

# MET ONE 831



## Citizen Science Operating Procedure

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## Met One 831



The Met One 831 sensor measures particulate matter (PM) by counting and sizing individual particles using scattered laser light. The unit then converts the count data to mass measurements in micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). The Met One 831 counts particles in four different PM size ranges simultaneously ( $\text{PM}_{10}$ ,  $\text{PM}_{2.5}$ ,  $\text{PM}_4$ , and  $\text{PM}_{10}$ ). Each of these represents a maximum particle size.

Thus,  $\text{PM}_{10}$  measures all particles 10 micrometers ( $\mu\text{m}$ ) in diameter or less and  $\text{PM}_1$  measures all particles 1  $\mu\text{m}$  in diameter or less. This handheld device was designed for use in applications such as remote sampling, indoor air quality monitoring, and industrial and occupational hygiene. It has an internal battery pack that provides 8 hours of continuous operation, and it can store up to 2,500 data points that can be either viewed on the Met One 831 display or exported to a computer using a USB cable. This operating procedure explains what you need to do to collect quality data using the Met One 831 for your monitoring project.

## What Is PM?

PM pollution is a mixture of particles of various sizes such as soot, smoke, dirt, and dust. Many pollutant particles that make their way indoors are generated and released into the air from outdoor sources such as power plants, industrial processes, and automobiles. Living near a major roadway, for instance, can significantly increase PM exposure. Other particles are generated within the home from activities such as cooking or burning wood in fireplaces. Small particles also include mold and bacteria and larger particles include pollen and dust mite casings. PM can have both short- and long-term health effects, with the smallest particles posing the greatest health risk. Effects of PM pollution exposure include increased respiratory (breathing) symptoms such as coughing and difficulty breathing as well as aggravated asthma or other existing respiratory and cardiovascular conditions. For more information on particle pollution, visit the U.S. Environmental Protection Agency's Web site at <http://www.epa.gov/airquality/particlepollution/index.html>.

## What You Will Need

- ❖ Met One Model 831 PM sensor
- ❖ USB (Universal Serial Bus) cable (part no. 500787)
- ❖ Battery charger (part no. 390031)
- ❖ Comet Communications utility software (part no. 80248)
- ❖ Computer with Windows operating system
- ❖ Zero filter kit (part no. 80846), optional
- ❖ Flow meter kit (part no. 80530), optional

## Important Considerations

- ❖ The Met One 831 must be calibrated annually by the manufacturer as described in the User's Manual, and calibration should not be performed by the user.
- ❖ The Met One 831 has no user-repairable parts. It must be returned to the manufacturer when repairs are required.
- ❖ If using more than one Met One 831, place the devices at least 18 inches away from each other and ensure they have access to ambient air.

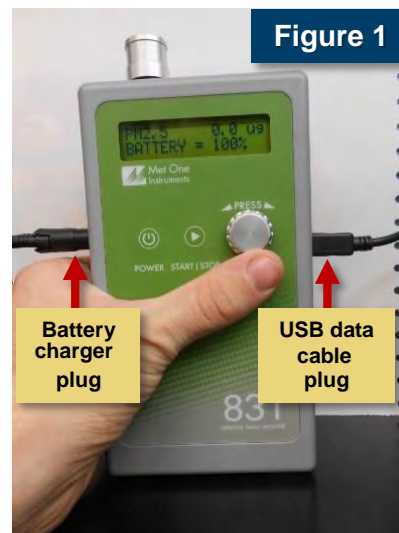
## Preparing the Device

Before collecting data with the Met One 831, you must charge the battery and install the software. This section also explains how to set the device's internal clock. The following procedures will guide you through preparing your device for data collection.

### Charging the Battery

The battery must be charged before initial operation. To charge the battery, simply connect the battery charger AC power cord to an AC power outlet, and connect the battery charger DC plug to the socket on the left side of the Met One 831. The light on the charger will turn from red to green and the 831 will display the message "BATTERY = 100%" (Figure 1) when the battery is fully charged. A completely discharged (drained) battery takes approximately 2.5 hours to charge fully.

The universal battery charger that comes with the Met One 831 works with power line voltages of 100 to 240 volts, at 50/60 Hz. When fully charged, the battery will power the 831 for approximately 8 hours of continuous sampling. For extended operation, you can operate the unit with the battery charger attached.



### Caution

**Use only the charger and adapter that came with your Met One 831. Using others might damage the device.**

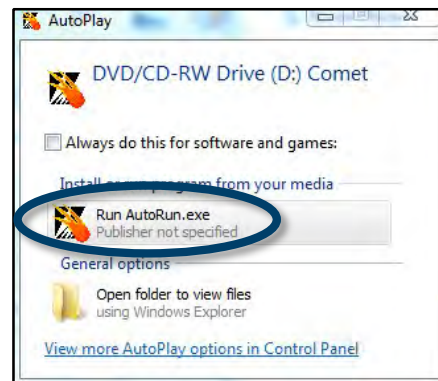


## Installing the Software

The Comet communications utility software must be installed on a computer in order to retrieve data from the 831. It can be installed from the CD included with the sensor as outlined in the following procedure.

### Procedure: Install Software from CD

1. Insert CD and click **'Run AutoRun.exe'**.



2. Click **'Install Comet'**.



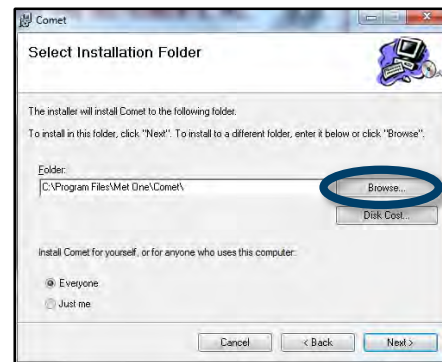
3. Click **'Next'** to continue.



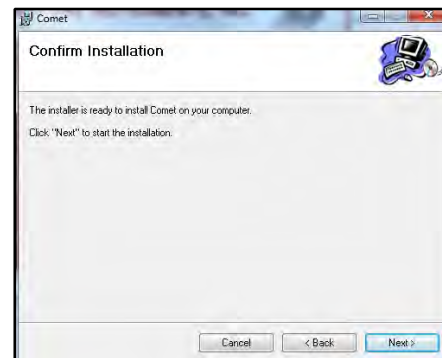
- Click the **"I Agree"** radio button to accept the terms of the license and then click **'Next'**.



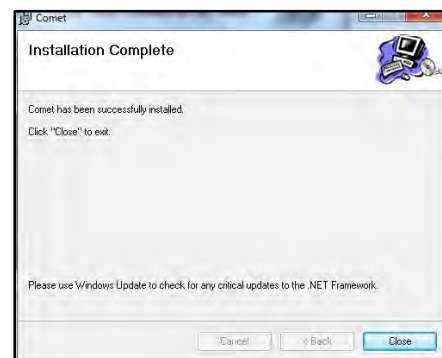
- Use the **'Browse'** button to choose the folder where you want to install the software and press **'Next'**.



- Press **'Next'** to confirm the installation.



- Click **'Close'** when the installation is complete.





## Setting the 831 Internal Clock

The internal clock of the Met One 831 can be set using the Comet Communications utility software included with the sensor.

### Procedure: Set Device Clock

1. Ensure the time is accurate on the computer your device is connected to.
2. Open the Comet software and select the '**SetUp**' tab (Figure 2).
3. Click the '**Synchronize Device's Clock**' checkbox to synchronize the 831's internal clock with the computer.
4. Press the '**Set**' button to send these instructions to the 831.

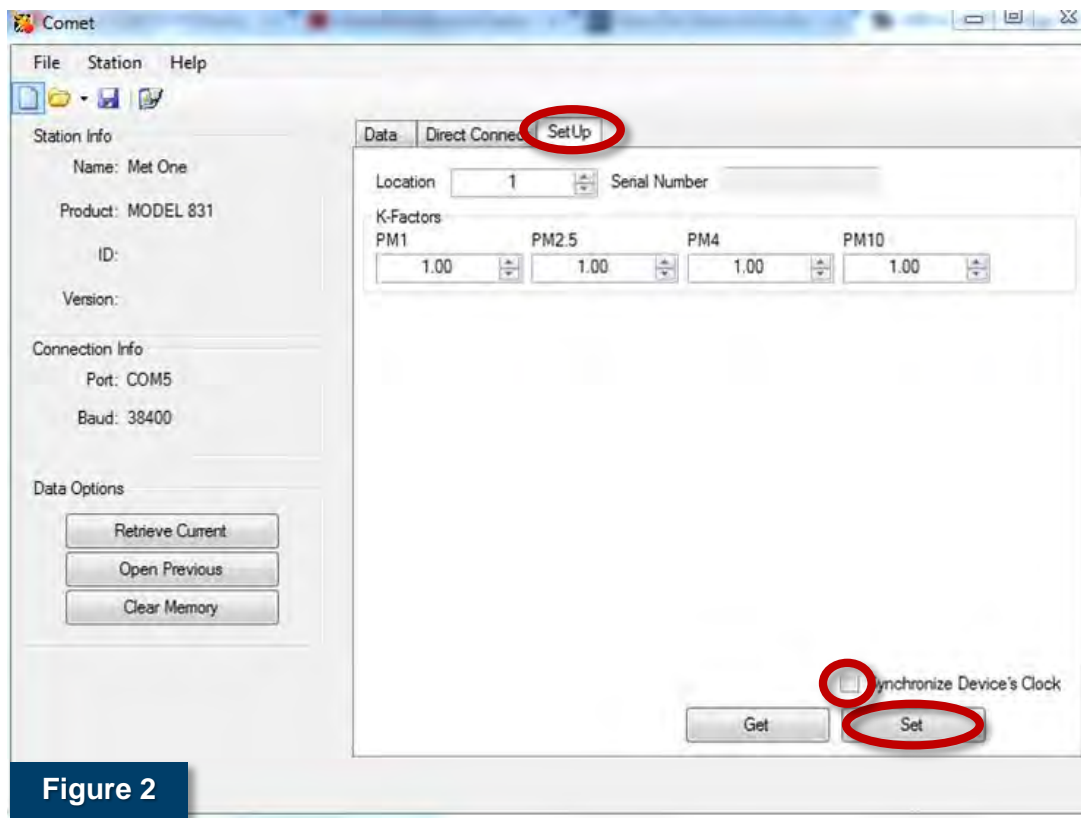


Figure 2

## Routine Data Collection

With a charged battery and installed software, you are now ready to collect data. The following procedures will guide you through data collection, retrieval, and processing. Note that if anything goes wrong with the sensor during data collection, the Met One 831 will display an error message. Possible error messages include the following:



- ❖ “LOW BATTERY!” – Indicates that approximately 15 minutes of operation left before sampling stops.
- ❖ “Sensor Noise” or “Sensor Error” – the Met One 831 detects a problem in the particle sensor.

If you see the “Sensor Noise” error, perform the zero count test described in the Maintenance section. Contact the Met One Service Center if you receive the “Sensor Error” message. For other troubleshooting guidance, consult the *Model 831 Manual*.

## Verifying Proper Operation

Before collecting data, ensure that your setup is correct and that your Met One 831 is collecting data properly.

### Procedure: Verify Proper Operation

1. Press the ‘**Power**’ button () for at least half a second to turn on the power (Figure 3). A startup screen (Figure 4) will display for 3 seconds and then the sampling screen will be displayed (Figure 5).
2. Press the ‘**Start/Stop**’ button () to begin sampling. One data point will be taken per minute.
3. After at least 1 minute has passed, stop the device with the ‘**Start/Stop**’ button.
4. Check the mass values on the display, and rotate the ‘**Select**’ dial (Figure 6) to view additional PM ranges (PM<sub>1</sub>, PM<sub>4</sub>, and PM<sub>10</sub>).

If no error messages are displayed, the unit is ready for use.



Figure 3



Figure 4



Figure 5



Figure 6

## Collecting Data

After you have verified that your device is working properly, you can begin collecting data. While the Met One 831 can store approximately 41 hours of data internally, using the Direct Connect feature allows data to be stored directly on the computer's hard drive instead. The following procedure will guide you through collecting data using the Direct Connect feature.

### Procedure: Collect Data

1. Connect the 831 to a computer using a USB cable (Figure 7).
2. Open the Comet communications utility software by clicking the icon that was created on the desktop during installation.
3. Select an existing station or create a new one in the **Startup** dialog box as shown in Figure 8. The station is the name of the file where you want the downloaded data to be stored. Once you have specified a station, the **Data**, **Chart**, **Direct Connect**, and **SetUp** tabs become available as shown in Figure 9.



Figure 7

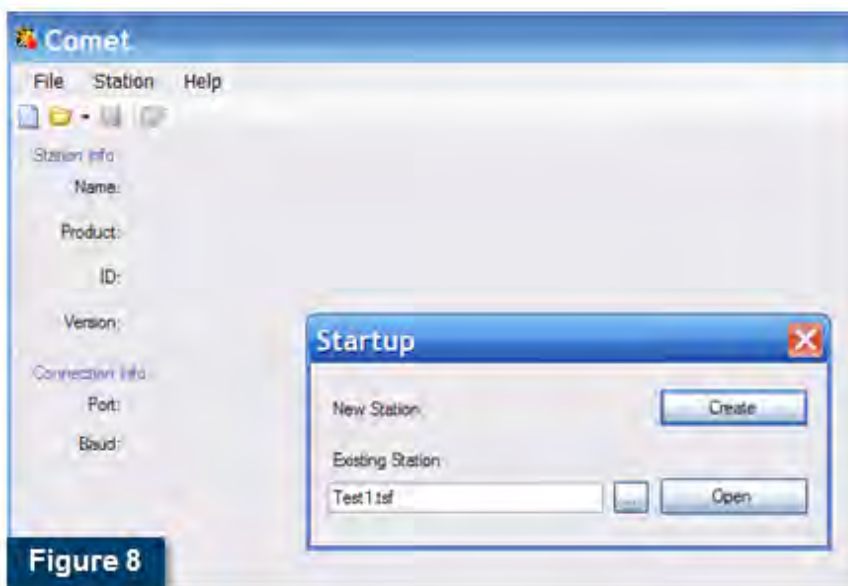


Figure 8



4. View or change the data storage directory for your station under **File > Settings** (Figure 9).

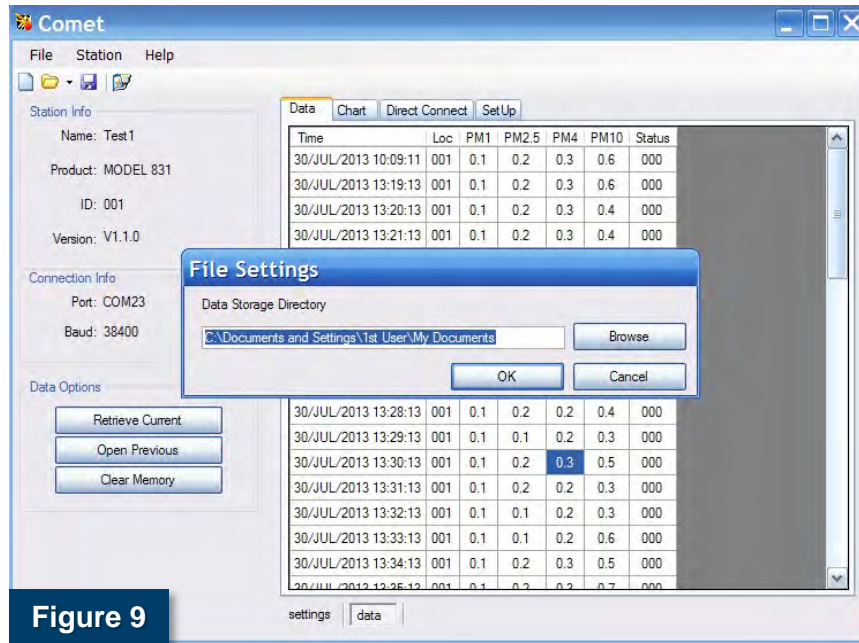


Figure 9

5. Click the '**Direct Connect**' tab (Figure 10) for continuous monitoring, and click the '**Connect**' button to connect the computer to the 831.

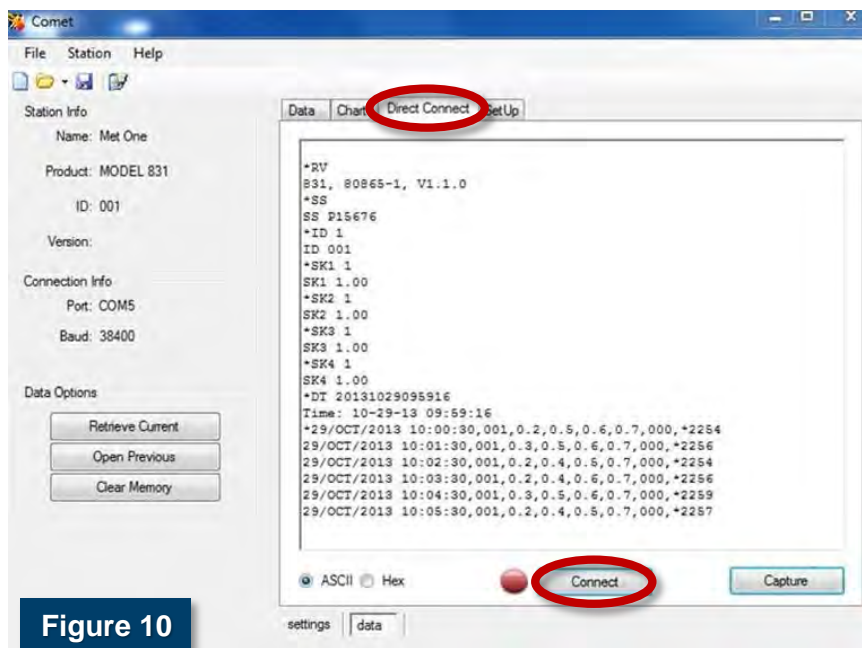

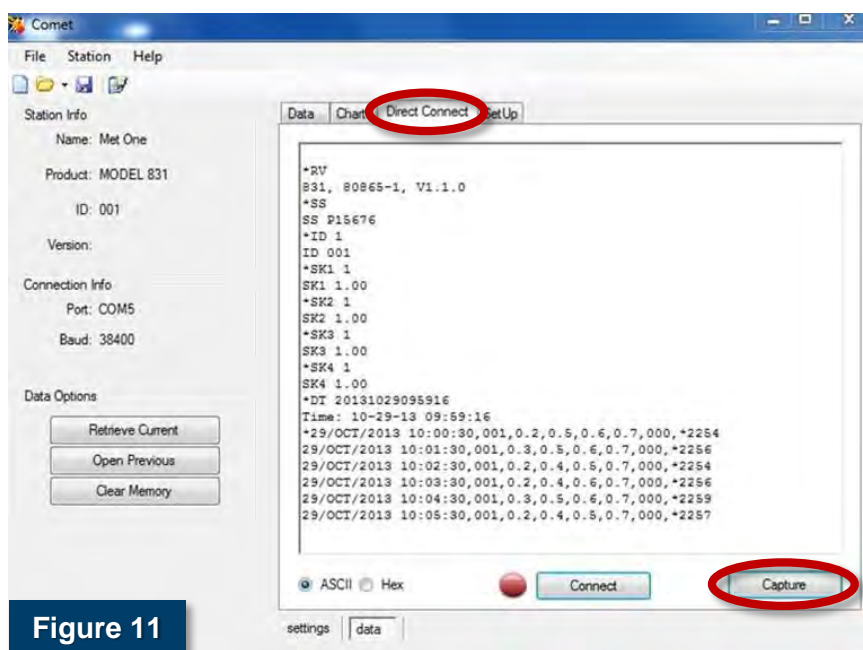



Figure 10

6. Press the **'Start/Stop'** button (  ) on the Met One 831 to begin measurements. The **'Direct Connect'** tab window will be appended with a new line of data each minute.
7. At the end of each sampling period, click the **'Capture'** button on the **'Direct Connect'** tab (Figure 11) to save the data as a text file. It is recommended that data be downloaded from the unit at the end of each day.



**Figure 11**

8. Press the **'Start/Stop'** button again to end measurements.
9. Press the **'Power'** button (  ) to turn the unit off.

## Processing Data

Data should be downloaded at the end of each collection day. All generated data are saved in the current Direct Connect session as a text file (\*.txt). The name of the text file is automatically derived from the time and date when the Capture button was clicked, as described in the data collection procedure. In this text file (Figure 12), all values are separated, or 'delimited', by commas. The order of the columns in the text files generated by the Met One 831 are as follows: timestamp (includes both date and time), location code (default = 001), PM<sub>1</sub>, PM<sub>2.5</sub>, PM<sub>4</sub>, and PM<sub>10</sub>. The last two columns contain error codes and diagnostic data (these are not of concern to the user but can help the manufacturer with troubleshooting the device if necessary).



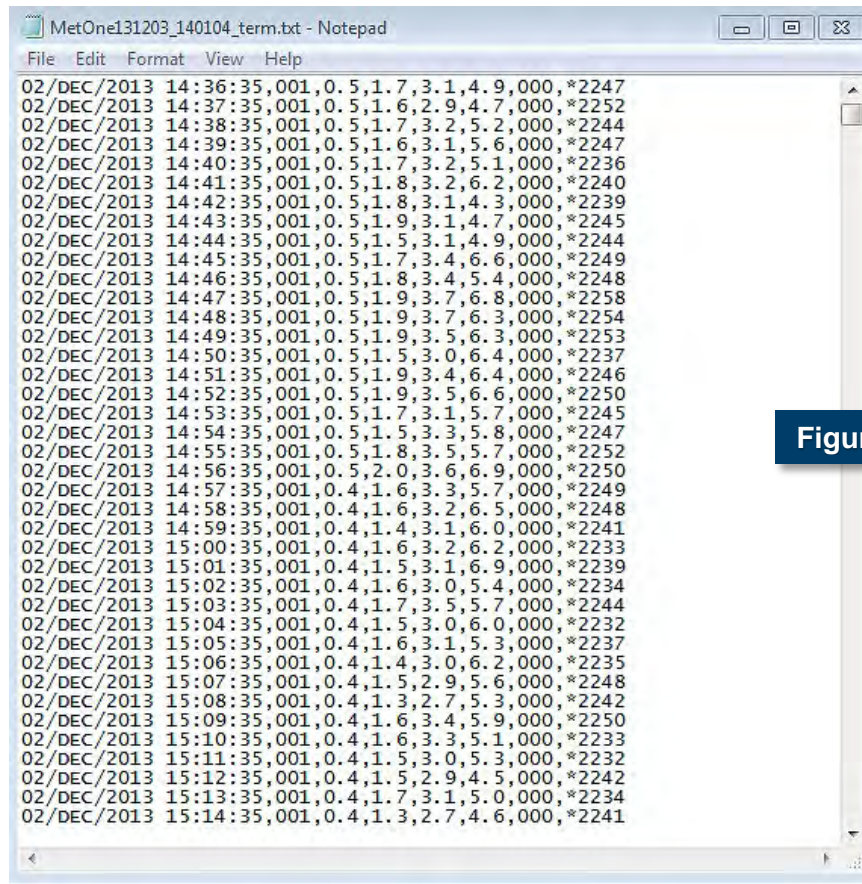


Figure 12

To process the collected data, use the following procedure to transfer the text file created by the Met One 831 to spreadsheet software such as Microsoft Excel. Most spreadsheet programs are able to read data from a text file in a delimited format. Microsoft Excel 2013 is used here to illustrate the data transfer, but the relative locations of import options are similar in earlier versions of Microsoft Excel (dating back to 2003).

### Procedure: Process Data

1. Open a new Microsoft Excel spreadsheet and select **Data > Get External Data > From Text**.
2. When prompted, use Windows Explorer to navigate to the folder containing the text file previously specified in the '**Configure Data Destination**' window.
3. When prompted, in the next screens select '**Delimited**' and '**Comma-delimited**'.
4. Press '**Finish**' to display the data in columns in the Excel spreadsheet (Figure 13).

|    | A               | B | C   | D   | E   | F   | G | H     | I | J | K | L |
|----|-----------------|---|-----|-----|-----|-----|---|-------|---|---|---|---|
| 1  | 12/2/2013 14:36 | 1 | 0.5 | 1.7 | 3.1 | 4.9 | 0 | *2247 |   |   |   |   |
| 2  | 12/2/2013 14:37 | 1 | 0.5 | 1.6 | 2.9 | 4.7 | 0 | *2252 |   |   |   |   |
| 3  | 12/2/2013 14:38 | 1 | 0.5 | 1.7 | 3.2 | 5.2 | 0 | *2244 |   |   |   |   |
| 4  | 12/2/2013 14:39 | 1 | 0.5 | 1.6 | 3.1 | 5.6 | 0 | *2247 |   |   |   |   |
| 5  | 12/2/2013 14:40 | 1 | 0.5 | 1.7 | 3.2 | 5.1 | 0 | *2236 |   |   |   |   |
| 6  | 12/2/2013 14:41 | 1 | 0.5 | 1.8 | 3.2 | 6.2 | 0 | *2240 |   |   |   |   |
| 7  | 12/2/2013 14:42 | 1 | 0.5 | 1.8 | 3.1 | 4.3 | 0 | *2239 |   |   |   |   |
| 8  | 12/2/2013 14:43 | 1 | 0.5 | 1.9 | 3.1 | 4.7 | 0 | *2245 |   |   |   |   |
| 9  | 12/2/2013 14:44 | 1 | 0.5 | 1.5 | 3.1 | 4.9 | 0 | *2244 |   |   |   |   |
| 10 | 12/2/2013 14:45 | 1 | 0.5 | 1.7 | 3.4 | 6.6 | 0 | *2249 |   |   |   |   |
| 11 | 12/2/2013 14:46 | 1 | 0.5 | 1.8 | 3.4 | 5.4 | 0 | *2248 |   |   |   |   |
| 12 | 12/2/2013 14:47 | 1 | 0.5 | 1.9 | 3.7 | 6.8 | 0 | *2258 |   |   |   |   |
| 13 | 12/2/2013 14:48 | 1 | 0.5 | 1.9 | 3.7 | 6.3 | 0 | *2254 |   |   |   |   |
| 14 | 12/2/2013 14:49 | 1 | 0.5 | 1.9 | 3.5 | 6.3 | 0 | *2253 |   |   |   |   |
| 15 | 12/2/2013 14:50 | 1 | 0.5 | 1.5 | 3   | 6.4 | 0 | *2237 |   |   |   |   |
| 16 | 12/2/2013 14:51 | 1 | 0.5 | 1.9 | 3.4 | 6.4 | 0 | *2246 |   |   |   |   |
| 17 | 12/2/2013 14:52 | 1 | 0.5 | 1.9 | 3.5 | 6.6 | 0 | *2250 |   |   |   |   |
| 18 | 12/2/2013 14:53 | 1 | 0.5 | 1.7 | 3.1 | 5.7 | 0 | *2245 |   |   |   |   |
| 19 | 12/2/2013 14:54 | 1 | 0.5 | 1.5 | 3.3 | 5.8 | 0 | *2247 |   |   |   |   |
| 20 | 12/2/2013 14:55 | 1 | 0.5 | 1.8 | 3.5 | 5.7 | 0 | *2252 |   |   |   |   |
| 21 | 12/2/2013 14:56 | 1 | 0.5 | 2   | 3.6 | 6.9 | 0 | *2250 |   |   |   |   |
| 22 | 12/2/2013 14:57 | 1 | 0.4 | 1.6 | 3.3 | 5.7 | 0 | *2249 |   |   |   |   |
| 23 | 12/2/2013 14:58 | 1 | 0.4 | 1.6 | 3.2 | 6.5 | 0 | *2248 |   |   |   |   |
| 24 | 12/2/2013 14:59 | 1 | 0.4 | 1.4 | 3.1 | 6   | 0 | *2241 |   |   |   |   |
| 25 | 12/2/2013 15:00 | 1 | 0.4 | 1.6 | 3.2 | 6.2 | 0 | *2233 |   |   |   |   |
| 26 | 12/2/2013 15:01 | 1 | 0.4 | 1.5 | 3.1 | 6.9 | 0 | *2239 |   |   |   |   |

Figure 13

## Maintenance

The manufacturer recommends that a couple of procedures be performed regularly to keep the Met One 831 generating reliable data:

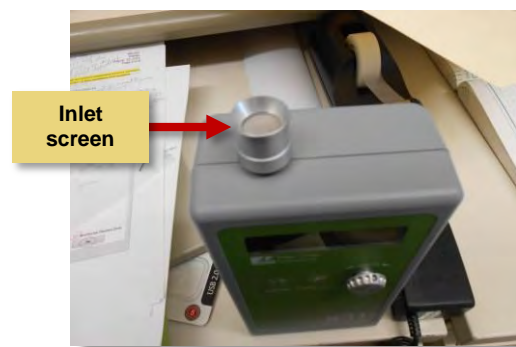
- ❖ A monthly check of the flow rate
- ❖ An optional zero count test weekly

### Checking the Flow Rate (Optional)

The sample flow rate is factory set to 0.1 cubic feet per minute (cfm), or 2.83 liters per minute (lpm). Continued use and variations in ambient temperature and pressure might cause minor changes in the flow that can reduce measurement accuracy. The following steps guide you through checking the flow rate and adjusting it if necessary.

#### Procedure: Check Flow Rate

1. Remove the silver-colored inlet screen from the inlet nozzle cover. The screen pulls off easily.

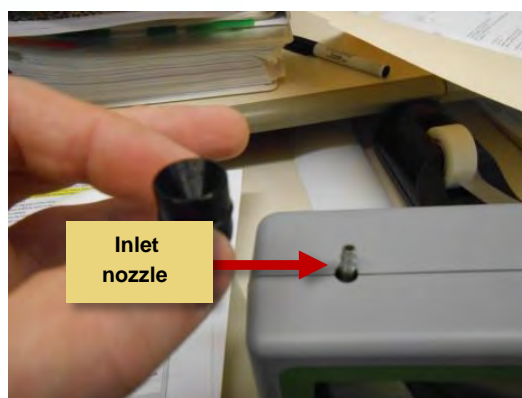


2. Use the small Allen wrench provided in the flow meter kit to remove the two hex set screws securing the inlet cover.





3. Gently lift the cover off the inlet nozzle.



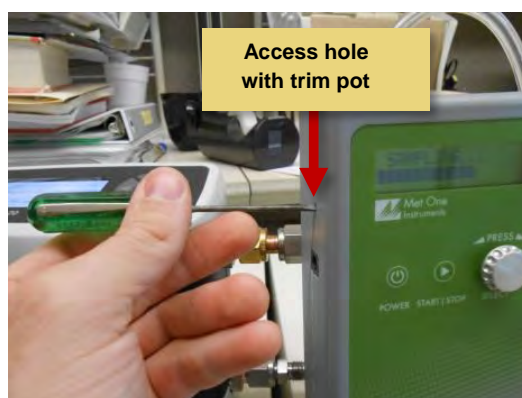
4. Connect a flow meter (not included) to the inlet nozzle, and start both the 831 and the flow meter.



5. Begin sampling and check the flow meter reading after approximately 30 seconds. The flow rate should be  $0.1 \text{ cfm}$  ( $2.83 \text{ lpm}$ )  $\pm 5\%$ . If the flow is not within the acceptable range ( $0.095\text{--}0.105 \text{ cfm}$  or  $2.69\text{--}2.97 \text{ lpm}$ ), proceed to the next step.



6. Adjust the flow by using a small flathead screwdriver to turn the trimmer potentiometer, or trim pot (a miniature adjustable electrical component set at the factory), located in the access hole in the side of the unit: Turn the trim pot clockwise to increase flow and counterclockwise to decrease flow. Repeat Step 5 to determine flow rate and ensure it is within the acceptable range.



### Performing a Zero Count Test (Optional)

In addition to the flow rate test, the manufacturer recommends that a zero filter test be performed weekly and as needed in response to a “Sensor Noise” error.

#### Procedure: Perform Zero Count Test

1. Remove the screen and inlet cover as done for the flow rate test (steps 1–3).
2. Attach the zero filter included with the unit (Figure 14).
3. Allow the unit to flow for 5 minutes with the zero filter attached.
4. Take at least one measurement with the unit to confirm that it reads zero.

Contact the manufacturer if you are unable to obtain a zero reading.

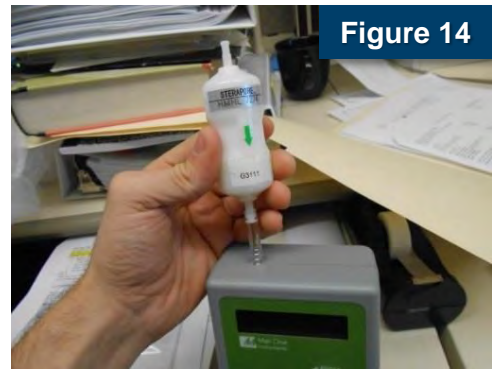


Figure 14

## For Additional Help

*Model 831 Manual*, 831-9800 Rev D1.doc, Met One Instruments, Inc., 1600 Washington Blvd. Grants Pass, OR 97526, [http://www.metone.com/docs/831\\_operationmanual.pdf](http://www.metone.com/docs/831_operationmanual.pdf), last accessed May 13, 2015.

U.S. Environmental Protection Agency, Particulate Matter (PM), <http://www.epa.gov/airquality/particlepollution/index.html>, last accessed May 13, 2015.

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