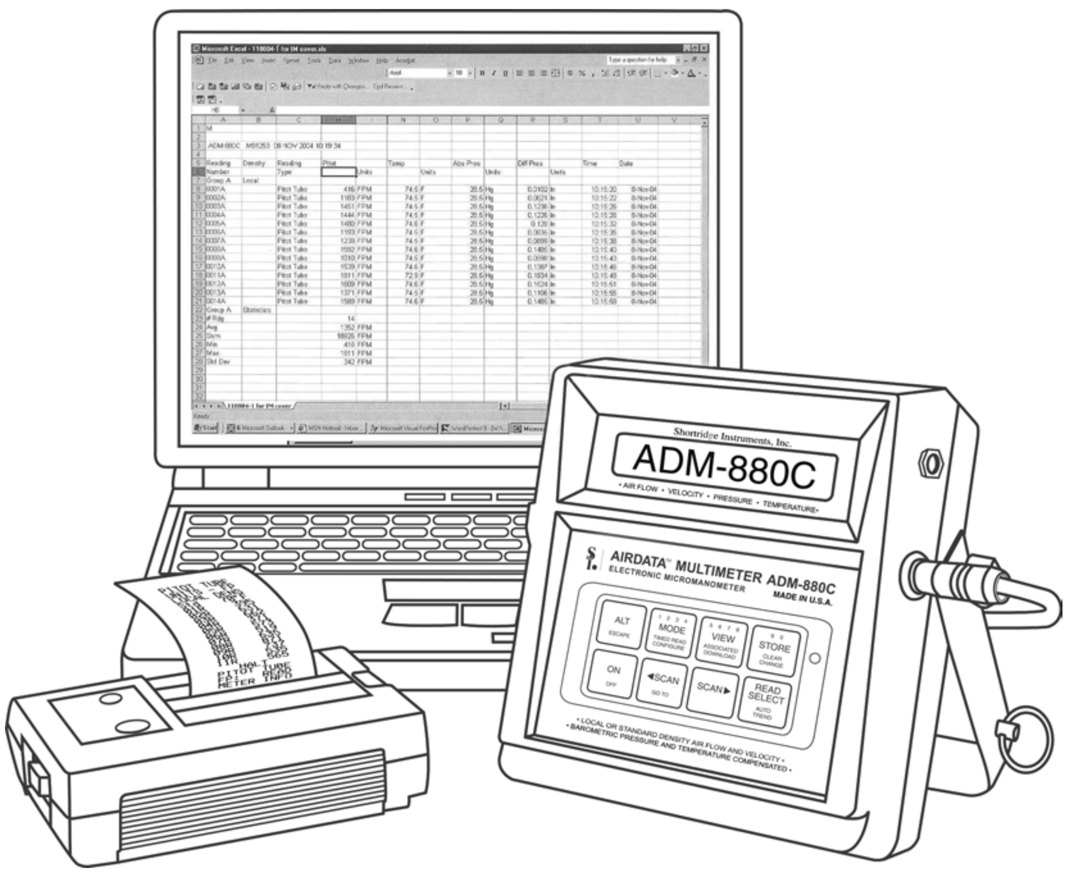
AIRDATA™ MULTIMETER ADM-880C

ELECTRONIC MICROMANOMETER
WITH 2000 READING MEMORY, DATALOGGING
CAPABILITY AND RS232 COMMUNICATIONS PORT

• AIR FLOW • VELOCITY • PRESSURE • TEMPERATURE •

OPERATING INSTRUCTIONS



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1.0 INTRODUCTION

This meter measures air velocity when used with a Dwyer Series 160 standard pitot tube, AirFoil probe, or VelGrid and automatically corrects for density variations due to local barometric pressure. The meter also automatically corrects for density variations due to local temperature if the TemProbe is connected. Velocity ranges are 25-29,000 fpm using a pitot tube, 25-5,000 fpm using the AirFoil probe, and 25-2500 fpm using the VelGrid. The associated temperature, absolute pressure, time and date may be viewed for any manual or automatic reading taken with an AirFoil probe or VelGrid in the velocity mode. The associated differential pressure (velocity pressure) may also be viewed for velocity readings taken using the pitot tube. Velocity measurements may be displayed in either local air density or the standard density (mass flow) sea level equivalent. All measurement modes may be displayed in either English or metric units.

When used with the Series 8400 FlowHood System, this unit measures air flow, compensates for the density effects of barometric pressure and temperature and may also be used to compensate for backpressure effects, allowing direct air flow readings from 25-2500 cfm. The associated temperature, absolute pressure, time and date may be viewed for any manual or automatic reading taken in the FlowHood mode. Flow measurements may be displayed in either local air density or the standard density (mass flow) sea level equivalent.

Differential pressure measurements can be obtained from 0.0001 in wc to 60.00 in wc. Absolute pressure measurements range from 10-40 in Hg. Temperatures can be measured from -67˚ F to 250˚ F, either individually, or in conjunction with an air flow or velocity measurement.

The Model ADM-880C AirData Multimeter offers additional features which greatly simplify the complex technical requirements of highly demanding test and balance projects.

This model features an automatic reading mode which registers repeated measurements in any mode, with sequential storage and recall of up to 2000 automatically or individually stored readings, with sequence tags for each value. Readings may be stored in up to 25 different memory groups. Recall of the sum, average, standard deviation, time and date for all readings in each measurement mode in any memory group, along with the minimum and maximum readings for each measurement mode within the memory group is available at any point, without terminating the process. Readings in either the current or a previous memory group may be erased or replaced with a new reading along with the new time, date and associated data. The statistics will be revised to include the revised information.

This meter also features datalogging capabilities. The meter may be programmed with start, stop and interval times to take and store up to 2000 readings at specified intervals with all of the recall capabilities described above.

The ADM-880C AirData Multimeter includes a custom serial cable with an RS232 connector for use with the RS232 port on the meter. The kit also includes the Shortridge Instruments, Inc. ADM DataFlow software utility, which may be used to download readings into a Microsoft Excel® or similar spreadsheet for display, analysis, and manipulation. The DataFlow software downloads all readings in all measurement modes, along with all related statistics and associated data for each measurement mode.

This RS232 port and cable may also be used with a compatible portable printer. The contents of all readings stored in memory can be downloaded and printed as needed.

Internal calibration and zeroing of the AirData Multimeter are fully automatic. No external adjustments are ever needed. This instrument is extremely tolerant of overpressure, and is unaffected by position or ambient temperatures from 40˚ F to 140˚ F. It is recommended that the AirData Multimeter kit be returned to the factory at least every two years for recalibration and software update. This preventive maintenance program will assure that the original accuracy of the meter is maintained throughout the life of the meter.

2.0 SPECIFICATIONS

AIR VELOCITY: Measured in feet per minute (fpm), or meters per second (m/s), corrected for local or standard air density. The measurement range is 25 to 29,000 fpm with a Dwyer Series 160 standard pitot tube, and 25 to 5,000 fpm with the Shortridge Instruments, Inc. AirFoil probe. The measurement range using the VelGrid is 25 to 2500 fpm. Accuracy is ± 3% of reading ± 7 fpm from 50 to 8000 fpm. Pitot tube velocity readings from 8,000 fpm to 29,000 fpm are based on compressible isentropic flow theory and are not certified NIST traceable.

DIFFERENTIAL PRESSURE: Measured in inches of water column (in wc) or Pascals (Pa). The measurement range is from 0.0001 to 60.00 in wc. Maximum safe pressures are 20 psid (900% full scale) and 60 psia common mode. Accuracy is ± 2% of reading ± 0.001 in wc from 0.0500 to 50.00 in wc.

ABSOLUTE PRESSURE: Measured in inches of mercury (in Hg) or bars with reference to a vacuum. The measurement range is 10-40 in Hg. Maximum safe pressure is 60 psia. Accuracy is ± 2% of reading ± 0.1 in Hg from 14 to 40 in Hg.

TEMPERATURE: Accuracy is ± 0.5˚ F from 32˚ F to 158˚ F with a resolution of 0.1˚ F using the ADT442, ADT443, ADT444, ADT445 or ADT446 TemProbes. AirData Multimeters display readings from -67.0˚ F to 250.0˚ F. Safe exposure range for the TemProbes is -100˚ F to 250˚ F. Do not expose the plastic base of the TemProbe or the extension wand to temperatures above 200˚ F.

AIR FLOW: Measured in cubic feet per minute (cfm) or liters per second (L/s), corrected for air density. This function requires the use of the Shortridge Instruments, Inc. Series 8400 Backpressure Compensating FlowHood System. The measurement range is 25 to 2500 cfm supply and 25 to 1500 cfm exhaust. Accuracy is ± 3% of reading ± 7 cfm from 100 to 2000 cfm (nonbackpressure compensated readings).

AIR DENSITY CORRECTION: The air density correction range is 14-40 in Hg and 32˚ F to 158˚ F for correction of air flow and velocity measurements. The readings represent **either** local density air flow **or** standard density sea level equivalent (mass flow) for air flow or velocity. Readings are corrected for the density effects of temperature and absolute pressure.

MEMORY: 2000 readings with sequential recall of each reading along with the average, sum, minimum, maximum and standard deviation. Data may be stored in 25 separate memory groups.

RESPONSE TIME: Varies from one second at higher pressure inputs to seven seconds at less than 0.0003 in wc (70 fpm). Extremely low pressure/flow/velocity inputs require longer sample times than higher pressure/flow/velocity inputs. TREND mode provides continuous readings in less than two second intervals. (Accuracy specifications do not apply in TREND mode).

READOUT: Ten digit, 0.4 inch, liquid crystal display (LCD).

METER HOUSING: High impact, molded, "T" grade ABS.

METER WEIGHT: 36 ounces (1.02 kg), including batteries.

SIZE: 6.0" x 6.4" x 2.7" (15.2 x 16.3 x 6.9 cm).

BATTERY LIFE: A ten-hour charge will normally allow two working days of heavy use, or up to 3000 readings per charge if the backlight is not being used. Increasing the charge time to 48 hours (such as a weekend) will increase the working time by 25%. Continuous use of the backlight may reduce the battery life by up to one half.

A set of rechargeable type AA NiCad batteries is supplied in each meter. Each battery has a storage capacity of 1100 milliAmp hours. These batteries may be recharged up to 500 times before replacement. If 1100 mAh batteries are not available in a field situation, 700 mAh batteries (all 12) may be substituted. If 700 mAh batteries are mixed with 1100 mAh batteries, the 700 mAh batteries may be damaged as the battery charge is depleted. If rechargeable batteries are not available in a field situation, the batteries may be replaced with 12 non-rechargeable "AA" pen cell batteries.

WARNING: Do not plug the charger in if **any** non-rechargeable batteries are in the meter. The meter will be seriously damaged along with the batteries and charger.

The approximate level of charge remaining in the batteries may be displayed by pressing SHIFT/SHIFT. The display will read BATT FULL if the batteries are highly charged. The display will read BATT 2/3, BATT 1/3, or LOCHARGE as the level of charge decreases. NOTE: A battery charge level displayed when the meter is first turned on may not be representative of the true level of battery charge. Wait five or ten minutes after turning the meter on to view the charge status.

BATTERY CHARGERS: The battery charger (P/N PS8201) used in the U.S.A. and many other countries requires 120 Volts AC, 60Hz, 8W. The battery charger (P/N PS8202) used in Europe and certain other locations requires 220 Volts AC, 50Hz. Both chargers deliver 24 Volts AC to the meter. **Batteries may be left on charge for an unlimited time without harm.** The temperature of the instrument during charge should be kept between 40˚ F and 113˚ F (5˚ C to 45˚ C). The meter is fully operational during recharge.

OPERATIONAL TEMPERATURE LIMITS: The specified accuracy for measurements is maintained over a meter exposure temperature range of 40˚ F to 140˚ F (5˚ C to 60˚ C).

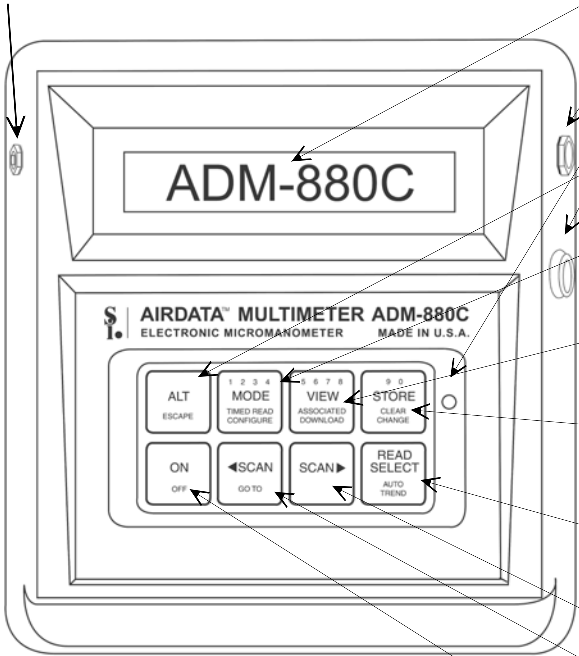
STORAGE TEMPERATURE LIMITS: -4˚ F to 140˚ F (-20˚ C to 60˚ C).

AIR BLEED: Each pressure measurement requires a small volume of air to pass through the meter. The pressure source must be capable of supplying this volume without significant depletion to assure accurate measurements. Bleed through is typically 0.0004 cubic inch per in wc per measurement. Quiescent bleed through (maximum) is 0.0005 cubic inch per in wc per minute.

TUBING: The maximum recommended length of pneumatic tubing for the measurement of air flow, velocity, or differential pressure is 18 feet. Minimum tubing size is 3/16 inch, inside diameter. The VelGrid is used with the two eight foot lengths of 3/16 inch ID tubing furnished with the kit.

3.0 EXTERNAL FEATURES

External Read Jack for Pushbutton Handle Plug



10 Digit, 0.4" LCD Display

Battery Charger Jack

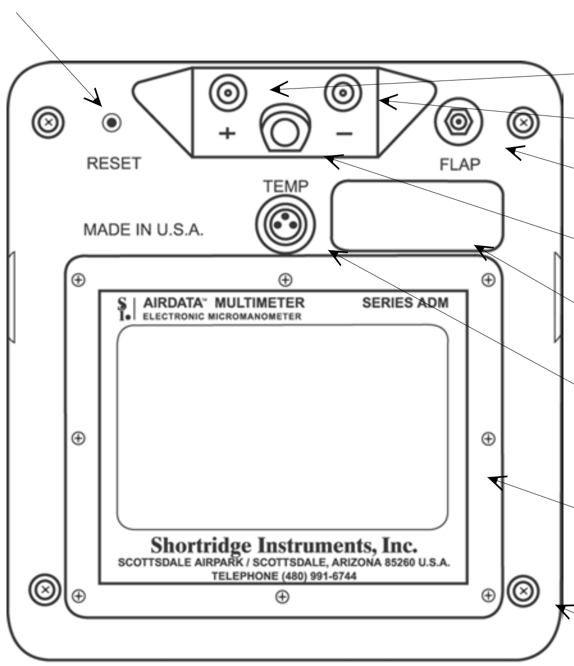
Green LED indicates if charger is plugged in

RS232 Serial Port Jack

ALT ESCAPE	Alters function of following key Exits loop; displays current selections
MODE TIMED READ CONFIGURE	Flow/Press/Temp/VelGrid/AirFoil/Pitot Set up for timed readings Set up Units, Density, Time, Date
VIEW ASSOCIATED DOWNLOAD	View statistics View Assoc Press, Temp, Time, Date Download to printer
STORE CLEAR CHANGE	Store in memory Clear memory Change mem group; erase; replace
READ SELECT AUTO TREND	Initiate reading; halt read sequence Select displayed option Automatic readings TREND readings
SCAN ▸	Recall in entry order
◂ SCAN GO TO	Recall in reverse order Go To a designated reading
ON OFF	Power On; turn light On & Off Power Off after ALT

ADM-880C METER FRONT

Pushbutton Reset



Positive (+) Pressure Port

Negative (-) Pressure Port

Flaps Jack for FlowHood Flaps Plug

Threaded Insert for Attachment to FlowHood with Captive Screw

Calibration Label with Serial Number & Date

Temperature Input Jack for TemProbe, Retractile Cord or MultiTemp

Battery Compartment Cover - Remove the 8 Small Phillips Head Screws to Test or Replace the Batteries (12 AA NICAD)

Four Large Phillips Head Screws That Hold the Meter Case Together - DO NOT REMOVE

METER BACK

FIGURE 3.1 ADM-880C METER FRONT AND BACK

3.1 KEYPAD LAYOUT

There are eight keys on the keypad, arranged as shown below. Several keys have multiple functions.

ALT ESCAPE	1 2 3 4 MODE TIMED READ CONFIGURE	5 6 7 8 VIEW ASSOCIATED DOWNLOAD	9 0 STORE CLEAR CHANGE
ON OFF	<SCAN GO TO	SCAN>	READ SELECT AUTO TREND

KEY	PRIMARY FUNCTION (F)	SECONDARY FUNCTION (ALT / F)	TERTIARY FUNCTION (ALT / F / ALT / F)
ALT	Alternate	Escape	
MODE	MEASUREMENT Differential pressure Temperature VelGrid velocity AirFoil velocity Pitot tube velocity Absolute pressure FlowHood air flow	TIMED READ Interval Time Begin Time End Time Number of Readings	CONFIGURE Units - English or Metric Density - Local or Standard Time Date
VIEW	STATISTICS Average Sum Minimum Maximum Standard deviation	ASSOCIATED DATA Mode/Units Temperature Absolute pressure Differential pressure Time and date	DOWNLOAD Download to printer
STORE	STORE Store All Store Last Store Off	CLEAR MEMORY	CHANGE MEMORY Select memory group Erase reading in memory Replace reading in memory
ON	If meter off, turn on If meter on, turn light on If light on, turn light off	Turn meter off	
◂SCAN	Scan memory sequence ascending	Go To	
SCAN▸	Scan memory sequence descending	Reset display	
READ	Read/Select	Automatic Readings	Trend Readings

3.3 FEATURES ON SIDES AND BACK OF METER

BATTERY CHARGER JACK

When viewed from the front, the battery charger jack is on the right side of the meter toward the top. The battery charger plug is to be connected here.

EXTERNAL READ JACK

When viewed from the front, the external read jack is on the left side of the meter toward the top. The plug for the external thumbswitch is connected here. This feature allows the operator to trigger measurements from the FlowHood or VelGrid handgrip while working overhead or in awkward circumstances. The thumbswitch performs the same function as the READ key.

FLAPS JACK

The flaps jack is on the back of the meter, in the upper right hand corner. The flaps plug on the FlowHood is inserted here.

TEMPERATURE INPUT JACK

The temperature input jack is centered on the back of the meter, slightly toward the top. The flexible TemProbe sensor must be connected to this receptacle whenever temperature density correction is desired for either flow or velocity measurements. A retractile cord connects the TemProbe or the MultiTemp to the temperature input jack for remote temperature sensing.

RESET SWITCH

The reset pushbutton switch is on the back of the meter in a recess near the upper left corner. This switch is used to reset the meter in the unlikely event that the microprocessor becomes lost in its program. This may occur if the meter is dropped, and may cause the keypad to become nonfunctional until the meter is reset. Press the reset switch for one second to restart the meter.

Readings saved in memory since the meter was last turned on may be lost if the meter must be reset. If the meter continues to fall into "lockout" after being reset, it may have been damaged, and should be returned for repair.

PNEUMATIC PRESSURE INLETS

Two pneumatic pressure inlets positive (+) and negative (-) are centered on the back of the meter at the top edge and may be connected to various pressure sources for the measurement of air velocity, flow, or pressure. Sources include the FlowHood, AirFoil probe, VelGrid, pitot tubes, static pressure probes, or any other pressure source not exceeding the safe limits for the meter. The negative (-) inlet senses the static pressure during flow or velocity measurements, and also is used for direct absolute pressure measurements.

SERIAL PORT JACK

When viewed from the front, the serial port jack is centered on the right side of the meter just below the battery charger jack. The circular plug of a custom RS232 serial cable is connected here. The other end of the cable provides a standard DB9 connection for a printer or computer.

4.0 DISPLAY MESSAGES AND PROMPTS

The display messages and prompts displayed by the meter are listed alphabetically within this section. Display messages and prompts are shown within square brackets throughout the text in other sections of this Instruction Manual. An AirFoil probe reading in MANUAL reading mode is shown as [FP▮ ± nnnn].

Manual and automatic reading prompts and measurement displays have a battery symbol (▮) as the third or fourth character of the display. This battery symbol indicates the level of charge in the batteries. This battery symbol is not generally shown in the text throughout this manual.

If either the STORE or AUTO STORE mode has been selected, the read prompts and measurement displays have a letter as the first character to the right of the reading sequence number. This letter represents the memory grouping and is not generally shown in the text throughout this manual. Where it is shown in the manual, it is represented by the letter “G”. An AirFoil probe reading in either STORE mode is shown as [nnG ± nnnn]. When the charge in the batteries begins to fail, the letter representing the memory group will be replaced by the symbol for an empty battery.

If the TREND mode has been selected, the measurement displays have an arrow as the first character to the right of the units abbreviation. When the charge in the batteries begins to fail, the message [LOCHARGE] will be displayed after every 30 readings displayed.

4.1 READ PROMPTS

The following ten prompts all include the term READ, which is a signal for the operator to press the READ key to trigger the actual measurement.

English Units

CF READ

This display indicates that the meter has been placed in the air flow measurement mode (cfm). This message will appear automatically upon power up if the flaps plug of the FlowHood is connected to the meter.

˚ F READ

This display indicates that the meter has been placed in the temperature measurement mode (˚ F).

FP READ

This display indicates that the meter has been placed in a velocity measurement mode (fpm).

Hg READ

This display indicates that the meter has been placed in the absolute pressure measurement mode (in Hg) with reference to a vacuum.

In READ

This display indicates that the meter has been placed in the differential pressure measurement mode (in wc).

Metric Units

Bar READ

This display indicates that the absolute pressure readings will be displayed in bars (1 bar = 100 kPa) with reference to a vacuum.

˚ C READ

Display indicates that the temperature readings will be displayed in degrees Celsius (˚ C).

LS READ

This display indicates that the meter has been placed in the air flow measurement mode and will read in liters per second (L/s).

MS READ

This display indicates that the velocity readings will be displayed in meters per second (m/s).

Pa READ

This display indicates that differential pressure readings will be displayed in Pascals (Pa).

4.2 MEASUREMENT READOUTS

In the following 12 examples, n indicates a number in the displayed result. If no sign is displayed, the result is a positive number. A negative sign indicates a negative number. English and metric units are shown for each example.

English Units

CF c ± nnnn

Indicates that the result represents an air flow measurement (cfm). "C" indicates that the result has been compensated for backpressure effects.

CF u ± nnnn

Indicates that the result represents an air flow measurement (cfm). "U" indicates that the result has not been compensated for backpressure effects.

FP ± nnnn

Indicates that the displayed result represents a velocity measurement (fpm).

˚ F ± nnn.n

Indicates that the displayed result represents a temperature measurement (˚ F).

Hg ± nn.n

Indicates that the result represents an absolute pressure measurement (in Hg).

In ± n.nnnn

Indicates that the result represents a differential pressure measurement (in wc).

Metric Units

Bar n.nnn

Indicates that the result represents an absolute pressure measurement (bar). (One bar = 100 kPa).

˚ C ± nnn.n

Indicates that the displayed result represents a temperature measurement (˚ C).

LS c ± nnnn

Indicates that the result represents an air flow measurement (L/s). "C" indicates that the result has been compensated for backpressure effects.

LS u ± nnnn

Indicates that the result represents an air flow measurement (L/s). "U" indicates that the result has not been compensated for backpressure effects.

Pa ± nnn.nn

Indicates that the result represents a differential pressure measurement (Pa).

MS ± nnn.nn

Indicates that the displayed result represents a velocity measurement (m/s).

4.3 FUNCTION READOUTS

The following prompts and messages are listed in alphabetical order.

▮▮▮▮▮▮▮▮▮

Blocks of pixels will be displayed to test the operation of the display each time the meter is turned on.

nnnn M

This display is used to enter the number of timed readings required in a timed reading sequence.

nn:nn:nnB

This display is used to set the BEGIN TIME for the TIMED READ mode and is also used to display the time after the setup has been completed. The display follows the [HH:MM:SS B] sequence, where HH is the hour, MM is the minutes and SS is the seconds. The letter B at the right represents BEGIN. If the meter has been set to a 12 hour clock, the letter A for am or P for pm will be displayed to the left of the letter B.

nn:nn:nnE

This display is used to set the END TIME for the TIMED READ mode and is also used to display the time after the setup has been completed. The display follows the [HH:MM:SS E] sequence, where HH is the hour, MM is the minutes and SS is the seconds. The letter E at the right represents END. If the meter has been set to a 12 hour clock, the letter A for am or P for pm will be displayed to the left of the letter E.

nn:nn:nnI

This display is used to set the INTERVAL TIME for the TIMED READ mode and is also used to display the time after the setup has been completed. The display follows the [HH:MM:SS I] sequence, where HH is the hour, MM is the minutes and SS is the seconds. The letter I at the right represents INTERVAL.

nn:nn:nnT

This message displays the time settings for the meter after the setup has been completed. The display follows the [HH:MM:SS T] sequence, where HH is the hour, MM is the minutes and SS is the seconds. The letter T at the right represents TIME. If the meter has been set to a 12 hour clock, the letter A for am or P for pm will be displayed to the left of the letter T.

nnG n.nnnn

Displays a reading and its place in the reading sequence within its memory group during an AUTO or MANUAL STORE sequence. Number of decimal places will vary.

nn NP 0

Indicates that the reading being displayed in an AUTO or MANUAL STORE sequence is a negative pitot tube reading.

nn c nnnn

This message indicates that backpressure compensated air flow readings have been stored. The display shows the reading and its order in the stored reading sequence.

nn ERASED

This message is displayed after a listed reading is erased. The erased reading will not be included in subsequent calculations of statistics for the memory group.

nn u nnnn

This message indicates that nonbackpressure compensated air flow readings have been stored. The display shows the reading and its order in the stored reading sequence.

nn $\overline{X}$ n.nnnn

Displays the number of readings in memory and the average of the readings. Displayed when the VIEW key is pressed once during a MANUAL STORE sequence or after HALT during a AUTO STORE sequence. Number of decimal places will vary.

∑ n.nnnn

Displays the sum of the readings in memory. Displayed when the VIEW key is pressed twice during a MANUAL STORE sequence or after HALT during a AUTO STORE sequence. Number of decimal places will vary.

σ n.nnnn

Displays the standard deviation of the readings in memory. Displayed when the VIEW key is pressed five times during a MANUAL STORE sequence or after HALT during a AUTO STORE sequence. Number of decimal places will vary.

xx ▯ n.nnnn

This display indicates that the battery charge is nearly depleted. xx indicates the units for the reading. The meter will also begin displaying LOCHARGE periodically.

xx▮ n.nnnn

This display indicates that the battery is highly charged. xx indicates the units for the reading. The area of the battery symbol that is dark will decrease incrementally as the battery charge declines.

xx→ n.nnnn

This display indicates that the meter is in TREND mode and that the readings are remaining relatively constant. xx indicates the units for the reading.

xx↗ n.nnnn

This display indicates that the meter is in TREND mode and that the readings are increasing slowly. xx indicates the units for the reading.

xx↑ n.nnnn

This display indicates that the meter is in TREND mode and that the readings are increasing rapidly. xx indicates the units for the reading.

xx↘ n.nnnn

This display indicates that the meter is in TREND mode and that the readings are decreasing slowly. xx indicates the units for the reading.

xx↓ n.nnnn

This display indicates that the meter is in TREND mode and that the readings are decreasing rapidly. xx indicates the units for the reading.

$xx^{\wedge}$ n.nnnn

Displays the maximum (greatest value) reading for a given measurement mode stored in a specific memory group during a STORE sequence. Displayed when a particular reading in that measurement mode within that memory group has been selected using a SCAN key, and the VIEW key is pressed four times. Number of decimal places will vary.

xx_{v} n.nnnn

Displays the minimum (least value) reading for a given measurement mode stored in a specific memory group during a STORE sequence. Displayed when a particular reading in that measurement mode within that memory group has been selected using a SCAN key, and the VIEW key is pressed three times. Number of decimal places will vary.

12-HR s

This prompt indicates that a 12 hour clock is being selected using the meter configuration loop.

24-HR s

This prompt indicates that a 24 hour clock is being selected using the meter configuration loop.

ABS PRES

This signal will be flashed when the absolute pressure measurement mode is selected, and also each time the READ key is pressed when in the absolute pressure measurement mode. It is also part of the ASSOCIATED READING sequence and precedes the display of an absolute pressure reading associated with a flow or velocity reading.

ADM-880C

This message is flashed following ▮▮▮▮▮▮▮▮ when the meter is first turned on.

AIRFOIL

This signal will be flashed when the AirFoil probe measurement mode is selected and also upon each subsequent operation of the READ key.

ALT

This message is displayed when the ALT key is pressed.

ASSOCIATED

This message is briefly displayed when ALT / VIEW is pressed while a selected reading in memory is being displayed. User may toggle through the associated reading displays by pressing the VIEW key repeatedly.

AUTO

This message is displayed as part of the overall meter status if the user presses ALT / READ to display [AUTO READY], then presses ALT / ALT instead of READ. It indicates that the meter is still ready to initiate an automatic reading sequence, and will do so if the user presses READ.

AUTO READY

This message indicates that the meter has been placed in the automatic reading function. Press the READ key to start the automatic reading sequence. Press the READ key to HALT the reading process. [HALT] will be displayed.

AUTO STORE

This message indicates that the meter has been placed in the automatic memory mode, which integrates the automatic reading function with the sequential storage function, and permits recall of the readings, sum, average and standard deviation at any point. Press the READ key to initiate the actual reading process. Press the READ key again to stop the automatic reading sequence. [HALT] will be displayed. Press ALT / AUTO / STORE to resume the store sequence within the same memory group.

AUTO ZERO
When the meter is first turned ON, it will perform a self-calibration process that takes a few seconds. The display will read [AUTO ZERO] during this period and the operating controls will be inhibited. No READ operations or function changes may be made during the AUTO ZERO period. The meter will also perform a brief self-calibration cycle periodically throughout normal operation.

BATTERY
This message will appear as part of the [NO LIGHT / BATTERY / TOO LOW] display sequence, when the battery charge is too low to support use of the light.

BATT 1/3
This message indicates that about 1/3 of the useful battery charge remains. This message is displayed every five minutes in MANUAL reading mode and also after pressing ALT / ALT.

BATT 2/3
This message indicates that about 2/3 of the useful battery charge remains. This message is displayed every five minutes in MANUAL reading mode and also following ALT / ALT.

BATT FULL
This message indicates that the batteries are fully (or close to fully) charged. This message is displayed every five minutes in MANUAL reading mode and also following ALT / ALT.

BEGIN WAIT
This message indicates that the meter is in TIMED READ mode and is waiting for the Begin Time to occur.

CALC STATS
This message is displayed while the meter is calculating the statistics for a large memory group.

CHANGE
This message indicates that a connection to the meter, such as the TemProbe, has been altered. [CHANGE] may be preceded by the display of the connection type.

CHANGE MEM
This message is flashed when the user presses ALT / STORE / ALT / STORE to access the function to select a new memory group, erase a reading or replace a reading in memory.

CHANGE / NOT ALLOWD
This message is displayed in sequence with other messages to indicate that a selected function is not available.

CHG GROUPs
This message is displayed to prompt the user to press the SELECT key to select a new memory group.

?CLR ALL? s
This message indicates that the meter has more than 50 readings in one memory group or is using more than one memory group and all readings will be deleted from memory when the READ / SELECT key is pressed.

CLEAR
This message is displayed when the operator has pressed ALT / STORE / SELECT and no readings are in memory.

CLEAR AUTO
This message is flashed if the user presses ALT / READ to display [AUTO READY] , then presses ALT / STORE / SELECT. The meter displays this message briefly and returns to the MANUAL reading mode.

CLEAR MEMs
This message is displayed when the operator has pressed ALT / STORE, and is the prompt to press the READ key to clear all readings in memory.

CLEAR TREN
This message is flashed if the user presses ALT / READ / ALT / READ to display [TREND RDY], then presses ALT / CLEAR / SELECT. The meter displays this message briefly and returns to the MANUAL reading mode.

CONFIGURE
This message is flashed if the user presses ALT / MODE / ALT / MODE and indicates that the configuration loop has been selected by the user.

CORR
Part of the FLO-HOOD / CORR message sequence. This message sequence indicates that the meter is taking a FlowHood reading that is compensated for backpressure..

DATA ERROR
This message indicates that a number has been entered which is not appropriate for that type of data entry, such as a three for the first digit of the hour setting for time.

DATE s
This is the fourth option available when the user presses the MODE key repeatedly after selecting the CONFIGURE mode, and is used to change the date settings in the meter.

DENSITY / CHANGE / NOT ALLOWD
This message is displayed if the density selection is changed while readings are being stored in an air flow or velocity measurement mode. A change in the density selection while storing air flow or velocity readings requires the user to select a new memory group, as readings stored with local and standard densities must not be averaged together.

DENSITY s
This is the second option available when the user presses the MODE key repeatedly after selecting the CONFIGURE mode and is used to change the density settings in the meter.

DIFF PRES
This signal will be flashed when the differential pressure measurement mode is selected, and upon each subsequent operation of the READ key. It is also displayed as part of the sequence of displays when the associated readings are being viewed by pressing ALT / VIEW following a pitot tube velocity reading. It precedes the display of the velocity pressure read by the meter to produce the pitot tube reading.

D PRESS IN
This message is displayed as part of the sequence of displays when associated readings are being viewed following a differential pressure reading.

ENGLISH
This message indicates that the readings will be in English units. The meter will save the units selection (metric or English) and will automatically default to the selected units the next time it is turned on.

ENGLISH s
This prompt indicates that English units are being selected using the meter configuration loop.

ERASE s
This message is displayed when the operator has pressed ALT / STORE / ALT / STORE, followed by pressing the STORE key twice while viewing a stored reading. The reading displayed will be erased when the operator presses the READ/SELECT key.

ERASING
This message is displayed when the selected reading displayed using a SCAN key is being erased.

ESCAPE
This message is displayed when the user presses ALT / ALT. The meter will revert to the prior selections.

FLO-HOOD
This message will be flashed when the FlowHood measurement mode is selected, or when the meter is first turned on, if the flaps plug is connected.

FLO-HOOD / CORR
This message sequence indicates that the meter is taking a FlowHood reading that is compensated for backpressure.

FLO-HOOD / UNCORR
This message sequence indicates that the meter is taking a FlowHood reading that is not compensated for backpressure.

FLOW H CFM

This message is part of the ASSOCIATED READING sequence and precedes the display of the temperature and absolute pressure readings associated with an air flow reading.

FLOW ONLY

[FLOW ONLY] will be displayed if the operator inserts the FlowHood flaps plug while the meter is in a velocity or differential pressure measurement mode and presses the READ key.

GRP IN USE

This message is displayed to indicate that the user is selecting a memory group that is currently in use, or already has been used. New readings can not be added to a memory group after it has been exited.

HALT

This message will be displayed when an automatic reading, automatic reading storage, or TREND mode sequence has been halted manually by pressing the READ key. The individual readings, or the average, total, minimum, maximum and standard deviation of the readings, may now be displayed if the auto-reading memory function is being used.

If the TREND mode is being used, the meter will revert to the MANUAL reading mode and the last reading displayed will be a standard MANUAL reading.

LIGHT OFF

This message indicates that the display backlight has been turned off. Battery time is extended when the backlight is turned off.

LIGHT ON

This message indicates that the display backlight has been turned on. Battery time is reduced when the backlight is turned on.

LOCAL DENS

This message indicates that flow or velocity readings will be corrected for local air density. The meter automatically starts up in the local density mode, unless the meter was last turned off with readings stored in the standard density mode.

LOC DENS s

This prompt indicates that local density is being selected using the meter configuration loop.

LOCHARGE

This message indicates that the battery cells are nearing the end of their useful charge. The meter will continue to function normally for about twenty minutes, depending on light use, before recharge is required. The third character of all MANUAL, AUTO and STORE readings will become the symbol for an empty battery cell.

MANUAL

This message is flashed when the user halts a series of TREND readings, as the meter reverts to the MANUAL mode and takes a final, MANUAL reading.

MEM CLEAR

This message is flashed when the ALT / CLEAR keys are pressed to clear the AUTO STORE mode.

MEM EMPTY

This message indicates that the meter is in STORE mode, but no readings have been saved.

METRIC

This message indicates that the readings will be in metric units. This option is selected using the CONFIGURE loop, which is accessed by pressing ALT / MODE / ALT / MODE. [UNITS s] is displayed as the first option. Press the READ key to select the UNITS loop. Press the MODE key to toggle between metric and English units, then press the READ key to select the units required. The meter will save the units selection (metric or English) and will automatically default to the selected units the next time it is turned on.

METRIC s

This prompt indicates that metric units are being selected using the meter configuration loop.

MODE CHANG / NOT ALLOWD

This message sequence is displayed when a change in setup would invalidate the result in incompatible readings.

MODE / UNITS

This message sequence is displayed when the ASSOCIATED function has been selected. It is followed by a display of the measurement mode and units for that particular reading.

NEG PITOT

This message indicates an invalid, negative, pitot tube velocity reading. This may result from reversed tubing connections to the meter, or from other conditions described in the section on PITOT TUBE VELOCITY MEASUREMENT.

NO FLAPS

This message advises that the flaps plug on the FlowHood has not been connected to the meter for air flow measurements. The meter senses the position of the flaps through the flaps plug.

NO LIGHT

This message will appear as part of the [NO LIGHT / BATTERY / TOO LOW] sequence, when the battery charge is too low to support use of the backlight.

NO LIGHT / BATTERY / TOO LOW

This sequence of messages indicates that the battery charge is low and the backlight may not be used until the batteries are recharged.

NO PROBE

This message appears when the operator has neglected to install the TemProbe sensor prior to initiating a temperature measurement. This term is also displayed if the TemProbe or extension cord has been damaged so as to create an open circuit.

NO READING

This is part of the ASSOCIATED READING sequence and is displayed when an associated reading is not available for that type of primary reading.

NO STATS

This message is displayed when the VIEW key is pressed while there are no readings in memory.

NOT A GRP

This message is displayed when an empty memory group is selected using the ALT / ◂SCAN function.

NOT ALLOWD

This message is displayed if the user tries to select the STORE mode while in TREND mode and in sequence with other messages to indicate that a selected function is not available.

NP 0

This message is displayed when a stored negative pitot tube reading is viewed using a SCAN key.

OPEN FLAPS

This message advises that the operator has attempted to perform a nonbackpressure compensated air flow measurement at greater than 500 cfm with the flaps closed. The flaps must be opened to proceed.

OVER FLOW

This display advises the operator that the air flow measurement being attempted is beyond the range of the meter.

OVER PRES

This display advises the operator that the pressure measurement being attempted is beyond the range of the meter. [OVER PRES] may also be displayed if internal voltage settings or linearity is out of proper range. (Contact the factory if the meter continues to read [OVER PRES] at inappropriate times).

OVER TEMP

This display advises the operator that the temperature measurement being attempted exceeds the upper range of the meter.

OVER VEL

This display advises the operator that the velocity measurement being attempted is beyond the range of the meter. [OVER VEL] may also be displayed if internal voltage settings are out of proper range. (Contact the factory if the meter continues to read [OVER VEL] at inappropriate times).

PITOT TUBE

This signal will be flashed when the pitot tube measurement mode is selected, and also upon each subsequent operation of the READ key.

PRESS READ

Please refer to [TIMED RDY / PRESS READ].

PRINTER s

This prompt is displayed when the operator has selected the PRINT mode. If an appropriate printer is connected to the RS232 jack on the meter, and the READ key is pressed, the entire contents of the memory will be downloaded to the printer.

PRINTING

This message is displayed when the operator is printing readings from memory.

PROBE

This message is displayed following ALT / ALT if the TemProbe is connected.

RATIO ERR

This message advises the operator that the backpressure compensated air flow measurement, which is in process, is invalid because the numerical ratio of the two parts of the measurement sequence exceeds the predetermined limits. Normally, this means that the operator has made a procedural error, or that a dynamic change (such as a changed damper setting) has occurred between the two parts of the backpressure compensated air flow measurement process.

READING

This is part of the ASSOCIATED reading sequence and precedes the final display of the primary reading selected by the user.

RECHARGE

This message signals that the batteries have reached the end of their useful charge, and must be recharged. The meter will turn off following the display of [RECHARGE / SHUT DOWN].

REPLACE s

This message is displayed when the operator has pressed ALT / STORE / ALT / STORE followed by the STORE key while viewing stored readings. This message indicates the current reading displayed will be replaced with a new reading when the operator presses the READ key.

REPLACING

This message is displayed when the current reading displayed is being replaced with a new reading.

SHUT DOWN

The meter will display [SHUT DOWN] and turn itself off if the battery charge becomes too low or if the meter is exposed to temperatures beyond the specified limits.

STATS

This message is displayed when the user selects a reading stored in memory, and then presses the VIEW key. The sum, average, minimum, maximum and standard deviation of all readings of the same measurement mode within that memory group will be displayed sequentially.

STD 70˚ F or STD 21.1˚ C

This message will be flashed during air flow or velocity measurements performed without the TemProbe. The resulting flow or velocity value will be calculated using the standard temperature, 70˚ F or 21.1˚ C. The correction for the ambient barometric pressure will still occur.

STD DENS

This message indicates that readings will be calculated to display standard density sea level equivalent (mass flow). It will also be displayed during the actual measurement interval.

STD DENS s

This prompt indicates that standard density is being selected using the meter configuration loop.

STORE ALL

This message indicates that the meter will store every following reading in sequence.

STORE FULL

This message indicates that the number of readings in memory has reached the maximum storage capacity of 2000 readings.

STORE LAST

This message indicates that the meter has been placed in the STORE LAST mode and the reading on display [nn?nnn] will be saved when the user presses the READ.

STORE MODE

This message is displayed as part of the [STORE MODE / NOT ALLOWD] sequence to indicate that the meter is in the STORE mode. The units and density may not be changed while readings are being stored in the current memory group.

STORE OFF

This message indicates that the meter is not in the STORE mode.

TEMP

This signal will be flashed when the temperature measurement mode is selected, and also upon each subsequent operation of the READ key. It is also displayed as part of the sequence of displays when ASSOCIATED reading is selected following an air flow or velocity reading. It precedes the display of the temperature associated with that reading.

TEMPROBE

This message is displayed as part of a display sequence to indicate a change in the TemProbe connection status during a STORE sequence.

TEMPROBE / CHANGE / NOT ALLOWD

This message is displayed if the TemProbe status is changed while readings are being stored in an air flow or velocity measurement mode. A change in the TemProbe setup while storing air flow or velocity readings requires the user to select a new memory group, as readings stored with actual and standard temperatures must not be averaged together.

TIME s

This is the third option available when the user presses the MODE key repeatedly after selecting the CONFIGURE mode, and is used to change the time settings in the meter.

TIMED DONE

This message indicates that the meter has completed a TIMED READ sequence as programmed by the user.

TIMED READ

This message is displayed just prior to the first reading when the meter begins a TIMED reading sequence.

TIMED RDY / PRESS READ

This message is displayed when the user completes the configuration of a TIMED READ. When the READ key is pressed, the meter begins the waiting period prior to the Begin Time. If the user did not program a Begin Time, the meter will begin the programmed reading process when the READ key is pressed.

TIMED WAIT

This message indicates that the meter is in the waiting interval between TIMED readings..

TOO HOT or TOO COLD

If the internal temperature of the meter exceeds its operational limits, it will display [TOO HOT] or [TOO COLD] and shut down. The meter will retain any readings in memory. The meter must be cooled down or warmed up, as the case may be, before normal operation can be resumed. If the meter has displayed [OVER RANGE] after displaying either [TOO HOT] or [TOO COLD], but has not shut down, this message indicates that the TemProbe sensor was being exposed to temperature levels beyond the proper operating range. If [TOO HOT / OVER RANGE] has been displayed, but the meter has not shut down, the TemProbe sensor may be short circuited.

TOO LOW

This message will appear as part of the [NO LIGHT / BATTERY / TOO LOW] sequence, when the battery charge is too low to support use of the light.

TREND

This message is displayed as part of the overall meter status if the user presses ALT / READ / ALT / READ to display [TREND RDY], then presses ALT / ALT instead of READ. It indicates that the TREND reading mode has been selected and readings will begin when the READ/SELECT key is pressed.

TREND RDY

This message is displayed when the meter has been placed in the TREND mode. TREND readings are not certified for accuracy.

UNCORR

Part of the [FLO-HOOD / UNCORR] message sequence. This message sequence indicates that the meter is taking a FlowHood reading that is not compensated for backpressure.

UNDER TEMP

This display advises the operator that the temperature measurement being attempted exceeds the lower range of the meter

UNITS - XX

This message will be displayed to indicate the units in which readings are being stored. It is also one of the parameters displayed after ALT / ALT is pressed.

UNITS / RESTORED

This message will be displayed if readings are stored in memory, then STORE OFF is selected, a different units configuration is used to take non-stored readings. When the user presses STORE to return to the current memory group, the meter will automatically restore the units previously used to store readings. The meter will display the following sequence [STORE ALL / STORE MODE / UNITS / RESTORED].

UNITS s

This is the first option available after the user has selected the CONFIGURE mode. Press READ / SELECT to change the units from English to metric, or metric to English, or press the MODE key to access other options.

VELGRID

This signal will be flashed when the VELGRID measurement mode is selected, and also upon each subsequent operation of the READ key.

5.0 USING THE ADM-880C AIRDATA MULTIMETER

5.1 KEYPAD

These instructions will be easier to follow if you have the meter in front of you as you are reading. You will be able to press the keys and observe the results as you work your way through the instructions. Sections 5.2 ALT KEY through Section 5.9 MODE KEY, describe the use of each meter key in detail, beginning with the ALT key in the upper left of the keypad, working across the bottom of the keypad to the READ key on the lower right, up to the STORE key on the upper right and then across to the MODE key on the left side of the keypad. Pressing the ALT key twice at any time serves as an ESCAPE key, causing the meter to exit a keypad option and return to the previous settings. Pressing ALT / ALT does not affect the memory contents. This ESCAPE function is very useful if the user has begun making selection loop changes and is interrupted. The user can press ALT / ALT and begin again.

5.1.1 KEYPAD LAYOUT

There are eight keys on the keypad, arranged as shown below. Several keys have multiple functions.

ALT ESCAPE	1 2 3 4 MODE TIMED READ CONFIGURE	5 6 7 8 VIEW ASSOCIATED DOWNLOAD	9 0 STORE CLEAR CHANGE
ON OFF	◂SCAN GO TO	SCAN▸	READ SELECT AUTO TREND

5.1.2 KEYPAD FUNCTIONS

The primary function on a key is shown in large type and is accessed by pressing the key. Some keys, such as the MODE key, have multiple options within the primary function loop. The primary function on the MODE key is used to select a measurement mode from the options available: differential pressure, absolute pressure, temperature, air flow, pitot tube velocity, AirFoil velocity or VelGrid velocity. Scroll through the options within any primary function loop by pressing the function key repeatedly.

The secondary function loop is accessed by pressing the ALT key, followed by a specific function key, such as the MODE key, which allows access to the secondary function for that key. The secondary function for the MODE key is the TIMED READ mode. The options within a secondary function loop may be selected by pressing the READ/SELECT key if the displayed prompt is followed by a small letter “s”, or may be scrolled through by pressing the specific function key, such as the MODE key, repeatedly. These instructions will use the convention that “press ALT / MODE” means “press the ALT key, then press the MODE key”.

The tertiary (third level) function loop is accessed by pressing ALT, followed by a specific function key such as the MODE key, then ALT again, then the specific function key again (ALT / MODE / ALT / MODE). The tertiary function for the MODE key is CONFIGURE. The options within the tertiary function loop may need to be selected by pressing the READ/SELECT key, if the displayed prompt is followed by a small letter “s”, or may be scrolled through by pressing the specific function key, such as the MODE key, repeatedly.

The numerical entry functions shown on certain keys are only accessible when required to enter a number, such as using the “GO TO” function to find a particular reading in memory, or configuring the date or time.

Keypad functions are outlined on the following page.

KEY	PRIMARY FUNCTION (F)	SECONDARY FUNCTION (ALT / F)	TERTIARY FUNCTION (ALT / F / ALT / F)
ALT	Alternate	Escape	
MODE	MEASUREMENT Differential pressure Temperature VelGrid velocity AirFoil velocity Pitot tube velocity Absolute pressure FlowHood air flow	TIMED READ Interval Time Begin Time End Time Max # of Readings	CONFIGURE Units - English or Metric Density - Local or Standard Time Date
VIEW	STATISTICS Average Sum Minimum Maximum Standard deviation	ASSOCIATED DATA Mode/Units Temperature Absolute pressure Differential pressure Time and date	DOWNLOAD Download to printer
STORE	STORE Store All Store Last Store Off	CLEAR MEMORY	CHANGE MEMORY Select memory group Erase reading in memory Replace reading in memory
ON	If meter off, turn on If meter on, turn light on If light on, turn light off	Turn meter off	
◂SCAN	Scan memory sequence ascending	Go To	
SCAN▸	Scan memory sequence descending	Reset display	
READ	Read/Select	Automatic Readings	Trend Readings

5.1.3 NUMERICAL ENTRY
Numbers must be entered to set the meter's clock, to set up the timed reading mode, and as part of a GO TO command using the ◂SCAN key.

Numbers are always prompted by a cursor below the number, and require as many key presses as their **position** on the key indicates. Selecting the number four requires four key presses, selecting the number eight also requires four key presses, and selecting the number nine requires one key press.

After a pause, the meter moves the cursor to the next prompting position (to the right) automatically. The cursor may also be moved using the ◂SCAN and SCAN▸ keys.

5.1.4 GENERAL USE
Press the ON key to turn the meter on. The meter will display a row of pixel blocks to test the display, and will then display AUTO ZERO while performing a brief internal calibration test. It will briefly display the current measurement mode, such as [DIFF PRESS], followed by a display, such as [IN▮ READ], that indicates that the meter is ready to take a reading . In this example, the IN indicates that the units selected are inches of water column. The small battery cell displays the current battery status, which may be Full, 2/3, 1/3, or Low, depending on the amount of shading within the battery symbol.

The MODE key may be pressed repeatedly to select one of the following measurement modes: temperature, VelGrid velocity, AirFoil probe velocity, pitot tube velocity, differential pressure, absolute pressure, or FlowHood air flow. The meter will briefly display the mode, followed by a two-letter symbol for the units to be used, a battery status symbol, and the word READ. The meter is ready to take a reading in the manual mode.

Press the READ key to take a reading in the selected mode. The meter will briefly display the measurement mode, followed by the measurement result. Pressing the READ key again will trigger another measurement, which will clear all previous data from the display and display the new result. If the reading was taken in a velocity or flow mode, the meter may briefly display the temperature probe status and the density selection before displaying the measurement result.

Press ALT / OFF to turn the meter off. Turning the meter off will not affect the following settings:

- Measurement mode, unless the FlowHood or TemProbe connections have been changed
- Units selection (English or metric)
- Time
- Date
- Store mode
- Readings in memory

Turning the meter off will reset the density selection to local density, unless readings have been stored in the standard density mode in the current memory group.

5.2 ALT KEY

The ALT key functions as an alternative function key, an escape key and also may be used to view the battery status and selections at any time.

5.2.1 ALTERNATE FUNCTION

Pressing the ALT key prior to one of the other function keys, switches that function key into the second or third level loop accessed using that key. For example, pressing the MODE key accesses the primary selection loop which is the measurement mode. Pressing ALT / MODE accesses the secondary selection loop which is the TIMED READ mode. Pressing ALT / MODE / ALT / MODE accesses the CONFIGURATION loop.

5.2.2 ESCAPE

The secondary function of the ALT key serves as an escape key. Pressing ALT / ALT before pressing the READ/SELECT key will cause the meter to exit a loop and return to the previous settings. Pressing ALT / ALT does not affect the memory contents. This ESCAPE function is very useful if the user is in the process of selection loop changes and is interrupted. The user can press ALT / ALT and begin again.

5.2.3 VIEW BATTERY LEVEL AND METER SETTINGS

The battery status and meter mode selections can always be viewed by pressing ALT / ALT. The display will read [ESCAPE], followed by the approximate remaining battery life: [BATTFULL], [BATT 2/3], [BATT 1/3] or [LOCHARGE]. The meter will then display the selected measurement mode (for instance, [VELGRID]), and the density selected ([LOCAL] or [STANDARD]). If the TemProbe is connected, [PROBE] will be displayed, followed by the date and time. If the temperature probe is not being used during flow or velocity readings, the standard temperature ([STD 70 ˚F] or [STD 21.1 ˚C]) will be displayed.

5.3 ON/OFF KEY

The ON/OFF key is used to turn the meter on and off, and to control the backlight.

5.3.1 ON AND OFF

Press the ON/OFF key to turn the meter on. The meter is turned off by pressing the ALT key, then the ON/OFF key. The meter will turn itself off automatically if not used for several minutes.

If the selected measurement mode was temperature when the meter was turned off, and the TemProbe was disconnected before the meter was turned on again, the meter will initialize in the differential pressure mode. If the meter was in the FlowHood mode when the meter was turned off, and the flaps jack is no longer connected when the meter is turned on again, the meter will initialize in the differential pressure mode. The meter turns on in a useful mode rather than one that would require an immediate warning.

5.3.2 BACKLIGHT

The display has a backlight for use in low light conditions. The backlight may be turned on by pressing the ON/OFF key when the meter is already on. The meter will briefly display [LIGHT ON]. Press the ON/OFF key again to turn the backlight off. The meter will briefly display [LIGHT OFF].

Note that using the backlight significantly increases the drain on the batteries and reduces the operating time (continuous reading operation) by about 50 percent. The backlight may not be turned on when the battery charge is insufficient. The display will read [NO LIGHT / BATTERY / TOO LOW].

5.4 ◂SCAN KEY

5.4.1 SCROLL THROUGH MEMORY - DESCENDING

Pressing the ◂SCAN key scrolls through all the readings in memory in descending order. The scan begins with the last reading in the most recently saved memory group, and scrolls through all readings in memory. The speed of a scan will increase as the key is held down. Individual readings are displayed in reading sequence within each memory group. The memory groups are displayed in the order in which they were originally saved, not in alphabetical order.

The statistics and the associated data for any reading stored in memory can be viewed while the reading is on display as described in Sections 5.8.1 VIEW GROUP STATISTICS and 5.8.2 VIEW ASSOCIATED DATA. Readings may be erased or replaced in the current or a prior memory group as described in Sections 5.7.3.2 REPLACE READING IN MEMORY or 5.7.3.3 ERASE READING IN MEMORY and the revised statistics and associated data may be viewed.

5.4.2 "GO TO" A READING

The large memory can be more quickly traversed using the GO TO function. The GO TO function is accessed by pressing ALT / ◂SCAN. The meter briefly displays [GO TO], and then displays [RDG/GROUPs]. Press the READ/SELECT key. The meter will display the first reading in the most recently used memory group as the default for modification by the user. The cursor will appear under the first number to the left. Enter the reading number required, one character at a time, using the numerical entry method described in Section 5.1.3 NUMERICAL ENTRY. Press the SCAN▸ key to move the cursor beneath the memory group letter, then press either SCAN key to scroll through the memory groups. When the entry is complete, press the READ/SELECT key. The meter will display the specified reading number, memory group letter, and the reading.

If a number is entered that does not exist in the specified memory group, the meter will display the first reading in that group, so that readings may be scrolled from the beginning.

5.5 SCAN▸ KEY

5.5.1 SCROLL THROUGH MEMORY - ASCENDING

Pressing the SCAN▸ key scrolls through all the readings in memory in ascending order. The scan begins with the first reading in the first memory group used, and scrolls through all readings in memory. The speed of a scan will increase as the key is held down. Individual readings are displayed in reading sequence within each memory group. The memory groups are displayed in the order in which they were originally saved, not in alphabetical order.

The statistics and the associated data for any reading stored in memory can be viewed while the reading is on display as described in Sections 5.8.1 VIEW GROUP STATISTICS and Section 5.8.2 VIEW ASSOCIATED DATA. Readings may be erased or replaced in the current or a prior memory group as described in Sections 5.7.3.2 REPLACE READING IN MEMORY or 5.7.3.3 ERASE READING IN MEMORY and the revised statistics and associated data may be viewed.

5.5.2 RESET DISPLAY

The ALT / SCAN▸ key sequence may also be used to reset the display and cause a long reading to scroll across the display again. This function is useful when the message contains more than ten characters and the leftmost visible character is underlined, indicating that characters further to the left are not being displayed. ALT / SCAN allows the user to view the reading again, and note the leftmost characters before they move off the display. For example, a differential pressure reading of [1348G-.6543] is one character too long for the 10 digit display. It would first be displayed as [1348G-.654]. It would then scroll to the left and be displayed as [<u>3</u>48G-.6543]. Press the SCAN▸ key, and the reading will be scrolled across the display again. Repeated scrolls of the same number only require that the SCAN▸ key (not ALT / SCAN▸) be pressed.

5.6 READ/SELECT KEY

There are four reading modes: MANUAL, AUTO (automatic), TREND, and TIMED. Manual and automatic readings may be stored in memory. Timed readings are always stored in memory. The meter cannot be turned off while the meter is making AUTO, TREND, or TIMED readings. The reading process must first be halted. Halting these continuous reading modes always returns the meter to the MANUAL reading mode. Therefore, the meter is always in MANUAL mode when it is turned off, and always initializes in the MANUAL reading mode when it is turned on.

If the FlowHood mode is selected, but the flaps jack has not been installed when the READ key is pressed, the meter will display [NO FLAPS], and will not take a reading. If the temperature mode is selected, but the TemProbe has not been installed when the READ key is pressed, the meter will display [NO PROBE] and will not take a reading. If the FlowHood flaps jack has been installed, the meter will read in the FlowHood, temperature and absolute pressure measurement modes.

5.6.1 MANUAL READINGS

When READ is pressed, the meter takes one reading in the current measurement mode, and displays the result. The meter will briefly display the measurement mode, followed by the measurement result. Pressing the READ key again will trigger another measurement, which will clear all previous data from the display and display the new result. If the reading was taken in a velocity or flow mode, the meter may briefly display the temperature probe status and the density selection before displaying the measurement result.

5.6.2 AUTOMATIC READINGS

Select the AUTO (automatic) reading mode by pressing ALT / READ. The meter will display [AUTO READY]. When the READ/SELECT key is pressed again, the meter takes continuous, repeated readings. Readings will continue until the user executes a halt by pressing the READ/SELECT key again. The meter then displays [HALT]. Automatic readings may be stored in memory by pressing ALT / READ / STORE as described in Section 5.7.1.1 STORE ALL. The meter will store continuous, repeated readings until the READ/SELECT key is pressed to halt the readings.

5.6.3 TREND READINGS

Select the TREND reading mode by pressing ALT / READ / ALT / READ. The meter will display [TREND RDY]. When the READ/SELECT key is pressed, the meter will take continuous measurements at the rate of approximately one every second. Readings will continue until the user executes a halt by pressing the READ/SELECT key again. The meter will then display [HALT]. Trend readings reduce accuracy to gain faster readings. TREND measurements are as accurate as they can be in one second, but they are less accurate than MANUAL and AUTO readings. Accurate measurements require sufficient time, one to eight seconds depending on the signal level, to properly evaluate the analog signal being sensed. Also, the last digit in all flow, velocity, and differential pressure readings made in the TREND mode is rounded to the nearest five units (the last digit will be either a zero or a five). Absolute pressure and temperature readings in the TREND mode are not rounded. TREND readings are designed for damper adjustments and other situations where quick feedback is preferable to a longer, more accurate measurement. Trend readings may not be stored in memory. The meter displays an arrow during TREND mode readings to indicate the rate and direction of change for the measured values. A vertical up or down arrow indicates a rapid rate of change. A diagonal arrow indicates a slower rate of increase or decrease.

5.6.4 SELECT

The READ key also functions as the SELECT key. Press READ / SELECT to confirm a selection when the letter “s” is displayed at the right of a display.

5.7 STORE KEY

The STORE key is used to select a STORE mode, CLEAR all readings in memory, and CHANGE memory. The options under CHANGE memory include exiting the current memory group and selecting a new memory group, erasing a stored reading, and replacing a stored reading.

5.7.1 STORE MODE

Press the STORE key repeatedly to access the three memory options:

Store All	All subsequent readings are saved in memory.
Store Last	Reading is displayed, user chooses to store reading in memory or discard.
Store Off	Readings are taken in MANUAL or AUTO read mode and are not stored in memory.

There are restrictive relationships between the reading options and the memory modes:

Reading Modes	Store Off	Store All	Store Last
Manual	Allowed	Allowed	Allowed
Automatic	Allowed	Allowed	Not Allowed
Trend	Required	Not Allowed	Not Allowed
Timed	Not Allowed	Required	Not Allowed

The memory can be divided into 25 different memory groups, lettered from A to Z (the letter O is not used because of possible confusion with zero). Each memory group can store as few as a single reading, or as many as necessary, up to the maximum of 2000 total readings across all groups. A single memory group may be used, or as many different memory groups as needed. Group letters may be skipped or selected in any order. However, if many memory groups are being used, the maximum number of readings may decline slightly to between 1950 and 2000. The group letter is displayed as the third character in the reading sequence number, for example [01A .0205].

The measurement mode may be changed while either the STORE ALL or STORE LAST modes are active. Any memory group may contain any or all types of measurements. For example, the results of a pitot tube velocity traverse of a duct may be stored as readings 01A through 09A. The user may then press the MODE key to change the measurement mode to differential pressure. After installing the appropriate accessories, the user may then make and store a static pressure reading 10A at the site of the duct traverse.

When the number of readings in memory reaches the maximum of 2000, the meter will stop reading and display [STORE FULL]. Clear the [STORE FULL] display by pressing any key. The meter will exit the STORE mode and display [STORE

OFF]. No further readings can be stored until the memory has been cleared by pressing ALT / STORE. However, while the memory is full, the user may make non-stored readings in the MANUAL or AUTO read modes.

If the meter was in a STORE mode when it was turned off, it will display the last reading taken along with the STORE mode when it is turned on again.

5.7.1.1 STORE ALL
Press STORE repeatedly until [STORE ALL] is displayed. Subsequently, every reading taken will be stored in memory. Press the READ key to take a reading. The meter will display the number of the reading in the sequence and the letter of the memory group. For example, [01A 365] would be the first reading in memory group "A".

The automatic reading function and the memory function may be used together to store up to 2000 automatic, repeated readings within a single group. This measurement and storage process will continue until interrupted by pressing the READ key, or until the meter registers STORE FULL at 2000 readings.

Press the STORE key to select the memory mode, followed by the ALT key, then press the READ key to select automatic readings. The meter will display [AUTO STORE], at which point the actual measurements are initiated by pressing the READ key. The auto-reading memory sequence may be interrupted by pressing the READ key. [HALT] will be displayed, followed by the last reading taken. The auto-reading memory sequence may be resumed by pressing ALT / READ again.

The TemProbe status, units (English or metric) and density selection (local or standard) must remain consistent throughout a memory group. If memory group "A" is begun with a pitot tube reading using a TemProbe, then all following velocity and flow readings in Group "A" must also use the TemProbe. If the probe is removed and the user attempts another pitot tube reading, the meter will briefly display [TEMPROBE / CHANGE / NOT ALLOWD] and will not execute a reading.

The user may turn the STORE mode off while in a particular memory group. The user may then change the TemProbe status, units and density selection and take non-stored readings. If the units have been changed, when the user presses STORE to return to the current memory group, the meter will automatically restore the units previously used to store readings. The meter will display the following sequence [STORE ALL / STORE MODE / UNITS / RESTORED].

If the density was changed, and the meter is being used in the FlowHood or velocity modes, the meter will also display [DENS CHANGE / NOT ALLOWD] and will not store a reading until the density is set back to that previously used to store readings in the current group.

5.7.1.2 STORE LAST
The STORE LAST mode is selected by repeatedly pressing the STORE key until the meter displays [STORE LAST]. Press READ to take a reading. The meter will display the results along with the potential sequence of the reading and a question mark. If the user presses READ while the question mark is being displayed, the meter will discard the displayed reading, take a new measurement, and will display the new measurement with the potential sequence and a question mark. If the user presses the STORE key while the question mark is being displayed, the meter will store the reading in the current memory group, then display the measurement value and its sequence in the current memory group. The STORE LAST mode may only be used with the MANUAL reading mode.

An individual reading may be abandoned in the STORE LAST mode while the meter is displaying the result of the reading with the question mark. Pressing ALT / ALT will delete the reading, the meter will display [ESCAPE], will sequence through the meter status displays, and then display [STORE LAST]. Previously saved contents of the memory group are not affected and the currently selected memory group is not changed.

5.7.1.3 STORE OFF
Press STORE repeatedly until the meter displays [STORE OFF] to return to the MANUAL reading mode. Manual or automatic manual readings may be taken without affecting the contents of the current or prior memory groups.

5.7.2 CLEAR MEMORY
The ALT / STORE sequence is used to clear **all** readings stored in memory. Press ALT / STORE. The meter will briefly display [MEM CLEAR], then display [CLEAR MEM s]. Press the READ/SELECT key. The meter will display [CLEAR MEM] and erase all readings from memory. If readings have been stored in more than one memory group and/or more than 50 readings have been stored in a single memory group, the meter will display an additional message [?CLR ALL?s]. If the READ/SELECT key is pressed again, the entire contents of the memory will be erased. After clearing the memory, the meter resets the memory group letter to the default "A".

5.7.3 CHANGE MEMORY
This key sequence is used to change to a new memory group and to erase or replace readings in memory.

5.7.3.1 CHANGE MEMORY GROUP

Press ALT / STORE / ALT / STORE. The meter will briefly display [CHANGE MEM], and then will display [CHG GROUPs]. Press the READ/SELECT key. The meter will display the current memory group letter. Press ◂SCAN repeatedly to show prior memory letters or SCAN▸ to show the following group letters. Press the READ/SELECT key while the letter for a new memory group is being displayed. The meter will automatically place the meter in the STORE ALL mode in the new memory group.

Groups are lettered A to Z in capitals, excluding O to avoid confusion with zero. Group "A" is set to be the default group. The total combined memory holds up to 2000 readings. The user may save all 2000 readings in Group "A", or none in "A" and all in "B", or store readings as desired throughout the available 25 groups. Readings can not be added to a previous memory group after a new group has been selected. If a previously used memory group is selected, the meter will display [GRP IN USE].

5.7.3.2 REPLACE READING IN MEMORY

A questionable reading may be replaced and the related statistics updated. Press STORE and the meter will display [STORE ALL]. Use the SCAN keys and/or GO TO command to display a particular reading. Press ALT / STORE / ALT / STORE. The meter will briefly display the selection loop [CHANGE MEM], and then [CHG GROUPs]. Press STORE again. Display will read [REPLACE s]. Press READ to take a new measurement that will replace the previous reading, retaining the same reading sequence and memory group letter. The memory group statistics and associated data will be automatically updated. When the replacement reading is taken, the user must take care to use the same measurement mode and same settings for units, density, and TemProbe connection as the original reading. The REPLACE function is not available when the memory is full.

5.7.3.3 ERASE READING IN MEMORY

A questionable reading may be erased instead of replaced. Press STORE and the meter will display [STORE ALL]. Use the SCAN keys and/or GO TO command to display a particular reading. Press ALT / STORE / ALT / STORE. The meter will briefly display the name of the selection loop [CHANGE MEM], and then will display [CHG GROUPs]. Press STORE twice. The meter will display [ERASE s]. Press the READ/SELECT key to erase the reading from memory and automatically update the memory group statistics. If there were 10 readings in the memory group, and one is erased, the new statistics will represent the remaining nine readings. When the erased reading is viewed using a SCAN key, the meter will display the reading sequence number and memory group letter and the word [ERASED]. The other readings in the memory group are not affected. The ERASE function is not available when the meter's memory is full.

5.8 VIEW KEY

The VIEW key is used to display group statistics and associated data for stored readings, and also to download stored readings to a printer. Readings must have been previously stored in memory as described in Section 5.7.1 STORE MODE.

5.8.1 VIEW GROUP STATISTICS

The displayed statistics include the average, sum, minimum, maximum and standard deviation. The statistics are calculated for all of the readings within a specific memory group that are of the same measurement mode as the displayed reading. If memory group "A" contains all possible types of measurements, differential pressure, absolute pressure, temperature, pitot tube, VelGrid, AirFoil, backpressure compensated air flow and nonbackpressure compensated air flow, and the user presses either SCAN key until a pitot tube reading in memory group "A" is displayed, then presses the VIEW key, the meter will display the statistics for only the pitot tube readings in memory group "A". If the user then scans to a differential pressure reading in memory group "A" and presses the VIEW key, the statistics displayed are calculated only for the differential pressure readings in memory group "A". It may take a few minutes for the meter to calculate the statistics if there are a very large number of readings in memory.

Store readings in memory as described in Section 5.7.1.1 STORE ALL or Section 5.7.1.2 STORE LAST. Scroll to a particular reading within a particular group using the SCAN keys as described in Section 5.4 ◂SCAN KEY and Section 5.5 SCAN▸ KEY. Scroll through the available statistics by pressing the VIEW key repeatedly. Press any key other than the VIEW key to exit the statistics display loop at any time.

Note that statistics may be viewed for readings taken in a prior group, while the meter is currently in a STORE mode in a later group. The following is an example of statistics which may be viewed by pressing the VIEW key repeatedly.

10$\bar{X}$ .2090	10 is the number of readings taken in that measurement mode within that memory group, $\bar{X}$ is the average (mean) symbol and .2090 is the average of the readings
∑ 2.0903	∑ is the sum symbol and 2.0903 is the sum of the readings
10v .1008	10 is the sequence of the lowest reading, v is the minimum reading symbol and .1008 is the lowest reading

3^ .4129	3 is the sequence of the highest reading, ^ is the maximum reading symbol and .4129 is the highest reading
σ .12639	σ is the standard deviation symbol and .12639 is the standard deviation of the readings
DIFF PRES	Displays the measurement mode for the viewed statistics
03A .4129	Display returns to the specific reading originally displayed

5.8.2 VIEW ASSOCIATED DATA

The ADM-880C AirData Multimeter records the time and date when all readings are taken and stores other related data, depending on the mode. This associated data may be viewed immediately following a MANUAL reading by pressing ALT / VIEW. The associated data for readings previously stored in memory may also be viewed using the ALT / VIEW function while a stored reading is on display. The associated data may be viewed for the last reading in an automatic reading sequence which has not been stored.

MEASUREMENT MODE	ASSOCIATED DATA
Temperature	Date and time
Differential pressure	Date and time
Absolute pressure	Date and time
Pitot tube velocity	Temperature, absolute pressure, differential pressure (velocity pressure), date and time
VelGrid velocity	Temperature, absolute pressure, date and time
AirFoil velocity	Temperature, absolute pressure, date and time
FlowHood	Temperature, absolute pressure, date and time

Select ALT / VIEW while a MANUAL reading is on display to view the associated data. If the meter is in a STORE mode, scroll using a SCAN key to select a particular reading, then press ALT / VIEW. The meter will briefly display [ASSOCIATED], followed by [MODE / UNITS], then an abbreviation for the measurement mode of the displayed reading. Press VIEW repeatedly to view each associated measurement. If associated data is not available, the display will read [NO READING]. For example, the meter will display differential pressure in association with pitot tube measurements, but not in association with VelGrid, AirFoil, or FlowHood readings.

5.8.3 DOWNLOAD TO PRINTER

Readings stored in memory may be downloaded from the meter to a compatible printer after the sequence of readings has been completed.

Connect the barrel connector on the serial cable to the RS232 jack on the right side of the meter. The red dot on the connector aligns with the red rectangle on the lower part of the jack. Connect the null modem adapter to the DB9 connector on the serial cable and then plug the null modem adapter into the serial port on the printer.
Refer to the instructions supplied by the printer manufacturer for any further setup requirements. The RS232 port on the meter is set for 9600 BAUD, 8 data bits, no parity, and one stop bit. There is no flow control.

Press the ALT / VIEW / ALT / VIEW key sequence. The display will read [PRINTER s]. Press the READ/SELECT key to download all readings stored in memory to the printer. [PRINTING] will be displayed while the readings are being printed. The readings will remain stored in memory until the memory is cleared.

The meter will download the current date, time, and the meter serial number, followed by the memory contents sorted by memory group. Memory groups are printed in the order saved, rather than in alphabetical order. Each group header will indicate the density selection for that group. Each line printed will show the reading number and memory group, reading value, units, date of reading, and time of reading. The statistics for each group will be printed following the list of the reading values. An example of readings printed from memory in the absolute pressure mode is shown below:

ADM-880C
M02007
25 SEP 2004 10:17:53

Group A Local
Abs Pres
0001A 28.5 Hg25SEP07:26
0002A 28.6 Hg25SEP07:27
0003A 28.5 Hg25SEP0729
Group A Statistics

Rdg
3 Abs Pres
Avg
28.5 Hg Abs Pres
Sum
85.6 Hg Abs Pres
Min
28.5 Hg Abs Pres
Max
28.6 Hg Abs Pres
Std Dev
0.05 Hg Abs Pres

5.9 MODE KEY

The MODE key is used to access the measurement modes, the TIMED READ setup options, and the CONFIGURATION setup options for English or metric units, local or standard density, time and date.

5.9.1 MEASUREMENT MODE

The meter has seven measurement modes: differential pressure, absolute pressure, temperature, pitot tube velocity, VelGrid velocity, AirFoil Velocity, and FlowHood air flow. Press the MODE key repeatedly to scroll through the measurement modes until the required mode is displayed.

5.9.2 TIMED READING MODE

The TIMED READ mode stores readings at specified intervals. The readings will be stored in the currently active memory group, unless a new memory group is selected. If a memory group has not been selected, the timed readings will be stored in memory group “A”. A BEGIN TIME may be specified by the user, or the user may press the READ key while the display reads TIMED RDY to begin the reading process. A reading INTERVAL may be specified by the user. If the interval is set to zero, continuous readings will be stored as rapidly as the meter is able to take each reading. An END TIME may be specified by the user, or, if no end time is specified, the meter will continue to read and store readings until the 2000 reading storage limit is reached. ALT / ALT may be pressed at any time to exit the TIMED READ setup loop.

It is important to allow enough time to complete the TIMED READ setup before readings are to begin. If the actual time passes the BEGIN TIME before the setup is complete and the loop is exited, the meter will interpret the BEGIN TIME as being on the following day.

ENTRY	DEFAULT DISPLAY	PROCEDURE	ALTERNATE PROCEDURE
Interval Length	00:00:15 I	Enter interval between 00:00:15 and 24:00:00	Press READ/SELECT to accept 15 second intervals or enter 00:00:00 to make continuous, no-interval readings
Begin Time	Current time	Enter begin time	Press READ/SELECT to begin readings when READ key is pressed
End Time	Begin Time	Enter end time	Press READ/SELECT to read until HALT or STORE FULL
Maximum Readings	2000 M	Enter required number of readings	Press READ/SELECT to read until HALT or STORE FULL

Setup is begun by selecting the required measurement mode. A new memory group for the TIMED readings may also be selected as described in Section 5.7.3.1 CHANGE MEMORY GROUP. Press ALT / MODE to access the TIMED READ selection loop. The meter will display [TIMED s]. Press the READ/SELECT key. The meter will display [00:00:15 I] with the cursor under the first 0 to the left. The default display is set to an interval of 15 seconds and follows the [HH:MM:SS I] sequence, where HH is the hour, MM is the minutes and SS is the seconds. The letter I at the right represents INTERVAL.

Enter the reading interval required by inserting numbers into the display as described in Section 5.1.3 NUMERICAL ENTRY. The cursor beneath the numbers leads the user through the numerical entries for hours, minutes, and seconds. The minimum non-zero interval accepted is 15 seconds. The maximum interval accepted is 24 hours. If the user enters all zeros, the meter will take readings continuously with no pauses between readings, similar to the automatic reading mode. When the last digit to the right has been entered, the “I” in the display will be replaced by the letter “s”. Press the READ/SELECT key to confirm the interval time entered and advance to the BEGIN TIME data entry display.

The BEGIN TIME data entry display will initialize with the current time shown as a reference. Enter a BEGIN TIME using the number keys. If the user does not revise the BEGIN TIME before pressing the READ/SELECT key, the reading process may be started manually by pressing the READ/SELECT key following the [STORE ALL / TIMED RDY / PRESS READ] display sequence. Press the READ/SELECT key to confirm the BEGIN TIME entered and advance to the END TIME data entry display.

The END TIME data entry display will initialize with the BEGIN TIME shown as a reference. Enter an END TIME using the number keys. If the user does not revise the END TIME before pressing the READ/SELECT key, the reading process will run until either the 2000 reading memory is full, or the user presses the READ/SELECT key to HALT the reading process. Press the READ/SELECT key to confirm the END TIME entered and advance to the MAXIMUM reading display.

The MAXIMUM reading display will default to 2000 readings, the maximum number of readings which can be stored in memory. Enter the required number of readings using the number keys, and then press the READ/SELECT key to confirm the number of readings.

The meter will display [STORE ALL / TIMED RDY / PRESS READ]. When the READ/SELECT key is pressed, the timed reading process will begin. The meter will display [BEGIN WAIT], followed by [TIMED READ] during the actual reading, then display the actual reading, then display [TIMED WAIT] between readings. [TIMED DONE] will be displayed when the timed reading process is complete.

The time at which a reading is taken is recorded at the end of a reading, after as few as one, or as many as eight seconds of sampling time. For this reason, timed readings that were programmed to start at perfect intervals may create readings whose time stamps are not so perfectly separated in time.

If the timed reading sequence is halted, either manually or automatically, it can not be started again. Additional readings may be added to the current memory group by beginning a new TIMED READ sequence.

5.9.3 CONFIGURATION SETTINGS

Units (English or metric), density (local or standard), time and date are specified using the configuration loop. These settings are saved indefinitely in memory with the exception of standard density. The meter always initializes in the local density mode, unless the user has stored standard density readings in the **currently** selected memory group.

Press ALT / MODE / ALT / MODE to access the configuration setup loop. The meter will flash the name of the selection loop [CONFIGURE], then display [UNITS s]. Press the MODE key repeatedly to scroll through [UNITS s], [DENSITY s], [TIME s], and [DATE s], then press the READ/SELECT key while the required option is being displayed.

5.9.3.1 CONFIGURE UNITS

Press the READ/SELECT key while [UNITS s] is being displayed. [ENGLISH s] will be displayed. Press the MODE key to toggle between the two units options, [ENGLISH s] or [METRIC s], then press the READ/SELECT key to choose the desired type of units.

5.9.3.2 CONFIGURE DENSITY

Press the READ/SELECT key while [DENSITY s] is being displayed. [LOCAL s] will be displayed. Press the MODE key to toggle between the two density options, [STANDARD s] or [LOCAL s], then press the READ/SELECT key while the required density is displayed.

The density setting must remain consistent for all readings taken within a memory group. In order to store readings with a different density than previously used, select a new memory group, then immediately select the required density, and use it consistently until the readings for that memory group have been completed.

NOTE: If the meter is turned off, either manually or automatically, the meter will reset the density selection from standard density to local density, unless standard density readings have been stored in the currently selected memory group.

5.9.3.3 CONFIGURE TIME

The meter may be configured to use either a 12-hour clock or a 24-hour clock. Press the MODE key repeatedly while in the CONFIGURE loop, until [TIME s] is displayed. Press the MODE key to toggle between the 12 and 24 hour options, then press the READ/SELECT key to select the format required.

The default time setup is a 24 hour clock. The meter will display its current time in the 24-hour format with colons between the hours, minutes, and seconds. For example, [16:45:19 T] (rather than 4:45:19 PM). If the current time is correct and no corrections are necessary, press ALT / ALT to exit the selection loop or press the READ/SELECT key to accept the time displayed.

If a time correction is required, press the number keys as described in Section 5.1.3 NUMERICAL ENTRY to set the correct time. When the cursor reaches “T”, the “T” will change to “s”. Press the READ/SELECT key to update the clock to the corrected time.

If the user prefers a 12 hour clock, with am and pm indicated, then press the MODE key twice after the meter displays [TIME s]. The meter will display [12-HR s]. Press the READ/SELECT key. The meter will display the time and an A for am or a P for pm. Correct the time as necessary, using the SCAN▸ key to change the A to a P or vice-versa. If no keys are pressed for a few moments, the cursor will move under the “T” and the “T” will change to an “s”.

The READ/SELECT key may be pressed at any point to update the meter’s clock after changing at least one character. ALT / ALT may be pressed at any time before pressing the READ/SELECT key to escape the time-change configure loop.

5.9.3.4 CONFIGURE DATE

Press the MODE key repeatedly while in the CONFIGURE loop, until [DATE s] is displayed. The date previously set in the meter will be displayed in the DD/MM/YY format. If a date correction is required, press the number keys as described in Section 5.1.3 NUMERICAL ENTRY to set the correct date. When the cursor reaches the D at the right of the display, the “D” will change to an “s”. Press the READ/SELECT key to accept the corrected date.

5.10 RS232 DOWNLOAD USING ADM DATAFLOW SOFTWARE

The readings stored in memory in an ADM-880C AirData Multimeter may be electronically downloaded directly into a personal computer using an RS232 serial cable. The data communications utility program that performs the data download is Shortridge Instruments, Inc. ADM DataFlow®. DataFlow ports the data from the meter to the computer and then saves the data in a format known as comma separated value (CSV). This *.csv file is a text file, which can be directly imported into most spreadsheet applications, including Microsoft Excel®.

5.10.1 QUALIFIED OPERATING SYSTEMS

The DataFlow software has been qualified on computers running these Microsoft Windows operating systems: 98SE, Win2K, XP and VISTA. Windows NT has not been specifically tested, but can be considered qualified based on its similarity to Win2K. Computers with Microsoft Me may also be used with slightly diminished functionality (less COM port visibility).

5.10.2 INSTALLING DATAFLOW SOFTWARE

Insert the DataFlow installation CD into a CD drive. If the computer is configured for autostart, the installation software will begin within a few seconds. If the installation does not begin , open Windows Explorer, navigate to the root directory of the CD drive, and double click startup.exe.

An InstallShield application will start first, which will serve as a guide for the rest of the installation. DataFlow requires the Microsoft .NET Application Framework. The first part of the installation process launches the .NET installer, which presents the .NET user agreement from Microsoft. After reading the agreement, select “I Agree”, then click the “Install” button. After .NET has finished installing, the InstallShield Wizard will display a prompt to install DataFlow. Click the “Next” button to continue, and follow the prompts until installation is complete.

5.10.3 USING DATAFLOW SOFTWARE

Connect the meter to a serial port on the computer using the supplied RS232 serial cable. The meter must be turned on, and must be in the MANUAL reading mode. Any AUTO read, TREND, or TIMED readings in progress must be halted before attempting the download. Readings in memory may be downloaded while any message is being displayed except [TIMED DONE]. If the display reads [TIMED DONE], press the ALT key to display the last reading stored.

Launch DataFlow by selecting the red Shortridge Instruments ADM FlowHood icon on the computer desktop, or select *Start > Programs > Shortridge Instruments > DataFlow* from the computer main menu. The DataFlow window will be displayed. Click the “Connect” button on the upper right side of the DataFlow window. On first use a list box will pop up listing the available COM ports. Highlight the port to which the ADM-880C is connected, and click “OK”. The DataFlow software will communicate with the meter, and the status bar at the bottom of the window will display something similar to *Connected to ADM-880C, Serial #Mnnnnn, Ready to download 400 readings.*

Click the *Download* button. A standard Windows file selection dialogue will open, prompting for a name and directory for the file in which the downloaded data will be stored. The default directory is MyDocuments\Shortridge ADM Data. If the default directory is changed, the new directory will become the default for all future downloads from the ADM-880C AirData Multimeter. Enter a file name and click *Save*. The download will begin automatically, and the status may be viewed on the progress bar which appears at the bottom of the DataFlow window.

A pop-up window will appear when the download is complete. Click the *Download More Data* button to continue the application, or click *Exit DataFlow*. The download process does not affect the contents of the memory stored in the meter.

The readings will remain stored in the meter memory until the memory is cleared by pressing the ALT / STORE / READ key sequence.

5.10.4 IMPORTING SAVED DATA INTO A SPREADSHEET

The following example is for Microsoft Excel. Start Excel, and select *File* > *Open*. Navigate to the directory where the data file was saved. In the "Files of Type" box at the bottom of the Windows file dialogue box, select "Text Files" or "All Files". Select the file where the data was saved (it will have a *.csv extension). The data will be imported into the Excel spreadsheet. It may be necessary to adjust the column widths and cell justification settings to improve readability. The spreadsheet may be saved and recalled as an Excel file with a *.xls extension.

An example of ADM-880C AirData Multimeter readings imported into an Excel spreadsheet is shown on the following page.

5.11 BATTERY DISPLAY AND BATTERY LIFE

The AA NICAD batteries supplied with the meter are capable of supplying power for more than 3000 readings after one 10-hour charge. When the batteries are nearing the end of their useful charge, the meter will begin displaying [LOCHARGE]. If the meter is in the MANUAL or automatic reading mode, the symbol of a discharged battery cell will appear in the third block of the displayed reading. The operator should plan to complete the reading session when [LOCHARGE] is displayed.

If the meter is being used with the backlight turned off, the user will have approximately 20 minutes of runtime before the meter displays [RECHARGE / SHUT DOWN] and turns itself off. The time period will vary depending on prior use. The batteries must be recharged prior to further use.

If the meter has been being used with the display backlight turned on, the user will have approximately five to 20 minutes of runtime before the meter displays [RECHARGE / SHUT DOWN] and turns itself off. The time period will vary depending on prior use. The meter may be turned back on **without the backlight** for use until [LOCHARGE] is displayed again. The user will have five to ten minutes of additional runtime before the meter displays [RECHARGE / SHUT DOWN] and turns itself off. The batteries must be recharged prior to further use. See Section 2.0 SPECIFICATIONS and APPENDIX C for more information about the batteries and the battery charger.

The battery status can always be viewed by pressing ALT / ALT. The first display indicates the approximate remaining battery life: [BATTFULL], [BATT 2/3], [BATT 1/3] or [LOCHARGE]. A battery charge level displayed when the meter is first turned on, may not be representative of the true level of battery charge. Wait five or ten minutes after turning the meter on to view the charge level.

5.12 RESET SWITCH

If the meter is dropped or affected by static electricity, it may become unresponsive. Press the red reset pin on the back of the meter for one second. A reset causes the loss of all readings stored in memory since the meter was last turned on. However, readings in memory when the meter is turned off are saved such that a subsequent reset will not affect them.

5.1 ADM-880C AIRDATA MULTIMETER SPREADSHEET EXAMPLE

M																				
ADM-880C M02008 07 OCT 2004 11:06:46A																				
Reading	Density	Reading	FlowHood		FlowHood		Pitot		AirFoil		VelGrid		Temp		Abs Pres		Diff Pres		Time	Date
Number		Type	Uncompensated	Units	Compensated	Units		Units		Units		Units		Units		Units		Units		
Group A	Local																			
0001A		Diff Pres															0.01	In	10:59:24A	7-Oct-04
0002A		Diff Pres															0.0101	In	10:59:27A	7-Oct-04
0003A		Diff Pres															0.0106	In	10:59:32A	7-Oct-04
0004A		Diff Pres															0.0087	In	10:59:37A	7-Oct-04
0005A		Temp											91.8	F					10:59:52A	7-Oct-04
0006A		Temp											90.6	F					10:59:53A	7-Oct-04
0007A		Temp											89.7	F					10:59:55A	7-Oct-04
0008A		Abs Pres													28.6	Hg			11:00:02A	7-Oct-04
0009A		Abs Pres													28.6	Hg			11:00:04A	7-Oct-04
0010A		Abs Pres													28.6	Hg			11:00:05A	7-Oct-04
Group A	Statistics																			
# Rdg													3		3		4			
Avg													90.7	F	28.6	Hg	0.0099	In		
Sum													272.1	F	85.8	Hg	0.0394	In		
Min													89.7	F	28.6	Hg	0.0087	In		
Max													91.8	F	28.6	Hg	0.0106	In		
Std Dev													1.05	F	0	Hg	0.00081	In		
Group B	Local																			
0001B		AirFoil							293	FPM			75.6	F	28.6	Hg			11:00:31A	7-Oct-04
0002B		AirFoil							348	FPM			75	F	28.6	Hg			11:00:34A	7-Oct-04
0003B		AirFoil							344	FPM			74.5	F	28.6	Hg			11:00:38A	7-Oct-04
Group B	Statistics																			
# Rdg									3											
Avg									328	FPM										
Sum									985	FPM										
Min									293	FPM										
Max									348	FPM										
Std Dev									30.7	FPM										
Group C	Local																			
0001C		Flo-Hood	270	CFMu									72.6	F	28.6	Hg			11:02:32A	7-Oct-04
0002C		Flo-Hood			267	CFMc							73.4	F	28.6	Hg			11:02:49A	7-Oct-04
0003C		Flo-Hood	270	CFMu									74.8	F	28.6	Hg			11:04:39A	7-Oct-04
0004C		Flo-Hood			268	CFMc							75.4	F	28.6	Hg			11:04:57A	7-Oct-04
0005C		Flo-Hood	286	CFMu									72.1	F	28.6	Hg			11:01:26A	7-Oct-04
0006C		Flo-Hood			298	CFMc							71.9	F	28.6	Hg			11:01:33A	7-Oct-04
0007C		Erased																		
Group C	Statistics																			
# Rdg			3		3															
Avg			275	CFM	278	CFM														
Sum			826	CFM	833	CFM														
Min			270	CFM	267	CFM														
Max			286	CFM	298	CFM														
Std Dev			9.2	CFM	17.6	CFM														

6.0 VELOCITY MEASUREMENT

Air velocity measurements obtained with the AirData Multimeter are automatically corrected for the density effect of barometric pressure on the velocity readings. The TemProbe sensor must also be used to obtain readings corrected for the changes in density caused by the temperature of the air being measured. If the TemProbe has not been connected to the meter, [STD 70˚ F] or [STD 21.1˚ C] will be displayed during the calculation period, and all data will be processed using the standard temperature.

Pressing ALT / VIEW while a pitot tube velocity reading is being displayed will display the temperature, absolute pressure, differential pressure (velocity pressure), time and date associated with that pitot tube velocity reading. Pressing ALT / VIEW while a AirFoil probe or VelGrid velocity reading is being displayed will display the temperature, absolute pressure, time and date associated with that velocity reading.

The AirData Multimeter default air density correction for flow and velocity readings is to local air density with reference to barometric pressure. Comparison with "hot wire" anemometer readings may require the correction of the "hot wire" readings to local density conditions. See Section 6.6 VELOCITY: LOCAL VERSUS STANDARD DENSITY.

6.1 VELOCITY CORRECTION FACTORS

Prior to the development of capture hoods for measuring air flow directly, face velocity and jet velocity measurements were used to calculate air flow. Since the primary interest was in determining accurate volumetric air flow, obtaining accurate velocity measurements was not a priority. Only the repeatability of the velocity readings was considered to be important.

The manufacturers of the various air movement devices developed what became known as A_k or "area correction factors". These A_k factors actually corrected for the variations in velocity reading for the different types of instruments being used to measure velocity. It was necessary to develop different A_k factors for each type of test instrument used to test velocity, because each type is affected differently by the configuration of a given air movement device (AMD).

Use of the terms A_k or area constant diverted attention from the fact that average face velocity readings taken with different instruments on the same AMD were not the same, nor were readings taken with the same instrument likely to be the same on two or more AMDs with identical areas, but with different configurations.

We continue to use A_k factors when calculating the air flow for diffusers with uneven throw and other special applications. The use of an A_k factor is not appropriate, however, in the measurement of face velocities, work zone velocities or in calculating air flow from velocity measurements at most air movement devices such as CleanRoom HEPA filters, chemical exhaust hoods, safety cabinets, laminar flow work stations, coil and filter face velocities, kitchen exhaust hoods or any air movement device that affects velocity measuring instruments by its shape or configuration.

Various air measurement instruments will display differing readings when used on various (AMD) air movement devices, but the resulting calculated velocity or flow will be the same if the correct "k" factor is used for each particular instrument on that device. This correction factor is not an area correction factor,"A_k" (and never really was), but is actually a "Kv" velocity correction factor which must be applied to the velocity readings obtained with a specific instrument used in a specific manner on a specific AMD.

The area of the AMD is the gross active face area (frame to frame actual face area, plus leakage or bypass areas). The measured velocity multiplied by the correct "Kv" results in a corrected velocity reading that represents the true average face velocity relative to the gross active area. The measured velocity multiplied by the "Kv" multiplied by the active face area results in a calculated volumetric flow in cfm, l/s, etc.

Ideally, the manufacturers of the various air movement devices (AMD) will eventually develop and provide Kv correction factors and procedures to be used with each of their products and various velocity measurement instruments.

In the meantime, Kv factors will have to be established through field testing of AMDs in the following manner.

1. Determine the **gross active area of** the filter, coil, grille, opening or exhaust hood. Be sure to deduct the area of all obstructions to air passage such as support bands, T-bars, glue line and repaired areas on HEPA filters. The total intake area of an exhaust hood includes all areas of air entry, including the space behind and around the sash, under the threshold, and through service openings. It is accepted practice to assume that the velocity through these additional areas is the same as that of the sash opening area.

2. Determine the "actual" volumetric air flow through the given AMD air movement device. Pitot tube duct traverse is likely the most reliable means of determining the actual air flow. Direct air flow measurements can also be used in areas where duct air velocity measurements are not practical, by using the FlowHood with custom designed tops.

3. Calculate the effective average face velocity (fpm) by dividing the actual air flow measured in Step #2 (cfm) by the gross active face area (sq ft) calculated in Step #1.

4. Measure the average face velocity at the AMD using the VelGrid, AirFoil probe or other velocity instrument being tested for a Kv. Document the procedure used to obtain the average face velocity including all factors such as: the instrument used, the sensing probe positions, spacing of the velocity sample points and the number of readings taken to obtain the average for each measurement location. Always record the instrument type and any specific set up conditions such as whether readings were taken in local or standard air density, and whether or not the correction included temperature.

5. Calculate the velocity correction factor "Kv" for this particular AMD by dividing the effective average velocity obtained in Step #3 above by the measured velocity obtained in Step #4 above. This "Kv" factor should now be used routinely as a required multiplier to correct velocity readings taken at this specific AMD design, model and size. The specific procedures developed for measuring air velocities at a given AMD must always be used to obtain the air velocity measurements.

This "demanding" five step procedure seems to leave little room for the "art" of Testing and Balancing. This is not altogether true. The measurement of the air velocity in Step #4 is affected by the position and orientation of the air velocity measuring probe. By selective experimental positioning of the sampling point locations, a procedure can be developed which will result in a Kv for this particular AMD very near or equal to 1.0.

The face velocity test procedure should be included in the AMD test report. The result is a documented, repeatable face velocity measurement that can be confirmed by a trained technician using the proper instrumentation and following the test procedure. This procedure may also be used by laboratory personnel to retest the air flow at periodic intervals to confirm that the flow still conforms to test report data.

6.2 PITOT TUBE VELOCITY MEASUREMENT

The pitot tube is primarily used to obtain air velocity measurements in ductwork. A pitot tube is stainless steel with a 90 degree bend at one end and two connectors at a 90 degree angle located near the base. The measurement range of the AirData Multimeter with the pitot tube is 25 to 29,000 fpm (calibration accuracy is certified from 50 to 8,000 fpm). A "traverse" of the duct is obtained by taking multiple air velocity readings at equal area locations within the duct cross-section. See AIR BALANCE MANUALS AND TRAINING PROGRAMS for sources of detailed information on performing duct traverses and other air balance procedures. The stainless steel pitot tube included in the AirData Multimeter kit is suitable for use in temperatures up to 1500˚ F.

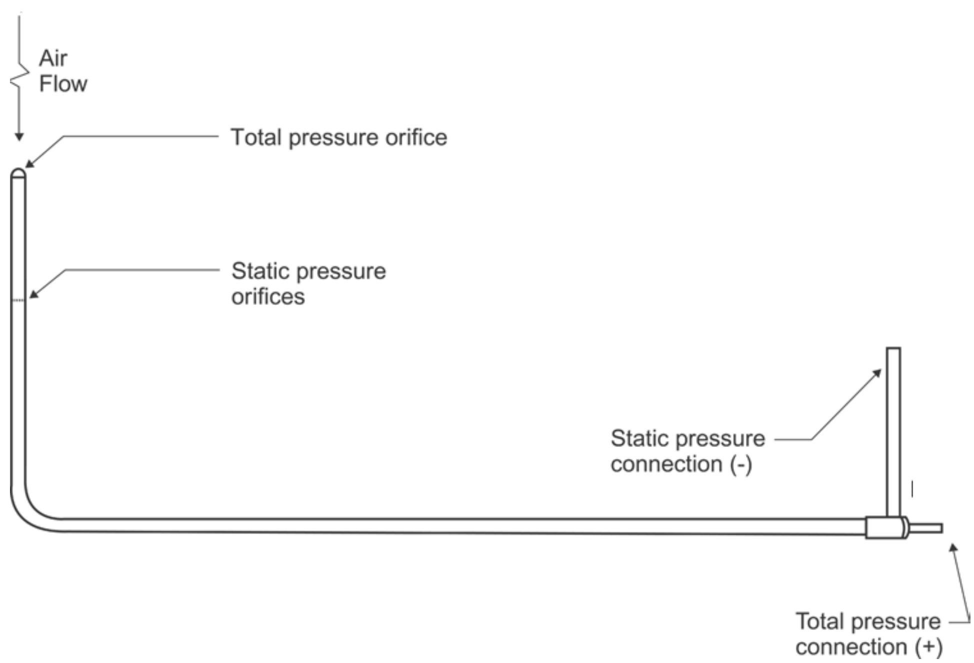


FIGURE 6.1 PITOT TUBE

Connect one of the tubing sections from the positive (+) port of the meter to the total pressure connection (in line with the main shaft) on the pitot tube and connect the negative (-) port to the static pressure connection (perpendicular to the main shaft).

If the hoses are connected incorrectly, the readings will show as negative air velocity and the meter will display [NEG PITOT]. All passages and connections must be dry, clean, and free of leaks, sharp bends and other obstructions.

After turning the meter on, press the MODE key until [PITOT TUBE] is displayed. Use the retractile cord to connect the TemProbe to the meter. Insert the pitot tube and the TemProbe into 3/8 inch holes drilled into the side of the duct, being careful to align the point of the pitot tube so that it is facing directly into the airstream. If the negative (-) connection of the pitot tube is exactly parallel to the duct, the point of the pitot tube should be facing directly into the airstream. The shaft of the pitot tube is marked at one inch intervals to make it easier to control the location of the pitot tube within the duct. Press the READ key to obtain the air velocity measurement.

The accuracy of pitot tube results depends heavily upon uniformity of air flow and completeness of the duct traverse. Careful technique is critical to good results. Pitot tubes are available in several different sizes and configurations to simplify different applications which may be encountered.

When a pitot tube is used in internally insulated ducts, small particles of fiberglass may be dislodged and become caught in the openings of the tube. This will effect the accuracy of the readings and eventually clog the tube. Remove the connections to the meter and blow compressed air through the bottom of the inside tube to discharge fiberglass particles from the tip of the pitot tube.

[NEG PITOT] will be displayed if the pitot tube readings are negative. This will occur if the positive (+) and negative (-) hoses have been incorrectly connected to the inlet ports of the meter; if the probe has been improperly positioned in the air stream; or if the pitot tube tip has been placed in an area of flow reversal or eddy. It is common practice, although not a purely accurate procedure, to consider negative pitot tube readings as zero in the averages of pitot tube traverse readings. If a memory sequence has been started, a [NEG PITOT] reading will be stored as zero. This zero will be calculated in the velocity sum and average, and will be recalled as nns NP 0. **A memory sequence cannot be started with a [NEG PITOT] reading.**

Air flow within a duct may be calculated by multiplying the **average** duct air velocity (fpm) as measured with the pitot tube, by the duct area (sq ft). The resultant flow is expressed in cubic feet per minute (cfm).

The standard pitot tube is .3125 inches in diameter and reduces the duct cross-sectional area by only 0.077 square inches in the measurement plane of the duct. This duct area reduction is less than 1% for ducts greater than three inches in diameter and does not need to be deducted in the duct area calculation.

It is important to note that most publications assume that the pitot tube reading is expressed in velocity pressure, rather than velocity. The AirData Multimeter used with a pitot tube reads out directly in velocity when used in the [PITOT TUBE] mode, and reads velocity pressure when used in the [DIFF PRES] mode.

6.3 AIRFOIL PROBE VELOCITY MEASUREMENT

IMPORTANT: See Section 6.1 VELOCITY CORRECTION FACTORS

The AirFoil probe offers increased versatility in velocity measurements. This accessory amplifies the velocity pressure signal, giving greatly increased sensitivity at extremely low velocities. It is of particular value in small diameter ducts since, due to its smaller size and straight configuration, it does not require lateral rotation for insertion into the duct. The AirFoil probe is also relatively tolerant of rotational misalignment. The measurement range of the AirFoil probe is 25 to 5,000 fpm.

The AirFoil probe is useful for free point air velocity measurements, such as exhaust hood face velocities, HEPA filters or laminar hood velocities. A pitot tube senses total pressure at the tip and static pressure several inches behind the tip, and in many cases is not as suitable for point air velocity measurements.

The AirFoil probe is connected to the meter in a manner similar to the pitot tube. The total pressure and lee side pressure connections are to be connected respectively to the positive (+) and negative (-) connections of the meter. The length of each 3/16 inch (internal diameter) external tube should be limited to 18 feet.

The air flow should impinge directly onto the total pressure (+) side of the AirFoil probe tip during measurements. The probe tip should be held perpendicular to the direction of the air stream. Press the MODE key until [AIRFOIL] is displayed. Use the retractile cord to connect the TemProbe to the meter. Insert the AirFoil probe and the TemProbe into 3/8 inch holes drilled into the side of the duct, being careful to align the AirFoil probe tip as discussed above. Press the READ key to obtain the air velocity measurement.

NOTE: The AirFoil probe readings will be displayed with a negative sign if the hoses are connected backwards to the meter or to the probe. The AirFoil probe lee side pressure connector should point downstream with the air flow.

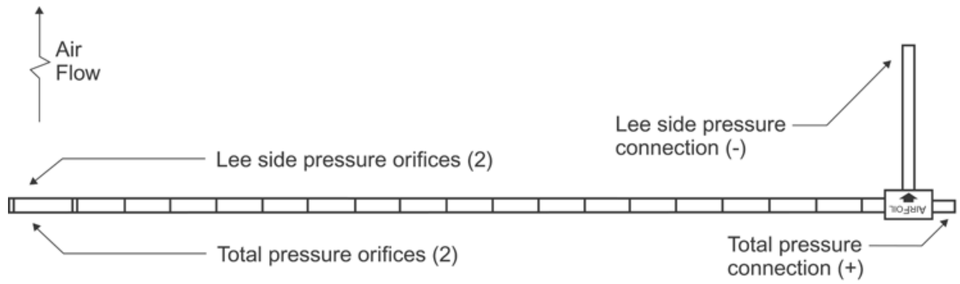


FIGURE 6.2 AIRFOIL PROBE

The AirFoil probe lee side pressure port is not equivalent to the static pressure port on a pitot tube, and must not be used to obtain static pressure readings.

6.3.1 DUCT VELOCITY USING AIRFOIL PROBE

The scribed rings on the AirFoil probe shaft are located at one inch increments from the tip orifice, and are provided to assist in controlling the probe measurement depth during duct velocity readings. It is helpful to apply a single wrap of electrical tape around the probe shaft at each desired depth increment to mark measurement points.

Negative air velocities may exist in some areas of a duct traverse due to turbulence or eddy currents. The AirFoil probe tip is designed to provide equal differential pressure for velocity in either direction across the tip. Therefore, it is recommended that the negative velocity readings be **included** in the averages of the readings taken with the AirFoil probe.

6.3.2 FUME HOODS AND SAFETY CABINETS

The AirFoil probe may be used to test the downflow air pattern and average velocity in the horizontal plane at the sash height of safety cabinets. This test is usually done at 6" centers on a 6" x 6" traverse pattern and at 8" or 10" above the work opening threshold. This is normally 9" to 11" above the work surface pan.

Position the AirFoil probe horizontally and up against the bottom edge of the sash door. Tape markers on the AirFoil probe and along the sash door edge at 6" centers will aid in accurate positioning of the AirFoil probe. The individual readings for the downflow grid should be recorded to establish the uniformity, or zone velocity profile, and compliance with the standards required. Also the average of the downflow readings may be used to calculate the downflow cfm if required. The work opening face velocity on total exhaust cabinets may be tested in a manner similar to procedures for fume exhaust hoods. The velocity sample grid should be a 4" square grid for 8" sash height and a 5" grid for 10" sash settings. When calculating average velocity or total flow, the "K_v" factor must be taken into account as discussed in Section 6.1 VELOCITY CORRECTION FACTORS.

The exhaust filter face velocity may also be tested with the AirFoil probe to determine exhaust air flow. The cabinet manufacturer's probe position schedule should be used as a guide. The AirFoil probe readings have been found to be essentially the same as "hotwire" anemometer readings taken in laboratory and field condition testing of filter discharge face velocity.

NOTE: The exhaust air flow is most accurately determined by direct air flow measurement using the FlowHood. The 1' x 4' top assembly should be positioned so as to capture all of the intake air at the work opening. This may require the use of masking tape and materials to block off part of the opening, depending upon the size of the cabinet.

6.3.3 EXHAUST HOODS - AIRFOIL PROBE

The AirFoil probe provides single point air velocity samples and may be used to collect data for graphing face velocity profiles at exhaust hoods.

Air flow at the extremely low velocities (50 to 150 fpm) used in chemical exhaust hoods and safety cabinets will show significant percentage variability at any given point (slight fluctuations in velocity represent a very large percentage fluctuation at low velocities). Readings should be repeated several times at each sampling point to obtain an average velocity reading for that point.

The face of the exhaust hood should be divided into a grid with each section of the grid representing an equal area division of the exhaust hood. The equal area divisions are often set at 6" x 6", and seldom need to be set at less than 4" x 4". Each velocity sampling location should be at the center of an equal area division of the grid. All equal area divisions should be tested. The leading edge of the AirFoil probe should be directly in line with the plane of the sash while taking face velocity sample measurements.

The actual airstream direction is usually at various angles to the plane of the opening around the sash perimeter, so velocities cannot be reliably measured near the edge of the opening. The tip of the AirFoil probe must be positioned at least 2 inches from the edge of the sash opening of the exhaust hoods.

The standard AirFoil probe is a straight probe. It is often difficult to position the standard probe across an exhaust hood opening if the hood opening frame has some relief depth on the sides and at the threshold. Special pattern AirFoil probes are available that have the end of the probe at 90 degrees to the shaft. These probes are more easily positioned in such hood openings and are designed to fit in the AirData Multimeter accessory kit carrying case.

6.3.4 LAMINAR FLOW WORKSTATIONS - AIRFOIL PROBE

The AirFoil probe may also be used to measure face velocities and work zone velocities for very small sample areas. The average of several readings must be used to represent small sample areas, due to the variability of air flow at low velocities. Readings that vary ± 50% are not unusual when taking single point velocity readings. The more variable the readings, the more readings must be included in the average obtained at each location. Ten readings per sample point is usually adequate.

6.4 SINGLE POINT CENTERLINE AIR VELOCITY MEASUREMENTS

It may be necessary to take single point centerline air velocity readings using the AirFoil probe or pitot tube under certain test conditions. These conditions may include very small ductwork (minimum size is four inches) or other situations where it is very difficult to perform a full pitot tube traverse and it is not appropriate to use the FlowHood.

Position the pitot tube or AirFoil probe carefully in the center of the duct. Take five or more velocity readings and determine the average of the readings. Multiply the average of the readings by a factor of 0.9 to calculate the approximate average velocity for the duct.

6.5 VELGRID AIR VELOCITY

IMPORTANT: See Section 6.1 VELOCITY CORRECTION FACTORS

The VelGrid accessory is designed especially for use in the measurement of general "face velocity" conditions, such as HEPA clean room filter outlets; laminar flow work benches; exhaust hoods; terminal air face velocities; and large filter bank and coil face velocity measurements. The measurement range using the VelGrid is 25 to 2500 fpm. Each reading represents 16 velocity points over a 14" x 14" area (1.36 sq ft).

The VelGrid unit is assembled by attaching the pushbutton handle to one of the captive knob screws of the handle bracket, and attaching one or more of the extension rods to the other end of the handle bracket as shown in Figure 6.3. The VelGrid swivel bracket is attached to the extension rod end. The two hoses are connected to the VelGrid hose connectors and to the ports on the meter. The pushbutton handle cord plugs into the external read jack on the left side of the meter. A neckstrap is provided with the VelGrid to support the meter and allow hands free operation. The TemProbe must also be used as discussed if full density correction for temperature is required. If the TemProbe is not used, the velocity will be calculated using the standard temperature of 70˚ F or 21.1˚ C.

After turning the meter on, press the MODE key until [VELGRID] is displayed, followed by [FP READ]. Press the READ key to initiate the actual measurement. (Press the STORE key if the memory function is desired). [STORE RDY] will be displayed. Place the VelGrid directly on the face of the filter or coil, with the standoff spacers of the grid against the outlet or inlet face. When placing the VelGrid near the edges of the filter, grille, coil face, or other opening, the perimeter standoff spacers should be at least 1.5" from the edge of the **active** face area. This 1.5" margin maintains the proper "traverse" spacing of the velocity sample points at 3.5" centers on a 14" x 14" area.

Overlapping of reading positions is better than getting too close to the face area edges. If the dimensions of the outlet are smaller than the VelGrid, the orifices of the grid that are not directly exposed to the air flow must be covered with tape. All unused orifice positions on **both** sides of the grid manifold **must** be covered. Note: The VelGrid temperature exposure limit is 0˚ F to 140˚ F.

The VelGrid is bidirectional in function. A negative sign will be displayed if the hose connections are reversed or if the air flow direction is reversed in relation to the higher pressure side of the VelGrid. If you know that the hoses are reversed, you may disregard the negative sign.

6.5.1 CHEMICAL EXHAUST HOODS - VELGRID

The VelGrid provides the average of 16 measurement points at 3.5 inch centers, and represents a 14" x 14" area for each reading. When using the VelGrid for chemical exhaust hood readings, the sash opening must be set at a minimum opening of 14 inches in width for horizontal sliding sash, or 14 inches in height for vertically adjustable sash. If the opening is less than 14 inches in width or length, the AirFoil probe should be used.

The VelGrid must be carefully positioned so that the perimeter orifices of the VelGrid are at least 1.75 inches in from the edge of the opening. The leading (side the air strikes first) surface of the VelGrid should be evenly aligned and parallel with the plane of the sash. Correct positioning of the VelGrid is easier if equal length, stiff wire "feelers" are taped to the leading surface of the VelGrid. Coat hanger wire taped in place with plastic electrical tape works well for this purpose.

6.5.2 LAMINAR FLOW WORKSTATION - VELGRID

The VelGrid can be used to measure average face velocities at the work zone or plane of a laminar work station using much the same method as described for chemical exhaust hoods. It is important to position the leading edge of the VelGrid at 90 degrees to the direction of air flow when measuring work zone velocities. The VelGrid may also be positioned so the 1.5 inch standoffs are placed directly against the perforated supply panel face. The velocity average obtained in this manner can be used to calculate the volumetric air flow rate as described in Section 6.5.3 AIR FLOW CALCULATION.

6.5.3 AIR FLOW CALCULATION FROM VELGRID VELOCITY

Accurate volumetric air flow calculation using the average face velocity requires careful measurement of the **active gross face area** of the filter, grille, coil, or opening. Be sure to deduct the area of all obstructions to air passage through the device to be tested, such as: support bands; T-bars, including the perimeter glue line; and repaired areas of HEPA filters.

Even with careful measurement of the active area, the meter and the sensing probe will be affected by different design configurations of the outlet, inlet, filter, coil or exhaust hood. It is best to establish a procedure and confirm the air flow by pitot tube duct traverse or some other reliable flow measurement means for a given type of air movement device. IMPORTANT: See Section 6.1 VELOCITY CORRECTION FACTORS.

The measurement of exhaust hood intake velocity requires careful placement of the VelGrid to align the leading edge of the grid directly in line with the plane of the sash opening. Maintain the 1.5" perimeter margin as illustrated. The total intake area and air flow of an exhaust hood includes all areas of air entry, including the space behind and around the sash; under the threshold; and through service openings. It is accepted practice to assume that the velocity through these additional areas is the same as that of the sash opening area. (See the following section regarding hot wire anemometer reading correction for true air velocity).

6.6 VELOCITY: LOCAL DENSITY VERSUS STANDARD DENSITY (MASS FLOW)

The AirData Multimeter measures **true** air velocity past the sensor at a given time, when used in the **local density** mode. This is in contrast to thermal anemometers or "hot wire" instruments which measure mass flow (mass flux/unit time). Mass flow represents the number of molecules of air flowing past a given point during a given time. Mass flow only represents true velocity when measured at standard sea level conditions of 29.921 in Hg and 70˚ F (.075 lbs/cu ft). Hot wire, mass flow, "velocity" readings at density conditions other than standard must be corrected for local air density conditions if these results are to represent true velocity.

Air velocity readings taken with the ADM-880C in the **standard density** mode are comparable to readings taken with a hot wire anemometer. If local density corrected velocity readings taken with the AirData Multimeter are to be compared with hot wire anemometer readings, the actual air velocity should be measured in the **local density** mode with the AirData Multimeter, and the **hot wire readings must be corrected** for local air density conditions.

The precise method for calculating density corrected air velocity measurements taken with a **hot wire anemometer** requires the use of the following equation:

$$\underset{(\textit{true air velocity})}{\textit{LOCAL DENSITY VELOCITY}} = \underset{(\textit{hot wire})}{\textit{MEASURED VELOCITY}} \; X \left(\frac{29.92}{P_b} \; X \; \frac{460 + {}^{o}F}{530} \right)$$

Where: P_b = local barometric pressure (in Hg)
˚ F = temperature of air stream

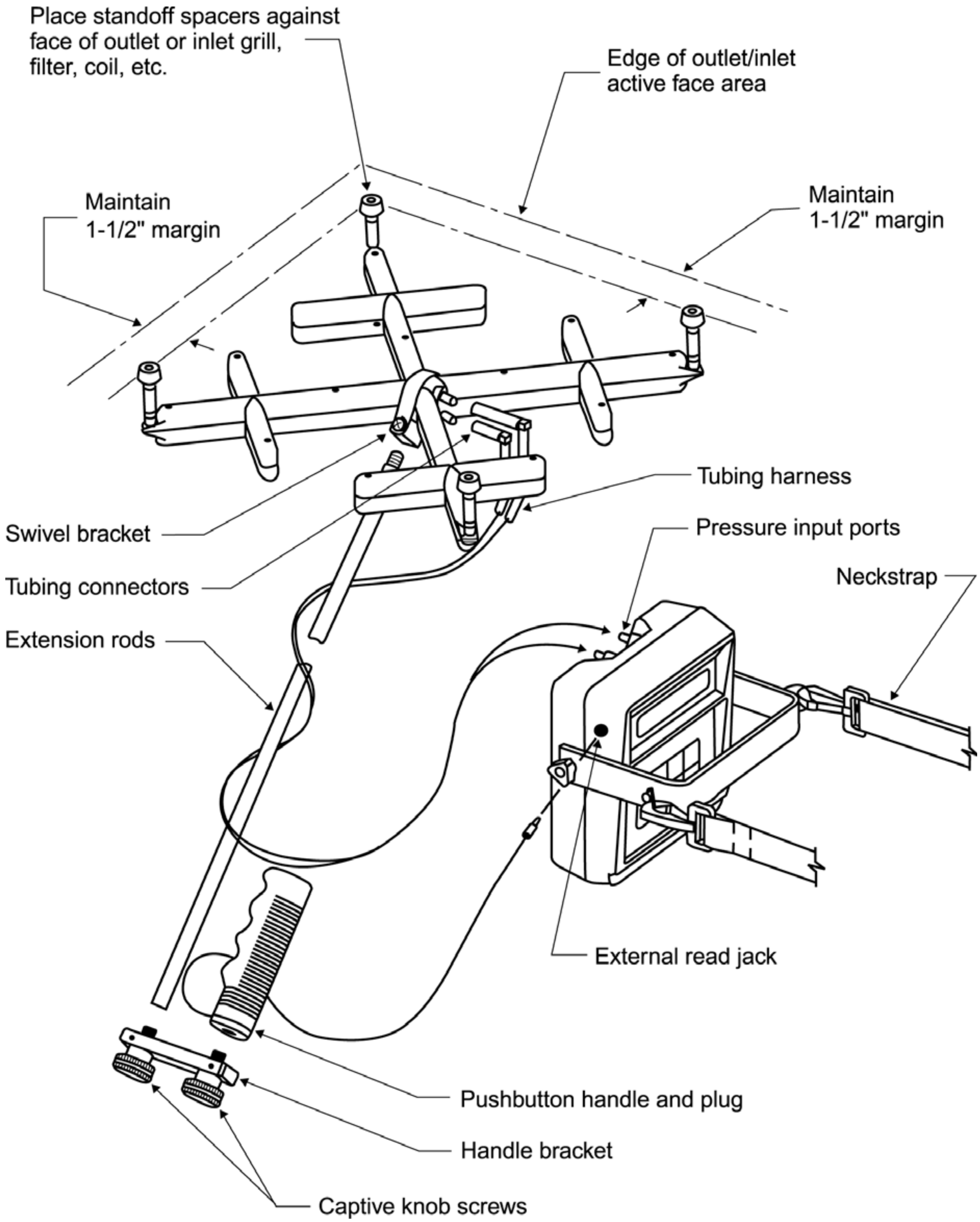


FIGURE 6.3 VELGRID ASSEMBLY

7.0 PRESSURE MEASUREMENT

7.1 DIFFERENTIAL PRESSURE

Differential pressure measurements can be made with static pressure probes, a pitot tube or by connecting the pneumatic tubing directly to any appropriate pressure source **within the safe operating limits for the meter**. The manner in which a pitot tube is connected to the meter is critical to the type of differential pressure measurement obtained. The meter will display DIFF PRES and read out in the same units for all types of differential pressure measurements.

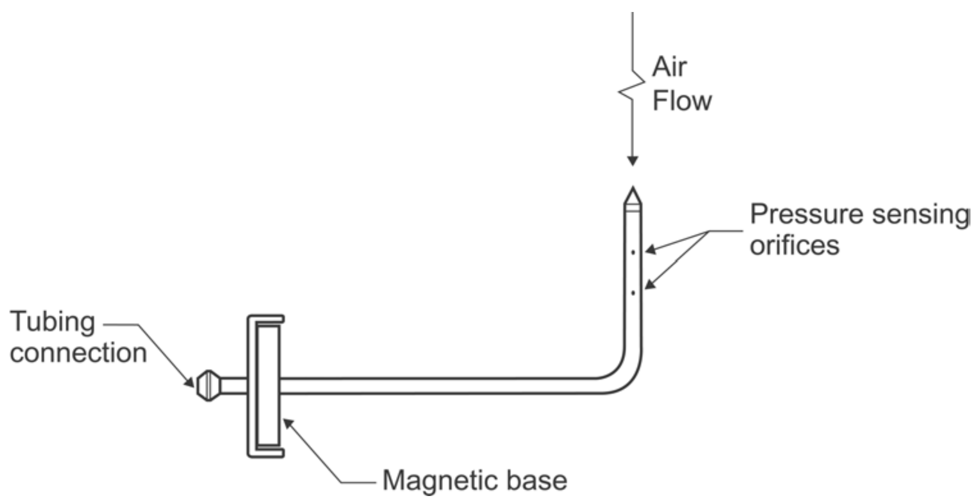
The positive (+) and negative (-) ports of the meter are connected as a pair to the pneumatic pressure source for differential pressure measurements. Maximum safe pressures for differential pressure measurements are 20 psid (900% full scale) and 60 psia common mode. The length of each external pneumatic tube should not exceed 18 feet of 3/16" ID tubing.

Press the MODE key to toggle through the modes to differential pressure. The meter will display [DIFF PRES] and then [IN READ]. Press the READ key to obtain the pressure measurement.

The differential pressure between two rooms, or any other two areas may be obtained by connecting the tubing to the positive (+) port of the meter and leaving the negative (-) port open to the ambient air pressure. Place the end of the tubing in one area and place the meter in the other. The meter will measure the pressure differential between the two areas.

7.1.1 STATIC PRESSURE PROBES

Static pressures are measured with static pressure probes. These probes are brass colored and have a single tubing connection in the magnetic base. Connect the tubing from the static pressure probe to the positive (+) port of the meter. Leave the negative (-) port open to the room air. Insert the static pressure probe into a 3/8" hole drilled into the duct until the magnet is flush with the surface of the duct. Point the tip of the static pressure probe directly into the airstream. Press the READ key. The meter will read the differential between the pressure within the duct and the ambient pressure on the negative port of the meter.



7.1 STATIC PRESSURE PROBE

7.1.2 PITOT TUBE "VELOCITY PRESSURES"

Velocity pressures are obtained when a pitot tube is used and the meter is set to read out in differential pressure. The resulting reading is recorded as velocity pressure. Connect one of the tubing sections from the positive (+) port of the meter to the total pressure connection (in line with the main shaft) on the pitot tube and connect the negative (-) port to the static pressure connection (perpendicular to the main shaft). The pitot tube connections are shown in Figure 6.1. If the connections are reversed, the readings will be negative. Insert the pitot tube into a 3/8" hole drilled into the side of the duct, being careful to align the point of the pitot tube so that it is facing directly into the airstream. If the negative (-) connection (perpendicular to the main shaft) of the pitot tube is upstream and parallel to the duct, the point of the pitot tube should be facing directly into the airstream.

7.1.3 PITOT TUBE "STATIC PRESSURES"

Static pressures may be obtained using the pitot tube and the differential pressure mode by connecting the positive (+) port on the meter to the static pressure connection (perpendicular to the main shaft) of the pitot tube and leaving the negative (-) port exposed to the ambient pressure. Insert the pitot tube into the airstream as discussed under Section 7.1.2 PITOT TUBE VELOCITY PRESSURES above. The resulting pressure differential is recorded as static pressure.

7.1.4 PITOT TUBE "TOTAL PRESSURES"

Total pressure measurements may be obtained using the pitot tube and the differential pressure mode by connecting the positive (+) port on the meter to the total pressure connection (in line with the main shaft) of the pitot tube and leaving the negative port of the meter exposed to the ambient pressure. Insert the pitot tube into the airstream as discussed under Section 7.1.2 PITOT TUBE VELOCITY PRESSURES above. The resulting differential pressure reading represents total pressure.

7.2 ABSOLUTE PRESSURE

The absolute pressure function is intended mainly to provide automatic air density correction for the velocity and flow measurements. Absolute barometric pressure measurements are obtained when the negative (-) port is open to the atmosphere and the meter is in the absolute pressure mode. The measurement range is 10-40 in Hg.

Specific absolute pressure source measurements may be obtained by connecting the pressure source directly to both the positive (+) and the negative (-) ports (**in common**) of the meter. Press the MODE key until [ABS PRES] is displayed. The meter will then display [Hg READ] or [Bar READ]. Press the READ key to take a reading.

CAUTION

> If an absolute pressure source **is likely to be greater than 60 in Hg (30 psia**), the pressure source **must** be connected in common to both the positive (+) and negative (-) meter ports **simultaneously**. This precaution avoids excessive differential pressure input which will damage the pressure transducer. Maximum safe pressure is 60 psia common mode and 20 psi differential pressure.

The absolute pressure measuring accuracy should be checked periodically. Readings taken with the negative port (-) open to the atmosphere should be within ± 2% of the actual barometric pressure to assure rated accuracy of density corrected flow and velocity readings.

NOTE: Weather service or airport reports of barometric pressure have usually been adjusted for altitude, so the pressure can be used for altimeter adjustment. The barometric pressure announced on television or radio stations is generally obtained from weather service reports. This altitude corrected barometric pressure must **not** be used in density correction equations for comparison with a FlowHood. An estimation of the actual barometric pressure may be obtained by deducting approximately 1.0 in Hg for each 1000 feet above sea level.

8.0 TEMPERATURE MEASUREMENT

8.1 TEMPROBE

Temperature measurements are obtained using the TemProbe temperature probe. The TemProbe may be plugged directly into the temperature input jack on the back of the meter. Since this receptacle is keyed, the plug of the TemProbe sensor must be correctly aligned for proper insertion. The release button on the side of the TemProbe must be pressed to disconnect the TemProbe from the meter.

The “settling in” time required for the thermistor to stabilize at the temperature of the air being measured will vary with the specifications of the TemProbe being used, the temperature differential between the TemProbe and the air, and also with the velocity of the air across the probe. The “settling in” time is typically less than for a standard glass thermometer.

After turning the meter on, press the MODE key until [TEMP] is briefly displayed, followed by [˚ F READ]. Then, using the retractile cord if necessary, place the TemProbe sensor in the medium to be sampled. Press the READ key to take a temperature reading. If the TemProbe is not installed on the meter, or if it is open circuited (defective), the display will read [NO PROBE].

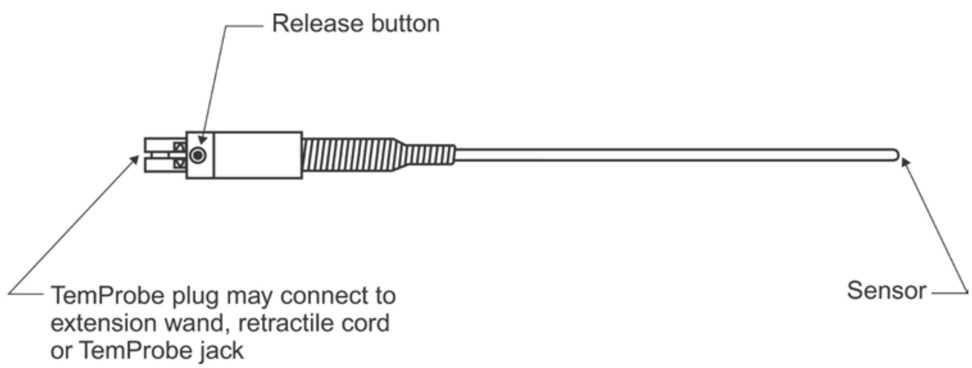


FIGURE 8.1 ADT442 TEMPROBE

The specified accuracy using the ADT442, ADT443, ADT444, ADT445 or ADT446 TemProbes is ± 0.5˚ F from 32˚ F to 158˚ F. Measurement range for the ADT-446 TemProbe is -20˚ F to 180˚ F. Measurement range for the ADT442, ADT443, ADT444 or ADT445 TemProbes is -67.0˚ F to 250.0˚ F. Meter will display [OVER TEMP] or [UNDER TEMP] if the probe is exposed to temperatures beyond this range. The maximum safe exposure range is -100˚ F to 250˚ F and the probe accuracy may be affected by exposure beyond this range. Do not expose the plastic base of the TemProbe or the extension wand to temperatures above 200˚ F.

NOTICE: The use of more than one temperature cable extender may reduce the meter reading by a non-linear degree depending on the combination of cable type, length and TemProbe temperature. This is due to the added resistance of the additional cable(s). This effect is likely to be negligible at very low temperatures, but may be $\geq$ 0.15˚ F per additional cable extender at 154˚ F. The offset correction(s) must be determined by comparing readings taken with and without the extender cables at the temperature(s) to be measured.

8.2 AIRDATA MULTITEMP

The MT-440K MultiTemp comes with six insertion probes, two surface probes, one eight-position switch, and a small carrying case. The measuring capability of the MultiTemp combines with the memory function of the AirData Multimeter to store up to 2000 temperature readings along with the sequence tag for each reading. Each temperature reading may be entered into memory in two seconds or less. A full set of eight readings may be entered into memory in about 15 seconds.

Plug the single cord on the bottom edge of the MultiTemp into the temperature input jack on the back of the AirData Multimeter. Up to eight temperature probes (each with a 12' cord) can be connected into the eight small, numbered temperature input jacks on the top edge of the switch box. The jack numbers correspond to the eight switch position numbers surrounding the switch. Place each of the temperature probes in the system as required and allow the probe temperatures to stabilize. A typical system testing application is shown in Figure 8.2. Set the meter for the temperature function as discussed in Section 5.0 USING THE AIRDATA MULTIMETER. Set the MultiTemp for switch position #1 and take a reading for the probe connected to temperature input jack #1. Turn the switch to switch position #2 and take a reading for temperature jack #2. Continue for as many of the eight temperature jacks as needed.

The automatic reading function may be used with the MultiTemp. Set the meter for automatic readings and take as many readings as needed for any of the switch positions. Press the READ key to halt the reading process prior to changing switch positions. Changing switch positions during the actual reading process will cause false readings.

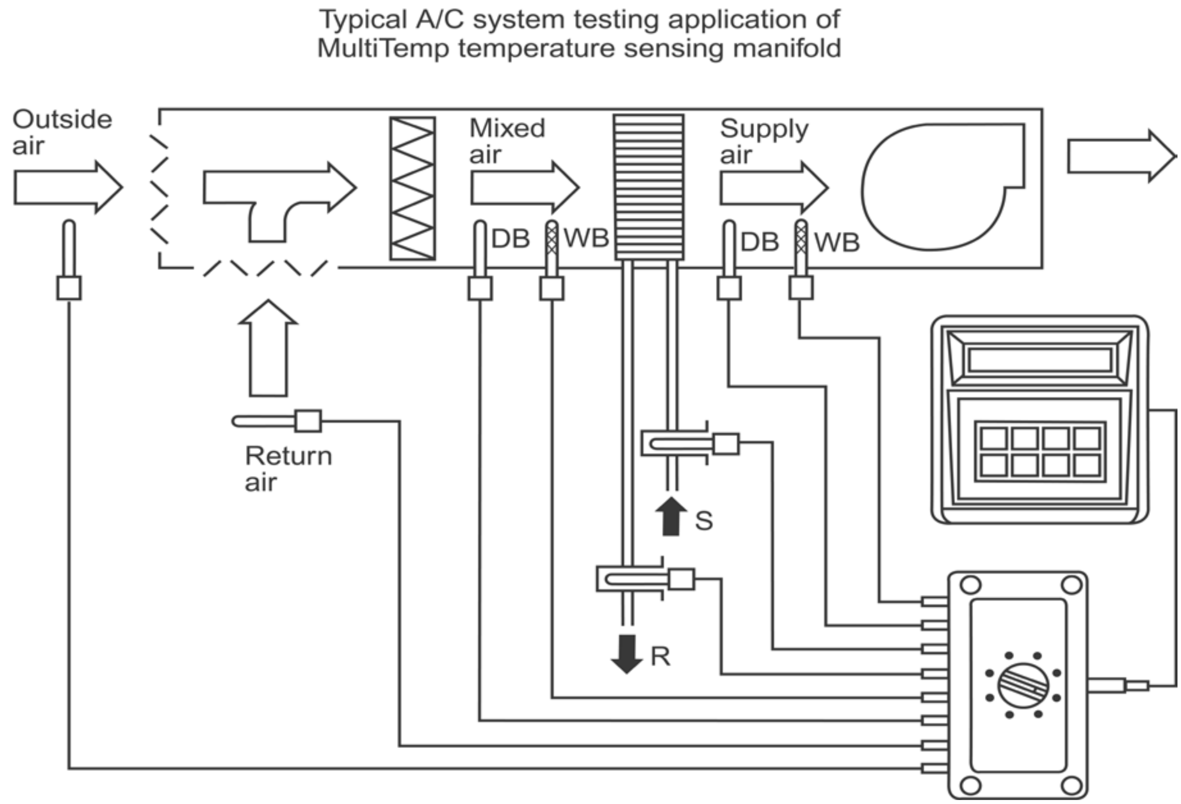


FIGURE 8.2 AIRDATA MULTITEMP

The individual and automatic storage functions may also be used with the MultiTemp. Set the meter for the individual storage or automatic reading storage functions as needed. Take as many readings as needed for each of the switch positions. Careful recording of which switch position readings are entered into memory under which sequence tag is essential to accurate recall of readings for performance calculations.

Additional points may be measured in the same measurement sequence by using more than one MultiTemp switch unit connected in series (piggybacking). Reading and memory entry of 64 temperature points would take about two minutes (after temperature probes have stabilized). Connect the primary MultiTemp module to the meter as described above. Connect the output jack of each secondary MultiTemp to the input jack of the primary MultiTemp using plug adapter P/N PA-447. Each switch position of the primary MultiTemp can support up to eight switch positions on a secondary MultiTemp. The temperature probes used with the MultiTemp and AirData Multimeter are typically interchangeable.

These probes may be used in any liquid or gas compatible with stainless steel. Typical uses include: wet or dry bulb air temperatures; thermometer wells; "Pete's" plugs; or direct immersion. Some applications include humidity control systems; direct expansion A/C systems; outside air adjustment; hot water heating; chilled water; condenser water; and many other circulating process liquid systems.

The surface probes may be used to measure pipeline surface temperatures when piping systems do not have thermometer wells. These probes may also be used as fast acting air probes.

NOTICE: The use of more than one MultiTemp and temperature cable extender set may reduce the meter reading by a non-linear degree depending on the combination of cable type, length and TemProbe temperature. This is due to the added resistance of the additional MultiTemp(s) and cable(s). This effect is likely to be negligible at very low temperatures, but may be ≥ 0.25˚ F per additional MultiTemp and cable extender at 154˚ F. The offset correction(s) must be determined by comparing readings taken with and without the additional MultiTemps and extender cables at the temperature(s) to be measured.

9.0 AIR FLOW MEASUREMENT

9.1 FLOWHOOD FUNCTION

The AirData Multimeter utilizes the Series 8400 FlowHood Kit for backpressure compensated measurement of air flow. The FlowHood unit captures and directs the air flow from an outlet, or inlet, across the highly sensitive flow sensing manifold within the FlowHood base. This manifold simultaneously senses the total pressure, and the static pressure, at sixteen precision orifices spaced at the correct representative measurement points for the known cross-sectional area of the FlowHood base. The sensed total pressure and static pressure are combined to a single differential pressure, which is transmitted to the meter for conversion to direct air flow readout.

Air flow readings taken using the AirData Multimeter are automatically corrected for the density effect due to barometric pressure. If the temperature probe has been installed during the measurement, the air flow reading is further corrected for the density effect due to the temperature of the air stream, and the result is corrected for local air density. If flow measurements are initiated without the temperature probe, [STD 70˚ F] or [STD 21.1˚ C] will be flashed on the display immediately prior to the display of the air flow reading. The flow will be calculated using this assumed standard temperature.

NOTE: The FlowHood may require the development and use of correction factors when used on swirl diffusers, or on other types of diffusers with uneven air throw. The FlowHood may not be appropriate for use on small supply outlets at high jet velocities or “nozzle” type outlets. These outlets cause an extreme concentration of air velocity on portions of the flow sensing grid. The FlowHood readings may be inaccurate under such conditions.

Consideration must be given to other system components, such as may be encountered on some **single** supply air outlet applications, where the FlowHood's slight backpressure may directly affect fan performance.

9.2 BACKPRESSURE COMPENSATION

The air flow delivery of a supply or return outlet will be reduced to some variable degree whenever **any** capture hood device is placed over the outlet. The degree of flow reduction is a function of the capture hood resistance combined with the outlet resistance for a given air flow. A duct velocity traverse is often used as a reference air delivery test, to determine the "average" backpressure compensation factor for a particular system. This "average" correction factor does not specifically apply to each outlet, but only to the average outlet for that system. This method, commonly used in the air balance industry, may result in significant inherent errors, particularly in flow readings taken at low resistance outlets, and also on the larger, more efficient, low resistance, ducted or "extended plenum" types of air delivery systems.

The FlowHood air balance system provides backpressure compensated air flow measurement. This capability allows the operator to determine the flow that is passing through an air terminal without the added pressure loss caused by the FlowHood System. The backpressure compensated flow value is obtained through a two part measurement performed at each duct terminal, using the flaps feature of the FlowHood unit. The backpressure compensated measurement is always performed following a **required preliminary nonbackpressure compensated measurement taken with the flaps open**.

10.0 FLOWHOOD ASSEMBLY

10.1 UNPACKING

The FlowHood case has been specifically designed for the most efficient storage and handling of the FlowHood unit and its accessories. Note the arrangement of the various items as you unpack the unit. Especially note the placement of the foam cushioning around the instrument, and the orientation of the meter face toward the side of the case. The FlowHood should be packed in exactly the same
manner whenever it is returned for recalibration. Save the foam packing and carton for this purpose.

The base assembly and 2'x2' top assembly will arrive already assembled as a unit and packed as shown in Figure 10.1. The handle assembly, accessory tops, and support dowels are enclosed in the built-in storage compartment at the rear of the carrying case. The frame channels for the accessory top assemblies are stored at the bottom of the carrying case beneath the frame storage retainers as shown in Figure 10.2. The top support assembly is stored in the top of the base assembly just above the grid. The legs have been folded upward, and the curved sections at the bottom of the legs have been inserted into the first and the third holes of the corner tubes of the base. The head of the support assembly should be positioned toward the back of the base assembly. The four spring rods are positioned downward, so that they do not directly contact the flow sensing grid. Foam packing, cloth skirts and accessories should not be stored on top of the grid.

10.2 FRAME ASSEMBLIES

FlowHood system kits include frames for up to six standard top sizes. Custom top sizes are available upon request. The 2'x2' and 14"x14" top frames are assembled and stored as complete units. The 2'x4', 1'x4', 1'x5', and 3'x3' frames use interchangeable parts to construct any of the four sizes. Refer to Figures 10.4 through 10.8 to determine the frame channels needed to assemble any of the standard size frames. Each frame corner section utilizes an eyelet and slot arrangement which self-locks into a similar eyelet and slot on the corresponding frame channel, when the two pieces are slid together. Side extension channels are joined together by a thumbnut and splice angle arrangement.

The individual frame pieces are stamped with a frame number, as shown circled below. A corresponding red part number label is glued to each frame piece.

1'x4' Use two part no. 141 ①, two part no. 142 ②, and two part no. 143 ③ frames.

2'x4' Use two part no. 141 ①, two part no. 142 ②, and two part no. 244 ④ frames.

1'x5' Use two part no. 141 ①, two part no. 142 ②, two part no. 143 ③ and two part no. 155 ⑤ frames.

3'x3' Use four part no. 141 ①, and four part no. 336 ⑥ frames.

Frame pieces should be stored in the frame storage retainers at the bottom of the carrying case when not being used. This will help to avoid damage or loss.

10.3 FABRIC TOPS

The top size has been stamped on each FlowHood fabric top (the 2'x2' top has been imprinted with the FlowHood logo). The desired top is attached to the matching frame assembly by pressing the corded hem of the top into the U-shaped retention channels on the outside of the frame assembly. After the top is attached to the frame assembly, the similarly corded hem on the lower edge of the fabric top is pressed into the retention channels on the upper edge of the base assembly. The seams of the fabric top must always be placed at the corners of both the frame and base assemblies.

10.4 TOP SUPPORT ASSEMBLY

The top support assembly and support dowels are assembled as shown in Figure 10.3. Position the top support assembly so that the spring rods are at the top. Swing the long rods around and down, into the position shown, and insert the ends of the rods into the center hole of the corner tubes of the FlowHood base. The rod ends may be moved upward or downward as needed to control the tightness of the fabric top. The support dowels can now be slid over the ends of the spring rods.

The location and correct combinations of frames, support dowels, dowel extenders and frame support cups to be used with each size are shown in Figures 10.4 through 10.8. The 8.5" dowel extenders are used with the 23.5" fiberglass support dowels when necessary to adjust for variations in frame size.

The 2'x2', 2'x4' and 1'x4' tops do not require dowel extenders. When using the 2'x2' frame, insert the support dowel end pins into each corner bracket of the 2'x2' frame assembly as shown in Figure 10.4. The dowel end pins are inserted into the **outer** set of frame support cups when assembling a 1'x4' top and into the **inner** set when assembling a 2'x4' top as shown in Figures 10.5 and 10.6. The 1'x5' top requires an 8.5" dowel extender at the **bottom** of each support dowel. The dowel end pins are to be inserted into the **inner** set of frame support cups as shown in Figure 10.7.

The 3'x3' top requires dowel extenders added to both the top and bottom of the support dowels. The dowel end pins are to be inserted into the frame corner brackets as shown in Figure 10.8. Each frame piece has been labeled to indicate positioning of the support dowels for different frame sizes.

When the top assembly is complete, the springs on the short rods of the top support assembly should be compressed to approximately 50% of normal extension.

10.5 HANDLE

Attach the handle assembly to the handle plate using the knob type screw provided with the handle.

SEE THE NEXT FOUR PAGES FOR DIAGRAMS OF THE CORRECT METHOD FOR ASSEMBLING STANDARD FLOWHOOD TOPS AND FRAME SETS.

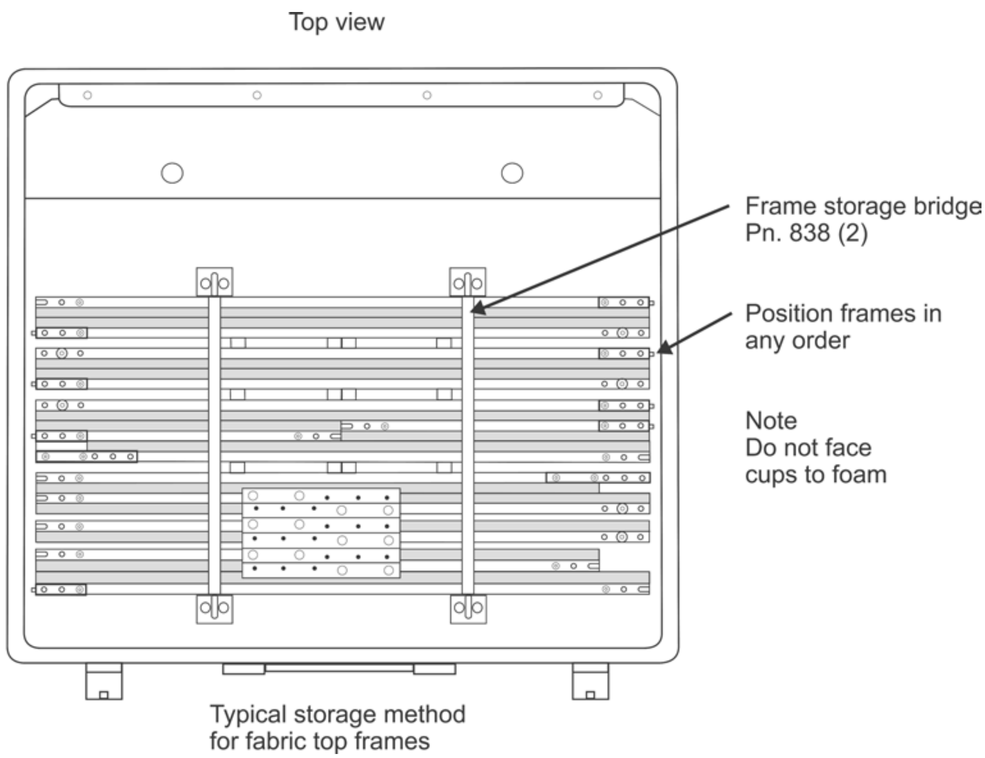


FIGURE 10.1 FRAME STORAGE

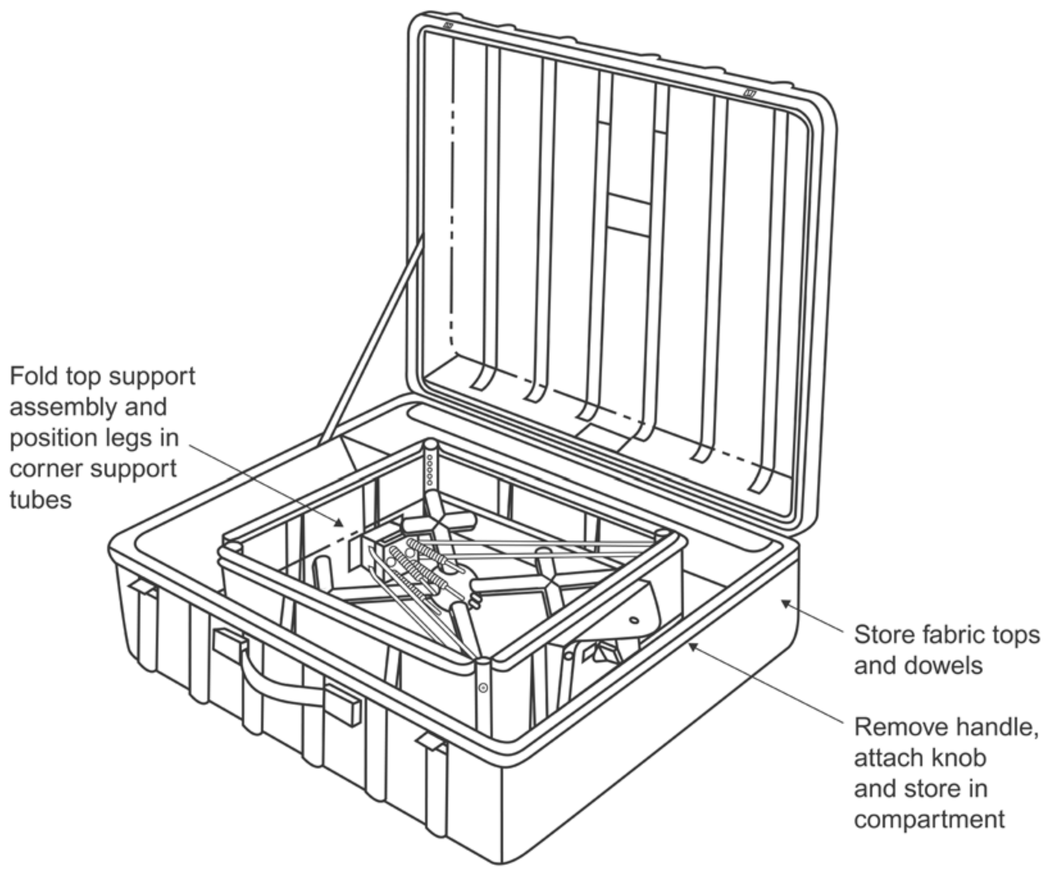


FIGURE 10.2 FLOWHOOD IN CASE

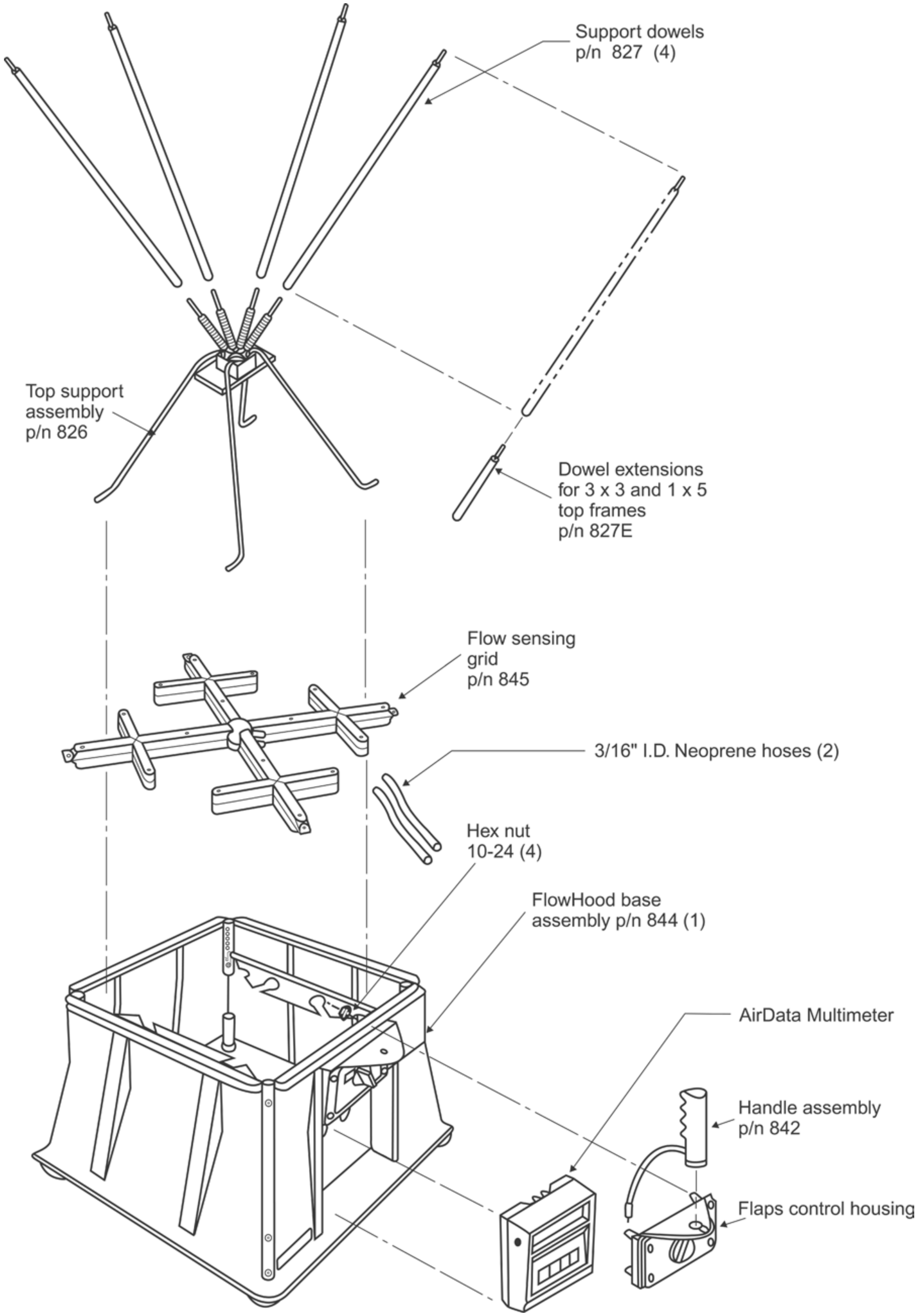


FIGURE 10.3 FLOWHOOD ASSEMBLY

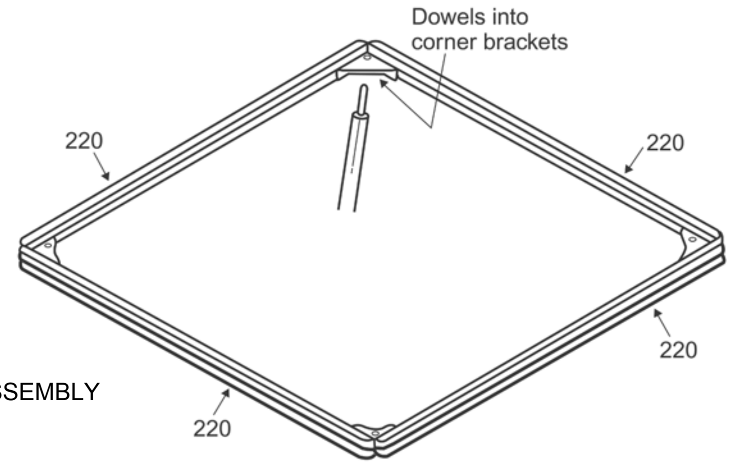


FIGURE 10.4 2X2 FRAME ASSEMBLY

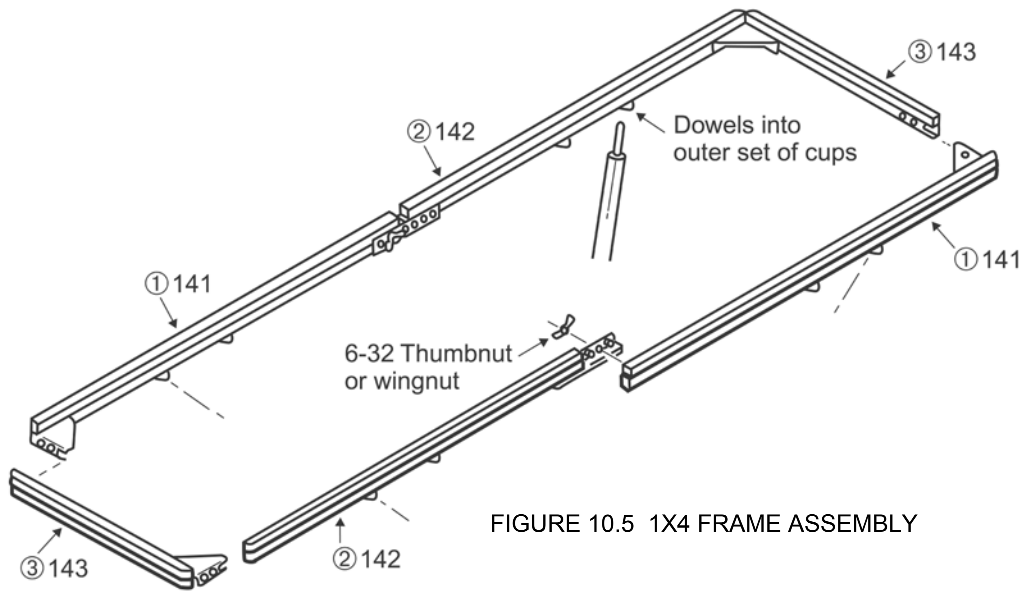


FIGURE 10.5 1X4 FRAME ASSEMBLY

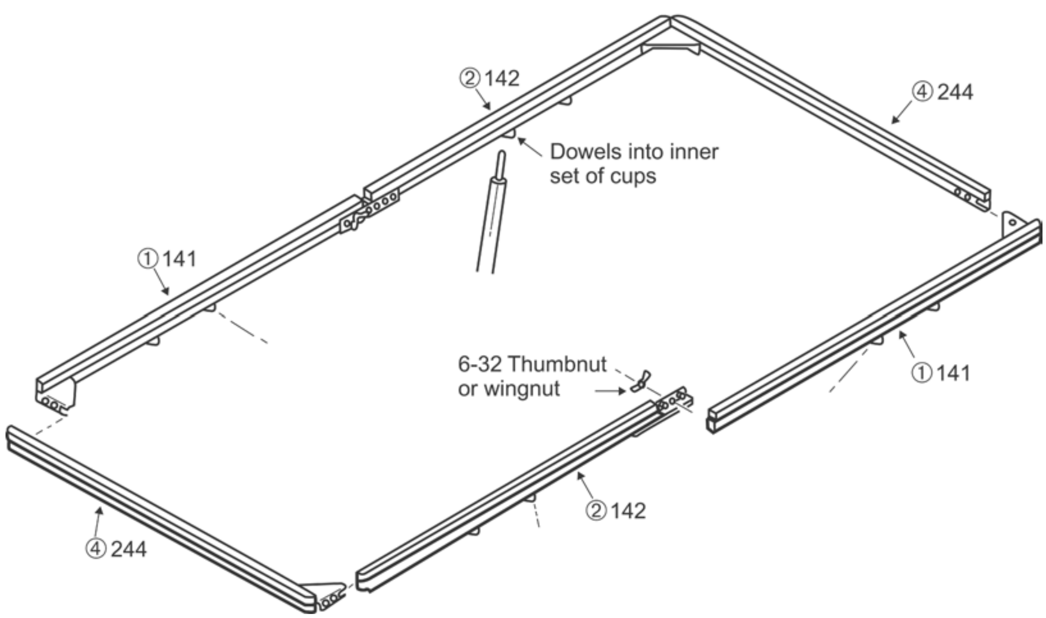


FIGURE 10.6 2X4 FRAME ASSEMBLY

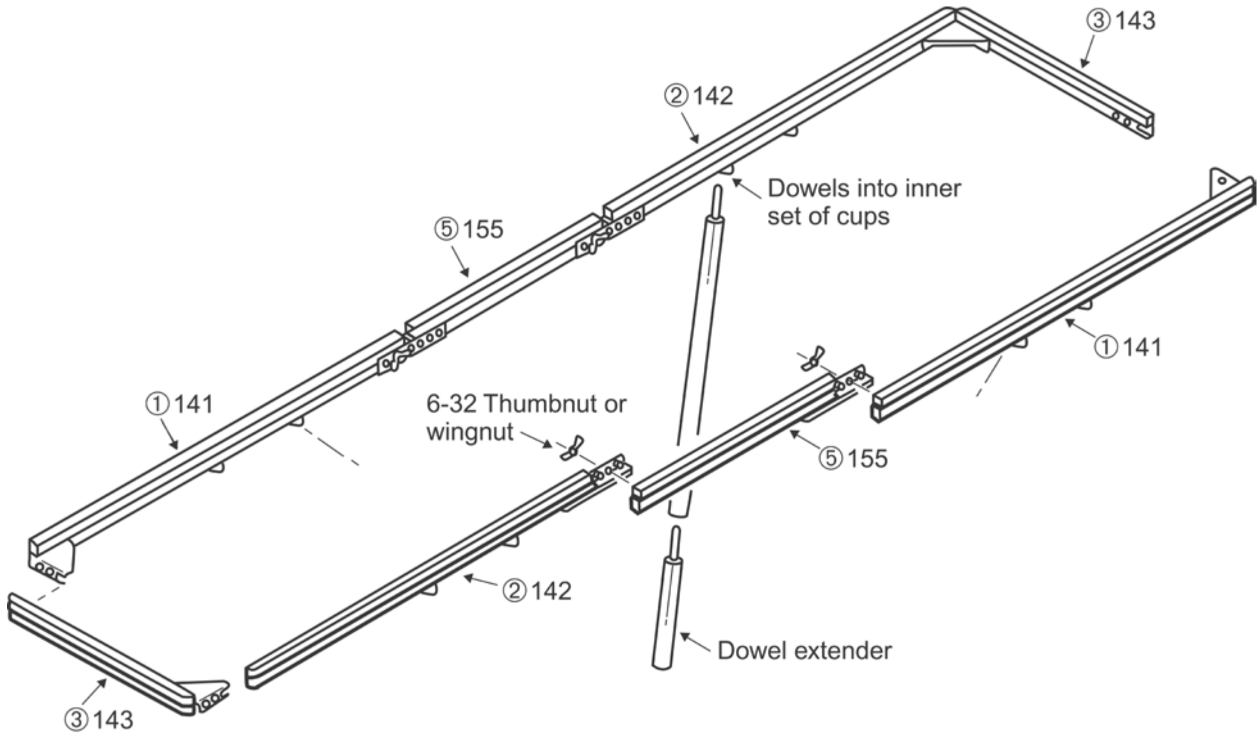


FIGURE 10.7 1X5 FRAME ASSEMBLY

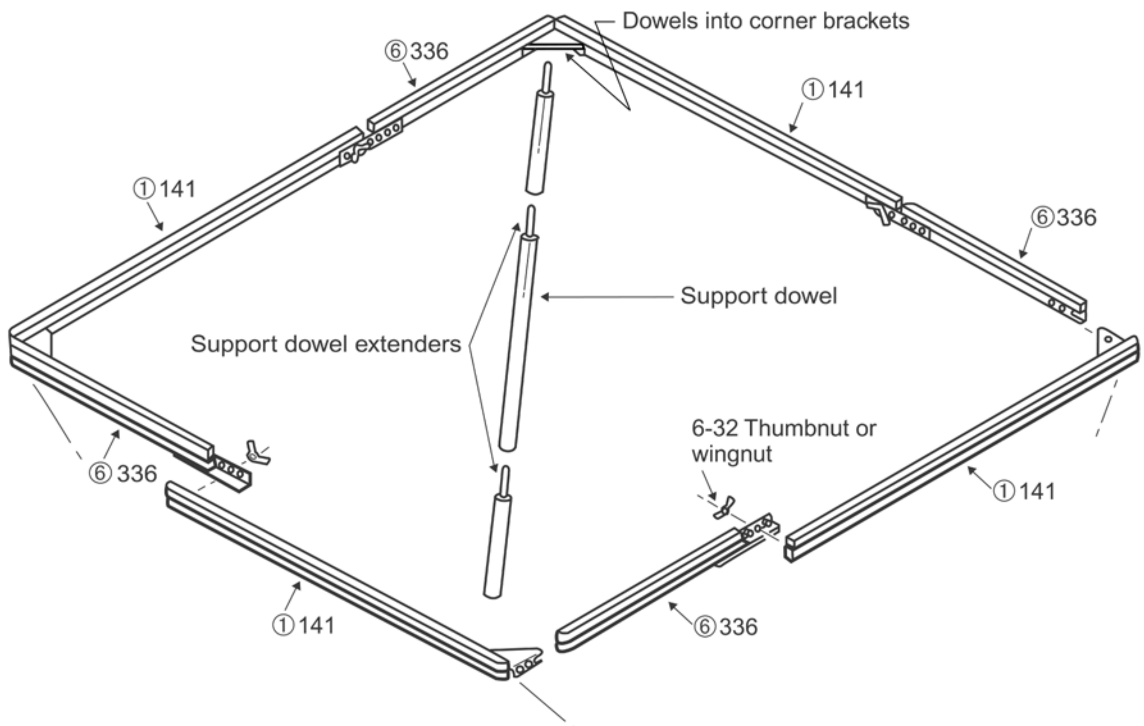


FIGURE 10.8 3X3 FRAME ASSEMBLY

11.0 FLOWHOOD OPERATING PROCEDURE

The meter handle should be removed from the AirData Multimeter by unscrewing the captive fasteners on the sides. The meter is inserted into the recess in the FlowHood base, using the captive fastener inside the base to secure it. The two pneumatic tubes from the flow sensing grid attach to the pneumatic inlets on the meter. The tube from the top side of the grid connects to the positive (+) pneumatic inlet on the meter; it is important that these connections are not reversed, since this will cause false flow measurements. The flaps plug inserts into the flaps receptacle on the back of the meter.

The thumbswitch plug connected to the handgrip is inserted into the external read jack on the left side of the meter. The TemProbe sensor plugs into the temperature input jack on the back of the meter through the cutout designed into the FlowHood base.

CAUTION: Avoid possible damage by removing all three electrical connections and both pneumatic connections before removing the meter from the FlowHood base.

Place the FlowHood over the outlet (or inlet) diffuser or grille, so as to capture and direct the air flow through the FlowHood base. The foam gasket around the edge of the top assembly should be firmly pressed against the ceiling or the edges of the diffuser. Air flow through the unit should not be blocked or influenced by any object within one foot of the FlowHood base. The unit should be supported with both hands, one on the handle, and the other at any convenient point on the outside of the base. Set the flaps control knob to the open position.

Press the READ key or the thumbswitch on the FlowHood handle and the reading will be displayed directly in cfm or liters/sec. A negative number indicates that the air flow is being exhausted through a return outlet. A second reading with the flaps closed will be necessary to determine the actual air flow.

SAFETY NOTICE

When using the FlowHood to test air flow at ceiling outlets, be sure that you can safely raise and support the unit during the measurement. This is especially important when working on a ladder.

11.1 AIR FLOW - NONBACKPRESSURE COMPENSATED READINGS

See Section 9.2 BACKPRESSURE COMPENSATION for a general discussion of backpressure and its effect on any capture hood device before using the FlowHood for nonbackpressure compensated readings. This technique measures air flow **without compensating** for FlowHood induced backpressure. This method may be used for both supply and return outlets.

Attach the meter and all of its connections to the FlowHood, as described previously. Turn the meter on. The display will read [FLO HOOD], followed by [CF READ]. Set the flaps control knob to the open position. Place the FlowHood over the outlet (or inlet) diffuser or grille. Wait two or three seconds to allow the air flow to stabilize, and then press the READ key or the thumbswitch on the FlowHood handle. The meter will display [FLO HOOD], followed by [CF UNCORR], then either [LOCAL DENS] or [STD DENS] during the measurement period. The reading will be displayed as [CF u nnnn]. Each subsequent air flow measurement is triggered by pressing the READ key.

The displayed result is a nonbackpressure compensated air flow reading and represents the flow value of the outlet while the FlowHood is in place. This flow reading will generally be somewhat less than the actual flow, due to the backpressure effect of the FlowHood.

11.2 AIR FLOW - BACKPRESSURE COMPENSATED READINGS

Air flow through an outlet (or inlet) is reduced to some degree by **any** capture hood device placed over the opening. Correction curves had traditionally been used to provide an **average** correction factor for the backpressure effects at different air flows.

This method measures air flow with compensation for the FlowHood induced backpressure automatically calculated into the displayed result. Backpressure compensation requires two readings in immediate sequence. The first reading is the flaps open reading discussed above. The second reading is performed with the flaps closed. The meter automatically determines the required backpressure compensation calculated from the relationship between the two readings, and displays the compensated result. A backpressure compensated reading must **always be immediately preceded by a nonbackpressure compensated (flaps open) reading at the same location**. The meter will register incorrect readings if the uncompensated reading is taken at another time or any other location. **Any** adjustments or changes to the air flow system between the two measurements will result in inaccurate results.

This technique may be used for either supply or return outlets. Backpressure compensated readings may be performed at any flow rate, but are usually unnecessary at flows less than 100 cfm.

First, perform the nonbackpressure compensated portion of the measurement with the flaps open, as described above in Section 11.1 NONBACKPRESSURE COMPENSATED READINGS. This first reading will be displayed with a small ‘u’ for uncompensated (nonbackpressure compensated) as [CF u nnn]. Close the flaps after the reading is displayed. Allow the system to settle, then press the READ key to take the second (backpressure compensated) reading. If necessary, the FlowHood may be removed from the outlet in order to close the flaps. Position the FlowHood as before, and **wait** three seconds for the air flow to stabilize before taking the second reading.

After the operator presses the READ key, the meter will display [FLO HOOD], followed by [CF CORR], followed by either [LOCAL DENS] or [STD DENS] during the measurement period. The reading will be displayed as [CF c nnnn].

11.2.1 MEMORY DISPLAY IN FLOWHOOD MODE

Backpressure compensated and noncompensated readings are recorded separately in memory. Individual readings displayed using the SCAN keys will have a small ‘c’ for stored, backpressure compensated readings or a small ‘u’ for stored, nonbackpressure compensated readings.

The statistics for a reading are displayed by pressing the VIEW key repeatedly, while a reading is on display. The statistics viewed while a nonbackpressure compensated air flow reading is on display will be calculated only for the nonbackpressure compensated air flow readings within the memory group for the reading on display. The statistics viewed while a backpressure compensated air flow reading is on display will be calculated only for the backpressure compensated air flow readings within the memory group for the reading on display.

11.2.2 RATIO ERR DISPLAY

The meter may display RATIO ERR following a backpressure compensated measurement in which the numerical ratio of the two parts of the measurement sequence exceeds predetermined limits. Normally this indicates, either that the operator has made a procedural error, or that a dynamic change (such as a changed damper setting) has occurred between the two parts of the backpressure compensated measurement process.

RATIO ERR may also be displayed as the result of measurements taken at outlets with extremely low pressure drops (less than .003 in wc @ 500 cfm). These outlets may not be suitable for the backpressure compensation method, and may require other means of air flow measurement.

12.0 SPECIAL BALANCING PROCEDURES

12.1 PROPORTIONAL BALANCING
Backpressure compensated readings should be taken during the preliminary survey of the entire system with all dampers fully open, and also during the final reading after balancing is complete. Nonbackpressure compensated readings require less time and are usually adequate for the preliminary balancing of outlets.

12.2 LARGE RETURN AIR GRILLES
Fan systems such as package air conditioning units or fan coil units may have only one main return air inlet. This is common in residential air conditioning systems ranging from two tons to 7 ½ tons of cooling capacity. The rated air delivery range is 800 to 3000 cfm. The FlowHood may be used to measure the return air flow if special attention is paid to avoiding excessive restriction of the air flow. The flow restriction is kept to a minimum by taking readings in two or more segments. For instance, if the return air grille is 30" x 24" and rated flow is 2400 cfm, read each half of the grille (15" x 24") using backpressure compensation. The sum of the backpressure compensated readings taken on each half is the total air flow through the return air grille. Keep in mind that this flow measurement represents only the flow at the return air grille. The total air flow at the fan includes return air duct leakage and possible outside air intake.

The reading for each portion of the grille would be even less restrictive and thereby more accurate if the 1'x 4' top were used on the FlowHood. The air flow could then be measured in three segments along the 30" dimension, with the excess length of the 48" top overlapping onto the ceiling. The 30" dimension of the grille could be broken into 9", 12" and 9" segments using the 12" width of the 1'x 4' FlowHood top. This procedure is also usable on large supply or discharge grilles and diffusers.

12.3 KITCHEN EXHAUST HOODS
Exhaust fan delivery of room temperature air in kitchens is reduced substantially when the cooking surfaces, ovens, broilers and fryers are heated to normal working temperatures. This is caused by the significant reduction in air density which occurs during the change from cool set-up to heated working conditions.

A fan which was set to deliver 5000 cfm at 75˚ F intake air will actually deliver only about 4610 cfm of the **75˚ F room air** when the air is heated to 140˚ F in the exhaust hood. It is very important that a kitchen system balance be confirmed by measurements for air flow, room pressure, and actual makeup air, while the cooking devices are at their normal working temperatures.

12.3.1 RANGE EXHAUST FILTERS AND GREASE EXTRACTORS
IMPORTANT: See Section 6.1 VELOCITY CORRECTION FACTORS
The VelGrid may be used to measure the range exhaust washable filter and grease extractor face velocities as described below. NOTE: The VelGrid is **not** designed to be used without the standoffs.

Begin by determining the gross face area of each filter or grease extractor to be tested. In this case, the nominal filter size marked on the filter should be used to calculate the full gross face area. For example, a 20" x 25" filter is 500 inches square overall (or 3.47 feet square overall). Measure the face velocity of each filter or extractor with the VelGrid positioned at the center of the filter face only. The 1.5" standoffs must be pressed against the face of the filter to hold the VelGrid 1.5" from the filter face. Determine the Kv factor for this type of filter as described in Section 6.1 VELOCITY CORRECTION FACTORS. Multiply the center face velocity by the calculated Kv factor to obtain the corrected face velocity for that filter or extractor. The air flow in cfm or l/s is calculated by multiplying the gross face area of the filter or extractor by the **corrected** face velocity.

Most commercial grade exhaust hoods leak to some degree between the filters and along the filter support tracks. The sum of the filter air flows obtained in the manner described above is generally sufficiently accurate for properly constructed kitchen exhaust hoods. Hoods which have been installed with excessive clearances and leakage will require correction for leakage.

12.4 CONSTANT VOLUME CONTROLLERS
The backpressure compensation process requires special attention when used to measure air flow at individually controlled constant volume air terminals. The nonbackpressure compensated and the backpressure compensated air flow readings should be essentially equal for fast acting constant volume air terminals. The controller responds to the additional backpressure and maintains the preset air flow. If the controller is slow acting, the FlowHood must be held in place long enough for the controller to re-attain the set point.

Master and slave, volume controlled outlets often do not interact favorably with the FlowHood backpressure compensation function. Air delivery measurement for this type system should be performed using a nonbackpressure compensated measurement.

12.5 LINEAR SLOT DIFFUSERS
Linear slot diffusers deliver supply air in a sheet or air curtain that tends to follow the side of the cloth transition as it flows

to the FlowHood base. This can result in an extremely uneven velocity distribution across the flow sensing grid when the flaps are open. The air flow is more evenly distributed across the flow sensing grid when the flaps are closed.

Linear slot diffuser readings at **less** than 100 cfm **per lineal foot of diffuser** should be taken with the FlowHood **flaps closed**. The AirData Multimeter will permit flaps closed, nonbackpressure compensated readings up to 500 cfm. In most cases, the FlowHood backpressure effect on linear slot diffusers is not significant. Accurate readings can normally be obtained with **flaps open** readings on linear diffusers sized for **more** than 100 cfm per lineal foot.

The tendency of a sheet of air to cling to, or follow the side of the FlowHood top, can be reduced by using a top width dimension that is as close as possible to the outlet width. Special transition tops can be constructed of corrugated cardboard and duct tape. Custom dimension, cloth and frame top sizes may be ordered from our factory. A commonly used size is 5.25" x 47" with a 4.25" x 46" inside frame dimension.

12.6 SIDEWALL REGISTERS

The FlowHood may be used to measure air delivery of supply sidewall registers using the standard 30" length, 2'x2' top or larger top sizes. It is best if the top dimensions closely match the outlet size to assure even air flow across the flow sensing grid. Exact matching of hood size to the outlet size is not practical in most cases.

The standard 30" length top sizes may be used with equal accuracy on supply or return air outlets. However, small supply outlets at high jet velocity, "punkah" diffusers or nozzle type outlets may cause an extreme concentration of air velocity on portions of the flow sensing grid. The FlowHood readings will be inaccurate under such conditions.

Reading accuracy is improved by adjusting the register deflection blades to a four-way spreading pattern before starting the measuring and balancing process. The deflection can then be readjusted for the desired deflection pattern after the final balancing and readings are completed. Resetting deflection patterns after air balance usually has little effect on the air delivery. Special top sizes may be ordered from our factory. The most popular size for sidewall outlets is 1' x 2' (13" x 25" outside dimension).

12.7 14"x14"x14" SHORT TOP SET

This short top design is intended for use on return or exhaust air outlets. The use of this top size on deflection type supply outlets such as multiblade diffusers or registers with the blades set for a spreading pattern is not recommended. The 14"x14"x14" top is too short to provide the attenuation of the jet velocities necessary to even-out the air flow over the flow sensing grid and readings will not be reliable.

Reasonable accuracy can only be obtained on **supply** outlets when using the short top set if the outlet is at least 12" x 12" with no air deflection, such as a perforated plate, bar grille, egg crate grille, or unfinished opening.

12.8 SYSTEM PROBLEMS

If the measured air delivery is less than expected, check the meter functions first, as described in section 14.0 on METER ACCURACY FIELD TESTING. If the meter is functioning properly, check significant sources of error such as: duct leakage; loose outlet connections; missing or loose end caps; belt slippage; backward fan rotation; closed or partially closed dampers of any type; dirty filters or coils; foreign material caught in turning vanes or fan wheels or other locations where obstructions can occur; square elbows without turning vanes; radical duct transitions; and any other situations where faulty system design or installation errors can cause inadequate air delivery.

13.0 CORRECTION FACTORS

13.1 BAROMETRIC PRESSURE DENSITY CORRECTION

The AirData Multimeter automatically corrects air flow and velocity readings to represent local density cfm or fpm as effected by barometric pressure.

13.2 TEMPERATURE DENSITY CORRECTION

Air flow and velocity readings are density corrected for the effect of temperature **if** the TemProbe temperature sensor is used during flow or velocity measurements. If the temperature probe is **not** used, the meter calculates the air density using an assumed temperature of 70˚ F. If the TemProbe sensor was **not** used during an air flow measurement, the displayed reading must be corrected for the density effect of temperature as follows:

$$\textit{LOCAL DENSITY FLOW OR VELOCITY (true velocity or flow)} = \textit{flow or velocity reading (taken in local density mode)} \; X \; \sqrt{\frac{460 + {}^{o}F}{530}}$$

$$\textit{STANDARD DENSITY FLOW OR VELOCITY (mass flow equivalent)} = \textit{flow or velocity reading (taken in standard density mode)} \; X \; \sqrt{\frac{530}{460 + {}^{o}F}}$$

Where: ˚ F = measured temperature of air stream.

13.3 RELATIVE HUMIDITY CORRECTION

The ADM-880C AirData Multimeter does not correct for the density effects of relative humidity on air flow and velocity readings. The effect of variations in relative humidity on local air density (and therefore on flow and velocity readings) is relatively small under normal room temperature conditions. The density effect of relative humidity at higher temperatures and higher relative humidities may be more significant.

Local air density velocity and flow readings may be corrected for the density effects of relative humidity using the formula shown below. This calculation requires the use of the vapor pressure, which must be looked up on a Dew Point/Vapor Pressure conversion chart. The dew point may be measured directly using a very accurate dewpointer. Psychrometric charts are also available for determining the dew point and may be used if the ambient temperature and relative humidity are known.

Note: If the vapor pressure is in metric units, the barometric pressure must also be in metric units. Many Dew Point/Vapor Pressure conversion charts are in metric units.

Local air density velocity readings may be corrected for relative humidity using the following formula.

$$VELOCITY_{moist\ air} = \left(\frac{P_b \; X \; V_{dry}}{P_b - P_{vapor}} \right)$$

Where: P_b = local barometric pressure
V_{dry} = velocity corrected for local density (temperature and barometric pressure)
P_{vapor} = vapor pressure

Local air density air flow readings may be corrected for relative humidity using the following formula.

$$FLOW_{moist\ air} = \left(\frac{P_b \; X \; F_{dry}}{P_b - P_{vapor}} \right)$$

Where: P_b = local barometric pressure
F_{dry} = air flow corrected for local density (temperature and barometric pressure)
P_{vapor} = vapor pressure

13.4 HOT WIRE ANEMOMETER VERSUS AIRDATA MULTIMETER

The ADM-880C AirData Multimeter measures local density **true** air velocity or standard density sea level equivalent air velocity. This is in contrast to thermal anemometers or "hot wire" instruments which only measure mass flow standard density velocity. Mass flow represents the number of molecules of air flowing past a given point during a given time. Mass flow only represents **true velocity** when measured at standard sea level conditions of 29.921 in Hg and 70˚ F (.075 lbs/cu

ft). Hot wire, mass flow, "velocity" readings at density conditions other than standard **must** be corrected for local air density conditions if these results are to represent true air velocity.

Local density velocity readings taken with the ADM-880C AirData Multimeter may be compared with hot wire anemometer readings if the hot wire readings are corrected for local air density conditions to obtain true air velocity results.

The precise method for calculating local density corrected air velocity from measurements taken with a **hot wire anemometer** requires the use of the following equation:

$$TRUE\ AIR\ VEL\ (LOCAL) = \underset{(hot\ wire)}{VELOCITY\ MEASURED}\ X \left(\frac{29.92}{P_b}\ X\ \frac{460 + {}^oF}{530} \right)$$

Where: P_b = local barometric pressure (in Hg)
˚ F = temperature of air stream

Velocity measurements taken with a thermal anemometer may be compared **directly** to AirData Multimeter velocity readings taken in the **standard density mode**.

14.0 METER ACCURACY FIELD TESTING

14.1 METER ZERO FUNCTION

Disconnect all tubing from the positive (+) and negative (-) ports of the meter. Perform several readings with the meter set for the flow or velocity mode, with **no air** passing across the meter ports. The meter should display zero readings, but may occasionally show a low reading such as 25 cfm or fpm. An **occasional** positive or negative reading is random electronic "noise" and may be disregarded.

If the zero test readings tend to be either positive or negative and greater than 25 cfm, the zero bias indicated will affect the accuracy of low air flow or velocity measurements. Check for any obstruction of the meter connections and clean if needed.

Be sure that there is no moisture or condensation in the meter or meter connections. If the meter has been exposed to water or high humidity, followed by rapid cooling, water may have condensed inside the meter. In this event, the meter should be placed in a warm dry atmosphere (between 80˚ F and 130˚ F) for 24 hours. Afterward, the batteries will need to be recharged for 10 hours at a temperature less than 113˚ F. If a zero bias or other problem persists, call the factory for advice.

14.2 DIFFERENTIAL PRESSURE FUNCTION

Check the DIFF PRES function zero accuracy by taking a reading with both meter ports open to the atmosphere. Be sure the ports are **not** exposed to a draft. The reading should be 0.0000 in wc ± 0.0001 in wc.

Check the differential pressure reading accuracy by measuring a static pressure source at approximately the following pressures: 0.1250 in wc; 2.000 in wc; 30.00 in wc. Confirm the pressure readings by comparison with an appropriately accurate inclined manometer at the 0.1250 and 2.000 in wc differential. The 30.00 in wc differential may be checked using a U-tube and water.

Since the AirData Multimeter passes a very small sample of the air through the meter during each measurement (see SPECIFICATIONS), it should be connected to the pressure source independently of any other meter, manometer, or U-tube. To avoid pulsation or "cross talk" through the pressure source tubing, use shutoff valves to isolate the AirData Multimeter and the reference pressure gage. The pressure source must be self-replenishing, such as a pressure drop across a needle valve, orifice, or orifice plate.

14.3 ABSOLUTE PRESSURE FUNCTION

You may confirm the accuracy of the absolute pressure correction by taking a reading with the meter ports open to the atmosphere and comparing the reading with the actual barometric pressure. The reading should be within ± 2% (approximately .5 in Hg) of the actual barometric pressure to maintain the specified accuracy for velocity and air flow density correction.

CAUTION: Testing of absolute pressures greater or less than local barometric pressure must be performed with the reference pressure applied to the positive (+) and the negative (-) ports at the same time. This precaution avoids excessive pressure input to the differential pressure transducer.

NOTE: Weather service or airport reports of barometric pressure have usually been adjusted for altitude, so the pressure can be used for altimeter adjustment. The barometric pressure announced on television or radio stations is generally obtained from weather service reports. This altitude corrected barometric pressure must **not** be used in density correction equations for comparison with a FlowHood. An estimation of the actual barometric pressure may be obtained by deducting approximately 1.0 in Hg for each 1000 feet above sea level.

14.4 AIR FLOW ACCURACY

Air flow accuracy is confirmed by comparing a very careful pitot tube traverse with the results obtained using the FlowHood. An accurate inclined manometer, micromanometer, or AirData Multimeter may be used for the duct traverse. An inclined manometer used for the duct traverse should have minor scale divisions of .005 in wc or less, and should have direct velocity markings down to at least 400 fpm. The accuracy of the comparison tests will depend on both the accuracy of the velocity traverse, and the accuracy of the air flow calculations.

A multipoint pitot tube traverse is performed on a supply duct which serves a single supply diffuser. The pitot tube should be a type approved by the NPL (National Physics Laboratory, U.K.) or AMCA (Air Moving and Conditioning Association, U.S.). The duct velocity should be at least 800 fpm; the duct should be properly sealed and taped; and the connection to the diffuser should be airtight. The duct traverse location should have straight duct for six to eight duct diameters upstream, and three to four diameters downstream. For example, a one foot diameter duct requires eight feet of straight duct upstream and four feet downstream.

14.5 DUCT TRAVERSE COMPARISON, INCLINED MANOMETER OR MICROMANOMETER

An inclined manometer or standard micromanometer does not correct for density effects due to barometric pressure or temperature.

The density correction necessary for duct traverse readings which are to be compared with FlowHood readings taken **with** the TemProbe in place is as follows:

$$\underset{(\textit{true air velocity})}{\textit{LOCAL DENSITY FPM}} = \underset{(\textit{duct velocity})}{\textit{MANOMETER FPM}} \times \sqrt{\frac{29.92}{P_b} \times \frac{460 + {}^{\circ}F}{530}}$$

Where: P_b = local barometric pressure (in Hg)
˚F = temperature of measured air stream

If the TemProbe is not attached during the flow measurement, the FlowHood meter will assume standard 70˚ F conditions (as do the inclined manometer and the standard micromanometer). In this case, it is **not** necessary to correct the duct traverse velocity for the density effect due to temperature. However, since the FlowHood does automatically correct for the density effect of barometric pressure, the duct traverse readings must be corrected as follows:

$$\underset{(\textit{corrected for } P_b \textit{ only})}{\textit{LOCAL DENSITY FPM}} = \underset{(\textit{duct velocity})}{\textit{MANOMETER FPM}} \times \sqrt{\frac{29.92}{P_b}}$$

Where: P_b = local barometric pressure (in Hg)

14.6 DUCT TRAVERSE USING THE AIRDATA MULTIMETER

No corrections for density are necessary when the AirData Multimeter is used for the comparison pitot tube traverse **if** use of the TemProbe is consistent during **both** the air flow measurement using the FlowHood and the velocity measurement using the AirData Multimeter and pitot tube. This means that, if the TemProbe is used, it must be used for both types of measurements.

If the TemProbe is not used for either flow or velocity, it must not be used for the other type of measurement. In this case, both sets of measurements will be calculated using standard 70˚ F conditions.

14.7 BACKPRESSURE COMPENSATED COMPARISON READING

Perform a multipoint pitot tube traverse of a supply duct which serves a single supply diffuser. Calculate the air flow with careful attention to all of the factors discussed in this section. A **backpressure compensated** reading on this **same** diffuser should be within ± 5% of the air flow calculated from this traverse.

14.8 NONBACKPRESSURE COMPENSATED READING

After determining the air delivery by duct traverse, measure and record the duct centerline velocity, both with and without the FlowHood (flaps open) in place. (A reduction in the duct centerline velocity when the FlowHood is placed over the diffuser, is caused by the flow resistance (backpressure) of the FlowHood).

A flaps open, nonbackpressure compensated FlowHood reading on this **same** diffuser should be within ± 3% of $FLOW_2$ (calculated from the ratio of the two centerline readings).

$FLOW_2$ is obtained from the following calculation:

$$FLOW_2 = FLOW_1 \times \left(\frac{\textit{duct centerline velocity (with FLOWHOOD)}}{\textit{duct centerline velocity (without FLOWHOOD)}} \right)$$

Where: $Flow_1$ = flow calculated from duct traverse
$Flow_2$ = flow in duct with FlowHood in place (flaps open)

15.0 METER MAINTENANCE

The AirData Multimeter is a precision instrument designed for long term field use if given reasonable care and maintenance. The meter and FlowHood should be kept reasonably clean, and should be stored in the protective case when not in use. The meter case and internal components are rugged, and well able to withstand normal handling. Continued rough handling will eventually cause damage.

The meter case is water resistant, but is not waterproof. Do not use the meter in conditions where liquids or corrosive gases might enter the case or pneumatic inlets.

Do not use or store the meter in temperatures outside the specified ranges. The meter may seem to tolerate summertime storage in such places as the trunk of a vehicle, but battery life and other functions will eventually deteriorate.

CAUTION: When replacing the batteries, be very careful to insert each cell in its **indicated position** for polarity. The polarity position marking for each cell is embossed in the housing beneath each cell position. Take note that the cells are **not** all oriented in the same way. **Failure to observe proper cell positioning can result in severe damage to the meter**.

Battery life will be prolonged if the batteries are periodically permitted to discharge until the display registers LOCHARGE or RECHARGE. The battery charger cord should be coiled in gentle loops rather than wound tightly around the body of the charger transformer. This will greatly extend the life of the charger cord.

If rechargeable batteries are not available in a field situation, the batteries may be replaced with 12 nonrechargeable, alkaline "AA" pen cell batteries. WARNING: Do not plug the charger in if **any** nonrechargeable batteries are in the meter. The meter may be seriously damaged along with the batteries and charger.

Any attempt to service or repair anything inside the meter will void the Warranty and may cause serious damage to the sensitive electronic components.

The AirData Multimeter should be returned to the factory at least every two years for recalibration, maintenance, and software update. This will keep the meter up to date with ongoing improvements and new features as they develop and will assure that the original accuracy of the meter is maintained throughout the life of the meter.

16.0 FLOWHOOD MAINTENANCE

The flow sensing grid in the FlowHood unit is high impact ABS plastic. It can be damaged if subjected to physical abuse or excessive stress. Accurate air flow measurements are dependent on the integrity of this grid. Even a hairline crack will effect the results. The grid should not be exposed to temperatures in excess of 140˚ F for extended periods, or 160˚ F for five minutes. **Do not lay anything on the grid or interfere with the tension of the support springs**.

Check the flow sensing grid periodically for damage, poor connections to the meter, or an accumulation of dirt or dust particles. The grid may be cleaned by wiping carefully with alcohol. Care must be taken to avoid knocking dirt or dust particles into the grid orifices.

The top support assembly, consisting of the aluminum rod structure that supports the cloth skirt and frame assembly, should be stored folded with the ends of each pair of legs inserted into the top and middle holes of the two front base corner tubes. The head of the assembly should be toward the back of the base assembly. The four spring rods should be positioned downward to avoid applying pressure to the flow sensing grid.

The fabric tops should be washed periodically in cool water with a mild detergent. The tops must be air dried only as heat may cause the fabric to shrink. Excessive dirt build up should be avoided. Reasonable care will prolong the life of the fabric tops. Sharp objects or corners can puncture the fabric and affect the accuracy of the readings.

17.0 RECALIBRATION AND REPAIR INFORMATION

If an apparent problem develops with the AirData Multimeter or accessories, contact the factory, specifying the model number, and details of the difficulty. Return the unit (in original carton and packing) to the factory, transportation prepaid. The repair Purchase Order and description of the problem should be enclosed in a packing slip on the **outside** of the shipping container. If the unit is no longer under warranty, regular repair charges will apply. An estimate of the cost will be furnished before repair work begins unless the customer specifies otherwise.

The complete meter kit and all accessories should be returned to the factory for recalibration and/or repair. If just the meter must be returned, the meter should be individually wrapped in several layers of foam padding, and shipped in a carton approximately 12" x 12" x 8" with sufficient additional cushioning to fill the carton. Do not use spray foam. Spray foam can damage the meter and it is also possible to “lose” a meter in a chunk of spray foam.

Ship directly to:

Shortridge Instruments, Inc.
7855 E. Redfield Rd.
Scottsdale, Arizona 85260
Attention: Recalibration and Repair Dept.
Telephone: (480) 991-6744 Fax: (480) 443-1267
www.shortridge.com

AIR BALANCE MANUALS & TRAINING PROGRAMS

Several publications are available from the following organizations.

Associated Air Balance Council (AABC)
1518 K Street NW
Washington, DC 20005
(202) 737-0202 • FAX (202) 638-4833 • www.aabchq.com

AABC offers membership, training programs and certification to air balance firms.

National Environmental Balancing Bureau (NEBB)
8575 Grovemont Circle
Gaithersburg, MD 20877-4121
(301) 977-3698 • FAX (301) 977-9589 • www.nebb.org

NEBB offers membership training programs and certification for contractors, engineers, and others.

Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA)
4201 Lafayette Center Drive
Chantilly, VA 20151-1209
(703) 803-2980 • FAX (703) 803-3732 • www.smacna.org

SMACNA offers Technical Manuals and Standards Publications

WARRANTY

The seller warrants to the Purchaser that any equipment manufactured by it and bearing its name plate is free from defects in material or workmanship, under proper and normal use and service, as follows: if, at any time within one (1) year from the date of shipment, the Purchaser notifies the Seller that in his opinion, the equipment is defective, and returns the equipment to the Seller's originating factory, prepaid, and the Seller's inspection finds the equipment to be defective in material or workmanship, the Seller will promptly correct it by either, at its option, repairing any defective part or material, or replacing it free of charge, and return shipped lowest cost transportation prepaid (if Purchaser requests premium transportation, Purchaser will be billed for difference in transportation costs). If inspection by the Seller does not disclose any defect in material or workmanship, the Seller's regular charges will apply. This warranty shall be effective only if use and maintenance is in accordance with our instructions and written notice of a defect is given to the Seller within such period. THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY OTHER WARRANTIES, WRITTEN, ORAL OR IMPLIED. SPECIFICALLY, WITHOUT LIMITATION, THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PURPOSE. The liability of the Seller shall be limited to the repair or replacement of materials or parts as above set forth.

LIMITATION OF LIABILITY

The Seller shall not be liable for any claim or consequential or special loss or damage arising or alleged to have arisen from any delay in delivery or malfunction or failure of the equipment. The Seller's liability for any other loss or damage arising out of or connected with the manufacture or use of the equipment sold, including damage due to negligence, shall not in any event exceed the price of the equipment supplied by us.

Shortridge Instruments, Inc. reserves the right to make changes at any time, without notice, in prices, colors, materials, specifications and models, and also to discontinue models.

APPENDIX A - NIST VELOCITY TESTING

The AirData Multimeter is primarily an electronic micromanometer which measures pressures very accurately. The velocity pressure generated by the various probes is used to calculate and display air velocity and air flow. Confirmation of the meter pressure measurement accuracy is fairly simple using NIST traceable transfer standard gages.

The testing of the meter with various velocity probes, however, is not as straight forward. Velocity accuracy testing requires the use of a fairly large wind tunnel to reduce boundary layer and wall effects. The wind tunnel must provide a very flat velocity profile and a range from 50 to 9000 fpm.

Such a facility does exist at NIST and can provide directly traceable testing and certification.

National Institute of Standards and Technology
Rt. #I-270 & Quince Orchard Road, Bldg. 230
Fluid Mechanics Bldg.
Gaithersburg, MD 20899
Phone: (301) 975-5947

RECOMMENDED TEST PROCEDURES

The AirData Multimeter automatically corrects air velocity and flow readings for the density effects of barometric pressure. The meter also automatically corrects for density variations due to local temperature if the TemProbe is connected. Readings will be corrected to local density true air speed unless standard density, mass flow readout is specifically selected. No such selection is required, since the NIST velocity correction is normally for local air density. The AirData Multimeter does not correct air velocity readings for relative humidity.

The AirData Multimeter TemProbe and extension cord must be plugged into the meter and placed in the wind tunnel airstream to correct the readings for the density effect of variations in temperature. Record the AirData Multimeter temperature and absolute (barometric) pressure reading at the beginning and end of each probe test range. These readings must fall within the specified tolerances to allow velocity testing.

The hose lengths connecting the probes to the AirData Multimeter should not exceed 15 feet of 3/16" ID flexible tubing.

The air velocity test points should be preselected to provide data over the full range of each probe, with additional test points at the velocities of most interest for a given application. Suggested test points might include:

Pitot tube:
50, 75, 100, 150, 200, 300, 500, 1000, 1500, 2000, 2500, 3000, 4000, 5000, 6000, 8000 fpm

AirFoil probe:
50, 75, 100, 150, 200, 300, 500, 750, 1000, 1500, 2000, 2500, 3000, 4000, 5000 fpm

VelGrid:
50, 75, 100, 150, 200, 250, 300, 500, 1000, 1500, 2000, 2500 fpm

NIST LASER DOPPLER VELOCIMETER WIND TUNNEL TESTING

The AirData Multimeter probes **must** be positioned at the wind tunnel centerline.

Select the automatic storage mode on the AirData Multimeter. When the air velocity has stabilized, begin the AirData Multimeter velocity sampling interval. The AirData Multimeter must be taking readings throughout the LDV sampling period. The simultaneous sampling period must be long enough for the AirData Multimeter to obtain the average of at least 10 readings at velocities less than 200 fpm. Record the LDV and AirData Multimeter averages for each test measured velocity.

The tests described above are extensive and relatively expensive. The expense of obtaining such traceability is justifiable when a transfer standard meter and probes are designated as a "Sheltered Set". This "Sheltered Set" should only be used to verify the accuracy of instruments which are used in the field.

APPENDIX B - LABORATORY DIFFERENTIAL PRESSURE TEST

Some applications such as nuclear power plants, health care facilities and clean rooms require more frequent instrument calibration testing and accuracy verification. Calibration services and documentation is available at Shortridge Instruments, Inc. However, if interim calibration tests are required at your own metrology department or at an independent laboratory, the following information will be helpful.

The reference pressure source may be very accurately controlled by using two deadweight test units that are set up with different pressures of precisely the desired test differential pressure. These testers must be carefully adjusted to an equal base pressure of approximately 3 psi before adding the weight to one unit to generate the required differential pressure.

The AirData Multimeter should be tested at a minimum of three pressures:

0.1250 in wc	≈	(31 Pa)
2.000 in wc	≈	(500 Pa)
30.000 in wc	≈	(7500 Pa)

If more test points are required, the following schedule is recommended:

0.0500 in wc	≈	(12 Pa)
0.1250 in wc	≈	(31 Pa)
0.2250 in wc	≈	(56 Pa)
0.2700 in wc	≈	(67 Pa)
2.000 in wc	≈	(500 Pa)
3.600 in wc	≈	(900 Pa)
4.400 in wc	≈	(1100 Pa)
27.00 in wc	≈	(6750 Pa)
50.00 in wc	≈	(12,500 Pa)

Refer to Section 14.2 DIFFERENTIAL PRESSURE FUNCTION under Section 14.0 METER ACCURACY FIELD TESTING of this manual for additional information.

APPENDIX C - BATTERY TEST PROCEDURE

Insufficient battery charge (entire set or individual cells) can cause the meter to display garbled messages or TOO HOT, TOO COLD, RECHARGE or other messages. This garbled display usually is seen when the meter is just turned on and the supply voltage drops so fast that the meter gets lost. The following tests should be performed before you call the manufacturer or return the meter.

1. Check the battery charger transformer. The output should be 24 to 30 volts AC. Be sure the charger is plugged into a live outlet. The green LED on the front panel indicates when the battery charger is powered.

2. Does the meter function properly while the charger is attached and plugged-in? If so, a bad battery cell is likely. Allow ten minutes for minimum charging to take effect before testing meter function.

3. Place the meter face down with the air connectors turned away from you. Remove the battery compartment cover by unscrewing the eight small phillips head screws. Check the battery clips. Remove the batteries and re-spring the clips to provide proper contact pressure with the ends of the batteries.

   Be sure to reinstall the batteries in the proper orientation as shown in the compartment. Turn the meter on to see if the problem display still exists. If the problem persists, test the positive (+) and negative (-) charging circuits as follows:

   a. Measure the DC voltage of the upper half [positive(+) six cells] of the battery set by placing your DC voltmeter common (ground) probe at the left center battery clip and the other probe at the upper right corner battery clip. The voltage should be between 7.2 volts and 8.5 volts DC.

      This voltage should rise when the charger is plugged in and should fall when the charger is unplugged.

   b. If the voltage does not rise and fall with the changes in charger input, then the charging circuit in the meter is not working and the meter must be returned to the factory for repair.

   c. Test the lower half [negative (-) six cells] of the battery set in the same manner described above by placing the voltmeter probes at the left center battery clips and at the lower right corner battery clip.

4. Check each battery cell voltage with the charger unplugged and with the meter turned on (if it will stay turned on).

   Each cell should have a voltage of 1.1 to 1.3 volts. If you find one or two very low cells, they may be weak cells and may need to be replaced. If most of the cells are less than 1.1 volts, it is possible that all are near the end of the discharge cycle and just need to be recharged.

5. Replace weak or low capacity battery cells with rechargeable cells of the **same** capacity (mAh) as the existing cells. If the same capacity cells are not available, replace all 12 cells with new batteries. See the Instruction Manual Section 15.0 METER MAINTENANCE.

6. If the problem is not corrected through these procedures, please return the meter to our factory for repair and calibration services.

Shortridge Instruments, Inc.
7855 E. Redfield Road
Attn: Recalibration Department
Scottsdale, Arizona, USA 85260
Phone: (480) 991-6744 Fax: (480) 443-1267
www.shortridge.com

PROLONGING BATTERY LIFE

The NiCad “memory effect” occurs when batteries are only partially discharged and recharged repeatedly. This effect substantially reduces the level of useable charge in the batteries. The batteries can be restored to maximum usable capacity by discharging the batteries until the meter displays RECHARGE at least once a month. This can be accomplished at the end of the work week by running the meter continuously until the batteries run down. The meter will remain on if left in TREND mode. The backlight should be off during the discharge period. The meter will shut off automatically when RECHARGE is displayed. Place the meter on charge for at least 24 hours, so the meter will be fully charged for the next week's work.

Long term storage of batteries can temporarily degrade their performance. If the meter is to be stored without being used for at least three months, discharge the batteries as described above. The temperature during storage should be less than 95˚ F. The batteries will function best after storage if reconditioned by performing two full cycles of 24 hour charge and full discharge, followed by a third 24 hour charge. This process will restore the batteries to maximum usable capacity.

WARNING: Do not plug in the charger if **ANY** nonrechargeable batteries are in the meter.

BATTERY RECYCLING

RECYCLE
1-800-822-8837

The EPA certified RBC® Battery Recycling Seal on the nickel-cadmium (Ni-Cd) battery indicates Shortridge Instruments, Inc. is voluntarily participating in an industry program to collect and recycle these batteries at the end of their useful life, when taken out of service in the United States or Canada. The RBC® program provides a convenient alternative to placing Ni-Cd batteries into the trash or the municipal waste stream, which may be illegal in your area. Please call 1-800-822-8837 for information on Ni-Cd battery recycling and disposal bans/restrictions in your area. Shortridge Instruments, Inc. involvement in this program is part of our commitment to preserving our environment and conserving our natural resources.

ADM-880C
REPLACEMENT PARTS LIST

Part no	No reqd per set	Description
ADM-880CM	1	Advanced AirData Multimeter
PS8201	1	Battery charger
PS8202	1	Battery charger for European use
0445	1	Plug adapter for use with PS8202 battery charger
AA-NICAD	12	Rechargeable Ni-Cd batteries
ADT442	1	TemProbe temperature probe - 4" x 1/8" diameter
TRC16	1	Temperature retractile cord - 1'x 6'
TEW19	1	Temperature extension wand 19"
A-303	2	Static pressure tip
160-18	1	Pitot tube - 18" length
NT316	1	3/16" ID Neoprene tubing, two 5' lengths
AFP18	1	AirFoil probe, 18" length (24", 36" or 48" available)
VLG84	1	VelGrid velocity grid with three 18" extension rods, pushbutton handle, bracket & 8' tubing harness
MC84	1	Fitted foam-lined carrying case
IM-880C	1	Instruction manual - ADM-880C
SEE-2	1	DataFlow software
PR-245-K	1	Seiko portable printer with accessories
PR-245	1	Seiko portable printer without accessories
CB-SERIAL1	1	RS232 serial cable for use with computer & printer
CB-NULL1	1	Null modem adapter for use with printer

SERIES 8400 FLOWHOOD ASSEMBLY

844	1	FlowHood base assembly with flaps
845	1	Flow sensing grid
842	1	Pushbutton handle assembly
826	1	Top support assembly
827	4	Top support dowels
827E	4	Top support dowel extenders
838	2	Frame storage bridge
829	1	Carrying case

2' x 2' TOP (61 x 61 cm)

220	4	Side channel (type 7)
2x2F	1	Complete frame assembly (all of above)
2x2S	1	Cloth skirt (24" x 24")
2x2T	1	2x2 top set complete

1' x 4' TOP (33 x 119.4 cm)

141	2	Side channel (type 1)
142	2	Side channel (type 2)
143	2	End channel (type 3)
1x4F	1	Complete frame assembly (all of above)
1x4S	1	Cloth skirt (13" x 47")
1x4T	1	1x4 top set complete

2' x 4' TOP (63.5 x 119.4 cm)

141	2	Side channel (type 1)
142	2	Side channel (type 2)
244	2	End channel (type 4)
2x4F	1	Complete frame assembly (all of above)
2x4S	1	Cloth skirt (25" x 47")
2x4T	1	2x4 top set complete

REPLACEMENT PARTS LIST (continued)

Part no	No required per set	Description
		1' x 5' TOP (33 x 152.4 cm)
141	2	Side channel (type 1)
142	2	Side channel (type 2)
143	2	End channel (type 3)
155	2	Side extender (type 5)
1x5F	1	Complete frame assembly (all of above)
1x5S	1	Cloth skirt (13" x 60")
827E	4	Support dowel extenders
1x5T	1	1x5 top set complete
		3' x 3' TOP (91.4 x 91.4 cm)
141	4	Side channel (type 1)
336	4	Side channel (type 6)
3x3F	1	Complete frame assembly (all of above)
3x3S	1	Cloth skirt (36" x 36")
827E	8	Support dowel extenders
3x3T	1	3x3 top set complete
		14" x 14" TOP (35.6 x 35.6 cm)
111	4	Replacement side channel (14" length)
14x14F	1	Complete frame assembly
14x14S	1	Cloth skirt (14"x14"x14" height)
827E	4	Support dowels (8 ½" length)
14x14T	1	14"x14"x14" top set complete

Special top sizes and combinations are available on request. Maximum perimeter length is 14 feet.

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