**NTH Consultants, Ltd.**

Infrastructure Engineering
and Environmental Services

2990 W. Grand Blvd., Suite M-10
Detroit, MI 48202
Phone: 313-237-3900
Fax: 313-237-3909

Mr. Hosam Hassanien, PG, CPG
City of Detroit
Environmental Affairs
2 Woodward Avenue – CAYMC, Suite 401
Detroit, MI 48226

June 8, 2021
NTH Project No. 74-200457-05

**RE: Ambient Air Quality Monitoring – 1st Construction Phase Monitoring Report**
**Proposed Amazon Distribution Center**
**Detroit, Michigan**

Dear Mr. Hassanien:

The City of Detroit (City) recently completed a property transaction for a new Amazon Fulfillment Center to be constructed on a 137-acre parcel at the former State Fairgrounds property located at 1120 W. State Fair Avenue in Detroit, Michigan. The City contracted NTH Consultants, Ltd. (NTH) to conduct ambient air quality monitoring at the proposed Amazon Distribution Center site (Site).

The monitoring program consists of siting localized monitors at an upwind and downwind locations to measure concentrations of particulate matter ($PM_{10}$ and $PM_{2.5}$), nitrogen oxide ($NO_x$, as $NO_2$) and volatile organic compounds (VOCs), and evaluate air quality from the Site during three (3) distinct phases:

- Pre-development baseline period
- Construction phase
- Post-construction facility operation

**Pre-Development Baseline Period (Completed)**

NTH's Baseline Monitoring Report, dated May 7, 2021, presented ambient concentrations prior to significant construction activities at the Site. The baseline period included monitoring data collected by Montrose Air Quality Services, LLC (MAQS), NTH's subconsultant for on-site air monitoring services, from January 22, 2021 through March 5, 2021, and was supplemented with monitoring data collected by the Site developer's consultant (Langan) from November 13, 2020 through December 2, 2020. The purpose of the Baseline Monitoring Report was to establish an ambient background concentration for each pollutant and use that concentration as a baseline whereas concentrations measured above these levels during construction would trigger the contractor to employ additional mitigation efforts to reduce pollutant concentrations.

The concentrations presented in Table 1 were presented in the Baseline Monitoring Report and presented pollutant concentrations prior to start of significant construction activities. Each concentration is also compared to the applicable National Ambient Air Quality Standards (NAAQS) protective of public health and the environment.

**Table 1 – Site-Specific Baseline Concentrations**
**Pre-Development Baseline Period**

| Pollutant | Operator | Monitor [1] | Baseline Concentration | Date of Baseline Concentration | NAAQS | Units |
|---|---|---|---|---|---|---|
| $PM_{10}$ | Langan | ML2 | 47 | 11/25/2020 | 150 | $\mu g/m^3$ |
| $PM_{2.5}$ | Langan | ML2 | 22 | 11/25/2020 | 35 | $\mu g/m^3$ |
| $NO_2$ | MAQS | Unit 1480 | 52 | 1/30/2021 | 100 | ppb |
| VOC | Langan | ML1 | 0.11 | 11/14/2020 | NA[2] | ppm |

[1] Baseline Monitoring included two (2) Site monitors operated by MAQS for NTH from January 22 through March 5, 2021 and identified as Unit 1479 (upwind location) and Unit 1480 (downwind location), as well as monitoring data provided by Hillwood Development Company (HDC), the project developers, for the period November 13, 2020 through December 2, 2020 from five (5) monitoring locations at the project Site and identified as ML1, ML2, ML3, ML4 and ML5.

[2] NAAQS have not been established for VOC. VOCs are considered precursors to the formation of ozone. Ozone is formed downwind by photochemical reaction of $NO_x$ and VOCs in certain ambient conditions (typically hot, sunny weather)

## Construction Phase Monitoring

This letter and enclosed report present the results of the 1st construction phase monitoring event that was conducted for the one (1)-week period of April 14 through April 21, 2021. The goal of construction phase monitoring is to collect concentration data of target air pollutants during construction activities consisting of installation of fencing, striping paved surfaces, concrete work, and steel construction, and assess whether additional mitigation efforts are warranted to reduce pollutant concentrations to below baseline levels.

The enclosed 1st Construction Phase Monitoring Report describes the monitoring program, objectives, Site overview, monitor locations and equipment, monitoring results, and an overview of data quality assurance.

The report includes monitoring data from two (2) available sources, including:

- Two (2) Site monitors operated by MAQS for NTH during the monitoring period (April 14 through April 21, 2021) and identified as Unit 1479 (upwind location) and Unit 1480 (downwind location).

- Nearby off-site monitors operated by Michigan Department of Environment, Great Lakes, and Energy (EGLE) during the MAQS monitoring period.

As part of this air monitoring program, MAQS collected one (1) week of air monitoring data for $NO_x$ (as $NO_2$), $PM_{10}$ and $PM_{2.5}$, and VOCs at two (2) monitors, along with prevailing wind directions and speeds (vectors).

The City anticipates that development of the proposed Amazon Distribution Center may result in direct and fugitive air emissions from construction activities, as well as future operations. Sources of $NO_x$ and VOC emissions related to construction may include vehicular traffic and diesel engines (over-the-road and non-road heavy duty construction). Potential emissions of $PM_{10}$ and

$PM_{2.5}$ related to construction may include fugitive dust associated with vehicular traffic, soil handling, material storage piles, concrete batching, and abrasives blasting.

The monitors, designated as Unit 1479 and Unit 1480, were located on opposite sides of the Site and both stations also collected meteorological data. The upwind monitor (Unit 1479) measures pollutant concentrations that have not blown across the Site and should be free from potential impacts of on-site development activity and is representative of local area background concentrations.

**Results of Construction Phase Monitoring**

As presented below and in the enclosed report for monitoring conducted April 14 through April 21, 2021, concentrations of $NO_x$ (as $NO_2$) and VOC are within the baseline concentrations as well as the associated 1-hour NAAQS of 100 ppb for $NO_2$.[1]

Monitored $PM_{10}$ and $PM_{2.5}$ concentrations are within the 24-hour NAAQS of 150 µg/m$^3$ and 35 µg/m$^3$, respectively. However, on April 19, 2021, daily concentrations of $PM_{2.5}$ and $PM_{10}$ at downwind monitor Unit 1480 exceeded the baseline concentrations, as summarized in Table 2. The elevated PM concentrations measured at Unit 1480 coincided with strong southwesterly winds and were consistent with elevated concentrations observed at nearby off-site EGLE Dearborn monitors on April 19, 2021, indicative of local meteorological factors (sustained elevated wind speeds). Note that particulate matter can become airborne when wind speeds are elevated regardless of on-site construction activities.

**Table 2 – Summary of Air Monitoring from April 14 through April 21, 2021**

| Pollutant | Maximum Concentration | Monitor | Date of Maximum Concentration | Baseline Concentration | NAAQS | Units |
|---|---|---|---|---|---|---|
| $PM_{10}$ | 83.4 | Unit 1480 | 4/19/2021 | 47 | 150 | µg/m$^3$ |
| $PM_{2.5}$ | 24.8 | Unit 1480 | 4/19/2021 | 22 | 35 | µg/m$^3$ |
| $NO_2$ | 34.7 | Unit 1480 | 4/19/2021 | 52 | 100 | ppb |
| VOC | 0.01 | Unit 1480 | 4/19/2021 | 0.11 | NA[1] | ppm |

On April 20, 2021, NTH notified the construction contractor Gray regarding elevated particulate matter concentrations observed on April 19, 2021 and recommended that they immediately implement appropriate corrective measures to prevent such exceedances during construction. Gray indicated that they are actively watering/wetting the Site to help mitigate dust issues.

As neither $NO_2$ nor VOC were elevated, we conclude that elevated wind speeds in excess of 30 mph at times was the primary reason that concentrations of $PM_{2.5}$ and $PM_{10}$ were above the baseline values. The monitored $PM_{10}$ and $PM_{2.5}$ were likely due to dust caused by the dry, windy

[1] NAAQS have not been established for VOC. VOCs are considered precursors to the formation of ozone. Ozone is formed downwind by photochemical reaction of $NO_x$ and VOCs in certain ambient conditions (typically hot, sunny weather).

conditions and likely related to moving vehicles and conducting work on storm sewers near the monitor.

In summary, the data collected during this air monitoring event are not indicative of a threat to public health or unusual concentrations of the analyzed parameters.

We appreciate this opportunity to be of service to you. If you have questions or need additional information, please contact us at 248-662-2740.

Sincerely,

NTH Consultants, Ltd.

Rhiana C. Dornbos, P.E.
Sr. Project Engineer

Bhushan C. Modi
Project Manager

RCD/BCM/clm

Attachments

# 1st CONSTRUCTION PHASE MONITORING REPORT
# PROPOSED AMAZON DISTRIBUTION CENTER
# (FORMER MICHIGAN STATE FAIRGROUNDS)
# CITY OF DETROIT
# DETROIT, MICHIGAN

Prepared For:
**NTH Consultants, Ltd.**
2990 W. Grand Blvd., Suite M-10
Detroit, MI 48202

Prepared By:
**Montrose Air Quality Services, LLC**
45 U.S. 46, Suite 601
Pine Brook, NJ 07058

| | |
|---|---|
| Document Number: | **011AA-5509-RT-1** |
| NTH Project Number: | **74-200457-03** |
| Monitoring Period: | **April 14 through April 21, 2021** |
| Submittal Date: | **June 3, 2021** |

STAC STACK TESTING ACCREDITATION COUNCIL
A2LA ACCREDITED TO ASTM D7036 ONLY CERT #3925.01

MONTROSE AIR QUALITY SERVICES

# Table of Contents

# Project Overview

## Background

NTH Consultants, Ltd. (NTH) contracted Montrose Air Quality Services, LLC (Montrose) to conduct an ambient air monitoring program on behalf of the City of Detroit at the proposed Amazon Distribution Center located at the former Michigan State Fairgrounds in Detroit, Michigan. The program is conducted to monitor for a mixture of pollutants that may originate from construction activities as well as future Site operations including vehicular traffic, surface attrition, and dust emissions.

The Baseline Monitoring Report presented ambient concentrations prior to significant Site construction activities. The baseline period included monitoring data collected by Montrose for the period January 22, 2021 through March 5, 2021 and was supplemented with monitoring data collected by the Site developer during the period November 13, 2020 through December 2, 2020. The purpose of the Baseline Monitoring report was to establish an ambient background concentration for each pollutant and use that concentration as a baseline whereas concentrations measured above these levels during construction would trigger the contractor to employ additional mitigation efforts to reduce pollutant concentrations to below baseline.

This report includes data from monitors operated by Montrose and Michigan Department of Environment, Great Lakes, and Energy (EGLE) during the monitoring period commencing on April 14 and concluding on April 21, 2021.

## Objectives

The specific objectives are to measure ambient concentrations of the following parameters at two (2) monitoring locations:

- Particulate Matter ($PM_{10}$) of diameter equal to or less than 10 microns
- Particulate Matter ($PM_{2.5}$) of diameter equal to or less than 2.5 microns
- Nitrogen Dioxide ($NO_2$)
- Volatile Organic Compounds (VOC)
- Meteorological parameters (i.e., wind speed, wind direction, temperature, relative humidity, and barometric pressure)

## Potential Sources

Sources of $NO_2$ and VOC emissions related to construction include vehicular traffic and diesel engines (over-the-road and non-road, heavy-duty construction). Potential emissions of $PM_{10}$ and $PM_{2.5}$ related to construction may include the sources identified above for $NO_x$ and VOC emissions and also fugitive dust associated with vehicular traffic, soil handling, material storage piles, concrete batching, and abrasives blasting.

## Operational Staff and Contacts

### Facility Information

Monitoring Location: Proposed Amazon Distribution Facility
Former Michigan State Fairgrounds
1120 W. State Fair Avenue
Detroit, MI 48203

### Monitoring Program Coordinator

NTH Consultants, Ltd.
2990 W. Grand Blvd., Suite M-10
Detroit, MI 48202

Project Contacts: Mr. Bhushan Modi
Role: Project Manager
Company: NTH Consultants, Ltd.
Telephone: 248-662-2740
Email: bmodi@nthconsultants.com

### Monitoring Team Contact Information

Testing Firm: Montrose Air Quality Services, LLC (Montrose)

Contact: David Cummings
Title: District Manager
Telephone: 201-213-2913
Email: dcummings@montrose-env.com

Contact: Kevin Ruggiero
Title: Project Manager
Telephone: 973-417-6487
Email: kruggiero@montrose-env.com

Contact: Jeffrey Peitzsch
Title: Shop Coordinator
Telephone: 313-213-4816
Email: jbpeitzsch@montrose-env.com

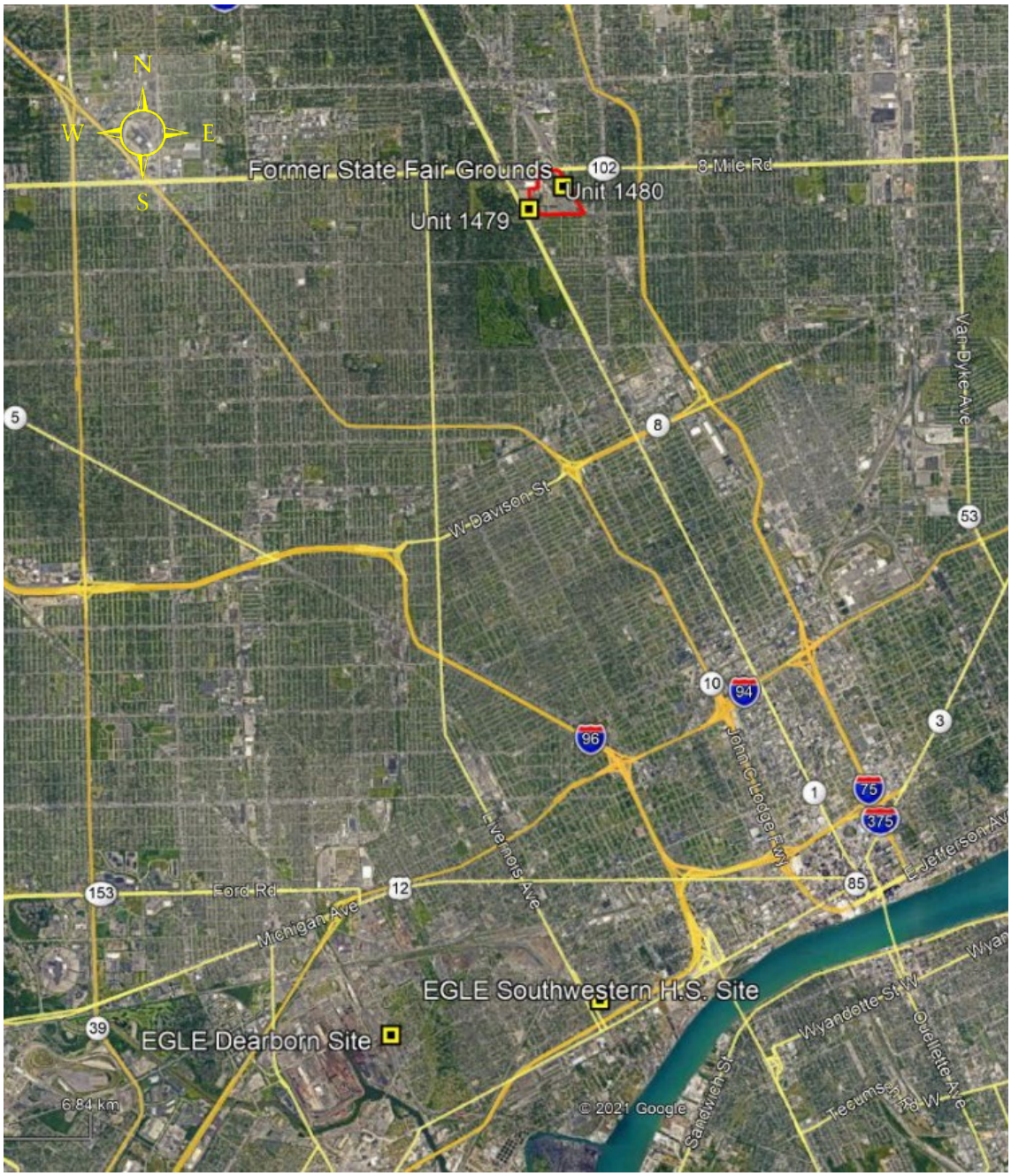
## Site Overview

The Site air quality monitoring was performed at the proposed Amazon Distribution Center (former Michigan State Fairgrounds) property located at 1120 W State Fair Avenue in Detroit, MI. This area was purchased by Hillwood Development Company, LLC (Hillwood) who will be demolishing the existing structures onsite and building a large warehouse that will be occupied by an Amazon distribution center. The two (2) Site monitor locations are identified in Figure 1-A below.

**Figure 1-A – Monitor Locations at the Proposed Amazon Distribution Center (Former Michigan State Fairgrounds) Property**

Figure 1-B is an aerial view of the two monitoring Site locations at the proposed Amazon Distribution Center (former Michigan State Fairgrounds) property and two nearby air monitoring stations maintained by the Michigan Department of Environment, Great Lakes, and Energy (EGLE). Monitoring data available from the two nearby EGLE monitoring stations are intercompared in this report with corresponding monitoring data reported from the monitors operated at the former Michigan State Fairgrounds property.

**Figure 1-B – Monitor Locations at the Proposed Amazon Distribution Center (Former Michigan State Fairgrounds) Property and Nearby MI EGLE Monitoring Stations**



## Monitoring Equipment

The air monitoring at the proposed Amazon Distribution Center (former Michigan State Fairgrounds) was performed using an AQS1 Urban Air Quality Monitor manufactured by Aeroqual. In the device, sampling occurs actively by pulling in ambient air via a pump and the air sample passing over the surface of each sensor. Each device used in this project is powered by deep-cycle batteries charged by solar photovoltaic panels and transmits data via cellular signal. Monitoring was conducted for the constituents listed in Table 1.

**Table 1 - Pollutants Monitored**

| Air Pollutant/Parameter Category | Principle of Operation |
|---|---|
| $PM_{10}$ and $PM_{2.5}$ | Laser Scattering |
| $NO_2$ | Electrochemical |
| VOC | Photoionization |
| Wind Speed, Wind Direction, Temperature, Relative Humidity, Barometric Pressure | Sonic Anemometer and Various |

The sampled particles are measured by the physical principle of light scattering. Each single particle is illuminated by a defined laser light and each scattering signal is detected at an angle of 90° by a photo diode. In accordance with the Mie theory, each measured pulse height is directly proportional to the particle size, where each pulse is classified in an electronic register of 32 different size channels.

Electrochemical sensors measure the concentration of a specific gas within an external circuit via oxidation or reduction reactions. These reactions generate the positive or negative current flow through the external circuit. An electrochemical sensor is made up of a working counter and reference electrode. All of these components are situated inside of a sensor housing along with a liquid electrolyte that is specific to the compound of interest.

A Photoionization Detector (PID) sensor contains a lamp that produces photons that carry enough energy to break molecules into ions. The PID will only respond to molecules that have an ionization energy at or below the energy of the lamp; the PID used on this project employs a 10.6 electron-volt lamp. The produced ions then generate an electrical current that is measured as the output of the detector.

All operation and maintenance procedures contained in the monitoring plan dated January 10, 2021 were followed for the continuous monitoring equipment.

## Discussion of Results

The results of $PM_{10}$, $PM_{2.5}$, $NO_2$, and VOC monitoring data are presented in Figures 3 through 6 in this report. These figures also include data from nearby air monitoring stations maintained by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) for the same time period. The EGLE data contained in this report are from monitors that are routinely subjected to calibration and maintenance. It should be noted that, as of the date of this report, the EGLE data have not yet been processed through EGLE final quality assurance procedures. The monitor locations for EGLE Sites can be found on the map provided in Appendix C (*State Monitor Map*).

The Clean Air Act requires EPA to establish National Ambient Air Quality Standards (NAAQS) for certain air pollutants considered harmful to public health and the environment. Air pollutants for which NAAQS are established include $NO_2$, $PM_{2.5}$ and $PM_{10}$. NAAQS have not been established for VOCs. VOCs are considered precursors to the formation of ozone. Ozone is formed downwind by photochemical reaction of $NO_x$ and VOCs in certain ambient conditions.

The graphed data shown in Figures 3 through 5 for these pollutants present measured concentrations for these pollutants collected during the monitoring period relative to the Baseline concentration and NAAQS Standard.

The NAAQS for $NO_2$, $PM_{2.5}$, and $PM_{10}$ were not exceeded during these monitoring periods.

Electronic records of all data and calibrations have been uploaded to the Montrose Data Server, where they will be archived for a period of at least three (3) years.

## Meteorological Data Collected

Figures 2-A and 2-B present wind roses derived from the meteorological data collected from each of the two monitors operated at the former State Fairgrounds over the course of the monitoring period of 4/14/21 to 4/21/21. The wind rose presented in Figure 2-A is derived from wind speed and wind direction data collected from monitor 1479. The wind rose presented in Figure 2-B is derived from wind speed and wind direction data collected from monitor 1480.

**Figure 2-A – Wind Rose From 1479 Monitor**

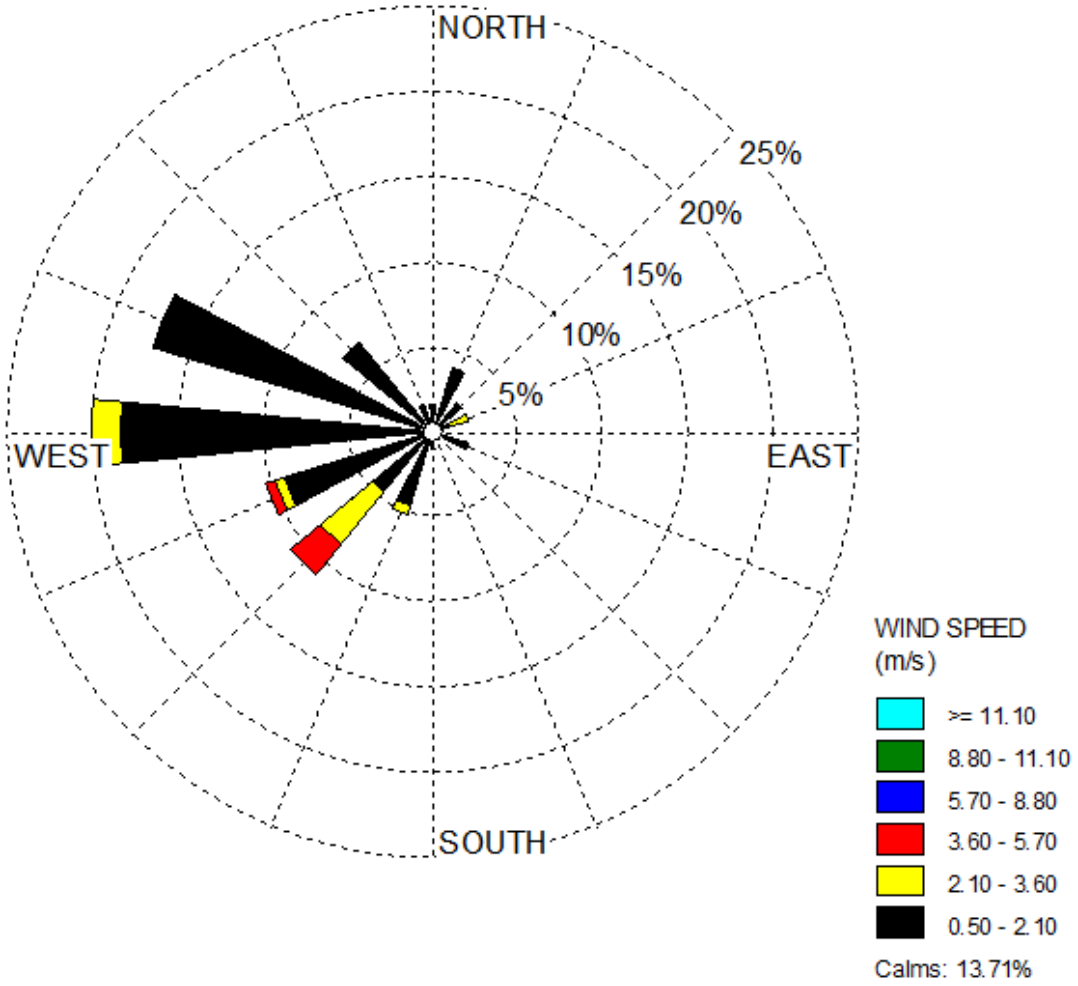
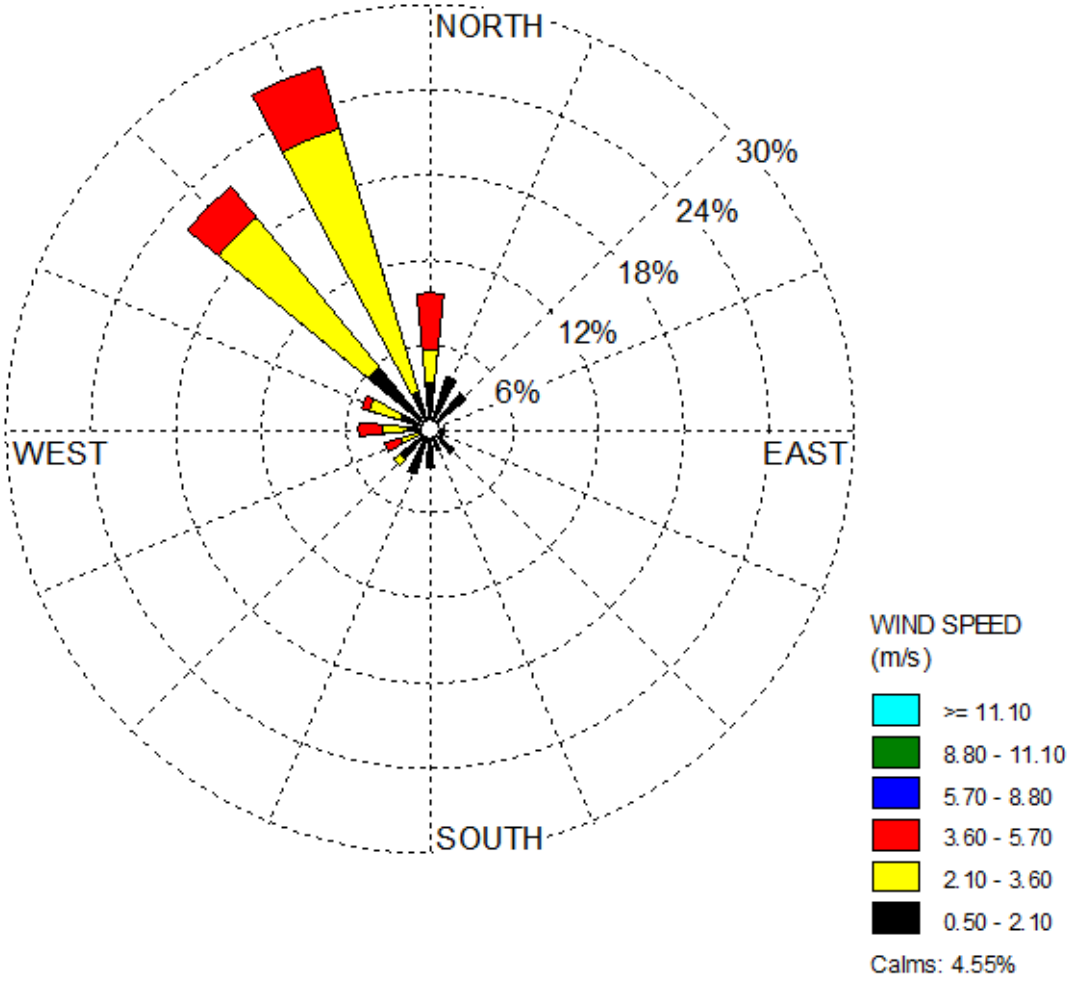


**Figure 2-B – Wind Rose From 1480 Monitor**



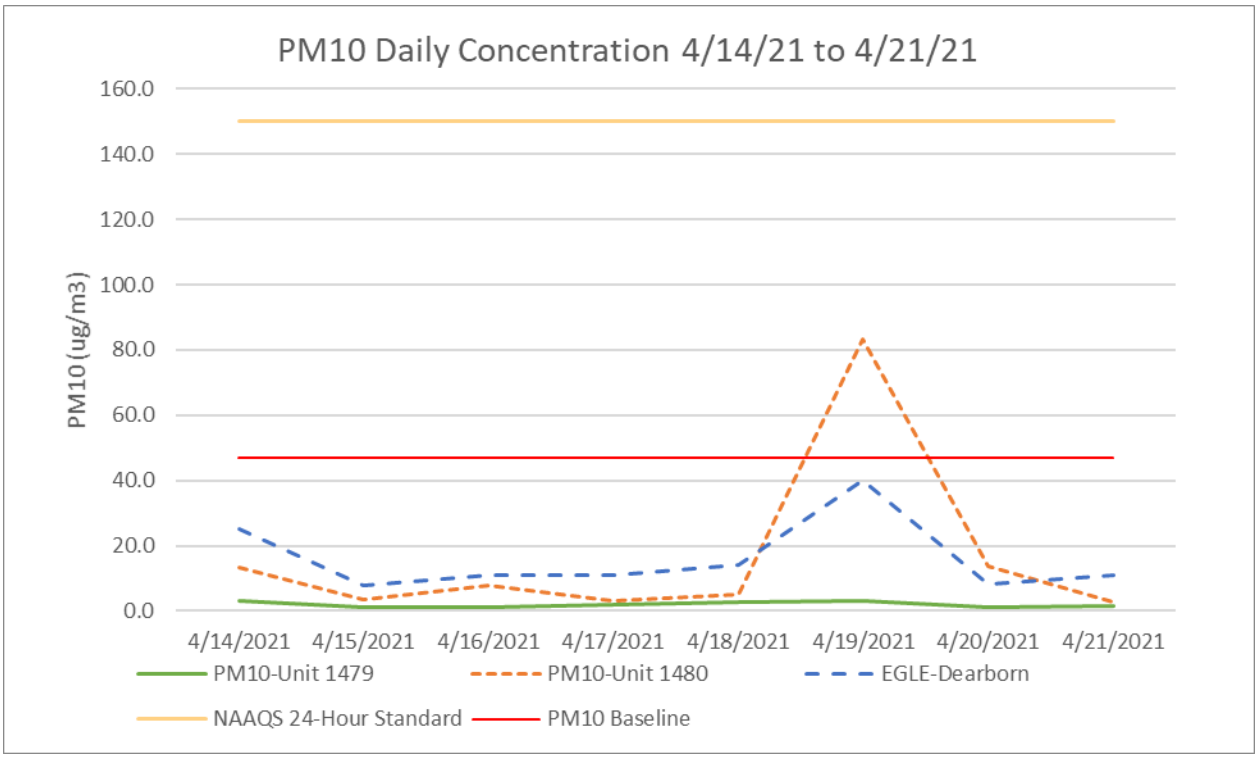

As is evident from the wind rose data, predominant winds were from the west and northwest during the monitoring period. Wind speeds recorded at monitor 1479 were generally very light; wind speeds recorded by monitor were generally light to moderate.

# Pollutant Data Collected

## Figure 3 – $PM_{10}$ Data

The graph below represents the ambient $PM_{10}$ measurement data collected at the former Michigan State Fairgrounds property during the monitoring period of 4/14/21 to 4/21/21. This graph is a plot of the $PM_{10}$ measurement data as averaged over each daily monitoring period. The daily averaging interval for $PM_{10}$ data is consistent with the associated EPA primary and secondary $PM_{10}$ NAAQS; a 24-hour (daily) averaged value of 150 micrograms per cubic meter ($\mu g/m^3$) not to be exceeded more than once per year on average over 3 years.

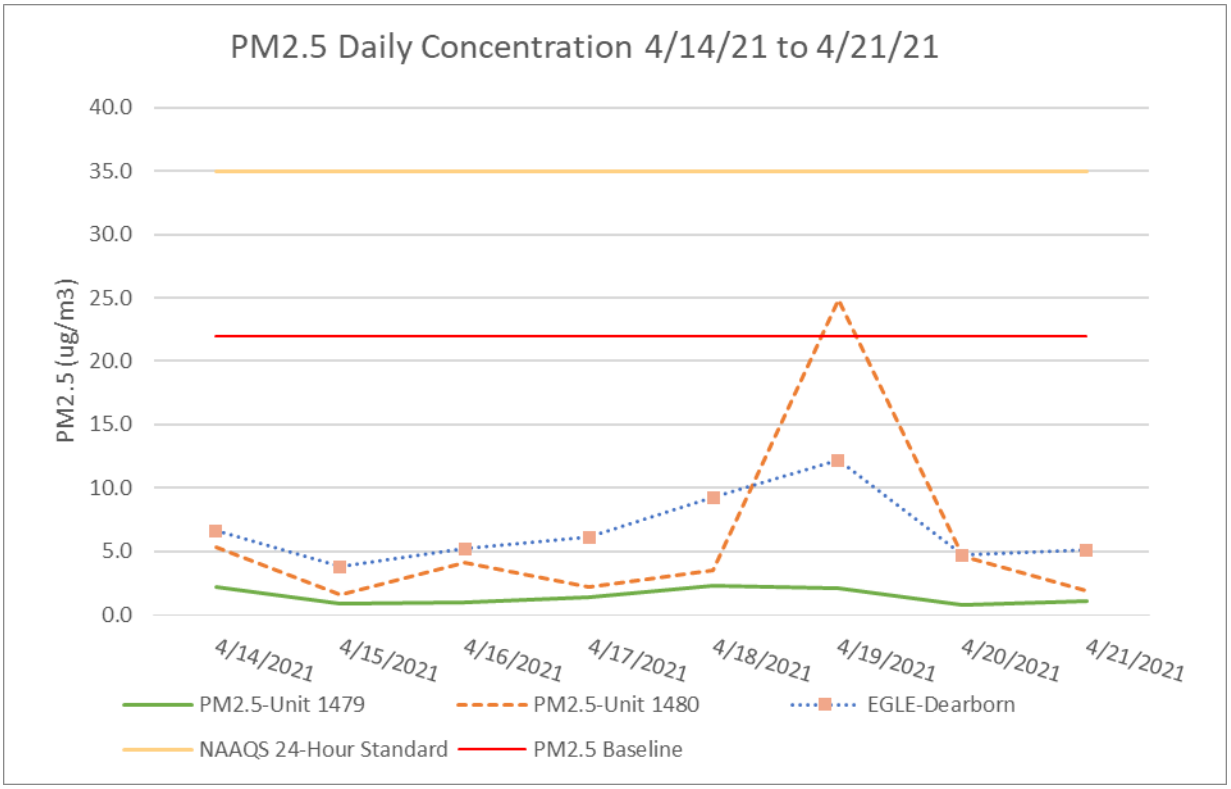
The solid yellow line represents the 24-hour $PM_{10}$ NAAQS of 150 $\mu g/m^3$. The solid red line represents the baseline concentration established in the 1st Baseline Report. The $PM_{10}$ monitor at the EGLE Dearborn Site is the closest state-operated $PM_{10}$ monitor relative to the former Michigan State Fairgrounds property. Therefore, the graph below presents the 24-hour averaged data from the EGLE Dearborn continuous $PM_{10}$ monitor for comparison to corresponding $PM_{10}$ measurement data reported from the on-site monitors.



## Figure 4 – $PM_{2.5}$ Data

The graph below represents the ambient $PM_{2.5}$ measurement data collected at the former Michigan State Fairgrounds property during the monitoring period of 4/14/21 to 4/21/21. This graph is a plot of the $PM_{2.5}$ measurement data as averaged over each daily monitoring period. The daily averaging interval for $PM_{2.5}$ data is consistent with the associated EPA primary and secondary $PM_{2.5}$ NAAQS: A 24-hour (daily) averaged value of 35 micrograms per cubic meter ($\mu g/m^3$) not to be exceeded more than once per year on average over 3 years.

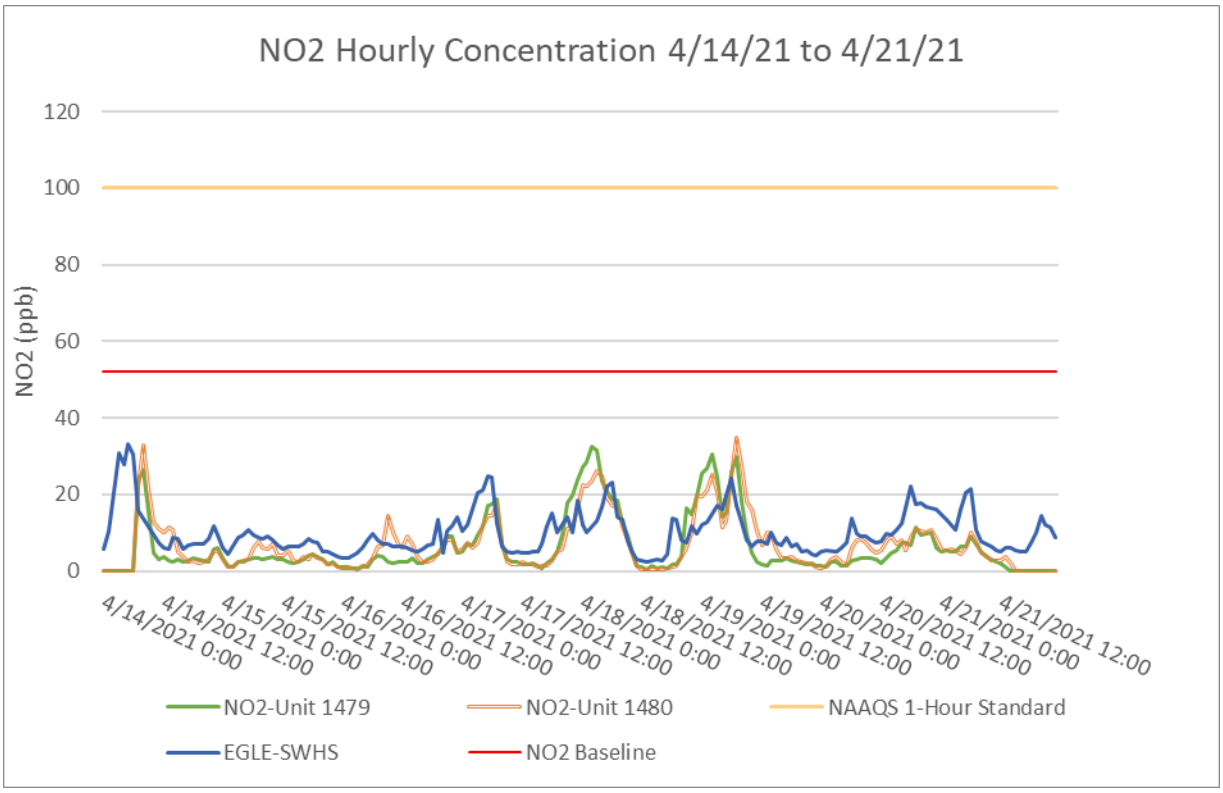
The solid yellow line represents the 24-hour $PM_{2.5}$ NAAQS of 35 $\mu g/m^3$. The solid red line represents the baseline concentration established in the 1st Baseline Report. The EGLE Oak Park monitoring Site is the nearest state-operated $PM_{2.5}$ monitor relative to the former Michigan State Fairgrounds property. The EGLE Oak Park $PM_{2.5}$ monitor is a 24-hour, filter-based sampler that collects a sample at 3-day intervals. Filter-based PM samples require gravimetric analysis at a laboratory; EGLE estimates that analytical results for the Oak Park $PM_{2.5}$ filters will not be available until July 2021. Therefore, the graph below presents the 24-hour averaged data from the EGLE Dearborn continuous $PM_{2.5}$ monitor for comparison to corresponding $PM_{2.5}$ measurement data reported from the on-site monitors.



## Figure 5 – $NO_2$ Data

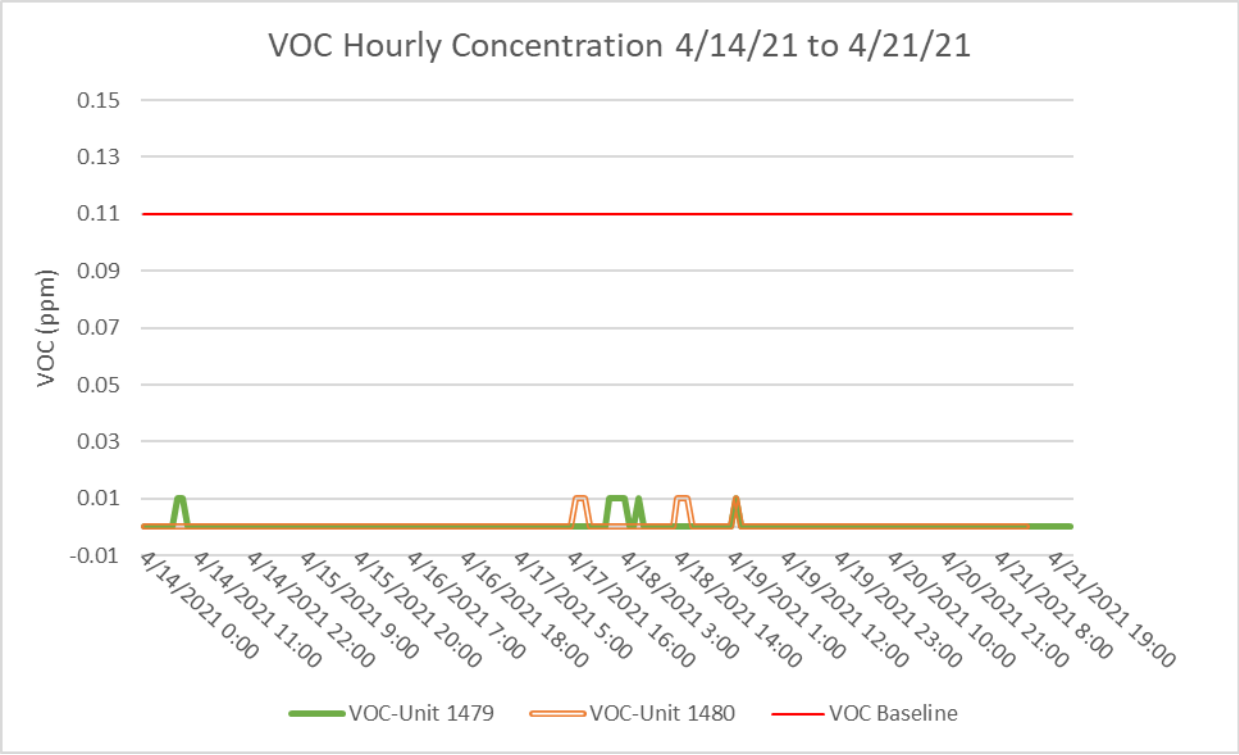
The graph below represents the ambient $NO_2$ measurement data collected at the former Michigan State Fairgrounds property during the monitoring period of 4/14/21 to 4/21/21. This graph is a plot of the $NO_2$ measurement data as averaged over a period of one (1) hour. This is consistent with the associated EPA primary $NO_2$ NAAQS: A 1-hour averaged value of 100 parts-per-billion (ppb) not to be exceeded more than once per year on average over 3 years.

The solid yellow line represents the 1-hour $NO_2$ NAAQS of 100 ppb. The solid red line represents the baseline concentration established in the 1st Baseline Report. The $NO_2$ monitor at the EGLE Southwestern High School (SWHS) Site is the closest state-operated $NO_2$ monitor relative to the former Michigan State Fairgrounds property. Therefore, the graph below presents the 1-hour averaged data from the EGLE SWHS continuous $NO_2$ monitor for comparison to corresponding $NO_2$ measurement data reported from the on-site monitors.



## Figure 6 – VOC Data

The graph below presents the ambient VOC measurement data collected at the former Michigan State Fairgrounds property during the monitoring period of 4/14/21 to 4/21/21. This graph is a plot of the VOC measurement data as averaged over a period of one (1) hour. The solid red line represents the baseline concentration established in the 1st Baseline Report. The EPA has not established a NAAQS for VOC. VOC data are not available from nearby EGLE monitoring Sites.



# Data Quality Assurance/Quality Control

## Quality Assurance/Quality Control

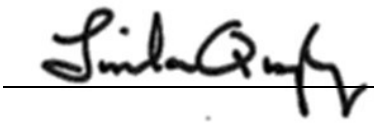
Quality assurance is a general term for the procedures used to ensure that a particular measurement meets the quality requirements for its intended use. Quality control of continuous analyzers consists of precision and span checks or flow verifications. Quality objectives were assessed via Site system audits.

All work performed by Montrose in support of this project follows the operating procedures described in the "Former Michigan State Fairgrounds Work Plan" dated 1/10/21.

All quality control data for the on-site monitors operated at the former Michigan State Fairgrounds property can be found in Appendix A to this report entitled *"Quality Assurance Logs"*. Certificates of traceability for the calibration standards and equipment used in support of quality assurance checks are presented in Appendix B to this report entitled *"Calibration Certification Sheets"*.

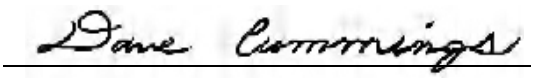
## Signature Page

Prepared by:



Linda Quigley
Data Manager
Montrose Air Quality Services LLC

Reviewed by:



David Cummings
District Manager
Montrose Air Quality Services LLC

# Appendix

*A: Quality Assurance Logs*

# AEROQUAL AQS-1 FLOW and LEAK CHECK FORM

**QC Checks are:** X Scheduled _____ Unscheduled (If unscheduled, explain reason why in "Comments" Section)

| | | | | | |
|---|---|---|---|---|---|
| **Network:** | City of Detroit (Amazon) | **Site:** | Fairgrounds | **Date of Checks:** | 4/12/2021 |
| **Operator:** | Rob Bienenstein | | | **Time Off-Line:** | 11:23 EST |
| **AEROQUAL QS-1 S/N** | 1479 | | | **Time On-Line:** | 11:59 EST |

**Reference Standards:**

| | | | | | |
|---|---|---|---|---|---|
| **Flow Standard:** | Mesa Defender 530+ | **S/N#** | M153584 | **Cert Date:** | 5/8/2020 |

## AS FOUND CHECK DATA

**Checks are "as found" checks. Adjust profiler flow or resolve leak and complete "as left" section below if any acceptability limits are exceeded or if any adjustments to the monitor are to be made.**

**FLOW CHECK DATA:**

| AQS-1 Expected Flow Rate (A) | Reference Flow Rate (B) | Profiler Flow Rate Error LPM (A-B) | Profiler Flow Rate Error Δ% (A-B) ÷ A x 100 |
|---|---|---|---|
| 1.0 LPM | 1.0 LPM | 0.00 | 0.0% |

Flow Check Procedure Link

**Acceptability Limits: The expected AQS-1 Particle Profiler Flow Rate is 1.0 LPM ± 0.05 LPM (between 0.95 LPM and 1.05 LPM) or ≤±5%.**

**LEAK CHECK DATA:**

| | | |
|---|---|---|
| **PROFILER LEAKAGE RATE:** | >30 seconds | (Must be >10 sec for 10 kPa pressure change) |

Leak Check Procedure Link

## AS LEFT CHECK DATA

**FLOW CHECK DATA:**

| AQS-1 Expected Flow Rate (A) | Reference Flow Rate (B) | Profiler Flow Rate Error LPM | Profiler Flow Rate Error Δ% |
|---|---|---|---|
| 1.0 LPM | LPM | | |

**LEAK CHECK DATA:**

| | | |
|---|---|---|
| **PROFILER LEAKAGE RATE:** | seconds | (Must be > 10 sec for 10 kPa pressure change) |

Comments:

Technician: *Rob Bienenstein*

QA Review: Ken Kagen

**MONTROSE AIR QUALITY SERVICES LLC**

# AEROQUAL AQS-1 VOC HIGH RANGE MODULE VERIFICATION/CALIBRATION FORM

| Network: | City of Detroit | Site: | MTMS Lab | Date: | 4/12/21 |
|---|---|---|---|---|---|
| Time Off-Line: | 12:04 EDT | Time On-Line: | 13:14 EDT | Technician: | Dennis Weyburne |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Equipment Info.** | Analyzer Model: | Aeroqual AQS-1 | S/N: | 1479 | Last Cal: | 3/12/21 |
| | Calibrator Model No: | Teledyne API | S/N: | 69 | Cal. Date: | 12/29/20 |
| | Zero Air Model No: | Teledyne API | S/N: | n/a | Cert Date: | n/a |
| | Gas Supplier: | GASCO #1-1 | Cyl. Conc. (PPM): | 0.99 | Cyl. Pressure (PSIG) | 200 |
| | Gas Supplier: | GASCO #3-2 | Cyl. Conc. (PPM): | 3.10 | Cyl. Pressure (PSIG) | 250 |

| VOC Sensor Module Calibration Settings | "As Found" (Before Any Adjustment) | "As Left" (After Adjustment) |
|---|---|---|
| **OFFSET** | 0.00 | 0.00 |
| **GAIN** | 1.774 | 1.422 |

## "AS FOUND" (UNADJUSTED) TEST DATA

| Calibrator Flow and Test Gas Data | | | | | Observed VOC Response from AQS-1 | | Error (Δ%) |
|---|---|---|---|---|---|---|---|
| Calibrator Gas Channel | | Calibrator Air Channel | | Known VOC Input Gas Conc. (PPM) | | | |
| Display Setting (SLPM) | Actual Flow Rate (SLPM) | Display Setting (SLPM) | Actual Flow Rate (SLPM) | | Response (PPM) | Std. Dev. (PPM) | |
| OFF | OFF | 5.0000 | 5.0130 | 0.00 | -0.01 | 0.00 | - |
| n/a | n/a | 1.0000 | n/a | 0.99 | 1.06 | 0.00 | 7.1% |
| n/a | n/a | 1.0000 | n/a | 3.10 | 3.10 | 0.00 | 0.0% |

## "AS LEFT" (ADJUSTED) TEST DATA

| Calibrator Flow and Test Gas Data | | | | | Observed VOC Response from AQS-1 | | Error (Δ%) |
|---|---|---|---|---|---|---|---|
| Calibrator Gas Channel | | Calibrator Air Channel | | Known VOC Input Gas Conc. (PPM) | | | |
| Display Setting (SLPM) | Actual Flow Rate (SLPM) | Display Setting (SLPM) | Actual Flow Rate (SLPM) | | Response (PPM) | Std. Dev. (PPM) | |
| | | | | | | | - |
| | | | | | | | |
| | | | | | | | |

**NOTES:**

1. The VOC sensor zero response should be 0.0 ppm ± 0.2 ppm with a Std. Dev. < 0.2 ppm. If the sensor response error is greater than ± 0.2 ppm then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppm then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppm ± 0.2 ppm.
3. The VOC sensor SPAN response should be ± 1 ppm (5% span of 20 ppm) with a Std. Dev. < 0.4 ppm (2% span of 20 ppm). If the sensor response error is greater than ± 1 ppm then a GAIN adjustment is required. If the Std. Dev. is greater than 0.4 ppm then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 0.0 ppm ± 1 ppm.

**Comments:**

Technician: *Dennis Weyburne*

QA Review: Kenneth Cain

**MONTROSE AIR QUALITY SERVICES LLC**

## AEROQUAL AQS-1 NO2 MODULE MULTI-POINT CALIBRATION FORM

| Calibration Data on This Form Are For: | | | **Unadjusted Cal.** | X | | **Adjusted Cal.** | |
|---|---|---|---|---|---|---|---|
| Network: | City of Detroit | | Site: | MTMS Lab | | Date: | 4/12/21 |
| Time Off-Line: | 12:04 EDT | | Time On-Line: | 17:37 EDT | | Technician: | Dennis Weyburne |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Equipment Info.** | Analyzer Model: | Aeroqual AQS-1 | S/N: | 1479 | Last Cal: | 3/11/21 |
| | Calibrator Model No.: | Teledyne API | S/N: | 69 | Cal. Date: | 12/29/20 |
| | Zero Air Model No.: | Teledyne API | S/N: | n/a | Cert Date: | n/a |
| | Gas Supplier: | Airgas | Cyl. Cert. Date: | 1/26/21 | Cyl. Pressure (PSIG) | 2,000 |
| | Gas Cylinder ID #: | D068357 | Cyl. Conc. (PPM): | 30.95 | Gas Module Total Flow Rate | 131 mL |

| **Analyzer Calibration Settings** | **"As Found" (Before Any Adjustment)** | **"As Left" (After Adjustment)** |
|---|---|---|
| **OFFSET** | 0.0 | 0.5 |
| **GAIN** | 1.036 | 1.199 |

| **Calibrator Flow and Test Gas Data** | | | | | **$NO_2$ Response** ***Observed from AQS-1*** | | Δ% (Observed Response Vs. Known Conc.) 3 | PASS/FAIL |
|---|---|---|---|---|---|---|---|---|
| **Calibrator Gas Channel** | | **Calibrator Air Channel** | | **Known $NO_2$ Gas Conc. (PPB)** | | | | |
| Display Setting (SLPM) | **Actual Flow Rate** (SLPM) | Display Setting (SLPM) | **Actual Flow Rate** (SLPM) | | Response (PPB) | Std. Dev. (PPB) | | |
| 0.0500 | 0.0501 | 3.8497 | 3.8636 | 396.2 | 398.1 | 0.6 | 0.5% | |
| 0.0145 | 0.0146 | 4.4855 | 4.5075 | 99.9 | 95.3 | 0.7 | -4.6% | |
| 0.0081 | 0.0082 | 4.9919 | 5.0132 | 50.5 | 44.9 | 0.9 | -11.1% | |
| 0.0048 | 0.0050 | 4.9952 | 5.0174 | 30.8 | 26.8 | 0.7 | -13.0% | |
| OFF | OFF | 5.0000 | 5.0150 | 0.0 | -0.1 | 0.4 | | |
| **Linear Regression Analysis:** | | | | | | | | |
| Slope: | 1.012712 | | Intercept: | -3.947984 | Corr. Coefficient (r): | | 0.999884 | |

**NOTES:**

1. The NO2 sensor zero response should be 0.0 ppb ± 0.2 ppb with a Std. Dev. < 0.2 ppb. If the sensor response error is greater than ± 0.2 ppb then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppb then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppb ± 0.2 ppb.
3. The NO2 sensor SPAN response should be 400 ppb ± 20 ppb (5% span of 400 ppb) with a Std. Dev. < 8 ppb (2% span of 400 ppb). If the sensor response error is greater than ±20 ppb then a GAIN adjustment is required. If the Std. Dev. is greater than 8.0 ppb then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 400 ppb ± 20 ppb.

**Comments:**

Technician: *Dennis Weyburne*

QA Review: Kenneth Stein

**MONTROSE AIR QUALITY SERVICES LLC**

# AEROQUAL AQS-1 FLOW and LEAK CHECK FORM

**QC Checks are:** X Scheduled _____ Unscheduled (If unscheduled, explain reason why in "Comments" Section)

| | | | | | |
|---|---|---|---|---|---|
| **Network:** | City of Detroit (Amazon) | **Site:** | Fairgrounds | **Date of Checks:** | 4/22/2021 |
| **Operator:** | Rob Bienenstein | | | **Time Off-Line:** | 11:23 EST |
| **AEROQUAL QS-1 S/N** | 1479 | | | **Time On-Line:** | 11:59 EST |

**Reference Standards:**

| | | | | | |
|---|---|---|---|---|---|
| **Flow Standard:** | Mesa Defender 530+ | **S/N#** | M153584 | **Cert Date:** | 5/8/2020 |

## AS FOUND CHECK DATA

**Checks are "as found" checks. Adjust profiler flow or resolve leak and complete "as left" section below if any acceptability limits are exceeded or if any adjustments to the monitor are to be made.**

**FLOW CHECK DATA:**

| AQS-1 Expected Flow Rate (A) | Reference Flow Rate (B) | Profiler Flow Rate Error LPM (A-B) | Profiler Flow Rate Error Δ% (A-B) ÷ A x 100 |
|---|---|---|---|
| 1.0 LPM | 1.0 LPM | 0.00 | 0.0% |

Flow Check Procedure Link

**Acceptability Limits: The expected AQS-1 Particle Profiler Flow Rate is 1.0 LPM ± 0.05 LPM (between 0.95 LPM and 1.05 LPM) or ≤±5%.**

**LEAK CHECK DATA:**

| | | |
|---|---|---|
| **PROFILER LEAKAGE RATE:** | >30 seconds | (Must be >10 sec for 10 kPa pressure change) |

Leak Check Procedure Link

## AS LEFT CHECK DATA

**FLOW CHECK DATA:**

| AQS-1 Expected Flow Rate (A) | Reference Flow Rate (B) | Profiler Flow Rate Error LPM | Profiler Flow Rate Error Δ% |
|---|---|---|---|
| 1.0 LPM | LPM | | |

**LEAK CHECK DATA:**

| | | |
|---|---|---|
| **PROFILER LEAKAGE RATE:** | seconds | (Must be > 10 sec for 10 kPa pressure change) |

Comments:

Technician: *Rob Bienenstein*

QA Review: Ken Liggett

**MONTROSE AIR QUALITY SERVICES LLC**

# AEROQUAL AQS-1 VOC HIGH RANGE MODULE VERIFICATION/CALIBRATION FORM

| Network: | City of Detroit | Site: | MTMS Lab | Date: | 4/22/21 |
|---|---|---|---|---|---|
| Time Off-Line: | 07:40 EDT | Time On-Line: | 08:20 EDT | Technician: | Dennis Weyburne |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Equipment Info.** | Analyzer Model: | Aeroqual AQS-1 | S/N: | 1479 | Last Cal: | 4/12/21 |
| | Calibrator Model No: | Teledyne API | S/N: | 69 | Cal. Date: | 12/29/20 |
| | Zero Air Model No: | Teledyne API | S/N: | n/a | Cert Date: | n/a |
| | Gas Supplier: | GASCO #1-3 | Cyl. Conc. (PPM): | 0.99 | Cyl. Pressure (PSIG) | 350 |
| | Gas Supplier: | GASCO #3-3 | Cyl. Conc. (PPM): | 3.10 | Cyl. Pressure (PSIG) | 335 |

| VOC Sensor Module Calibration Settings | "As Found" (Before Any Adjustment) | "As Left" (After Adjustment) |
|---|---|---|
| **OFFSET** | 0.00 | |
| **GAIN** | 1.422 | |

## "AS FOUND" (UNADJUSTED) TEST DATA

| Calibrator Flow and Test Gas Data | | | | | Observed VOC Response from AQS-1 | | Error (Δ%) |
|---|---|---|---|---|---|---|---|
| Calibrator Gas Channel | | Calibrator Air Channel | | Known VOC Input Gas Conc. (PPM) | | | |
| Display Setting (SLPM) | Actual Flow Rate (SLPM) | Display Setting (SLPM) | Actual Flow Rate (SLPM) | | Response (PPM) | Std. Dev. (PPM) | |
| OFF | OFF | 5.0000 | 5.0130 | 0.00 | 0.00 | 0.00 | - |
| n/a | n/a | 1.0000 | n/a | 0.99 | 0.94 | 0.01 | -5.1% |
| n/a | n/a | 1.0000 | n/a | 3.10 | 3.02 | 0.01 | -2.6% |

## "AS LEFT" (ADJUSTED) TEST DATA

| Calibrator Flow and Test Gas Data | | | | | Observed VOC Response from AQS-1 | | Error (Δ%) |
|---|---|---|---|---|---|---|---|
| Calibrator Gas Channel | | Calibrator Air Channel | | Known VOC Input Gas Conc. (PPM) | | | |
| Display Setting (SLPM) | Actual Flow Rate (SLPM) | Display Setting (SLPM) | Actual Flow Rate (SLPM) | | Response (PPM) | Std. Dev. (PPM) | |
| | | | | | | | - |
| | | | | | | | |
| | | | | | | | |

**NOTES:**

1. The VOC sensor zero response should be 0.0 ppm ± 0.2 ppm with a Std. Dev. < 0.2 ppm. If the sensor response error is greater than ± 0.2 ppm then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppm then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppm ± 0.2 ppm.
3. The VOC sensor SPAN response should be ± 1 ppm (5% span of 20 ppm) with a Std. Dev. < 0.4 ppm (2% span of 20 ppm). If the sensor response error is greater than ± 1 ppm then a GAIN adjustment is required. If the Std. Dev. is greater than 0.4 ppm then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 0.0 ppm ± 1 ppm.

**Comments:**

Technician: *Dennis Weyburne*

QA Review: Ken Liggett

**MONTROSE AIR QUALITY SERVICES LLC**

## AEROQUAL AQS-1 NO2 MODULE MULTI-POINT CALIBRATION FORM

| Calibration Data on This Form Are For: | | | **Unadjusted Cal.** | X | **Adjusted Cal.** | |
|---|---|---|---|---|---|---|
| Network: | City of Detroit | Site: | MTMS Lab | | Date: | 4/22/21 |
| Time Off-Line: | 08:24 EDT | Time On-Line: | 10:53 EDT | | Technician: | Kevin Ruggiero |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Equipment Info.** | Analyzer Model: | Aeroqual AQS-1 | S/N: | 1479 | Last Cal: | 4/12/21 |
| | Calibrator Model No.: | Teledyne API | S/N: | 69 | Cal. Date: | 12/29/20 |
| | Zero Air Model No.: | Teledyne API | S/N: | n/a | Cert Date: | n/a |
| | Gas Supplier: | Airgas | Cyl. Cert. Date: | 1/26/21 | Cyl. Pressure (PSIG) | 2,000 |
| | Gas Cylinder ID #: | D068357 | Cyl. Conc. (PPM): | 30.95 | Gas Module Total Flow Rate | 137 mL |

| **Analyzer Calibration Settings** | **"As Found" (Before Any Adjustment)** | **"As Left" (After Adjustment)** |
|---|---|---|
| **OFFSET** | 0.5 | |
| **GAIN** | 1.199 | |

| **Calibrator Flow and Test Gas Data** | | | | | **$NO_2$ Response** ***Observed from AQS-1*** | | Δ% (Observed Response Vs. Known Conc.) 3 | PASS/FAIL |
|---|---|---|---|---|---|---|---|---|
| **Calibrator Gas Channel** | | **Calibrator Air Channel** | | **Known $NO_2$ Gas Conc. (PPB)** | | | | |
| Display Setting (SLPM) | **Actual Flow Rate** (SLPM) | Display Setting (SLPM) | **Actual Flow Rate** (SLPM) | | Response (PPB) | Std. Dev. (PPB) | | |
| 0.0500 | 0.0501 | 3.8497 | 3.8681 | 395.7 | 419.8 | 1.1 | 6.1% | |
| 0.0145 | 0.0146 | 4.4855 | 4.5075 | 99.9 | 101.0 | 0.5 | 1.1% | |
| 0.0081 | 0.0082 | 4.9919 | 5.0132 | 50.5 | 47.3 | 0.1 | -6.3% | |
| 0.0048 | 0.0050 | 4.9952 | 5.0174 | 30.8 | 27.2 | 0.3 | -11.7% | |
| OFF | OFF | 5.0000 | 5.0150 | 0.0 | -1.5 | 0.7 | | |
| **Linear Regression Analysis:** | | | | | | | | |
| Slope: | 1.071732 | | Intercept: | -4.896414 | Corr. Coefficient (r): | | 0.999925 | |

**NOTES:**

1. The NO2 sensor zero response should be 0.0 ppb ± 0.2 ppb with a Std. Dev. < 0.2 ppb. If the sensor response error is greater than ± 0.2 ppb then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppb then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppb ± 0.2 ppb.
3. The NO2 sensor SPAN response should be 400 ppb ± 20 ppb (5% span of 400 ppb) with a Std. Dev. < 8 ppb (2% span of 400 ppb). If the sensor response error is greater than ±20 ppb then a GAIN adjustment is required. If the Std. Dev. is greater than 8.0 ppb then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 400 ppb ± 20 ppb.

**Comments:**

Technician: *Dennis Weyburne*

QA Review: Kevin Ruggiero

**MONTROSE AIR QUALITY SERVICES LLC**

# AEROQUAL AQS-1 FLOW and LEAK CHECK FORM

**QC Checks are:** X Scheduled _____ Unscheduled (If unscheduled, explain reason why in "Comments" Section)

| | | | | | |
|---|---|---|---|---|---|
| **Network:** | City of Detroit (Amazon) | **Site:** | Fairgrounds | **Date of Checks:** | 4/12/2021 |
| **Operator:** | Rob Bienenstein | | | **Time Off-Line:** | 11:23 EST |
| **AEROQUAL QS-1 S/N** | 1480 | | | **Time On-Line:** | 11:59 EST |

**Reference Standards:**

| | | | | | |
|---|---|---|---|---|---|
| **Flow Standard:** | Mesa Defender 530+ | **S/N#** | M153584 | **Cert Date:** | 5/8/2020 |

## AS FOUND CHECK DATA

**Checks are "as found" checks. Adjust profiler flow or resolve leak and complete "as left" section below if any acceptability limits are exceeded or if any adjustments to the monitor are to be made.**

**FLOW CHECK DATA:**

| AQS-1 Expected Flow Rate (A) | Reference Flow Rate (B) | Profiler Flow Rate Error LPM (A-B) | Profiler Flow Rate Error Δ% (A-B) ÷ A x 100 |
|---|---|---|---|
| 1.0 LPM | 1.0 LPM | 0.00 | 0.0% |

Flow Check Procedure Link

**Acceptability Limits: The expected AQS-1 Particle Profiler Flow Rate is 1.0 LPM ± 0.05 LPM (between 0.95 LPM and 1.05 LPM) or ≤±5%.**

**LEAK CHECK DATA:**

| | | |
|---|---|---|
| **PROFILER LEAKAGE RATE:** | >30 seconds | (Must be >10 sec for 10 kPa pressure change) |

Leak Check Procedure Link

## AS LEFT CHECK DATA

**FLOW CHECK DATA:**

| AQS-1 Expected Flow Rate (A) | Reference Flow Rate (B) | Profiler Flow Rate Error LPM | Profiler Flow Rate Error Δ% |
|---|---|---|---|
| 1.0 LPM | LPM | | |

**LEAK CHECK DATA:**

| | | |
|---|---|---|
| **PROFILER LEAKAGE RATE:** | seconds | (Must be > 10 sec for 10 kPa pressure change) |

Comments:

Technician: *Rob Bienenstein*

QA Review: Kenneth Lyssy

**MONTROSE AIR QUALITY SERVICES LLC**

# AEROQUAL AQS-1 VOC HIGH RANGE MODULE VERIFICATION/CALIBRATION FORM

| Network: | City of Detroit | Site: | MTMS Lab | Date: | 4/12/21 |
|---|---|---|---|---|---|
| Time Off-Line: | 12:04 EDT | Time On-Line: | 12:43 EDT | Technician: | Denis Weyburne |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Equipment Info.** | Analyzer Model: | Aeroqual AQS-1 | S/N: | 1480 | Last Cal: | 3/12/21 |
| | Calibrator Model No: | Teledyne API | S/N: | 69 | Cal. Date: | 12/29/20 |
| | Zero Air Model No: | Teledyne API | S/N: | n/a | Cert Date: | n/a |
| | Gas Supplier: | GASCO #1-1 | Cyl. Conc. (PPM): | 0.99 | Cyl. Pressure (PSIG) | 200 |
| | Gas Supplier: | GASCO #3-2 | Cyl. Conc. (PPM): | 3.10 | Cyl. Pressure (PSIG) | 250 |

| VOC Sensor Module Calibration Settings | "As Found" (Before Any Adjustment) | "As Left" (After Adjustment) |
|---|---|---|
| **OFFSET** | 0.00 | 0.00 |
| **GAIN** | 2.210 | 2.047 |

## "AS FOUND" (UNADJUSTED) TEST DATA

| Calibrator Flow and Test Gas Data | | | | | Observed VOC Response from AQS-1 | | Error (Δ%) |
|---|---|---|---|---|---|---|---|
| Calibrator Gas Channel | | Calibrator Air Channel | | Known VOC Input Gas Conc. (PPM) | | | |
| Display Setting (SLPM) | Actual Flow Rate (SLPM) | Display Setting (SLPM) | Actual Flow Rate (SLPM) | | Response (PPM) | Std. Dev. (PPM) | |
| OFF | OFF | 5.0000 | 5.0130 | 0.00 | -0.01 | 0.00 | - |
| n/a | n/a | 1.0000 | n/a | 0.99 | 1.02 | 0.00 | 3.0% |
| n/a | n/a | 1.0000 | n/a | 3.10 | 3.10 | 0.01 | 0.0% |

## "AS LEFT" (ADJUSTED) TEST DATA

| Calibrator Flow and Test Gas Data | | | | | Observed VOC Response from AQS-1 | | Error (Δ%) |
|---|---|---|---|---|---|---|---|
| Calibrator Gas Channel | | Calibrator Air Channel | | Known VOC Input Gas Conc. (PPM) | | | |
| Display Setting (SLPM) | Actual Flow Rate (SLPM) | Display Setting (SLPM) | Actual Flow Rate (SLPM) | | Response (PPM) | Std. Dev. (PPM) | |
| | | | | | | | - |
| | | | | | | | |
| | | | | | | | |

**NOTES:**

1. The VOC sensor zero response should be 0.0 ppm ± 0.2 ppm with a Std. Dev. < 0.2 ppm. If the sensor response error is greater than ± 0.2 ppm then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppm then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppm ± 0.2 ppm.
3. The VOC sensor SPAN response should be ± 1 ppm (5% span of 20 ppm) with a Std. Dev. < 0.4 ppm (2% span of 20 ppm). If the sensor response error is greater than ± 1 ppm then a GAIN adjustment is required. If the Std. Dev. is greater than 0.4 ppm then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 0.0 ppm ± 1 ppm.

**Comments:**

Technician: *Dennis Weyburne*

QA Review: Kenneth Cain

**MONTROSE AIR QUALITY SERVICES LLC**

## AEROQUAL AQS-1 NO2 MODULE MULTI-POINT CALIBRATION FORM

| Calibration Data on This Form Are For: | | | **Unadjusted Cal.** | X | | **Adjusted Cal.** | |
|---|---|---|---|---|---|---|---|
| Network: | City of Detroit | | Site: | MTMS Lab | | Date: | 4/12/21 |
| Time Off-Line: | 12:04 EDT | | Time On-Line: | 17:37 EDT | | Technician: | Dennis Weyburne |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Equipment Info.** | Analyzer Model: | Aeroqual AQS-1 | S/N: | 1480 | Last Cal: | 3/11/21 |
| | Calibrator Model No.: | Teledyne API | S/N: | 69 | Cal. Date: | 12/29/20 |
| | Zero Air Model No.: | Teledyne API | S/N: | n/a | Cert Date: | n/a |
| | Gas Supplier: | Airgas | Cyl. Cert. Date: | 1/26/21 | Cyl. Pressure (PSIG) | 2,000 |
| | Gas Cylinder ID #: | D068357 | Cyl. Conc. (PPM): | 30.95 | Gas Module Total Flow Rate | 126 mL |

| **Analyzer Calibration Settings** | **"As Found" (Before Any Adjustment)** | **"As Left" (After Adjustment)** |
|---|---|---|
| **OFFSET** | 0.0 | 0.6 |
| **GAIN** | 1.052 | 1.273 |

| **Calibrator Flow and Test Gas Data** | | | | | **$NO_2$ Response** | | | |
|---|---|---|---|---|---|---|---|---|
| **Calibrator Gas Channel** | | **Calibrator Air Channel** | | | ***Observed from AQS-1*** | | | |
| Display Setting (SLPM) | **Actual Flow Rate** (SLPM) | Display Setting (SLPM) | **Actual Flow Rate** (SLPM) | **Known $NO_2$ Gas Conc. (PPB)** | Response (PPB) | Std. Dev. (PPB) | Δ% (Observed Response Vs. Known Conc.) 3 | PASS/FAIL |
| 0.0500 | 0.0501 | 3.8497 | 3.8636 | 396.2 | 398.0 | 1.0 | 0.5% | |
| 0.0145 | 0.0146 | 4.4855 | 4.5075 | 99.9 | 95.5 | 1.1 | -4.4% | |
| 0.0081 | 0.0082 | 4.9919 | 5.0132 | 50.5 | 44.9 | 1.1 | -11.1% | |
| 0.0048 | 0.0050 | 4.9952 | 5.0174 | 30.8 | 26.5 | 0.2 | -14.0% | |
| OFF | OFF | 5.0000 | 5.0150 | 0.0 | -0.3 | 0.4 | | |
| **Linear Regression Analysis:** | | | | | | | | |
| Slope: | 1.012879 | Intercept: | -4.047248 | Corr. Coefficient (r): | 0.999894 | | | |

**NOTES:**

1. The NO2 sensor zero response should be 0.0 ppb ± 0.2 ppb with a Std. Dev. < 0.2 ppb. If the sensor response error is greater than ± 0.2 ppb then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppb then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppb ± 0.2 ppb.
3. The NO2 sensor SPAN response should be 400 ppb ± 20 ppb (5% span of 400 ppb) with a Std. Dev. < 8 ppb (2% span of 400 ppb). If the sensor response error is greater than ±20 ppb then a GAIN adjustment is required. If the Std. Dev. is greater than 8.0 ppb then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 400 ppb ± 20 ppb.

**Comments:**

Technician: *Dennis Weyburne*

QA Review: Kenneth Stein

**MONTROSE AIR QUALITY SERVICES LLC**

# AEROQUAL AQS-1 FLOW and LEAK CHECK FORM

**QC Checks are:** X Scheduled _____ Unscheduled (If unscheduled, explain reason why in "Comments" Section)

| | | | | | |
|---|---|---|---|---|---|
| **Network:** | City of Detroit (Amazon) | **Site:** | Fairgrounds | **Date of Checks:** | 4/22/2021 |
| **Operator:** | Rob Bienenstein | | | **Time Off-Line:** | 11:23 EST |
| **AEROQUAL QS-1 S/N** | 1480 | | | **Time On-Line:** | 11:59 EST |

**Reference Standards:**

| | | | | | |
|---|---|---|---|---|---|
| **Flow Standard:** | Mesa Defender 530+ | **S/N#** | M153584 | **Cert Date:** | 5/8/2020 |

## AS FOUND CHECK DATA

**Checks are "as found" checks. Adjust profiler flow or resolve leak and complete "as left" section below if any acceptability limits are exceeded or if any adjustments to the monitor are to be made.**

**FLOW CHECK DATA:**

| AQS-1 Expected Flow Rate (A) | Reference Flow Rate (B) | Profiler Flow Rate Error LPM (A-B) | Profiler Flow Rate Error Δ% (A-B) ÷ A x 100 |
|---|---|---|---|
| 1.0 LPM | 1.0 LPM | 0.00 | 0.0% |

Flow Check Procedure Link

**Acceptability Limits: The expected AQS-1 Particle Profiler Flow Rate is 1.0 LPM ± 0.05 LPM (between 0.95 LPM and 1.05 LPM) or ≤±5%.**

**LEAK CHECK DATA:**

| | | |
|---|---|---|
| **PROFILER LEAKAGE RATE:** | >30 seconds | (Must be >10 sec for 10 kPa pressure change) |

Leak Check Procedure Link

## AS LEFT CHECK DATA

**FLOW CHECK DATA:**

| AQS-1 Expected Flow Rate (A) | Reference Flow Rate (B) | Profiler Flow Rate Error LPM | Profiler Flow Rate Error Δ% |
|---|---|---|---|
| 1.0 LPM | LPM | | |

**LEAK CHECK DATA:**

| | | |
|---|---|---|
| **PROFILER LEAKAGE RATE:** | seconds | (Must be > 10 sec for 10 kPa pressure change) |

Comments:

Technician: *Rob Bienenstein*

QA Review: _____

**MONTROSE AIR QUALITY SERVICES LLC**

# AEROQUAL AQS-1 VOC HIGH RANGE MODULE VERIFICATION/CALIBRATION FORM

| Network: | City of Detroit | Site: | MTMS Lab | Date: | 4/22/21 |
|---|---|---|---|---|---|
| Time Off-Line: | 07:40 EDT | Time On-Line: | 08:20 EDT | Technician: | Denis Weyburne |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Equipment Info.** | Analyzer Model: | Aeroqual AQS-1 | S/N: | 1480 | Last Cal: | 4/12/21 |
| | Calibrator Model No: | Teledyne API | S/N: | 69 | Cal. Date: | 12/29/20 |
| | Zero Air Model No: | Teledyne API | S/N: | n/a | Cert Date: | n/a |
| | Gas Supplier: | GASCO #1-3 | Cyl. Conc. (PPM): | 0.99 | Cyl. Pressure (PSIG) | 350 |
| | Gas Supplier: | GASCO #3-3 | Cyl. Conc. (PPM): | 3.10 | Cyl. Pressure (PSIG) | 335 |

| VOC Sensor Module Calibration Settings | "As Found" (Before Any Adjustment) | "As Left" (After Adjustment) |
|---|---|---|
| **OFFSET** | 0.00 | |
| **GAIN** | 2.047 | |

## "AS FOUND" (UNADJUSTED) TEST DATA

| Calibrator Flow and Test Gas Data | | | | | Observed VOC Response from AQS-1 | | Error (Δ%) |
|---|---|---|---|---|---|---|---|
| Calibrator Gas Channel | | Calibrator Air Channel | | Known VOC Input Gas Conc. (PPM) | | | |
| Display Setting (SLPM) | Actual Flow Rate (SLPM) | Display Setting (SLPM) | Actual Flow Rate (SLPM) | | Response (PPM) | Std. Dev. (PPM) | |
| OFF | OFF | 5.0000 | 5.0130 | 0.00 | 0.00 | 0.00 | - |
| n/a | n/a | 1.0000 | n/a | 0.99 | 0.95 | 0.00 | -4.0% |
| n/a | n/a | 1.0000 | n/a | 3.10 | 3.03 | 0.00 | -2.3% |

## "AS LEFT" (ADJUSTED) TEST DATA

| Calibrator Flow and Test Gas Data | | | | | Observed VOC Response from AQS-1 | | Error (Δ%) |
|---|---|---|---|---|---|---|---|
| Calibrator Gas Channel | | Calibrator Air Channel | | Known VOC Input Gas Conc. (PPM) | | | |
| Display Setting (SLPM) | Actual Flow Rate (SLPM) | Display Setting (SLPM) | Actual Flow Rate (SLPM) | | Response (PPM) | Std. Dev. (PPM) | |
| | | | | | | | - |
| | | | | | | | |
| | | | | | | | |

**NOTES:**

1. The VOC sensor zero response should be 0.0 ppm ± 0.2 ppm with a Std. Dev. < 0.2 ppm. If the sensor response error is greater than ± 0.2 ppm then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppm then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppm ± 0.2 ppm.
3. The VOC sensor SPAN response should be ± 1 ppm (5% span of 20 ppm) with a Std. Dev. < 0.4 ppm (2% span of 20 ppm). If the sensor response error is greater than ± 1 ppm then a GAIN adjustment is required. If the Std. Dev. is greater than 0.4 ppm then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 0.0 ppm ± 1 ppm.

**Comments:**

Technician: *Dennis Weyburne*

QA Review: Kenneth Cain

**MONTROSE AIR QUALITY SERVICES LLC**

## AEROQUAL AQS-1 NO2 MODULE MULTI-POINT CALIBRATION FORM

| Calibration Data on This Form Are For: | | | **Unadjusted Cal.** | X | **Adjusted Cal.** | |
|---|---|---|---|---|---|---|
| Network: | City of Detroit | Site: | MTMS Lab | | Date: | 4/22/21 |
| Time Off-Line: | 08:24 EDT | Time On-Line: | 10:53 EDT | | Technician: | Dennis Weyburne |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Equipment Info.** | Analyzer Model: | Aeroqual AQS-1 | S/N: | 1480 | Last Cal: | 4/12/21 |
| | Calibrator Model No.: | Teledyne API | S/N: | 69 | Cal. Date: | 12/29/20 |
| | Zero Air Model No.: | Teledyne API | S/N: | n/a | Cert Date: | n/a |
| | Gas Supplier: | Airgas | Cyl. Cert. Date: | 1/26/21 | Cyl. Pressure (PSIG) | 2,000 |
| | Gas Cylinder ID #: | D068357 | Cyl. Conc. (PPM): | 30.95 | Gas Module Total Flow Rate | 130 mL |

| **Analyzer Calibration Settings** | **"As Found" (Before Any Adjustment)** | **"As Left" (After Adjustment)** |
|---|---|---|
| **OFFSET** | 0.6 | |
| **GAIN** | 1.273 | |

| **Calibrator Flow and Test Gas Data** | | | | | **$NO_2$ Response** *Observed from AQS-1* | | | |
|---|---|---|---|---|---|---|---|---|
| **Calibrator Gas Channel** | | **Calibrator Air Channel** | | **Known $NO_2$ Gas Conc. (PPB)** | Response (PPB) | Std. Dev. (PPB) | Δ% (Observed Response Vs. Known Conc.) 3 | PASS/FAIL |
| Display Setting (SLPM) | **Actual Flow Rate** (SLPM) | Display Setting (SLPM) | **Actual Flow Rate** (SLPM) | | | | | |
| 0.0500 | 0.0501 | 3.8497 | 3.8681 | 395.7 | 431.3 | 0.9 | 9.0% | |
| 0.0145 | 0.0146 | 4.4855 | 4.5075 | 99.9 | 103.1 | 0.1 | 3.2% | |
| 0.0081 | 0.0082 | 4.9919 | 5.0132 | 50.5 | 47.9 | 0.3 | -5.1% | |
| 0.0048 | 0.0050 | 4.9952 | 5.0174 | 30.8 | 26.8 | 0.3 | -13.0% | |
| OFF | OFF | 5.0000 | 5.0150 | 0.0 | -0.7 | 0.2 | | |
| **Linear Regression Analysis:** | | | | | | | | |
| Slope: | 1.101625 | Intercept: | -5.425475 | Corr. Coefficient (r): | 0.999866 | | | |

**NOTES:**

1. The NO2 sensor zero response should be 0.0 ppb ± 0.2 ppb with a Std. Dev. < 0.2 ppb. If the sensor response error is greater than ± 0.2 ppb then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppb then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppb ± 0.2 ppb.
3. The NO2 sensor SPAN response should be 400 ppb ± 20 ppb (5% span of 400 ppb) with a Std. Dev. < 8 ppb (2% span of 400 ppb). If the sensor response error is greater than ±20 ppb then a GAIN adjustment is required. If the Std. Dev. is greater than 8.0 ppb then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 400 ppb ± 20 ppb.

**Comments:**

Technician: *Dennis Weyburne*

QA Review: Kenneth Stein

**MONTROSE AIR QUALITY SERVICES LLC**

***B: Calibration Certification Sheets***

MesaLabs

NVLAP Lab Code 200661-0
Calibration

# Calibration Certificate

| | | | |
|---|---|---|---|
| **CertificateNo.** | 388679 | **Sold To:** | Montrose Air Quality Services, LLC |
| **Product** | 200-530+ Medium Defender 530+ Medium Flow | | 45 US Hwy 46 East, Suite 601 |
| **Serial No.** | 153584 | | Pine Brook, NJ 07058 |
| **Cal. Date** | 08-May-2020 | | US |

All calibrations are performed at Mesa Laboratories, Inc., 10 Park Place, Butler, NJ, 07405, an ISO 17025:2005 accredited laboratory through NVLAP of NIST. This report shall not be reproduced except in full without the written approval of the laboratory. Results only relate to the items calibrated. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

## As Received Calibration Data

| | | | |
|---|---|---|---|
| **Technician** | Lilianna Malinowska | **Lab. Pressure** | 747 mmHg |
| | | **Lab. Temperature** | 22.1 °C |

| Instrument Reading | Lab Standard Reading | Deviation | Allowable Deviation | As Received |
|---|---|---|---|---|
| 4807.28 sccm | 4794.46 sccm | 0.27% | 1.00% | In Tolerance |
| 1088.33 sccm | 1089.94 sccm | -0.15% | 1.00% | In Tolerance |
| 289.44 sccm | 290.04 sccm | -0.21% | 1.00% | In tolerance |
| 21.5 °C | 21.9 °C | - | ± 0.8°C | In Tolerance |
| 747 mmHg | 746 mmHg | - | ± 3.5 mmHg | In Tolerance |

## Mesa Laboratories Standards Used

| Description | Standard Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|
| ML-800-24 | 100439 | 30-Mar-2020 | 30-Mar-2021 |
| Percision Thermometer | 305460 | 08-Oct-2019 | 07-Oct-2020 |
| Precision Barometer | 2981392 | 19-Jul-2019 | 18-Jul-2020 |

MesaLabs

NVLAP Lab Code 200661-0
Calibration

## As Shipped Calibration Data

| | | | |
|---|---|---|---|
| **Certificate No** | 388679 | **Lab. Pressure** | 747 mmHg |
| **Technician** | Lilianna Malinowska | **Lab. Temperature** | 22.1 °C |

| Instrument Reading | Lab Standard Reading | Deviation | Allowable Deviation | As Shipped |
|---|---|---|---|---|
| 4790.5 sccm | 4802.74 sccm | -0.25% | 1.00% | In Tolerance |
| 1089.45 sccm | 1091.86 sccm | -0.22% | 1.00% | In Tolerance |
| 290.28 sccm | 290.92 sccm | -0.22% | 1.00% | In Tolerance |
| 22.8 °C | 22.8 °C | - | ± 0.8°C | In Tolerance |
| 747 mmHg | 747 mmHg | - | ± 3.5 mmHg | In Tolerance |

## Mesa Laboratories Standards Used

| Description | Standard Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|
| ML-800-24 | 117991 | 11-Feb-2020 | 10-Feb-2021 |
| Percision Thermometer | 305460 | 08-Oct-2019 | 07-Oct-2020 |
| Precision Barometer | 2981392 | 19-Jul-2019 | 18-Jul-2020 |

**Calibration Notes**

The expanded uncertainty of flow, temperature, and pressure measurements all have a coverage factor of k = 2 for a confidence interval of approximately 95%.

Flow testing is in accordance with our test number PR18-13 with an expanded uncertainty of 0.18% using high-purity nitrogen or filtered laboratory air. Flow readings in sccm are performed at STP of 21.1°C and 760 mmHg.

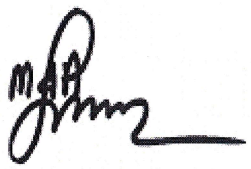
Pressure testing is in accordance with our test number PR18-11 with an expanded uncertainty of 0.16 mmHg.

Temperature testing is in accordance with our test number PR18-12 with an expanded uncertainty of 0.04 °C.

Traceability to the International System of Units (SI) is verified by accreditation to ISO/IEC 17025 by NVLAP under NVLAP Code 200661-0.

Technician Notes:

By:



Mohammed Aziz
Director of Engineering
Mesa Laboratories, Inc., Butler, NJ

# TAPI T700 MFC CALIBRATION

**PPLICATION INFORMATION:**

| | | | | | |
|---|---|---|---|---|---|
| Calibrator Model/S/N: | TAPI T700; SN 69 | NETWORK: | Marathon Detroit PAMS | SITE: | MTMS |
| Calibration Site: | MTMS Site | Test Date: | 12/29/2020 | | |
| Barometric Pressure (Pa, in mmHg): | 740.0 | Calibrated by: | Dennis Weyburne | | |
| Flow Standard Model: | Mesa Labs Defender 530+ | Air Temp. (Ta, in deg. C): | 27.4 | (=deg. K): | 300.6 |
| Flow Standard Base S/N: | Not Applicable | Flow Cell Model No: | 530+ High Flow | | |
| Certification Date: | Not Applicable | Flow Cell S/N: | 153452 | | |
| | | Flow Cell Certification Date: | 5/8/2020 | | |

Check One: **X** Air Channel _____ Gas Channel

| (X) MFC Drive Voltage (mVDC) | Flow Meter Readings (5 sets of 10 averaged flows) $F_1$ (SLPM) | $F_2$ (SLPM) | $F_3$ (SLPM) | $F_4$ (SLPM) | $F_5$ (SLPM) | Average Flow (F1...F5) (SLPM) | STD DEV F1...F5 (in *sccm*) | Flow Rate ***From Previous Cal*** (SLPM) | Δ% ("New Cal Flow" Vs "Prev. Cal Flow") |
|---|---|---|---|---|---|---|---|---|---|
| 5000 | 10.6340 | 10.6400 | 10.6380 | 10.6400 | 10.6350 | 10.637 | 2.8 | 10.657 | 0.2% |
| 4750 | 10.1050 | 10.1020 | 10.0960 | 10.0950 | 10.0870 | 10.097 | 7.0 | 10.101 | 0.0% |
| 4500 | 9.5920 | 9.5815 | 9.5763 | 9.5981 | 9.5759 | 9.585 | 9.9 | 9.573 | -0.1% |
| 4250 | 8.9901 | 8.9977 | 8.9954 | 8.9918 | 8.9909 | 8.993 | 3.2 | 9.030 | 0.4% |
| 4000 | 8.4595 | 8.4595 | 8.4599 | 8.4604 | 8.4516 | 8.458 | 3.7 | 8.478 | 0.2% |
| 3750 | 7.9298 | 7.9289 | 7.9244 | 7.9223 | 7.9254 | 7.926 | 3.1 | 7.955 | 0.4% |
| 3500 | 7.3934 | 7.3891 | 7.3861 | 7.3909 | 7.3974 | 7.391 | 4.3 | 7.406 | 0.2% |
| 3250 | 6.8480 | 6.8463 | 6.8474 | 6.8470 | 6.8487 | 6.847 | 0.9 | 6.872 | 0.4% |
| 3000 | 6.3225 | 6.3215 | 6.3208 | 6.3174 | 6.3198 | 6.320 | 1.9 | 6.332 | 0.2% |
| 2750 | 5.7859 | 5.7866 | 5.7889 | 5.7868 | 5.7835 | 5.786 | 1.9 | 5.800 | 0.2% |
| 2500 | 5.2548 | 5.2542 | 5.2557 | 5.2541 | 5.2538 | 5.255 | 0.8 | 5.264 | 0.2% |
| 2250 | 4.7312 | 4.7316 | 4.7310 | 4.7321 | 4.7311 | 4.731 | 0.5 | 4.738 | 0.1% |
| 2000 | 4.2061 | 4.2039 | 4.2018 | 4.1994 | 4.1999 | 4.202 | 2.8 | 4.203 | 0.0% |
| 1750 | 3.6657 | 3.6700 | 3.6710 | 3.6695 | 3.6697 | 3.669 | 2.0 | 3.673 | 0.1% |
| 1500 | 3.1310 | 3.1318 | 3.1317 | 3.1316 | 3.1320 | 3.132 | 0.4 | 3.140 | 0.3% |
| 1250 | 2.6006 | 2.6011 | 2.6014 | 2.6026 | 2.6023 | 2.602 | 0.8 | 2.609 | 0.3% |
| 1000 | 2.0700 | 2.0706 | 2.0695 | 2.0687 | 2.0696 | 2.070 | 0.7 | 2.075 | 0.2% |
| 750 | 1.5436 | 1.5450 | 1.5450 | 1.5466 | 1.5465 | 1.545 | 1.2 | 1.548 | 0.2% |
| 500 | 1.0150 | 1.0150 | 1.0150 | 1.0150 | 1.0150 | 1.015 | 0.0 | 1.015 | 0.0% |
| 250 | 0.48082 | 0.48108 | 0.48340 | 0.48327 | 0.48351 | 0.482 | 1.3 | 0.483 | 0.0% |
| **SLOPE:** | **0.002135607** | | **INTERCEPT:** | **-0.068705011** | **CORRELATION COEFF (r ):** | | | **0.999983645** | |

Comments:

echnician: Dennis Weyburne 12/29/2020

(signature) Date

# TAPI T700 MFC CALIBRATION

**CALIBRATOR APPLICATION INFORMATION:**

| | | | | | |
|---|---|---|---|---|---|
| Calibrator Model/S/N: | TAPI T700; SN 69 | NETWORK: | Marathon Detroit PAMS | SITE: | MTMS |
| Calibration Site: | MTMS Site | Test Date: | 12/29/2020 | | |
| Barometric Pressure (Pa, in mmHg): | 731.0 | Calibrated by: | Dennis Weyburne | | |
| Flow Standard Model: | Mesa Labs Defender 530+ | Air Temp. (Ta, in deg. C): | 24.4 25.0 | (=deg. K): | 298.2 |
| Flow Standard Base S/N: | Not Applicable | Flow Cell Model No: | 530+ Low Flow | | |
| Base Certification Date: | Not Applicable | Flow Cell S/N: | 153435 | | |
| | | Flow Cell Certification Date: | 5/8/2020 | | |

Check One: _____ Air Channel **X** Gas Channel

| **(X)** MFC Drive Voltage (mVDC) | Flow Meter Readings (5 sets of 10 averaged flows) | | | | | Average Flow (F1...F5) (SLPM) | STD DEV F1...F5 (in *sccm*) | Flow Rate ***From Previous Cal*** (SLPM) | Δ% ("New Cal Flow" Vs "Prev. Cal Flow") |
|---|---|---|---|---|---|---|---|---|---|
| | $F_1$ (SLPM) | $F_2$ (SLPM) | $F_3$ (SLPM) | $F_4$ (SLPM) | $F_5$ (SLPM) | | | | |
| 5000 | 0.05390 | 0.05399 | 0.05399 | 0.05399 | 0.05399 | 0.0540 | 0.04 | 0.0540 | 0.0% |
| 4750 | 0.05139 | 0.05138 | 0.05136 | 0.05140 | 0.05141 | 0.0514 | 0.02 | 0.0514 | 0.0% |
| 4500 | 0.04866 | 0.04868 | 0.04867 | 0.04870 | 0.04866 | 0.0487 | 0.02 | 0.0487 | 0.1% |
| 4250 | 0.04596 | 0.04597 | 0.04598 | 0.04599 | 0.04599 | 0.0460 | 0.01 | 0.0459 | -0.1% |
| 4000 | 0.04325 | 0.04327 | 0.04327 | 0.04329 | 0.04330 | 0.0433 | 0.02 | 0.0432 | -0.1% |
| 3750 | 0.04059 | 0.04056 | 0.04058 | 0.04057 | 0.04051 | 0.0406 | 0.03 | 0.0406 | 0.1% |
| 3500 | 0.03791 | 0.03789 | 0.03790 | 0.03790 | 0.03791 | 0.0379 | 0.01 | 0.0380 | 0.3% |
| 3250 | 0.03522 | 0.03524 | 0.03524 | 0.03524 | 0.03524 | 0.0352 | 0.01 | 0.0353 | 0.3% |
| 3000 | 0.03259 | 0.03258 | 0.03258 | 0.03259 | 0.03259 | 0.0326 | 0.01 | 0.0327 | 0.2% |
| 2750 | 0.02990 | 0.02991 | 0.02992 | 0.02991 | 0.02993 | 0.0299 | 0.01 | 0.0300 | 0.3% |
| 2500 | 0.02724 | 0.02724 | 0.02725 | 0.02724 | 0.02724 | 0.0272 | 0.00 | 0.0274 | 0.5% |
| 2250 | 0.02462 | 0.02462 | 0.02463 | 0.02454 | 0.02460 | 0.0246 | 0.04 | 0.0247 | 0.3% |
| 2000 | 0.02190 | 0.02188 | 0.02189 | 0.02190 | 0.02191 | 0.0219 | 0.01 | 0.0220 | 0.3% |
| 1750 | 0.01917 | 0.01918 | 0.01918 | 0.01918 | 0.01918 | 0.0192 | 0.00 | 0.0193 | 0.4% |
| 1500 | 0.01644 | 0.01644 | 0.01643 | 0.01641 | 0.01643 | 0.0164 | 0.01 | 0.0165 | 0.6% |
| 1250 | 0.01370 | 0.01369 | 0.01369 | 0.01369 | 0.01369 | 0.0137 | 0.00 | 0.0138 | 0.6% |
| 1000 | 0.01098 | 0.01096 | 0.01097 | 0.01091 | 0.01092 | 0.0109 | 0.03 | 0.0110 | 0.5% |
| 750 | 0.00819 | 0.00818 | 0.00819 | 0.00818 | 0.00819 | 0.0082 | 0.01 | 0.0082 | 0.5% |
| 500 | 0.00536 | 0.00533 | 0.00535 | 0.00535 | 0.00538 | 0.0054 | 0.02 | 0.0054 | 1.0% |
| 250 | 0.00250 | 0.00250 | 0.00250 | 0.00250 | 0.00250 | 0.0025 | 0.00 | 0.0025 | 0.0% |
| **SLOPE: 0.000011** | | | **INTERCEPT: 0.0002130** | | | **CORRELATION COEFF (r ): 0.999980** | | | |

Comments:

Technician: Dennis Weyburne 12/29/20

(signature) Date

Airgas
an Air Liquide company

**Airgas Specialty Gases**
Airgas USA, LLC
12722 S. Wentworth Ave.
Chicago, IL 60628
Airgas.com

# CERTIFICATE OF ANALYSIS

## Grade of Product: TRACEABILITY STANDARD

| | | | |
|---|---|---|---|
| Part Number: | X02NI99T33W0004 | Reference Number: | 54-402006473-1 |
| Cylinder Number: | D068357 | Cylinder Volume: | 32.0 CF |
| Laboratory: | 124 - Chicago (SAP) - IL | Cylinder Pressure: | 2218 PSIG |
| | | Valve Outlet: | 660 |
| | | Certification Date: | Jan 26, 2021 |

**Expiration Date: Jan 26, 2024**

This cylinder has been analytically certified as directly traceable to NIST with a total analytical uncertainty as stated below with a confidence level of 95%, in accordance with Airgas ISO procedures. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder Below 100 psig.

### ANALYTICAL RESULTS

| Component | Requested Concentration | Actual Concentration | Total Relative Uncertainty |
|---|---|---|---|
| NITROGEN DIOXIDE | 30.00 PPM | 30.95 PPM | +/- 1% NIST Traceable |
| NITROGEN | Balance | | |

### CALIBRATION STANDARDS

| Type | Lot ID | Cylinder No | Concentration | Uncertainty | Expiration Date |
|---|---|---|---|---|---|
| GMIS | 401438584104 | EB0120492 | 48.18 PPM NITROGEN DIOXIDE/NITROGEN | +/- 1.8% | Nov 01, 2022 |

### ANALYTICAL EQUIPMENT

| Instrument/Make/Model | Analytical Principle | Last Multipoint Calibration |
|---|---|---|
| MKS FTIR NO2 017707558 | FTIR | Jan 07, 2021 |

**Triad Data Available Upon Request**

**PERMANENT NOTES:** OXYGEN ADDED TO MAINTAIN STABILITY

Approved for Release

GASCO AFFILIATES, LLC.

320 Scarlet Blvd.
Oldsmar, FL 34677
(800) 910-0051
fax: (866) 755-8920
www.gascogas.com

# CERTIFICATE OF ANALYSIS

**Date:** January 13, 2021
**Order Number:** 1199610
**Lot Number:** 304-402007938-1

**Customer:** Cal Gas Direct Inc.

**Use Before:** 01/13/2025

| Component | Requested Concentration | Analytical Result (+/- 2%) |
|---|---|---|
| Isobutylene | 1 PPM | 0.99 PPM |
| Air | Balance | Balance |

**Cylinder Size:** 1.2 Cu. Ft.
**Contents:** 34 Liter

**Valve:** CGA 600
**Pressure:** 500 psig

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/ or N.I.S.T. Gas Mixture reference materials.

**Analyst**:

Afton Eakins

Afton Eakins

GASCO AFFILIATES, LLC.

320 Scarlet Blvd.
Oldsmar, FL 34677
(800) 910-0051
fax: (866) 755-8920
www.gascogas.com

# CERTIFICATE OF ANALYSIS

**Date:** January 13, 2021
**Order Number:** 1199610
**Lot Number:** 304-402007939-1

**Customer:** Cal Gas Direct Inc.

**Use Before:** 01/13/2025

| Component | Requested Concentration | Analytical Result (+/- 2%) |
|---|---|---|
| Isobutylene | 3 PPM | 3.1 PPM |
| Air | Balance | Balance |

**Cylinder Size:** 1.2 Cu. Ft.
**Contents:** 34 Liter

**Valve:** CGA 600
**Pressure:** 500 psig

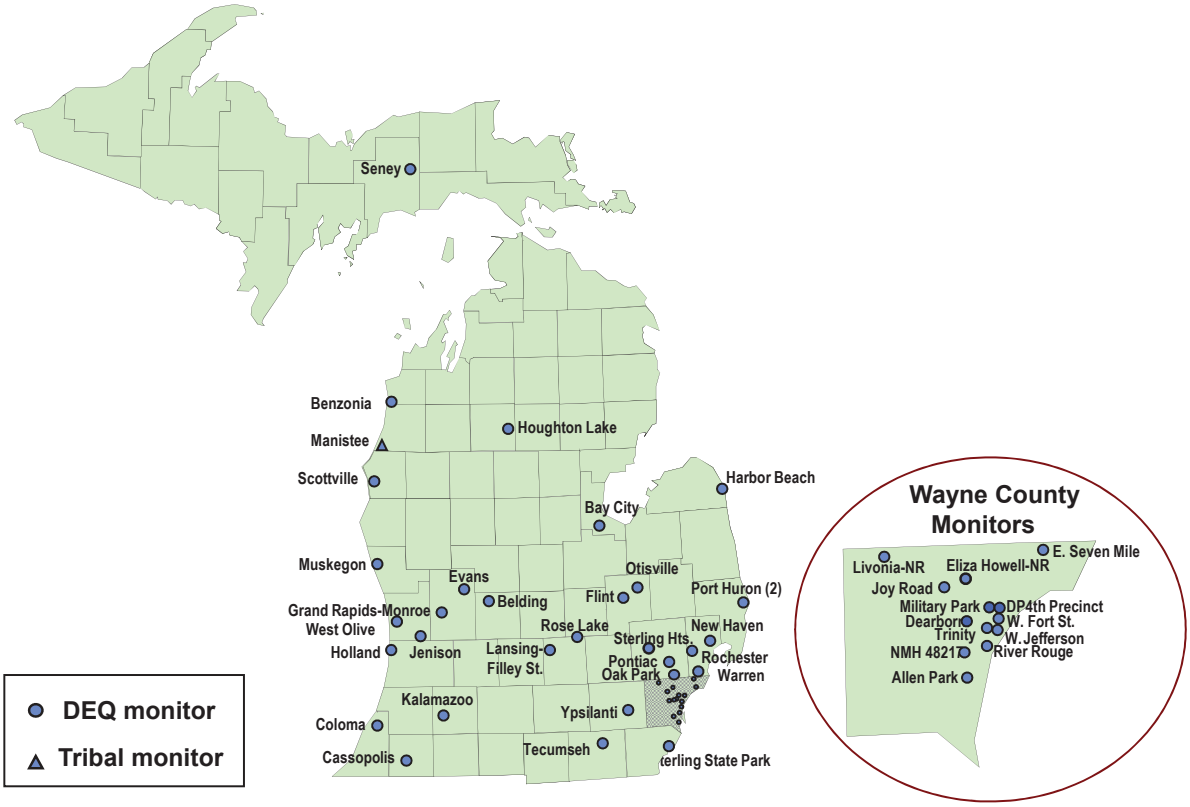
Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/ or N.I.S.T. Gas Mixture reference materials.

**Analyst**:

Clifton Eakins
Clifton Eakins

***C: State Monitor Map***

# Michigan Air Monitor Network




Updated June 2019