Ventilation Testing/Balancing

Model 8345/8346/8347/8347A VELOCICALC® Air Velocity Meters

Operation and Service Manual

1980277, Revision E
November 2002

TSI®

Model 8345/8346/8347/8347A
VELOCICALC®
Air Velocity Meters

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Service Policy

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 (800) 874-2811 (USA) and (1) 651-490-2811 (International).

CONTENTS

Chapters

Chapter 1

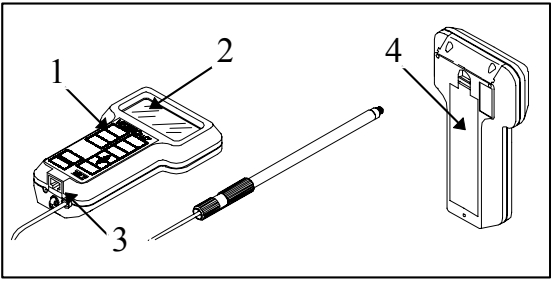
Unpacking and Parts Identification

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

Table 1. List of Components

Qty	Item Description	Part/model
1	Model 8345 VELOCICALC or Model 8346 VELOCICALC or Model 8347 VELOCICALC or Model 8347A VELOCICALC	8345 8346 8347 8347A
1	Carrying Case (8345/46) or Carrying Case (8347/47A)	1319125 1319114
4	AA Alkaline batteries	1208013
1	AC Adapter (Optional) 115 V, NEMA-5 230 V, European CEE 7/16 230 V, Great Britain 240 V, Australian	 2613033 2613078 800169 2613105
1	Operation and Service Manual	1980277

Parts Identification



1. Keypad
2. Display
3. Printer Interface Port
4. Battery Access Cover

Chapter 2

Setting-Up

Supplying Power to the VELOCICALC

The VELOCICALC can be powered in one of two ways: four size AA batteries or the optional AC adapter.

Installing the Batteries

Insert four AA batteries as indicated by the diagram located on the inside of the battery compartment. TSI ships the unit with alkaline batteries. The VELOCICALC is designed to operate with either alkaline or NiCd rechargeable batteries. Carbon-zinc batteries are not recommended because of the danger of battery acid leakage. The typical battery life for alkaline batteries at 20°C at 150 ft/min is 10 hours.

Using the Optional AC Adapter

The optional AC adapter allows you to power the VELOCICALC from a wall outlet. When using the AC adapter, the batteries (if installed) will be bypassed. The AC adapter is not a battery charger.

Auto Power Off Feature

The VELOCICALC's auto power off feature will automatically power the instrument off after a specified time. In velocity mode, the instrument will power off after 15 minutes provided that the velocity is zero and no keys have been pressed during this time. In temperature mode, the instrument will power off after 15 minutes if no keys have been pressed. This feature can be turned off if desired by switching DIP switch #5 to the OFF position. See Appendix B, DIP Switch Settings.

(Note: Any samples taken will not be lost if the VELOCICALC automatically powers off.)

Selecting the Display Units

The VELOCICALC is capable of displaying the measured values in several different measurement units, as shown in Table 2-2.

Table 2-2. Choices of Measurement Units

Velocity	Temperature	Flow Rate
ft/min	°F	ft^3/min
m/s	°C	m^3/hr
		l/s

If you wish to change the display units on your VELOCICALC, see Appendix B, "DIP Switch Settings."

Using The Telescoping Probe

The telescoping probe of the VELOCICALC contains the velocity, temperature, and humidity sensors. When using the probe, make sure the sensor window is fully exposed and the orientation dot is facing upstream.

Extending The Probe

To extend the probe, hold the handle in one hand while pulling on the probe tip with the other hand.

Retracting The Probe

To retract the probe, hold the handle in one hand while pushing on the probe tip with the other hand. If you feel the probe antenna binding, pull gently on the probe cable until the smallest antenna section is retracted. Collapse the rest of the antenna by pressing the probe tip. Do not hold the cable while retracting the probe as this prevents the probe from moving.

Articulating Probe (Model 8346/8347A)

The articulating probe has the ability to bend at a 90° angle for those hard to reach places. To bend the probe of the Model 8347A, loosen the knurled nut on the joint, bend the probe, and tighten the nut. To straighten the probe, loosen the nut, straighten the probe, and tighten the nut.

Chapter 3

Operation

Overview

The Model 8345/46 VELOCICALC measures air velocity and temperature and calculates volumetric flow rate. The Model 8347/47A measures air velocity, temperature, volumetric flow rate, humidity, dew point temperature, and wet bulb temperature. Models 8346 and 8347A have an articulating probe. The VELOCICALC can compute statistics for groups of readings.

Keypad Functions

When pressing the keys on the front panel, the VELOCICALC will beep to confirm the function. If you press a key and the VELOCICALC does not beep, then the VELOCICALC does not allow that function during the selected mode. The beep function can be disabled by changing the internal DIP switch (refer to Appendix B).

ON/OFF Key

Press the ON/OFF key to turn the VELOCICALC on and off. When the instrument is first turned on it goes through a preprogrammed power-up sequence

that includes an internal self-check. First, all displayable items will appear for a few seconds. If a problem is detected, the display will light 'CAL' to indicate that it should be returned for servicing and calibration.

Measuring Velocity

Press the VELOCITY key to display velocity measurements (the VELOCICALC will automatically start in velocity mode). The velocity will be displayed in ft/min or m/s depending on the DIP switch settings (refer to Appendix B). Place the end of the probe in the location where you want to make the measurement. Make sure the sensor window is fully opened and the red orientation dot is facing upstream.

Measuring Temperature

Press the TEMP key to display air temperature readings. The VELOCICALC will display temperature readings in either degrees Celsius (°C) or degrees Fahrenheit (°F), depending on the DIP switch settings (refer to Appendix B). Allow about 30 seconds for the temperature reading to stabilize after switching to temperature mode. This is necessary because the velocity sensor is heated during velocity mode, and some heat is conducted down to the temperature sensor.

Flow Rate Function

The VELOCICALC's flow rate function can calculate flow rate using a known area. The VELOCICALC displays the volumetric flow rate in ft^3/min, m^3/hr, or l/s, depending on the DIP switch setting (refer to Appendix B). The flow rate can be calculated for a round, square or rectangular duct. The shape and size of the duct or other area through which the flow will be measured must be entered.

Entering Shape and Size

Press the FLOWRATE key to put the VELOCICALC in flow rate mode. The VELOCICALC will prompt the user to enter the shape and size, if this has not been done since the instrument was turned on. The VELOCICALC will request entry of the shape by alternately displaying the rectangle and the circle. If shape and size have been entered, the VELOCICALC will go directly to displaying flow rate.

Press the up and down arrow keys (↑↓) to select the shape of the area, rectangular (square) or circular, to measure. Each time an up or down arrow key (↑↓) is pressed, the display will toggle between the circle and rectangle. When the desired shape appears on the display press either the ENTER or

FLOWRATE key. This will enter the shape and the VELOCICALC will then ask for the size.

Use the up and down arrow keys (↑↓) to select the size of the flow rate area. For a circular flow shape the VELOCICALC will ask for one size, the diameter of the circular area. Select the size and press either the ENTER or FLOWRATE key to accept it. For a rectangular area the VELOCICALC will ask for two dimensions. First select the X dimension and press either the ENTER or FLOWRATE key, then select the Y dimension and press either the ENTER or FLOWRATE key. To change the shape or dimensions after they have been entered, press the up and down arrow keys (↑↓). Proceed as above to enter the shape and dimensions.

Humidity Function (Model 8347/8347A)

Press the HUMIDITY key to toggle between displaying % relative humidity, dew point temperature, and wet bulb temperature. NOTE: To display accurate wet bulb temperature, the correct barometric pressure must be entered.

Entering Barometric Pressure

While wet bulb temperature is displayed, press the up or down arrow key to display

barometric pressure. Use the arrow keys to change the barometric pressure and press ENTER to accept it and return to measuring mode.

NOTE: For temperature and humidity measurements, make sure that at least 3 inches (7.5 cm) of the probe is in the flow to allow the temperature and humidity sensors to be in the air stream.

Time Constant Function

Momentarily press and release the TIME CONSTANT key to view the current time constant. To change the time constant, press and hold the key. The available time constant choices (1, 5, 10, 15 and 20 seconds) will sequence on the display. When the desired value is displayed immediately release the key.

The VELOCICALC will always store the chosen time constant when the meter is turned off. When the VELOCICALC is turned on again, the last time constant is used.

The time constant is actually an averaging period. The VELOCICALC display is always updated every second, however, the reading displayed is the average reading over the last time constant period.

For example, if the current time constant is set to 10 seconds, the display will show readings averaged over the previous 10 seconds, updated every second. This is also called a 10 second "moving average."

Using the Clear, Sample and Statistics Functions

The VELOCICALC has the ability to compute the average of a number of individual sampled readings. When the SAMPLE key is pressed, the currently displayed reading is added to a sample buffer. When the STATISTICS key is pressed, the sum of the readings in the sample buffer is divided by the number of sampled readings to get the average. The CLEAR key is used to clear out the sample buffer in order to start taking a new average.

Sample Function

Press the SAMPLE key to start the sample. The display will flash "SAMPLE" for one time constant and a number indicating the number of sampled readings that are in memory. Then the sampled value will be displayed.

The individual sampled values cannot be recalled. Only the statistics of the sampled values can be recalled. There are five different

statistics buffers: one for both velocity and flow rate, temperature, humidity, dew point temperature, and wet bulb temperature. You can switch between measuring modes and sample data without affecting the statistics in the buffer for another measuring mode. You can later return to any mode and add additional values to the existing statistics.

The statistics data will be lost when the instrument is manually powered off. This data can be kept upon power off by switching DIP switch #6 to the ON position. See Appendix B, DIP Switch Settings.

Statistics Function

Press the STATISTICS key to display the average of the sampled values of the current operating mode. The message "AVERAGE" will appear along with a number (between 1 and 255) indicating how many sampled values were averaged. The average value is then displayed for one second. To keep displaying the average value, press and hold the STATISTICS key. If the STATISTICS key is pressed repeatedly, the minimum, maximum, and count are displayed. Additional values can be sampled after the STATISTICS key has been pressed. The next time the STATISTICS key is pressed, the

additional values are averaged with those already accumulated.

Clear Function

Press the CLEAR key to erase the sampled values in the buffer of the currently active function. Pushing the CLEAR key for velocity/flow rate will not affect the values in temperature, humidity, dew point, or wet bulb buffer. However, velocity and flow rate use the same buffer, so clearing velocity will also clear the flow rate.

Printer Port

If the optional Portable Printer is connected the following will be printed: While pushing the SAMPLE, STATISTICS or CLEAR key the currently displayed data is transmitted to the printer port. In flow rate mode, shape and size data is also transmitted when it is entered or changed. The value of the time constant is transmitted when it is changed.

The data will print in a format such as 12345.67. If you desire, the VELOCICALC can print in a format such as 12345,67 by switching DIP switch #4 ON. See Appendix B, DIP Switch Settings.

Chapter 4

Maintenance

Probe Tip

Periodically inspect the probe tip to ensure that it is clean. Dust and oil deposits on the velocity sensor decrease the accuracy of the VELOCICALC.

Caution: The VELOCICALC must be switched off for cleaning. Do **not** use high-pressure air or strong solvents to clean the sensor tip; damage to the sensors could result.

To remove dust, blow it off with a gentle stream of air or rinse it off with a gentle stream of water. To remove a combination of dust and oil, rinse the probe tip in isopropyl alcohol and then blow it off with a gentle stream of air. ***Be careful not to allow water to enter the articulating probe joint on the Model 8346/8347A.***

Recalibration

To maintain a high degree of accuracy in your measurements, TSI recommends that you return your instrument for annual recalibration. For a nominal fee, we will recalibrate the unit and return

it to you with a certificate of calibration and US National Institute of Standards and Technology (NIST) traceability. This 'annual checkup' assures you of consistently accurate readings; it is especially important in applications where strict calibration records must be maintained.

Cases

If the instrument case or storage case needs cleaning, wipe it off with a soft cloth and isopropyl alcohol or a mild detergent. Never submerge the VELOCICALC.

Storage

When storing the VELOCICALC for more than a month, it is recommended to remove the batteries. This prevents damage due to battery leakage.

Chapter 5

Troubleshooting

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

Table 5. Troubleshooting the VELOCICALC

Symptom	Possible Causes	Corrective Action
No display	Unit not switched on	Switch on the unit.
	Low or dead batteries	Replace the batteries or plug in the AC adapter.
	Dirty battery contacts	Clean the battery contacts.
Battery symbol is blinking	Batteries are low	Replace or recharge batteries.

Symptom	Possible Causes	Corrective Action
Display reads "LO"	Low battery charge	Replace or recharge batteries.
	Wrong AC adapter	Replace with the correct AC adapter.
	Low AC line voltage	Correct the AC line voltage or use batteries.
	Dirty battery contacts	Clean the battery contacts.
Temperature initially reads high	Temperature sensor is still warm from velocity mode	Allow about 30 seconds before reading temperature.
Display reads "ERR"	You are trying to enter more than 255 readings	Read or record the average; clear the sample register and proceed.

Symptom	Possible Causes	Corrective Action
Display reads "CAL"	The VELOCICALC has detected an internal fault	Return to factory for service.
Velocity reading fluctuates badly	The flow is fluctuating	Reposition the probe in a less turbulent section of the flow or use a longer time constant.
Display says "OVER"	Velocity or temperature is too high	Use an alternate measurement method.
Display flashes "888.8"	Velocity or temperature is too high	Use an alternate measurement method.

WARNING!
Remove the probe from excess temperature immediately: excessive heat can damage the sensor.

Appendix A

Specifications

Specifications are subject to change without notice.
Specifications in parentheses () indicate metric equivalents.

VELOCITY:

Range:	0 to 6000 ft/min (0 to 30 m/s)
Accuracy[1&2]:	3.0% of reading or ± 3 ft/min (± 0.015 m/s), whichever is greater

TEMPERATURE:

Range (8345/46):	0 to 200 °F (-17.8 to 93.3 °C)
Range (8347/47A):	14 to 140 °F (-10 to 60 °C)
Resolution:	0.1 °F (0.1 °C)
Accuracy[3]:	± 0.5 °F (± 0.3 °C)

INSTRUMENT TEMPERATURE RANGE:

Operating (electronics):	40 to 113 °F (5 to 45 °C)
note: deleted probe line here	
Storage:	-22 to 194 °F (-30 to 90 °C)

VOLUMETRIC FLOWRATE:

Range[4]:	0.1 to 195,000 l/s, 0.0424 to 702,000 m^3/hr, 0.2 to 2,700,000 ft^3/min

DUCT SIZE:

Range:	1 to 100 inches in increments of 0.5 inches, 100 to 255 inches in increments of 1 inch (1 to 100 cm in increments of 0.5 cm, 100 to 255 cm in increments of 1 cm)

RELATIVE HUMIDITY (MODELS 8347/8347A):

Range:	0 to 95% RH
Accuracy [5]:	±3% RH
Resolution:	0.1% RH

WET BULB TEMPERATURE (MODELS 8347/8347A)

Range:	40 to 140°F (5 to 60°C)
Resolution:	0.1°F (0.1°C)

DEW POINT (MODEL 8347/8347A):

Range:	5 to 120°F (-15 to 49°C)
Resolution:	0.1°F (0.1°C)

AVERAGING CAPABILITY:

Range:	Up to 255 values of each velocity (or flowrate), temperature, humidity, dew point temperature, and wet bulb temperature

TIME CONSTANT:

Range:	Adjustable from 1 to 20 seconds

RESPONSE TIME:

To velocity:	200 msec
To temperature	
8345/46:	8 seconds
8347/47A:	34 seconds

EXTERNAL METER DIMENSIONS:

Size measurements:	3.9 in. x 6.6 in. x 1.5 in. (10 cm x 16.8 cm x 3.8 cm)

METER PROBE DIMENSIONS:

Probe length (8345):	37 in. (94 cm) telescopic
Probe length (8346):	37 in. (94 cm) telescopic articulating
Probe length (8347):	40 in. (102 cm) telescopic
Probe length (8347A):	40 in. (102 cm) telescopic articulating

METER WEIGHT DIMENSIONS:

Weight (with batteries):	1.1 lbs (0.5 kg)

METER DISPLAY DIMENSIONS:

Display:	4-digit LCD, 0.6 in. (15 mm) digit height

POWER REQUIREMENTS:

Four AA-size batteries (included) or AC adapter (optional)

PRINTER INTERFACE:

Type:	Serial
Baud Rate:	1200

[1] Temperature compensated over an air temperature range of 40 to 150 °F (5 to 65 °C).

[2] The accuracy statement of ± 3 ft/min (± 0.015 m/s), applies to 30 ft/min through 6,000 ft/min.

[3] Accuracy with instrument case at 77 °F (25 °C), add uncertainty of 0.05 °F/°F (0.03 °C/°C) for change in instrument temperature. Deleted RF statement here.

[4] Actual range is a function of maximum velocity and duct size.

[5] Accuracy with probe at 77°F(25°C). Add uncertainty of 0.1% RH/°F (0.2% RH/°C) for change in probe temperature. Includes 1% hysteresis.

Appendix B

DIP Switch Settings

To access the DIP switches, remove the batteries from the battery compartment. On the inside of the battery compartment, there is a window with eight DIP switches. The table below shows the functions for each switch.

Caution: Make certain that power is turned off before changing DIP switch settings.

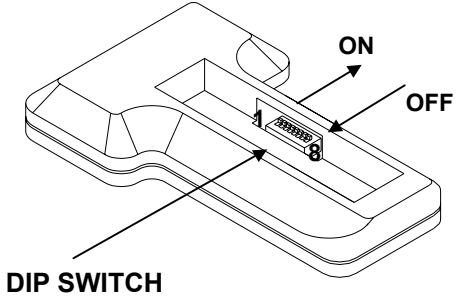


Figure B - 1: DIP Switch Location

Switch	Function	OFF	ON
1	Velocity	ft/min & ft^3/min	m/s
2	Flow Rate*	l/s	m^3/hr
3	Temperature	Degrees Fahrenheit (°F)	Degrees Celsius (°C)
4	Decimals	"." used in printing	"," used in printing
5	Auto off disable	Automatic power off	Auto off disabled
6	Sample data	Data lost on manual power off	Data kept
7	Reserved	Reserved	Reserved
8	Beep	Beep Disabled	Beep Enabled

The ON position is away from the batteries and OFF is towards the batteries.
Always leave DIP switch #7 in the OFF position.

* To select flow rate to display l/s or m^3/hr, DIP switch #1 must be in the ON position.

Appendix C

Standard Velocity vs. Actual Velocity

Since thermal air velocity sensors are sensitive to changes in air density and air velocity, all thermal anemometers indicate velocities with reference to a set of standard conditions. For TSI instruments, standard conditions are defined as 70° F (21.1° C) and 14.7 psia (101.4 kPa). Other manufacturers may use different values.

Standard velocity is the velocity the air would be moving if the temperature and pressure were at standard conditions. It is usually the most useful measure of airflow because it defines the heat-carrying capacity of the air.

Actual velocity is the velocity at which a microscopic particle of dust would be traveling if it were in the air stream.

In some instances, actual air velocity rather than standard velocity may be of interest. To obtain the value for actual velocity, multiply your standard velocity by the following density correction factor:

$$Actual\ Velocity = (Standard\ Velocity)\left[\frac{460+T}{460+70}\right]\left[\frac{14.7}{P}\right]$$

Where

T = Ambient temperature in degrees Fahrenheit

P = Ambient pressure in psia

If you use metric units, the equation becomes:

$$Actual\ Velocity = (Standard\ Velocity)\left[\frac{273+T_m}{273+21.1}\right]\frac{101.4}{P_m}$$

Where

T_m = Ambient temperature in degrees Celsius

P_m = Ambient pressure in kPa

Example No. 1:

You want to measure the actual velocity in a duct. The air temperature in the duct is 55°F and the pressure is 14.24 psia. You take a measurement and the display reads 1200 feet per minute (ft/min).

$$ActualVelocity = 1200\left[\frac{460+55}{460+70}\right]\frac{14.7}{14.24} = 1203.7\,ft/min$$

Example No. 2:

You need to measure the actual velocity in a plenum. The air pressure is 99.4 kPa and the temperature is 27°C. The display reading is 2.3 meters per second (m/s).

$$ActualVelocity = 2.3\left[\frac{273+27}{273+21.1}\right]\frac{101.4}{99.4} = 2.39\,m/s$$

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