OWNER'S MANUAL

AXD 510
MicroManometer

ALNOR®
A TSI® Company

ALNOR INSTRUMENT COMPANY
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AXD 510 Series MicroManometer Specifications

Measurement Units	**Models available in:** in. H_2O inches of Water Column or Pa Pascals
Resolution	See individual product labels
Range	See individual product labels
Operating Temperature	14°F to 122°F (-10°C to 50°C)
Storage Temperature	-40°F to 176°F (-40°C to 80°C)
Overpressure Limit	20 psi or 553 in. H_20 or 137 kPa maximum
Accuracy (Factory Calibration conditions) For pressure measurements only, after zeroing	**59 °F to 95 °F (15 °C to 35 °C)** ±(2.5% of indicated reading+resolution) **otherwise** ±(5% of indicated reading+resolution)
Display	0.5 inch high, $3^1/_2$ digit, 7 segment LCD, no backlight
Physical Dimensions	7.9 x 3.2 x 1.3 in. (201 x 81 x 33 mm)
Weight	8.6 oz (242g)
Power Source	9V. alkaline battery
Battery Life	Minimum 100 hours continuous use

Model	Description	Part No.
AXD 510	Meter with 9V battery, manual and two-year limited warranty.	call Alnor customer service
AXD 512	Manometer kit with AXD 510 meter, 18 inch pitot probe, carrying case, 9V battery, manual, 2 static pressure probes, 100 duct plugs, two rubber hoses, and two-year limited warranty.	call Alnor customer service

Pitot Probes

Model	Part No.
12 inch pitot probe	634-634-000
18 inch pitot probe	634-634-001
24 inch pitot probe	634-634-002
36 inch pitot probe	634-634-003
60 inch pitot probe	634-634-005
Telescoping pitot probe	634-634-004

Optional Accessories

Model	Part No.
Static pressure probes	361-010-000
Duct plugs (100 piece sample pack)	593-000-000
Rubber hose (8 ft.)	372-000-000
Carrying case	534-550-001
HVAC conversion calculator	118-550-001

Specifications subject to change without notice

Warranty

Alnor Instrument Company (Alnor) warrants this product to be free of defects in material and workmanship for a period of two years from the date of original purchase. If the product should become defective during the warranty period, Alnor will repair it or elect to replace it free of charge under the following conditions:

1. Product is returned postpaid per the instructions for return, located in the owner's manual.
2. Owner submits proof of original date of purchase.
3. Alnor will inspect product for defects in material and workmanship. Alnor's decision as to existence of defect, and in the case of defect, to repair or replace will be final.

THIS WARRANTY IS EXCLUSIVE. THERE ARE NO OTHER WARRANTIES EITHER EXPRESSED OR IMPLIED. SPECIFICALLY AND WITHOUT LIMITATION, THERE IS NO WARRANTY, EXPRESSED OR IMPLIED, OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE.

This warranty is void if product is misused, used contrary to procedures set forth in the owner's manual, or if product is serviced by anyone other than Alnor's authorized service. This warranty does not cover consumables e.g. light bulbs, paper or batteries.

Alnor's liability for this product is limited to the above stated warranty and shall not in any event exceed the cost of the product. In no event will Alnor be liable for any direct or consequential damages, including but not limited to lost profits, loss of use, inaccuracies, loss of data, dismantling or reinstallation.

Table of Contents

Features

The AXD 510 MicroManometer is an instrument that measures differential pressure of air.

Each meter is designed to display a specific range and unit of measurement.

The AXD 510 displays measurement results on a liquid-crystal display (LCD). If a low battery condition exists, the display will show LOBAT.

It features two built-in pressure ports for attachment to the pressure source to be measured. Optional hoses and pitot-static probes are available.

The AXD 510 uses one 9V DC alkaline battery for low replacement cost. Battery life is greater than 100 hours.

Using the AXD 510 Safely

- When using the instrument to check air flow in an elevated workplace, make certain that you can safely raise and hold the instrument while taking measurements. This is especially important when you are working on a ladder.
- Avoid catching hoses or attachments in moving machinery.
- Use the instrument only for measuring air.
- Avoid contact with any corrosive or other dangerous or explosive gas mixtures.

  Please dispose of used batteries in a responsible manner.

Back view of instrument

Low battery display

Getting Started

Installing Batteries

The AXD 510 uses one 9V non-rechargeable battery. The unit was shipped with battery not installed. The battery is in the instrument package.

To install the battery:

- Loosen the battery cover screw on the rear of the instrument.
- Slide the cover up and lift it out.
- Lift battery out, detach it, and install a new battery.
- Replace the cover and tighten the screw.

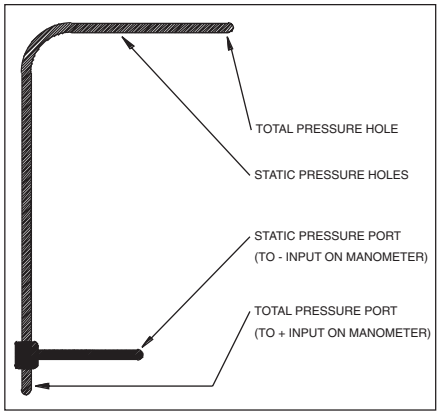
Note: When the battery charge becomes low, the LCD will show [LOBAT] to the left of the reading. From that point, there will be about one hour of normal use left.*

Always have a replacement battery available.

* Normal use is when the meter is still within its tolerance.

Preparing the Instrument

Attach hoses to the pressure ports at the top of the instrument. Then attach the other hose end to the pressure source to be measured, making sure the unit's (+) pressure port is connected to the most positive pressure under test.



Pitot-static probe

Attaching the Optional Pitot-Static Probe

To attach the probe for measuring air velocity:

- Remove the pitot-static probe and rubber hose from their carrying case.
- Remove the protective caps from the probe and save them for replacing on the probe later.

- Attach one section of flexible hose to the probe's static pressure port, and another to the probe's total pressure port.
- Identify the (+) and (–) pressure ports at the top of the AXD 510.
- Attach the hose from the total pressure port of the pitot probe to the (+) port of the MicroManometer.
- Attach the hose from the static pressure port of the pitot probe to the (–) port of the MicroManometer.
- Check to ensure that all hose connections are tight.

Power-On Sequence

At the bottom of the instrument, push the slide switch to the 'I' position. The meter will start to display the measured differential pressure. If the battery is low, the "LOBAT" indicator will be on.

Pitot-static probe

Zeroing the Instrument

Before you begin taking measurements, the AXD 510 may have to be zeroed by following these steps:

- Most hand-held meters using differential pressure sensors require a warm-up time. Turn on your Alnor AXD 510 at least 5 minutes before zeroing and taking your first measurement.
- Make sure there is no air flowing past a pitot-static probe and verify that none of the hoses are accidentally squeezed.
- Turn the "Zero Knob" located at the bottom of the instrument clockwise (if the reading is positive) or counter-clockwise (if the reading is negative) until the display reads all zeros.

APPENDIX A: Traversing a Duct to Determine Average Air Velocity or Volume

The following techniques can be used to measure air flow inside ducts using a velocity probe or pitot-static probe. When using a pitot probe, the individual velocities must be calculated for each pressure reading then averaged together. Averaging pressure with a pitot probe and then converting the average into velocity will give an incorrect result, especially if many readings are more than ±25% from the average pressure. Remember that for a pitot probe, velocity is proportional to the square root of the pressure.

Where to Take the Measurement

In order to make air velocity measurements in a duct, it is best to measure at least 7.5 duct diameters downstream and at least 3 duct diameters from any turns or flow obstructions. It is possible to do a traverse as few as 2 duct diameters downstream or 1 duct diameter upstream from obstructions, but measurement accuracy will be impaired. When measuring rectangular ducts, use the following formula to find the equivalent diameter of the duct when calculating how far 7.5 diameters downstream or 3 diameters upstream is.

Equivalent Diameter = $\sqrt{4HV/\pi}$

Where: H = horizontal duct dimension
V = vertical duct dimension
π = 3.14

It is also possible to take a single reading to measure air velocity or air volume flow in a duct, measuring in the center of the duct and multiplying the reading by 0.9 to correct for the higher velocity at the duct's center. If conditions are very good, accuracy of ±5 to ±10% can be obtained this way. This method is not very reliable, however, and should only be used where small duct size or other conditions do not permit a full traverse.

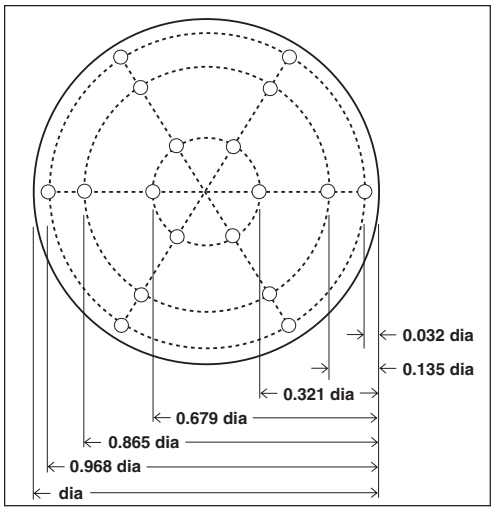


Figure 1: Location of measuring points when traversing a round duct using the log-Tchebycheff method.

Traversing a Round Duct

Using the log-Tchebycheff method, the duct is divided into concentric circles, each containing equal area. An equal number of readings is taken from each circular area, thus obtaining the best average. Commonly, three concentric circles (six measuring points per diameter) are used for ducts with diameters of 10 inches or smaller. Four or five concentric circles (eight or ten measuring points per diameter) are used for ducts with diameters of 10 inches or more.

The preferred method is to drill three holes in the duct at 60½ angles from one another as shown in Figure 1. Three traverses are taken across the duct, and the velocities obtained are averaged at each measuring point. The average velocity is multiplied by the duct area to get the flow rate. (A different method uses two holes at 90½ angles from one another, decreasing the number of traverses with the probe by one.)

Number of measuring points per diameter	Position relative to inner wall
6	0.32, 0.135, 0.321, 0.679, 0.865, 0.968
8	0.021, 0.117, 0.184, 0.345, 0.655, 0.816, 0.883, 0.981
10	0.019, 0.077, 0.153, 0.217, 0.361, 0.639, 0.783, 0.847, 0.923, 0.981

Before taking the measurement, multiply the numbers in the table by the duct diameter to get the insertion depth for the probe. (Do not forget to use the inside dimension of the duct if it is lined with insulation.)

Traversing a Square Duct

Using the log-Tchebycheff method, the duct is divided into rectangular areas, which are further adjusted in size to account for the effect of the duct wall on air flow. A minimum of 25 points must be measured in order to get a good average. The number of data points to be taken along each side of the duct depends on how wide the duct is. For duct sides shorter than 30 inches, five traversal points must be taken. For duct sides of 30 through 36 inches, six points must be taken. For duct sides longer than 36 inches, seven points must be taken. Multiply the numbers in the table by the duct dimension to get the insertion depth for the probe.

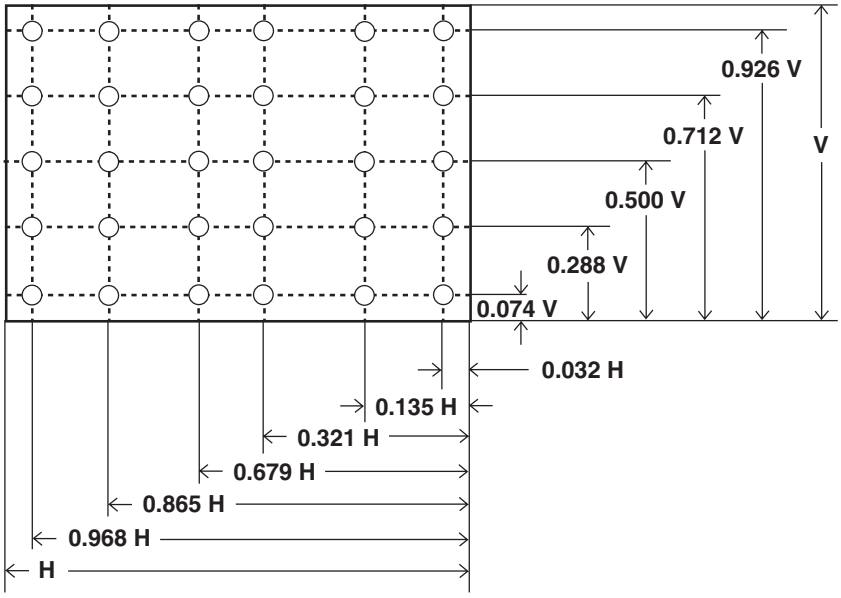


Figure 2: Location of measuring points for traversing a rectangular duct using the log-Tchebycheff method.

The duct in Figure 2 has a horizontal dimension between 30 and 36 inches, requiring six points (or six traverse lines). The duct's vertical dimension is less than 30 inches, requiring five points (or five traverse lines).

Number of points or traverse lines per side	Position relative to inner wall
5	0.074, 0.288, 0.500, 0.712, 0.926
6	0.061, 0.235, 0.437, 0.563, 0.765, 0.939
7	0.053, 0.203, 0.366, 0.500, 0.634, 0.797, 0.947

Notice of Disclaimer

Alnor Instrument Company has made a good faith effort to provide reliable information regarding the use of the AXD 510 to conduct a duct traverse. However, we cannot guarantee that the material presented here will guarantee conformance to any particular method or specification, or that this material is free from error. Traverse methods outside of the USA may be different. Alnor recommends purchasing a copy of the duct traverse specification you require from an approved regulatory or professional organization.

For further information, refer to the 1993 ASHRAE Fundamentals Handbook Section 13, or to ASHRAE Standard 111 (1988).

APPENDIX B: Pressure to Velocity Conversion Charts

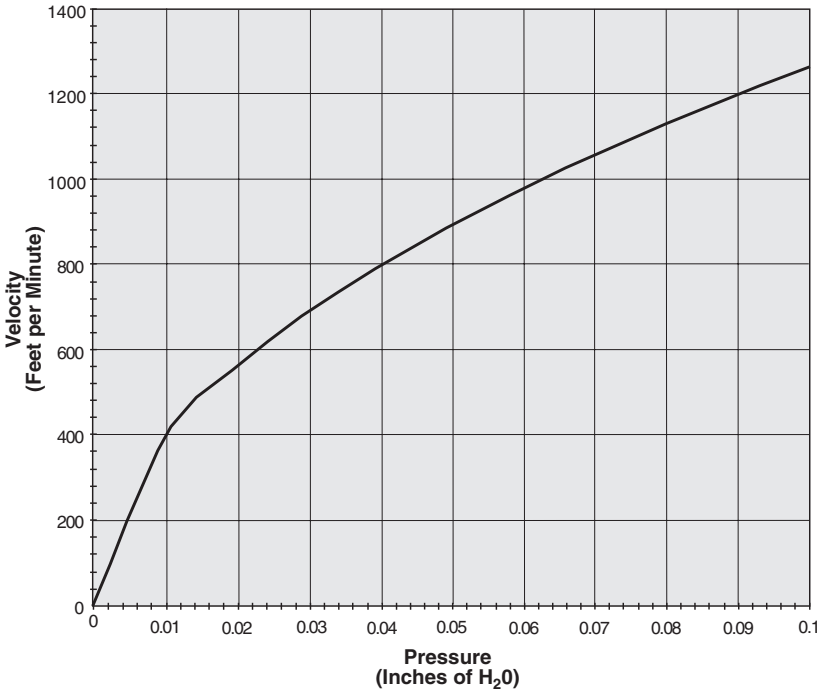
Using the graph below, a user can easily convert pressure to velocity, or can do so by using the following equations:

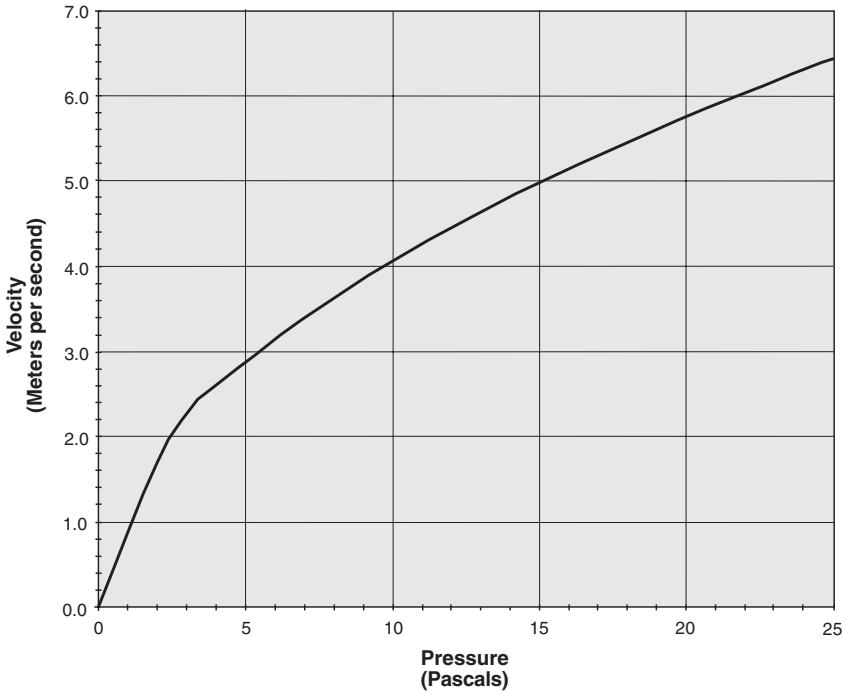
$V^{(fpm)} = 4005 \sqrt{DP}$ Pressure in inches H_20

$V^{(m/s)} = 1.29 \sqrt{DP}$ Pressure in Pa

Please note that for small pressure readings, an increment in pressure can cause large steps in velocity, but at larger readings, the steps in velocity are much less pronounced as a percentage of reading. A MicroManometer should not be used with a pitot probe at very low differential pressures to measure velocity, because resolution errors will be large.

The following graphs show approximate velocities for certain differential pressures in the range 0–0.10 inches H_20 (0–25 Pa).




7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Velocity
(Meters per second)
0
5
10
15
20
25
Pressure
(Pascals)

APPENDIX C: Maintenance & Troubleshooting

Maintenance

Periodic maintenance should be performed on the meter.

- The battery should be replaced when the low battery indication is on.
- To prevent possible damage due to leakage, the battery should be removed if the meter will not be used for two (2) months or longer.
- Calibration checks are recommended every 12 months.
- Keep the meter clean by using a mild detergent on its case. DO NOT use abrasives or solvents. Also, DO NOT allow liquids to enter the meter's case. Dry thoroughly after cleaning.
- Use an eyeglass cleaner and lens paper to clean the LCD window.

Troubleshooting

Symptom	Possible Cause—Actions to Remedy
Display shows [ ] or [-]	The measured value is beyond the instrument's range. • Be sure there is no applied pressure, or remove pitot probes from airstream. • Attempt to ZERO the meter.
Display does not change	Input might simply be very stable. Test meter by pinching the hoses, or adjusting the zero.
Erratic or erroneous readings	Make sure that the pitot probe is perpendicular to the air flow you are measuring. Make sure probe is held steady. Pitot probe is dirty—clean it. Take measurements at a different location.

If any of these problems persist, call Alnor Customer Service for assistance. See page 13.

Repair Information

Contact the distributor in your country, or Alnor Instrument Company directly, before returning your instrument. See INSTRUCTIONS FOR RETURN. Follow the procedure carefully as it will expedite processing. Failure to follow the procedure may cause return of the unit unrepaired. Send your instrument to the factory transportation prepaid. To assure fast turnaround time, photocopy and fill out this form with as much detail as possible and attach it to the instrument.

RMA Number _____

Instrument Model _____

Serial Number _____

Date of Purchase _____

Where Purchased _____

Describe Malfunction _____

Describe Environment _____

Return Instrument to:

Name _____

Company _____

Address _____

_____

Telephone _____

Address Correspondence to:

Name _____

Company _____

Address _____

_____

Telephone _____

Instructions for Return

Damaged in Transit

All shipments are carefully examined by Alnor Quality Assurance and carefully packed for shipment. On receipt, if the shipping container appears to have been damaged during shipment, the instrument should be thoroughly inspected. The delivering carrier's papers should be signed noting the apparent damage.

If the instrument itself has been damaged, a claim should be promptly filed against the carrier by the customer. The selling agent will assist the customer by supplying all pertinent shipping information; however, the claim must be filed by the insured.

If the instrument is damaged beyond use, a new order should be placed with Alnor while awaiting reimbursement from the carrier for the damaged instrument.

Call Alnor directly for assistance if necessary.

Repair/Calibration

Please follow these steps should you require factory service or repair of your Alnor Instrument:

1. Contact the Alnor distributor in your country for the cost of repair or recalibration and shipping instructions. Obtain a purchase order number from your Purchasing Department showing instrument model number and cost of repair and/or recalibration. Securely package your instrument in a strong container surrounded by at least two inches (5 cm) of suitable shock-absorbing material. Reference the purchase order number on your packing slip. Forward the instrument prepaid. See back cover for address.

   OR

2. Contact the Service Department at Alnor for the cost of repair or recalibration, Return Material Authorization (RMA) number, and shipping instructions. For instruments being returned for recalibration, determine whether you prefer:

   - Certificate of Calibration, no data (states instrument checked and found to be within accuracy claimed and specifications listed in current literature).
   - Certificate of Traceability to National Institute of Standards and Technology (NIST, formerly NBS) with data (states instrument compared with factory standard traceable to NIST, lists of calibration data, i.e., "Standards reads. . ." and "This instrument reads. . .")

   Obtain a purchase order number from your Purchasing Department showing instrument model number and cost of repair and/or recalibration. Securely package your instrument in a strong container surrounded by at least two inches (5 cm) of suitable shock-absorbing material. Reference the purchase order number on your packing slip. Mark the outside of the shipping container with the RMA number. Forward the instrument prepaid. See back cover for address.

Please note that instruments received improperly marked or without an accompanying purchase order may be returned at your expense. Please also note that if an RMA number has been assigned, it will be canceled if the instrument is not received by Alnor within 60 days.

Ownership/Calibration Log

Equipment Log

Date of Purchase _____

Calibration Record _____

1. _____ 2. _____ 3. _____

4. _____ 5. _____ 6. _____

7. _____ 8. _____ 9. _____

10. _____ 11. _____ 12. _____

Notes: _____

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