A	Fritted Stainless Steel
External Filter	Yes	Yes
External Filter Material	Glass Fiber Mat	Borosilicate Glass Fiber Mat
External Filter Set-Point	Prevent Condensation (>230°F)	248°F±25°F
Sample Delivery System		
Heated Sample Line Material	Stainless Steel or Teflon	Teflon
Heated Sample Line Set-Point	Prevent Condensation (>230°F)	248°F±25°F
Heated Sample Line Connections	Probe Exit to Analyzer	Probe to Moisture System and THC Analyzer
Moisture Removal System	N/A	Refrigerator-type condenser
Sample Pump Type	N/A	Diaphragm
Sample Pump Material	Non-reactive to sample gases	Teflon
Sample Flow Control	Constant Rate	Constant Rate (±10%)
Non-Heated Sample Line Material	N/A	Teflon
Non-Heated Sample Line Connections	N/A	Moisture Removal to Diluent Analyzers
Additional Filters	Optional	Yes
Additional Filter Type	N/A	Particulate Removal
Additional Filter Location	Optional	Before Analyzers
Filter Material	N/A	Quartz Fiber
Analyzer Description		
Oxygen (O_2)	EPA Method 3A (Paramagnetic)	EPA Method 3A (Paramagnetic)
Carbon Dioxide (CO_2)	EPA Method 3A (NDIR)	EPA Method 3A (NDIR)
Sulfur Dioxide (SO_2)	N/A	
Nitrogen Oxides (NO_x)	N/A	
Carbon Monoxide (CO)	N/A	
Total Hydrocarbon (THC)	EPA Method 25A (Flame Ionization Detection)	EPA Method 25A (Flame Ionization Detection)
Hydrogen Chloride (HCl)	N/A	
Ammonia (NH_3)	N/A	

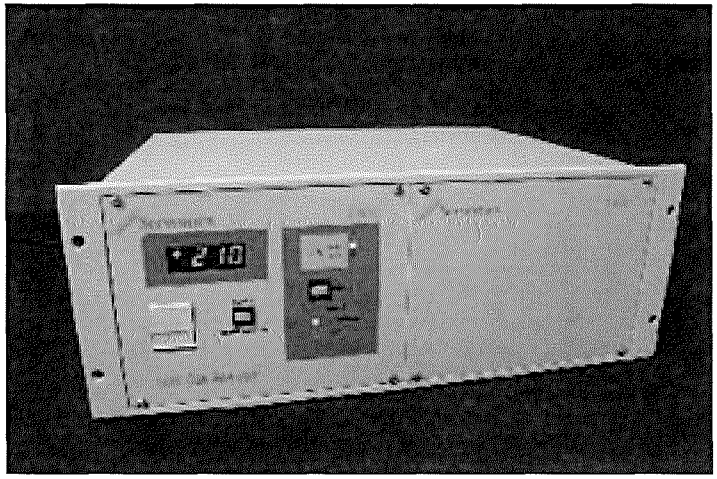
Specification Sheet for EPA Method 25A

	Standard Method Specification	Actual Specification Used
Instrument Span Range		
Oxygen (O_2)	≤ 1.33 x Expected Maximum	0-22.13%
Carbon Dioxide (CO_2)	≤ 1.33 x Expected Maximum	0-10.10%
Sulfur Dioxide (SO_2)	N/A	N/A
Nitrogen Oxides (NO_x)	N/A	N/A
Carbon Monoxide (CO)	N/A	N/A
Total Hydrocarbon (THC)	1.5 to 2.5 x Expected Maximum	0-85.9 ppm
Hydrogen Chloride (HCl)	N/A	N/A
Ammonia (NH_3)	N/A	N/A
Data Acquisition		
Data Recorder	Strip chart, Analog Computer or Digital Recorder	Analog Computer
Recorder Resolution	0.5 Percent of Span	0.1 Percent of Span
Data Storage	Manually or Automatic	Manually
Measurement Freq. <60 min. Sample Time	1-min. intervals or 30 measurements (less restrictive)	One reading per second
Recording Freq. <60 min. Sample Time	1-min. intervals or 30 measurements (less restrictive)	One Minute Average (60, 1 second readings)
Measurement Freq. >60 min. Sample Time	2-min. intervals or 96 measurements (less restrictive)	N/A
Recording Freq. >60 min. Sample Time	2-min. intervals or 96 measurements (less restrictive)	N/A
Calibration Gas Specifications		
Oxygen (O_2)	EPA Protocol 1	EPA Protocol 1
Carbon Dioxide (CO_2)	EPA Protocol 1	EPA Protocol 1
Sulfur Dioxide (SO_2)	N/A	
Nitrogen Oxides (NO_x)	N/A	
Carbon Monoxide (CO)	N/A	
Total Hydrocarbon (THC)	EPA Protocol 1	EPA Protocol 1
Hydrogen Chloride (HCl)	N/A	
Ammonia (NH_3)	N/A	

EPA Methods 3A and 25A
Sampling Train Configuration



Servomex 1420C Oxygen Analyzer



Rental and Application Notes:

- Shipping Weight: 28 lbs.
- The analyzer measures the partial pressure of oxygen in the sample gas. Therefore, any change in sample pressure at the measuring cell will have an effect, which is proportional to the change in absolute pressure from the time of calibration.
- The Servomex 1420C/1415C can be plumbed together in a 19" rack mount. The combined weight is 44 lbs.
- These units are compatible with the older 1400B series.

Specifications:

- Weight: 12 lbs.
- Dimensions: 19" x 7" x 14".
- Power: 120VAC.
- Output: 0-1V or 4 - 20mA.
- Range: 0 - 25 & 100% O_2.
- Response Time (T_{90}): 2.5 sec.
- Accuracy: $\pm$ 0.1%.
- Flow Rate: 1 - 6 L/min.
- Inlet Pressure: 1-10 psig.
- Vent Pressure: 11.8 to 15.9 psia.
- Linearity: $\pm$ 0.1%.
- Repeatability: $\pm$ 0.1% O_2.
- Zero Drift: < $\pm$ 0.002% O_2/hour.
- Span Drift: < $\pm$ 0.002% O_2/hour.
- Relative Humidity: 0 - 90% non-condensing.

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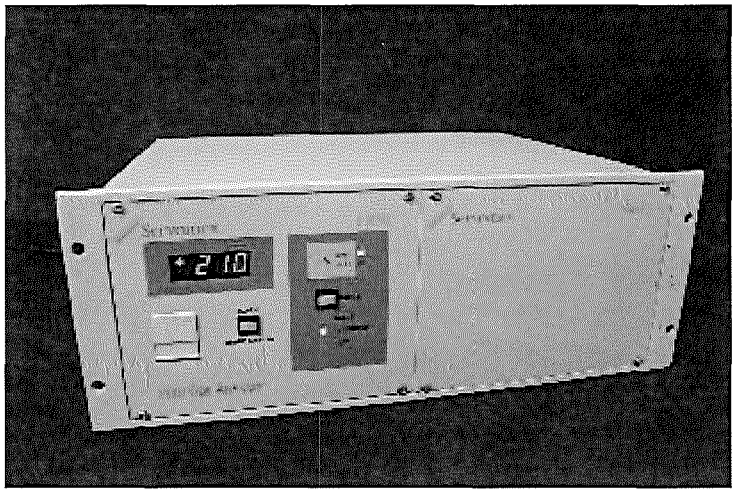
Servomex 1415 CO_2 Analyzer



Rental and Application Notes:

- Shipping Weight: 28 lbs.
- The Servomex 1420C/1415C can be plumbed together in a 19" rack mount. The combined weight is 44 lbs.
- These units are compatible wiith the older 1400B series.

Specifications:

- Weight: 12 lbs.
- Dimensions: 19" x 7" x 14"
- Power: 120VAC.
- Output: 0-1v non-isolated or 4-20mA.
- Range: 0-20 & 25% CO_2.
- Response Time (T_{90}): <10 seconds.
- Accuracy: 1% of selected range.
- Flow Rate: 1 - 6 L/min.
- Inlet Pressure: 1 - 10 psig.
- Vent Pressure: 13.1 to 16.0 psia.
- Linearity: 1% of selected range.
- Repeatability: 1% of selected range.
- Zero Drift: 2% of full scale/week.
- Span Drift: 1% of reading/day.
- Relative Humidity: 0% - 90% non-condensing.
- Storage Temperature: -4°F to 158°F.
- Infrared Detector.

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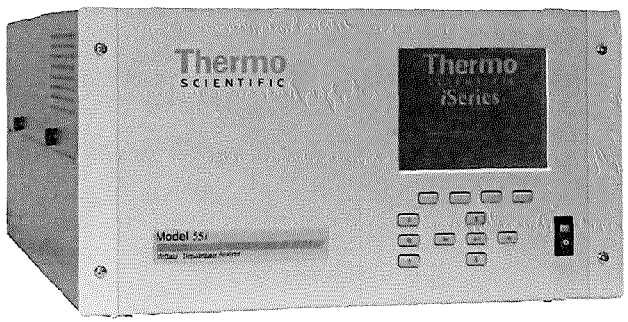
Thermo Model 55i Methane, Non-Methane Analyzer



Rental and Application Notes:

- Shipping Weight: 65 lbs.
- Designed for automated measurement of methane and non-methane hydrocarbons.
- Real time correction of THC readings.
- Carrier Gas; Nitrogen, combustion air, Hydrogen fuel.
- Utilizes a back-flush GC system to measure non-methane hydrocarbons directly.

Specifications:

- Weight: 50lbs.
- Dimensions: 16.75"x8.62"x23".
- Power: 105-125 VAC, 500w.
- Detection Method: Flame Ionization (FID)
- Lower Detection Limit: 20 ppb methane, 50ppb NMHC.
- Outputs: selectable voltage, RS232/RS485, TCP/IP, 10 status relays, and power fail indication, 4-20 mA isolated current output. Output is scalable to the exact range.
- Inputs: 16 Digital Inputs (standard) 8 0-10vds Analog optional.
- Range: 0-10ppm, 100ppm, 1000ppm; or 0-20pm, 200ppm, 2000ppm; or 0-50ppm, 500ppm, 5000ppm (select one option)
- Response Time: 70 sec. or less.
- Temperature: 15 to 35°C.
- Flow Rate: 500 ml/min.
- Span Drift: < 2% (24h) without auto calibration.
- Zero Drift: Auto-zero each cycle.
- Linearity: ± 2% of span (at concentrations 10-100% of span).

End of Appendix Section