

**LINE 2 GLASS PROCESSING
PARTICULATE MATTER, AMMONIA, HAP METALS, AND SULFURIC ACID MIST
EMISSIONS TEST REPORT
GUARDIAN INDUSTRIES CORPORATION
CARLETON, MICHIGAN**

Test Dates: July 21 and 22, 2015

Report Date: September 30, 2015

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Prepared for:

Guardian Industries Corp.
14600 Romine Road
Carleton, Michigan 48117

Prepared by:

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PA Lab Registration #02-04775

Project Number: 15-081

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GUARDIAN INDUSTRIES CORPORATION
CARLETON, MICHIGAN**

1 TEST RESULTS SUMMARY

Permit Number: PTI 105-14			
Source Name: Line 2 Glass Production			
Source ID: EU00080			
Pollutant	Average Result	Limit	Compliant/ Non-compliant
Filterable Particulate Matter	0.136 lb/ton	0.45 lb/ton	Compliant
PM ₁₀	2.39 lb/hr	12.2 lb/hr	Compliant
PM _{2.5}	2.39 lb/hr	12.2 lb/hr	Compliant
Sulfuric Acid Mist (H ₂ SO ₄)	13.3 lb/hr	1.6 lb/hr	Non-compliant
Ammonia (NH ₃)	24.9 ppm _{dv}	NA	NA
HAP Metals	< 0.0182 lb/ton	0.02 lb/ton	Compliant
Selenium	0.313 lb/hr	2.03 lb/hr	Compliant

2 INTRODUCTION

Guardian Industries Corporation (Guardian) contracted Air/Compliance Consultants, Inc. (ACCI), an affiliate of Montrose Air Quality Services, LLC. (Montrose), to perform an evaluation of emissions at their facility located in Carleton, Michigan. Testing was conducted on the Line 2 Glass Production (Line 2) in accordance with Michigan Department of Environmental Quality (MDEQ) requirements, and United States Environmental Protection Agency (USEPA), Title 40 CFR, Part 60, Appendices A and B, and procedures outlined in the March 2015 Test Protocol, to determine filterable particulate matter (FPM), sulfuric acid mist (H₂SO₄), ammonia (NH₃), and metal (Antimony [Sb], Arsenic [As], Cadmium [Cd], Chromium [Cr], Cobalt [Co], Lead [Pb], Manganese [Mn], Mercury [Hg], Nickel [Ni], and Selenium [Se] hazardous air pollutants (HAP) compliance with the Permit to Install (PTI) 105-14. A copy of the March 2015 Test Protocol is contained in Appendix A.

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3 CONTACT INFORMATION

Facility Contact	Testing Firm
Ms. Laura Rye Compliance Engineer Guardian Industries Corporation 14600 Romine Road Carleton, Michigan 48117 (734)-654-4381 – Telephone lrve@guardian.com	Mr. Paul A. Jadlowiec, QSTI Senior Project Manager Air/Compliance Consultants, Inc. 1050 William Pitt Way Pittsburgh, Pennsylvania 15238 (412) 826-3636 – Telephone pjadlowiec@montrose-env.com

4 TEST DATES AND PERSONNEL INFORMATION

Emissions testing for FPM and NH₃ was conducted on July 21, 2015. The emissions testing for H₂SO₄ was conducted on July 22, 2015.

The following table details the contact personnel regarding this test program:

Organization	Personnel	Responsibility
Guardian	Joe Ventline	Test Liaison
MDEQ	Mark Dziadosz	Agency Observer
	Joshua S. Varner, QSTI, Project Scientist	Instrumental Methods and Sample Recovery
	Justin G. Bryan, QSTI, Scientist I	RMs 1, 2, 4, 5, 013B, 027, and 29
ACCI/Montrose	John E. Wilson, QSTI, Technician II	RMs 1, 2, 4, 5, 013B, 027, and 29
	Owen H. Daly, Scientist I	RMs 1, 2, 4, 5, 013B, 027, and 29

5 ANALYTICAL LABORATORY INFORMATION

Samples were collected and analyzed according to the applicable method. Audit samples metals and sulfuric acid were provided by ERA. Analyses were performed by the following:

USEPA Method 5	USEPA CTM 013B / USEPA CTM027 / USEPA Method 29
Erin M. Houpt Air/Compliance Consultants, Inc. 1050 William Pitt Way Pittsburgh, Pennsylvania 15238 (412) 826-3636 –Telephone PA Lab Registration #02-04775 ehaupt@montrose-env.com	Maxxam Analytics Inc. Mr. Clayton Johnson 6740 Campbello Road Mississauga, Ontario, Canada L5N 2LB (905) 817-5769 –Telephone cjohnson@maxxam.ca PA Lab Registration #68-01745

6 PROCESS DESCRIPTION AND PROCESS DATA

6.1 Process Description

Guardian manufactures flat glass at the Carleton, Michigan facility. Line 2 (EU00080) consists of a raw material melting furnace, glass forming and finishing, and glass cutting. Line 2 produces flat glass using the float method. Raw materials of sand, soda ash, dolomite, limestone and other minor constituents are weighed and mixed with water in the batch-house before entering the natural gas fired furnace. The percentages of the raw material mixes varies depending on the product type desired. Glass then enters the tin bath to be formed and drawn, and then it enters a lehr to reduce its temperature. Line 2 rated capacity is 650 tons of glass pulled per day.

Line 2 emissions are controlled by a newly installed control system consisting of a dry scrubber, particulate filter, and selective catalytic reduction (SCR). The dry scrubber uses hydrated lime stored in a 3,000 cubic foot storage silo with a passive bin vent for injection into the scrubber to remove gaseous pollutants. Aqueous NH₃, stored in a 20,000 gallon pressurized storage tank, is injected into the gas stream to treat the exhaust gas for NO_x control. An UltraCat Filter System removes particulate after the dry scrubber control. The final control is selective catalyst reduction that uses high temperature, light weight ceramic filters impregnated with catalyst to remove remaining gaseous emissions which a component of the UltraCat Filter Control System.

6.2 Process Data

Guardian personnel were responsible for recording pertinent process data at a minimum of once every 15 minutes during each emission testing period. The specific process data recorded was:

- Glass pull rate (tph & tpd)
- Natural gas usage

Plant process data is contained in Appendix B.

7 TEST PROCEDURES

Testing was performed in accordance with USEPA Methods and the procedures outlined in USEPA 40 CFR, Part 60, Appendices A and B and the March 2015 Test Protocol. All field data sheets are contained in Appendix C.

7.1 Testing Stations and Traverse Locations – USEPA Method 1

USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources*, was utilized to determine the number and location of the traverse points. Figure 1 provides a schematic of the sampling and traverse point locations as measured in the field. A copy of the cyclonic flow check data can be found in Appendix C.

7.2 Gas Velocity and Moisture – USEPA Method 2

The gas flow and temperature measurements followed the principles of USEPA Method 2, *Determination of Stack Gas Velocity and Volumetric Flow Rate (S-Type Pitot Tube)*. The gas flow rate and temperature profiles for the gas stream were measured by conducting simultaneous velocity and temperature traverses during each sampling run. Gas velocity head was measured using a calibrated S-Type Pitot tube that was connected to a manometer. The static pressure was measured using the same Pitot tube and manometer. A Chrome-Alumel thermocouple attached to a digital indicator was used to measure the gas temperature at each of the traverse points.

7.3 Moisture Content Sampling – USEPA Method 4

Moisture content sampling was conducted concurrently with each sampling run using the principles and sampling apparatus presented in USEPA Method 4, *Determination of Moisture Content in Stack Gases*. The parameters evaluated to determine the gas-stream moisture content were sample gas volume, temperature and pressure, and impinger and silica gel moisture gain.

7.4 Determination of Particulate Matter and Metal Emissions – USEPA Method 5/29

For this project, USEPA Method 29, *Determination of Metals Emissions from Stationary Sources* was combined with the USEPA Method 5, *Determination of Particulate Emissions from Stationary Sources* to measure FPM and HAP metal emissions.

FPM results are presented as follows:

- FPM – Method 5 Filter and Acetone Wash Weight Catch
- All FPM is assumed to be PM₁₀ and PM_{2.5}

Metal results are presented as follows:

- HAP Metals- The sum of Antimony, Arsenic, Cadmium, Chromium, Cobalt, Lead, Manganese, Mercury, Nickel, and Selenium
- Selenium-Reported separately

7.4.1 Method 5/29 Sampling Train Setup and Operation

The sampling apparatus contained a glass-lined temperature-controlled (248°F ± 25°F) probe equipped with a S-Type Pitot tube and a sharp-edged glass button-hook nozzle. The probe liner and nozzle were connected utilizing a glass-coated stainless-steel union and graphite ferrules. The exit of the probe was connected to a tarred, high-efficiency quartz glass fiber filter supported in a glass-filter holder inside an oven heated so the exit of the filter holder maintained at 248°F ± 25°F. The exit of the filter holder was connected to a USEPA Method 29 impinger set.

Prior to sampling, all glassware was cleaned with soap and water, rinsed with tap water and deionized (DI) water. After cleaning, the glassware was soaked in a 10% nitric acid solution for at least 4 hours. Following soaking, the glassware was then rinsed with DI water, and then finally rinsed with acetone and allowed to air dry.

The exit of the filter holder was connected to a series of six impingers. The first (modified Greenburg-Smith) and second (standard Greenburg-Smith) impingers each contained 100 milliliters (ml) of 5% nitric acid (HNO₃) / 10% hydrogen peroxide (H₂O₂), the third (modified Greenburg-Smith) was empty, the fourth and fifth (both modified Greenburg-Smith) contained 100 ml of acidic potassium permanganate (KMnO₄), and the sixth impinger contained pre-weighed silica gel. The first five impingers were weighed to the nearest ± 0.1 gram (g) using a

calibrated field balance prior to the start of sampling for determination of moisture content in the gas stream. By weighing the impingers instead of measuring the liquid using a graduated cylinder, there was less potential for contamination of the sample.

The impinger train was connected to a commercially available metering system. Prior to sampling, the dry gas meter was calibrated utilizing the critical orifice procedures detailed in Section 16.2 of USEPA Method 5. A critical orifice set covering the sampling rates was utilized. Along with pre-test and post-test meter calibrations, the S-Type Pitot, thermocouple and nozzle were also calibrated prior to and following use in the field according to USEPA Method 5 procedures.

The sample train was assembled, allowed to reach operating temperature, and leak checked by plugging the nozzle with a rubber septum and pulling a vacuum of approximately 15" of Hg. Once an acceptable leak-check of less than 0.02 cubic feet per minute (cfm) was achieved, the sampling train was placed at the first traverse point and sampling began immediately. The sampling train was operated at an isokinetic rate with an isokinetic variation between 90% and 110%. Each test run was 120 minutes in duration and had a minimum sample volume of 72 dry standard cubic feet (DSCF). At the conclusion of each test run, the sample train was cooled sufficiently, utilizing ambient air or ice, to allow the nozzle to be plugged with the rubber septum. The sampling train was leak-checked at a vacuum equal to or greater than the maximum value reached during sampling. An acceptable leakage rate was less than 0.02 cfm or 4% of the average sampling rate (whichever was less).

7.4.2 Method 5/29 Sample Recovery and Analysis

Container No. 1 – Removed the filter from the filter holder and placed it in its labeled petri dish container.

Container No. 2 – The nozzle, probe, front-half of the filter holder and connections were rinsed with a total of 100 ml of acetone. The rinses were stored in a labeled, sealed glass bottle for shipment to the laboratory. The acetone catch with the net gain of the filter catch was used to determine the FPM emissions.

Container No. 3 – The nozzle, probe, front-half of the filter holder and connections were rinsed with a total of 100 ml of 0.1 N HNO₃. The rinses were stored in a labeled, sealed glass bottle for shipment to the laboratory. The rinses repeated with water and acetone; both of these rinses were discarded.

Container No. 4 (Impingers 1 through 3) - The liquid was measured to the nearest ± 0.5 ml using a graduated cylinder. The contents were then transferred to a glass sample bottle. The back half of the filter holder, connecting glassware and impingers were rinsed with 100 ml 0.1 N HNO₃; these rinses were added to the same sample bottle. The bottle was labeled and stored at ambient temperature for shipment to the laboratory for analysis.

Container No. 5A (0.1 N HNO₃) – Impinger 4 was measured to the nearest ± 0.5 ml using a graduated cylinder. The liquid along with the 100 ml 0.1 N HNO₃ rinse of the impinger was transferred to a glass sample bottle, labeled and stored for shipment to the laboratory.

Container 5B (KMnO₄/H₂SO₄ absorbing solution) – Impingers 5 and 6 were measured to the nearest ± 0.5 ml using a graduated cylinder. The contents were transferred to a labeled amber glass sample bottle. The impingers were rinsed with exactly 100 ml of fresh acidified KMnO₄ for all three rinses. These rinses were added to the same container. Similarly, three rinses of the same impingers were performed using exactly 100 ml of water. These rinses were also added to Container 5B. The sample bottle lid had a small hole to allow for pressure to release.

Container 5C (8 N HCl rinse and dilution) – If deposits remained on Impingers 5 and 6 following the rinses, a wash of 25 ml total of 8 N HCl was performed. The 25 ml of 8 N HCl was added to Impinger 5, swirled, and then transferred to Impinger 6 and swirled. This wash was added to a labeled sample bottle that contained 200 ml of water.

Container 6 (silica gel) - The silica gel was transferred to the original container and weighed to the nearest ± 0.5 g.

All samples were maintained at ambient temperature. Each fraction was recorded on the sample chain of custody and transported to the laboratory for analysis. USEPA Method 29 requires reagent blanks. The blanks were collected as described in §8.2 of USEPA Method 29,

specifically Containers 8A, 8B, 9, 10, 11, and 12. All blanks were analyzed with the samples. Analytical results, along with all method quality assurance/quality control data, is included in Appendix D.

Following the USEPA Guidelines for Audit Samples, audit samples were requested from ERA, A Waters Company, that meet the National Environmental Laboratory Accreditation Program (NELAP) for Audit Samples. USEPA Method 29 audit samples containing the HAP metals on filter paper and also in impinger solution were analyzed. The audit samples were shipped to ACCI to hold until testing was completed. They were then shipped to the laboratory for analysis alongside the field samples.

FPM, metals and metal audit sample laboratory results are contained in Appendix D. Selenium is reported separately. FPM, HAP metals and selenium emissions are reported on a lb/hr and lb/ton basis.

7.5 Determination of O₂ and CO₂ – USEPA Method 3A

The principles of USEPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)*, were utilized for the determination of oxygen (O₂) and carbon dioxide (CO₂) for the test program. A paramagnetic analyzer was used to continuously measure O₂ concentrations and a non-dispersive infrared (NDIR) analyzer was used to continuously measure CO₂ concentrations. Nitrogen (N₂) concentration was determined by the difference. The O₂, CO₂ and N₂ contents were used to calculate the gas density of the exhaust gas stream to calculate the exhaust gas flow rate. One-minute readings are included in Appendix C.

7.5.1 Sampling System Setup

The sampling system contained a 3/8" heated stainless-steel or Inconel sheathed probe, a glass fiber 30 x 100 mm heated filter, a calibration "T", a heated sample line, a gas conditioner, a gas distribution manifold, and pollutant specific analyzers. Sampling components prior to the gas conditioner (i.e., probe, filter, sample line) were heated to maintain temperatures above the dew point of the exhaust gas. Prior to sampling, the entire system was leak checked by capping off the end of the sample probe and drawing a vacuum on the entire system.

7.5.2 Testing Procedures

To the extent practicable, analyzer spans were between 20% to 100% of the measured emissions. If, during pre-test determinations, concentration spikes were observed, instrument spans were set to accommodate the highest instantaneous spike value observed.

At the beginning of each sampling day, an internal calibration error (CE) check was performed; a zero gas and calibration gases at 40% to 60% of span and 100% of span were introduced to the analyzers. The internal calibration responses were then checked against the known cylinder gas values. The difference between the cylinder values and analyzer responses was divided by the span value of the gas to give the CE. An allowable CE is 2% of analyzer span. Each analyzer demonstrated acceptable CE at all times.

The analyzer was then placed in a system calibration bias mode. Zero and upscale gases were introduced at the probe exit to allow evaluation of the sampling line, gas conditioner, and analyzer in a normal sampling mode. No adjustments to the sampling system were made and the response of each gas was recorded. The difference between the sampling system response in the bias mode minus the analyzer response during the internal calibration check was divided by the analyzer span value. This calculated value represents the sampling system bias and did not exceed $\pm 5\%$ for any analyzer at any time per test run.

The sampling probe was traversed across three (3) points (at points of 16.7%, 50.0%, and 83.3% of the stack inner diameter), in a single port. Each point was sampled for two minutes. (See Appendix C for the results of this stratification check and the system response times for the applicable analyzer). When each individual test run was complete, a post-test sampling system bias check was conducted. No adjustments to the sampling system were made and the response of each gas was recorded. The difference between the sampling system response in the bias mode minus the analyzer response during the internal check was divided by the analyzer span value. This calculated value represents the sampling system bias and did not exceed $\pm 5\%$ for any analyzer at any time per test run.

The responses from the second bias check were compared with those from the pre-test system bias check. The difference between the post-test and pre-test bias check responses were divided

by the analyzer span value. This value was the amount of drift between the pre-test and post-test bias checks. A calibration drift of $\leq 3\%$ is acceptable.

7.6 Determination of Sulfuric Acid Mist – USEPA Method CTM 013B

Sulfuric acid mist emissions were conducted in accordance with the procedures outlined in USEPA Method CTM 013B, *Determination of Sulfuric Acid and Sulfur Dioxide Emissions from Combination Fuel Boilers, Recovery Furnaces, and Thermal Oxidizers – Isokinetic Method*.

7.6.1 Sampling Train Setup and Operation

Prior to sampling, all glassware was cleaned with soap and water, rinsed with tap water, and DI water.

The sampling apparatus contained a quartz nozzle connected to a quartz-lined temperature-controlled ($\sim 400^\circ\text{F}$) probe using a glass-coated stainless steel union and graphite ferrules. The exit of the probe was connected to a quartz filter holder containing a 30 x 100 mm diameter quartz filter. The filter was inside an oven heated to $> 500^\circ\text{F}$. The exit of the filter holder was connected to six Greenburg-Smith impingers. The first and second impingers contained 100 ml of 100% isopropyl alcohol (IPA). The outlet of the second impinger was connected to an unheated borosilicate glass filter holder with glass frit filter support containing a glass fiber filter. The third impinger was left empty and was followed by the fourth and fifth impingers contained 100 ml each of DI water. The sixth impinger contained a known quantity of silica gel.

The impinger train was connected to a commercially available metering system. Prior to sampling, the dry gas meter was calibrated utilizing the critical orifice procedures detailed in Section 16.2 of USEPA Method 5. A calibrated critical orifice set covering the anticipated sampling rates was utilized. Along with pre-test and post-test meter calibrations, the S-Type Pitot, thermocouple and nozzle were calibrated prior to and following use in the field according to USEPA Method 5 procedures.

The sample train was assembled, allowed to reach operating temperature, and leak checked by plugging the nozzle with a rubber septum and pulling a vacuum of approximately 15" of mercury (Hg). Once an acceptable leak check of less than 0.02 cfm was achieved, the sampling train was

placed at the first traverse point and sampling began immediately. The sampling train was operated at an isokinetic rate with an isokinetic variation of 90% to 110%.

Each test run was 60-minutes in duration. At the conclusion of each test run, the sample train was cooled sufficiently, utilizing ambient air or ice, to allow the nozzle to be plugged with the rubber septum. The sampling train was leak-checked at a vacuum equal to or greater than the maximum value reached during sampling. An acceptable leakage rate was less than 0.02 cfm or 4% of the average sampling rate (whichever is less). In addition a post-test Pitot leak check was performed. At the conclusion of the leak checks, the probe was disconnected and the remaining parts of the train were purged with clean ambient air for 15 minutes at the average sampling rate used during sampling.

7.6.2 Sample Recovery and Analysis

The probe and front-half of the quartz filter holder were rinsed with 100% IPA and added to a high density polyethylene (HDPE) sample bottle along with the quartz filter (Container 1). The extract was analyzed for SO_4^{2-} by ion chromatography (IC).

The contents of impingers 1, 2 and 3 were quantitatively transferred to a HDPE sample bottle (Container 2). The back half of the filter holder, all connections, and the impingers were rinsed with a minimal amount of 100% IPA and these rinses were added to Container 2.

The unheated filter was transferred into a separate HDPE sample bottle (Container 3) containing approximately the same volume of 80% IPA as Container 2. The connections from the back of the third impinger and the front-half of the unheated filter holder were rinsed with a minimal amount of 100% IPA and added to Container 3. Container 4 contained the contents of the fourth and fifth impingers and the DI water rinses of these impingers and connections.

Field blanks of 25 ml of 80% IPA, 25 ml of 3% H_2O_2 , 200 ml DI water and one field train blank per batch of reagent were analyzed along with the samples by IC.

Sulfuric acid mist and audit sample laboratory results are contained in Appendix D. Sulfuric acid mist emissions are reported on a lb/hr and lb/ton basis.

7.7 Ammonia Emissions – USEPA Method CTM-027

Ammonia emissions were determined using the principles of USEPA CTM-027, *Procedure for Collection and Analysis of Ammonia in Stationary Sources*.

i. Sampling Train Setup and Operation

Prior to sampling, all glassware was cleaned with soap and water, rinsed with tap water, and DI water.

The sampling apparatus contained a glass-lined temperature-controlled probe equipped with a Type S Pitot tube and a sharp-edged glass button-hook nozzle and an in-stack filter holder and high-efficiency quartz glass fiber filter. The in-stack filter holder, nozzle and probe were connected utilizing glass-coated stainless-steel unions and graphite ferrules. The exit of the probe was connected to a series of four impingers. The first (standard Greenburg-Smith) and second (standard Greenburg-Smith) impingers each contained 100 ml of 0.1 N H₂SO₄, the third (modified Greenburg-Smith) contained 100 ml of 0.1 N H₂SO₄ to prevent breakthrough in the instance there is high ammonia concentrations or high flow rate requirements, and the fourth impinger contained pre-weighed silica gel. The first three impingers were weighed to the nearest ± 0.1 g using a calibrated field balance prior to the start of sampling for determination of moisture content in the gas stream. By weighing the impingers instead of measuring the liquid using a graduated cylinder, there is less potential for contamination of the sample.

The impinger train was connected to a commercially available metering system. Prior to sampling, the dry gas meter was calibrated utilizing the critical orifice procedures detailed in Section 16.2 of USEPA Method 5. A calibrated critical orifice set covering the anticipated sampling rates was utilized. Along with pre-test and post-test meter calibrations, the Type S Pitot, thermocouple and nozzle were also calibrated prior to and following use in the field according to USEPA Method 5 procedures.

The sample train was assembled, allowed to reach operating temperature, and leak checked by plugging the nozzle with a rubber septum and pulling a vacuum of approximately 15" of Hg. Once an acceptable leak check on the entire system of less than 0.02 cfm is achieved, the sampling train was placed at the first traverse point and sampling began immediately.

Each test run was 60 minutes in duration. The sampling train was operated at an isokinetic rate with an isokinetic variation of 90% to 110%. At the conclusion of each test run, the nozzle was cooled sufficiently, utilizing ambient air or ice, to allow it to be plugged with the rubber septum. The sampling train was leak-checked at a vacuum equal to or greater than the maximum value reached during sampling.

ii. Sample Recovery and Analysis

Container 1 - At the end of the sampling duration, the filter was removed from the filter holder and placed in a labeled polystyrene Petri dish. Analysis of the filter catch is not required for the purpose of this method.

Container 2 - The nozzle was rinsed with DI water and discarded. The probe and connection to the filter holder was rinsed with a minimal amount of DI water and stored in a labeled, sealed HDPE sample bottle and kept chilled for shipment to the laboratory. The rinses were repeated with water and acetone; both of these rinses were discarded.

Containers 3, 4 and 5 - The liquid in the first three impingers were weighed to the nearest ± 0.1 g using a calibrated field balance. The contents of each impinger were transferred to separate HDPE sample bottles. Each impinger was rinsed with DI water; limiting the volume of the rinses to ensure the total volume of each impinger plus its rinses is no more than 230 ml, and added to their respective sample containers. The sample containers were labeled, sealed and chilled for shipment to the laboratory for analysis.

Container 6 - A field blank of 100 ml 0.1 N H_2SO_4 was prepared by placing it in an impinger, allowing it to be exposed to ambient conditions for a duration of 1 hour, and then collecting it using the same procedures as described above.

No audit sample is available for CTM-027. Laboratory results are contained in Appendix D. Emission results are reported as parts per million, dry volume (ppm_{dv}).

7.8 Quality Assurance and Quality Control

All quality assurance/quality control (QA/QC) procedures as required by each USEPA Method were followed with no modifications. Appendix E contains all related QA/QC information.

The following field equipment calibrations are contained in Appendix E:

- Nozzle
- Pitot Tubes
- Thermocouple (TC)
- Dry Gas Meter and Orifices
- Analyzer Interference Checks
- Calibration Gas Certificates
- Qualified Source Testing Individual (QSTI) Certifications

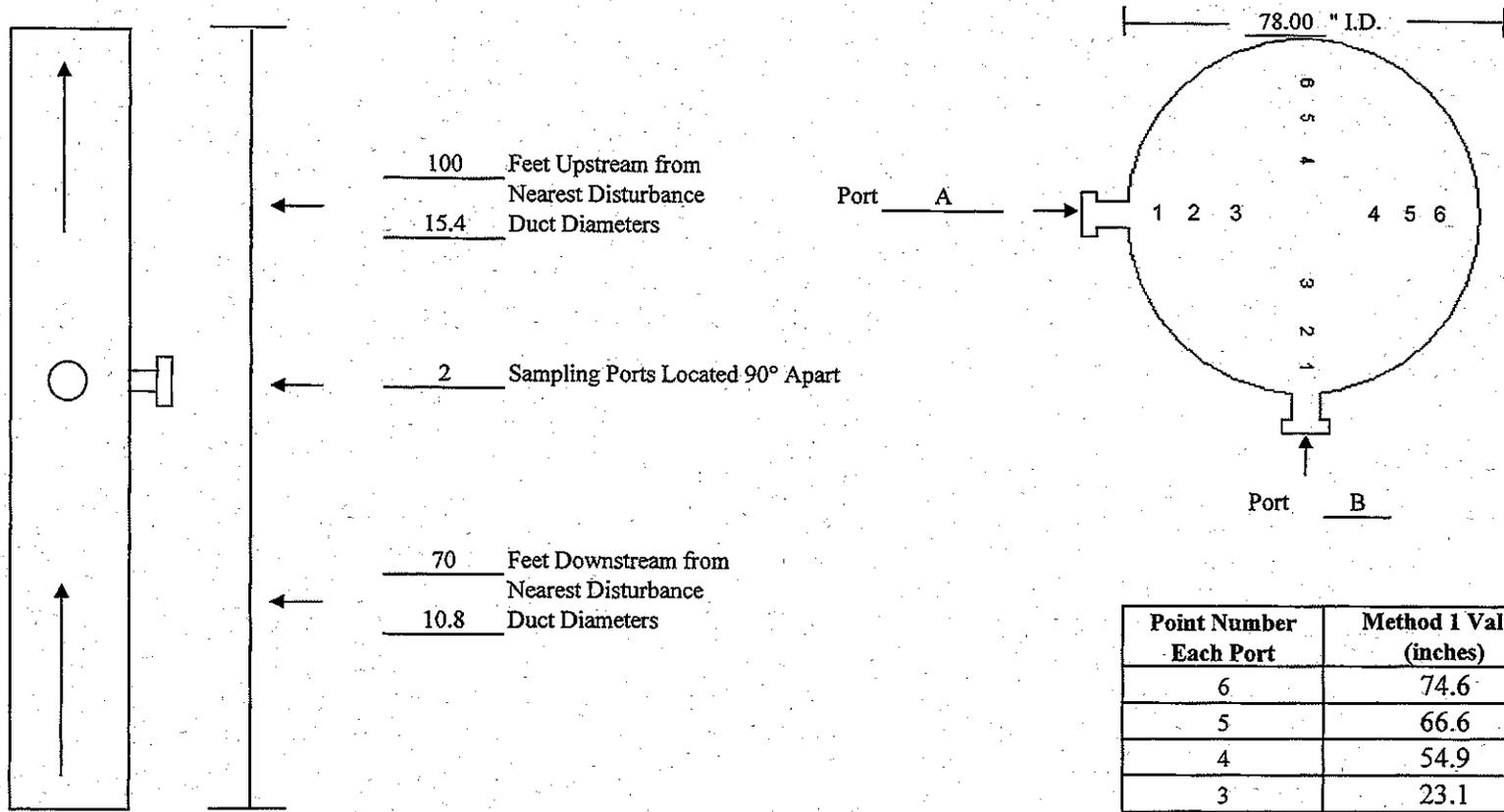
8 TEST RESULTS

FPM, HAP metals and selenium test results are contained in Table 1. Sulfuric acid mist test results are contained in Table 2. NH₃ test results are contained in Table 3. Table 4 contains the table nomenclature. Appendix F contains sample calculations for one complete testing run.

9 CONCLUSION

Air/Compliance Consultants, Inc. has completed FPM, HAP metals, selenium, sulfuric acid mist and NH₃ compliance emissions testing for the Guardian Industries Corporation, Glass Manufacturing Line 2, at their Carleton, Michigan facility. ACCI believes the test results are representative of the prevailing operating conditions at the time of testing.

REPORT – FIGURE



100 Feet Upstream from Nearest Disturbance
15.4 Duct Diameters

2 Sampling Ports Located 90° Apart

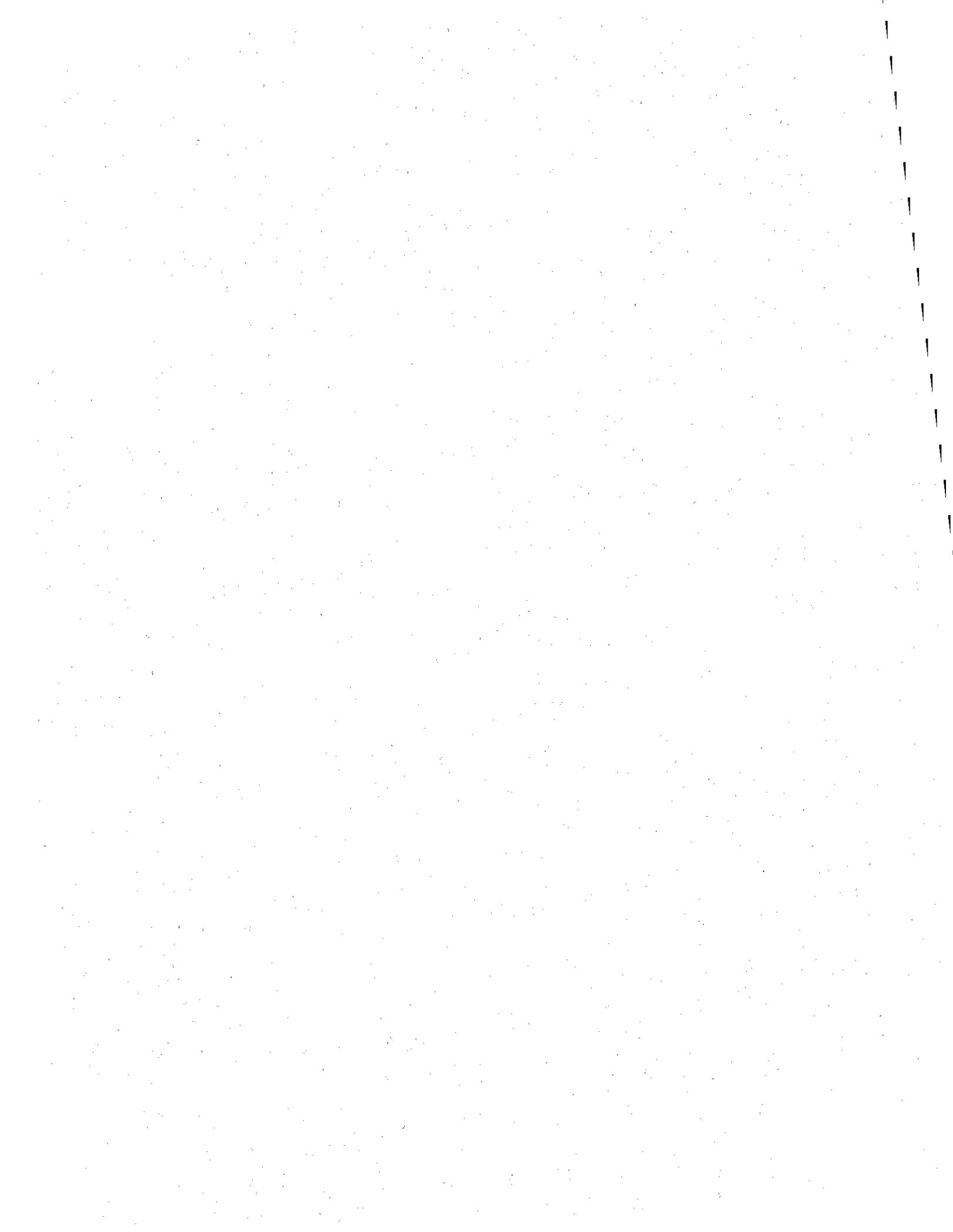
70 Feet Downstream from Nearest Disturbance
10.8 Duct Diameters

Point Number Each Port	Method 1 Value (inches)
6	74.6
5	66.6
4	54.9
3	23.1
2	11.4
1	3.4



**Glass Manufacturing Line 2 Sampling Stack Diagram
Guardian Industries Corporation, Carleton, MI**

Figure 1



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REPORT - TABLES

Table 1. Filterable Particulate and Metal Emission Test Results, Line 2 Glass Production
Guardian Industries, Carleton, Michigan

Test Data		Run 1	Run 2	Run 3	Average	
Date		07/21/15	07/21/15	07/21/15		
Start Time		8:40 AM	12:55 PM	12:55 PM		
End Time		11:23 AM	3:18 PM	3:18 PM		
Flow Rate	(ACFM)	130030	130959	131049	130,680	
Flow Rate	(DSCFM)	55169	56463	56719	56,117	
Sample Volume	(DSCF)	76.479	78.725	81.042	78.748	
Carbon Dioxide	(dry volume %)	6.46	6.37	6.39	6.41	
Oxygen	(dry volume %)	12.13	12.21	12.23	12.19	
Water Vapor	(volume %)	10.9%	10.0%	9.7%	10.2%	
Stack Temperature	(°F)	616.6	609.8	609.2	611.8	
Percent of Isokinetic Sampling	(%)	96.5	97.0	99.4	97.6	
Production Rate	(ton/hr)	17.5	17.5	17.5	17.5	
Results						Limit
Filterable Particulate Results						
Mass Collected	(mg)	46.10	12.85	18.15	25.70	
Emission Concentration	(gr/DSCF)	0.0092	0.0024	0.0034	0.0050	
Emission Rate	(lb/hr)	4.35	1.17	1.64	2.39	
Emission Rate	(lb/ton of glass pulled)	0.249	0.067	0.094	0.136	0.45
HAP Metal Results						
Mass Collected	(ug)	2285.983	3228.812	4666.260	3393.685	
Emission Rate	(lb/hr)	0.218	0.306	0.432	0.319	
Emission Rate	(lb/ton of glass pulled)	0.0125	0.0175	0.0247	0.0182	0.02
Selenium Results						
Mass Collected	(ug)	2220	3160	4610	3330	
Emission Rate	(lb/hr)	0.212	0.300	0.427	0.313	2.03
Emission Rate	(lb/ton of glass pulled)	0.0121	0.0171	0.0244	0.0179	

Table 2. Sulfur Acid Mist Emission Test Results Summary, Line 2 Glass Production
Guardian Industries, Carleton, Michigan

Test Data		Run 1	Run 2	Run 3	Average	
Date		7/22/15	7/22/15	7/22/15		
Start Time		8:45 AM	11:50 AM	2:20 PM		
End Time		9:58 AM	12:57 PM	3:27 PM		
Flow Rate	(ACFM)	131,568	124,325	123,983	126,625	
Flow Rate	(SCFM)	63,335	60,022	60,439	61,265	
Flow Rate	(DSCFM)	57,094	53,764	56,864	55,907	
Sample Volume	(DSCF)	57.372	52.589	53.901	54.621	
Carbon Dioxide (CO ₂)	(dry volume %)	6.46	6.37	6.39	6.41	
Oxygen (O ₂)	(dry volume %)	12.13	12.21	12.23	12.19	
Water Vapor (H ₂ O)	(volume %)	9.85	10.43	5.91	8.73	
Stack Temperature	(°F)	607.4	604.3	594.1	601.9	
Percent of Isokinetic Sampling	(%)	99.5	96.9	93.9	96.7	
Product Rate (Glass Pull Rate)	(ton/hr)	17.5	17.5	17.5	17.5	
Results						Limit
Sulfuric Acid Mist (H₂SO₄)						
Total mass as H ₂ SO ₄	(mg)	85.0	82.60	125.2	97.60	
Sulfuric Acid Mist Concentration as H ₂ SO ₄	(ppm _{dv})	12.8	13.6	20.1	15.5	
Sulfuric Acid Mist Emission as H ₂ SO ₄	(lb/hr)	11.2	11.2	17.5	13.3	1.6
Sulfuric Acid Mist Emission as H ₂ SO ₄	(lb/ton of glass)	0.639	0.638	0.998	0.759	

Table 3.

Ammonia Emission Test Results, Line 2 Glass Production
Guardian Industries, Carleton, Michigan

Test Data		Run 1	Run 2	Run 3	Average
Date		7/21/15	7/21/15	7/21/15	
Start Time		9:23 AM	1:25 PM	3:34 PM	
End Time		10:48 AM	2:50 PM	4:59 PM	
Flow Rate	(ACFM)	126,176	127,112	127,855	127,048
Flow Rate	(SCFM)	60,750	61,470	61,645	61,289
Flow Rate	(DSCFM)	53,890	53,607	53,756	53,751
Sample Volume	(DSCF)	52.87	51.53	52.53	52.31
Carbon Dioxide (CO ₂)	(dry volume %)	6.46	6.37	6.39	6.41
Oxygen (O ₂)	(dry volume %)	12.13	12.21	12.23	12.19
Water Vapor (H ₂ O)	(volume %)	11.29	12.79	12.80	12.29
Stack Temperature	(°F)	604.3	599.6	602.8	602.2
Percent of Isokinetic Sampling	(%)	97.21	95.25	96.84	96.4
Production Rate	(ton/hr)	17.5	17.5	17.5	17.5

Results

Ammonia

Emission Mass Catch	ug	25031	27559	25144	25911
Collection Efficiency	%	99.94	99.83	99.83	99.87
Emission Concentration	lb/dscf	1.04E-06	1.18E-06	1.06E-06	1.09E-06
Emission Concentration	ppm _{dv}	23.8	26.8	24.0	24.9
Emission Rate	lb/hr	3.37	3.79	3.40	3.52
Emission Rate	lb/ton product	0.193	0.217	0.194	0.201

Table 4.

TABLE NOMENCLATURE

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
%	- Percent	gpm	- Gallons per minute	O ₂	- Oxygen
% Volume	- Percent by volume	gr/DSCF	- Grains per dry standard cubic feet	OSHA	- Occupational Safety & Health Administration
°F	- Degrees Fahrenheit	H ₂ O	- Water	PADEP	- PA Department of Environmental Protection
<	- Less than	H ₂ SO ₄	- Sulfuric acid	Pb	- Lead
>	- Greater than	HAP	- Hazardous air pollutant	PEL	- Permissible exposure limit
AB	- Acetone Blank	Hg	- Mercury	PM	- Particulate matter
ACFM	- Actual cubic feet per minute	HI	- Heat input	PM ₁₀	- Particulate matter less than 10 microns
BACT	- Best Available Control Technology	Hp	- Horsepower	ppb	- Parts per billion
BHP	- Brake horsepower	hr	- Hour	PPE	- Personal protective equipment
BTU	- British thermal units	IC	- Ion chromatography	ppm	- Parts per million
BTU/scf	- British thermal units per standard cubic feet	in H ₂ O	- Inches of Water	ppm _{dv}	- Parts per million, dry volume
C ₃ H ₈	- Propane	in Hg	- Inches of Mercury	ppm _{wv}	- Parts per million, wet volume
CE	- Capture efficiency	Kg	- Kilograms	psia	- Pounds per square inch absolute
CEMS	- Continuous emission monitor system	lb	- Pound	psig	- Pounds per square inch gauge
cf	- Cubic foot	lb/hr	- Pound per hour	PTI	- Permit to Install
CFR	- Code of Federal Regulations	lb/lb-mole	- Pound per pound mole	PTE	- Permanent total enclosure
CH ₄	- Methane	MACT	- Maximum Achievable Control Technology	RA	- Relative Accuracy
C ₂ H ₆	- Ethane	m ³	- Cubic meters	RATA	- Relative Accuracy Test Audit
Cl ₂	- Chlorine	MDL	- Minimum detection limit	RM	- Reference Method
CO	- Carbon monoxide	mg	- Milligrams	RMD	- Relative mean difference
CO ₂	- Carbon dioxide	mg/g	- Milligrams per gram	rpm	- Revolutions per minute
COG	- Coke oven gas	min	- Minute	S	- Sulfur
DACF	- Dry actual cubic feet	mL	- Milliliter	SCF	- Standard cubic feet
DACM	- Dry actual cubic meters	mm HG	- Millimeters of mercury	SCFM	- Standard cubic feet per minute
DE	- Destruction efficiency	MMBtu	- Million British thermal units	SCM	- Standard cubic meters
DSCF	- Dry standard cubic feet	MNOC	- Maximum normal operating capacity	SO ₂	- Sulfur dioxide
DSCFM	- Dry standard cubic feet per minute	MSDS	- Material Safety Data Sheet	STD	- Standard
FID	- Flame Ionization Detector	MW	- Megawatts	TEQ	- Toxicity Equivalence Quotient
ft	- Foot	N ₂	- Nitrogen	THC	- Total hydrocarbons
ft/sec	- Feet per second	ND	- Non-detectable	tph	- Tons per hour
ft ²	- Square feet	NDO	- Natural draft opening	tpy	- Tons per year
ft ³	- Cubic feet	NESHAP	- National Emission Standard for Hazardous Air Pollutants	µg	- Micrograms
ft ³ /lb-mole	- Cubic feet per pound mole	ng	- Nanograms	USEPA	- United States Environmental Protection Agency
g	- Grams	NMEVOC	- Non-methane, non-ethane volatile organic compounds	VE	- Visible emissions
g/bhp-hr	- Grams of brake horsepower per hour	NMVOC	- Non-methane volatile organic compound	VOC	- Volatile organic compound
g/mL	- Gram per milliliter	NO ₂	- Nitrous Oxide	vol.	- Volume
GC	- Gas Chromatography	NO _x	- Oxides of Nitrogen	w/o	- With out