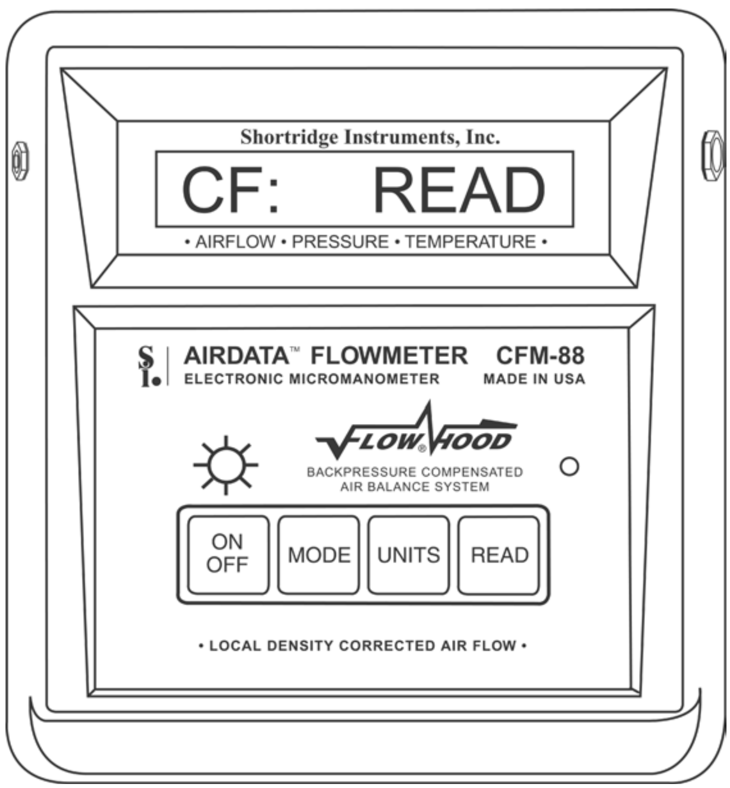
CFM-88L

BACKPRESSURE COMPENSATED AIR BALANCE SYSTEM

OPERATING INSTRUCTIONS



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CFM-88L 07/20/09

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1.0 INTRODUCTION

1.1 GENERAL DISCUSSION

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

The CFM-88L AirData FlowMeter performs the following essential functions. When used with the Series 8400 FlowHood Kit, this meter measures air flow and compensates for air density and backpressure effects, allowing direct air flow readings. Temperature and absolute pressure measurements can be taken over a wide range.

The AirData FlowMeter and the AirData Multimeter automatically correct for air density variations due to local barometric pressure. The meter also automatically corrects for the density effect of temperature if the TemProbe is connected. These meters also may be used to compensate for the backpressure effect which occurs when any capture hood is placed over an outlet. These capabilities eliminate several possible error factors, and the time consuming calculations normally necessary to convert the air flow readings to local density results.

Internal calibration and zeroing of the AirData FlowMeter are fully automatic. No external adjustments are ever needed. This instrument is extremely tolerant of overpressure, and is unaffected by position or ambient temperatures from 40˚F to 140˚F.

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, or where the FlowHood's backpressure correction function may be affected by immediate response from a volume control box or air valve.

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

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 extension wand to temperatures above 200˚F.

AIR DENSITY CORRECTION: The air density correction range is 14-40 in Hg and 32˚F to 158˚F for correction of air flow measurements. The readings represent local density air flow corrected for the density effects of temperature and absolute pressure.

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

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

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

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

FLOWHOOD WEIGHT: FlowHood unit with meter and 2'x2' top, 10.0 lbs.

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

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

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

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

The approximate level of charge remaining in the batteries is displayed using a schematic battery symbol in the third or fourth character of most displays. The battery symbol will have four different appearances, representing the progressive decrease in the level of charge as the meter is used. A solid battery symbol represents a fully charged battery. The shading changes to represent battery charge levels of 2/3, 1/3 and LOCHARGE, which is represented by a hollow battery symbol.

NOTE: A battery charge level displayed when the meter is first turned on may not be representative of the true level of battery charge. Wait five or ten minutes after turning the meter on to view the charge status.

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

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

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

3.0 EXTERNAL FEATURES

3.1 KEYPAD

Control Name	Function
ON/OFF	Turns the meter on or off.
MODE	Sequential action for air flow, absolute pressure, temperature.
UNITS	Alternate action for English or metric units.
READ	Initiate a measurement; initiate or halt TREND readings.
☼	Turns the back-light on or off.

3.2 FEATURES ON SIDES AND BACK OF METER

BATTERY CHARGER JACK

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

EXTERNAL READ JACK

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

FLAPS JACK

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

TEMPERATURE INPUT JACK

The temperature input jack is centered on the back of the meter, slightly toward the top. The flexible TemProbe sensor must be connected to this receptacle whenever temperature density correction is desired for air flow measurements.

OFF/RESET SWITCH

The reset pushbutton switch is on the back of the meter in a recess near the upper left corner. This switch is used to reset the meter in the unlikely event that the microprocessor becomes lost in its program. This may occur if the meter is dropped, and may cause the keypad to become nonfunctional until the meter is reset. If the meter continues to fall into "lockout", it may have been damaged, and should be returned for repair. Press the reset switch once to restart the meter. Do not hold the switch down or press the switch twice in close sequence.

PNEUMATIC PRESSURE INLETS

Two pneumatic pressure inlets positive (+) and negative (-) are centered on the back of the meter at the top edge. These inlets are connected to the flow sensing grid with two 3/16 inch ID neoprene tubes.

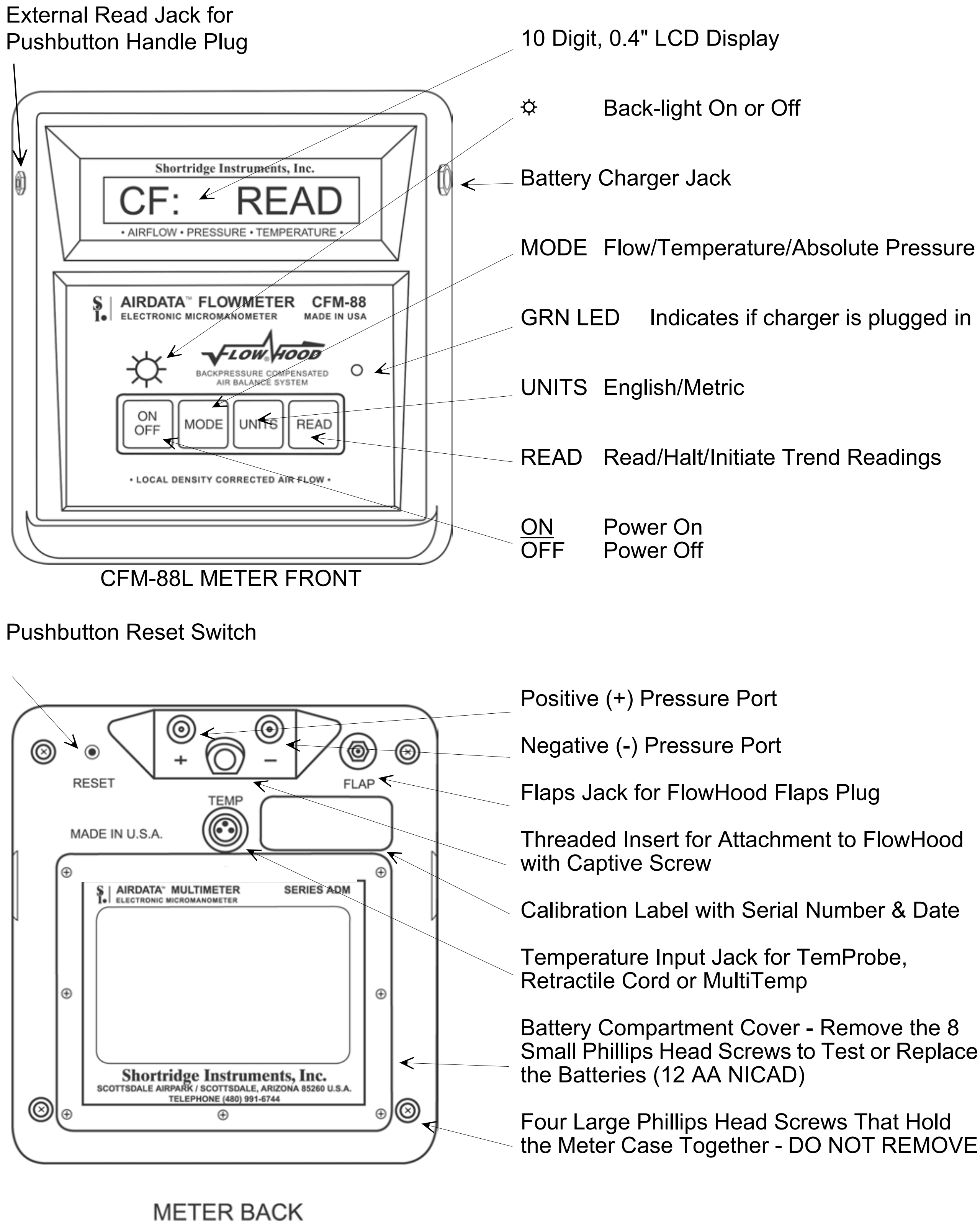

FIGURE 3.1 CFM-88L METER FRONT AND BACK

4.0 DISPLAY MESSAGES AND PROMPTS

4.1 READ PROMPTS

The following six prompts all include the term READ, which is a signal for the operator to press the READ key to trigger the actual measurement. The units designation will always be followed by one of the three meter status characters, either a symbol for the level of battery charge, the light symbol or the TREND mode symbol.

English Units

CF READ

This display indicates that the meter has been placed in the air flow function (cfm) and will appear automatically upon power up (following FLO-HOOD) if the flaps plug of the FlowHood is connected to the meter.

˚F READ

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

Hg READ

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

Metric Units

LS READ

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

˚C READ

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

Bar READ

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

4.2 MEASUREMENT READOUTS

In the following six 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.

˚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).

Metric Units

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.

˚C ± nnn.n

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

Bar n.nnn

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

4.3 FUNCTION READOUTS

The following prompts and messages are listed in alphabetical order.

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

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

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

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

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

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

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

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

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

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.

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

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

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

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

CFM-88L
This message is flashed following ▮▮▮▮▮▮▮▮ when the meter is first turned on.

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

FLO-HOOD
This message will be flashed when the meter is first turned on if the flaps plug is connected.

HALT
This message will be displayed when a TREND mode sequence has been halted manually by holding down the READ key. The meter automatically switches to the manual reading mode and displays a standard manual reading after HALT is displayed.

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

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

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

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

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

MANUAL
This message is displayed (followed by READING) during the manual reading that is taken when a series of TREND readings is halted.

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

NO FLAPS
This message advises that the flaps plug on the FlowHood has not been connected to the meter for air flow measurements. The meter senses the position of the flaps through the flaps plug.

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

NO LIGHT/BATTERY/TOO LOW
This sequence of messages indicates that the battery charge is low and the back-light may not be used until the batteries are recharged.

NO PROBE
This message appears when the operator has neglected to install the TemProbe sensor prior to initiating a temperature measurement. This message is also displayed if the TemProbe or extension cord has been damaged so as to create an open circuit.

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

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

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

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

READING

This message is displayed following MANUAL during the manual reading that is taken when a series of TREND readings is halted.

RECHARGE

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

SHUT DOWN

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

STD 70˚F or STD 21.1˚C

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

TEMP

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

TOO HOT or TOO COLD

If the internal temperature of the meter exceeds its operational limits, the meter will display TOO HOT or TOO COLD and shut down. The meter must be cooled down or warmed up, as the case may be, before normal operation can resume.

If the meter has displayed OVER RANGE after displaying either TOO HOT or TOO COLD, but has not shut down, this message indicates that the TemProbe sensor was being exposed to temperature levels beyond the proper operating range. If TOO HOT/OVER RANGE has been displayed, but the meter has not shut down, the TemProbe sensor may be short circuited.

TOO LOW

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

TREND

This message indicates that the meter is being used in the TREND mode.

UNDER TEMP

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

5.0 USING THE AIRDATA FLOWMETER

5.1 GENERAL USE

The CFM-88L AirData FlowMeter keypad has four function keys and a ☼ key for the back-light. Press the ON key to turn the meter on. The meter will display a row of pixel blocks to test the display, and will then display AUTO ZERO while performing a brief internal calibration test.

If the FlowHood flaps plug has been plugged into the meter, the meter will initialize in the FlowHood measurement mode, and will display FLO-HOOD briefly, followed by CF READ. Press the READ key to take an air flow reading. Pressing the READ key again will trigger another measurement, which will clear all previous data from the display and display the new result. If the flaps plug is not connected, the display will read NO FLAPS.

Press the MODE key to toggle between the air flow, temperature and absolute pressure modes. If the TemProbe is not connected while the temperature mode is selected, the meter will display TEMP, followed by NO PROBE, when the READ key is pressed.

Press the UNITS key to toggle between English and metric units. The meter will store the units selection (metric or English) and will automatically start up in the selected units the next time it is turned on.

The display has a back-light for use in low-light conditions. The back-light is turned on or off by pressing the light symbol ☼ located above the ON/OFF key. The display will read LIGHT ON or LIGHT OFF as appropriate. The third or fourth character in each READ display will be the light symbol when the light is on.

Note that using the back-light significantly increases the drain on the batteries and reduces operating time (continuous reading operation) by about 50 percent.

The meter is turned off manually by pressing the OFF key. The meter will turn itself OFF automatically to save battery power if the meter has not been used for several minutes.

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

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

If the meter has been being used with the back-light turned on, the user will have approximately five to 20 minutes of runtime before the meter displays RECHARGE/SHUT DOWN and turns itself off. The time period will vary depending on prior use. After the meter has displayed RECHARGE/SHUT DOWN and turned itself off, the meter may be turned back on **without the back-light** and used until LOCHARGE is displayed. The user will have five to 10 minutes of runtime before the meter displays RECHARGE/SHUT DOWN and turns itself off again. At this point, the batteries must be recharged prior to further use. See Section 2.0 SPECIFICATIONS and APPENDIX A for more information about the batteries and the battery charger.

5.2 TREND READINGS

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

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

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

6.0 TEMPERATURE MEASUREMENT

6.1 TEMPROBE

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

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

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

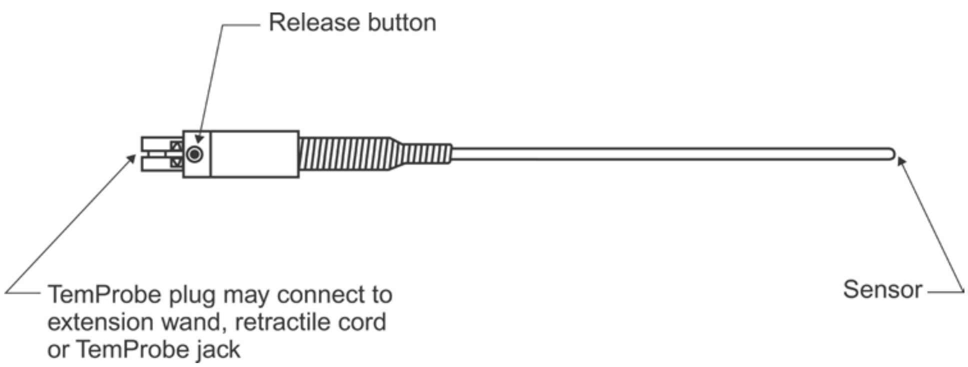

FIGURE 6.1 ADT442 TEMPROBE

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 the other ADT400 Series TemProbes. Meter will display OVER TEMP or UNDER TEMP if the probe is exposed to temperatures beyond this range. 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 plastic base of the TemProbe or the extension wand to temperatures above 200˚F.

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

6.2 AIRDATA MULTITEMP

The MT-440K MultiTemp comes with six insertion probes, two surface probes, one eight-position switch, and a small carrying case.

Plug the single cord on the bottom edge of the MultiTemp into the temperature input jack on the back of the AirData FlowMeter. Up to eight temperature probes (each with a 12' cord) can be connected into the eight small, numbered temperature input jacks on the top edge of the switch box. The jack numbers correspond to the eight switch position numbers surrounding the switch.

Place each of the temperature probes in the system as required and allow the probe temperatures to stabilize. A typical system testing application is shown in Figure 6.2. Set the meter for the temperature function as discussed in Section 5.0 USING THE AIRDATA FLOWMETER. Set the MultiTemp for switch position #1 and take a reading for the probe connected to temperature input jack #1. Turn the switch to position #2 and take a reading for temperature jack #2. Continue for as many of the eight temperature jacks as needed.

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

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

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

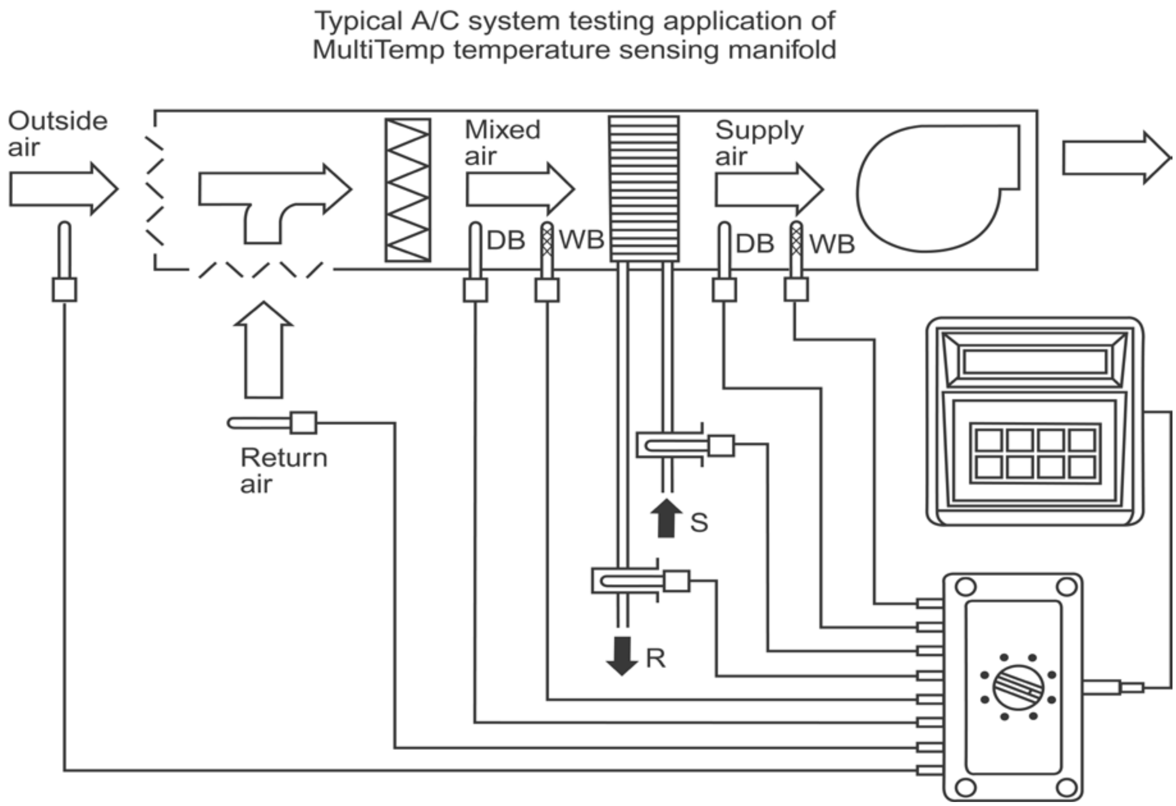

FIGURE 6.2 AIRDATA MULTITEMP

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

7.0 ABSOLUTE PRESSURE

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

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

CAUTION

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

The absolute pressure measuring accuracy should be checked 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.

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 AIR FLOW MEASUREMENT

8.1 FLOWHOOD FUNCTION

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

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

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

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

8.2 BACKPRESSURE COMPENSATION

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

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

9.0 FLOWHOOD ASSEMBLY

9.1 UNPACKING

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

The base assembly and 2'x2' top assembly will arrive already assembled as a unit and packed as shown in Figure 9.1. The handle assembly, accessory tops, and support dowels are enclosed in the built-in storage compartment at the rear of the carrying case. The frame channels for the accessory top assemblies are stored at the bottom of the carrying case beneath the frame storage retainers as shown in Figure 9.2. The top support assembly is stored in the top of the base assembly just above the grid. The legs have been folded upward, and the curved sections at the bottom of the legs have been inserted into the first and the third holes of the corner tubes of the base. The head of the top support assembly should be positioned toward the back of the base assembly. The four spring rods are positioned downward, so that they do not directly contact the flow sensing grid. Foam packing, cloth skirts and accessories should not be stored on top of the grid.

9.2 FRAME ASSEMBLIES

FlowHood system kits include frames for up to six standard top sizes. Custom top sizes are available upon request. The 2'x2' and 14"x14" top frames are assembled and stored as complete units. The 2'x4', 1'x4', 1'x5', and 3'x3' frames use interchangeable parts to construct any of the four sizes. Refer to Figures 9.4 through 9.8 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.

9.3 FABRIC TOPS

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

9.4 TOP SUPPORT ASSEMBLY

The top support assembly and support dowels are assembled as shown in Figure 9.3. Position the top support assembly so that the spring rods are at the top. Swing the long rods around and down, into the position shown, and insert the ends of the rods into the center hole of the corner tubes of the FlowHood base. The rod ends may be moved upward or downward as needed to control the tightness of the fabric top. The support dowels can now be slid over the ends of the spring rods.

The location and correct combinations of frames, support dowels, dowel extenders and frame support cups to be used with each size are shown in Figures 8.4 through 8.8. The 8.5" dowel extenders are used with the 23.5" fiberglass support dowels when necessary to adjust for variations in frame size.

The 2'x2', 2'x4' and 1'x4' tops do not require dowel extenders. When using the 2'x2' frame, insert the support dowel end pins into each corner bracket of the 2'x2' frame assembly as shown in Figure 8.4. 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 9.5 and 9.6. 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 9.7.

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 9.8. 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.

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

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

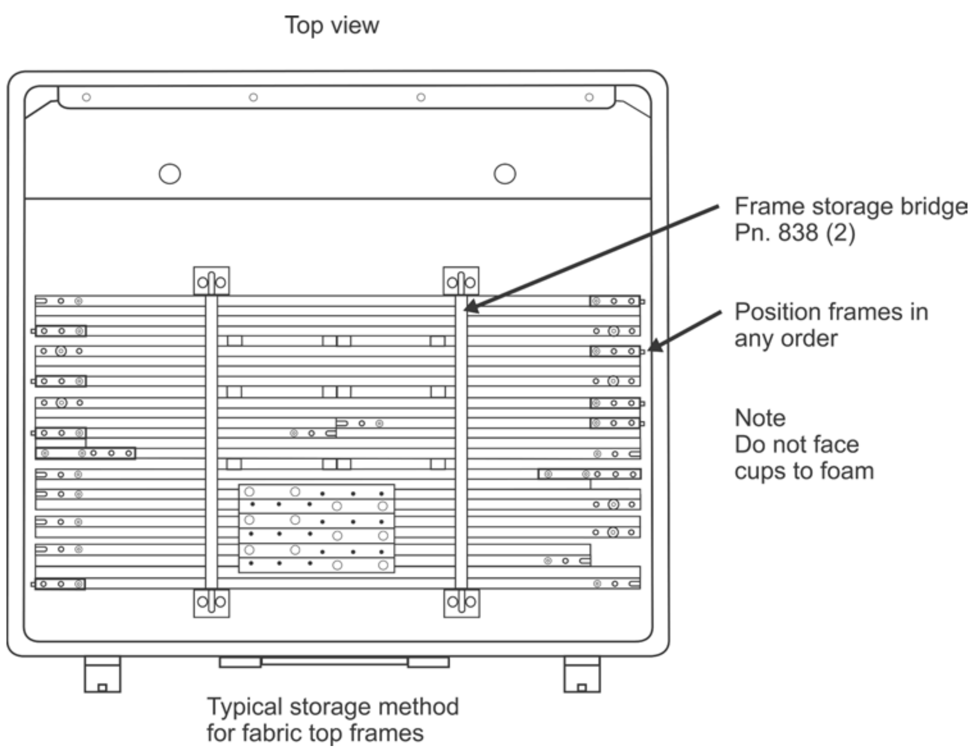

FIGURE 9.1 FRAME STORAGE

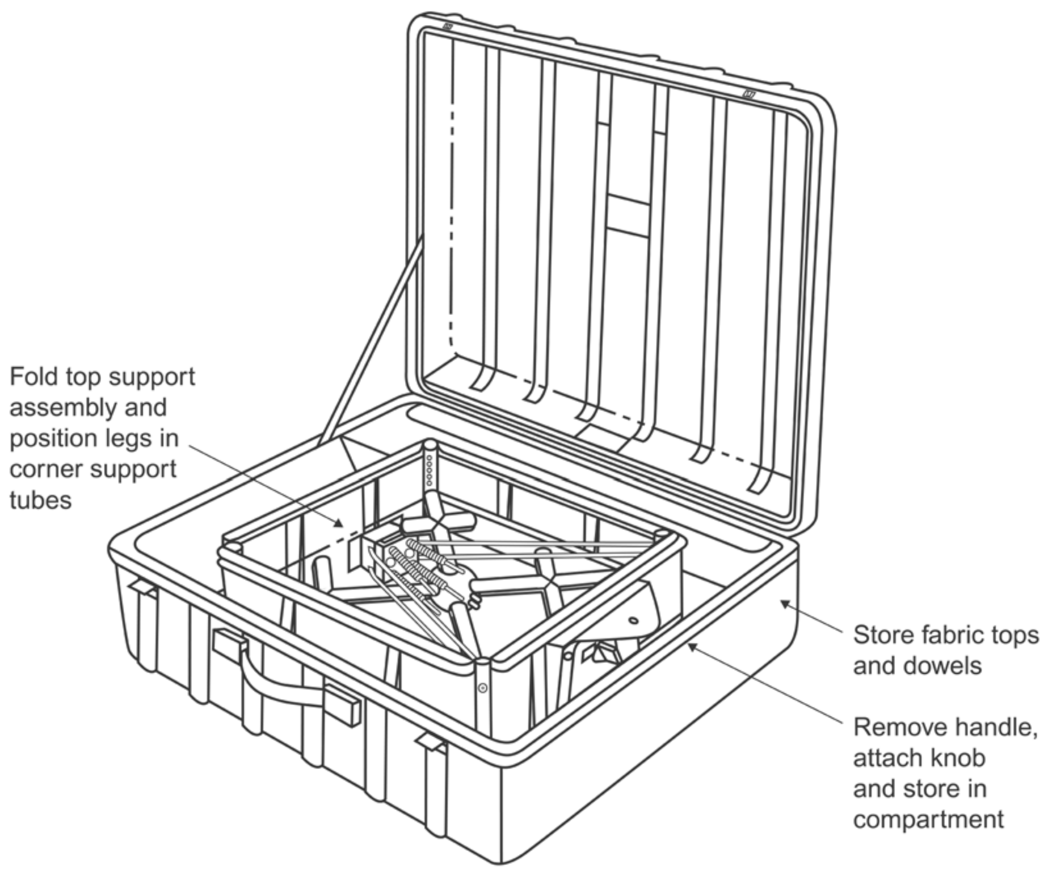

FIGURE 9.2 FLOWHOOD IN CASE

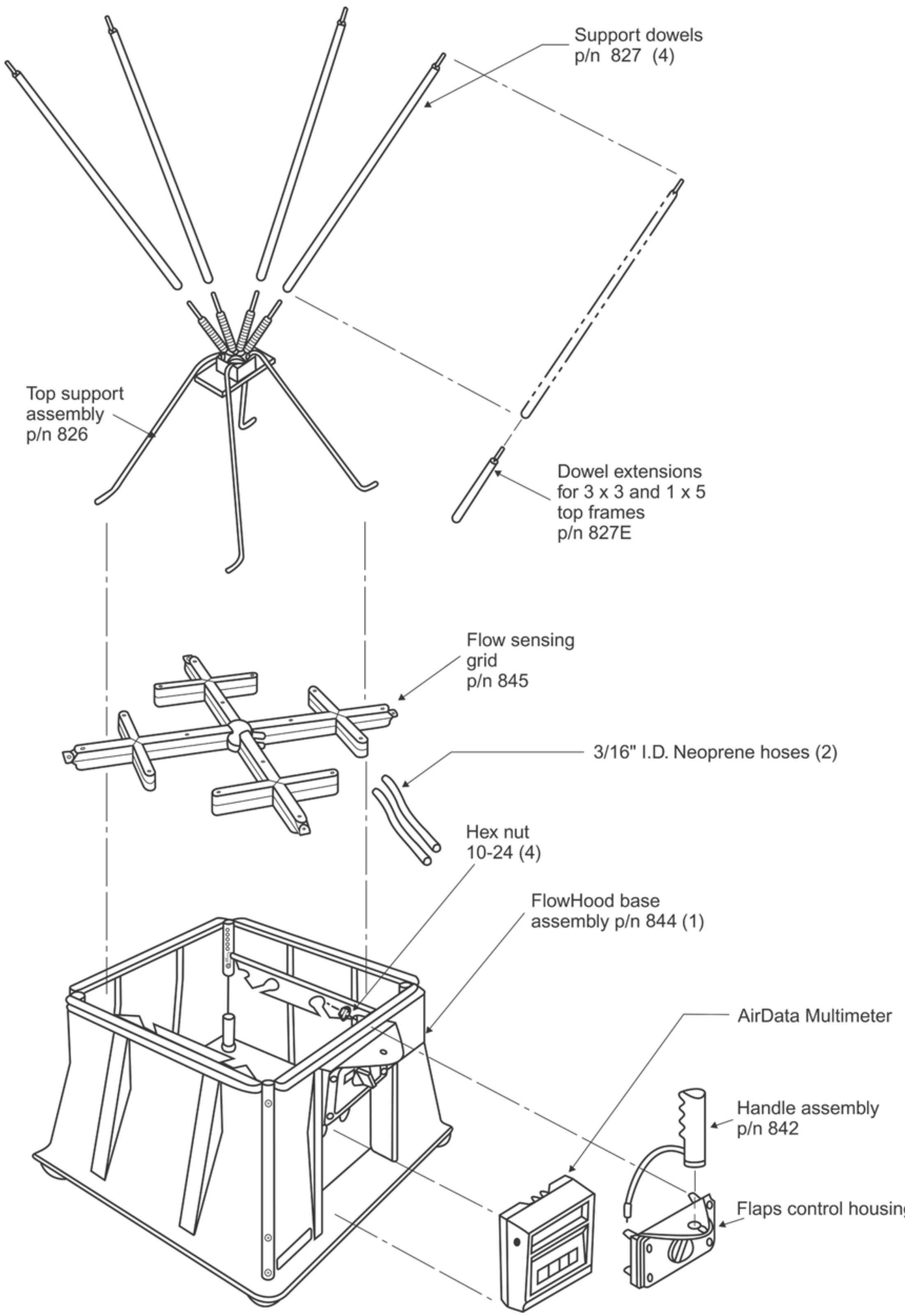

FIGURE 9.3 FLOWHOOD ASSEMBLY

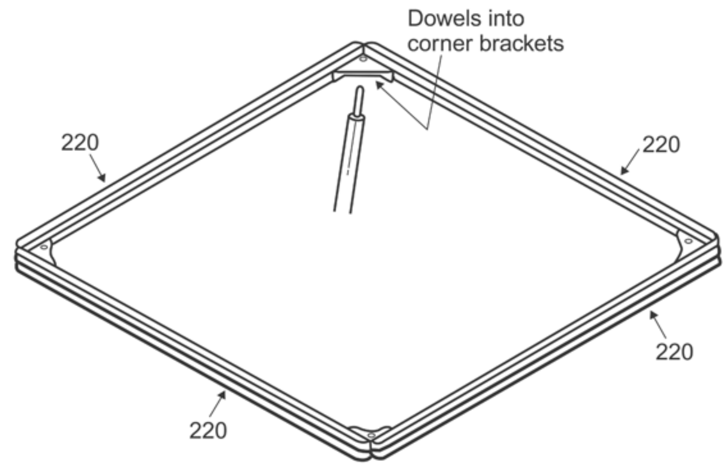

FIGURE 9.4 2X2 FRAME ASSEMBLY

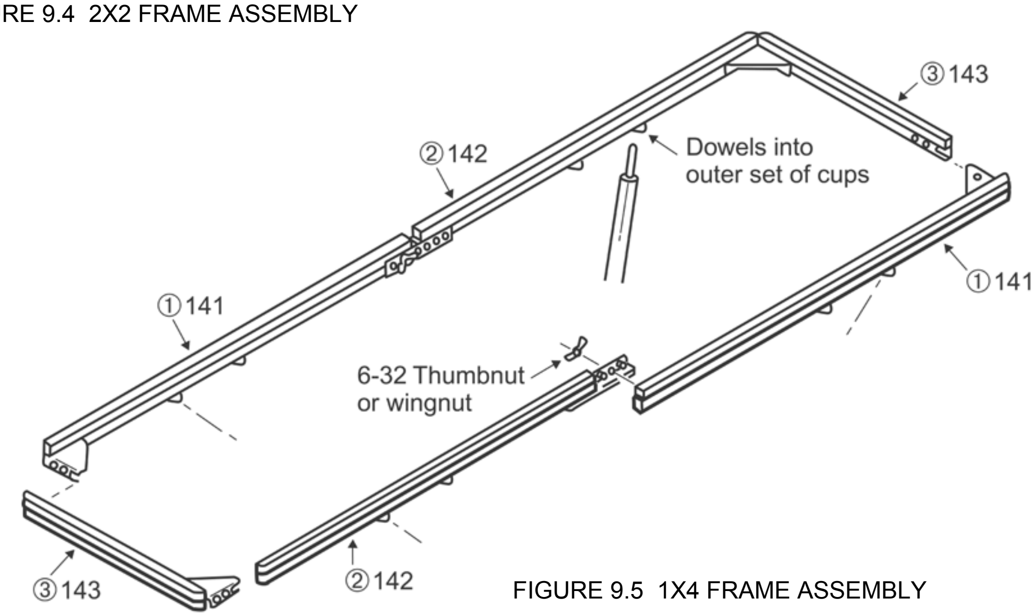

FIGURE 9.5 1X4 FRAME ASSEMBLY

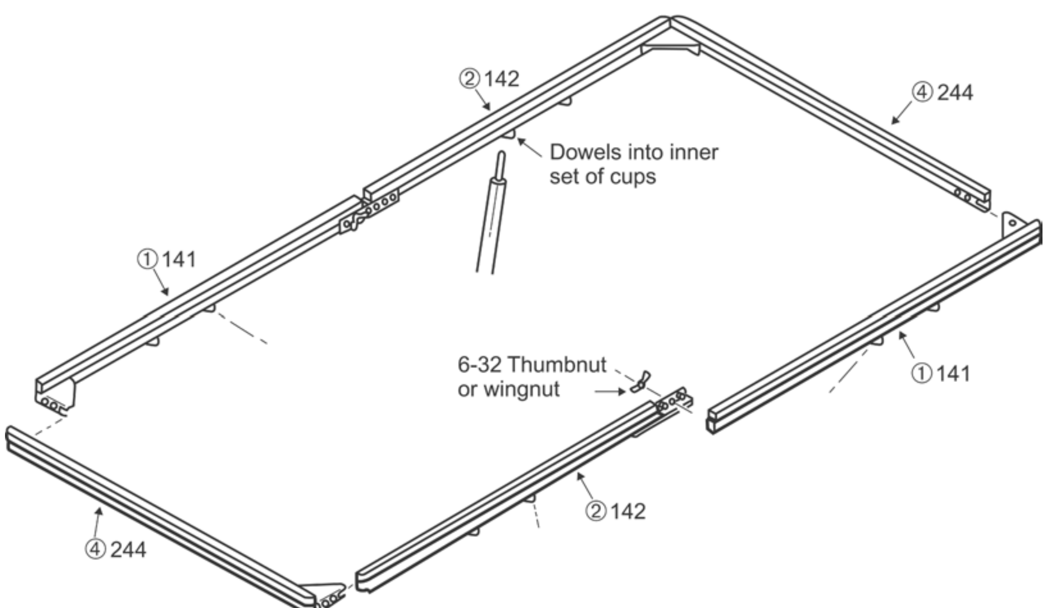

FIGURE 9.6 2X4 FRAME ASSEMBLY

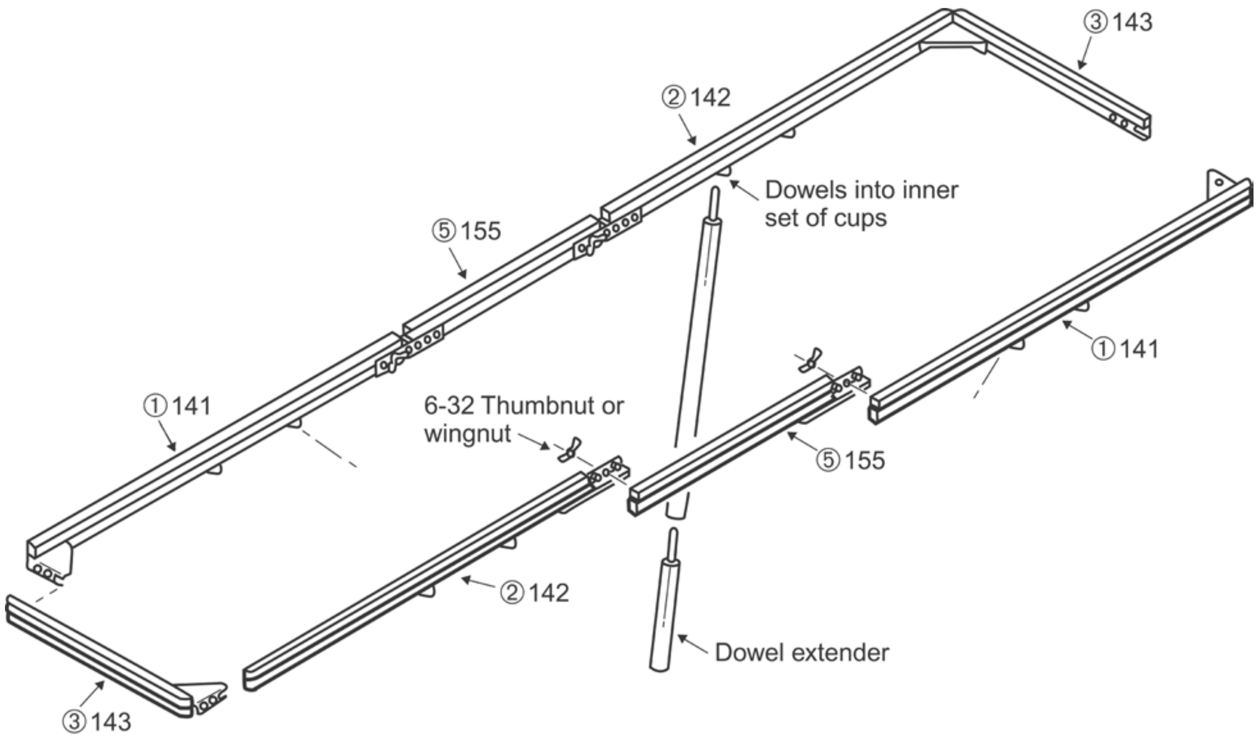

FIGURE 9.7 1X5 FRAME ASSEMBLY

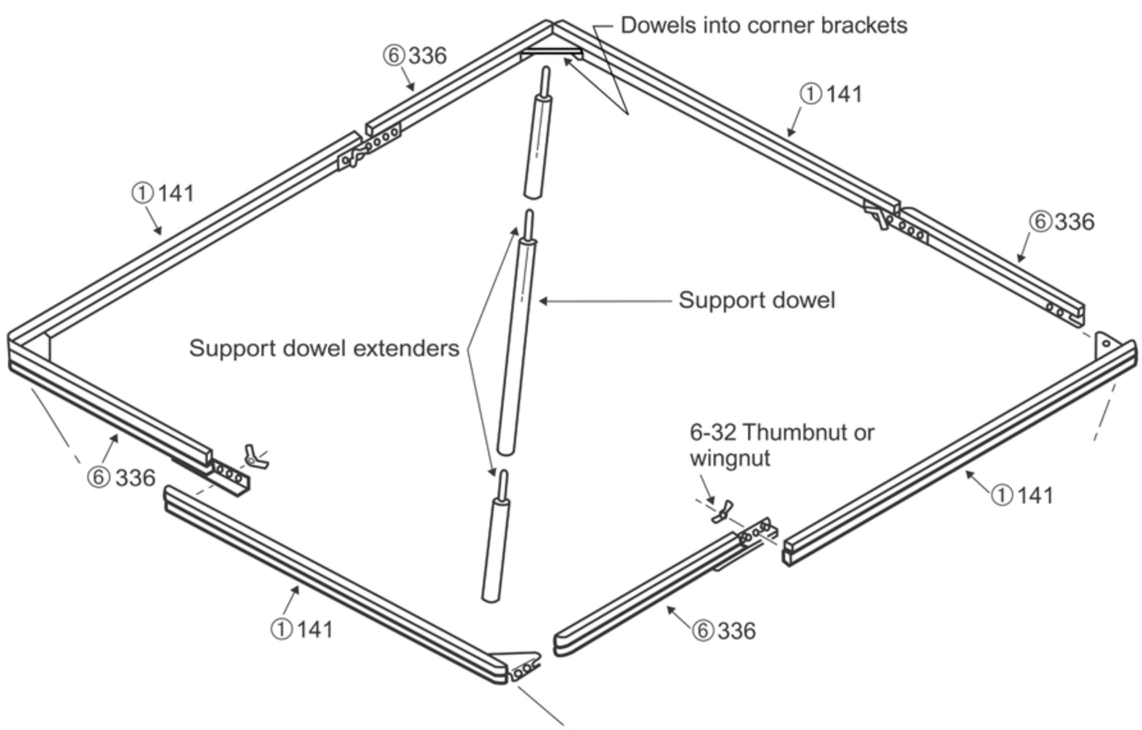

FIGURE 9.8 3X3 FRAME ASSEMBLY

10.0 FLOWHOOD OPERATING PROCEDURE

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

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

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

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

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

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

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.

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

10.1 AIR FLOW - NONBACKPRESSURE COMPENSATED READINGS

See Section 8.2 BACKPRESSURE COMPENSATION for a general discussion of backpressure and its effect on any capture hood device before using the FlowHood for nonbackpressure compensated readings. This technique measures air flow **without compensating** for FlowHood induced backpressure. This method may be used for both supply and return outlets.

After the meter and all of its connections have been attached to the FlowHood, as described previously, set the flaps control knob to the open position. Place the FlowHood over the outlet (or inlet) diffuser or grille. Wait two or three seconds to allow the air flow to stabilize, and then press the READ key or the thumbswitch on the FlowHood handle. The displayed result will represent the flow value of the outlet while the FlowHood is in place. This flow reading will generally be somewhat less than the actual flow, due to the backpressure effect of the FlowHood.

10.2 AIR FLOW - BACKPRESSURE COMPENSATED READINGS

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

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

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

First, perform the nonbackpressure compensated portion of the measurement with the flaps open, as described above in Section 10.1 NONBACKPRESSURE COMPENSATED READINGS. This first reading will be displayed with a small ‘u’ for uncompensated (nonbackpressure compensated) as CF u nn. Close the flaps after the reading is displayed. Allow the system to settle, then press the READ key to take the second (backpressure compensated) reading. If necessary, the FlowHood may be removed from the outlet in order to close the flaps. Position the FlowHood as before, and **wait** three seconds for the flow to stabilize before taking the second reading. The compensated reading will be displayed with a ‘c’ for compensated, as CF c nn.

10.2.1 RATIO ERR DISPLAY

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

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

11.0 SPECIAL BALANCING PROCEDURES

11.1 PROPORTIONAL BALANCING

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

11.2 LARGE RETURN AIR GRILLES

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

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

11.3 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.

11.4 CONSTANT VOLUME CONTROLLERS

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

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

11.5 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 FlowMeter 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.

11.6 SIDEWALL REGISTERS

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

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

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

11.7 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.

11.8 SYSTEM PROBLEMS

If the measured air delivery is less than expected, check the meter functions first, as described in Section 13.0 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.

12.0 CORRECTION FACTORS AND CONVERSION FORMULAS

12.1 BAROMETRIC PRESSURE DENSITY CORRECTION - LOCAL DENSITY

The CFM-88L AirData FlowMeter automatically corrects air flow readings to represent local density cfm as affected by barometric pressure.

12.2 BAROMETRIC PRESSURE DENSITY CONVERSION - STANDARD DENSITY

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

12.2.1 STANDARD DENSITY - TEMPROBE USED

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

$$\begin{matrix}\textit{STANDARD DENSITYFLOW} \\ (\textit{mass flow equivalent})\end{matrix} = \textit{local density flow} \; X \left(\frac{P_b}{29.92}\right) X \left(\frac{530}{460 + {}^oF}\right)$$

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

12.2.2 STANDARD DENSITY - TEMPROBE NOT USED

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

$$\begin{matrix}\textit{STANDARD DENSITY FLOW} \\ (\textit{mass flow equivalent})\end{matrix} = \textit{local density flow} \; X \left(\frac{P_b}{29.92}\right) X \sqrt{\frac{530}{460 + {}^oF}}$$

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

12.3 TEMPERATURE DENSITY CORRECTION

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

$$\begin{matrix}\textit{LOCAL DENSITY FLOW} \\ (\textit{true air flow})\end{matrix} = \begin{matrix}\textit{flow reading} \\ (\textit{taken in local density mode})\end{matrix} \; X \sqrt{\frac{460 + {}^oF}{530}}$$

Where: ˚F = measured temperature of airstream.

12.4 RELATIVE HUMIDITY CORRECTION

The CFM-88L AirData FlowMeter does not correct for the density effects of relative humidity on air flow readings. The effect of minor variations in relative humidity on local air density (and therefore on flow 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 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 air flow readings may be corrected for relative humidity using the following formula.

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

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

13.0 METER ACCURACY FIELD TESTING

13.1 METER ZERO FUNCTION

Take several air flow readings 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 the meter connections and clean if needed.

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

13.2 ABSOLUTE PRESSURE FUNCTION

You may confirm the accuracy of the absolute pressure correction by taking a reading with the meter ports open to the atmosphere and comparing the reading with the actual barometric pressure. The reading should be within ± 2% (approximately 0.5 in Hg) of the actual barometric pressure to maintain the specified accuracy for air flow density correction.

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.

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

13.3 AIR FLOW ACCURACY

Air flow accuracy is confirmed by comparing a very careful pitot tube traverse with the results obtained using the FlowHood. An accurate inclined manometer, micromanometer, or AirData Multimeter may be used for the duct traverse. An inclined manometer used for the duct traverse should have minor scale divisions of 0.005 in wc or less, and should have direct velocity markings down to at least 400 fpm. The accuracy of the comparison tests will depend on both the accuracy of the velocity traverse, and the accuracy of the air flow calculations.

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

13.4 DUCT TRAVERSE COMPARISONS - INCLINED MANOMETER OR MICROMANOMETER

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

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

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

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

If the TemProbe is not attached during the flow measurement, the FlowHood meter will assume standard 70˚F (or 21.1˚C) conditions (as do the inclined manometer and the standard micromanometer). In this case, it is **not** necessary to correct the duct traverse velocity for the density effect due to temperature. However, since the FlowHood does automatically correct for the density effect of barometric pressure, the duct traverse readings must be corrected as follows:

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

Where: P_b = local barometric pressure (in Hg)

13.5 DUCT TRAVERSE USING THE AIRDATA MULTIMETER

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

If the TemProbe is not used for either flow or velocity, it must not be used for the other type of measurement. In this case, both sets of measurements will be calculated using standard 70˚F (or 21.1˚C) conditions.

13.6 BACKPRESSURE COMPENSATED COMPARISON READING

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

13.7 NONBACKPRESSURE COMPENSATED COMPARISON READING

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

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

$FLOW_2$ is obtained from the following calculation:

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

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

14.0 METER MAINTENANCE

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

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

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

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

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

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

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

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

15.0 FLOWHOOD MAINTENANCE

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

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

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

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

16.0 RECALIBRATION AND REPAIR INFORMATION

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

The complete meter kit and all accessories should be returned to the factory for recalibration and/or repair. If just the meter must be returned, the meter should be individually wrapped in several layers of foam padding, and shipped in a carton approximately 12"x12"x8" with sufficient additional cushioning to fill the carton. Do not use spray foam. Spray foam can damage the meter and it is also possible to “lose” a meter in a chunk of spray foam.

Ship directly to:

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

AIR BALANCE MANUALS & TRAINING PROGRAMS

Several publications are available from the following organizations.

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

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

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

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

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

SMACNA offers Technical Manuals and Standards Publications

WARRANTY

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

LIMITATION OF LIABILITY

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

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

APPENDIX A - BATTERY TEST PROCEDURE

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

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

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

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

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

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

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

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

   c. Test the lower half [negative (-) six cells] of the battery set in the same manner described above by placing the voltmeter probes at the left center battery 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 (mAh) as the existing cells. If the same capacity cells are not available, replace all 12 cells with new batteries. See the Instruction Manual Section 14.0 METER MAINTENANCE.

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

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

PROLONGING BATTERY LIFE

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

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

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

BATTERY RECYCLING

RECYCLE
1-800-822-8837

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

CFM-88L
REPLACEMENT PARTS LIST

Part no	No reqd per set	Description
CFM-88LM	1	AirData FlowMeter
PS8201	1	Battery charger
PS8202	1	Battery charger for European use
0445	1	Plug adapter for use with PS8202 battery charger
AA-NICAD	12	Rechargeable batteries
ADT442	1	TemProbe temperature probe - 4" x 1/8" diameter
IM-88L	1	Instruction manual - CFM-88L

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 (all of the above)

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 (all of the above)

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 (all of the above)

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 (all of the above)

REPLACEMENT PARTS LIST (continued)

3' x 3' TOP (91.4 x 91.4 cm)

Part no	No rqd per set	Description
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 (all of the above)

14" x 14" TOP (35.6 x 35.6 cm)

Part no	No rqd per set	Description
111	4	Replacement side channel (14" length)
14x14F	1	Complete frame assembly
14x14S	1	Cloth skirt (14"x14"x14" height)
827E	4	Support dowels (8 ½" length)
14x14T	1	14"x14"x14" top set complete (all of the above)

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

CFM-88L INDEX