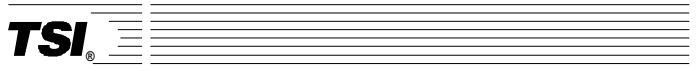


Model 8570

***PROTECTAIR™
Multi-Gas Monitor***

***Operation and Service
Manual***

*October 1999
P/N 1980331, Rev. A*



TSI Incorporated

Model 8570

PROTECTAIR™
Multi-Gas Monitor

**Operation and Service
Manual**

*October 1999
P/N 1980331, Rev. A*

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Limitation of Warranty and Liability

Seller warrants that this product, under normal use and service as described in the operator's manual, shall be free from defects in workmanship and material for a period of twenty-four (24) months, or the length of time specified in operator's manual, from the date of shipment to the customer. This limited warranty is subject to the following exclusions:

- a. Batteries, hot wire or hot film sensors and certain other components when indicated in specifications are warranted for a period of 90 days from the date of shipment to the customer.
- b. Seller does not provide any warranty on gas sensors that are exposed to known sensor poisons, as listed in Product User Manual.
- c. With respect to any repair services rendered, Seller warrants that the parts repaired or replaced will be free from defects in workmanship and material, under normal use, for a period of 90 days from the date of shipment to the customer.
- d. Seller does not provide any warranty on finished goods manufactured by others. Only the original manufacturer's warranty applies.
- e. Unless specifically authorized in a separate writing by Seller, Seller makes no warranty with respect to, and shall have no liability in connection with, any goods which are incorporated into other products or equipment by the Buyer. All goods returned under warranty shall be at the Buyer's risk of loss, Seller's factory prepaid, and will be returned at Seller's risk of loss, Buyer's factory prepaid.

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Service Policy

Knowing that inoperative or defective instruments are as detrimental to TSI as they are to our customers, our service policy is designed to give prompt attention to any problems. If any malfunction is discovered, please contact your nearest sales office or representative, or call TSI's Customer Service department at (800) 926-8378 (USA) or (001 651) 490-2760 (International).

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To obtain Application Notes for this instrument, contact TSI at:
U.S. (800) 926-8378 / (651) 490-2760, Fax: (651) 490-2704
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Application Notes can also be found under
TSI's web site:

http://www.tsi.com, Click on:
Health and Safety Instruments, then
Applications



SAFETY INFORMATION

The following message types will be used throughout this manual to draw your attention to special information that is critical to the safe and correct operation of the PROTECTAIR Multi-Gas Monitor. These messages appear in **bold** and should be read carefully.

WARNING: Notifies you of potentially dangerous situations or conditions that could result in personal injury or death.

Caution: Notifies you of potential damage to equipment.

Note: Notifies you of additional or important information.



WARNING

This instrument has been designed to respond to oxygen, toxic and combustible gases and provide advanced warning of potentially dangerous or life-threatening conditions. In order for this instrument to work properly and provide the maximum level of safety, it is essential to read, understand and follow all instructions in this manual.



WARNING

Both oxygen-enriched and oxygen-deficient atmospheres can affect the accuracy of the combustible gas sensor. You must exercise extreme caution when operating in either environment.




Caution

The response of the combustible gas sensor can be affected by silicone compound and leaded gasoline vapors, causing erroneously low readings. If the instrument has been exposed to such vapors, verify the instrument calibration before further use.


Note: *This instrument has been classified by the Underwriters Laboratory to be intrinsically safe in Class I, Division 1, Groups A, B, C and D with a temperature rating of T3 (with NiMH battery pack #801162) and T4 (with alkaline batteries).*

The following information and/or warning labels are located on the PROTECTAIR Multi-Gas Monitor and on various instrument accessories.

TSI INCORPORATED
PROTECTAIR DOCKING STATION
P/N: 801551
CAUTION: REPLACE/CHARGE
BATTERIES IN AN AREA KNOWN TO
BE NON-HAZARDOUS.



TSI INCORPORATED
PROTECTAIR PUMP MODEL 8571-03
INTRINSICALLY SAFE
USE ONLY WITH PROTECTAIR MODEL 8570
WARNING: SUBSTITUTION OF
COMPONENTS MAY IMPAIR INTRINSIC
SAFETY.

 S/N:



TSI INCORPORATED
PROTECTAIR NiMH BATTERY PACK
PART NUMBER: 801162
CAUTION: REPLACE/CHARGE
BATTERIES IN AN AREA KNOWN TO
BE NON-HAZARDOUS.

USE ONLY WITH
PROTECTAIR PUMP
MODEL 8571-03

TSI INCORPORATED
MODEL 8751-04. SEE
OPERATORS MANUAL

USE ONLY WITH
PROTECTAIR REMOTE
ALARM, MODEL 8571-04

TSI INCORPORATED PROTECTAIR MODEL 8570 INTRINSICALLY SAFE CLASS I DIVISION 1 GROUP A, B, C, D
TEMP CODE T3 (WITH TSI PACK PN:801162) OR TEMP CODE T4 WITH 6 SIZE AA, ALKALINE 1.5V BATTERIES.
WARNING: NOT INTENDED FOR USE IN ATMOSPHERES CONTAINING AN OXYGEN CONCENTRATION
GREATER THAN 21%. CAUTION: REPLACE/RECHARGE BATTERIES IN AN AREA KNOWN TO BE NON-
HAZARDOUS. WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

 INTRINSICALLY
SAFE EQUIPMENT
AND SYSTEMS
FOR USE IN
HAZARDOUS
LOCATIONS.

Chapter 1

Unpacking the PROTECTAIR Multi-Gas Monitor

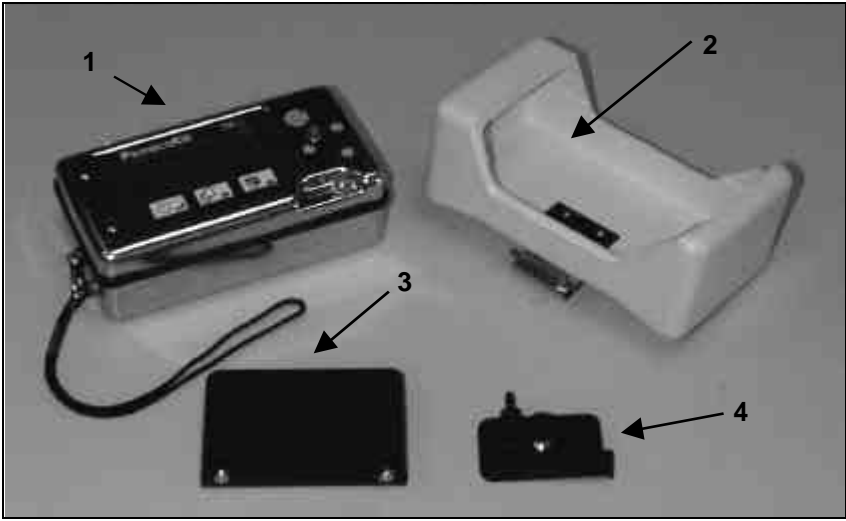
Carefully unpack the Model 8570 PROTECTAIR Multi-Gas Monitor and any optional accessories from their shipping containers. Use the tables and illustrations below to make certain that there are no missing components. Contact TSI immediately if anything is missing or damaged.

Unpacking the Model 8570 PROTECTAIR Multi-Gas Monitor

Compare all the components you received with those listed in Figure 1-1.

Figure 1-1: Model 8570 PROTECTAIR Multi-Gas Monitor

Quantity	Item Description	Part/Model	Ref
1	Model 8570 Multi-Gas Monitor	8570	1
1	Protective Rubber Boot	801511	2
1	Alkaline Battery Pack	801553	3
6	AA Alkaline Batteries (not shown)	1208013	
1	Calibration Adapter	801512	4
1	Data Dock	801602	5
1	Computer cable, 9-pin to RJ-45	800563	6
1	TRAKPRO Data Analysis software 3.5" diskettes	800700	7
1	Operation and Service Manual	1980331	8



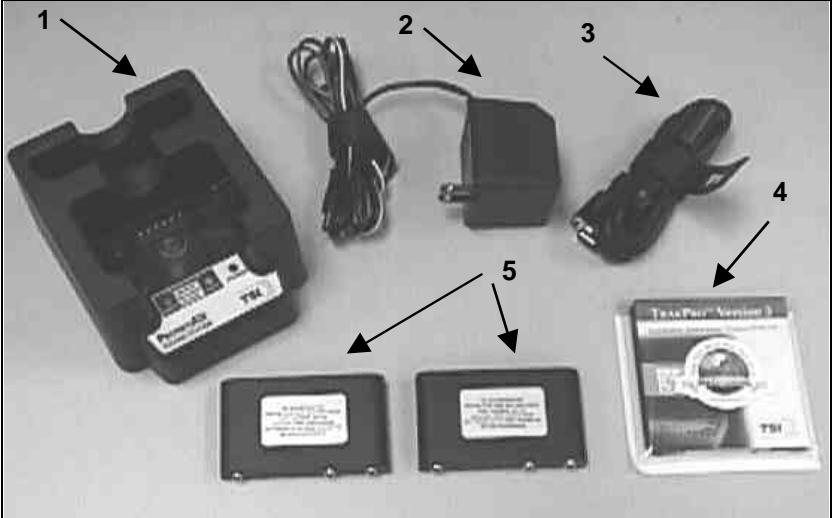
The following pages contain component identification information for the optional accessories available for the PROTECTAIR Multi-Gas Monitor.

Unpacking the Model 8571-01 Smart Charging/Docking Station

Compare all the components you received with those listed in Figure 1-2.

Figure 1-2: Model 8571-01 Smart Charging/Docking Station

Quantity	Item Description	Part/Model	Ref
1	Smart charging/docking station	801551	1
1	For North American applications: AC adapter 115 VAC / 60 Hz	2613140	2
1	For all-other applications: AC adapter 100-250 VAC / 50-60 Hz	2613141	2a
1	Power cord for AC adapter (country specific; not shown)	Contact TSI/ Customer Service	2b
1	Computer cable, 9-pin to RJ-45	800563	3
1	TRAKPRO Data Analysis software 3.5" diskettes	800700	4
2	NiMH rechargeable battery pack	801162	5

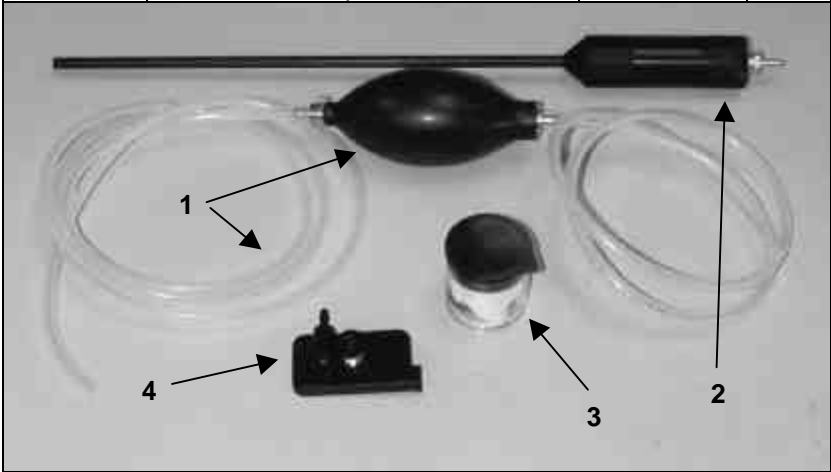


Unpacking the Model 8571-02 Manual Sample Pump

Compare all the components you received with those listed in Figure 1-3.

Figure 1-3: Model 8571-02 Manual Sample Pump

Quantity	Item Description	Part/Model	Ref
1	Manual sample pump and tubing	1082773	1
1	Sample probe	801515	2
1	Sample probe spare parts kit 3 particle filter disks 3 hydrophobic filter membranes 2 O-rings	801513	3
1	Calibration Adapter	801512	4



Unpacking the Model 8571-03 Continuous Sample Pump

Compare all the components you received with those listed in Figure 1-4.

Figure 1-4: Model 8571-03 Continuous Sample Pump

Quantity	Item Description	Part/Model	Ref
1	Continuous sample pump, with boot	801552	1
1	Sample probe	801515	2
1	Sample probe spare parts kit 3 particle filter disks 3 hydrophobic filter membranes 2 O-rings	801513	3
1	5 ft sample tubing	801581	4

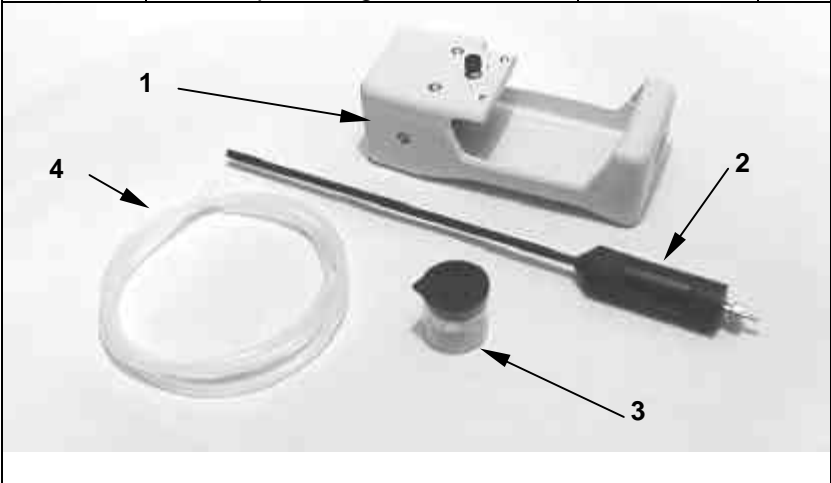


Figure 1-5: Other Accessories

Item Description	Part/Model
Remote alarm	8571-04
Belt Holster	8571-05
Carrying case	8571-06
Hydrogen sulfide calibration kit (25 ppm) ¹	801567
Carbon monoxide calibration Kit (50 ppm) ¹	801568
Nitrogen dioxide calibration Kit (10 ppm) ¹	801569
Nitric oxide calibration kit (25 ppm) ¹	801570
Sulfur dioxide calibration kit (10 ppm) ¹	801571
Combustible gas calibration kit (50% LEL)	801587
Multi-gas calibration kit (50%LEL CH ₄ , 25 ppm H ₂ S, 50 ppm CO, 12%O ₂)	801572

¹ All calibration kits include a carrying case, regulator, tubing and one cylinder of calibration gas.

Figure 1-6: Spare Parts for the PROTECTAIR Multi-Gas Monitor

Item Description	Part/Model
Hydrogen sulfide calibration gas (25 ppm)	801301
Carbon monoxide calibration gas (50 ppm)	801584
Nitrogen dioxide calibration gas (10 ppm)	801303
Nitric oxide calibration gas (25 ppm)	801304
Sulfur dioxide calibration gas (10 ppm)	801302
Methane calibration gas (50 % LEL)	801300
4-gas mixture calibration gas (50%LEL CH ₄ , 25 ppm H ₂ S, 50 ppm CO, 12%O ₂)	801305
Zero air calibration gas (air)	800697
0.75 LPM gas regulator	801306
Combustible gas sensor	2917016
Oxygen sensor	801573
Carbon monoxide sensor	801369
Hydrogen sulfide sensor	801370
Sulfur dioxide sensor	801371
Nitric oxide sensor	801372
Nitrogen dioxide sensor	801373
3V lithium battery	801596
5' sample tubing	801581
25' sample tubing	801582
100' sample tubing	801583

Chapter 2

Instrument Operation

This section contains operating instructions for the Model 8570 PROTECTAIR Multi-Gas Monitor. Operating instructions for the instrument accessories are found in Chapter 3.

Parts Identification for the PROTECTAIR Multi-Gas Monitor

Figures 2-1A, 2-1B, and 2-1C identify the parts of the Model 8570 PROTECTAIR Multi-Gas Monitor. Please become familiar with these components before proceeding.

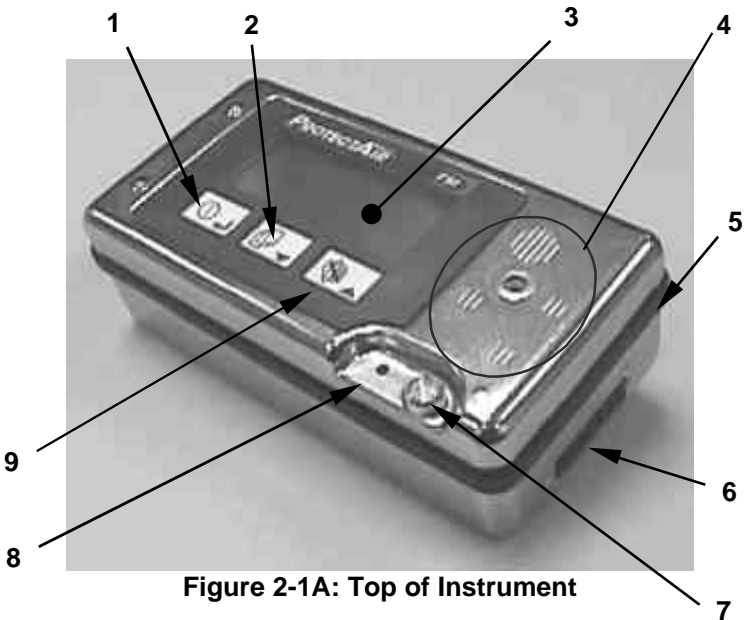


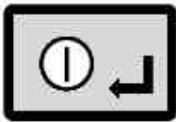
Figure 2-1A: Top of Instrument

- | | |
|--------------------------|----------------------|
| 1. Power (ENTER) key | 6. Docking connector |
| 2. Page (DOWN) key | 7. Visual alarm |
| 3. LCD display | 8. Audible alarm |
| 4. Sensor diffusion area | 9. Reset (UP) key |
| 5. Sealing gasket | |



Figure 2-1B: Bottom of Instrument

- | | |
|----------------------------|------------------|
| 10. Remote alarm connector | 12. Battery door |
| 11. "Quick Start" label | 13. Wrist strap |



ENTER



PAGE(DOWN)











RESET(UP)

Figure 2-1C: Instrument Keys

Quick Start Label

The PROTECTAIR Multi-Gas Monitor contains a “Quick Start” reminder label on the back of the instrument. This label reminds you how to perform routine operations. See the sample below.

Operation	Procedure	PROTECTAIR
Turn on	Press and hold  . Follow prompt on display.	
Continue Shift	Press  when prompted during instrument startup.	
Battery Life	Displayed during startup. Replace if less than 10%.	
Instrument Status	Press  key to scroll status screens.	
Advanced Setup Mode	Press and hold   keys during turn on. Scroll selections with   arrow keys. Follow prompts on display.	
Turn Off	Press and hold  . Follow prompt on display.	

Installing the Battery Pack



WARNING

In order to prevent the risk of an explosion, replace or recharge batteries in an area known to be non-hazardous.

The instrument is powered with either an alkaline battery pack or a rechargeable nickel metal hydride (NiMH) pack. To install the pack, open the battery access door by loosening the captive screw. Then, insert the battery pack as shown in Figure 2-2 with the battery contacts facing inward. Close the battery door and retighten the captive screw fully.



Figure 2-2: Installing NiMH (left) and Alkaline Battery Packs



WARNING

Use only 6 AA alkaline batteries (type CR121) or TSI NiMH pack P/N: 801162. Substitution of components may impair intrinsic safety.

Note: *When using the alkaline pack, make sure the batteries are installed in the pack according to the polarity markings on the outside of the pack.*

Attaching the Rubber Boot

The instrument can be used with or without the rubber boot. The rubber boot comes with a captive-style belt clip. To attach the rubber boot to the instrument, do the following:

1. Insert the wrist strap through the opening on the left side and push the instrument into the boot as shown in Figure 2-3.
2. Push the right side of the instrument into the boot and pull the boot over the top edge of the instrument.



Figure 2-3: Attaching the Rubber Boot

Turning the Instrument On

Turn the instrument on by pressing the POWER (enter) key and holding it down for 3 seconds. The instrument will display the following message:

```
POWER DELAY  
HOLD KEYPAD: 3
```

After 3 seconds, the audible and visual alarms will sound. Release the POWER key. The instrument will go through a start-up sequence and then into normal operation.

Turning the Instrument Off

The instrument can be turned off at any time following the start-up by pressing the POWER key and holding it down for at least 3 seconds. The instrument will display the following message:

```
POWER DELAY  
HOLD KEYPAD: 3
```

After 3 seconds, the audible and visual alarms sound. Release the POWER key and the instrument will turn off.

Selecting Battery Type

After turning on the instrument, you must select the type of battery currently installed in the PROTECTAIR. Simply select the left key (ENTER) if using alkaline batteries or the right key (RESET) if using nickel metal-hydride. The instrument will display the following message:

```
PRESS KEY BELOW  
BATTERY TYPE  
  
ALKALINE      NiMH
```

Continuing Shift Averages

Each time the instrument is turned on, the TWA, STEL, and peak values are reset. If desired, these values can be carried over from the previous logging interval using the “Continue Shift” function.

Note: *This function is useful when you want to shut off the instrument for a period of time (for example, a lunch break) but then desire to continue the previously recorded values for peak, STEL, and TWA.*

During the start-up sequence, the following message is displayed for 4 seconds to allow the instrument to continue with the last TWA, STEL, and peak values. These values are described later in this chapter.

```
PRESS ENTER TO  
CONTINUE SHIFT
```

When ENTER is pressed, the instrument returns the message, “SHIFT CONTINUED.”

Selecting the User ID

The User ID is a 16-character string that is used to identify you each time the instrument is turned on. The instrument can store up to 20 unique User IDs. During the start-up sequence, the current User ID displays for 2 seconds as shown below.

```
--USER ID--  
                USER 01  
PRESS ENTER TO  
CHANGE USER
```

To select a different User ID, press the ENTER key and use the UP and DOWN arrow keys to choose from any of the 20 available User IDs. Press the ENTER key again to accept the new User ID. The available list of User IDs is changed using TRAKPRO software.

To edit the list of User IDs in TRAKPRO software, select **Instrument Setup, Parameters, and Users**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

Note: *If the CONTINUE SHIFT option has been selected, the USER ID and LOCATION ID screens will not display. The selections made for the previous logging interval will be carried over for this “continued” logging interval.*

Selecting the Location ID

The Location ID is a 16-character string that is used to identify a specific location each time the instrument is turned on. The instrument can store up to 20 unique Location IDs. During the start-up sequence, the current Location ID is displayed for 2 seconds as shown below.

```
--LOCATION ID--  
                LOCATION 01  
PRESS ENTER TO  
CHANGE LOCATION
```

To select a different Location ID, press the ENTER key and use the UP and DOWN arrow keys to choose from any of the 20 available Location IDs. The list of Location IDs is changed using TRAKPRO software.

To edit the list of Location IDs in TRAKPRO software, select **Instrument Setup, Parameters, and Locations**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

Accessing Available Display Pages

The instrument has seven different pages that are accessed by pressing the PAGE key. Each time the key is pressed, the next page is displayed. If no key is pressed for 30 seconds, the instrument returns to the VALUES page. By default, all pages are accessible. You can lockout all pages except the VALUES, FRESH AIR ZERO and STATUS pages through the Advanced Setup or with TRAKPRO software.

VALUES Page

The VALUES page is used to display the gases that are being measured, the concentrations, and a status message for each sensor. The symbol “EX” is used for the combustible gas sensor.

EX	∅	OK
O2	2∅.9	OK
CO	∅	OK
H2S	∅	OK

Figure 2-4 lists the possible status messages that could appear on the VALUES page.

Figure 2-4: Status Messages

Message	Definition
OK	Sensor is operational
ALM	Alarm indication
CAL	Sensor calibration interval has expired; sensor must be calibrated
ZER	Zero error
SPN	Span error
FLT	Sensor fault
---	No sensor installed
UNKNOWN SENSOR	Sensor not recognized by firmware

Refer to Appendix B for complete information about sensor status indications.

ZERO Page

The Zero page is used to perform a “fresh air zero” on the instrument at any time the instrument is in use. Refer to Chapter 4 for details on zeroing the instrument.

Z	PRESS ENTER
E	TO FRESH AIR
R	ZERO
O	INSTRUMENT

UNIT Page

The UNIT Page displays which sensors are currently installed in the PROTECTAIR and the units of measurement for each sensor. The first two slots are reserved for the combustible and oxygen sensors, respectively. The third and fourth slots are reserved for toxic gas sensors.

U	EX	%LEL
N	O2	%VOL
I	CO	PPM
T	H2S	PPM

PEAK Page

The PEAK page displays the maximum concentrations for each gas and the minimum oxygen concentration the instrument has measured since the instrument was turned on. If the shift values were continued on start-up (using “CONTINUE SHIFT”), the PEAK page displays the maximum concentrations for each gas and the minimum oxygen concentration the instrument has measured since the values were last reset.

P	EX	Ø
E	O2	2Ø.4 21.Ø
A	CO	5
K	H2S	2

STEL Page

The STEL page displays the Short Term Exposure Limit for each toxic sensor that is installed along with the STEL alarm condition. By default, the STEL is a running average of the last 15 minutes. The STEL value will be blank for the first three minutes of instrument operation. From 3 minutes until 15 minutes, the instrument displays a predicted STEL value. The averaging time may be changed through TRAKPRO software, under **Instrument Setup, Alarms**.

S			
T			
E	CO	Ø	OK
L	H2S	Ø	OK

TWA Page

The TWA page displays the Time-Weighted Average for each toxic sensor that is installed. The TWA is based on eight hours. The TWA page also displays the elapsed time (ET, in 24-hour format) since the unit was turned on. In the example below, the elapsed time is 1 hour, 25 minutes.

T		ET: 01:25	
W			
A	CO	Ø	OK
	H2S	Ø	OK

Note: *The elapsed time (ET) is also continued when using the CONTINUE SHIFT option. The ET is the sum of the previous logging period plus the present period.*

STATUS Page

The STATUS page displays the date, time (in 24-hour format), the battery charge remaining, and memory space available.

10/06/98
14:25:01
BATT CHARGE: 75%
MEMORY FREE: 64%

Turning the Backlight On

The instrument has a display backlight that automatically turns on whenever any button is pressed or any alarm occurs. By default, the backlight automatically turns off after 30 seconds. The amount of time the

backlight stays on can be changed through the Advanced Setup. See Chapter 5 for more details.

To edit the backlight “on” time in TRAKPRO software, select **Instrument Setup, Parameters, and Other**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

Instrument Alarms

The PROTECTAIR Multi-Gas Monitor produces an alarm under two main conditions: system faults and general alarms.

System Faults

A system fault occurs when the instrument is not operating correctly. System faults require attention and corrective action before the instrument can be put back into service. When a system fault occurs, one of the following messages will be displayed:

-SYSTEM FAULT- PUMP STOPPED PRESS RESET	Indicates the flow through the continuous sample pump has stopped. Pressing the RESET key twice starts the pump up again.
-SYSTEM FAULT- LOW BATTERY PLEASE REPLACE	Indicates the battery voltage is too low. The battery pack must be replaced.
-SYSTEM FAULT- BACKUP BATTERY IS LOW - REPLACE	Indicates the backup battery used to power the memory and sensors is low and needs to be replaced.

General Alarms

A general alarm occurs when a gas concentration exceeds the defined alarm level or there is a problem with one of the sensors. Figure 2-5 describes the different types of general alarms along with the message that is displayed on the VALUES page and the type of audible/visual alarm given.

Figure 2-5: General Alarms

Alarm Type	Message	Audible/Visual Alarm
Calibration required	CAL	Slow pulse ¹
Sensor fault	FLT	Slow pulse ¹
Span fault	SPN	Slow pulse ¹
Zero fault	ZER	Slow pulse ¹
EX shut down	OFF	Steady
EX low alarm	ALM	Slow pulse ¹
EX high alarm	ALM	Steady
O ₂ low alarm	ALM	Steady
O ₂ high alarm	ALM	Steady
Toxic TWA alarm	ALM	Steady
Toxic STEL alarm	ALM	Steady
Toxic peak alarm	ALM	Steady

¹ Slow pulse alarms sound once every 10 seconds.

Alarm Modes

There are two types of alarm modes: a non-latching mode and a latching mode.

Non-latching Mode

In the non-latching mode, the audible and visual alarms are active and the ALM message appears on the display whenever the concentration exceeds the defined alarm level and stops when the concentration comes back into the normal range.

The audible and visible alarms may be momentarily silenced by pressing the RESET button (the ALM message remains on the display). If the alarm condition continues to occur 1 minute after the RESET, the audible and visual alarms are reactivated. The ALM message on the display automatically resets after the concentration comes back into the normal range.

Latching Mode

In the latching mode, the audible and visual alarms behave in the same manner as the non-latching mode (that is, they may be RESET and will reactivate in the presence of the gas). The difference comes in the ALM message. In the latching mode, the ALM message remains on the display until the instrument is turned off.

Note: *The alarm for the combustible gas measurement is always latching.*



Caution

If the instrument measures a combustible gas concentration over 100% LEL, the instrument will shut down the combustible gas sensor to prevent permanent damage to the sensor. The only way to clear this alarm is to turn the instrument off and restart it in an area known to be non-hazardous. The combustible gas sensor should be calibrated before further use.

The instrument alarm levels and alarm mode are changed through the Advanced Setup (see Chapter 5) or with the TRAKPRO software.

To edit the alarm mode (latching or non-latching) in TRAKPRO software, select **Instrument Setup, Parameters, and Other**. To edit the alarm levels, select **Instrument Setup, Alarms**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

Data Logging

Every Model 8570 PROTECTAIR Multi-Gas Monitor has built-in data logging capabilities. Every time the instrument is turned on, it automatically starts a new test and logs data in one-minute intervals. Data is logged for each sensor that is installed in the instrument, along with the date and time each test started. The instrument is capable of storing approximately 40 hours of data and can store up to 35 different tests.

TRAKPRO Data Analysis Software and a Data Dock are supplied with each PROTECTAIR instrument. The Data Dock allows you to connect the PROTECTAIR to a personal computer and download the data files using TRAKPRO Data Analysis Software.

To download a data file using TRAKPRO software, do the following:

1. Connect the supplied serial cable from the Data Dock to a serial port on the computer.
2. Make sure the instrument is turned on.
3. Place the instrument into the Data Dock or the Smart Charging/Docking station.
4. Start TRAKPRO software and select the PROTECTAIR under **Options, Software Configure**.
5. Select **File, Receive** or the “Receive Data” icon on the menu bar. This opens a self-prompting dialog box for downloading data files. Follow the onscreen instructions or open the Help function (F1) to obtain further information.

Note: *When the data logging memory becomes full, the instrument automatically deletes the oldest test to free up necessary memory. If this data has not been downloaded to a computer, it will be lost.*

Chapter 3

Accessory Operation

This chapter contains operating information on the Model 8570 PROTECTAIR Multi-Gas Monitor accessories. Operating instructions for the instrument are found in Chapter 2.

Manual Sample Pump

The manual sample pump consists of a hand-aspirated squeeze bulb and two sections of tubing. The shorter section of tubing is attached to the instrument and the longer section is used to draw a sample of air. The squeeze bulb has two check valves which only allows air to flow in one direction. The manual sample pump must be used with the calibration adapter.

Attaching the Manual Sample Pump

To attach the manual sample pump to the instrument, first attach the calibration adapter to the instrument by positioning the calibration adapter over the sensor diffusion area and locking it in place with the captive screw. Then attach the shorter end of the sample tubing to the calibration adapter (refer to Figure 3-1).



Figure 3-1: Manual Sample Pump

Testing the Manual Sample Pump



WARNING

Inaccurate readings may result if the manual sample pump is not installed correctly. To ensure everything is working properly, the manual sample pump must be tested every time it is used.

To test the manual sample pump, refer to Figure 3-2 and follow the procedure below.

1. Compress and hold the squeeze bulb.
2. Plug the inlet of the sample tubing with your finger.
3. Release the squeeze bulb.
4. Watch the squeeze bulb. It should remain collapsed as long as the inlet is blocked off.
5. If the squeeze bulb fills with air when the inlet is blocked off, check the setup and make sure all tubing is free of any defects and attached securely.



Figure 3-2: Testing Manual Sample Pump



Caution

The most likely cause of a manual sample pump failure is connecting the pump in the wrong direction. Make sure the directional arrow on the pump body is pointing in the direction of the instrument.

Continuous Sample Pump

This section describes the parts of the continuous sample pump, installing the instrument into the continuous sample pump and using the continuous sample pump.

Parts Identification for the Continuous Sample Pump

Figure 3-3 identifies the parts of the Model 8571-03 Continuous Sample Pump. Please become familiar with these components before proceeding.

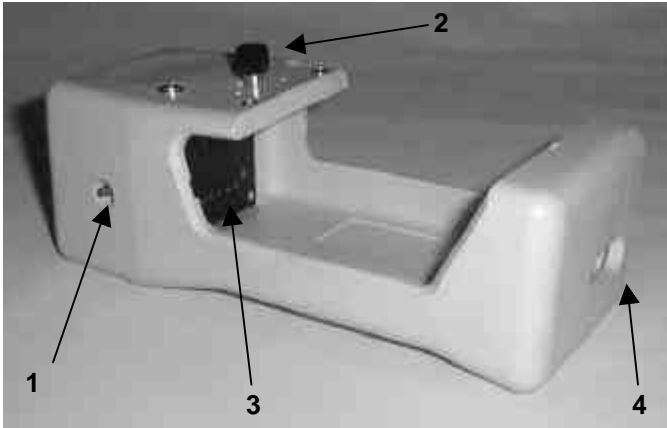


Figure 3-3: Continuous Sample Pump

- | | |
|----------------------|----------------------------|
| 1. Gas inlet fitting | 3. Docking connector |
| 2. Captive screw | 4. Remote connector cutout |

Installing Instrument into Continuous Sample Pump

To install the instrument into the continuous sample pump, follow these steps:

1. Push the instrument into the pump boot as shown in Figure 3-4. Make sure the docking connector on the instrument lines up with the connector on the pump.
2. Insert the wrist strap through the opening in the boot.
3. Finally, push the right side of the instrument into the boot and pull the boot over the top edge.



Figure 3-4: Installing Instrument into Continuous Sample Pump

Using the Continuous Sample Pump

The continuous sample pump has a built-in pump that draws approximately 1 LPM of air into the instrument. The pump draws power directly from the instrument. TSI recommends using the continuous sample pump with the provided sample probe. The sample probe has built-in particle and hydrophobic filters that keep the pump clean and prevent liquid from drawing into the pump. Figure 3-5 shows the continuous sample pump used with the sample probe.



Figure 3-5: Continuous Sample Pump With Sample Probe

Note: *The instrument continuously monitors the pump, turns the pump off and provides an alarm if the flow is blocked. If this occurs, clear the obstruction and press the RESET key **TWICE** to start the pump again.*

Smart Charging/Docking Station

The docking station recharges the NiMH batteries and downloads data from the instrument to the computer for analysis with TRAKPRO Data Analysis Software.

Parts Identification for the Smart Charging/Docking Station

Figure 3-6 lists the parts of the Model 8571-01 Smart Charging/Docking Station. Please become familiar with these components before proceeding.

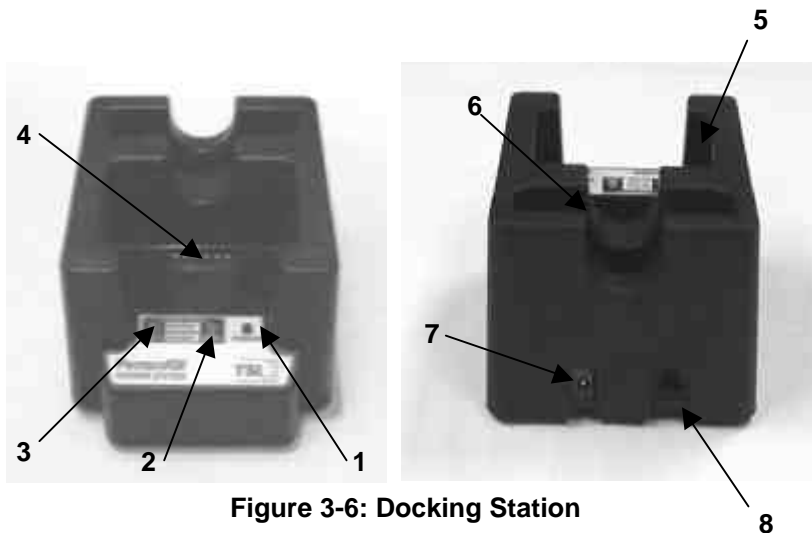


Figure 3-6: Docking Station

- | | |
|--------------------------|--------------------|
| 1. Power LED | 5. Instrument Slot |
| 2. Instrument Status LED | 6. Battery Slot |
| 3. Battery Status LED | 7. Power Connector |
| 4. Docking Connector | 8. Data Port |

Recharging the Nickel Metal Hydride (NiMH) Batteries



WARNING

To prevent the risk of an explosion, replace/charge batteries in an area known to be non-hazardous.

The docking station is capable of recharging both the NiMH battery pack installed in the instrument as well as the spare NiMH battery pack (see Figure 3-7).

Note: *The instrument must be turned off for the battery in the instrument to be charged.*



Figure 3-7: Operating the Docking Station

If both the instrument and spare battery are placed in the docking station, the docking station charges the battery that was installed first and then automatically charges the other battery. There are two status LEDs: one for the instrument and one for the spare battery. Figure 3-8 describes the meaning of the different LED states.

Figure 3-8: LED States

LED	Status
Steady green	Battery is fully charged
Steady red	Battery is charging
Pulsing red	Waiting for other battery to be charged first

It takes approximately 1 to 1½ hours to charge a NiMH battery pack.

Note: *The docking station will not charge batteries in the alkaline pack, even if a rechargeable type battery is used. Alkaline batteries installed in the instrument are also not charged.*

Downloading Data to a Computer

The docking station can also be used to download data from the instrument to a computer using the TRAKPRO software. Refer to Figure 3-9 for the proper location for the computer cable.

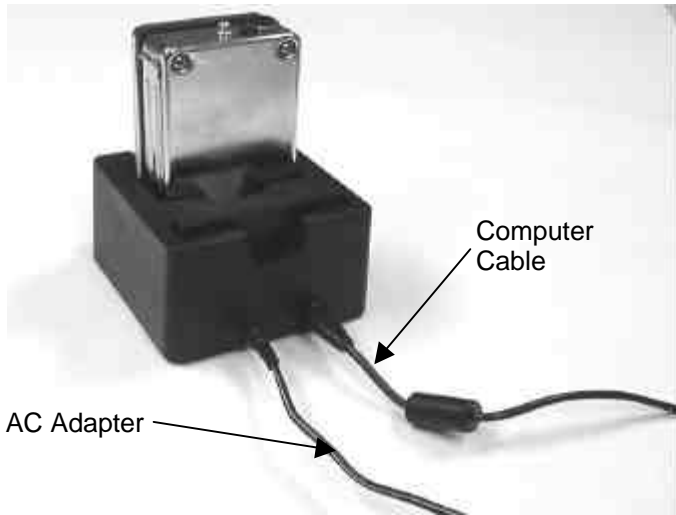


Figure 3-9: Cable Connections

To download a data file using TRAKPRO software, do the following:

1. Connect the supplied serial cable from the Data Dock to a serial port on the computer.
2. Make sure the instrument is turned on.
3. Place the instrument into the Data Dock or the Smart Charging/Docking station.
4. Start TRAKPRO software and select the PROTECTAIR under **Options, Software Configure**.
5. Select **File, Receive** or the “Receive Data” icon on the menu bar. This opens a self-prompting dialog box for downloading data files. Follow the onscreen instructions or open the Help function (F1) to obtain further information.

Remote Alarm

This section describes how to attach and use the remote alarm.

Attaching the Remote Alarm

To attach the remote alarm to the instrument, follow these steps:

1. Remove the protective cap from the auxiliary connector on the left side of the instrument.
2. Insert the remote alarm connector as shown in Figure 3-10.

3. Twist the connector shell clockwise one turn, to engage the locking feature.

Note: *After engaging locking feature on connector, tug gently on connector to make sure it is properly engaged.*



Figure 3-10: Attaching the Remote Alarm

Using the Remote Alarm

When attached to the instrument, the remote alarm is capable of providing both an audible and vibratory alarm. The remote alarm is activated whenever the audible and visual alarms on the instrument are activated. The remote alarm should be securely attached to your clothing, using the supplied clip. In high-noise environments, make sure the remote alarm is located close to the head/ear.

Chapter 4

Calibration and Maintenance

The Model 8570 PROTECTAIR Multi-gas monitor is designed for easy maintenance and calibration in the field. Some users will establish service criteria in accordance with their internal confined space or other requirements. The PROTECTAIR does not require factory servicing by TSI unless the instrument fails to function and is not repairable with the parts available through your local representative.

Factory Servicing

For optimal performance, some users choose to return the PROTECTAIR to TSI for annual servicing. TSI's annual servicing assures the highest performance and reliability of the instrument but is not a substitute for routine calibration and maintenance by the user. For instruments currently operating, factory service consists of cleaning and calibrating.

The following work will be performed when you order service numbers 85701 or 85702:

- Inspect the instrument for physical damage (extensive damage may result in irreparable instrument)
- Operate instrument to generate *as found* data, to be returned to customer
- Disassemble and clean, interior and exterior
- Clean and check function of standard components returned with the instrument, repair or replace as needed
- Remove, clean, repair or replace components as needed, including but not limited to:
 - PC boards
 - LCD display
 - Membrane switch
 - Lithium battery
 - All other mechanical components
- Replace gas sensors, at additional charge, if needed
- Upgrade EPROM (firmware) to most current version
- Reassemble and install new alkaline batteries
- Perform functional check
- Recalibrate with NIST traceable gases
- Replace calibration label
- Repackage in original carrying case with accessories (if applicable)
- Replace/Upgrade all manuals and software

If the instrument is not operating correctly and is in need of repair, the instrument should be returned to TSI for the Clean, Repair and Calibrate service. When this repair is included, use service numbers 85703 or 85704.

Calibration and Maintenance Schedule

Other than normal calibrations, the Model 8570 PROTECTAIR Multi-Gas Monitor requires very little maintenance. Figure 4-1 lists the factory-recommended calibration and maintenance schedule.

Figure 4-1: Recommended Calibration & Maintenance Schedule

Item	Frequency
Zeroing the instrument: “fresh air zero”	Prior to each use
Calibrating the instrument and/or checking the instrument response	Prior to each use
Replacing sensors	As needed
Replacing probe filters	As needed, depends on usage
Replacing lithium backup battery	As needed (≈2-3 years)

Instrument Calibration

This section gives instructions on zeroing the instrument, doing a quick check of the sensor response and calibrating the PROTECTAIR.



W A R N I N G
In order to ensure the PROTECTAIR Multi-Gas Monitor is providing the highest degree of safety, TSI recommends “fresh air zeroing” the instrument and verifying the instrument response to the gases of interest prior to each use.



W A R N I N G
The combustible gas sensor must be calibrated using the gas of interest. The combustible gas sensor in the instrument will <i>not</i> respond one-to-one for combustible gases different than the gas used to calibrate the instrument.



WARNING

When installing new sensors, the instrument must be calibrated before use. However, the instrument should not be calibrated for at least one hour. This allows sufficient time for the sensors to stabilize and will result in a more accurate calibration.

Note: TSI recommends that the instrument be in a stable environment for at least one hour before performing a calibration. This ensures the instrument is at the same temperature as the environment and will result in a more accurate calibration.

Note: The flowrate of all calibration gas should be between 0.75 and 1.0 liters per minute. Using flowrates outside this range could result in inaccurate calibrations.

Fresh Air Zero

To “fresh air zero” the instrument, turn the instrument on and wait for it to go through the start-up sequence. Then, press the PAGE key once to access the “fresh air zero” page, as shown below.

```
Z  PRESS ENTER
E  TO FRESH AIR
R   ZERO
O   INSTRUMENT
```

Pressing the ENTER key will display the following screen.

```
FRESH AIR ZERO
EX  Ø O2 2Ø.9
CO  Ø H2S  Ø
ZEROING      15
```

The display will count down from 15 and will then zero the instrument.

Note: If a cylinder of “zero” air is used for the fresh air zero, it must be turned on prior to pressing ENTER.

Error Detection during Fresh Air Zero

If toxic or combustible gases are present (even in small quantities) during a “fresh air zero,” the instrument will detect their presence and will return an error message on the VALUES page (see example below):

EX	∅	OK
O ₂	2∅.9	OK
CO	∅	ZER
H ₂ S	∅	OK

In this example, CO was present in sufficient quantity to prevent a reliable “fresh air zero.” This safety function of the instrument prevents you from inadvertently zeroing the instrument in contaminated air.

The error flag on the sensor warns you that the sensor(s) were not properly zeroed. This error must be corrected before the instrument is put into service.

Note: *When the sensor(s) display the ZER error, the instrument will retain the previous values for “zero.” The sensors will continue to function and the alarms will activate if gases are detected. However, without a reliable zero, there is no guarantee of their accuracy.*

If you are certain the atmosphere does **not** contain any pollutant gases, you must perform a Zero Calibration, which resets the instrument zero values. See Chapter 5, “Advanced Setup,” for complete details.

Attaching the Calibration Gas Adapter and Cylinder

The instrument is supplied with a special calibration adapter. This adapter is used when supplying calibration and/or zero gas to the instrument. Attach the calibration gas adapter and cylinder as follows:

1. Attach the calibration adapter to the instrument as shown in Figure 4-2, making sure that the captive screw on the calibration adapter is hand-tight.
2. Connect the gas delivery tube from the calibration cylinder to the inlet of the calibration adapter as shown in Figure 4-3.



Figure 4-2: Attaching the Calibration Adapter

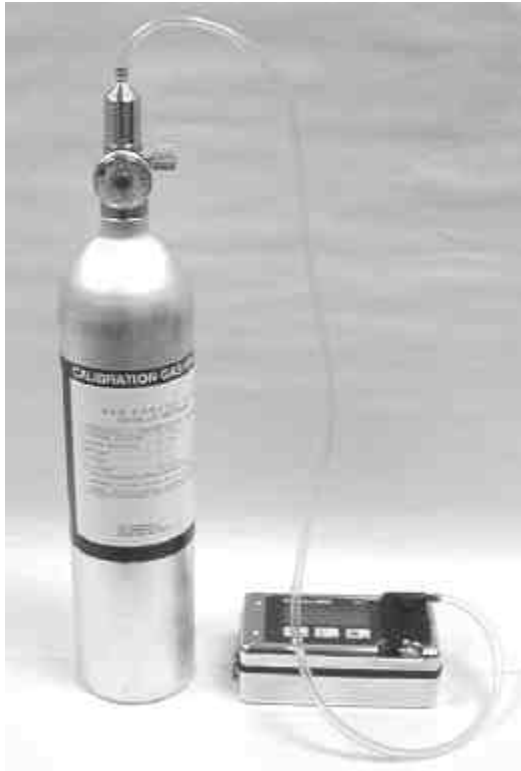


Figure 4-3: Attaching the Calibration Gas

Checking Instrument Response



WARNING

Accuracy of the instrument must be checked with a known concentration calibration gas prior to each use.

The instrument response should be checked daily or before each use. To check the instrument response, do the following:

1. Attach the calibration adapter and a tank of calibration gas to the instrument.
2. Turn on the calibration gas. Wait approximately 60 seconds and verify that the instrument is reading within $\pm 5\%$ of the known value. For example, the CO sensor is normally checked with 50 ppm span gas. After stabilizing, the instrument should read between 47 and 53 ppm.
3. If the instrument response is outside this range, it must be zeroed and spanned before using.

Calibrating the Instrument

To calibrate the instrument access the Advanced Setup menu, select the “CALIBRATION” option and press ENTER. The following screen is displayed:

```
--CALIBRATION--  
-> ZERO CALIB  
    SPAN ALL  
    EX SPAN  
-----  
    O2 SPAN  
    TOX1 SPAN  
    TOX2 SPAN  
    EXIT
```

Use the UP and DOWN arrow keys to select the type of calibration to perform and press the ENTER key. SPAN ALL will perform a span calibration on all sensors that are installed in the instrument. The other menu options allow the calibration of individual sensors. Please refer to Chapter 5, “Advanced Setup,” for complete information on calibration.

Replacing Sensors



Warning

The instrument must be calibrated whenever a sensor is replaced. However, the instrument should not be calibrated for at least one hour. This allows sufficient time for the sensors to stabilize and results in a more accurate calibration.

All of the sensors in the instrument are field replaceable. Replacement intervals depend on the type of sensor and the conditions to which each sensor was exposed. There are dedicated slots for the combustible and oxygen sensors and two inter-changeable slots for the toxic sensors. Use the following procedure when replacing sensors.

1. Remove the battery pack from the instrument.
2. Locate the four screws on the bottom of the instrument and remove them with a Phillips screwdriver as shown in Figure 4-5.
3. Turn the instrument over and gently lift the front cover off and set it down next to the instrument as shown in Figure 4-5. The ribbon cable will remain attached to the front panel/display.



Caution

Once the front cover has been removed, the electronics inside the instrument are exposed. Avoid contact with electronic components, as damage may occur.

4. Use Figure 4-6 to locate the sensor that will be replaced.
5. Remove the sensor from the instrument by gently pulling the sensor straight up.
6. Install the new sensor taking notice of pin orientation for the combustible gas sensor and the connector alignment notch for the oxygen and toxic sensors.
7. Place the front cover directly over the instrument and slowly lower it into position. Align the four standoffs on the front cover with the holes in the PC board and make sure the front cover is positioned correctly inside the sealing H-gasket.

Note: Take care to make sure the H-gasket is properly aligned before tightening the screws. Misalignment of this gasket may affect the water resistance or EMI immunity of the instrument.

8. Turn the instrument over and install the four screws to hold the case together.
9. After waiting one hour for the sensors to stabilize, calibrate all new sensors.



Figure 4-5: Removing Front Cover

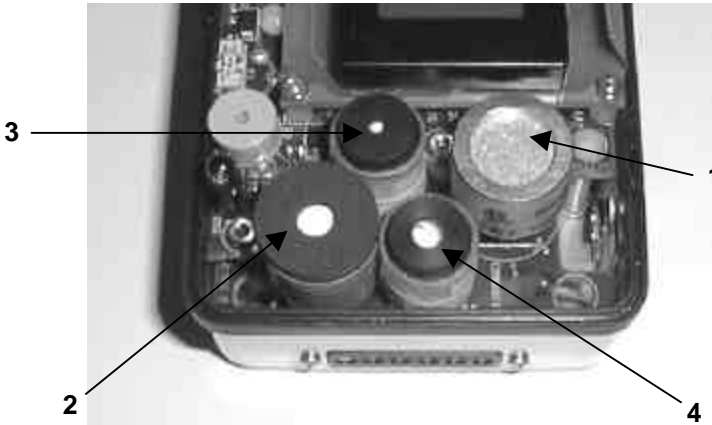


Figure 4-6: Sensor Compartment

- | | |
|---------------------------|-------------------|
| 1. Combustible Gas Sensor | 3. Toxic Sensor 1 |
| 2. Oxygen Sensor | 4. Toxic Sensor 2 |

Replacing Sample Probe Filters

Figure 4-7 shows the different parts of the sample probe.

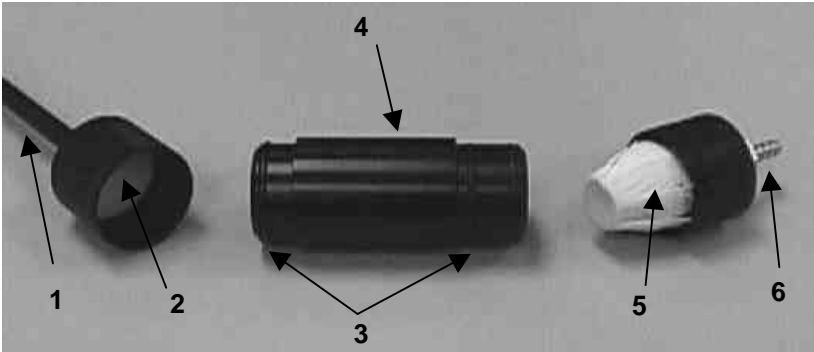


Figure 4-7: Sample Probe Filters

- | | |
|--------------------|--------------------------------|
| 1. Probe Tip | 4. Probe Handle |
| 2. Particle Filter | 5. Hydrophobic Membrane Filter |
| 3. O-Rings | 6. Sample Tube Fitting |

During normal use of the sample probe, the particle filter and hydrophobic filter need periodic replacement. The replacement interval depends on usage and the environment the probe is used in. TSI recommends replacing these filters quarterly under regular operating conditions.

The hydrophobic filter prevents water from passing through the sample probe. If water is drawn into the sample probe, the probe must be taken apart to allow the water to drain and the particle filter must be dried before being reinstalled into the probe.

The particle filter is accessed by holding onto the probe handle and simultaneously pulling and twisting off the FRONT end of the probe.

The hydrophobic filter is accessed by removing the back portion of the probe. Hold onto the probe handle and gently twist the back portion to disengage the “bayonet” style pin. Complete the removal by pulling the back portion off the handle. Figures 4-8 and 4-9 show how to replace the particle and hydrophobic filters.



Figure 4-8: Particle Filter



Figure 4-9: Hydrophobic Filter

Replacing the Lithium Backup Battery

The instrument contains a lithium battery that provides battery backup for the memory. It also supplies power to the electrochemical sensors. This battery needs replacement approximately every three years. The instrument displays the following message when the lithium battery needs replacement:

```
-SYSTEM FAULT-  
  
BACKUP BATTERY  
IS LOW - REPLACE
```

Cautions Before Replacing Lithium Battery

The lithium battery provides battery backup for the custom instrument settings. When the battery is replaced, these settings will be lost. This includes the following:

- Custom user password (default password is retained)
- Custom alarm settings
- Custom user IDs and Locations
- Date and time information
- Alarm latching mode will be reset to factory default (latched)
- Password enable will be reset to factory default (disabled)
- Display mode will be reset to factory default (display all)
- Calibration due, backlight delay, and confidence chirp intervals will be reset to the factory default
- All logged data inside the memory will also be lost.
- All stored information will be lost, including calibration data

If you do not want to lose these values, the instrument may be returned to the factory or an authorized service center. They will be able to replace the lithium backup battery without loss of custom settings.

You should download any logged data, using TRAKPRO software, to prevent the loss of this data.

Replacing the Lithium Battery

1. Remove the battery pack from the instrument.
2. Locate the four screws on the bottom of the instrument and remove them with a Phillips screwdriver as shown in Figure 4-10.
3. Turn the instrument over and gently lift the front cover off and set it down next to the instrument as shown in Figure 4-10.



Caution

Once the front cover has been removed, the electronics inside the instrument are exposed. Avoid touching the electronic components, to reduce the risk of damage.

4. Locate the lithium battery and remove the locking clip as shown in Figure 4-11. To remove the sides of the locking clip: first, gently pry out on the clips (this disengages the locking tab); then lift up.
5. Remove the old lithium battery and replace it with a new one, making sure to follow the polarity markings in the battery holder.
6. Attach the locking clip by gently pressing the clip in place on both ends of the battery holder.
7. Place the front cover directly over the instrument and slowly lower it into position. Align the four standoffs on the front cover with the holes in the PC board and make sure the front cover is positioned correctly inside the sealing H-gasket.

Note: Take care to make sure the H-gasket is properly aligned before tightening the screws. Misalignment of this gasket may affect the water resistance or EMI immunity of the instrument.

8. Turn the instrument over and install the four screws to hold the case together.

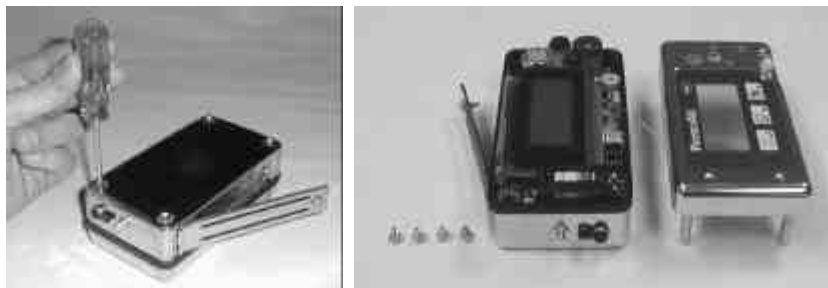


Figure 4-10: Removing Front Cover



Figure 4-11: Lithium Battery



C a u t i o n

Whenever the lithium battery is replaced, the instrument must be allowed to stabilize for at least one hour before use. Re-zero instrument and re-calibrate the sensors.

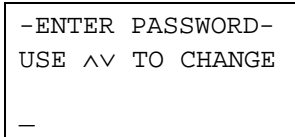
Chapter 5

Advanced Setup

There are many features of the instrument that can be modified to fit the specific needs of each user. These features can be modified through the Advanced Setup menu or through TRAKPRO Software. This section describes how to modify the instrument settings either directly from the instrument or through TRAKPRO Software.

Accessing the Advanced Setup Menu

Access the Advanced Setup menu by holding down the PAGE key while turning on the instrument. If the password function is enabled, the following screen is displayed:



-ENTER PASSWORD-
USE ^v TO CHANGE
_

Use the UP and DOWN arrow keys to scroll through the alphabet, using the ENTER key to select each of the three password characters in turn. The instrument is shipped from the factory with the password set to **PRO**. This default password will **always** work, even if a different user password is entered.

Note: *If desired, the password function may be disabled. In this case, the Advanced Setup menu is entered directly, without need of a password. Refer to later sections of this appendix, for more information on enabling/disabling the password function.*

Note: *If the password is entered incorrectly, an error message will be displayed. You will have two more chances to enter the correct password. After three incorrect attempts, the instrument will bypass the Advanced Setup menu and begin the startup sequence.*

To change the user password or enable/disable the password option in TRAKPRO software, select **Instrument Setup**, **Parameters**, and **Other**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

Once a valid password has been entered, the Advanced Setup menu is displayed as shown below:

```
-ADVANCED SETUP-  
->CALIBRATION  
  ALARM LEVELS  
  ALARM LATCH  
  DISPLAY MODE  
  BACKLIGHT  
  CAL REMINDER  
  CHIRP  
  CHNGE PASSWORD  
  PASSWORD ENABL  
  TIME  
  DATE  
  EXIT
```

Use the UP and DOWN arrow keys to select the setting you want to change and press the ENTER key.

Calibrating the Instrument: General Information

To calibrate the instrument, select the CALIBRATION option from the setup menu. The following menu is displayed:

```
--CALIBRATION--  
-> ZERO CALIB  
  SPAN ALL  
  EX SPAN  
  O2 SPAN  
  TOX1 SPAN  
  TOX2 SPAN  
  EXIT
```

Use the UP and DOWN arrow key to select which type of calibration to perform. Press ENTER to begin the calibration.

Note: *The names TOX1 and TOX2 in the above menu will be replaced with the actual names of the sensors when the specific SPAN menu is entered. For example, if the TOX1 slot contains a CO sensor, it will be properly identified when the TOX1 SPAN menu begins.*

If you mistakenly select the wrong sensor to span, the span process may be discontinued by pressing the RESET key.

For all of the span calibration procedures, you must have a tank of the correct span gas attached to the instrument (with the gas turned off) before entering the CALIBRATION: SPAN menu. Once the menu is entered, the process begins automatically. See Chapter 4, “Attaching the Calibration Gas Adapter and Cylinder” for specific information on this procedure.

If the calibration gas is not attached before beginning the span procedure, you may quit the process by pressing the RESET key. The following screen is displayed:

SPAN CALIBRATION DISCONTINUED VALUES UNCHANGED
--

Zero Calibration

Why do I Have to be so Careful With Zero Calibration?

The “fresh air zero” procedure only allows the sensor’s zero to be reset a small amount at a time. This is an important safety aspect of this procedure. However, the “Zero Calibration” procedure has more power to reset the sensor’s zero point. This also means the “Zero Calibration” procedure contains fewer safety checks than the “fresh air zero.” It is imperative you verify that there are no toxic or combustible gases present during a Zero Calibration. Please note the following WARNING.



WARNING
Perform a zero calibration only in areas that are known to be completely free from toxic or combustible gases and that have a normal concentration of oxygen. Small concentrations of toxic or combustible gases could prevent an accurate zero. If the quality of the air is unknown, TSI recommends using a cylinder of instrument grade zero air.

When to Use Zero Calibration

Zero calibration should ONLY be done when the “fresh air zero” does not work. If a “fresh air zero” causes a ZER error message on any sensor, it means one of two things:

1. *Either* there are pollutant gases present that are preventing the fresh air zero,
2. *Or*, the sensor zero point has drifted too far, and must be reset.

If a ZER error occurs on any sensor, you must clear the error before using the instrument. If a second attempt at performing a “fresh air zero” still results in a zero, you must perform a Zero Calibration.

How to Perform a Zero Calibration

To perform a zero calibration, do the following:

1. Make sure the instrument is located in an area completely free from toxic or combustible gases, and with a normal concentration of oxygen.
2. Select the ZERO CALIB option on the CALIBRATION menu and press ENTER. The following screen is displayed:

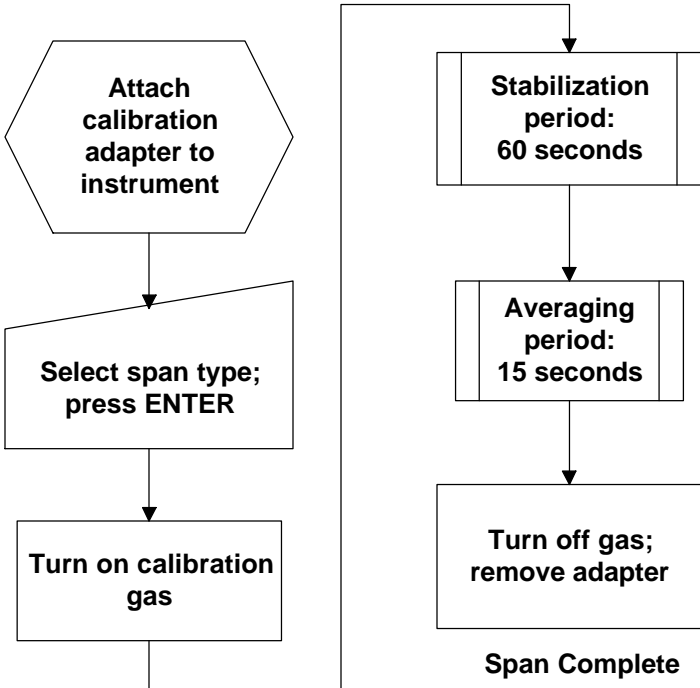
ZERO CALIBRATION	
EX	Ø O2 2Ø.9
CO	Ø H2S Ø
ZEROING	15

3. The display will count down from 15 and will then zero the instrument. The display will return to the CALIBRATION menu.

Note: *If a cylinder of “zero” air is used for the zero calibration, it must be turned on prior to pressing ENTER.*

Basic Span Calibration Procedure

All span calibrations consist of several basic steps, summarized in the following flowchart:



Span All Calibration

SPAN ALL calibration is the most common method of calibrating (spanning) the sensors. SPAN ALL is performed using a cylinder of calibration gas that contains all four types of gases, in a multi-component mixture. The SPAN ALL procedure should only be used when the instrument is configured with EX, O₂, CO and H₂S sensors. To perform a SPAN ALL, do the following:

1. Attach a cylinder of multi-gas mixture to the instrument, using the calibration adapter (leave gas OFF).

Note: You must use a multi-gas mixture that conforms to TSI requirements. The span gas values are **not** user adjustable. See Figure 1-6, "Spare Parts," for more information.

2. Select SPAN ALL from the CALIBRATION menu, and press ENTER.
The following screen is displayed:

SPAN CALIBRATION			
EX	Ø	O2	2Ø.9
CO	Ø	H2S	Ø
START GAS	60		

Note: *The gases listed on this sample screen may vary from the actual instrument screen.*

3. **Promptly** turn on the gas cylinder. The regulator will provide a constant 0.75 lpm of calibration gas, regardless of the tank pressure. The screen will display a 60-second stabilization period countdown.
4. After the stabilization time has elapsed, the instrument begins an averaging period for 15 seconds.
5. At the conclusion of the averaging period (span value) the screen will instruct you to remove and turn off the gas.
6. The span calibration is now complete.

SPAN ALL Error: Gas Not Turned On; Discontinue Span

The most common error you can make when performing the SPAN ALL calibration is **not** turning on the gas cylinder. If you do **not** promptly turn on the gas cylinder at the beginning of the span calibration period, the instrument will not have sufficient time to reach equilibrium. The toxic gas sensors are slower to respond than the EX or O2 sensors, and require a minute to reach the full span value.

To detect this error, the instrument “looks for” a 50% span reading at the halfway point in the stabilization period. If the sensors have **not** reached this point after 30 seconds, the instrument displays the following two screens:

SPAN CALIBRATION	
SPAN GAS	
NOT DETECTED	
START GAS	29

SPAN CALIBRATION	
PRESS RESET KEY	
TO DISCONTINUE	
START GAS	27

You should discontinue this particular attempt to span the instrument by pressing the RESET key as instructed. When this is done, the following screen is displayed:

SPAN CALIBRATION DISCONTINUED VALUES UNCHANGED
--

SPAN ALL Error: Gas Not Turned On; Continue Span

If you fail to discontinue the SPAN CALIBRATION by pressing the RESET button, the sensor(s) will return an SPN error. If this error happens during the SPAN ALL, all four sensors return this error.

Note: *Despite the displayed SPN error message, the sensors retain their previous span values and continue to function. These span values (and the resulting sensor readings) may or may not be correct. You MUST return to the SPAN CALIBRATION menu and complete a successful span procedure, to eliminate the error message.*

SPAN ALL Error: Sensor Mis-Match

The SPAN ALL procedure should only be used when the instrument is configured with EX, O₂, CO and H₂S sensors. If one or more of the toxic sensors are different from the multi-gas mixture, these sensors will not be properly spanned during the procedure. They will return an SPN (span) error message on the VALUES screen. These sensors must be individually spanned, using the proper calibration gas, before being returned to service.

Single Gas Span Calibration

An individual sensor is spanned in an identical manner as the SPAN ALL procedure. You do the following:

1. Connect the appropriate tank of span gas to the instrument, using the calibration adapter.
2. Select the span gas menu item and press ENTER.
3. Turn on the calibration gas.
4. The instrument cycles through the stabilization period, followed by the averaging period.

Note: *The stabilization period is set to 60 seconds for all sensors with the exception of SO₂, which is set for 90 seconds.*

- At the end of the averaging period, the span calibration is complete. Remove the cal gas.

The same error messages are generated for the single gas span as the SPAN ALL. Please refer to the previous SPAN ALL section in this chapter for more information.

Note: *You must use single span gases that conform to TSI requirements. The span gas values are NOT user adjustable. See Figure 1-6, “Spare Parts,” for more information.*

Note: *The oxygen sensor is “spanned” at 12% O₂. The ambient concentration of 20.9% is set during the “zero” procedure.*

Alarm Levels

Factory Alarm Levels

The instrument is shipped from the factory with a set of default alarm levels. These alarm levels comply with regulatory and/or advisory standards, where they exist (for example, OSHA, ACGIH, etc.). In the absence of clearly defined levels, the alarm levels are set in accordance with conservative, industry practice.



Warning	
	You are allowed to make changes to the alarm level setting. However, any changes must be done only by authorized personnel, with full knowledge of and compliance to all applicable regulations and standards.



Warning	
	You are allowed to adjust the alarm level within the full range of the instrument. This is done to allow maximum flexibility for different applications. Setting the alarm levels above the recommended factory levels or above regulatory levels, however, may expose you to risk of injury or death.

The following table lists the default setting for each type of sensor, along with the factory recommended range and the allowable range.

Alarm Type	Default Setting	Recommended Range¹	Allowable Range²
O2 low alarm	19.5%	20.9-19.5%	0-30%
O2 high alarm	23%	20.9-23.5%	0-30%
Ex low alarm	10%LEL	0-50%	0-100%
Ex high alarm	20%LEL	0-50%	0-100%
CO peak alarm	35 ppm	0-200 ppm	0-400 ppm
CO STEL alarm	35 ppm	0-100 ppm	0-400 ppm
CO TWA	35ppm	0-35 ppm	0-400 ppm
H2S peak alarm	10 ppm	0-10 ppm	0-200 ppm
H2S STEL alarm	10 ppm	0-10 ppm	0-200 ppm
H2S TWA	10 ppm	0-10 ppm	0-200 ppm
SO2 peak alarm	2.0 ppm	0-5.0 ppm	0-50 ppm
SO2 STEL alarm	2.0 ppm	0-5.0 ppm	0-50 ppm
SO2 TWA	2.0 ppm	0-5.0 ppm	0-50 ppm
NO peak alarm	25 ppm	0-25 ppm	0-300 ppm
NO STEL alarm	25 ppm	0-25 ppm	0-300 ppm
NO TWA	25 ppm	0-25 ppm	0-300 ppm
NO2 peak alarm	1.0 ppm	0-1.0 ppm	0-20 ppm
NO2 STEL alarm	1.0 ppm	0-1.0 ppm	0-20 ppm
NO2 TWA	1.0 ppm	0-1.0 ppm	0-20 ppm

Notes:

1. In most cases, the recommended range runs from zero to the factory default. In the case of H₂S peak, for example, the factory default is 10 ppm and the range is 0-10 ppm. For oxygen, the “zero” point is referenced from the ambient concentration of 20.9%.
2. The allowable range corresponds to the measurement range of the sensor/instrument. You must exercise great caution when setting the instrument outside of the recommended range. See the warnings shown on previous page.

Alarm Levels Menu

To change the alarm levels, select the ALARM LEVELS option from the Advanced Setup menu. The following menu is displayed:

```
--ALARM LEVELS--  
->DEFAULT ALARMS  
O2 LOW ALARM  
O2 HIGH ALARM  
EX LOW ALARM  
EX HIGH ALARM  
TOX1 PEAK ALM  
TOX1 STEL ALM  
TOX1 TWA ALM  
TOX2 PEAK ALM  
TOX2 STEL ALM  
TOX2 TWA ALM  
EXIT
```

Note: The names TOX1 and TOX2 in the above menu will be replaced with the actual name of the sensor when the menu item is selected. If the wrong sensor has been selected, simply press ENTER to accept the alarm value and return to the ALARM LEVELS menu.

Restoring Default Alarm Levels

If you have changed the default alarm levels and desire to restore the factory default levels, simply select DEFAULT ALARMS and press ENTER.

Changing an Alarm Level

To modify an individual alarm level, use the UP and DOWN arrow keys to select which alarm to modify. Press ENTER to actually modify the alarm setting. A screen similar to the following will be displayed (this example shows the O2 Low Alarm, with a default setting of 19.5%):

```
--O2 LOW ALARM--  
USE ^v TO CHANGE  
  
19.5
```

Use the UP and DOWN arrow keys to modify the alarm setting. Press ENTER to accept the new value and return to the ALARM LEVELS screen.

If you have selected an alarm level that is outside the factory recommended range, the instrument will display screens similar to the following (this example is for oxygen):

-WARNING! O2
ALARM LEVELS
EXCEED VALUES
RECOMMENDED

Note: For more information see previous list of factory default values and recommended ranges.

Changing Alarm Levels Using TrakPro Software

TRAKPRO software provides a convenient method for viewing current alarm levels, changing alarm settings and restoring factory default alarm settings.

Viewing Alarm Levels

To view the current alarm settings, select **Instrument Setup, Alarms** (instrument must be turned on, in docking station, with TRAKPRO software running).

Changing Alarm Levels

To modify the alarm settings, simply type in a new value in the dialog box. If you place the cursor inside the box and leave it there for several seconds, TRAKPRO will prompt you, giving the recommended range for that alarm setting.

When your changes are complete, press the **Send** button to program the PROTECTAIR instrument. If you have selected a value outside the *allowable* range, the software will return an error message and the instrument alarm settings will be unchanged. If you have selected a value outside the *recommended* range, the software will return a caution message, but the instrument will be properly programmed.

To restore the factory default alarm settings, simply select the **Restore Defaults** button in the **Instrument Setup, Alarms** dialog box.

Setting the Alarm Latching Mode

Selecting the ALARM LATCH option displays the following menu:

```
--ALARM LATCH--  
USE ^v TO CHANGE  
  
ON
```

The instrument is supplied with the ALARM LATCH set to “ON.” Use the UP and DOWN arrow keys to toggle between **LATCHING MODE** (ALARM LATCH “ON”) and **NON-LATCHING MODE** (ALARM LATCH “OFF”). Press the ENTER key to accept the displayed mode and return to the setup menu.

To edit the alarm mode (latching or non-latching) in TRAKPRO software, select **Instrument Setup, Parameters, and Other**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

See Chapter 2, “Instrument Operation,” “Alarm Modes,” for more information about Latching and Non-Latching Modes.

Setting the Display Mode

Selecting the DISPLAY MODE option displays the following menu:

```
--DISPLAY MODE--  
USE ^v TO CHANGE  
  
DISPLAY ALL
```

Use the UP and DOWN arrow keys to toggle between **DISPLAY ALL** and **BASIC DISPLAY**. Press the ENTER key to accept the chosen display mode and return to the setup menu.

DISPLAY ALL will give access to the following pages during normal operation:

EX	Ø	OK
O2	2Ø.9	OK
CO	Ø	OK
H2S	Ø	OK

VALUES Page

```
Z  PRESS ENTER
E  TO FRESH AIR
R    ZERO
O   INSTRUMENT
```

ZERO Page

```
U  EX %LEL
N  O2 %VOL
I  CO PPM
T  H2S PPM
```

UNITS Page

```
P  EX    Ø
E  O2 2Ø.9 21.1
A  CO    Ø
K  H2S   Ø
```

PEAK Page

```
S
T
E  CO    Ø OK
L  H2S   Ø OK
```

STEL Page

```
T      ET  12:15
W
A  CO    Ø OK
   H2S   Ø OK
```

TWA Page

```
10/08/98
08:25:00
BATT CHARGE: 75%
MEMORY FREE: 47%
```

STATUS Page

BASIC DISPLAY will only give access to the VALUES, FRESH AIR ZERO and STATUS pages.

Setting the Backlight Delay

The backlight delay determines how long the backlight stays on after a key is pressed or an alarm occurs. After the delay, the backlight automatically turns off.

To change the backlight delay, select the BACKLIGHT option from the Advanced Setup menu. The following screen is displayed:

```
-BACKLIGHT DELAY
USE ^v TO CHANGE

30 SECOND
```

Use the UP and DOWN arrow keys to scroll through the available options and press the ENTER key to accept the displayed value. The available options are: No Backlight, 15 seconds, 30 seconds, 1 minute, 5 minutes, 10 minutes, and 15 minutes. The default value is 30 seconds.

Note: *Prolonged use of the backlight reduces the overall battery life.*

To edit the backlight “on” time in TRAKPRO software, select **Instrument Setup, Parameters, and Other**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

Setting the Calibration Reminder

When the instrument is turned on, the final screen during start-up displays the calibration interval status, which includes the date last calibrated and the calibration interval.

```
-CALIBRATION
INTERVAL OK-
LAST 10/12/98
INTERVAL 15 DAY
```

If the time from the last calibration is less than the calibration interval, the screen displays “CALIBRATION INTERVAL OK.”



Warning	
The message “Calibration Interval OK” means only that the programmed time between calibrations has not elapsed. It does not mean that the sensors are in calibration or functioning correctly. You must still set the instrument zero and check sensor response before each use.	

If the time from the last calibration is *greater* than the calibration interval, the instrument displays a screen similar to the following, during startup.

CALIBRATION		
REQUIRED		
LAST	9/12/98	
INTERVAL	15	DAY

The sensor(s) needing calibration have a CAL message in the status area of the VALUES screen. The screen below shows one example, where all sensors are due for calibration.

EX	Ø	CAL
O2	2Ø.9	CAL
CO	Ø	CAL
H2S	Ø	CAL

Note: *The error message, CAL, means that the user-defined calibration interval has expired. It does not necessarily mean that the sensor is out of calibration.*

The instrument continues to alarm even with a CAL error. The alarm message will continue to correctly display. To clear the CAL message, you must go to the Advanced Setup menu and calibrate the required sensors.

To change the calibration reminder interval, select the CAL REMINDER option from the Advanced Setup menu. The following screen is displayed:

--CAL REMINDER--	
USE ^v TO CHANGE	
30	DAYS

Use the UP and DOWN arrow keys to increase or decrease the number of days and press the ENTER key to accept the displayed interval. The calibration interval can be 0-180 days. The default is 30 days. A value of zero disables the calibration reminder.

To edit the calibration reminder interval in TRAKPRO software, select **Instrument Setup, Parameters, and Other**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

Setting the Confidence Chirp Interval

The confidence chirp consists of a short activation of both the audible and visual alarms. This alarm chirp repeats at the defined interval. The confidence chirp lets you know the instrument is operating normally.

To change the confidence chirp interval, select the CHIRP option from the setup menu. The following screen is displayed:

```
-CHIRP INTERVAL-  
USE ^v TO CHANGE  
  
30 MINUTES
```

Use the UP and DOWN arrow keys to scroll through the available options and press the ENTER key to accept the displayed interval. The available options are None, 1 minute, 5 minutes, 15 minutes, 30 minutes, and 1 hour. The default interval is None.

To edit the confidence chirp interval in TRAKPRO software, select **Instrument Setup, Parameters, and Other**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

Changing the Password

To change the password, select the CHNGE PASSWORD option from the Advanced Setup menu. The following screen is displayed:

```
-CHANGE PASSWORD  
USE ^v TO CHANGE  
  
PRO
```

Use the UP and DOWN arrow keys to select the three characters of the password. Press the ENTER key to accept the character and move the cursor to the next position.

Note: *The default password PRO is displayed during the initial setup. Entering a new user password will **not** delete this default password. It will simply add an additional, unique password.*

Note: *You must enter three characters. Blanks count as characters.*

To change the password in TRAKPRO software, select **Instrument Setup, Parameters, and Other**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

Enabling/Disabling the Password

To enable or disable the password protection function (protecting access to the Advanced Setup menu), select the PASSWORD ENABL option from the Advanced Setup menu. The following screen is displayed:

```
-PASSWORD ENABLE
USE ^v TO CHANGE
OFF
```

Use the UP and DOWN arrow keys to change each of the three characters of the password. Press the ENTER key to accept the character and move the cursor to the next position. The default setting is ON (password protection enabled).

To enable/disable the password feature in TRAKPRO software, select **Instrument Setup, Parameters, and Other**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

Changing the Time

To change the time, select the TIME option from the Advanced Setup menu. The following screen is displayed, along with the current time information:

```
-- SET CLOCK--
14:35:50
```

Use the UP and DOWN arrow keys to toggle each digit of the time. Press the ENTER key to accept each character and advance the cursor to the next position. After each character has been changed, the time is updated and the Advanced Setup menu is displayed.

To change the instrument time in TRAKPRO software, select **Instrument Setup, Parameters, and Clock**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

Changing the Date

To change the date, select the DATE option from the Advanced Setup menu. The following screen is displayed, along with the current date information:

```
-- SET DATE--  
  
10/18/98
```

Use the UP and DOWN arrow keys to toggle each digit of the date. Press the ENTER key to accept each character and advance the cursor to the next position. After each character has been changed, the date is updated and the setup menu is displayed.

To change the instrument date in TRAKPRO software, select **Instrument Setup, Parameters, and Clock**. Follow the onscreen prompts or open the Help function (F1) to obtain further information.

Chapter 6

Troubleshooting

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

Figure 6-1: Troubleshooting Guide

Symptom	Possible Cause	Corrective Action
Instrument doesn't turn on	No batteries installed	Install NiMH or Alkaline battery pack
	AA batteries installed incorrectly	Check polarity of batteries
	Battery pack installed backwards	Install pack correctly
	Dirty battery contacts	Clean the battery contacts
	Keypad connector not attached to PC board	Remove front cover and attach connector
Backlight doesn't come on	Backlight setting set to "NO BACKLIGHT"	Access the Advanced Setup or use the TRAKPRO software to change the backlight setting.
User password doesn't work	The unique user password is reset whenever the lithium battery is replaced.	Access the advanced setup or use the TRAKPRO software to change your password. <i>or</i> Use default password, "PRO."
Erratic readings	Improper calibration	Recalibrate the sensor
	Sensor getting old	Replace the sensor

Symptom	Possible Cause	Corrective Action
Negative readings	Improper zero calibration Sensor was poisoned	Perform zero calibration or “fresh air zero.” Recalibrate the sensor. Replace the sensor if necessary.
System Fault: Pump Stopped	Sample tube is blocked Liquid in probe or sample tube Dirty filters Too much restriction in sample line	Clear sample tube Drain liquid from probe or sample tube Replace particle and hydrophobic filters Use a shorter sample tube. Maximum recommended length is 25 ft.
System Fault: Low Battery	Battery voltage of main batteries is low	Install charged NiMH or fresh alkaline pack
System Fault: Backup Battery is Low	Battery voltage of backup lithium battery is low	Install new lithium backup battery

Appendix A

Specifications

Specifications are subject to change without notice.

Measuring Range:

EX (combustible gas)	0-100% LEL
O ₂ (oxygen).....	0-30% VOL
CO (carbon monoxide).....	0-400 ppm
H ₂ S (hydrogen sulfide)	0-200 ppm
SO ₂ (sulfur dioxide).....	0-50 ppm
NO (nitric oxide).....	0-300 ppm
NO ₂ (nitrogen dioxide)	0-20 ppm

Instrument Temperature Range:

Operating range:	-20 to 50°C (-4 to 122°F)
Storage range:	-40 to 60°C (-40 to 140°F)

Instrument Humidity Range:

Continuous:.....	15 to 90 % rh
Intermittent:.....	5 to 99 % rh non-condensing

Data Logging:

Logging interval:	fixed at 1 minute
Memory capacity:.....	40 hours
Maximum tests:.....	35

Power Requirements:

Batteries:.....	6 AA-size alkaline (CR121) or NiMH pack
Approximate battery life without pump	20 hours with alkaline 12 hours with NiMH

Physical:

External dimensions:.....	5.75 x 3 x 2 in (146 x 76 x 51 mm)
Weight:	22.4 oz (0.64 kg) without batteries
.....	28.8 oz (0.82 kg) with batteries
Display:.....	4 x 16 alphanumeric LCD
Case material:.....	stainless steel

Maintenance Schedule:

Factory calibration:.....	Annually
User calibration:.....	As needed

Appendix B

Sensor Status Information

This appendix contains detailed information on sensor alarms and status indicators.

Message	Meaning	What Should I Do?
OK	The sensor is operating normally.	You must still follow standard practice for zeroing and checking for gas response, each time the instrument is used.
ALM	The sensor has exceeded a pre-set alarm level. The alarm could be either a Peak, STEL, or TWA alarm.	<ol style="list-style-type: none">1. When an alarm is detected, you must immediately determine the cause of the alarm and take appropriate action.2. You may check the STEL or TWA page to determine which condition triggered the alarm.
ZER	The instrument has detected a zero error with this sensor. The zero error may have been caused by: <ol style="list-style-type: none">1) The presence of a small amount of gas during a “fresh air zero”.2) A new sensor has been installed or the existing sensor has drifted.	The zero error must be corrected before the instrument is placed in service. To correct the error, <ol style="list-style-type: none">1. You should first attempt a repeat “fresh air zero,” making certain there are no gases present in the environment.2. For a new sensor or a sensor that has drifted, you must perform a zero calibration.3. If the zero calibration fails, the sensor must be replaced.

Message	Meaning	What Should I Do?
SPN	<p>The instrument has detected a span error with this sensor.</p> <p>The usual cause of this error is an improper span calibration sequence. You may have:</p> <ol style="list-style-type: none"> 1) failed to turn on the calibration gas 2) turned it on too late 3) used the wrong type of calibration gas. <p>If the instrument was carefully spanned (no errors in method) it is possible that the span gas is “out of date” (the actual concentration has diminished below the specified value).</p> <p>If the cal gas is known to be “fresh”, it is likely that the sensor needs replacement.</p>	<p>Remove the instrument from service until the problem is corrected!</p> <p>To correct a span error, first make sure the span was performed correctly (you may need to repeat the span, making sure the span gas was turned on at the correct time).</p> <p>If the calibration gas is out-of-date, it may need to be replaced. The reactive toxic gases often have a very short shelf life. Contact TSI Customer Service for more information.</p> <p>If other methods fail, the sensor may need replacement. Please contact TSI Customer Service.</p>
CAL	<p>The Calibration Reminder time interval has elapsed. For example, if the interval is set to 30 days, this means that the sensor was last calibrated more than 30 days ago.</p>	<p>Calibrate (span) the sensor(s) to clear the error message.</p> <p>Although the instrument will continue to function with a CAL error, you should span the sensors as soon as possible.</p>

Message	Meaning	What Should I Do?
FLT	<p>The sensor has been removed from it's socket or is not in place.</p> <p>This error message is an indication of the loss of the sensor signal, and could be due to an electrical fault.</p>	<p>The indicated sensor is missing or has stopped functioning! Remove the instrument from service immediately!</p> <ol style="list-style-type: none"> 1. Open the top cover and make sure all sensors are properly installed in their correct sockets. 2. It may be necessary to return the instrument to the factory for servicing.
---	Sensor not installed.	No action required.
OFF	<p>This message is displayed only for the EX sensor. It indicates that the sensor has been exposed to a condition exceeding 100% of the LEL, and was turned off to avoid damage to the instrument and potential harm to you.</p>	<p>Leave the exposure area immediately and take the instrument out of service!</p> <p>Turn the instrument off and then back on. The error condition should correct itself.</p>
Unknown Sensor	<p>The instrument contains a new style toxic sensor that the software does not recognize.</p>	<p>Take the instrument out of service!</p> <p>Return the instrument to the factory for a software upgrade.</p>

Appendix C

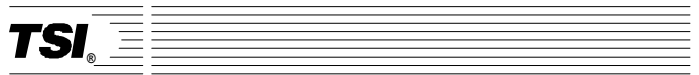
Sensor Poisoning

The combustible sensor used in the PROTECTAIR Multigas Monitor may be damaged by exposure to known sensor poisons. These include silicones and tetra-ethyl lead (leaded gasoline). Exposure to these poisons may severely damage the combustible sensor and will void the warranty for this sensor.



WARNING

If you suspect that the combustible sensor (EX) was exposed to one of these poisons, you must take the instrument out of service immediately and verify the proper instrument response to the LEL calibration gas. The sensor must be spanned before returning the instrument to service.



TSI Incorporated

