Model 8520
DUSTTRAK™ Aerosol Monitor

TRAKPRO™ Data Analysis Software enclosed

Operation and Service Manual

1980198, Revision R
June 2006

TSI®

Model 8520
DUSTTRAK™ Aerosol Monitor

Operation and Service Manual

TSI®

Limitation of Warranty and Liability (effective July 2000)

Seller warrants the goods sold hereunder, under normal use and service as described in the operator's manual, shall be free from defects in workmanship and material for twenty-four (24) months, or 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:

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. 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.

c. 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.

d. Unless specifically authorized in a separate writing by Seller, Seller makes no warranty with respect to, and shall have no liability in connection with, goods which are incorporated into other products or equipment, or which are modified by any person other than Seller.

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Buyer and all users are deemed to have accepted this LIMITATION OF WARRANTY AND LIABILITY, which contains the complete and exclusive limited warranty of Seller. This LIMITATION OF WARRANTY AND LIABILITY may not be amended, modified or its terms waived, except by writing signed by an Officer of Seller.

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 at (800) 874-2811 (USA) or (001 651) 490-2811 (International).

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To obtain any of the listed Application Notes, contact TSI at:
         U.S. (800) 874-2811/(651) 490-2811, Fax: (651) 490-3824
         International (001 651) 490-2811, Fax: (001 651) 490-3824

These Application Notes can also be found under TSI's web site:
http://www.tsi.com

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 like the one shown below is affixed to each instrument.

```
S/N
        13990

MFD:    May, 2006
THIS LASER PRODUCT COMFORMS
TO 21 CFR 1040.10 BUREAU OF
RADIOLOGICAL HEALTH AND
SAFETY REGULATIONS.

              TSI INCORPORATED
TSI.          500 CARDIGAN ROAD
  ®           SHOREVIEW, MN 55126 USA
```
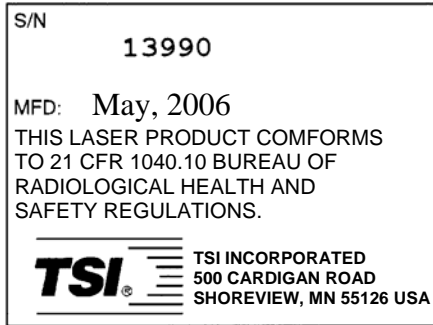
There are no user-serviceable parts inside this instrument. Performing services other than those described in this manual may result in exposure to harmful (invisible) laser radiation. A warning label like the one shown below is affixed to the internal laser device.

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

⚠ **W A R N I N G**

The DUSTTRAK monitor Alarm Output function should *not* be used to detect hazardous conditions or to provide an alarm for protecting human life, health, or safety.
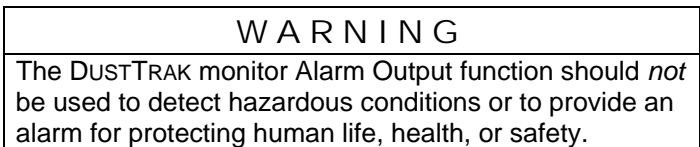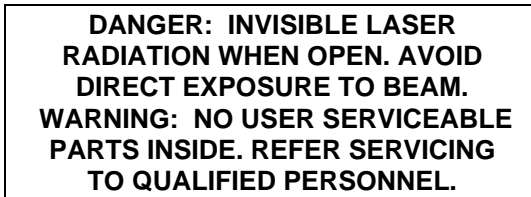
Chapter 1

Unpacking and Parts Identification

Carefully unpack the Model 8520 DUSTTRAK™ Aerosol Monitor from the shipping container. Use the tables and illustrations below to make certain that there are no missing components. Contact TSI immediately if anything is missing or damaged.

Unpacking the DUSTTRAK Aerosol Monitor

Compare all the components you received with those listed in the table below. If any parts are missing, contact TSI.

Quantity	Item Description	Part/Model
1	Model 8520 Aerosol Monitor	8520
1	Carrying Case	800686
4	C-size Alkaline Batteries	1208018
1	AC adapter	
	115 V, NEMA-1-15	2613033
	230 V, Eur., CEE 7/16	2613078
	230 V, Great Britain	800169
	240 V, Australian	2613105
1	Data Analysis Software CD-ROM	800700
1	Zero Filter	800663
1	Computer Cable, 9-pin to RJ-45	800563
1	25-Pin to 9-Pin Serial Cable Adapter	962003
1	Model 8520 DUSTTRAK Aerosol Monitor Operation and Service Manual	1980198
1	Calibration Certificate	—
1	10 mm Nylon Dorr-Oliver Cyclone	800665
1	Flowmeter, 0–2.5 L/min	800669
4 feet	Plastic Tubing, 1/4 in I.D.	800668
1	Small Screwdriver	800661
1	Sample Nozzle Removal Tool	800662
8	Spare Internal Filter Element	1602188
1	Wrist Strap	2913028
1	Shoulder Strap	2913120
1	Sample Nozzle Cleaning Brush	800699
10	Cotton Swab	—
1	Inlet Nozzle, 2.5 µm	1508112
1	Inlet Nozzle, 1.0 µm	1508113
1	Impactor Plate	1508114
1	Tube, Grease	801163
1	Analog Output/Alarm:connector, with cable	801652

Parts Identification for the DUSTTRAK Aerosol Monitor

Figures 1–1 and 1–2 identify the parts of the Model 8520 DUSTTRAK Aerosol Monitor. Become familiar with these components before proceeding.
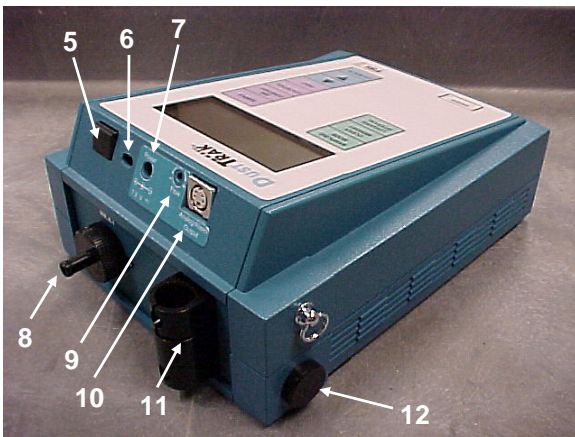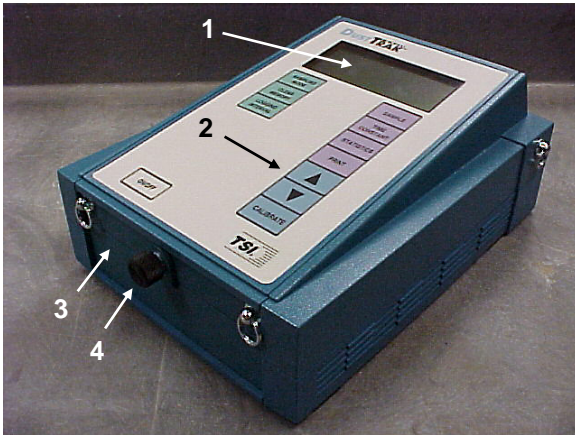
Figure 1–1: Top and Front of the DUSTTRAK Monitor

1. Display
2. Keypad
3. Battery Cover
4. Battery Cover Thumb Screw
5. Data Port
6. Display/Keypad Lockout Switch
7. External Power Socket
8. Sample Inlet Nozzle and Port
9. Flow Adjustment Screw
10. Analog Output/Alarm Connector
11. Cyclone Holder Clip
12. Exhaust Port
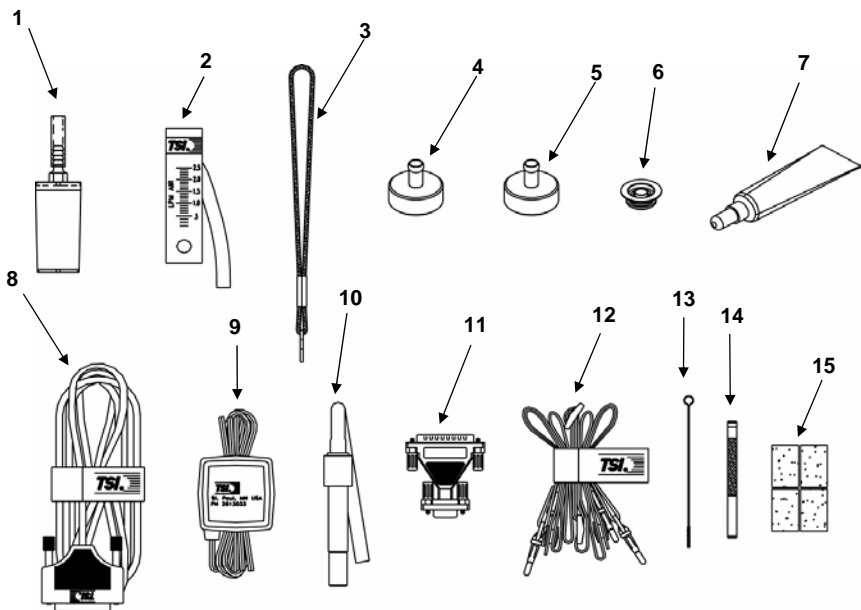
Figure 1–2: DUSTTRAK Aerosol Monitor Accessories

1. Zero Filter
2. Flowmeter
3. Wrist Strap
4. 2.5 µm Inlet Nozzle
5. 1.0 µm Inlet Nozzle
6. Impactor Plate
7. Grease
8. Computer Cable
9. AC Adapter
10. Cyclone
11. 25-Pin to 9-Pin Adapter
12. Shoulder Strap
13. Sample Tube Cleaning Brush
14. Sample Tube Removal Tool
15. Internal Filter Elements
16. Analog/Alarm Cable (not shown)

Chapter 1

Chapter 2

Setting-Up

Supplying Power to the DUSTTRAK Aerosol Monitor

The Model 8520 DUSTTRAK™ Aerosol Monitor must be powered in one of two ways: four size C batteries or the supplied AC adapter.

Installing the Batteries

Remove the battery cover and slide the battery holder out of the battery compartment and insert four size C batteries.

Hold the wires out of the way and slide the battery holder back into the battery compartment. Tuck the wires in and then re-install the battery cover (see Figure 2–1).
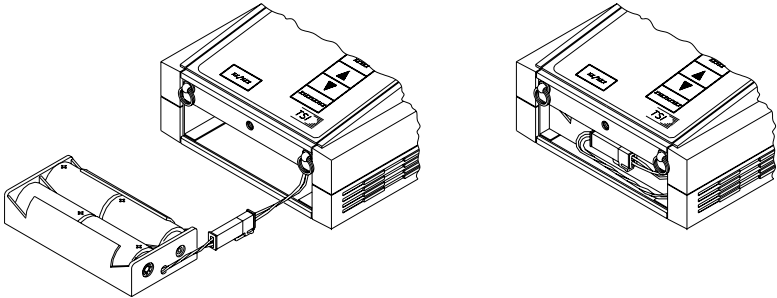
Figure 2–1: Tuck the Wires In and Close the Cover

Using the AC Adapter

The AC adapter allows you to power the DUSTTRAK monitor from an AC wall outlet. When using the AC adapter, the batteries (if installed) will be bypassed. The AC adapter will not charge the batteries.

The DUSTTRAK monitor has an internal, non-user accessible battery that is used to keep logged data intact when power is turned off. Changing the C-size batteries or disconnecting the AC adapter will not cause data to be lost. This battery will last for years. TSI will install a new battery, if necessary, when the unit is returned to the factory for service.

Instrument Setup

The DUSTTRAK monitor comes with special software called TRAKPRO™ Data Analysis Software, which is designed to provide you with maximum flexibility and power when using the DUSTTRAK monitor. The following sections describe how to install the software and set up the computer.

Setting-up TRAKPRO Data Analysis Software

TRAKPRO software contains a very comprehensive Help Function. This utility provides all the necessary information to guide you in all aspects of software operation.

Connecting the DUSTTRAK Aerosol Monitor to the Computer

Each DUSTTRAK monitor comes equipped with an RS-232 cable and a 25-pin to 9-pin serial cable adapter. One end of the cable is a 25-pin D subminiature connector labeled COMPUTER; the other end is an RJ-45 modular connector that connects with the logging instrument. Serial port connectors always have pins (male) on the computer side.

1. Locate an available serial port on your computer: COM1, COM2, COM3, or COM4.

2. If the port has a 25-pin connector, you do *not* need the adapter. If the port has a 9-pin connector, plug the 25-pin end of the adapter into the RS-232 cable.

3. Connect the RS-232 cable to the available serial port on your computer.

4. Connect the RJ-45 connector to the DUSTTRAK monitor.

Set-Up the Communications Port

To communicate with the DUSTTRAK monitor, the software must be configured for the proper COM port. The TRAKPRO software can be manually set to operate on a specific COM port, or it can automatically find a DUSTTRAK monitor that is attached to any COM port. To set up the COM port, do the following:

1. Turn on the DUSTTRAK monitor and start the TRAKPRO software.

2. Select **Communications** from the **Instrument Setup** menu. The following dialog is displayed:

Communications Port Setup

Serial Port
- ● COM 1
- ○ COM 2
- ○ COM 3
- ○ COM 4

Baud Rate
- ○ 1200
- ○ 2400
- ○ 4800
- ● 9600
- ○ 19200

OK
Cancel
Find Port
Test

Parity N, Data 8, Stop 1
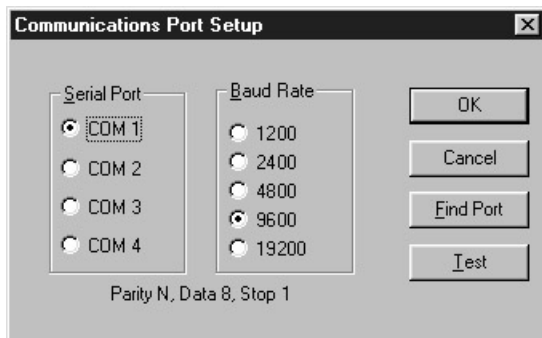
3. Select the following:

Serial Port	Select the name of the serial port to which the logging device is connected: COM1, COM2, COM3, or COM4.
Baud Rate	Select the baud rate for the port. Higher baud rates are recommended to transfer data at a faster rate. Select a lower baud rate only if you are having trouble communicating at a higher rate.

4. Select **Test** to verify that you have set up the communications port properly. The system displays an informative message indicating whether it was able to establish communications.

5. As an alternate, you can select **Find Port**, to have the TRAKPRO software search the available COM ports, looking for an attached DUSTTRAK monitor.

6. Select **OK** to accept the setup or **Cancel** to discard the changes.

Note: *Some computers do* not *communicate reliably at baud rates above 9600.*

Setting the Real-Time Clock

The DUSTTRAK monitor has an internal real-time clock that keeps track of the time of day (The format is HH:MM where HH is the hour in 24-hour format and the MM is minutes) and the date. It is very important for the DUSTTRAK monitor to have the time and date correctly set; otherwise, date and time stamping of recorded data and calibrations will not be correct.

There are two ways to set the time and date. The first is to use the supplied TRAKPRO™ Data Analysis Software.

Programming the Date/Time Using TRAKPRO Software

To program the DUSTTRAK monitor date and time:

1. Make sure the DUSTTRAK monitor is connected to the computer and turned on.

2. Select **Parameters**, then **Clock** from the **Instrument Setup** menu. The TRAKPRO software retrieves the current date and time settings from the DUSTTRAK monitor and displays them in the following dialog:
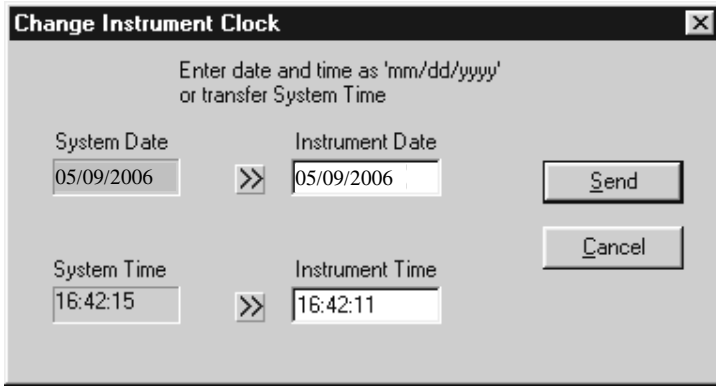
3. The system date and time (from the computer) can be transferred to the DUSTTRAK monitor using the "arrows" keys. Alternately, the date and time can be manually entered into the dialog box.

4. Select **Send** to reprogram the DUSTTRAK monitor.

Manually Setting the Real-Time Clock

To set the time and date with the keypad, you must press and hold the SAMPLE key while the DUSTTRAK monitor displays the time of day during its power-up. Release when the DUSTTRAK monitor "beeps." You will have an opportunity to view and/or change the hours, minutes, year, month, and day of month in sequence. Use the up and down arrow keys (↑↓) to change a setting. Use the SAMPLE key to store each setting and advance to the next one.

Connecting the Optional Portable Printer

To connect the portable printer to the DUSTTRAK monitor, locate Printer Interface Cable and connect the 9-pin end labeled "PRINTER" to the printer and the other end to the data port on the DUSTTRAK. monitor Always turn the DUSTTRAK monitor on BEFORE the printer. If the printer prints question marks (??????), asterisks (******), or random characters, reset it by turning

it off and then on again. If necessary, refer to the *Portable Printer Operation and Service Manual*.

Connecting/Wiring the Analog/Alarm Output Connector

The Model 8520 DUSTTRAK Aerosol Monitor is capable of providing an analog output voltage signal that is proportional to the displayed concentration. It also contains a switch closure that is tied to an alarm value (see Chapter 3, "Operation," for complete specifications and operational information for these features). The DUSTTRAK monitor is supplied with an output cable. The cable contains a 4-pin, mini-DIN connector. See Figure 2-2 below.
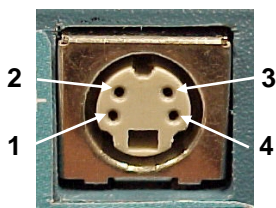
1. Analog Ground (-)   3. Alarm Positive (+)
2. Analog Output (+)   4. Alarm Ground (-)

Figure 2–2: Analog/Alarm Connector Pin-Outs

Since every application of this function will have unique requirements, the customer is responsible for making connections to their own equipment. The output cable contains a label, showing the wiring diagram/pin-outs.

Please see TSI Application Notes ITI-073 and ITI-074 for complete information and examples of wiring and using the Analog/Alarm Outputs. These Application Notes are available at the TSI website, http://www.tsi.com.

Chapter 3

Operation

Overview

The Model 8520 DUSTTRAK™ Aerosol Monitor has four modes of operation, Survey, LOG 1, LOG 2, and LOG 3. When the DUSTTRAK monitor is first turned on it will be in Survey mode, which is used to display real-time readings and to determine statistics such as average, minimum, and maximum readings. LOG 1 mode is used to record individual data points for later analysis using a fixed protocol. LOG 2 and LOG 3 modes have a user-defined protocol, set up using TRAKPRO™ Data Analysis Software. TRAKPRO software is used for analysis of data taken in any of the three LOG modes, but cannot be used on samples taken in Survey mode.

DUSTTRAK Aerosol Monitor Keypad Functions

When pressing the keys on the front panel, the DUSTTRAK monitor beeps to confirm the function. If you press a key and the DUSTTRAK monitor does not beep, the DUSTTRAK monitor does not allow that function during the selected sampling mode.

ON/OFF Key

Press the ON/OFF key to power the DUSTTRAK monitor. The DUSTTRAK monitor immediately begins an internal self-check, while illuminating all the display digits and symbols. If a problem is detected, the display shows the message "SERVICE" along with a number to indicate that the DUSTTRAK monitor requires servicing. Refer to the Chapter 5: "Troubleshooting," for information regarding service numbers. If the "SERVICE" message appears, the DUSTTRAK monitor pauses until any key is pressed.

When the DUSTTRAK monitor completes its internal self-check, it displays the approximate percentage of battery life remaining. The DUSTTRAK monitor displays the battery symbol $\boxed{+ \ -}$ when the battery voltage becomes very low. After the battery symbol appears, the DUSTTRAK monitor runs for approximately 60 minutes before displaying the message "LO" (for a few seconds) and then automatically turning off. This feature is accurate for alkaline batteries only.

Note: *The percentage life remaining will not be accurate for NiCd batteries. The battery symbol appears when battery voltage becomes low, but the DUSTTRAK monitor runs considerably less than 60 minutes before displaying the message "LO" and turning off.*

| CALIBRATE ZERO RECORDING ↑ | CO$_2$ SAMPLE |
| HR:MN:SEC TEST ID LOG 123 ↓ | ELAPSED TIME |

PPM CONSTANT
°F°C AVERAGE
%RH MIN MAX
mg/m^3 SERVICE
+ − % MEMORY
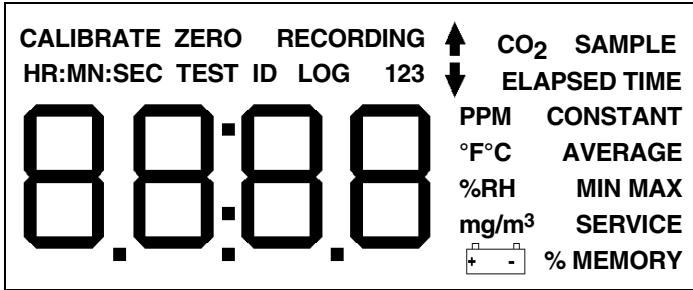
Figure 3–1: DUSTTRAK Display with All Elements Shown

After displaying the percentage of battery life remaining, the current time set on the internal real-time clock is displayed. When the self-check is complete, the DUSTTRAK monitor will be in Survey mode.

SAMPLE Key

Press the SAMPLE key to start/stop data sampling. The word "SAMPLE" appears in the upper right corner of the display while the DUSTTRAK monitor is taking a sample. When sampling is stopped, the DUSTTRAK monitor automatically scrolls through statistics for the sample that just ended.

TIME CONSTANT Key

Momentarily press and release the TIME CONSTANT key to view the current time-constant. To change the time-constant, press and hold the key down. The available time-constant choices will scroll on the display. When the desired value is displayed, immediately release the key.

The time-constant is actually an averaging period. The DUSTTRAK monitor display is always updated every second. However, the reading displayed is the average reading over the last time-constant period. For example, if the current time-constant is set to 10-seconds, the display shows readings averaged over the previous 10 seconds, updated every second. This is also called a 10-second "moving average."

As configured at the factory, the available time-constant values are 1, 5, 10, 15, and 30 seconds. The internal list of time-constant values can be altered using TRAKPRO Data Analysis Software supplied with the DUSTTRAK monitor. The range of time constants allowed is 1–60 seconds. See the following instructions.

Programming the Available Time Constants

To program the list of time constants using TRAKPRO Data Analysis Software:

1. Make sure the DUSTTRAK monitor is connected to the computer and turned on.

2. Select **Parameters,** then **Time Constants** from the **Instrument Setup** menu. TRAKPRO software retrieves the current time constant settings from the DUSTTRAK monitor and displays them in the following dialog:

3. Enter a value for each of the five available time constants. (The range is limited to 1-60 seconds.)

4. Select **Send**.

The DUSTTRAK monitor is reprogrammed to offer the time constants you have specified.

STATISTICS Key

Use the STATISTICS key to sequentially view the average, minimum, and maximum readings as well as the elapsed time of the most recently sampled data. If one of the LOG modes is active, a test identification number will be displayed also. Press the STATISTICS key once to display the average reading, again to display the minimum reading, again to display the maximum reading, and again to display the elapsed time for that sample (and again for the test ID if in LOG mode). If you press the STATISTICS key a fifth time (sixth time if in LOG mode), the DUSTTRAK monitor switches back into the currently selected measuring mode. You must sequence through all four statistic displays (i.e., press the STATISTICS key five

times, six if in LOG mode) before the DUSTTRAK monitor goes back into the measuring mode.

PRINT Key

Use the PRINT key to print information on the optional Portable Printer. The information printed will be different depending on what the DUSTTRAK monitor is currently doing.

When the DUSTTRAK monitor is displaying real-time readings, pressing the PRINT key causes the reading to be printed along with the time and date. Each time the PRINT key is pressed, one reading will print. The reading printed reflects the current time-constant; therefore, it is the same as the displayed reading.

When the DUSTTRAK monitor is displaying any statistic, pressing the PRINT key causes the current statistics to print.

When the DUSTTRAK monitor is in one of the LOG modes and is idle ("%MEMORY" is displayed), pressing the PRINT key causes the logging setup for the current LOG mode to print.

During the power-up sequence, if you press and hold the PRINT key *after the time is displayed*, a printout will be generated showing certain system information (printer must be connected and turned on).

SAMPLING MODE Key

The SAMPLING MODE key allows you to select among the four sampling modes: Survey, LOG 1, LOG 2, and LOG 3. Each time you press the SAMPLING MODE key, the DUSTTRAK monitor sequences to the next mode. When the DUSTTRAK monitor is in Survey mode, the current measurement will be shown on the display. When one of the LOG modes is selected, the LOG mode number, i.e. LOG 1, LOG 2, or LOG 3 will be displayed along with the percentage of free memory available.

Survey Mode

When the DUSTTRAK monitor is first turned on, it will always be in Survey mode. Survey mode allows you to make real-time measurements of aerosol concentration, and to obtain statistics for that sample. The statistics include the average, minimum, and maximum values, as well as the elapsed time for that sample. Individual data points are not recorded (this can be done in any of the LOG modes). Each new sample taken in Survey mode clears the previous sample data from memory. Data taken in Survey mode remains in memory until another sample is made, or until samples are taken in one of the LOG modes. Turning the

DUSTTRAK monitor off will *not* erase data. Use the SAMPLE key to start and stop a sample.

LOG Modes

There are three LOG modes: LOG 1, LOG 2, and LOG 3. When one of these modes is selected using the SAMPLING MODE key, the LOG mode number will be listed at the top of the display. The LOG modes allow you to record aerosol concentration data points for later retrieval and analysis using the software provided with the instrument.

Use the SAMPLE key to start and stop recording. The word "RECORDING" appears at the top of the display when recording is in progress.

The frequency that data is recorded can be set for LOG 1 mode with the LOGGING INTERVAL key. Use TRAKPRO software for LOG 2 and LOG 3 modes.

Data recorded using one of the LOG modes can only be erased by using the CLEAR MEMORY key. Turning the DUSTTRAK monitor off *will not* erase data. Recording another sample with one of the LOG modes without clearing memory first will cause new data to be added to the existing data (using a new test ID).

CLEAR MEMORY Key

Use the CLEAR MEMORY key to erase all data. The CLEAR MEMORY key will not respond unless the DUSTTRAK monitor is first put into one of the three LOG modes by using the SAMPLING MODE key.

Note: Before clearing memory, you should first download the data to a computer through the TRAKPRO software. There is only one block of memory in the DUSTTRAK monitor. Clearing the memory for one LOG mode clears memory for all LOG modes.

To clear memory, press and hold the CLEAR MEMORY key until the countdown reaches zero, then release quickly. This prevents accidental erasure of data. Releasing the key too soon or too late prevents memory from being cleared.

LOGGING INTERVAL Key

Use the LOGGING INTERVAL key to view or set the frequency/averaging period for recording data in LOG 1 mode or to view the current interval setting in LOG 2 and LOG 3 mode. Use TRAKPRO software to set the logging interval for LOG 2 and LOG 3 mode (see following section). The LOGGING INTERVAL key will *not* respond unless the DUSTTRAK monitor is first put into one of the three logging modes. Press the LOGGING

INTERVAL key momentarily to view the current logging interval. Press and hold the LOGGING INTERVAL key to sequence through the available choices and release the key when the desired interval is on the display (LOG 1 mode only).

The logging interval is both a frequency and an averaging period. For example, when the logging interval is set to 30-minutes, readings will be recorded at 30-minute intervals. Each reading will be the average value measured over a 30-minute interval.

As shipped from the factory, the available logging intervals for LOG 1 mode are 1 second, 1 minute, 5 minutes, 15 minutes, and 30 minutes. Use the TRAKPRO Data Analysis Software to alter these values.

Programming the Logging Intervals using TRAKPRO Software

To program the list of logging intervals available for LOG 1 mode:

1. Make sure the DUSTTRAK monitor is connected to the computer and turned on.

2. Select **Parameters**, then **Logging Intervals** from the **Instrument Setup** menu. TRAKPRO software retrieves the current logging intervals from the DUSTTRAK monitor and displays them in the following dialog:
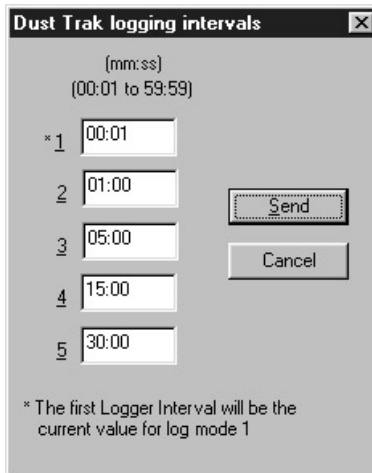
3. Enter a value for each of the five available logging intervals (the range is from 1 second to 59 minutes and 59 seconds).

4. Select **Send**.

The DUSTTRAK monitor is reprogrammed to offer the logging intervals you have specified.

Chapter 3

⬆ and ⬇ Keys

The two arrow keys are used to adjust readings when calibrating the DUSTTRAK monitor and for adjusting the time and date for the internal real-time clock.

CALIBRATE Key

Use the CALIBRATE key to put the DUSTTRAK monitor into calibration mode. See Chapter 4, "Maintenance" for details on how to calibrate.

Display/Keypad Lockout Switch

Recording data over extended time periods often requires leaving the DUSTTRAK monitor unattended. To reduce the risk of having an unauthorized person either intentionally or inadvertently interrupt the measurements, you can lock the display and keypad.

The lockout switch is on the backside of the DUSTTRAK monitor between the data port and the external power socket. It is a small slide switch and is recessed so that a pointed instrument must be used to move it.

With the switch in the right side position (nearest the power socket), all keypad and display functions will work normally. With the switch in the left side position (closest to the data port), the display and keypad will go into lockout mode. There are two ways to use the lockout switch. You can lock the keypad after recording starts, or you can put the switch into the lockout position prior to when recording starts. If you select the second method, you will be able to operate all functions normally *until* the SAMPLE key is pressed in one of the LOG modes. At that time the keypad automatically locks. When the display and keypad are locked, the display shows the words "RECORDING LOG X ⬇" where "X" is the current LOG mode number.

Remote Sampling

The DUSTTRAK Aerosol Monitor can be used for remote sampling by attaching a length of tubing to the inlet. For example, it can be set up for a test and hidden away where only the sample tubing extends into the area to be monitored. A 4-foot length of tubing is included with the DUSTTRAK monitor for remote sampling purposes.

Note: *Using a sampling tube longer than 4 feet is not recommended because particle transport losses in the tube may adversely affect the measurement. Also, do not use Teflon or silicone tubing because they can cause significant transport losses. Tygon® tubing is a good choice, as is metal tubing if it is grounded to dissipate static charges.*

®Tygon is a registered trademark of Norton company.

Respirable Mass Sampling with the Cyclone

The 10-mm Nylon Dorr-Oliver Cyclone included with your aerosol monitor can be used to discriminate between the respirable fraction and other portions of the ambient aerosol. Four micrometers (µm) is internationally accepted as the 50 percent cut-off size for respirable aerosol mass. Particles larger than 4 µm impact onto the surfaces of the upper respiratory tract and cannot reach the lungs. The cyclone accessory provided with the DUSTTRAK monitor is designed to provide a cut-off at 4 µm. This is specified as a 50 percent 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, you can assume that all particles smaller than the cut-off size pass through and all larger particles become trapped in the grit pot.

The cut-off size for any cyclone is dependent on flow rate. **It is very important that the sample flow rate through the DUSTTRAK monitor be set at 1.7 liters per minute (L/min). If some other flow rate is set, the cut-off size will *not* be at 4 µm.**

Using the Cyclone

To use the cyclone, be sure that you have the black inlet nozzle in place and that the blue impactor plate is removed from the inlet. Then you must adjust the sample flow rate to 1.7 L/min. See Chapter 4: "Maintenance," for details.

After the flow rate is properly set, attach it to the DUSTTRAK monitor inlet port using the section of plastic tubing supplied with the cyclone. Slide the cyclone body into the holder provided on the back of the DUSTTRAK monitor. See Figure 3–2.
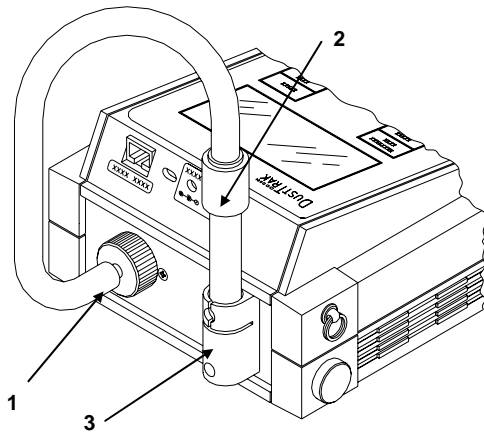
Figure 3–2: Connecting the Cyclone

1. DUSTTRAK Sample Inlet   3. Cyclone Holder
2. Cyclone

Using the 1.0 or 2.5 μm Inlet Conditioners

The two blue inlet nozzles appear similar to the standard black inlet nozzle but are engraved with their respective cut size. The blue nozzles should always be used with the blue impactor plate. The black nozzle has a cut size of 10 μm and should **never** be used with the impactor plate.

Install either the 1.0 or 2.5 μm inlet conditioner as follows.

1. Turn the DUSTTRAK monitor off.

2. Remove the black inlet nozzle.

3. Evenly coat the center plateau of the blue impactor plate with a thin layer of the supplied grease (Figure 3–3). Avoid getting the grease on other parts of the impactor plate. If you do, simply wipe off the extra.

Notes: *Do* not *use grease other than that supplied with this kit. This grease has been chosen for its low outgassing and good wicking properties to hold a large mass of particles.*

     The grease on the impactor plate increases the amount of time that you can sample before particle bounce begins to affect the impactor performance. Particle bounce results from particles not sticking to the impactor plate and falling back into the aerosol stream.

4. Insert the blue impactor plate into the DUSTTRAK monitor.

5. Select the blue nozzle with the cut size you want and make sure there is an O-ring inside.

6. Thread the nozzle on the inlet.

7. Turn on the DUSTTRAK monitor and verify that the flow rate is at 1.7 L/min. You might need to make a small adjustment when you switch nozzles.

The DUSTTRAK monitor is calibrated to the respirable fraction of ISO 12103-1, A1 (formerly called ultrafine Arizona test dust or SAE ultrafine). To increase the accuracy while using the inlet conditioners, you will need to calibrate in the aerosol you wish to test. Please refer to the manual for calibration details.
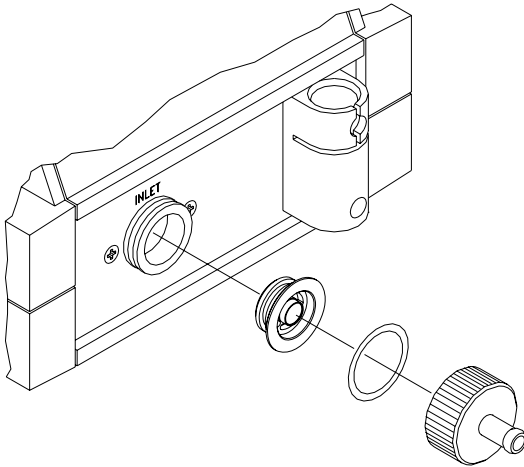
Figure 3–3: Installing the 1.0 or 2.5 µm Inlet Conditioners

Because of the much higher percentage of particles being removed from the stream when using the smaller cut-size inlets, you will need to clean the inlet more frequently than for the standard 10 µm nozzle (black.) See maintenance schedule in Chapter 4 for the inlet cleaning frequency.

Using the 10 µm Nozzle

1. Remove the blue nozzle and blue impactor plate.

Note: **The blue impactor plate** must *be removed from the inlet when using the black nozzle.* Performance of the 10 micrometer nozzle will be severely degraded if the impactor plate is not removed.

2. Thread the black nozzle onto the DUSTTRAK monitor inlet.

3. Verify that the flow rate is at 1.7 L/min.

4. The DUSTTRAK monitor now measures aerosol with an upper particle size limit of 10 µm.

Analog Output

Newer models of the Model 8520 DUSTTRAK Aerosol Monitor contain an analog output feature. This means the instrument is capable of providing an analog voltage signal that is proportional to mass concentration.

Note: *Before using this feature, it is important to read this operational section. For further information, please see Application Note ITI-073, which describes the Analog Output programming and operation. This Application Note is available at the TSI website, **http://www.tsi.com**.*

Because the DUSTTRAK monitor measures aerosol over such a wide dynamic range, it is necessary to select the appropriate range before using the analog output feature. The instrument may be programmed to one of four options, using the TRAKPRO software. When shipped from the factory, the instrument is programmed to the lowest range. To select the analog output range, do the following:

1. Turn on the DUSTTRAK monitor and start the TRAKPRO software (version 3.2 or higher).

2. Select **Parameters**, **Analog Output**, from the **Instrument Setup** menu. The following dialog is displayed:
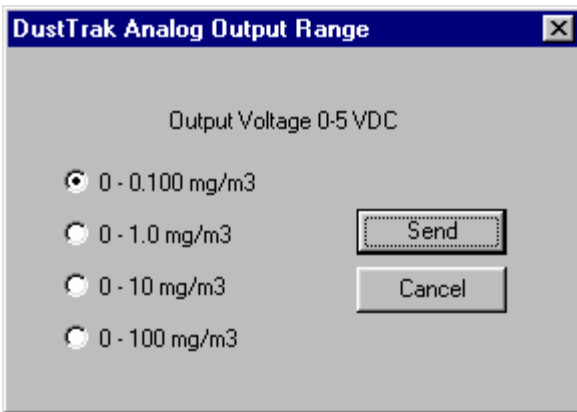
3. Select one of the four ranges, and press **Send**.

Please note the following considerations when using the analog output feature.

*   The analog output function is always "On." You do *not* need to activate this function.

*   The interpretation of the analog output voltage is directly tied to the chosen range. For example, at the lowest range, each "0.001 mg/m^3" of

aerosol is equivalent to "0.050 VDC." If the instrument display shows "0.018 mg/m^3," the analog output voltage would be "18 x 0.050 VDC" or "0.9 VDC" (see Application Note ITI-073, for more specifications and examples).

- Select the lowest range consistent with your desired application. For example, if you typically measure aerosol mass concentrations around 0.025 mg/m^3, you should use the first range. This will provide you with the best resolution (strongest signal) corresponding to the mass concentration.

- If your application involves high-mass concentrations (wood dust, etc.) you may want to choose the second or third range.

- If the DUSTTRAK monitor measures mass concentrations that are greater than the selected range, the analog voltage will "rail" at 5.0 volts (maximum output; no change in signal beyond that point).

- All of the ranges are referenced back to "zero" mg/m^3.

Alarm Output

Newer models of the DUSTTRAK Aerosol Monitor contain an alarm output feature. This means the instrument is capable of providing an alarm signal when the measured mass concentration exceeds a certain threshold.

Note: *Before using this feature, it is important to read this operational section. For further information, please see Application Note ITI-074, which describes the Alarm Output programming and operation. This Application Note is available at the TSI website, http://www.tsi.com .*

Alarm Output Specifications

Please note the following considerations when using the analog output feature.

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W A R N I N G

The DUSTTRAK monitor Alarm Output function should *not* be used to detect hazardous conditions or to provide an alarm for protecting human life, health or safety.

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</table>

- The alarm output function default status is "Off." You must activate this function and set the alarm level, before using the alarm output (see section below, on programming the Alarm Output).

- You must supply your own powered alarm system. The DUSTTRAK monitor only contains a switch that closes (activates) the alarm, when the detected levels exceed the threshold.

- The user alarm must be DC-powered only! The alarm system must *not* exceed a maximum supply voltage rating of 15 VDC or a current draw of 1 amp.

<table>
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C a u t i o n

The alarm switch must not be wired to AC power! Failure to properly install the user alarm could damage the DUSTTRAK instrument and/or void the instrument warranty! Please read and follow all instructions before wiring or operating the user alarm.

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</tr>
</table>

- The alarm switch contained within the DUSTTRAK monitor has an electrical polarity. It must be wired with the supply voltage connected to the positive pole. If the user alarm is wired with reverse polarity, it will not function properly.

- The alarm threshold must be set between the values of 0.002 and 100 mg/m^3.

- The alarm switch will turn on the instant the setpoint is reached. It will remain "latched" for a minimum of 5 seconds.

- While the alarm is triggered, the DUSTTRAK monitor's internal beeper will sound once per second, and the display will alternately exhibit the characters "AL" to indicate an alarm condition.

- The alarm switch will turn off when the measured concentration falls 5% below the setpoint (dead-band).

- The alarm output function operates totally independently of the analog output.

Programming the Alarm Setpoint

To program the alarm output function, do the following:

1. Turn on the DUSTTRAK monitor and start the TRAKPRO software (version 3.2 or higher).

2. Select **Parameters**, **Alarm Setpoint**, from the **Instrument Setup** menu. The following dialog is displayed:
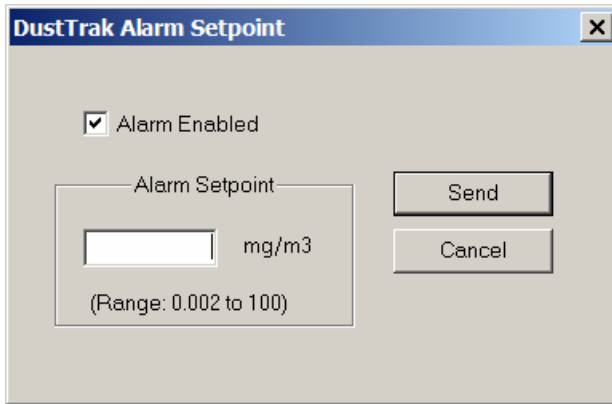
3. Turn "On" the alarm function by checking the "Alarm Enabled" check box. Enter a value within the acceptable range. In this example, the DUSTTRAK monitor is programmed to a setting of "0.100 mg/m^3." Press the **Send** button, to program the instrument.

Upgrading the DUSTTRAK Aerosol Monitor to Add Analog and Alarm Functions

The newest version of the DUSTTRAK Aerosol Monitor contains the analog output and alarm functions. Older instruments may be hardware compatible with these functions and may only require a factory upgrade to install these features. Instruments manufactured before August 1999 are not capable of being upgraded to add these features. These three scenarios are summarized below.

Identifying an Instrument with Analog/Alarm Functions

If your instrument contains an Analog/Alarm Output connector on the back of the instrument, it is fully functional for both analog and alarm output functions.

Identifying an Instrument that may be Upgraded to Add Analog/Alarm Functions

If your DUSTTRAK Aerosol Monitor was manufactured after August 1999 (serial number 21960 or later) and does *not* contain the analog/alarm output connector, it may be upgraded at the factory to add this feature. To verify this status, simply attach the instrument to the TRAKPRO software and attempt to program the Analog or Alarm Setpoint functions. You should receive the following message:

This instrument may be returned to the factory, for a Cleaning, Calibration and Upgrade (there is a charge for this service).

Identifying an Instrument That May Not Be Upgraded

If your DUSTTRAK Aerosol Monitor was manufactured prior to August 1999 (serial number 21959 or earlier), it is not hardware compatible with these functions. It is not possible to upgrade these instruments to add analog/alarm functions. To verify this status, simply attach the instrument to the TRAKPRO software and attempt to program the Analog or Alarm Setpoint functions. You should receive the following message:
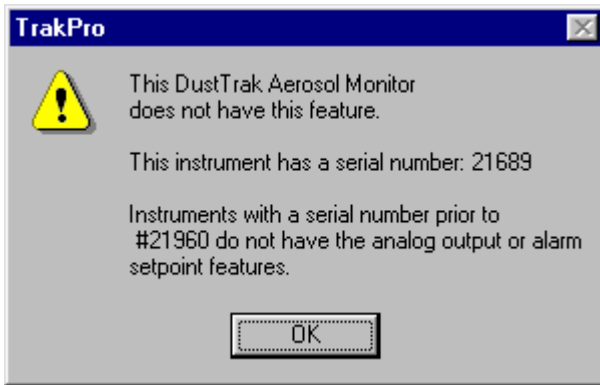
Programming Advanced Modes: LOG 2 and LOG 3

Use LOG 2 or LOG 3 modes for unattended recording and setting user protocols. With LOG 2 and LOG 3 modes you can set the start date, start time, test length, logging interval, number of tests and the time delay between tests. All or selected parameters can be set.

To program a protocol for LOG 2 or LOG 3 mode:

1. Make sure the DUSTTRAK monitor is connected to the computer and turned on.

2. Select **Logging Setup** from the **Instrument Setup** menu. The TRAKPRO software retrieves the current settings for LOG 2 and LOG 3 modes from the DUSTTRAK monitor and displays them in the following dialog:
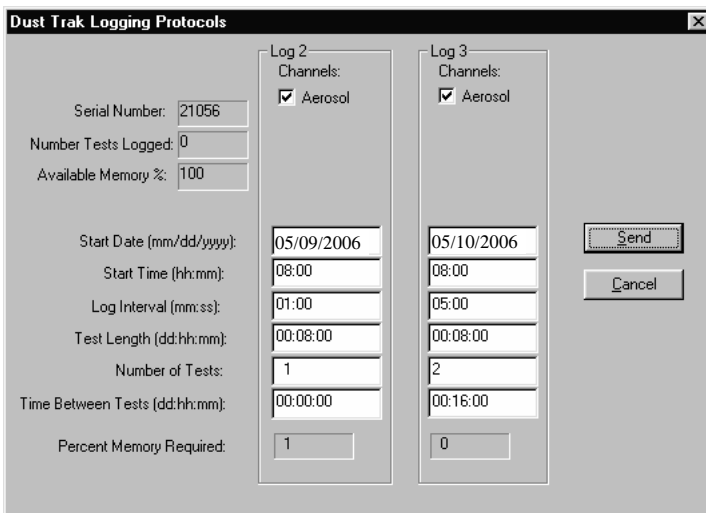
The following table summarizes the information displayed in the DUSTTRAK Logging Protocols dialog box:

Serial Number	Displays the serial number of the logging instrument.
Number of tests logged	Displays the number of tests currently logged and stored in the logging instrument.
Available Memory (%)	Displays the percent of available memory in the logging instrument.

LOG 2 and LOG 3 Mode Protocols	
Channels	Displays the channels selected for sampling in LOG 2 and LOG 3 modes.
Start Date	Displays the start date for LOG 2 and LOG 3 modes.
Start Time	Displays the start time for LOG 2 and LOG 3 modes.
Log interval	Displays the log interval for LOG 2 and LOG 3 modes.
Test length	Displays the test length for LOG 2 and LOG 3 modes.
Number of tests	Displays the number of tests for LOG 2 and LOG 3 modes.
Time between tests	Displays the time between tests for LOG 2 and LOG 3 modes.
Percent memory required.	Displays the percent of logger memory required to perform a LOG 2 or a LOG 3 mode sample. To store the results of a LOG 2 or LOG 3 mode sample, the **Available Memory** must be equal to or greater than the **Percent memory required**.

3. Enter the following for LOG 2 and LOG 3 modes:

Channels	Select the channels for which you want to log data. In the case of the DUSTTRAK monitor, there is only one channel to select: Aerosol.
Start Date Start Time	Enter the date and time to begin the sample: • If you enter a blank for a start date, the sample begins whenever the specified start time occurs. • If you enter a blank for the start time, both start date and start time are ignored, and the sample begins when the operator manually starts the sample.
Log interval	Enter the log interval to use for the test.
Test length	Enter the length for the sample: • If you enter a value, the instrument automatically turns off when the last test is complete. • If you enter a blank, the operator must manually stop the sample.
Number of tests	Enter the number of tests to perform.
Time between tests	If you have specified more than one **Number of tests**, enter the time between tests. If you enter 0 or blank, the next test is started immediately after the last test is complete.

While you are entering values for LOG 2 and LOG 3 modes, the **Percent Memory Required** is dynamically updated to show the amount of logger memory required to take the programmed sample. If the protocol you have defined requires more than 100% of memory, you can decrease the amount of memory required by manipulating the following protocol parameters:

- Increase the logging interval.
- Decrease the length for the test.
- Decrease the number of tests.

The settings for each LOG mode must *not* require more than 100% of the logger memory.

Note: *If the **Percent memory required** is greater than the **Available memory**, the logging instrument automatically stops the test when memory is full.*

4. When you have finished defining the parameters for LOG 2 and LOG 3 modes, select **Send**.

5. You can now disconnect the DUSTTRAK monitor and cable from the computer.

Sample Protocol for LOG 2 and LOG 3 Modes

The following steps describe how to program a sample protocol for LOG 2 or LOG 3 mode.

The sample protocol for LOG 2 is set to take unattended aerosol readings for one day, 11/02/2004. The logging sample begins at 8:00 a.m. and continues for eight hours.

The sample protocol for LOG 3 is set up to take unattended aerosol readings for two days, beginning on 11/02/2004. The logging sample begins at 8:00 a.m. and continues for eight hours. The instrument is off for 16 hours, and then repeats the eight hours test on the following day.

The following graphic gives the appearance of the dialog box displayed in the TRAKPRO software, with these particular logging parameters.

To program this logging example, do the following:

1. Make sure the DUSTTRAK monitor is connected to the computer and turned on.

2. Select **Logging Setup** from the **Instrument Setup** menu. The TRAKPRO software retrieves the current settings for LOG 2 and LOG 3 modes from the DUSTTRAK monitor and displays them in the previous dialog.

3. Enter the following for LOG 2 and LOG 3:

Setting	LOG 2	LOG 3
Channels	Aerosol	Aerosol
Start Date	05/09/2006	05/10/2006
Start Time	08:00	08:00
Log interval	01:00	05:00
Test length	00:08:00	00:08:00
Number of tests	1	2
Time between tests	00:00:00	00:16:00

4. Select **Send**. The logging instrument is programmed for the mode 2 and mode 3 protocols.

5. Note that the LOG 2 test requires 1% of the available memory and LOG 3 requires less than 1% of the memory. A total of 100% of the memory is available for use.

6. You can now disconnect your DUSTTRAK monitor from the computer. Refer to other sections of this Operation and Service Manual for details on making measurements using LOG 2 and LOG 3 modes.

After programming the DUSTTRAK monitor with the TRAKPRO Data Analysis Software, take the DUSTTRAK monitor to the desired location and turn it on. Put it into LOG 2 or LOG 3 mode (whichever you programmed) using the SAMPLING MODE key. Press the SAMPLE key to initiate the program.

If you have set a start time and/or date, the display toggles between the next "TEST ID" and the "ELAPSED TIME 0" message. If the test start time is greater than one minute away, the DUSTTRAK monitor shuts off until one minute before the test start time. This indicates that the DUSTTRAK monitor is waiting until the programmed start time and dates occur. To prevent tampering, lockout the display and keypad at this time.

Things You Should Know About Taking Pre-Programmed Samples

If you press the SAMPLE key during programmed operation, the program terminates (unless the keypad is locked).

If the programmed start time/date has already passed, pressing the SAMPLE key has no effect. The program will never execute.

It is always best to enter both a start time and start date! However, setting the start time but no start date causes the DUSTTRAK monitor to start at the specified time regardless of the date. The instrument may not shut down prior to beginning logging.

If no start time is set, the DUSTTRAK monitor waits for you to press the SAMPLE key and then starts sampling immediately.

If no test length is set, the DUSTTRAK monitor takes samples continuously until the SAMPLE key is pressed to stop sampling or until memory is full.

When a pre-programmed test ends, the DUSTTRAK monitor automatically shuts off.

Memory Considerations

The DUSTTRAK monitor has a great deal of memory and you will not normally have to be concerned with running out. The DUSTTRAK monitor can store more than 31,000 data points. Therefore 1% of memory is about 310 data points.

This should be considered when selecting a logging interval. Shorter logging intervals use memory more quickly than longer intervals.

The logging interval and the available memory determine the maximum possible duration of a data logging session. The equation below can be used to determine any memory, recording time or logging interval restraints.

$$\% \text{ Memory} \approx \frac{[\text{ Elapsed Time }]}{[315] \times [\text{Logging Interval}]}$$

(*Note: Elapsed Time and Logging Interval are in units of minutes.*)

Custom Calibrations

In most situations, the DUSTTRAK monitor with its built-in data logger can provide very good information on how the concentration of an aerosol changes for different processes over time. Factory calibration to the respirable fraction of standard ISO 12103-1, A1 test dust (formerly 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 in which a custom calibration would improve your accuracy for a specific aerosol.

The DUSTTRAK monitor has several features to aid in obtaining good accuracy for a particular aerosol.

- The DUSTTRAK monitor's custom calibration factor can be changed through the instrument keypad. All future readings from the DUSTTRAK monitor will correspond to a specific aerosol until the calibration factor is changed back to the factory setting.

- Custom calibration factors can be stored in a table and downloaded to the DUSTTRAK 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 you determine a true mass concentration (e.g., gravimetric analysis) for the aerosol you want to measure. The true mass concentration is used to calculate the custom calibration factor for that aerosol. Once you have a custom calibration factor, you can reuse it each time you make measurements in the same or similar aerosol environment.

Determining the Calibration Factor for a Specific Aerosol

The DUSTTRAK monitor is factory calibrated to the respirable fraction of standard ISO 12103-1, A1 test dust. The DUSTTRAK monitor can be easily calibrated to any arbitrary aerosol by adjusting the custom calibration factor. The DUSTTRAK monitor's custom calibration factor is assigned the value of 1.00 for the standard ISO test dust. This procedure describes how to determine the calibration factor for a specific aerosol. Using a value of 1.00 will always revert back to the factory calibration.

To determine a new calibration factor you need some way of accurately measuring the concentration of aerosol, hereafter referred to as the reference instrument. A gravimetric analysis is often the best choice, though it is limited to nonvolatile aerosols.

To make an accurate calibration you must simultaneously measure the aerosol concentration with the DUSTTRAK monitor and your reference instrument.

1. Zero the DUSTTRAK monitor as described in the Maintenance chapter.

2. Put the instrument in Log Mode 1.

3. Set the logging interval by pressing and holding the LOGGING INTERVAL button down. The default choices for the logging intervals can be reprogrammed using TRAKPRO software. One minute (i.e., "01:00") is often a good choice.

4. Locate the DUSTTRAK monitor and the reference sampler together so that they are measuring from the same area.

5. Start sampling aerosol with both instruments at the same time.

   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.*

6. Stop sampling with both instruments at the same time.

7. Record the DUSTTRAK monitor average concentration. Press the STATISTICS key to view the average for the last test. If you wish to determine a custom calibration factor for this test only, you can instead receive the data into the TRAKPRO software.

8. Determine the mass concentration in mg/m^3 from your reference instrument. For gravimetric sampling this means having the gravimetric sample weighed.

9. Compute the new calibration constant, NewCal, using the following formula:

$$NewCal = \left(\frac{Reference\ Concentration}{DustTrak\ Concentration} \right) \cdot CurrentCal$$

   The calibration factor, OldCal, can be obtained from the DUSTTRAK monitor. In Survey mode, press and hold the CALIBRATE key down until the display counts down to zero. Release immediately when zero is reached and "CALIBRATE ZERO" appears on the display. If not, try again until it does. Press CALIBRATE again and the current calibration factor will be displayed with flashing up and down arrows. Record this value to make your calculation. Press CALIBRATE again to exit calibration mode.

Setting Custom Calibration Factor from Keypad

1. In Survey mode, press and hold the CALIBRATE key down until the DUSTTRAK monitor counts down to zero. Release the button

immediately when zero is reached and "CALIBRATE ZERO" appears on the display. If not, try again until it does.

2. Press CALIBRATE again and the current calibration factor will be displayed with flashing up and down arrows.

3. Use the up and down arrows on the keypad to adjust the calibration factor. To revert back to factory calibration, set to 1.00.

4. Press SAMPLE to store the value and exit calibration mode, or press CALIBRATE to exit without saving the new value.

Setting Custom Calibration Factors using TRAKPRO Software

The TRAKPRO software allows you to store several custom calibration factors along with a brief title for the aerosol or environment the calibration was taken. A calibration factor can be downloaded to the DUSTTRAK monitor when you want to make measurements of that aerosol or environment. All future measurements will be adjusted by the new custom calibration factor until you change it to some other value. To set this new custom calibration factor using TRAKPRO software, do the following:

1. Connect your DUSTTRAK monitor to the computer and start the TRAKPRO software.

2. Select **DUSTTRAK Model 8520** from the **Options** menu. Or, select **DUSTTRAK** from list of available instruments on the Drop-Down menu on the menu bar.

3. Select **Calibration** in the **Instrument Setup** menu. The following dialog box is displayed.

Chapter 3

4. Click the **Set DᴜꜱᴛTʀᴀᴋ Calibration** button. The following dialog box is displayed.
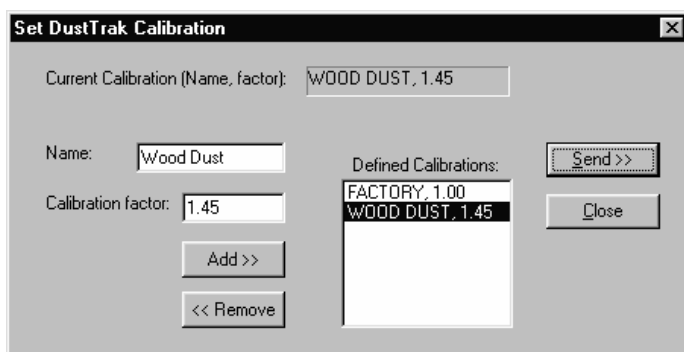
5. Enter a new **Calibration Factor** along with a new **Name** and press **Add**. This adds the new **Calibration Factor** to the list of available factors. In the example above, the "Wood Dust" factor, with a value of 1.45, was added to the list.

   Note: *This step does* **not** *automatically download the new value to the DᴜꜱᴛTʀᴀᴋ monitor. This must be done in a separate step.*

6. Highlight the desired **Defined Calibration** factor (either the new one or a previous factor) by clicking on it, and press **Send**. This downloads the new Calibration Factor to the DᴜꜱᴛTʀᴀᴋ monitor. You can enter up to 25 different custom calibrations.

7. The DᴜꜱᴛTʀᴀᴋ monitor response for all subsequent measurements will be multiplied by the new factor. To reset the DᴜꜱᴛTʀᴀᴋ monitor to factory calibration, simply send the factory setting of 1.

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 TʀᴀᴋPʀᴏ 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, follow these steps:

Note: *This process converts existing data files using a new calibration factor. It does not affect the current reading of the DᴜꜱᴛTʀᴀᴋ monitor. Future measurements will continue to be read and logged with the original calibration factor (normally 1.0) and will not be converted automatically.*

1. Connect your DᴜꜱᴛTʀᴀᴋ monitor to the computer and start the TʀᴀᴋPʀᴏ software.

2. Select **DustTrak Model 8520** from the **Options** menu under **Software Configure**. Or, select **DustTrak** from list of available instruments on the drop-down menu on the menu bar.

3. Open the file that contains the data to be converted. Highlight a single test within that data file.

4. Select **Define DustTrak Calibration** from the **Options** menu. The following dialog box is displayed.
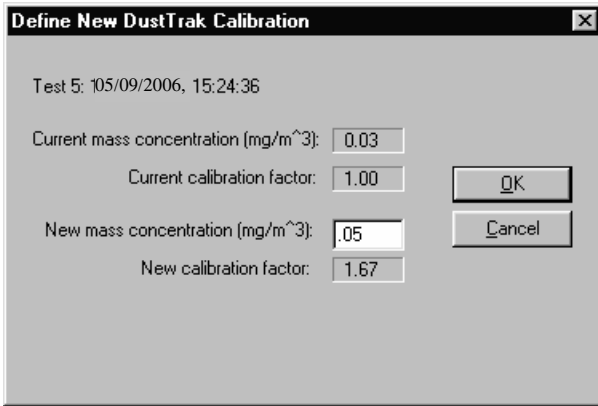
5. Enter the **New Mass Concentration** value (in mg/m^3). The **New Calibration Factor** is calculated and automatically updated. Press **OK**.

6. When you click OK, a new data set of the *same name* will be generated calibrated to the mass concentration that you entered. This data set will be appended to the same file. The original data remains.

7. If you want to adjust the data to a previously determined custom calibration factor without performing a gravimetric calibration, enter the new calibration factor. The **New Mass Concentration** automatically updates.

Chapter 4

Maintenance

The DUSTTRAK monitor can be maintained and calibrated in the field using the instructions below. Even so, TSI recommends that you return your DUSTTRAK monitor to the factory for annual calibration. For a reasonable fee, we will quickly clean and calibrate the unit and return it to you in "as new" working condition, along with a Certificate of Calibration. This "annual checkup" helps ensure that the DUSTTRAK monitor is always in good operating condition.

The DUSTTRAK monitor is factory calibrated to the standard ISO 12103-1, A1 test dust (formerly Arizona Test Dust). The calibration data is stored internally and cannot be accessed by you. This standard test dust is used because of its wide particle size distribution. This makes the internal calibration representative of an average of most types of ambient aerosol you might encounter.

For many applications, the factory calibration provides accurate measurements. There may be times when more accurate mass concentration data is needed because the aerosol being sampled is significantly different than the standard ISO test dust. To accommodate such a measurement, the DUSTTRAK monitor has been designed to allow for field calibration.

Note: There are no user-serviceable parts inside this instrument. TSI recommends that you return the DUSTTRAK monitor to the factory for any required maintenance or service not described in this manual.

Maintenance Schedule

Your Model 8520 DUSTTRAK Aerosol Monitor requires maintenance on a regular basis. Table 4–1 lists the factory recommended maintenance schedule.

Some maintenance items are required each time the DUSTTRAK monitor is used or on an annual basis. Other items are scheduled according to how much aerosol is drawn through the instrument. For example, cleaning the inlet sample tube is recommended after 350 hours of sampling a 1 mg/m^3 concentration of aerosol. This recommendation should be pro-rated according to how the instrument is used. 350 hours at 1 mg/m^3 is the same amount of aerosol as 700 hours at 0.5 mg/m^3 or 175 hours at 2 mg/m^3, etc.

When using the 1.0 or 2.5 µm inlet nozzles you need to clean the inlet more frequently than for the standard 10 µm nozzle (black) because of the much higher percentage of particles being removed from the stream. Table 4–1 represents estimates of how long you can run before cleaning is necessary. The actual time you can run between cleanings varies with the size distribution of particles you are measuring.

Table 4–1. Recommended Maintenance Schedule

Item	Frequency
Perform zero check	Daily (or before long tests)
Clean 1.0 µm nozzle	5 hr. at 1 mg/m^3*
Clean 2.5 µm nozzle	30 hr. at 1 mg/m^3*
Clean 10 µm nozzle, inlet, and sample tube	350 hr. at 1 mg/m^3*
Replace internal filters	700 hr. at 1 mg/m^3*
Clean cyclone	Before each use
Return to factory for cleaning and calibration	Annually

*Pro-rated, see discussion above.

The DUSTTRAK monitor keeps track of the accumulated amount of aerosol drawn through it since its last cleaning. When sample tube cleaning or internal filter replacement is due, the display shows the message "SERVICE 4" or "SERVICE 5," respectively, during power-up. Press any key to bypass the message, but be sure to perform the maintenance procedures at your earliest convenience.

TSI recommends that you perform a zero check each day the DUSTTRAK monitor is used, before running any extended tests, and after the instrument experiences a significant environmental change. Examples of significant environmental changes would be ambient temperature changes that exceed 15 °F (8 °C) or moving from locations with high aerosol concentrations to low concentrations.

Zero Checking/Re-Zeroing

1. Put the DUSTTRAK monitor in Survey mode.

2. Put zero filter on aerosol sample inlet. See Figure 4–1.

3. Set the time-constant to 10 seconds. Press and hold the TIME CONSTANT key until "10" is displayed, then release.

4. Wait 10–60 seconds for displayed values to settle to zero.

5. If the displayed value is between -0.001 and +0.001 mg/m^3, the DUSTTRAK monitor does not need adjustment. If the displayed value exceeds this limit, follow steps 7 to 9 below to re-zero the instrument.

Note: *Negative mass concentration readings are an indication that the DUSTTRAK monitor needs to be re-zeroed. The negative reading of –0.001 in step 5 above is the only time when a negative reading is acceptable.*
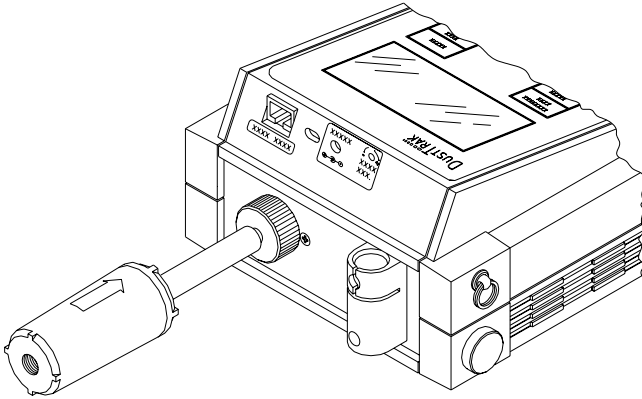
Figure 4–1: Zero Checking the DUSTTRAK Aerosol Monitor

6. Press and hold the CALIBRATE key and wait for the displayed countdown to reach 0, then immediately release the key. The message "CALIBRATE ZERO" is displayed… if not, try again.

7. Press the SAMPLE key and wait for the 60-second countdown. When the countdown is completed, the current calibration constant will be displayed.

8. Press the CALIBRATE key again to return to survey mode. The re-zeroing process is now completed.

Cleaning the 1.0 μm and 2.5 μm Inlet Conditioners

1. Turn the DUSTTRAK monitor off.

2. Remove the inlet nozzle and impactor plate.

3. Wipe the old grease and other residue off from the impactor plate and nozzle. Once the nozzle and impactor plate are removed from the DUSTTRAK monitor, compressed air can be used to blow them off. Do *not* blow directly into the DUSTTRAK inlet. You can use isopropanol or soap and water to clean the parts, but be sure they are dry before reassembly.

4. Inspect the inlet for residue and clean as necessary.

5. Reapply grease to the impactor plate.

6. Reassemble the inlet conditioners.

Cleaning the 10 μm Inlet and Sample Tube

The aerosol inlet needs to be cleaned regularly. The inlet nozzle should be cleaned based on the schedule in Table 4–1 above or especially when changing from very high concentrations of aerosols to low concentrations. The "SERVICE 4" message will be displayed during power-up when nozzle cleaning is due. The DUSTTRAK monitor pauses when any of the service messages come on. Press any key to bypass the message and continue. The "SERVICE 4" message is a one-time indicator to remind you that inlet port cleaning is due. This message will automatically reset.

1. Move to a relatively clean environment. (Aerosol concentration less than 0.1 mg/m^3.)

2. Turn the DUSTTRAK monitor off.
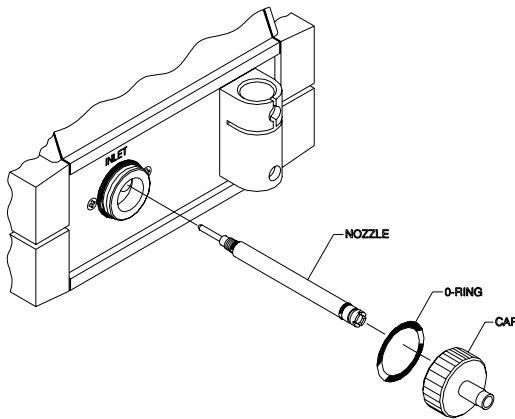
Figure 4–2: Exploded View of Inlet Assembly

3. Remove the sample inlet nozzle and O-ring. The O-ring will usually stay inside the nozzle.

4. Use the sample tube removal tool to unscrew the tube from the inside of the inlet port. The cross-pattern on one end of the tool mates with the end of the sample tube.

5. Use the hook end of the tool to pull the sample tube out of the inlet port.

6. Clean the sample tube and inlet port. A cotton swab can be used to clean the inside of the inlet port, cap, O-ring, and ends of the tube. The swabs can be dampened with water or a light solvent (e.g., isopropanol).

   Note: *Do not use compressed air to clean the inlet area. Compressed air forces particulates into the optics chamber and contaminates the optics.*

Chapter 4

The inside of the sample tube can be cleaned using the sample tube cleaning brush provided, along with a light solvent. Dry the tube by blowing it out with compressed air, or let it air-dry thoroughly. Be careful *not* to blow particles into the DUSTTRAK monitor inlet port.

7. Insert the sample tube back into the port and screw it in using the sample tube removal tool.

8. Replace the inlet nozzle and O-ring.

9. Perform a zero check and re-zero if necessary.

10. Turn the DUSTTRAK monitor off and turn it on again while pressing and holding the CALIBRATE key. This action resets the internal circuit that keeps track of the total aerosol quantity that has gone through the instrument. The inlet port cleaning procedure is now completed.

Replacing the Internal Filters

The internal filters should be replaced based on the schedule in Table 4–1 or when the "SERVICE 5" is displayed during power-up. This "service reminder" will appear each time at power-up, until you reset this message. To reset the "SERVICE 5" reminder, do the following:

1. Turn the instrument off.

2. Press and hold the CALIBRATE key while turning on the instrument.

3. The service message is now reset.

If you change the filters before the "SERVICE 5" message appears, you should reset this reminder by using the same technique.

The operation of the built-in total mass tracking circuit is dependent upon the instrument calibration and the instrument flow rate. The assumed flow rate is 1.7 L/min.

To replace the internal filters, follow the procedure below. Refer to Figure 4-3.

1. Move to a relatively clean environment (aerosol concentration less than 0.1 mg/m^3).

2. Turn the DUSTTRAK Aerosol Monitor off.
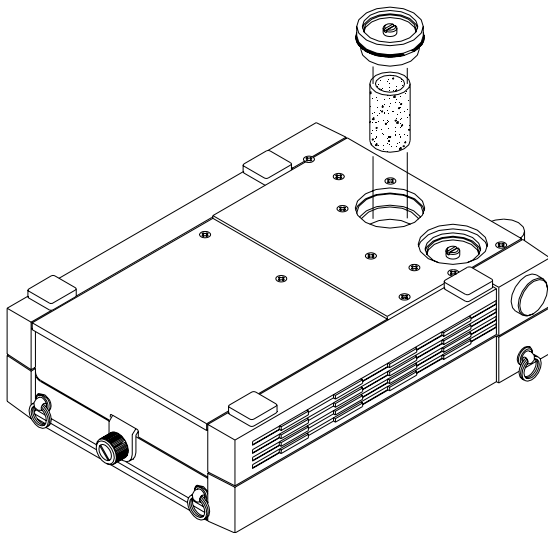
Figure 4–3: Internal Filter Replacement

3. Turn the aerosol monitor over on its keypad so the filter wells are facing up.

4. Use the small flat-blade screwdriver to unscrew the retaining screws at the center of each filter well. The screws are "captive" and will stay in the caps.

5. Grip the screw heads between your thumb and forefinger. Lift to pull the filter well caps off. There is an O-ring under each cap that may lift out with the cap.

6. Pull out the internal filter elements and discard them.

7. Clean the inside of the filter wells if necessary with a mild solvent like isopropanol and a cotton swab. Do *not* use compressed air.

8. Replace the internal filter elements with TSI part no. 800666.

   Note: Only the recommended high efficiency particulate air (HEPA) filters should be used. The DUSTTRAK monitor should never be run without filters in place. Doing so will contaminate the optics and probably require you to send the unit back to the factory for cleaning.

9. Replace the O-rings and caps.

10. Use the small screwdriver to tighten the hold-down screws until "finger-tight." Do *not* over-tighten.

11. Zero the mass tracking circuit to turn the service message off. This is done by pressing and holding the CALIBRATE key during power-up. The procedure is now completed.

Setting the Flow Rate

The sample flow rate through the DUSTTRAK monitor is set at the factory at 1.7 L/min. The flow rate can be easily adjusted if necessary by following the procedure below. You need an instrument that precisely measures flow rate for use as a reference such as the flowmeter supplied with the DUSTTRAK monitor.

Note: *The mass concentration readings are not affected by flow rate changes because the volume of sampled air "seen" by the DUSTTRAK detector is fixed. Flow rate **is** critical when using the cyclone or other aerosol separation devices.*

1. Clean the inlet port as described in this chapter. If necessary, replace the internal filters as described in this chapter.

2. Connect the flowmeter to the DUSTTRAK monitor sample port using the tubing provided.

3. With the DUSTTRAK monitor running, use the supplied screwdriver to turn the flow adjustment screw located on the back of the DUSTTRAK monitor (see Figure 4–4). Observe the reading on the flowmeter (reading is taken at the center of the ball) and adjust the flow until the desired reading is obtained. The factory setting is 1.7 L/min.

4. Disconnect the flowmeter. The procedure is now completed.
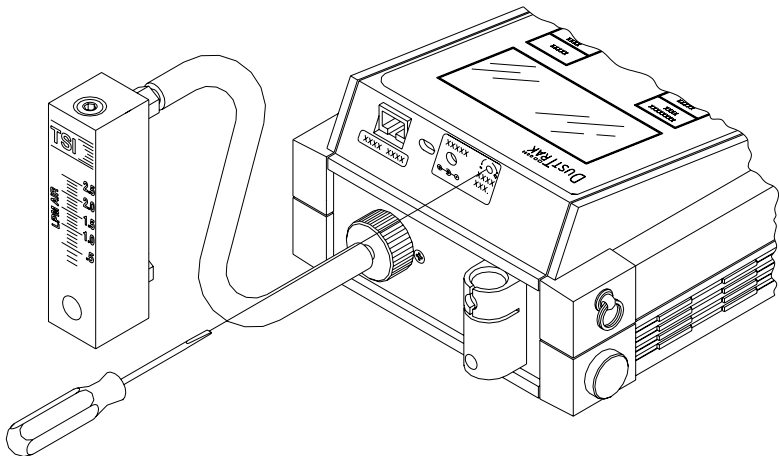
**Figure 4–4: Adjusting the Flow Rate**

Cleaning the Cyclone

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

1. Detach the cyclone from the DUSTTRAK monitor.

2. Unscrew the grit pot from the bottom of the cyclone and pull the top off the cyclone by pulling on the plastic tubing.

3. Hold the open end of the grit pot 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 pot or the cyclone body, it may be necessary to blow compressed air into the cyclone parts and/or to clean them with soap and water. A mild solvent like isopropanol may also be used. Make certain that the cyclone is perfectly dry before using it.*

4. Re-assemble the cyclone. Refer to Figure 4–5 below. The cyclone cleaning procedure is now completed.
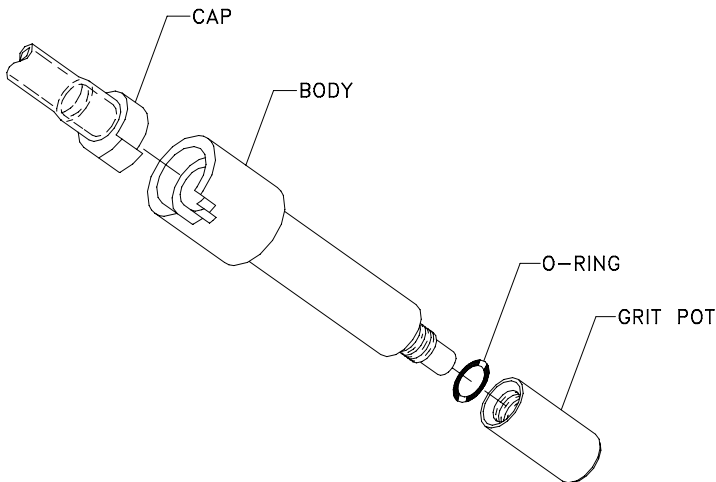
Figure 4–5: Exploded View of 10 mm Nylon Dorr-Oliver Cyclone

Storage Precautions

When storing the DUSTTRAK monitor for more than 30 days, you should remove the batteries. This prevents damage due to battery leakage.

This instrument must be stored in a location where the temperature remains between –20 and 60°C (–4 and 140°F).

Chapter 5

Troubleshooting

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

Symptom	Possible Cause	Corrective Action
Erratic zero reading.	Leak.	Check connections for leaks.
		Replace zero filter.
		Tighten inlet cap.
	Dirty inlet port and/or sample tube.	Clean inlet port. Clean or replace tubing.
	Sample nozzle missing.	Remove inlet port cap and check sample nozzle. Replace if missing.
	Internal filter(s) not installed properly (leaking).	Inspect internal filter wells to make certain the filters and o-rings are seated properly. Replace internal filters if necessary.
No display.	Unit not switched on.	Switch unit on.
	Low or dead batteries.	Replace the batteries or plug in the AC adapter.
	Batteries installed backwards.	Observe polarity indication on battery holder diagram.
	Dirty battery contacts.	Clean the battery contacts.
No keypad response.	Display/Lockout switch in lockout position.	Slide lockout switch to normal position (to the right).
Incorrect function displayed.	Two keys have been pressed at the same time.	Press only one key at a time.

Symptom	Possible Cause	Corrective Action
Battery symbol is displayed. (constant or blinking)	Low battery charge.	Replace batteries or use AC adapter.
	Incorrect AC adapter.	Replace with the correct AC adapter.
	Low AC line Voltage	Correct the AC line voltage or use batteries.
	Dirty battery contacts.	Clean the battery contacts.
Analog output does not work	Cable/connector not correctly installed.	Make sure cable connector is fully seated.
	Output wired with reverse polarity.	Make sure analog out (+) and analog ground (-) are wired correctly to data-logger.
Analog output is not in proportion to display	Analog output range in DUSTTRAK monitor may be set incorrectly.	Program analog output to desired range: • $0 – 0.100$ mg/m^3 • $0 – 1.00$ mg/m^3 • $0 – 10.0$ mg/m^3 • $0 - 100$ mg/m^3
	Data logger scaling factor may be set incorrectly.	Scaling factor must be consistent with DUSTTRAK monitor.
Alarm output does not work.	Alarm function not turned on.	Alarm function is "off" by default. It must be programmed "on" (using TRAKPRO software).
Alarm does not turn on correctly.	Alarm setting incorrect.	Program alarm setting using TRAKPRO software.
	Cable/connector not correctly installed.	Make sure cable connector is fully seated.
	Alarm output wired with reverse polarity.	Alarm wires are polarized. Voltage input must be wired to alarm input (+).

Symptom	Possible Cause	Corrective Action
Display reads "MEMORY 0%."	Memory is full.	Download memory to a PC if desired, then clear memory.
"SERVICE" and "1" displayed.	Memory has been cleared due to temporary loss of power from internal backup battery.	Factory service required if condition persists. Press any key to bypass.
"SERVICE" and "2" displayed.	Calibration memory error. Internal calibration data corrupted.	Factory service required.
"SERVICE" and "3" displayed.	Backup battery low.	Factory service required. Press any key to bypass.
"SERVICE" and "4" displayed.	The sample inlet nozzle is due for cleaning.	Clean the nozzle and sample inlet port. Press any key to bypass.
"SERVICE" and "5" displayed.	Internal filters are due for replacement.	Replace internal filters and reset service reminder. See "Replacing the Internal Filters" for more information.
"SERVICE" and "6" displayed.	Flow obstruction on previous power up.	Remove obstruction if still present. Press any key to bypass.
	Internal pump failing, indicated by inability to adjust flow rate to full range.	If Service 6, recurs on each power up even after bypassing, factory service may be required.

Symptom	Possible Cause	Corrective Action
"SERVICE" and "7" displayed.	High humidity or laser failure.	Typically occurs if the unit is turned ON either after sampling under high humidity conditions or when instruments are stored at a different temperature than that of the sampling area. Bypass this error by pressing "Calibrate" key. Zero the DUSTTRAK by following the instructions given in Chapter 4, "Maintenance," under section "Zero Checking/Re-Zeroing". If the unit cannot be zeroed, let the DUSTTRAK equilibrate to ambient conditions and try zeroing the DUSTTRAK again. If the Service 7 error still persists, it might be due to laser failure and the unit needs to be returned to TSI.

Appendix A

Specifications

Specifications are subject to change without notice.

Sensitivity:
Sensor type: .... 90° light scattering, laser diode
Range: .... 0.001–100 mg/m^3 (calibrated to respirable fraction of standard ISO 12103-1, A1 test dust)
Resolution: .... ±0.1 % of reading or ±0.001 mg/m^3, whichever is greater
Zero stability: .... ±0.001 mg/m^3 over 24 hours using 10-second time-constant
Particle size range: .... 0.1–approximate 10 µm (Upper limit is dependent on flow rate)
Flow rate range: .... 1.4–2.4 L/min.
Temperature coefficient: .. +0.001 mg/m^3 per °C (for variations from temperature at which DUSTTRAK monitor was zeroed)

Instrument 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)

Time Constant:
Range: .... Adjustable from 1 to 60 seconds

Data Logging:
Data points: .... >31,000 (21 days logging every minute)
Logging interval: .... Adjustable from 1 second to 1 hour

Analog Output (selected instruments only):
Selectable ranges: .... 0 – 0.100 mg/m^3
                                       0 – 1.0 mg/m^3
                                       0 – 10.0 mg/m^3
                                       0 – 100 mg/m^3
Voltage output .... 0 – 5 VDC
Output impedance .... 0.01 ohms
Maximum current .... 15 mA

Alarm Output (selected instruments only):
Range............................. 0.002 to 100 mg/m^3
Maximum voltage input .... 15 VDC
Maximum current .... 1 amp

Physical:
External dimensions:........ 221 mm x 150 mm x 87 mm (8.7 in x 5.9 in x 3.4 in)
Weight (with batteries): ... 1.5 kg (3.3 lb.)
Display:............................ 4 digit LCD, 15 mm (0.6 in) digit height

Factory Maintenance:
Factory clean/calibrate:.... Annually

User Maintenance:
User calibration: .... As needed
Clean nozzle: .... After every 350 hours at 1 mg/m^3 (e.g., 350 hours at 1 mg/m^3, 35 hours at 10 mg/m^3 or 3.5 hours at 100 mg/m^3)
Change internal filters: ..... After every 700 hours at 1 mg/m^3 (e.g., 700 hours at 1 mg/m^3, 70 hours at 10 mg/m^3 or 7 hours at 100 mg/m^3)

Serial Interface:
Type: RS-232
BAUD rate: 1200
Data Bits:......................... 8
Stop Bits:......................... 1
Data Format: .... ASCII

Power Requirements:
External Adapter: .... 6 VDC, 300 ma
  or
Batteries: .... 4 C-size Alkaline
Battery run-time:............... 16 hours (typical)

EMI/RF Immunity:
1. Complies with Emissions Directive Standard: EN50081-1:1992
2. Complies with Immunity Directive Standard: EN50082-1:1992

Appendix A

Appendix B

Model 8520-1 DUSTTRAK Environmental Enclosure Operation and Maintenance Manual

Unpacking the DUSTTRAK Environmental Enclosure

Carefully unpack the Model 8520-1 DUSTTRAK Environmental Enclosure from the shipping container. Use the tables and illustrations below to make certain that there are no missing components. Contact TSI immediately if anything is missing or damaged.

Table B–1: Model 8520-1 DUSTTRAK Environmental Enclosure

Quantity	Item Description	Part/Model
1	Model 8520-1 DUSTTRAK Environmental Enclosure Case	8520-1
1	7.5 V Universal Input Battery Charger	1208033
2	6 V, 10 A-Hr Lead/Acid Battery	801563
1	Aerosol Inlet Assembly	801565
1	Water Trap Bottle	2002032
2	Velcro Strap	2913125
2	Tygon Plastic Tubing, 1/4 in ID	3001252
1	DB9 Connector Dust Caps	1304132
1	Transportation Inlet Port Plug	2602013
1	Tripod Mount Screw Plug	5010005
1	Model 8520 DUSTTRAK Aerosol Monitor Operation and Service Manual	1980198

Spare Parts

The following kit contains replacement parts that may be needed if the standard parts are lost or destroyed. It contains O-rings, storage caps (DB9 and inlet) and replacement tubing.

| Quantity	Item Description	Part/Model
1	Environmental Enclosure Spare parts	801566

Parts Identification: Environmental Enclosure

Figures B–1and B–2 identify the parts of the Model 8520-1 DUSTTRAK Environmental Enclosure. Please become familiar with these components before proceeding.
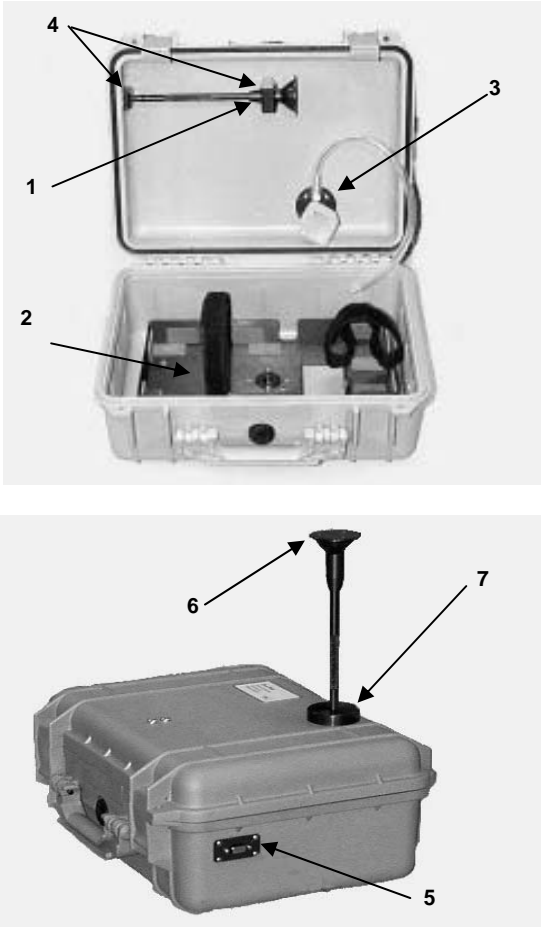
Figure B–1: Inside and Outside Views of Environmental Enclosure

1. Inlet Assembly (in storage)
2. DUSTTRAK/Battery Bracket
3. Water Trap Bottle
4. Inlet Mounting Brackets
5. Feed Thru DB9 Adapter
6. Inlet Assembly (sampling)
7. Inlet Ring
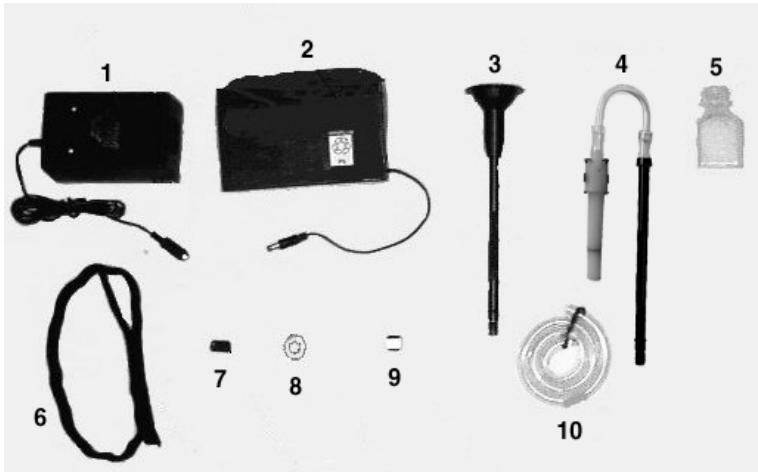
Figure B–2: DᴜꜱᴛTʀᴀᴋ Environmental Enclosure Accessories

1. 6 V-10 Ah Battery Pack (X2)
2. 7.5 V Universal Input/Dual Step Charger
3. Aerosol Sampling Inlet
4. Respirable Sampling Inlet (optional)
5. Water Trap Bottle
6. Velcro Straps
7. DB9 Dust Cap
8. Transport Inlet Plug
9. Tripod Mount Screw Plug
10. Tubing
11. Manual (not shown)

Setting-Up

The setup of the Environmental Enclosure is an important part in allowing reliable and accurate sampling of aerosols in a wide range of conditions. TSI cannot ensure accurate measurements if any of the components are set up incorrectly. Damage to the enclosure or its components can result if these procedures are not followed.

⚠️

W A R N I N G
The DUSTTRAK monitor is not rated for intrinsic safety. The DUSTTRAK monitor, with the Environmental Enclosure, must *never* be operated under conditions where there is a risk of fire or explosion.

⚠️

C a u t i o n
The enclosure is designed to be water resistant to rain or spray. It is not designed to be waterproof when immersed. Setting it in a pool of water will result in flooding the inner compartment with water. This will severely damage both your DUSTTRAK monitor and battery pack. Do **not** set the Environmental Enclosure in **water**!

Installing the Aerosol or Respirable Aerosol Inlet

There are two inlet assemblies, either of which may be stored inside the lid of the Environmental Enclosure, allowing ambient aerosols to be sampled efficiently in a wide range of conditions. Proper installation into its sampling position ensures that the DUSTTRAK monitor measures an accurate ambient aerosol mass concentration. Follow these instructions to install either of the aerosol inlets:

- Hold the inlet assembly by the knurled section on the tube and remove it from the holding bracket by unscrewing it (see Figure B-3).

⚠️

| **C a u t i o n** |
| :--- |
| Always hold the inlet assembly by the knurled portion of the tube. *Do not* twist on the inlet assembly cap. |

- Carefully slide the inlet through the upper mounting bracket and remove the inlet from the box.
- Remove the Inlet Transport Plug from the top of the box.

Figure B–3: Unscrew Inlet from Inner Bracket

- Thread the inlet assembly into upper inlet ring found on the top of the Environmental Enclosure (See Figure B-4).
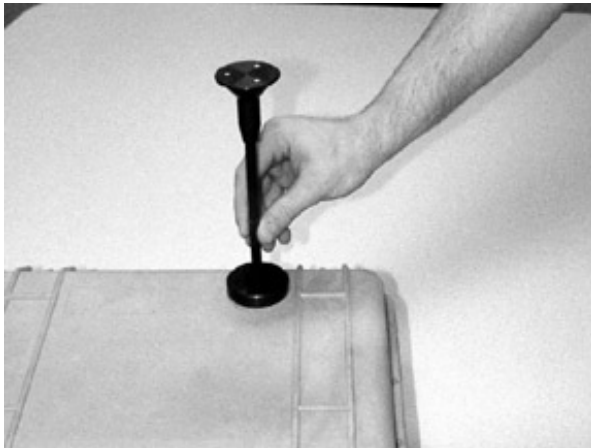
Figure B–4: Thread the Inlet into the Inlet Ring

Notes: *Make sure that a thin film of vacuum grease is coating the O-ring on the inlet tube to ensure a good seal before installing it.*

*Do **not** use the Respirable Aerosol Inlet in the rain. As it will aspirate rainwater into the cyclone body.*

Install Water Trap Bottle

The translucent bottle that attaches to the bottom of the inner inlet is used to collect any water that is drawn into the sampled flow. This prevents water from reaching the DUSTTRAK monitor and damaging it. The bottle is installed on the Environmental Enclosure when it is shipped. If the bottle is removed for cleaning, follow these precautions when re-installing:

- Before screwing the bottle into inner inlet ring, be sure that the O-ring found in the bottom of the threaded hole is greased. This ensures an air-tight seal.

- When threading the bottle into the inlet be careful not to damage its threads. Figure B-5 demonstrates how to install the water trap correctly.

- Make sure the bottle has been tightened securely.

Figure B–5: Installing the Water Trap Bottle

Correct Placement of Velcro Straps

The battery and the DUSTTRAK monitor are held in place by Velcro straps. One end of each strap is secured into place. Figure B-6 shows the correct placement of each strap (before the DUSTTRAK monitor and battery pack are installed).
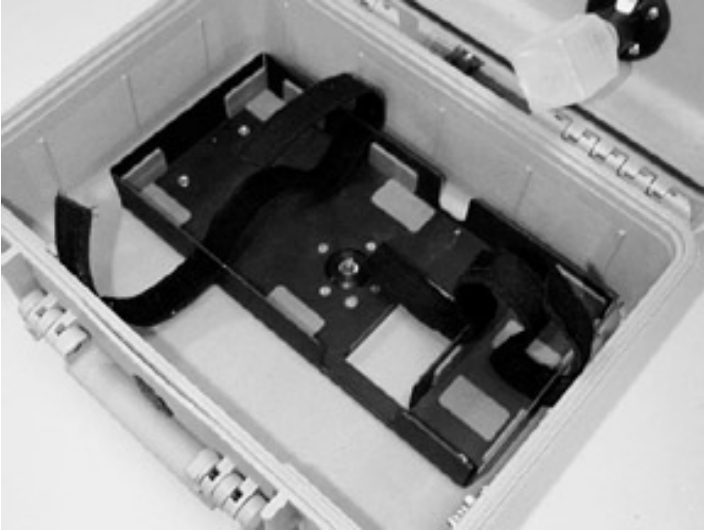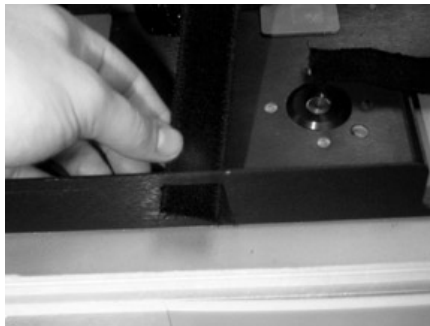

Figure B–6: Placement of Velcro Straps

Install DUSTTRAK Monitor into Environmental Enclosure

To correctly install the DUSTTRAK monitor follow the instructions below:

- Slip the free end of the Velcro strap through the slot on the DUSTTRAK monitor portion of the main bracket (see Figure B-7).

Figure B–7: Slip Velcro Strap Through Slot in Bracket

- Slide the DUSTTRAK monitor under the Velcro and into the bracket with the DUSTTRAK monitor inlet towards the center of the case (see Figure B-8).

Figure B–8: Sliding DUSTTRAK Monitor into the Bracket

- Tighten the Velcro Strap around the DUSTTRAK monitor (see Figure B-9).
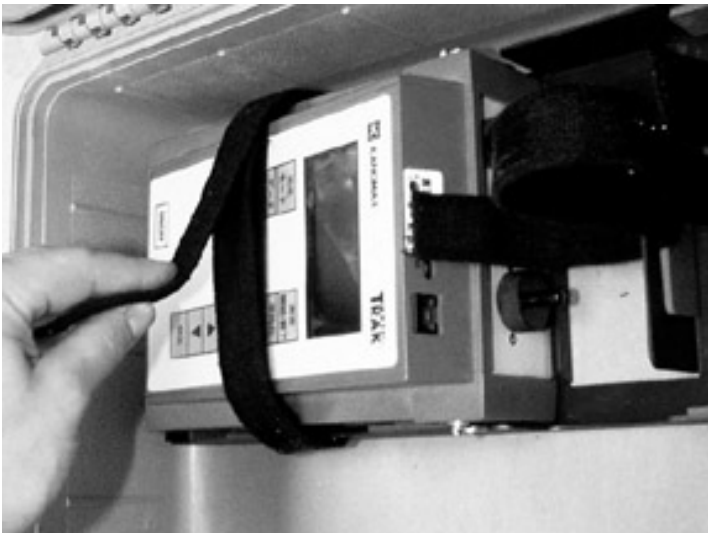
Figure B–9: Tighten the Velcro Strap

Appendix B

The DUSTTRAK monitor is now safely secured. When access is needed to the keypad covered by the Velcro strap, loosen it to expose them. Be sure to reattach the strap when done using the keypad.

Connecting Tubing

A length of tubing is provided to transport the aerosol from the external inlet to the DUSTTRAK inlet. Before attempting to sample, make sure that this tubing is securely fastened to the barbs from both of the inlets. When closing the enclosure, make sure that this tube *does not* get kinked. The best way to prevent this is to pull the tube towards the front of the box as you close it (see Figure B-10).

Figure B–10: Keeping the Tube Unkinked

Supplying Power to the DUSTTRAK Aerosol Monitor

The Model 8520 DUSTTRAK Aerosol Monitor may be powered in one of two ways when used with the 8520-1 Environmental Enclosure:

1. Using the standard internal battery pack (consisting of 4, C size batteries)

2. Using the supplied external battery pack.

The internal battery pack will supply power for approximately 16 hours of operation (may be less under cold conditions). This is adequate for single shift (8-hour) monitoring, but will *not* work for 24-hour operation.

|	**C a u t i o n**
⚠	TSI does *not* recommend using the standard AC adapter when operating outside. This device is ***not*** rated for external exposure.

Using the External Battery Pack

The battery packs supplied with the Environmental Enclosure allow for extended use of the DUSTTRAK monitor. These battery packs enable the DUSTTRAK monitor to operate for at least 24 hours (even in cold conditions). The battery packs should be rotated and properly charged after each use, to ensure a prolonged lifetime (see Maintenance section for further information). Make sure that the internal C size batteries are installed correctly within the DUSTTRAK monitor to make it possible to continue sampling when changing the external battery packs.

Install External Battery Pack

To correctly install the Battery Pack follow the instructions below:

- Slip the free end of the Velcro strap through the slot on the battery pack portion of the main bracket (See Figure B-11).
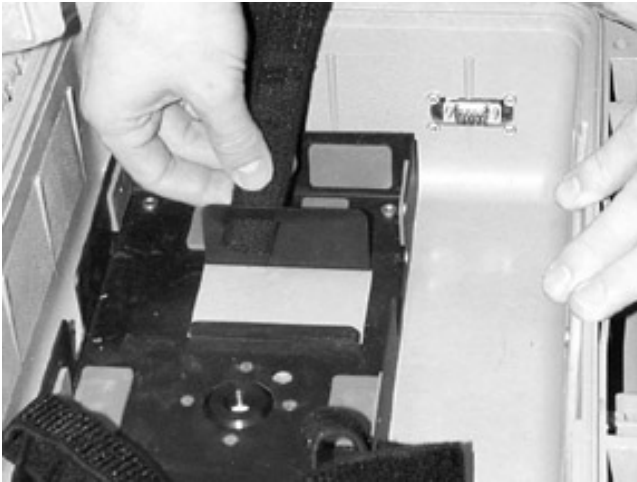
Figure B–11: Slip Velcro Strap Through Slot.

- Slide the battery pack into the correct space in the sheet metal bracket such that the leads are oriented up, and the PC board is in the upper left hand quarter.

- Tighten the Velcro strap around the battery pack (See Figure B-12).

Figure B–12: Tighten Velcro Around Battery.

- Connect the external battery pack to the DUSTTRAK monitor by inserting the power plug protruding from the battery to the power jack in the top of the DUSTTRAK monitor.

Mounting to a Surveyor Tripod

The Environmental Enclosure may be mounted to a standard surveyor tripod equipped with a $\frac{5}{8}$"-11 threaded stud. Mounting the Enclosure on a tripod is useful when doing outdoor site monitoring. Figure B-13 shows the Environmental Enclosure mounted on a surveyor tripod.

Figure B–13: Enclosure Mounted on a Tripod.

⚠	**C a u t i o n**
	Do not place the Environmental Enclosure in direct contact with the ground. The bottom of the Environmental Enclosure contains an exhaust port that may allow water to enter the enclosure, resulting in damage to the DUSTTRAK monitor.

Downloading a Data File

To download a file under normal data-logging operations, you would do the following:

- Open the Environmental Enclosure.

- Discontinue sampling.

- Attach the supplied RJ45 to the RS-232 cable from the DUSTTRAK monitor to a notebook computer.

- Download the data file using TRAKPRO software (refer to Chapter 2 of this manual for further details).

Real-Time Monitoring

The Environmental Enclosure comes equipped with an external DB9 connector. This allows the DUSTTRAK monitor to be connected to a computer for continuous real-time monitoring. To set up the Environmental Enclosure for real-time monitoring follow these instructions:

- Connect the DUSTTRAK monitor to the DB9 connector, which is mounted on the inside of the enclosure, using the Computer Interface Cable provided with the DUSTTRAK monitor.

- Attach a standard 9-pin serial cable (not supplied) from the DB9 connector on the outside of the enclosure to a computer serial port. The computer can be configured to query the DUSTTRAK monitor when in a terminal emulator mode. See Application Note ITI-044 for more information on these commands.

Setting-up TRAKPRO™ Data Analysis Software

Information on setting-up and using TRAKPRO software can be found in Chapter 2 of this manual.

Transporting the Environmental Enclosure

When transporting the Environmental Enclosure it is important to store its components correctly. The following steps should be taken to ensure that no damage is done to the enclosure or its components during transportation:

⚠ !	**A t t e n t i o n**
	The Environmental Enclosure is designed to protect equipment during stationary sampling only. Do *not* transport or ship equipment inside the Environmental Enclosure.

- Unscrew the aerosol inlet from the top of the case, and install it into the inlet-mounting bracket inside the lid of the enclosure.
- Insert the Inlet Transport Plug into the opening in the inlet ring in the top of the box.
- Empty any water from the water trap.
- Remove DUSTTRAK monitor and battery pack.
- If mounted on a tripod, take the enclosure off the tripod and screw in the tripod mount plug.

Wiring the Analog/Alarm Cable in the Enclosure

You may desire to install the Analog/Alarm cable to the DUSTTRAK monitor, when operated inside the Environmental Enclosure. The serial connector, installed in the side of the enclosure, may be used for this purpose.

Note: *If additional penetrations are made into the wall of the enclosure, you should take precautions to install a sealing (water-tight) connector around the cable.*

Operation

Overview

The DUSTTRAK Environmental Enclosure can be used in conjunction with the DUSTTRAK monitor for many different applications. Its primary use is in outdoor applications to give the DUSTTRAK monitor protection from the elements and the ability to sample efficiently in different wind speeds. The enclosure and extended-life battery may also be advantageous in indoor industrial applications, to provide additional security and protection to the DUSTTRAK monitor.

How to Properly Orient the Environmental Enclosure

The Environmental Enclosure should be set up in a location where it can sample the particles of interest. It should be placed "out in the open," away from obstructions which may affect wind currents. It should not, for example, be placed at the corner of a building, which would cause swirling wind currents and result in poor particle sampling.

The Environmental Enclosure should be used in wind conditions with speeds of 22 mph or less to obtain the most accurate readings. An increase in wind speed over 22 mph can decrease the sampling efficiency of the inlet to under the efficiency specified by PM-10 standards. If wind gusts of over 22 mph are present, the data collected is still valid, but be aware that the readings will be slightly lower than the actual mass concentration of aerosol present. See Application Note ITI-060 for more information on the wind speed dependency of the external inlet's sampling characteristics.

Changing and Re-charging the Battery Packs

The battery pack within the Environmental Enclosure should be changed every 24 hours of use during the daily maintenance check described in the Maintenance Section. A voltage cutoff switch will cut the power to the DUSTTRAK monitor when the battery voltage reaches 5.1 V. This ensures that the battery does not become deeply discharged. Preventing this condition will prolong the life of the battery.

Receiving Data from the DUSTTRAK Aerosol Monitor

The DUSTTRAK monitor records data in either the manual sampling mode (LOG 1) or the programmable modes (LOG 2, LOG 3). See the DUSTTRAK User Manual for more information on setting up the logging modes. The data can be downloaded by opening the Environmental Enclosure lid, attaching the supplied RJ45/RS-232 cable from the DUSTTRAK monitor to a computer COM port, and using the RECEIVE DATA command within the TRAKPRO software.

If desired, the DUSTTRAK RJ45 cable may be attached directly to the inside of the DB9 connector located on the side of the Environmental Enclosure. A serial cable (not supplied) may then be attached from the outside of the DB9 connector to the computer COM port.

Note: *In order to download a data file the DUSTTRAK monitor cannot be in a sampling mode.*

The primary use for the external DB9 connector is to facilitate real-time data monitoring. An external computer or data logger can be directly attached to the DUSTTRAK monitor, while still keeping the instrument inside its weatherproof enclosure. The DUSTTRAK monitor can be queried through a set of ASCII commands to provide periodic information.

Zeroing the DUSTTRAK Aerosol Monitor

The DUSTTRAK monitor should always be zeroed before beginning a sample. See the instructions in Chapter 3 of this manual for more information. If possible, the instrument should be zeroed under stable ambient temperature conditions (since variations in temperature will have a small impact upon the DUSTTRAK monitor readings). If this is not possible (for example, 24-hour outdoor sampling, with wide temperature swings) the instrument should be kept closed inside the Environmental Enclosure. The thermal mass of the Enclosure will dampen out the affect of temperature swings, radiant heat, etc.

Note: *See the DUSTTRAK monitor Specifications in Appendix A for more information on the temperature dependence.*

In nearly all cases, the temperature impact upon the DUSTTRAK monitor reading is very small in comparison to the ambient particle concentration.

Setting the Flow Rate

The aerosol inlet on the Environmental Enclosure was designed to operate at a 1.7 liters/minute flow rate. Before each sample, the flow rate should be verified and/or adjusted as described in the DUSTTRAK monitor Maintenance section (Chapter 4).

Locking the Environmental Enclosure

To avoid theft of the DUSTTRAK monitor, when left inside the Environmental Enclosure, a padlock should be used to lock the box. There are two holes on the front of the box that allow for a standard padlock to be attached. A padlock is *not* supplied with the 8520-1.

Checklist for Sampling with the Environmental Enclosure

Before beginning a sample check to see that all of the following conditions are satisfied:

- The flow rate is set to 1.7 liters/minute.

- All components are properly installed into the enclosure as described in the Setup section.

- The DUSTTRAK monitor has been zeroed at the temperature at which it will be sampling (if possible).

- The Environmental Enclosure has been put in a place clear of any obstructions that will affect the flow around the enclosure (putting it on a tripod is optional).

- The Enclosure is not resting directly on the ground (no standing water).

- The DUSTTRAK monitor has been set to the appropriate logging mode.

- The Enclosure is locked shut to prevent theft or vandalism to instrument.

- Plans have been made to check for maintenance and data collection every 24 hours after initial set up.

After the completion of monitoring, follow the procedures for transporting the Environmental Enclosure in the Setting-Up section of this appendix. This prevents the instrument from becoming damaged.

Maintenance

Daily Maintenance Checks

The DUSTTRAK monitor should be checked a minimum of once a day to change the battery pack and make sure the instrument is operating properly. A visual inspection of the instrument and case can ensure that the water trap is empty, the sampling inlet is unobstructed and the tubing is not kinked.

Cleaning the Aerosol Inlet

Under normal operating conditions, the external aerosol inlet will remain clean and unobstructed. Under very dirty conditions; however, the inlet may become obstructed with vegetative debris or insects. To ensure the inside of the aerosol inlet is clean, periodically blow compressed air through the bottom of the inlet.

/!\	**C a u t i o n**
	Do _not_ disassemble the Environmental Enclosure aerosol inlet for any reason. It is not designed for field service and reassembly.

Cleaning the Respirable Aerosol Inlet

Follow the same procedure found in of this manual in the section entitled "Cleaning the Cyclone."

When to Change the Battery

The battery packs are designed to provide power to the DUSTTRAK monitor for a minimum of 24 hours, even under cold ambient conditions. To ensure uninterrupted operation, the packs should be replaced daily. If a battery pack has been forgotten and left connected to a running DUSTTRAK monitor, the extended-life battery will automatically quit delivering current to the DUSTTRAK monitor after its voltage drops below 5.1. At this point the internal, C-cell battery pack automatically switches over and begins powering the DUSTTRAK monitor with no loss of data.

Note: *An internal battery backs up the DUSTTRAK monitor memory. The logged data will not be lost even if **both** battery packs lose power.*

Replacing the Battery Pack

When changing the battery pack, you do *not* have to interrupt the sampling process as long as fresh batteries are installed in the DUSTTRAK monitor's *internal* battery compartment. Replace the discharged external battery with the newly charged one, taking care to secure the fully charged battery with the Velcro strap. When closing the case make sure that the tubing does *not* become kinked. Pull the tubing in front of the battery bracket while closing

the case to prevent this from occurring. To prevent long term damage and loss of capacity recharge the battery promptly after removing it.

Recharging the Battery Packs

The following steps should be followed to correctly recharge the battery packs:

- Disconnect the battery pack from the DUSTTRAK monitor and remove it from the Environmental Enclosure.

- Take it to a protected area where it can be charged undisturbed for 12 to 15 hours.

- Check on the bottom of the charger to see that the red voltage switch is set appropriately to either 115V or 230V.

- Supply power to the charger. The green LED lights on the front of the charger.

- Insert the power plug protruding from the battery pack into the output jack attached to the charger. The charger will now quick-charge the battery. This is indicated by an illuminated yellow LED.

- Charging is complete when the yellow LED shuts off. A trickle charge will maintain the full charge. A fully discharged battery will require up to 15 hours to fully recharge.

Note: *Do Not Store A Battery Pack That Has Not Been Fully Charged. Storing a discharged battery for any length of time will negatively affect the battery life.*

Battery Pack Life

Lead acid batteries have a finite life of about 300 charging cycles. This means that the two battery packs last around two years without need of replacement. This assumes that the batteries are being used to run a DUSTTRAK monitor every day, and that they are properly cared for and rotated daily. To help track battery lifetime, an In-service Date sticker has been attached to the front of the battery pack to inform you when each battery pack was shipped from TSI. Replacement battery packs may be ordered from TSI. See the previous section of this appendix on "Parts Identification" for more information.

Emptying the Water Trap

If any water or moisture has accumulated in the water trap, be sure to unscrew the water trap from the internal inlet and empty it. Take care when removing and reinstalling the bottle to prevent damage to the threads. The bottle must be securely hand tightened to seal against the O-ring to prevent leaking.

Storage Precautions

This instrument must be stored in a location where the temperature remains between –20 and 60°C (–4 and 140°F).

Troubleshooting the Environmental Enclosure

The table below lists the symptoms, possible causes and recommended solutions for common problems encountered with the DUSTTRAK Environmental Enclosure.

Symptom	Possible Cause	Corrective Action
DUSTTRAK monitor does not turn on.	Uncharged battery.	Connect to charger and wait until the yellow LED turns off.
	External battery pack not plugged to DUSTTRAK monitor.	Plug battery power plug into the power jack in DUSTTRAK monitor.
	Bad battery pack (no longer able to be recharged).	Replace with new battery pack.
Readings are unusually low.	Zero was not checked on DUSTTRAK monitor.	Re-zero DUSTTRAK monitor at desired sampling conditions.
	Plugged external inlet.	Remove inlet from the Enclosure; blow out debris with compressed air. Rinse with clean air, if needed. DO NOT DISASSEMBLE COVER ON INLET ASSEMBLY.
		Take off water trap bottle and clean all exposed surfaces.
	Sampling in wind speeds over 22 mph.	DUSTTRAK monitor will under-sample slightly in high wind speeds. No correction possible.
	Enclosure located near an object that obstructs the flow.	Move the Environmental Enclosure into a more open area.
	Leak in the inlet.	Make sure the upper inlet assembly and the water trap are screwed in tightly.
		Make sure tubing is secured on the enclosure barb and the DUSTTRAK monitor.

Symptom	Possible Cause	Corrective Action
Readings are unusually low *(cont.)*.	Leak in the inlet. *(cont.)*	Make sure inlet assembly O-ring is in place. Re-grease the O-rings sealing the inlet assembly and the water trap bottle.
DUSTTRAK monitor Display reads "MEMORY 0%".	Memory is full.	Download memory to a PC if desired then clear memory.

Specifications: Environmental Enclosure

Specifications are subject to change without notice.

Sampling Conditions:

Operating Temperature: . 0 °C to 50 °C (32 °F to 120 °F)

Wind Speed: .... 0 m/s to 10 m/s (0 mph to 22.5 mph)

Aerosol Concentration
Range: .... 0.001–100 mg/m^3 (calibrated to respirable
fraction of standard ISO 12103-1, A1 test
dust)

Storage Temperature:...... -20 °C to 60 °C (-4 °F to 140

Zero stability:................... ±0.001 mg/m^3 over 24 hours using
10-second time-constant

Particle size range: .... 0.1–approximate 10 μm (Upper limit is
dependent on flow rate)

Flow rate: .... 1.7 L/min.

Temperature coefficient: .. +0.001 mg/m^3 per °C (for variations from
temperature at which DUSTTRAK monitor
was zeroed)

Physical:

External dimensions:........ 406 mm x 330 mm x 191 mm
(16 in. x 13 in. x 7.5 in.)

Weight (with battery and
DUSTTRAK monitor): .... 7.2 kg (15.8 lb.)

USER MAINTENANCE:

Maintenance Check/
Data Collection:............... Daily

Clean inlet: .... Weekly or daily if concentrations of over
30 mg/cm^3 are measured.

Re-grease O-rings: .... As needed

Power Requirements:

External Battery Pack: ..... 6 VDC, 10 Ah

Battery run-time: .... 24–60 hours (typical)

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