AIRDATA™ MULTIMETER ADM-870

ELECTRONIC MICROMANOMETER

AIR FLOW • VELOCITY • PRESSURE • TEMPERATURE

OPERATING INSTRUCTIONS

Shortridge Instruments, Inc.
7855 East Redfield Road / Scottsdale, Arizona 85260-3430
Phone (480) 991-6744 • Fax (480) 443-1267
www.shortridge.com

ADM-870 07/23/09

CONTENTS

 Addendums or revisions made to this manual after July 2009 may be found at www.shortridge.com.

ILLUSTRATIONS

1.0 INTRODUCTION

You will find these instructions much easier to follow if you have the meter 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 AirData Multimeter performs the following essential functions. This meter measures air velocity when used with a Dwyer Series 160 standard pitot tube, an AirFoil probe, or a VelGrid and automatically corrects for density variations due to barometric pressure. The meter also corrects for density variations due to temperature if the TemProbe is connected. Velocity ranges are 25-29,000 fpm using a pitot tube, 25-5,000 fpm using the AirFoil probe, and 25-2500 fpm using the VelGrid.

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

When used with the Series 8400 FlowHood System, this unit measures air flow and may compensate for density and backpressure effects, allowing direct air flow readings from 25-2500 cfm. Accurate differential pressure measurements can be obtained from 0.0001 in wc to 60.00 in wc.

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 by ambient temperatures from 40˚ F to 140˚ F.

It is recommended that the AirData Multimeter kit be returned to the factory at least every two years for recalibration and software update. This preventive maintenance program will assure that the original accuracy of the meter is maintained throughout the life of the meter.

2.0 SPECIFICATIONS

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

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

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

TEMPERATURE: Accuracy is ± 0.5˚ F from 32˚ F to 158˚ F with a resolution of 0.1˚ F using the ADT442, ADT443, ADT444, ADT445 or ADT446 TemProbes. 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 litres per second (L/s), corrected for 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 **either** local density air flow **or** standard density sea level equivalent (mass flow) for air flow or velocity. Readings are corrected for the density effects of temperature and absolute pressure.

MEMORY: 100 readings with sequential recall of each reading with average and sum.

RESPONSE TIME: Five seconds or less at pressures greater than .002 in wc (180 fpm), and up to eight seconds at less than .0003 in wc (70 fpm). SPEED-READ mode provides continuous readings in as little as two second intervals. (Accuracy specifications do not apply).

READOUT: Eight digit, 0.5 inch, liquid crystal display (LCD).

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

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: Normally two working days of heavy use, or 3000 readings per charge. A set of rechargeable type AA NiCad batteries is supplied in each meter. Batteries may be recharged up to 500 times before replacement. 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 may be seriously damaged along with the batteries and charger.

BATTERY CHARGER: The battery charger requires 120V, 60Hz, 6W. Batteries recharge in a maximum of 10 hours, and **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 allows 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. Bleedthrough (typ) 0.0004 cu in/in wc/measurement. Quiescent bleedthrough (max) 0.0005 cu in/in wc/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 internal 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 key may include multiple functions that may be activated, either alternately, or by pressing the shift key followed by the function key. The instructions 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 and vice versa.
UNITS	Alternate action for English or metric units.
DENS	Alternate action for local or standard density.
CLEAR	Clears memory, auto-read and average functions.
OFF	Turns the meter off.
AUTO	Automatic repeat reading.

B. **Lower half of keys** BLACK - always active except following SHIFT.

Control Name	Function
MODE	Sequential action for all measurement modes (air flow, velocity, pressure and temperature).
ASSOC	Recalls associated temperature and pressure for flow and velocity
STORE	Activates memory mode, then alternate action for average and for total. (This key was labeled "MEM" prior to May, 1993).
ON	Turns the meter on.
◂ RCL	Recalls stored readings in reverse order.
RCL ▸	Recalls stored readings in entry order.
READ	Initiate measurement, and SPEED-READ or halt automatic 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 air flow measurements from the FlowHood or VelGrid handgrip while working overhead or in awkward circumstances. The thumbswitch performs exactly 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 connected 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.

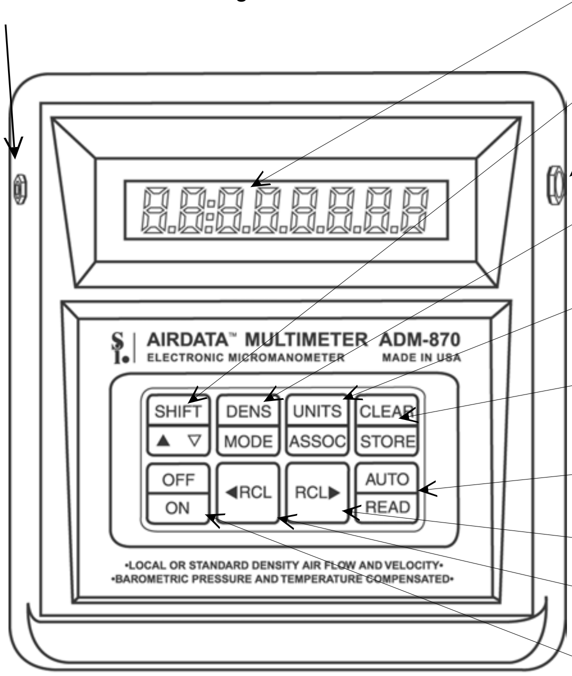
OFF/RESET SWITCH

The off/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.

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.

External Read Jack for
Pushbutton Handle Plug



ADM-870 METER FRONT

8 Digit, 0.5" LCD Display

SHIFT Activates Upper Half of Keys

Battery Charger Jack

DENS Local Density/Standard Density
MODE Flow/Pres/Temp/VLG/AFP/Pitot/Abs

UNITS English/Metric
ASSOC Associated Pressure & Temperature

CLEAR Clear for Memory and Speed-Read
STORE Memory/Average/Total

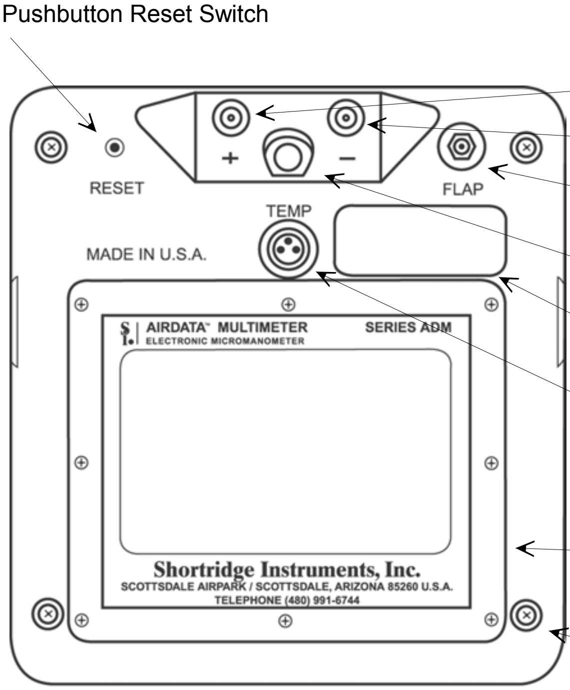
AUTO Automatic Readings
READ Read/Hold for Speed or Halt

RCL ▸ Recall in Entry Order

◂ RCL Recall in Reverse Order

OFF Power Off
ON Power On

Pushbutton Reset Switch



METER BACK

Positive (+) Pressure Port

Negative (-) Pressure Port

Flaps Jack for FlowHood Flaps Plug

Threaded Insert for Attachment to FlowHood with Captive Screw

Calibration Label with Serial Number & Date

Temperature Input Jack for TemProbe,
Retractile Cord or MultiTemp

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

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

FIGURE 3.1 ADM-870 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 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

This display 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

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

˚ C: READ

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

LS: READ

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

≡S: 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: ± nnnnn

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

≡S: ± nnnnnn
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.

8.8:8.8.8.8.8.8
A sequence of eights will be flashed briefly to test the operation of the display each time the meter is turned on.

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.

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

AUTOSTOR
This message indicates that the meter has been placed in the automatic memory mode, which integrates the automatic reading function with the sequential storage function, and permits recall of the readings, sum or average at any point. Press the READ key to initiate the actual reading process. Press and hold the READ key until HALT is displayed in order to stop the automatic reading sequence.

AUTO RDY
This message indicates that the meter has been placed in the automatic reading function. Press the READ key to initiate the actual measurement and hold the READ key down to halt the process.

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

CALC
This message indicates that the measurement sampling period has been completed, and that the calculations are in process. When CALC has been displayed, the sensors, or the FlowHood, may be removed from the measurement position without affecting the result.

CF: CORR
This message indicates that the air flow measurement being performed will be backpressure compensated.

CF: UNCORR
This message indicates that the air flow measurement being performed will not be backpressure compensated.

CLEAR
This signal is flashed as the memory, auto, or SPEED-READ function is cleared.

DIF 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 SHIFT key and then the UNITS key will switch the meter to metric units. The meter automatically starts up in English units when first turned on. Metric startup is available if requested.

ERROR

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, 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 air flow measurement process. ERROR will also be displayed during a memory sequence, either manual or automatic, that has been interrupted by an alteration in the meter set up, such as the connection of the flaps plug or temperature probe.

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.

HALT

This message will be displayed when an automatic reading sequence has been halted manually by holding down the READ key. The individual readings, or the average and total of the readings, may now be displayed if the memory mode is active.

LOCAL

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 function normally for approximately one more hour of operation before recharge is required.

LS: CORR

This message indicates that the air flow measurement will be backpressure compensated.

LS: UNCORR

This message indicates that the air flow measurement will not be backpressure compensated.

METRIC

This message indicates that the readings will be in metric units as selected by first pressing the SHIFT key and then the UNITS key.

NEGPITOT

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 the section on VELOCITY MEASUREMENT, PITOT TUBE.

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 PROBE

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

OPEN FLAP

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.

OVERANGE

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

PITOTUBE

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

PROBE

Flashes during the actual temperature measurement to confirm TemProbe function.

READING

This term is displayed during differential pressure measurements, and also during the first reading period of some automatic reading sequences.

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.

SHIFT

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

SPEED

The meter will display SPEED when the SPEED-READ mode is initiated by holding the READ key down throughout any measurement. SPEED is also displayed when SPEED readings are restarted from a HALT condition. NOTE: Accuracy specifications do not apply to SPEED readings.

STD 70˚ F

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. The correction for the ambient barometric pressure will still occur.

STORFULL

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

STOR RDY

This message indicates that the meter has been placed in the memory mode, and that selective, individually obtained readings may be sequentially entered into storage by pressing the STORE key, or by taking another reading. This function permits recall of readings with the RCL keys, or of their sum and average by pressing the STORE key, at any point.

STANDARD

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

TOO HOT or TOO COLD

If the internal temperature of the meter exceeds its operational limits, it will display TOO HOT or TOO COLD and shut down. 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 OVERANGE 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. Also, if TOO HOT/OVERANGE has been displayed, but the meter has not shut down, the TemProbe sensor may have become short circuited.

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

The meter is automatically set to read in English units and local density. The SHIFT key must be pressed, followed by the desired units or density key, to shift the meter into either the metric units function, the standard density function, or both. The meter will revert to English units and local density each time it is turned off.

After being turned on, the meter will flash a full set of eights to test the display, and will display CAL while performing a brief internal calibration test. If the FlowHood flaps plug is plugged into the meter, the meter will display FLO-HOOD and then CF: READ. If the flaps plug is not plugged in, the meter will display DIF PRES and then IN: READ and is then ready for differential pressure measurements. The functions shown in the lower dark colored section of each key may be activated directly by pressing the desired key. The SHIFT key must be pressed prior to the selection of any of the functions shown in the light colored upper half of each key. When the MODE key is pressed, the selected function will be briefly displayed, immediately followed by display of the two letter abbreviation for the function being used, combined with READ; for example, CF: READ.

After the READ key is pressed, the selected function will again be briefly displayed. READING will be displayed during the measurement period, followed by CALC during the calculation period. Then the measurement result will be displayed.

Each successive measurement is triggered by pressing the READ key, which also clears all previous data from the display. The meter remains in the previously selected units and function.

The meter will turn off automatically if it has not been used for eight consecutive minutes, except when readings have been entered into memory; or if performing measurements in the SPEED-READ mode or the automatic reading mode.

5.1 AUTOMATIC READINGS

Automatic sequential readings are initiated by first pressing the function and units keys required, then pressing the SHIFT key and the AUTO/READ key. The meter will display AUTO RDY. Pressing the READ key starts the actual measurement process. The automatic reading sequence may be interrupted by holding the READ key down until the reading in process has been completed. Release the READ key when HALT is displayed. The automatic reading sequence will be resumed if the READ key is pressed again when the display reads HALT. The automatic reading function may be exited by pressing the SHIFT key, followed by the CLEAR key.

5.2 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 sum of the 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. The STORE key is first used to place the meter in the memory function, and then is used to alternately display the average and the sum of the readings, after the readings have been entered into memory. This key is also used to interrupt the memory entry process. The last reading of a sequence is entered into memory by pressing the STORE key. The memory is cleared by pressing the SHIFT key and then the CLEAR/STORE key.

5.2.1 MEMORY OPERATION

Press the MODE key. The meter will flash the selected function followed by a READ prompt. Press the STORE key (MEM key prior to April, 1993). The meter will display STOR RDY. When the READ key is pressed, the meter will display the selected function during the measurement. (If the TemProbe is not in place during flow or velocity measurements, the meter will flash STD 70˚ F prior to the display of the result). When the READ key is pressed again, the reading that is on display will be entered into memory as the next reading is being taken. The meter will briefly flash the sequence number of the reading being placed in memory. A reading will not be entered into memory until READ is pressed for the next reading, or STORE is pressed to interrupt the sequence.

The reading and memory entry process will continue as long as you continue to take readings. When the reading shown on the display is the last reading desired, or if you wish to check the average and sum to that point, press the STORE key. The last reading will be entered into memory, and the number of readings that have been taken, along with the average of the readings will be displayed: such as 07:395. The first two digits are the number of readings taken (reading 100 is displayed as 00:nnn). The digits following the colon are the average of the readings. 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. The measurement sequence may be resumed by pressing the READ key, and may be interrupted at any point by pressing the STORE key.

If the meter's full capacity of 100 readings has been reached, STOR 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 before a new reading sequence begins.

5.2.2 RECALL

The RCL keys are used to sequentially recall all readings that are in memory, and in general are used after the STORE key has been pressed. 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.

5.2.3 DISCARD READING

A displayed reading may appear to be abnormal, may have been taken at the wrong time, or with an improperly positioned sensor. If a RCL key is pressed while a reading is still on display, that reading will be bypassed, and discarded, and will not be entered into memory. The interrupted sequence may be resumed by pressing the READ key. The readings taken after pressing the recall key to discard a reading will be integrated with the readings already in memory.

5.2.4 CLEAR MEMORY

The memory is cleared by pressing the SHIFT key followed by the STORE key. This sequence removes all readings from memory. Press the STORE key a second time and a new averaging 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 and the existing readings will remain in memory.

The measurement mode or other conditions may not be changed while the meter is in the memory function. The meter may not be turned off, either automatically or manually, after the first reading has been placed in memory unless the SHIFT key is first pressed, followed by the CLEAR key. This feature reduces the risk of accidental loss of readings from memory.

5.2.5 ERROR

ERROR will be displayed if the TemProbe is inserted or removed during an averaging sequence for flow or velocity readings. That is, if the first reading in memory was taken with the TemProbe installed, then all following readings must be taken with the TemProbe in place.

5.3 AUTOMATIC READING MEMORY

The automatic reading function and the memory function may be combined to gain the increased resolution afforded by the increased time base of the measurement interval. This function permits the operator to store up to 100 **fully automatic**, repeated readings for the same function. This measurement and storage process will continue until interrupted by the operator, or until the meter registers STORFULL at 100 readings.

The auto-reading memory sequence is initiated by first pressing the function and units keys required. Then press the SHIFT key, followed by the AUTO/READ key, then press the STORE key. The meter will display AUTOSTOR, at which point the actual measurements are initiated by pressing READ.

The auto-reading memory sequence may be interrupted by holding the READ key down until the measurement in process has been completed. Release the READ key when HALT is displayed. The auto-reading memory sequence will be resumed if the READ key is pressed again. When the auto-reading memory sequence has been completed or interrupted, press the STORE key. The number of readings and the average will be displayed. Press the STORE key a second time to display the sum of the readings, or press one of the RCL keys to recall individual readings. This function may be exited by holding the READ key down until the display reads HALT, then pressing the SHIFT key followed by the CLEAR key.

5.4 SPEED-READ FEATURE Note: Accuracy specifications do not apply to SPEED readings.

The SPEED-READ feature is used for fast automatic readings. This mode may be used for all primary functions and is especially useful for proportional air balance, which requires that the damper positions be adjusted while the air flow is being measured at the outlet. One person using the FlowHood set for SPEED-READ, can very quickly relay the required damper changes to another person who is adjusting the dampers. Damper adjustments must always be made on a proportional, percentage change basis when using the SPEED-READ feature, since these readings are not compensated for backpressure.

SPEED-READ is also useful for monitoring or averaging any measurements that are changing rapidly, such as fluctuating or "hunting" damper or temperature controls. Velocity readings at turbulent locations can also be quickly averaged by using the memory mode.

SPEED-READ must not be used for tasks which require moving a probe or the FlowHood from one location to another. Examples of improper uses are pitot tube traverses, preliminary and final outlet readings using the FlowHood, and very low readings of building or room air pressures.

The first reading taken after moving a sensor is not valid when using SPEED-READ and must not be relied upon. At least two or three more readings would have to be taken to assure a stable readout. It is faster to take individually triggered readings whenever the process requires changing positions.

5.4.1 SPEED-READ OPERATION

Hold the READ key down until SPEED is displayed. Release the READ key immediately when SPEED is displayed and automatic fast readings will begin and continue until the sequence is interrupted by pressing the READ key until HALT is displayed. (Release the READ key immediately when HALT is displayed or the reading process will begin again). Pressing the READ key again will restart the SPEED-READ process. The SPEED-READ function may be terminated while HALT is displayed by pressing the SHIFT key, followed by the CLEAR key, or by turning the meter off.

The memory function may be activated while HALT is being displayed by pressing the STORE key. AUTOSTOR will be displayed. Press the READ key and up to 100 subsequent readings will be entered into memory.

Backpressure compensated air flow measurements can not be made in the SPEED-READ function. Also, the SPEED-READ function can not be entered directly following a change in the flaps position. This limitation is designed to prevent accidental initiation of the SPEED-READ function while backpressure compensated readings are being taken with the FlowHood.

SPEED-READ can not be entered when the flaps are closed, or when the meter is already in the memory mode. However, SPEED readings can be made with the flaps closed by first starting SPEED-READ with the flaps open and then closing the flaps. This allows very low flow readings during the proportional balancing process.

6.0 VELOCITY MEASUREMENT

Air velocity measurements obtained with the AirData Multimeter are automatically corrected for the density effect of barometric pressure. The TemProbe must be used to obtain readings corrected for the density effect of temperature. If the TemProbe has not been connected to the meter, STD 70˚ F will be flashed during the calculation time, and all data will be processed using the standard temperature of 70˚ F.

An optional temperature value associated with the previous velocity measurement (associated temperature) may be recalled, without leaving the velocity mode, by pressing the ASSOC key after the velocity reading has been displayed (if the TemProbe was connected during the reading). The associated differential pressure value may also be displayed by pressing the ASSOC key again.

6.1 VELOCITY CORRECTION FACTORS

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

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

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

We continue to use A_k factors when calculating the air flow for diffusers with uneven throw and other special applications. The use of an A_k factor is not appropriate, however, in the measurement of face velocities, work zone velocities or in calculating air flow from velocity measurements at most air movement devices such as 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 resultant calculated velocity or flow will be the same if the correct "k" factor is used for each particular instrument on that device. This correction factor is not an area correction factor,"A_k" (and never really was), but is actually a "Kv" velocity correction factor which must be applied to the velocity readings obtained with a specific instrument used in a specific manner on a specific AMD.

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

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

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

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

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

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

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

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

procedures developed for measuring air velocities at a given AMD must always be used to obtain the air velocity measurements.

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

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

6.2 PITOT TUBE VELOCITY MEASUREMENT

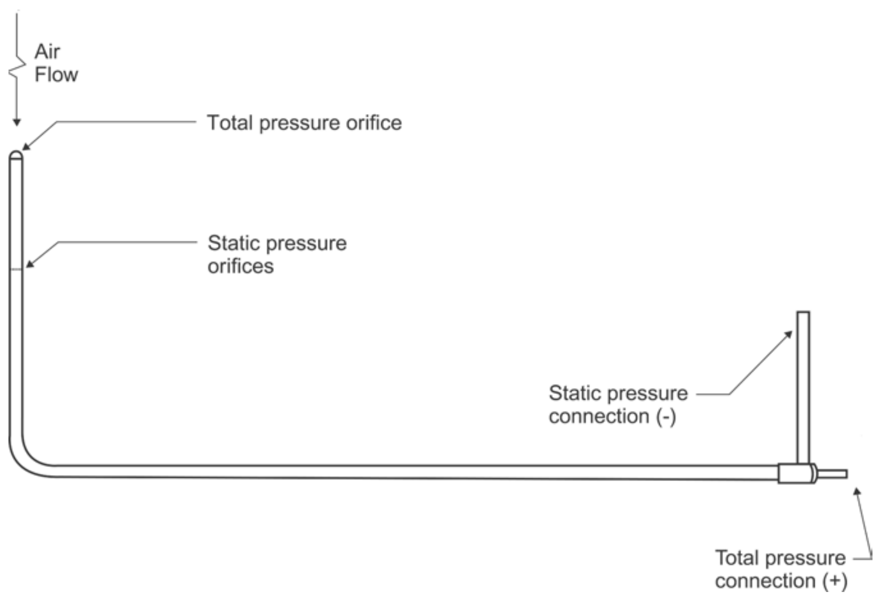
The pitot tube is primarily used to obtain air velocity measurements in ductwork. A pitot tube is stainless steel with a 90 degree bend at one end and two connectors at a 90 degree angle located near the base. The measurement range of the AirData Multimeter with the pitot tube is 25 to 29,000 fpm. (calibration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

Connect one of the tubing sections from the positive (+) port of the meter to the total pressure connection (in line with the main shaft) on the pitot tube and connect the negative (-) port to the static pressure connection (perpendicular to the main shaft). If the hoses are connected incorrectly the readings will show as negative air velocity and the meter will display NEGPITOT. 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 PITOTUBE 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. As soon as the display reads CALC, the pitot tube may be moved to the next traverse position.

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.



6.1 PITOT TUBE

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. NEGPITOT 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 pitot tube has been improperly positioned in the air stream; or if the pitot tube tip has been placed in an area of flow reversal or eddy. It is common practice, although not a purely accurate procedure, to consider negative pitot tube readings as zero in the averages of pitot tube traverse readings. If a memory sequence has been started, a NEGPITOT display will be immediately replaced by "-0". This negative zero may be entered into memory by pressing the STORE or the READ key and will be counted as a zero in the velocity average, and will be recalled as "-0". NEGPITOT (-0) readings will not be entered into memory while the meter is in the SPEED-READ memory mode). A memory sequence cannot be started with a "NEGPITOT" reading.

Air flow within the duct may be calculated by multiplying the average duct air velocity (fpm) 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.

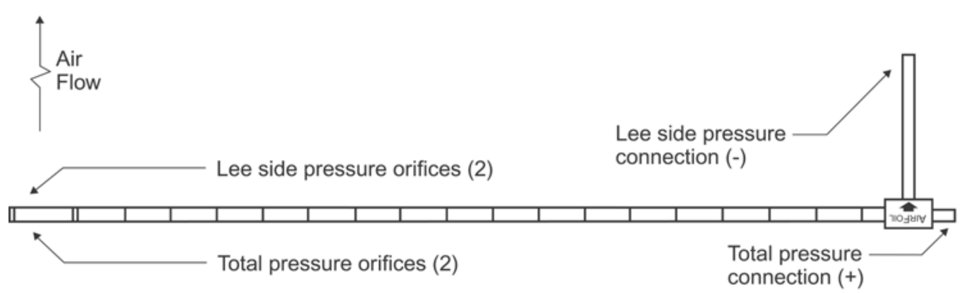
It is important to note that most publications assume that the pitot tube is reading velocity pressure, rather than velocity. A pitot tube used with the AirData Multimeter reads out directly in velocity when used in the PITOTUBE mode, and reads velocity pressure when used in the DIF PRES mode.

6.3 AIRFOIL PROBE
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 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 filter 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 static pressure connections are to be connected respectively to the positive (+) and negative (-) connections of the meter. The length of each 3/16" I.D. 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 AirFoil probe tip should be held perpendicular to the direction of the air stream. Press the MODE key until AIRFOIL is displayed. Use the retractile cord to connect the TemProbe to the meter. Insert the AirFoil probe and the TemProbe into 3/8" holes drilled into the side of the duct, being careful to align the AirFoil tip as discussed above. Press the READ key to obtain the air velocity measurement. As soon as the display reads CALC, the AirFoil probe may be moved to another position.



6.2 AIRFOIL PROBE

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 static pressure connector should point downstream with the air flow.

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 AirFoil probe measurement depth. It is helpful to apply a single wrap of electrical tape around the 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

The AirFoil probe may be used to test the downflow air pattern and average velocity in the horizontal plane at the sash height of fume hoods and 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 of the downflow grid should be recorded to establish the "evenness" and compliance with the standards required. Also the average of the downflow readings may be used to calculate the downflow cfm if required.

The work opening face velocity on total exhaust cabinets may be tested in a manner similar to procedures for fume exhaust hoods. The velocity sample grid should be a 4" square grid for 8" sash height and a 5" grid for 10" sash settings. When calculating average velocity or total flow, the "K_v" factor must be taken into account as discussed in Section 6.1 VELOCITY CORRECTION FACTORS.

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

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

The AirData Multimeter default air density correction is to local air density with reference to barometric pressure. Comparison with "hot wire" anemometer readings may require the correction of the "hot wire" readings to local density conditions. See Section 13.4 HOT WIRE ANEMOMETER VS AIRDATA MULTIMETER. Also, see Section 6.5 VELOCITY: LOCAL VS STANDARD DENSITY.

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 or safety cabinet. 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 can not 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° 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 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"x14" 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 6.4. 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 STD 70˚ F.

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). STOR 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"x14" area.

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

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

6.4.1 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 aligned with the plane of the sash. Correct positioning of the VelGrid is easier if 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.

6.4.2 LAMINAR FLOW WORKSTATION - VELGRID

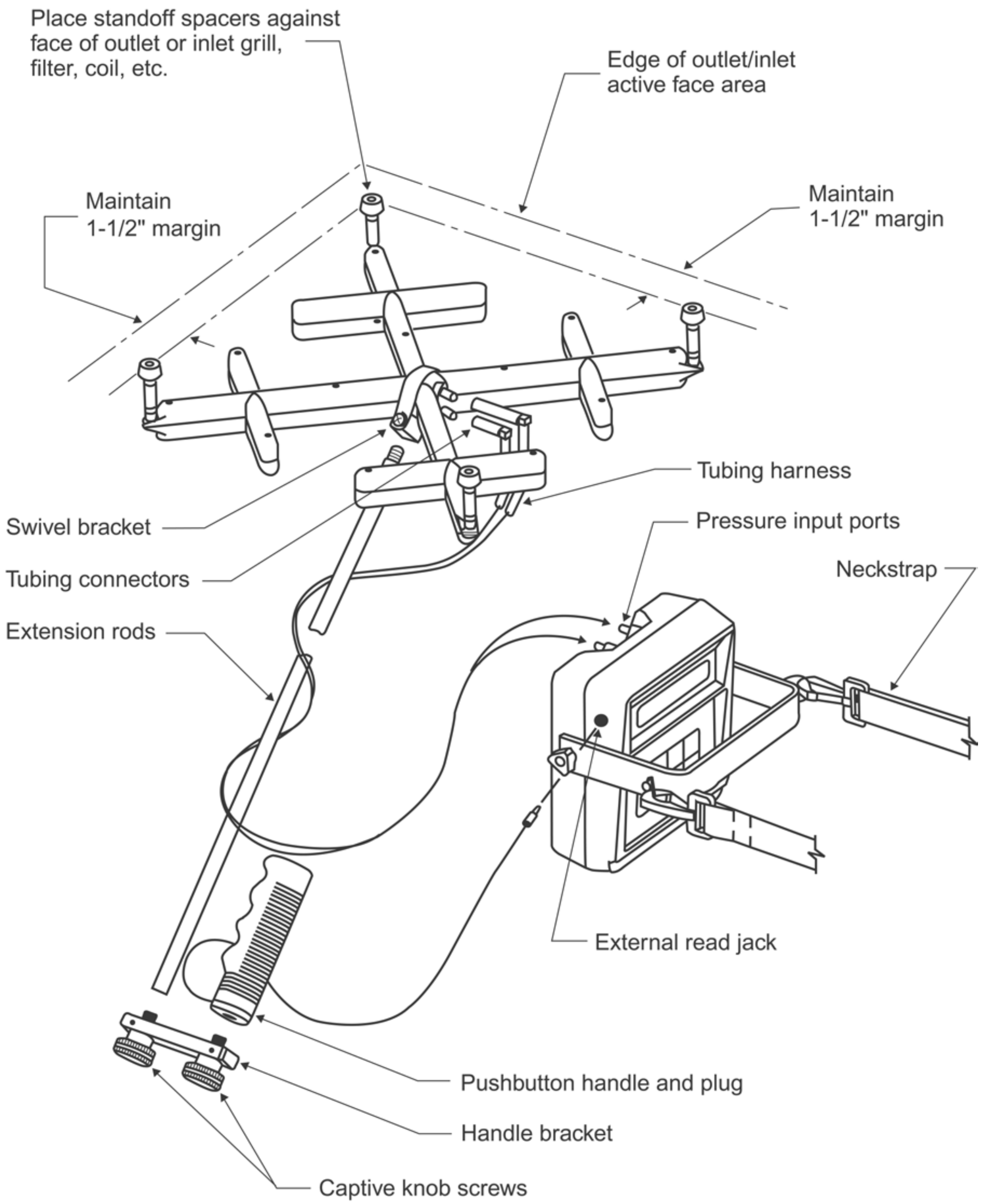
The VelGrid can be used to measure average face velocities at the work zone or plane of a laminar work station using much the same method as described for chemical exhaust hoods. It is important to position the leading edge of the VelGrid at 90° to the direction of air flow when measuring work zone velocities. 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 6.4.3 AIR FLOW CALCULATION.

6.4.3 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. See Section 6.1 VELOCITY CORRECTION FACTORS.

The measurement of exhaust hood intake velocity requires careful placement of the VelGrid to align the leading edge of the grid directly in line with the plane of the sash opening. Maintain the 1.5" perimeter margin as illustrated. The total intake area and air flow of an exhaust hood includes all areas of air entry, including the space behind and around the sash; under the threshold; and through service openings. It is accepted practice to assume that the velocity through these additional areas is the same as that of the sash opening area. (See Section 13.4 regarding hot wire anemometer reading correction for true air velocity).



6.3 VELGRID ASSEMBLY

6.5 VELOCITY: LOCAL DENSITY VS STANDARD DENSITY (MASS FLOW)
The AirData Multimeter measures **true** air velocity past the sensor at a given time, when used in the **local density** mode. This is in contrast to thermal anemometers or "hot wire" instruments which measure mass flow (mass flux/unit time). Mass flow represents the number of molecules of air flowing past a given point during a given time. Mass flow only represents true velocity when measured at standard sea level conditions of 29.92 in Hg and 70˚ F (.075 lbs/cu ft). Hot wire, mass flow, "velocity" readings at density conditions other than standard must be corrected for local air density conditions if these results are to represent true velocity.

Air velocity readings taken with the ADM-870 in the **standard density** mode are comparable to readings taken with a hot wire anemometer. If velocity readings taken with the AirData Multimeter are to be compared with hot wire anemometer readings, the actual air velocity should be measured in the **local density** mode with the AirData Multimeter, and the **hot wire readings must be corrected** for local air density conditions.

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

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

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

7.0 PRESSURE MEASUREMENT

7.1 DIFFERENTIAL PRESSURE

Differential pressure measurements can be made with static pressure probes, pitot tubes, 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 being made. The meter will display DIF PRES and read out in the same units for all types of differential pressure measurements. The operator must use care to keep track of the type of differential pressure being measured.

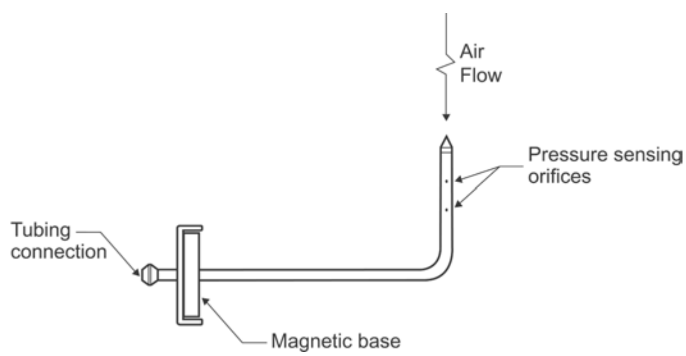
The positive (+) and negative (-) ports of the meter are connected as a pair to the pneumatic pressure source for differential pressure measurements. Maximum safe pressures for differential pressure measurement are 20 psid (900% full scale) and 60 psia common mode. The length of each external pneumatic tube should not exceed 18 feet of 3/16" ID tubing. The handle on the meter may be locked in various positions, allowing the meter to be set upright in order to avoid kinking the pneumatic tubing.

The meter will automatically select the differential pressure mode when first turned on if the flaps plug is not plugged in. The meter will display DIF 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 on 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 the pitot tube is used and the meter is set to read out in differential pressure. The resulting reading is recorded as velocity pressure. Connect one of the tubing sections from the positive (+) port of the meter to the total pressure connection (in line with the main shaft) on the pitot tube and connect the negative (-) port to the static pressure connection (perpendicular to the main shaft). 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 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 exposed to the ambient pressure. Insert the pitot tube into the airstream as discussed under VELOCITY PRESSURES above. The resulting differential pressure represents total pressure.

7.2 ABSOLUTE PRESSURES

The absolute pressure function is intended mainly to provide automatic air density correction for 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 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 avoids excessive differential pressure input which will damage the differential pressure transducer. Maximum safe pressure is 60 psia common mode and 20 psi differential pressure.

The absolute pressure measuring accuracy should be checked regularly. 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.

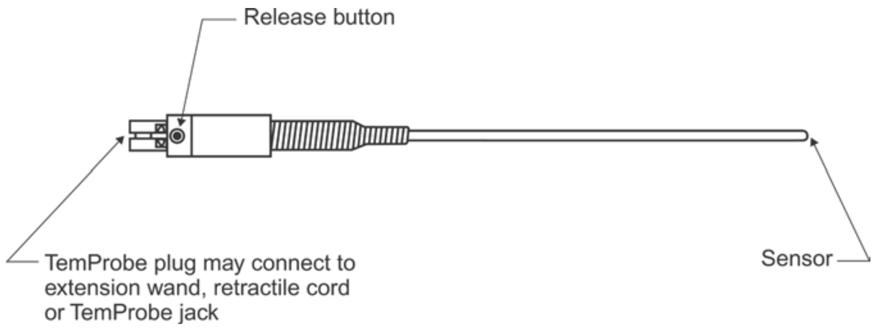
NOTE: Weather service or airport reports of barometric pressure have usually been adjusted for altitude, so the pressure can be used for altimeter adjustment. The barometric pressure announced on television or radio stations is generally obtained from weather service reports. This altitude corrected 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

The TemProbe temperature probe is used for temperature measurements. 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.

After turning the meter on, press the MODE key until ˚ F: READ is displayed. Then, using the retractile cord if necessary, place the TemProbe sensor in the medium to be sampled. If the TemProbe is not installed on the meter, or if it is open circuited (defective), the display will read NO PROBE.



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 temperature cable extenders reduces the meter reading by a non-linear degree depending on the combination of cable type, length and TemProbe temperature. The offset correction 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 as a unit with six insertion probes, two surface probes, one eight-position switch, and a padded 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 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 point 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 under USING THE AIRDATA MULTIMETER. Set the MultiTemp for switch position #1 and take a reading for the probe connected to temperature input jack #1. Turn the switch to switch position #2 and take a reading for temperature jack #2. Continue for as many of the eight temperature jacks as needed.

The individual reading storage function may also be used with the MultiTemp. Set the meter for the individual storage function. 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.

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

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

Additional points may be measured in the same measurement sequence by using more than one MultiTemp switch unit connected in series (piggybacking). Reading and memory entry of 64 temperature points would take about two minutes (after temperature probes have stabilized).

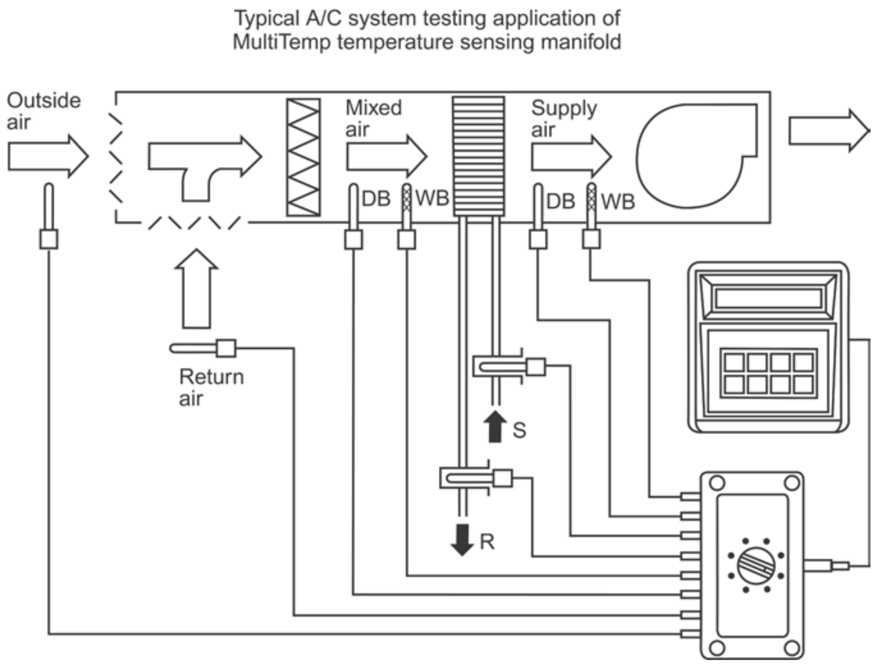


FIGURE 8.2 AIRDATA MULTITEMP

The temperature probes used with the MultiTemp and AirData Multimeter are typically interchangeable to within 0.4˚ F. 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 uses 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 due to barometric pressure. If the temperature probe has been installed during the measurement, the air flow reading is further corrected for the density effect due to the temperature of the air stream, and the result is corrected for local air density. If flow measurements are initiated without the temperature probe, STD 70˚ F will be flashed on the display immediately prior to the display of the air flow reading. The flow is calculated using an assumed standard temperature of 70˚ F.

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 correction factor for a particular system. This "average" correction factor does not specifically apply to each outlet, but only to the average outlet for that system. This method, commonly used in the air balance industry, may result in significant inherent errors, particularly in flow readings taken at low resistance outlets, and also on the larger, more efficient, low resistance, ducted or "extended plenum" types of air delivery systems.

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

10.0 FLOWHOOD ASSEMBLY

10.1 UNPACKING

The FlowHood case has been specifically designed for the most efficient storage and handling of the FlowHood unit and its accessories. Note the arrangement of the various items as you unpack the unit. Especially note the placement of the foam cushioning around the instrument, and the orientation of the meter face toward the side of the case. The FlowHood should be packed in exactly the same manner whenever it is returned for recalibration. The foam packing and carton should be saved 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 on the base. The head of the support assembly should be positioned toward the back of the base assembly. The four spring rods are positioned downward, so that they do not directly contact the flow sensing grid. Foam packing, cloth skirts and accessories should not be stored on top of the grid.

10.2 FRAME CHANNELS

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). Each top is attached to its 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 SUPPORT ASSEMBLY

The top support assembly and support dowels are assembled as shown in Figure 10.3. Position the 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 (see 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 CORRECT METHOD OF ASSEMBLING STANDARD FLOWHOOD TOPS AND FRAME SETS.

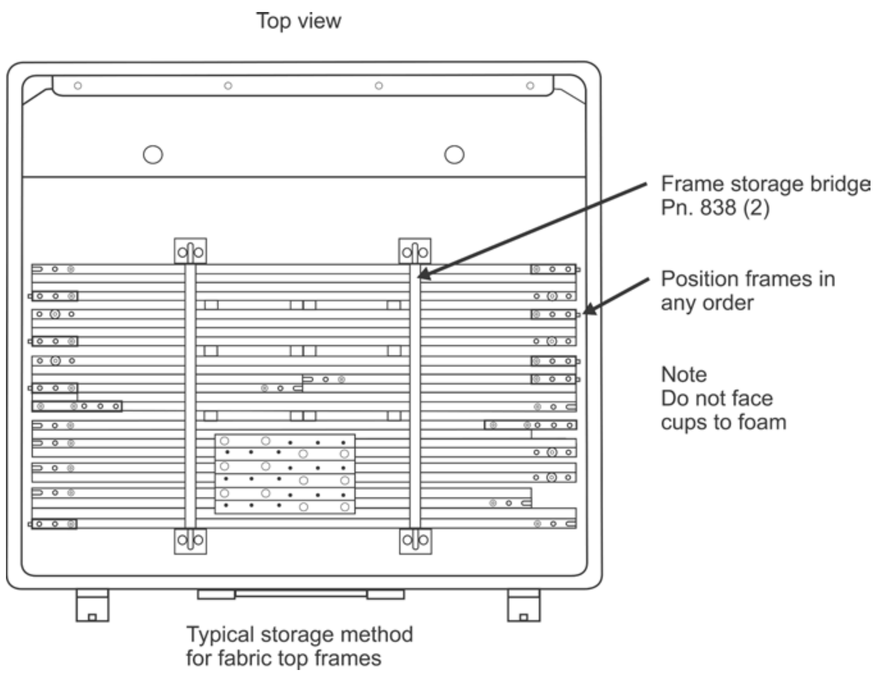


FIGURE 10.1 FRAME STORAGE

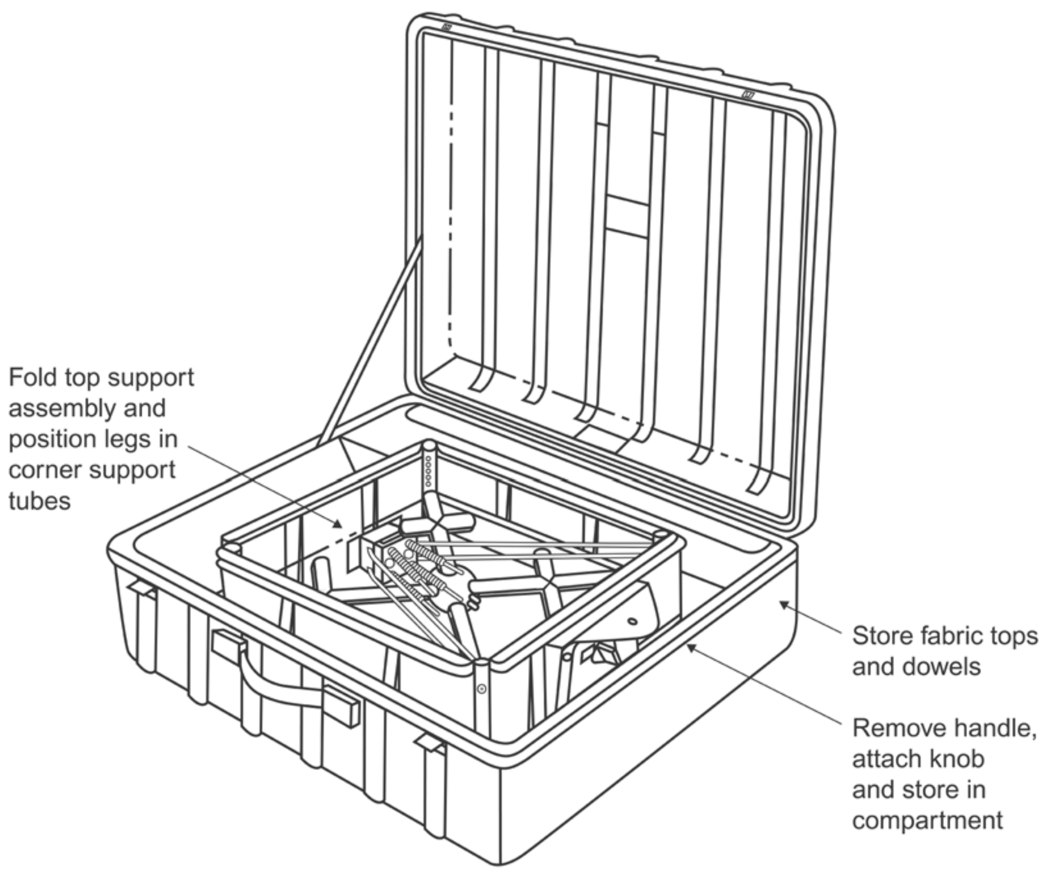


FIGURE 10.2 FLOWHOOD IN CASE

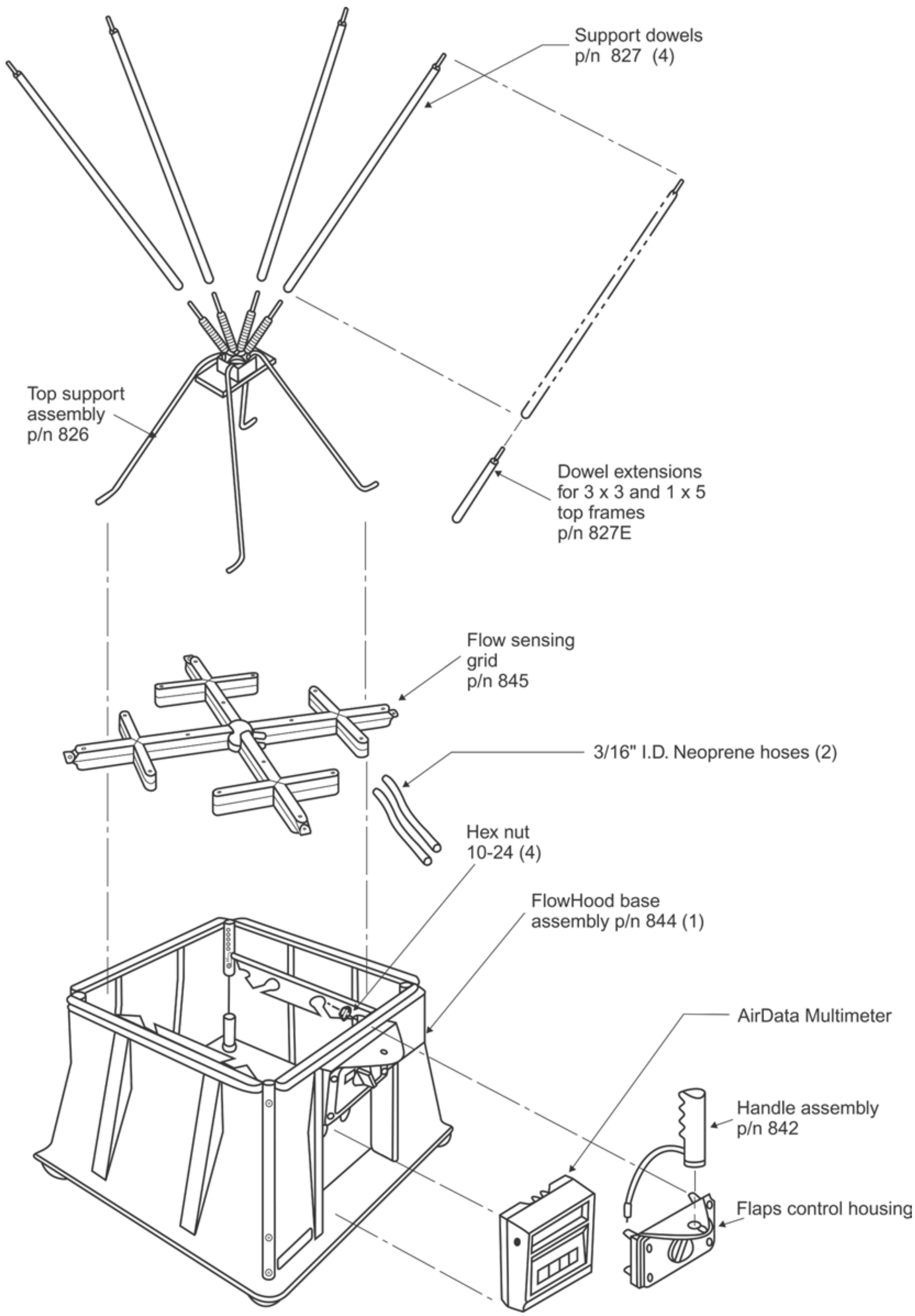


FIGURE 10.3 FLOWHOOD ASSEMBLY

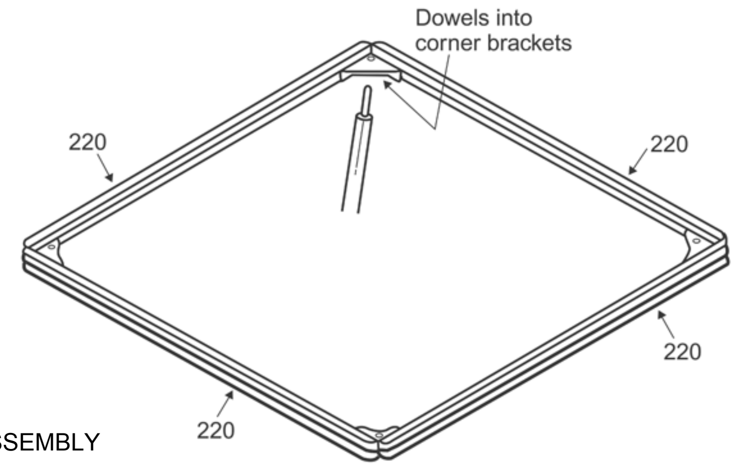


FIGURE 10.4 2X2 FRAME ASSEMBLY

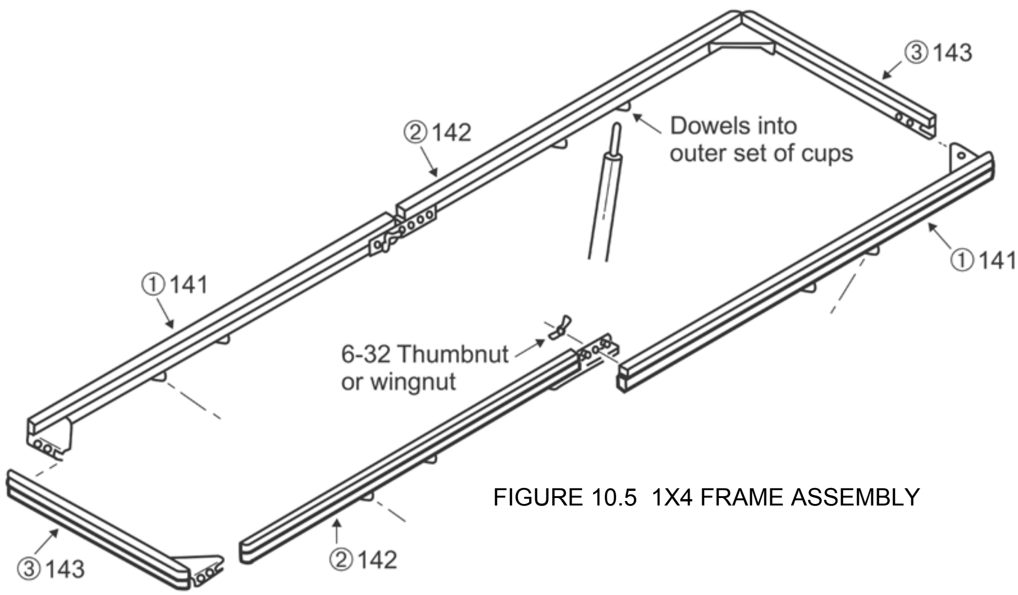


FIGURE 10.5 1X4 FRAME ASSEMBLY

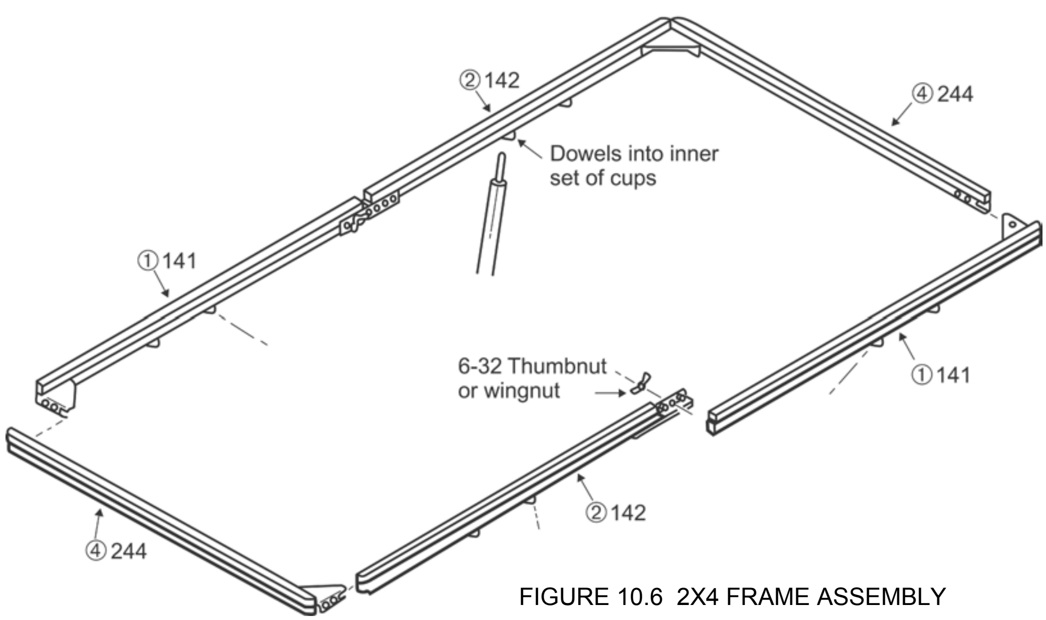


FIGURE 10.6 2X4 FRAME ASSEMBLY

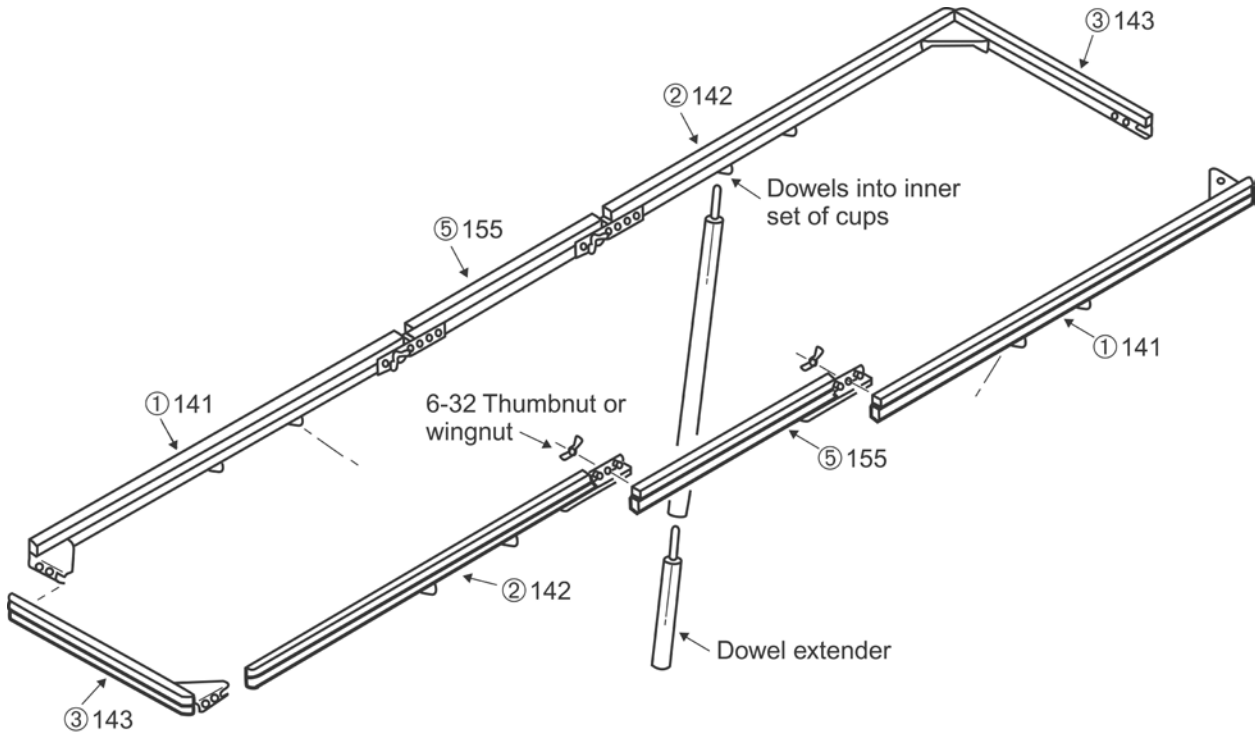


FIGURE 10.7 1X5 FRAME ASSEMBLY

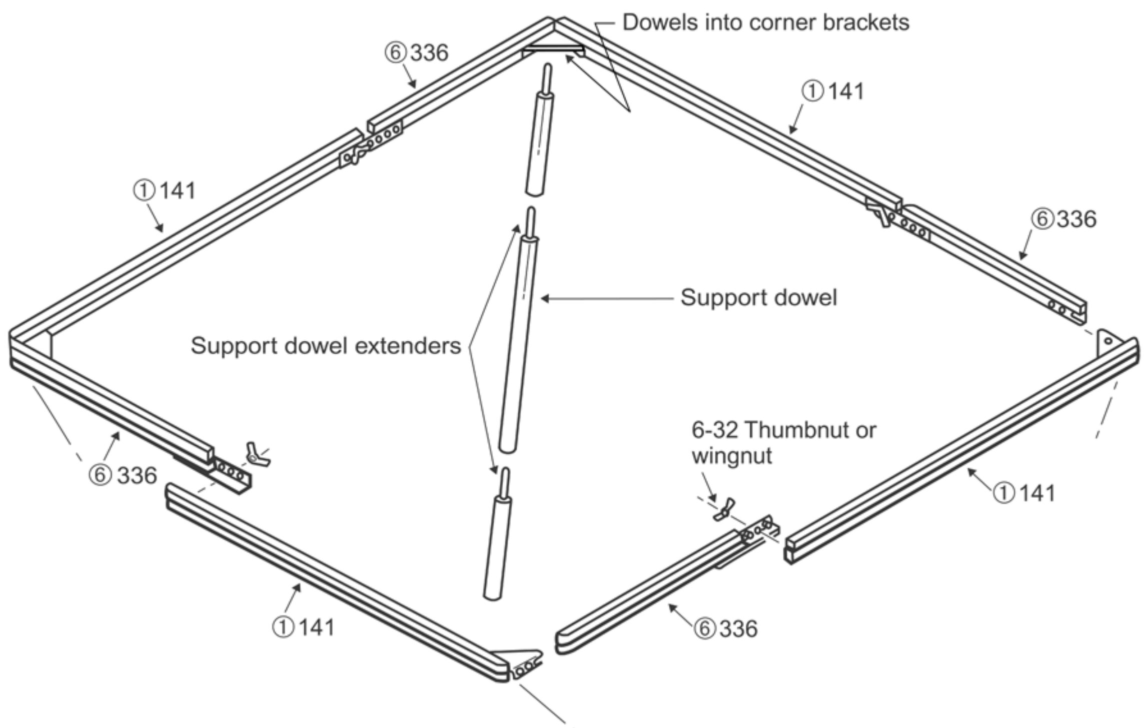


FIGURE 10.8 3X3 FRAME ASSEMBLY

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 invalid flow measurements. The flaps plug inserts into the flaps jack 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 is plugged 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.

After being turned on, the meter will flash a full set of eights to test the display, and then pass through a brief CAL phase. The display will then read FLO-HOOD, followed by CF: READ. After the operator presses the READ key, either CF: UNCORR or CF: CORR will be displayed during the measurement period. CALC will be displayed during the brief calculation period, followed by the results. Each subsequent measurement is triggered by pressing the READ key. Pressing the READ key also clears all previous data from the registers and the display. The meter will automatically turn off if not used for eight consecutive minutes unless readings are stored in memory.

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 litres/sec. A negative number indicates that the air flow is being exhausted through a return outlet (or that the hoses are crossed). A second reading with the flaps closed will be necessary to determine the backpressure compensated 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 throughout 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 is 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.

Readings as low as 23 cfm may be taken with the flaps open. Readings as low as 17 cfm may be taken with the flaps closed (see section 12.5 LINEAR SLOT DIFFUSERS). The meter will not permit nonbackpressure compensated readings of more than 500 cfm if the flaps are closed. The flaps must be opened to continue.

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 is used for both supply and return outlets. Backpressure compensation readings may be performed at any flow rate, but are usually unnecessary at flows less than 80 cfm.

First, perform the nonbackpressure compensated portion of the measurement with the flaps open, as described above. Close the flaps when the meter displays CALC. When the first reading is displayed, 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. Reposition the FlowHood as before, and wait two or three seconds for the flow to stabilize before taking the second reading. The FlowHood may be removed from the outlet as soon as CALC is displayed. The compensated reading will be displayed within two seconds.

11.2.1 ERROR

The meter may display ERROR following a backpressure compensated measurement in which the numerical ratio of the two parts of the measurement sequence exceeds predetermined limits. Normally this indicates 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. ERROR may also be displayed as the result of measurements taken at extremely low resistance outlets (less than .003 in wc @ 500 cfm). These outlets are not 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 readings after balancing is complete. Nonbackpressure compensated readings require less time and are usually adequate for the proportional balancing of outlets (see Section 5.4 SPEED-READ).

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 useable 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 reattain 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 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-870 AirData Multimeter automatically corrects air flow and velocity readings to represent local or standard density cfm or fpm as affected by barometric pressure.

13.2 TEMPERATURE DENSITY CORRECTION

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

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

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

Where: ˚F = measured temperature of air stream.

13.3 RELATIVE HUMIDITY CORRECTION

The ADM-870 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.

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

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.

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

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

13.4 HOT WIRE ANEMOMETER VERSUS AIRDATA MULTIMETER

The ADM-870 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 29.92 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-870 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:

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

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

14.0 METER ACCURACY FIELD TESTING

14.1 METER ZERO FUNCTION

Take several readings with the meter set for air flow or velocity, with no air passing through the FlowHood unit. The meter should display zero readings, but may occasionally show a low reading such as 25 cfm. 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 measurements. Check for any obstruction of meter connections and clean if needed.

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

14.2 DIFFERENTIAL PRESSURE FUNCTION

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

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

Confirm the accuracy of the absolute pressure correction by taking a reading with the meter ports open to the atmosphere and compare the reading with the actual barometric pressure. The reading should be within ± 2% (approximately .5 in Hg) of the actual barometric pressure to maintain the specified accuracy of 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 (-) parts at the same time. This precaution avoids excessive pressure input to the differential pressure transducer.

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

14.4 AIR FLOW ACCURACY

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

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:

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

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

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

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

Where: P_b = Local barometric pressure (in Hg)

14.6 DUCT TRAVERSE USING THE AIRDATA MULTIMETER

No corrections for density are necessary when the AirData Multimeter is used with a pitot tube 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 the flow or velocity measurement, it must not be used for the other type of measurement. In this case, both sets of measurements will be calculated using standard 70˚ F conditions.

14.7 BACKPRESSURE COMPENSATED COMPARISON READINGS

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 READINGS

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:

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

Where: $FLOW_1$ = flow calculated from duct traverse
$FLOW_2$ = flow in duct with FlowHood in place (flaps open)

15.0 METER & FLOWHOOD MAINTENANCE

15.1 METER MAINTENANCE

The AirData Multimeter is a precision instrument designed for long term field use if given reasonable care and maintenance. The meter and accessories 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.

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.

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.

If rechargeable batteries are not available in a field situation, the batteries may be replaced with 12 non-rechargeable, alkaline "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.

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. This preventive maintenance program will assure that the original accuracy of the meter is maintained throughout the life of the meter.

15.2 FLOWHOOD MAINTENANCE

The flow sensing grid in the FlowHood unit is constructed of 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 as heat may cause the fabric to shrink. Excessive dirt build up should be avoided. The tops must be air dried only, as heat may cause the fabric to shrink. 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.

16.0 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 repairs begin unless the customer specifies otherwise.

The complete meter kit and all accessories should be returned to the factory for recalibration and repair. If just the meter must be returned for repair, 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 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 to be 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 and for the density effects of 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, as 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 accurate equal base pressure of approximately 3 psi before adding 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 or return the meter.

1. Check the battery charger transformer. The output should be 24 to 30 volts AC with 115 volt, single phase input. Be sure the charger is plugged into a live outlet.

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 (8) small phillips head screws. Check the battery clips. Remove the batteries and respring 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)(+) (6 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 6.6 volts and 7.8 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. The meter must be returned to the factory for repair.

   c. Test the lower (negative)(-) half of the battery set in the same manner described above by placing the voltmeter probes at the left center battery clip 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 (milliamphr) as the existing cells. If the same capacity cells are not available, replace all 12 cells with new batteries. See "Operating Instructions" manual section titled METER MAINTENANCE.

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

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.

REPLACEMENT PARTS LIST

Part no	No rqd per set	Description
ADM-870M	1	AirData Multimeter
PS8201	1	Battery charger
AA-NICAD	12	Rechargeable Ni-Cd batteries
ADT442	1	TemProbe temperature probe - 4" x 1/8" diameter
TRC16	1	Temperature retractile cord - 1'x 6'
TEW19	1	Temperature extension wand 19"
A-303	2	Static pressure tip
160-18	1	Pitot tube - 18" length
NT316	1	3/16" ID Neoprene tubing, two 5' lengths
AFP18	1	AirFoil probe, 18" length (24", 36" or 48" available)
VLG84	1	VelGrid with three 18" extension rods, pushbutton handle, bracket & 8' tubing harness
MC84	1	Fitted foam-lined carrying case
IM-870	1	Instruction manual - ADM-870

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

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

REPLACEMENT PARTS LIST (continued)

Part no	No rqd per set	Description
		3' x 3' TOP (91.4 x 91.4 cm)
141	4	Side channel (type 1)
336	4	Side channel (type 6)
3x3F	1	Complete frame assembly (all of above)
3x3S	1	Cloth skirt (36" x 36")
827E	8	Support dowel extenders
3x3T	1	3x3 top set complete
		14" x 14" TOP (35.6 x 35.6 cm)
111	4	Replacement side channel (14" length)
14x14F	1	Complete frame assembly
14x14S	1	Cloth skirt (14"x14"x14" height)
827E	4	Support dowels extenders
14x14T	1	14"x14"x14" top set complete

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