SIDEPAK™ PERSONAL AEROSOL MONITOR MODEL AM520

USER GUIDE

P/N 6009829 REV. A
JUNE 2016



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Limitation of Warranty and Liability (effective February 2015)
Seller warrants the goods, excluding software, sold hereunder, under normal use and service as described in the operator's manual, to be free from defects in workmanship and material for **24 months**, or if less, the length of time specified in the operator's manual, from the date of shipment to the customer. This warranty period is inclusive of any statutory warranty. **This limited warranty is subject to the following exclusions and exceptions**:

a. Hot-wire or hot-film sensors used with research anemometers, and certain other components when indicated in specifications, are warranted for 90 days from the date of shipment;
b. SidePak AM520 internal pump and battery are warranted for one (1) year from the date of manufacture.
c. Parts repaired or replaced as a result of repair services are warranted to be free from defects in workmanship and material, under normal use, for 90 days from the date of shipment;
d. Seller does not provide any warranty on finished goods manufactured by others or on any fuses, batteries or other consumable materials. Only the original manufacturer's warranty applies;
e. This warranty does not cover calibration requirements, and seller warrants only that the instrument or product is properly calibrated at the time of its manufacture. Instruments returned for calibration are not covered by this warranty;
f. This warranty is **VOID** if the instrument is opened by anyone other than a factory authorized service center with the one exception where requirements set forth in the manual allow an operator to replace consumables or perform recommended cleaning;
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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) or (001 651) 490-2811 (International).

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Safety Information

When operated according to the manufacturer's instruction, this device is a Class I laser product as defined by U.S. Department of Health and Human Services standards under the Radiation Control for Health and Safety Act of 1968.

A certification and identification label similar to the one shown below is affixed to each instrument.



There are no user-serviceable parts inside this instrument. Performing services other than those described in this manual may result in exposure to harmful (visible) laser radiation. A warning label like the one shown below is affixed to the internal laser device.

DANGER: VISIBLE LASER RADIATION WHEN OPEN. AVOID DIRECT EXPOSURE TO BEAM
WARNING: NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL.

IP Rating

The **I**nternational **P**rotection Rating, sometimes referred to as an **I**ngress **P**rotection rating, is a set of codes used to define specific levels of protection of the equipment from solids and liquids.

IP54	Protected from limited dust ingress	Protected from water spray in any direction

The SidePak AM520 has an IP Rating of IP54.



WARNING/AVERTISSEMENT

- **THE EFFECT OF THE INTERNAL LASER ON GAS MIXTURES HAS NOT BEEN EVALUATED BY CSA**
  LES EFFETS DU LASER INTERNE SUR LES MELANGES DE GAZ N'ONT PAS ÉTÉ ÉVALUÉS PAR CSA
- **EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY**
  RISQUE D'EXPLOSION – LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SÉCURITÉ INTRINSÈQUE
- **FOR USE ONLY WITH BATTERY PACK MODEL NUMBER 803300**
  N'UTILISEZ QUE LE BLOC-PILES DE MODÈLE NUMÉRO 803300
- **CHANGE AND/OR RECHARGE BATTERIES ONLY IN A NONHAZARDOUS LOCATION**
  REMPLACEZ ET/OU RECHARGEZ LES BATTERIES UNIQUEMENT DANS UNE ZONE NON DANGEREUSE
- **BATTERY TO BE CHARGED ONLY WITH POWER SUPPLY 6001583**
  BATTERIE A CHERGER UNIQUEMENT AVEC L'ALIMENTATION 6001583
- **TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTIBLE ATMOSPHERES, READ, UNDERSTAND AND ADHERE TO THE MAINTENANCE PROCEDURES CONTAINED IN THIS MANUAL**
  POUR EVITER L'INFLAMMATION DES ATMOSPHERES INFLAMMABLES, LISEZ, COMPRENEZ ET RESPECTEZ LES PROCEDURES D'ENTRETIEN CONTENUES DANS LE MANUEL

WARNING

Any damage to the base unit that results in a cracked or broken case should be immediately returned to TSI for repair as it may affect safety rating compliance of the equipment. A damaged case could allow for the ingress of dust, dirt or other material and moisture into the unit and diminish the safety of the device.



WARNING/ AVERTISSEMENT

- **DO NOT** attempt to disassemble or service the battery pack.
- **DO NOT** short-circuit the battery pack.
- **DO NOT** incinerate or destroy the battery pack.
- **DO NOT** attempt to charge the battery pack using anything except a TSI approved power supply. Doing so may cause permanent damage to the pack.

Failure to comply with any of these warnings can cause burns, blindness, severe injury or death. TSI will not service any pack which has been damaged due to user neglect.

Keep away from children. **DO NOT** dispose of in fire. Always dispose of your pack in compliance with regional requirements.

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Chapter 1

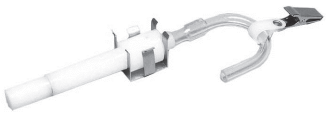
Unpacking and Parts Identification

Carefully unpack the AM520 SidePak™ Personal Aerosol Monitor from the shipping container. Use the table below to identify the components that are included with the unit. A photo and description of each item follows the table. If any parts are missing, contact TSI immediately. This list also includes items that are not packaged with the product, yet available as accessories sold separately.

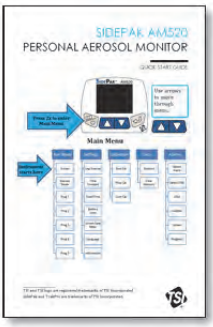


AM520 with all accessories

(continued on next page)

Item Description	Part/Order Number	Reference Picture
AM520 Personal Aerosol Monitor (shown with battery pack)	AM520	
Battery Pack, 5400mAH	803300	
Single Carry Case 11.25” x 9” x 4.25” (28.6 x 22.9 x 10.8 cm)	1319289	
AM520 Impactor Kit (impactor oil, impactor disc (3x), Blank inlet, PM_1 inlet, $PM_{2.5}$ inlet, PM_5 inlet, PM_{10} inlet.)	803301	
Dorr-Oliver 10-mm Nylon Cyclone Kit	801701	
DPM Cyclone Kit	803303	

Item Description	Part/Order Number	Reference Picture
Calibration Jar, 1ltr *(Accessory sold separately.)*	803310	 *(photo courtesy of Zefon)*
TrakPro™ Data Analysis Software CD *(Accessory sold separately.)*	7003173	
Zero Filter	800663	
AM520 Power Supply with Universal Plug Set	803302	
AM520 USB Cable	803305	
Sample Tube, Tygon® conductive tubing 3 feet (~1 m)	801703	
Phillips Screwdriver	803307	

Item Description	Part/Order Number	Reference Picture
AM520 Calibration Certificate	N/A	
AM520 User Guide	6009829	
Quick Start Guide and Keypad Functions	6009830	
SidePak AM520 Personal Aerosol Monitor Li-Ion Battery Maintenance Card	6009831	

Chapter 2

Setting-Up

Supplying Power to the SidePak Aerosol Monitor

Attach the rechargeable battery pack to the SidePak™ Personal Aerosol Monitor before use. This will “wake up” the battery from storage mode. The battery can power the AM520 by itself or in conjunction with the TSI AC adapter.

The SidePak monitor also contains a miniature coin cell for powering a Real-Time Clock. Changing the battery pack or disconnecting the power supply/charger will not cause data to be lost. Flash memory retains the data. The coin cell will last for many years. TSI will install a new coin cell, if necessary, when the unit is returned for service. The coin cell is not user-serviceable.

Installing the Lithium Ion Rechargeable Battery Pack

Battery packs slide on and off the AM520 in the direction shown below:



W A R N I N G / A V E R T I S S E M E N T

FOR USE ONLY WITH BATTERY PACK MODEL NUMBER 803300
N’UTILISEZ QUE LE BLOC-PILES DE MODÈLE NUMÉRO 803300

CHANGE AND/OR RECHARGE BATTERIES ONLY IN A NONHAZARDOUS LOCATION
REMPLACEZ ET/OU RECHARGEZ LES BATTERIES UNIQUEMENT DANS UNE ZONE NON DANGEREUSE

Note

Plug in power cord and charge fully before turning on instrument the first time. See AM520 Smart Battery Management™ System technology below.

Installing the Lithium Ion Battery Pack

1. Place the battery pack under the AM520.	
2. Push firmly to slide into place.	
3. Fasten it in place using the two battery screws provided.	

Removing the Lithium Ion Battery Pack

1. To remove battery, remove battery screws.	
2. Firmly grip sides of instrument and sides of battery.	
3. Pull apart.	

AM520 Smart Battery Management System™ technology

The rechargeable Lithium Ion battery pack is designed with Smart Battery Management System™ (SBMS) technology. It contains a gas gauge/supervisor chip to monitor pack capacity and control charging/discharging.

The SBMS supervisor prevents the battery from overcharging when the AC adapter has been left plugged into the battery. At end of the charge cycle the SBMS supervisor disconnects (stops charging) the cells while continuing to pass power on to the instrument. The SBMS supervisor also prevents excessive discharge when the battery is depleted.

TSI recommends fully charging the battery before first use of a new instrument. The battery can be charged when not installed in the instrument. Accordingly, a second battery can be charged on its own, while the equipment is in use with another battery. TSI also recommends recharging the battery after each use.

The SBMS system requires a few charge/discharge cycles to learn the capacity of a new pack. (It should be close to capacity when you first receive the battery.)

The SBMS system will learn the battery pack capacity more quickly if the pack is fully charged and then fully discharged multiple times.

To maintain the greatest accuracy of the SBMS gas gauge, you should periodically fully discharge then fully charge the battery (once every few months).

Storing the Battery Pack between Uses

The rechargeable battery must not be allowed to sit in a fully discharged state for long periods of time to prevent damage to the instrument. The battery pack should be charged before storage and recharged every six (6) months when not being used.

The rechargeable battery will last longer if it is stored in a cool place. Hot temperatures over long periods of time (several months) will increase cell internal self-discharge and eventually degrade the battery capacity.

W A R N I N G / A V E R T I S S E M E N T

Remove LiOn battery during storage and transportation of instrument.

Using the AC Adapter (power supply)

The AC adapter powers the AM520 from an AC wall outlet, and charges the rechargeable battery pack. The AC adapter can run the instrument and charge the battery at the same time. The battery will charge more slowly when the instrument is running.



Connect the AC adapter to an AC wall outlet and plug the other end into the barrel jack on the side of the rechargeable battery.

W A R N I N G / A V E R T I S S E M E N T

CHANGE AND/OR RECHARGE BATTERIES ONLY IN A NONHAZARDOUS LOCATION
REMPLACEZ ET/OU RECHARGEZ LES BATTERIES UNIQUEMENT DANS UNE ZONE NON DANGEREUSE

BATTERY TO BE CHARGED ONLY WITH POWER SUPPLY 6001583
BATTERIE A CHERGER UNIQUEMENT AVEC L'ALIMENTATION 6001583

Normal charge time is about 4 hours with the instrument off or when the battery is removed from the instrument.

Battery LED

When charging the battery, the green LED in the battery pack will repeatedly flash from dim to bright. When the battery is fully charged, the LED will stay on until the AC adapter is unplugged.



If the temperature is too hot or too cold to charge the battery, the LED will flash 3 seconds on, then 1 second off. If the battery has an internal fault that prevents charging, the LED flashes rapidly.

Battery Icon on Display

When the battery is charging, the battery icon on the AM520 display repeatedly flashes a pattern with increasing numbers of segments. When charging is complete, the icon indicates a full charge. A full battery icon means at least 10 hours of battery life is available. When battery life is less than 10 hours, the battery icon will show proportionally less full.

When the battery life remaining is less than 15 minutes, the battery icon will flash red. When the battery is depleted, the AM520 will display a “LOW BATTERY” message for 5 seconds and then turn itself off.

AM520 Displayed Battery Life

The AM520 shows battery life remaining in Hours:Minutes or Minutes (user selectable) when displaying the Survey mode menu or while actively data logging and showing the Logging menu. Those screens may first show battery life as asterisks (*) for a few seconds while the instrument gathers power consumption data. If the AC adapter is plugged in, "A/C Power" is displayed.

Installing TrakPro™ Data Analysis Software

TrakPro Data Analysis Software can preprogram the SidePak AM520 monitor, download data, view data, create graphs and statistical reports, and combine graphs with data from other TSI instruments that use TrakPro software. Refer to the *TrakPro Data Analysis Software manual* for installation and operating instructions.

Chapter 3

Operation

Overview

The SidePak™ Personal Aerosol Monitor is a miniature battery-operated laser photometer that measures airborne particle mass-concentration in units of milligrams per cubic meter (mg/m^3).

The built-in sampling pump flow rate is user-adjustable; giving the user the flexibility to attach a wide variety of inlet conditioners to sample from the worker's breathing zone or other locations. The rugged belt-mountable unit is small, quiet, and lightweight, minimizing interference and discomfort for the wearer. The high resolution OLED display shows aerosol concentration and 8-hour TWA (time-weighted average) in real time. Information can be stored and later downloaded via a Windows®-based PC using the enclosed TrakPro software and USB (Universal Serial Bus) communications cable.

Identifying SidePak AM520 Features

USB Port

Use the Universal Serial Bus (USB) port and USB cable to connect the SidePak AM520 to an available USB port on your computer. The connector on the instrument is a USB Micro-B receptacle.





WARNING/AVERTISSEMENT

Prior to entering a hazardous location, be sure to seal the USB port with the attached USB dust plug.

Power Port

Connect the power supply to this port to charge the TSI battery pack or to power the instrument at any time.



Note

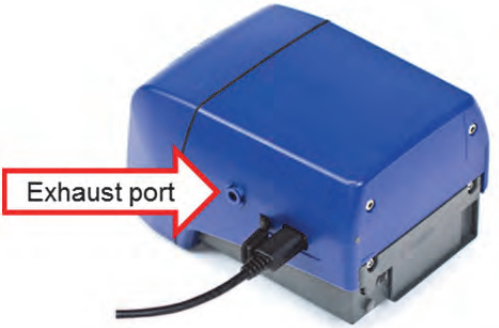
Many power supplies look alike. Use the proper power supply to prevent damage.

Note

After charging the battery, close/seal the AC power port with the attached AC dust plug.

Exhaust Port

Air drawn though the instrument exits here.



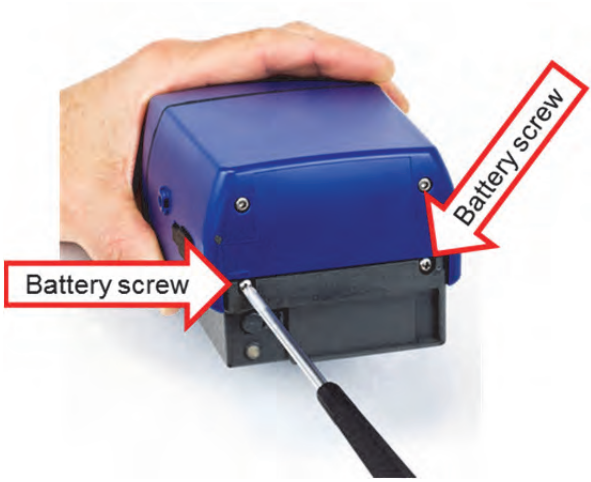
Inlet

Interchangeable inlet. Install the standard inlet or one of four impactors provided with SidePak AM520 Kits.



Battery Screws

Remove these two screws to remove the battery.



W A R N I N G / A V E R T I S S E M E N T

BATTERY TO BE CHARGED ONLY WITH POWER SUPPLY 6001583.
BATTERIE A CHERGER UNIQUEMENT AVEC L'ALIMENTATION 6001583.

CHANGE AND/OR RECHARGE BATTERIES ONLY IN A NONHAZARDOUS LOCATION
REMPLACEZ ET/OU RECHARGEZ LES BATTERIES UNIQUEMENT DANS UNE ZONE NON DANGEREUSE.

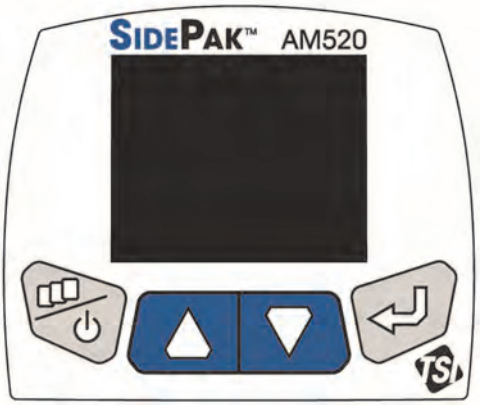
Keypad Functions

To turn the instrument ON, press the **ESC** key.

To turn the instrument OFF, press and hold the **ESC** key for three (3) seconds (release key when the countdown reaches "0 SECONDS."

The model number, serial number, and firmware revision are displayed for a few seconds before entering Survey Mode.

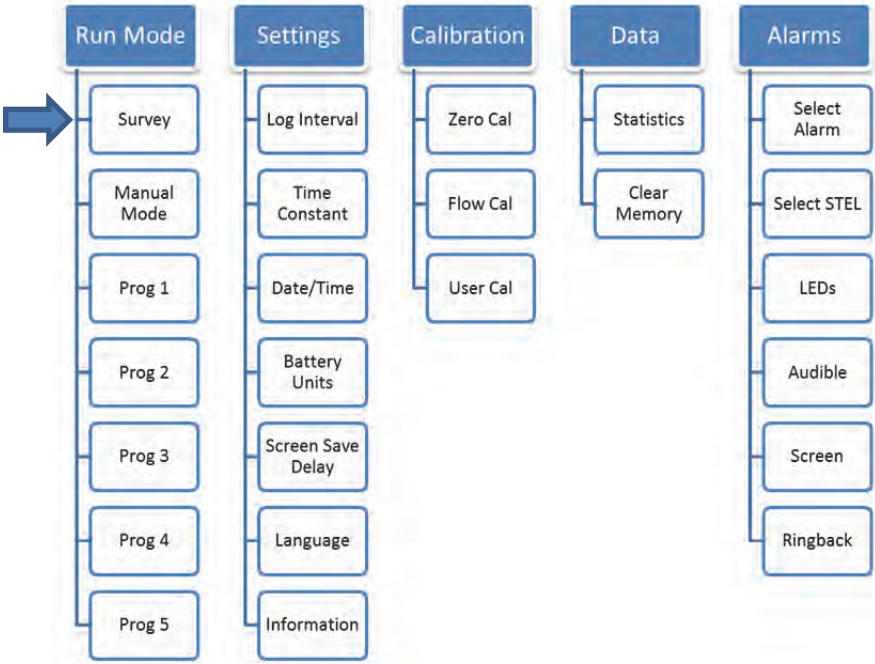
Press the **ESC** key twice to enter the Main Menu.

<table>
<tr><td colspan="2">
</td></tr>
<tr><td></td><td>ESC key. Used to turn power on and off, and to go back to the previous menu.</td></tr>
<tr><td></td><td>Use the ▲▼ arrow keys to scroll through vertical menus and to change numeric values.</td></tr>
<tr><td></td><td>Use the ↵ (ENTER) key to execute selected menu options and confirm changes.</td></tr>
<tr><td></td><td>Locked keypad. To lock the keypad, press the ▲ key and simultaneously press ↵ (ENTER). A red lock icon is briefly shown to indicate that the keys are locked. To unlock the keypad, use the same method.

This function is only available from Survey Mode or Logging Mode while the screen saver is active, or while Program Logging is active and the “PROG DELAY” screen is shown while waiting for Program Logging to start.</td></tr>
</table>

Main Menu

The menu structure of the SidePak monitor is very easy to use. The graphic below shows the menu structure from the Main Menu. After power up, the instrument will be in Survey Mode as indicated by the ➡.



From the Main Menu, use the ▲ ▼ keys to select one of the following category menus and then press the Enter key:

- Run Mode
- Settings
- Calibration
- Data
- Alarms

Refer to the sections below for details on each of the sub-menu items under each category.

Power Up

Turn the SidePak AM520 on by pressing the **ESC** key. The instrument displays the TSI logo followed by the model number, serial number, and firmware version.



The instrument will begin Survey Mode. "Survey" will display briefly, then just the survey mass concentration reading.

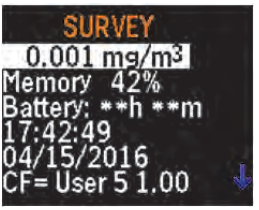


Power Down

To power the instrument off, *press and hold* the **ESC** key and release it after the 3-second countdown reaches zero.

Survey Mode

After Powering Up the unit, it will be in 'SURVEY' mode, data logging is not yet enabled. Use the Enter key to toggle back and forth between the Survey mode screen and the Survey mode menu. The Survey mode menu displays:



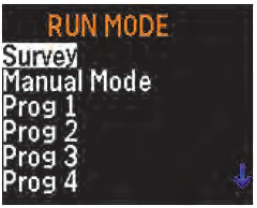
- Real-time aerosol concentration in units of milligrams per cubic meter (mg/m³)
- Percentage of logging memory available
- Battery life remaining
- Time of day
- Current Date
- Currently selected calibration factor

When the monitor is in Survey screen saver mode, the title "Survey" and the battery icon are briefly displayed and will disappear after a few seconds. Real-time aerosol concentration is shown at a random screen location, which changes every 15 minutes to prevent display burn-in.

In this mode, the pushbuttons can be locked by first pressing ▲ key, then simultaneously pressing **ENTER** key. A red lock icon is briefly shown to indicate that the keys are locked. The keys can be unlocked in the same fashion: by first pressing the ▲ key, then simultaneously pressing **ENTER** key.

When in the Survey mode, you can access the Main Menu by pressing the **ESC** key twice.

Data Logging



The AM520 can log data in either:

- Manual logging mode, *or*
- Program logging mode.

To run the AM520 in Manual logging mode, select **Manual Mode** from the **RUN MODE** menu and press the **ENTER** key. The AM520 will immediately start logging and it will use the Log Interval (set in the Log Interval option of the **SETTINGS** menu). Manual logging stops automatically when logging memory is full or the **ESC** key is pressed.

To run the AM520 in Program logging mode, select the desired program logging mode from the **RUN MODE** menu, and press **ENTER**. There are five program logging modes available. The default names are “Prog 1” through “Prog 5”. These can be renamed and the values set using TrakPro Data Analysis Software. If a specific start time or date was selected using TrakPro software, the AM520 will wait until the start time and then automatically begin logging. If the start time/date is in the past, the AM520 will show the error message "Invalid start time."

If the AM520 is programmed to wait before logging, it will show a “PROG DELAY” screen with the current time/date and the programmed start time/date. If the starting time/date is more than one minute in the future, the instrument will turn off the pump and laser in order to save power.

The “PROG DELAY” screen will disappear after a few seconds and “PROG DELAY” will flash briefly once every two seconds to show that the AM520 is waiting to start. If a key is pressed while the AM520 is waiting, it will show the full “PROG DELAY” screen again.



Programmed logging mode uses start and stop time/date, logging interval, Test length, number of Tests, and wait time between Tests programmed in TrakPro software.

While data logging is active, the screen can be toggled back and forth between the LOGGING DATA menu and the screen saver. The LOGGING DATA menu displays:

- Real-time aerosol concentration in units of milligrams per cubic meter (mg/m^3)
- Which logging mode is being used
- Battery life remaining
- 8-hour Time Weighted Average (TWA), if available
- Time spent logging
- Time of day
- Current date
- Log interval

Six menu items are displayed at a time. Scroll down to view additional menu items that are off screen.

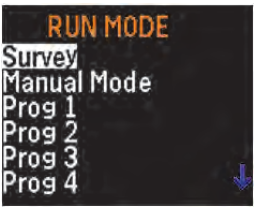
The AM520 displays the “Logging Data” screen saver after a user-selectable delay, or if **ENTER** is pressed. The AM520 can be toggled back and forth between the LOGGING DATA menu and the screen saver using the **ENTER** key.



The screen saver briefly displays the title “Logging Data” and shows the battery icon. These disappear after a few seconds to save power. Real-time aerosol concentration is shown at a random screen location. When the screen saver is active, the keys can be locked by first pressing the ▲ key, and simultaneously pressing **ENTER** key. A red lock icon is briefly shown to indicate that the keys are locked. The keys can be unlocked in the same fashion: by first pressing the ▲ key, and simultaneously pressing **ENTER** key. The keys can also be locked/unlocked while the “PROG DELAY” screen is active waiting for programmed logging to start.

To stop logging or cancel a logging program, press the **ESC** key. If logging is already in process, you will have to confirm by pressing **ENTER**. When data logging stops, the AM520 displays a message showing whether any data was saved.

Run Mode



The Run Mode menu contains the following options:

- *Survey*
- *Manual Mode*
- *Prog 1* though *Prog 5*

Use the ▲ ▼ keys to make a selection, and press ↵ **ENTER** to accept.

Survey Mode

See description of Survey Mode above.

Manual Mode

Data logging begins when Manual Mode is selected by pressing ENTER. The data logging session is called a “Test”. See Data Logging, above. The test is stopped by pressing **ESC** then **ENTER**.

While running a manual test, the display shows **LOGGING DATA** as well as the time-constant concentration. Manual tests use the logging interval defined in Log Interval under the **SETTINGS** menu.

Each test is assigned a sequential number (for example, TEST#1, TEST#2, … TEST#100) until memory is used up or cleared.

Press ↵ or **ESC** to stop a test in progress. The AM520 will ask to confirm to stop the test or not, while data logging continues. If **ESC** is pressed to continue, there will be no break in the logged data.

Program Mode

Prog 1 …**Prog 5** activates a data logging test that has been preprogrammed using TrakPro Data Analysis Software. Preprogramming allows a great deal of flexibility that is not available with manual logging, such as predefined start and stop times, logging intervals, calibration factors, and more. See the *TrakPro software manual* for more information.

During data logging, use the **ESC** key to view:

- Battery life remaining displayed in minutes
- 8-hour TWA
- Elapsed time
- Current time and date
- Log interval

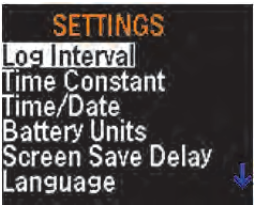
If the user-selectable screen save delay elapses without a key being pressed, the display reverts back to the **LOGGING DATA** screen saver.

To stop a test, press the **ESC** key. The AM520 will confirm to stop the test or not, while data logging continues. If the **ESC** key is pressed, data logging will continue with no break in the logged data.

If a test in progress is stopped, the AM520 will display the message "Logging Stopped" and show whether any data was saved. If the test is stopped before any data points have been recorded, the display will show "no data saved". This may happen if the logging interval is set to one minute and the test is stopped before the first data point is recorded.

Settings

Access the SETTINGS menu from the MAIN MENU, then use the ▼ key to select **SETTINGS** and press ↵.



The **SETTINGS** menu provides access to the following items. Use the ▲ ▼ keys to select the item you want to access and press ↵. Each selection is described in detail below.

- Log Interval
- Time Constant
- Time/Date
- Battery Units
- Screen Save Delay
- Language
- Information

Setting the Log Interval



The *Log Interval* is the time interval used between recorded data points during Manual Mode logging operations (log intervals for Prog-1 through Prog-5 are set using TrakPro Software). For example, if the *Log Interval* is set to 30 seconds, a data point is stored to memory once every 30 seconds. Longer Log Intervals can be used to conserve memory for long duration tests.

The SidePak AM520 always makes a measurement once every second regardless of the log interval selected. Using a log interval greater than one second results in stored data points that are averages of the 1-second readings. For example, a 10-second log interval will result in one stored data point every 10 seconds. Each of those data points will represent the computed average of ten, 1-second readings.

Do not confuse log intervals with time Constant. Log intervals only affect recorded readings. Time Constant only affects the AM520 OLED display.

Five log intervals choices are preprogrammed. This list of available log intervals can be modified using TrakPro Software.

After selecting Log Interval from the Setup Menu, the display will show LOG INTVLx where "x" is a number from 1 to 5. This is the currently selected log interval. The value of that log interval is shown on the second line.

Use the ▲ ▼ keys to scroll through the available log intervals. Press ↵ when the interval you wish to use is displayed. The factory-preset choices are:

- Log Interval 1: 1 Sec.
- Log Interval 2: 1 Min.
- Log Interval 3: 5 Mins.
- Log Interval 4: 15 Mins.
- Log Interval 5: 30 Mins.

Setting the Time Constant



The *Time Constant* is used to dampen fluctuations in the displayed readings and make them easier to read. The Time Constant setting affects values shown on the AM520 display only. Do not confuse Time Constant with logging intervals. Time Constant only affects the AM520 display. Log intervals only affect recorded readings.

The SidePak AM520 always makes a measurement once every second and updates the display every second regardless of the Time Constant selected. Using a Time Constant greater than one second results in displayed readings that are averages of the 1-second readings. For example, a 10-second Time Constant will cause the display to show an average of the most recent ten 1-second readings. In other words it is a 10-second "moving average," updated every second.

There are five preprogrammed choices for Time Constant. If necessary, the list of available Time Constant may be permanently altered using TrakPro Software.

After selecting **TIME CONSTANT** from the **SETTINGS** menu, the display will show **Time Constant x** where "x" is a number from 1 to 5. This is the currently active Time Constant. The value of that Time Constant is shown on the second line.

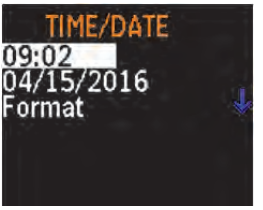
Use the ▲ ▼ keys to scroll through the available Time Constants. Press ↵ when the Time Constant you wish to use is displayed. The factory-preset choices are:

- Time Constant 1: 1 sec
- Time Constant 2: 5 sec
- Time Constant 3: 10 sec
- Time Constant 4: 15 sec
- Time Constant 5: 30 sec

Log Interval vs. Time Constant

- The *Log Interval* is the time interval used between recorded data points. It can be set using the SETTINGS menu and in Program logging mode using TrakPro software.
- The AM520 always takes a measurement once every second regardless of the Log Interval. Using a Log Interval greater than one second results in stored data points that are averages of the 1-second readings. For example, a 10-second log interval will result in one stored data point every 10 seconds, with each data point being the average of ten 1-second readings. Using a longer logging interval conserves memory in the instrument during long sample runs.
- The *Time Constant* is an averaging period used to dampen fluctuations in displayed readings so they are easier to read.
- The AM520 always takes a measurement once every second regardless of the Time Constant selected. Using a Time Constant greater than one second results in displayed readings that are averages of the 1-second readings. For example, a 10-second Time Constant will cause the display to show an average of the most recent ten 1-second readings. This results in a 10-second moving average, updated on the display every second.
- **DO NOT** confuse Time Constants with Log Intervals. Time Constants affect *only* the AM520 display. Log Intervals affect *only* the recorded readings. Therefore, the recorded logged data will generally **not** match the displayed log data.
- When using general Alarms or STEL Alarms, the alarm is triggered based on the displayed Time-Constant reading, not the value of the logged data over the Log Interval. Therefore, the recorded logged data will generally **not** match the alarm values exactly. For instance, if a Time Constant of 30 seconds and a Log Interval of one second are chosen, the displayed reading will be smoothed out over 30 seconds. Since the Alarms trigger from the displayed value and not the logged value, there could be one or more data points saved in the logged Test with values above the Alarm setting, but if the average over 30 seconds is less than the Alarm setting, the Alarm will not trigger.

Setting the Time and Date and Date Format





Set the Date Format

The date format is user-selectable. The formats available are:

- yyyy/mm/dd (default)
- mm/dd/yyyy
- dd/mm/yyyy

where yyyy is the 4-digit year, mm is the 2-digit month, and dd is the 2-digit day of month.

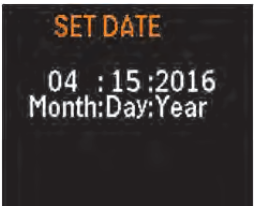
1. Select **SETTINGS** from the MAIN MENU with the ▲ ▼ keys and press ↵.
2. Under SETTINGS MENU, select **TIME/DATE** with the ▲ ▼ keys and press ↵**.**
3. Under TIME/DATE, select **Format** with the ▲ ▼ keys and press ↵.
4. Use the ▲ ▼ keys, select the desired format, then press ↵.
5. Press the **ESC** key to return to TIME/DATE menu.

Set the Current Time



1. Select **SETTINGS** from the MAIN MENU with the ▲ ▼ keys and press ↵.
2. Under SETTINGS MENU, select **TIME/DATE** with the ▲ ▼ keys and press ↵**.**
3. Under the TIME/DATE menu, use the ▲ ▼ keys to select the time.
4. Set the correct hour in 24-hour format (e.g., 3 pm = 15 hours) then press ↵.
5. Set the correct minutes using the ▲ ▼ keys then press ↵.
6. Press the **ESC** key to return to TIME/DATE menu.

Set the Current Date



1. Select **SETTINGS** from the MAIN MENU with the ▲ ▼ keys and press ↵.
2. Under SETTINGS menu, select **TIME/DATE** with the ▲ ▼ keys and press ↵**.**
3. Under TIME/DATE menu, select the date and press **RETURN**.
4. Use the ▲ ▼ keys to set the month, day and year and press ↵ after each value is entered.
5. Press the **ESC** key to return to TIME/DATE menu.

Battery Units



Battery life remaining can be displayed in minutes or in hours and minutes.

1. Select **SETTINGS** from the MAIN MENU with the ▲ ▼ keys and press ↵.
2. Under SETTINGS menu, select **Battery Units** with the ▲ ▼ keys and press ↵**.**
3. Use the ▲ ▼ keys to select Minutes or Hour+Min and press ↵. The format selected will be displayed on all screens, then return to the SETTINGS menu.

Screen Save Delay



The OLED screen display can be set to go blank after a period of time to safe battery life. To set the delay:

1. Select **SETTINGS** from the MAIN MENU with the ▲ ▼ keys and press ↵.
2. Under SETTINGS menu, select **Screen Save Delay** with the ▲ ▼ keys and press ↵**.**
3. Use the ▲ ▼ keys to select the delay. Options are 10, 15, 20, 30 or 60 seconds.
4. Press ↵. The delay selected takes effect immediately, and returns to the SETTINGS menu.

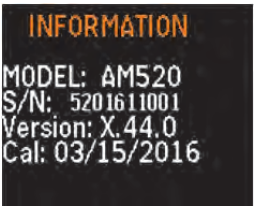
Language



The display language can be changed to English (default) or Chinese. To set the language:

1. Select **SETTINGS** from the MAIN MENU with the ▲ ▼ keys and press ↵.
2. Under SETTINGS menu, select **Language** with the ▲ ▼ keys and press ↵**.**
3. Use the ▲ ▼ keys to select the desired language.
4. Press ↵. The language you selected takes effect immediately, and returns to the SETTINGS menu.

Information



Information about the SidePak model number, serial number, firmware version and last date of calibration is displayed under the INFORMATION selection. To view the information:

1. Select **SETTINGS** from the MAIN MENU with the ▲ ▼ keys and press ↵.
2. Under SETTINGS menu, select **Information** with the ▲ ▼ keys and press ↵**.**
3. View the information.
4. Press **RETURN** to return to the SETTINGS menu.

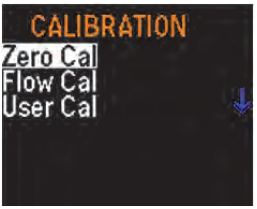
Calibration

The calibration (CAL) factor is a multiplier that is applied to the raw data prior to being displayed or recorded. The purpose of the calibration factor is to compensate the readings for aerosols that have different photometric properties than the aerosol used during factory calibration.

Effect of Calibration Factors on Full Scale and Alarms

- Note that the AM520 maximum full scale reading is not fixed at 100 mg/m³; it changes when the Calibration Factor is changed.
- For instance, if a Calibration factor of 2.00 is chosen, all readings are multiplied by 2.00, and the effective maximum full scale reading of the AM520 is then 200 mg/m³.
- Since the range of selectable Calibration factors is 0.10 to 10.00, the effective maximum full scale reading can be anywhere between 10.0 and 1000 mg/m³.
- Since the Alarm value must be allowed to approach full scale, the maximum Alarm value is 999 mg/m³. This creates a situation where the Alarm value can be set higher than the AM520 maximum full scale reading. In this case, the AM520 will never be able to read high enough to trigger the Alarm.
- To prevent this situation, the AM520 displays the message "**Warning: Alarm value is out of range**" if you try to enter a value that is out of range.

There are three items on the Calibration menu.



- **Zero Cal**: This activates a function which re-zeroes the measurement using a filter.
- **Flow Cal**: This activates a function which allows you to set the pump voltage to achieve the desired sample flow.
- **User Cal**: This allows you to select a photometric calibration factor to adjust the instrument response to more closely match the properties of the aerosol being measured.

Zero Cal

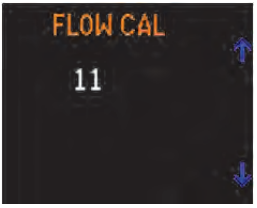


For best results, it is important to zero the AM520 before each test. This ensures accurate data, especially for low aerosol concentrations. The process only takes a few minutes.



1. Locate the zero filter provided with the AM520 kit and attach it to the inlet of the SidePak monitor.
2. Start the AM520 by pressing the **ESC** key. After the monitor goes into SURVEY mode, press the **ESC** key to reach the MAIN MENU.
3. Under MAIN MENU, use the ▲ ▼ keys to scroll to CALIBRATION and press ↵.
4. Under the CALIBRATION menu, use the ▲ ▼ keys to scroll to Zero Cal and press ↵.
5. The AM520 will prompt you to attach the zero filter to the inlet of the AM520. When the zero filter is connected, press ↵.
6. The AM520 will count-down from 60 to 0 and display Zero Cal Complete.
7. Press the **RETURN** key to return to the CALIBRATION men.
8. The instrument is now ready to make accurate measurements.

Flow Cal



Aerosol concentration measurements with the SidePak AM520 are accurate regardless of the flow rate through the instrument. However, size-selective aerosol sampling inlets such as impactors and cyclones require specific flow rates to function within their design specifications. If using a size-selective inlet, adjust the flow rate precisely. It's always a good practice to adjust the flow rate before the start of a sampling session.



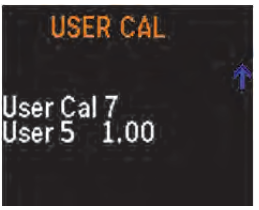
AM520 connected to TSI 4146 Flowmeter (sold separately)

To adjust the flow rate, you will need a flow calibrator. This can be a simple rotameter or a precision flow calibrator often used for setting the flow on personal sampling pumps. A flow calibrator is an optional item and is not included with standard AM520 kits.

1. Connect a flow calibrator to the AM520 inlet.
2. Start the AM520 by pressing the **ESC** key. After the SidePak monitor goes into SURVEY mode, press the ↵ key to reach the MAIN MENU.
3. Under MAIN MENU, use the ▲ ▼ keys to scroll to CALIBRATION and press ↵.
4. Under the CALIBRATION menu, use the ▲ ▼ keys to select FLOW CAL and press ↵.
5. Press ↵**.**
6. Each single click of an ▲ ▼ key changes the flow by 1 percent of the available range. The flow rate can be changed more quickly by holding the arrow key down. The range is 0 to 200.

User Cal

Selecting a Photometric Calibration Factor will cause the SidePak monitor's response for all subsequent measurements to be multiplied by the new calibration factor. User cal 1 to 7 can be selected through the user interface or TrakPro software.



To select the calibration factor through the user interface:

1. Under MAIN MENU, use the ▲ ▼ keys to scroll to CALIBRATIONS and press ↵.
2. Under CALIBRATION menu, use the ▲ ▼ keys to select **USER CAL** and press ↵.
3. Under USER CAL, use the ▲ ▼ keys to select the calibration you want and then press ↵ to confirm the setting.

   User Cal 1 (Factory) is set to 1.00 by TSI and cannot be adjusted.

   User Cal 2 (Ambient) is set to 0.38 by TSI and cannot be adjusted.

   User Cal 3 to 7 default to 1.00 and can be adjusted from 0.10 to 10.00 through TrakPro.

   User Cal 3 to 7 can be changed in the field through the AM520 menu, after pressing ↵ to select the desired factor, adjust the value of the cal factor using the ▲ ▼ keys. Press the ↵ key again to accept the changes and return to the CALIBRATION Menu.

After selecting Cal Factor, the display will show the currently active cal factor (“CF= x.xx”) when the Survey menu is displayed.

Data

The DATA menu lets you view statistics of the SidePak monitor and clear the memory.



Statistics

To view Statistics:

1. Select **Data** from the MAIN MENU with the ▲ ▼ keys and press ↵.
2. Under DATA menu, select **Statistics** with the ▲ ▼ keys and press ↵.
3. Select the Test (for example Test 3) with the ▲ ▼ keys and press ↵.



4. The Statistics menu displays computed statistics for each test (up to 100 tests) that have been made using Run Manual, and Prog 1 through Prog 7 data logging methods. The statistics computed by the SidePak AM520 include:
   - Max: Maximum concentration value recorded (mg/m^3)
   - Min: Minimum concentration value recorded (mg/m^3)
   - Avg: Average of recorded concentration values (mg/m^3)
   - TWA: 8-hour time-weighted average (mg/m^3)
   - Time: Elapsed time of test
5. If the display shows N/A for the TWA, it means that there is not enough data in that test to compute the TWA. The instrument must be operated for a minimum of 15 minutes before a valid TWA may be calculated.
6. Select **RETURN** key to return to STATISTICS menu.

Clear Memory

Clear Memory permanently erases *all* logged data and associated statistics stored in memory. It will not affect the Prog-1 through Prog-7 stored programs, stored Cal Factors, or any other settings.



To Clear Memory

1. Select **Data** from the MAIN MENU with the ▲ ▼ keys and press ↵.
2. Under DATA menu, select **Clear Memory** with the ▲ ▼ keys and press ↵**.**
3. You will be prompted to confirm your intention.
4. Press **Enter**. You will be returned to the Data menu.

Alarms

The unit is equipped with two alarm types:

- General Alarm
- STEL Alarm

Both the *General Alarm* and the *STEL Alarm* have five default alarm settings: 0.5 mg/m^3, 1 mg/m^3, 3 mg/m^3, 5 mg/m^3, and 15 mg/m^3 and OFF.

TrakPro™ v5 software can be used to set alarm values from 0.001 to 999 mg/m^3.

A *General Alarm* is active during *Survey* mode and while data logging. If the displayed Time-Constant reading exceeds the *Alarm* value, the alarm triggers. Depending on settings in the ALARMS menu, the display will flash red or the LEDs on the membrane switch may flash or an audible beeper may sound. All three of those alarm indications can be turned ON/OFF through the ALARMS menu.

Once triggered, the Alarm stays active until the displayed reading drops below 95% of the Alarm value. The alarm can be “delayed” or “muted” with the Ringback delay function. If the displayed reading is more than 90% of the Alarm value, the display flashes yellow.

A *STEL Alarm* is active during data logging only and is *not* active in Survey mode. If the displayed Time-Constant reading exceeds the STEL Alarm value, the STEL Alarm triggers. When the STEL Alarm triggers, a STEL Record is started in the logged data. A STEL Record contains the average concentration taken every minute during the length of the STEL Record.

STEL Record length is selectable from 5 to 30 minutes through TrakPro™ software. Since the start of a STEL Record is not usually aligned with the Log Interval, the values of averages saved in the STEL Record will generally **not** match the values saved each Log Interval.



Ringback delay: The Ringback delay is a user function that will "mute" an activated alarm for the selected period of time. General Alarms and STEL Alarms can be muted for the duration of the Ringback delay setting: 30 sec, 1 min, 3 min, 5 min, 10 min, off. After the Ringback delay expires, the Alarm will sound again.

When an alarm sounds, the Ringback delay can be activated by pressing the ↵ button. The Ringback delay button is functional even when the front panel is locked.

To select an alarm and an alarm action:

1. Select **ALARMS** from the MAIN MENU with the ▲ ▼ keys and press ↵.

   The ALARMS menu has the following options:

   - Select Alarm
   - Select STEL
   - LEDs
   - Audible
   - Screen
   - Ringback

2. Select **Alarm** or **STEL** with the ▲ ▼ keys and press ↵.
3. Select the setting you want to use from the list of available values with the ▲ ▼ keys and press ↵
4. Use the ▲ ▼ keys to select an alarm indicator: LEDs, Audible, Screen or Ringback and press ↵.
5. Turn the indicator ON or OFF for LEDs, Audible, and Screen.
6. Select a Ringback delay time from the RINGBACK menu.

Post-Sampling Data Reporting and Graphing

After collecting and logging data, all tests and data can be downloaded to a personal computer via the supplied USB cable. For data report generation and graphing, use the TSI TrakPro™ v5 Data Analysis Software (TSI P/N 7003173).

With the TrakPro v5 software, you can also program the internal settings of the AM520 units for performing future dust monitoring studies. See the product information of the TSI TrakPro v5 software for all the features and capabilities that enhance the use of your SidePak AM520 Personal Aerosol Monitor.

TrakPro v5 software is available for download from the TSI website at: *http://www.tsi.com/Software-Firmware/.*

Chapter 4

Maintenance

The SidePak™ AM520 Personal Aerosol Monitor requires periodic maintenance. The most common procedures are:

- General Cleaning
- Impactor maintenance
- Cyclone maintenance
- Charging batteries
- Zeroing

In addition to the procedures in this chapter, TSI recommends that you return your SidePak AM520 Personal Aerosol Monitor to the factory for annual calibration. Regular factory-authorized cleaning and recalibration helps ensure that your instrument is working properly, has the latest updates, and will provide accurate and reliable measurements.

Returning the Instrument to TSI for Service

When sending the instrument to TSI for repair or service, include all parts and accessories. To troubleshoot a problem, a TSI Technician will attempt to recreate the problem by running the instrument. All equipment used with the instrument is needed to do this.

WARNING/AVERTISSEMENT
Remove LiON batteries from instrument before shipping. **DO NOT** ship AM520 with batteries installed.

General Cleaning

General cleaning of the SidePak AM520 case should be done with soap and water applied with a damp cloth. ***Do not*** use chemical cleaners, alcohol or petroleum derived cleaners on the case or front panel of the instrument.

Use a foam or lint-free swab to clean the alarm vents on the front of the unit. ***Do not*** use high pressure compressed air as this may harm the internal membrane of the alarm horn and re-aerosolize particulate matter.

Using and Maintaining Built-in Impactors

The standard inlet on the SidePak AM520 was designed not to cause any specific particle size separations. It is intended for use with external size-selective aerosol samplers such as a cyclone or external impactor at any flow rate within the allowable range. The standard inlet can be differentiated from the built-in impactor by the absence of a particle size marking on the side and top.



The AM520 includes a set of four impactors that can be used in place of the standard inlet to conveniently separate specific particle size fractions. The 50% cut-off size is marked in micrometers (*µ*) on each impactor. The four impactors provide cuts at *1.0µ*, *2.5µ*, 5*µ,* and *10µ*, corresponding to $PM_{1.0}$, $PM_{2.5}$, PM_5, and PM_{10} specifications respectively. All inlets are made of conductive plastic to eliminate particle losses due to static charges.

Note

SidePak monitor built-in impactors must be operated with the flow rate set to 1.7 L/min for proper performance. Using other flow rates will result in unknown particle size fractions. The standard inlet can be used at any flow rate.

Always use the standard (unmarked) inlet when sampling through an external size-selective sampler such as a cyclone or external impactor.

SidePak size-selective inlets use an internal impactor disk. The impactor disk functions as a collection plate where particles larger than the cut-size are trapped. The same impactor disk is used for all impactors, but it is ***not*** *used for the standard inlet*.



To make sure unwanted (large) particles remain trapped on the impactor disk, it is necessary to apply 1 to 4 drops of impactor oil on the impactor disk for particles to stick to. Wipe off any excess oil if necessary.

Note

Size-selective impactors will not function unless an impactor disk is installed. To ensure proper performance, the impactor disk should be removed, cleaned and re-oiled prior to each use.

1. Remove the impactor by loosening the two captive screws that hold the impactor in place.





2 Flip the AM520 upside down to remove the impactor disk.



3 Clean the impactor inlet and impactor disk with a clean lint-free swab or microfiber cloth and light solvent. Gently blow impactor body dry with canned/pressurized clean air or allow to air dry. Use a lint-free swab or microfiber cloth to clean impactor well inside the instrument case to remove accumulated particles.





WARNING/ AVERTISSEMENT

To prevent driving contamination into the optics, never blow air directly into the sample inlet opening of the AM520.

4 Apply 1 to 4 drops of oil to the top of the impactor disk (collection plate). Wipe off excess oil if necessary.



5 Slide the impactor disk into the impactor well until it is seated.



6 Add impactor inlet.

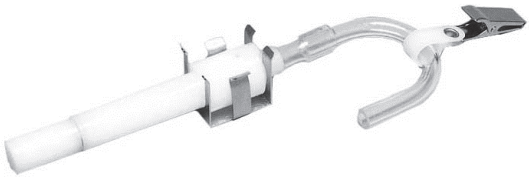


7 Screw the impactor assembly back onto the AM520 body and tighten the two captive screws. To avoid damage, **DO NOT** over-tighten.



Using and Maintaining the Respirable Cyclone

The 10-mm Nylon Dorr-Oliver Cyclone included with the AM520 can be used to differentiate between the respirable fraction and other portions of the ambient aerosol. It is ideal for making breathing zone measurements because it can be attached to a worker's clothing near his or her head. TSI supplies a U-tube and clip with the cyclone specifically for this purpose.



4 µm is internationally accepted as the 50% cut-off size for respirable aerosols. Particles larger than 4 µm impact onto the surfaces of the upper respiratory tract and cannot reach the lungs. The cyclone accessory provided with SidePak AM520 is designed to provide a cut-off at 4 µm. This is specified as a 50% cut-off at 4 µm.

The cyclone works by forcing the particle-laden air sample to swirl inside the cyclone body. Larger (higher mass) particles cannot follow the air stream and become trapped while smaller particles stay in the air stream and pass through. When using the cyclone, assume that all particles smaller than the cut-off size pass through and all larger particles become trapped in the grit potentiometer.

The cut-off size for any cyclone is dependent on flow rate.

Note

It is very important that the sample flow rate through the SidePak AM520 monitor be set at 1.7 liters per minute (L/min). If some other flow rate is set, the cut-off size will be unknown.

1. Install the standard inlet (unmarked) on the SidePak AM520 body **without** an impactor disk inside.
2. Attach the cyclone and sample tube onto the AM520 inlet.
3. Adjust the flow rate of the AM520 to 1.7 L/min. See the Operation chapter for instructions on setting the flow rate.

The SidePak monitor and cyclone are now ready to use. Attach the cyclone to the individual test subject's clothing using the U-tube and clip provided with the cyclone.

Cleaning the Cyclone

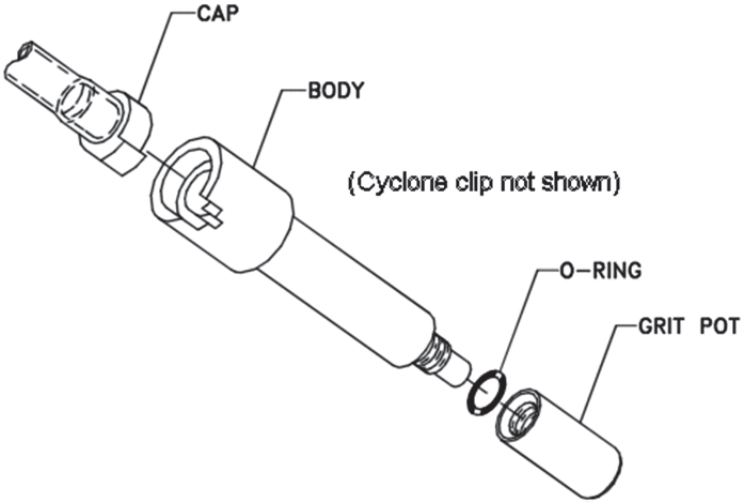
The 10-mm Nylon Dorr-Oliver Cyclone should be cleaned prior to each use. In most cases, simply cleaning the grit potentiometer is all that is necessary. Inspect the inside of the cyclone body regularly and clean it if necessary.

1. Unscrew the grit potentiometer from the bottom of the cyclone. Remove the stainless steel cyclone clip and pull the cap off.
2. Hold the open end of the grit potentiometer down and tap it on a hard surface to dislodge particles. Repeat with the cyclone body.

Note

If dirt is visible inside either the grit potentiometer or the cyclone body, it may be necessary to blow canned/pressurized air into the cyclone parts and/or to clean them with soap and water. A mild solvent like isopropanol may also be used inside the cyclone. Make certain that the cyclone is perfectly dry before re-assembly and use.

3. Re-assemble the cyclone. Note that the stainless steel cyclone clip that holds the cap onto the body will only fit one way. The cyclone cleaning procedure is now completed.



Exploded View of 10 mm Nylon Dorr-Oliver Cyclone

Using and Maintaining the Diesel Particulate Matter DPM Cyclone

The DPM Cyclone included with the AM520 can be used to differentiate between the diesel particulate matter and other portions of the ambient aerosol. It is ideal for making breathing zone measurements because it can be attached to clothing near the wearers face/breathing zone. TSI supplies a U-tube, clip, and a Dorr-Oliver cyclone with the DPM cyclone specifically for this purpose.



The DPM cyclone is designed with a 50 percent cut-off size of 0.8 µm. The Dorr-Oliver cyclone is positioned upstream of the DPM cyclone to filter out particles larger than 4 µm preventing large particles from clogging the inlet of the DPM cyclone.

The cyclone works by forcing the particle-laden air sample to swirl inside the cyclone body. Larger (higher mass) particles cannot follow the air stream and become trapped while smaller particles stay in the air stream and pass through. When using the cyclone, you can assume that all particles smaller than the cut-off size pass through and all larger particles become trapped in the grit potentiometer.

The cut-off size for any cyclone is dependent on flow rate.

Note

It is very important that the sample flow rate through the SidePak monitor be set at 1.7 liters per minute (L/min). If some other flow rate is set, the cut-off size will be unknown.

1. Be sure to have the standard inlet (unmarked) installed on the SidePak AM520 body and that there is no impactor disk inside.





2. Attach the Dorr-Oliver cyclone to the DPM cyclone to create the DPM assembly.



3. Attach the DPM cyclone assembly and sample tube onto the AM520 inlet.



4. Adjust the flow rate of the AM520 to 1.7 L/min. See Chapter 3, “Operation” for instructions on how to set the flow rate.





TSI 4146 flow meter (sold separately) being used to calibrate flow setting for AM520

The SidePak monitor and DPM cyclone assembly are now ready to use. Attach the DPM cyclone assembly to the individual test subject's clothing using the U-tube and clip provided with the DPM cyclone assembly.

Cleaning the Diesel Particulate Matter DPM Cyclone

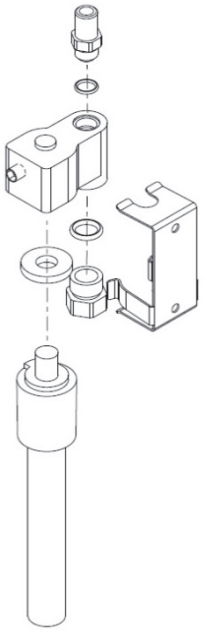
The DPM Cyclone should be cleaned prior to each use. In most cases, simply cleaning the grit potentiometer is all that is needed. Inspect the inside of the cyclone body regularly and clean it if necessary.

1. Unscrew the grit potentiometer from the bottom of the cyclone. Remove the stainless steel cyclone clip and pull the cap off.
2. Hold the open end of the grit potentiometer down and tap it on a hard surface to dislodge particles. Repeat with the cyclone body.

Note

If dirt is visible inside either the grit potentiometer or the cyclone body, it may be necessary to blow canned/pressurized air into the cyclone parts and/or to clean them with soap and water. A mild solvent like isopropanol may also be used inside the cyclone. Make certain that the cyclone is perfectly dry before re-assembly and use.

3. Re-assemble the cyclone. Note that the stainless steel cyclone clip that holds the cap onto the body will only fit one way. The cyclone cleaning procedure is now completed.



Exploded View of 0.8 µm DPM Cyclone

Note

When re-assembling the cyclone, fully seat the cap to maintain the proper flow rate. Failure to seat the cap may affect the particle cut-size of the cyclone.

Calibrating of Measuring DPM

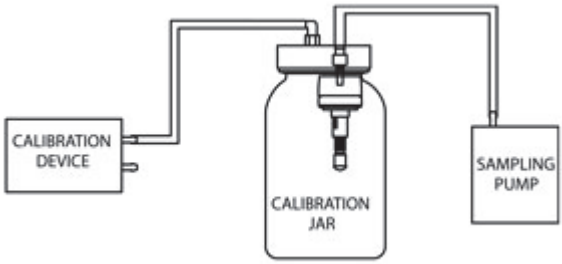
The Zefon Cyclone Calibration Jar is a 1 liter container with all the proper fittings and connections needed to calibrate sampling pump flow rates with Zefon or SKC Aluminum Cyclones.



Features:

- 1 liter Size
- Compatible with both Zefon and SKC Aluminum Cyclones
- Complete with all fittings and Tygon® tubing for connecting sampling pump (as shown)

Example Calibration Setup



AM520 Field Service Kit – sold separately

The SidePak AM520 Field Service Kit (P/N 803306) includes the following to replace damaged or lost items:

Qty	Description
3	USB Dust Plugs
3	Impactor Plates
3	Impactor Gaskets



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Chapter 5

Troubleshooting

TSI recommends the SidePak Model AM520 Personal Aerosol Monitor be returned to the factory for annual calibration. Regular factory-authorized cleaning and recalibration helps ensure that the instrument is working properly, has the latest updates, and will provide accurate and reliable measurements.

If you are having a problem with your SidePak AM520, use the information below to try and resolve it in the field. If necessary, contact TSI Incorporated or a local TSI distributor to arrange for service.

Contact information:

TSI Incorporated
500 Cardigan Road
Shoreview, MN 55126
USA

Tel: 651-490-2811 or 1-800-874-2811
Website: www.tsi.com
E-mail: answers@tsi.com

The following table lists the symptoms, possible causes, and recommended solutions for common problems encountered with the SidePak monitor.

Troubleshooting Table

Symptom	Possible Cause	Corrective Action
Erratic zero reading.	Leak.	Check all connections for leaks. Carefully tighten sample inlet screws (***do not*** over-tighten!). If using an impactor, remove, clean and re-oil the impactor disc. Make sure the O-ring is in place and not damaged. Make sure the impactor disc is seated squarely into the fitting, before replacing the inlet (see "Using and Maintaining Built-in Impactors", in Chapter 4, for more information).
	Dirty inlet and/or sample tube.	Clean inlet. Clean or replace tubing.
	Extreme temperature swings during operation.	Zero instrument, at ambient temperature, before beginning test. Protect from extreme temperature swings.
	Internal optics chamber is contaminated.	Return to factory for cleaning and servicing.
Nothing visible on display.	Unit not switched on.	Press the **ESC** key firmly for 2 seconds minimum.
	Low or dead battery.	Replace the battery or plug in the AC adapter.
Mass concentration number is blinking and stays on the same value.	Instrument has reached the calibrated limit of its range (multiplied by Cal Factor).	N/A

Symptom	Possible Cause	Corrective Action
No keypad response. Display shows a red lock icon. 	Keypad is locked out. When the keypad is locked, the display shows a red lock icon.	To unlock the keypad, press and hold the ▲ key and press ↵. See Data Logging in Chapter 3 for more information.
The battery icon is flashing red.	Low battery charge.	Recharge battery or use AC adapter.
Green LED on battery flashing on for 3 seconds and off for 1 second.	The battery is either too hot or too cold to charge.	Allow battery to warm or cool to room temperature.
Green LED on battery flashing rapidly.	Internal battery pack fault. Battery cannot charge.	Replace battery.
FLOW BLOCKED message is displayed.	Inlet flow is blocked.	Remove obstructions. Check for pinched sample tube. Check for correct installation of impactor inlet (if used).
	Outlet flow is blocked.	Remove obstructions from outlet flow fitting (next to connectors).
	Internal screen filter is plugged.	Return to factory for servicing, or replace internal screen filter. See "AM520 Field Service Kit" section, in Chapter 4, for more information.
LOGGING STOPPED, NO DATA SAVED. message is displayed.	User has discontinued data logging before a single data point was recorded.	N/A
INVALID START TIME message is displayed.	User is attempting to run a data logging program and the program start time is in the past (expired).	Setup logging protocol for program logging using TrakPro software.

Symptom	Possible Cause	Corrective Action
LOG PROGRAM READ or LOG PROGRAM WRITE error message is displayed.	There is a problem with an entered logging program.	Use TrakPro software to read and set the logging programs. If error recurs, return to factory for servicing.
NO DATA message is displayed.	User is attempting to review Test Statistics. However, no Tests have been properly stored in memory.	Record Tests using Manual or Program logging.
One or more of: LASER CURRENT LOW. LASER CURRENT HIGH. LASER POWER LOW. LASER POWER HIGH. messages are displayed.	The laser or laser control circuit has failed.	Return to factory for servicing.
The: LASER CURRENT HIGH message is displayed without the: LASER POWER LOW. message.	The laser is aging and should be replaced soon. However, the instrument is probably still operational.	Return to factory for servicing.
ZERO DRIFT message is displayed.	Zero baseline on instrument has drifted. This error can be caused by zeroing with a dirty or leaking filter.	Perform a zero calibration. See “Calibration, Zero Cal”, in Chapter 3, for more information.

Symptom	Possible Cause	Corrective Action
COIN CELL VOLTAGE error message is displayed.	The coin cell used to power the clock and store logged data is depleted.	Download logged data to TrakPro software (if desired to save). Return to factory for servicing.
METER ID READ error message is displayed.	There is a problem with the saved instrument Model or Serial number. User settings, calibration, etc. are unaffected.	Return to factory for servicing.
CLOCK READ or CLOCK WRITE error message is displayed.	There is a problem with the time setting of the Real-Time Clock. User settings, calibration, etc. are unaffected.	If error recurs, return to factory for servicing.
USER CONFIG READ or USER CONFIG WRITE error message is displayed.	There is a problem with user settings such as time constant, pump setting, selected alarm, etc.	Check all user settings for accuracy. If error recurs, return to factory for servicing.
CALIBRATION READ or CALIBRATION WRITE error message is displayed.	There is a problem with the calibration. Instrument accuracy is in question.	Return to factory for servicing.
LOG DATA READ or LOG DATA WRITE error message is displayed.	Logged data may have been corrupted.	Download logged data to TrakPro software (to save) then do CLEAR MEMORY to clear the corrupt data.
One of: ADC READ ADS1220 READ SPIFI MEMORY ERROR PUMP VOLTAGE LOW messages are displayed.	Internal hardware fault.	If error recurs, return to factory for servicing. The message gives information for the factory tech.

Symptom	Possible Cause	Corrective Action
PUMP CURRENT LOW message is displayed.	The pump brushes may be nearing the end of useful life.	If error recurs, return to factory for servicing.
BATTERY VOLTAGE DANGEROUSLY HIGH. UNPLUG AC. message is displayed.	There is a problem with the charge circuit inside the battery. It is not controlling battery charge properly.	To prevent safety concerns, immediately unplug the AC adapter from the battery. Run the instrument until the battery is discharged, then dispose of battery according to regulations. **Do not** attempt to use the battery again.

Technical Contacts

If you have any difficulty setting up or operating the AM520 SidePak aerosol monitor, or if you have technical or application questions about this system, contact Technical Support at TSI Incorporated, 1-800-874-2811 (USA) or (651) 490-2811 or e-mail technical.service@tsi.com.

If the SidePak aerosol monitor, does not operate properly, or if you are returning the instrument for service, visit our website at http://rma.tsi.com, or contact TSI Customer Service at 1-800-874-2811 (USA) or (651) 490-2811.

International Contacts

Service

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150 Kampong Ampat
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Singapore 368324

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Fax: +65 6595-6399
E-mail: tsi-singapore@tsi.com

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Fax: +33 (0)1 41 19 21 96
E-mail: tsifrance@tsi.com

Returning for Service

Visit our website at http://rma.tsi.com and complete the on-line "Return Merchandise Authorization" form or call TSI at 1-800-874-2811 (USA), (651) 490-2811, or 001 651 490-2811 (International) for specific return instructions.

Customer Service will need the following information:

- The instrument model number
- The instrument serial number
- A purchase order number (unless under warranty)
- A billing address
- A shipping address

Use the original packing material to return the instrument to TSI. If you no longer have the original packing material, seal off any ports to prevent debris from entering the instrument and ensure that the display and the connectors on the instrument front and back panels are protected. **This instrument is very fragile and must be packed, labeled and shipped in a manner appropriate for a precision instrument.**

WARNING/AVERTISSEMENT
Remove LiON batteries from instrument before shipping. ***Do not*** ship AM520 with batteries installed.

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Appendix A

Specifications

Specifications are subject to change without notice.

Sensitivity	
Sensor type	90° light scattering, 650 nm laser diode
Aerosol concentration range	0.001 to 100 mg/m^3 (calibrated to respirable fraction of ISO 12103-1, A1 Test Dust)
Particle size range	0.1 to 10 µm
Minimum resolution	0.001 mg/m^3
Zero stability	±0.001 mg/m^3 over 24 hours using 10-second time-Constant
Temperature coefficient	approximately +0.0005 mg/m^3 per °C (for variations from temperature at which instrument was last zeroed)
Flow Rate	
Range	User-adjustable, 0 to 1.8 liters/min (L/min) *Note: Upper range is dependent on impactor or cyclone attached to the AM520.*
Temperature Range	
Operating range	0 °C to 50 °C (32 °F to 120 °F)
Storage range	-20 °C to 60 °C (-4 °F to 140 °F)
Operational humidity	0 to 95% RH, non-condensing
Time Constant (OLED display)	
Range	User-adjustable, 1 to 60 seconds

Built-in Inlets	
Standard inlet	Not size-specific
$PM_{1.0}$ impactor	50% cut-off at 1.0 µm
$PM_{2.5}$ impactor	50% cut-off at 2.5 µm
$PM_{5.0}$ impactor	50% cut-off at 5.0 µm
PM_{10} impactor	50% cut-off at 10.0 µm
Attachable Cyclones	
4 µm Dorr-Oliver	50% cutoff at 4.0 µm
0.8 µm DPM	50% cut-off at 0.8 µm
Alarms	
Alarm Types	General, STEL
Default Settings	0.5 mg/m^3, 1 mg/m^3, 3 mg/m^3, 5 mg/m^3, 15 mg/m^3, Off Programmable from 0.001 to 999 mg/m^3 through TrakPro Software
Alarm Indicator	95 dBA (at one foot) audible horn, blinking red LED, flashing red OLED display
Ringback Delay	30 sec, 1 min, 3 min, 5 min, 10 min, Off
Data Logging	
Data points	Approx. 80,000 (55 days logging once per minute)
Logging interval	User-adjustable, 1-second to 60-minutes
User-Select Calibration Factors	
Factory setting	1.0 (non-adjustable)
Ambient setting	0.38 (non-adjustable)
User-defined settings	5, with user-defined labels via TrakPro v5 Software
Range	0.1 to 10.0, user-adjustable

Physical	
External dimensions	5.1 x 3.7 x 3.1 inch (129.5 x 94 x 78.4 mm) with 803300 battery
Weight	22 oz (0.62 kg) with 803300 battery
Display	160 x 128 resolution color OLED display
Tripod socket	¼-20 female thread
Battery	
Rating	5400 mAH Li-Ion Pack
Run Time	Greater than 20 hours at 1.7 L/min with a $PM_{2.5}$ impactor
Charge Time	4.0 hours (with a fully depleted battery)
Power Supply (p/n 803302)	
Input voltage range	100 to 240 VAC, 50 to 60 Hz
Output voltage	12 VDC @ 3.0 A
Maintenance	
Factory clean/calibrate	Recommended annually
User zero calibration	Before each use
User flow calibration	As needed
Communications Interface	
Type	USB 2.0
Connector, instrument	USB Micro-B (socket)
Minimum Computer Requirements for TrakPro Software	
Communications port	Universal Serial Bus (USB) v2.0 or higher
Operating system	Microsoft Windows® 7, 8, or 10 (32-bit or 64-bit) operating systems

Approvals	
AM520 with TSI Battery Pack P/N 803300	
CE 0344	
Immunity	EN61326-1:2013
Emissions	EN61326-1:2013 Class B
Safety	IEC 61010-1:2010 IEC 60825-1:2014

Appendix B

Custom Calibrations

In most situations, the Model AM520 provides very good information on how the concentration of an aerosol changes for over time. Factory calibration to the respirable fraction of standard ISO 12103-1, A1 Test Dust (aka, Arizona Test Dust) allows comparisons between measurements where the source or type of dust is predominately the same. Because optical mass measurements are dependent upon particle size and material properties, there may be times when a custom calibration will improve your accuracy for a specific aerosol.

The SidePak™ AM520 monitor has several features to aid in obtaining good accuracy for a specific aerosol.

- The SidePak monitor's photometric calibration factor can be changed through the instrument keypad. All future readings from the SidePak monitor will correspond to a specific aerosol until the calibration factor is changed back to the factory setting.
- Photometric calibration factors can be stored in a table and downloaded to the SidePak monitor using the TrakPro Data Analysis Software. All future measurements will correspond to a specific aerosol until the calibration factor is changed back to the factory setting.
- A single set of logged data can be converted to data calibrated to a specific aerosol with the use of the TrakPro software. This conversion can be done by knowing either the true mass concentration for the logged data or the calibration factor for the aerosol. Future measurements will continue to be read and logged with the original calibration factor (normally 1.0) and will not be converted automatically.

All of these options require that a true mass concentration (via gravimetric analysis) is determined for the aerosol measured. The true mass concentration is used to calculate the photometric calibration factor for that aerosol. Once a photometric calibration factor is developed, it can be used repeatedly to improve measurements in the same or similar aerosol environment.

Developing a Photometric Calibration Factor for a Specific Aerosol

The SidePak AM520 Personal Aerosol Monitor is factory calibrated to the respirable fraction of standard ISO 12103-1, A1 Test Dust. The SidePak AM520 monitor can be easily calibrated to any arbitrary aerosol by adjusting the photometric calibration factor. The SidePak monitor's photometric calibration factor is assigned the value of 1.00 (factory setting) for the standard ISO test dust. This procedure describes how to determine the photometric calibration factor for a specific aerosol. Using a photometric calibration factor value of 1.00 will always revert back to the factory calibration.

To determine a new photometric calibration factor, a reference instrument is needed to accurately measure the concentration of aerosol. Gravimetric analysis is often the best choice, although it is limited to nonvolatile aerosols.

To develop an accurate photometric calibration factor, a simultaneous measure must be made of the aerosol concentration with the SidePak AM520 monitor and the reference instrument.

Note

See Application Note EXPMN-014 *Developing Photometric Calibration Factor for Respirable Silic*a, and Application Note EXPMN-013 *Developing Photometric Calibration Factors for Diesel Particulate Matter*.

Photometric Calibration Factor Procedure

1. Set up photometer and sampling pump in similar manner.
   - SidePak AM520 (with Dorr-Oliver Cyclone if measuring respirable size fraction.
   - Sample pump with a sampling cassette (with Dorr-Oliver Cyclone if measuring respirable size fraction)
2. Adjust flow rate for appropriate inlet conditioner (if used).
   - Flow rate set to 1.7 L/min for both instruments if using Dorr-Oliver Cyclone.
3. Zero the photometer and calibrate the sample pump prior to sampling.
4. Co-locate both samplers side-by-side either in a work area or on a worker in the breathing zone.

5. Start photometer and sampling pump at same time, sample for same duration.
   - Data log aerosol measurements with photometer.
   - Collect gravimetric sample with sample pump.
   - Sample time does not need to be full shift like compliance monitoring. The key is to collect at least the minimum volume necessary for valid analysis with the analytical method.
6. Sample a few locations to gather data. (***Note**: Ideally use a statistically significant number of samples to properly represent the worker population*.)
   - Review gravimetric data as it becomes available.
   - Conduct more sampling if considerable data variability is found.
7. Send gravimetric samples to accredited analytical lab.
8. Compare photometric and gravimetric data.
   - Calculate averages for each from representative number of samples.
   - If sample variability is high, collect more samples to improve the representation of the sample population.
9. Calculate new photometric calibration factor using the formula below.

   PCF= Photometric Calibration Factor
   Reference Concentration = Average Gravimetric Concentration
   Data Log Concentration = Average Photometric Concentration
   ECF = Existing Calibration Factor (by default Factory calibration is 1.0)

$$PCF = \frac{Reference\ Concentration}{Data\ Log\ Concentration} \times ECF$$

10. Enter new Photometric Calibration Factor into the photometer.
11. Repeat the co-located, paired sampling process using new PCF setting in photometer.

    Note: Conducting at least one additional pair-sample set using the new PCF will help to verify the photometric calibration factor is applicable to the reference aerosol.

12. Compare gravimetric and PCF photometric sample data.
    - Results should be closer, “more accurate,” using the new PCF.

Note

Greater accuracy will be obtained with longer samples. The time you permit for sampling often depends on the reference instrument and characteristics of the measured aerosol. It may take some time to collect sufficient aerosol onto a filter cassette for accurate gravimetric analysis. Refer to instructions of your reference instrument for sampling times.

Appendix C

Converting Stored Data to Calibrated Data

A single set of logged data can be converted to data calibrated to a specific aerosol with the use of the TrakPro™ Data Analysis Software. This conversion can be done by knowing either the true mass concentration for the logged data or the calibration factor for the aerosol. To perform this conversion, refer to the TrakPro manual.

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