microAeth® AL30

Operating Manual

AETHLABS

https://aethlabs.com
Mar 2025, rev00

TABLE OF CONTENTS

1. Introduction

1.1. Serial Number

The model and serial number of the microAeth AL30 is located on the bottom and back of the instrument adjacent to the USB port. Record the serial number in the space provided below. Refer to these numbers whenever you contact AethLabs for service.

Model: microAeth® AL30

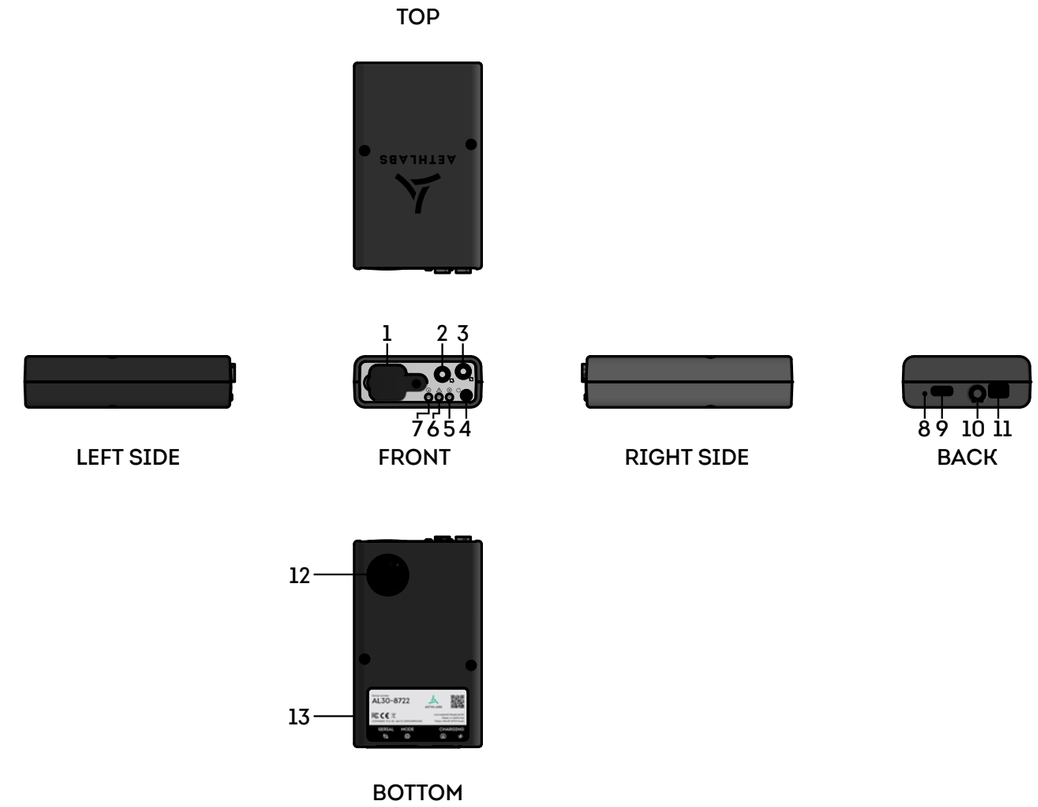
Serial Number: AL30-_____

1.2. Overview

Thank you for your purchase of the AethLabs microAeth® Black Carbon monitor. This product is the result of many years of research and development and represents a leap forward in mobile and stationary Black Carbon measurements. We hope that the features and capabilities of this product will enable new types of research and scientific inquiry. Please let us know how you use the instrument and if there is anything we can do to help.

The microAeth AL30 is a portable scientific instrument which measure the mass concentration of light absorbing carbonaceous particles in a sampled aerosol. The instrument has 1 analytical channel operating at the 880 nm wavelength. Measurement at 880 nm is interpreted as concentration of Black Carbon ('BC').

1.3. Instrument Diagram



1. Filter strip front cover
2. Inlet port
3. Outlet port
4. Power button
5. Operation Indicator
6. Warning Indicator
7. Notification Indicator
8. Charging Indicator
9. USB-C Charging port
10. WiFi Mode button
11. 4-pin 3.3V TTL serial port
12. Filter strip release button
13. Serial number label

2. Safety, Handling, and Support

2.1. Important Safety Information

WARNING: Correct operation of the microAeth is imperative for safe functioning. Failure to follow these safety instructions could result in fire, electric shock, injury, or damage to the microAeth, accessories, or other property. Only AethLabs authorized service personnel should remove covers except for the filter strip front cover. Always make sure the filter strip front cover is reinstalled when the instrument is in use. Never disassemble or make modifications to the microAeth as it may cause damage or hazard. Read all safety information and familiarize yourself with the contents of this user manual before using the microAeth.

2.1.1 Handling

Please handle the microAeth with care. The microAeth has sensitive electronic and mechanical components inside that if disturbed or damaged can cause measurement issues and possible hazard. The microAeth and its lithium-ion battery can be damaged if dropped, impacted, burned, punctured, crushed, or exposed to liquid. If damage is noticed or suspected, discontinue use of the microAeth and any accessories until the instrument has been inspected or repaired by AethLabs authorized service personnel.

2.1.2. Repair

Only AethLabs authorized service personnel should repair or service the microAeth. Never disassemble the microAeth for any reason including repair. Never remove covers except for the filter strip front cover. Always make sure the filter strip front cover is reinstalled when the instrument is in use. Making modifications or repairs to the microAeth will void any warranty and may cause damage or hazard.

2.1.3. Light Sources

The microAeth contains components with emissions in the invisible infrared spectrum. These components are covered during operation and not directly accessible but can cause injury and damage if unauthorized disassembly or repair is made to these sources or any of their mating components. Do not look directly at the light sources as it may be hazardous to do so with the naked eye or with the aid of optical instruments. Do not directly view the light sources with optical instruments. Only AethLabs authorized service personnel should move, modify, service, or repair the light sources and mating components.

2.1.4. Battery

Do not attempt to disconnect, connect, or replace the lithium-ion battery in the microAeth. Do not expose the battery to sources of excessive heat. Only AethLabs authorized service personnel should service or replace the battery in the microAeth. Never remove covers except for the filter strip front cover. Always make sure the filter strip front cover is reinstalled while the instrument is in use. The lithium-ion battery in the microAeth must be recycled or disposed of properly and separately from general or household waste in compliance with local laws and regulations. The lithium-ion battery contained in the microAeth and therefore the microAeth must be packaged and shipped properly. Please see section 2.2.11. Shipping for more information. Do not incinerate the battery. Do not handle damaged or leaking lithium-ion batteries. CAUTION RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE.

2.1.5. Charging / Power Source

The microAeth should only be operated and charged from the power source types indicated in the instrument specifications. Charge and operate the microAeth with the supplied AC Wall USB-C power adapter and cable. Only genuine cables and power chargers from AethLabs should be used. Do not use any cables, power chargers, or power sources with the microAeth that are not supplied by, or recommended by AethLabs, as they may cause damage or a hazard. Always inspect ports and cables before making any connection to the instrument. Damaged cables or chargers, or charging when moisture is present, can cause fire, electrical shock, other injury, or damage.

2.1.6. Heat Exposure

Do not expose the microAeth or its battery to sources of excessive heat such as direct, high intensity sunshine or fire. Always provide adequate ventilation, shelter, or protection for the instrument.

2.1.7. Radio Frequency Exposure

The microAeth uses radio signals for wireless communications with networks and other instruments.

2.1.8. Radio Frequency Interference (FCC and IC Compliance Statements)

The effect of electromagnetic fields from components and radios contained in the microAeth on other electronic devices is dependent on various factors and is unpredictable. The microAeth complies with Part 15 of the FCC Rules and with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Do not use near life critical systems. The electromagnetic fields from the instrument may interfere with other electronic devices. Follow all signs and notifications that prohibit or restrict the use of electronic devices and wireless transmitters.

Important: Changes or modifications to this product not authorized by AethLabs could void the electromagnetic compatibility (EMC) and wireless compliance and negate your authority to operate the product. This product has demonstrated EMC compliance under conditions that included the use of compliant peripheral devices and shielded cables between system components. It is important that you use compliant peripheral devices and shielded cables between system components to reduce the possibility of causing interference to radios, televisions, and other electronic devices.

2.1.9. Medical Device Interference

The effect of electromagnetic fields from components and radios contained in the microAeth on medical devices is dependent on various factors and is unpredictable. The electromagnetic fields from the instrument may interfere with medical devices.

2.1.10. Explosive Atmospheres

Never use, charge, or make connections to the microAeth in any area with a potentially explosive atmosphere or near fire or flammable substances.

2.1.11. High-consequence Activities

The microAeth is not intended for use where the failure of the microAeth could lead to death, personal injury, or severe environmental damage.

2.1.12. Choking Hazard

Some microAeth components and accessories may present a choking hazard to children. Keep these components and accessories away from children.

2.2. Important Handling Information

2.2.1. Moving Parts

The microAeth contains moving parts. Be careful of moving parts when the filter strip front cover is open and or interacting with the filter strip and analysis chamber mechanisms.

2.2.2. Exposure to liquid, excessive dust, or foreign objects

Never expose the microAeth, ports, cables, or connections to the instrument to liquid or excessive dust. Never insert foreign objects into any opening or port. This instrument, ports, and air passageways should not be exposed to rain, moisture, objects filled with liquids, or any other sources or forms of liquid.

2.2.3. Using connectors, ports, and buttons

Never force any connector, cable, or foreign object into any port or opening in the instrument. Do not apply excessive pressure when inserting the filter strip into the instrument, pressing a button, or inserting or threading a cable or tubing connector into a port. Be careful to align threaded connectors correctly and to assure correct orientation while inserting all connectors. If the cable or tubing connector and port do not join with reasonable ease, they may not be compatible or there may be an obstruction. Always inspect ports and cables before making any connection to the instrument. If a port is obstructed or a cable is damaged or frayed, contact AethLabs or an authorized representative immediately for support and genuine AethLabs replacement components.

2.2.4. Operating Temperature

The microAeth is designed to operate in ambient temperatures and conditions of 0 ~ 40 °C, non-condensing. The microAeth can be damaged and battery life shortened if stored or operated outside of these conditions. For safety reasons the internal battery charger may disable battery charging if the instrument is operating at extreme temperatures. Avoid exposing the microAeth, connections, and tubing to rapid and dramatic changes in temperature or humidity. Care must be taken to identify installation and use conditions that might cause condensation of the sample aerosol stream or of the instrument itself. Such condensation can cause instrument damage, electrical shock, or hazard.

2.2.5. Consumables

Filter strips will require replacement on a regular basis depending on the measurement environment and the operating settings of the instrument. Only genuine AethLabs filter material and strips, supplied by AethLabs or authorized representative, should be used in the microAeth.

2.2.6. Cleaning

If the microAeth is exposed to any liquids or other damaging contaminants, immediately turn off the instrument, disconnect all cables, and remove any foreign substances in contact with the instrument. Do not use liquids or other cleaning products on the instrument. Wait until the microAeth is completely dry before charging or turning on the instrument. Only AethLabs authorized service personnel should clean the air passageways and internal components of the microAeth. Keeping the microAeth and its air passageways, internal components, and optical chambers clean is critical for maintaining the instrument and producing quality measurements. Contamination of the instrument can cause increased measurement noise, poor sealing of the analytical area and degraded operational lifetime of some components. AethLabs recommends sending your instrument for annual service, or more frequent service depending on use and operating conditions.

2.2.7. Replacement Parts

Only genuine AethLabs parts should be used in the microAeth. Only AethLabs authorized service personnel should make repairs, install replacement parts, or open the instrument except for the filter strip front cover. Always make sure the filter strip front cover is reinstalled when the instrument is in use.

2.2.8. Accessories

Only use genuine accessories from AethLabs or recommended by AethLabs. Do not use any accessories with the microAeth that are not supplied by or recommended by AethLabs, as they may cause damage or hazard.

2.2.9. Servicing

Only AethLabs authorized service personnel should service the microAeth. Never remove covers except for the filter strip front cover. Always make sure the filter strip front cover is reinstalled when the instrument is in use.

2.2.10. Disposal

The microAeth and/or its battery must be recycled or disposed of properly and separately from general or household waste in compliance with local laws and regulations. When this product reaches its end of life, take it to a collection point designated by local authorities. The separate collection and recycling of your product and/or its battery at the time of disposal will help conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment.

2.2.11. Shipping

The microAeth AL30 contains a lithium-ion battery and therefore must be packaged and shipped properly according to regulations for different shipping methods. Please refer to International Air Transport Association (IATA) regulations when shipping the microAeth as there are limits to how many microAeth can be shipped in a single box based on the battery size in each instrument. The microAeth AL30 contains a 3.7V 2200 mAh (8.14 Wh), 1 cell rechargeable lithium-ion battery. Please contact your shipping carrier for more information and for packing instructions.

2.3. Warranty

If product(s) were not purchased directly from AethLabs. please check with your reseller for Warranty details.

Disclaimer of Warranties; Limitation of Liability. Seller warrants that the Products sold hereunder, under normal use and service as described in the operator's manual, shall be free from defects in workmanship and material for the lesser of (i) twelve (12) months, or (ii) the length of time specified in the operator's manual, from the date of the shipment to the Buyer ("Warranty Period"). This Warranty Period is inclusive of any statutory warranty. Notwithstanding the foregoing, this limited warranty is subject to the following exclusions and exceptions: (i) air pumps are warranted only for ninety (90) days unless otherwise specified in the operator's manuals; (ii) parts repaired or replaced as a result of repair services are warranted to be free from defects in workmanship and material, under normal use, for the later of (a) ninety (90) days from the date of shipment to the Buyer, or (b) the end of the Warranty Period; (iii) Seller does not provide any warranty on finished goods manufactured by others or on other consumable materials; and (iv) unless specifically authorized by separate writing by Seller, Seller makes no warranty with respect to, and shall have no liability in connection with, goods which are incorporated into other products or equipment, or which are modified by any person other than Seller. Seller agrees during the Warranty Period, to repair or replace, at Seller's option, defective Products so as to cause the same to operate in substantial conformance with the published specifications thereof; provided that Buyer shall (i) promptly notify Seller in writing upon the discovery of any defect, which notice shall be provided during the Warranty Period and shall include the product model and serial number (if applicable) and details of the warranty claim, and (ii) prepay the shipment costs. Replacement parts may be new or refurbished, at the election of Seller. All replaced parts shall become the property of Seller. Shipment to customer of repaired or replacement Products shall be made in accordance with the delivery provisions set forth in these Terms. In no event shall Seller have any obligation to make repairs, replacements or corrections required, in whole or in part, as the result of: (i) normal wear and tear; (ii) accident, disaster or event of force majeure; (iii) misuse, fault or negligence of or by Buyer; (iv) use of the Products in a manner for which they were not designed; (v) causes external to the Products such as, but not limited to, water damage, impact damage from fall, power failure or electrical power surges, lack of maintenance; (vi) improper storage and handling of the Products; or (vii) use of the Products in combination with equipment or software not supplied by Seller. If Seller determines that Products for which Buyer has requested warranty services are not covered by the warranty hereunder, Buyer shall pay or reimburse Seller for all costs of investigating and responding to such request at Seller's then prevailing time and materials rates. If Seller provides repair services or replacement parts that are not covered by this warranty, Buyer shall pay Seller therefore at Seller's then prevailing time and materials rates. ANY INSTALLATION, MAINTENANCE, REPAIR, SERVICE, RELOCATION OR ALTERATION TO OR OF, OR OTHER TAMPERING WITH, THE PRODUCTS PERFORMED BY ANY PERSON OR ENTITY OTHER THAN SELLER WITHOUT SELLER S PRIOR WRITTEN APPROVAL, OR ANY USE OF REPLACEMENT PARTS NOT SUPPLIED BY SELLER, SHALL IMMEDIATELY VOID AND CANCEL ALL WARRANTIES WITH RESPECT TO THE AFFECTED PRODUCTS. THE OBLIGATIONS CREATED BY THIS WARRANTY STATEMENT TO REPAIR OR REPLACE A DEFECTIVE PRODUCT SHALL BE THE SOLE REMEDY OF BUYER IN THE EVENT OF A DEFECTIVE PRODUCT OR OTHERWISE FOR BREACH OF THIS WARRANTY OR THESE TERMS. EXCEPT AS EXPRESSLY PROVIDED IN THIS WARRANTY STATEMENT, SELLER DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, ORAL OR WRITTEN, WITH RESPECT TO THE PRODUCTS, INCLUDING WITHOUT LIMITATION ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE PRODUCTS ARE ERROR-FREE OR WILL ACCOMPLISH ANY PARTICULAR RESULT. SELLER MAKES NO OTHER REPRESENTATION OR WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, REGARDING THE PRODUCTS, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL SELLER BE LIABLE FOR COSTS OF PROCUREMENT

OF SUBSTITUTE GOODS AND SERVICES, LOSS OF USE OR LOST PROFITS, OR ANY OTHER SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES, ARISING OUT OF OR RELATED TO ANY SALE OF THE PRODUCTS OR THE USE OR PERFORMANCE OF THE PRODUCTS, HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN AN ACTION FOR CONTRACT, TORT OR OTHERWISE, AND WHETHER OR NOT SELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

2.4. End User License Agreement (EULA)

READ THIS END USER LICENSE AGREEMENT ("AGREEMENT") CAREFULLY BEFORE USING THE ACCOMPANYING SOFTWARE AND ANY ASSOCIATED FIRMWARE (COLLECTIVELY, THE "SOFTWARE"). BY DOWNLOADING AND USING THE SOFTWARE, YOU ACKNOWLEDGE THAT YOU HAVE READ THIS AGREEMENT, THAT YOU UNDERSTAND IT, AND THAT YOU ACCEPT AND AGREE TO BE BOUND BY ITS TERMS. IF YOU ARE NOT WILLING TO BE BOUND BY THE TERMS OF THIS AGREEMENT, YOU SHOULD TERMINATE THE DOWNLOAD AND/OR INSTALLATION PROCESS, AND REFRAIN FROM ACCESSING OR USING THE SOFTWARE.

THE SOFTWARE IS COPYRIGHTED AND IS LICENSED TO YOU UNDER THIS AGREEMENT; IT IS NOT SOLD TO YOU. THIS AGREEMENT REPRESENTS THE ENTIRE AGREEMENT BETWEEN YOU AND MICROAETH CORPORATION DBA AETHLABS CONCERNING THE SOFTWARE, AND THIS AGREEMENT SUPERSEDES AND REPLACES ANY PRIOR PROPOSAL, REPRESENTATION, OR UNDERSTANDING YOU MAY HAVE HAD WITH AETHLABS RELATING TO THE SOFTWARE.

License Grant. microAeth Corporation DBA AethLabs ("Licensor") hereby grants you a personal, non-transferable and non-exclusive license to use (i) the Software, and (ii) any related documentation or electronic instructions accompanying the Software (the "Documentation").

You obtain no right, title or ownership in any Software or Documentation, nor do you obtain any right to sublicense the Software. The Software may be used only as provided in either machine-readable object code form or machine-compressed form. This license is not a sale of the original or any copy of the Software.
You may use the Documentation to assist in your use of the Software, but you may not make copies of the Documentation.
Use Restrictions. Except to the extent these restrictions are prohibited by applicable law or prohibited by the terms of any Open Source License, you must not, and must not allow any other person to: (a) use the Software to conduct comparative or competitive analyses, including benchmarking; (b) reverse engineer, decompile, reverse compile, reduce in human readable form or otherwise access the source code of the Software; (c) sublicense, rent, lease, modify, enhance, supplement, create derivative works from the Software; (d) copy the Software; (e) remove or otherwise tamper with any proprietary notices contained on or in the Software; or (f) use or permit the Software to be used to perform services for third parties, without Licensor's express written authorization.
Software Transfers. Unless Licensor has given you specific written permission to do so, you may not copy, transfer, transmit, sublicense or assign your rights to use the Software, grant a security interest in or over your rights to use the Software, or otherwise transfer any part of your rights to use the Software.
Warranty Disclaimers, Limitations on Liability and Remedies. THE SOFTWARE IS PROVIDED TO YOU ON AN "AS IS" BASIS AND IS USED ONLY AT YOUR SOLE RISK. TO THE FULLEST EXTENT PERMISSIBLE BY LAW, LICENSOR DISCLAIMS ALL WARRANTIES, EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE, OF ANY KIND REGARDING SOFTWARE, INCLUDING ANY IMPLIED WARRANTIES AS TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, TITLE, NON-INFRINGEMENT, RESULTS, ACCURACY,

COMPLETENESS, ACCESSIBILITY, COMPATIBILITY, SECURITY AND FREEDOM FROM COMPUTER VIRUS. IF APPLICABLE LAW DOES NOT ALLOW THE EXCLUSION OF SOME OR ALL OF THE ABOVE IMPLIED WARRANTIES TO APPLY TO YOU, THE ABOVE EXCLUSIONS WILL APPLY TO YOU TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW. Any warranties that by law survive the foregoing disclaimers shall terminate ninety (90) days from the date you received the Software.

The entire risk as to the quality and performance of the Software and the Documentation is with you. Should the Software or the Documentation prove defective, you (and not Licensor or its distributors, licensors or dealers) assume the entire cost of all necessary servicing or repair. Licensor does not warrant that the functions contained in the Software will meet your requirements or operate in the combination that you may select for use, that the operation of the Software will be uninterrupted or error free, or that defects in the Software will be corrected. No oral or written statement by Licensor or by a representative of Licensor shall create a warranty or increase the scope of this warranty.

LICENSOR'S ENTIRE LIABILITY AND YOUR EXCLUSIVE REMEDY WITH RESPECT TO ANY DISPUTE WITH LICENSOR (INCLUDING WITHOUT LIMITATION YOUR USE OF THE SOFTWARE) IS TO DISCONTINUE YOUR USE OF THE SOFTWARE. LICENSOR AND ITS VENDORS SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGE ARISING FROM YOUR USE OF THIS SOFTWARE OR FOR ANY OTHER CLAIM RELATED IN ANY WAY TO YOUR USE OR REGISTRATION WITH LICENSOR. THESE EXCLUSIONS FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES INCLUDE, WITHOUT LIMITATION, DAMAGES FOR LOST PROFITS, LOST DATA, LOSS OF GOODWILL, WORK STOPPAGE, COMPUTER FAILURE OR MALFUNCTION, OR ANY OTHER COMMERCIAL DAMAGES OR LOSSES, EVEN IF LICENSOR HAD BEEN ADVISED OF THE POSSIBILITY THEREOF AND REGARDLESS OF THE LEGAL OR EQUITABLE THEORY UPON WHICH THE CLAIM IS BASED. BECAUSE SOME STATES OR JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR THE LIMITATION OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, IN SUCH STATES OR JURISDICTIONS, LICENSOR AND ITS VENDORS' LIABILITY IN SUCH STATE OR JURISDICTION SHALL BE LIMITED TO THE FULLEST EXTENT PERMITTED BY LAW. IN ANY EVENT, IF ANY OF THE ABOVE PROVISIONS IN THIS SECTION ARE NOT ENFORCEABLE IN AN APPLICABLE JURISDICTION, THE MAXIMUM LIABILITY OF LICENSOR WILL BE LIMITED TO, IN THE SOLE DISCRETION OF LICENSOR, EITHER THE (1) CORRECTION OR DELETION OF ANY DEFECTIVE SOFTWARE; OR (2) REFUND OF ANY FEES FOR THIS SOFTWARE RECEIVED BY LICENSOR FROM YOU, IF ANY.

Ownership and Licenses. Licensor and its licensors own all copyright, trademarks, designs, patents, know-how, trade secrets, trade, business or company names, domain names and related registration rights and all other intellectual property rights in the Software, including any modifications ("Licensor IP"). Licensor IP is protected by U.S. and international copyright and other intellectual property laws. You are only granted license rights in the Software, expressly stated in this Agreement. You must not do anything to jeopardize Licensor's or its licensors' rights in the Licensor IP including to (i) copy, modify, merge, or transmit Licensor IP; (ii) register or attempt to register any competing intellectual property rights to the Licensor IP; (iii) delete or tamper with any proprietary notices on or in the Licensor IP, (iv) take or use any action that diminishes the value of any trademarks included in the Licensor IP, or (v) use the Software in violation of applicable law. These restrictions are in addition to those stated in Section 2.

Third Party and Open Source Software. Portions of the Software may utilize or incorporate third party software and other copyrighted material. Acknowledgements, licensing terms and additional disclaimers for any such material are contained in the Documentation or may otherwise accompany such material, and your use of such material is governed by their respective terms. Certain software libraries and other third party

software included within the Software are open source software and licensed under the terms of licenses such as the BSD License, GNU General Public License ("GPL"), and/or GNU Lesser General Public License ("LGPL"). To the extent that portions of the Software are distributed under and subject to open source licenses obligating Licensor to make the source code for such portions publicly available (such as the GPL and LGPL), Licensor will make such source code portions (including Licensor modifications, as appropriate) available upon request for a period of up to three (3) years from the date of distribution. Such request can be made in writing to: microAeth Corporation (refer to current mailing address available at https://aethlabs.com). A copy of the GPL may be obtained at http://www.gnu.org/licenses/gpl.html, and a copy of the LGPL at http://www.gnu.org/licenses/lgpl.html.

Term and Termination of Agreement. This Agreement is effective upon your downloading, accessing or using the Software. This Agreement shall continue in effect until terminated. Without prejudice to any other rights, this Agreement will terminate automatically if you fail to comply with any of the limitations or other requirements described herein. Furthermore, you may terminate this Agreement at any time by destroying all copies of the Software and Documentation. All obligations of confidentiality and restrictions on use, and all other provisions that may reasonably be interpreted to survive termination of this Agreement, will survive termination of this Agreement for any reason.

U.S. Government Restricted Rights. If you are a U.S. Government user, then the Software and Documentation (i) are provided with "RESTRICTED RIGHTS" and the use, duplication or disclosure of the Software and Documentation is subject to the restrictions set forth in subparagraphs (c)(1) and (c)(2) of the Commercial Computer Software-Restricted Rights (Jun 1987) clause at FAR 52.227-19, and (ii) are provided with "LIMITED RIGHTS" and the use, duplication and disclosure of the Software and Documentation is subject to the restrictions set forth in subparagraphs (a)(13) and (b)(3) of the Rights in Technical Data-Noncommercial Items (Nov 1995) clause at DFARS 252.227-7013, as applicable, or their successors or any similar future statutes or regulations. Manufacturer is microAeth Corporation DBA AethLabs.

Export Control Laws. You agree to comply with all laws, rules and regulations applicable to the export of the Software or the Documentation. Specifically, you shall not export, re-export or transship the Software or the Documentation, or the direct product thereof, in violation of any United States or other laws and regulations which may from time to time be applicable. None of the Software, Documentation or underlying information or technology may be downloaded or otherwise exported or re-exported (i) into (or to a national or resident of) Cuba, Iran, Iraq, Libya, Serbia, Montenegro, North Korea, Syria or any other country to which the U.S. has embargoed goods; or (ii) to anyone on the U.S. Treasury Department's list of Specially Designated Nationals or the U.S. Commerce Department's Table of Denial Order. By using the Software, you are agreeing to the foregoing and you are representing and warranting that you are not located in, under the control of, or a national or resident of any such country or on any such list.

Applicable Law and Forum. With respect to any and all disputes arising out of or in connection with this Agreement, Licensor and you agree to negotiate in good faith and undertake reasonable efforts to cooperate with one another in order to achieve a mutually satisfactory resolution. Licensor has no obligation to become involved in any dispute between you and any other person. This Agreement and any dispute arising in connection therewith shall be exclusively governed by and construed in accordance with the laws of the State of California without regard to its conflict of law principles. Licensor and you agree that all disputes arising under this Agreement shall be resolved by confidential binding arbitration administered by the American Arbitration Association ("AAA") in San Francisco, California, or another forum mutually agreed upon by you and Licensor, pursuant to the Commercial Arbitration Rules ("Rules") of the AAA by a sole arbitrator nominated by agreement of you and Licensor and confirmed in accordance with the Rules. If AAA is not hearing consumer commercial disputes at the time, Licensor may select another arbitral body in its sole discretion. The arbitrator's award shall be binding and may be entered as a judgment in a court of competent

jurisdiction. You agree that Licensor is entitled to obtain preliminary injunctive relief to the extent allowed by law to enforce any of the terms of this Agreement pending a final arbitral decision.

Indemnification. You agree to defend, indemnify and hold harmless Licensor, and its affiliates, officers, directors, employees and contractors from any demands, claims, damages, liabilities, expenses or harms, including attorneys' fees, arising in connection with your use of the Software, breach of this Agreement, or dealings or transactions with other persons resulting from use of this Software.

Entire Agreement. This Agreement constitutes the complete agreement between Licensor and you with respect to the subject matter hereof, and supersedes all prior agreements, oral or written, with respect to the subject matter hereof.

2.5. Regulatory and Compliance Notices

This instrument meets the requirements of CE certification.

This device complies with Part 15 of the FCC Rules.

This Class A digital apparatus complies with Canadian ICES-003.

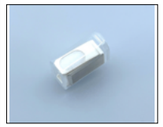
Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada. If changes are made to this instrument or it is opened without the authorization of the manufacturer, this declaration will be rendered invalid.

Regulatory information, certification, and compliance marks specific to microAeth are available on microAeth and within the microAeth manual.

3. Unpacking

Carefully unpack the instrument and accessories from their packaging. Check to identify that all items are present and that there is no damage. Retain original packaging for safe storage and shipping of the instrument.

3.1. AL30 Included Items

Quantity	Part Number	Description
1	AL30	 microAeth AL30
1	ALX-FS30	 Pack of 30 ALx Filter Strips, also 1 filter strip installed in instrument
1	AC-ALX-USBC-PS-<CC>	 AL30 AC Wall USB-C Power Adapter with fixed territory-specific plug
1	USB-C-ALX-10	 USB-C power cable, 1 meter length
1	MASH-40	 Sampling Hose with Barb Fitting Swivel Connector, 40 inches (1 meter)
1	MALC	 Lapel clip for sampling hose
Download		Quick Start Guide (download via AethLabs website)
Download		Manual (download via AethLabs website)

3.2. Consumable

ALx Filter Strip
The ALx filter strips are custom designed for use in the microAeth® AL30. The ALx filter strip has PTFE filter material for collecting a 3 mm sample spot.

3.4. Accessories

microCyclone™ 50, PM2.5 Size-selective inlet
The microCyclone is a miniature PM2.5 size-selective inlet for the microAeth. This sharp-cut cyclone has a size cut of 2.5 micron at 50 ml/min and 1.6 micron at 100 ml/min.

microCyclone™ 170, PM2.5 Size-selective inlet
The microCyclone is a miniature PM2.5 size-selective inlet for the microAeth. This sharp-cut cyclone has a size cut of 2.5 micron at 170 ml/min and 2.9 micron at 150 ml/min.

MAx/ALx Series Flow Calibration Kit
The microAeth MAx/ALx Series Flow Calibration Kit comes with all of the components necessary to reliably perform a flow calibration of the microAeth® MAx Series and ALx Series instruments. This kit includes a custom designed external mass flowmeter and all necessary tubing, connectors, and cables to perform the simple and fully automated flow calibration of the MAx instruments and the manual flow calibration of the ALx insruments. The only way to perform a flow calibration on the MAx and ALx Series instruments is to use the AethLabs MAx/ALx Series Flow Calibration Kit.

Portable Aerosol Dryer
A small, portable, passive nafion / dessicant aerosol dryer. Dessicant life of 72 liters before recharge or replacement. Dimensions (including fittings): L: 121.5 mm (4.78 in), W: 61.5 mm (2.42 in), D: 25.5 mm (1.00 in) Weight (including fittings): 128 grams (4.51 ounces)

Barb Fitting Swivel Connector
The barb fitting swivel connector allows the attachment of flexible hose that can swivel independently of the microAeth®. The barb fitting swivel connector joins a 1/8" inside diameter (ID) hose on one side with a 10-32 threaded fitting on the other - which fits into the inlet of outlet port on the microAeth.

1/8" Compression fitting connector
The 1/8" Compression Fitting Connector joins a 1/8" outside diameter (OD) metal tube on one side with a 10-32 threaded fitting on the other - which fits into the inlet or outlet port on the device. This fitting is made of 316 Stainless Steel.

1/4" Compression fitting connector
The 1/4" Compression Fitting Connector joins a 1/4" outside diameter (OD) metal tube on one side with a 10-32 threaded fitting on the other - which fits into the inlet or outlet port on the device. This fitting is made of 316 Stainless Steel.

Lapel Clip for Sampling Hose
The lapel clip allows the sampling hose to be securely situated near the target site of measurement - near the face, for instance.

Sampling Hose cut to length
Additional sampling hose with 1/8" inside diameter (ID) and 1/4" outside diameter (OD) in custom lengths can be acquired (in multiples of 10 feet) for various applications. This is a black static dissipative polyurethane hose.

17" Carrying case with foam
This black, protective carrying case for microAeth with Pick N Pluck Foam has exterior dimensions of 17" x 13.25", 4.5".

20" Carrying case with foam
This black, protective carrying case for microAeth with Pick N Pluck Foam has exterior dimensions of 20" x 14.75", 6".

3.6. Replacement Parts

AL30 AC Wall USB-C Power Adapter
The AL30 AC Wall USB-C Power Adapter is intended for use with the microAeth AL30 instrument and has a fixed region-specific plug, and both powers operation of the unit and charges the battery. We offer the following fixed AC plug options: USA (Type A), Europe (Type C), UK (Type G), and Australia (Type I). This item is included with all AL30 instrument.

USB-C Power Cable, 1 meter length
The USB-C cable can be used for charging the instrument wirh the supplied USB-C Power Supply or another USB-C power source to charge the battery and power the unit. This cable is included with all AL30 instruments.

17" Carrying case replacement foam
This is the replacement Pick N Pluck foam for the above protective carrying case for microAeth with exterior dimensions of 17" x 13.25", 4.5". This item is included with the 17" Carrying case with foam.

20" Carrying case replacement foam
This is the replacement Pick N Pluck foam for the above protective carrying case for microAeth with exterior dimensions of 20" x 14.75", 6". This item is included with the 20" Carrying case with foam.

4. Measurements

4.1. Particles

The microAeth AL30 instrument makes real-time one wavelength optical analyses by measuring the rate of decrease in transmitted light through the sample filter, due to continuous particle deposition on the filter. Measurement at 880 nm is interpreted as the concentration of Black Carbon (‘BC’).

4.2. Temperature

A temperature measurement of the sample air stream is made every Timebase. The sensor value for this measurement is very close to both the filter sampling location and the internal mass flowmeter. The datastream from this sensor is representative of the internal temperature of the sample air and while it may track changes in external air temperature, it may have a temperature offset compared with actual external ambient air temperature due to internal heating or cooling of the instrument. This sensor value is always recorded. In the data output, this value is recorded in the column labeled “Sample temp (C).” The accuracy of the temperature measurement is typically ± 0.2 °C.

A temperature measurement of the internal chassis of the instrument is made every Timebase. This sensor value is always recorded. In the data output, this value is recorded in the column labeled “Internal temp (C).” The accuracy of the temperature measurement is typically ± 1 °C at 25 °C and typically ± 3 °C over the temperature measurement range of -40 to +85 °C.

4.3. Relative Humidity and Dewpoint

A relative humidity measurement of the sample air stream is made every Timebase. This sensor value for this measurement is very close to both the filter sampling location and the internal mass flowmeter. The datastream from this sensor is representative of the internal relative humidity of the sample air and while it may track changes in external air humidity, it may have a humidity offset compared with actual external ambient air humidity due to internal heating or cooling of the instrument. This sensor value is always recorded. In the data output, this value is recorded in the column labeled “Sample RH (%).” The accuracy of the relative humidity measurement is typically ± 1.8 %RH between 10-90 %RH at 25 °C.

A dewpoint calculation is made by the instrument every Timebase. This value is always calculated and recorded using the temperature and relative humidity senors measurements. In the data output, this value is recorded in the column labeled “Sample dewpoint (C).”

4.4. Altimeter/Barometer

A pressure measurement of the internal chassis of the instrument is made every Timebase. This sensor is always recorded. In the data output, this value is recorded in the column labeled “Internal pressure (Pa)”. The accuracy of the absolute pressure measurement is typically ± 0.4 kPa at test conditions of 50 to 110 kPa over –10 °C to 70 °C.

4.5. Accelerometer

A 3-axis acceleration measurement of the internal chassis of the instrument is made every Timebase. This sensor is always recorded. In the data output, this value is recorded in the columns labeled “Accel X,” “Accel Y,” and “Accel Z.”

4.6. Flow

One mass flowmeter makes flow measurements of the sample air stream and is recorded every Timebase. This sensor measurement is always recorded and represents the average flow through the timebase period (not instantaneous). In the data output, these values are recorded in the column labeled “Flow total (mL/min).” The accuracy of the flow measurements is typically ± 5% FS 0-1 L/min (25 °C characteristic). The repeatability of the flow measurements is typically ±0.4% FS 0-1 L/min.

5. Configuration and Operation

5.1. Overview

The microAeth AL30 is a highly sensitive, portable, and miniature one-wavelength instrument designed for measuring the light absorbing carbon (‘LAC’) particles. The instrument has an 880 nm optical channel which is primarily interpreted as Black Carbon (‘BC’). The instrument is based on the well-established Aethalometer® measurement principle used for over 40 years in laboratory-sized analyzers and over 15 years in microAethalometer pocket-sized alanalyzers. The microAeth AL30 draws an air sample at a flow rate of 50, 75, 100, 125, 150, 175, 200, 225, or 250 ml/min through a 3 mm diameter portion of the filter media. Optical transmission through the ‘Sensing’ spot is illuminated by stabilized 880 nm (IR) LED light source and measured by a detector. The optical attenuation (ATN) due to absorbance of particles collected on the spot is measured relative to an adjacent ‘Reference’ portion of the filter where no particles are accumulated. This change in ATN is derived using a starting measurement and an additional measurement at the end of the timebase period. The gradual accumulation of optically-absorbing particles leads to an increase in ATN from one period to the next. The air flow rate through the spot is measured by one or more mass flow sensor(s) which are also used to stabilize the pump. The electronics and microprocessor measure and store the data each timebase period to determine the ATN increment during each timebase. This is then converted to a mass concentration of BC expressed in nanograms per cubic meter (ng/m^3) using the known optical absorbance per unit mass of Black Carbon material. The AL30 operating parameters are set up by the on-board WiFi hosted interface or web-based interface. Operation is completely automatic after the instrument is turned on and sampling is started. During operation, the microprocessor performs the optical measurements, measures and stabilizes the air flow, calculates the BC mass concentration and records data to internal nonvolatile memory. The data may be transmitted in real time by WiFi to the AethLabs website or downloaded at a later time using the on-board WiFi hosted interface. The microAeth AL30 derives its power from an internal rechargeable lithium-ion battery.

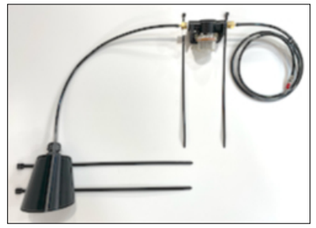
5.2. Installation & Environmental Considerations

The microAeth instrument is specifically designed to be used in a wide range of measurement scenarios. Each research deployment will require its own specific considerations for protecting the instrument and ensuring the integrity of your data. The included sample tubing assembly with threaded insert should be installed into the inlet of the instrument. Obstruction of either the inlet or outlet port should be prevented as this will affect the flow of air into the instrument.

IMPORTANT: Be sure that the aerosol inlet to the microAeth is at atmospheric pressure and that there is no differential pressure between the aerosol inlet and the operating environment of the microAeth. For example, if sampling from a plenum or chamber, the plenum or chamber must be at the same pressure as the instrument itself. If other instrumentation is measuring in parallel, we always recommend that microAeth instruments have their own sampling line so there is no impact from other devices that might have large flow rates. Failure to meet this requirement may cause sampling and/or measurement errors

In personal monitoring applications, the included lapel clip can assist in positioning the sampling inlet near to the person's breathing zone, care must be taken to ensure the inlet, or microCyclone inlet, are free from obstruction.

For outdoor deployments, protection of the instrument and the inlet and outlet ports must be considered. An Inlet Protection Kit (WPK-20-25) should be used to help protect the instrument and data from moderate water and bug intrusion and in-line condensation through the sampling train.



Outdoor installation requires protection from rapid temperature changes and moisture / precipitation. In addition to potentially having signal-to-noise implications on your data, rapidly changing environmental conditions can harm your instrument without proper protection. It is possible that an environmentally controlled enclosure could be helpful and/or necessary. The instrument should be shielded from solar radiation to reduce impact of rapid heating from the sun.

Temperature:
microAeth instruments are specified to operate between 5 ~ 40 °C. Furthermore, rapid changes in temperature can impact data. Such effects are inversely propertional to timebase and flow rate settings. It is possible that an environmentally controlled enclosure could be helpful and/or necessary depending on the application.

Humidity:
As with many other types of particle measurement instrumentation, changes in relative humidity can change the size and optical properties of particles. For locations with high RH variability, an external sample dryer or heater may be used to condition the sample. AethLabs offers a portable aerosol dryer for this application. Moving between a dry, air conditioned environment, to a high humidity environment can impact the data while the device equilibrates. Selecting a higher flowrate and longer timebase will help to reduce these effects.

Contamination:
Preventative maintenance for your deployment and sampling apparatus are important for protecting your instrument. Keeping the microAeth and its air passageways, internal components, and optical chambers clean is critical for maintaining the instrument and producing quality measurements. **We recommend, at a minimum, Standard Maintenance Service at AethLabs or an authorized service center on at least an annual basis.**

Typically, Black Carbon particles are smaller than one micron in diameter. In some sampling conditions where the aerosol is primarily composed of light scattering particulate matter, such as dust or smoke from biomass fuels, there can be a prevalent fraction of larger-diameter particles. Contamination of the instrument can cause increased measurement noise, poor sealing of the analytical area and degraded operational lifetime of some components.

For these applications, and to add contamination protection for your microAeth in high concentrations, AethLabs offers a microCyclone™ size selective inlet that will limit the size of the particles entering the microAeth to less than 2.5 microns in diameter when used at the specified flow rate.

5.3. Recommendations for Best Use Practices

The small size and light weight of the microAeth® allow it to be used to gather data in a wide range of operational scenarios, not always possible using larger instruments. Optimization of performance across the breadth of applications requires an understanding of scientific objectives, operational settings, their impact on instrumental sensitivity and trade-offs, as well as proper maintenance of the instrument. The following recommendations provide general guidelines.

5.3.1. Instrument Settings: Measurement Timebase and Flow Rate

In order to get the best data from the microAeth for a sampling campaign, we highly recommend that the instrument warm up for approximately 30 minutes so that it can equilibrate. The microAeth can acquire data on timebase settings: 1, 10, 30, 60, 150 or 300 seconds. The 1 second timebase should only be used under special circumstances where a decreased signal-to-noise ratio is acceptable. At this setting, instrumental noise is larger and typically requires post-processing. The microAeth pump can operate at multiple sampling flow rate settings: 50, 75, 100, 125, 150, 175, 200, 225, or 250 ml/min. The choice of these parameters affects the operation and data. On a 1 second timebase, the instrument will acquire about 25 megabytes of data per day, which may be more challenging to handle and take longer to download.

5.3.2. Battery Runtime on Single Charge

Battery Runtime on Single Charge: Affected by flow rate and timebase settings.
NOTE: Battery life will gradually diminish after many cycles (~ 1 year of use). Runtimes vary based on individual microAeth instruments and specific environments.

5.3.3. Effects of Contamination

Effects of Contamination, Vibration, and Impact: Primarily affected by timebase setting.

1 second	10 seconds	30 seconds	60 seconds	150 seconds	300 seconds
very large	large	moderate	low	low	least

5.3.4. Recommended Settings for Different Scenarios

Different Black Carbon measurement scenarios require different operational settings for optimum performance. The 1 second timebase setting is a 'Data Acquisition Mode' intended for subsequent processing, and should NOT be used for routine monitoring. On a 1 second timebase, the instrument will acquire about 25 megabytes of data per day, which may be more challenging to handle and take longer to download. Data collected on a 1 second timebase should always be smoothed or averaged over longer periods, in order to optimize the signal-to-noise ratio at the desired time resolution.

5.3.5. Contamination, Maintenance, and Cleaning of Sample Chamber

If a loose particle of contamination enters the sample chamber of the microAeth or the instrument experiences vibration or impact, the data may be degraded. Shaking or tapping a "dirty" instrument may create data excursions that are far larger than those of a "clean" unit. These effects are amplified greatly at the shorter timebase settings. Our recommendations for cleaning are based upon the likelihood of contamination and the nature of use.

5.3.7. Contamination Probability for Various Use Scenarios

Sampling Scenario without use of microCyclone™	Contamination Probability
Dry, dusty environment	High
Occupational settings with combustion exhaust	High
Exposure to “oily” smokes such as biomass-burning plumes, 2-cycle engine exhaust	High
Presence of suspended fluff, fibers, pollen	High
Immediate vicinity of traffic and roadways	High
Outdoor urban environments	High
Outdoor rural environments (without dust, fluff, pollen)	High
Residential indoor environments	High

5.3.8. microAeth Recommended Cleaning & Maintenance Intervals

It is suggested to perform standard maintenance on the microAeth at least once per 12-18 months. Unique, dirtier and or higher concentration sampling environments and applications may require standard maintenance on more regular intervals. It is recommended that users plan standard maintenance schedules that best coincide with and allow for the best data quality during measurement campaigns.

5.3.9. microCyclone™ 50, PM2.5 Size-selective inlet

The microCyclone™ 50 may help to prevent contamination in dusty or dirty environments where larger diameter particles are present. The microCyclone PM2.5 Size-selective inlet can be connected to the inlet of the microAeth to provide a PM2.5 size cutpoint when the microAeth is set to a 50 ml/min flow rate. A 1.6 micron size cutpoint is provided by the microCyclone when connected to a microAeth with a 100 ml/min flow rate.

IMPORTANT: If a microCyclone is being used with your microAeth, please clean it on a frequent basis, depending on sampling environment and concentrations. Please see microCyclone manual and documentation for more information.

5.3.10. microCyclone™ 170, PM2.5 Size-selective inlet

The microCyclone™ 170 may help to prevent contamination in dusty or dirty environments where larger diameter particles are present. The microCyclone PM2.5 Size-selective inlet can be connected to the inlet of the microAeth to provide a PM2.5 size cutpoint when the microAeth is set to a 170 ml/min flow rate. A 2.9 micron size cutpoint is provided by the microCyclone when connected to a microAeth with a 150 ml/min flow rate.

IMPORTANT: If a microCyclone is being used with your microAeth, please clean it on a frequent basis, depending on sampling environment and concentrations. Please see microCyclone manual and documentation for more information.

5.4. Measurement Sampling Connections

5.4.1. Inlet Port

The inlet port is a 10-32 UNF inch threaded port.

The inlet port and all connections to the inlet port must be properly protected from the environment. There must be limited restriction to flow while protection from water, insects, bugs, and other objects that can block or infiltrate the instrument air pathway. Extra precaution must be taken as the internal pump of the instrument is pulling air into the instrument through this port.

It is always recommended to use the sampling tube assembly supplied with your microAeth, screwed into the instrument's inlet port. Using this sampling tube assembly allows for more targeted sampling, can provide basic protection to the instrument inlet, and prevents the possibility of light leakage into the instrument's sample chamber.

5.4.2. Outlet Port

The outlet port is a 10-32 UNF inch threaded port.

The outlet port and all connections to the outlet port must be properly protected from the environment. There must be limited restriction to flow while protection from water, insects, bugs, and other objects that can block or infiltrate the instrument air pathway.

5.5. Power

5.5.1. Charging

Input: 100~240 VAC 50/60Hz 0.4A, Output: 5VDC / 2A, with option for Type A, C, G, or I plug
The power source via USB may introduce additional noise to measurement data.

Before using the instrument, the internal battery can be charged by plugging it into external power using the USB-C power adapter. Battery runtime varies with settings and age of the pump and battery.

The yellow LED charging indicator on the back panel of the instrument is illuminated when the instrument is connected to an external power source and is charging using the USB-C port.

Charging time with instrument turned off:
Approximately 2.2 hours to full charge (using USB-C AC adapter, instrument turned off).

5.6. Communication

5.6.1. WiFi

The microAeth has 802.11 b/g/n WiFi with WPA2 encryption built-in. WiFi is used to connect to the microAeth directly or on a local WiFi network. Once connected to the microAeth directly or connected to the common local WiFi network, a user can access the microAeth hosted webpage where all settings can be modified, the instrument can be controlled, and data can be downloaded. WiFi can also be enabled and used to stream data to the AethLabs website where microAeth settings can be modified, the instrument can be controlled and updated, and data can be downloaded.

5.6.2. 3.3V TTL Serial

The microAeth has a 4-pin 3.3V TTL serial port which is only used for flow calibration communication. Currently, automated flow calibration is not available and this port is not used.

5.6.3. Bluetooth Low Energy

The microAeth has Bluetooth Low Energy built-in. Bluetooth is not available for use.

5.7. Instrument Operation

IMPORTANT:

-Always make sure that a filter strip is installed in the microAeth AL30 when it is operating.

-Do not install previously used filter strips.

5.7.1. Turn On

1) Turn on the AL30 by depressing the power button on the front panel for 2 seconds until the instrument beeps and the ⚠ Warning red LED and ⏵ Operation green LED illuminate together. The instrument will automatically start sampling and making measurements.

5.7.2. Turn Off

1) Turn off the AL30 by depressing the power button on the front panel for 2 seconds. The front panel LEDs will turn off.

5.7.3. Configuration and Control

By accessing the microAeth interface webpage through a local WiFi connection, the user is able to download data and operate and configure the instrument.

5.7.4. On-board Status Indications

5.7.4.1. Front and Back Panel Indicator LEDs:

Symbol	Indicator Name	Description
ⓘ	Notification Indicator	RGB LED
⚠	Warning Indicator	Red LED
⏵	Operation Indicator	Green LED
⚡	Charging Indicator	Yellow LED

5.7.4.2. LED Indicator Status:

Symbol	Color	Illumination	Description
Run Mode			
⏵	Green	1 blink every 3 sec	Sampling and acquiring data
Warnings during Run Mode (see above)			
⚠	Red	1 blink every 1 sec	Warning - Change filter strip, Filter has reached ATN threshold user setting
⚠	Red	2 blinks every 1 sec	Warning - Battery low
⚠	Red	3 blinks every 1 sec	Warning - Flow warning (out of range +/- %)
Stop / Idle Mode			
⏵ & ⚠	Green & Red	Synchronous 1 blink every 1 sec	Startup - Beeping, Not collecting data until ready Idle - No Beeping, Not collecting data until restart of device or sampling
⚠	Red	Solid	**Sampler stopped after logging error** Critical hardware error: • Main supply voltage too high or too low • Light source current too high or too low • Light source feedback circuit error
Notifications			
ⓘ	Green	Solid	WiFi network mode
ⓘ	Blue	Solid	WiFi access point mode
⚡	Yellow	1 blink every 1 sec	Charging
⚡	Yellow	Solid	Charged
Notifications when ⚙ WiFi Mode button is depressed			
ⓘ	Blue	Blinking	WiFi mode button is depressed for less than 2 seconds - user is pressing button but no change to WiFi Mode
ⓘ	Blue	Solid	WiFi mode button is depressed for 2-6 seconds - Access Point mode has been enabled and button should be released to use Access Point mode
ⓘ	Red & Blue	Alternate Blinking	WiFi mode button is depressed for 6-10 seconds - Warning user that RESET of WiFi / Access Point password will happen if button continues to be depressed
ⓘ	Red	Solid	WiFi mode button is depressed for more than 10 seconds - WiFi / Access Point password have been reset to factory default

5.7.4.3. Other Symbols:

Symbol	Name	Description
	Inlet Port	Sample Inlet, 10-32 UNF imperial (inch) threaded port
	Outlet Port	Outlet, 10-32 UNF imperial (inch) threaded port
	Power On/Off Button	Front panel button for turning on and off
	USB-C Charging Port	USB-C port for charging only
	WiFi Mode Button	Back panel button for enabling WiFi Access Point even if disabled and factory reset of all settings
	Serial Port	4-pin 3.3V TTL serial port for automatic flow calibration only - currently unavailable

5.8. Filter Strip Installation/Exchange

The AL30 uses the ALx Filter Strip (ALX-FS), each with 1 sampling location.

IMPORTANT:
-Always make sure that a filter strip is installed in the microAeth AL30 when it is operating.
-Do not install previously used filter strips.

To install/exchange filter strip:
1) Make sure that the microAeth is not sampling. It is prefered that the intrument is off.
2) Hold the AL30 in one hand, with the release button on the bottom.
3) Loosen the rubber front cover on the front of the AL30 by pulling the tab away from the instrument. This will expose the filter strip slot.
4) If there is a filter strip already installed, depress the circular release button on the bottom of the instrument with your thumb and pull the filter strip out of the sampling head.
5) Install a new filter strip by pressing and holding the circular release button on the bottom of the instrument and then inserting the new filter strip into the sample chamber opening.
6) Make sure to push the new filter strip all the way into the slot.
7) Release the button.
8) Replace the rubber front cover. A tight fit is essential to prevent the entry of contamination and stray light into the sample chamber.



5.9. Performing Measurements

The inlet and outlet ports are 10-32 UNF imperial (inch) threaded ports.

The inlet port, outlet port, and all connections to the inlet port must be properly protected from the environment. There must be limited restriction to flow while protection from water, insects, bugs, and other objects that can block or infiltrate the instrument air pathway through both the inlet and outlet ports of the instrument. Extra precaution must be taken as the internal pump of the instrument is pulling air into the instrument through the inlet port.

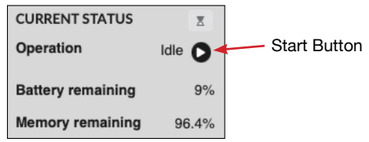


5.9.1. To Start Sampling and Measurements:

A) Using the front panel power button:

1) Ensure there is a filter strip uinstalled in the microAeth AL30.
2) Turn on the AL30 by depressing the power button on the front panel for 2 seconds until the instrument beeps and the ⚠ Warning red LED and ⏵ Operation green LED illuminate together.
3) Release the power button and wait for a few seconds. The pump will turn on and the ⚠ Warning red LED and ⏵ Operation green LED will then begin to blink on and off in unison about every second until the beginning of the next minute.
4) When the LEDs stop blinking, the instrument will beep and the ⏵ Operation green LED will blink indicating the start of data collection.
5) While the unit is operating, the ⏵ Operation green LED will blink once every 3 seconds.

B) Using the microAeth interface webpage:



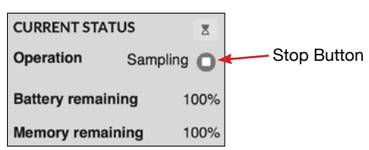
1) Ensure there is a filter strip uinstalled in the microAeth AL30.
2) When the AL30 is Idle, click the ⏵ Start button next to the Operation Idle in the Current Status section of the microAeth interface webpage

5.9.2. To Stop Sampling and Measurements:

A) Using the front panel power button

1) Turn off the AL30 by depressing the power button on the front panel for 2 seconds until the instrument beeps and the front panel LEDs turn off.

B) Using the microAeth interface webpage:

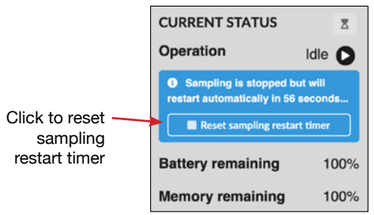


1) When the AL30 is Sampling, click the ⏹ Stop button next to the Operation Sampling in the Current Status section of the microAeth interface webpage.
2) When Samping is stopped using the microAeth interface webpage, the Operation status will change to

'Idle' and a notification will appear showing a 15 minute count down until the AL30 will restart sampling automatically.

3) To Reset the automatic sampling restart timer, click the 'Reset sampling restart timer' button.

4) The notification will update with the reset count down timer.



5.10. Initial Setup and WiFi Communications

The microAeth instrument hosts an interface webpage over WiFi which allows the user to download data and configure and operate the instrument.

NOTE: The microAeth Access Point WiFi mode is enabled by default for initial setup or when reset to default factory settings.

5.10.1. WiFi SSID

The microAeth WiFi SSID is always its serial the device serial number (ID). "AL30-<xxxx>" where <xxxx> matches the unique 4 digits of the AL30 serial number. Example: "AL30-0001"

5.10.2. Default Password:

The default password of the microAeth is "AL30-<xxxx>pass" where <xxxx> matches the unique 4 digits of the AL30 serial number. Example: "AL30-0001pass"

5.10.3. Connecting directly to the microAeth WiFi Access Point

This process is used for initial setup of the microAeth and when Access Point WiFi is enabled.

1) Turn on the AL30.

2) Open the WiFi Settings or available WiFi networks viewer on your computer, tablet, or phone.

3) Browse the available WiFi networks and select the WiFi SSID that matches the serial number of the instrument. "AL30-<xxxx>" where <xxxx> matches the unique 4 digits of the AL30 serial number. Example: "AL30-0001"

4) When asked for a password for the WiFi SSID that matches the serial number of the AL30:

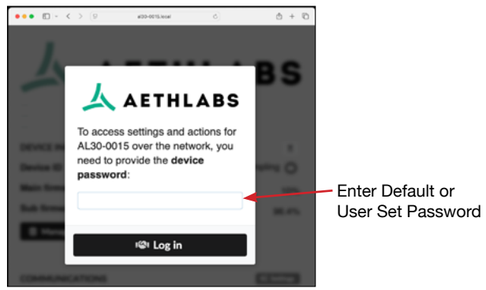
i) Initial Setup with factory default password: "AL30-<xxxx>pass" where <xxxx> matches the unique 4 digits of the AL30 serial number. Example: "AL30-0001pass"

OR

ii) The unique AL30 WiFi password that the user set for the device after initial setup.

5) Once a WiFi connection is established, open a web browser with URL: "http://AL30-<xxxx>.local" where <xxxx> matches the unique 4 digits of the AL30 serial number. Example: "http://AL30-0001.local"

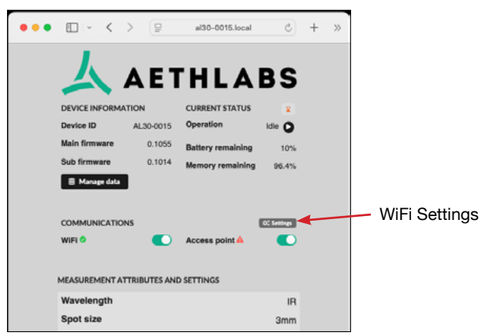
6) The microAeth interface webpage will ask for the Device password (same as the Access Point password), which is the same password as the microAeth Access Point WiFi SSID password.



7) The microAeth interface webpage will load and can be used for configuration and control of the microAeth and data download.

5.10.4. Configure the microAeth WiFi network communications and Access Point password

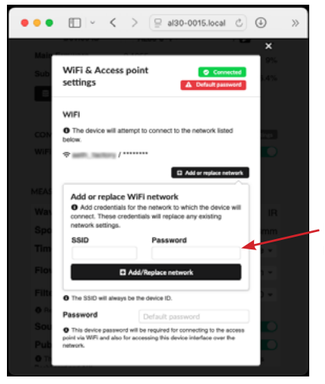
1) Once the microAeth interface webpage is loaded, click the "Settings" button in the Communications section.



2) The "WiFi & Access Point settings" pop-up window will appear.

Add or replace network

3) **STRONGLY ADVISED:** In order to change the AL30 Access Point network password and the interface webpage password, enter a new password in the ‘Password’ field in the ‘Access Point’ section.
4) In order to add a WiFi network to the microAeth, click the “Add or replace network” button in the “WiFi” section.



Enter WiFi network password

5) Enter the WiFi network SSID and Password into the corresponding fields
6) Click the “Add/Replace network” button
7) The pop-up window will close and the SSID and Password will be added to the list of WiFi networks (currently only 1 WiFi SSID is allowed)
8) Click the “X” at the top right corner to close the “WiFi & Access Point settings” window.
9) Once the microAeth connects to the local WiFi networks using the user entered SSID and Password, the microAeth interface webpage can also be accessed over the local WiFi network as long as the “WiFi” setting in the Communications section is enabled.

5.10.5. Connecting to the microAeth by common local WiFi network

This process is used when WiFi communications is enabled and the microAeth is configured to use and is connected to a local WiFi network.

1) Turn on the AL30.
2) Open the WiFi Settings or available WiFi networks viewer on your computer, tablet, or phone.
3) Browse the available WiFi networks and select the WiFi SSID of the network that the microAeth is also connected to.

3) When asked, enter the corresponging password for the WiFi network.
4) Once a WiFi connection is established, open a web browser with
URL: “http://AL30-<xxxx>.local” where <xxxx> matches the unique 4 digits of the AL30 serial number.
Example: “http://AL30-0001.local”
5) The microAeth interface webpage will ask for the instrument password, which is the same password as the microAeth Access Point WiFi SSID password.
6) The microAeth interface webpage will load and can be used for configuration and control of the microAeth and data download.

5.11. Instrument Operating Parameters

5.7.1. Wavelength

The measurement wavelength is a fixed parameter that is set to the IR wavelength for particle measurements.

IR wavelength: IR (880 nm)

5.7.2. Spot size

The measurement spot size is a fixed parameter that is set to 3mm diameter for particle measurements.

Spot size: 3mm diameter

5.7.3. Timebase

The timebase setting permits the user to select a measurement integrating time of 1, 10, 30, 60, 150 or 300 second(s). The date and time (timestamp) is recorded at the end of the sampling and measurement interval.

It is recommended to use a 60 second timebase for most ‘human exposure’ or ‘ambient monitoring’ measurements. Faster timebases will result in higher noise, and are most useful either for direct source monitoring (tailpipe analysis) or for other applications requiring extremely rapid data. A 300 second timebase can be selected for longer run times and extended battery life. Please read section 5.3. Recommendations for Best Use Practices for more information.

5.7.4. Flow setpoint

The sampling flow setpoint setting permits the user to select a sampling flow rate setpoint of 50, 75, 100, 125, 150, 175, 200, 225, or 250 ml/min. It is recommended to use lower flow rates in areas with high BC concentrations, and higher flow rates when maximum sensitivity is required in areas of low BC concentrations. A lower flow rate should also be selected for longer run times and extended battery life. Please read section 5.2 Recommendations for Best Use Practices for more information.

5.7.4. Filter change ATN threshold

The filter change ATN threshold setting permits the user to enter the attenuation (ATN) threshold natural number value of 1 to 100 that will trigger a notification to change the filter.

5.7.5. Sound notifications

The sound notification setting permits the user to turn sound notifications from the device on or off.

5.7.6. Public data

The public data setting permits the user to make data collected as publicly accessible in the AethLabs Dashboard website and API (makes data public).

5.7.7. Timezone

The timezone setting permits the user to select a timezone offset from Coordinated Universal Time (UTC) to be used as part of the ISO 8601 time and date format in the instrument and recorded with instrument measurement data. Daylight savings time offsets are automatically adjusted by the instrument.

5.7.8. Date & time

The time on the microAeth can be automatically synchronized to a server using its on-board WiFi. Time synchronization will automatically occur when an internet connection is present. Time is ISO 8601 formatted.

It is very important to confirm the date and time of the microAeth before a sampling campaign.

5.8. Configure the microAeth using the microAeth interface webpage

5.8.1. Overview

The microAeth interface webpage is a locally hosted webpage that can be accessed using any web browser when connected directly to the microAaeth hosted WiFi network or when connected to the common local WiFi network that the microAeth is also connected to. By accessing to the microAeth interface webpage through a local WiFi connection, the user is able to download data and operate and configure the instrument.

5.8.2. Directly connected to the microAeth hosted WiFi network

When directly connected to the microAeth hosted WiFi network, a user can access the microAeth hosted webpage where all settings can be modified, the instrument can be controlled, and data can be downloaded. WiFi can also be enabled and used to stream data to the AethLabs website where microAeth settings can also be modified, the instrument can be controlled, and data can be downloaded.

5.8.3. Connected to the microAeth on common local WiFi network

When connected to the common local WiFi network, a user can access the microAeth hosted webpage where all settings can be modified, the instrument can be controlled, and data can be downloaded. WiFi can also be enabled and used to stream data to the AethLabs website where microAeth settings can also be modified, the instrument can be controlled, and data can be downloaded.

5.8.4. microAeth Interface Webpage Status

This page will refresh with the latest device information:

1) Whenever a setting is changed or a button is clicked.

2) Automatically every 60 seconds (hourglass icon will turn orange when a refresh will occur within the next 5 seconds).

3) When the ‘Refresh now’ button is clicked.

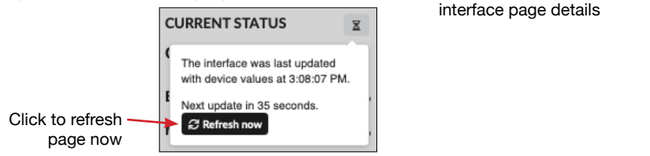
⧗	>5 seconds until interface page refresh
⧗	≤5 seconds until interface page refresh

To see details when the page was last refreshed with the latest device information, the user can click on the Current Status hourglass icon. A pop-up will show the following:

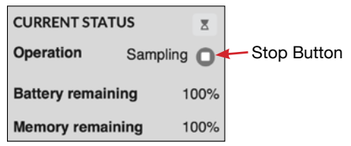
1) Time of last page refresh

2) Count down until next automatic page refresh

3) Button to refresh page now



IMPORTANT: In order to change instrument settings, the AL30 must stop sampling:

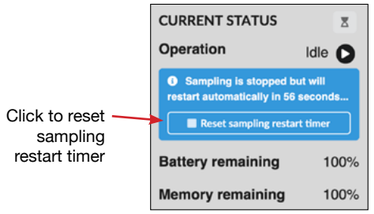


1) When the AL30 is Sampling, click the ◻ Stop button next to the Operation Sampling in the Current Status section of the microAeth interface webpage.

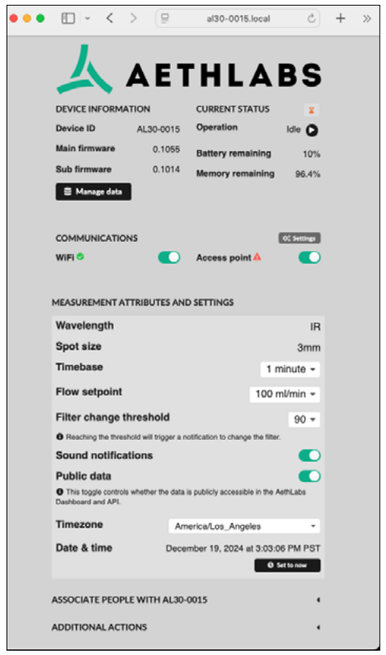
2) When Samping is stopped using the microAeth interface webpage, the Operation status will change to ‘Idle’ and a notification will appear showing a 15 minute count down until the AL30 will restart sampling automatically.

3) To Reset the automatic sampling restart timer, click the ‘Reset sampling restart timer’ button.

4) The notification will update with the reset count down timer.



5.8.5. microAeth Interface Webpage Information and Settings



5.8.4.1. Device Information

5.8.4.1.1. Device ID
Serial number of the device

5.8.4.1.2. Main firmware
Firmware version of the communications hardware

5.8.4.1.3. Sub firmware
Firmware version of the measurement hardware

5.8.4.2. Current Status

5.8.4.2.1. Operation
Shows if the device is Sampling or Idle (not making measurements).

5.8.4.2.2. Operation Button
When the AL30 is Sampling, click the Stop button to stop measurements.
When the AL30 is Idle, click the Start button to start measurements.

5.8.4.2.3. Battery remaining
Percentage amount of battery remaining.

5.8.4.2.4. Memory remaining
Percentage amount of data storage remaining

5.8.4.2.5. Manage data Button
Click this button to open the data mangement window where data can be downloaded or erased.

5.8.4.3. Communications

5.8.4.3.1. Settings Button
Click this button to open the WiFi & Access point settings window where associated WiFi network can be configured and device WiFi access point password can be modified (see instructions in section 5.10. Initial Setup and WiFi Communications)

5.8.4.3.2. WiFi
Toggle to enable/disable connection to local WiFi network. **If the WiFi communications setting is diabled, then the instrument will not be able to carry out firmware updates or send data to the AethLabs website.**

5.8.4.3.3. Access point
Toggle to enable/disable microAeth access point hosted WiFi network for direct WiFi connection to the microAeth

5.8.4.4. Measurement attributes and settings

5.8.4.4.1. Wavelength
Displays the measurement wavelength: IR (880 nm)

5.8.4.4.2. Spot size
Displays the measurement spot size: 3mm diameter

5.8.4.4.3. Timebase
Select 1, 10, 30, 60, 150, or 300 seconds measurement interval

5.8.4.4.4. Flow setpoint
Select 50, 75, 100, 125, 150, 175, 200, 225, or 250 ml/min flow rate

5.8.4.4.5. Filter change ATN threshold
Select 1-100 ATN unit sampling notification threshold

5.8.4.4.6. Sound noifications
Toggle to enable/disable sound notificatios from the device

5.8.4.4.7. Public data
Toggle to enable/disable if data collected is publicly accessible in the AethLabs Dashboard website and API (makes data public)

5.8.4.4.8. Timezone
Select local timezone to use as offset from UTC recorded date and time

5.8.4.4.9. Date & time
Displays current date & time on device

5.8.4.4.10. Set to now Button
Click this button to set device date & time to current time of the viewing device (e.g. computer, tablet, phone).

5.8.4.5. Associate people with AL30-<xxxx> (expendable menu item)
Use this section to invite people to manage this device and view data on the AethLabs Dashboard website.

5.8.4.5.1. Your name
Input your name and organization to inform the invitee(s) who their invitation is from.

5.8.4.5.2. Email(s)
Input the email address(es) of the invitee(s) that you would like to manage this device and view data on the AethLabs Dashboard website.

5.8.4.6. Additional actions (expendable menu item)

5.8.4.6.1. Reboot Button
Click this button to restart the device. Sampling and measurements will autically start after the device is restarted.

5.8.4.6.2. Calibrate flow Button
Click this button to open the Calibrate flow window where the flow calibration process can be conducted.

5.8.4.6.3. Erase memory
Click this button to delete all data stored on the device. **CAUTION: This action cannot be reversed.**

5.8.5. Data Sessions in the microAeth Interface Webpage
Data is divided and displayed as data sessions in the microAeth Inface Webpage. A data session is created when the instrument starts sampling and measurements and the data session is closed when the instrument sampling and measurements are stopped. The data sessions can then be downloaded to one .json or .csv file per session using the Data management section of the microAeth Interface Webpage. Individual or multiple data sessions can be selected and downloaded.

Data session files are downloaded to the web browser downloads folder.

Session data files are downloaded as .json or .csv files with the following naming system that includes the device serial number, session ID, and starting date and time with timezone offset:
ALxx-xxxx_S1_S2_yyyy-MM-ddThh_mm_ss+hh_mm
ALxx-xxxx is the serial number of the instrument
S1 is the major session ID number
S2 is the minor session ID number
yyyy is the year
MM is the month
dd is the day
hh is the hour
mm is the minute
ss is the second
(+) hh is the timezone offset hours
(+) mm is the timezone offset minutes

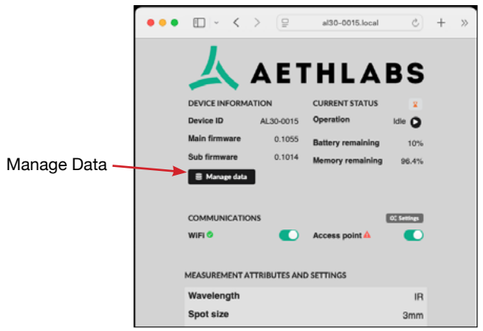
Example File Name: AL30-0031_5_1_2025-03-21T20_24_02+00_00

5.8.6. Data Download & Management in the microAeth Interface Webpage

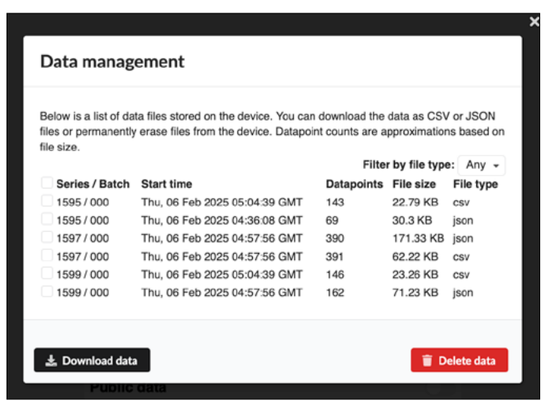
Manage data collected and stored on the microAeth by using the microAeth interface webpage: The microAeth interface webpage is a locally hosted webpage that can be accessed using any web browser when connected directly to the microAaeth hosted WiFi network or when connected to the common local WiFi network that the microAeth is also connected to. Data files are downloaded to the local device over WiFi in .json or .csv file format.

Data file format: .json or .csv file formats

1) Connect to the microAeth interface webpage. See instructions in section 5.10.3. Connecting directly to the microAeth WiFi Access Point or section 5.10.5. Connecting to the microAeth by common local WiFi network
2) Click the ‘Manage data’ button to open the data management window where data can be downloaded or erased.

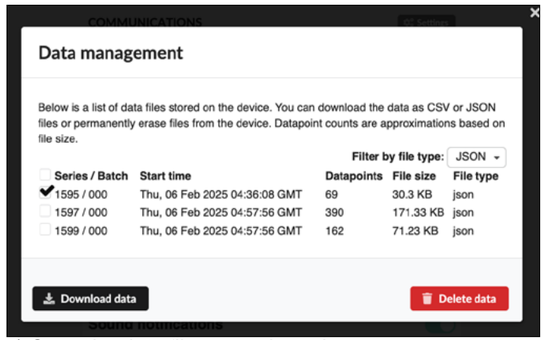


3) The data files stored on the instrument are listed in the new window that opens.



4) If desired, the Filter by file type dropdown can be used limit the file types shown

5) Select the checkboxes of any or all Series / Batch data files to either download or erase.



6) Once the data files are selected:

i) Click the ‘Download data’ button to download the files over WiFi from the AL30 to the local device.

OR

ii) Click the ‘Delete data’ button to delete the data files on the AL30. **CAUTION: This action cannot be reversed.**

7) Click the “X” at the top right corner to close the “Data management” window.

5.10. Filter Media

The sample collection and analysis is performed on a roll of polytetrafluoroethylene (PTFE) filter strip that is housed in a Polyethylene terephthalate (PET) structure. As the aerosol sample is drawn through the filter media by the instrument’s integrated, internal sample pump, the aerosol sample collects gradually on the filter medium to create a gray spot 3mm in diameter. The microAeth determines the optical attenuation as the accumulated particles increase the optical density of the filter spot. After the optical density reaches a certain level, which is set by the filter change ATN threshold, the filter strip must be replaced to maintain measurement integrity.

5.11. Data Safety

AethLabs highly recommends keeping a prestine backup of the original data collected on the instrument in an exported file.

6. Viewing and Analyzing Measurement Data

6.1. Data File Structure

The data files downloaded through the microAeth Interface Webpage are plain text with the extension .json or .csv.

6.1.1. JSON File Format Data File Structure

The JSON data file consists of paired keys (data label) and values (data) for each set (or line) of data. As the microAeth is starting a new sampling and measurement session, the first few minutes of data do not contain the BC calculation; all subsequent lines of data show this value.

Downloaded JSON Data File Structure:


```
[
  {
    "deviceId": "AL30-0031",
    "sessionId": "5:0",
    "dataPlatform": "-",
    "firmwareVersion": "0.1075",
    "subFirmwareVersion": "0.1029",
    "datumId": 1,
    "timestamp": "2025-03-21T20:24:02+00:00",
    "timezone": "America/Los_Angeles",
    "timebase": 60,
    "errors": 0,
    "batteryRemaining": 91,
    "accX": 0,
    "accY": 0,
    "accZ": 0,
    "flowSetPoint": 4,
    "flowTotal": 100,
    "sampleTemp": 26524,
    "sampleRH": 21239,
    "sampleDewpoint": 0,
    "internalPress": 16536916,
    "internalTemp": 152870,
    "sen": 849822,
    "ref": 908720,
    "atn": 6.70101,
    "bc": 0,
    "bcSmooth": 0,
    "pump": 0,
    "latitude": 0,
    "longitude": 0,
    "elevation": 0,
    "indoor": false,
    "installationHeight": 0
  }
]
```


Downloaded JSON Data File Structure Details			
Key	**Value Units / Format**	**Example Key/Data Pair**	**Description**
deviceId	Model and number (AL30-xxxx)	"deviceId": "AL30-0001"	Unique identification number for the Instrument.

Downloaded JSON Data File Structure Details			
Key	**Value Units / Format**	**Example Key/Data Pair**	**Description**
sessionId	Whole number : Whole number	"sessionId": "5:0"	Identification number assigned to each sampling and measurement session. This value is incremented each time a new sampling and measurement session is started (changes from STOPPED to SAMPLING mode).
dataPlatform	Natural number	"dataPlatform": "-"	Unique identification number for downloaded data file structure.
firmwareVersion	Decimal number	"firmwareVersion": "0.1078"	Unique identification number for firmware running on instrument when measurement was recorded.
subFirmwareVersion	Decimal number	"subFirmwareVersion": "0.1029"	Unique identification number for sub-firmware running on instrument when measurement was recorded.
datumId	Whole number	"datumId": 1	Identification number assigned to each line of recorded data.
timestamp	Year, month, day, hours, minutes, seconds, Timezone offset (yyyy-MM-ddThh :mm:ss+hh:mm)	"timestamp": "2025-03-21T20:24:02+00:00"	Local date and time from instrument's internal clock using Coordinated Universal Time (UTC) and Timezone.
timezone	Letters, Symbols	"timezone": "America/Los_ Angeles"	Human readable timezone selection.
timebase	Seconds (Natural number)	"timebase": 60	Value in seconds of the measurement interval between measurements.
errors	Whole number	"errors": 0	See section 6.2. Status / Error Codes for detailed information.
batteryRemaining	Percent (Whole number)	"batteryRemaining": 91	Percent of instrument internal battery remaining.
accX	Integer	"accX": 0	Measured instantaneous acceleration in the x-axis.
accY	Integer	"accY": 0	Measured instantaneous acceleration in the y-axis.
accZ	Integer	"accZ": 0	Measured instantaneous acceleration in the z-axis.
flowSetPoint	Milliliters per minute (Whole number)	"flowSetPoint": 100	Target value of the instrument total flow rate in milliliters per minute.
flowTotal	Milliliters per minute (Decimal number)	"flowTotal": 100.10	Measured total flow through the instrument in milliliters per minute.
sampleTemp	Degrees celsius (Decimal number)	"sampleTemp": 26.670	Measured temperature of instrument sampling stream in degrees celsius.
sampleRH	Percent (Decimal number)	"sampleRH": 22.614	Measured relative humidity of instrument sampling stream in percent.
sampleDewpoint	Degrees celsius (Decimal number)	"sampleDewpoint": 10.3270	Calculated temperature of dewpoint of instrument sampling stream in degrees celsius.
internalPress	Pascal (Natural number)	"internalPress": 100692	Measured pressure inside instrument case in pascals.

Downloaded JSON Data File Structure Details			
Key	**Value Units / Format**	**Example Key/Data Pair**	**Description**
internalTemp	Degrees celsius (Decimal number)	"internalTemp": 35.375	Measured temperature inside instrument case in Celsius.
sen	Counts (Whole number)	"sen": 657342	Measured optical intensity of infrared (IR) wavelength for sample spot sense in counts.
ref	Counts (Whole number)	"ref": 976403	Measured optical intensity of infrared (IR) wavelength for reference spot in counts.
atn	Attenuation units (Decimal number)	"atn": 8.610901	Calculated attenuation of infrared (IR) wavelength for sample spot sense in attenuation units.
bc	Nanograms per cubic meter (ng/m^3) (Integer)	"bc": 2395	Calculated mass concentration for infrared (IR) wavelength for sample sense spot in nanograms per cubic meter.
bcSmooth	Nanograms per cubic meter (ng/m^3) (Integer)	"bcSmooth": 2395	Calculated mass concentration for infrared (IR) wavelength for sample sense spot in nanograms per cubic meter with 15 minute double exponential moving average smoothing applied.
pump	Whole number	"pump": 135	Pump power level. Maximum is 1024
latitude	Degrees (ddmm.mmmmm)	"latitude": 37.7461101412773	Manually entered latitude or relative angular distance north or south on Earth's surface in degrees from the equator.
longitude	Degrees (ddmm.mmmmm)	"longitude": -122.420443087816	Manually entered longitude or relative angular distance east or west on Earth's surface in degrees from the prime meridian.
elevation	Meters (Decimal number)	"elevation": 10.0	Manually entered elevation above sea level in meters.
indoor	True (1) / False (0)	"indoor": 0	Manually entered true or false if device is indoor.
installationHeight	Meters (Decimal number)	"installationHeight": 0.5	Manually entered height above ground level in meters.

6.1.2. CSV File Format Data File Structure

The CSV data file consists of a header containing descriptive information; a line identifying the data columns; and then a number of data lines with each item separated by a comma. As the microAeth is starting a new sampling and measurement session, the first few minutes of data do not contain the BC calculation; all subsequent lines of data show this value.

Downloaded CSV Data File Structure:
Device ID, Session ID, Data Platform, Firmware version, Sub-Firmware Version, Datum ID, Timestamp, Timezone, Timebase (s), Errors, Battery Remaining (%), Accelerometer X (m/s^2), Accelerometer Y (m/s^2) Accelerometer Z (m/s^2), Flow Set Point (mL/min), Flow Total (mL/min), Sample Temp (°C), Sample RH (%), Sample Dewpoint (C), Internal Pressure (Pa), Internal Temp (C), Sense, Reference, Attenuation, Black Carbon (ng/m^3), Black Carbon smooth (ng/m^3), Pump drive, Latitude (°), Longitude (°), Elevation (m), Indoor, Installation Height (m)

Downloaded CSV Data File Structure Details			
Header	**Units / Format**	**Example Data**	**Description**
Device ID	Model and number (AL30-xxxx)	AL30-0001	Unique identification number for the Instrument.

Downloaded CSV Data File Structure Details			
Header	**Units / Format**	**Example Data**	**Description**
Session ID	Whole number : Whole number	5:0	Identification number assigned to each sampling and measurement session. This value is incremented each time a new sampling and measurement session is started (changes from STOPPED to SAMPLING mode).
Data Platform	Natural number	1	Unique identification number for downloaded data file structure.
Firmware Version	Decimal number	0.1078	Unique identification number for firmware running on instrument when measurement was recorded.
Sub-Firmware Version	Decimal number	0.1029	Unique identification number for sub-firmware running on instrument when measurement was recorded.
Datum ID	Whole number	1	Identification number assigned to each line of recorded data.
Timestamp	Year, month, day, hours, minutes, seconds, Timezone offset (yyyy-MM-ddThh :mm:ss+hh:mm)	2018-03-21T14:17:00+00:00	Local date and time from instrument's internal clock using Coordinated Universal Time (UTC) and Timezone.
Timezone	Letters, Symbols	America/Los_Angeles	Human readable timezone selection.
Timebase (s)	Seconds (Natural number)	60	Value in seconds of the measurement interval between measurements.
Errors	Whole number	1	See section 6.2. Status / Error Codes for detailed information.
Battery Remaining (%)	Percent (Whole number)	88	Percent of instrument internal battery remaining.
Accelerometer X (m/s^2)	Integer	-5	Measured instantaneous acceleration in the x-axis.
Accelerometer Y (m/s^2)	Integer	-8	Measured instantaneous acceleration in the y-axis.
Accelerometer Z (m/s^2)	Integer	-255	Measured instantaneous acceleration in the z-axis.
Flow Set Point (mL/min)	Milliliters per minute (Whole number)	100	Target value of the instrument total flow rate in milliliters per minute.
Flow Total (mL/min)	Milliliters per minute (Decimal number)	100.10	Measured total flow through the instrument in milliliters per minute.
Sample Temp (°C)	Degrees celsius (Decimal number)	26.670	Measured temperature of instrument sampling stream in degrees celsius.
Sample RH (%)	Percent (Decimal number)	22.614	Measured relative humidity of instrument sampling stream in percent.
Sample Dewpoint (°C)	Degrees celsius (Decimal number)	10.3270	Calculated temperature of dewpoint of instrument sampling stream in degrees celsius.
Internal Pressure (Pa)	Pascal (Natural number)	100692	Measured pressure inside instrument case in pascals.
Internal Temp (°C)	Degrees celsius (Decimal number)	35.375	Measured temperature inside instrument case in Celsius.
Sense	Counts (Whole number)	657342	Measured optical intensity of infrared (IR) wavelength for sample spot sense in counts.
Reference	Counts (Whole number)	976403	Measured optical intensity of infrared (IR) wavelength for reference spot in counts.

Downloaded CSV Data File Structure Details			
Header	**Units / Format**	**Example Data**	**Description**
Attenuation	Attenuation units (Decimal number)	8.610901	Calculated attenuation of infrared (IR) wavelength for sample spot sense in attenuation units.
Black Carbon (ng/m^3)	Nanograms per cubic meter (ng/m^3) (Integer)	2395	Calculated mass concentration for infrared (IR) wavelength for sample sense spot in nanograms per cubic meter.
Black Carbon smooth (ng/m^3)	Nanograms per cubic meter (ng/m^3) (Integer)	2395	Calculated mass concentration for infrared (IR) wavelength for sample sense spot in nanograms per cubic meter with 15 minute double exponential moving average smoothing applied.
Pump drive	Whole number	135	Pump power level. Maximum is 1024
Latitude (°)	Degrees (ddmm.mmmmm)	37.7461101412773	Manually entered latitude or relative angular distance north or south on Earth's surface in degrees from the equator.
Longitude (°)	Degrees (ddmm.mmmmm)	-122.420443087816	Manually entered longitude or relative angular distance east or west on Earth's surface in degrees from the prime meridian.
Elevation (m)	Meters (Decimal number)	10.0	Manually entered elevation above sea level in meters.
Indoor	True (1) / False (0)	0	Manually entered true or false if device is indoor.
Installation Height (m)	Meters (Decimal number)	0.5	Manually entered height above ground level in meters.

6.2. Status / Error Codes

Code Value	Readable status	Status Description
1	Battery Low	Battery is low
2	PCB Power Supply 5V5 Error	PCB Power Supply 5V5 Error
4	PCB Power Supply Reference Error	PCB Power Supply 5V5 Error
8		N/A
16	Optical saturation	Optical saturation

If more than one status code is active simultaneously, the resulting code written to the data file is the sum of the codes shown in the table above. For example, if the instrument has low battery (status code = 1) and optical saturation (status code = 16), the status (error) code shown in the data file will be 17.

7. Maintenance and Service

7.1. Cleaning

If the microAeth is exposed to any liquids or other damaging contaminants, immediately turn off the instrument, disconnect all cables, and remove any foreign substances in contact with the instrument. Do not use liquids or other cleaning products on the instrument. Wait until the microAeth is completely dry before charging or turning on the instrument. Only AethLabs authorized service personnel should clean the air passageways and internal components of the microAeth. Keeping the microAeth and its air passageways, internal components, and optical chambers clean is critical for maintaining the instrument and producing quality measurements. Contamination of the instrument can cause increased measurement noise, poor sealing of the analytical area and degraded operational lifetime of some components. **AethLabs recommends sending your instrument for annual service, or more frequent service depending on use and operating conditions.**

7.2. Flow Calibration

7.2.1. Flow Calibration Table

The flow calibration table stored in the microAeth is used to control and measure the instrument's flow system. The instrument's internal flow sensors and pump are calibrated to an accurate flow rate for each setpoint in the flow calibration table using an external mass flowmeter as a reference standard.

Many commercial flowmeters are mass flowmeters. They calculate a flow rate by measuring the amount of gas molecules (or mass of the gas) moving through the device during a certain amount of time. However, because we commonly measure gases such as air as the volumes they occupy (as cc's or liters, for instance), usually at standard atmospheric pressure and temperature, flowmeters most often report flow rates not as a mass unit over time, but as a volume unit over time. The internal flow sensors are also measuring mass flow and converting these values to volumetric values using the flow calibration table. **Only the external mass flowmeter in the AethLabs ALx / MAx Series Flow Calibration Kit is recommended for use with the AL30.** The external flowmeter in the microAeth ALx / MAx Series Flow Calibration Kit is a custom unit made for AethLabs specifically for the microAeth ALx and MAx Series instruments to optimize the measurement flow range for the low flow and low back pressure requirements.

Other flowmeters may not be suitable for use with the ALx and MAx Series instruments for a few reasons. (1) Other flowmeters with wider flow measurement ranges may only have one or two calibration setpoints in the full range of the ALx and MAx Series instuments. (2) Many ΔP based flowmeters have higher backpressure, and as such, very little flow will be drawn through the instrument. (3) Bubble meters are far too slow to be used with the ALx and MAx Series instruments in the required automated flow calibration process. (4) The flow calibration of MAx Series instruments must be automated because the process is complicated with multiple solenoid switches and a high possibility for human error, therefore it requires a direct communication interface with the external flowmeter.

7.2.2. Display and Check Flow Calibration Table

The flow calibration table stored in the microAeth can be viewed in order to verify that a good, complete flow calibration table exists. A good, complete flow calibration table is critical in order to obtain the best results from the microAeth.

To view the flow calibration table and the complete results from the previous flow calibration, the microAeth interface webpage is used.

7.2.2.1. Flow Calibration Table Example

Below is an example of a flow calibration table that will be displayed in the Calibrate flow window of the microAeth interface webpage. The values in the flow calibration table can be analyzed and verified in order to determine if another flow calibration is required. If multiple flow calibrations have been performed and still there are issues, please contact AethLabs.

CURRENT TABLE

Setpoint	Cal	Ref
0	0	0
25	240	775
50	288	925
75	336	1075
100	396	1260
125	436	1380
150	482	1525
175	526	1655
200	566	1780
225	602	1895
250	637	1995

7.2.2.2. Test Flow Procedure

The Calibrate flow window of the microAeth interface webpage can be used to test flow setpoints and see what the external flowmeter is reading.

IMPORTANT:

-Always use a new unused filter strip when testing the flow of the microAeth.

-Do not install previously used filter strips.

-Only the external flowmeter of the microAeth ALx / MAx Series Flow Calibration Kit or other low backpressure external flowmeter should be used.

Flow Connections: **The inlet port of the microAeth AL30 instrument must be connected to the outlet port of the external flowmeter of the microAeth ALx / MAx Series Flow Calibration Kit.** The arrow on the front of the external flowmeter shows the air flow direction with the point of the arrow being the outlet port and the opposite being the inlet port. The inlet port of the external flowmeter should be connected to the low backpressure inline disc filter.

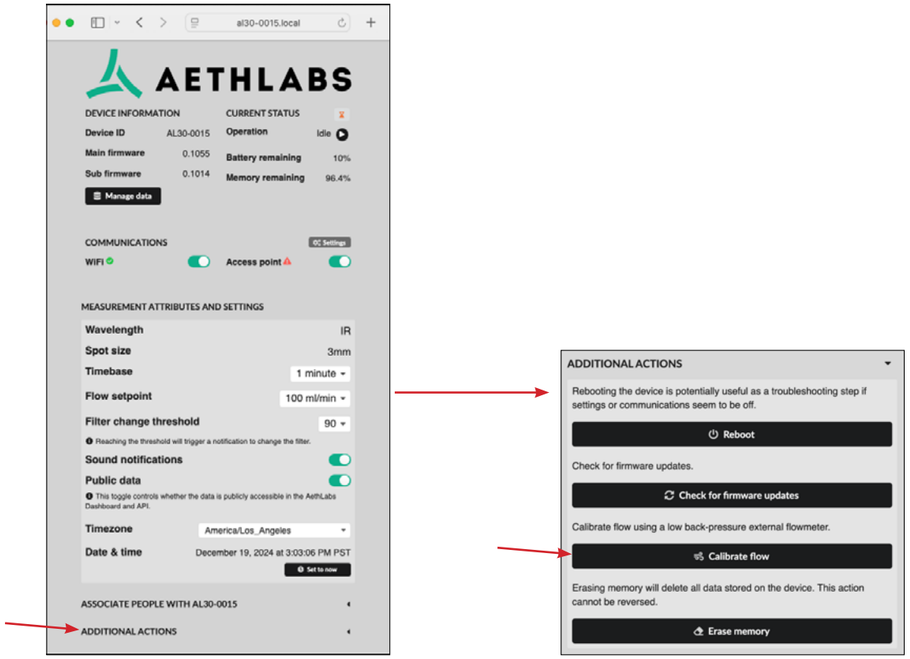
1) Install a new unused filter strip in the microAeth.

2) If checking flow of the microAeth to an external standard, connect the outlet port of the external flowmeter to the inlet port of the microAeth.

3) Make sure that all connections are tight and sealed so that no leaks are present.

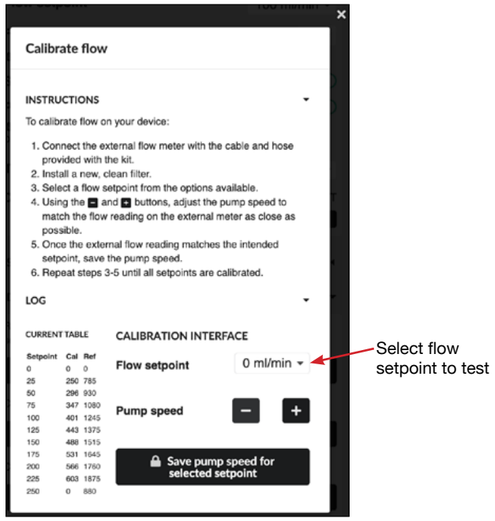
4) Connect to the microAeth interface webpage via WiFi and an internet browser. See instructions in section 5.10.3. Connecting directly to the microAeth WiFi Access Point or section 5.10.5. Connecting to the microAeth by common local WiFi network

5) Expand the Additional actions menu

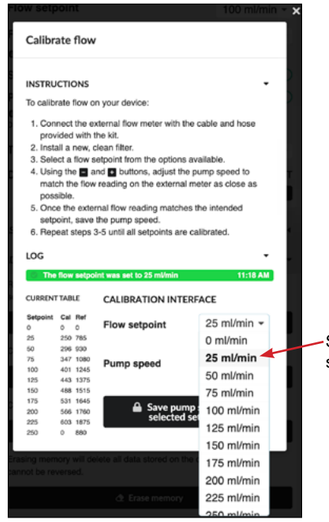


6) Click the Calibrate flow button to open the Flow calibration window.

7) Use the Flow setpoint dropdown menu to select a flow rate. When selected, the pump will change to the desired flow rate. Allow the microAeth a few seconds to adjust pump speed and for the flow to become stable.



Select flow setpoint to test



Select flow setpoint to test

8) The flow of the external flowmeter can be viewed over time as there will be fluctuations.

9) Repeat steps 7 and 8 as needed to check flow setpoints.

10) Click the “X” at the top right corner to close the "Calibrate flow" window.

7.2.3. Flow Calibration Kit Setup

It is recommended that all microAeth ALx / MAx Series Flow Calibration Kits use the provided low backpressure inline disc filter on the inlet of the external flowmeter to keep the external flowmeter clean and to keep the microAeth sampling filter clean during flow calibration. An inline filter isn't required but is recommended especially if a flow calibration is being completed outdoors or in a dirty environment.

Flow Connections: **The inlet port of the microAeth AL30 instrument must be connected to the outlet port of the external flowmeter of the microAeth ALx / MAx Series Flow Calibration Kit.** The arrow on the front of the external flowmeter shows the air flow direction with the point of the arrow being the outlet port and the opposite being the inlet port. The inlet port of the external flowmeter should be connected to the low backpressure inline disc filter.

External Flowmeter Settings: The recommended settings of the external flowmeter for the flow calibration process are as follows:

microAeth ALx / MAx Series Flow Calibration Kit External Flowmeter	
Setting	**Value**
Communication Baud Rate:	57600
Unit ID:	A
Gas:	Air
Volumetric Flow Units:	milliliters per minute (ml/m)
Mass Flow Units:	milliliters per minute (Sml/m)
Flow Averaging:	255
Pressure Averaging:	255
Standard Temperature:	25.00 °C
Standard Pressure:	14.70 PSIA
Normal Temperature:	0.00 °C
Normal Pressure:	14.70 PSIA

7.2.4. Flow Calibration Procedure

The Calibrate flow window of the microAeth interface webpage can be used to test flow setpoints and see what the external flowmeter is reading.

IMPORTANT:

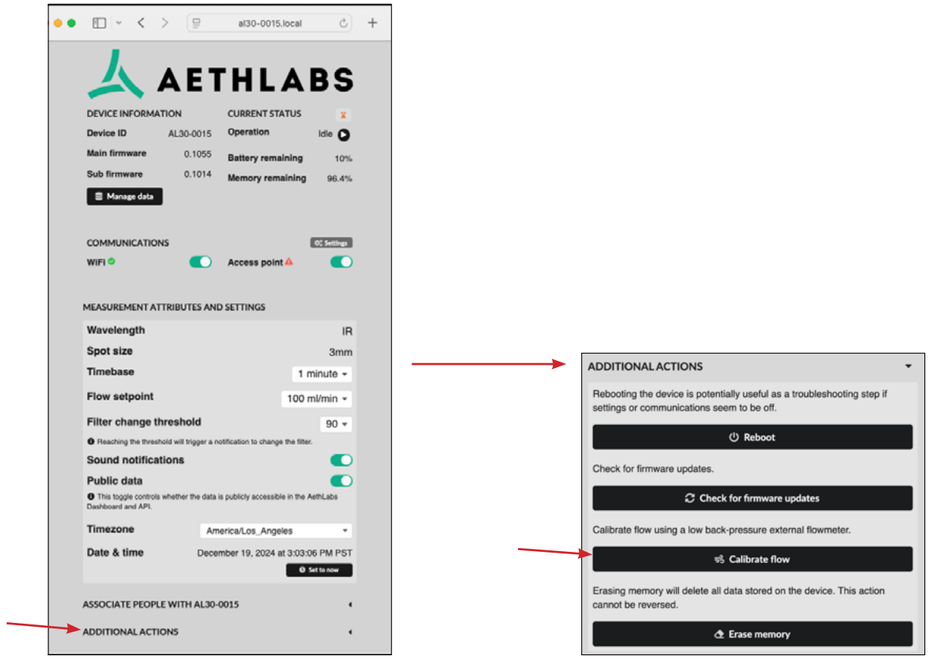
-Always use a new unused filter strip when testing the flow of the microAeth.

-Do not install previously used filter strips.

-Only the external flowmeter of the microAeth ALx / MAx Series Flow Calibration Kit or other low backpressure external flowmeter should be used.

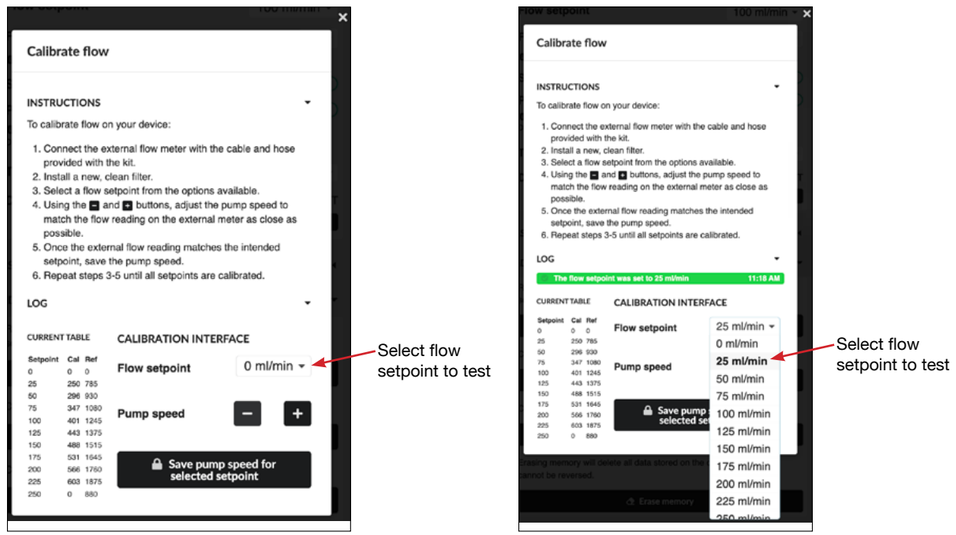
Flow Connections: **The inlet port of the microAeth AL30 instrument must be connected to the outlet port of the external flowmeter of the microAeth ALx / MAx Series Flow Calibration Kit.** The arrow on the front of the external flowmeter shows the air flow direction with the point of the arrow being the outlet port and the opposite being the inlet port. The inlet port of the external flowmeter should be connected to the low backpressure inline disc filter.

1) Install a new unused filter strip in the microAeth.
2) Connect the outlet port of the external flowmeter to the inlet port of the microAeth.
3) Make sure that all connections are tight and sealed so that no leaks are present.
4) Connect to the microAeth interface webpage via WiFi and an internet browser. See instructions in section 5.10.3. Connecting directly to the microAeth WiFi Access Point or section 5.10.5. Connecting to the microAeth by common local WiFi network
5) Expand the Additional actions menu

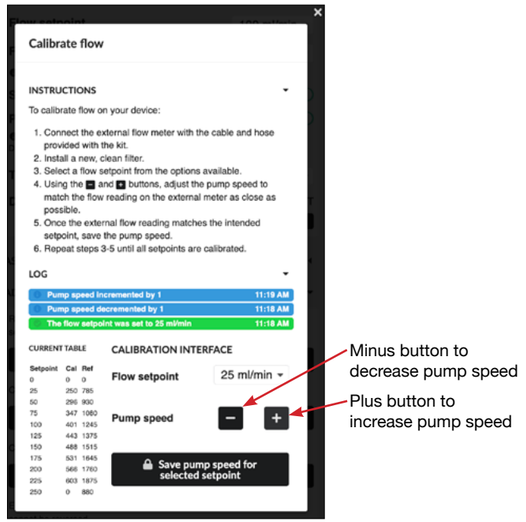


6) Click the Calibrate flow button to open the Flow calibration window.

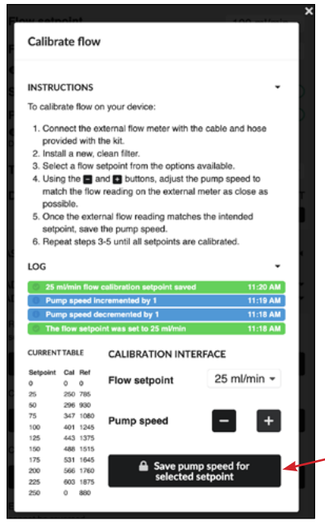
7) Use the Flow setpoint dropdown menu to select a flow rate. When selected, the pump will change to the desired flow rate. Allow the microAeth a few seconds to adjust pump speed and for the flow to become stable.



8) Use the the − Minus and + Plus buttons to adjust the pump speed so that the flow reading on the external flowmeter matches the flow setpoint as close as possible.The flow readings of the external flowmeter can be viewed over time as there will be fluctuations.



9) Once the flow reading of the external flowmeter matches the intended setpoint value, click the Save pump speed for selected setpoint button. **NOTE: The SAVE button must be clicked otherwise the adjusted pump speed value will not be saved.**



Save button for current pump speed at current flow setpoint

10) Repeat steps 7-9 to calibrate all setpoints.

11) Click the “X” at the top right corner to close the "Calibrate flow" window.

7.3. Over-the-air (OTA) Automatic Firmware Updates

The microAeth AL30 conducts Over-the-air (OTA) automatic firmware updates when connected to the internet through a WiFi connection. The AL30 will check for firmware updates every 15 minutes.

Automatic firmware updates can be enabled/disabled for a specific instrument using the AethLabs Dashboard website.

If the WiFi communications setting on the AL30 is disabled, then the instrument will not be able to carry out firmware updates or send data to the AethLabs website.

8. Technical Specifications

Measurement Method
Real-time Aethalometer® method by measuring the rate of change in absorption of transmitted light due to continuous collection of aerosol deposit on filter. Measurement at 880 nm interpreted as concentration of Black Carbon (‘BC’).

Measurement Wavelength
880 nm

Timebases (User setting)
1, 60, or 300 seconds

Flow Rates (User setting)
Internal pump provides 50, 75, 100, 125, 150, 175, 200, 225 or 250 ml/min

Measurement Range
0-1 mg BC/m^3, filter life time dependent on concentration and flow rate setting:
avg. 5 µg BC/m^3 for 24 hours @ 100 ml/min
avg. 100 µg BC/m^3 for 3 hours @ 50 ml/min
avg. 1 mg BC/m^3 for 15 minutes @ 50 ml/min

Measurement Resolution
0.001 µg BC/m^3

Limit of Detection
0.010 µg BC/m^3, 5 minute timebase, 250 ml/min flow rate
<0.003 µg BC/m^3, 1 hour average from 5 min timebase, 250 ml/min flow rate

Pump
Internal micro rotary vane pump

Flow Control
Internal mass flowmeter with closed-loop control

Filter Material / Capacity
Polytetrafluoroethylene (PTFE) filter strip material with 1 sampling location per filter

Sampling
3 mm spot created on filter strip containing insert of
PTFE filter material. PM2.5 size selective inlet available

Environmental Sensors
Temperature, Relative Humidity, Altimeter/Barometer, Accelerometer

Dimensions and Weight
Length: 98.5mm (3.878 inches)
Width: 61mm (2.401 inches)
Depth: 24.5mm (0.964 inch)
Weight: 162 grams (5.71 ounces)

Memory
4 GB internal flash memory, providing data storage up to:
9 years operating on 1 minute timebase
55 days operating on 1 second timebase

Wireless Communications / Data Output
Data Stored in local memory.
Direct local data download over WiFi interface.
WiFi transmission to cloud data management system. Real-time and bulk data transfer when network is available
802.11 b/g/n Wi-Fi

Connections
USB-C (Power)
3.3V TTL Serial (Flow Calibration Communication)
Aerosol sample inlet and outlet ports

Total Run Time (Single battery charge)
Up to 24 hours @ 5 minute timebase, 50 ml/min
flow rate. Run time may vary due to settings and PM
concentrations.

Battery
Internal 3.7V 2200 mAh (8.14 Wh) 1 cell rechargeable lithium-ion battery.

Charging Time
Approximately 2.2 hours to full charge (using USB-C AC adapter, instrument turned off).

Power Supply Adapter
Input: 100~240 VAC 50/60 Hz 0.4 A
Output: 5VDC / 2A, USB-C

Operation Environment
5 ~ 40 °C operating, non-condensing.

Included
microAeth AL30
1 Pack of 30 Filter Strips
1 USB-C power cable
1 territory-specific USB-C AC wall adapter
1 one meter sampling hose with swivel tube connector
1 Lapel clip for sampling hose
Manual available for download via AethLabs website

Specifications are subject to change without notice.