OWNER'S MANUAL

AXD 550
MicroManometer

ALNOR®
TSI Incorporated

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Knowing that inoperative or defective instruments are as detrimental to TSI as they are to our customers, our service policy is designed to give prompt attention to any problems. If any malfunction is discovered, please contact your nearest sales office or representative, or call Customer Service at (800) 424-7427 (USA) and (1) 651-490-2811 (International).

Table Of Contents

General Description

The AXD 550 MicroManometer is a meter that measures differential pressure. It is also capable of measuring and displaying air velocity and volume flow.

Functions are selected through a 7-key pad or an RS232 serial port. With the exception of the **ZERO** key, each key has dual functions. In addition, the user can choose from among many menu-driven items for added measuring flexibility. Options such as units of measurement and time-constant settings can also be selected.

The AXD 550 displays measurement results on a liquid-crystal display (LCD), with additional display segments for memory locations and units of measure.

It features two built-in pressure ports for attachment to the pressure source you will measure. Optional hoses and pitot probes are available.

The instrument's memory can hold 100 readings of pressure, velocity, or volume. For convenience, memory can be organized into sections called "pages." All data is saved by the instrument's own battery-powered system.

Readings can also be printed out during operation by an optional printer, or can be saved for subsequent downloading. The RS232-C serial connection attaches the AXD 550 to a printer or personal computer.

The AXD 550 uses three (3) AA size alkaline batteries for low replacement cost. The instrument's automatic shut-off option can be used to conserve battery power.

Safety

- When using the instrument to check air flow in an elevated workplace, make certain that you can safely raise and hold the instrument while making 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 measurements using air.
- Avoid any corrosive or other dangerous or explosive gas mixtures.

NOTICE

Please dispose of used batteries in a responsible manner.

Installing Batteries

The AXD 550 uses three (3) AA size nonrechargeable batteries. The unit was shipped with batteries not installed. You will find the batteries in the instrument package.

Figure 1: Back view of instrument

To install the batteries:

- Loosen the battery cover screw on the back of the instrument (Figure 1).
- Slide the cover up and lift it out.
- Install the batteries over the pull strap, taking care to observe each battery's polarity.
- Replace the cover and tighten the screws.

Note: *When the batteries become low, the LCD will show* [**LO BATT**] *above the reading. From that point, you will have about one hour of normal use left. If* [bAtt] *comes on continuously and replaces the reading, the battery voltage is too low for accurate measurements and the meter will turn itself off.*

Always keep a replacement set of new batteries available.

Preparing the Instrument

The unit is shipped with its auto shut-off feature enabled. This setting will automatically turn the unit off after a twenty-minute period of keyboard inactivity. To disable this feature, follow the instructions in the menu selections section of this manual.

Attach hoses to the pressure ports at the top of the instrument. Do **not** exceed maximum pressure.

If desired, attach the wrist strap to the bottom of the instrument.

Attaching the Optional Pitot Probe

To attach the probe for measuring air velocity:

- Remove the Pitot probe and rubber tubing from their carrying case.
- Remove the protective caps from the probe and save them for re-storing the probe later.
- Attach one section of flexible tubing 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 550.
- Attach the tubing from the total pressure port of the Pitot probe to the (+) port of the MicroManometer.
- Attach the tubing from the static pressure port of the Pitot probe to the (-) port of the MicroManometer.
- Check to ensure that all tubing connections are tight (see Figure 2).

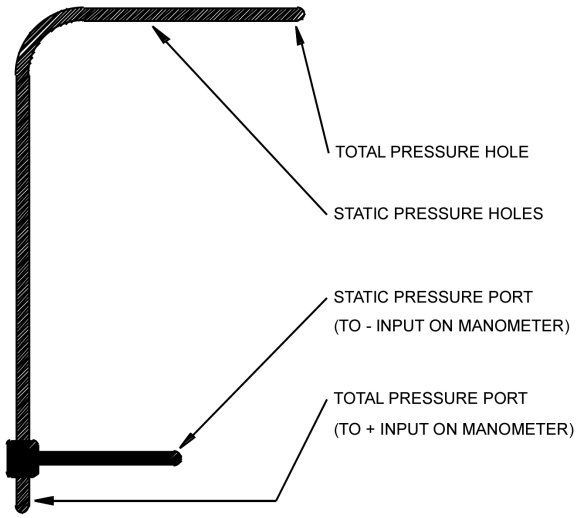


Figure 2: Pitot probe

Attaching a MicroPrinter

Connect the 8521 to the AXD 550 before turning on the instrument. The connector on the AXD 550 is a telephone-style jack.

To attach the printer:

- Grasp the 8521 integral cable at the connector.
- Align the keyway.
- Gently push the connector into the AXD 550 until it is locked.

Start-Up Sequence

Each time you turn the instrument on, some basic functions are tested. The following will occur:

- All the LCD segments will turn on.
- The current software revision level will be displayed.
- The message [bUSY] will appear.
- The last unit of measurement will be displayed.
- The meter will begin to measure.

Zeroing the Instrument

Before you begin taking measurements, the AXD 550 must be zeroed by following these steps:

- Most hand-held meters using differential pressure sensors require a warm-up time. Turn on your AXD 550 a minimum of five (5) minutes before zeroing and taking your first measurements.
- Make sure there is no air flowing past a Pitot probe. Also verify that none of the tubing is pressurized by accidental squeezing.
- Press the **ZERO** key until [ZEro] appears on the display.

The instrument will automatically zero its readings. Repeat this procedure if necessary, because at high resolutions the AXD 550 will read small pressure changes.

Clearing the Memory

If this is the first time you are using the AXD 550, clear the memory before using the instrument.

Clearing the memory is done with the following steps:

- Push **CLR** for three seconds.
- Push ↑ until [YES] appears.
- Push . ↵ to clear memory.

The meter starts in **RUN** mode. It will display measurement values associated with the unit last used. If the value is **OVERRANGE** the display will show [or]; similarily if the instrument is measuring an **UNDERRANGE** value the display will show [ur].

The Display

The AXD 550 uses a 4-digit, 7-segment LCD. As a result, measurements exceeding 9,999 of a given unit of measure will be displayed in a scientific notation format of XXEY. The actual reading will be rounded to the nearest thousand, XX. The Y indicates the number of zeros after XX. For example, 12,751 is displayed as [13E3].

The AXD 550 is measuring and averaging the *actual* value of the reading, not the rounded scientific notation value. No accuracy loss will be encountered. When printing the data on the 8521 MicroPrinter or downloading the data to a host PC, the actual reading will be seen.

Modes

The AXD 550 operates and takes measurements in the **RUN** mode. You may be in the **RUN** mode or one of the menu selection modes.

AXD 550 Keypad and Menus

The AXD 550 Keypad

Each key (except **ZERO**) has two different functions. The *primary* function is shown above the diagonal line on the key's surface. The *secondary* function is shown below the diagonal line. A more detailed description of each function follows.

In the **RUN** mode, if a key is held for *less than three seconds*, the primary function is activated. When a key is held for *more than three seconds*, the secondary function is activated. The exceptions to this are the ↑ and ↓ keys. Because they are used to move between menu options, these keys do not function in **RUN** mode.

⚠ CAUTION

The cycle time of the AXD 550 software may cause the meter to react slowly to a key push. The reaction time of a key push will vary with different functions (1–3 seconds). Do **not** push a key twice because of a slow response time. Doing so may result in accidental activation of a secondary function or duplication of a desired function.

Primary Key Functions:

ON/OFF 	This key is used to turn the instrument on or off when in the **RUN** mode. If the instrument is in any other mode, pressing this key will exit that function and go back to the **RUN** mode without making any changes.
VOL 	The **VOL** key prepares the AXD 550 for air volume measurements. After pressing this key, you must indicate whether you're measuring by area, or whether you're measuring a round or rectangular duct. Choose one of these options by pressing the ↑ or ↓ keys, followed by the ↵ key to make a selection. After you make your selection, use the ↑ or ↓ keys to enter the dimensions, then the ↵ key to enter the units.
MENU 	**MENU** allows you to select one of several options. Use the ↑ or ↓ keys to move through the choices. To choose a selection, push ↵, or return to **RUN** mode by pushing **ON/OFF**. The **MENU** selections are as follows: [PAGE] Changes memory page [Print] Prints all stored data [cF] Correction Factor [Auto] Enables or disables auto shut-off [CHEC] Scans meter voltages [CAL] This is only used by the factory [Port] Enables or disables the serial port [tc] Time constant selection (See also "Menu Selections," next page.)
HOLD 	Pressing this key freezes data in **RUN** mode for input to memory or output to a printer. The display flashes. Pushing **HOLD** again stores and prints your data. Pressing **ON/OFF** returns you to **RUN** mode without storing or printing.

UNIT 	The **UNIT** key allows you to select a unit of measurement. The ↑ and ↓ keys move through the choices. Use the ↵ key to accept a choice, or press **ON/ OFF** to return to **RUN** mode without making changes.
MEM 	The **MEMORY** key is used to review stored data. When it is pressed, the display will show the current page number. The ↑ and ↓ keys will move you to any page you wish to review. To examine data, press the ↵ key. If memory is empty, the unit automatically jumps back to **RUN** mode. Otherwise, you can return there by pressing the **ON/OFF** key. (See also PAGES in "Data Storage.")
ZERO 	The AXD 550 will zero the instrument any time this key is pushed. To get a proper zero, make sure no pressure difference is applied across the ports and no kinks are in the hoses. (See also "Zeroing the Instrument.")

Secondary Key Functions:

↑ and ↓  	These keys allow you to move or scroll through menu selections in forward (↑) or reverse (↓) order.
AVE 	If held for three (3) seconds, the **AVE** key lets you view the average of the current page of measurements which has been stored. Pushing **ON/OFF** returns you to **RUN** mode.
↵ 	This key accepts all selected choices such as values and menu items. After each entry, [bUSY] appears on the display as the AXD 550 stores new information.

Menu Selections

Pressing the **MENU** key activates the main menu. Use the ↑ and ↓ keys to scroll through the available selections. Once you find your desired selection, choose it by pressing ↵. Pressing **ON/OFF** exits the menu, returning you to **RUN** mode.

Menu items (to select any of the following press ↵):

PAGE	Measurements stored in the instrument's memory are organized into pages. This key changes the page onto which you are saving your measurements. If there is no stored data on the current page, the page number will not increase. A total of 100 sets, or lines, of data can be stored. You may have 100 pages of one line each, one page of 100 lines each, or any combination of pages and lines not exceeding 100 readings.
Prnt	This copies all stored data to a connected printer or computer. You can abort the printout at any time by pressing and holding the **ON/OFF** key.
cF	The Correction Factor is an all-purpose multiplying factor which is applied when measuring velocities or volumes. cF is set to 1.000 unless it is changed in the menu. An annunciator (t) tells the user when "cF=1." cF is usually used when air density conditions deviate from standard. See Appendix E. Select values with the ↑ or ↓ key, then press ↵ to accept them or **ON/OFF** to reject them.

AUto	This automatic shut-off option can be enabled or disabled by pushing ↑ or ↓ to select [YES] or [nO], then pushing the . key to enter your selection. When enabled, the automatic shut-off will power-down the AXD 550 after 20 minutes of keyboard inactivity.
CHEC	This diagnostic tool allows you to view important analog voltages within the instrument. Pushing ↑ or ↓ views the eight different channels, which include the following: C0 — O V dc. C5 — 4.965 to 5.025 V dc. C7 — battery voltage (3.5 V fresh batteries)
CAL	Factory use only.

Port	Selecting this item allows the user to enable (on) or disable (off) the serial port. • Press the ↵ key. • Using the ↑ or the ↓ key, scroll to ON or OFF . • Press the ↵ key. • Press the **ON/OFF** key to return to the **RUN** mode. ***Note:*** *the serial port must be* ON *when interfacing to a computer. Keep the port* OFF *when not in use to conserve batteries.*
tc	tc allows you to select from five different speeds of display response. • A setting of 1 is a quick response. • A setting of 5 is a slow response. • The meter is always shipped with tc=2. See the Time Constant Averaging section in Appendix B for the exact method the AXD 550 uses to display a series of measurements.

Using the AXD 550

Basic Functions

To Change Units:

- Push the **UNIT** key until [Unit] appears.
- Use the ↑ and ↓ keys to view new measurement units.
- The display annunciator ▲ will move to the selected unit (see Figure 3).
- Push ↵ to select a new measurement unit.

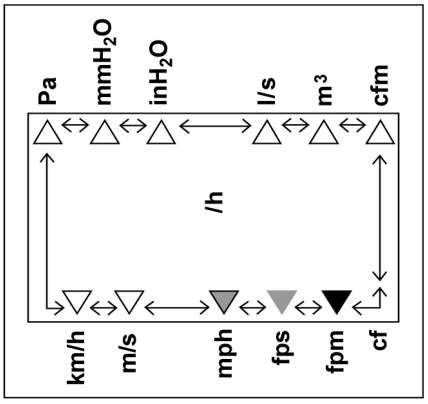


Figure 3: Display with annunciator and units of measure

For example: To change the units of measurement from feet per minute (fpm) to meters per second (m/s):

- Push the **UNIT** key until [Unit] appears.
- Push ↑ until the display annunciator ▲ moves to m/s, selecting meters per second.
- Push ↵ to select the measurement unit.

To Hold a Reading (For storage or printing):

- Push the **HOLD** key briefly until the measured value flashes.
- Push **HOLD** again to **STORE** this reading to memory, or push **ON/OFF** to reject it and return to **RUN** mode.

Measurement Modes

You can set the AXD 550 for pressure, velocity, or volume measurement by pressing the **UNIT** key.

Pressure Selection:

The AXD 550 is a pressure measuring instrument. Its factory default setting is to measure pressure in inches of water (in. H_2O) or pascals (Pa).

Velocity Selection:

Air velocity measurement can be accomplished using a Pitot probe.

The following equations are used for pressure to velocity conversions:

Pressure in inches H_2O	Velocity = 4005 +△P (inches H_2O) in feet/min
Pressure in Pascals	Velocity = 1.29 +△P (Pa) in meters/second

The velocity calculations assume standard conditions. Use the cF menu option to adjust the velocity or volume readings. (See Appendix E for air density correction factors and Appendix D for pressure to velocity conversion charts.)

Volume Selection (or reviewing the latest area):

Air volume measurement is achieved by multiplying a velocity reading by an area.

- When you press the **VOL** key, the [uOLU] menu appears on the display and provides a way to choose whether you are measuring by area (in square units) or by a round or rectangular cross-section.
- Make your selection by scrolling using the ↑ and ↓ keys, then pressing the ↵ key to accept your choice.
- If you choose to use a cross-section, you must then indicate dimensions as follows.

Area (review or select new value):

- When selected, [ArEA] flashes the current units ft^2 [Ft2] or m^2 [m2].
- The display will then show the last area value selected in ft^2 or m^2.
- Modify these values by using the ↑ and ↓ keys to change the volume, pressing the ↵ key to accept the value.

Rectangular:

- After [rEct] is selected, the units of linear distance will be flashed briefly in inches or meters.
- The display will then show starting X dimension values [12.0] in inches or [0.50] meters. Accepting the X value affects choice of a volume dimension (e.g., cfm).
- Change these values using ↑ or ↓. Press the ↵ key to accept.
- The next display shows desired Y dimension values of [12.0] in inches or [0.50] meters.
- Change these values using ↑ or ↓. Press the ↵ key to accept.
- Press the ↑ or ↓ key until the desired value is reached, then press ↵ to accept.

Round:

- The display will show starting point diameter values [12.0] in inches or [0.50] meters.
- Change the value to the necessary diameter using ↑ or ↓. Press the ↵ key to accept.

Data Storage

All measurements stored in the instrument's memory are recorded on pages. A page is created whenever:

- the unit of measurement changes,
- or page is selected from the **MENU**.

For example, if you are measuring feet per second and decide to take measurements in miles per hour, a new page will be created.

The AXD 550 memory has a total capacity of 100 sets of data. This means you can have one page of 100 lines, or one hundred pages of one line, or any combination of pages and lines totaling 100 readings.

Each time the **HOLD** key is pressed for the "second" time, the instrument will store measurements and the correction factor. Readings are stored in battery-backed memory so that powering off or changing batteries does not erase readings. These stored readings will remain in memory until they are cleared or if the instrument is damaged or malfunctions.

A copy of this data can be obtained if a printer or computer is attached to the instrument.

If a printer is connected:

- Press the **MENU** key, then the ↑ or ↓ key until [PrnT] appears.
- Press ↵ to print the data.
- To escape from the print routine, press and hold the **ON/OFF** key until [PrnT] appears, then press the **ON/OFF** key to return to the **RUN** mode.

To erase stored data:

- Press the **CLR** key until [CLr] appears.
- Push the ↑or ↓ key until [YES] appears.
- Press ↵ to clear the memory.

Note: *Keep in mind that you cannot erase individual pages. Clearing data erases every page in the instrument's memory.*

Troubleshooting

Symptom	Possible Cause and Corrective Action
Display shows [or]	The measured value is beyond the instrument's range. Be sure there is no applied pressure, then press **ZERO**.
Display shows [bUSY]	Connection between the meter and the sensor is faulty. Turn the meter off, then turn it back on again.
Display does not change	Your meter could be in a mode other than **RUN**. Press the **ON/OFF** key until the unit turns off. Then turn it on and try again. Your input might simply be very stable. Test your meter by pinching the hoses.
Meter turns off after completing start-up cycle	The batteries are too low for your meter start.vWatch for the [bAtt] indication just before the meter turns off, then replace the batteries.
Meter turns off by itself	Check the auto shut-off feature. Your batteries are probably too low; replace them. If after 20 minutes your meter turns off again, disable the auto shut-off feature.
Meter does not turn off	Be sure your meter is in **RUN** mode, since it must be in **RUN** mode to turn off.

Symptom	Possible Cause and Corrective Action
Measurement is erratic	The input is not steady. Change your time constant setting to a higher value. Check to see that your Pitot probe is held steady.
Erroneous readings	Make sure that your Pitot probe is perpendicular to the air flow you are measuring. Change the value of your time constant. It may be inappropriate for your current application. Clean your Pitot probe—it may be dirty. Take measurements at a different location. Verify your correction factor setting.
Meter does not download to computer	Make sure the serial port on the meter is enabled. Review the stored date. There must be data stored for printing.

If any of these problems persist, call TSI for assistance.

Maintenance

Periodic maintenance should be performed on the meter.

- Batteries should be replaced when the low battery indication is on or when the unit turns itself off after power-up.
- Batteries should be removed from the meter if it 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.

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

The following techniques can be used to measure airflow inside ducts using a velocity probe or Pitot tube. When using a Pitot tube, the individual velocities must be calculated for each pressure reading then averaged together.* Averaging pressure with a Pitot tube and then converting that 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 tube, 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 little 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.

$$\text{Equivalent Diameter} = \sqrt{4HV/Pi}$$

Where: H = horizontal duct dimension

V = vertical duct dimension

Pi = 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 or ±10 percent can be obtained this way. This method is not reliable, however, and should only be used where small duct size or other conditions do not permit a full traverse.

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 4. 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.)

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.

*The AXD 550 MicroManometer is able to calculate averages automatically, thus eliminating the need for additional calculations. Refer to "AVE" on page 6 of this manual.

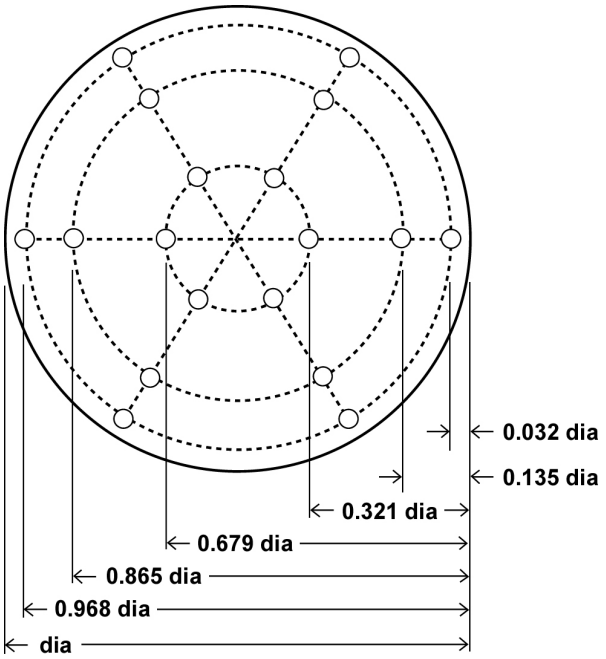


Figure 4: Location of measuring points when traversing a round duct using the log-Tchebycheff method

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

The duct in Figure 5 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).

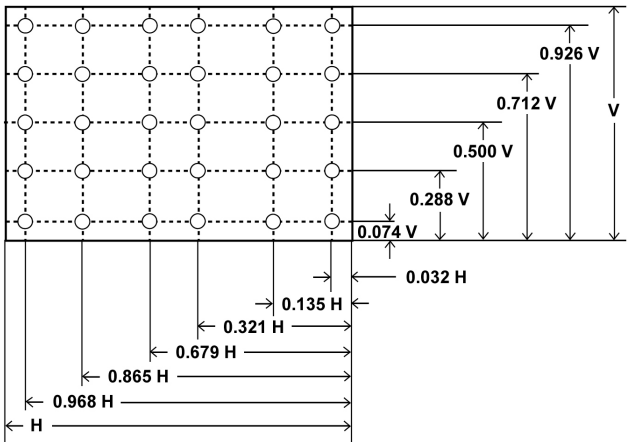


Figure 5: Location of measuring points for traversing a rectangular duct using the log-Tchebycheff method

Number of points or traverse lines per side	Position relative to inner wall
5	0.074, 0.288, 0.500, 0.712, 0.926
8	0.061, 0.235, 0.437, 0.563, 0.765, 0.939
10	0.053, 0.203, 0.366, 0.500, 0.634, 0.797, 0.947

Notice of Disclaimer

TSI Incorporated has made a good faith effort to provide reliable information regarding the use of the AXD 550 to conduct a duct traverse. However, we cannot guarantee conformance to any particular method of specification, or that this material is free from error. Traverse methods outside of the USA will be slightly different. TSI 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:
Time Constant Averaging Technique

The averaging technique is common to many types of instrumentation. It also tends to increase the display rate of the microprocessor on the LCD. In other words, the lower the time constant value, the higher the percentage of the new value is displayed at an increased time rate.

This technique uses a percentage of the newly acquired value and adds it to a percentage of the "old" value. The two percentages must add up to 100%. The meter then displays the resultant value. This displayed value then becomes the "old" value while a new pressure is being measured. Then the process starts over. By using less than 100% of the new value for the displayed reading, a more stable displayed reading results. The following table shows the [tc] value and the percentages of new and old values that will be used.

In any circumstance, if the new value is more than 50% different than the old value, 100% of the new value will be used. This "override" percentage allows the meter to quickly attain a new value when the higher [tc] settings are used, and provides the desired damping to typical input fluctuations. Without this feature, the meter would take a long time to reach its final value when exposed to large changes in input value.

Setting	New Value %	Old Value %	Time to Reach 95% of input is less than override %	Time to reach input if more than override %	Override %
1	100%	0%	1.5 seconds	1.5 seconds	50%
2	50%	50%	6.0 seconds	1.5 seconds	50%
3	25%	75%	12 seconds	1.5 seconds	50%
4	10%	90%	34 seconds	1.5 seconds	50%
5	5%	95%	68 seconds	1.5 seconds	50%

Note: The time at 1.5 seconds is the time to reach input if more than override % column corresponds to two update intervals. Depending on when in the update cycle the stop change would occur, this is the maximum time which would be needed to see the change. It is possible to view the change after one update.

Appendix C:
Serial Communication using Microsoft® Windows™ "Terminal"

To prepare meter and computer for serial communication:

Turn on your meter.

1. Connect the meter to the serial port on your PC using the Interface Cable (part no. 634-493-404).
2. Start Windows on your PC.

   Windows "Terminal" is located in the Accessories group.
3. Open "Terminal."
4. From the Settings menu, choose Communications.
5. In the Communications window, you must verify the following parameters:

Baud Rate	1200
Data Bits	8
Stop Bits	1
Parity	None
Flow Control	None
Connector	Select the communications port to which the meter isconnected

6. Choose the **OK** key.
7. From the Settings menu, choose **Terminal Preferences**.
8. In the Terminal Preferences window, you must:

   8a. Verify that there is no X in the local Echo box.

   8b. Set the Buffer Lines to 399.
9. Choose the **OK** key.

To download memory from a meter to "Terminal":

There are two ways to download the memory contents from an Alnor meter to a terminal. For both methods, make certain that the serial port is enabled and the **CAPS LOCK** key is activated.

First method:

At the terminal, type in `GEE1` then press the **ENTER** key. Notice: keep typing the `G` until it reappears on the terminal screen, then continue typing `EE1`.

Second method:

At the terminal and after following the steps under "To prepare meter and computer for serial communication:"

- Select "SETTINGS"
- Select "TERMINAL PREFERENCES"
- In the box titled "CR—>CR/LF", select "inbound"

Now at the meter:

- Press the "**MENU**/ ↓" key
- Keep pressing the "**MENU**/↑ " key until "Prnt" appears
- Press the "**UNIT**/↵" key to begin downloading.

After all data is received:

- The meter displays "Prnt"
- Momentarily press the "**ON/OFF**" key to return to the "**RUN**" mode.

To export data from "Terminal" to another Windows application:

After downloading memory from the meter to "Terminal," you may want to transfer the data from "Terminal" to another Windows application, such as Microsoft Word, to be able to reformat or manipulate the data further.

1. From the Edit menu, choose **Select All**.
2. From the Edit menu, choose **Copy**.

   All of your data has now been transferred and copied to the Clipboard. It is ready to paste into any Windows application.
3. Open the application in which the data is to be transferred, i.e., Microsoft Word.
4. From the Edit menu, select **Paste**.

   The downloaded data will now appear in the application. Now you are able to save the data.
5. From the File menu, choose **Save As**.

6. Enter the filename under which you will store the data.
7. Choose the **OK** key.

Serial Communication Through Windows 95

- Click on **Hyperterminal.exe** located in the accessories menu.
- If a box comes up requesting modem installation, click **No**.
- Enter a name (Alnor) and choose an icon for meter downloading to the PC, click **OK**.
- Connect using **Com1** connection, click **OK**.
- Set port settings under **Com1 Properties** to 1200BPS, 8 data bits, no parity, stop bits 1, and **Flow Control** to **None**, click **OK**.
- Click File and choose **Properties**.
- Click on **Settings**, choose **ASCII** set up. Verify checkmark for **Terminal Keys**, **Emulation** to **Auto Detect**, and **Backscroll Buffer Lines** to **500**.
- Place a check mark under **ASCII Receiving** in the boxes marked **Append Line Feeds To Incoming Line Ends** and **Wrap Lines That Exceed Terminal Width**, click **OK**.
- Click O**K** again to exit **Properties**.
- **Hyperterminal** is now ready to receive information from the meter.
- Save terminal configuration for future use.

Appendix D:
Pressure to Velocity Conversion Charts

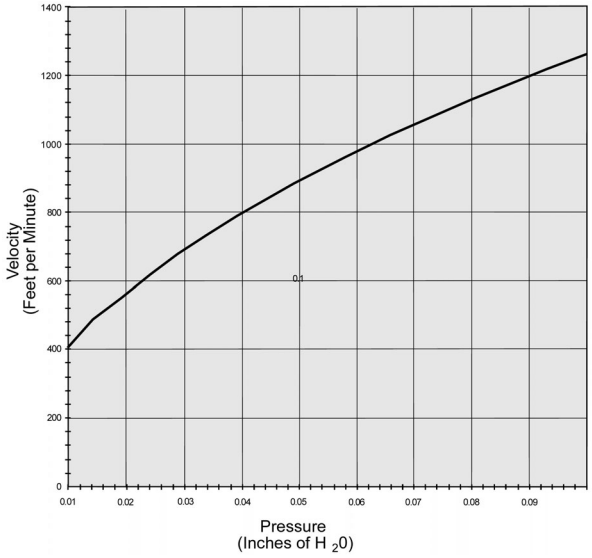
The AXD 550 MicroManometer converts pressure readings to velocity using the formula for standard conditions:

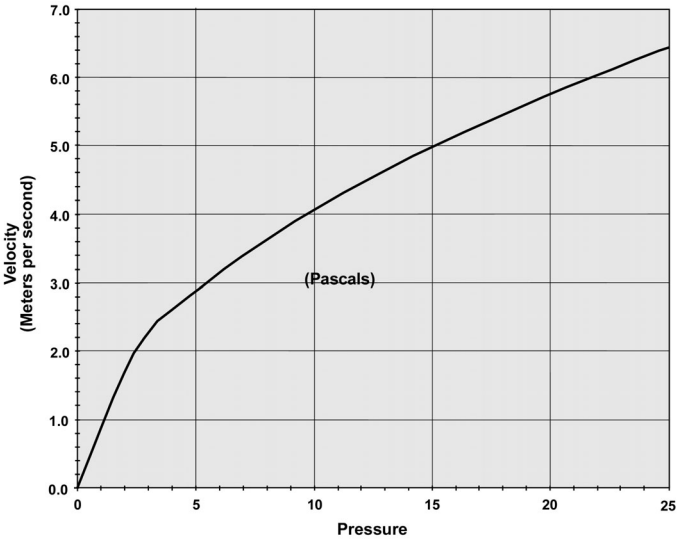
$V^{(fpm)} = 4005\sqrt{\Delta P}$ Pressure in inches H_20

$V^{(m/s)} = 1.29\sqrt{\Delta P}$ 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 Micro-Manometer should not be used with a pitot tube 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 range0–0.10 inches H_20 (0–25 Pa).





Appendix E:
Correction Factors for Non-Standard Conditions

The AXD 550 is a differential pressure instrument. When it is connected to a Pitot-static probe, it can be used to measure velocity. When a Bernoulli's equation is applied to the Pitot-static probe, the resultant equation has the form V(ft/min) = 4005 $[P(in\ H_2O)]^{1/2}$ when the density of the air is 0.075 lb/ft. The velocity values displayed by the AXD 550 are the actual velocities *only* if the density where the Pitot probe measurements are being taken is 0.075 lb/ft^2. Otherwise, a correction step must be performed to obtain a correct value. Listed below in *decreasing* order of accuracy are methods for determining a correction factor.

***Note**: In the United States, the barometric pressure reported by the National Weather Service is corrected to sea level and, therefore, cannot be used unless your measurements are taken at sea level. The preferred method is to use the atmospheric pressure at the location of the measurement. If you do not have access to that value, then Method 3 in this appendix can be used. This method is most accurate when the pressure reported by the national weather service is 29.92 in Hg due to the assumption of standard density.*

Method 1

If you have the absolute pressure, temperature and relative humidity, record the differential pressure from the AXD 550, the absolute pressure, the temperature, and the relative humidity at the measurement location. Compute the density using the techniques used in the 1993 ASHRAE fundamentals handbook. With the density and the differential pressure, use the formula for Pitot probes also found in that handbook to compute the actual velocity.

Method 2

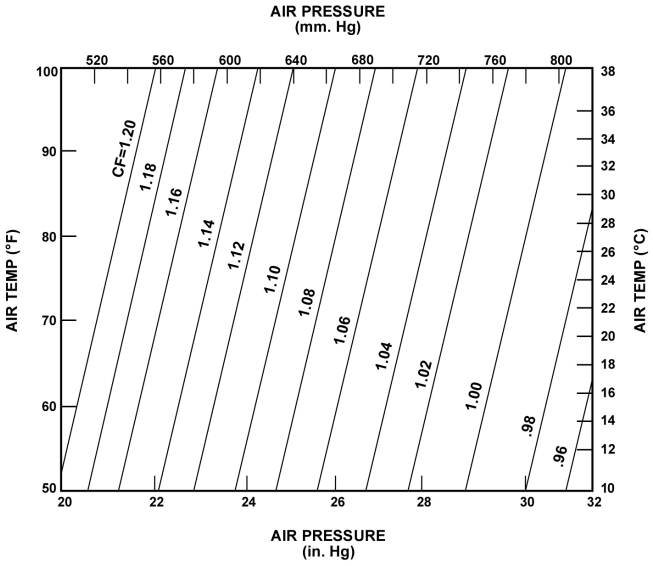
If you have the absolute pressure and the temperature, you have two options.

a) Record the displayed velocity measurement along with the absolute pressure and temperature. Convert to units of °F and in Hg if the temperature and pressure were not taken in those units. To obtain actual velocity, use Equation 1 in this appendix to calculate the correction factor and multiply the velocity reading by that factor.

b) If using the equation is not convenient, the Air Pressure vs. Air Temperature chart in this appendix can be used to determine the correction factor. However, inaccuracies can result from using the graphical technique instead of a direct calculation to obtain actual velocity.

Method 3

You can use this method if you know the altitude above sea level and the air temperature but are unable to determine the absolute pressure. Using the AXD 550 Density Correction Factors chart, find the appropriate correction factor value. Multiply the displayed value by the value in this chart to get the "corrected" value.



NOTE: 1 (in. H_2O) X 7.36 (10^{-2}) = 1 in. Hg.

Eq. 1: $$\text{CORRECTION FACTOR} = \sqrt{\frac{.075 \text{ X } (459.7 + \text{TEMP } (°F))}{1.325 \text{ X AIR PRESSURE (in. Hg.)}}}$$

AXD 550 Density Correction Factors

For Different Altitudes and Temperatures

Air Temp F°	Altitude (ft.)										
	Sea Level	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
-40°	0.89	0.91	0.92	0.94	0.96	0.98	1.00	1.02	1.04	1.05	1.07
0°	0.93	0.95	0.97	0.99	1.01	1.03	1.05	1.06	1.08	1.10	1.13
40°	0.97	0.99	1.01	1.03	1.04	1.07	1.08	1.10	1.13	1.15	1.17
70°	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.19	1.20
100°	1.03	1.04	1.07	1.08	1.11	1.13	1.15	1.17	1.20	1.21	1.24
150°	1.07	1.09	1.11	1.13	1.15	1.18	1.20	1.22	1.24	1.27	1.29
200°	1.12	1.14	1.16	1.19	1.20	1.23	1.25	1.27	1.29	1.32	1.35
250°	1.15	1.18	1.20	1.22	1.25	1.27	1.29	1.31	1.34	1.36	1.40
300°	1.20	1.22	1.24	1.27	1.29	1.31	1.34	1.36	1.39	1.41	1.44
350°	1.24	1.27	1.29	1.31	1.34	1.36	1.39	1.40	1.43	1.46	1.49
400°	1.27	1.29	1.32	1.35	1.37	1.40	1.43	1.44	1.47	1.51	1.54
450°	1.31	1.34	1.36	1.39	1.41	1.44	1.47	1.49	1.52	1.54	1.58
500°	1.35	1.37	1.40	1.43	1.46	1.49	1.51	1.52	1.56	1.60	1.62
550°	1.37	1.40	1.43	1.46	1.49	1.51	1.54	1.56	1.60	1.62	1.67
600°	1.41	1.44	1.47	1.49	1.52	1.56	1.58	1.60	1.64	1.69	1.71
700°	1.47	1.51	1.52	1.56	1.60	1.62	1.64	1.69	1.71	1.74	1.77
800°	1.54	1.58	1.60	1.64	1.67	1.69	1.74	1.77	1.80	1.83	1.86
900°	1.60	1.64	1.67	1.69	1.74	1.77	1.80	1.83	1.86	1.89	1.92
1000°	1.67	1.69	1.74	1.77	1.80	1.83	1.86	1.89	1.92	1.96	2.00

Standard Air Density = 0.075 lb/cu ft

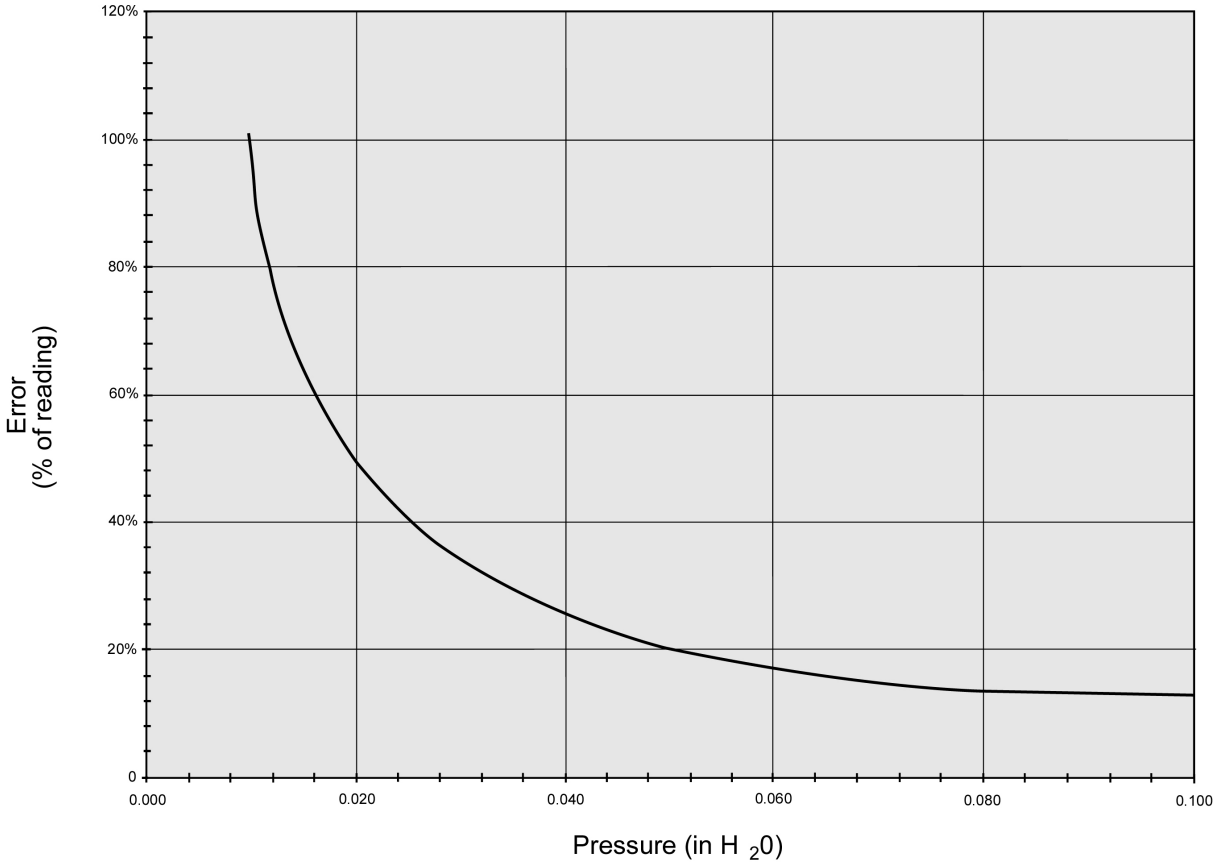
Appendix F:
Effects of Resolution on Accuracy Statement

The AXD 550 MicroManometer has a resolution of .01 inches H_2O (1 Pa in metric units).

The accuracy statement reads ± (1% of indicated reading + resolution). At very low differential pressures, therefore, the accuracy approximates the resolution.

e.g. differential pressure of .01 inches H_2O accuracy statement is ± (.01 x .01 + .01) or ±.0101 inches H_2O or reading error is ±101% of reading.

As differential pressure increases, the resolution effect is decreased. The graph below shows the approximate error in % of reading you can expect as differential pressure increases. (See specifications for detailed specifications).



Error as a percentage of reading in inches of water due to meter resolution

Service Information

Contact TSI Incorporated 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 turn-around time, photocopy and fill out this form with as much detail as possible and attach it to the instrument.

RMA No. _____

Instrument Model _____

Serial Number _____

Date of Purchase _____

Where Purchased _____

Describe Malfunction _____

Describe Environment _____

Return Instrument to:

Name _____
(Your name or company)

Address _____

Telephone _____

Address Correspondence to:

Name _____

Address _____

Telephone _____

Instructions for Return

Service and Repair

Please return your Product Registration Card immediately. This allows us to send you service reminders, special offers, and important information about your product.

Before sending your instrument for calibration or repair, you should call Customer Service. The service department will provide you with the cost of service or calibration, Return Material Authorization (RMA) number, and shipping instructions.

Please have the following information available when you call:

- Owner's name, address, and phone number
- Billing address, if different and applicable
- Instrument name and model
- Serial number
- Date of purchase
- Where purchased

TSI recommends that you keep a "calibration log" and keep all records of service on your instrument.

Instructions for Return

Send the instrument to TSI prepaid. Securely package your instrument in a strong container surrounded by at least 2 inches (5 cm) of suitable shock-absorbing material. Include a purchase order that clearly shows the instrument model number and serial number, a contact name, phone, fax number, and RMA number. Mark the outside of your shipping container with the RMA number. This will expedite processing of your instrument when we receive it.

Damaged in Transit

All orders are 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. DO NOT DISCARD THE BOX.

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 TSI while awaiting reimbursement from the carrier for the damaged instrument.

Call TSI directly for assistance if necessary.

Ownership/Calibration Log

Equipment Log

Date of Purchase _____

Calibration Record _____

1. _____ 2. _____ 3. _____

4. _____ 5. _____ 6. _____

7. _____ 8. _____ 9. _____

10. _____ 11. _____ 12. _____

Notes: _____

AXD 550 MicroManometer Specifications

Measurement Units

Pa	Pascals
in. H_2O	inches of Water Column
mm. H_2O	millimeters of Water Column
fpm	feet per minute
fps	feet per second
m/s	meters per second
mph	miles per hour
km/h	kilometers per hour
cfm	cubic feet per minute
m^3/h	cubic meters per hour
l/s	liters per second

Resolution

Pressure Measurement
0.002 in. H_2O (-.998 to +.998)
0.01 in. H_2O (-4.01 to -1.00)
0.01 in. H_2O (1.00 to 9.99)
0.1 in. H_2O (10.0 to 20.0)

1 Pa except 0.5 Pa (-99.5 to +99.5 Pa)

Display resolutions for Velocity and Volume units are:

0.01	(0 to 99.99)
0.1	(100 to 999.9)
1	(1000 to 9,999)
scientific notation	(10,000+)

Measured values are stored with better precision.

Range

Pressure Measurement
-4.00 to +20.00 in. H_2O
-1000 to 5000 Pascals

Velocity Measurement
(using Alnor-supplied 12 inch Pitot probe)
179 to 17,910 fpm
4.17 to 298.5 fps
2.84 to 203.5 mph
1.29 to 91.21 m/s
0.78 to 5.47 km/h

Volume Measurement
Velocity values may be multiplied by area values up to:
78.8 ft^2
2.0 m^2

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 137 kPa or 553 in. H_2O maximum

Accuracy (Factory Calibration conditions)
For pressure measurement only, after zeroing.
±(1% of indicated reading +resolution +0.01)

Display: .45 inch high, 4 digit, 7 segment LCD, no backlight
.15 inch high, 2 1/2 digit memory indicator

Data Memory: One hundred memory locations are available to store units of measure, and pressure, velocity, or volume readings.

Physical Dimensions: 7.6 x 3.2 x 1.3 inches
193 x 81 x 33 millimeters

Weight: 11.6 oz. (330g) with batteries

Power Source: 3 AA-size alkaline batteries

Battery Life: 15 hours with continuous use

Power-Saving Feature: Selectable automatic shut-off

Model		Part No.
AXD 552	Kit with AXD 550 meter, Alnor Pitot tube, hoses, 8521 MicroPrinter, carrying case, 3 AA-size batteries, operator's manual, calibration data sheet, and two year limited warranty.	632-550-112
AXD 551	AXD 550 meter, carrying case, 3 AA-size batteries, operator's manual, calibration data sheet, and two year limited warranty.	632-550-111
AXD 550	AXD 550 meter, protective pouch, 3 AA-size batteries, operator's manual, calibration data sheet, and two year limited warranty.	632-550-110

Accessories

Model	Part No.
12" Pitot probe (1/4" diameter)	634-634-000
18" Pitot probe (1/4" diameter)	634-634-001
24" Pitot probe (1/4" diameter)	634-634-002
36" Pitot probe (1/4" diameter)	634-634-003
60" Pitot probe (1/4" diameter)	634-634-005
Serial interface cable For downloading stored data to a host PC	634-493-404
Rubber hose (8 ft.)	372-000-000
Carrying case	534-493-235
Model 8521 MicroPrinter Thermal printer with battery charger and two rolls of paper	634-493-010
Thermal printer paper	538-493-010

Specifications are subject to change without notice.

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INTERTEK CERTIFICATION

ACCREDITED REGISTRAR ANSI-RAB

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