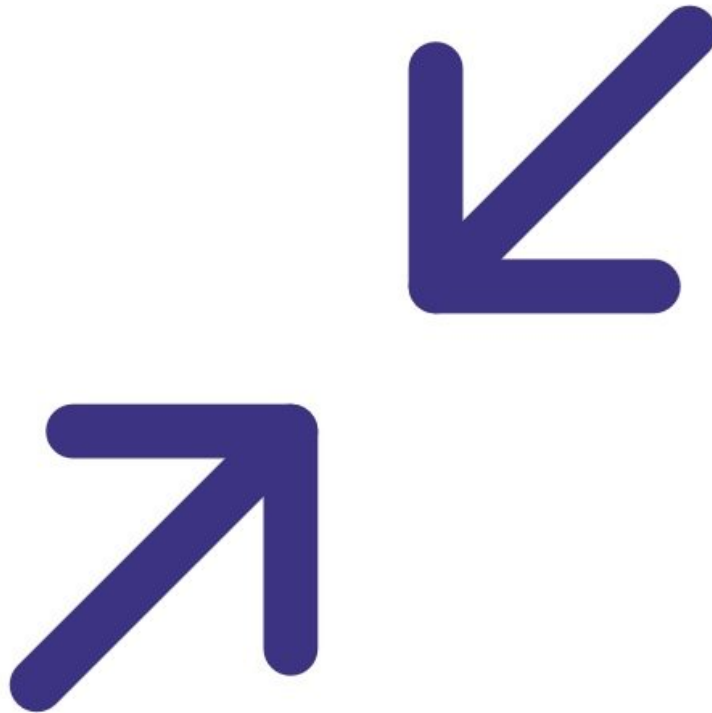




3. Perform zero calibration (all modules except CO2)

Written By: Tanya Taylor



INTRODUCTION

Zero calibration can be performed on all gas modules simultaneously because all gas modules are sampling the same zero air source. The exception is CO₂ which is zero calibrated separately.

It takes approximately 30 to 40 minutes for all of the modules to stabilize towards zero air, after which all offsets can be changed quickly, one after the other, and in any order, using either the **Manual Entry** or the **Calibration** areas of the **Calibration and Service** app.

If you have an AQS 1, use this procedure to zero calibrate your O₃, NO₂, CO and VOC gas modules. If you have an AQM 65, use it to zero calibrate your O₃, NO₂, NO_x, SO₂, CO, H₂S and VOC gas modules.

If your monitor uses the O_x/O₃ system to measure NO₂, you can also use this guide to zero calibrate your Ox module.

Gas modules must be zero calibrated using zero air. N₂ can't be used.

We recommend you leave any failed modules running in the monitor throughout the zero and span calibration process. After you've calibrated the remaining modules, you can open the door to the monitor and remove the failed modules for inspection.

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



TOOLS:

- [Adjustable spanner](#) (1)



PARTS:


- [AirCal 1000 portable calibrator](#) (1)


Step 1 — Turn on calibrator

Table 7: Zero calibration results

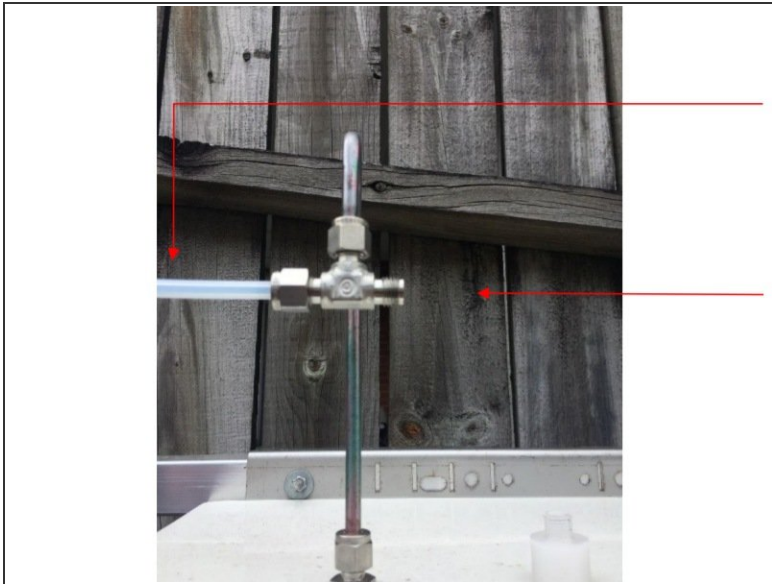
Module	Current offset	Reading after stabilization 10-minute average	Target zero acceptable range (ppm) 10-minute average	Acceptable standard deviation during zero calibration 10-minute average	New offset	Minimum and maximum recommended offset (ppm)	Offset uploaded	Reading after offset changed	Pass / fail
NO ₂ (O ₂)	0.000		0.000 ± 0.005	0.002	N/A	N/A	N/A	N/A	
NO ₂ (direct)			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
NO _x			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₂			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₃			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO			0.000 ± 0.050	0.020		Max +0.05 Min -0.05			
VOC low			0.000 ± 0.010	0.005		Max +0.05 Min -0.05			
VOC high			0.000 ± 0.100	0.020		Max +0.05 Min -0.05			
SO ₂			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
H ₂ S			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO ₂			0.000 ± 10.000	5.000		Max +0.05 Min -0.05			
Comments									

- If you haven't already done so, turn on the AirCal 1000 and switch on the pump override switch on the back panel for at least 30 mins before starting the calibration. (The AirCal 1000 takes time to warm up and become stable).

 The pump inside the calibrator draws ambient air in through the zero air inlet on the back. The ambient air passes through scrubbers to produce 'zero air'.

- As the monitor is warming up, record the current offsets for each of your gas modules in the **Current offset** column in table 7 of the calibration form.
-  If an O_x module is fitted, NO₂ doesn't have a zero offset adjustment.

Step 2 — Connect calibrator



- Remove the Kynar fitting (inlet mesh filter) from the monitor's gas inlet.
- Connect the 3-way tee to the inlet.
- Use the flow assembly that came with your AirCal 1000 ($\frac{1}{4}$ OD PTFE tubing and compression fitting) to connect the outlet on the front of the AirCal 1000 to one side the tee.
- Leave the other side uncapped.
- ❗ With the calibrator connected, you should notice excess zero air flowing out the open side of the tee.
- Double-check the connections are safe and secure.
- ❗ The AirCal 1000 isn't IP rated, so you need to take care when operating outdoors.

Step 3 — Determine stability

Real time measurements							Last 10 readings		
Time	CO ppm	NO2 ppm	NOx ppm	O3 ppm	SO2 ppm	PID ppm			
10:45 p.m.	0.404	-0.003	-0.011	0.001	0.085	0.801			
10:44 p.m.	0.404	-0.003	-0.012	0.002	0.061	0.793			
10:43 p.m.	0.403	-0.002	-0.011	0.001	0.103	0.803			
10:42 p.m.	0.402	-0.002	-0.010	0.002	0.067	0.791			
10:41 p.m.	0.402	0.000	-0.012	0.001	0.089	0.808			
10:40 p.m.	0.401	0.001	-0.011	0.001	0.102	0.802			
10:39 p.m.	0.338	0.002	-0.010	0.002	0.071	0.796			
10:38 p.m.	0.336	0.003	-0.012	0.001	0.101	0.800			
10:37 p.m.	0.336	0.003	-0.011	0.001	0.065	0.795			
10:36 p.m.	0.335	0.004	-0.010	0.002	0.106	0.800			
10:35 p.m.	0.333	0.005	-0.011	0.001	0.068	0.792			
Average	0.372	0.001	-0.011	0.001	0.083	0.798			
Std Dev	0.035	0.003	0.001	0.001	0.018	0.005			

Table 7: Zero calibration results									
Module	Current offset	Reading after stabilization 10-minute average	Target zero acceptable range (ppm) 10-minute average	Acceptable standard deviation during zero calibration 10-minute average	New offset	Minimum and maximum recommended offset (ppm)	Offset uploaded	Reading after offset changed	Pass / fail
NO ₂ (O ₂)	0.000		0.000 ± 0.005	0.002	N/A	N/A	N/A	N/A	
NO ₂ (direct)			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
NO _x			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₂			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₃			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO			0.000 ± 0.050	0.020		Max +0.05 Min -0.05			
VOC low			0.000 ± 0.010	0.005		Max +0.05 Min -0.05			
VOC high			0.000 ± 0.100	0.020		Max +0.05 Min -0.05			
SO ₂			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
H ₂ S			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO ₂			0.000 ± 10.000	5.000		Max +0.05 Min -0.05			
Comments									

- Wait 30 to 40 minutes for the module readings to stabilize towards zero air.
- To determine if stabilization is successful:
 - Look at the standard deviation over a ten-minute period in the **Manual Entry** (shown) or **Calibration** areas of the **Calibration and Service** app.
 - See if they fall within the acceptable range listed in the **Acceptable standard deviation during zero calibration** column of your calibration form.
- To be stable, the readings mustn't be increasing or decreasing and within acceptable range.
- If the values don't stabilize, write *fail* in the **Pass / fail** column and move on to next module.

Step 4 — Determine need for adjustment

Table 7: Zero calibration results

Module	Current offset	Reading after stabilization 10-minute average	Target zero acceptable range (ppm) 10-minute average	Acceptable standard deviation during zero calibration 10-minute average	New offset	Minimum and maximum recommended offset (ppm)	Offset uploaded	Reading after offset changed	Pass / fail
NO ₂ (O ₂)	0.000		0.000 ± 0.005	0.002	N/A	N/A	N/A	N/A	
NO ₂ (direct)			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
NO _x			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₂			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₃			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO			0.000 ± 0.050	0.020		Max +0.05 Min -0.05			
VOC low			0.000 ± 0.010	0.005		Max +0.05 Min -0.05			
VOC high			0.000 ± 0.100	0.020		Max +0.05 Min -0.05			
SO ₂			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
H ₂ S			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO ₂			0.000 ± 10.000	5.000		Max +0.05 Min -0.05			
Comments									

- Record the stabilized reading from the 10-minute average in the **Reading after stabilization** column.
- If the stabilized value is within the accepted range (see **Target zero acceptable range** column), no offset adjustment is required. Write *pass* in the **Pass / fail** column and move on to next module.
- If the stabilized value is outside the accepted range, you need to make an offset adjustment.

Step 5 — Manually calculate offset

$$\text{New offset} = \text{current offset} + (\text{gas reading} / \text{gain})$$

Module	Current offset	Reading after stabilization 10-minute average	Target zero acceptable range (ppm) 10-minute average	Acceptable standard deviation during zero calibration 10-minute average	New offset	Minimum and maximum recommended offset (ppm)	Offset uploaded	Reading after offset changed	Pass / fail
NO ₂ (O ₂)	0.000		0.000 ± 0.005	0.002	N/A	N/A	N/A	N/A	
NO ₂ (direct)			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
NO _x			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₂			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₃			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO			0.000 ± 0.050	0.020		Max +0.05 Min -0.05			
VOC low			0.000 ± 0.010	0.005		Max +0.05 Min -0.05			
VOC high			0.000 ± 0.100	0.020		Max +0.05 Min -0.05			
SO ₂			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
H ₂ S			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO ₂			0.000 ± 10.000	5.000		Max +0.05 Min -0.05			
Comments									

- If you're using the **Manual Entry** area to upload offset adjustments, you need to calculate your new offset using the equation shown.
- To make the calculation, you need to know the module's:
 - Current offset
 - Current gain
 - 10-minute average reading.
- Record the calculated offset in the **New offset** column.

Step 6 — Automatically calculate offset

start calibration run

previous calibrations

Offset Gain

Current offset: 0.0 New offset: -4.7 New offset = (current reading / current gain) + current offset

Recommend Apply

Time	Current	Average	Std Dev
2:21:00 PM	-4.7	-4.7	0.7
2:20:00 PM	-4.3	-4.7	0.7
2:19:00 PM	-5.6	-4.7	0.7
2:18:00 PM	-5.7	-4.7	0.7
2:17:00 PM	-3.8	-4.8	0.8
2:16:00 PM	-3.8	-4.9	0.8
2:15:00 PM	-4.0	-5.0	0.7
2:14:00 PM	-4.7	-5.0	0.7
2:13:00 PM	-5.1	-5.0	0.7
2:12:00 PM	-5.2	-4.8	0.9

Table 7: Zero calibration results

Module	Current offset	Reading after stabilization 10-minute average	Target zero acceptable range (ppm) 10-minute average	Acceptable standard deviation during zero calibration 10-minute average	New offset	Minimum and maximum recommended offset (ppm)	Offset uploaded	Reading after offset changed	Pass / fail
NO ₂ (O ₂)	0.000		0.000 ± 0.005	0.002	N/A	N/A	N/A	N/A	
NO ₂ (direct)			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
NO _x			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₂			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₃			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO			0.000 ± 0.050	0.020		Max +0.05 Min -0.05			
VOC low			0.000 ± 0.010	0.005		Max +0.05 Min -0.05			
VOC high			0.000 ± 0.100	0.020		Max +0.05 Min -0.05			
SO ₂			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
H ₂ S			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO ₂			0.000 ± 10.000	5.000		Max +0.05 Min -0.05			
Comments									

- If you're using the **Calibration** area to upload offset adjustments, select the correct gas channel and click the **Recommend** button to calculate the offset for your selected gas.
- Record the calculated offset in the **New offset** column.
- To learn more about the functionality in the **Calibration** area, [go here](#).

Step 7 — Apply offset adjustment

Table 7: Zero calibration results

Module	Current offset	Reading after stabilization 10-minute average	Target zero acceptable range (ppm) 10-minute average	Acceptable standard deviation during zero calibration 10-minute average	New offset	Minimum and maximum recommended offset (ppm)	Offset uploaded	Reading after offset changed	Pass / fail
NOx(O ₃)	0.000		0.000 ± 0.005	0.002	N/A	N/A	N/A	N/A	
NOx(direct)			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
NO _x			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₃			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₃			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO			0.000 ± 0.050	0.020		Max +0.05 Min -0.05			
VOC low			0.000 ± 0.010	0.005		Max +0.05 Min -0.05			
VOC high			0.000 ± 0.100	0.020		Max +0.05 Min -0.05			
SO ₂			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
H ₂ S			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO ₂			0.000 ± 0.000	0.000		Max +0.05 Min -0.05			
Comments									

Calibration parameters

	NO ₂ ppb	O ₃ ppb	O ₃ ppb	O ₃ raw ppb	PM _{2.5} raw µg/m ³	PM _{2.5} µg/m ³	TEMP °C	RH %	Pass / fail
Gain	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Offset	-5.4	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0
a	1.100			2.550					
b				1.870					

Save changes?

Real time measurements Last 1

Time	NO ₂ ppb	O ₃ ppb	O ₃ ppb	O ₃ raw ppb	PM _{2.5} raw µg/m ³	PM _{2.5} µg/m ³	TEMP °C	RH %	Pass / fail
1:29 p.m.	3.5	27.4	30.0	28.4	0.7	0.7	17.60	46.6	6
1:28 p.m.	4.0	28.3	30.1	28.4	0.6	0.6	17.60	46.9	6
1:27 p.m.	3.6	27.5	30.1	28.4	0.6	0.5	17.44	47.0	6
1:26 p.m.	2.6	26.4	30.4	28.2	0.7	0.7	17.39	46.6	5
1:25 p.m.	2.5	26.2	30.2	28.3	0.8	0.7	17.33	46.9	5

Start calibration run **Offset** **Gain**

Current offset: 0.0 New offset: -4.7 New offset = (current reading / current gain) + current offset

Previous calibrations

Time	Current	Average	Std
2:21:00 PM	-4.7	-4.7	
2:20:00 PM	-4.3	-4.7	
2:19:00 PM	-5.6	-4.7	
2:18:00 PM	-5.7	-4.7	
2:17:00 PM	-3.8	-4.8	
2:16:00 PM	-3.8	-4.9	
2:15:00 PM	-4.0	-5.0	
2:14:00 PM	-4.7	-5.0	
2:13:00 PM	-5.1	-5.0	
2:12:00 PM	-5.2	-4.8	

Gas modules can be offset adjusted in any order.

- If the new offset is within the accepted range (see the **Minimum and maximum recommended offset** column), you can upload your new offset.
- If you're using the **Manual Entry** area, click the appropriate cell, type in the new value and click **Save**.
- If you're using the **Calibration** area, simply click the **Apply** button.
- It might take several minutes for the offset to be applied and to see the changed readings.
- If the new offset is outside the accepted range, don't upload the offset. Write *fail* in the **Pass / fail** column and move on to next module.

Step 8 — Record applied offset

Table 7: Zero calibration results

Module	Current offset	Reading after stabilization 10-minute average	Target zero acceptable range (ppm) 10-minute average	Acceptable standard deviation during zero calibration 10-minute average	New offset	Minimum and maximum recommended offset (ppm)	Offset uploaded	Reading after offset changed	Pass / fail
NO ₂ (O ₂)	0.000		0.000 ± 0.005	0.002	N/A	N/A	N/A	N/A	
NO ₂ (direct)			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
NO _x			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O _x			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
O ₃			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO			0.000 ± 0.050	0.020		Max +0.05 Min -0.05			
VOC low			0.000 ± 0.010	0.005		Max +0.05 Min -0.05			
VOC high			0.000 ± 0.100	0.020		Max +0.05 Min -0.05			
SO ₂			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
H ₂ S			0.000 ± 0.005	0.002		Max +0.05 Min -0.05			
CO ₂			0.000 ± 10.000	5.000		Max +0.05 Min -0.05			
Comments									

- Record the offset you uploaded in the **Offset uploaded** column.
- Wait 2 or 3 minutes then record the current reading in the **Reading after offset changed** column.
- Confirm the reading is within acceptable limits. If yes, write *pass* in the **Pass / fail** column. If not, write *fail*.
- Move on to next module.

Step 9 — Journal records



- There may be times when either the module doesn't stabilize, or a very large positive or negative offset is calculated. Make a note of this in the journal and then carry on with the rest of the zero calibration. Don't open the door to check the module because this causes temperature instability.

- ① The journal automatically records any changes you apply to the offset so you don't need to make any manual entries.

Step 10 — Calibrating multiple monitors



- The outlet flow rate of the AirCal 1000 is fixed at approximately 2.5 LPM which means you can use it to calibrate more than one monitor simultaneously.
- In this scenario, connect the flow assembly for the second monitor to the open end of the inlet tee. Repeat this, making sure the last monitor in the chain has an open tee.
- ① You need to know the total inlet flow rate for your chain. You should still see excess zero air flowing out the open side of the last tee.

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