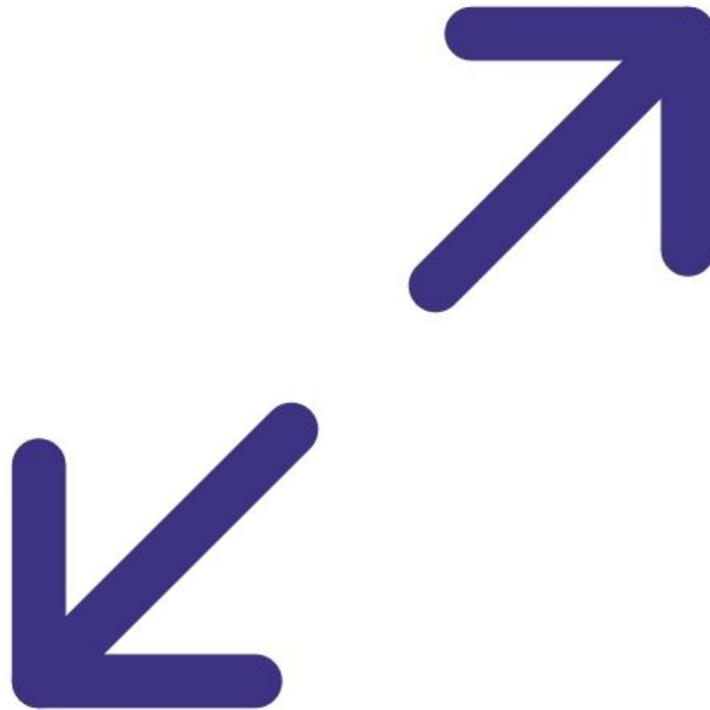




## 7. Perform span calibration (Ox/O3 for measuring NO2)

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## INTRODUCTION

Aeroqual monitors sold between May 2018 and November 2019 measure NO<sub>2</sub> using a combined O<sub>x</sub>/O<sub>3</sub> module system.

Before then, NO<sub>2</sub> was measured directly by its own large NO<sub>2</sub> module. In November 2019, Aeroqual returned to a single (but smaller) module for measuring NO<sub>2</sub> directly. These two NO<sub>2</sub> modules are span calibrated like you would any other gas.

If your monitor contains the O<sub>x</sub>/O<sub>3</sub> system, span calibration involves some extra steps. It includes the calculation of an **a** value, and relies on the modules being calibrated in the following order:

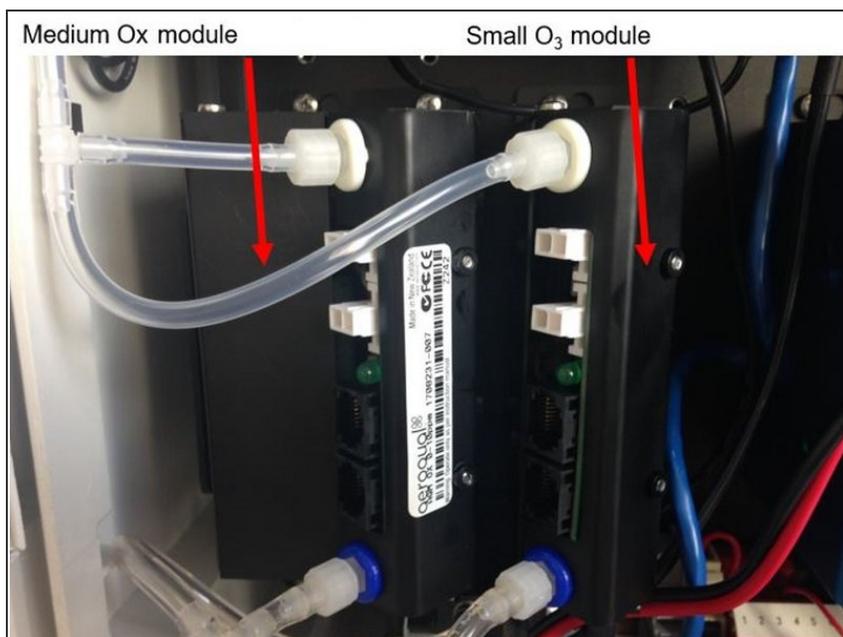
- O<sub>x</sub> gain (using NO<sub>2</sub> calibration gas)
- O<sub>3</sub> gain (using O<sub>3</sub> calibration gas)
- NO<sub>2</sub> **a** value (using O<sub>3</sub> calibration gas)
- All other modules

When an Ox module is fitted, NO<sub>2</sub> doesn't have a zero or gain adjustment. The NO<sub>2</sub> calibration (**a** adjustment) is performed during the ozone span gas delivery.

The **a** value should be checked and adjusted as part of your routine span calibration.

To understand how often you should perform this service activity, [click here](#).

## Step 1 — Ox and O3 system



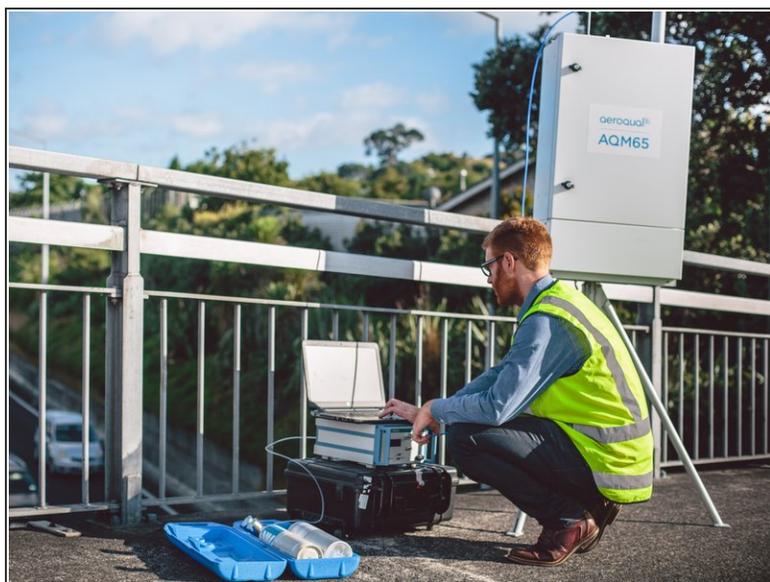
- Aeroqual monitors sold between May 2018 and November 2019 use the Ox and O3 modules to measure NO<sub>2</sub>.
- There are two ways to determine if you have an Ox module fitted:
  - Open the **Calibration and Service** app. If Ox appears in the parameters and there's data, it's installed. If there's no data, it may have been removed but not deleted from the sensor list.
  - Look for the physical module in the monitor. You can identify the gas type by checking the barcode label of the module – the code includes the monitor type, the gas type and a unique number sequence, eg. AQM Ox 0-10ppm 0000000-000.
- ⓘ This image shows the Ox and O3 modules side by side. Note: The power and communication cables have been removed for clarity.

## Step 2 — Record current a value

- Record the initial NO2 **a** value in the **Current a value** column of your calibration form.

| Module                            | Current gain | Current a value | Span point | Reading after stabilization 10-minute average | Target span acceptable range (ppm) 10-minute average | Acceptable standard deviation during span calibration 10-minute average | New gain | Minimum and maximum recommended gain (ppm) | New a value | Ratio of gain change | Gain uploaded | Reading after gain changed | Pass / fail |
|-----------------------------------|--------------|-----------------|------------|---|--|---|----------|--|-------------|----------------------|---------------|----------------------------|-------------|
| NO <sub>2</sub> (O <sub>2</sub> ) | 1.000        |                 |            |   | span ± 5 %   | 2 % of span   | N/A      |  |             |                      |               |                            |             |
| NO <sub>2</sub> (direct)          |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| NO <sub>x</sub>                   |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| O <sub>2</sub>                    |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| O <sub>3</sub>                    |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| CO                                |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| VOC                               |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| SO <sub>2</sub>                   |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| H <sub>2</sub> S                  |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| CO <sub>2</sub>                   |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| <b>Comments</b>                   |              |                 |            |   |  |   |          |  |             |                      |               |                            |             |

## Step 3 — Calibrate Ox module



- i** This guide assumes the AirCal 1000 is already connected to the gas inlet via a 3-way tee that's open (uncapped) on one side.

  - To calibrate the Ox module, start the NO<sub>2</sub> calibration gas flowing at your chosen span point. Aeroqual recommends 0.1 ppm.
  - [Follow steps 3-11 in this guide to complete a span calibration for Ox.](#)
- i** The NO<sub>2</sub> module should read 0.1 ppm during the 0.1 ppm Ox span calibration. It might may read slightly less than 0.1. This is normal so don't adjust the NO<sub>2</sub> gain.
- i** If the Ox module fails calibration, the NO<sub>2</sub> measurement can't be used but you can still calibrate the O<sub>3</sub> module.

## Step 4 — Calibrate O3 module



- To calibrate the O3 module, change the gas connection from the AirCal 1000 to the Ozone Calibration Source.
- [Follow the steps in this guide to complete a span calibration for O3.](#)
- ⓘ If the O3 module fails calibration, the NO2 measurement can't be used.

## Step 5 — Calculate NO2 a value

$$a = \text{Ox reading} / \text{O3 span concentration}$$

- During the O3 is calibration, the Ox module should show a response towards O3 calibration gas. Wait for the Ox values to stabilise towards O3.
- After the Ox values have stabilized, calculate the **a** value using the equation shown.
  - ⓘ The **a** value should be in the range 0.3 to 1.5.
- If your calculated a value falls outside this range, don't change the **a** value. For support, contact [Technical Support](#).

## Step 6 — Apply a value adjustment

| Module                            | Current gain | Current <i>a</i> value | Span point | Reading after stabilization 10-minute average | Target span acceptable range (ppm) 10-minute average | Acceptable standard deviation during span calibration 10-minute average | New gain | Minimum and maximum recommended gain (ppm) | New <i>a</i> value | Ratio of gain change | Gain uploaded | Reading after gain changed | Pass / fail |
|-----------------------------------|--------------|------------------------|------------|---|--|---|----------|--|--------------------|----------------------|---------------|----------------------------|-------------|
| NO <sub>2</sub> (O <sub>2</sub> ) | 1.000        |                        |            |   | span ± 5 %   | 2 % of span   | N/A      |  |                    |                      |               |                            |             |
| NO <sub>2</sub> (direct)          |              | N/A                    |            |   | span ± 5 %   | 2 % of span   |          |  | N/A                |                      |               |                            |             |
| NO <sub>x</sub>                   |              | N/A                    |            |   | span ± 5 %   | 2 % of span   |          |  | N/A                |                      |               |                            |             |
| O <sub>2</sub>                    |              | N/A                    |            |   | span ± 5 %   | 2 % of span   |          |  | N/A                |                      |               |                            |             |
| O <sub>3</sub>                    |              | N/A                    |            |   | span ± 5 %   | 2 % of span   |          |  | N/A                |                      |               |                            |             |
| CO                                |              | N/A                    |            |   | span ± 5 %   | 2 % of span   |          |  | N/A                |                      |               |                            |             |
| VOC                               |              | N/A                    |            |   | span ± 5 %   | 2 % of span   |          |  | N/A                |                      |               |                            |             |
| SO <sub>2</sub>                   |              | N/A                    |            |   | span ± 5 %   | 2 % of span   |          |  | N/A                |                      |               |                            |             |
| H <sub>2</sub> S                  |              | N/A                    |            |   | span ± 5 %   | 2 % of span   |          |  | N/A                |                      |               |                            |             |
| CO <sub>2</sub>                   |              | N/A                    |            |   | span ± 5 %   | 2 % of span   |          |  | N/A                |                      |               |                            |             |
| Comments                          |              |                        |            |   |  |   |          |  |                    |                      |               |                            |             |

External calibration run in progress | 68 minutes remaining

Calibration

Manual Entry >

| Calibration parameters |                      |                    |                    |                                     |
|------------------------|----------------------|--------------------|--------------------|-------------------------------------|
|                        | cNO <sub>2</sub> ppm | O <sub>x</sub> ppm | O <sub>3</sub> ppm | PM <sub>2.5</sub> µg/m <sup>3</sup> |
| Gain                   | 1.000                | 1.015              | 1.105              | 1.000                               |
| Offset                 | 0.000                | 0.001              | 0.002              | 0.00                                |
| <i>a</i>               | 0.890                |                    |                    |                                     |

Save changes?

| Real time measurements |                      |                    |                    |                                     | Last 5 readings ▼ |
|------------------------|----------------------|--------------------|--------------------|-------------------------------------|-------------------|
| Time                   | cNO <sub>2</sub> ppm | O <sub>x</sub> ppm | O <sub>3</sub> ppm | PM <sub>2.5</sub> µg/m <sup>3</sup> | Inlet             |
| 1:15 pm                | 0.038                | 0.090              | 0.102              | 1.18                                | Sample            |
| 1:14 pm                | 0.037                | 0.089              | 0.102              | 0.23                                | Sample            |
| 1:13 pm                | 0.037                | 0.089              | 0.101              | 2.02                                | Sample            |
| 1:12 pm                | 0.037                | 0.089              | 0.101              | 1.14                                | Sample            |
| 1:11 pm                | 0.037                | 0.089              | 0.101              | 0.58                                | Sample            |
| Average                | 0.037                | 0.089              | 0.102              | 1.03                                |                   |
| Std Dev                | 0.000                | 0.001              | 0.000              | 0.61                                |                   |

- Record the new *a* value in the **New *a* value** column.
  - Upload the new *a* value for NO<sub>2</sub> in the **Manual Entry** area of the **Calibration and Service** screen.
- ☞ Only the *a* value is set for NO<sub>2</sub>. The offset should be left at 0.000 and the gain should be left at 1.000.

## Step 7 — Purge gas lines

| Module                            | Current gain | Current a value | Span point | Reading after stabilization 10-minute average | Target span acceptable range (ppm) 10-minute average | Acceptable standard deviation during span calibration 10-minute average | New gain | Minimum and maximum recommended gain (ppm) | New a value | Ratio of gain change | Gain uploaded | Reading after gain changed | Pass / fail |
|-----------------------------------|--------------|-----------------|------------|---|--|---|----------|--|-------------|----------------------|---------------|----------------------------|-------------|
| NO <sub>2</sub> (O <sub>2</sub> ) | 1.000        |                 |            |   | span ± 5 %   | 2 % of span   | N/A      |  |             |                      |               |                            |             |
| NO <sub>2</sub> (direct)          |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| NO <sub>x</sub>                   |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| O <sub>2</sub>                    |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| O <sub>3</sub>                    |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| CO                                |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| VOC                               |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| SO <sub>2</sub>                   |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| H <sub>2</sub> S                  |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| CO <sub>2</sub>                   |              | N/A             |            |   | span ± 5 %   | 2 % of span   |          |  | N/A         |                      |               |                            |             |
| Comments                          |              |                 |            |   |  |   |          |  |             |                      |               |                            |             |

- After you've uploaded the Ox gain, O3 gain and NO<sub>2</sub> **a** value, record the current NO<sub>2</sub> readings in the **Reading after gain changed** column.
- Don't adjust any calibration settings for the NO<sub>2</sub> channel.
- Disconnect the Ozone Calibration Source from your monitor and connect the AirCal 1000 calibrator.
- Remove the cap from the other side of the tee.
- Flow zero air for 10 minutes to purge (clean) the gas lines.

## Step 8 — Video of steps



- For extra help, watch our video.

For further support, contact [Technical Support](#).