

OWNER'S MANUAL

DB 150 Electronic Balometer[®]



ALNOR[®]
A TSI[®] Company

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SECTION 1

General Description

Instrument Features

The Alnor DB 150 Balometer is designed to measure supply or return air flow from diffusers or grilles in HVAC systems. Its measurement range is 50 to 2000 cfm (85 to 3400 m³/h or 24 to 945 l/s). The instrument includes a removable meter on a lightweight base and a nylon hood that captures air flow. The DB 150 meter displays measurement results on a liquid-crystal display (LCD), with additional display segments for memory locations and units of measure.

The DB 150 Balometer stores and sums up to 100 volume air flow measurements. For convenience, memory can be organized into sections called pages. All flow measurements are saved in battery-backed memory. Readings can be printed out during operation by an optional printer, or can be saved for subsequent downloading. An RS-232 serial connection is used to connect the DB 150 to

a serial printer, a personal computer, or an RS-232/RS-485 zonebus converter.

The DB 150 Balometer operates on four “C” size batteries when the meter is attached. When the meter is removed from the base, three “AA” size batteries power the DB 150 meter only. An automatic shut-off can be enabled by the user to increase battery life in either case.

Association with Johnson Controls, Inc.

This instrument was designed to communicate with the Johnson Controls, Inc. VMA1400 VAV Controller family. When the meter is hooked up to the controller via an RS-232/RS-485 zonebus cable, the user can change room parameters such as: fan settings, damper positions, and set points. The meter ‘talks’ to the VMA when it is attached to the instrument base or when it is removed.

SECTION 2

Theory of Operation: Capture Hoods and Thermo-Anemometry Sensing

As air exits a diffuser, it is captured through the hood and directed over a manifold. The manifold averages the velocity pressure and directs air over the sensors. The velocity of the air passing through the manifold is measured, using a constant temperature thermo-anemometer. The voltage output from the thermo-anemometer is calibrated for the entire volume rate passing through the DB 150 Balometer.

All capture hoods are susceptible to “odd” air flow patterns. “Odd” could refer to any air flow pattern that is different from the pattern where it was calibrated. Substantial negative effects

can be observed when using a large hood on a small diffuser, for example, using a 2' x 2' hood on a 10" x 10" diffuser. This creates large recirculation regions on the sides of the fabric hood and causes an “odd” air flow pattern as it passes over the manifold. It is recommended to match the hood closely to the size of the diffuser.

Note: Throughout this manual, the units cfm, m³/h and l/s are used for simplicity. Note, however, that the DB 150 Balometer actually reads in standard cubic feet per minute (scfm), standard cubic meters per hour (std. m³/h), or standard liters per second (std. l/s).

Standards

All Balometers or hoods are calibrated to some standard. Different manufacturers or calibration facilities may use standards or methods that are different from those used at Alnor Instrument Company. Alnor uses laminar flow elements as the standard to calibrate Balometers. These devices are made up of a very fine honeycomb mesh. The pressure drop across a laminar flow element is approximately linear with the flow going through the element. Alnor Balometers are calibrated using a standard 2' x 2' square diffuser. Other manufacturers may use orifice plates or nozzles and may not use a diffuser.

When using proportional balancing techniques, these differences will not be important. However, when comparing Balometers against other hoods, or when comparing Balometers calibrated at Alnor versus other calibration facilities, these differences may be important. It is not unusual to see air flow calibration differences on the order of 5% because of different standards.

Flow Resistance

All capture hoods cause flow resistance on the air handling system. Just as different diffuser styles have their own characteristic flow resistance, so do capture hoods. This added resistance reduces the true amount of air exiting the diffuser. *In the majority of cases, this error is less than or equal to the accuracy of the*

instrument. Proportional balancing techniques will also assist in making these effects negligible.

To determine if the flow resistance effects are important, perform duct traverses to determine the volume rate exiting a diffuser both with and without the capture hood in place. The difference between the volume rate with and without the capture hood in place is the flow resistance effect for that diffuser.

To determine a flow resistance correction factor for use with similar diffusers and duct configurations, use the volume rates as determined from the duct traverses both with and without the hood as follows.

V_{hood} = Flow rate with the hood in place

$V_{\text{no hood}}$ = Flow rate without the hood in place

CF = $V_{\text{no hood}} / V_{\text{hood}}$

V_{measured} = Volume rate as displayed by the capture hood

$V_{\text{corrected}}$ = Volume rate corrected for the flow resistance of the capture hood

$V_{\text{corrected}} = CF * V_{\text{measured}}$

Atmospheric Pressure

Above 500 cfm (250 l/s), large changes in atmospheric pressure can affect readings from the Balometer. The correct value is inversely proportional to the atmospheric pressure. A change in atmospheric pressure of -3% will require the display to be multiplied by +3%.

SECTION 3 Safety

When using the DB 150 Balometer to check air flow at ceiling diffusers, make certain that you can safely raise and hold the unit while making measurements. Be especially careful when working on a ladder.

Observe all necessary precautions so that the unit does not become caught in moving

machinery or touch any exposed electrical wiring.

The DB 150 Balometer is not designed for gas mixtures other than air. Use with corrosive or other dangerous or explosive gas mixtures is not recommended, and is at the user's risk.

SECTION 4

About the Instrument, Meter, and Display

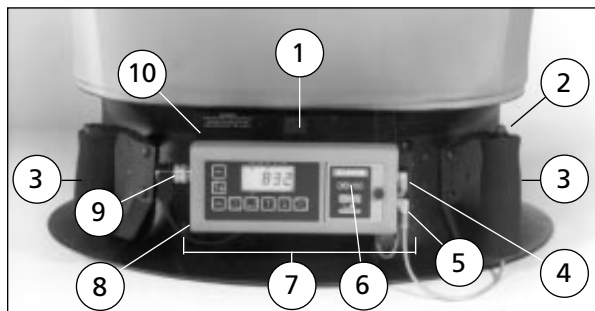


Figure 1

Index No.	Description
1	For detachable middle handle
2	Handle hold button
3	Side handles
4	Battery jack—must be plugged in when using meter with base
5	Hold switch cable
6	Meter battery compartment
7	DB 150 meter
8	Base wing nut
9	Sensor connector—only connect/disconnect when meter is OFF
10	Base battery compartment

Table 1—Reference Figure 1

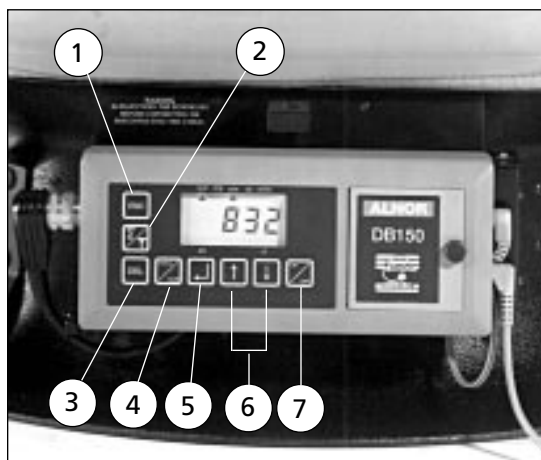


Figure 2—The Meter

The Meter



1. **ESC**

Exits a selected menu without altering any of its values.



2. **SUPPLY RETURN**

Selects the desired measuring mode.



3. **DEL**

Deletes stored flow measurements.



4. **HOLD/SUM**

Freezes data in measurement mode for input to memory. The displayed measured value will flash. Push **HOLD/SUM** again to store your data. Press **ESC** to return to measurement mode without storing. (When holding the DB 150 Balometer up to a grille, it might be easier to use the red hold button on the right handle to freeze or store a reading.)

This key also sums and displays all of the values of the page selected, while in the [PAGE] menu.



5. **ENTER**

Accepts selected choices such as values and menu selections.



6. **UP/DOWN**

Scrolls through the menu structure. Makes YES/NO or ON/OFF selections within menu. Increases or decreases values.



7. **ON/OFF**

Turns the instrument on or off.

The Display

The DB 150 meter uses a custom liquid crystal display (LCD) to show measured values, units of measure, page and line numbers of data stored, an indicator showing if the correction factor is equal to 1, and an indicator to show JCI operation.

The display is only capable of showing a number no higher than 9999. In the event that a number is greater than 9999, the display will show the number in scientific

notation. The format will be XXEY. The reading will be rounded to the nearest thousand, XX. The Y indicates the number of zeros after XX. For example, 12751 is displayed as 13E3. The DB 150 Balometer is measuring and averaging the *actual* value of the reading, not the rounded scientific notation value. No accuracy loss will be encountered. When printing the data on the 8521 MicroPrinter or downloading the data to a host PC, the scientific notation reading will be seen.

SECTION 5

Set-up

Installing Batteries

The DB 150 Balometer operates on three 'AA' and four 'C' batteries. Batteries are not installed in your instrument when it leaves Alnor; they can be found in the accessory pocket underneath the base.

The four "C" size batteries are installed under the meter tilt mechanism on the base assembly. The battery jack that exits from the rear of the base assembly must be plugged into the right side of the DB 150 meter.

To install the "C" batteries (See figure 3):

1. Disconnect the battery jack from the right side of the DB 150 meter.
2. Loosen the wing nut on the *left* side and tilt the base all the way forward.
3. Install the batteries by placing them in the battery case, being sure to note polarity.
4. Return the base to the original position and tighten the wing nut.
5. Plug the battery jack back into the DB 150 meter.

The DB 150 meter, by itself, operates on 3 AA size batteries.

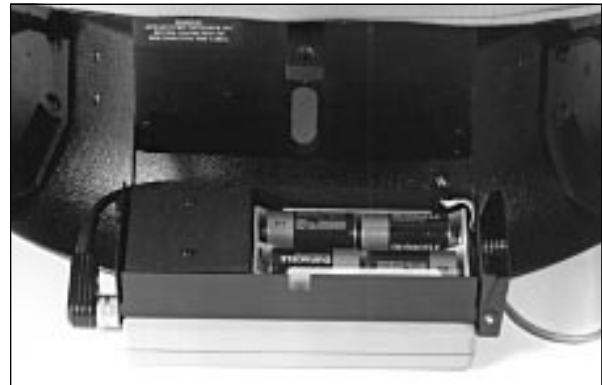


Figure 3

To install the "AA" batteries:

1. Loosen the battery cover screw on the front of the DB 150 meter. See figure 4.
2. Slide the cover left and lift it out.
3. Install the batteries over the pull strap, taking care to observe each battery's polarity.
4. Replace the cover and tighten the screw.

When the batteries become low, the LCD will show [L 0 b A E E] above the reading. From that point, you will have about one hour of normal use left. If [b A E E] comes on continuously and replaces the reading, the battery voltage is too low for accurate measurements and the meter will turn itself off. Always keep a replacement set of new batteries available.



Figure 4

The meter is shipped with its auto shut-off feature enabled. This setting will automatically turn the unit off after a twenty minute period of keypad inactivity. To disable this feature, follow the instructions in Section 7.

Battery charger:

The optional battery charger kit (P/N 634-513-525) with 4 "C" size NiCd batteries has its own operating manual. Please refer to this for further information.

Attaching the 2' x 2' Nylon Hood

Before removing any parts from the carrying case, the arrangement of the various items should be noted so that packing can be done easily. See Figures 5a and 5b.

Note: The DB 150 Electronic Balometer system comes from the factory with a 2' x 2' (600 x 600 mm) nylon hood installed on the base.

1. Undo the velcro tie down straps at the two locations shown in Figure 5a.
2. Holding the 2' x 2' (600 x 600 mm) hood frame, gently lift the entire instrument assembly and set it to the side of the carrying case. The accessory pocket, located underneath the DB 150 Balometer, is now exposed (figure 5b). It contains the spider assembly, support dowels and handle. Remove these items from the inside pocket.

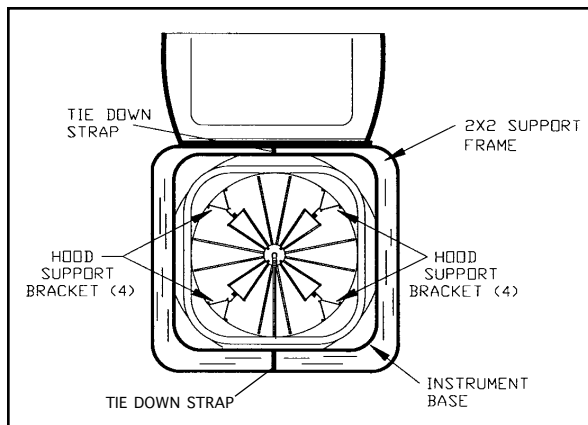


Figure 5a—Top view of carry case

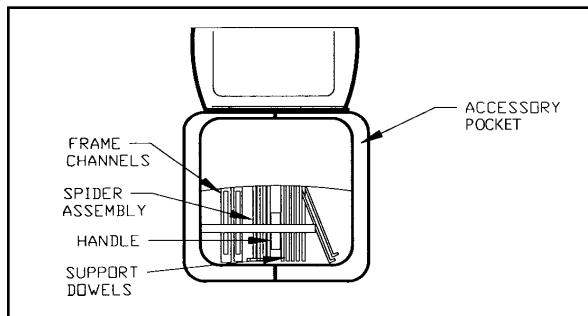


Figure 5b—Unpacking accessory pocket

3. Unfold the spider assembly mechanism. See Figure 6. This mechanism will now be inserted into the four hood support brackets located in each corner of the base. Grasp one of the wire formed legs in each hand. Insert each of the legs into the center hole of the hood support brackets. Grasp the remaining two legs and insert them into the center holes of the remaining hood support brackets. If it is later found that the hood is not held as tautly as required, the spider assembly can be moved upward to compensate.
4. Place the four support dowels on the spider assembly mechanism as shown in Figure 6. The aluminum tips on the dowels should be facing up.

5. Raise the hood up until it is taut. Insert a support dowel into one of the corners of the frame nearest to you. Take care to ensure that the support dowel is not pressing against the hood material. Insert a second support dowel into the remaining corner close to you. Lift up the far side of the hood. Pressing firmly down on the support dowel, move the dowel into the third corner. Finally, pressing down on the last dowel, insert it into the remaining corner.

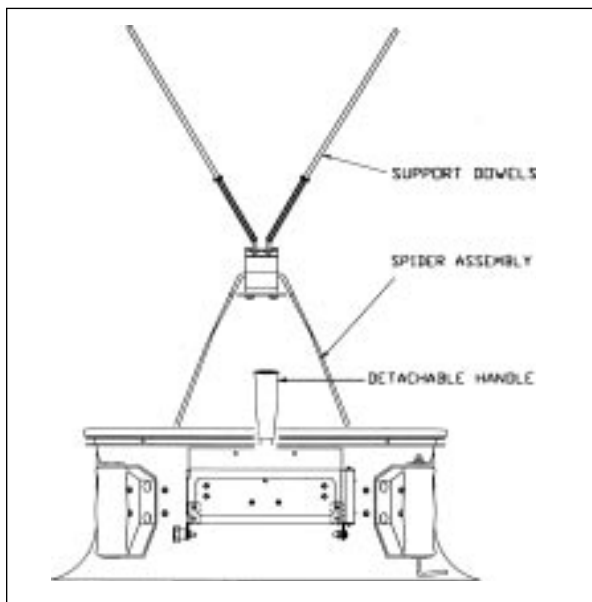


Figure 6—Instrument assembly

6. If desired, install the detachable handle as shown in Figure 6.

CAUTION Make a habit of checking the tightness of this handle each time before use. Be sure it does not loosen while the instrument is being used or while it is being carried from place to place.

Note: For other hood sizes, please use *Instruction Sheet 116-513-100, Alternate Hood Installation*.

Instrument Set-up

1. Verify that the sensor connector is attached to the meter. If it is not attached, line up the key as shown in Figure 7 and firmly press the connector into the meter. Tighten the connector by rotating the knurled ring.



Figure 7

2. Verify that the hold switch cable and the battery jack are plugged into the meter as shown in Figure 7.
3. The meter base may be tilted for convenient viewing by loosening the base wing nut located at the lower left side of the meter mounting base. Adjust the meter base to the desired angle and tighten the wing nut.

SECTION 6

Getting Started

When the meter is turned on, it is in measurement mode. It will display measurement values associated with the unit last used. If the value is **OVERRANGE** the display will show [O r].

To take basic air volume measurements:

1. Turn the meter on and select supply mode. The meter always starts measuring in the supply mode; the annunciator arrow below SUP will be on. To select the return mode, press the **SUPPLY/RETURN** key. If the meter is in the return mode, the annunciator arrow below RTN will be on.
2. To take a measurement, raise the hood assembly to the diffuser making certain

the hood frame fits around the entire diffuser and is held tightly against the ceiling or wall. Let the display settle to a steady reading.

3. Press the **HOLD** key or the red handle button. The display will flash the measured value. If this reading is not satisfactory, press the **ESC** key to return to the measure mode without storing the value.
4. If the reading is satisfactory, press the **HOLD** key again to store the value. The stored value is saved in the page that is presently selected.

Note: *If the meter displays [OPEN] turn unit off and check that the sensor connector is plugged into the meter. If this is the first time you used the meter, clear the memory.*

SECTION 7

Complete Operation Procedure

Menu Items and Operation:

When in measurement mode, use the **UP** or **DOWN** keys to scroll through the menu structure of the DB 150 meter.

PAGE

Measurements stored in the instrument's memory are organized into pages. This menu allows the user to change the page onto which they are saving measurements and to review stored values. A total of 100 readings can be stored, in varying combinations of lines and pages.

1. Press the **UP/DOWN** key until [PAGE] appears.
2. Press **ENTER** to change the page.

3. Press **ESC** to return to measurement mode.

The page number is automatically saved until you change the page number again or until a new unit of measurement is selected. For example, if you are measuring cubic feet per minute and decide to take measurements in liters per second, a new page will be created.

Print

When the DB 150 meter is connected to the Alnor MicroPrinter 8521 or a computer, stored data can be printed.

Press the **UP** or **DOWN** key until [Print] appears.

Press the **ENT** key, either [ESC] or [Alt] will appear.

Press the **UP** or **DOWN** key to select between [CUT] and [All]. [CUT] will only print the selected page; [All] will print every saved page.

The meter will return to the [P r n t] menu after printing is completed.

Use **ESC** to return to measurement mode.

CUT

This menu option enables the user to clear ALL stored data in ALL pages.

To erase stored data:

Press the **UP** or **DOWN** key until [CUT] appears.

Press the **ENT** key, [n0] will appear.

Press the **UP** key to select [YES], then press **ENT** to clear the memory.

The meter will return to the [CUT] menu.

Use the **ESC** key or $\uparrow \downarrow$ arrows to return to measurement mode.

Note: You can not clear only one reading. Clearing data erases every page in the instrument's memory. To clear individual readings, see the section on Detailed Operation.

Unit

Press the **UP/DOWN** keys to move to the preferred units of measure.

UP moves the display annunciator to the right; **DOWN** moves to the left.

Press enter upon reaching the preferred unit of measure.

Use the **ESC** or **ENTER** key to return to measurement mode.

After turning power **OFF** and then **ON** again, the meter will be set to the units as they were before power was turned OFF. Keep in mind that changing units will automatically change the PAGE.

cF

The Correction Factor is an all-purpose multiplying factor which is applied to all measurements. cF is set to 1.000 unless it is changed in the menu. An annunciator at (t) tells the user when "cF = 1". cF is usually used when air density conditions deviate from standard, see Appendix C.

To change the cF value:

Press the **UP** or **DOWN** key until [cF] appears.

Press the **ENT** key, and the present value will appear.

Press the **UP** or **DOWN** key to select the value desired, then press **ENT**.

The meter will return to the [cF] menu.

Auto

When enabled, the automatic shut-off will power-down the DB 150 after twenty minutes of keypad inactivity

To enable the auto shut-off feature:

Press the **UP** or **DOWN** key until [Auto] appears.

Press the **ENT** key, [n0] will appear.

Press the **UP** key to select [YES], then press **ENT** to enable the auto feature.

The meter will return to the [Auto] menu.

ESC takes you back to measurement mode.

CALb

Factory use only.

bc

The user can select from five different speeds of display response. See Appendix A.

- A setting of 1 is a quick response.
- A setting of 5 is a slow response

To change the value of tc:

Press the **UP** or **DOWN** key until [tc] appears.

Press the **ENT** key, and its value will appear.

Press the **UP** or **DOWN** key to select the desired value, then press **ENT**.

The meter will return to the [tc] menu.

ESC takes you back to measurement mode.



Entering this menu allows the DB 150 meter to establish communications with the Johnson Controls VMA/400 Controller if the RS-232/RS-485 (ZoneBus) converter is connected. See Section 8 for more details.

Detailed Operating Procedure

When the meter is turned on, the display will show:

- All segments of the display
- The latest software revision.

Then the meter starts to measure air flow.

For basic air flow measurements, see section 6, Getting Started.

When you have a complete set of data, create a new page, see page 8.

To examine stored data in a page, press the **UP** or **DOWN** key until [P R G E] is displayed. Press the **ENT** key. The display will show the current working page. Press the **UP** or **DOWN** key to select the page that you would like to view. Then press **ENT**.

The display will now show the stored line number, the value stored and its units. To continue reviewing the data, press the **UP** key. Pressing the **ESC** key will return the meter to

the [P R G E] menu. Pressing **ESC** again will return the meter to the measurement mode.

The meter can store up to 100 sets of data, in any combination of lines or pages. When attempting to store more than 100, the display will indicate [F u | |]. The user must clear some unwanted stored values to continue.

Stored data will ALWAYS be in succession whether the user is storing data or deleting data.

To delete a certain value, select the line number as you are viewing it, then press delete. The value and the corresponding line number are deleted. The display will return to the [P R G E] menu.

To delete an entire page, the user must delete every line number in that page. The user can delete ALL of the stored pages by using the [C | r] function. See page 9.

When viewing a page number, the user can sum all of the readings of that page by pressing the **HOLD/SUM** key while in that menu. The summed value will be shown in scientific notation if the value exceeds 9999.

To get a hard copy of the stored data from a printer or download to a computer, see page 9. The printed data will look like this:

PAGE # (# is the page number)

(line number)	(the measured value)	(its units)
(line number)	(the measured value)	(its units)
"	"	"

up to the last line stored

SUM: summed values

Date:

Name:

After all data is printed, the [r n E] display will be shown. Press the **ESC** key to return to the measurement mode.

SECTION 8

Johnson Controls Communication Interface

The DB 150 meter is designed to communicate with the Johnson Controls, Inc. VMA1400 series VAV controller. When the user enters the [JCI] menu, all of the control settings can be viewed and many of them can be altered. The DB 150 meter does not need to be connected to the Balometer base when the user wants to communicate with the VMA.

In order to communicate with VMA, the user needs to connect the DB 150 meter to the VMA using the RS-232/RS-485 (ZoneBus) Converter #535-150-150. The RS-232 end connects to the DB 150 and the RS-485 connects to the JCI TSTAT. After these connections are complete, the user should scroll to the [JCI] menu and press **ENT**. The display will respond by flashing [bUSS]. This indicates that the DB 150 is waiting for the VMA to establish communications. This waiting period can last as long as 50 seconds.

When communication is established, the display will show [bA L] and the JCI arrow will flash. Now the user can use the **UP** and **DOWN** keys to select various Johnson Control parameters that the VMA Controller uses. The read-only values are updated every 5-7 seconds. The structure of the JCI menu is shown below:

Note: *Not all applications use all of the parameters listed here. In the event that this is true for a parameter, the display will show "----".*

Map of JCI menus and submenus in DB 150 meter

[JCI]

[bA L] Balancing Functions

[FLD] Current Flow Reading
(Read Only)

[rE] Room Temp (Read Only)

[POS] Damper Position (Read Only)

[FL O] Flow Override Setting

[min F] Min Flow

[max F] Max Flow

[ZFO] Zero Flow

[rE I] Release

[CALF] Calibrate kFactor

[FLCA] Flow Calculations

[AREA] Box Area

[COF] kFactor

[FLOC] Flow Coefficient

[Units] Units

[TEMP] Temperature Setpoints

[CETS] Common Temp Setpoint

[LLET] Low Limit Temp Setpoint

[CETS] Cooling Temp Setpoint

[HETS] Heating Temp Setpoint

[OCBS] Occupied Cooling Temp Bias

[SCBS] Standby Cooling Temp Bias

[UCBS] Unoccupied Cooling Temp Bias

[OHBS] Occupied Heating Temp Bias

[SHBS] Standby Heating Temp Bias

[UHBS] Unoccupied Heating Temp
Bias

[FLSP] Flow Setpoints

[CFS] Cooling Max Flow Setpoint

[OCFS] Occupied Cooling Min Flow
Setpoint

[UCFS] Unoccupied Min Flow
Setpoint

[UUFFS] Warmup Min Flow Setpoint

[OHFS] Occupied Heating Min Flow
Setpoint

[UHFS] Unoccupied Heating Min
Flow Setpoint
[FSP] Fan Speed Percent
[MODE] Modes
[OCCN] Occupancy Mode
[VAV] VAV Mode
[OVRD] Overrides
[FLOS] Flow Setpoint
[dPSE] Damper Setpoint
[rht] Reheat Setting
[SHt] Supplemental Heat Settin
[FRN] Fan Setting
[REL] Release All Override
[CAL] Auto Calibration
[dPS] DP Sensor
[Act] Actuator

Your options within the JCI menu and sub menu are:

JCI BUSY

(Establishing communication waiting period, up to 50 seconds.)

bal

FLO

Current Flow Reading (read only)

This is the current flow being measured by the VMA.

rht

Room Temperature (read only)

This is the current temperature being measured by the VMA.

POS

Valve Position (read only)

This is the current VMA valve position.

FLO

Flow Override Settings

Entering this menu allows the flow setting to be overridden to min/max settings or released. After selecting any one of the functions below and then pressing **ENT**, the display will blink for 2 seconds while the message is being sent to the VMA.

nn F

Overrides the Flow Setpoint to [OCFS] occupied cooling Min Flow Setpoint

nn F

Overrides the Flow Setpoint to [CFS] Cooling Max Flow Setpoint

00 F

Overrides the Flow setting to 0 flow.

REL

Releases any overrides

CALF

Entering this menu calculates a new Pickup Gain correction factor based on the sum of flows from the current page, the current Pickup Gain, and the current flow reading. The user can modify the newly calculated value using the **UP** and/or **DOWN** keys. Pressing **ENT** will accept and send the new value to the VMA. Pressing **ESC** will ignore the new value completely.

FLCA

Flow Calculations

A-EA

This is the area of the VAV box. Pressing **ENT** displays the current value and allows it to be changed.

CO-F

This is the Pickup Gain correction factor used in the flow calculation. Pressing **ENT** displays this value and allows it to be changed.

FLOC

This is the flow co-efficient used in the flow calculation. Pressing **ENT** displays the current value and allows it to be changed.

Unit

This is the type of units used by the VMA. Pressing **ENT** displays the current units and allows it to be changed.

TEMP

This menu gives access to the temperature setpoints and biases. Pressing **ENT** at any one of these allows them to be viewed and/or changed. The value is changed using the **UP** or **DOWN** keys. **ESC** rejects the entry, **ENT** accepts the entry and will blink the display for 2 seconds while the message is sent to the VMA.

CTES

Common Temp Setpoint

LTES

Low Limit Temp Setpoint

CTES

Cooling Temp Setpoint

HES

Heating Temp Setpoint

OCBS

Occupied Cooling Temp Bias

SCBS

Standby Cooling Temp Bias

UCBS

Unoccupied Cooling Temp Bias

OHBS

Occupied Heating Temp Bias

SHBS

Standby Heating Temp Bias

UHBS

Unoccupied Heating Temp Bias

FLSP

This menu gives access to the flow min/max setpoints. Pressing **ENT** at any one of these allows them to be viewed and/or changed. The value is changed using the **UP** or **DOWN** keys. **ESC** will reject the entry; **ENT** will accept the entry and will make the display blink for 2 seconds while the message is being sent to the VMA.

CF5

Cooling Max Flow Setpoint

OCFS

Occupied Cooling Min Flow Setpoint

UCFS

Unoccupied Cooling Min Flow Setpoint

UUFS

Warm-up Min Flow Setpoint

OHFS

Occupied Heating Min Flow Setpoint

UHFS

Unoccupied Heating Min Flow Setpoint

FSP

Fan Speed Percent

MODE

Entering this menu allows the operating mode of the VMA to be viewed. These cannot be changed by the user.

Occan

Occupancy Mode

0 = Unoccupied

1 = Standby

2 = Occupied

UAU

VAV Mode

0 = Shutdown Closed

1 = Shutdown Open

2 = Warm-up

3 = Water System Flush

4 = Low Limit

5 = Satisfied

6 = Cooling

7 = Heating

Overd

Entering this menu allows various attributes of the VMA to be overridden. Pressing **ENT** at any one of these displays the current value and allows it to be changed.

FLOS

Flow Setpoint

dPSE

Damper Setpoint

rht

Box Heating Present Value

ShE

Supplemental Heat Setting Present Value

FAN

Fan Setting

rEL

Release All Overrides

ACAL

Entering this menu allows the pressure sensor or the actuator to be calibrated.

dP S

DP Sensor

Selecting [4 E 5] will trigger the Autocalibration sequence of the pressure sensor. The damper will close, the fan will be turned off and the dP analog input value will be zeroed. This process can take as long as 3 minutes to complete.

ActE

Actuator

Selecting [4 E 5] will trigger the damper to determine its full range of movement. The actuator will first open completely and then close. This process can take as long as 1 minute to complete.

SECTION 9

Troubleshooting

Symptom	Probable Cause/Corrective Action
No Display	Instrument is not on. Press ON/OFF . Dead batteries. Replace batteries. Batteries incorrectly installed. Check polarity and correct.
LO BATT indication on	Battery voltage is low. Replace batteries.
Random pattern on display	Battery voltage is too low. Replace batteries.
Display does not change, but flashes	HOLD/SUM button was depressed. Press hold again to release.
Display shows [OPEN]	Sensor not connected or loose. Check connection to meter and tighten if required. Sensor damaged. Call Alnor.
HOLD/SUM does not work	Hold connector between handle and meter is not plugged in or is loose. Reconnect.
Measurement is erratic and low	Input is unstable. Interpret value from high display limits or increase time constant setting.
Erroneous readings	Wrong measurement units. Verify correct units. Hood frame not sealing properly around diffuser or grill. Press hood evenly against diffuser. Supply/Exhaust mode was incorrectly chosen. Use key  to select desired mode. Note: <i>meter always starts up in supply mode.</i> Connection between manifold and sensor/meter is broken. Call Alnor. Manifold is damaged. Call Alnor. Manifold holes are plugged. See Maintenance section of manual. Condensation inside sensor module. Allow unit to warm up to room temperature.

SECTION 10

Maintenance

Nylon Hoods

The hoods may be hand washed periodically using cool water and mild detergent. When washing, do not let the material come in contact with sharp corners or other objects which may tear the hood.

Manifold

The manifold should be checked before using to be certain that the sensing holes have not become clogged with dirt or dust particles. The manifold may be cleaned using mild detergent and warm water. Do not immerse the manifold in water. It is recommended that cleaning be done with the manifold in place, and with care.

SECTION 11

Service and Repair

If a fault of the instrument or the instrument's calibration is suspected, it should be returned to Alnor for repair or calibration to original standards. In any event, it is good practice to have the instrument checked at least once a year.

Service and Repair

Please return your Product Registration Card immediately. This allows us to send you service reminders, special offers, and important information about your product.

Before sending your instrument for calibration or repair, you should call Alnor Customer Service (1-800-424-7427 or 1-847-677-3500).

The Service Department will provide you with the cost of service or calibration, Return Material Authorization (RMA) number, and shipping instructions.

Please have the following information available when you call:

Owner's name, address, and phone number
Billing address, if different

Instrument Name or Model
Serial Number
Date of Purchase
Where Purchased

Alnor recommends that you keep a 'calibration log' and keep all records of service on your instrument.

Instructions for Return

Send the instrument prepaid. Securely package your instrument in its original packaging or a strong container surrounded by at least two inches (5 cm) of suitable shock-absorbing material. Include a Purchase Order showing instrument model number, cost of service and/or calibration, and the RMA number. Mark the outside of the shipping container with the RMA number. This will expedite processing of your instrument when we receive it. See back cover for factory addresses.

Please note that instruments received improperly marked or without an accompanying Purchase Order may be returned at your expense.

Damaged in Transit

All orders are carefully packed for shipment. On receipt, if the shipping container appears to have been damaged during shipment, the instrument should be thoroughly inspected. The delivering carrier's papers should be signed noting the apparent damage. DO NOT DISCARD THE BOX.

If the instrument itself has been damaged, a claim should be promptly filed against the

carrier by the customer. The selling agent will assist the customer by supplying all pertinent shipping information; however, the claim must be filed by the insured. If the instrument is damaged beyond use, a new order should be placed with Alnor while awaiting reimbursement from the carrier for the damaged instrument.

Call Alnor directly for assistance if necessary.

APPENDIX A: Time Constant Running Averaging Technique

The time constant running averaging technique is common to many types of instrumentation. The lower the time constant value, the lower number of values are used to determine the displayed value.

This technique measures the flow at a certain time period, adds it to the group of previous measured values, disregards the oldest value, and divides the group by the total number of measurements. The meter then displays the resultant value. This displayed value then becomes the "old" value while a new flow is being measured. Then the process starts over.

Using a higher [tc] value will result in a more stable displayed reading. The following table shows the [tc] value and the number values that will be used.

tc VALUE	# OF VALUES
1	6
2	7
3	8
4	9
5	10

APPENDIX B: Serial Communication Using Microsoft® Windows™ "Terminal"

To Prepare Meter and Computer for Serial Communication:

For Windows 3.1

1. Turn on your meter. Connect the meter to the serial port on your PC using the Alnor Interface Cable (part no. 634-493-404).

2. Start Windows™ on your PC. Windows "Terminal" is located in the Accessories group.
3. Open "Terminal."
4. From the Settings menu, choose Communications.
5. In the Communications window, you must verify the following parameters:

Baud Rate	1200
Data Bits	8
Stop Bits	1
Parity	None
Flow Control	None
Connector	Select the communications port to which the meter is connected

6. Choose the **OK** key.
7. From the Settings menu, choose Terminal Preferences.
8. In the Terminal Preferences window, you must:
 - a. Verify that there is no X in the local Echo box.
 - b. Set the Buffer Lines to 399.
9. Choose the **OK** key.

For Windows 95

1. Click on Hyperterminal.exe located in the accessories menu.
2. If a box comes up requesting modem installation, click No.
3. Click on the Hypertrm icon in the Hyperterminal menu screen.
4. Enter a name (Alnor) and choose an icon for meter downloading to the PC, click **OK**.
5. Connect using Com1 connection, click **OK**.
6. Set port settings under Com1 Properties to:
1200BPS
8 data bits
no parity
stop bits 1
Flow Control to None
click **OK**

7. Click File and choose Properties.
8. Click on Settings, verify checkmark for Terminal Keys, Emulation to Auto Detect, and Backscroll Buffer Lines to 500, choose ASCII set up.
9. Place a check mark under ASCII Receiving in the boxes marked Append Line Feeds To Incoming Line Ends and Wrap Lines That Exceed Terminal Width, click **OK**.
10. Click **OK** again to exit Properties.
11. Hyperterminal is now ready to receive information from the meter.

To Export Data from "Terminal" to Another Windows Application:

After downloading memory from the meter to "Terminal," you may want to transfer the data from "Terminal" to another Windows application, such as Microsoft Word,[®] in order to reformat or manipulate the data further.

1. From the Edit menu, choose Select All.
2. From the Edit menu, choose Copy.

All of your data has now been transferred and copied to the Clipboard. It is ready to paste into any Windows application.

3. Open the application in which the data is to be transferred, i.e. Microsoft Word.
4. From the Edit menu, select Paste.

The downloaded data will now appear in the application. Now you are able to save the data.

5. From the File menu, choose Save As.
6. Enter the filename under which you will store the data.
7. Choose the **OK** key.

APPENDIX C:

Correction Factors for Thermo-Anemometers to Actual Conditions

Velocity is generally expressed in one of two ways: actual (true) velocity or standard velocity. Actual velocity is the average speed at which the molecules are traveling. Standard velocity is referenced to standard conditions and is equal to the actual velocity of the air only when the air is at standard density. The calibration facilities at Alnor Instrument Co. adjust the actual velocity so that the same number of molecules per unit time is passing over the heated elements as if the density were standard density. This makes the instruments display standard velocity.

To correct the standard velocity to actual velocity use the equation below.

$$V_a = V_{std} \times CF$$

$$V_a = \text{Actual velocity}$$

V_{std} = Standard Velocity (this is displayed by the instrument)

r_{std} = Standard density 0.075 lb/ft³ (at 70°F and 29.92 in Hg)

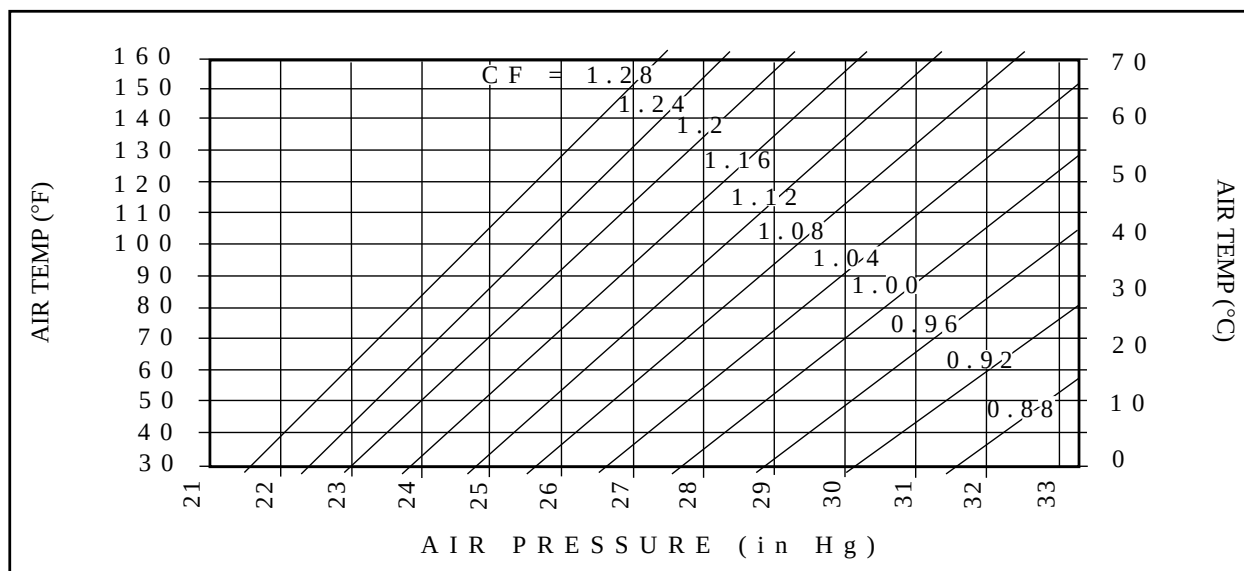
r_a = Actual density in lb/ft³

$CF = r_{std}/r_a$ (Correction Factor)

For your convenience we have made a chart for determining the correction factor given temperature and pressure.

Note: The atmospheric pressure as reported by the National Weather Service is corrected to sea level and can not be used if measurements are not at sea level.

For more information on calculating local air density, call the customer service department at Alnor.



Measurement Units		Packaged Weight	21 lb, 13 oz (10.8 kg) with one hood
cfm	cubic feet per minute	Power Source	3 AA 1.5V alkaline batteries (Meter Only)
l/s	liters per second		4 C 1.5V alkaline batteries (Base and Meter Assembly)
m³/h	cubic meters per hour	Battery Life	15 hrs. minimum with continuous use
Resolution		Power Saving Feature	Selectable auto shut-off
Volume Flow	1 cfm (1 l/s, 1 m³/h)		
Range			
Volume Flow	50 to 2000 cfm		
	24 to 945 l/s		
	85 to 3400 m³/h		
Accuracy			
Volume Flow (Supply)	±3% of reading (±7 cfm), (±3 l/s), (±12 m³/h)	Model	Description
Volume Flow (Exhaust)	±4% of reading (±7 cfm), (±3 l/s), (±12 m³/h)	Part no.	
Pressure Drop Across Balometer	0.01 in. H ₂ O (differential pressure) @ 500 cfm, 2.5 Pascals (differential pressure) @ 236 l/s or 850 m³/h	DB 151	Complete with base, meter, one 2 x 2 ft (600 x 600 mm) hood, soft carrying case, batteries, two year limited warranty and owner's manual
Balometer Hood Sizes	16 x 16 in; 2 x 2 ft; 2 x 4 ft; 1 x 4 ft; 1 x 5 ft; 3 x 3 ft; (400 x 400 mm; 600 x 600 mm; 600 x 1200 mm; 300 x 1200 mm; 300 x 1500 mm; 900 x 900 mm)	DB 153	Same as DB 151 plus 2 x 4 ft and 1 x 4 ft hood
Display	.45 in high, 3½ digit, 7 segment LCD .15 in high with memory indicator and 6 parameter annunciators.	DB 155	Same as DB 153 plus 3 x 3 ft and 1 x 5 ft hood
Memory Capability	Up to 100 sets of readings	Hood Kit A	(2 x 4 ft, 1 x 4 ft)
Summing Capability (Volume)	99E9 in all units	Hood Kit B	(1 x 5 ft, 3 x 3 ft)
Meter Dimensions	7.5 x 3.2 x 1.3 in (190 x 80 x 33 mm)	Shorty Hood	6" shorter than regular 2' hood
Meter Weight	11 oz (315 g)	16" Hood	16 x 16 in (400 x 400 mm)
Operating Weight		Micro Printer 8521	Thermal printer with battery charger and 2 rolls of paper
With 2 x 2 ft hood	9 lb, 3 oz (4.6 kg)		Thermal printer paper
Packaged Dimensions	27 x 14 x 27 in (686 x 356 x 686 mm)		Computer interface cable
			RS-232 to JCI Zone Bus adapter cable, 12 feet (3.7 m)
			Extension cable for RS-232, 30 feet (9.2 m)
			Battery charger kit, includes 4 C size Nicad cells and charger.

WARRANTY

Alnor Instrument Company (Alnor) warrants this product to be free of defects in material and workmanship for a period of two years from the date of original purchase. If the product should become defective during the warranty period, Alnor will repair it or elect to replace it free of charge under the following conditions:

1. Product is returned postpaid per the instructions for return, located in the owner's manual.
2. Owner submits proof of original date of purchase.
3. Alnor will inspect product for defects in material and workmanship. Alnor's decision as to existence of defect, and in the case of defect, to repair or replace will be final.

THIS WARRANTY IS EXCLUSIVE. THERE ARE NO OTHER WARRANTIES EITHER EXPRESSED

OR IMPLIED. SPECIFICALLY AND WITHOUT LIMITATION, THERE IS NO WARRANTY, EXPRESSED OR IMPLIED, OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE.

This warranty is void if product is misused, used contrary to procedures set forth in the owner's manual, or if product is serviced by anyone other than Alnor's authorized service. This warranty does not cover consumables such as light bulbs, paper, batteries, etc.

Alnor's liability for this product is limited to the above stated warranty and shall not in any event exceed the cost of the product. In no event will Alnor be liable for any direct or consequential damages, including but not limited to lost profits, loss of use, inaccuracies, loss of data, dismantling or reinstallation.



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