AQMesh

User manual

Environmental Instruments Ltd
Unit 5 The Mansley Centre
Timothy's Bridge Road
Stratford-upon-Avon
Warwickshire
CV37 9NQ

Tel: +44 (0)1789 777703
Email: support@aqmesh.com
Website: www.aqmesh.com

Table of contents

1 Document guidelines

1.1 Introduction

AQMesh has been designed to offer a robust and easy-to-use air quality monitoring platform, including data processing algorithms that can deliver near real-time air quality readings in all environmental conditions anywhere, at any time.

Pods are simple to install in their location and to power on and connect to the AQMesh server; technical staff are not required.

Readings cannot be downloaded directly from the pod itself. The raw signals from the AQMesh sensors are transmitted to the secure AQMesh server for data processing, which includes carefully developed compensation for cross-gas effects and environmental factors.

This document aims to provide the necessary information for the user to successfully install their AQMesh pods and achieve the best possible results.

1.2 Hyperlinks

Hyperlinks to other sections of this manual, websites or email addresses are in the following format:

www.aqmesh.com

1.3 Notes

Important/useful information and instructions are shown clearly throughout the manual in the note format below:

> ✍ *Note: For further information please contact AQMesh technical support by emailing support@aqmesh.com or contacting your distributor*

1.4 Safety information

Information in this manual that may affect the safety of users and others is preceded by the following symbol:

⚠ Warning

Failure to follow this information may result in physical injury, which in some cases could be fatal.

> ✍ *Note: Whilst robust in design the monitor is a sensitive piece of scientific equipment and should be treated as such.*

2 Product safety information

2.1 Safety information

Warning ⚠	The AQMesh pods have a back-plate that covers any accessible components which may cause electric shocks or burns. This plate must only be removed when power to the system has been removed. Failure to isolate the supply could result in an electric shock or burns. It is the responsibility of the owner of this equipment to complete a risk assessment on its installation, operation, and maintenance prior to it being used.

Only suitably trained personnel should carry out the installation in accordance with the relevant applicable codes of practice.

Repair and maintenance of this equipment should be carried out in accordance with the relevant applicable codes of practice by trained personnel.

Only the manufacturers approved components are to be used as replacement parts.

If the equipment is likely to be exposed to aggressive substances, e.g. acidic liquids, gases that may attack metals or solvents that may affect polymeric materials, then it is the responsibility of the user to take suitable precautions.

⚠ Warning	When opening the AQMesh pod great care must be taken by the operator. It is the responsibility of the owner of the equipment to ensure that all personnel are adequately trained. The equipment should not be altered in any way other than described within this operating manual. Alterations or changes outside of this operating manual could make the equipment unsafe.

	It is vital that the instructions in this operating manual are followed closely. Failure to comply could cause an injury to the operator.

2.2 Range of environmental conditions

AQMesh pods are tested for use in ambient temperatures in the range of -20°C to +50°C. The AQMesh pods are designed for use outdoors and have an IP65 rating.

2.3 Safety symbols used

The following safety symbols may be used on the AQMesh pods:

	Protective conductor terminal
	Caution, risk of electric shock
	Caution, refer to operation manual.
	Class 2 laser, risk of blindness.

Warning	Where the symbol ⚠ or  is used on the product, the operating manual must be consulted.

General product label symbols are listed as follows:

CE	CE conformity-The CE-marking is the manufacturer's statement to the UK/EU authorities that the product complies with all relevant CE-marking Directives.		Separate collection, handling and disposal for waste electrical and electronic equipment and its components.
	VDE mark is a symbol for electrical, mechanical, thermal, toxic, radiological and other hazards.		Refer to operators manual.
	Double insulated construction - does not require an Earth.		Equipment for indoor use only.

2.4 Power options

AQMesh pods can be supplied with a number of different power options, specified at time of manufacture.

Power options	⚠ Warning
Internal primary Lithium battery pack. (AQM-BATTERY). Output : 3.6V ⎓ 76Ah, 273.6Wh.	Contains Lithium Thionyl chloride Batteries. Do not use if damaged. Fire, explosion hazard if used incorrectly. Do not recharge, disassemble, heat above 100degC, incinerate or expose contents to water. Please do not return if faulty. Dispose of according to local regulations.
Internal rechargeable NiMH Battery pack. (AQM-RECHARGE) Output : 3.6V ⎓ 9Ah, 32.4Wh.	Contains NiMH Batteries. Do not use if damaged. Fire, explosion hazard if used incorrectly. Please do not return if faulty. Dispose of according to local regulations. Recharge indoors in an open area on a fire-resistant surface using the manufacturer supplied charger (part no.) only.
External manufacturer battery pack (Option only available at time of manufacture) Output : 3.6V ⎓ 456Ah, 1641Wh 3.6V⎓ 200mA. ⎓	Contains Lithium Thionyl chloride Batteries. Do not use if damaged. Fire, explosion hazard if used incorrectly. Do not recharge, disassemble, heat above 100degC, incinerate or expose contents to water. Please do not return if faulty.

	Dispose of according to local regulations.
External DC power (Option only available at time of manufacture) Input: 9-25V ⎓ 130mA @9V ⎓ Solar panel assembly (Option only available at time of manufacture) Input: 12V ⎓ 100mA @12V ⎓	⚠ Danger risk of electric shock No user serviceable parts. Do not open. AQMesh pods are supplied with 1.5M of arctic grade 2-core electrical cable which should be trimmed and terminated in a suitable junction box. ⚠ Danger risk of electric shock and hot surfaces No user serviceable parts. Do not open. AQMesh pods are supplied with 1.5M of arctic grade 2-core electrical cable with military style connectors for connecting the pod and solar panel. Extension leads are available AQM-EXT.

2.5 Safely shipping pods

If fitted with an internal lithium battery pack, specified at time of manufacture, AQMesh pods are considered class 9 dangerous goods. It is therefore not possible to ship these AQMesh pods via a normal courier service, or travel with them on any commercial flight, unless you remove the lithium battery pack first.

> ✍ *Note: The transportation of dangerous goods is controlled and governed by a variety of different regulatory regimes, operating at both the national and international levels. Collectively, these regulatory regimes mandate the means by which dangerous goods are to be handled, packaged, labelled and transported.*

If you are sending pods fitted with lithium batteries to a new location they must be packaged accordingly for class 9 dangerous goods and sent via a dangerous goods carrier with all relevant paperwork and notifications.

AQMesh pods which are not fitted with the lithium battery pack can be shipped via any normal courier service.

3 Handling & maintenance advice

⚠ Warning	Never pick up the pod by the antenna.

3.1 Storage

When not in use the AQMesh pods should be kept in a clean, dry and ambient temperature environment, such as an office. It should be stored upright on its base, which helps prolong the life of the sensors.

3.2 Internal memory

Data is automatically transferred to the AQMesh server for secure storage and processing. Data is only stored temporarily locally when it cannot be transmitted to the server. The internal memory should not be used as a permanent storage medium and any important data should be transferred to AQMeshData as soon as possible. The monitor should not be stored for prolonged periods with valuable data in its memory. The pod memory should be cleared after any power cycle to avoid potential corruption of its memory leading to loss of data.

3.3 General service

If handled and operated correctly your AQMesh pods will last for many years but should go through regular maintenance to ensure correct operation and accurate readings. The manufacturer recommends replacement of all electrochemical sensors and (if fitted) the internal lithium battery when required or as a minimum every 2 years.
Note: *Battery life can vary according to configuration and settings!*

The optional particle counter should be routinely serviced annually (more frequent service may be required depending on local conditions.

3.4 General cleaning

The AQMesh housing and fixings can be wiped clean using a damp non-fibrous cloth. Do not submerge in water. Do not attempt clean the sensor membranes.

✍ *Note: Do not use solvents or any other chemical cleaners as they may damage the finish and adversely affect the gas readings.*

3.5 Electrochemical sensors

Should an electrochemical sensor fail, the user will be alerted to the failure via the AQMesh server or via email. Should the failure occur within the warranty period of the sensor a free of charge replacement will be issued. The user must then replace the sensor both physically in the AQMesh pod, and on the AQMesh server. It is important the failed sensor is removed quickly, even if it is not going to be replaced, as there is a risk of leaked electrolyte which can damage the PCB.

The risk of sensor failure is worst when pods are moved around or shipped. Please ensure that relative humidity levels and temperature is changed gradually and the pods are handled gently, particularly when they have been recently exposed to high relative humidity For example, when wanting to bring pods indoors they should be left to sit in cool, dry conditions for 24 hours prior to bringing them fully indoors.

If AQMesh pods have been moved to a new location they should go through the rebasing process in their new environment. This has to be manually initiated by logging in to the AQMesh server and selecting the rebasing option. See section 11 Pod Relocation for more information.

3.6 Optical particle counter

Regular maintenance and cleaning of the particle counter is advised, with frequency dependent on the environment in which the pod is located. Specific instructions on completing this process are available via the manufacturer or local distributor. Lasers and pumps should typically be changed annually for best practice; however, this is dependent on the measurement strategy chosen, with particle counters working well beyond 2 years with no interruption dependent upon the measurement strategy.

4 Installation instructions

4.1 Tools required

- Basic tool kit
- Handle for hex security bit

Each installation is different depending on the site and method of mounting. Therefore, the tooling requirements for placement and fixing of the mounting bracket is not covered by this document.

4.2 Preparation

It is the manufacturer's recommendation that the installation is always carried out in accordance with this operation manual. Any electrical work should be carried out by a competent electrician and the relevant codes of practice should be followed at all time.

⚠ Warning	Power should NOT be applied to a pod before all fixings and wiring have been completed and tested. Only a qualified competent person should make electrical connections.

In order to effectively install AQMesh pods it is important that the site is ready and in a fit state. In particular, the following points should be noted:

- This manual has been read and fully understood
- A risk assessment has been performed that includes installation, operation and maintenance of the system and the removal, where practically possible, or any identified hazards
- Applicable codes of practice identified
- The AQMesh pod has been received on site, unpacked, contents checked and packaging checked for obvious damage
- A suitable location is determined for the installation of the AQMesh pod
- If required a suitable isolated D/C power supply is installed

✍ *Note: Failure to comply with any of the above may result in additional time on site and additional costs.*

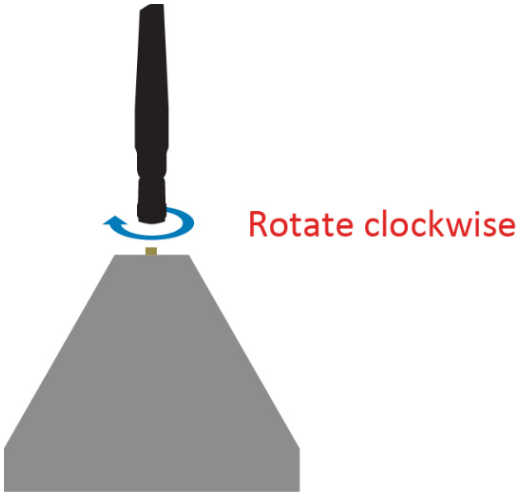
Carefully unpack your AQMesh pod. You should have the following items:-

- AQMesh pod serial number XXXXXXX fitted with its sun shield
- An antenna
- A mounting bracket and two jubilee clips
- A security screw and security screwdriver bit
- 2mm Hex key

⚠ Warning	DO NOTE POWER UP THE AQMESH POD WITHOUT THE AERIAL IN PLACE AS IT CAN DAMAGE THE ELECTRONICS.

⚠ Warning	Never pick up the pod by the antenna.

Install the antenna to the threaded fitting on the top of the AQMesh pod. Care should be taken to ensure a good connection but don't over-tighten.

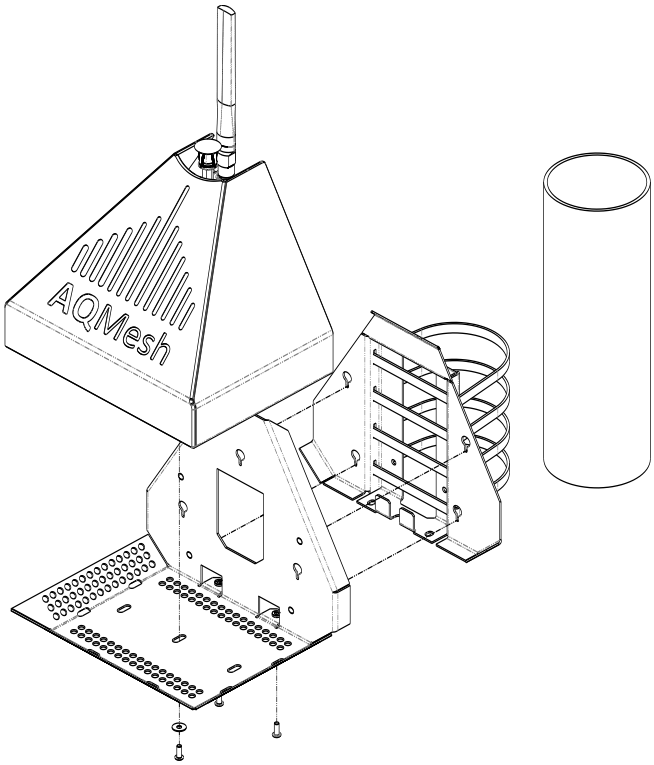


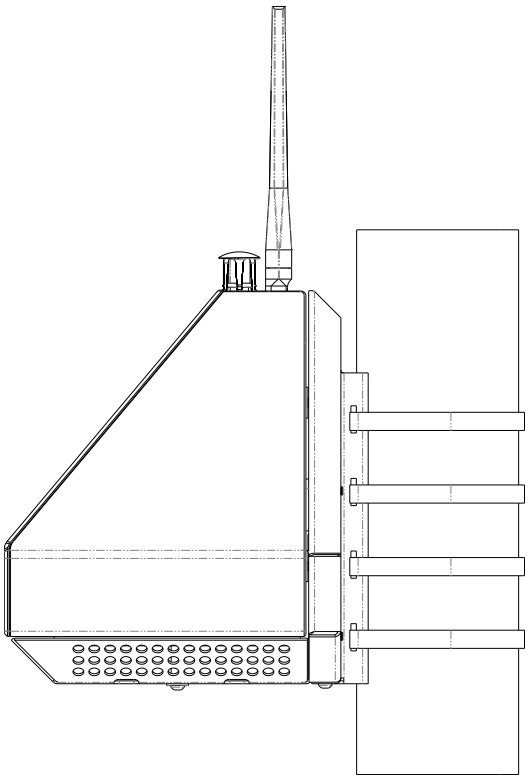
4.3 Installation method

⚠ Warning	Always ensure that you refer to and comply with the relevant National Working at Heights regulations prior to any installation work. Only a qualified competent person should make electrical connections.

For mounting on a pole:

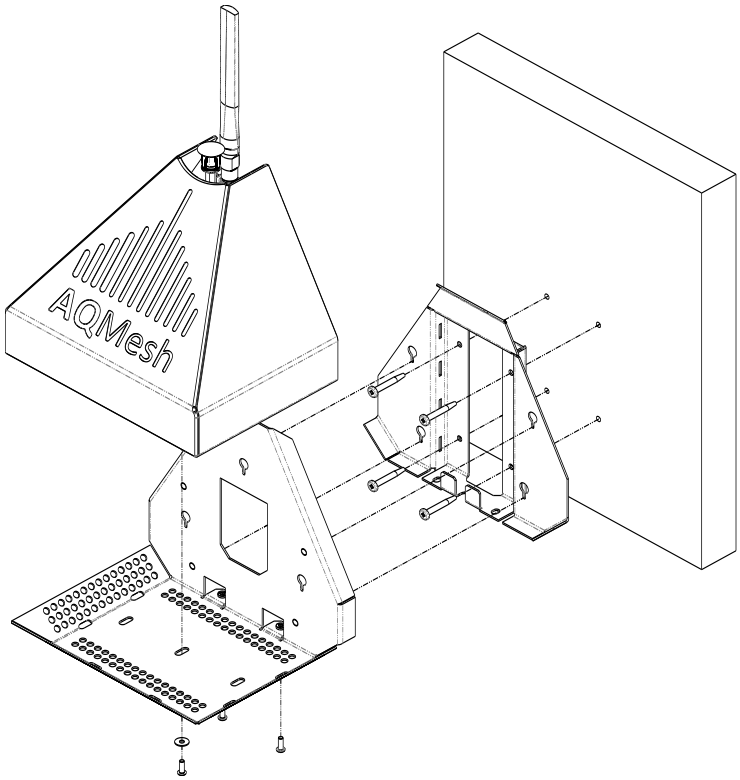
Install the pod mounting bracket securely in position on the pole with the supplied jubilee clips.

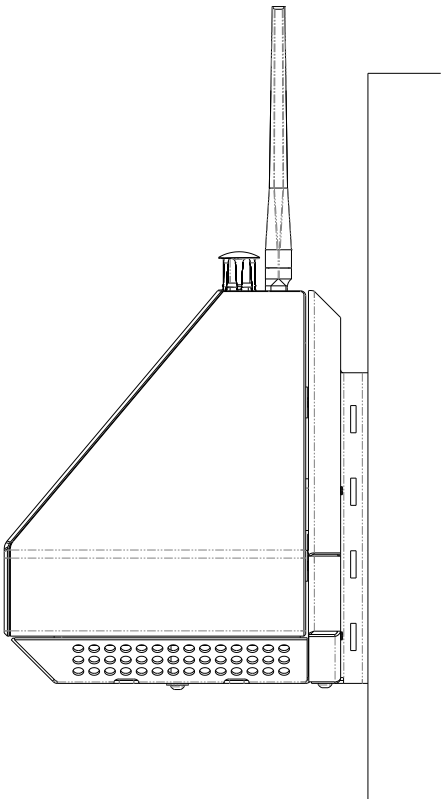

AQMesh



For mounting on a wall:

Install the pod mounting bracket securely onto a wall with appropriate fittings (not supplied).





Please consider the following requirements for all potential installation sites.

- Weight of AQMesh assembly (approx. 2.0kg without battery)
- GPRS/3G coverage
- Safety of the public
- Security (the pod is not designed to be vandal proof)
- Permissions for access and installation of equipment
- Environmental conditions:-
- Temperature (-20 to +50 ˚C)
- Humidity (15-85%)

Please consider the following requirements when positioning your AQMesh pod:-

- It has free access to ambient air
- It is not placed close to metal constructions
- It is not placed directly onto a flat surface
- It is mounted clear of any surface that may collect water or reflect heat onto the pod
- It is installed away from potential sources of contamination
- The GPRS signal strength with its aerial in the upright position is good
- Orient and angle the solar panel (if used) to the prevailing sunlight – see www.aqmesh.com/solarmanual for more information

⚠ Warning	The power cable must enter the pod via the cable gland supplied and the supply should be isolated (see wiring) to allow safe connection.

4.4 Cable conductor sizes and cable insulation requirements

For the external DC wiring, the conductor must be suitably selected for the current carrying capacity, the environment and the distance to the supply. The cable insulation must comply with a recognised standard and have a flammability rating of V1 or better and be suitable for use outdoors in the local environmental conditions.

AQMesh pods are supplied with 1.5M of blue artic grade 2-core 1.5mm2 300/500V electrical cable which should be trimmed and terminated in a suitable junction box that is isolated from the main supply.

⚠ Warning	Incorrect cable selection or installation could result in a hazard.

4.5 How to wire the external DC supply

⚠ Warning	Only a qualified competent person should make electrical connections to the system. Ensure the power is isolated before wiring to the system. If using armoured cable, the armour must not be used as the main earth connection for the AQMesh pod. If earthing of the armour is required, this must not be taken from the AQMesh pod. All cables should be crimped with an appropriate ferrule for the size of the cable being used. In addition, the cable insulation must be housed adequately within the protective sheath of the ferrule.

The dedicated external DC power supply has the following characteristics:-

- CE approved, intended for operation in a Class B (residential/light industrial) environment
- Doubly insulated from the mains source
- Output voltage: fixed, 9-25Vdc
- Output current rating: 1A (2A if using a heated inlet for PM monitoring)

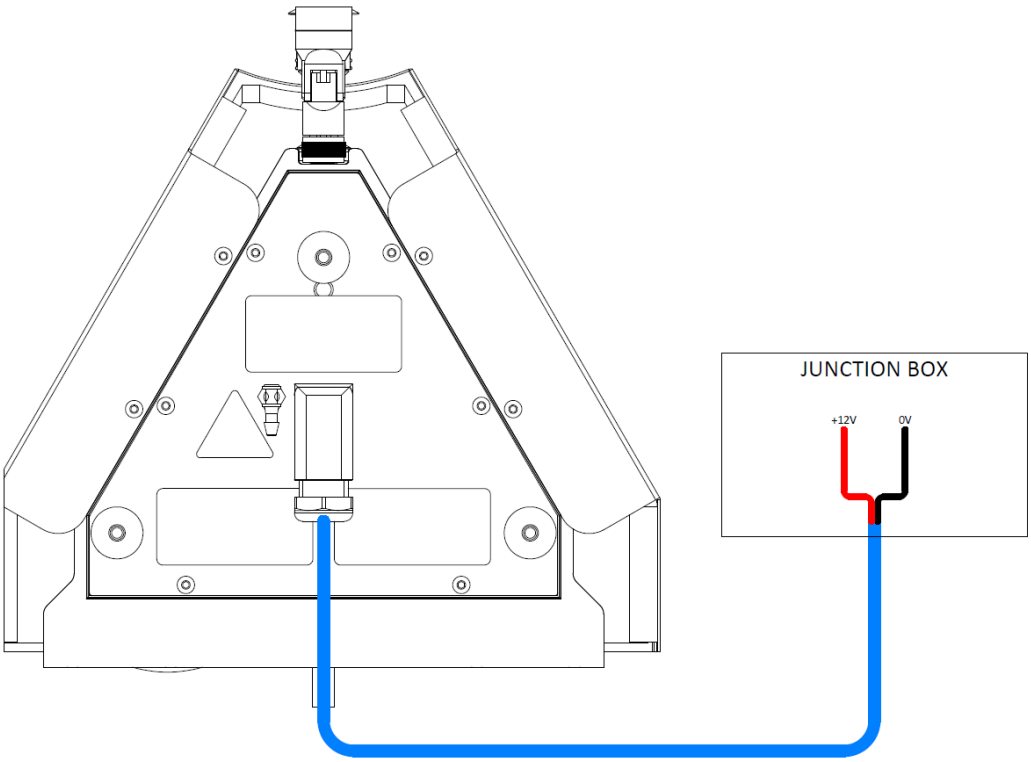
While the pod has its own internal 3.15A fuse, the AC wiring to the external DC supply should also be fused and protected, according to national wiring regulations.

The DC power lead from the DC supply to the pod should be as short as possible and less than 3m.

To minimise voltage drops the cable should be as thick as practical, up to 16AWG.

✍ *Note: If a 9V PSU is used (the lowest acceptable voltage) to supply a pod measuring PM and a 3m cable is required, then a 16AWG cable MUST be used.*

Refer to the diagram below for how to wire the cable to an AQMesh pods. Labelled terminals within the system identify the appropriate inputs, namely +Ve and –Ve. Please ensure your junction box has a suitably rated cable gland to prevent water ingress.



4.6 Deployment tips to minimise electromagnetic compatibility

Electromagnetic compatibility (EMC) is the subject covering the interactions between electronic equipment due to unwanted conducted or radiated emissions from one product to another, which results in the equipment not operating as intended.

Whilst all products under emissions and immunity testing to ensure a level of performance, it does not exclude the possibility of problems for all deployment scenarios and environments.

AQMesh pods contain an array of very sensitive sensors and their performance can potentially be degraded if subjected to overly strong interfering signals. The following tips should be considering during installation:-

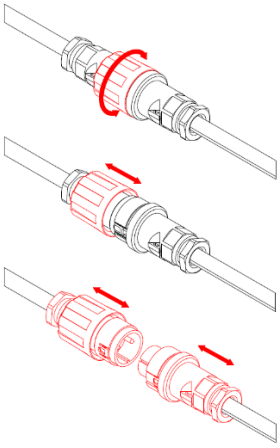
- AQMesh pods are intended for residential, commercial and light industrial environments

- Avoid deploying close to radio transmitters, such as radio masts, WiFi access points and microwave links
- Avoid deploying close to motorised or power switching machinery, such as HVAC systems, fans, lift tops, industrial workshops, welding work and high current carrying cables
- Keep the DC supply cable as short as practical and do not loop or gather the cable together. Cables are potential antennas which can pick up strong interference. The AC cable length to the DC power supply is non-critical and only subject to national wiring regulations
- When finishing off cable bundles and trays, do not mix DC, AC and data cables together
- Avoid running the DC supply cable alongside other data or power cables

If a pod at a particular site appears to be having problems and the pod is not faulty then look for other potential radiating sources. Within the wider consumer electronics industry emission problems have also been reported from a diverse range of products, particularly those containing high efficiency DC power supplies, such as LED lighting, street lighting, extractor fans and backup battery rechargers. Switching suspect products off whilst monitoring the performance of the pod may identify the interfering source. A collaborative approach to investigations in the field and preparedness to relocate products can lead to a mutually beneficial conclusion.

4.7 How to connect the external high capacity battery pack

Specified at time of manufacture both the AQMesh pod and external high capacity battery pack are supplied with appropriate arctic grade 2-core flex. Simply connect together using the inline connector provided.



4.8 How to connect the solar panel assembly

Specified at time of manufacture both the AQMesh pod and solar panel assembly are supplied with appropriate arctic grade 2-core flex. Simply connect together using the inline connector provided.

Full installation instructions for the solar panel can be found at www.aqmesh.com/solarmanual

4.9 NiMH rechargeable battery

The NiMH battery used in the AQMesh is a nickel metal hydride pack and is manufactured specifically for AQMesh as a pack from three individual cells. This type of battery is not so susceptible to the top-up charging memory effects as nickel cadmium batteries, although it is recommended that the pack is not given small top-up charges.

⚠ Warning	The battery charger is NOT suitable for use in the field. The battery must be charged indoors in a safe area.

The battery charger is intelligent and will indicate when the unit is charging and has charged. The charger should only be disconnected when fully charged is indicated.

Charging	flashes green
Ready	lights green
Error	flashes red

The pack must be charged ONLY using the battery charger supplied with the pack. The battery charger supplied is intended for indoor use only. Please ensure adequate ventilation whilst charging.

✍ *Note: Connect the charger to the mains attaching the appropriate adaptor. Contact the manufacturer for further information.*

Charger:	Input voltage:	100-240V A/C +/- 10%
	Input frequency:	50-60Hz +/- 10%
	Input power:	58W
	Output voltage:	12V D/C max
	Output current:	2.5A max

A full charge will take approximately 3-4 hours. The operating life will depend on the AQMesh configuration and measurement strategy. In default mode 'gas only' will last approximately 3-4 months. Particulate measurements use considerably more power and will last approximately 1 month in default mode. The ambient temperature can dramatically affect NiMH battery life; please take this into account when estimating battery life.

4.10 Changing the battery

The battery fitted to the pod should be changed as required by the measurement scheme.

- Remove the six screws holding the back plate in position and remove the plate. Take care not to damage any wires or tubing that may be attached
- Slide the ON/OFF switch into the OFF position
- Disconnect the power connector and remove the battery pack by sliding it towards you
- Fit and connect the new battery pack
- Slide the ON/OFF switch into the ON position
- Replace the back plate and secure its six screws. Take care to reposition any wires or tubing that may be connected to the back plate
- Following battery replacements where power is lost or removed, the memory should be cleared either locally using the serial cable or remotely via the server

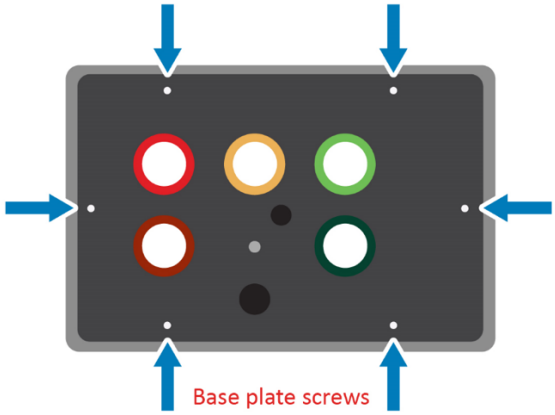
> ✍ *Note: It is possible to change the battery without removing the power to maintain continuous measurement, where frequent battery changes are necessary. This can be achieved by connecting the new (charged) battery to the spare power connector before disconnecting the old battery. This assumes the old battery till has power and has not run flat already.*

4.11 Activation method

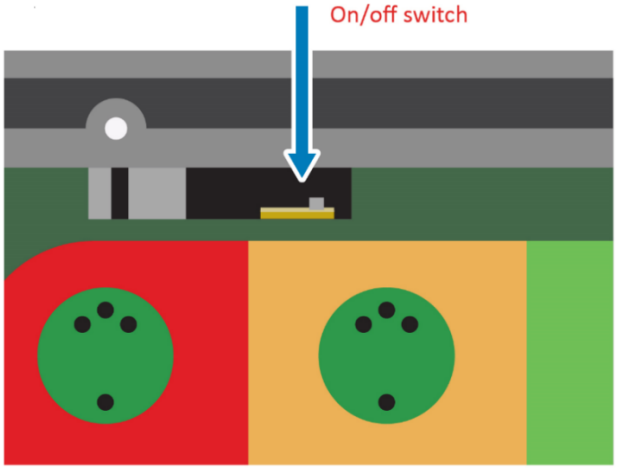
Where appropriate the AQMesh pod is shipped with the battery in place but it has been switched off for safety during shipping.

> ✍ *Note: Ensure the antenna is attached before turning the pod on.*

- Remove the six screws holding the base plate in position and remove the plate



- Slide the ON/OFF switch into the ON position



- Ensure the status LED located behind the window in the AQMesh label lights up. The LED should blink alternately green and red during start-up.
- Observe the LED sequence to determine that a connection to the server has been achieved:-

1 Alternate green/red blink, power-up, followed by a pause for up to 30 seconds

↓

2 Slow green blink, warming up

↓

3 Fast green blink, connecting to the server

↓

4 Green dot-dash, establishing a GPS lock

↓

5 Green on for 5 seconds then permanently off, connection succeeded

- Replace the base plate and secure its six screws
- Check the web server is receiving data from the AQMesh pod
- Install the AQMesh pod on the mounting bracket
- Secure the AQMesh pod onto the mounting bracket using the security screw provided

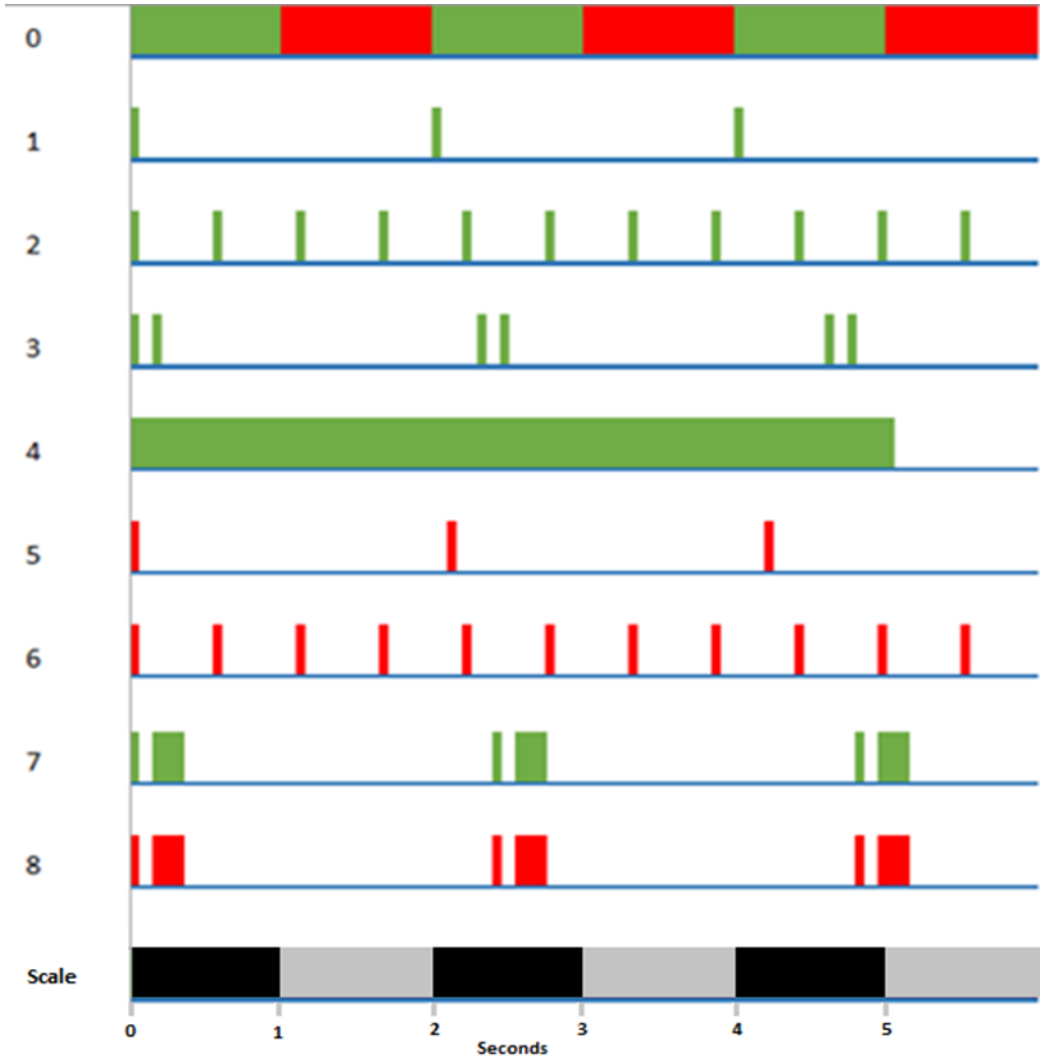
The activation sequence can also be monitored using the Technician Page on AQMeshData.net please contact your supplier for more information.

The sensors in the AQMesh pod may take 2 days to stabilise within their new environment, followed by 2 to 4 days for the baseline adjustment. It is very important that this is performed in the environment in which the pod will be used and not in an office or a local test site. The stabilisation period can be restarted on the server.

⚠ Warning	If the equipment is likely to be used with equipment conforming to IEC60950 and there is a hazard due to moisture or liquids (e.g. using a PC during installation outside) please take the precautions necessary as stated by the equipment manufacturer's instructions. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

4.12 LED codes during the start-up sequence

LED Summary table



	Description
0	Power On
1	Preparing to connect to the server
2	Connecting to the server
3	Warming up
4	Connection succeeded
5	Connection failed due to a local issue
6	Connection failed due to a server issue
7	Getting GPS Lock
8	SIM Card Error

4.13 Getting online

Each AQMesh pod is automatically registered on the AQMesh server when it is manufactured. The pods are then assigned to a distributor who will in turn assign them to the user and open an AQMesh online account for the user.

A username and password should have been supplied by the local distributor with the AQMesh pod if this option was taken at purchase, or API access. If no login details have been received please contact the local distributor.

Once the pod has been activated, log onto the AQMesh server.

Each pod can be selected and setup and details can be viewed or changed depending on your access privileges. Data can be viewed in tabular or graphical formats via the AQMeshData.net web interface.

The login details can be amended at any time.

5 Replacing a sensor

5.1 Sensor failure alerts

You will be notified by email if any of the sensors in your AQMesh pod have failed. Changing a sensor involves 2 steps. In addition to replacing the sensor in the pod itself, the AQMesh server needs updating to associate the relevant calibration data (stored on the server) with the new sensor serial number.

It is important that the pod is opened quickly to remove the failed sensor, even if the sensor is not going to be replaced, as the failed sensor can leak electrolyte and damage the PCB.

It is recommended that gloves are worn when handling failed sensors as the electrolyte is a weak acid.

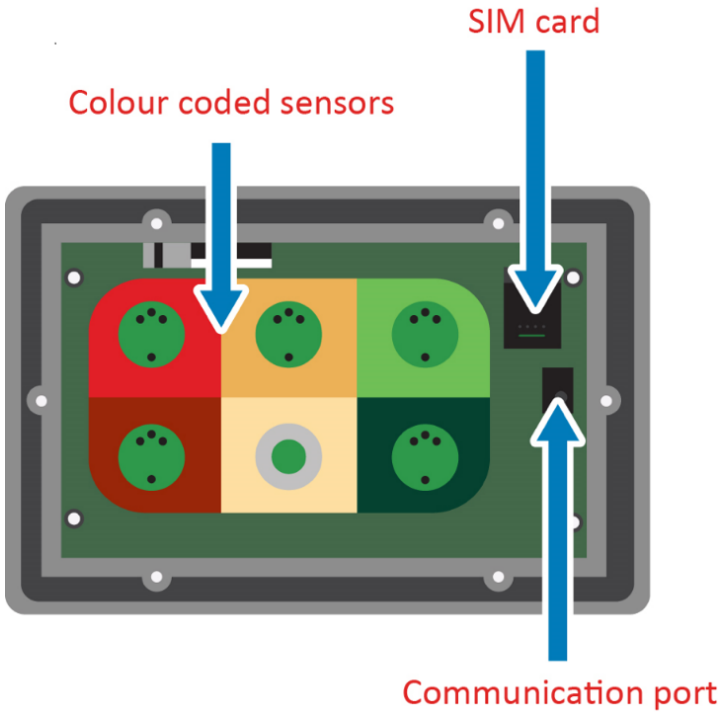
> ✍ *Note: The pod MUST be opened quickly to remove the failed sensor, even if the sensor is not going to be replaced, as the failed sensor can leak electrolyte and damage the PCB.*

5.2 Physical replacement

The sensor must be replaced in the pod before the server is updated. Failure to do this may cause the new sensor to be associated with a failure, which will restrict data to the user. Follow these steps to replace the sensor:-

> ✍ *Note: It is recommended that protective gloves are worn when handling failed sensors as the electrolyte is a weak acid.*

- Remove the six screws holding the sensor plate in position and remove the plate
- Slide the ON/OFF switch into the OFF position



- Wearing protective gloves, locate and carefully remove the required sensor from its socket. It pulls straight out but may require some gentle force
- Should any residue remain on the PCB this should be cleaned
- Carefully insert the new sensor in position, taking care not to damage the sensitive gas interface membrane on its surface
- Slide the ON/OFF switch into the ON position
- Ensure the status LED located behind the window in the AQMesh label lights up
- Observe the LED sequence to determine a connection to the server has been achieved
- Replace the sensor plate and secure in position with its six screws
- Check the server is receiving data from the AQMesh pod (see separate instructions)

5.3 Updating the serial number on the AQMesh server

- Login to the AQMesh web application using your user ID and password
- Select the correct AQMesh pod
- Confirm the sensor has been changed using the link in the notification email. Alternatively, enter the new sensor's barcode in to the field for the appropriate sensor type and confirm the update.

The new sensor in the AQMesh pod may take 2 days to stabilise within its environment, followed by 2 to 4 days for baseline adjustment.

Failed sensors should be returned to an AQMesh distributor or the manufacturer as soon as possible

Sensor failures are almost certainly caused by high ambient relative humidity and low temperatures, and the sensors are most vulnerable during periods of sustained high humidity.

The risk of failure is worst when pods are moved around or shipped. Please ensure that relative humidity and temperature are changed gradually and the pods are handled gently, particularly when they may have been exposed to high relative humidity. For example, when pods are brought indoors they should be left in cool, dry conditions for at least 24 hours before taking them fully indoors.

Please be aware that it is important the sensor serial number is changed on the server soon after the sensor is replaced so that the corresponding correct figures are used by the algorithm ad that stabilisation is triggered correctly.

All failed electrochemical sensors are replaced under warranty in the first year.

6 Monitoring principles

6.1 Electrochemical sensors

AQMesh uses electrochemical sensors designed for measuring a range of gases at ppb levels.

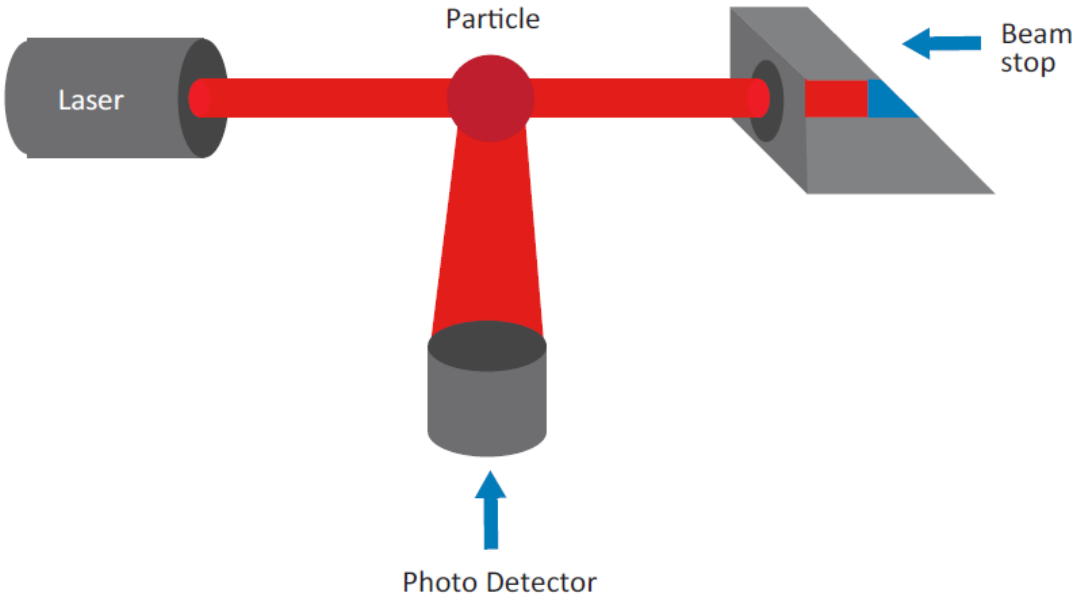
Electrochemical sensors work by reacting to the target gas, generating an electrical output which varies with the amount of target gas present.

The innovative difference in the new sensors used in AQMesh is their fourth electrode. This is embedded in the sensor electrolyte, allowing the reaction from environmental effects to be measured without the effects from the target gas. This means AQMesh is able to mitigate the effects of environmental factors such as temperature and humidity.

AQMesh, using these two outputs from the sensor, applies an algorithm to produce an accurate ppb value for the target gas. The algorithm for V5.0 onwards uses sensor-specific characteristics, derived through a QA/QC process at factory, to improve the compensation of environmental and cross-gas effects.

6.2 Optical particle counter

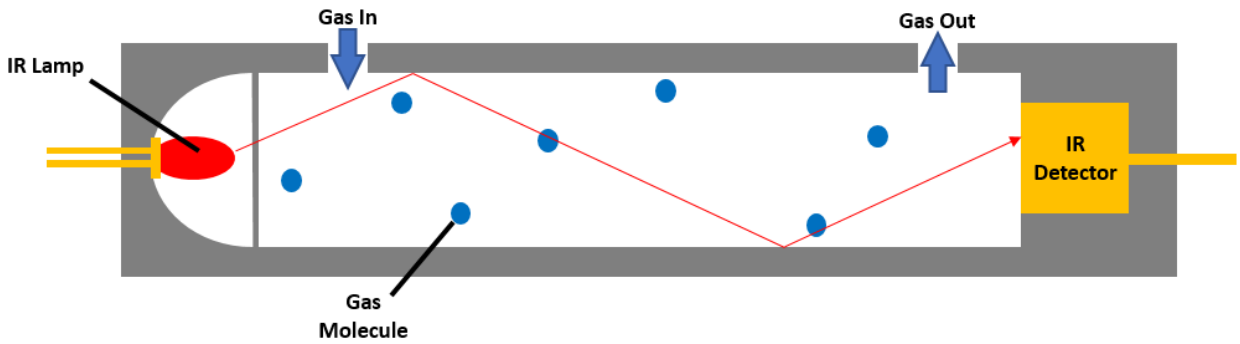
The AQMesh optical particle counter works by drawing a sample of air through the system via a pump. The gas sample, containing particulate matter, falls through the path of an internally mounted and optically focused laser. The path of this laser is deflected as an individual particle is hit by the laser. This deflection is detected by an optical sensor which counts the number of deflections as particles.



At the same time the particle diameter is determined allowing the counts to be sorted into size defined bins. Using these size-specific bins, along with assumptions that all particles measured are spherical and have a standardised density, allow the accurate estimation of particle mass. This can then be broken down into PM1, PM2.5, PM10 and PM_Total fractions.

6.3 NDIR sensors

Non-dispersive infrared (NDIR) sensors can be used to measure a range of gases. By passing the emissions from an infrared light source, for which the wavelength has been tuned to a specific gas, through a sample of gas, an optical infrared sensor can then be used to determine the amount of the target gas present within the sample in ppm or percentage levels.



6.4 Noise sensor

Through use of a high-quality omnidirectional microphone, sampling at the same P1 interval as electrochemical and environmental sensors, AQMesh provides both average and peak noise over the user selected P2 interval through analysis of the samples taken in decibels (dB).

Due to the frequency range of the noise sensor used in AQMesh, it is not Class 1 or Class 2, but does provide a similar level of accuracy as Class 1 noise sensors within its limited frequency range. The frequency range has been targeted to identify potential pollution sources, for example, providing an indication of traffic volume close to the pod.

6.5 Wind speed and direction sensor

AQMesh also offers a wind speed and direction sensor, allowing a more understood meteorological view of how air pollution is generated as well as the information required for source apportionment, i.e. identifying where higher levels of pollution are coming from such as busy traffic junctions or industrial sites.

The wind speed and direction sensor works using a group of ultrasonic transducers. Working in two axes, the time taken for the ultrasound to travel to the opposite transducer is measured, with the sound travelling faster if in the direction of the wind or slower if travelling against the wind direction. Using the two axes, a direction can be determined and the four results used to ascertain the speed of the wind in that direction.

7 Interferences

7.1 Electrochemical sensors

Electrochemical sensors are susceptible to interference from multiple conditions found in the ambient environment, including temperature, humidity and cross-gas effects. The AQMesh algorithms are developed for individual sensor types. And are specifically designed to compensate for these environmental variables to provide the best possible precision and accuracy of measurement.

AQMesh algorithms are continually being improved to provide greater accuracy under increased ranges of environmental conditions.

7.2 Optical particle counter

The use of the heated Inlet option removes the effect of varying particle size due to deliquescence by maintaining the relative humidity of the sample being measured below the point of deliquescence, ~50% relative humidity. Thus, providing a more consistent correlation with equivalence instruments which also dry or condition their sample.

AQMesh also provides an option of the particle counter with no heater to dry the air sample taken, all particles including water droplets will therefore be counted and sized from within the air sample at the ambient temperature and humidity.

As such, variation in particle type, i.e. hygroscopic or hygrophobic particles, or density variation, can also affect consistency of results in comparison to equivalence methods. The v3.0 PM processing does include a confidence flag for users to remove samples which have a high potential for affects due to the effects of high humidity on hygroscopic particles, however this is not suitable for all applications.

7.3 NDIR sensors (CO2 sensor only)

NDIR sensors require an uninterrupted signal from the infrared light source. On very rare occasions, small amounts of condensation may form on the sensor and interfere with the signal, which may cause an anomalous reading.

7.4 Background baseline

Some pollutants generally have a background level above zero. All V5.1 and V5.3 CO2 and CO sensors are corrected to have a consistent baseline, at the following levels:

- CO2 400ppm
- CO 300ppb

Should your location have a known higher or lower background level for these gases, a coarse correction can be applied using the 'offset' function on the AQMeshData.net user interface relative to the listed values. For example, if the known background for CO is 200ppb, apply an offset of -100ppb.

8 Precision & accuracy

8.1 Stabilisation & rebasing

Stabilisation is a period whereby a sensor provides “bad” data due to not being in a state of equilibrium. Once the sensor settles in its environment after being recently moved in a manner which may shock or destabilise the sensor or after its being first installed, it will provide usable data. This process takes 2 days to complete for electrochemical sensors, 12 hours for NDIR and is not required for the OPC.

The rebasing process standardises sensor output following the stabilisation of a sensor and is a vital stage before the start of a new project if there is any possibility that sensors have been destabilised. Sensors automatically rebase when first shipped by the manufacturer or if the sensor has been replaced, but after that, including if the pod is first switched on at a location other than the monitoring site, such as in an office, the process must be triggered manually. This will give the best possible pod-to-pod comparability and ‘out-of-the-box’ accuracy.

Please note:

1 Sensors must stabilise in the monitoring environment for two days before rebasing starts; rebasing will not be effective if carried out on a destabilised sensor

2 Re-basing must be carried out in the monitoring environment and not be interrupted by moving the pod during the process.

8.2 Measurement procedure

The sampling interval for all measurement types is broken down into 3 levels. For environmental parameters and gas sensors this is split into: -

P1 – Reading frequency	Frequency of sample taken, e.g. 10 seconds
P2 – Averaging frequency	Time period samples are averaged out to, e.g. 15 minutes
P3 – Transmission frequency	Frequency of raw signals being sent to the AQMesh server

This process is similar for the particle counter, however slightly different: -

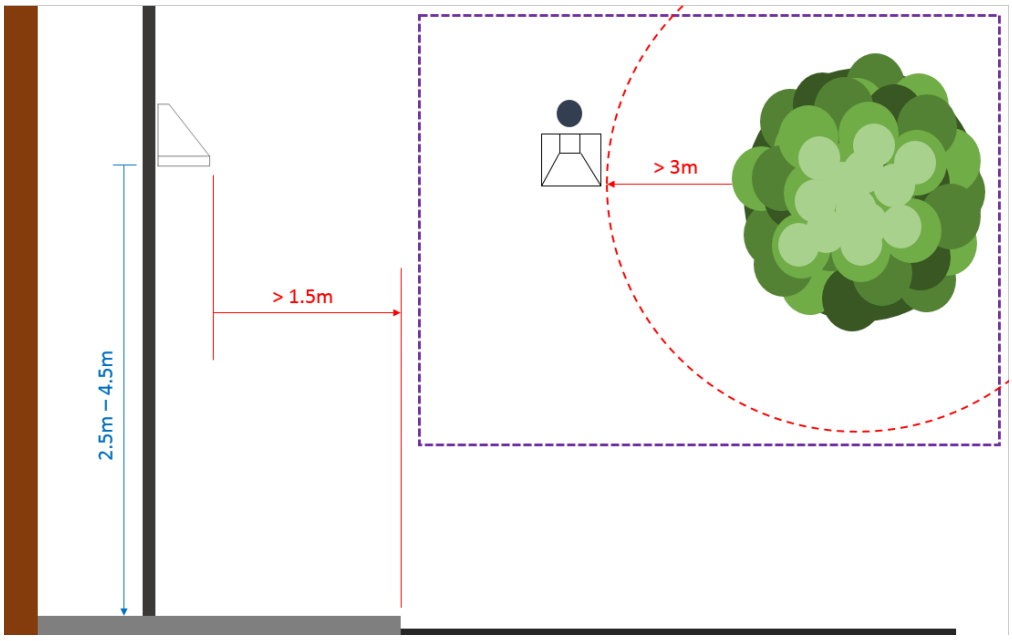
T1 – Sample duration	Pump run time for the sample, e.g. ≤60s. sampling at 1-minute intervals
T2 – Averaging frequency	Time period samples are averaged out to, e.g. 15 minutes
T3 – Transmission frequency	Frequency of raw signals being sent to the AQMesh server

8.3 Optimal positioning

While AQMesh is very versatile and can be positioned almost anywhere, it is still important to realise that some locations are unsuitable. These can be for a number of reasons, such as: -

- Vicinity to oxidising surfaces – causing a change in the measured pollutants at the specific location in comparison to ambient
- Incorrect direction/vicinity to reflective surfaces – the AQMesh sunshield is designed to protect the instrument and its sensors, from increases in temperature. However, the back and base of the pod are not protected, so direct sunlight and reflected/radiated heat onto these surfaces can cause erroneous results.
- Vicinity to reflective or heat radiating surfaces which can increase the pod internal temperature, affecting compensation.

As such, we suggest the following parameters with regards to pod positioning when installing a pod. These are not hard and fast, but should provide a good degree of “margin for error” without data being affected.



8.4 Summary of scaling & validation options

VALIDATION LEVEL	DESCRIPTION	Suitable for single pod deployment	Suitable for multiple pod networks
Basic	Correct Stabilisation and Rebasing completed		
Tier 1	Analysis of each sensor's variation to the group average over the network. Is the variation as expected? Or anomalous? Can any variation be explained by local changes in the pollution source?		
Tier 2	Gold pod Scaling. Co-location of one or more AQMesh pods with reference to scale and validate each sensor, before being moved alongside other pods in the network as a transfer standard or used to monitor a chosen point away from the reference station.		
Tier 3	Frequent validation of individual pods through comparison to reference or gold pod at a set interval, with analysis looking at variation over time for the network.		

The above are just examples of some of the measures which can be used to help validate AQMesh results when in the field, both individually or as part of a larger network. The specifics on how best to achieve an acceptable level of validation and the means to achieve it, will vary for each project, based on expectations.

8.5 With access to reference or diffusion tubes

When users have access to reference instrumentation it is possible to correct AQMesh slope and offset values to improve the accuracy of results moving forward by completing a co-location study and comparison of data over a period of days or weeks. If multiple locations with reference equipment are available, we advise that the site with the highest pollution levels is used. However, if no reference is available, diffusion tubes (indicative, interpolated standard of measurement for some pollutants can be used as per the method listed at the end of this document) can be used instead.

Once a pod has been successfully scaled against multi-point reference, equivalence or indicative measurements it can be used as a transfer standard or "Gold Pod" to scale other AQMesh pods in the local network, thus allowing only 1 pod being required to be moved for QAQC rather than the full network.

8.6 No access to reference or diffusion tubes – single pod

Without scaling locally, the AQMesh V5.0 algorithm provides a degree of accuracy using factory slope and offset values. Average variance without local calibration is typically as listed in the table below.

Sensor Type	Best accuracy versus reference/equivalence of uncalibrated results at hourly sample intervals	
NO	+/- 1ppb	
NO_2	+/- 4ppb	
NO_x	+/- 4ppb	
O_3	+/- 5ppb	
CO	+/- 20ppb	
SO_2	+/- 5ppb	
CO_2	+/- 30ppm	
PM 10	+/- 30ug/m^3	+/- 5 ug/m^3 *
PM 2.5	+/- 20ug/m^3	+/- 5 ug/m^3 *
PM 1	+/- 15ug/m^3	+/- 5 ug/m^3 *
Average Noise	+/- 1dB	
Peak Noise	+/- 3dB	

* When using heated inlet and v3.0 PM processing.

8.7 No access to reference or diffusion tubes – multiple pods

If the user does not have access to reference and has multiple pods they can be used comparatively. By scaling one or more pods against a single pod so that all pods provide the exact same output using the same methodology as when comparing versus reference, they can then be deployed around an area to show pollution "hot spots" with the same validity as when moving the same pod however concurrently. Allowing users to mitigate for pollution levels by through comparison of the different areas being measured, e.g. one pod could be in a park and show low pollution levels, while a roadside pod shows comparatively high results. While these values may not be proven to be 100% accurate, they do show when air quality is poor, when it is good and can indicate when mitigation from the user improves air quality within the area being measured.

8.8 QA/QC of an AQMesh network

An important factor in the QA/QC of AQMesh is the traceability back to a known (preferably reference) standard and having confidence in consistency throughout the network. This can be done with correct co-location (described later in this document) and calibration/scaling (again described in detail later in this document). By calibrating AQMesh pod(s) against this using this method it is possible to determine both the uncertainty of measurement between AQMesh and the reference standard and, based on the uncertainty of the reference used, the uncertainty of AQMesh measurements when moved away from the reference instrument.
We refer to this process as creating a "Gold standard" pod, the scaled results from which can then be used as a transfer standard.

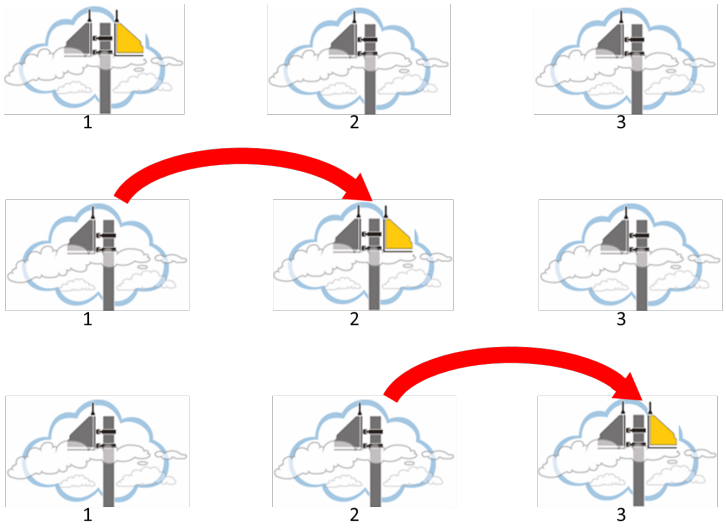
Once a network of AQMesh pods has been positioned in the areas of interest for your project, the Gold standard pod(s) can be moved around the network to scale or validate the results from each pod within the network in turn, this

typically takes 7-10 days of co-location at each position, returning to the reference as frequently as required by the user's QA/QC and confidence levels.

Period 1: Gold pod co-located with pod at position 1 for QA/QC and scaling.

Period 2: Gold pod moved to be co-located with pod at position 2 for QA/QC and scaling.

Period 3: Gold pod moved again to be co-located with pod at position 3.



This same process can be used to locally scale any replacement sensors without the need to move pods from their measurement location. This allows continuous measurement from sensors which have not failed until maintenance of the affected pod has been completed.

8.9 Pre-ratification process

The ultimate goal of AQMesh is to provide precise and accurate data with so that users have confidence in their results. To do this the AQMesh team have provided coded diagnostics for users so that they understand which data points are good and to be trusted, but also the reasoning behind why some data points should be ignored so that both experienced and less experienced users of AQMesh can use the data gathered by AQMesh in the simplest of ways, without requiring detailed analysis and high level quality assurance of each data point gathered.

While the Pre-Ratification process is efficient at removing obvious outliers, and identifying the cause of those outliers, it is still advised that "good" data provided by AQMesh which is used is validated and calibrated locally to provide quality assurance.

The following table explains the codes used and under what circumstances the post-algorithm value may be returned to the downloadable dataset.

8.9.1 Gas sensor pre-ratification codes

Code	Label	Description	Effect on Data
-999	Stabilisation	Period of 2 days from installation of a new sensor which needs to settle in its new environment	Data classified as stabilising will remain as non-viewable
-998	Rebasing	Typically, this is a 2-day period where local variables are calculated for use in the AQMesh algorithm are found	During the flagged period the coded flag will remain, however upon completion of this process, valid data will write over the code
-996	Sensor Failure	In the event of a sensor failure, all post-failure results will be removed from view as the data is classed as erroneous	Data from a failed sensor will remain as non-viewable
-995	Cross Gas Error	If a sensor fails which is relied upon for the removal of interferences on another sensor, data from the reliant sensor becomes invalid	Data will remain as non-viewable until compensating sensor is replaced and producing good results, data gathered while compensating sensor was failed will remain as non-viewable
-994	No Data	If a sensor has been removed or data cannot be processed by the server due to a fault the “No Data” flag will alert the user to that further investigation can take place	If sensor is working, then data will be processed as soon as any fault has been fixed. Causing no data loss
-993	Destabilisation	Rapid changes in environment can cause the sensors to provide erroneous data until they settle into their new environment, this can take either 1 or 6 hours depending on the severity of the rapid change in temperature or humidity	Data classified as destabilising will remain as non-viewable
-992	Extreme Environment	Following intensive testing of all electrochemical sensors we have determined the combination of extremes in climate in which the electrochemical sensors do not provide consistent outputs. As such precise and accurate measurement is not possible	Data classified as within the extreme ranges of environment will remain as non-viewable
-991	Condensation	NDIR sensor affected by condensation on the detector	Data classified as being affected by condensation will remain as non-viewable

8.9.2 Particle counter pre-ratification codes

Code	Label	Description	Long term effects
	Deliquescence	When not using the heated inlet option, outlying data points caused by hydroscopic particle size growth will be removed following analysis of the particle count distribution	Data classified as being affected by will only be viewable by request on the server. i.e. this “flag” can be turned on or off by the user depending on their needs
-892	Other fault zero	The particle counter is unable to provide a particle reading following a power-cycle and/or a change in the pod settings. These will be flagged as **OFZ (First reading after restart)**. On occasions where the particle counter is unable to provide a particle count for some other reason these will be labelled **OFZ (no measurements)** depending of the frequency these may require service or further investigation.	Occasional loss of data.
-893	Misread	Particle counter misread again depending of the frequency these may require investigation.	Occasional loss of data.

9 Additional features

9.1 Fast transmission

Transmission of data from pods to the server via the 3G/GPRS modem was previously limited to 30 or 60 minute intervals. Now, using the MK4 hardware and v3.2 firmware and onwards 1 minute interval data can be transmitted as frequently as every 5 minutes. Earlier versions of hardware will still be limited to transmitting data every 30 or 60 minutes.

1 minute interval data and 5 minute transmission is only available on our premium data packages. Information on our range of data access options can be found here:-

https://www.aqmesh.com/product/data-access/

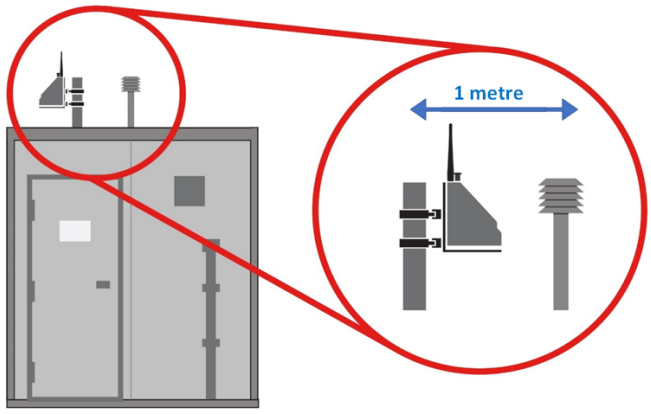
If you are unsure about your data contract please contact support@aqmesh.com

10 Co-location requirements

10.1 Setting up an effective co-location comparison trial

To set up an effective trial to compare AQMesh performance and complete the scaling exercise against a reference station or gold standard pod, the following conditions must be adhered to in order to complete a valid comparison of AQMesh and reference/equivalence instruments. Not complying with these conditions will likely cause poor correlation which may lead to poor scaling of results:

- A reliable reference station (maintained and ideally certified) should be chosen as the trial location, in an environment where there is some pollution, e.g.: ideally at least several weekly peaks above 10ppb for gas parameters and 10 µg/m^3 for particle fractions.
- All pods being co-located for scaling or validation should be placed next to the reference station inlet (or gold pod), ideally immediately adjacent or no further than 1m apart.
- Pods should be mounted away from any reflective or known oxidising surfaces or air conditioning exhausts which cause the pod's local environment to be different from ambient, i.e. 0.5m or greater from the floor.
- Pod should be placed in a position with free movement of air, i.e. not affected by turbulence from local barriers.



IF NOT CARRIED OUT AS SPECIFIED, COMPARISONS ARE LIKELY TO BE INVALID.

11 Pod relocation

11.1 Relocating pods to a new location

When relocating a pod to a new location, to limit failures of electrochemical sensors, it is advised that they remain in ambient conditions. Exposure to rapid changes in temperature following exposure to high RH can commonly cause sensor failures.

If pods are required to move from an outdoor to indoor location, pods should be transitioned slowly between environments. For example, if moving from a hot climate to a cool indoor area it is advised that the pod be moved at the coolest point of the day, when the temperature change is preferably not more than 10 Celsius cooler than ambient. This advice is reversed for areas with cold climate, where pods are moving to warm indoor conditions, by moving the pod at the hottest point of the day, and to an area which is no greater than 10 Celsius hotter than ambient, sensor failure rates can be limited.

11.2 Manual stabilisation & rebasing

If moving a pod to a new location the conditions which the pod is moving to, how it was moved and whether you are wanting to use previous scaling of the sensors in it are very important. For example, if you have scaled a pod at site A and want to move it to site B which is 20 miles away, if it is transported in a manner which will **not** shock the sensors the scaling of that pod should still be accurate. However, if the pod is moved between an air-conditioned space and outdoors in the process, causing thermal shock, the scaling will be invalidated and likely require the stabilisation and rebasing periods to be restarted. This will require the user to manually restart this process via the user interface and begin the scaling process again.

Manual stabilisation and rebasing may also be required following first receipt of the pod from factory or distributor. Whether this is required can be confirmed by looking downloading data over the first two days of installation to confirm that automatic stabilisation has occurred.

12 Calibration & improving accuracy

It is advised that AQMesh sensors are locally calibrated (scaled) as frequently as the reference or equivalence instrument being used for the process. Reference instruments are typically calibrated on at least a 6-monthly basis however this varies between instrument manufacturers, regions, etc.

12.1 Scaling

Scaling is a common tool for air quality instrumentation. It is used across most instruments designed for ambient air quality measurement, including reference equipment, and provides an increased level of accuracy based on the local environmental conditions and how the sensors used react to that environment during stabilisation and rebasing.

For AQMesh to provide the greatest degree of accuracy it is advised to co-locate the pod with a local serviced and calibrated reference station. This will provide the information necessary for calculating scaling variables; offset and slope for all sensors where comparison is available.

AQMesh pods which are not locally scaled will still be able to provide dependable and repeatable performance, as scaling does not affect correlation (R^2) values. However, without reference the accuracy of results will have a greater level of uncertainty.

Scaling values are calculated over a specific time period and as such are based on the environmental conditions on site over this period. By applying these values for offset and slope we are able to determine the best possible performance for this pod over the same period and improve the accuracy of the pod moving forward.

For optimum results from AQMesh, the scaling of sensors is recommended every 6 months, or in line with service and calibration of the reference instrument being used to validate the AQMesh results, but also in the following circumstances, i.e.

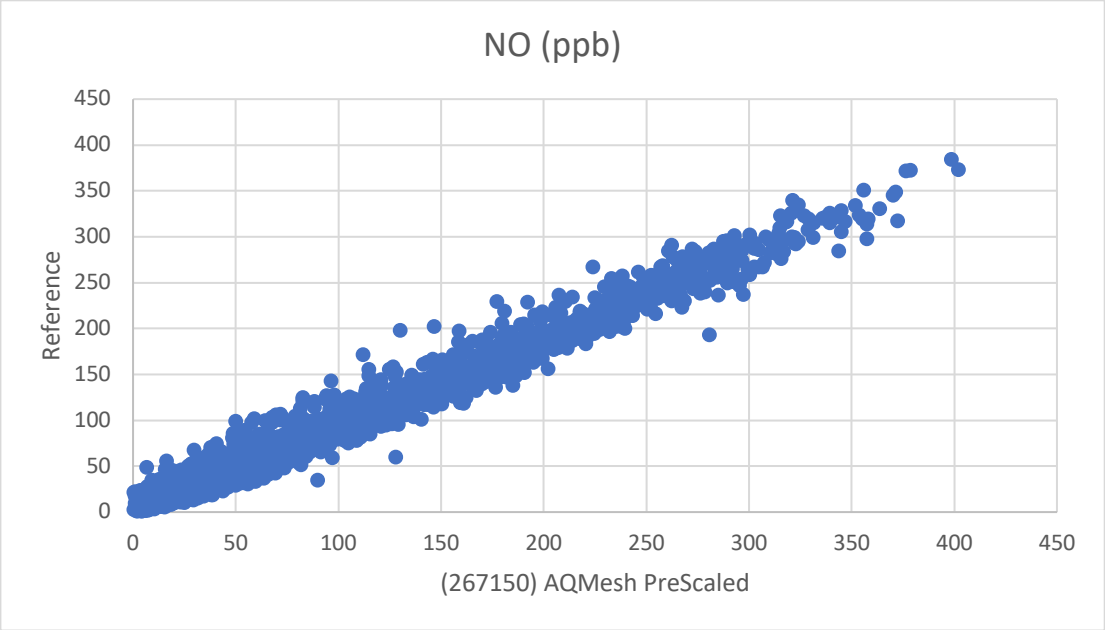
- Following a sensor change, the new sensor will need scaling to its new environment
- Following a large step change in environmental conditions at the site, e.g. a change in average temperature of 10 degrees Celsius or more, compared to when it was scaled.

To complete the following scaling methodology, the user must first download “PreScaled” values for each sensor, these are available via the user interface or API.

12.2 Scaling process for calibration & verification

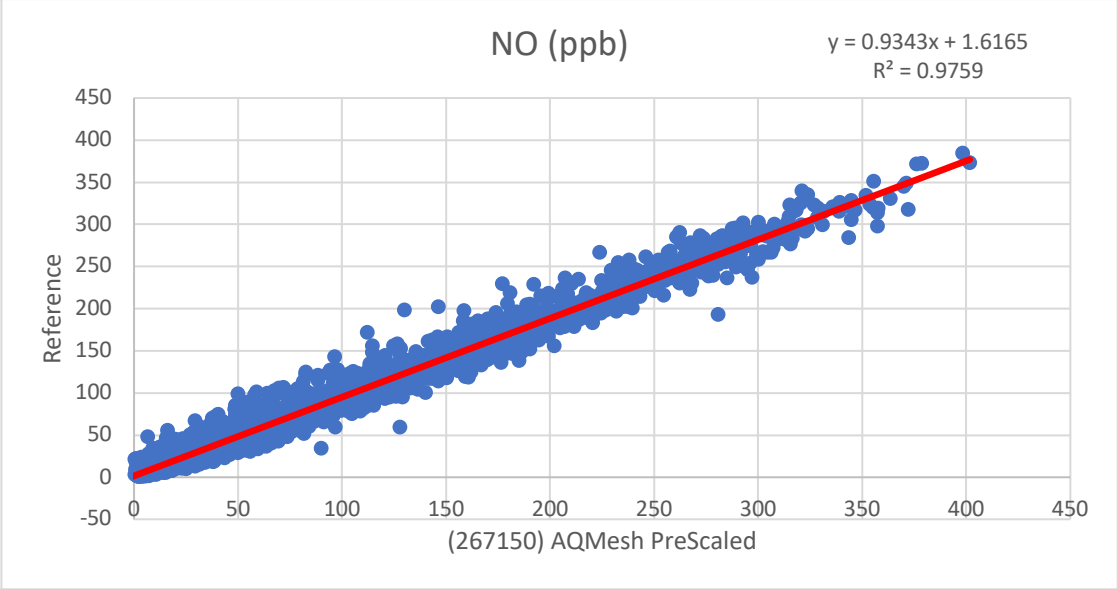
- **STEP 1**

Regression comparison of AQMesh PreScaled data versus reference or Gold Pod Scaled data, using the candidate pod on the x axis and the reference on the y axis. Switching axis from the standard method is done as it simplifies the calculation of slope and offset results significantly later in this process. Regression analysis can be completed using Microsoft Excel, Mathcad or similar mathematical programs.



- **STEP 2**

Removal of potential erroneous data points, such as -99# codes and other obvious outlying data points, and find the linear trend line with associated Cartesian equation.



- **STEP 3**

Apply Offset and slope to full PreScaled data set (including erroneous data points)

Reference ≈ (PreScaled data *x* Gradient) *+* Y-Intercept
Gradient = Slope
Y-Intercept = Offset
AQMesh Scaled data = (PreScaled data *x* Slope) *+* Offset

For the example shown in step 2: -

Y = (0.9343. X) + 1.6165
Slope = 0.9343
Offset = 1.6165

- **STEP 4**

Upload slope and offset values to the online application for each gas sensor and particle fraction.

- **STEP 5**

Validate pod accuracy by following the scaling process by either a second co-location with reference or co-location with Gold pod at the target location, at an interval determined by the users own QAQC process.

For long projects, it is advised that data is validated every six months to account for any changes in calibration at the reference station.
For shorter projects, good practice for validation of data would be to run a scaling exercise both pre and post the trial period, providing full confidence in the data received from the trial.

12.3 Method adjustment for use with diffusion tubes

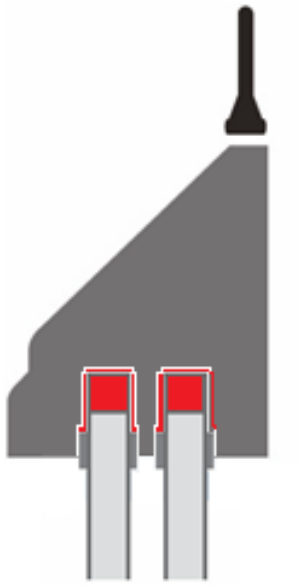
As not all users have access to reference equipment to perform standard scaling of pods, but still require the improved accuracy and validation of results which scaling provides, comparison versus diffusion tubes can provide a good alternative.

Set up

1. Set pod to sample (P2 setting) at the desired minimum required interval, e.g. 1 minute intervals.

2. Position pod in desired location for monitoring following criteria set out in section 6. “Co-location requirements” of the AQMesh S.O.P

3. Position diffusion tubes within 1 metre of the pod, or preferably attached to the side of the



-

1. Once equipment positioned correctly, turn on the AQMesh

2. Following completion of the AQMesh 2 days Stabilisation period, open diffusion tubes in line with manufacturer’s specification – It is typically advised to open 2 tubes for each measurement point in case of failure/contamination and leave 1 closed.

3. Log the date and precise time that diffusion tubes were opened, along with the tube serial number.

4. Once the period required for a suitably accurate sample has finished (typically 1 month) close the diffusion tube lids

5. Log the date and precise time that diffusion tubes were closed, along with the tube serial number.

6. Repeat a minimum of 3 further times over different time periods, as each sample only creates one point of comparison and multiple sample points are required for accurate scaling.

NB: To reduce the time required for this process, comparison periods can overlap, i.e. Open sets of diffusion tubes on consecutive days, rather than on consecutive months.

7. Return all diffusion tubes for analysis

8. Continue to use AQMesh at the desired location to gather data

- **Analysis**

It is important to remember that the diffusion tubes provide the mean levels of the target gas over the period of deployment, therefore any comparison with real-time monitoring devices, such as AQMesh should be with results averaged over the same period.

Once results from diffusion tubes have been returned to you: -

1. Gather your diffusion tube results into a format where you can include the start and end dates

2. Download AQMesh data for the whole period of comparison

3. Find the mean AQMesh PreScaled result between each diffusion tube start and end date/time

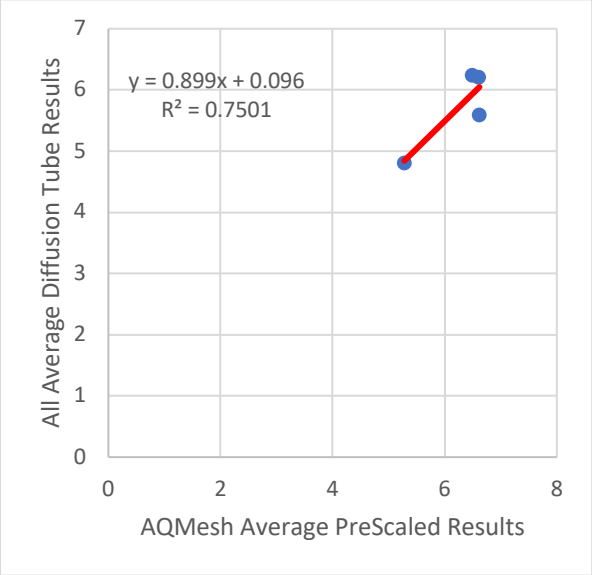
4. List these averaged pod results alongside the diffusion tube in chronological order

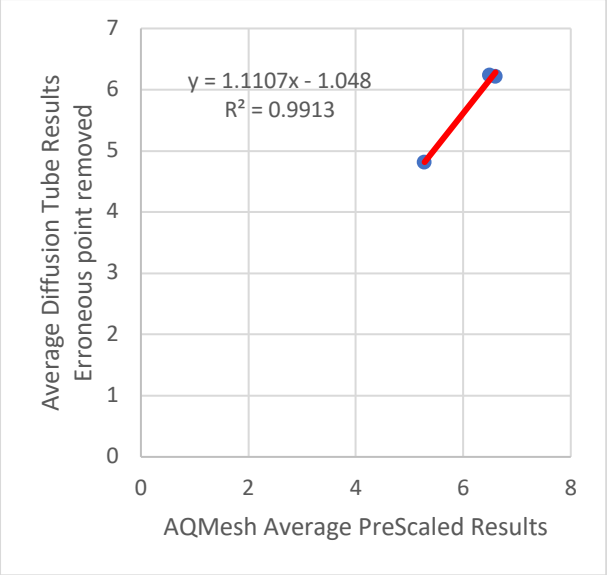
Regression comparison of AQMesh PreScaled data versus diffusion tube data, using the candidate pod on the x axis and the tube data on the y axis. Regression analysis can be completed using Microsoft Excel, MathCad or similar mathematical programs in the same manner as the standard methodology.

- **Example results**

Sample Start Time	Sample End Time	Diffusion Tube 1 Result	Diffusion Tube 2 Result	Diffusion Tube Average	AQMesh PreScaled Average Over Same Period
5th Sept 09:00	6th Oct 09:00	5.57*	5.61*	5.59*	6.62*
10th Sept 09:00	11th Oct 09:00	4.84	4.78	4.81	5.28
15th Sept 09:00	16th Oct 09:00	6.19	6.29	6.24	6.49
20th Sept 09:00	22nd Oct 09:00	6.29	6.13	6.21	6.60

***Erroneous data point removed from analysis**





13 Important notices

13.1 AQMesh pod technical specification

- https://www.aqmesh.com/products/technical-specification/

13.2 Solar power unit technical specification

- https://www.aqmesh.com/resources/solar-pack-specification/

13.3 Warranty policy

This analyser is guaranteed, to the original end user purchaser, against defect in materials and workmanship for 12 months from the data of the shipment to the user. During this period the manufacturer will repair or replace defective parts on an exchange basis. The decision to repair or replace will be determined during repair.

To maintain this warranty, the purchaser must perform the installation and maintenance as prescribed in this operating manual. Only parts supplied by the manufacturer or its authorised distributors should be fitted. Normal wear and tear and parts damaged by abuse, misuse, negligence or accidents are specifically excluded from the warranty.

Electrochemical sensors carry a 12 month warranty.

The manufacturer will repair or replace (at the manufacturer's discretion) any goods supplied by the company in respect to defects arising within 12 months from the date of purchase or delivery, whichever is later, provided that:

The defect is due to faulty parts or workmanship provided by the manufacturer.

Proof of delivery/purchase must be provided to the manufacturer for any claims. This includes the manufacturer sales order, invoice or delivery note.

All warranty repairs can only be carried out by the manufacturer or its authorised agents. In certain circumstances, permission may be granted by the manufacturer for the owner to replace a supplied part under warranty.

Any repair or replacement component under warranty will not extend the warranty period of the system.
Products must have been returned for service and calibration as recommended by the manufacturer or its authorised agents.
Were replacement parts have been supplied by the manufacturer, under warranty, the replaced parts must be returned to the manufacture. If not returned, the manufacturer reserves the right to charge for the replacement part.

If no fault is found an investigation charge may apply.

Technical support MUST be notified in the event of a pending warranty claim. They will then issue a warranty reference number that must be included in any return. Failure to provide this will void any warranty claim.

The following is not included:

Normal wear and tear of parts that might wear out over time, or be consumed, is not covered.

A service is not part of a warranty claim.
Accidental damage, including dropping during installation.

Damage as a result of vandalism or theft.

Faults arising from use of the equipment that is not in accordance with standard operating procedures laid out in the manufacturer's operating manual.

Faults arising from use of the equipment in unsuitable applications.

Repairs or alterations carried out by parties other than that manufacturer, its authorised agents, or under the instruction of the manufacturer.

Any data stored on the equipment that may be lost.

A claim due to a failure in maintaining the system in accordance with the operating manual.

A claim as a result of poor quality or inadequate repairs.

Any business-related losses such as income, profits and contracts (as far as the law allows).
The following voids the warranty:

When non-approved manufacturer parts have been used for repair or maintenance.

When parts are added, or alterations made, to the system outside the scope of the operating manual.

The AQMesh pod has been opened in poor weather conditions that have resulted in damage to any of its components.

The equipment has been stored or installed outside of the operating range and environmental conditions determined in the operating manual.

> ✍ *Note: Warranty repair is only granted after an investigation by the manufacturer.*
> ✍ *Note: For assistance in determining if your equipment qualifies for warranty investigation, please contact your local distributor, or our technical support team at the manufacturer on +44(0)1789 777703 or email support@aqmesh.com*
> ✍ *Note: For any other queries please contact your local distributor, or our sales team at the manufacturer on +44(0)1789 777703 or email info@aqmesh.com*

13.4 WEEE compliance

The wheelie bin symbol displayed on equipment supplied by the manufacturer signifies that the apparatus must **NOT** be disposed of through the normal municipal waste stream but through a registered recycling scheme.

The Waste Electrical and Electronic Equipment Directive (WEEE) make producers responsible in meeting their obligations, with the fundamental aim of reducing the environmental impact of electrical and electronic equipment at the end of its life.

The manufacturer is registered with the Environment Agency as a producer and has joined a recycling scheme provider that manage and report on our electrical waste on our behalf.

Our producer registration number is WEE/FB5573RX

When your equipment (pod or sensor) is at the end of its life, please contact the manufacturer who will advise you on the next steps in order to help us meet our obligations.

13.5 Battery disposal considerations

Lithium-thionyl chloride batteries do not contain hazardous materials according to EC directives 91/157/EEC, 93/86/EEC, and 2011/65/EU (RoHS directive). The reaction products are inorganic and do not represent environmental hazards, once the decomposition or neutralization process has terminated. The batteries are free of mercury, lead, manganese, and cadmium.

NiMH batteries

EC battery directive 2006/66/EC has been implemented by most EC member states.

According to the EU Battery Directive, batteries are marked with the symbol of the crossed out wheeled bin (see figure above). The symbol reminds the end user that batteries are not permitted to be disposed of with household waste, but must be collected separately in accordance with applicable local regulations.

Do NOT incinerate.

Waste batteries must be effectively protected against short circuit during storage and transportation.

> ✍ *Note: For further information please contact AQMesh technical support by emailing support@aqmesh.com or contacting your distributor.*

13.6 Declaration of conformity

ENVIRONMENTAL Instruments

CE

Declaration of Conformity

In accordance with BS EN ISO/IEC 17050-1:2010

We – Environmental Instruments Ltd.

Of – Unit 5, The Mansley Centre, Timothy's Bridge Road, Stratford-upon-Avon, CV37 9NQ. UK

Declare that under our own responsibility the following products:

Name	AQMesh – Radio network variant
Description	A range of wireless outdoor air quality monitors and accessories measuring various atmospheric gases, particles and other parameters.
Models	GXXXXX-XXXX-X, PXXXXX-XXXX-X, CXXXXX-XXXX-X

In accordance with the following directives:

Directive 2014/53/EU	Radio Equipment Directive (RED).

Has been designed and manufactured to the following harmonized standards and specifications:

Essential requirement /Standard	**Title**
Article 3.1 (a): Health and Safety of persons	
EN 61010-1:2010 /A1:2019	Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General requirements
EN 62311:2008	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)
Article 3.1 (b): Electromagnetic Compatibility	
EN 61326-1:2013.	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements. Emissions: Group 1 Class B equipment. Immunity: Basic environment. Performance Criterion A limit: deviation <10% range.
EN301-489-1 V2.2	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard for Electromagnetic Compatibility
EN 301 489-19 V2.1.1	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 19: Specific conditions for Receive Only Mobile Earth Stations (ROMES) operating in the 1,5 GHz band providing data communications and GNSS receivers operating in the RNSS band (ROGNSS) providing positioning, navigation, and timing data; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU
EN 301 489-52 V1.1.0	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 52: Specific conditions for Cellular Communication User Equipment (UE) radio and ancillary equipment; Harmonised Standard for Electromagnetic Compatibility
Article 3.2: Effective use of radio spectrum	

EN 301 511 V12.5.1	Global System for Mobile communications (GSM); Mobile Stations (MS) equipment; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU
EN 301 908-1 V13.1.1	IMT cellular networks; Harmonised Standard for access to radio spectrum; Part 1: Introduction and common requirements
EN 301 908-13 V13.1.1	IMT cellular networks; Harmonised Standard for access to radio spectrum; Part 13: Evolved Universal Terrestrial Radio Access (E-UTRA) User Equipment (UE)
EN 303 413 V1.1.1	Satellite Earth Stations and Systems (SES); Global Navigation Satellite System (GNSS) receivers; Radio equipment operating in the 1164 MHz to 1300 MHz and 1559 MHz to 1610 MHz frequency bands; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

Signed by:

Name: Mr Stephen Earp

Position: Technical Director

Done at: Environmental Instruments, Warwickshire, UK

On: 29/09/2023

Last two digits of the year that CE marking was first affixed : 13

13.7 Document history and version control

AQMesh user manual	
AQMesh algorithm version	**V5.0, V5.1, V5.2, V5.3**

Prepared by: Tom Townend, Product Manager **Signed:** 

Authorised by: Steve Earp, Technical Director **Signed:** 

Version Control QMS ISO9001:2015 Controlled electronically in Environmental Instruments Ltd "Compliance" SharePoint only		
Version number	**Changes made**	**Date Issued**
1.0	**Original document – merging of AQMSOP and OMAQM**	**July 2021**
1.1	**Warning added on page 10 and 13 about not picking the pod up by the antenna**	**July 2022**
1.2	**1. Change to point 3.3 re battery change** **2. Removed AQMesh Technical specification details and added link** **3. Removed Solar Power unit technical specification and added link to website**	**February 2023**
1.3	**CE conformity-The CE-marking is the manufacturer's statement to the UK/EU** (UK added)	**October 2023**
1.4	**Minor update to OFZ codes.**	**April 2024**