

***Model 8370***

***ACCUBALANCE®***

***Flow Measuring Hood***

***Operation and Service  
Manual***

*September 1998  
P/N 1980145 Rev B*



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Knowing that inoperative or defective instruments are as detrimental to TSI as they are to our customers, our service policy is designed to give prompt attention to any problems. If any malfunction is discovered, please contact your nearest sales office or representative, or call TSI's Customer Service department at (651) 490-2711 or (800) 777-8356.

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## About this manual

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This manual explains how to set up, operate and maintain the Model 8370 ACCUBALANCE Flow Measuring Hood. Read it thoroughly before using the instrument.

### Formatting and Typography

Note that step-by-step instructions are numbered in boldface type: **1**, **2**, **3**, etc., set flush-left against the margin.

References to the front panel keys on the ACCUBALANCE, along with the instrument's displayed readout, are represented in this manual by the typeface called Helvetica Narrow. In addition to the different typeface, displayed messages appear in quotes.

When reference is made to other sections of the manual, the section title is italicized.

Example: The "HOLD" message will appear along with a flow value after you have activated the HOLD button (from *Display* in Chapter 1).

### ***HELP!***

If you need technical assistance with this instrument, have questions about the manual, or your flow hood needs repair or recalibration please call TSI's Industrial Test Instruments Group at (651) 490-2711 or (800) 777-8356. †



## Introduction

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The TSI Model 8370 ACCUBALANCE is an instrument designed to measure the air flow from diffusers and grilles or the air flow entering exhaust outlets. The ACCUBALANCE is lightweight and easy to use. The instrument can display the measured air flow in three different units: standard cubic feet per minute (SCFM), standard liters per second (Std l/s) and standard cubic meters per hour (Std m<sup>3</sup>/hr).

The ACCUBALANCE consists of a fabric hood, a molded plastic base which contains an electronic meter, and a flow sensing manifold located within the base. Air flowing through the hood is measured by a hot-film sensor located in the central hub of the flow sensing manifold. The twenty-four pairs of flow sensing ports in the manifold are strategically located so that the ACCUBALANCE provides the highest degree of measurement accuracy, even in non-uniform flow conditions.

The ACCUBALANCE is temperature-compensated to display a standard flow rate: SCFM, Std. l/s and Std. m<sup>3</sup>/hr. Standard flow rate is defined as the volumetric flow rate at standard conditions of 70°F (21.1°C) and 14.7 pounds per square inch (760 mmHg) barometric pressure. Standard flow rate is the measurement used most often in ventilation applications. †



# Chapter 1

## Set Up

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This chapter guides you through unpacking, setting up, and getting started using your ACCUBALANCE. See Chapter 2 for a detailed description of all operating features.

### Unpacking

Carefully unpack the instrument and accessories from the carrying case. Check the individual parts against the list of components in Table 1. If any are missing or damaged, notify TSI immediately.

Table 1. List of components

Qty	Item	Part No.
1	Model 8370 base	1081388
1	2 ft x 2 ft (610 mm x 610 mm) hood fabric	1307060
6	Frame support poles	1081390
4	2 ft (610 mm) frame tubing*	1081262
6	Right angle tubing connectors*	1081584
1	Battery holder	1081279
4	C-size batteries	1208018
1	Battery compartment cover	1081458
1	Carrying case	1319067
1	Operation and Service Manual	1980145

\*Four 2 ft frame tubings and four of the right angle connectors are shipped assembled inside the top of the hood fabric.

Table 1a. List of components: Model 8370-3

Qty	Item	Part No.
1	Model 8370 base	1081388
1	2 ft x 2 ft (610 mm x 610 mm) hood fabric	1307060
1	2 ft x 4 ft (610 mm x 1220 mm)hood fabric	1801065
1	1 ft x 4 ft (305 mm x 1220 mm)hood fabric	1801066
6	Frame support poles	1081390
6	2 ft (610 mm) frame tubing *	1081262
4	1 ft (305 mm) frame tubing	1081260
6	Right angle tubing connectors *	1081584
6	Straight tubing connectors	1302833
1	Battery holder	1081279
4	C-size batteries	1208018
1	Battery compartment cover	1081458
1	Carrying case	1319067
1	Operation and Service Manual	1980145

Table 1b. List of components: Model 8370-5

Qty	Item	Part No.
1	Model 8370 base	1081388
1	2 ft x 2 ft (610 mm x 610 mm) hood fabric	1307060
1	2 ft x 4 ft (610 mm x 1220 mm) hood fabric	1801065
1	1 ft x 4 ft (305 mm x 1220 mm) hood fabric	1801066
1	1 ft x 5 ft (305 mm x 1525 mm) hood fabric	1801067
1	3 ft x 3 ft (915 mm x 915 mm) hood fabric	1801068
6	Frame support poles	1081390
6	2 ft (610 mm) frame tubing *	1081262
4	1 ft (305 mm) frame tubing	1081260
6	Right angle tubing connectors *	1081584
6	Straight tubing connectors	1302833
1	Battery holder	1081279
2	1x tube connectors	1081580
4	C-size batteries	1208018
1	Battery compartment cover	1081458
1	Carrying case	1319067
1	Operation and Service Manual	1980145

\*Four of the 2 ft frame tubings and four of the right angle connectors are shipped assembled inside the top of the hood fabric.



**Figure 1.** The ACCUBALANCE and accessories

Included with every manual is a registration card. Look for yours at the front of this manual. Please complete and mail it promptly; it allows TSI to inform you of product updates.

## **Parts Identification**

Before proceeding with assembly and use of the ACCUBALANCE, please familiarize yourself with the various parts of the instrument. As you read the next sections, refer to figures 2 - 4.



**Figure 2.** ACCUBALANCE components

1. Hood fabric
2. Base
3. PRINT button in left handle
4. START/HOLD button in right handle

## Keypad



**Figure 3.** Electronic meter membrane switch

ON/OFF	Press to turn the ACCUBALANCE on and off.
PRINT	Press to transmit the displayed flow rate measurement to the printer or other serial device. <i>Note that the button in the left handle performs the same function.</i>
DATA PORT	Printer (or other serial device) connection port. (Remove Data Port Plug before connecting serial device.)

- START/HOLD** In the Averaging Mode, press to start a new reading. In the Continuous Reading Mode, press and release to hold the value on display. Press again to resume continuous readings. *Note that the button in the right handle performs the same function.*
- AVG/CONT** Press to switch between the Averaging and the Continuous Reading Modes.
- RETURN/SUPPLY** Press to switch between return air and supply air measurements.

## Display



**Figure 4.** Electronic meter display

Figure 4 shows the electronic meter display. All segments will be shown momentarily each time you turn on the ACCUBALANCE.

1. **Flow units:** CFM (cubic feet per minute), l/s (liters per second), and m<sup>3</sup>/hr (cubic meters per hour). The ACCUBALANCE indicates flow already corrected to "standard" conditions (see Appendix A).
2. **Flow value:** See specifications for range and resolution.
3. **Flow direction arrow:** Indicates if supply or return air flow calibration is being utilized by the ACCUBALANCE.

**Notice:** Be sure this arrow points in the direction of flow through the ACCUBALANCE, otherwise the measurements made will be inaccurate. To change the direction of the arrow, press the RETURN/SUPPLY switch.

4. **Averaging mode:** The "AVERAGE" message will appear on the display when you have selected the three-second or six-second averaging mode (See *Averaging Mode* section later in this chapter).
5. **Hold indicator.** The "HOLD" message will appear along with a flow value after you have activated the HOLD button.
6. "LOW BATTERY". Displayed when batteries are getting near the end of their useful life.
7. "BATTERY" will appear along with a value on the display during power-up to indicate the percent of battery life remaining.

## Preparing the Instrument for Use

### Hood Assembly

The ACCUBALANCE is shipped from the factory partially assembled with the 2 ft x 2 ft nylon hood attached to the base. If you wish to use another hood size, see *Changing Hoods* in Chapter 2.

To complete the assembly of the 2 ft x 2 ft hood, follow these six steps:

- 1 Place the base of the ACCUBALANCE on the floor.
- 2 Lift the top of the fabric. Insert one end of a support pole into its pole mount in the base of the ACCUBALANCE. There is a cup in each corner of the frame to accept the other end of each support pole. Helpful Hint: This step is made simpler by temporarily resting the opposite corner of the fabric top on a table edge as shown in Figure 5.



**Figure 5.** An easy way to begin assembly

- 3 Grasp the support pole. Bend the pole slightly to insert the top end of the pole into the support pole cup located in the corner of the fabric frame as shown in Figure 6.



**Figure 6.** Installing a support pole

- 4 Insert the second support pole into the pole mount on the opposite side of the ACCUBALANCE base.
- 5 Repeat step 3 for the second support pole.
- 6 Repeat steps 4 and 5 for the remaining two support poles.

## Display Units

The ACCUBALANCE is shipped with cubic feet per minute (CFM) as the default flow unit (unless the metric version was ordered). If you wish to change the units to l/s (liters per second) or m<sup>3</sup>/hr (cubic meters per hour), see *Changing Dip Switch Settings* in Chapter 2

## Installing the Batteries

The ACCUBALANCE requires four C-size batteries to operate. For your convenience, four alkaline batteries are included with the ACCUBALANCE.

To install the batteries, follow these three steps:

- 1 Remove the battery cover located behind the electronic meter on the inner side of the ACCUBALANCE base. To remove the battery cover, pull up on the latches located on the top and bottom of the cover.
- 2 Place batteries in the battery holder located inside the battery compartment. Follow the illustration on the battery holder for correct battery orientation.
- 3 Replace the battery cover. Notice that the battery cover is designed to fit only one way, with the tab pointing toward the fabric. Engage the latches by pressing down on them.

**WARNING:** Never leave batteries in the ACCUBALANCE for more than two weeks. Leaking batteries can cause electronic failure due to corrosion.

**Notice:** Remove batteries from the battery compartment during shipping, travel and transport. Jostling may jar the batteries loose and cause damage to the ACCUBALANCE .

## Start-Up

Press the ON/OFF button on the meter to turn on the power. The display will initially indicate the percent of battery power remaining.

During start-up the ACCUBALANCE performs a self test of its electronic functions. If an error is found, an error message will appear on the display. Refer to Chapter 4, *Troubleshooting*, if an error message appears. If no errors are found, the ACCUBALANCE will automatically proceed to one of two measurement modes: continuous reading mode or averaging mode.

## Continuous Reading Mode

In the continuous reading mode, the measurement is updated on the display every second. You can slow the update rate to once every two seconds by changing the setting of DIP Switch 7. For more details, see *Changing DIP Switch Settings* in Chapter 2.

The display continues to update until you press either the START/HOLD switch on the keypad or the button on the right handle. The current value will be held on the display along with the "HOLD" message. To resume continuous readings, press one of the START/HOLD buttons again. For more details about the continuous reading mode, see Chapter 2.

## Averaging Mode

In the averaging mode, a time-averaged reading is initiated each time you press the START/HOLD switch on the keypad or the button on the right handle. The time counts down from three seconds on the display. After the countdown, the average flow appears and remains on the display along with the "AVERAGE" message. To initiate a new reading, press one of the START/HOLD buttons again. You can select an

averaging time of six seconds by changing the setting of DIP Switch 6. See *Changing DIP Switch Settings* in Chapter 2. For more details on the averaging mode, see Chapter 2.

## Selecting Flow Direction

Each ACCUBALANCE is calibrated for supply and return air separately for increased accuracy. The ACCUBALANCE will assume that air is flowing in the same direction as the arrow on the right-hand side of the display. Be sure this arrow points in the direction of flow through the ACCUBALANCE, otherwise measurements will be inaccurate. To change the direction of the arrow, press the RETURN/SUPPLY switch.

## Taking a Flow Measurement

You are now ready to start measuring flow rates. First, turn on the ACCUBALANCE and select the appropriate flow direction. For measuring supply air flow, the arrow must point down away from the hood fabric; for return air flow measurements, the arrow must point up toward the hood fabric.

Next, choose the Continuous Reading Mode and be sure that the "HOLD" message is not on the display. If the "HOLD" message is on the display, press either the START/HOLD switch on the keypad or the button on the right handle to resume readings.

Finally, press the top of the ACCUBALANCE against the perimeter edge of the diffuser or grille so as to form a seal. The electronic meter will display standard flow readings.

If the readings are fluctuating, choose the averaging mode by pressing the AVG/CONT switch on the keypad. In the Averaging Mode, it is important to keep the ACCUBALANCE in place over the diffuser or grille during the countdown and until the average reading appears on the

display. A new average reading can be initiated by pressing the START/HOLD switch or the button on the right handle.

When making a flow measurement, keep objects out of the flow path at the base of the ACCUBALANCE (one foot clearance minimum). However, it is acceptable to have a hand supporting the flow hood at the bottom of the base.

## **Turning the ACCUBALANCE Off**

To turn off the ACCUBALANCE, simply press the ON/OFF switch.

## **Automatic Shut-off**

The ACCUBALANCE will automatically shut itself off if no switches or buttons have been pressed for 15 minutes. This feature minimizes accidental loss of battery power. †



## Chapter 2

### **Operations in More Detail**

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This chapter explains how to change fabrics and assemble different hood sizes and presents more detail on the various features of the ACCUBALANCE.

#### **Changing Hoods**

The ACCUBALANCE is shipped with a 2 ft x 2 ft hood attached to the base. Four other hood sizes are available from TSI and can be purchased separately or as part of standard packages. Available hood sizes are identified by the dimensions of the frame structure at the top of the hood and include 2 ft x 4 ft, 1 ft x 4 ft, 1 ft x 5 ft and 3 ft x 3 ft .

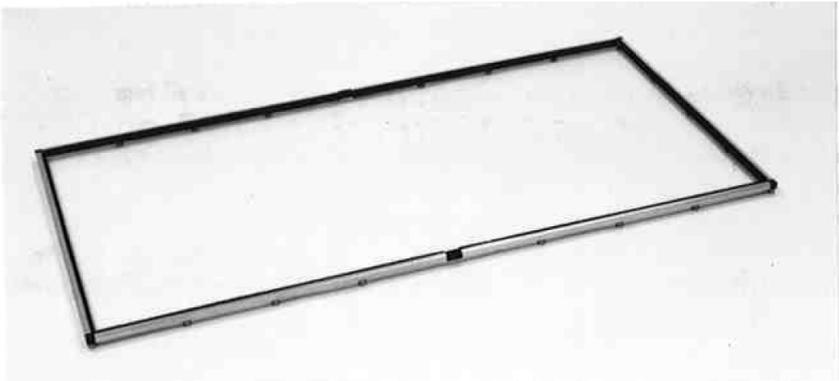
To change hood sizes, first remove the hood currently attached to the base. To remove the attached hood, first unlatch the cinch belt where the fabric is attached to the base. Then remove the fabric from its frame structure by peeling back the Velcro® from the aluminum frame tubing. Notice that the fabric stretches around the outside, then up and over the frame structure. The Velcro on the fabric reaches down to mate with the Velcro on the frame structure. Notice also that all Velcro surfaces on the frame tubing face inward. Finally, fold up the fabric you just removed so that it can fit into one of the accessory pockets inside the ACCUBALANCE carrying case. It is a good idea to fold the fabric so that the tag identifying its size remains visible for future reference.

## 2 ft x 4 ft Hood

To assemble and attach the 2 ft x 4 ft hood, carefully follow these 10 steps:

- 1 Build the 2 ft x 4 ft frame structure as shown in Figure 7 using six 2 ft aluminum frame tubing pieces, four right-angle tubing connectors, and two straight tubing connectors. Remember to construct the frame so that all Velcro surfaces face in (toward the center of the structure).

**Notice:** Make sure that all support pole cups in the aluminum frame tubing pieces are facing downward.



**Figure 7.** Assembled 2 ft x 4 ft frame

- 2 Unfold the 2 ft x 4 ft hood fabric.
- 3 Insert the frame into the fabric and fasten the fabric to the frame using the Velcro surfaces. The fabric stretches around the outside, then up and over the frame structure. The Velcro on the fabric reaches down to mate with the Velcro on the inner surface of the frame structure. When completed, the soft rubber gasket material should lie in a straight line along the top surface of all four sides of the frame.

**Notice:** Be sure to press the Velcro surfaces firmly together. When completed, the hood fabric will be stretched fairly taut and will require good bonding of the fabric to the frame.

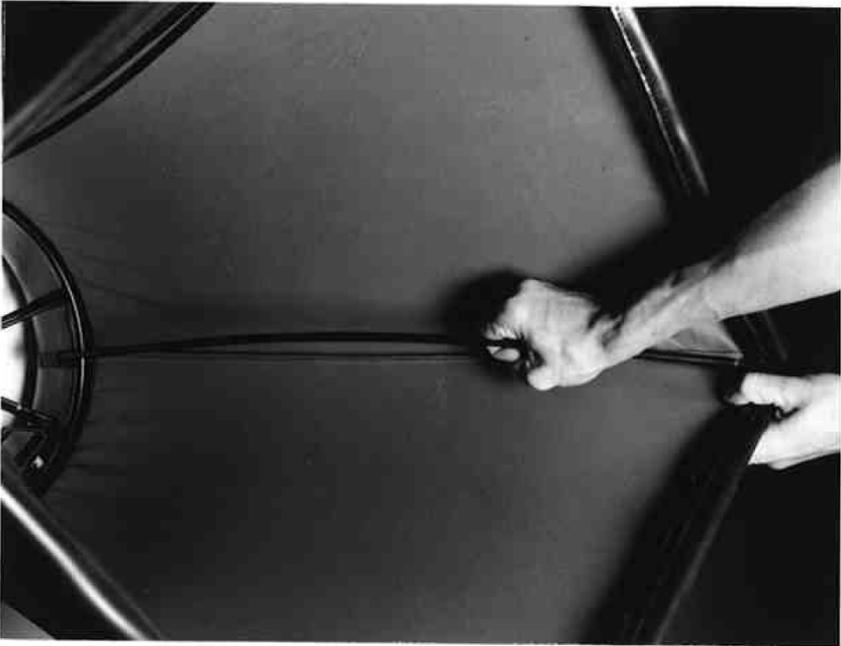
- 4 Stretch the cinch belt at the bottom of the fabric over the lip around the top of the molded plastic base of the ACCUBALANCE. Align the seams of the fabric panels with the pairs of screw heads that hold the four pole mounts to the ACCUBALANCE base. Align so that the cinch belt latch is on the side of the base opposite the electronics meter.
- 5 Pull the strap at the latch very tight to attach the fabric to the base. Make sure that the strap stays tucked under the protruding lip all around the top of the base. Pay particular attention to where the strap passes the handles.
- 6 Now it is time to install the support poles. You will find four white marks on the inside top edge of the fabric. These marks identify the location of cups on the underside of the frame tubing that will accept the ends of the support poles.

At this time it is helpful to be near a table or some other thigh-high surface to help hold up the fabric while you install the first support pole (refer to Figure 5 on page 12).

- 7 With the base of the ACCUBALANCE on the floor, lift the fabric frame up so that a white mark is directly in front of you. Support the opposite side of the frame structure on a nearby table or other level surface as shown in Figure 5.

Take one support pole and insert one end into its pole mount in the ACCUBALANCE base.

Bend the pole slightly to guide the other end into the corresponding support pole cup located on the underside of the frame near the white mark on the fabric.



**Figure 8.** Installing a support pole

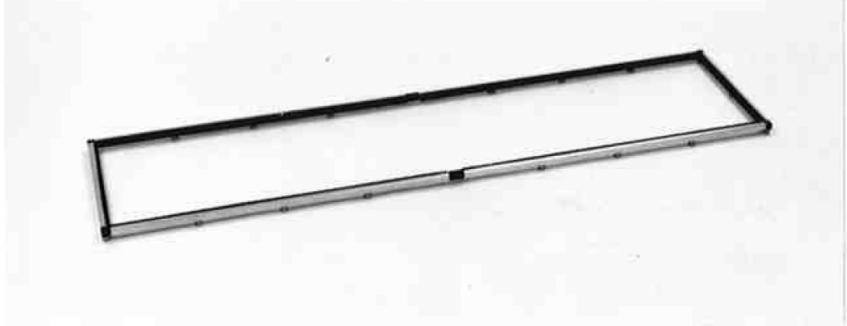
- 8 Repeat step 7 until all four support poles are installed.
- 9 Now that the hood is assembled and the fabric is stretched tight, it is a good practice to check the rubber gasket around the top edge of the ACCUBALANCE fabric. In order to achieve a good straight alignment of the rubber gasket along the top of the frame structure, you may need to peel back and re-attach small portions of the Velcro surfaces.
- 10 Finally, at the corners, tuck the straight rubber gasket flaps under the edges cut at an angle. This will create a virtually leak-free, soft, pliant seal.

## 1 ft x 4 ft Hood

To assemble and attach the 1 ft x 4 ft hood, carefully follow these 10 steps:

- 1 Build the 1 ft x 4 ft frame structure as shown in Figure 9 using four 2 ft aluminum frame tubing pieces, two 1 ft aluminum frame tubing pieces, four right-angle tubing connectors, and two straight tubing connectors. Remember to construct the frame so that all Velcro surfaces face in (toward the center of the structure).

**Notice:** Make sure that all support pole cups in the aluminum frame tubing pieces are facing downward.



**Figure 9.** Assembled 1 ft x 4 ft frame

- 2 Unfold the 1 ft x 4 ft fabric hood.

Continue with steps 3 through 10, beginning on page 20.

## 1 ft x 5 ft Hood

To assemble and attach the 1 ft x 5 ft hood, carefully follow these 10 steps:

- 1 Build the 1 ft x 5 ft frame structure as shown in Figure 10 using four 2 ft aluminum frame tubing pieces, two 1x tube connectors, two 1 ft aluminum frame tubing pieces, and four right-angle tubing connectors. Remember to construct the frame so that all Velcro surfaces face in (toward the center of the structure).

**Notice:** Make sure that all support pole cups in the aluminum frame tubing pieces are facing downward.



**Figure 10.** Assembled 1 ft x 5 ft frame

- 2 Unfold the 1 ft x 5 ft fabric hood.

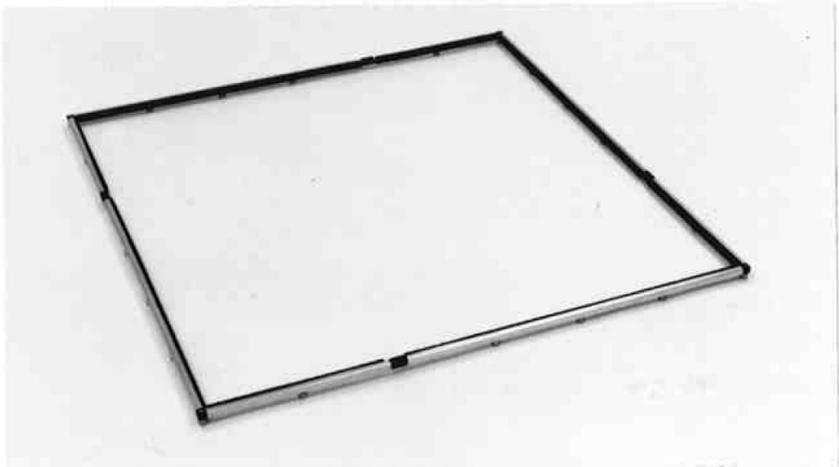
Continue with steps 3 through 10, beginning on page 20.

### 3 ft x 3 ft Hood

To assemble and attach the 3 ft x 3 ft hood, carefully follow these 10 steps:

- 1 Build the 3 ft x 3 ft frame structure as shown in Figure 11 using four 2 ft aluminum frame tubing pieces, four 1 ft aluminum frame tubing pieces, four right-angle tubing connectors, and four straight tubing connectors. Remember to construct the frame so that all Velcro surfaces face in (toward the center of the structure).

**Notice:** Make sure that all support pole cups in the aluminum frame tubing pieces are facing downward.



**Figure 11.** Assembled 3 ft x 3 ft frame

- 2 Unfold the 3 ft x 3 ft fabric hood.

Continue with steps 3 through 10, beginning on page 20.

## Switching On the Power

The power ON/OFF switch is located on the meter keypad of the ACCUBALANCE. To turn the power on, momentarily press the ON/OFF switch. The ACCUBALANCE will immediately light all display digits and sound the buzzer. After a second, the approximate percent of remaining battery life will be displayed. If fresh, new alkaline batteries are used, the value will be near 100-percent. Other batteries, such as NiCd batteries, may show a lower value even when they are fully charged.

**Notice:** The percent power remaining will not be accurate for NiCd batteries because they do not discharge linearly with power use.

While the battery life is being displayed, the ACCUBALANCE will automatically perform a series of self tests. If an error is detected, the display will show an error number. Refer to *Troubleshooting* in Chapter 4 for interpretation of the error message.

If no errors are detected during start-up, the ACCUBALANCE will proceed to one of its two operating modes: continuous reading mode or averaging mode. As long as the batteries have not been removed or the DIP switch settings have not been changed, the ACCUBALANCE will return to the mode it was in when it was last used.

## Selecting Flow Direction

The ACCUBALANCE is designed to accurately measure air flow in either direction through the hood. For highest performance accuracy, every ACCUBALANCE is calibrated with flow in each direction separately. Therefore, it is very important that you select the flow direction using the RETURN/SUPPLY switch on the keypad before you make a measurement. The arrow in the upper right hand area of the display will change direction each time you press the RETURN/SUPPLY switch

on the keypad. Make sure the arrow is pointing in the direction of the flow before you make a measurement.

## **Continuous Reading Mode**

In this mode the display is continuously updated either once every second or every other second. The ACCUBALANCE is shipped with a one-second display update rate. The update rate can be changed to once every two seconds by changing DIP switch 7 in the battery compartment (see *Changing DIP Switch Settings* later in this chapter). Changing the update rate to two seconds can help reduce fluctuations in the readings (using the averaging mode will also help stabilize the readings).

The flow rate can be held on the display by pressing the START/HOLD switch on the keypad or the button in the right handle. This is a valuable feature if you do not have the optional printer. The hold function will allow you to set the instrument down to manually record a measurement. Of course, the printer would make the job even easier. With the printer, all you would have to do is press the PRINT button instead of setting the instrument down and writing the value by hand.

To resume continuous readings when a value is being held on the display, simply press the START/HOLD switch or the button in the right handle.

## **Averaging Mode**

This mode can be identified by the "AVERAGE" message appearing on the display. You can toggle between continuous reading mode and averaging mode by repeatedly pressing the AVG/CONT switch on the keypad.

In the averaging mode, the ACCUBALANCE takes flow measurements for three or six seconds and then displays and holds the time-averaged flow. The averaging time can be changed between three and six seconds by changing DIP switch 6 inside the battery compartment (see *Changing DIP Switch Settings* later in this chapter). The display will count down while the ACCUBALANCE is taking flow measurements.

**Notice:** You *must* keep the ACCUBALANCE in place during the entire countdown and until the time-averaged measurement appears on the display.

## Selecting Flow Units

The ACCUBALANCE is capable of displaying measured flow rates in three different measurement units: CFM (Cubic Feet per Minute), l/s (Liters per Second), and m<sup>3</sup>/hr (Meters cubed per Hour). DIP switches 3 and 4 control the display units. Refer to *Changing DIP Switch Settings* later in this chapter to change the flow units.

## Selecting the Time Constant

The ACCUBALANCE allows you to choose between two measurement speeds in both the continuous reading mode and in the averaging mode. In the continuous reading mode you may select either a one-second or a two-second display update rate. The ACCUBALANCE is shipped from the factory set up to operate at the one-second display rate. You may change to a two-second display rate by adjusting switch 7 under the battery cover (see *Changing DIP Switch Settings*).

The flow sensor in the ACCUBALANCE is extremely fast and actually samples flow at a rate of 10 times per second. Thus, the values displayed in the one-second mode represent an integration of 10 readings each. Likewise, the values displayed in the 2-second mode represent an integration of 20 readings each. By selecting the slower

(2-second) display rate, you will therefore see less variation in the displayed values.

In the averaging mode, you may choose between a three-second and a six-second averaging time period. The ACCUBALANCE is shipped set up in the three-second averaging mode. You can change this by changing the setting of switch 6 in the battery compartment (see *Changing DIP Switch Settings*).

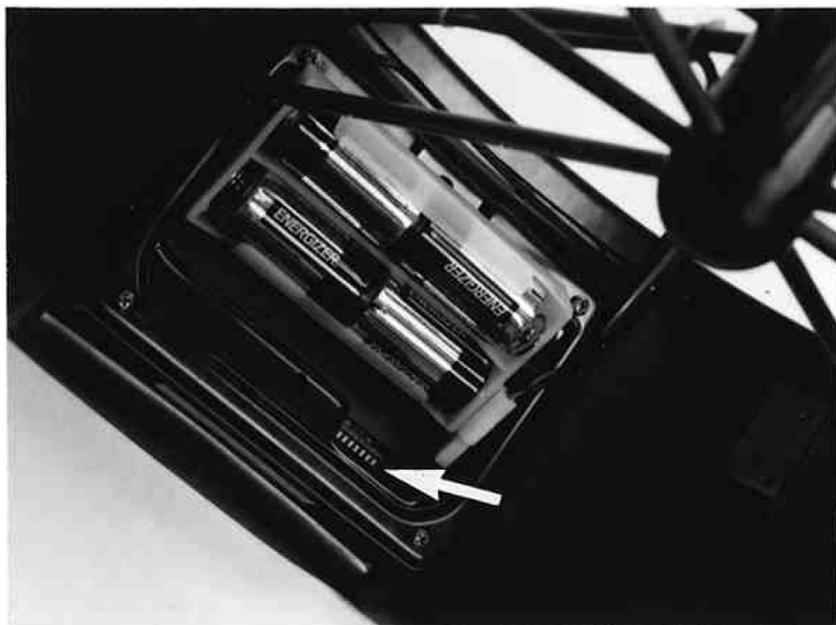
## **Changing DIP Switch Settings**

You can change flow units and time constants by adjusting the settings of the DIP switches located inside the battery compartment. To gain access to the DIP switches, first turn off the ACCUBALANCE and lay down the instrument with the electronic meter facing down as shown in Figure 12.



**Figure 12.** ACCUBALANCE lying face down

Remove the battery compartment cover by pulling up on the two latches. You will see the switches numbered 1 through 8 in the corner of the battery compartment. You may wish to remove or tilt up the battery pack to allow easier access to the switches as shown in Figure 13.



**Figure 13.** Location of DIP Switches

You may change the switch settings using the tip of a ball-point pen, pencil, compass, small screwdriver, or other small, pointed object. Refer to Table 2 for switch settings.

Table 2. DIP Switch Settings

Switch Number	Setting: Function
1	Leave in OFF position
2	Leave in OFF position
3,4	3 OFF, 4 OFF: Flow units = CFM
	3 OFF, 4 ON: Flow units = l/s
	3 ON, 4 ON: Flow units = m <sup>3</sup> /hr
5	Leave in OFF position for Rev A thru Rev M Leave in ON position for Rev N and later
6	OFF: 3-second averaging in Averaging Mode
	ON: 6-second averaging in Averaging Mode
7	OFF: 1-second display update rate in Continuous Reading Mode
	ON: 2-second display update rate in Continuous Reading Mode

\* See the serial number sticker on the unit to find the Rev level of your ACCUBALANCE unit.

## Low Battery Warning

When a battery power is running low, the message "LOW BATTERY" will appear on the display. *NOTE: The readings given by the ACCUBALANCE when "LOW BATTERY" is displayed are still valid.* Before the battery power gets so low that valid flow measurements are not possible, the ACCUBALANCE will shut itself off. When the "LOW BATTERY" message appears, you usually have at least a half hour of running time before the power gets so low that the ACCUBALANCE would automatically turn itself off. If the optional printer is connected, the message "LOW BATTERY" is printed just before the ACCUBALANCE turns itself off.

## Automatic Shut-off

The ACCUBALANCE has an automatic shut-off feature to help save battery life. If no switches or buttons are pushed for fifteen minutes, the ACCUBALANCE will shut itself off.

## Connecting the Optional Printer

The ACCUBALANCE can be used with an optional portable printer. The printer provides hard copy of selected flow rates and eliminates the awkward task of manually recording flow rates while operating a flow measuring hood. To connect a TSI Model 8925 Portable Printer to the ACCUBALANCE, locate the interface cable that was shipped with the printer. The cable has a modular RJ-45 (telephone type) connector on one end and a 9-pin D-connector on the other end. Simply connect the 9-pin D-connector to the printer and the RJ-45 connector to the ACCUBALANCE DATA PORT. If you find that the printer prints only question marks "?", turn the printer off and then on again. For details about how to operate the Model 8925 Portable Printer, refer to the manual that was shipped with it.

## RS-232 Serial Output

The DATA PORT on the ACCUBALANCE is used to interface to a printer, digital data logger, or other serial device. The connector required for the RS-232 port on the ACCUBALANCE is an eight-pin, modular RJ-45 type connector. For communications specifications and details about the cable wiring configuration of the RS-232 port, refer to Appendix C, *ACCUBALANCE Serial Interface Connections*.

The serial output from the ACCUBALANCE is transmitted in ASCII format. Table 3 lists examples of the output from the ACCUBALANCE.

Table 3. Print-out Examples

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### Continuous Reading Mode

Flow = 435 CFM

Flow = 1580 m<sup>3</sup>/hr

Flow = 132 l/s

## Averaging Mode

3 sec Average = 435 CFM

3 sec Average = 1580 m<sup>3</sup>/hr

6 sec Average = 132 l/s

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# Chapter 3

## Maintenance

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The ACCUBALANCE is designed for long-term field use. If the ACCUBALANCE is used with reasonable care, it should be able to make precise measurements over a long time period. Some of the components can be cleaned periodically. When cleaning the components, please follow the instructions given below.

### Fabric Hood

The hoods can be washed with mild detergent and cold water. When washing the hood, keep the hood away from objects with sharp corners or sharp edges. Careless cleaning may cause damage.

If the fabric gets ripped it should be replaced or repaired. Duct tape can be placed over the rip on both sides of the fabric for temporary repair.

To replace a damaged fabric or to order a different fabric size, contact your local TSI distributor. To determine who your local TSI distributor is, you may call TSI toll-free at 1-800-876-9874.

If you wish to order a new hood fabric, use the following part numbers shown in Table 4.

Table 4. Hood Fabric Part Numbers

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Fabric Hood Size	Part Number
2 ft x 2 ft (610 mm x 610 mm)	800590
2 ft x 4 ft (610 mm x 1220 mm)	800591
1 ft x 4 ft (305 mm x 1220 mm)	800592
3 ft x 3 ft (915 mm x 915 mm)	800593
1 ft x 5 ft (305 mm x 1525 mm)	800594

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It is recommended that you purchase a frame kit whenever you purchase a hood other than the 2 ft x 2 ft size. The frame kit contains all extra frame tubing and connectors required to build frames for the various size hoods. The frame kit consists of the following parts:

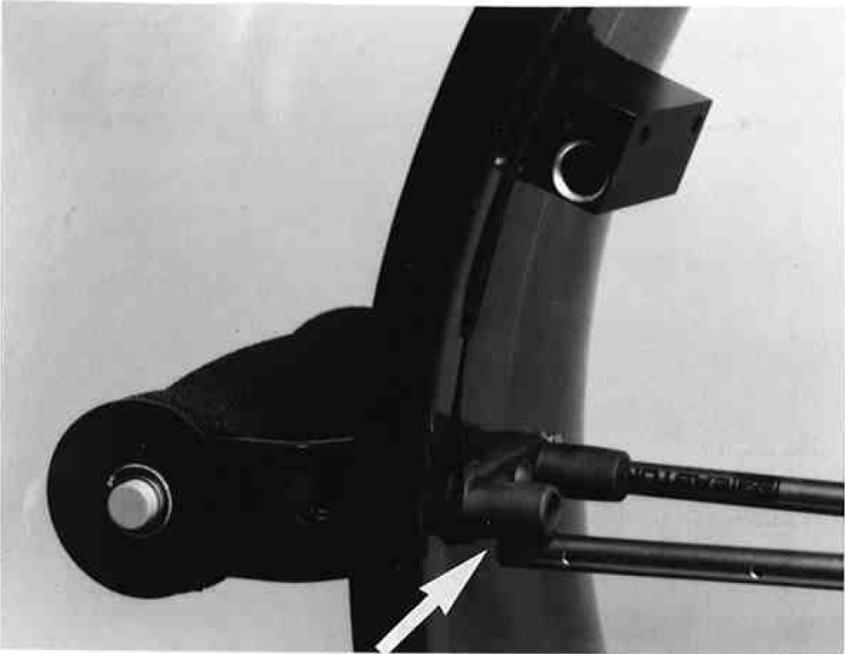
- 4 pieces 1-foot frame tubing
- 2 pieces 2-foot frame tubing
- 6 pieces straight tubing connectors

## Meter

The ACCUBALANCE has a built-in electronic flow meter. Do not try to detach the meter from the base. The ACCUBALANCE should be used and stored within the specified temperature range, 32 - 140° F (0-60° C). The meter case, display screen and membrane switch can be cleaned using a damp cloth with mild detergent solution. Do not immerse the meter in water. Wipe the meter dry before use.

## Manifold

If you notice that a tube in the flow sensing manifold has become disengaged from its rubber holder as shown in Figure 14, work the tube end back into the holder. The accuracy of the ACCUBALANCE is not affected by having one or two tubes out of their holders; however, it is a good practice to keep the tubes properly in place.



**Figure 14.** Flow Sensing Tube Out of Place

If you observe the flow sensing taps of the manifold becoming clogged with dust or other material, clean them with a damp cloth. The manifold should be kept in place during cleaning. Do not apply excessive forces on the grid tubes of the manifold. If any of the tubes are bent or damaged, please contact TSI for repair information.

## Calibration

TSI recommends an annual calibration for the ACCUBALANCE. For a nominal fee, TSI will calibrate the unit and return it to you with a certificate of calibration and NIST traceability. This 'annual checkup' assures you of consistently accurate readings. To calibrate the ACCUBALANCE, please ship TSI the complete package that includes the meter, the base, the manifold and any fabrics used. Everything should

be packed carefully within the ACCUBALANCE carrying case and then inside a proper shipping box, such as the original shipping box.

Ship directly to:            TSI, Inc.  
                                      ATTN: Customer Service  
                                      500 Cardigan Road  
                                      Shoreview, MN 55126-3996

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## Chapter 4

### Troubleshooting

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Table 5 lists the symptoms, possible causes, and recommended solutions for common problems encountered with the ACCUBALANCE. If your symptom is not listed, or if none of the solutions solves your problem, please contact TSI.

Table 5. Troubleshooting the ACCUBALANCE

Symptom	Possible Causes	Corrective Action
No display	Unit not switched on	Press ON/OFF button.
	Low or dead batteries	Replace the batteries.
	Dirty battery contacts	Clean the battery contacts.
	Battery holder not connected	Plug in battery holder.
"LOW BATTERY" on display	Low battery charge	Replace the batteries.
	Dirty battery contacts	Clean the battery contacts.
Flashing "0" (Flow is under range)	Trying to read too low a flow	Flow may not be measurable using the ACCUBALANCE.
	Object is blocking flow through ACCUBALANCE	Remove obstruction.

Table 5 (continued)

<b>Symptom</b>	<b>Possible Causes</b>	<b>Corrective Action</b>
	Sensor grid tubes are plugged	Clean the tubes.
	ACCUBALANCE is not sealing around diffuser	Reposition the ACCUBALANCE to form a seal.
Flashing flow value "> 0" (Flow is over range)	Trying to read too high a flow	Flow may not be measurable using the ACCUBALANCE.
Flow reading fluctuates badly	The flow is fluctuating	Use a longer time constant.
"ERR2" appears	The flow sensor is giving an erroneous reading	Return to the factory for service.
"ERR1" appears	Temperature compensation sensor is damaged	Return to the factory for service.
	Unit is or was recently in ambient temperature outside of operating temperature	Allow unit to stabilize in the operating temperature range of 32 - 140°F (0 - 60°C).
"ERR3" appears	The ACCUBALANCE has detected a calibration fault	Return to the factory for service.

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# Appendix A

## Standard Flow vs. Actual Flow

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Standard flow is defined as the volumetric flow rate of air at "Standard" temperature and barometric pressure conditions of 70°F (21.1°C) and 14.7 psia (760 mmHg). By contrast, actual flow is the volumetric flow rate of air at local temperature and barometric pressure conditions. It is common in ventilation test applications that standard flow is the desired measurement parameter. The ACCUBALANCE automatically indicates standard flow readings. There is therefore no need to apply a correction factor; however, if you wish to convert standard flow readings to actual flow readings, you must apply an air-density correction factor:

$$Actual\ Flow = (Standard\ Flow) \left[ \frac{14.7}{P_{act}} \right] \left[ \frac{460 + T_{act}}{530} \right]$$

where  $P_{act}$  = Your local barometric pressure in psia.  
 $T_{act}$  = Your air flow temperature in °F.

Or

$$Actual\ Flow = (Standard\ Flow) \left[ \frac{760}{P_{act}^1} \right] \left[ \frac{273.15 + T_{act}^1}{294.25} \right]$$

where  $P_{act}^1$  = Your local barometric pressure in mmHg.  
 $T_{act}^1$  = Your air flow temperature in °C.

**Example 1:**

Suppose your air flow temperature is 55°F and your local barometric pressure is 13.5 psia, and the standard flow indicated on the ACCUBALANCE is 200 (standard) CFM.

$$Actual\ Flow = 200 \left[ \frac{14.7}{13.5} \right] \frac{460 + 55}{530} = 212\ Actual\ CFM$$

**Example 2:**

Suppose your air flow temperature is 25°C, and your local barometric pressure is 730 mmHg, and the standard flow indicated on the ACCUBALANCE is 100 (standard) l/s.

$$Actual\ Flow = 100 \frac{760}{730} \left[ \frac{273.15 + 25}{294.25} \right] = 105\ Actual\ l/s \quad †$$

## Appendix B

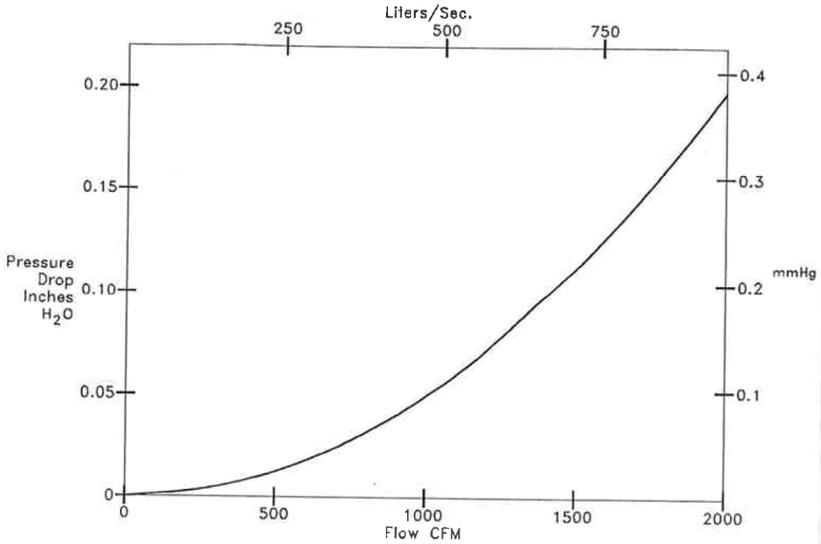
### **Back Pressure**

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It is commonly known that a flow measuring hood may induce a back pressure. In general, back pressures are caused by restrictions in the flow path as well as frictional pressure losses. In order to improve accuracy and sensitivity, all flow measuring hoods incorporate a contracted flow section. The contracted section restricts the flow through the hood which induces a back pressure. A hood having a more abrupt contraction than the ACCUBALANCE may induce greater back pressure due to the turbulence caused by the abrupt contraction. In addition any apparatus within the hood, such as supporting poles and the flow manifold, also induces some frictional pressure drop.

Back pressure may cause slight errors in the flow measurements. Figure 15 shows the pressure drop through the ACCUBALANCE over its entire flow range. As shown in the figure, the back pressure is only 0.05 in. H<sub>2</sub>O at a flow rate as high as 1000 CFM.



**Figure 15.** Pressure Drop through the ACCUBALANCE

If you wish to make back pressure corrections, you must first determine the back pressure correction factor,  $C_b$ . The back pressure correction factor,  $C_b$ , can be determined as follows:

$$C_b = \frac{V_0}{V} \quad (8-1)$$

where  $V$  and  $V_0$  are the average air velocities in the duct ahead of the diffuser with and without the capture hood in place, respectively. With the known correction factor, the back-pressure corrected flow can be determined using Equation (8-2):

$$\text{Back-pressure corrected flow} = \text{Displayed flow} \times C_b \quad (8-2) \quad †$$

# Appendix C

## ACCUBALANCE Serial Interface Connections

A 9-pin cable (Model 8926) is available for use with the ACCUBALANCE and the TSI Model 8925 Portable Printer. This cable allows a direct connection between the ACCUBALANCE and the printer. Its connections are as follows:

Signal Name	ACCUBALANCE	Printer	Signal Name
tied together	pin 1	pin 1	
tied together	pin 2	pin 7	
	pin 3	pin 2	
tied together	pin 4	pin 6	
transmit data	pin 5	pin 3	receive data
	pin 6	pin 9	
signal ground	pin 7	pin 5	signal ground
tied together	pin 8	pin 8	busy
	no connection	pin 4	

**Figure 16.** 9-pin, RS-232 serial interface connections for Model 8925 Printer

All lines shown are connected, but only the data line going to the printer and the ground are actually used in this configuration. The pins labeled "tied together" are connected together inside the ACCUBALANCE.

A 25-pin cable (Model 8927) is available for connecting the ACCUBALANCE to a personal computer. This cable allows a direct connection between the ACCUBALANCE and the computer. Its connections are as follows:

Signal Name	ACCUBALANCE	Computer	Signal Name
tied together	pin 1	pin 8	carrier detect
tied together	pin 2	pin 5	clear to send
	pin 3	pin 2	transmit data
tied together	pin 4	pin 6	data set ready
transmit data	pin 5	pin 3	receive data
	pin 6	pin 22	ring indicator
ground	pin 7	pin 7	ground
tied together	pin 8	pin 20	data term ready

**Figure 17.** 25-pin, RS-232 serial interface connections for personal computer

The pins labeled "tied together" are connected together inside the ACCUBALANCE. This puts the "data set ready" and "clear to send" lines at the proper logic level for your computer to receive data.

If you wish to connect the ACCUBALANCE to a computer which uses a 9-pin connector for serial communications, an adapter may be used. This is a standard 25-pin to 9-pin adapter with male pins on the 25-pin side and female pins on the 9-pin side. Such an adapter is supplied with the Model 8927 Computer Interface Cable or is available from a number of computer supply houses. Its connections are as follows:

9-Pin Female Side	25-Pin Male Side	Signal Name
pin 1	pin 8	carrier detect
pin 2	pin 3	receive data
pin 3	pin 2	transmit data
pin 4	pin 20	data term ready
pin 5	pin 7	ground
pin 6	pin 6	data set ready
pin 7	pin 4	request to send
pin 8	pin 5	clear to send
pin 9	pin 22	ring indicator

**Figure 18.** 25-pin to 9-pin, RS-232 serial interface connections †

# Appendix D

## Return Mode Low Flow Corrections

The ACCUBALANCE is calibrated in a vertical position. Thus, in the Return Mode, air is flowing up through the ACCUBALANCE base and then through the fabric hood.

When using the ACCUBALANCE in a horizontal orientation at flows below 100 CFM (50 l/s), such as at a side wall return vent, the ACCUBALANCE will read slightly lower than the true flow. At 80 CFM (40 l/s), for example, the ACCUBALANCE will read low by 2 CFM (1 l/s). Therefore, you may wish to add 2 CFM (1 l/s) when the indicated flow is 80 CFM (40 l/s); 3 CFM (1.5 l/s) at 50 CFM (25 l/s); and 4.5 CFM (2 l/s) at 30 CFM (15 l/s) to obtain a more accurate reading. *No correction is required at flows greater than 100 CFM (50 l/s).*

<p><b>Notice:</b> This correction factor is necessary only in the Return Mode. The Supply Mode does not require a correction.</p>
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# Appendix E

## Specifications

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Flow Range	30-2,000 CFM (15-1,000 l/s, 50-3,500 m <sup>3</sup> /hr)
Accuracy	±5% rdg, ±5 CFM (±2.4 l/s, 8.5 m <sup>3</sup> /hr)
Operating Temperature Range	32-140°F (0-60°C)
Weight (using 24 in × 24 in Hood)	7 lb 6 oz (3.4 kg)
Hood Sizes Available	24 in × 24 in; (610 mm × 610 mm) 24 in × 48 in; (610 mm × 1220 mm) 12 in × 48 in; (305 mm × 1220 mm) 12 in × 60 in; (305 mm × 1525 mm) 36 in × 36 in; (915 mm × 915 mm)
Power	4 C-size batteries (4 alkaline batteries provided)
Battery Life	At least 40 hours of continuous use
Carrying Case	26 in × 26 in × 7 in (660 mm × 660 mm × 180 mm)
RS-232C Output	ASCII Character codes 1200 Baud No parity 8 data bits 1 stop bit No handshaking

These specifications are subject to change without notice.

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