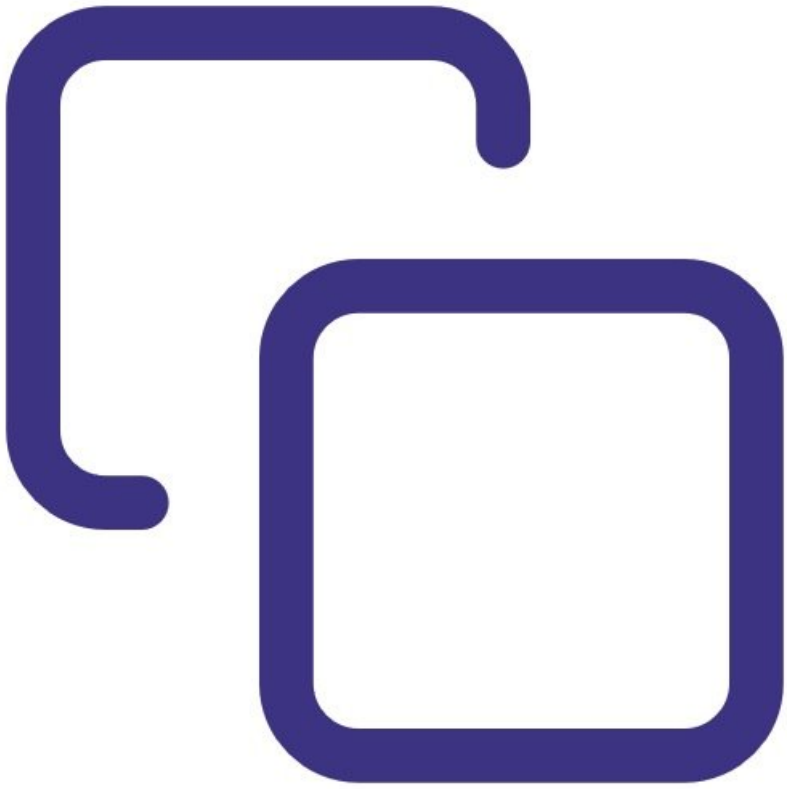
Perform co-location calibration

Written By: StJohn Vuetilovoni



INTRODUCTION

This is a standard operating procedure for calibrating your AQY 1.

Contact Technical Support if you'd like Aeroqual to do the NO_2 calibration calculation for you. The first calibration is free of charge for Aeroqual Plus customers.

To download the AQY 1 calibration template, click here.

Step 1 — Choose regulatory station

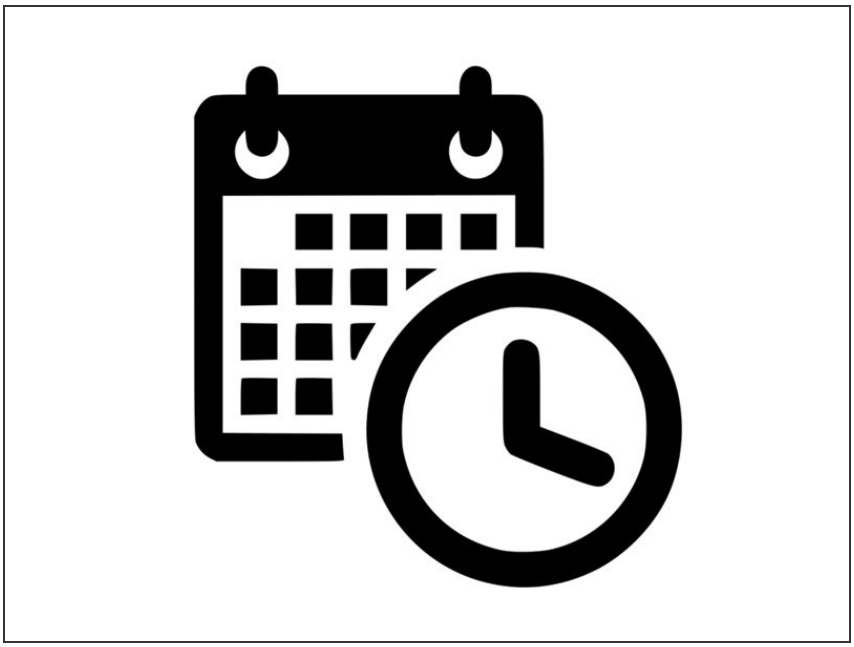
- The regulatory station should meet the following criteria:
  - It collects air quality data for all pollutants of interest (NO2, O3, PM2.5) and the data is available at 1 hour (or more frequent) average values.
  - The station has a secure and safe structure to mount the AQY 1 (e.g. roof railings).
  - There is mains power available for the AQY 1 at the station.
  - The pollutant concentrations (O3, NO2 and PM2.5) are expected to be reasonably high at the regulatory site for at least some of the days during the co-location. Ideally, there should be some hourly averaged values for O3 > 60 ppb, NO2 > 40 ppb and PM2.5 > 50 ug/m3.
  - If multiple stations are available, choose the one with environmental characteristics most similar to the project monitoring site of the AQY 1.

Step 2 — Co-locate monitors

- Install the AQY 1 on the regulatory station so the gas and PM inlets are as close as possible and at a similar height.
- Connect the power.
- If you're using Aeroqual Cloud, confirm the AQY 1 is connected and data is being logged.
- If you're not using Aeroqual Cloud, connect via Aeroqual Connect and confirm data is logging correctly.
- Confirm the date-time stamp of the AQY 1 matches the regulatory station.

ⓘ If you're calibrating multiple AQY 1 units, consider using an external 3G Wi-Fi router to connect all AQY 1 monitors to Aeroqual Cloud and save on data costs.

Step 3 — Collect data



- Leave the AQY 1 to run for a minimum of 3 days to collect enough data for a valid comparison.
- If pollutant data is low, you should extend the co-location interval.
- If the regulatory PM2.5 hourly averaged data is noisy, you may need to use 24 hour-averaged data and will need to co-locate for a considerably longer time, perhaps 2 weeks.
- If meteorological conditions are unusual during the co-location, such as the presence of fog, storms or wildfires, you should extend the co-location interval.

ⓘ The longer you can leave the AQY 1 at the co-location site the better, as more data will be collected, improving the accuracy of the calibration.

Step 4 — Prepare data

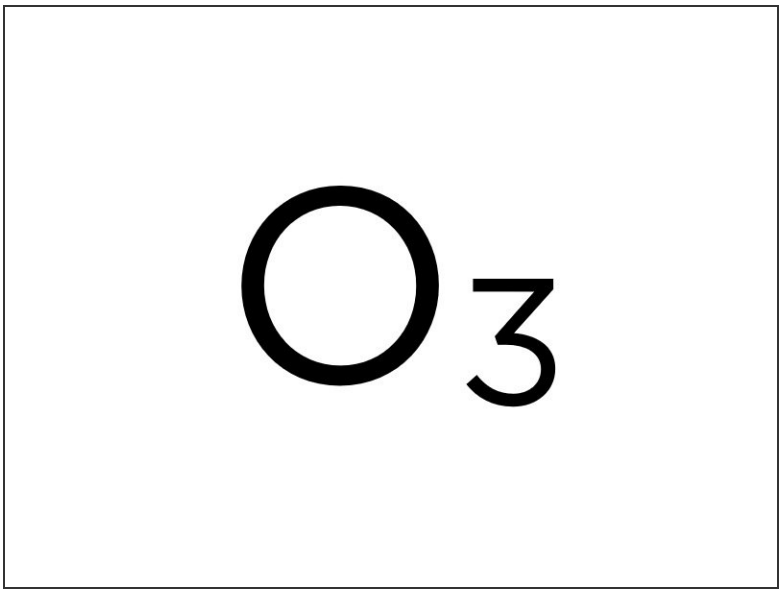
- Download the AQY 1 data and reference data and prepare the data for comparison by checking the following:
  - Ensure the date-time stamp for the reference station and the AQY 1 match. If not, make the required changes to align the AQY 1 data to the reference data.
  - Ensure the reference data and AQY 1 data are using the same units of measurement.
  - Check the reference data and remove any invalid data such as daily calibrations or maintenance.
  - Remove invalid data from the AQY 1 data, such as the warm-up period (first 4-6 hours of operation), any spikes or lost data from power issues.
  - You should have a pair of data sets which have the same number of data and are correctly synchronised.

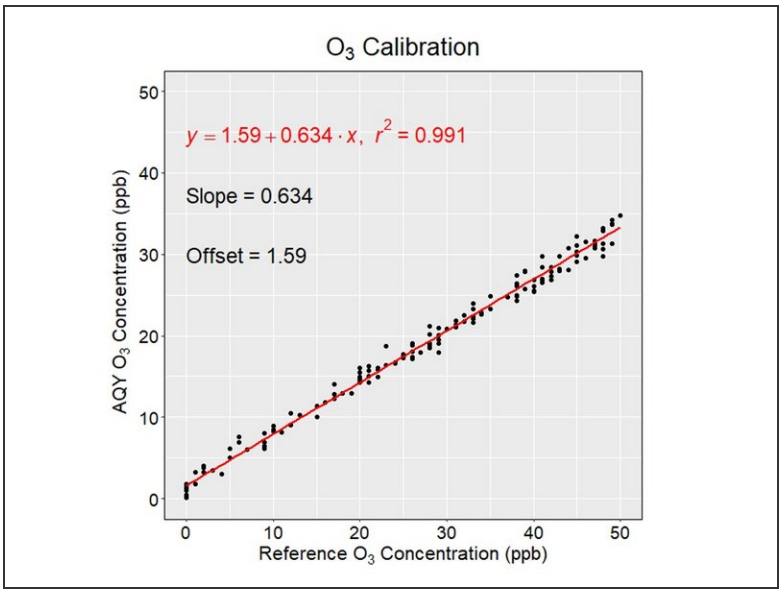
ⓘ The AQY 1 uses the calibration parameters *gain* and *offset* which are applied to the readings to produce an accurate concentration. The form of the equation on the monitor is: **[gas] = gain*(reading – offset)**.

Step 5 — Calibrate PM2.5

- Plot AQY 1 PM2.5 (y-axis) versus the regulatory PM2.5 (x-axis).
- Calculate the slope and intercept from a linear least squares fit to the data.
- Calculate the new AQY 1 gain and offset using the equations below:
  - **New gain = old gain/slope**
  - **New offset = old offset + (intercept/old gain)**

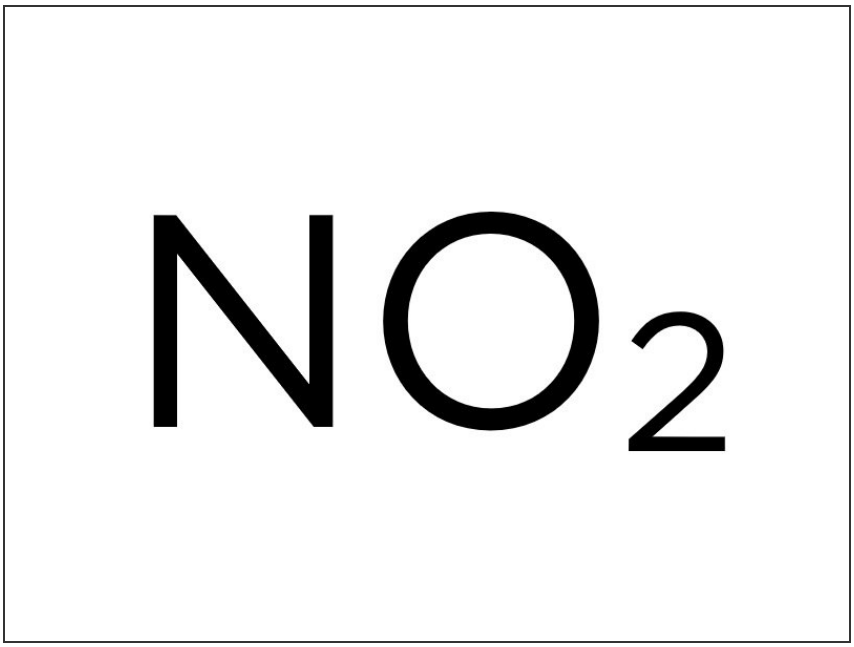
Step 6 — Calibrate O3





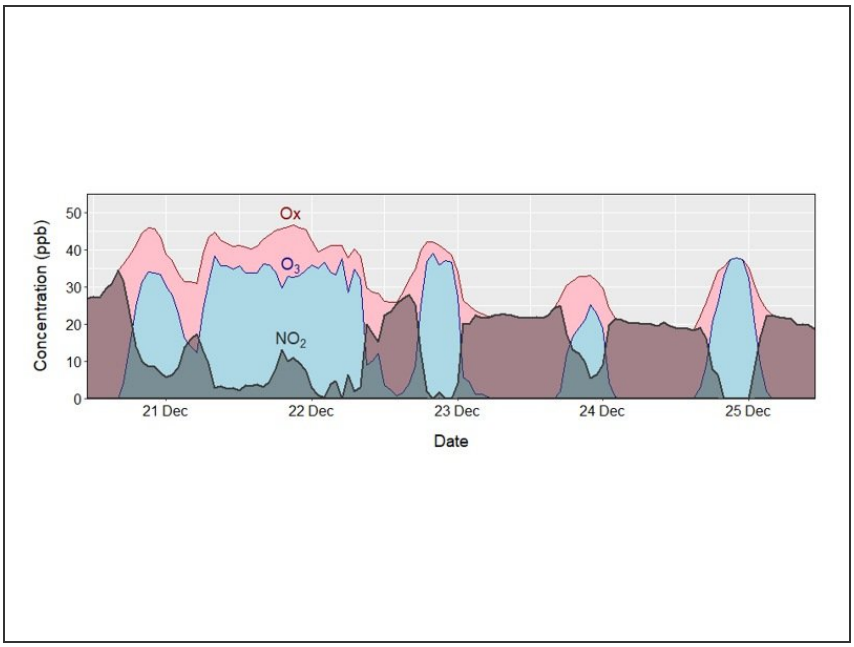
- Plot AQY 1 O3 (y-axis) versus the regulatory O3 (x-axis).
- Calculate the slope and intercept from a linear least squares fit to the data.
- Calculate the new AQY 1 gain and offset using the equations below:
  - **New gain = old gain/slope**
  - **New offset = old offset + (intercept/old gain)**
- The scatter-plot of ozone data shows a linear regression line with slope and intercept.

Step 7 — NO2 overview



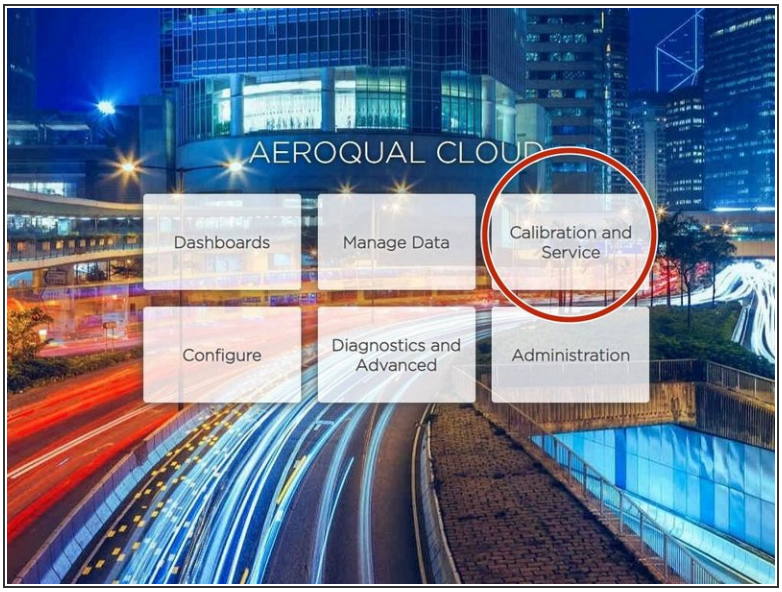
- The AQY 1 NO2 measurement uses two sensors to calculate the NO2 concentration: a GSE Ox sensor and a GSS O3 sensor.
- NO2 is calculated from the difference between the Ox and O3 sensors according to the equation **[NO2] = [Ox] – 1.1* [O3]**.
- The Ox and O3 sensor calibrations form part of the overall NO2 calibration and the sequence is important.
- Since Ox sensor data isn't reported by the AQY 1, it must first be determined by back-calculation.

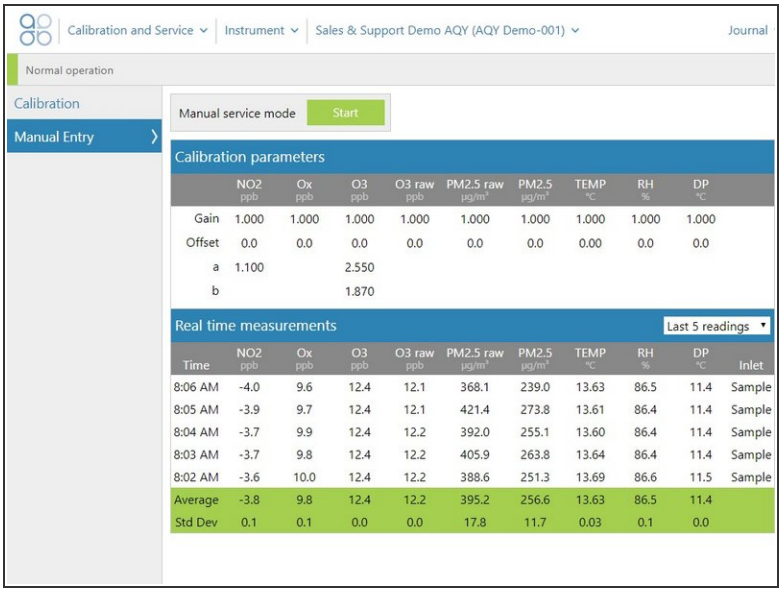
Step 8 — Calibrate NO2



- Back-calculate Ox using the equation: **AQY 1 NO2 + (1.1*AQY 1 O3)**.
- Calculate a new gain and offset for Ox using a linear least squares fit of **AQY 1 Ox vs Ref (NO2 + O3)**.
- Create calibrated Ox and O3 data (Oxcalibrated and O3calibrated) using the results of **AQY 1 Ox vs Ref (NO2 + O3)** and the **O3 slope and intercept**.
- Calculate a **NO2new** dataset using the calibrated Ox and O3 data where **NO2new = Oxcalibrated – 1.1*O3calibrated**.
- Undertake a linear least squares fit of **NO2new** to the reference NO2 to get slope and intercept for NO2.
- Calculate the new NO2 gain and offset using the equations: **New gain = old gain/slope** and **New offset = old offset + (intercept/old gain)**.
- The time series plot shows NO2 is the difference between Ox and O3.

Step 9 — Upload gain and offsets





- Upload new gains and offsets remotely via Aeroqual Cloud or onsite through Aeroqual Connect.
- Once they're uploaded, validate the calibration by continuing to run the AQY 1 at the regulatory station and collecting 2-3 days of data.
- Plot the scatterplots and confirm the slope and intercept of the linear regression line for each pollutant is close to 1 and 0, respectively. If they're significantly different, recheck your calculations.
- If you can't see any errors, it’s possible the monitor has drifted and you may need to repeat the calibration process.

Step 10 — Video of steps

- For extra help, watch our video.

For further support, contact Technical Support.