

1.0 EXECUTIVE SUMMARY

MOSTARDI PLATT conducted an organic hazardous air pollutant (oHAP) compliance particulate test program for St Marys Cement at the Charlevoix Plant in Charlevoix, Michigan on the Main Kiln Stack. Testing was performed during both “mill on” and “mill off” conditions. This report summarizes the results of the test program and test methods. St Marys Cement operates under Michigan Renewable Operating Permit MI-ROP-B1559-2014 and Permit to Install 140-15.

The test locations, test dates, and test parameter are summarized below.

TEST INFORMATION		
Test Locations	Test Dates	Test Parameter
Main Kiln Stack (Mill Off)	October 27, 2020	Oxygen (O ₂), oHAP, including: Formaldehyde, Acetaldehyde, Benzene, Toluene, Xylenes (m, o, and p), Styrene, and Naphthalene
Main Kiln Stack (Mill On)	October 29, 2020	

The purpose of the test program was to demonstrate compliance with Title 40, *Code of Federal Regulations*, Part 60 (40CFR60), and 40CFR63, Subpart LLL “*National Emission Standards for Hazardous Air Pollutants (NESHAP) for the Portland Cement Manufacturing Industry and Standards of Performance for Portland Cement Plants.*” Specifically, to demonstrate that each of the below listed sources meet their oHAP emission limit and to establish a site-specific operating limit (SSOL) utilizing the plant’s currently certified total hydrocarbon (THC) analyzer.

Test Location	Parameter	Emission Rate	Fraction of Time in Applicable Mode	oHAP Time Weighted Average Emissions	Emission Limit	THC 3-run Average	THC SSOL
Main Kiln Stack (Mill On)	oHAP	10.72 ppmvd @ 7% O ₂	90%	11.55 ppmvd @ 7% O ₂	12 ppmvd @ 7% O ₂	103.80 ppmvw	102.47 ppmvw
Main Kiln Stack (Mill Off)	oHAP	19.07 ppmvd @ 7% O ₂	10%			90.53 ppmvw	

Data in the above table includes the average of the spiked and unspiked sample trains and has been corrected for spike recovery percent per section 12.8 of Method 18. Results reported below the limit of quantitation (LOQ) are reported and included in the summation in calculating concentrations.

The identifications of the individuals associated with the test program are summarized below.

TEST PERSONNEL INFORMATION		
Location	Address	Contact
Test Facility	St Marys Cement Charlevoix Cement Plant 16000 Bells Bay Road Charlevoix, Michigan 49720	Ms. Laurie Leaman Environmental Manager (231) 237-1387 laurie.leaman@vcimentos.com
Testing Company Supervisor	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Mr. John Nestor Senior Project Manager 630-993-2100 (phone) jnestor@mp-mail.com

The test crew consisted of Messrs. J. Nestor and J. Carlson of Mostardi Platt.

2.0 TEST METHODOLOGY

Emission testing was conducted following the United States Environmental Protection Agency (USEPA) methods specified in 40CFR60 and 40CFR63, Appendix A in addition the Mostardi Platt Quality Manual. Schematics of the test section diagrams and sampling trains used are included in Appendix A and B respectively. Calculation nomenclature are included in Appendix C. Laboratory analysis for each test run are included in Appendix D. The computerized reference method test data is included in Appendix E. CPMS data and process data as provided by St Marys Cement are also included in Appendix F.

The following methodologies were used during the test program:

Method 3A Oxygen (O₂) Determination

Flue gas O₂ concentrations for the Main Kiln Stack were determined in accordance with USEPA Method 3A. An Ecom analyzer was used to determine the O₂ concentrations by connecting the analyzer to the outlet of the fourier transform infrared analyzer after the removal of moisture from the system. The O₂ instrument operates in the nominal range of 0% to 25% with the specific range determined by the high-level calibration gas. High and mid-range calibrations were performed using USEPA Protocol gas. Zero nitrogen (a low ppm pollutant in balance nitrogen calibration gases) was introduced during other instrument calibrations to check instrument zero. Zero and mid-range calibrations were performed using USEPA Protocol gas after each test run. Copies of the gas cylinder certifications are found in Appendix I.

Method 18 oHAP (Benzene, Toluene, Xylenes, Naphthalene, and Styrene) Determination

Stack gas oHAP concentrations and emission rates were determined in accordance with Method 18. Paired stainless-steel probes with teflon lines were used to draw sample at a rate of 0.5 lpm through a knockout impinger to remove condensate prior to oHAP being collected on a two section XAD trap followed by a two-section charcoal trap. Silica gel was placed after the charcoal trap (immediately prior to the dry gas meter) to remove any remaining moisture prior to reaching the dry gas meter.

One sample train for each run was unspiked, designated the "A" traps, while the 2nd sample train, designated the "B" traps, were spiked with approximately 200ug of benzene, toluene, xylenes,

naphthalene, and styrene. Based on the nominal sampling volume of 30 liters, a 200ug spike is equivalent to 6.67 ug/l (or mg/cubic meter). The table below shows approximate ppm values for each parameter, based upon the above spike level, 24.056 is the molar volume at 68F liters/mole, and molecular weight of each compound:

Spiked concentrations		
Parameter	Molecular Weight	ppmvd
Benzene	78.11	2.05
Toluene	92.14	1.74
Xylene	106.16	1.51
Naphthalene	128.17	1.25
Styrene	104.15	1.54

Condensate collected in the knockout impinger was recovered and collected in nominal 40 mL vials. Vials were filled with Type I deionized water to remove any headspace in order to prevent any volatilization of compounds prior to analysis. XAD "B" trap sections were spiked before field use. The final section of the charcoal trap was analyzed to demonstrate breakthrough did not occur during testing. The water fraction and breakthrough fraction were analyzed and are reported in the detailed laboratory report in Appendix D. Both of these fractions for every compound analyzed were below detection limit and therefore are not included in the detailed summary table in Section 3.0.

Method 320 Fourier Transform Infrared (FTIR) Detector Formaldehyde and Acetaldehyde Determination

FTIR data was collected using an MKS MultiGas 2030 FTIR spectrometer.

The FTIR was equipped with a temperature-controlled, 5.11 meter multi-pass gas cell maintained at 191°C. Gas flows and sampling system pressures were monitored using a rotameter and pressure transducer. All data was collected at 0.5 cm⁻¹ resolution. Each spectrum was derived from the coaddition of 64 scans, with a new data point generated approximately every one minute. Analyzer data for each run is presented in Appendix E.

SAMPLING SYSTEM PARAMETERS				
MKS Serial #	Sampling Line	Probe Assembly	Particulate Filter Media	Operating Temperatures
01819069	50' 3/8" dia., heated Teflon	Heated 8', 3/8" dia. SS	0.01µ heated borosilicate glass fiber	191°C

QA/QC procedures followed US EPA Method 320. See below for QA/QC procedure details and list of calibration gas standards. All calibration gases were introduced to the analyzer and the sampling system using an instrument grade stainless steel rotameter. All QA/QC procedures were within the acceptance criteria allowance of the applicable EPA methodology. See Appendix H for FTIR QA/QC Data.

FTIR QA/QC Procedures						
QA/QC Specification	Purpose	Calibration Gas Analyte	Delivery	Frequency	Acceptance Criteria	Result
M320: Zero	Verify that the FTIR is free of contaminants & zero the FTIR	Nitrogen (zero)	Direct to FTIR	pre/post test	< MDL or Noise	Pass
M320: Calibration Transfer Standard (CTS) Direct	Verify FTIR stability, confirm optical path length	Ethylene	Direct to FTIR	pretest	+/- 5% cert. value	Pass
M320: Analyte Direct	Verify FTIR calibration	Formaldehyde	Direct to FTIR	pretest	+/- 5% cert. value	Pass
M320: CTS Response	Verify system stability, recovery, response time	Ethylene	Sampling System	Daily, pre/post test	+/- 5% of Direct Measurement	Pass
M320: Zero Response	Verify system is free of contaminants, system bias	Nitrogen (zero)	Sampling System	pretest	Bias correct data	Pass
M320: Analyte Spike	Verify system ability to deliver and quantify analyte of interest in the presence of other effluent gases	Formaldehyde	Dynamic Addition to Sampling System, 1:10 effluent	Throughout testing – daily	+/- 30% theoretical recovery	Pass

Note: The determined concentrations from direct analyses were used in all system/spike recovery calculations.

Analyte Spiking

Formaldehyde spiking was performed prior to testing to verify the ability of the sampling system to quantitatively deliver a sample containing formaldehyde from the base of the probe to the FTIR. Analyte spiking assures the ability of the FTIR sampling system to recover acid gases in the presence of effluent gas.

As part of the spiking procedure, samples were measured to determine native formaldehyde concentrations to be used in the spike recovery calculations. The analyte spiking gases contained a low concentration of sulfur hexafluoride (SF₆). The determined SF₆ concentration in the spiked sample was used to calculate the dilution factor of the spike and thus used to calculate the concentration of the spiked formaldehyde. The spike target dilution ratio was 1:10 or less.

The following equation illustrates the percent recovery calculation.

$$DF = \frac{SF_6(spik)}{SF_6(direct)} \quad (\text{Sec. 9.2.3 (3) USEPA Method 320})$$

$$CS = DF * Spike(dir) + Unspike(1 - DF) \quad (\text{Sec. 9.2.3 (4) USEPA Method 320})$$

DF = Dilution factor of the spike gas

SF_{6(dir)} = SF₆ concentration measured directly in undiluted spike gas

SF_{6(spk)} = Diluted SF₆ concentration measured in a spiked sample

$Spike_{dir}$ = Concentration of the analyte in the spike standard measure by the FTIR directly
 CS = Expected concentration of the spiked samples
 $Unspike$ = Native concentration of analytes in unspiked samples

Post Collection Data Validation

As part of the data validation procedure, reference spectra are manually fit to that of the sample spectra and a concentration is determined. The reference spectra are scaled to match the peak amplitude of the sample, thus providing a scale factor. The scale factor multiplied by the reference spectra concentration is used to determine the concentration value for the sample spectra. Sample pressure and temperature corrections are then applied to compute the final sample concentration. The manually calculated results are then compared with the software-generated results. The data is then validated if the two concentrations are within $\pm 20\%$ agreement. If there is a difference greater than $\pm 20\%$ the spectra are reviewed for possible spectra interferences or any other possible causes leading to incorrectly quantified data.

Detection Limit

The detection limit of each analyte was calculated following Annex A2 of ASTM D6348-12 procedure using spectra that contained similar amounts of moisture.

FTIR DETECTION LIMITS			
Analyte	Detection Limit (ppmv wet)	Detection Limit (%v)	Detection Limit (%v wet)
Formaldehyde	0.2	-	-
Acetaldehyde	0.2	-	-
Water	-	0.1	N/A
Carbon Dioxide	-	N/A	0.1

QA/QC data are found in Appendix H. Copies of gas cylinder certifications are found in Appendix I. All concentration data were recorded on a wet, volume basis. Formaldehyde spiking was performed prior to testing to confirm the measurement system's ability to deliver and quantify formaldehyde. The sample and data collection followed the procedures outlined in Method 320.

3.0 TEST RESULT SUMMARIES

Organic HAP Results Summary

St Marys Cement

Kiln Stack

October 29, 2020

Raw Mill On

Run No.	1	2	3	Average
Time	13:05-14:05	14:40-15:40	16:10-17:10	
O2, %	8.8	8.7	8.8	8.8
Benzene Concentration, ppmvd @ 7% O2	2.92	3.09	3.24	3.08
Toluene Concentration, ppmvd @ 7% O2	0.72	0.87	0.88	0.82
m-xylene Concentration, ppmvd @ 7% O2	< 0.07	0.08	0.07	< 0.08
o-xylene Concentration, ppmvd @ 7% O2	< 0.08	< 0.08	< 0.05	< 0.08
p-xylene Concentration, ppmvd @ 7% O2	< 0.03	< 0.04	< 0.03	< 0.03
Naphthalene Concentration, ppmvd @ 7% O2	< 0.03	< 0.01	< 0.02	< 0.02
Styrene Concentration, ppmvd @ 7% O2	0.18	0.18	0.17	0.18
Formaldehyde Concentration, ppmvd @ 7% O2	1.90	1.52	1.50	1.64
Acetaldehyde Concentration, ppmvd @ 7% O2	4.58	4.81	5.01	4.80
Total o-HAP, ppmvd @ 7% O2	< 10.50	< 10.68	< 10.96	< 10.72
Prorated Mill On oHAP @ 7% O2	< 9.45	< 9.61	< 9.87	< 9.64
CEMS THC, ppmvw	86.65	106.70	118.06	103.80
Source oHAP Emissions Limit, ppmvd @ 7% O2	12			
THC CEMS Zero	0			
o-HAP, % of Emissions Limit	89.3%			
THC SSOL, Raw Mill On, ppmvw	103.80			

Organic HAP Results Summary
St Marys Cement
Kiln Stack
October 27, 2020
Raw Mill Off

Run No.	1	2	3	Average
Time	10:45-11:45	12:40-13:40	14:35-15:35	
O2, %	7.2	7.1	7.0	7.1
Benzene Concentration, ppmvd @ 7% O2	2.09	1.82	1.73	1.88
Toluene Concentration, ppmvd @ 7% O2	0.46	0.35	0.28	0.36
m-xylene Concentration, ppmvd @ 7% O2	< 0.05	< 0.04	< 0.04	< 0.05
o-xylene Concentration, ppmvd @ 7% O2	< 0.04	< 0.03	< 0.03	< 0.04
p-xylene Concentration, ppmvd @ 7% O2	< 0.02	< 0.01	< 0.02	< 0.02
Naphthalene Concentration, ppmvd @ 7% O2	< 0.03	< 0.02	< 0.02	< 0.02
Styrene Concentration, ppmvd @ 7% O2	0.10	< 0.07	< 0.06	< 0.07
Formaldehyde Concentration, ppmvd @ 7% O2	14.56	11.62	11.06	13.01
Acetaldehyde Concentration, ppmvd @ 7% O2	4.47	4.12	4.05	4.57
Total o-HAP, ppmvd @ 7% O2	< 21.81	< 18.09	< 17.29	< 19.06
Prorated Mill Off oHAP, ppmvd @ 7% O2	< 2.18	< 1.81	< 1.73	< 1.91
CEMS THC, ppmvw	89.50	87.55	94.53	90.53
Source oHAP Emissions Limit, ppmvd @ 7% O2	12			
THC CEMS Zero	0			
o-HAP, % of Emissions Limit	158.9%			
THC SSOL, Raw Mill Off, ppmvw	90.53			
Combined THC SSOL	102.47			
Total oHAP, ppmvd @ 7% O2	< 11.63	< 11.42	< 11.60	< 11.55

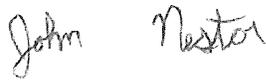
4.0 CERTIFICATION

MOSTARDI PLATT is pleased to have been of service to St Marys Cement. If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

CERTIFICATION

As the program manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results. The test program was performed in accordance with the test methods and the Mostardi Platt Quality Manual, as applicable.

MOSTARDI PLATT



John Nestor

Project Manager



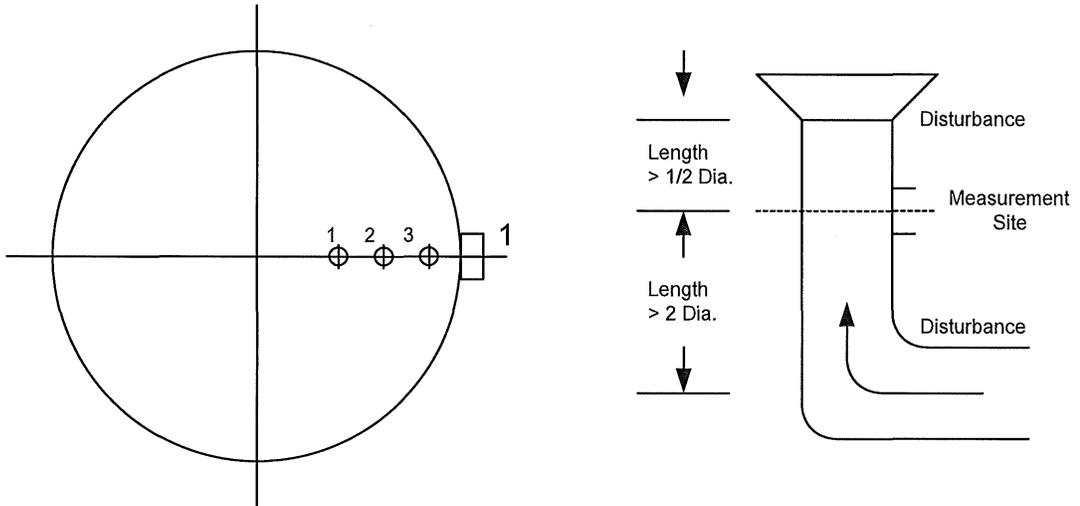
Eric L. Ehlers

Quality Assurance

APPENDICES

Appendix A - Test Section Diagram

GASEOUS TRAVERSE FOR ROUND DUCTS



Project: St Marys Cement
Charlevoix Cement Plant
Charlevoix, Michigan

Test Dates: October 27 and 29, 2020

Test Location: Main Kiln Stack

Stack Diameter: 10.58 Feet

Stack Area: 92.459 Square Feet

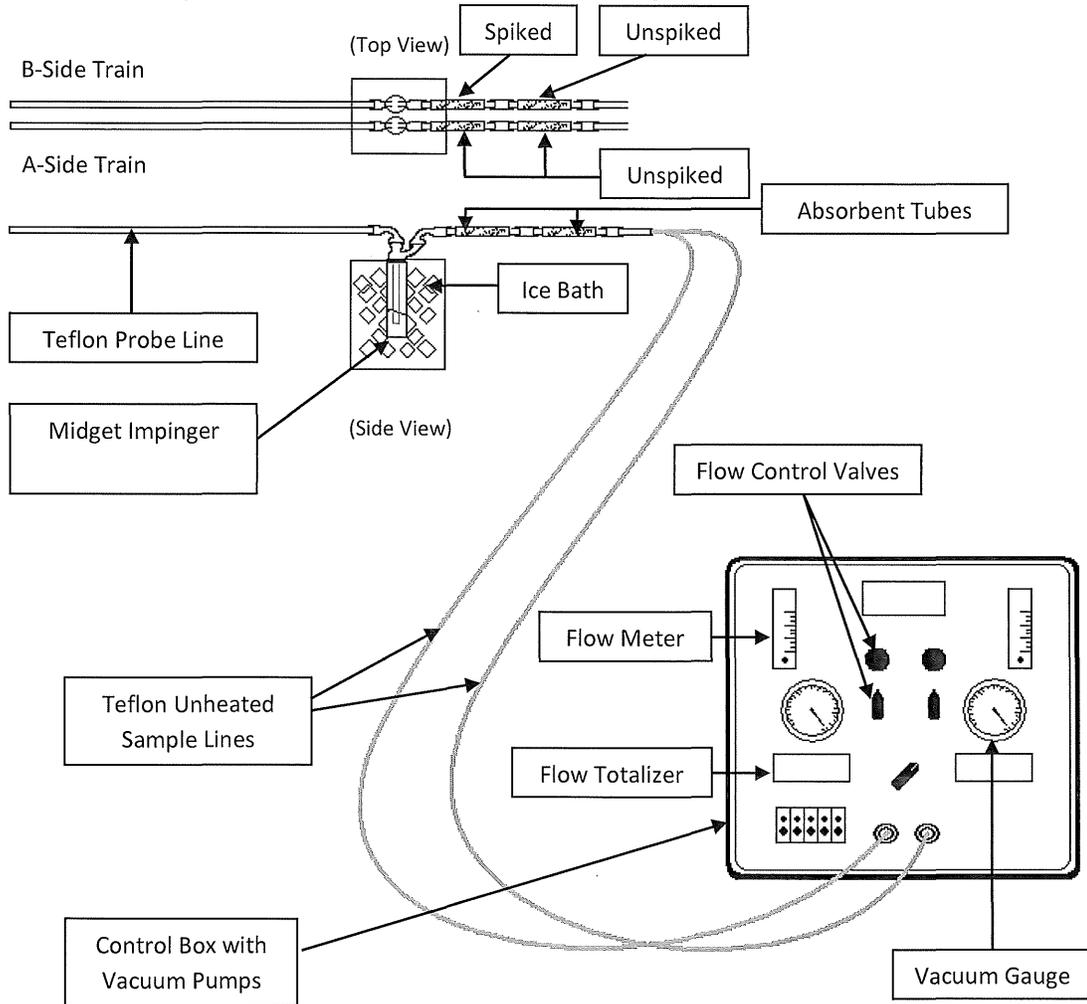
No. Sample Points: 3

Upstream Diameters: 7.9

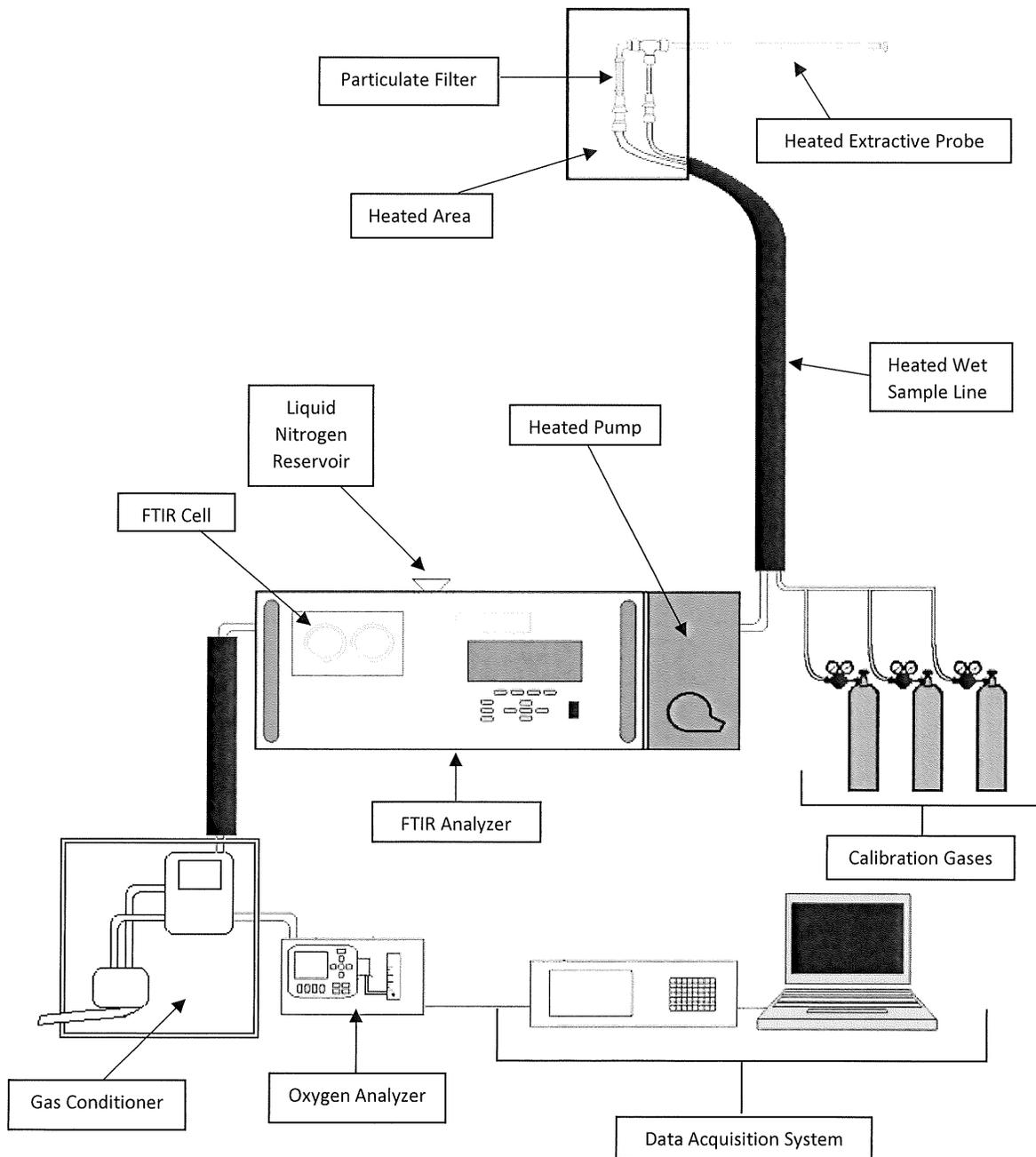
Downstream Diameters: 15.7

Appendix B - Sample Train Diagrams

USEPA Method 18 – Adsorbent Tube Sampling for Benzene, Toluene, Xylenes, Naphthalene, and Styrene



USEPA Methods 3A and 320 – Sample Train Diagram



Appendix C - Calculation Nomenclature and Formulas