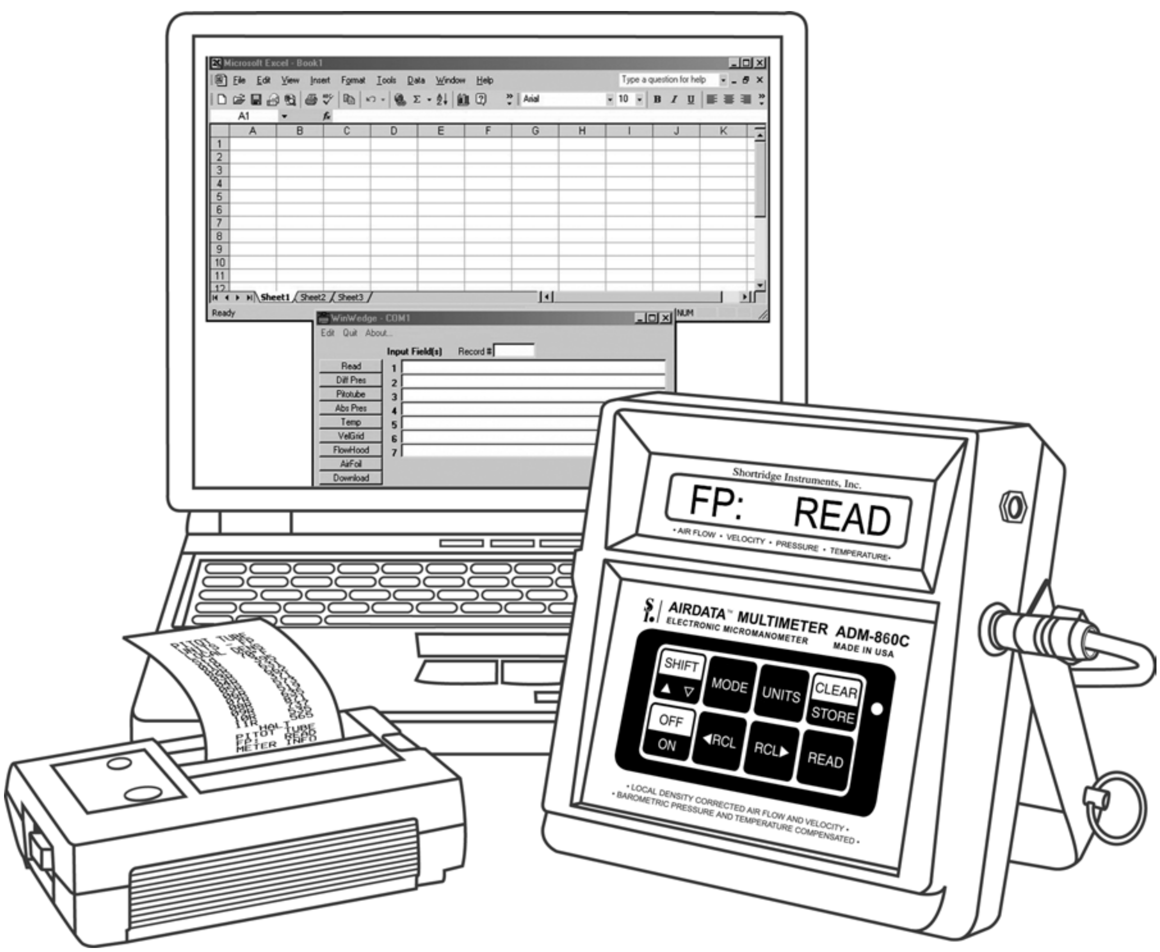
# AIRDATA™ MULTIMETER ADM-860C

## ELECTRONIC MICROMANOMETER
## WITH RS232 COMMUNICATIONS PORT

AIR FLOW • VELOCITY • PRESSURE • TEMPERATURE

# OPERATING INSTRUCTIONS





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ADM-860C 07/30/09

TABLE OF CONTENTS

ILLUSTRATIONS

# 1.0 INTRODUCTION

## 1.1 GENERAL DISCUSSION

These instructions will be much easier to follow if the meter is in front of you as you read through them. You can note the various connections and press the keys, observing the displayed results as you read through the various procedures. The operation of the meter is quite simple and straightforward, as will become apparent after a little practice.

The ADM-860C AirData Multimeter performs the following essential functions. 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 Dwyer Series 160 standard pitot tube, 25-5,000 fpm using the AirFoil probe, and 25-2500 fpm using the VelGrid.

When used with the Series 8400 FlowHood Kit, this meter measures air flow and compensates for air density and backpressure effects, allowing direct air flow readings. Air flow is automatically corrected 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.

Accurate differential pressure measurements can be obtained using static pressure probes, pitot tubes, or any direct pressure source. Temperature and absolute pressure measurements can be taken over a wide range.

The Model ADM-860C AirData Multimeter features sequential storage and recall of up to 100 individually obtained measurements, with sequence tags for each value. Recall of the sum and average, along with the minimum and maximum readings for the stored sequence is available at any point, without terminating the process.

The ADM-860C has an RS232 port that may be used with a portable printer. The optional printer and cable can download each reading as it is taken, or the contents of the memory can be downloaded and printed all at once. The RS232 link may also be used in conjunction with optional WinWedge software or HyperTerminal Private Edition and a computer to download readings directly into any 32 bit Windows® (95, 98, ME, NT 2000, XP or VISTA) application for display, analysis, and manipulation.

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 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. Meter will display readings from -67.0˚F to 250.0˚F. Safe exposure range for TemProbe 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 local air density. This function requires the use of the Shortridge Instruments' 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).

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.

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 local density air flow or velocity corrected for the density effects of temperature and absolute pressure.

MEMORY:100 readings with sequential recall of each reading with the average, the sum, minimum and maximum readings.

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 back-light 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 back-light 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

### 3.1 KEYPAD

The meter keypad has eight keys, each of which may include multiple functions. Functions are activated by pressing a function key once, twice or in sequence with other keys. This Instruction Manual will often refer to a key by only one of the functions shown on the key.

A. **Upper half of keys** SILVER - active only after pressing SHIFT key.

| Control name | Function |
|---|---|
| SHIFT | Shifts control from lower to upper half of keys. |
| CLEAR | Clears memory, TREND and STORE functions. |
| OFF | Turns the meter off after SHIFT key is pressed. |

B. **Lower half of keys (or all-black keys)** BLACK - always active except following SHIFT.

| Control Name | Function |
|---|---|
| MODE | Sequential action for all measurement modes (air flow, velocity, pressure and temperature). Also used to erase, replace and print readings in STORE mode. |
| UNITS | Alternate action for English or metric units. |
| STORE | Activates memory mode, then alternate action for display of the average, total, minimum and maximum readings. |
| ON | Turns the meter on. Turns light on and off after meter has been turned on. |
| ◂ RCL | Recalls stored readings in reverse order. |
| RCL ▸ | Recalls stored readings in entry order. |
| READ | Initiate measurement or halt TREND readings. |

### 3.2 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. If the meter continues to fall into "lockout", it may have been damaged, and should be returned for repair. Press the reset switch once to restart the meter. Do not hold the switch down or press the switch twice in close sequence.

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.

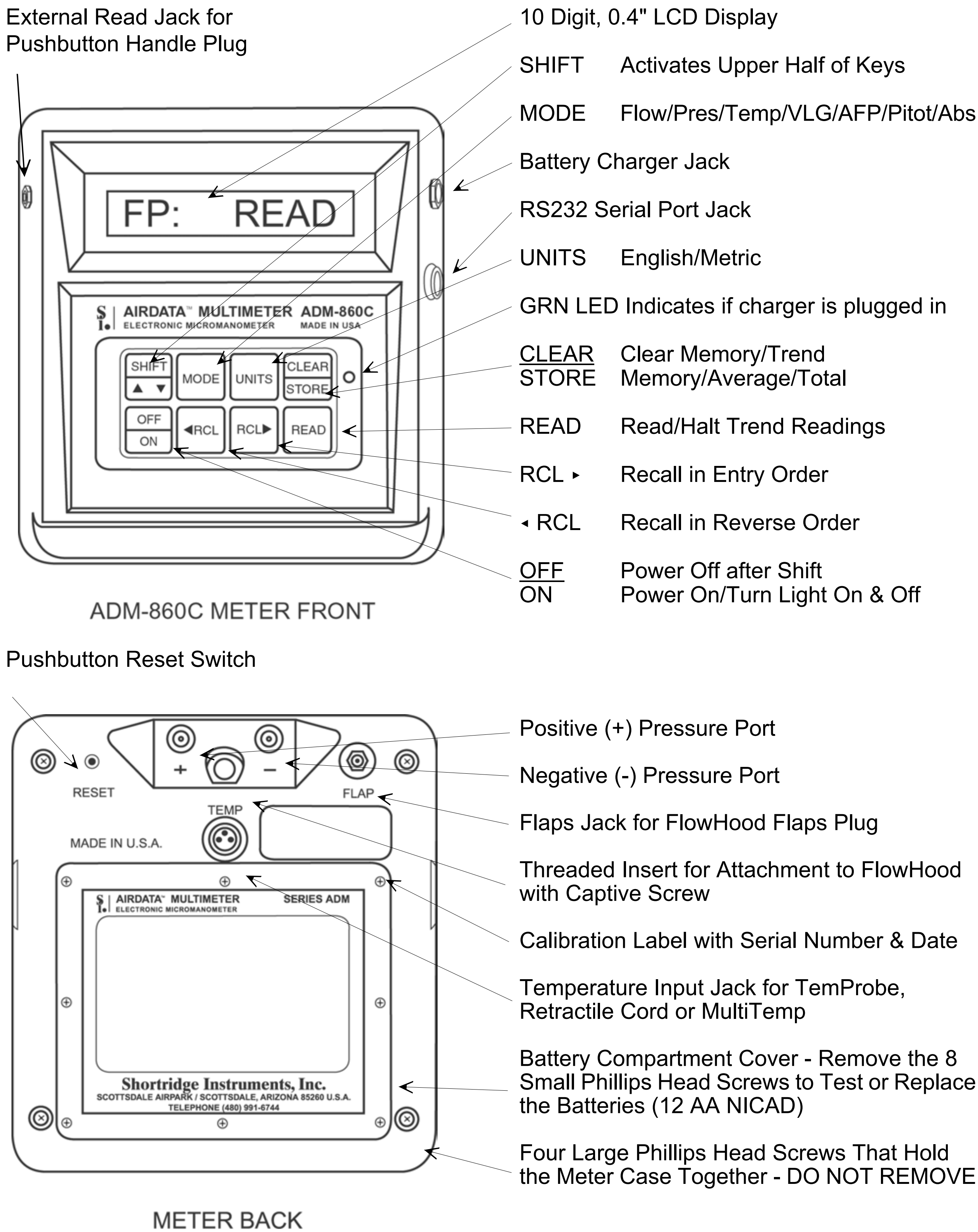



FIGURE 3.1 ADM-860C METER FRONT AND BACK

## 4.0 DISPLAY MESSAGES AND PROMPTS

### 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 function (cfm) and will appear automatically upon power up (following FLO-HOOD) 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 function (˚F).

FP: READ
This display indicates that the meter has been placed in a velocity function (fpm).

Hg: READ
Indicates that the meter has been placed in the absolute pressure function (in Hg) with reference to a vacuum.

IN: READ
This display indicates that the meter has been placed in the differential pressure function (in wc).

**Metric Units**

Bar: READ
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 function 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: ± nnnnnn
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.

nnc nnnn

Displays the number of nonbackpressure compensated readings in memory and the average of just the nonbackpressure compensated readings taken during a FlowHood reading sequence. Displays the average of just the backpressure compensated readings taken during a FlowHood reading sequence.

nnc NONE

Displayed if there are no backpressure compensated readings in memory during a FlowHood reading sequence.

nnR n.nnnn

Displays the current reading and its place in the reading sequence during a STORE sequence. Number of decimal places will vary.

nnR NP 0

Indicates that the current reading in a manual STORE sequence is a negative pitot tube reading.

nnRc nnnn

This message indicates that backpressure compensated air flow readings are being stored. The display shows the current reading and its order in the reading sequence during a STORE process.

nnRu nnnn

This message indicates that nonbackpressure compensated air flow readings are being stored. The display shows the current reading and its order in the reading sequence during a STORE process.

nnS n.nnnn

Displays a reading in memory and its place in the stored reading sequence. Accessed using forward or reverse RCL keys. Number of decimal places will vary.

nnS ERASED

This message indicates that the current reading displayed in RECALL ($nn_s$) has been erased.

nnS NP 0

This message is displayed when a stored negative pitot tube reading is accessed using a RECALL key.

nnSc nnnn

This message indicates a backpressure compensated air flow reading is being viewed in memory. The display shows the reading and its order in the reading sequence during a STORE process. Accessed using forward RCL keys.

nnSu nnnn

This message indicates a nonbackpressure compensated air flow reading is being viewed in memory. The display shows the reading and its place in the reading sequence during a STORE process. Accessed using forward RCL keys.

nnu nnnn

Displays the number of nonbackpressure compensated readings in memory and the average of just the nonbackpressure compensated readings taken during a FlowHood reading sequence.

nn $\overline{X}$ n.nnnn
Displays the number of readings in memory and the average of the readings. Displayed when the STORE key is pressed during a STORE sequence. Number of decimal places will vary.

∑ n.nnnn
Displays the sum of the readings in memory during a STORE sequence. Displayed when the STORE key is pressed twice if readings are in memory. Number of decimal places will vary.

∑c nnnn
Displays the sum of the backpressure compensated readings in memory during a STORE sequence. Displayed when the STORE key is pressed if readings are in memory. Number of decimal places will vary.

∑c NONE
This display indicates that there are no backpressure compensated readings in memory.

∑u nnnn
Displays the sum of the nonbackpressure compensated readings in memory during a STORE sequence. Displayed when the STORE key is pressed if readings are in memory. Number of decimal places will vary.

xx ☼ n.nnnn
This display indicates that the back-light is on and battery power draw has increased. xx indicates the units for the reading.

xx ▯ n.nnnn
This display indicates that the battery charge is nearly depleted. xx indicates the units for the reading. The meter will display LOCHARGE prior to displaying this symbol.

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^ n.nnnn
Displays the maximum (greatest value) reading stored in memory during a STORE sequence. Displayed when the STORE key is pressed four times after HALT during the STORE sequence. Number of decimal places will vary.

xxᵥ n.nnnn
Displays the minimum (least value) reading stored in memory during a STORE sequence. Displayed when the STORE key is pressed three times after HALT during the STORE sequence. Number of decimal places will vary.

xxᵥc nnnn
Displays the minimum reading of just the backpressure compensated readings stored in memory during a STORE sequence. Displayed when the STORE key is pressed three times after HALT during the STORE sequence.

xx^c nnnn
Displays the maximum reading of just the backpressure compensated readings stored in memory during a STORE sequence. Displayed when the STORE key is pressed three times after HALT during the STORE sequence.

$xx_{\vee}u$   nnnn

Displays the minimum reading of just the nonbackpressure compensated readings stored in memory during a STORE sequence. Displayed when the STORE key is pressed three times after HALT during the STORE sequence.

$xx^{\wedge}u$   nnnn

Displays the maximum reading of just the nonbackpressure compensated readings stored in memory during a STORE sequence. Displayed when the STORE key is pressed three times after HALT during the STORE sequence.

ABS PRES

This signal will be flashed when the absolute pressure mode is selected, and also each time the READ key is pressed when in the absolute pressure mode.

ADM-860C

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

AIRFOIL

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

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.

BATT 1/3

This message may be displayed following SHIFT/SHIFT and indicates that about one-third of the useful charge remains in the batteries.

BATT 2/3

This message may be displayed following SHIFT/SHIFT and indicates that about two-thirds of the useful charge remains in the batteries.

BATT FULL

This message is displayed following SHIFT/SHIFT when the batteries are fully charged.

BATTERY

This message may be displayed as part of a longer message sequence such as NO LIGHT/BATTERY/TOO LOW.

CF: CORR

This message indicates that the air flow measurement being performed is in cfm and will be backpressure compensated.

CF: UNCORR

This message indicates that the air flow measurement being performed is in cfm and will not be backpressure compensated.

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.

CLEAR

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

CLEAR MEM

This signal is flashed as the STORE functions are cleared.

DIFF PRES

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

ENGLISH

This message indicates that the readings will be in English units. Pressing the UNITS key will switch the meter to metric units. The meter will store the units selection (metric or English) and will automatically start up in the selected units the next time it is turned on.

ERASE n?

This message is displayed when the operator has pressed the MODE key twice while recalling stored readings. The current reading displayed in RECALL ($nn_s$) will be erased when the operator presses the READ key.

ERASING

This message is displayed when the current reading displayed using RECALL ($nn_S$) is being erased.

FLO-HOOD

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

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 mode and presses the READ key.

HALT

HALT is displayed when a TREND mode sequence is halted by holding the READ key down. The meter switches back to the manual reading mode and the last reading displayed is a standard manual reading.

LIGHT OFF

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

LIGHT ON

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

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 displayed readings will become the symbol for an empty battery cell. For example, FP: 983 will be displayed as FP ▯ 983, when meter is registering LOCHARGE.

LS: CORR

This message indicates that the air flow measurement is in liters/sec and will be backpressure compensated.

LS: UNCORR

This message indicates that the air flow measurement is in liters/sec and will not be backpressure compensated.

MANUAL

This message may be one of the parameters displayed following SHIFT/SHIFT and indicates that individual readings are being taken. The meter is not being used in the memory 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. Pressing the UNITS key will switch the meter to English units. The meter will store the units selection (metric or English) and will automatically start up in the selected units the next time it is turned on.

NEG PITOT

This message indicates an invalid, negative, pitot tube velocity reading. This may result from reversed tube connections to the meter, or from other conditions described in Section 6.2 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 back-light.

NO LIGHT/BATTERY/TOO LOW

This sequence of messages indicates that the battery charge is low and the back-light 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 message is also displayed if the TemProbe or extension cord has been damaged so as to create an open circuit.

NOT ALLOWD

This message is displayed if the user tries to select STORE mode while in TREND mode.

NP 0

This message is displayed when a stored NEG PITOT reading is accessed using a RCL 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 factory if 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 factory if meter continues to read OVER VEL at inappropriate times).

PITOT TUBE

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

PRINT MEM?

This message is displayed when the operator has selected the print mode by pressing the STORE key, followed by the MODE key. If an appropriate printer is connected to the RS232 jack and the READ key is pressed, the entire contents of the memory will be downloaded to the printer. This message is also displayed whiled readings are being downloaded to a computer using HyperTerminal.

PRINTING

This message is displayed when the operator is printing readings from memory by selecting PRINT MEM? and then pressing the READ key.

PROBE

This message is displayed following SHIFT/SHIFT 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 message is displayed during differential pressure measurements. It is also displayed during the manual reading which is taken when a set of TREND readings is halted.

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.

REPL nn?

This message is displayed when the operator has pressed the MODE key once while recalling stored readings. This message indicates the current reading displayed using RECALL (nnS) will be replaced with a new reading when the operator presses the READ key.

REPLACING

This message is displayed when the current reading displayed using RECALL (nnS) is being replaced with a new reading.

SHIFT

This message is displayed when the upper half of the keys are activated by pressing the SHIFT key.

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.

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.

STORE

This message may be one of the parameters displayed following SHIFT/SHIFT and indicates that the meter is being used in the STORE mode.

STORE FULL

This message indicates that the number of readings in memory has reached the maximum storage capacity of 100 readings.

STORE MODE

This message is displayed when a key other than READ, STORE or RCL is pressed when readings are in memory. This message may be displayed when the SHIFT key is pressed to indicate that the meter is in the STORE mode. The mode may not be changed until the readings in memory are cleared by pressing SHIFT/CLEAR.

STORE RDY

This message indicates that the meter has been placed in the memory mode, and that readings will be sequentially stored in memory. This function permits recall of readings using the RCL keys, or of their sum, average, minimum or maximum by pressing the STORE key at any point.

TEMP

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

TEMPROBE

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

TOO HOT or TOO COLD

If the internal temperature of the meter exceeds its operational limits, the meter will display TOO HOT or TOO COLD and shut down. However, if there are readings in memory, the meter will continue to display TOO HOT or TOO COLD, and will retain the readings in memory. The meter must be cooled down or warmed up, as the case may be, before normal operation can resume.

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 indicates that the battery charge is very low and the back-light may not be used until the batteries have been recharged (NO LIGHT/BATTERY/TOO LOW).

TREND RDY

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

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 SHIFT/SHIFT is pressed.

VELGRID

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

## 5.0 USING THE AIRDATA MULTIMETER

### 5.1 GENERAL USE

The ADM-860C keypad has eight keys, two of which are dual-purpose keys. The dual-purpose keys are OFF/ON and CLEAR/STORE. The functions shown in the lower, dark colored section of these keys may be activated by pressing the desired key. The functions in the upper, silver colored sections of the keys are accessed by first pressing the SHIFT key, then the key of the desired function.

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.

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. Selecting the FlowHood air flow mode is discussed in the next paragraph. When a mode is selected, the meter will briefly display the mode, followed by a two-letter symbol for the units to be used, and then display READ. For example, if the mode selected is pitot tube, the message would read PITOTUBE briefly, followed by FP: READ.

If the FlowHood flaps plug has been plugged into the meter, the meter will initialize in the FlowHood measurement mode, and will display FLO-HOOD briefly, followed by CF: READ. Press the Mode key repeatedly while the flaps plug is connected to cycle the meter through the only measurement modes which are appropriate when the meter is used on the FlowHood assembly. These modes are temperature, absolute pressure and air flow.

Press the READ key to take a reading in the selected mode. The meter will briefly display the selected function again, 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.

The display has a back-light for use in low-light conditions. The back-light may be turned on or off by pressing the ON/OFF key while the meter is turned on. The display will read LIGHT ON or LIGHT OFF as appropriate. The third character (colon) in each READ display is replaced by a schematic light symbol (☼) when the light is on.

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

The back-light will turn off automatically if the meter has not been used for several minutes. Press any key to turn the light back on.

The meter is turned off manually by pressing the SHIFT key, and then pressing the OFF key. The meter will turn itself OFF automatically to save battery power if the meter has not been used for several minutes, unless there are stored readings in memory or the meter is in TREND mode.

The meter saves any readings stored in memory, the measurement mode (pitot tube or differential pressure, for example) and the type of units (English or metric) during a normal shut-down, and will default to the stored settings when turned on again. The last reading stored in memory will be displayed.

Information stored in memory will be saved in blocks of 50 readings if the meter must be reset while readings are in memory. If the meter was turned off, then on again, while readings were in memory, but prior to resetting the meter, all readings saved prior to turning the meter off will remain in memory after the meter is reset.

The AA-NICAD batteries supplied with the meter are capable of supplying power for more than 3000 readings after one 10-hour charging period. When the batteries are nearing the end of their useful charge, the meter will display LOCHARGE and the symbol of a discharged battery cell will appear in the third block of the displayed reading. The meter will not display LOCHARGE again, but the symbol for the empty battery cell will remain on the display. Battery charge may be conserved by keeping the back-light turned off and turning the meter off between reading sessions.

If the meter is being used with the back-light 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 is being used with the back-light turned on, the user will have approximately 5 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 back-light** and used until LOCHARGE is displayed. The colon normally shown following the units for a displayed reading will be replaced by a symbol for an empty battery cell. The user will have 5 to 10 minutes of 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 and reading selections in effect can always be viewed by pressing SHIFT/SHIFT. The first display represents the approximate level of charge remaining in the batteries. 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. The meter will then display the measurement mode (for instance, VelGrid)and the units selected (English or metric). 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. 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.

**5.2 TREND READINGS**

TREND mode displays a continuous series of readings about once per second. TREND mode is ideal for closely tracking a changing environment, such as when damper settings are being changed. TREND displays a continuous series of readings as the air velocity or flow being adjusted approaches the set point.

TREND mode sequential readings are optimized for speed, not accuracy. When the air has stabilized near the required setting, the meter can be switched to the MANUAL reading mode for more accurate readings.

TREND mode is selected by pressing SHIFT/READ. Press and hold down READ until the meter displays HALT to exit TREND mode. The meter will automatically switch to the standard reading mode and a valid manual reading will be displayed after the TREND readings have been halted.

**5.3 MEMORY/AVERAGE/TOTAL FUNCTION**

The memory/average/total function may be used with any of the measurement modes and allows the storage of up to 100 individual readings for later recall of each reading, the average, and the sum of the readings, and the minimum and maximum readings.. This capacity may be used to facilitate such tasks as pitot tube duct traverses, VelGrid face velocity measurements, and the recording of outlet readings. These functions also assist in the averaging of coil face velocities and temperatures, static pressures, and pressure drop readings.

The STORE key is used only with the memory related functions and serves several purposes. Pressing the STORE key places the meter in the memory mode. Press the STORE key after readings have been entered into memory to alternately display the average, sum, minimum and maximum of the readings. The memory is cleared by pressing the SHIFT key and then the CLEAR key.

The meter stores individual readings with greater resolution than the rounded figures that are displayed. These stored values are used to calculate the sum and average. There may be a very small difference between the sum and average calculated by the meter and a sum and average calculated by the user from the individual readings.

**5.3.1 MEMORY OPERATION**

Press the MODE key. The meter will briefly flash the selected function followed by a READ prompt. Press the STORE key. The meter will display STORE RDY and is now ready to store a sequence of readings. Press the READ key to take a reading. The meter will display the mode, and then the units, prior to displaying the first reading. If readings are being taken in flow or velocity, LOCAL DENS will also be displayed. If the TemProbe is not in place during flow or velocity measurements, the meter will display STD 70˚F or STD 21.1˚C prior to the display of the first reading. Readings will be displayed as $nn_R$ nn, where $nn_R$ is the sequence number of the reading and nn is the actual reading. Subsequent readings will be displayed in succession.

The reading and memory entry process will continue as long as the READ key is pressed (up to a maximum of 100 readings). Press the STORE key at any point to view the sum and the average. The number of readings that have been taken, along with the average of the readings will be displayed, such as 07$\bar{x}$ 395. The first two digits are the number of readings taken (the average of 100 readings is displayed as 00$\bar{x}$ nnn). Press the STORE key again to display the sum of the readings. The number of readings in memory will not be displayed with the sum.

Press the STORE key again to display the minimum reading. The sequence number of the reading will be displayed along with the minimum reading, such as $xx_v$ n.nnnn. Press the STORE key again to display the maximum reading. The sequence number of the reading will be displayed along with the maximum reading, such as $xx^{\wedge}$ n.nnnn. The measurement sequence may be resumed by pressing the READ key, and may be interrupted at any point by pressing the STORE key again.

The measurement mode or other conditions may not be changed while the meter is in the memory function.

Air flow readings may be saved as either a sequence of nonbackpressure compensated readings, or as a sequence of alternating nonbackpressure compensated and backpressure compensated readings, with display of the sum, average, minimum and maximum available for each type of reading. See Section 11.1 AIR FLOW - NONBACKPRESSURE COMPENSATED READINGS and Section 11.2 AIR FLOW - BACKPRESSURE COMPENSATED READINGS for more information.

The TemProbe must not be connected or disconnected during a STORE sequence. If this occurs, TEMPROBE will be displayed followed by CHANGE. The TemProbe must be reconnected or disconnected before further readings can be taken. The STORE mode may be exited by pressing SHIFT/CLEAR if no further readings are needed.

If the storage capacity of 100 readings has been reached, STORE FULL will be displayed. Press the STORE key to alternately display the average and sum, or one of the RCL keys for recall of the individual readings. The memory must be cleared by pressing SHIFT/CLEAR before the next reading sequence may be begun.

**5.3.2 RECALL**

The RCL keys are used during a reading sequence to sequentially recall all readings that are in memory. ◂ RCL displays the last reading stored, and then displays readings in reverse order. RCL ▸ displays the first reading stored, and then displays readings in the order entered. These keys may be used either before or after the STORE key has been pressed. The sequence of the reading will be displayed along with the reading, such as 07s 395. A brief press of a RCL key will advance the display one number at a time. Holding a recall key down will fast forward or fast reverse the display through all the numbers that are in memory.

**5.3.3 REPLACE READING IN MEMORY**

A reading in memory may appear to be abnormal, or may have been taken at the wrong time, or with an improperly positioned sensor. Readings stored in memory may be replaced with a new measurement. Press one of the RCL keys to toggle through the individual readings in the stored sequence. Select a specific reading such as: 07s 395. This reading may be replaced while it is on display by pressing the MODE key. REPL n? will be displayed where n is the sequence number for that reading. Press the READ key. The meter will initiate a new reading and the result will replace the value previously stored for that position in the sequence. REPLACING will be displayed while the meter takes the new reading and stores it to memory. The new sum and average will be calculated using the new measurement and may be displayed by pressing the STORE key.

**5.3.4 ERASE READING IN MEMORY**

Readings stored in memory may be erased without replacement. Press one of the RCL keys to toggle through the individual readings in the stored sequence. Select a specific reading such as: 07s 395. This reading may be erased while it is on display by pressing the MODE key twice. ERASE n? will be displayed where n is the sequence number for that reading. Press the READ key. ERASING will be displayed. The erased reading will now be displayed as nns ERASED. There will be no value associated with that place in the sequence and the reading may be left blank or may be replaced with a new reading. The sum function will disregard the erased reading unless it is replaced. The average function will display the revised number of readings included in the average and the revised average.

**5.3.5 CLEAR MEMORY**

The memory is cleared and store mode is exited by pressing the SHIFT key followed by the CLEAR key. This sequence removes all readings from memory. Press the STORE key a second time and a new STORE sequence will be initiated. NOTE: Readings are still in memory after the SHIFT key has been pressed. Pressing the SHIFT key a second time will return the meter to the previous mode, display all existing parameters and the existing readings will remain in memory.

**5.4 DATA DOWNLOAD TO A PRINTER**

Readings may be downloaded directly from the meter to a printer, either as individual readings or multiple readings from memory. Shortridge Instruments, Inc. supplies the Seiko™ model DPU-H245, a palm-sized, portable printer which uses rechargeable batteries. Other compatible printers may also be used.

The Seiko model DPU-H245 printer is shipped complete with an RS232 printer (serial) cable, null modem adapter, battery and power cable.

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.

**5.4.1 DOWNLOAD INDIVIDUAL READINGS TO A PRINTER**

Turn the meter and the printer on. The default mode and units will be printed if the printer is turned on before the meter. Select the desired mode and units and press the READ key. The printer will print the information displayed throughout the reading sequence, including the mode, density selections, and readings. Press the READ key to print another reading. Example printouts are shown below.

If DIFF PRES and ENGLISH are selected and the READ key is pressed, the following will be printed:

DIFF PRES
In: 0.0468

If a velocity or flow mode is selected and the TemProbe **is** being used, when the READ key is pressed, the printout will be formatted like the following:

VELGRID
LOCAL DENS
FP: 1576

If a velocity or flow mode is selected and the TemProbe **is not** being used, when the READ key is pressed, the printout will be formatted like the following:

VELGRID
LOCAL DENS
STD 70˚F
FP: 1576

### 5.4.2 DOWNLOAD READINGS IN MEMORY TO A PRINTER

Readings stored in memory may be downloaded from the meter to a printer after the sequence of readings has been completed. Connect the printer to the meter using the RS232 cable as described in Section 5.4 DATA DOWNLOAD TO A PRINTER. Turn the printer and meter on.

Press the STORE key, then the MODE key. PRINT MEM? will be displayed. Press the READ 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 the meter memory until the memory is cleared by pressing the SHIFT key, followed by the CLEAR key. An example of readings printed from memory in the VelGrid mode is shown below:

VELGRID
LOCAL DENS

| | |
|---|---|
| 01 | 1576 FP |
| 02 | 1581 FP |
| 03 | 1578 FP |
| 04 | 1577 FP |
| Sum | 6312 Fp |
| 004 Avg | 1578 F |
| 001 Min | 1576 |
| 002 Max | 1581 |
| Std Dev | 2.2 |

An example of readings printed from memory in the FlowHood mode is shown below:

FLO-HOOD
LOCAL DENS

| | |
|---|---|
| 01 | 1474 CFu |
| 02 | 1524 CFc |
| 03 | 1482 CFu |
| 04 | 1531 CFc |
| Sum c | 3055 |
| Sum u | 2956 |
| 002 Avg c | 1527 |
| 002 Avg u | 1478 |
| 002 Min c | 1524 |
| 001 Min u | 1474 |
| 004 Max c | 1531 |
| 003 Max u | 1482 |
| Std Dev c | 4.9 |
| Std Dev u | 5.7 |

### 5.5 DATA DOWNLOAD TO A COMPUTER

Readings from the ADM-860C may be automatically transmitted to specific cells of a computer spreadsheet such as Microsoft Excel™ for display, analysis and manipulation. This functionality requires either HyperTerminal Private Edition or WinWedge software from TAL Technologies, Inc. as well as an RS232 serial cable. The procedure using HyperTerminal is supplied with the ADM-860C AirData Multimeter.

WinWedge collects data from scales and balances, gauges, laboratory instruments, meters, sensors or any other RS232 instrument or serial device and inputs the data directly into Microsoft Excel or any other Microsoft Windows™ application program.

Configuration files must be set up to specify how WinWedge will interact with the AirData Multimeter (or with any other device). A series of fully functional, example Configuration Files is provided along with the WinWedge software to help the user become familiar with the program. These Configuration Files are extremely easy to use and are provided so the most basic set-up will occur automatically and provide the user with an introduction to the available features. The Configuration Files may be copied repeatedly and each copy may be modified as required to suit the needs of the user.

An easy step-by-step set of instructions titled **GET A QUICK START USING THE WINWEDGE CONFIGURATION FILES**, is also provided along with the sample Configuration Files.

All of the port settings, data input settings, output settings, function keys, mouse buttons and other information required to use WinWedge with the AirData Multimeter have already been set up in each of the example Configuration Files. These files are ready to be used as soon as loaded. These files may also be copied repeatedly and each copy modified as required to suit the needs of the user.

It is recommended that the user begin by reading the relevant sections of the WinWedge software User's Manual to become familiar with issues of configuration, settings, output formats and any other areas of interest. The following information is only a preliminary exposure to the WinWedge capabilities.

Register the serial number of your WinWedge software to become eligible for free technical support from the software manufacturer. The contact information is:

TAL Technologies, Inc. www.taltech.com

More information is available in the WinWedge User's Manual.

### 5.5.1 CONFIGURATION FILE SET-UP IN WINWEDGE

Configuration files must be defined and saved prior to using WinWedge. The *WinWedge Set-up* main menu has three pull-down menu selections for access to the most important set-up windows required for use with the AirData Multimeter. These windows are used to determine the basic structure of configuration files used by WinWedge for receiving a data stream, processing the data received, and transmitting it to specific cells of a spreadsheet.

*Mode > Send Keystrokes To*

*Port > Settings*

*Define > Input Data Record Structure*
*> Pre-Input Character Translations*
*> Pre-Transfer Character Translations*
*> Serial Output Strings*
*> Hot Keys and Hot Key Actions*

The *Mode > Send Keystrokes To* selection defines the destination of the information downloaded from the meter. A spreadsheet must be open and active before using this option. If no destination has been specified, WinWedge will transmit the first field of the data stream to the location of the cursor on the spreadsheet that is open and active.

*Port > Settings* is discussed in Section 5.5.2 PORT AND DATA INPUT SETTINGS.

The *Define > Input Data Record Structure* must be defined for WinWedge to decipher the incoming stream of data and deliver the required data to the appropriate spreadsheet cell. The AirData Multimeter downloads data in a set of comma-delimited fields in ASCII format. This incoming data will be analyzed by the *Port > Analyze* function in WinWedge. The required data conversion is entered using *Define > Input Data Record Structure, Define > Pre-Input Character Translations*, and *Define > Pre-Transfer Character Translations*.

The number and type of fields which are downloaded from the meter into WinWedge, and therefore to the spreadsheet, depends on the type of measurement being taken. Possible fields include the measurement command type, measurement mode, density selection, standard temperature assumption, value of reading, and units.

The user may require a download format that includes only certain fields. This requires setting the WinWedge *Define > Input Data Record Structure* to ignore all other data fields and transfer only the relevant data field for each reading.

*Define > Serial Output Strings* is discussed in Section 5.5.8 AUTOMATIC REPEAT READINGS CONTROLLED BY WINWEDGE

*Define > Hot Keys and Hot Key Actions* is discussed in Section 5.5.3 FUNCTION KEY COMMANDS.

The user's completed set-up selections should be saved in a configuration file before being used unless the user is in *Test Mode*. Configuration files will be automatically saved in the same folder with WinWedge. Each configuration file will remain available for repeated use and modification.

All of the information in this section is discussed in much greater detail in the WinWedge User's Manual.

### 5.5.2 PORT AND DATA INPUT SETTINGS

The following port and data input settings are required for use with the ADM-860C AirData Multimeter:

Port: COM1 (an alternative serial port may be selected in *Port > Settings*)
Baud: 9600
Parity: None
Data Bits: 8

Stop Bits: 1
Flow Control: None

Input Buffer Size: 8192 The input buffer size needs to be large enough to store the100 reading memory.

Output Buffer Size: 512 The output buffer size only needs to be large enough for the ASCII command strings. The default of 512 is more than adequate.

**5.5.3 FUNCTION KEY COMMANDS**
The meter may be controlled from a computer keyboard by the use of function keys. Pressing a function key sends a command or a series of commands to the meter. The meter recognizes the command and responds by changing modes, taking a reading, or downloading stored readings from memory. The function keys are set up in the *WinWedge Setup* window under the menu option *Define > Hotkeys and Hotkeys Action*.

The list of commands used by the meter and the resulting action are specified in the list of recommended function keys shown below. For example, D<CR> (<CR> represents a hard return) changes the meter mode to Differential Pressure. WinWedge uses the musical note symbol that is #13 on the ASCII chart to represent a hard return. The following recommended function key definitions are used in each of the sample configuration files for Microsoft Excel which are supplied with the WinWedge software. The Configuration Files for QuattroPro™ are exactly the same, except the F1 key is replaced with ALT/F1. This is necessary because the F1 key is controlled as a system key in QuattroPro.

Function Key definitions:

| Key | Command sent to meter | Result |
|---|---|---|
| F1 Key | R<CR> | Initiates a meter reading |
| F2 Key | D<CR> | Changes mode to Differential Pressure |
| F3 Key | P<CR> | Changes mode to Pitot Tube |
| F4 Key | A<CR> | Changes mode to Absolute Pressure |
| F5 Key | T<CR> | Changes mode to Temperature |
| F6 Key | G<CR> | Changes mode to VelGrid |
| F7 Key | F<CR> | Changes mode to FlowHood |
| F8 Key | V<CR> | Changes mode to AirFoil probe |
| F9 Key | E<CR> | Toggles units between English and Metric |
| F10 Key | S<CR> | Used with 870C only |
| F11 Key | M<CR> | Initiates download from meter memory |

**5.5.4 SET-UP CONNECTIONS AND OPEN THE APPLICATIONS**
Load the WinWedge software onto the computer. Open the spreadsheet application first, then open the WinWedge window. Move and/or size the two application windows so they are adjacent or overlapping and both visible on the screen. This allows for optimal viewing of the applications and use of the cursor.

Click on *File > Open* in WinWedge to view a list of existing configuration files (if configuration files have been predefined and saved). Configuration files must be in the same folder as WinWedge or they will not be displayed. Open an existing configuration file by double clicking the file name or clicking on *Open* in the WinWedge menu bar.

Connect the serial cable barrel connector 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 DB9 connector to a computer port, either COM1 (preferable) or COM2.

If COM1 is not available on the computer being used, COM2 must be selected. Click on *Port > Settings* in WinWedge and change the port selection from COM1 to COM2. Click on OK.

Click on *Activate > Test Mode* in WinWedge. The displayed window will include a field for the record number and a series of input fields. WinWedge is now ready to communicate with the meter.

Always activate WinWedge in *Test Mode* during the learning process or while modifying a Configuration File. *Test Mode* permits the user to return to the WinWedge Main Menu and change ports or edit any of the configuration parameters. If WinWedge is activated in *Normal Mode*, none of the parameters can be modified without quitting WinWedge and beginning again.

**5.5.5 INDIVIDUAL READINGS CONTROLLED FROM COMPUTER KEYBOARD**
This method allows the user to control the meter from the computer keyboard while taking individual readings. Select or define and save the configuration file to be used. Position the cursor in the cell on the spreadsheet where data entry should begin. Select the appropriate mode on the meter using the predefined computer keyboard function key (see Section 5.5.3 FUNCTION KEY COMMANDS). Then take a reading using the predefined function key for initiating readings. The meter will take a reading and automatically download the results to the spreadsheet.

The cells will contain the fields which were selected using *Define > Input Data Record Structure*. Each field is downloaded into a single cell and the data is easily manipulated. The cursor should automatically relocate to the next vacant cell in the starting column for the next reading. If it does not, the cursor option in the spreadsheet application will need to be changed. If using Microsoft Excel, click on *Tools* > *Options* > *Edit* and change the cursor action following ENTER to be *Down*. If using QuattroPro, click on *Tools* > *Settings* > *General* and change *Move Cell Selector* > *Enter Key* to *Down*.

### 5.5.6 DOWNLOAD READINGS FROM MEMORY USING COMPUTER KEYBOARD

This method downloads all readings stored in the meter's memory. The number of stored readings may be any number up to 200. Disconnect the RS232 cable from the meter. Press SHIFT/CLEAR on the meter keypad, then select the desired measurement mode. Select the STORE mode and store as many readings as required.

Return to the computer and connect the meter to the RS232 cable. Position the cursor in the cell on the spreadsheet where data entry should begin. Press the predefined function key which initiates the download from meter memory. The readings will be downloaded as numerical entries that can be readily manipulated using the spreadsheet functions.

The readings will remain stored in the meter memory until the memory is cleared by pressing the SHIFT key, followed by the CLEAR key.

### 5.5.7 CONTROL BUTTONS, CURSOR CONTROL, AND FILE PATHS

Control Buttons may be defined when a WinWedge configuration file is being set-up. These buttons use the same meter commands as the Function Keys (D<CR> changes mode to Differential Pressure). The defined Control Buttons are then displayed to the left of the *Input Field(s)* when *Activate* > *Test Mode* is selected and act just like the Hot Keys/Function Keys discussed in Section 5.5.3 FUNCTION KEY COMMANDS.

However, clicking on the Control Buttons will cause the cursor focus to shift from the spreadsheet to the active WinWedge window. When this occurs, the data will not be downloaded into the spreadsheet. WinWedge can be configured to automatically assign the cursor focus to the spreadsheet application as needed. Select *Mode* > *Send Keystrokes To* in the WinWedge *Setup* window and enter the spreadsheet application title into the application title bar text space in the dialog box. It may be adequate to enter only the name of the spreadsheet from the Application Title Bar, or it may also be necessary to enter the complete file path to the application. When this is done, the commands to the meter can be controlled with the mouse, and WinWedge will place the data even though the cursor is not showing on the spreadsheet. If the output is changed to a different spreadsheet application, it will be necessary to change the entries in the *Send Keystrokes To* dialog window.

The cursor should automatically relocate to the next vacant cell in the starting column for the next reading. If it does not, the cursor option in the spreadsheet application will need to be changed. If using Microsoft Excel, click on *Tools* > *Options* > *Edit* and change the cursor action following ENTER to be *Down*. If using QuattroPro, click on *Tools* > *Settings* > *General* and change *Move Cell Selector* > *Enter Key* to *Down*.

### 5.5.8 AUTOMATIC REPEAT READINGS CONTROLLED BY WINWEDGE

The WinWedge software can be programmed to initiate automatic readings in a continuous series or at specified intervals up to 27 hours.

A *Serial Output String* is defined in the *Define* > *Serial Output Strings* menu pull-down. This setting generates a read command at the completion of each reading. Place an R, followed by the musical note symbol that is #13 on the ASCII chart in the *Define* > *Output String* window *Acknowledgment String* field. Press the predefined function key to begin the first reading. The meter will begin a new reading immediately after each previous reading is completed. Automatic readings will continue until the user selects *Quit* > *Quit or Quit* > *Suspend Wedge* in the WinWedge window.

Readings may also be programmed to take place at specified intervals. Open the *Define* > *Serial Output Strings* window in WinWedge. Delete any existing entry in the *Acknowledgment String* field. Enter an R, followed by the musical note symbol that is #13 on the ASCII Chart, in the *Timer Controlled Output String* field. Enter a time period (in ms) in the *Interval* field. Leave the *Timer Action* selection at *Transmit String*. This causes a series of read commands to be issued to the meter at the specified time intervals. The maximum interval between readings is 27 hours.

Avoid selecting a time period which will issue read commands at a faster rate than the meter can execute them. If the meter takes four seconds to complete a reading, and the interval is set to 1000 ms (one second), then the meter will receive four read commands during the time it takes to execute one reading. The WinWedge software would issue hundreds of read commands in a few minutes, which may be far more than desired. The meter will store the extra read commands in a queue and continue to read until the queue is empty, which could take several minutes or longer. If this occurs inadvertently and it is necessary to discontinue the readings, disconnect the RS232 cable from the meter and press the reset button on the back of the meter.

Note that programming the *Serial Output String* is completely separate from programming WinWedge for processing an incoming data stream. This is discussed further in the WinWedge User's Manual.

The timed commands for the *Serial Output Strings* may be suspended by clicking on *Quit* > *Disable Timed Output*. This does not stop the WinWedge processing of incoming data, which will continue as long as there is data to process from read commands issued manually or from stored read commands in the meter queue. The timed commands for the *Serial Output Strings* may be restarted by clicking on *Quit* > *Enable Timed Outputs*.

WinWedge processing of incoming data may be suspended and started again using the *Quit* > *Suspend* pull-down window. Suspending WinWedge will stop the *Serial Output Strings* read commands being transmitted to the meter, but will not stop the meter from processing commands which are already in the meter buffer.

### 5.5.9 MINIMIZING WINWEDGE

The WinWedge window may be minimized so the spreadsheet can utilize the entire screen while readings are being taken. There are two primary application windows, the *WinWedge Set-Up* window, and the so-called WinWedge window that is displayed when *WinWedge* > *Test Mode* is activated. If minimized during set-up, the WinWedge application bar will appear on the Windows Taskbar.

However, if the activated *WinWedge* > *Test Mode* window is minimized, WinWedge may appear to disappear entirely. The program may only be visible as a small icon in the system tray at the right of the Windows Taskbar. Right-click on the icon, then click on *Open* to maximize WinWedge again.

### 5.5.10 ALTERNATIVE DOWNLOAD METHOD

It is possible to use the printer download methods discussed in Sections 5.4.1 DOWNLOAD INDIVIDUAL READINGS TO A PRINTER and 5.4.2 DOWNLOAD READINGS IN MEMORY TO A PRINTER while connected to a computer and using the WinWedge application. This type of download is controlled with the meter keypad instead of the computer keyboard. The resulting spreadsheet format will look very similar to the printed format. However, the data stream is downloaded through WinWedge as alphanumeric text and is all placed in the same field on the spreadsheet. The data in alphanumeric fields can not be manipulated using the mathematical functions available in a spreadsheet. The meter is also more prone to locking up and experiencing other problems due to confusion between commands issued to the meter using the computer keyboard and commands issued to the meter using the meter keypad. This printer equivalent download method is not recommended.

## 6.0 VELOCITY MEASUREMENT

Air velocity measurements obtained with the ADM-860C 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.

Comparison with "hot wire" anemometer readings may require the correction of the "hot wire" readings to local density conditions. See Section 13.5 HOT WIRE ANEMOMETER VERSUS AIRDATA MULTIMETER

### 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 air 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 clean room 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 (ADM-870 and ADM-870C models read both local and standard 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.

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).

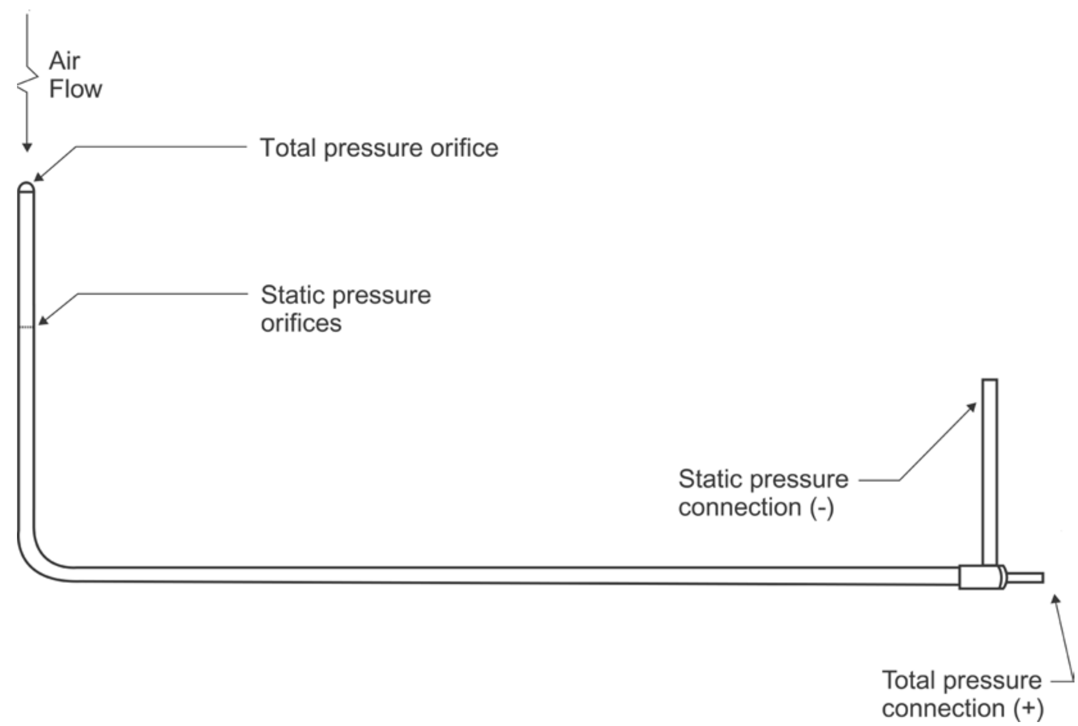



FIGURE 6.1 PITOT TUBE

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" 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 airstream; 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 display will be stored as zero. This zero will be calculated in the velocity sum and average, and will be displayed as a minimum reading of NP 0. It will also 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 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" ID 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 airstream.

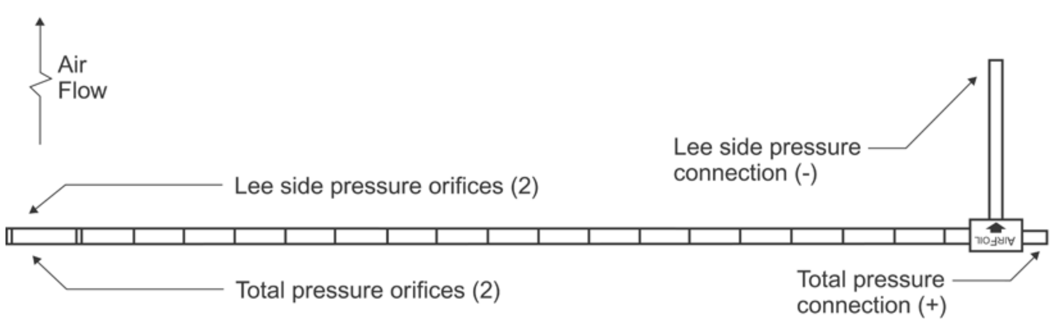



FIGURE 6.2 AIRFOIL PROBE

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" 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.

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 - AIRFOIL PROBE

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 "Kv" 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 (corrected to local air density) 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 the user knows that the hoses are reversed, the negative sign may be disregarded.

### 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 FROM VELGRID VELOCITY.

### 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.

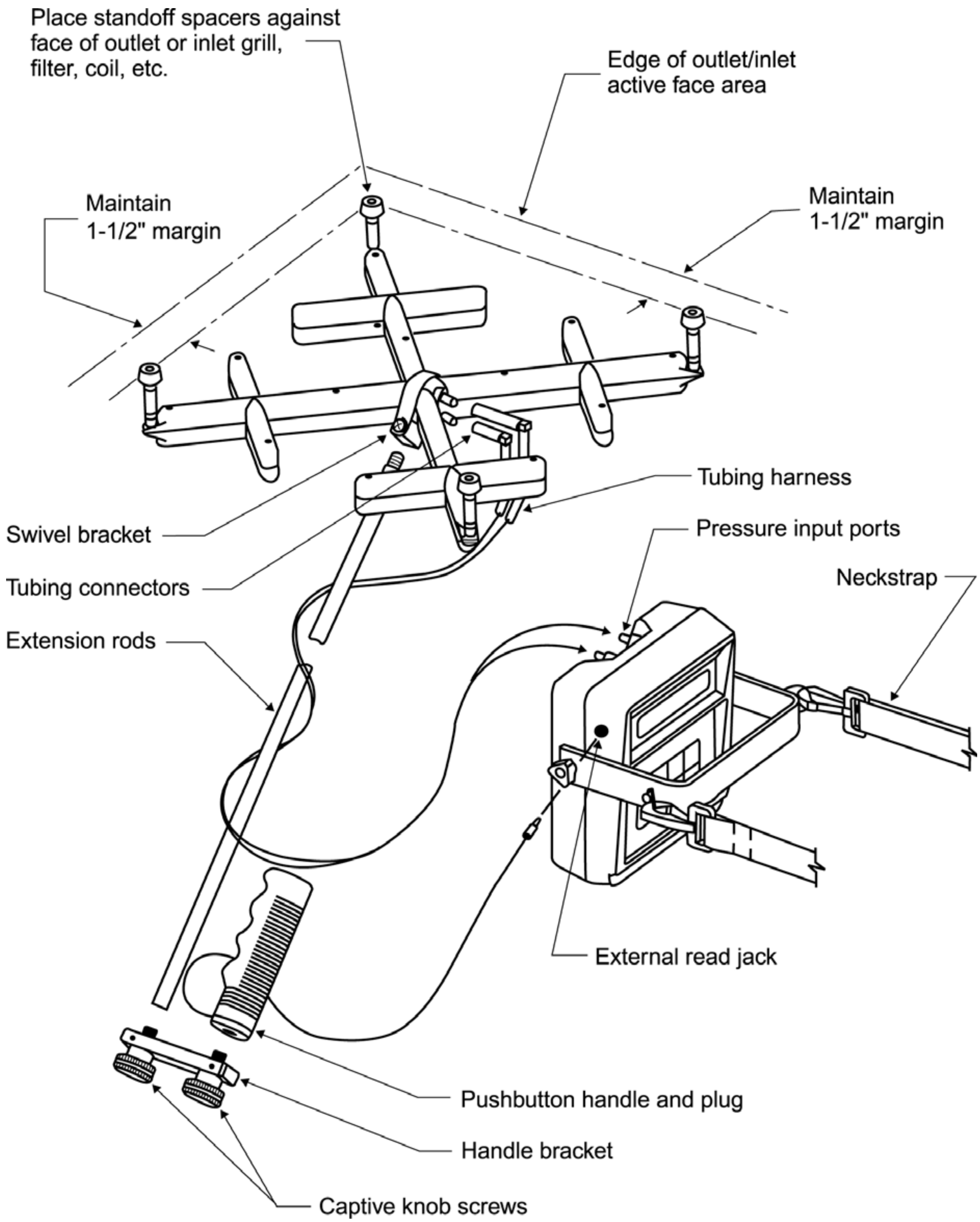



FIGURE 6.3 VELGRID ASSEMBLY

## 7.0 PRESSURE MEASUREMENT

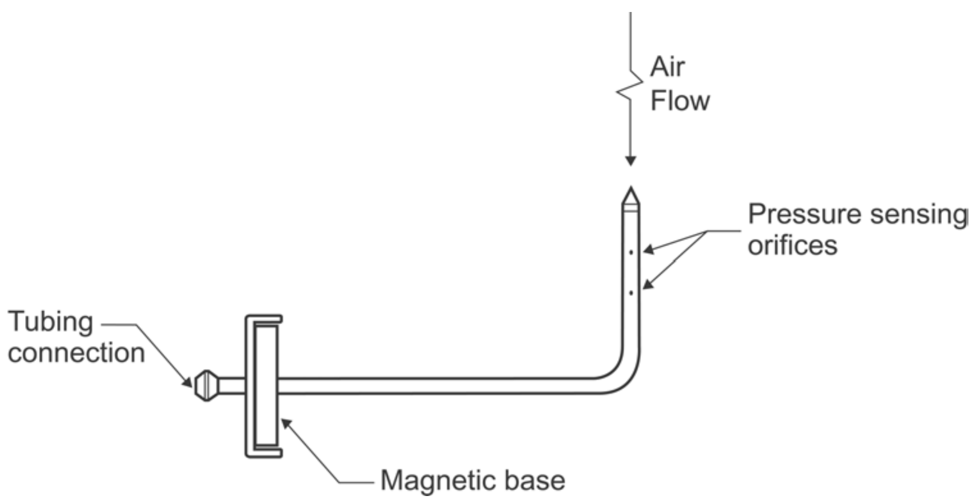
### 7.1 DIFFERENTIAL PRESSURE
Differential pressure measurements can be made with static pressure probes, a pitot tube or by connecting the pneumatic tubing directly to any appropriate pressure source **within the safe operating limits for the meter**. The manner in which a pitot tube is connected to 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. Connect the other tubing section from 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 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 the units and 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.

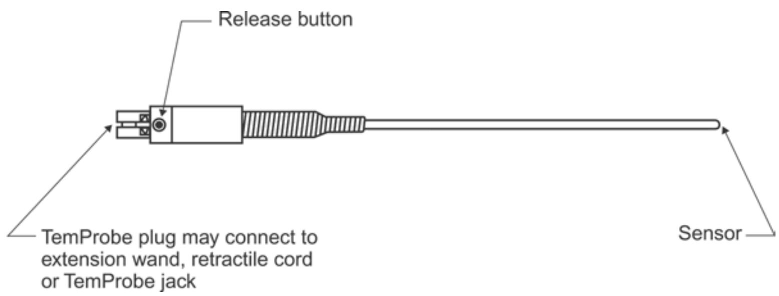



FIGURE 8.1 ADT442 TEMPROBE

Accuracy is ± 0.5˚F from 32˚F to 158˚F with a resolution of 0.1˚F using the ADT400 Series TemProbes. Measurement range for the ADT446 TemProbe is -20˚F to 180˚F and -67.0˚F to 250.0˚F for all the other ADT400 Series TemProbes. Meter will display OVER TEMP or UNDER TEMP if the probe is exposed to temperatures beyond this range. The maximum recommended safe exposure range is -100˚F to 250˚F and the probe accuracy may be effected 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 100 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 position #2 and take a reading for temperature jack #2. Continue for as many of the eight temperature jacks as needed.

The individual storage function may also be used with the MultiTemp. Select the STORE mode and then 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.

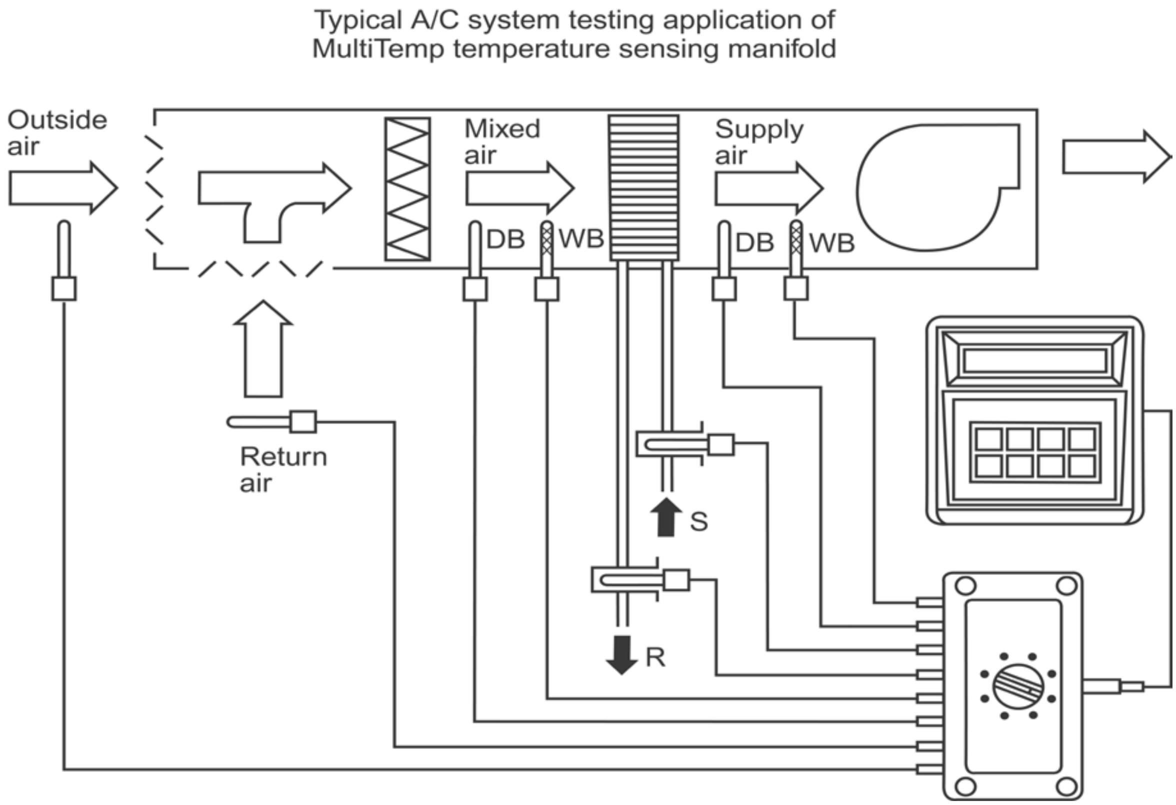



FIGURE 8.2 AIRDATA MULTITEMP

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 $\geq$ 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.

The FlowHood is a much more convenient alternative to time consuming multiple velocity readings across air diffusers, as this instrument eliminates the calculations necessary to convert the average velocity into air flow.

Air flow readings taken using the AirData Multimeter are automatically corrected for the density effect of barometric pressure. If the temperature probe has been installed during the measurement, the air flow reading is further corrected for the density effect of the temperature of the airstream, 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 the unit is unpacked. 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 10.2. 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 10.1. 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 top 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.

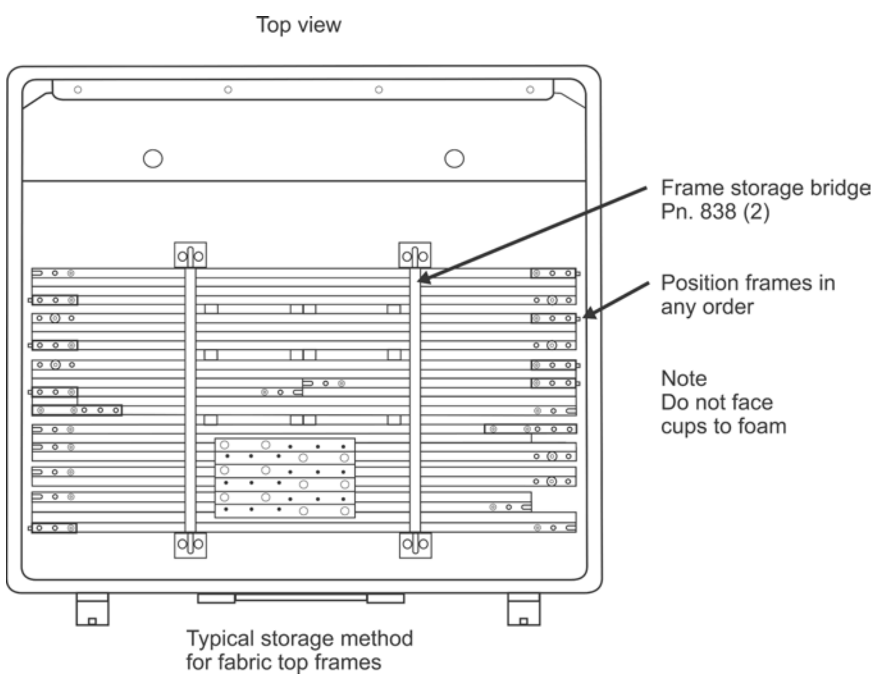



FIGURE 10.1  FRAME STORAGE

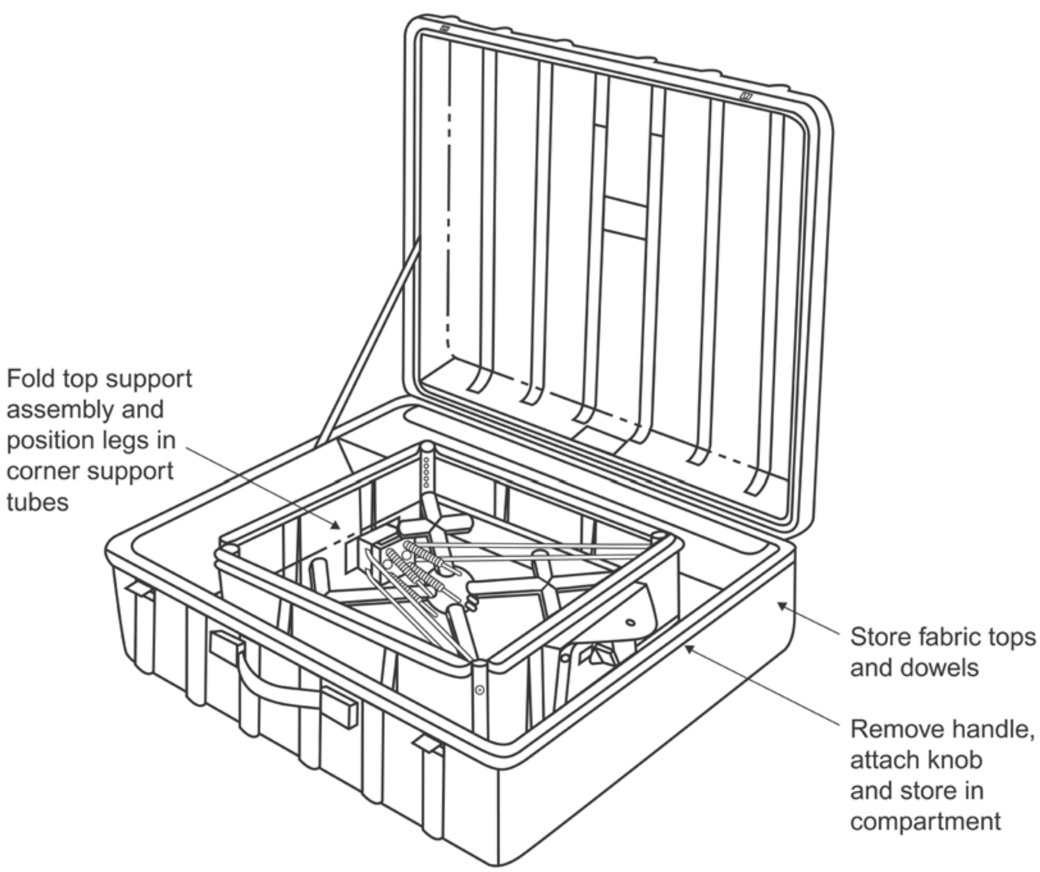



FIGURE 10.2  FLOWHOOD IN CASE

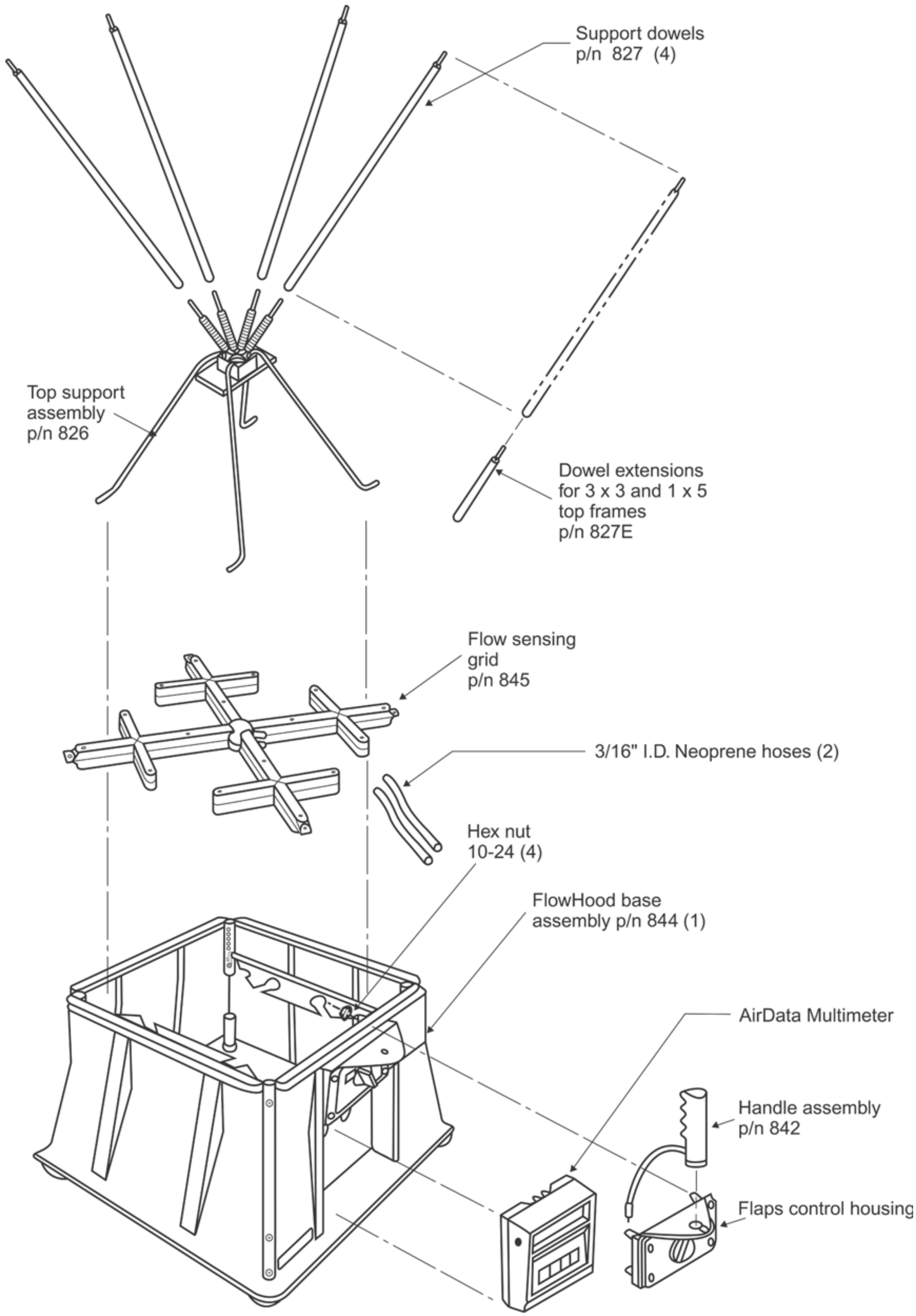



FIGURE 10.3 FLOWHOOD ASSEMBLY

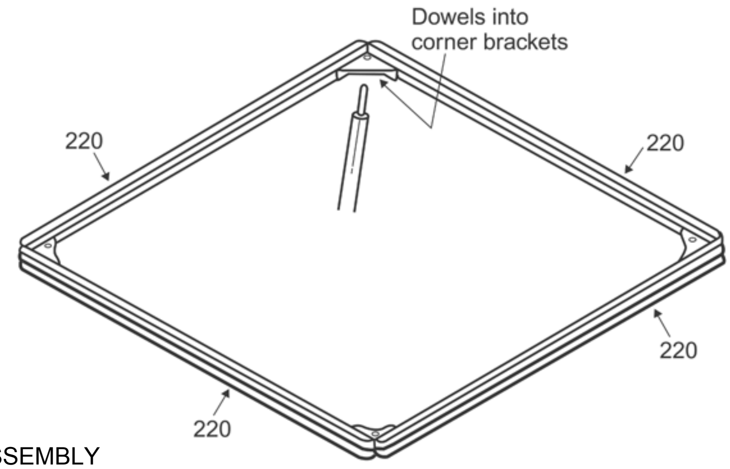


FIGURE 10.4  2X2 FRAME ASSEMBLY

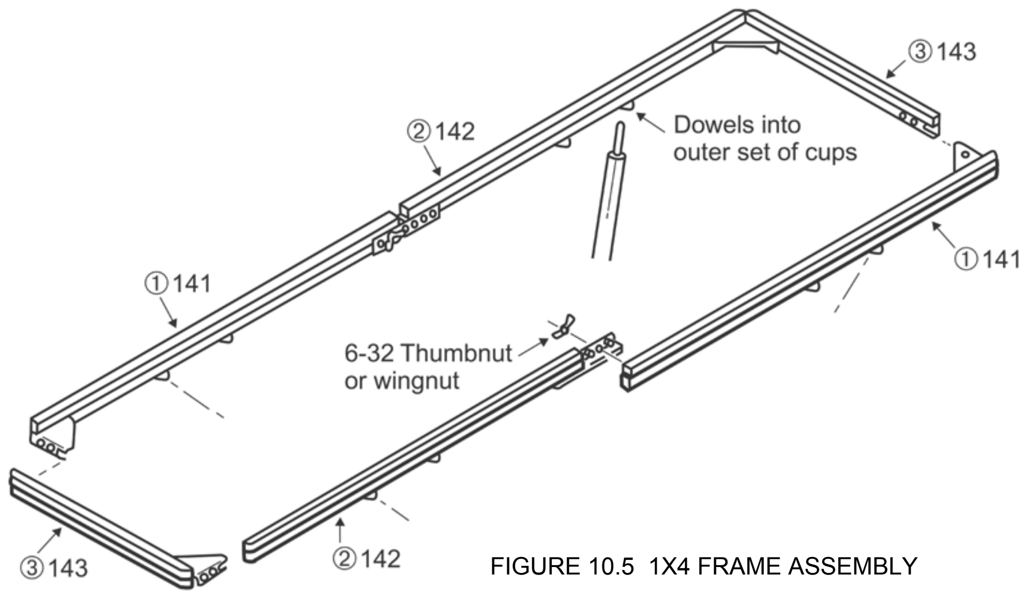


FIGURE 10.5  1X4 FRAME ASSEMBLY

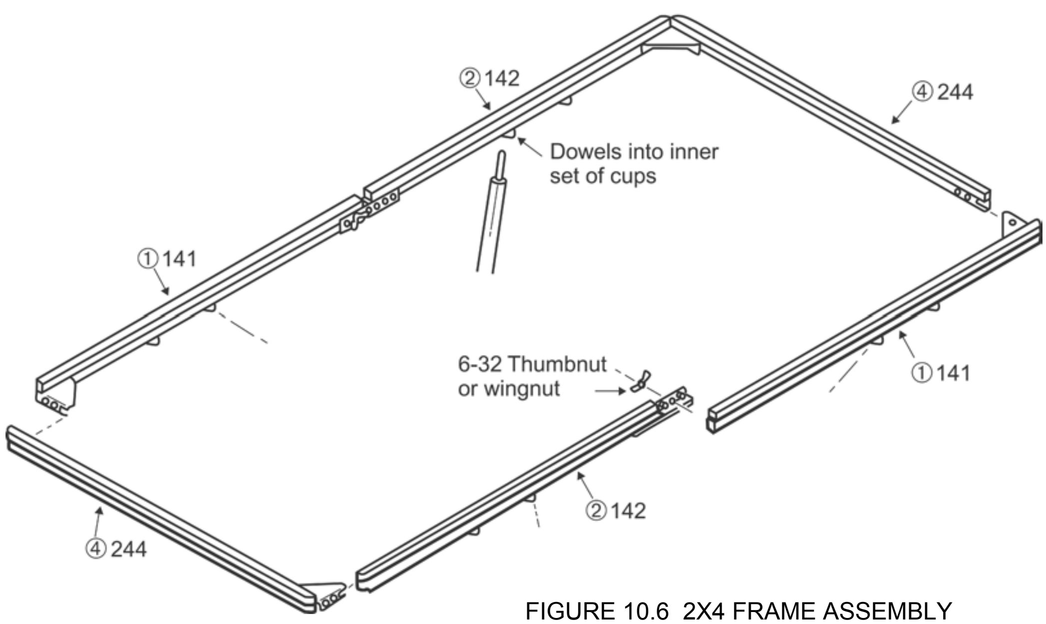


FIGURE 10.6  2X4 FRAME ASSEMBLY

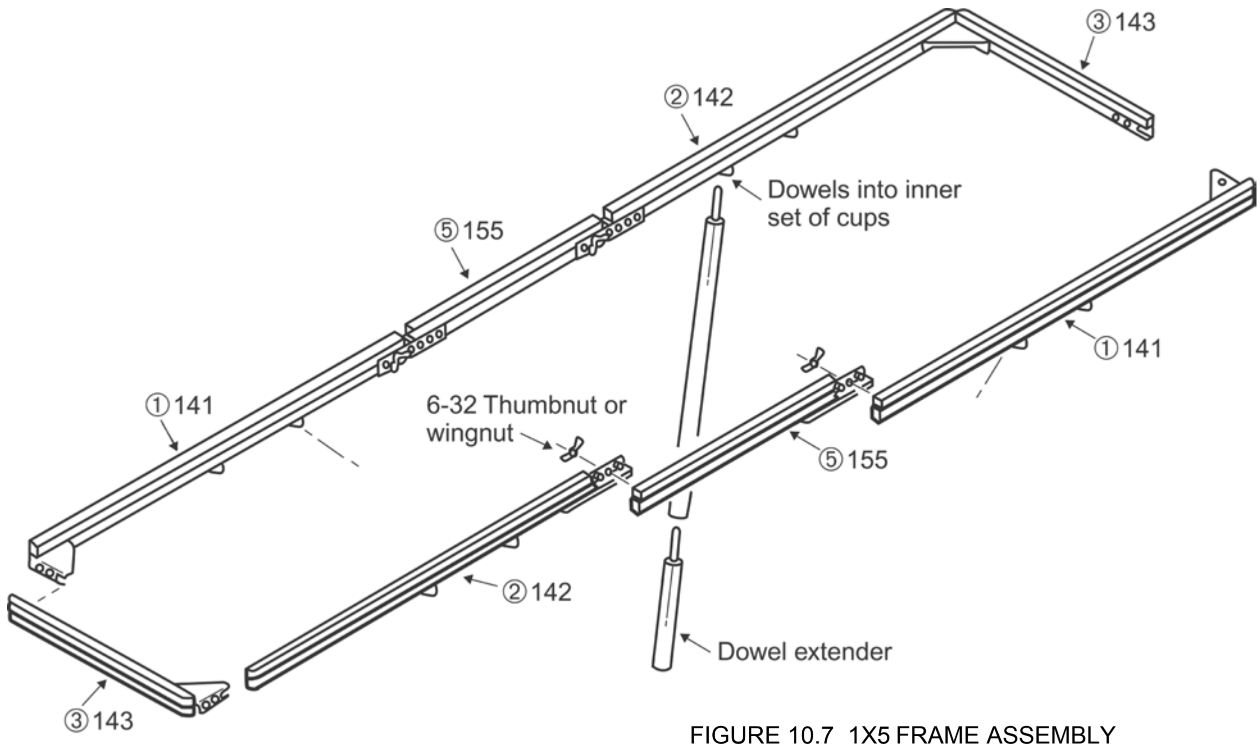



FIGURE 10.7 1X5 FRAME ASSEMBLY

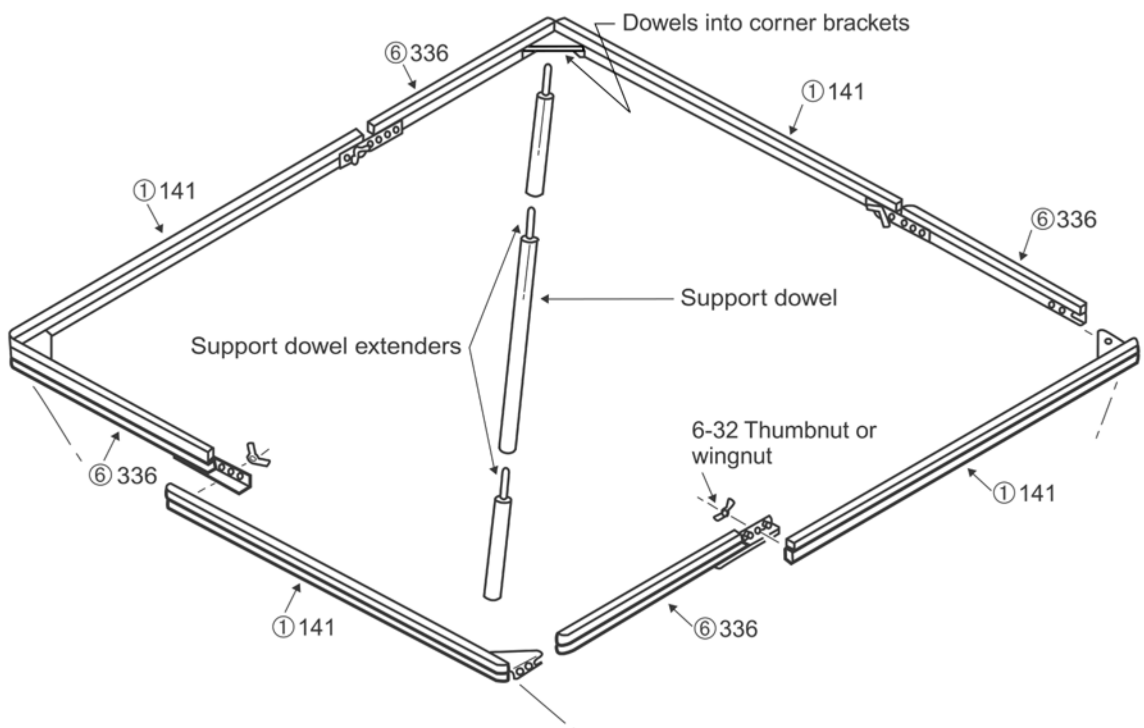



FIGURE 10.8 3X3 FRAME ASSEMBLY

## 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 very important that these connections are not reversed, since this will cause false flow measurements. The FlowHood 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.

Turn the meter on. The display will then read FLO-HOOD, followed by CF: READ. After the operator presses the READ key, either CF: UNCORR or CF: CORR, followed by LOCAL DENS, will be displayed during the measurement period if the TemProbe is being used. If the TemProbe is not being used, the standard temperature (70˚F or 21.1˚C) will be displayed following LOCAL DENS. Each subsequent air flow measurement is triggered by pressing the READ key.

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.

After the meter and all of its connections have been attached to the FlowHood, as described previously, 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 displayed result will represent 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 done 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 CF: UNCORR 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 nn. 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 flow to stabilize before taking the second reading. The compensated reading will be displayed with a ‘c’ for compensated, as CF:c nn.

### 11.2.1 MEMORY DISPLAY IN FLOWHOOD MODE

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

The average function will display two different averages. The average of just the backpressure compensated readings will be displayed as nnc nnnn. The average of just the nonbackpressure compensated readings will be displayed as nnu nnnn.

The sum function will display two different sums. The sum of just the backpressure compensated readings will be displayed as ∑c nnnn. The sum of the noncompensated readings will be displayed as ∑u nnnn.

The maximum and minimum functions will each display two different maximums or minimums. The maximum backpressure compensated reading will be displayed as $xx^{\wedge}c$ nnnn. The minimum of just the backpressure compensated readings will be displayed as $xx_{v}c$ nnnn. The maximum nonbackpressure compensated reading will be displayed as $xx^{\wedge}u$ nnnn. The minimum of just the nonbackpressure compensated readings will be displayed as $xx_{v}u$ nnnn.

### 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 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 AND CONVERSION FORMULAS

### 13.1 BAROMETRIC PRESSURE DENSITY CORRECTION - LOCAL DENSITY

The ADM-860C AirData Multimeter automatically corrects air flow and velocity readings to represent local density cfm or fpm as affected by barometric pressure.

### 13.2 BAROMETRIC PRESSURE DENSITY CORRECTION - STANDARD DENSITY

Standard density air flow or velocity is calculated as if the same mass flow (lb/min) existed at standard conditions (29.92 in Hg & 70˚F). Standard density (mass flow equivalent) results may be obtained by using one of the following conversion formulas:

#### 13.2.1 STANDARD DENSITY - TEMPROBE USED

If the TemProbe **was used** during the measurement, the conversion formula for standard density is:

$$\begin{array}{c}\textit{STANDARD DENSITY}\\ \textit{FLOW OR VELOCITY}\\ (\textit{mass flow equivalent})\end{array} = \begin{array}{c}\textit{local density}\\ \textit{flow or velocity}\end{array} \times \left(\frac{P_b}{29.92}\right) \times \left(\frac{530}{460 + {^\circ F}}\right)$$

Where: $P_b$ = local barometric pressure (in Hg)
˚F = measured temperature of the airstream

#### 13.2.2 STANDARD DENSITY - TEMPROBE NOT USED

If the TemProbe **was not** used during the measurement, the conversion formula is:

$$\begin{array}{c}\textit{STANDARD DENSITY}\\ \textit{FLOW OR VELOCITY}\\ (\textit{mass flow equivalent})\end{array} = \begin{array}{c}\textit{flow or velocity}\\ \textit{reading}\end{array} \times \left(\frac{P_b}{29.92}\right) \times \sqrt{\frac{530}{460 + {^\circ F}}}$$

Where: $P_b$ = local barometric pressure (in Hg)
˚F = measured temperature of the airstream

### 13.3 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:

$$\begin{array}{c}\textit{LOCAL DENSITY FLOW}\\ \textit{OR VELOCITY}\\ (\textit{true velocity or flow})\end{array} = \begin{array}{c}\textit{flow or velocity reading}\\ (\textit{taken in local density mode})\end{array} \times \sqrt{\frac{460 + {^\circ F}}{530}}$$

Where: ˚F = measured temperature of airstream.

### 13.4 RELATIVE HUMIDITY CORRECTION

The ADM-860C AirData Multimeter does not correct for the density effects of relative humidity on air flow and velocity readings. The effect of minor 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.

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

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

**13.5 HOT WIRE ANEMOMETER VERSUS AIRDATA MULTIMETER**

The ADM-860C AirData Multimeter measures local density **true** air velocity. 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 (0.075 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-860C 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:

$$TRUE\ AIR\ VEL\ (LOCAL) = \begin{matrix} velocity\ measured \\ (hot\ wire) \end{matrix} \ X \ \left( \frac{29.92}{P_b} \ X \ \frac{460 + {}^{\circ}F}{530} \right)$$

Where: $P_b$ = local barometric pressure (in Hg)
˚F = temperature of airstream

## 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 130º F) for 24 hours. Afterward, the batteries will need to be recharged for 10 hours at a temperature less than 113º F. If a zero bias or other problem persists, call the factory for advice.

### 14.2 DIFFERENTIAL PRESSURE FUNCTION

Check the differential pressure 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 constant 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 0.5 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 0.005 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 COMPARISONS, INCLINED MANOMETER, 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:

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

Where: $P_b$ = local barometric pressure (in Hg)
˚F = temperature of the measured airstream

If the TemProbe is not attached during the flow measurement, the FlowHood meter will assume standard 70˚F (or 21.1˚C) 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:

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

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 (or 21.1˚C) 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 COMPARISON 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:

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

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"x12"x8" 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 of the meter 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 back-light 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 RBRC® 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 RBRC® 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-860C - REPLACEMENT PARTS LIST

| Part no | No reqd per set | Description |
|---|---|---|
| ADM-860CM | 1 | Advanced AirData Multimeter |
| PS8201 | 1 | Battery charger |
| 220/110 AK | 1 | Voltage Converter 220/110 & plug adapter set |
| PS8202 | 1 | Battery charger for European use |
| 0445 | 1 | Plug adapter set 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), pushbutton handle, |
| VLG84 | 1 | VelGrid velocity grid with three 18" extension rods, bracket & 8' tubing harness |
| MC84 | 1 | Fitted foam-lined carrying case |
| IM-860C | 1 | Instruction manual - ADM-860C |
| SWE-1 | 1 | WinWedge software & sample template |
| 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 |

### 8400 FLOWHOOD

| | | |
|---|---|---|
| 844 | 1 | FlowHood base assembly with flaps |
| 845 | 1 | Flow sensing grid |
| 826 | 1 | Top support assembly |
| 842 | 1 | Pushbutton handle assembly |
| 827 | 4 | Support dowels |
| 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 |

## ADM-860C - REPLACEMENT PARTS LIST (continued)

| Part no | No reqd 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 dowel extenders |
| 14x14T | 1 | 14"x14"x14" top set complete |

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

INDEX