Model PDM3700

Personal Dust Monitor
Part Number 42-009904-3700
25Mar2016

Thermo SCIENTIFIC

Thermo Fisher Scientific
Air Quality Instruments
27 Forge Parkway
Franklin, MA 02038
1-508-520-0430
www.thermoscientific.com/aqi

Warranty

Seller warrants that the Products will operate or perform substantially in conformance with Seller's published specifications and be free from defects in material and workmanship, when subjected to normal, proper and intended usage by properly trained personnel, for the period of time set forth in the product documentation, published specifications or package inserts. If a period of time is not specified in Seller's product documentation, published specifications or package inserts, the warranty period shall be one (1) year from the date of shipment to Buyer for equipment and ninety (90) days for all other products (the "Warranty Period"). Seller agrees during the Warranty Period, to repair or replace, at Seller's option, defective Products so as to cause the same to operate in substantial conformance with said published specifications; provided that (a) Buyer shall promptly notify Seller in writing upon the discovery of any defect, which notice shall include the product model and serial number (if applicable) and details of the warranty claim; (b) after Seller's review, Seller will provide Buyer with service data and/or a Return Material Authorization ("RMA"), which may include biohazard decontamination procedures and other product-specific handling instructions; and (c) then, if applicable, Buyer may return the defective Products to Seller with all costs prepaid by Buyer. Replacement parts may be new or refurbished, at the election of Seller. All replaced parts shall become the property of Seller. Shipment to Buyer of repaired or replacement Products shall be made in accordance with the Delivery provisions of the Seller's Terms and Conditions of Sale. Consumables, including but not limited to lamps, fuses, batteries, bulbs and other such expendable items, are expressly excluded from the warranty under this warranty.

Notwithstanding the foregoing, Products supplied by Seller that are obtained by Seller from an original manufacturer or third party supplier are not warranted by Seller, but Seller agrees to assign to Buyer any warranty rights in such Product that Seller may have from the original manufacturer or third party supplier, to the extent such assignment is allowed by such original manufacturer or third party supplier.

In no event shall Seller have any obligation to make repairs, replacements or corrections required, in whole or in part, as the result of (i) normal wear and tear, (ii) accident, disaster or event of force majeure, (iii) misuse, fault or negligence of or by Buyer, (iv) use of the Products in a manner for which they were not designed, (v) causes external to the Products such as, but not limited to, power failure or electrical power surges, (vi) improper storage and handling of the Products or (vii) use of the Products in combination with equipment or software not supplied by Seller. If Seller determines that Products for which Buyer has requested warranty services are not

covered by the warranty hereunder, Buyer shall pay or reimburse Seller for all costs of investigating and responding to such request at Seller's then prevailing time and materials rates. If Seller provides repair services or replacement parts that are not covered by the warranty provided in this warranty, Buyer shall pay Seller therefor at Seller's then prevailing time and materials rates. ANY INSTALLATION, MAINTENANCE, REPAIR, SERVICE, RELOCATION OR ALTERATION TO OR OF, OR OTHER TAMPERING WITH, THE PRODUCTS PERFORMED BY ANY PERSON OR ENTITY OTHER THAN SELLER WITHOUT SELLER'S PRIOR WRITTEN APPROVAL, OR ANY USE OF REPLACEMENT PARTS NOT SUPPLIED BY SELLER, SHALL IMMEDIATELY VOID AND CANCEL ALL WARRANTIES WITH RESPECT TO THE AFFECTED PRODUCTS.

THE OBLIGATIONS CREATED BY THIS WARRANTY STATEMENT TO REPAIR OR REPLACE A DEFECTIVE PRODUCT SHALL BE THE SOLE REMEDY OF BUYER IN THE EVENT OF A DEFECTIVE PRODUCT. EXCEPT AS EXPRESSLY PROVIDED IN THIS WARRANTY STATEMENT, SELLER DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, ORAL OR WRITTEN, WITH RESPECT TO THE PRODUCTS, INCLUDING WITHOUT LIMITATION ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE PRODUCTS ARE ERROR-FREE OR WILL ACCOMPLISH ANY PARTICULAR RESULT.

WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:

Thermo Fisher Scientific has contracted with one or more recycling/disposal companies in each EU Member State, and this product should be disposed of or recycled through them. Further information on Thermo Fisher Scientific's compliance with these Directives, the recyclers in your country, and information on Thermo Fisher Scientific products which may assist the detection of substances subject to the RoHS Directive are available at:

www.thermoscientific.com/WEEERoHS.

Safety

Repair of instrumentation manufactured by Thermo Fisher Scientific should only be attempted by properly trained service personnel, and should only be conducted in accordance with system documentation. Do not tamper with this hardware. High voltages may be present in all instrument enclosures. Use established safety precautions when working with this instrument.

There are several safety hazards that the general operator and service technician must be aware of when operating and servicing the PDM3700. The hazards include: burn hazards, moving parts and pinch hazards, and voltage hazards.

The seller cannot foresee all possible modes of operation in which the user may attempt to utilize this instrumentation. The user assumes all liability associated with the use of this instrumentation. The seller further disclaims any responsibility for consequential damages. Use of this product in any manner not intended by the manufacturer will void the safety protection provided by the equipment, and may damage the equipment and subject the user to injury.

WARNING The battery pack (PN: 56-010897-2300) is designed with specific individual battery cells. These battery cells are not user replaceable. The battery packs may be replaced only by MSHA certified individuals pursuant to 30 CFR Parts 70, 71 & 90. All charging of these battery packs shall take place while installed in the PDM3700 and in fresh air in Battery Charging stations as defined in 30 CFR 75.340 or fresh air above ground. ▲

WARNING Only MSHA certified individuals may perform maintenance, calibration and sampling pursuant to 30 CFR Parts 70, 71 & 90. This includes changing the battery packs, sample pump, cleaning the sample inlet, and other maintenance items as described in the operator's manual. ▲

Electrical Safety and Conformity

Charger

Thermo Fisher Scientific certifies that the charger for the PDM3700 complies with all safety requirements as described below:

ANSI/UL 1012 Standard for Power Units Other Than Class 2' 7th edition 04/29/05

Product	Model
PDM3700 Battery Charger	57-010925-3700

WARNING The battery pack (PN: 56-010897-2300) is designed with specific individual battery cells. These battery cells are not user replaceable. The battery packs may be replaced only by MSHA certified individuals pursuant to 30 CFR Parts 70, 71 & 90. All charging of these battery packs shall take place while installed in the PDM3700 and in fresh air in Battery Charging stations as defined in 30 CFR 75.340 or fresh air above ground. ▲

Instrument

This product is certified as intrinsically safe for mine use by the Mine Safety Health Administration approval number 18-A140015-0.

Thermo Fisher Scientific certifies that this product operates in compliance with EN61326-1: 2005 and FCC Part 15 subpart B in reference to electrical emissions and immunity. Specifically, the equipment meets the requirements shown in the following table:

Basic Standards from EN 61326-1:2005 & FCC Part 15 Subpart B

Sub-Test	Test Parameter
Radiated Emissions CISPR11 & FCC Part 15 Subpart B	Emissions must be below Class A limits
AC Line-Conducted Emissions CISPR11 & FCC Part 15 Subpart B	Emissions must be below Class A limits
Harmonic Emissions EN 61000-3-2:2006	Emissions must be below Class A limits

Sub-Test	Test Parameter
Voltage Fluctuation and Flicker EN 61000-3-3:95+A1:02	4% dmax.
Electrical Fast Transients EN 61000-4-4:2004	±1kV AC mains, ±1kV I/O
Surges EN 61000-4-5:95+A1:01	±0.5kV Line to earth ±1kV Line to protected earth
Line Conducted RF Susceptibility EN 61000-4-6:96+A1:01	0.15-80Mhz @ 3 Vrms, 1kHz AM 80% modulation
Voltage Dips and Dropouts EN 61000-4-11:2004	-100% for 0.5 cycles -100% for 1 cycle -30% for 25 cycles -100% for 250 cycles

Equipment Rating

The following information can be used to determine the power service requirements of this product:

Line Voltage

120 V ~ 60 Hz 20 Amp

240 V ~ 50 Hz 10 Amp

Charger Fuse

Part Number	Current Rating
04-003268	2A time delay

About This Manual

Safety and Equipment Damage Alerts

This manual contains important information to alert you to potential safety hazards and risks of equipment damage. Refer to the following types of alerts you may see in this manual.

Safety and Equipment Damage Alert Descriptions

Alert		Description
	**DANGER**	A hazard is present that will result in death or serious personal injury if the warning is ignored.
	**WARNING**	A hazard is present or an unsafe practice can result in serious personal injury if the warning is ignored.
	**CAUTION**	The hazard or unsafe practice could result in minor to moderate personal injury if the warning is ignored.
	**Equipment Damage**	The hazard or unsafe practice could result in property damage if the warning is ignored.

Safety and Equipment Damage Alerts in this Manual

Alert		Description
	**DANGER**	Misusing or mishandling the battery pack can lead to fluid leakage, heat generation, fire or an explosion. ▲
	**WARNING**	The battery pack (PN: 56-010897-2300) is designed with specific individual battery cells. These battery cells are not user replaceable. The battery packs may be replaced only by MSHA certified individuals pursuant to 30 CFR Parts 70, 71 & 90. All charging of these battery packs shall take place while installed in the PDM3700 and in fresh air in Battery Charging stations as defined in 30 CFR 75.340 or fresh air above ground. ▲
	**WARNING**	Only MSHA certified individuals may perform maintenance, calibration and sampling pursuant to 30 CFR Parts 70, 71 & 90. This includes changing the battery packs, sample pump, cleaning the sample inlet, and other maintenance items as described in the operators manual. ▲
	**WARNING**	Do not operate the PDM3700 if its case is damaged or otherwise compromised. ▲

Alert		Description
	**WARNING**	Whenever the PDM3700 case is opened for maintenance, you must perform a case leak check after reassembling the case. The system must pass the case leak check prior to operating the instrument. Correct the leak and re-test the instrument if the leak check does not initially pass. Do not operate the instrument if the system does not pass the case leak check. ▲
	**CAUTION**	PDM3700 maintenance should only be performed by trained, authorized personnel. ▲
	**CAUTION**	Refer to Section 1 for a comprehensive list of cautions and warnings for the battery pack assembly. ▲
	**CAUTION**	Always properly dispose of the PDM3700 battery pack (recycling is preferable, contact Thermo Fisher Scientific for further information). Do not dispose of the battery pack in fire or heat.▲
	**Equipment Damage**	DO NOT use acetone to clean any parts of the PDM3700. ▲
	**Equipment Damage**	When moving the battery pack to access the wire connections, be sure to minimize stress on the wires and connectors. ▲
	**Equipment Damage**	Do not attempt to remove the security (non-Phillips head) screws on the top or front of the PDM3700. ▲

NIOSH Certification Label

This label is affixed to the back of the instrument. Only the parts listed should be used in order to maintain certifications.

Note All labels must be affixed to the instrument and not obscured for the unit to be approved for sampling. ▲

Contents

Chapter 1
Introduction

The Thermo Scientific™ PDM3700 Personal Dust Monitor (PDM), manufactured for miners, incorporates a real-time particulate monitor that measures respirable coal dust mass concentration, shift exposure, and accumulated exposure in real time (Figure 1–1). The monitor is suitable for personal and area monitoring in underground mines, or other occupational environments with elevated particulate concentrations. The PDM3700 is a wearable device that sets up quickly, delivers accurate results, recharges quickly and is easily serviced.

The PDM3700 contains all the hardware and software necessary to measure and store ambient particulate mass concentration. The mass measurement is a filter-based direct mass monitoring instrument using proprietary TEOM and momentum compensation technologies. The flow control system maintains a constant volumetric flow at 2.2 l/min and total filter loading to 6 inches-Hg (20.32 kPa).

Figure 1–1. PDM3700

The user interface includes membrane switches and a top-mounted character display that provides shift exposure information and status codes. The high contrast display provides basic data and statistics for the system, including status conditions. An additional PC-based user interface is provided through WinPDM communication software. The PDM3700 is powered by one internal lithium-ion battery assembly. See Table 1–1 and Table 1–2 for the PDM3700 system specifications.

Table 1–1. PDM3700 Specifications

PDM3700 Specifications	
Flow Rate	2.2 l/min ±2.5% when calibrated at set point*
Run Time: PDM	Minimum of 12 hours**
Humidity: PDM	0–100% RH, condensing and non-condensing
Humidity: Charging Station	5–95% RH, non-condensing
Altitude	-3,500 to 10,000 feet
Temperature: Sampled Air	-5 to +105 °F (-20 to +40 °C), typical range is 32–85 °F (0–30 °C)
Temperature Shock	40 °C/min
Temperature: Charging	32–105 °F (0 to 40 °C)

*The PDM 3700 must be calibrated at the mine location to achieve optimum results. A flow audit may be performed prior to an initial calibration, but the results may not meet the ±2.5% accuracy specification. If audit results are outside the ±2.5% accuracy requirement, perform a flow calibration.

**Minimum 12-hour shift possible with unit undergoing warm-up on charger. Warming up unit off charger will reduce maximum shift run time.

Table 1–2. Temperature of Mass Transducers and Heaters

Ambient Operating Temperature	Air Inlet Heater Set Point (C) (Az)	TE Heater Set Point (C) (Tz)
98–104 °F (37–40 °C)	57 °C	60 °C
86–97 °F (30–36 °C)	50 °C	53 °C
73–85 °F (23–29 °C)	43 °C	46 °C
60–72 °F (16–22 °C)	36 °C	39 °C
48–59 °F (9–15 °C)	29 °C	32 °C
35–47 °F (2–8 °C)	22 °C	25 °C
23–34 °F (-5 to +1 °C)	15 °C	18 °C
10–22 °F (-12 to -6 °C)	8 °C	11 °C
-2 to +9 °F (-19 to -13 °C)	1 °C	4 °C

The PDM3700 battery charger (Figure 1–2) is a separate unit that connects to the PDM3700 and provides a charging station as well as communication functions. A separate external power cord and communication/charge cable must be installed to operate the charger (Chapter 2).

Figure 1–2. PDM3700 Charger

Note The charger supplied with the PDM3700 is not the same charger that was supplied with the PDM3600. The PDM3600 included the integrated cap lamp in the device and needed a charging circuit to charge that battery. This charger circuit was removed from the charger supplied with the PDM3700. The charger supplied with the PDM3700 will not work with the PDM3600, however the charger supplied with the PDM3600 will work with both the PDM3700 and the PDM3600. The difference being that when charging the PDM3700 the cap lamp LED on the charger will not function. ▲

Note Always charge the PDM3700 in fresh air in Battery Charging stations as defined in 30 CFR 75.340 or fresh air above ground. ▲

Advanced Features

The PDM3700 offers a number of features to provide superior data quality, ease of use, and flexibility for the user. The following is a partial list of the instrument's advanced features:

- 30-minute mass concentration measurement in the range of 0.1 to 10 mg/m^3 (cumulative shift average)
- Accuracy for mass measurement: ±25% with 95% confidence, as compared to gravimetric reference samplers using similar cyclones, in the range of 0.2 mg/m^3 and greater
- Display resolution of 0.01 mg/m^3
- Starting with a new TEOM filter, the batteries allow a 12-hour run, up to a loading of 5 mg
- User-definable manual and programmed sample collection options, based on worker shift lengths
- Capable of indoor and outdoor use
- One internal lithium-ion battery pack; full charge in 6 hours from a depleted charge state (Note: the charging light may take up to 8 hours to turn from blinking green to solid green as part of an enhanced charging top-off feature)
- Lightweight - approximately 4.4 pounds (2 kg)
- Meets MSHA intrinsic safety requirements

The WinPDM software for the PDM3700 is a Microsoft Windows-based program. Users should have a general understanding of their personal computer (PC) and of the Windows operating system, including entering and editing text, and opening, closing and saving files.

Organization of Manual

This manual is divided into six sections and one appendix. The early sections describe set up of the system's hardware and software, while later sections explain the advanced features of the PDM3700. Users should read and understand earlier sections before attempting procedures described later in the manual. The following list provides an overview of the topics handled in each section of this manual:

- Chapter 1 "Introduction" explains features of the PDM3700 and describes the contents of this operating manual and the theory of operation of the device, as well as providing information about internal flows, sample inlets, and the flow control calculations.
- Chapter 2 "Basic Operation" describes how to set up the hardware and software for the PDM3700 and provides an overview of the PDM3700's firmware and explains the unit's status codes ("status" conditions).
- Chapter 3 "Using the WinPDM Software" explains how to set up manual and programmed samples.
- Chapter 4 "Viewing and Saving Data" describes how to configure data logging, view real-time data during the sample run and how to download data from the PDM3700.
- Chapter 5 "Maintenance and Calibration" explains how to verify the PDM3700's performance and describes basic maintenance procedures.
- Chapter 6 "Troubleshooting" presents guidelines for diagnosing equipment failures.
- Appendix A "Parts and Consumables" lists the spare parts and consumables with the PDM3700.

Operating Parameters

The PDM3700's flow rate is 2.2 l/min ±2.5% when calibrated at set point. Temperature set points of the air heater and TE heater are set automatically by selecting the appropriate operating temperature (Figure 3–12) when programming a shift (Section 3). Programmed shifts can be set up in advance using the WinPDM software. Currently, one shift-time can be programmed. Manual samples can be started through a membrane switch pad located on the top of the unit. All shifts require a 35-minute warm-up period before data begins collecting. Second samples taken within a programmed or manual sample do not require a separate warm-up.

The PDM3700 will accommodate programmed shift lengths from 1 minute to 24 hours in 1 minute increments. If sampling shifts longer than 12 hours are required, refer to MSHA guidelines as to performing this sampling.

The system flow schematic provides an overview of the PDM3700's flow connections (Figure 1–3). The air flow enters the system through a cyclone and is then drawn into a heated flow tube. After the air stream is heated, it flows into the mass transducer where the particulate matter is deposited onto the TEOM filter. The air flow is then directed through the hollow TE (tapered element), through the air temperature and relative humidity sensor block, past the flow differential pressure sensor, and finally through the pump. The air stream then exits the system.

The PDM3700 maintains a constant volumetric flow rate, and reports sampled volumes (m^3) in volumetric terms (based on the ambient temperature as measured near the cyclone).

The sampling system determines the ambient temperature and pressure for flow rate calculations through the use of sensors that continually provide updated information to the microprocessor system.

The PDM3700 is designed to operate in a position where the instrument display is oriented at the top of the unit. The sampler includes an integrated tilt sensor that automatically compensates the measurements when the position of the monitor moves. This is used to compensate for the natural motion of the sampler as an operator moves from one location to another, and is also used to compensate when the vertical orientation of the sampler changes.

If the sampler is placed or worn in a position where the display is upside down, the sampler will detect this position and discard the real-time mass and mass concentration data until this situation is corrected. While the real-time mass and mass concentration data is discarded during this time, the instrument will correctly determine the actual collected mass upon being placed in the proper orientation and resume proper mass and mass concentration measurements.

The displayed mass and mass concentration values will display the last valid measurement value and will not change when the sampler is placed in an inverted orientation.

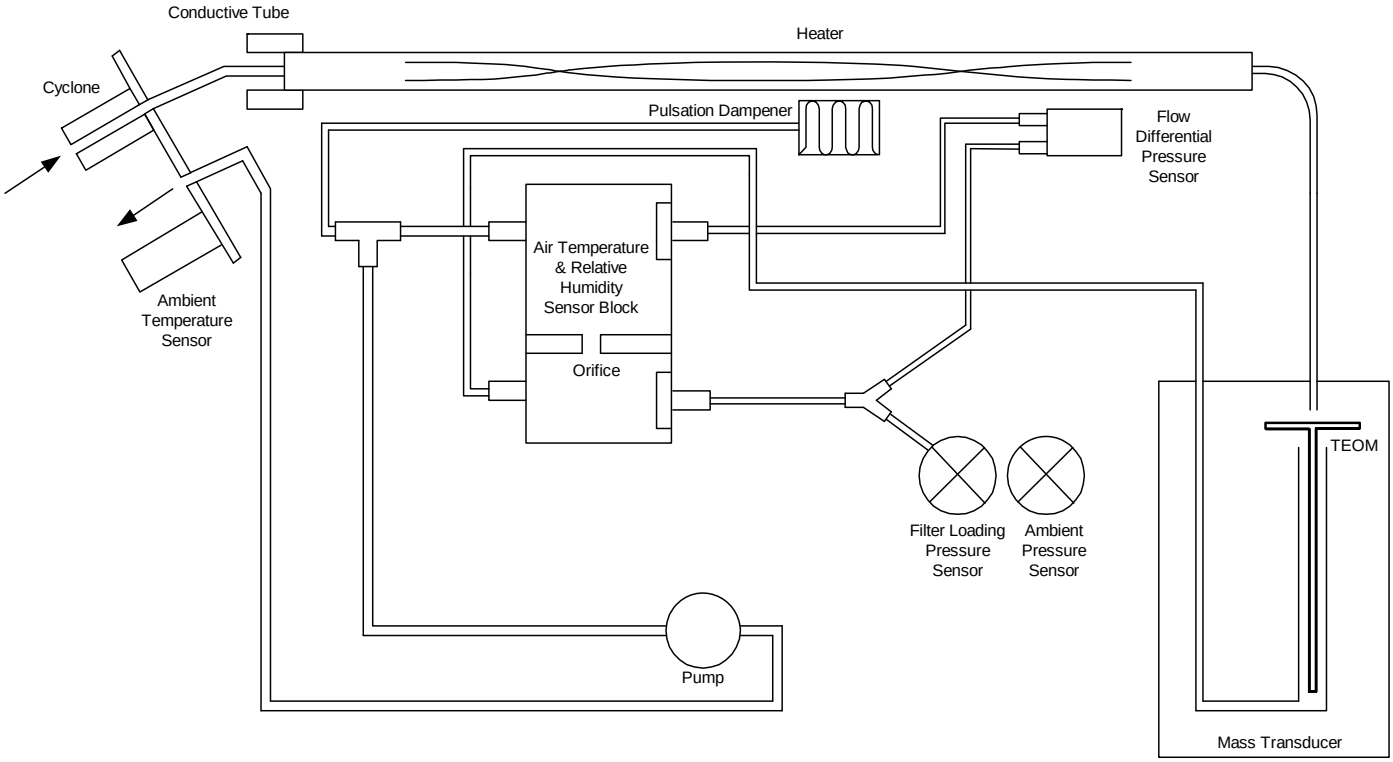


Figure 1–3. PDM3700 flow path

Battery Safety

The PDM3700 is powered by one internal lithium-ion battery pack assembly. The batteries can be charged daily through the communication/charge cable and charging unit (Figure 1–2). Be sure to charge the PDM3700 unit in a fresh-air environment.

Safety Test Criteria

The lithium-ion battery packs are designed to meet all U.S. Department of Transportation (DOT) criteria, per: UN Manual of Tests and Criteria Part III sub-section 38.3, T1, T2, T3, T4, T5, T7.

Battery Warnings

Various safety features have been included in the design of the lithium-ion battery packs. However, misusing or mishandling the battery packs can lead to fluid leakage, heat generation, fire or an explosion.

WARNING The battery pack (PN: 56-010897-2300) is designed with specific individual battery cells. These battery cells are not user replaceable. The battery packs may be replaced only by MSHA certified individuals pursuant to 30 CFR Parts 70, 71 & 90. All charging of these battery packs shall take place while installed in the PDM3700 and in fresh air in Battery Charging stations as defined in 30 CFR 75.340 or fresh air above ground. ▲

DANGER Misusing or mishandling the battery packs can lead to fluid leakage, heat generation, fire or an explosion. ▲

To prevent these situations from occurring and to ensure safe use of the battery packs, observe the following precautions:

- Do not use or store the battery packs in environments with high temperatures, such as in strong, direct sunlight, in vehicles during hot weather, or directly in front of a heater (80 °C or higher).
- Do not immerse the battery packs in water. Do not allow them to get wet.
- Do not break open or damage the battery packs or the casing of the lithium-ion batteries. Do not pierce the battery packs with a nail or other sharp object. Do not strike it with a hammer or step on it.
- Do not put the battery packs into a microwave oven or pressurized container.
- Do not strike, drop or throw the battery packs.
- Do not disassemble or modify the battery packs or the lithium-ion batteries located inside the battery packs.
- Do not install the battery packs into the PDM3700 if the battery packs leak electrolyte, change color, change shape, or become deformed in any other way. If leaked electrolyte comes in contact with your eyes, flush your eyes immediately. Wash them thoroughly with clean water and consult a physician. If skin or clothing comes in contact with leaked electrolyte, wash the area immediately with clean water.
- Do not charge the PDM3700 unit in a cold environment (below 0 °C).
- Do not charge the PDM3700 unit near fire or in an extremely hot environment.
- Always properly dispose of the PDM3700 battery packs (recycling is preferable, contact Thermo Fisher Scientific for further information). Do not dispose of the battery packs in fire or heat.

WARNING Do not operate the PDM3700 if its case is damaged or otherwise compromised. ▲

WARNING Only MSHA certified individuals may perform maintenance, calibration and sampling pursuant to 30 CFR Parts 70, 71 & 90. This includes changing the battery packs, sample pump, cleaning the sample inlet, and other maintenance items as described in the operator's manual. ▲

Note The PDM3700 should be returned to the factory annually for calibration and validation of acceptable performance to the instrument specifications. ▲

Chapter 2
Basic Operation

This section describes setting up the PDM3700 Personal Dust Monitor (PDM) and connecting it to the charger, installing a TEOM filter and setting up basic sample runs.

Upon receiving the PDM3700 unit, ensure that a TEOM filter is installed in the mass transducer and connect the unit to the charger (Figure 2–1). To fully charge the internal lithium-ion batteries, allow the PDM3700 unit to remain connected to the charger for approximately 6 hours before performing the first sample run. Charging must be completed in a fresh air environment.

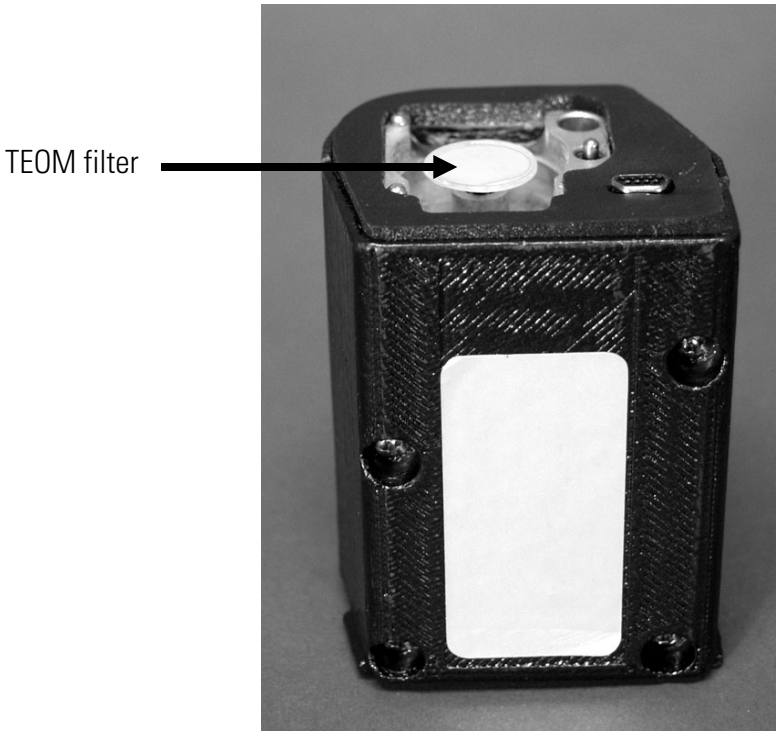


Figure 2–1. PDM3700 mass transducer with filter

Basic Components

The basic PDM3700 package is shipped with the following components:

PDM3700 unit with sampling tube and sample inlet assembly

Belt loops

5 peel-away scratch-protection overlays for the display

Box of 20 TEOM filters

Filter exchange tool

Tubing removal tool

Inlet spanner tool

Flow calibration kit

Sample line leak check plug

Case leak check suction cup

Leak check putty

K0 weights

RS232 cable

USB to RS232 adapter

Operating Manual

Quick Start Guide (Laminated)

CD-ROM (WinPDM software)

Operational Requirements

While the PDM3700 may be used as a stand-alone device, many of its features require the use of additional equipment. To access the full functionality of the PDM3700 the following items will be needed:

- Laptop or desktop personal computer (PC) running Microsoft Windows 98/NT/2000/XP/Vista/7/8.1/10
- 9-pin RS232 serial port available on the PC or USB-serial port adapter (supplied)
- WinPDM desktop software installed on the PC (Chapter 3)

The WinPDM software for the PDM3700 is a Microsoft Windows-based program. Users should have a general understanding of their personal computer (PC) and of the Windows operating system, including entering/editing text, and opening, closing and saving files.

Installing Optional Belt Loops

The PDM3700 is shipped with belt loops in the compilation package. The belt loops can be installed on the unit to allow the PDM3700 to be worn on an equipment belt during operation. To install the belt loops, remove the sealing screws installed on the charger side of the instrument and using the provided belt loop screws, attach the belt loops to the side of the instrument. When attaching the belt loops to the sampler, ensure that the small tabs on the belt loops are at the top on the belt loop.

Figure 2–2. Remove sealing screws. Retain for future use.

Figure 2–3. Installing belt loops on side of instrument. Note that small tab is at the top of the belt loop.

The PDM3700 is designed to operate in a position where the instrument display is oriented at the top of the unit. The sampler includes an integrated tilt sensor that automatically compensates the measurements when the position of the monitor moves. This is used to compensate for the natural motion of the sampler as an operator moves from one location to another, and is also used to compensate when the vertical orientation of the sampler changes.

If the sampler is placed or worn in a position where the display is upside down, the sampler will detect this position and discard the real-time mass and mass concentration data until this situation is corrected. While the real-time mass and mass concentration data is discarded during this time, the instrument will correctly determine the actual collected mass upon being placed in the proper orientation and resume proper mass and mass concentration measurements.

The displayed mass and mass concentration values will display the last valid measurement value and will not change when the sampler is placed in an inverted orientation.

Connecting to the Charger

The charger base functions as both a battery charger and a communications station. To fully charge the internal lithium-ion batteries, allow the PDM3700 unit to remain connected to the charger for approximately 6 hours before performing the first sample run. Charging must be completed in a fresh air environment.

To connect your PDM3700 to a PC:

1. Locate the PDM3700 charger and its power cord, attach the power cord to the back of the charger and then install the charger's power cord into an approved, grounded power source.

2. Locate the communications/charger cable and the connectors on the back of the PDM3700 unit (Figure 2–4 and Figure 2–5).

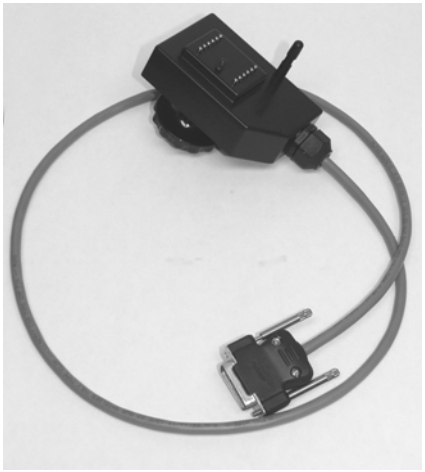


Figure 2–4. PDM3700 charger/communications cable

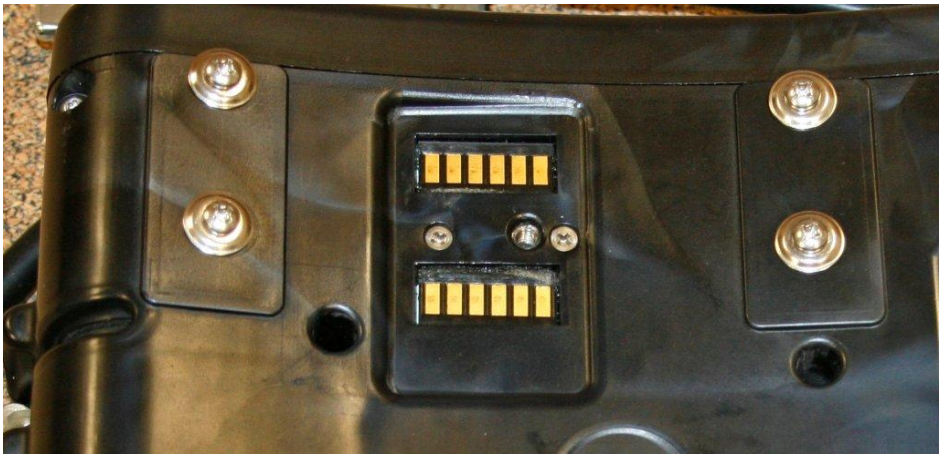


Figure 2–5. Charger connection on the back of the PDM3700 unit

3. Set the alignment post into the hole in the back of the PDM3700. Turn the handle to tighten the connection screw into the connector (Figure 2–6 and Figure 2–7).

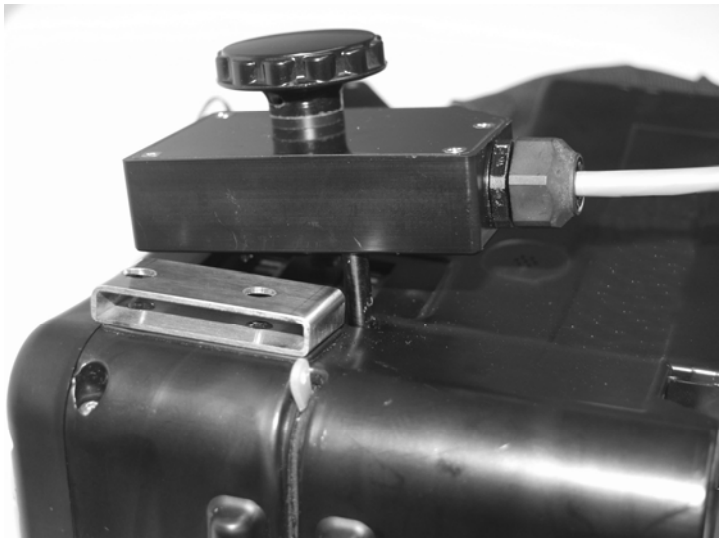


Figure 2–6. Setting the charger connector onto the unit

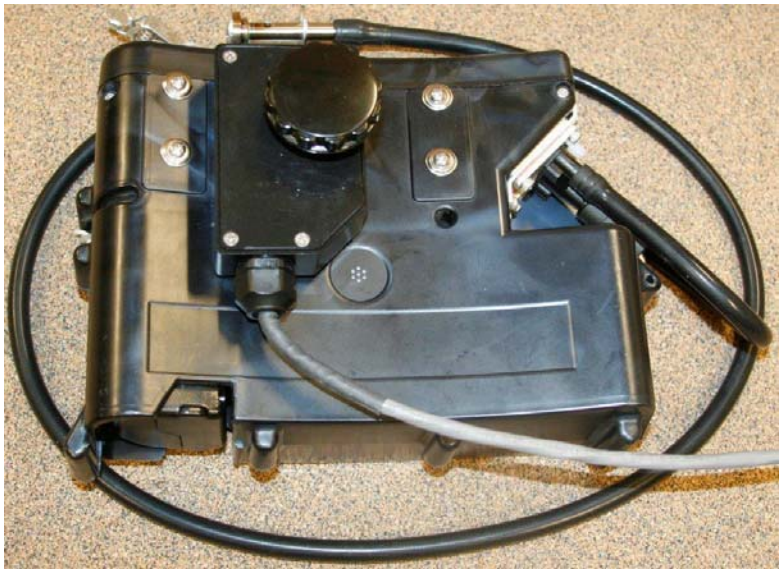


Figure 2–7. Locking in the PDM3700 charger connection

4. Install the 15-pin connector of the communications/power cable into the “TO PDM” port on the charger.

5. Locate the RS232 cable and install one end of the RS232 cable into the “TO PC” port on the charger and the other end of the RS232 cable onto a serial 9-pin COM port on your laptop/PC.

6. If the charger and the PDM3700 are both functioning correctly, the LEDs on the front of the charger will indicate the status of the unit (Figure 2–8).

   a) Solid grey (or off): Indicates that the PDM3700 is not properly connected to the charger, or the charger power is off.

   b) Solid green: Indicates that the battery is fully charged.

   c) Solid red: Indicates that the battery is being charged.

   d) Flashing green: Indicates the battery is at a minimum 80% charged.

   e) Flashing red: Indicates a problem with the charger or the connection.

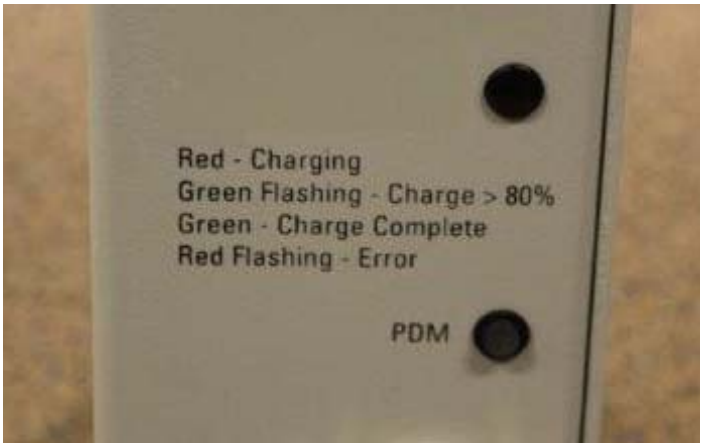


Figure 2–8. Charger LEDs

Note The charger supplied with the PDM3700 is not the same charger that was supplied with the PDM3600. The PDM3600 included the integrated cap lamp in the device and needed a charging circuit to charge that battery. This charger circuit was removed from the charger supplied with the PDM3700. The charger supplied with the PDM3700 will not work with the PDM3600, however the charger supplied with the PDM3600 will work with both the PDM3700 and the PDM3600. The difference being that when charging the PDM3700 the cap lamp LED on the charger will not function. ▲

7. Allow the PDM3700 unit to remain connected to a charger for approximately 6 hours (to fully charge the internal lithium-ion batteries) before performing your first sample run.

Note To fully charge the internal lithium-ion batteries, the PDM3700 unit must be connected to the charger for approximately 6 hours before performing the first sample run. Charging must be completed in a fresh air environment. The PDM3700 may be left on the charger after charging is complete until the next scheduled shift. ▲

Note The batteries will fully charge after approximately 6 hours. However, as part of an enhanced charging feature, the charging light will flash green for about two more hours as the charger will continue to provide a trickle charge to top off the battery. ▲

WARNING The battery pack (PN: 56-010897-2300) is designed with specific individual battery cells. These battery cells are not user replaceable. The battery packs may be replaced only by MSHA certified individuals pursuant to 30 CFR Parts 70, 71 & 90. All charging of these battery packs shall take place while installed in the PDM3700 and in fresh air in Battery Charging stations as defined in 30 CFR 75.340 or fresh air above ground. ▲

Removing a TEOM Filter

The PDM3700 unit is shipped with a Tapered Element Oscillating Microbalance (TEOM) filter installed on the tapered element (TE), but the filter must be changed after each shift.

1. Locate the TE handle on the side of the PDM3700 and slide the handle all the way to the right to unlock the mass transducer, as shown in Figure 2–9, and then pull the mass transducer out of the unit (Figure 2–10).

Figure 2–9. Slide the PDM3700 handle to the right

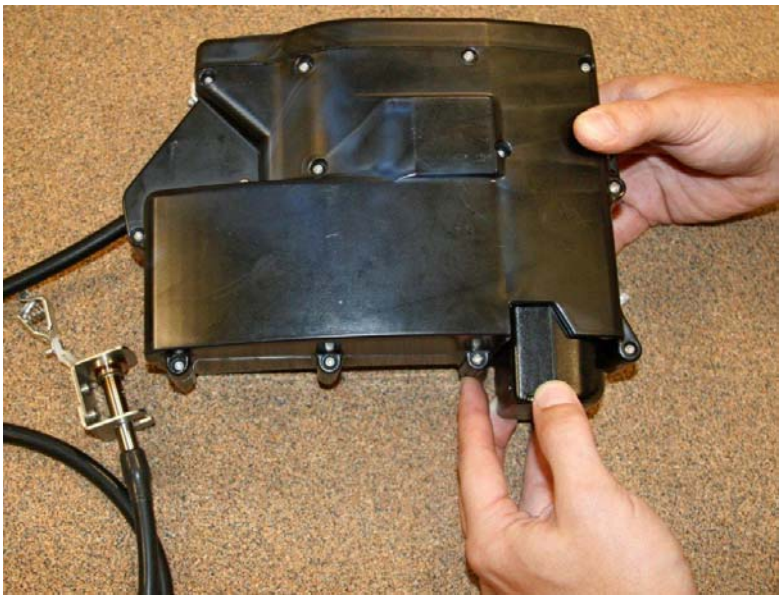


Figure 2–10. Removing the mass transducer

2. Carefully insert the lower fork of the filter exchange tool under the TEOM filter that is in the mass transducer so that the filter disk is between the lower fork and the upper tab of the filter exchange tool. The tines of the lower fork should straddle the hub of the filter base (Figure 2–11 and Figure 2–12).

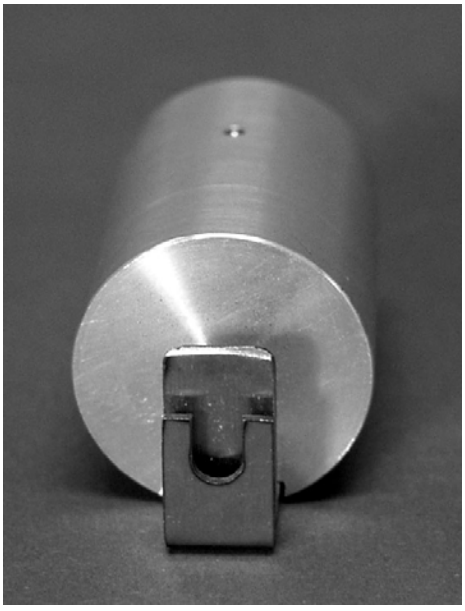


Figure 2–11. Filter tool

Figure 2–12. Removing the TEOM filter with the filter tool

3. Gently pull straight up from the tapered element (TE), lifting the TEOM filter from the TE (Figure 2–13).

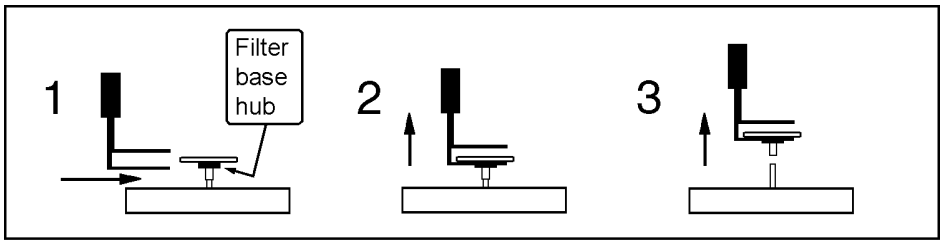


Figure 2–13. Removing the TE filter

Note Do not twist or tilt the filter exchange tool from side-to-side while removing the filter from the TE. This will damage the TE. ▲

Installing a TEOM Filter

The PDM3700 unit is shipped with a Tapered Element Oscillating Microbalance (TEOM) filter installed on the tapered element (TE), but the filter must be changed daily (or with each shift).

To install a TEOM filter:

1. Clean the exchange tool with canned air or a clean cloth. Use it to pick up a new TEOM filter from the box of filters, so that the filter disk lies between the fork and the upper tab of the tool, and the hub of the filter lies between the tines of the fork (Figure 2–14). Do not touch the filter with your fingers.

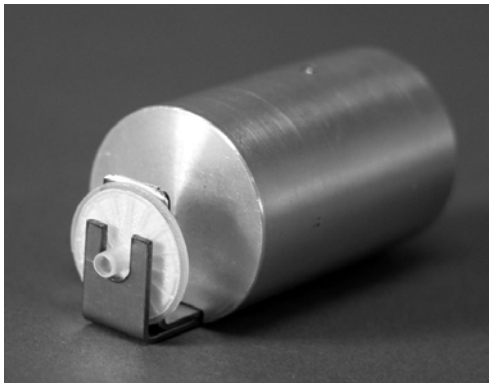


Figure 2–14. Filter tool with clean filter

2. Lightly place the hub of the filter onto the tip of the tapered element, then slide the tool toward the notch and remove (Figure 2–15 and Figure 2–16).

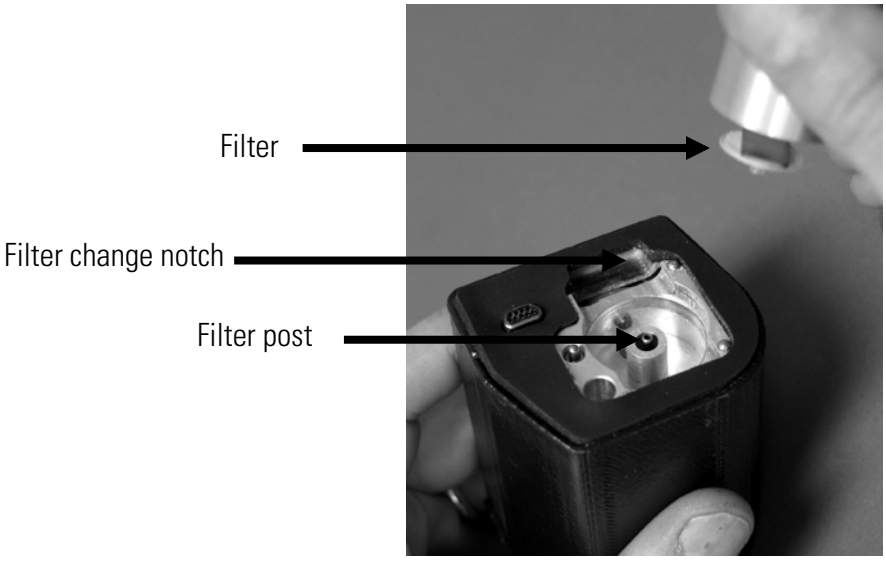


Figure 2–15. Empty mass transducer with filter change notch

Figure 2–16. Placing the filter on the post

3. Turn the tool upside down, place the bottom of the spring loaded filter exchange tool on top of the filter and apply downward pressure until the filter tool stops (Figure 2–17 and Figure 2–18).

4. Rotate the mass transducer 90° and press again. Repeat 2 more times, rotating the transducer 90° and applying the filter tool each time.

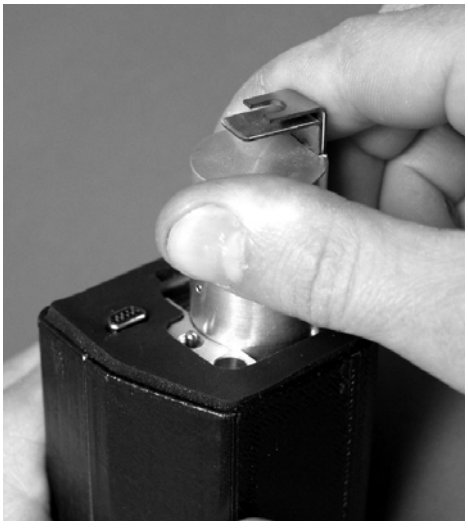


Figure 2–17. Back of filter exchange tool

Figure 2–18. Setting the filter

5. Install the mass transducer back into the PDM3700 unit.

PDM Display

When not running a sample, the PDM3700 will automatically turn off its LED display after 30 seconds of inactivity (power-save function). However, during the warm-up time and sampling cycle, the PDM3700 will continue to activate its LED display until the sample run ends. At the end of the sample run, after 30 seconds of inactivity, the PDM3700 will then automatically turn off its LED display. If the PDM3700 is connected to the WinPDM software, the PDM3700 display will stay on continuously.

The display on the top panel (Figure 2–19) of the PDM3700 allows for easy navigation through the instrument's firmware screens by pressing the "A" or "WAKE UP" button and the "B" or "SCROLL" button. Figure 2–20 provides a hierarchy of all the firmware screens that can be accessed by pressing the "A" and "B" buttons when the unit has been set up to run a manual sample run.

Figure 2–19. PDM3700 display

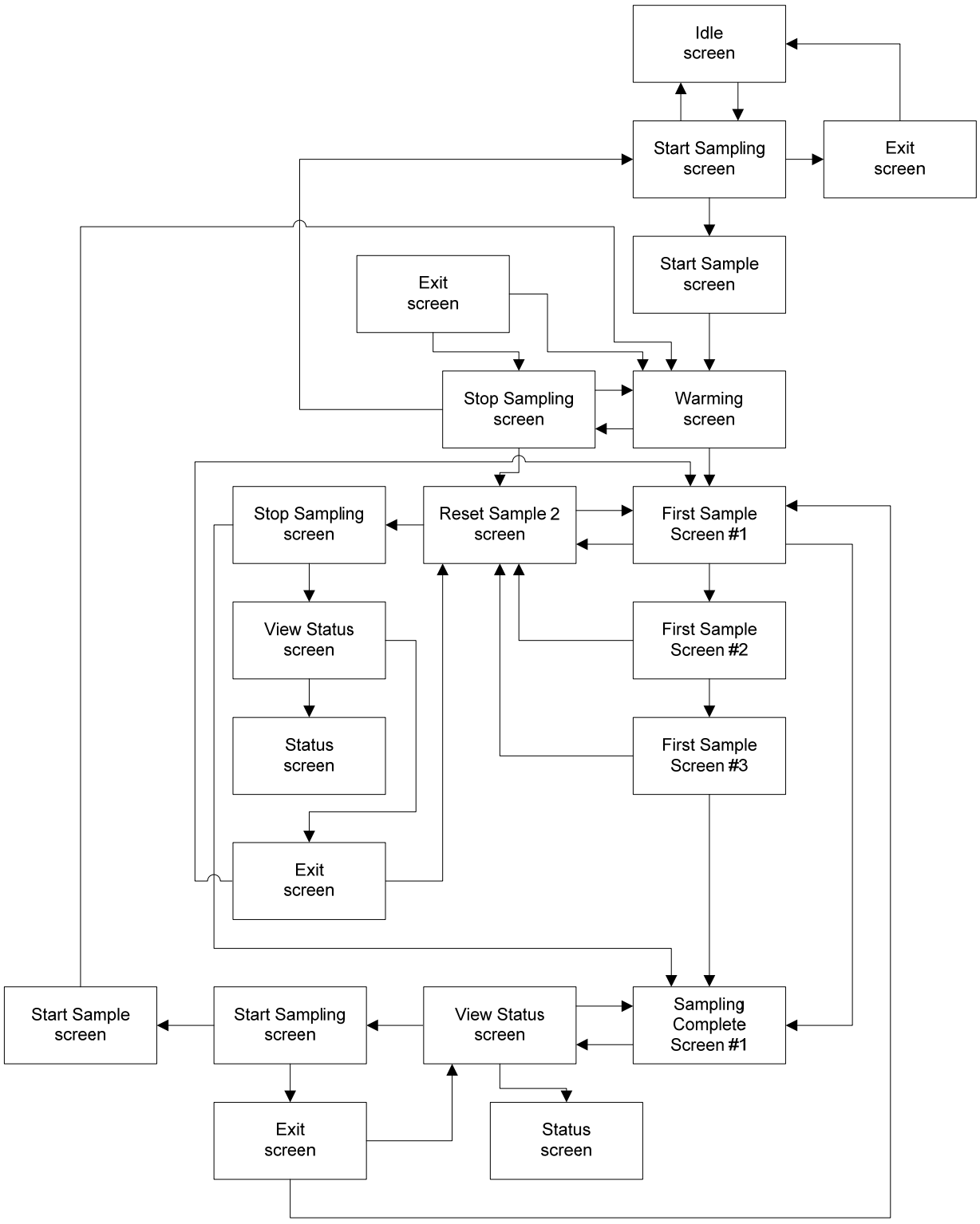


Figure 2–20. First manual sample run screen hierarchy

Idle Screen

When the PDM3700 is turned on and not sampling, the unit will briefly display the Thermo Fisher Scientific Splash screen (Figure 2–21) followed by the Idle screen. Press the "A" (WAKE UP) button (Figure 2–19) located on the top panel of the PDM3700 unit, the Idle screen (Figure 2–22) appears on the instrument's display.

Figure 2–21. Thermo Fisher Scientific Splash screen

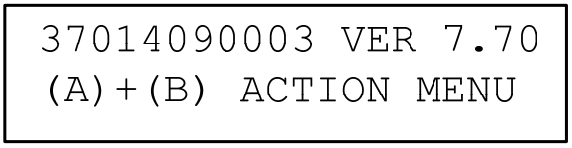


Figure 2–22. The Idle screen

The Idle screen contains the following information:

- **3701XXXXXXX**. This field contains the instrument's serial number (XXXXXXX).
- **Ver. X.XX**. This field contains the version number (X.XX) of the system firmware.
- **(A) + (B) action menu**. Press the A and the B button at the same time to display the unit's Start Sampling screen.
- **(B)**. Press the B button to display the EOS screen from the previous primary sample run (Figure 2–37).

When in the Idle screen, after 30 seconds of inactivity, the PDM3700 will automatically turn off its LED display. Press the "A" (WAKE UP) button to reactivate the LED display.

Starting a Primary Sample Run

There are two methods to start a primary sample run.

1. A manual sample run can be started from the instrument keypad as discussed in this section.

2. The WinPDM software can be used to create a program sample run as described in Chapter 3.

Note When collecting a sample for MSHA compliance and reporting purposes, the sample must be programmed and started using WinPDM. ▲

All screen displays and functions described in this chapter apply to both types of sample runs, except that a programmed sample run cannot be stopped from the instrument keypad.

Note When a sample is started, the instrument begins with a 35-minute warm-up period. To obtain maximum shift run time, Thermo recommends the warm-up be performed while connected to the charger. ▲

Start Sampling Screen

While the WinPDM program (Chapter 3) allows users to access advanced features of the unit, including programmed sample runs, the user can initiate a manual sample run using the instrument's display and buttons. When in the Idle screen (or the Sampling Complete Screen #1 if a sample has been recently completed), press both the "A" and the "B" buttons simultaneously to display the Start Sampling screen (Figure 2–23).

After 30 seconds of inactivity in the Start Sampling screen, the PDM3700 will automatically turn off its LED display. Press the "A" button to reactivate the LED display and to bring up the Idle screen, or the Sampling Complete Screen #1 (if the sample run is complete).

```
(A) START SAMPLING
(B) MORE OPTIONS...
```

Figure 2–23. Start sampling screen

The Start Sampling screen contains the following information:

- **(A) Start Sampling**. This field contains directions on how to start a manual sample run. When in the Start Sampling screen, press the "A" button to begin the sample run.
- **(B) more options....** This field contains directions on Hours Used, View Status screen, and on how to exit the Start Sampling screen. Refer to the following section for information on using the Exit screen.

Exit Screen

The user can exit various screens through the Exit screen (Figure 2–24).

Figure 2–24. Exit screen

The Exit screen contains the following information:

- (**A**) **Exit.** This field contains directions on how to exit the screen from which you accessed the Exit screen. When in the Exit screen, press the "A" button to exit the screen from which you accessed the Exit screen.
- (**B**) **more options**.... This field contains directions on how to display the Start Sampling screen, Hours Used, or the View Status screen. Refer to the appropriate section for more information on these screens.

Start Sample Screen

The user can initiate a manual sample run through the Start Sample screen. When in the Start Sampling screen (Figure 2–23), press the "B" button to display the Start Sample screen (Figure 2–25).

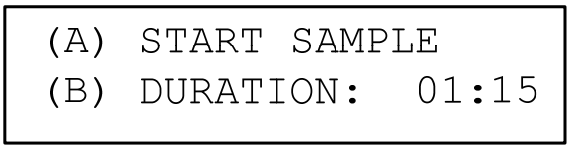


Figure 2–25. Start Sample screen

The Start Sample screen contains the following information:

- (**A**) **Start Sample.** This field contains directions on how to start a manual sample run.
- (**B**) **Duration: 01:15.** This field contains the time duration of the manual sample run. Press the "B" button to increase the time duration of the manual sample run.

Starting a Manual Sample

From the Start Sample screen, users can begin a manual sample run when a PC is not available or when a manual sample is desired. If the conditions change or the employees moves to a different area, a second manual sample run can be started running concurrently with the first sample run.

To start a first manual sample run:

1. In either the Idle screen or the Sampling Complete Screen #1, press the "A" and "B" buttons simultaneously to display the Start Sampling screen.

2. In the Start Sampling screen, press the "A" button to display the Start Sample screen (Figure 2–25).

3. To change the time duration of the first manual sample run before beginning the run, adjust the time duration by pressing the "B" button.

4. In the Start Sample screen, press the "A" button to begin a manual sample run. The Warming screen will display (Figure 2–26). When the sample run begins, the instrument will display First Sample Screen #1 (Figure 2–27).

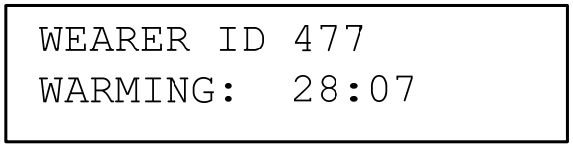


Figure 2–26. Warming screen

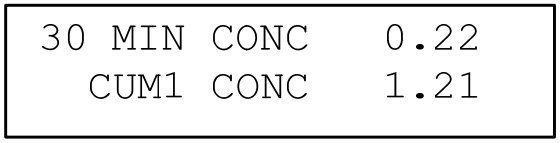


Figure 2–27. First Sample Screen #1

Starting a Second Sample Run

While sampling, a second sample may be started, for example if the conditions change or the employees moves to a different area, a second manual sample run can be started running concurrently with the first sample run.

To start a second manual sample run:

1. In the First Sample Screen #1 (Figure 2–27), press the "A" and "B" buttons simultaneously to display the Reset Sample 2 screen (Figure 2–28).

Figure 2–28. Reset Sample 2 screen

2. In the Reset Sample 2 screen, press the "A" button to begin a second manual sample run. The second manual sample run will begin immediately after pressing the "A" button. The PDM3700 unit will not perform another 35-minute warm-up period before beginning the second manual sample run, and the Second Sample screen will display.

Note After 30 seconds of inactivity in the Reset Sample 2 screen, the PDM3700 will automatically display the First Sample Screen #1. ▲

Second Sample Screen

The Second Sample Screen (Figure 2–29) displays the mass concentration, cumulative exposure and elapsed time for the second manual sample run ("Sample 2"). This screen will display immediately after the start of a second manual sample run.

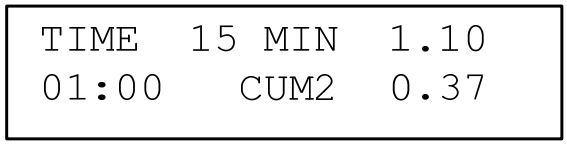


Figure 2–29. Second Sample screen

The Second Sample Screen #1 contains the following information:

- **15 MIN.** This field contains the averaged mass concentration value (mg) measured during the previous 15 minutes.
- **CUM2 CONC.** This field contains the cumulative mass concentration value (mg/m^3) measured from the beginning of the second sample run.
- **TIME.** This field contains the time duration (minutes/seconds) for the second sample run.

During the sampling run, the PDM3700 will run automatically until the sample cycle ends. At the end of the sample run, after 30 seconds of inactivity, the PDM3700 will turn off its LED display. Press the "A" button to reactivate the LED display. Figure 2–30 provides a hierarchy of all the firmware screens that can be accessed by pressing the "A" and "B" buttons when the unit has been set up to run a manual sample run.

Dynamic Warm Up

If the primary manual sample shift ends earlier than required, successive manual sample shifts can be started with much shorter warm-up times. During warm-up, the instrument monitors the sensors and will adjust the warm-up time to as little as 5 minutes. Accordingly, the longer the instrument has been off, the longer the warm-up time.

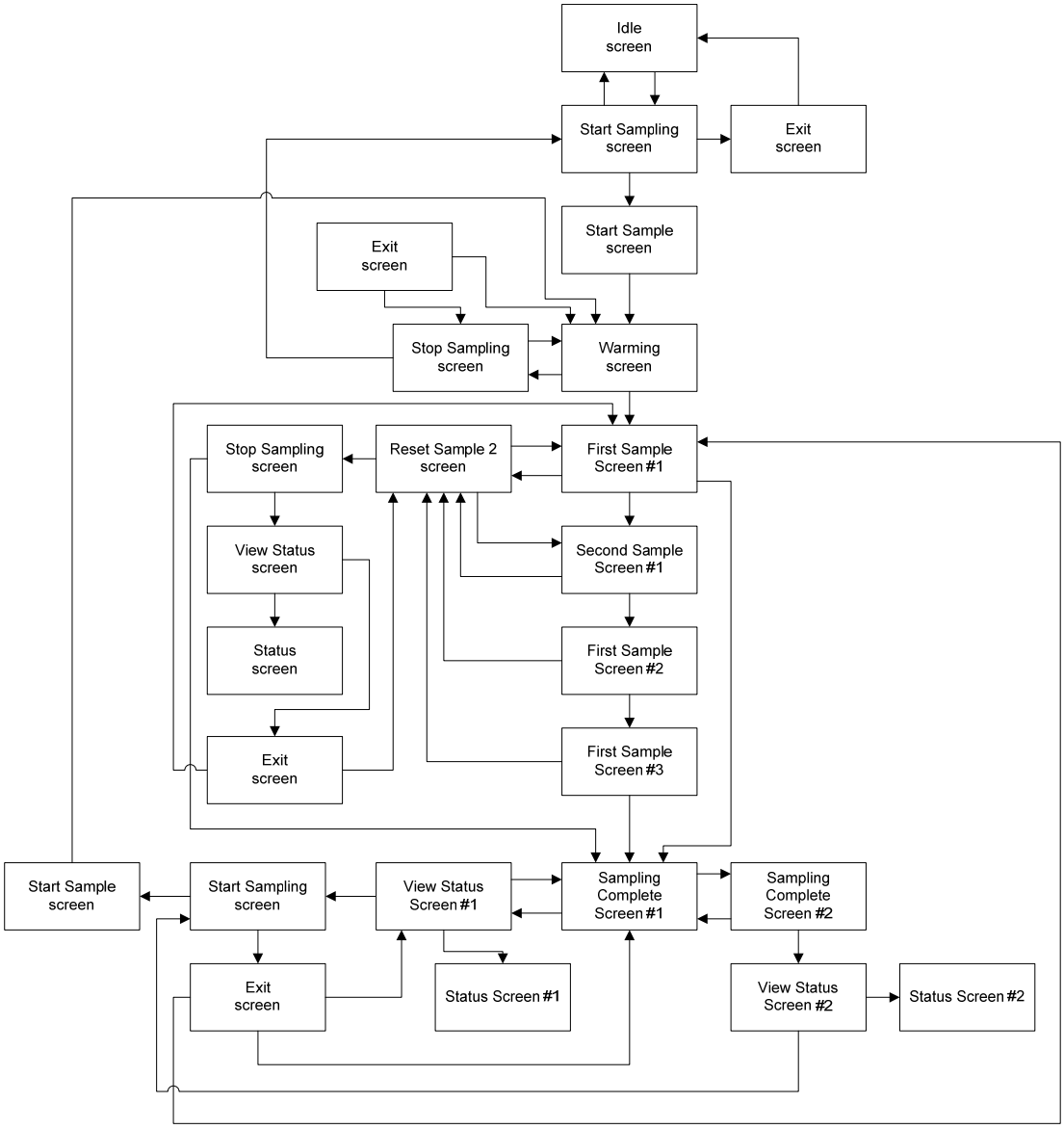


Figure 2–30. Screen hierarchy during a two-sample run

Stopping a Sample Run

The user can stop a manual sample run using the Stop Sampling screen (Figure 2–31). Stopping a sample run will stop the main sample run as well as the second sample run if one has been started. Stop the sample runs by pressing the “A” and “B” buttons simultaneously, and the Stop Sampling screen will display.

```
(A) STOP SAMPLING
(B) MORE OPTIONS...
```

Figure 2–31. Stop Sampling screen

The Stop Sampling screen contains the following information:

- (**A**) **Stop Sampling**. This field contains directions on how to stop a manual sample run. Press the A button to stop the sample run.
- (**B**) **more options...** This field contains directions on how to display the various operating screen. When in the Stop Sampling screen, press the "B" button to display either the Exit screen, View Status screen, or the Reset Sample 2 screen, depending on the screen from which you have accessed the Stop Sampling screen.

Stopping During Warm Up

Users can stop the unit either during the warm-up time or during the sample run.

To stop a manual sample run during the warm-up time:

1. In the Warming screen, press both the "A" and "B" buttons simultaneously to display the Stop Sampling screen.
2. In the Stop Sampling screen, press the "A" button ("Stop Sampling" option) to stop the manual sample run and display the Idle screen.

Stopping During Sampling

Users can stop the unit either during the warm-up time or during a manual sample run.

To stop a manual sample run during a sample run:

1. In the First Sample Screen #1, press the "A" and "B" buttons simultaneously to display the Reset Sample 2 screen.
2. In the Reset Sample 2 screen, press the "B" button ("more options") to display the Stop Sampling screen.
3. In the Stop Sampling screen, press the "A" button ("Stop Sampling" option) to stop the manual sample run and display the Sampling Complete - Screen #1. This action will stop both the first and second manual sample run (if you have started a second manual sample run).

Sample Run Screens

The PDM3700 displays several screens during a sample run. Information includes cumulative exposure and other data, as well as whether the instrument is operating properly (refer to the "System Status" section later in this chapter for more information on status.

Warming Screen

The Warming screen (Figure 2–32) displays a countdown of the unit's warm-up time duration before the unit starts a sample run.

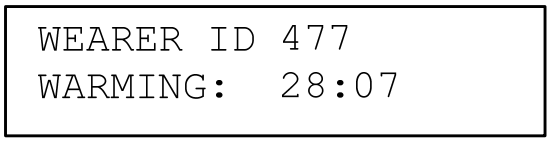


Figure 2–32. Warming screen

The Warming screen contains the following information:

- **Wearer ID** 477. This field contains an 8-digit user-identification number. You can set this value using the WinPDM software application (Chapter 4).
- **Warming: 28:07**. This field contains the time countdown (minutes:seconds) of the PDM3700 unit's warm-up time duration before the unit starts a first primary sample run. At the end of the warm-up time, the PDM3700 will automatically begin running a first primary sample run and display the First Sample - Screen #1.

First Sample - Screen #1

First Sample - Screen #1 (Figure 2–33) displays the mass concentration and cumulative exposure for the first primary sample run ("Sample 1") during the sample run. This screen will display automatically when the warm-up time duration for the first primary sample has completed.

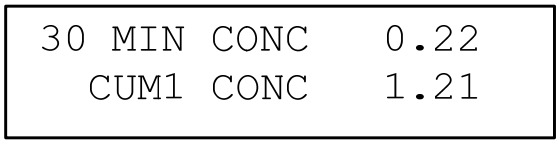


Figure 2–33. First Sample - Screen #1

This screen also displays the total mass concentration, and total cumulative exposure values at the end of the first primary sample run ("Sample 1").

The First Sample - Screen #1 contains the following information:

- **30 MIN CONC.** This field contains the mass concentration value (mg) averaged during the previous 30-minute period.
- **CUM1 CONC.** This field contains the cumulative mass concentration value (mg/m^3) measured from the beginning of the first primary sample run.

During the sampling run, the PDM3700 will run automatically until the sample cycle ends. After 30 seconds of inactivity at the end of the sample run, the PDM3700 will turn off its LED display. Press the "A" button to reactivate the LED display. This action will display the Sampling Complete - Screen #1.

First Sample - Screen #2

First Sample - Screen #2 (Figure 2–34) displays the shift mass concentration limit for the shift for the first primary sample run. Percent of exposure limit is the percentage of exposure limit for the first primary sample run.

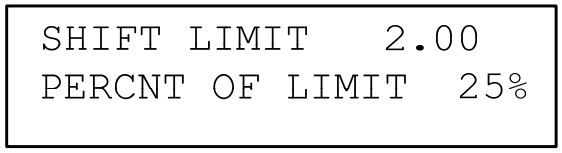


Figure 2–34. First Sample - Screen #2

First Sample - Screen #3

The First Sample - Screen #3 (Figure 2–35) displays a bar graph of the mass concentration (mg/m^3) collected during the entire primary sample run. When in the First Sample - Screen #1, press the "B" button to display the First Sample - Screen #3.

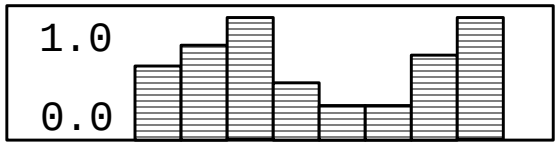


Figure 2–35. First Sample – Screen #3

Each bar represents the previous 30-minute, averaged mass concentration value. "The 1.0" denotes the highest mass concentration value measured; the "0.0" represents the lowest mass concentration value measures. A new bar is added to the graph every 30 minutes, with the width of each bar representing a 30 minute time period. When there are bars displayed across the entire screen and a new bar is added, the new bar will display at the far

right side of the screen, and the previously displayed bars will move to the left.

First Sample - Screen #4

The First Sample - Screen #4 (Figure 2–36) displays the elapsed sample time and sample time for the first primary sample run ("Sample 1"). In the First Sample - Screen #3, press the "B" button to display the First Sample - Screen #4.

```
ELAPSED TIME:   01:15
PROGRAM TIME:   08:00
```

Figure 2–36. First Sample - Screen #4

The First Sample - Screen #4 contains the following information:

- **Elapsed Time.** This field contains the elapsed sample time (hours:minutes) measured from the beginning of the first primary sample run.
- **Program Time.** This field contains the entire sample time duration or cycle (hours:minutes) that was set by the user in the Start Sample screen for the first primary sample run.

During the sampling run, the PDM3700 will run automatically until the sample cycle ends. After 30 seconds of inactivity at the end of the sample run, the PDM3700 will turn off its LED display. Press the "A" button to reactivate the LED display and to bring up the Sampling Complete - Screen #1 (Figure 2–37).

Second Sample Screen

The Second Sample Screen displays the mass concentration, cumulative exposure and elapsed time for the second primary sample run ("Sample 2"). This screen will display immediately after the start of a second primary sample run. Refer to "Starting a Second Sample Run" earlier in this chapter for more information on the Second Sample screen.

Sample Complete Screens

The PDM3700 displays several screens following a sample run. Information includes cumulative exposure and other data, as well as any status codes logged during the sample run(s).

Sampling Complete - Screen #1

The Sampling Complete - Screen #1 (Figure 2–37) displays the sample time duration and the total mass concentration (EOS) for the first primary

sample run (“Sample 1”). The Sampling Complete - Screen #1 automatically displays at the end of a primary sample run.

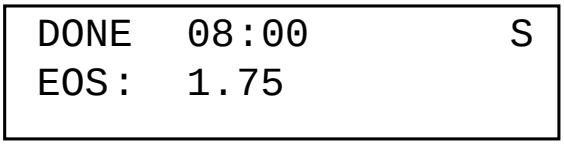


Figure 2–37. Sampling Complete - Screen #1

The Sampling Complete Screen #1 contains the following information:

- **DONE**. This field contains the entire sample time duration (minutes:seconds) for the first primary sample run.
- **EOS**. This field contains the total mass concentration value (mg/m^3) measured from the beginning of the first primary sample run.

When in the Sampling Complete - Screen #1, you can start another first primary sample run, or you can view any status conditions that may have occurred during the primary sample run. Refer to the following section “Status Conditions” for more information on status codes.

After 30 seconds of inactivity in the Sampling Complete Screen #1, the PDM3700 will turn off its LED display. Press the “A” button to reactivate the LED display.

Status Conditions

The PDM3700 monitors its performance during a sample run and registers any status conditions logged during the sample run(s). The unit displays a blinking “S” in the upper right-hand corner of the First Sample - Screen #1, Second Sample Screen, Sampling Complete - Screen #1, and the Sampling Complete - Screen #2 to identify that a status code has occurred during a primary or programmed sample run (Figure 2–38).

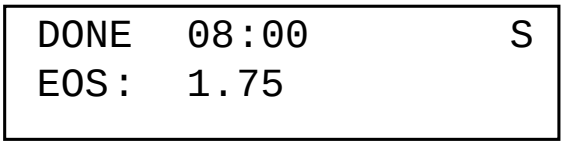


Figure 2–38. Screen with “S” in corner designating a status condition

View Status Screen

The View Status screen (Figure 2–39) allows users to view status conditions. Status codes can be viewed both during the sample run and after the sample run has ended.

Figure 2–39. View Status screen

The View Status screen contains the following information:

- **(A) View Status**. This field contains directions on how to display any status codes that may have occurred during the primary sample run. Press A to view system status codes.
- **(B) more options**.... This field contains directions on how to display the Exit screen, Reset Sample 2 screen, Stop Sampling screen, or the Start Sampling screen. When in the View Status screen, press the "B" button to access these options.

Viewing Status Codes During A Sample Run

Users must access the View Status screen during a sample run to view the status codes during the sample run.

To view status codes during a primary sample run:

1. In the First Sample - Screen #1, press the "A" and "B" buttons simultaneously to display the Reset Sample 2 screen.
2. In the Reset Sample 2 screen, press the "B" ("more options") button to display the Stop Sampling screen.
3. In the Stop Sampling screen, press the "B" button to display the View Status screen (Figure 2–39).
4. In the View Status screen, press the "A" button to display the Status screen (Figure 2-37).

Note Refer to "Status Codes" later in this section for more information on the Status screen. ▲

Viewing Status Codes After A Sample Run

To view status codes after a primary sample run has ended:

In the Sampling Complete - Screen #1 or the Sampling Complete - Screen #2, press the "A" and "B" buttons simultaneously to display the View Status screen (Figure 2–39).

When in the View Status screen, press the "A" button to display the Status screen (Figure 2-37).

Note Refer to "Status Codes" later in this section for more information on the Status screen. ▲

Status Codes

The Status screen (Figure 2–40) displays the actual status conditions that have occurred during the sample run. These status codes can also be located on the downloaded data files (Chapter 4) after the sample run has ended.

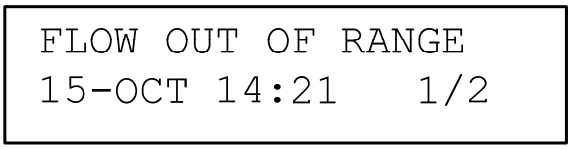


Figure 2–40. Status screen

If the PDM3700 unit has encountered more than one status condition, pressing the "B" button repeatedly allows viewing of all the status conditions that occurred during the primary sample run.

The current screen number and number of screens is displayed in the lower right corner. In this case, screen 1 of 2.

Status Codes When Sampling

There are a number of status codes that may appear during a programmed or primary sample run. A blinking 'S' in the upper right corner of the display indicates that a status condition has been encountered. The blinking can be stopped by navigating to the 'View Status' screen. The 'S' will remain for the duration of the sample run. If a new status code is flagged the 'S' will start blinking again until the new code is viewed.

Below is a list of the status codes that can be encountered during a sample run.

Status Codes List

Status Code Table

PDM3700 Firmware Status Codes	Description
TE not detected	Mass transducer not detected
High filter load	Differential pressure approaching maximum
Flow out of range	The flow rate is out of allowable range
Mass offset	The PDM3700 has gained or lost too much mass over a short period of time
CPU fault	A CPU fault was detected
Power low	The power remaining in the battery has reached a critically low level
TE Frequency	The TEOM frequency is out of range

PDM CPU reset	The PDM3700's CPU was reset
Power low shutdown	The PDM3700 was shutdown due to insufficient power
TE Temp out of range	The difference between the mass transducer and the setpoint is greater than 1 °C
Sample Start Time Missed	The programmed sample start time was missed

The PDM3700 status codes are as follows:

- **TE not detected.** This condition is reported when the PDM3700 unit senses that the mass transducer has been removed from the unit.
- **High filter load.** This condition is reported when the PDM3700 unit senses that the TEOM filter is approaching its maximum capacity. At this point, the filter can accept approximately -50 mmHg of additional particulate matter load before it must be replaced with a new TEOM filter (Section 2). This condition is reported when the minimum filter differential pressure exceeds -110 millimeters-Hg (-4.3 inches-Hg).
- **Flow out of range.** This condition is reported when the main flow rate (l/min) deviates from its set point by 0.1 l/min for more than 3 minutes.
- **Mass offset.** This condition is reported when the PDM3700 unit detects an instantaneous, significant and sustained change in the total mass value. It is designed to indicate that an event has occurred that may invalidate the current sample run.
- **CPU fault.** The PDM3700 unit has detected a problem with its internal CPU board.
- **Power low.** The PDM3700 unit has detected that the power remaining in the battery has reached a critically low level.
- **TE frequency.** The TE frequency is outside the acceptable range for more than 60 seconds.
- **PDM CPU reset.** The PDM3700 has detected an issue with the internal CPU board and has reset the program.
- **Power low shutdown.** If the PDM3700 senses the power low condition for more than 5 minutes, the instrument will shutdown to protect the CPU.

Downloading Data

User can view, download and store several different types of information at the end of a primary or programmed sample run using the WinPDM software. Refer to Chapter 4 for complete information on configuring, viewing and downloading data.

To download data from the PDM3700 unit:

1. Following a primary or programmed sample run, connect the PDM3700 unit to its charger and the charger to the PC. Ensure that the charger and the PDM3700 are both functioning correctly.

2. Start the WinPDM software application and select the "Download Sample" button.

3. When in the Download Data screen, select the sampling event that you want to download.

4. Select the "Download" button. A "downloading progress bar" will display at the bottom of the window.

5. If the PDM3700 unit encountered any status conditions during the sample run, the "Status Code List" screen will display.

6. If the status screen displays, select the "Save As" button. The "Save As" screen will display. Accept the data file name that the software provides for the data file or change the data file name, if necessary. Select the "Save" button.

Note The WinPDM software automatically names the status code file with the date and start hour of the sample run (yyyy-mm-dd-hh), the PDM3700 unit serial number, the Mine ID number, word "STATUS," and the vendor/instrument code. For example: 2014-08-19-06-0212502-0503836-STATUS-A.csv. ▲

7. When the Download Graph screen appears, the shift information screen appears (Figure 4–6).

8. Enter the shift tonnage information, Certified Person MIIN, and any notes for the shift.

   This screen also allows the operator to enter the sampler information for instances of multi-unit shift logging. If the sampler was used during a shift that lasted longer than 12 hours, two samplers must be used to

collect the shift data. If the downloaded data was part of a multi-unit shift, select yes on Multi-unit Shift field and enter the serial number of the first unit of the shift and the second unit of the shift. Ensure that the serial numbers of the two units are entered correctly and in the correct order. This information will be used to properly combine the data from the two samplers for the entire completed shift. The data from both samplers must be downloaded and sent to MSHA.

9. After entering the required information, you can view various graphs of the logging parameters that were recorded during the sample event. Select the parameters to view using the drop-down menu. For more information on the download data screen, refer to the "Download Graph Screen" section in Chapter 4.

10. After you have viewed the data, select the "Print Dust Data Card" button The Dust Data Card screen will display. Select the "Print" button to print a paper record of the sample run. This hard-copy record will display the data entered when the sample run was first programmed and the data results that were recorded.

11. After reviewing the data and to collect the data to send to MSHA for validation, select the Save Data button on the graph screen. When saving the data, you will be prompted to save the data to the PC. WinPDM will prompt to save two data files, one for local use and viewing, and a second data file for use by MSHA. The first data file is a .csv format that can be easily imported into Microsoft Excel, or other similar spreadsheet program. The second data file is a .MSHA file format and is required to be submitted to MSHA for validation. The .MSHA data file contains the data in the .csv file as well as a few additional information details that will be used by MSHA for validation. If the .MSHA data file is not required for a shift, press cancel when prompted to save the .MSHA data file.

Note To ensure proper data storage and file information, refer to MSHA guidelines for data reporting requirements. ▲

12. Select the "Save" button to save the data file.

Note The WinPDM software automatically names the data files with the date and start hour of the sample run (yyyy-mm-dd-hh), the PDM3700 unit serial number, the Mine ID number, and the vendor/instrument code. For example: 2014-08-19-06-0212502-0503836-A.csv or .MSHA. ▲

13. If you do not want to save the file, select the “Cancel” button. The Download Graph screen will display.

14. Click “Cancel” if you wish to exit the Download Graph screen.

15. After saving the data, please refer to MSHA instructions as to how to submit the .MSHA file to MSHA for review and validation.

Chapter 3
Using the WinPDM Software

This section explains how to install and set up the WinPDM software, and how to program a sample run for the instrument.

A programmed sample run or "shift" can be set up in advance using the WinPDM communications software program. One shift-time can be programmed, and all shifts require a 35-minute warm-up period before data begins collecting.

The PDM3700 will accommodate programmed shift-lengths from 1 minute to 24 hours. After the PDM3700 unit has completed a sample run (immediate or programmed), you can download the data collected to a personal computer (PC) for analysis.

Refer to Chapter 2: Basic Operation for information on starting a primary sample run using the keys on the PDM3700.

Note A version of WinPDM was supplied with the PDM3700 when delivered, however, this may not be the most current version of the software available. Always check that you are using the latest MSHA approved version prior to programming the PDM3700 and downloading the data from the instrument. Refer to installation instructions provided with new version. ▲

Installing WinPDM

This section explains how to locate and load the WinPDM communication software onto your personal computer (PC). System minimum requirements for running WinPDM software include a Pentium processor and 64 megabytes (MB) of random access memory (RAM) and 40 megabytes (MB) of hard drive space.

Prior to installing a new version of the WinPDM software, users must first remove the existing version from their PC. Use the PC's "Control Panel" in the Start menu, and the "Add/Remove Programs" function to remove older versions of the WinPDM software.

Note WinPDM version 7.52 or higher must be used for compliance with MSHA requirements for sampling and data submission. While earlier versions of WinPDM may operate with the PDM 3700, they do not meet

the MSHA requirements. Always verify that the latest approved version of WinPDM is being used. ▲

To install WinPDM onto a PC:

1. Exit all Windows programs currently running on your PC.

2. Place the PDM3700 software CD-ROM in the CD-ROM drive.

3. Open the "Software" folder on the PDM3700 software CD-ROM, then open the "WinPDM Setup.exe" file located in the Software folder.

4. The InstallShield Wizard screen (Figure 3–1) will post several temporary installation messages while WinPDM prepares the installation program. Then the WinPDM - InstallShield Wizard screen with a "Welcome" message will display. Select the "Next>" button.

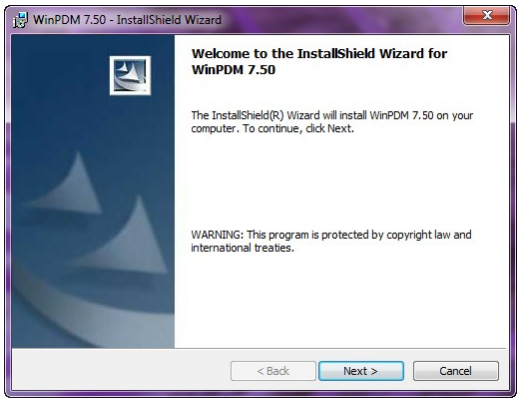


Figure 3–1. InstallShield Wizard screen with Welcome message

5. The InstallShield Wizard screen with a "License Agreement" message will display. Accept the terms of the license agreement then select the "Next>" button

6. The InstallShield Wizard screen with a "Customer Information" message will display. Enter the appropriate information into the white boxes, and then select the "Next>" button.

7. The InstallShield Wizard screen with a "Destination Folder" message will display. Select the "Next>" button.

8. The InstallShield Wizard screen with a "Ready to Install the Program" message will display. Select the "Install" button.

9. The InstallShield Wizard screen with an “Installing WinPDM” message will display, and then the WinPDM - InstallShield Wizard screen with an “InstallShield Wizard Completed” message will display.

10. When in the WinPDM - InstallShield Wizard screen with an “InstallShield Wizard Completed” message, select the “Finish” button.

You do not need to restart your computer to use WinPDM. Double-click on the WinPDM icon on the PC’s desktop to start the WinPDM communications software program.

Starting WinPDM

The PDM3700 must be connected to the charger and a PC to use the WinPDM program. Refer to Chapter 2 for information on connecting the PDM3700 unit to the charger and establishing communications.

To start the WinPDM software application:

1. Connect the PDM3700 unit to its charger and the charger to your PC (Chapter 2). Make sure both are on.

2. Ensure that the charger and PDM3700 are connected (Chapter 2).

3. Double-click on the WinPDM icon on the desktop to start the program. You also can select the “Start” button on your personal computer’s (PC’s) screen, and when the Start menu displays, select Programs > Thermo > **WinPDM**.”

4. The WinPDM Main screen will display. The splash screen in the middle of the screen will disappear after a few seconds, and then the “PDM-New Connection” screen will display (Figure 3–2).

New connection icon

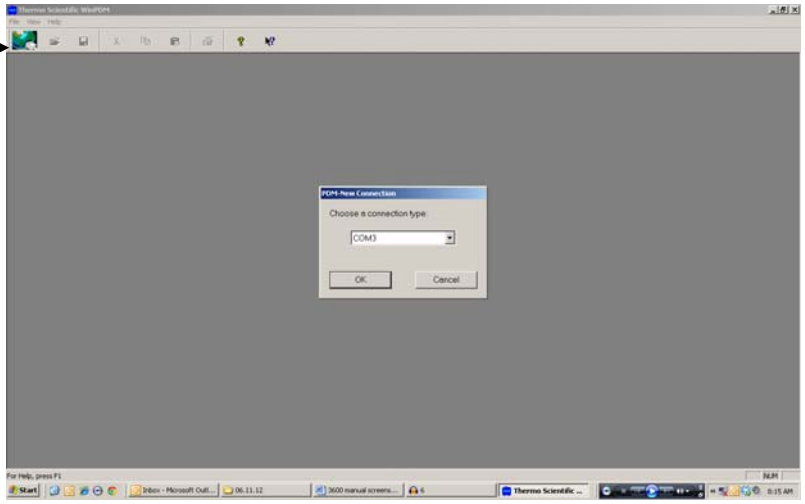


Figure 3–2. WinPDM Main screen with PDM3700 New Connection screen

Note You also can display the PDM-New Connection screen by selecting File > **Connect** from the drop-down menu, or by selecting the new connection icon in the top, left-hand corner of the toolbar. ▲

5. When in the "PDM-New Connection" screen, ensure that the appropriate COM port displays in the white box, and select the "OK" button. The "PDM - COM1" screen (Figure 3–3) will display.

Note If the connection between the PDM3700 and the PC is successful, the unit's serial number will display in the top, right-hand corner of the screen. ▲

Figure 3–3. Connect screen

6. If the connection is not successful or if there is no instrument attached, a "Not Connected To PDM" message will display (Figure 3–4) and the serial number will be blank or will display "N/A." Ensure that the cable connections are secure and installed correctly. Press the "A" ("WAKE UP") button on the PDM3700's display to verify that the PDM3700 is functioning properly and retry the connection.

7. The "Last Service" date is displayed in the lower left corner. This date will be updated by Thermo Fisher Scientific service personnel if the unit is returned for service.

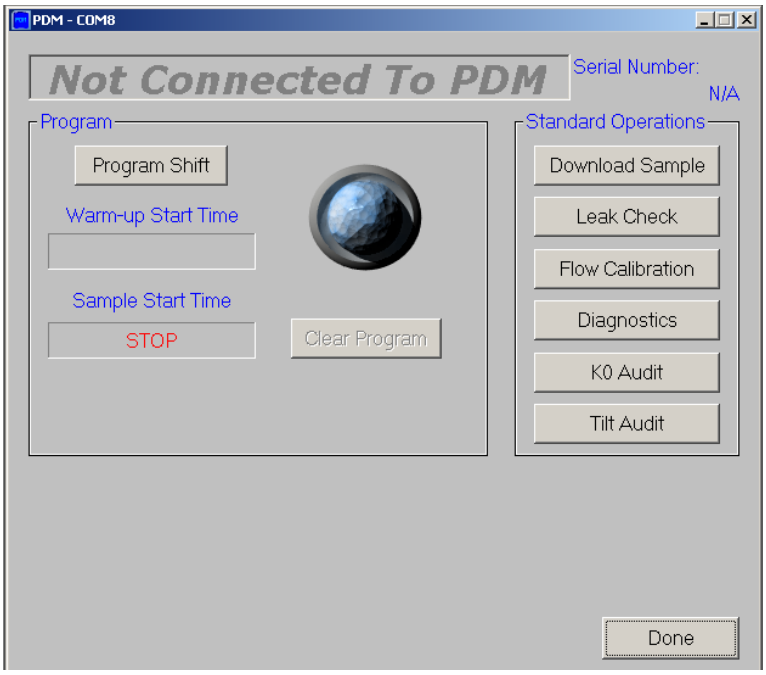


Figure 3–4. WinPDM showing "Not Connected"

Note If the cable connections are secure, and the PDM3700 is functioning correctly, but you still cannot make a successful connection between the PDM3700 and PC, contact Thermo Fisher Scientific.▲

Exiting the WinPDM Software Application

When the programming is complete, users can disconnect the PDM3700 and exit the WinPDM software.

To exit the WinPDM software application:

1. When in the PDM - COM1 screen, select the “Done” button located in the bottom, right-hand corner of the screen. The WinPDM Main screen will become the active screen on your laptop/personal computer.

2. When in the WinPDM Main screen, select the “X” icon in the top, right-hand corner of the screen to exit the WinPDM software application. You also can exit WinPDM by selecting File> **Exit** from the drop-down menu.

Starting a Programmed Sample Run

You must use the WinPDM communications software to start and stop a programmed sample run. When you use the WinPDM communications software application to set up a programmed sample run, you can not stop or change the sample run duration by pressing the "A" ("WAKE UP") or "B" ("SCROLL") button on the PDM3700's display.

If you want to stop or change a programmed sample run, you must connect the PDM3700 unit to its charger and to your PC, and use the WinPDM software to perform any necessary changes to the sample run.

To start a programmed sample run:

1. Connect the PDM3700 unit to its charger and the PC, and ensure that the charger and the PDM3700 are both functioning correctly.

2. Start the WinPDM software application.

3. When in the PDM - COM1 screen, select the "Program Shift" button (located on the left-hand side of the screen under the "Program" heading) to display the Program shift screen (Figure 3–5).

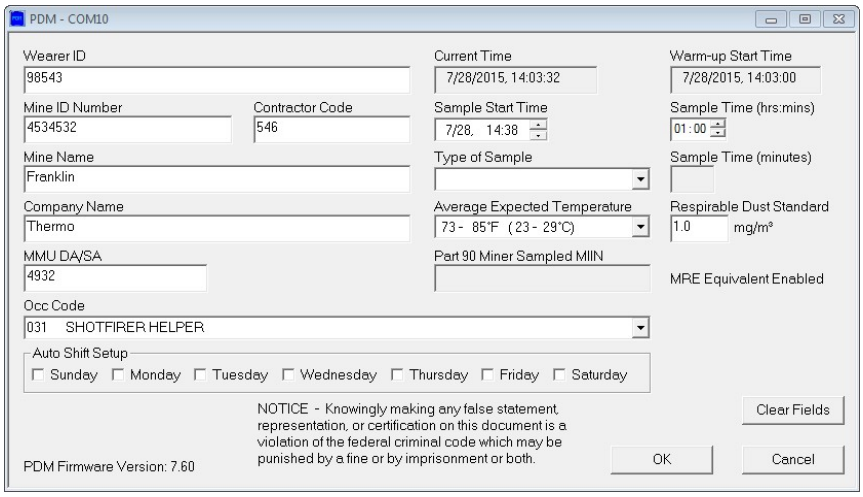


Figure 3–5. Program Shift screen

4. When in the Program Shift screen, set up the appropriate parameters for your sample run and then select the "OK" button. The screen will prompt if the entries are not valid. If you have correctly set up the sampling parameters, the PDM - COM1 screen will display the start date and time on the screen and the dark circular bulb located in the center of the screen will light up (Figure 3–6). If you have not correctly set up the sampling parameters, a Warning/Confirmation screen will

display. Refer to Configuring a Program Shift later in this chapter for more information on correcting programming errors.

Figure 3–6. Programmed

You can now exit from the WinPDM software application and disconnect the PDM3700 unit from its charger. If you leave the PDM3700 connected to the charger, the PDM - COM1 screen will display the “Start Time” (date and time) on the screen (Figure 3–7) until 35 minutes before the start date/time. At the 35-minutes mark, the PDM - COM1 screen will display a “Warming” message on the screen for 35-minutes. After the warming period ends, the PDM3700 unit will begin its sample run and the PDM - COM1 screen will display a “Running” message on the screen (Figure 3–8).

Figure 3–7. Warming

Figure 3–8. Running

When the sample run has completed, the WinPDM PDM - COM1 screen will display a "STOP" message on the screen. The PDM3700 unit will display the appropriate completed sample screens (Chapter 2) until you download the data from the PDM3700 unit, or until you start another primary or programmed sample run.

Stopping a Programmed Run

You can stop a programmed sample run at any time after you have programmed the sample run using the WinPDM software.

Follow these steps to stop a programmed sample run:

1. Connect the PDM3700 unit to its charger and the PC, and ensure that the charger and the PDM3700 are both functioning correctly.

2. Start the WinPDM software application. The circular bulb in the center of the PDM - COM1 screen should be "lit." Also, the PDM - COM1 screen should display the start date and time, a "Warming" message, or a "Running" message on the screen.

3. When in the PDM - COM1 screen, select the "Clear Program" button that is located in the middle of the screen. The PDM - COM1 screen will display a "STOP" message on the screen (Figure 3–9).

Figure 3–9. Clearing Program

PDM Display During Programmed Sample

The display on the top panel of the PDM3700 allows users to navigate through the instrument's firmware screens by pressing the "A" and "B" buttons. But when the WinPDM communications software is used to program a sample run, a user has no ability to change the parameters using the "A" and "B" buttons.

Note After programming a sample using the WinPDM software, users cannot stop the sample run by pressing the buttons on the PDM3700 unit's display. This feature allows users to complete compliance samples without the risk of "prematurely" terminating a sample run. ▲

Programmed Start Time Screen

The Programmed Start Time screen (Figure 3–10) displays the date and time that the PDM3700 unit is scheduled to start a first programmed sample run. This firmware screen will display on the PDM3700 unit after you have programmed a sample run. Users will not be able to display a different firmware screen when the Programmed Start Time screen is visible on the PDM3700 unit.

Figure 3–10. Programmed start time PDM3700 screen

The Programmed Start Time screen contains the following information:

- **Wearer ID** 477 This field contains an 8-digit user-identification number. This value can be set using the WinPDM software.
- **Start:** This field contains the date (dd-mmm) and time (hh:mm) that the PDM3700 unit is scheduled to begin a programmed sample run. The PDM3700 unit will automatically begin a 35-minute warm-up period before this scheduled start time and date.

Starting a Second Sample

If the conditions change or the employees moves to a different area, a second primary sample run can be started to run concurrently with the first programmed sample run. Refer to Chapter 2 for more information on the screens shown during a second sample run.

To start a second primary sample run:

1. In the First Sample Screen #1, press the "A" and "B" buttons simultaneously to display the Reset Sample 2 screen (Figure 3–11).

```
(A) RESET SAMPLE 2
(B) MORE OPTIONS...
```

Figure 3–11. Reset Sample 2 screen

2. In the Reset Sample 2 screen, press the "A" button to begin a second primary sample run. The second primary sample run will begin immediately after pressing the "A" button. The PDM3700 unit will not perform another 35-minute warm-up period before beginning the second primary sample run, and the Second Sample screen will display.

Note After 30 seconds of inactivity in the Reset Sample 2 screen, the PDM3700 will automatically display the First Sample Screen #1. ▲

Configuring a Program Shift

When in the Program Shift screen (Figure 3–12), you can set up your sample run parameters, including identifying the mine information and setting up the sample start time, duration and type.

When in the PDM - COM1 screen, select the "Program Shift" button to display the Program Shift screen. These values will be stored in the PDM3700's data storage buffer, and will display on the "Dust Data Card" that can be downloaded at the end of the sample run.

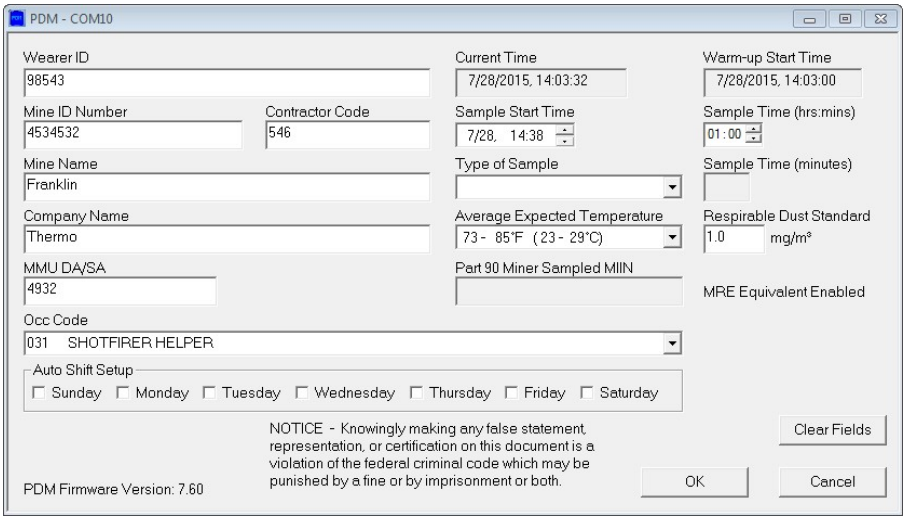


Figure 3–12. Program Shift screen

All shift setup fields must have an entry (Figure 3–13). For example, N/A can be used if a field is not required.

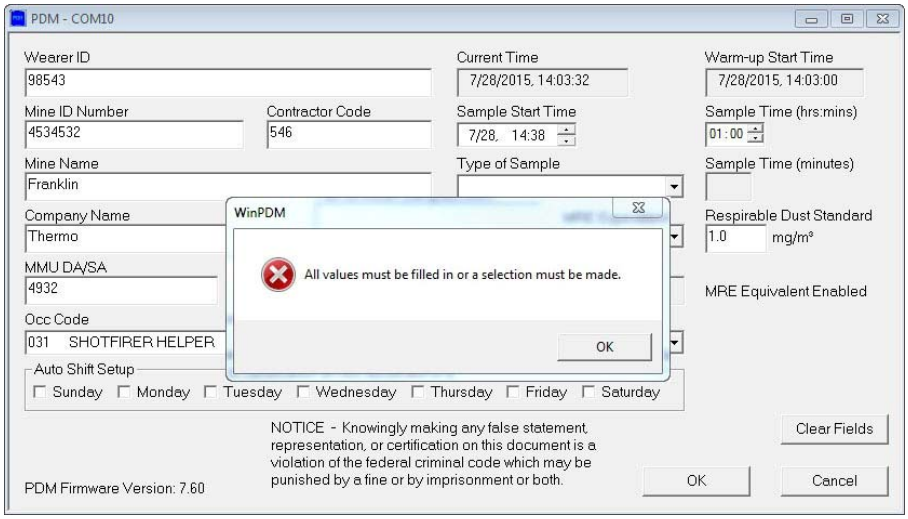


Figure 3–13. Field Entry Error message

The instrument stores the field information from the last programmed shift. This prompt acts as a reminder to confirm that the shift information has not changed (Figure 3–14).

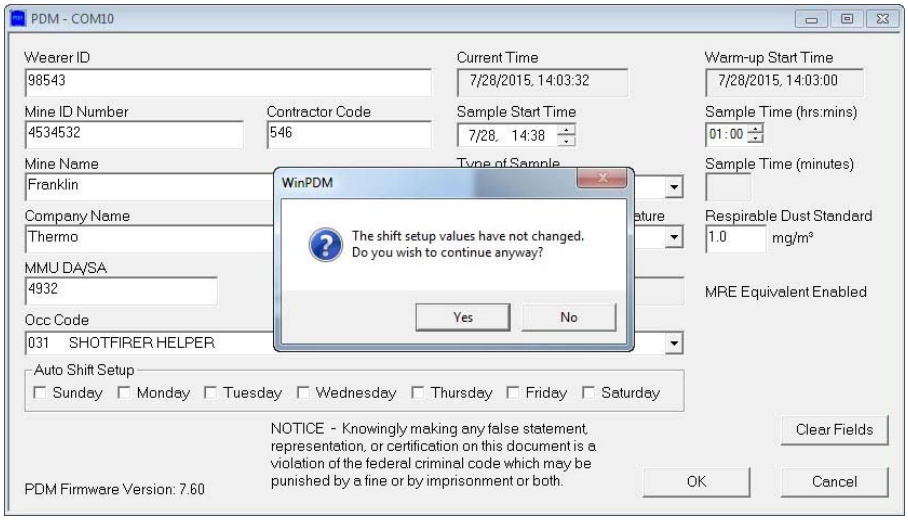


Figure 3–14. Field Entry Confirmation screen

The Program Shift screen contains the following information:

- **1. Wearer ID.** This field contains the identification number (8 digits) of the person who is wearing the PDM3700 unit.
- **2. Mine ID.** This field contains the identification number of the mine where the PDM3700 unit will be used for sampling.
- **3. Contractor Code.** This field contains the contractor code (or contractor identification number) of the contractor using the PDM3700 unit for sampling.
- **4. Mine Name.** This field contains the name of the mine where the PDM3700 unit will be used for sampling.
- **5. Company Name.** This field contains the name of the company using the PDM3700 unit for sampling.
- **6-7. Sample Start Time.** This field contains the start date and time that the PDM3700 unit will begin its programmed sample run (first sample).

Note This must be at least 35 minutes later than current time to accommodate 35 minute warm-up time. The warm-up time automatically adjusts when the sample time is set. ▲

- **8. Sample Time.** This field contains the time duration (hh:mm) of the sample run.
- **9. Type of Sample (select one).** This field contains the sampling type of the sampling run. The sampling types are: “1 – Designated Occupation”, “2 – Other Designated Occupation”, “3 – Designated Area”, “4 – Designated Work Position”, “5 – Part 90 Miner”, “6 – Nondesignated Area”, “7 – Intake Air”, “8 – Nondesignated Work Position”, and “E – Engineering Study”.
- **10. MMU DA/SA.** This field contains the 4-digit mechanized mining unit (MMU) identification code and the 4-digit designated area/designated work position (DA/SA) for the MMU that will be using the PDM3700 unit.
- **11. Occ Code.** This field contains the 3-digit occupational code of the operator using the PDM3700 unit.
- **Average Expected Temperature.** This field determines the operating temperature setting of the PDM3700. Determine the expected shift start and shift end ambient temperatures. Select the ambient temperature range from the WinPDM Shift Programming window so that the shift start and end temperatures fall within this programmed range. The possible temperature ranges to select are: “-2 to 9° F”, “10 -

22˚ F", "23 - 34˚ F", "35 - 47˚ F", "48 - 59˚ F", "60 – 72˚ F", "73 – 85˚ F", "86 – 97˚ F", and "98 - 104˚ F".

- **Auto Shift Setup.** Check the days of the week for the instrument to automatically start. Connect the instrument to the charger to recharge the battery, and the instrument will be ready to use the same time each consecutive day. Daily cleaning and filter changing must be performed between shifts.
- **MRE Equivalent.** Parts 70, 71, and 90 of Title 30 of the Code of Federal Regulations define respirable dust concentrations as being made with an instrument developed by the Mining Research Establishment (MRE) of the National Coal Board, England or its equivalent.

Setting Up Programmed Sample Parameters

Users can set up the PDM3700 sample run parameters, including identifying the mine information and setting up the sample start time, duration and type.

To set up programmed sample parameters:

1. When in the PDM - COM1 screen, select the "Program Shift" button to display the Program Shift screen (Figure 3–12).

2. When in the Program Shift screen, enter the basic parameters including, if necessary, the 8-digit identification number of the person who is wearing the PDM3700 unit ("1. Wearer ID"), the mine identification number ("2. Mine ID"), the contractor code ("3. Contractor Code"), the name of the mine where the PDM3700 unit will be sampling ("4. Mine Name") and the company name ("5. Company Name").

3. Enter the start date and time that you want the PDM3700 unit to begin its programmed sample run in the white box located under "6-7. Sample Start Time." Also, you can place your cursor on the small black arrow/triangles located on the right-hand side of the white box and click with your mouse to increase or decrease the start date and time. Set the sample time at least 35 minutes away to allow for the unit's warm-up time.

4. Enter the time duration that you want the PDM3700 unit to continuously run a programmed sample in the box under "8. Sample Duration". You can use the small arrows to the right the box to increase or decrease the sample duration time or type in the value directly.

5. Use the Type of Sample drop-down menu to select the appropriate sample type. The selected sample type should now be displayed in the "9. Type of Sample (select one)" box (Figure 3–15).

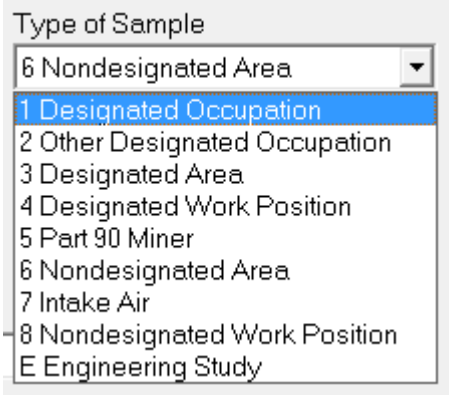


Figure 3–15. Selecting sample type

6. Enter the 4-digit mechanized mining unit (MMU) identification code and the 4-digit designated area/designated work position (DA/SA) for the MMU that will be using the PDM3700 unit, if necessary, in the box under "10. MMU DA/SA."

7. Enter the 3-digit occupational code of the operator that will be using the PDM3700 unit, if necessary, in the box under "11. Occ Code."

8. Use the "Average Expected Temperature" drop-down menu (Figure 3–16) to select the proper temperature setting for the PDM3700 for the programmed shift. Determine the expected shift start and shift end ambient temperatures. Select the ambient temperature range from the WinPDM Shift Programming window so that the shift start and end temperatures fall within this programmed range. The temperature range selected should now be displayed in the Average Expected Temperature box.

Note Operating at the upper limit of the selected range will provide longer run times. If the unit is operated at the lower end, a minimum of 12 hours run time will result. It is critical to select the correct range to achieve maximum operating time.▲

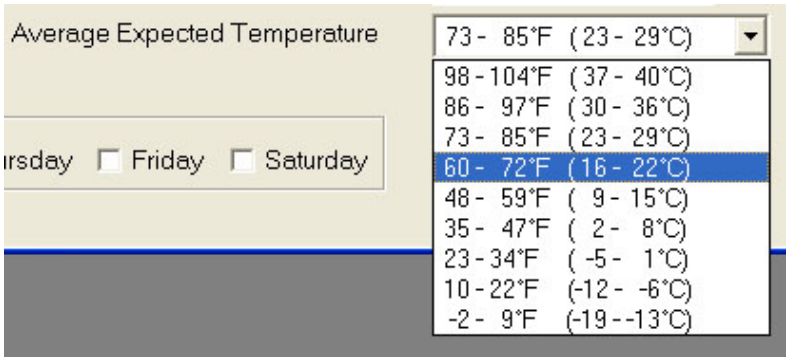


Figure 3–16. Selecting "Average Expected Temperature"

9. Select the "OK" button. If you have correctly set up the sampling parameters, the PDM - COM1 screen will display the start date and time on the screen and the dark circular bulb located in the center of the screen will light up (refer to Starting a Programmed Sample Run earlier in this chapter for more information). If you have not correctly set up the sampling parameters, a Warning/Confirmation screen will display. If a Warning/Confirmation screen displays, refer to the next section.

You can now exit from the WinPDM software application and disconnect the PDM3700 unit from its charger. If you leave the PDM3700 connected to the charger, the PDM - COM1 screen will display the "Start Time" (date and time) on the screen until 35 minutes before the start date/time. At the 35-minutes mark, the PDM - COM1 screen will display a "Warming" message on the screen for 35-minutes. After the warming period ends, the PDM3700 unit will begin its sample run and the PDM - COM1 screen will display a "Running" message on the screen.

When the sample run has completed, the WinPDM PDM - COM1 screen will display a "STOP" message on the screen. The PDM3700 unit will display the appropriate completed sample screens (Chapter 2) until you download the data from the PDM3700 unit, or until you start another primary or programmed sample run.

Program Shift Setup Problems

If you have not correctly set up the sampling parameters, a Warning/Confirmation screen will display. These screens indicate that you have either incorrectly set the sample start date or time, or the average expected temperature.

If you have incorrectly set the sample start date or time, the WinPDM software program will display the following Warning/Confirmation screen (Figure 3–17):

Figure 3–17. Date/time problem warning screen

If you have incorrectly set the average expected temperature, the WinPDM software program will display the following Warning/Confirmation screen (Figure 3–18):

Figure 3–18. Ambient Temperature Warning screen

Correcting Shift Setup Problems

The automatic warning screens force the user to correct the time or temperature errors before proceeding with the programming and sample run.

To correct improperly programmed sample parameters:

1. When in the Warning/Confirmation screen, record the warning information and select the “OK” button. The Program Shift screen will become the active screen on your PC's display.

2. When in the Program Shift screen, identify the appropriate section of the screen that you must correct. For example, during warm-up a sample could be redesignated from one wearer ID to another wearer ID on a different MMU and a different occupation.

3. Change the sampling parameters in that section (or sections), and then select the “OK” button (located in the bottom, left-hand corner of the screen). If you have correctly set up the sampling parameters, the PDM - COM1 screen will display the start date and time on the screen and the dark circular bulb located in the center of the screen will light up (refer to Starting a Programmed Sample Run earlier in this chapter for more information). If you continue to get a Warning/Confirmation screen after you believe you have entered correct values, contact Thermo Fisher Scientific.

Chapter 4
Viewing and Saving Data

This chapter describes how to configure the data downloading process, download data from the PDM3700, and how to view those data files using the buttons in the PDM-COM1 screen (Figure 4–1).

When running a primary sample run, the PDM3700 unit will log data points based on a pre-programmed logging template.

After you have performed a programmed sample run, you must use the WinPDM software and the RS232 cable to download data from the PDM3700 unit. Two data files are available for download; the first is a file with a comma-separated value (.csv) file format. The second file is in .msha format, which must be submitted to MSHA for validation. Both files can be saved to the local computer system. Only the .msha file is submitted to MSHA. The .csv data file can be viewed by using a spreadsheet program, such as Microsoft Excel. Some runs may generate a status file list, which can also be downloaded, saved, and viewed.

Note If the computer does not have a built-in RS232 port, use the supplied RS232 to USB adapter to connect the PC to the charger unit. ▲

Figure 4–1. PDM-COM1 screen

Configuring Data Downloading

The Download Data screen allows users to choose which sample data will be downloaded, and then download the data from this screen. When in the PDM – COM1 screen, select the "Download Sample" button to display the Download Data screen (Figure 4–2).

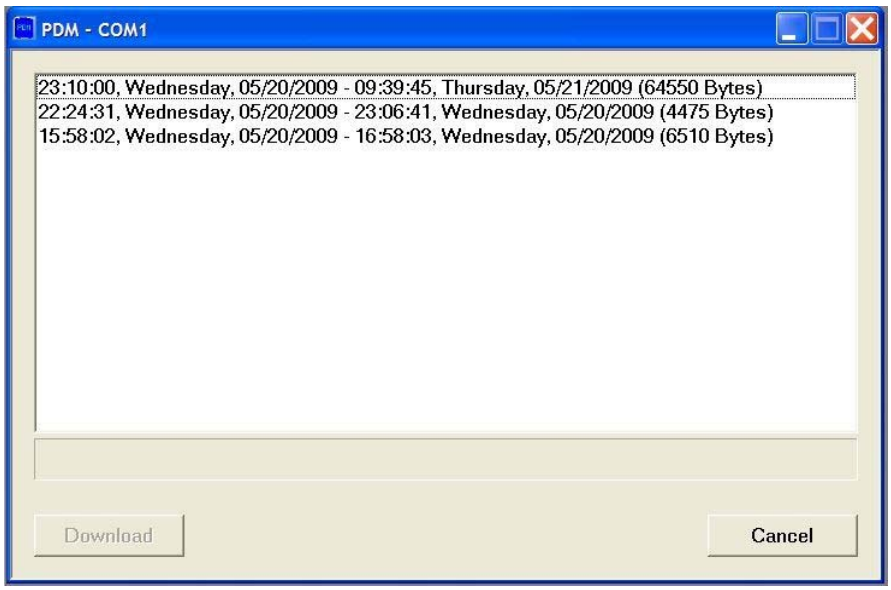


Figure 4–2. Download Data screen

The Download Data screen contains the following information:

- **Sample run events**. The top part of the screen contains the actual sample run events identified by the starting time and date (hh:mm:ss, weekday, mm/dd/yyyy), ending time and date (hh:mm:ss, weekday, mm/dd/yyyy), and size of the data file (Bytes). Each time that you perform a sample run, the PDM3700 unit logs the sample data and displays the data file information on this screen. It will continue to list the sampling events in the order that they are performed in this screen. The unit will not erase the sampling data, even after you download the data file. When the sample data storage buffer becomes full, then the PDM3700 unit will overwrite the oldest sampling data event with the most recent sample data event. Use the scroll bar on the right-hand side of the screen to display all of the sample run events that are stored in the sample data storage buffer.

Downloading Data

User can view, download and store several different types of information at the end of a primary or programmed sample run.

To download data from the PDM3700 unit:

1. Following a primary or programmed sample run, connect the PDM3700 unit to its charger and the charger to the PC. Ensure that the charger and the PDM3700 are both functioning correctly.

2. Start the WinPDM software application and select the "Download Sample" button.

3. When in the Download Data screen, highlight the sampling event that you want to download (Figure 4–3).

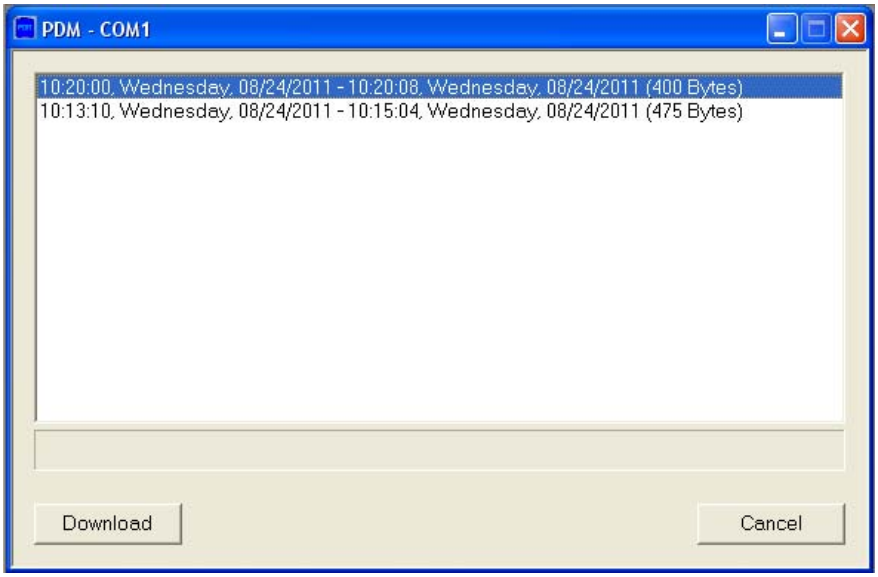


Figure 4–3. Download Data screen

4. Select the "Download" button. The Download Data screen will display a "downloading progress bar" at the bottom of the screen (Figure 4–4).

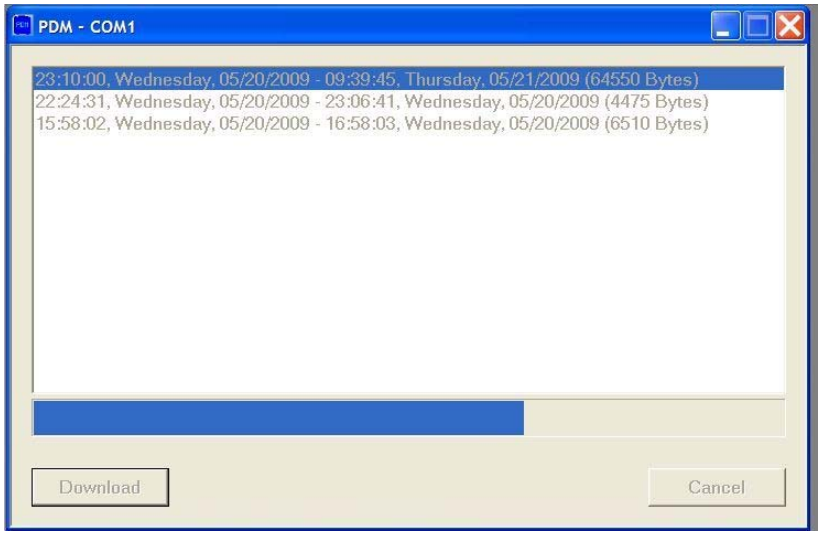


Figure 4–4. Download Data screen with progress bar

5. If the PDM3700 unit encountered any status conditions during the sample run, the "Status List" screen will display (Figure 4–5).

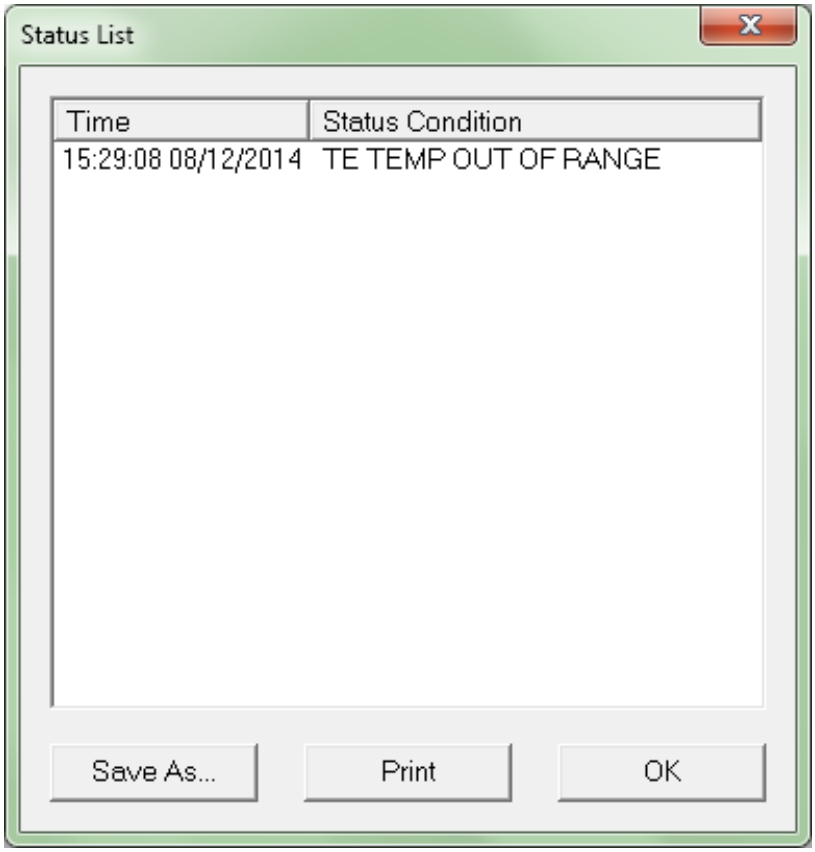


Figure 4–5. Status List screen

6. If the status list screen displays, select the “Save As” button. The “Save As” screen will display. Accept the data file name that the software provides for the data file or you can change the data file name, if necessary. Select the “Save” button.

Note The WinPDM software automatically names the status code file with the date and start hour of the sample run (yyyy-mm-dd-hh), the PDM3700 unit serial number, the Mine ID number, word “STATUS,” and the vendor/instrument code. For example: 2014-08-19-06-0212502-0503836-STATUS-A.csv or .msha. ▲

7. When the download Graph Screen appears, the Shift Information dialog box will appear. Enter the tonnage for the downloaded shift along with the 30 day average for that shift. Also enter the Certified Person MIIN. WinPDM will not allow you to move forward without entering a value for the Certified Person MIIN. (Figure 4–6).

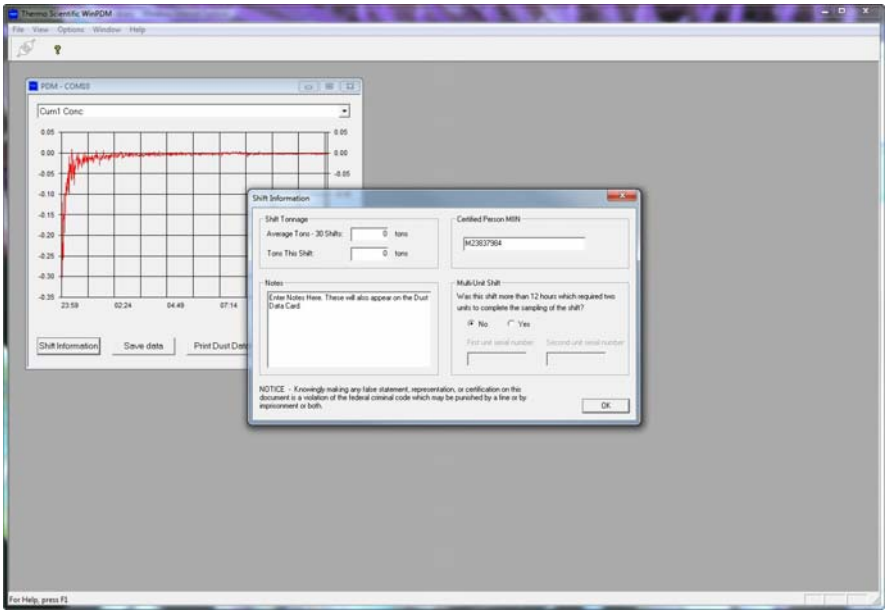


Figure 4–6. Download Graph and Shift Information screen

8. If there are any shift notes that are desired or required to be entered, enter them into the notes field.

   This screen also allows the operator to enter the sampler information for instances of multi-unit shift logging. If the sampler was used during a shift that lasted longer than 12 hours, two samplers must be used to collect the shift data. If the downloaded data was part of a multi-unit shift, select yes on Multi-unit Shift field and enter the serial number of the first unit of the shift and the second unit of the shift. Ensure that

the serial numbers of the two units are entered correctly and in the correct order. This information will be used to properly combine the data from the two samplers for the entire completed shift.

9. After entering the shift information, you can view various graphs of the logging parameters that were recorded during the sample event (Figure 4–7). Select the parameters to view using the drop-down menu. For more information on the download data screen, refer to the "Download Graph Screen" section later in this chapter.

10. After you have viewed the data, you can print the Dust Data Card (Figure 4–9 on page 4-9) or continue and save the data.

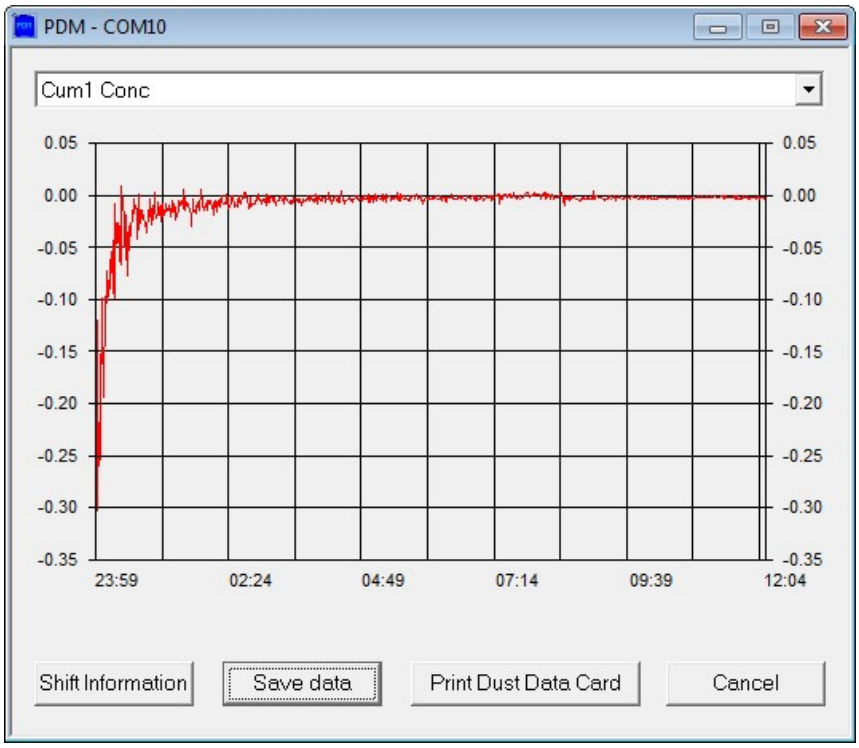


Figure 4–7. Download Graph screen

11. Select the "Print" button to print a paper record of the sample run. This hard-copy record will display the data entered when the sample run was first programmed and the data results that were recorded.

Note To ensure proper data storage and file information, refer to MSHA guidelines for data reporting requirements. ✳

12. To send the shift data to MSHA, the data file must be saved to the local computer. Press the "Save data" button.

Note The WinPDM software automatically names the data file with the date and start hour of the sample run (yyyy-mm-dd-hh), the PDM3700 unit serial number, the Mine ID number, and the vendor/instrument code. For example: 2014-08-19-06-0212502-0503836-A.csv or .msha. ▲

13. A Save As dialogue box will display prompting the operator to save a .csv file. This file is for the use of the operator. Select Save.

14. Next a second Save As dialogue box will appear prompting to save the .MSHA file. Select Save.

15. The PDM – COM1 screen will display. When in the PDM – COM1 screen, select the "Cancel" button that is located on the bottom, right-hand corner of the screen.

16. After saving the data, please refer to MSHA instructions as to how to submit the .MSHA file to MSHA for review and validation.

Download Graph Screen

When in the Download Graph screen (Figure 4–8), you can view various graphs of the logging parameters recorded during the sample event. You can access the Download Graph screen by selecting the Download Data button in the PDM-COM screen after performing a primary or programmed sample run.

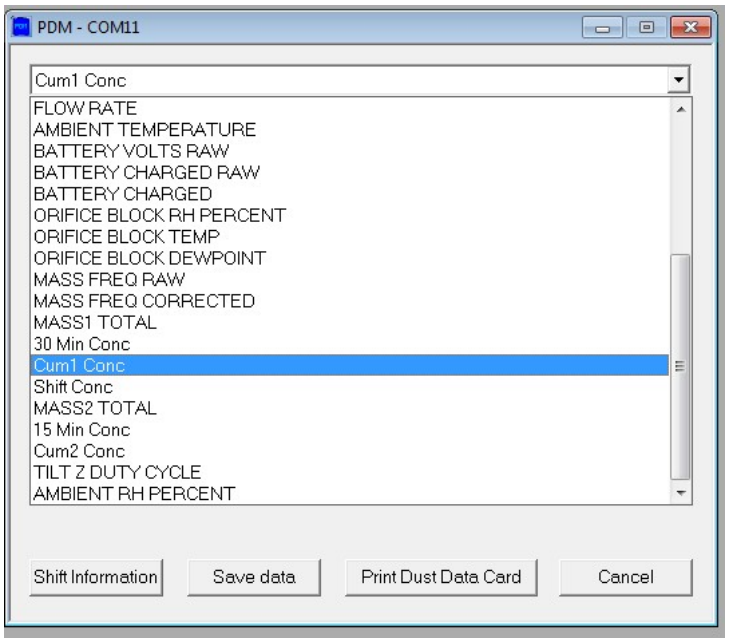


Figure 4–8. Download Graph screen with drop-down menu

When in the Download Graph screen, you can select the data parameter you want to view from a drop-down menu.

When in the Downloaded Logging Parameters drop-down menu, select the downloaded logging parameter that you want to display on the graph (Figure 4–8). The values that were recorded during the sample event for that logging parameter will now display on the graph. You can display any logging parameter on the graph that was recorded during the sample event by selecting those logging parameters from the Downloaded Logging Parameters drop-down menu.

When in the Download Graph screen, you also can display and print the "Dust Data Card," save the information, or exit the screen by selecting the "Cancel" button.

Dust Data Card Screen

When in the Dust Data Card screen (Figure 4–9), you can view the information that you entered in the Program Shift screen and print the Dust Data Card.

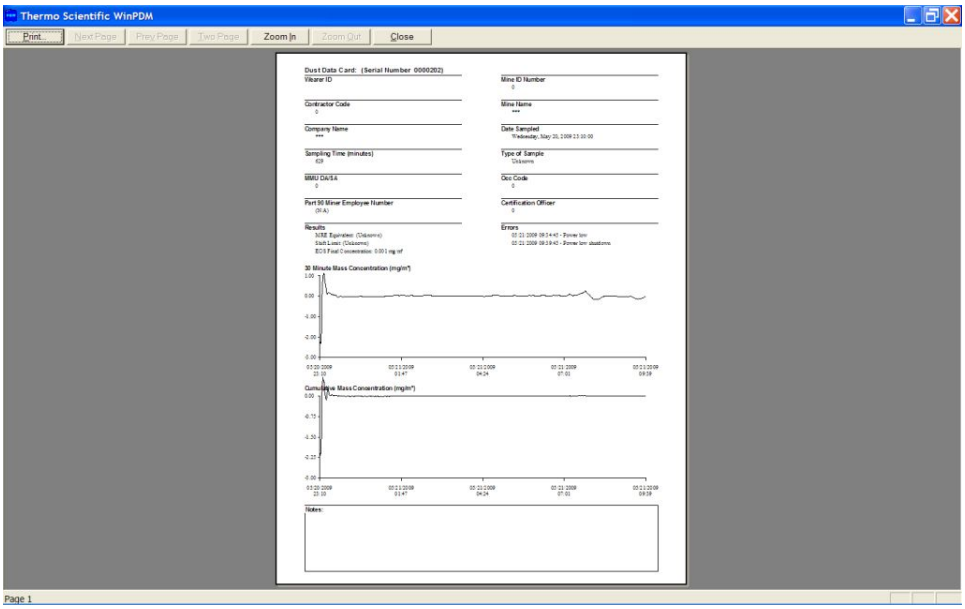


Figure 4–9. Dust Card Data screen

When in the Download Graph screen, select the “Print Dust Data Card” button (located in the bottom, center section of the screen) to display the Dust Data Card screen.

When in the Dust Data Card screen, you can print the Dust Data Card by selecting the “Print” button that is located in the top, left-hand corner of the screen.

This hard copy record will display the data entered when the sample run was first programmed, the results that were recorded, and the information entered in the Shift Information screen.

Viewing Data Files

After you have downloaded the data file and MSHA file (and status list file, if necessary), you can view the data file by using a spreadsheet program such as Microsoft Excel.

The data file format is a comma-separated value (".csv") text file format. The WinPDM software application allows the data files to be stored where needed by browsing to the desired folder.

Using a spreadsheet program (such as Microsoft Excel), open the data file (Figure 4–10).

At the top of the data file will be the data entered into the Program Shift screen when you first programmed the sample run. Below the program shift data, are the logging parameters that were stored only at the beginning and end of the sample run (header/footer information).

Below the Header/Footer logged parameters are the data values of the logging parameters that the unit saved during the sample run. The time interval is set to 60 seconds. Therefore, the data records are 1-minute increments.

The .msha file is in a special format required by MSHA and is used to validate or void the sample. Do not modify the file.

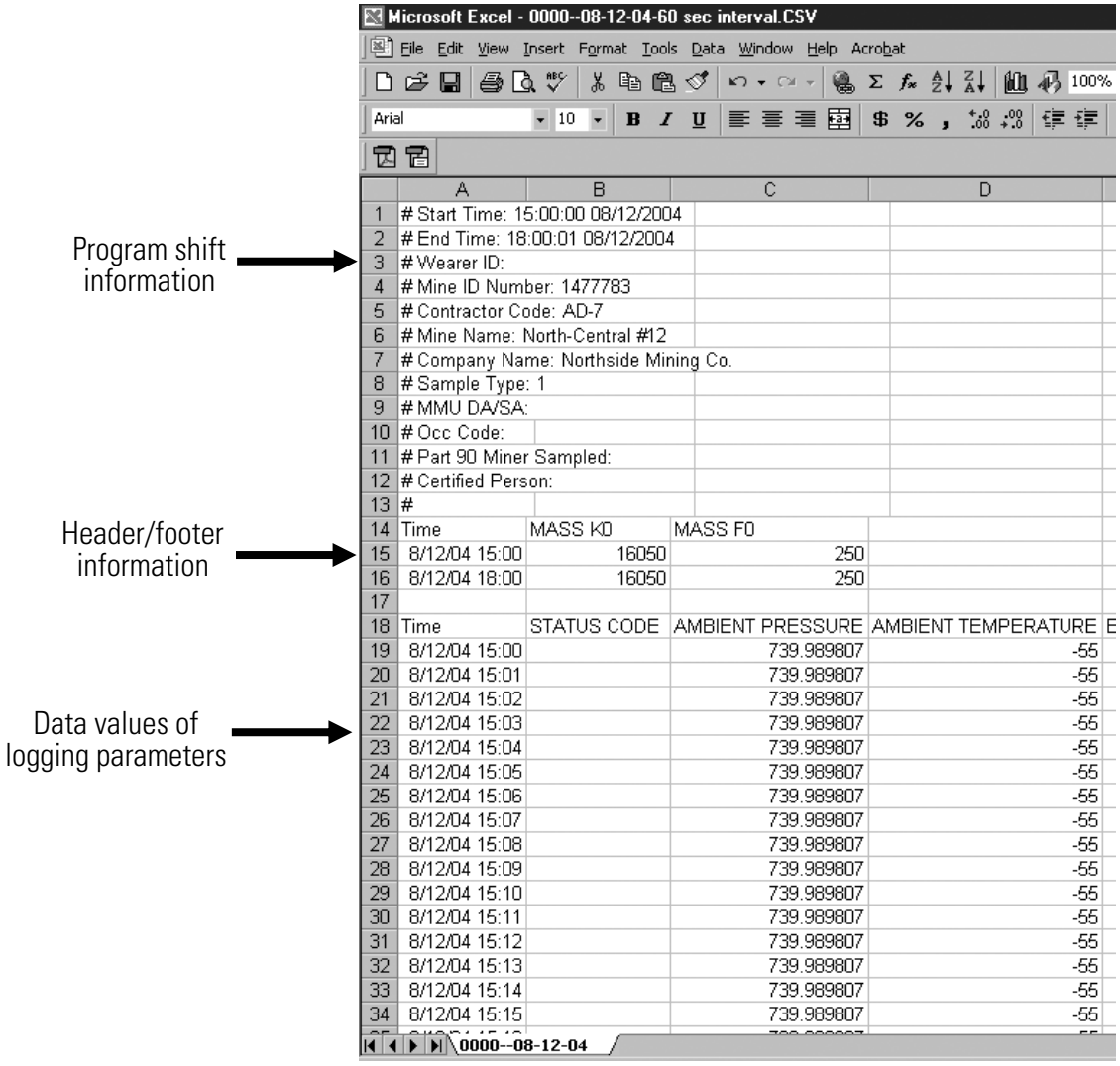
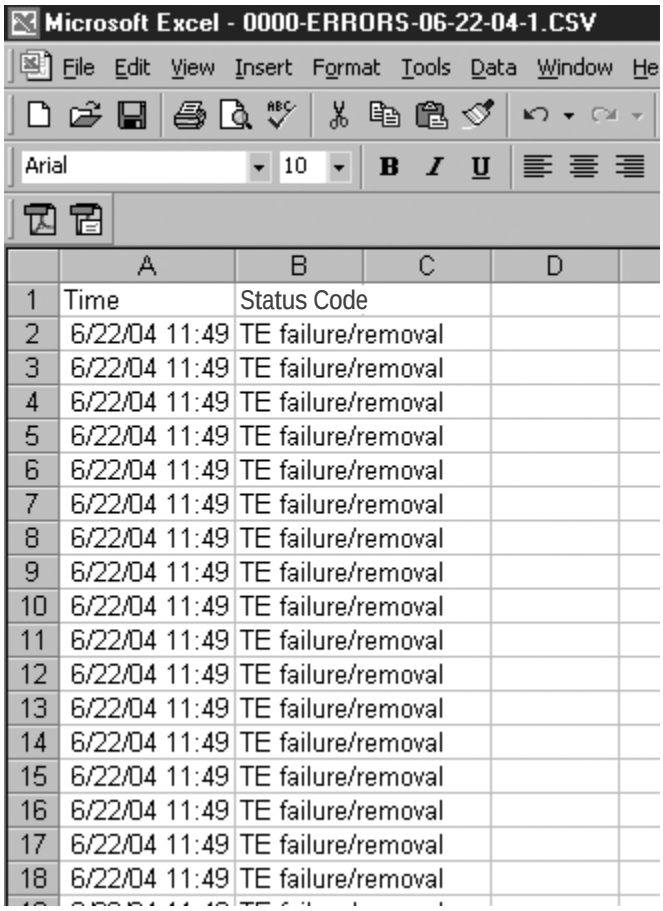


Figure 4–10. Excel file with downloaded data

Viewing a Status List

Locate the status list file that was downloaded in the WinPDM folder. The file format is a comma-separated value (".csv") text file format.

Using a spreadsheet program (such as Microsoft Excel), open the status list file (Figure 4–11). The file will contain the time that the status code occurred in the left-hand column, and the name of the status code in the right-hand column.



	A	B	C	D
1	Time	Status Code		
2	6/22/04 11:49	TE failure/removal		
3	6/22/04 11:49	TE failure/removal		
4	6/22/04 11:49	TE failure/removal		
5	6/22/04 11:49	TE failure/removal		
6	6/22/04 11:49	TE failure/removal		
7	6/22/04 11:49	TE failure/removal		
8	6/22/04 11:49	TE failure/removal		
9	6/22/04 11:49	TE failure/removal		
10	6/22/04 11:49	TE failure/removal		
11	6/22/04 11:49	TE failure/removal		
12	6/22/04 11:49	TE failure/removal		
13	6/22/04 11:49	TE failure/removal		
14	6/22/04 11:49	TE failure/removal		
15	6/22/04 11:49	TE failure/removal		
16	6/22/04 11:49	TE failure/removal		
17	6/22/04 11:49	TE failure/removal		
18	6/22/04 11:49	TE failure/removal		

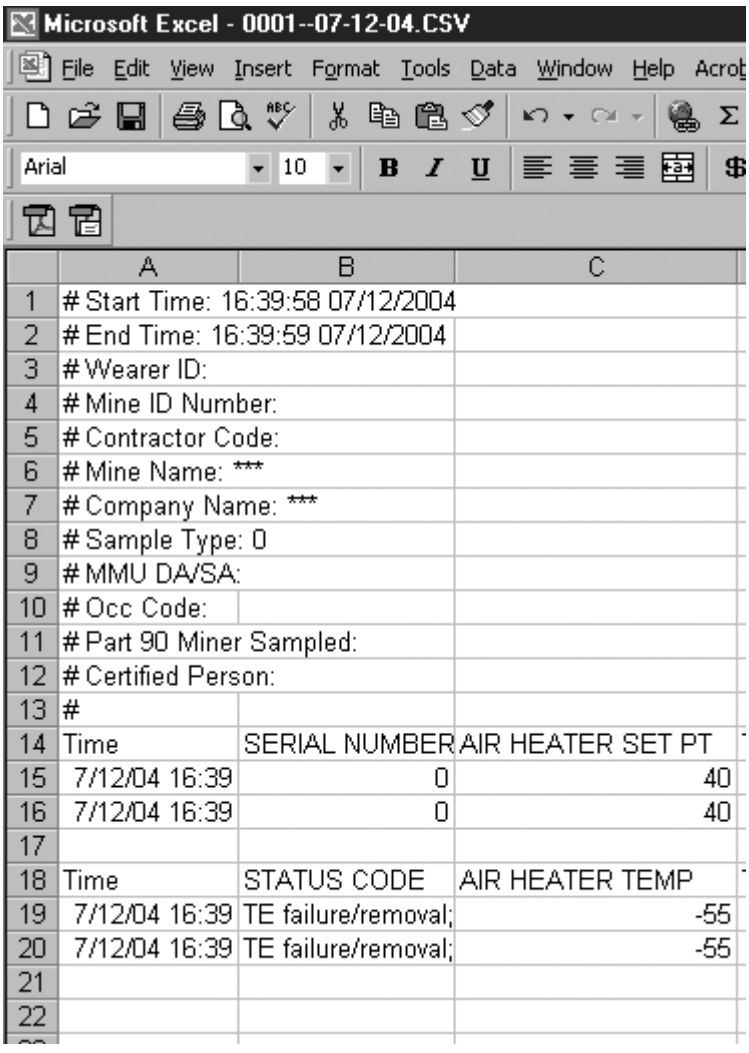
Figure 4–11. Status List file

Viewing Status Codes

Locate the status list file that was downloaded in the WinPDM folder. The status file format is a comma-separated value (".csv") text file format.

Using a spreadsheet program (such as Microsoft Excel), open the data file (Figure 4–12). You can locate the status code in the second column under the "STATUS CODE" heading.

Note Status codes will only be reported for the duration they are present. ✳



	A	B	C
1	# Start Time: 16:39:58 07/12/2004		
2	# End Time: 16:39:59 07/12/2004		
3	# Wearer ID:		
4	# Mine ID Number:		
5	# Contractor Code:		
6	# Mine Name: ***		
7	# Company Name: ***		
8	# Sample Type: 0		
9	# MMU DA/SA:		
10	# Occ Code:		
11	# Part 90 Miner Sampled:		
12	# Certified Person:		
13	#		
14	Time	SERIAL NUMBER	AIR HEATER SET PT
15	7/12/04 16:39	0	40
16	7/12/04 16:39	0	40
17			
18	Time	STATUS CODE	AIR HEATER TEMP
19	7/12/04 16:39	TE failure/removal;	-55
20	7/12/04 16:39	TE failure/removal;	-55
21			
22			

Figure 4–12. Data file with status codes

Chapter 5
Maintenance and Calibration

This section describes the procedures involved in verifying the calibration of the PDM3700 Monitor and maintaining the consistent operation of the hardware. In addition to regularly scheduled maintenance, the unit may require other maintenance as necessary, including replacing the battery, or other procedures.

The PDM3700 unit requires the following maintenance:

Daily

- **Charge the internal battery pack**. Charge the internal battery assembly before each use, or as necessary.
- **Clean the grit pot**. Clean the grit pot after each use, or as necessary.
- **Clean the mass transducer and sample tubing**. Replace the TEOM filter (Section 2) and clean the mass transducer area and sample tube after each use, or as necessary.

Monthly

- **Perform a flow audit**. Perform a flow audit procedure once per month, or as necessary. Perform leak check prior to flow audit.
- **Clean the cyclone and inlet tubing**. Clean the cyclone and sample tubing once per month, or as necessary.

Annual

- **K0 audit.** Perform an audit of the calibration constant (K0) once a year, or as necessary.
- **Tilt Audit.** Perform an audit of the tilt sensor once a year, or as necessary.

Note The PDM3700 should be returned to the factory annually for calibration and validation of acceptable performance to the instrument specifications. ✳

CAUTION PDM3700 maintenance should only be performed by trained, authorized personnel. ✳

WARNING Only MSHA certified individuals may perform maintenance, calibration and sampling pursuant to 30 CFR Parts 70, 71 & 90. This includes changing the battery packs, sample pump, cleaning the sample inlet, and other maintenance items as described in the operator's manual. ✳

Equipment Damage Do not use acetone to clean any of the parts of the PDM3700. ✳

Removing the Mass Transducer

Several maintenance procedures, including changing the filter, cleaning the grit pot and cleaning the sample lines, require the mass transducer to be removed from the unit.

To remove the mass transducer:

1. Locate the TE handle on the side of the PDM3700 and slide it all the way to the right as shown in to unlock the mass transducer, as shown in Figure 5–1.

Figure 5–1. Sliding the handle right to release the mass transducer

2. Pull the mass transducer out of the unit (Figure 5–2).

Figure 5–2. Removing the mass transducer

3. When ready, reinstall the mass transducer into the PDM3700 by aligning the flat side of the transducer toward the center of the PDM3700 and pushing it in until it seats firmly in place (Figure 5–3 and Figure 5–4).

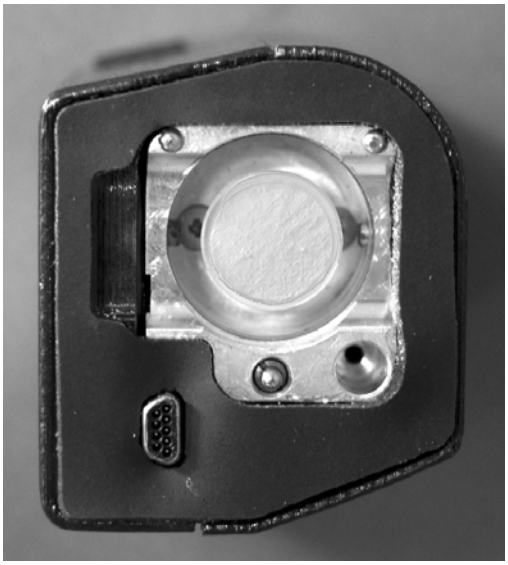


Figure 5–3. Mass transducer

Figure 5–4. Mass transducer, top view

4. Pull the TE handle to the towards the front of the instrument until it stops.

Cleaning the Grit Pot

The grit pot should be cleaned daily, or after each use.

Tool/materials needed for this procedure:

- Canned air
- Alcohol swab
- Silicone lubricant

To clean the grit pot

1. Remove the mass transducer.

2. Locate the grit pot on the right-hand side of the PDM3700 unit (Figure 5–5).

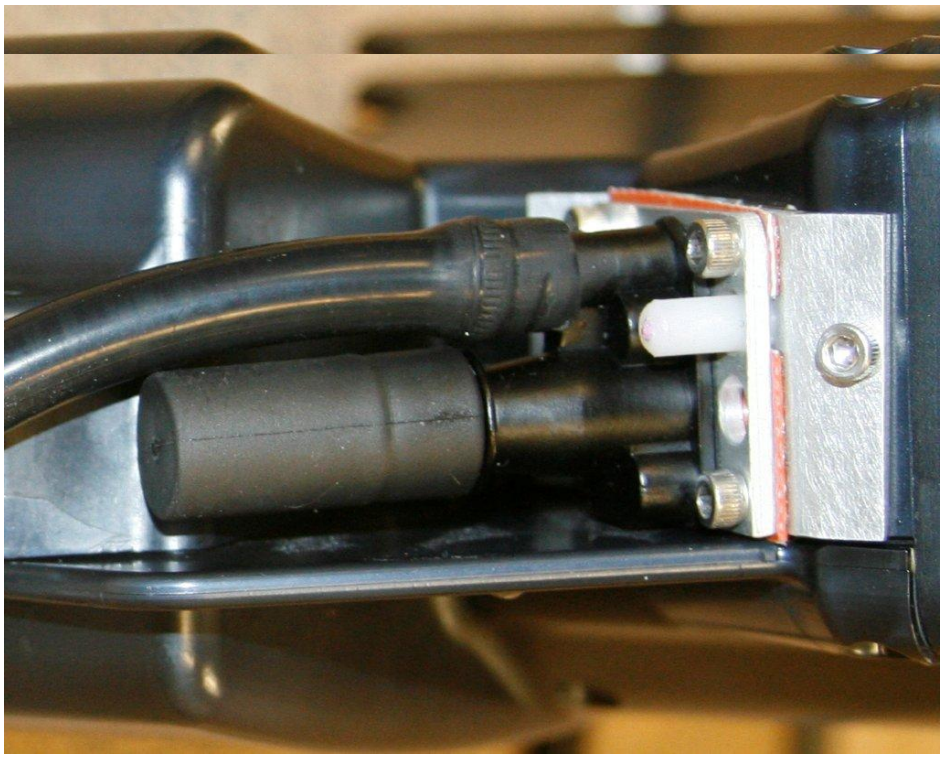


Figure 5–5. Photo showing location of grit pot

3. Gently remove the grit pot from the nozzle.

4. Use canned air to clean the inside of the grit pot, and an alcohol swab to clean the inside and outside surfaces (Figure 5–6).

Figure 5–6. Grit pot

5. Direct a burst of canned air into the cyclone nozzle to clean the inside of the nozzle. Use an alcohol swab to clean the inside and outside surfaces of the cyclone nozzle (Figure 5–7).

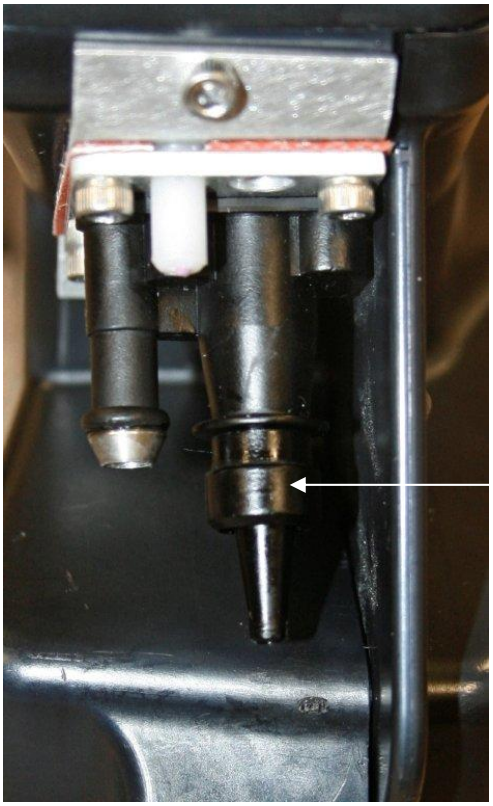


Figure 5–7. Instrument Inlet and Cyclone Nozzle

6. Reinstall the grit pot and mass transducer.

Note A light coating of silicone lubrication on the outside of the plastic nozzle can be used to prevent leaks. ✳

Cleaning the Mass Transducer and Sample Lines

The mass transducer and sample lines should be cleaned daily, or after each use.

Tool/materials needed for this procedure:

- Canned air
- Alcohol swab
- Phillips screwdriver
- Filter exchange tool
- Inlet spanner tool
- Silicone lubricant

Note The PDM 3700 is supplied with tubing of extra length (38 ± 0.5”) and must be trimmed before first use by the operator to meet agency requirements (35–37”). The tubing must be checked prior to use each day and may be trimmed due to breakage or fraying, but must always be between 35–37” during use. If the tubing is shorter than 35” it must be replaced. To measure the tubing, remove from the instrument and lay on a flat surface. Straighten the tubing and measure the total length without stretching the overall tubing length. ✳

To clean the mass transducer and sample lines:

1. Disconnect the sample line from the inlet assembly (Figure 5–8). Use care to ensure that the tubing does not break during removal.

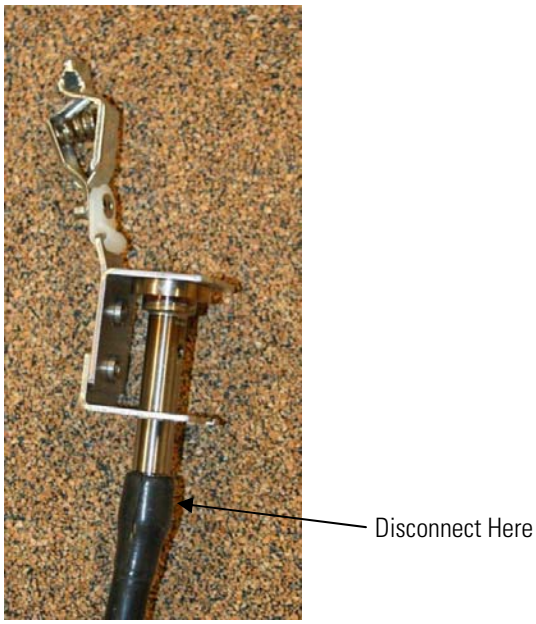


Figure 5–8. Disconnect the sample line

2. Remove the mass transducer from the PDM3700 unit and remove the TEOM filter from the mass transducer.

3. Use canned air then an alcohol swab to clean all surfaces of the mass transducer.

4. Use canned air and an alcohol swab to clean the bell-shaped inlet inside the PDM3700 unit and then direct a stream of air through the bell-shaped inlet (Figure 5–9 and Figure 5–10).

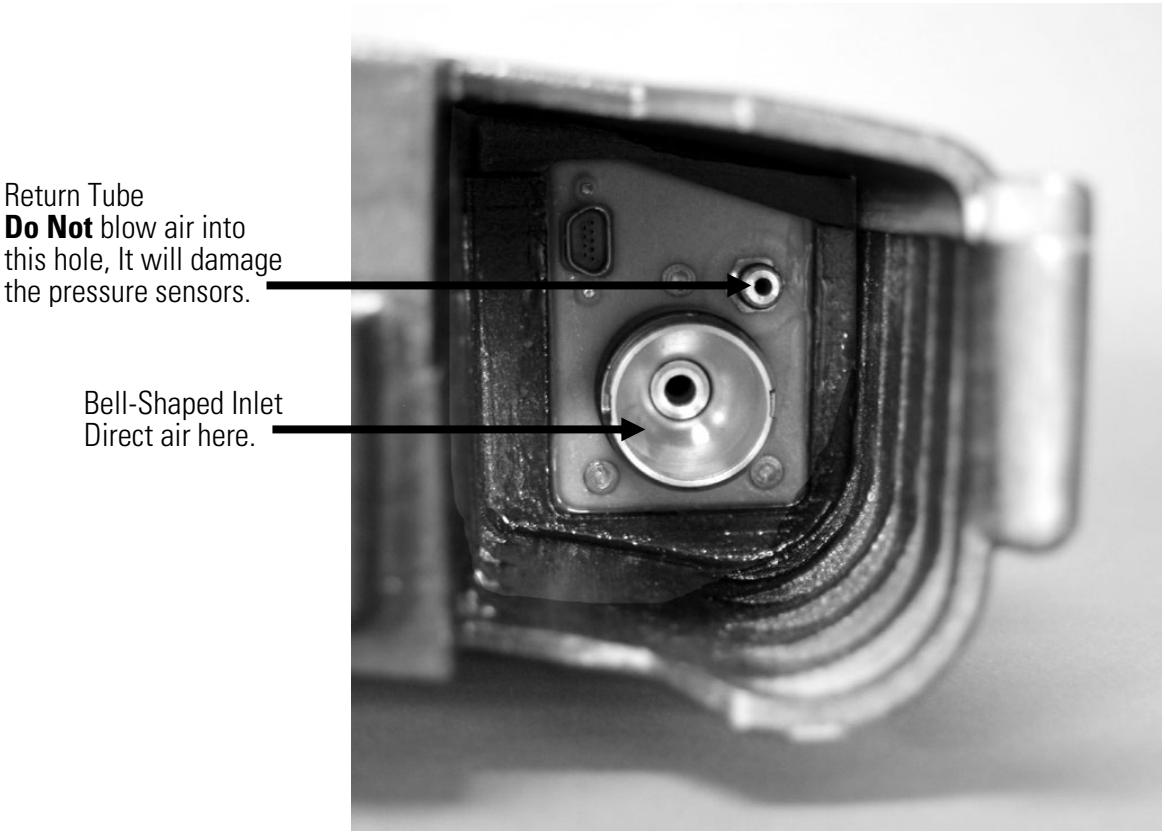


Figure 5–9. Clean the bell-shaped inlet with a swab and air

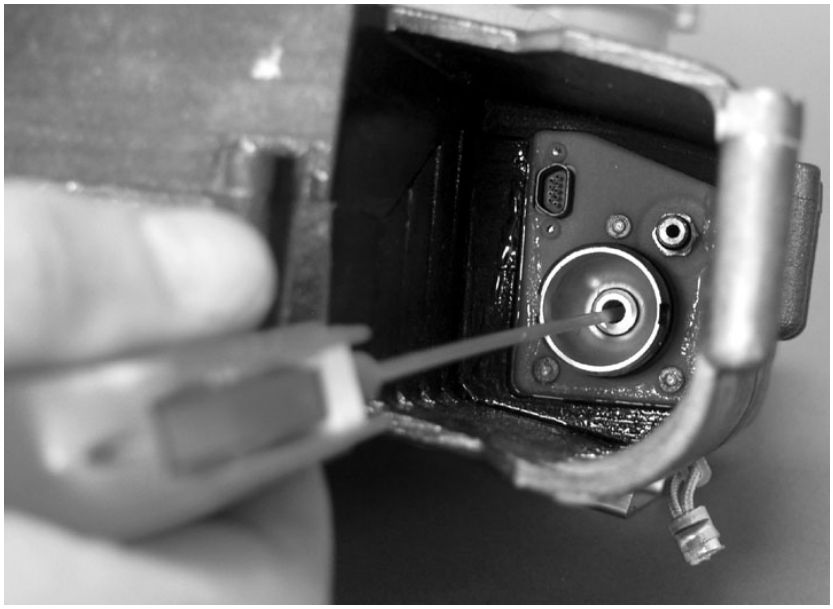


Figure 5–10. Clean the bell-shaped inlet with air

5. Use silicone lubricant to lightly coat o-rings on bell-shaped inlet and return tube.

6. Direct a stream of air through the end of the sample line removed from the inlet assembly and through the sample inlet on the bracket (Figure 5–11 and Figure 5–12).

Figure 5–11. Direct a stream of air through the sample line

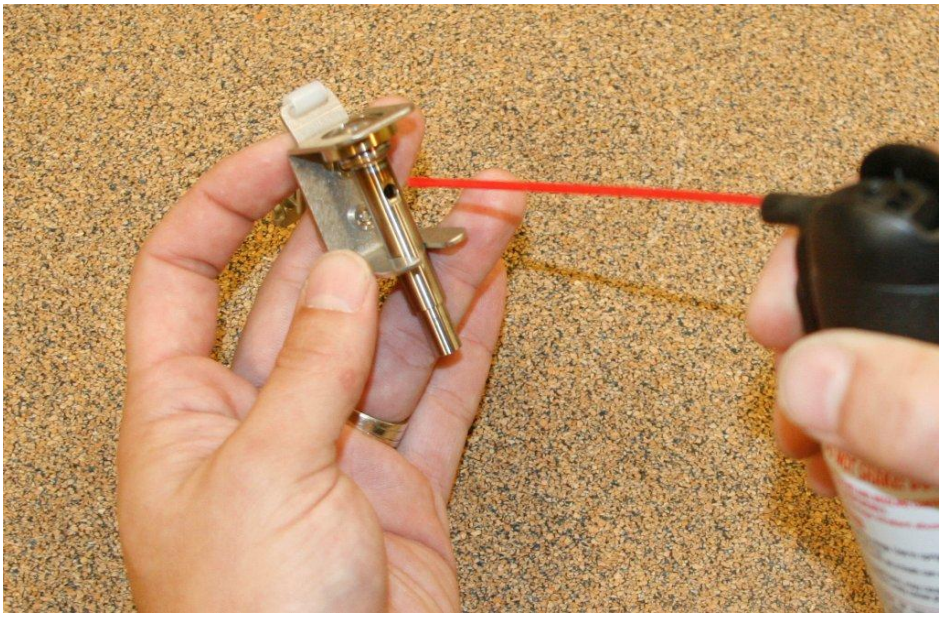


Figure 5–12. Direct a stream of air into the sample inlet

Figure 5–13. Loosen screws on rear of bracket

Figure 5–14. Open sample inlet assembly bracket

Figure 5–15. Slide out inlet

Figure 5–16. Remove sealing screw using inlet spanner tool

Figure 5–17. Clean inlet

Figure 5–18. Inspect o-ring in top of inlet for damage

7. Install a new TEOM filter onto the mass transducer and install the mass transducer into the PDM3700 unit.

8. Reassemble the sample inlet and reattach the sample line to the sample inlet.

9. Install the sample line onto the instrument inlet (Figure 5–7).

Note Care must be taken when reinstalling the sample tube onto the sample inlet to prevent cracking, gouging, or otherwise damaging the tubing. ✳

Performing a Flow Audit

Users should perform a flow audit on the unit once per month, or as necessary. Prior to performing a flow audit, complete the sample line leak check.

Tool and materials needed for this procedure:

- Flow meter
- Flow audit tubing adapter or other methods to connect flow meter to PDM (use as necessary)

Note These instructions are given for one type of flow audit device that requires the supplied tubing adapters. Other audit devices may need other adapters or no adapters at all. Modify these instructions as necessary based on the audit device being used. ✳

To perform a flow audit:

1. Disconnect the sample line from the inlet bracket.

2. Install one end of the tubing adapter into the sample line from the sample inlet assembly and the other end of the tubing adapter into the tubing that is attached to the flow meter (Figure 5–19 and Figure 5–20).

Figure 5–19. Flow audit/tubing adapter

Figure 5–20. Installing the flow/audit/tubing adapter

3. Connect the PDM3700 unit to the charger and make sure the charger is connected to your PC.

4. Open the WinPDM software and connect to the instrument.

5. Start a sample run on the PDM3700 unit (see Chapter 2). This programmed sample is for the purposes of the flow audit only. The sample run is programmed and when the audit is complete, the run can be terminated.

Note Care must be taken when reinstalling the sample tube onto the sample inlet to prevent cracking, gouging, or otherwise damaging the tubing. ✳

6. Wait 10 minutes to allow the flow rate to stabilize, then check the flow rate reading on the flow meter.

7. Ensure that this value matches the 2.2 lpm flow rate set point for the PDM3700 unit. If the flow meter reading is within the acceptable criteria of ±0.055 lpm, end the sample audit run, remove the tubing adapter, and reinstall the sample line. If the flow meter is not within your acceptance criteria, a flow calibration must be performed. See "Performing a Flow Calibration" later in this chapter.

Cleaning the Cyclone and Inlet Tubing

The cyclone and inlet tubing should be cleaned once per month, or as necessary. Tool/materials needed for this procedure:

- Canned air
- Alcohol swab
- Silicone lubricant

To clean the cyclone and inlet tube:

1. Remove the mass transducer from the PDM3700 unit.

2. Disconnect the sample line from the sample inlet assembly. Remove sample line from instrument cyclone.

3. Remove the grit pot from the PDM3700 unit and ensure that the grit pot and its plastic nozzle are clean (Refer to "Cleaning the Grit Pot" earlier in this chapter).

4. Using an alcohol swab, clean the end of the inlet tubing.

5. Install the sample line onto the sample inlet assembly.

Note Care must be taken when reinstalling the sample tube onto the sample inlet to prevent cracking, gouging, or otherwise damaging the tubing. ✳

6. Lightly lubricate the cyclone nozzle.

7. Install the grit pot.

8. Install the mass transducer into the PDM3700 unit.

9. Perform a sample line leak check.

Auditing the K0 Number

Once a year, the calibration constant (K0 number) of the unit should be audited. Tool/materials needed for this procedure:

- K0 audit kit (59-010020)
- Alcohol swab
- Small tweezers

Note PDM3700 should be placed upright while the frequency is stabilizing and after each weight is added. See Figure 5–26 for position. ✳

To perform a K0 audit:

1. Connect the PDM3700 unit to its charger and start the WinPDM software.

2. When in the PDM – COM1 screen, select the "K0 Audit" button to display the K0 Audit screen (Figure 5–21).

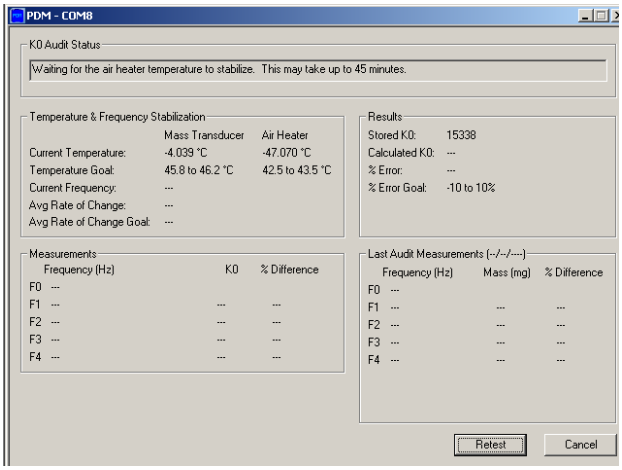


Figure 5–21. K0 Audit screen

3. The instrument could take up to 45 minutes to stabilize the TE frequency.

4. When stable, the computer will prompt to add the first weight to the filter (Figure 5–22). Use small tweezers to add the weight to the filter.

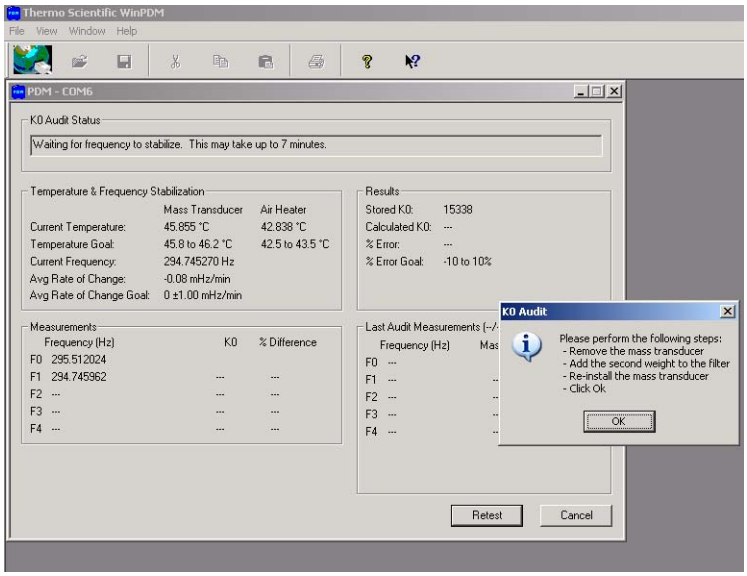


Figure 5–22. Prompt to add weight

5. The computer will prompt to add three more weights. Add each weight consecutively as shown in (Figure 5–23).

Figure 5–23. Add filters

6. After the final weight has been added, a % error will be displayed (Figure 5–24). The acceptable error limit is ±10%. If the results are greater than ±10%, repeat the audit. If the audit continues to fail, contact Thermo for support.

7. Remove K0 audit filter and replace with new filter.

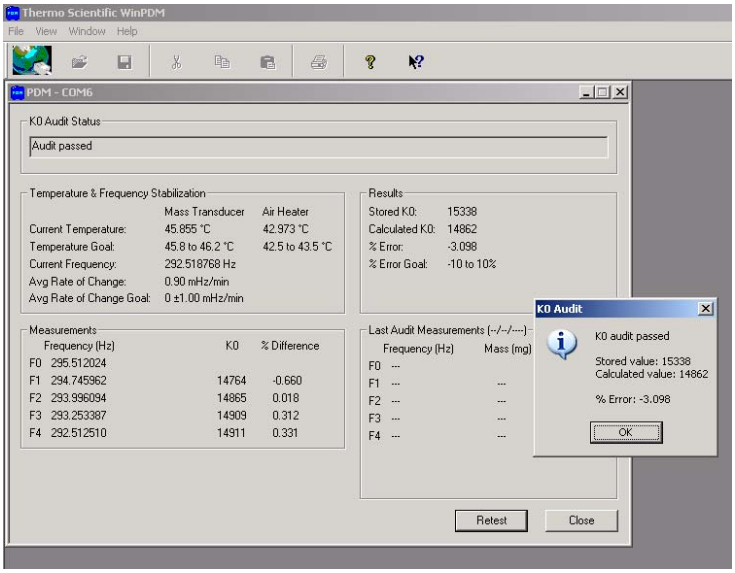


Figure 5–24. K0 audit passed prompt

Auditing the Tilt Sensor

The tilt sensor should be audited once a year.

The PDM3700 is designed to operate in a position where the instrument display is oriented at the top of the unit. The sampler includes an integrated tilt sensor that automatically compensates the measurements when the position of the monitor moves. This is used to compensate for the natural motion of the sampler as an operator moves from one location to another, and is also used to compensate when the vertical orientation of the sampler changes.

If the sampler is placed or worn in a position where the display is upside down, the sampler will detect this position and discard the real-time mass and mass concentration data until this situation is corrected. While the real-time mass and mass concentration data is discarded during this time, the instrument will correctly determine the actual collected mass upon being placed in the proper orientation and resume proper mass and mass concentration measurements.

The displayed mass and mass concentration values will display the last valid measurement value and will not change when the sampler is placed in an inverted orientation.

To perform a tilt sensor audit:

1. Connect the PDM3700 unit to its charger and start the WinPDM software.

2. When in the PDM – COM1 screen, select the “Tilt Audit” button to display the Tilt Audit screen (Figure 5–25).

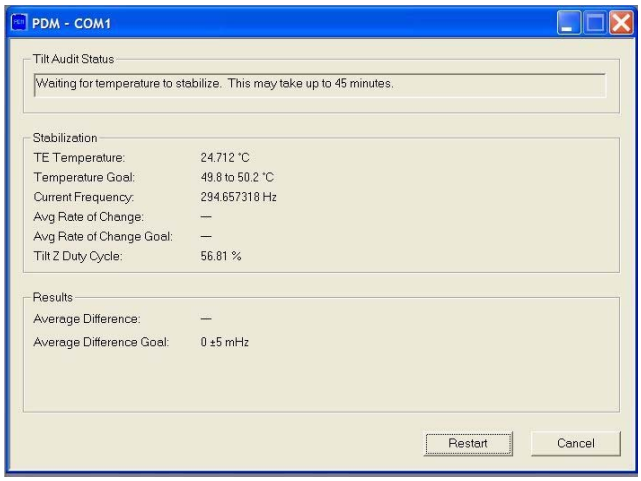


Figure 5–25. Tilt Audit screen

3. The instrument could take up to 45 minutes to stabilize the TE frequency.

4. When stable, the computer will prompt to position the instrument upright as shown in Figure 5–26. Place on a vibration-free table and support instrument so it does not move during test.

Figure 5–26. Place instrument in upright position

5. When prompted, position the instrument on the side (mass transducer) as shown in Figure 5–27. Support instrument so it does not move during test.

Figure 5–27. Position the instrument on the side as shown

6. When complete, the computer will indicate a pass or fail status (Figure 5–28).

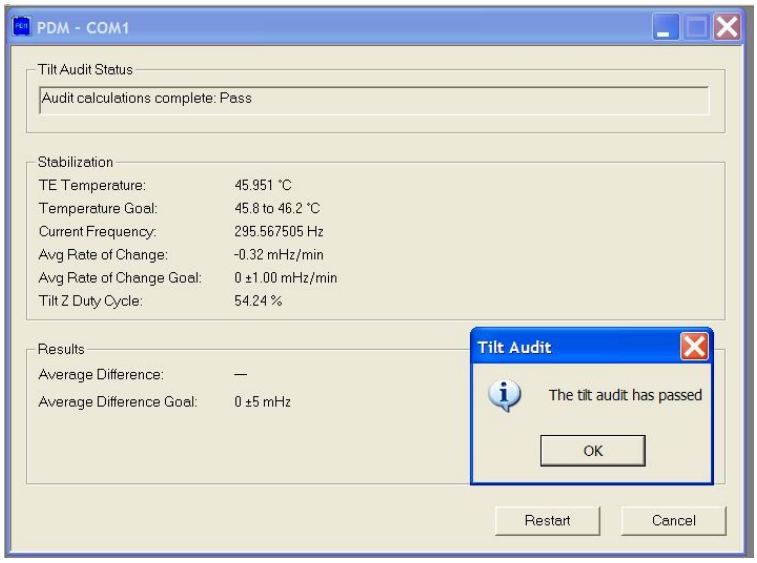


Figure 5–28. Tilt Audit Pass/Fail status prompt

Periodic Maintenance

In addition to regularly scheduled maintenance, the unit may require other maintenance, including:

- Replacing the battery pack
- Replacing the pump
- Lubricating the mass transducer O-rings
- Performing a flow calibration
- Lubricating cyclone grit pot

WARNING The battery pack (PN: 56-010897-2300) is designed with specific individual battery cells. These battery cells are not user replaceable. The battery packs may be replaced only by MSHA certified individuals pursuant to 30 CFR Parts 70, 71 & 90. All charging of these battery packs shall take place while installed in the PDM3700 and in fresh air in Battery Charging stations as defined in 30 CFR 75.340 or fresh air above ground. ✳

WARNING Do not operate the PDM3700 if its case is damaged or otherwise compromised. ▲

CAUTION PDM3700 maintenance should only be performed by trained, authorized personnel. ▲

WARNING Only MSHA certified individuals may perform maintenance, calibration and sampling pursuant to 30 CFR Parts 70, 71 & 90. This includes changing the battery packs, sample pump, cleaning the sample inlet, and other maintenance items as described in the operator's manual. ✳

Some of these procedures require the PDM3700 case to be opened. If the PDM3700 case is opened for any reason, a case leak check must be performed.

Opening the PDM3700 Case

Some of the maintenance procedures require the user to remove the cover panel of the case of the PDM3700 unit. A Phillips screwdriver is required to remove the cover panel of the unit.

WARNING Whenever the PDM3700 case is opened for maintenance, you must perform a case leak check after reassembling the case. The system must pass the case leak check prior to operating the instrument. Correct the leak and re-test the instrument if the leak check does not initially pass. Do not operate the instrument if the system does not pass the case leak check. ▲

To open the PDM3700 case:

1. Remove the mass transducer from the PDM3700 unit and place the unit on a flat surface so that the front is accessible.

2. Using the Phillips screwdriver, remove the screw from location 12 first (Figure 5–29). Next, in order, remove screws from locations 14, 13, 11, and 10. Finally, remove the remaining screws in any order of preference except ending with screws 2 and then 1.

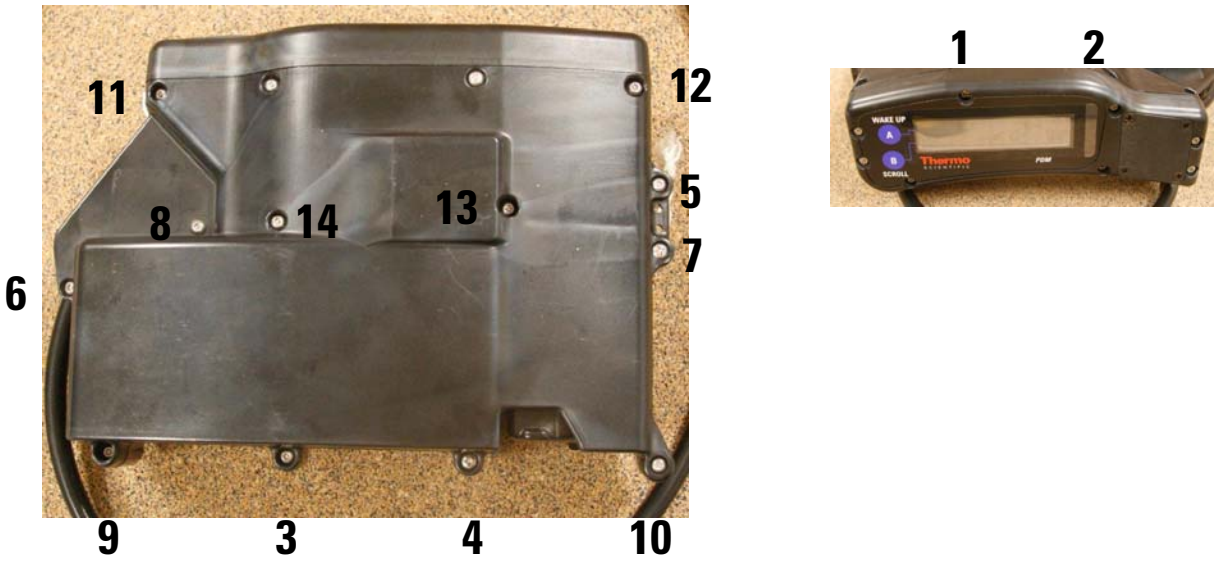


Figure 5–29. Cover panel screws

Figure 5–30. Screws on top display

Equipment Damage Do not attempt to remove the security (non-Phillips head) screws on the top or front of the PDM3700. ✳

3. Remove the cover panel (Figure 5–31).

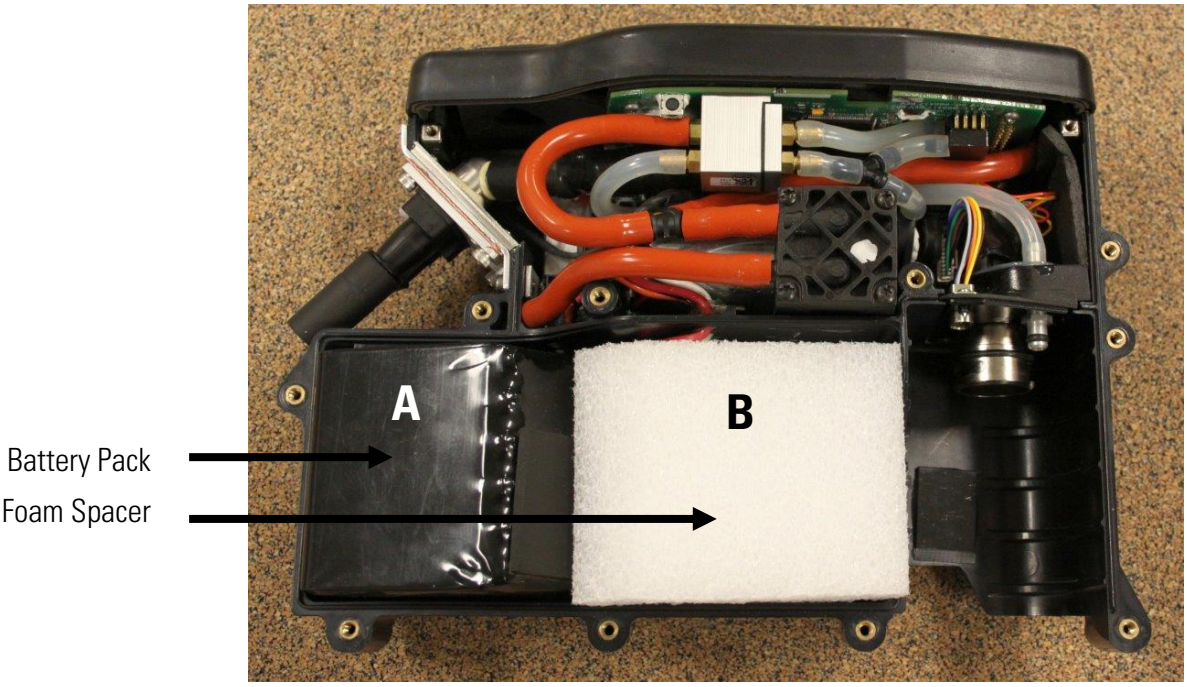


Figure 5–31. PDM3700 with cover panel removed

Installing the PDM3700 Cover Panel

The cover panel of the PDM3700 may have to be removed to perform certain maintenance tasks (Figure 5–31).

WARNING Whenever the PDM3700 case is opened for maintenance, you must perform a case leak check after reassembling the case. The system must pass the case leak check prior to operating the instrument. Correct the leak and re-test the instrument if the leak check does not initially pass. Do not operate the instrument if the system does not pass the case leak check. ▲

To install the PDM3700 cover panel:

1. Inspect the gasket and sealing surface to ensure they are clean and free of defects. Replace the gasket, if necessary (Seal Replacement Kit: 59-009961). Install the gasket.

2. Install the cover panel onto the PDM3700 case. Ensure that the two screw holes on the top of the cover panel are aligned with the screw holes on the top of the PDM3700.

3. Verify that all portions of the cover panel gasket are seated properly (Figure 5–32).

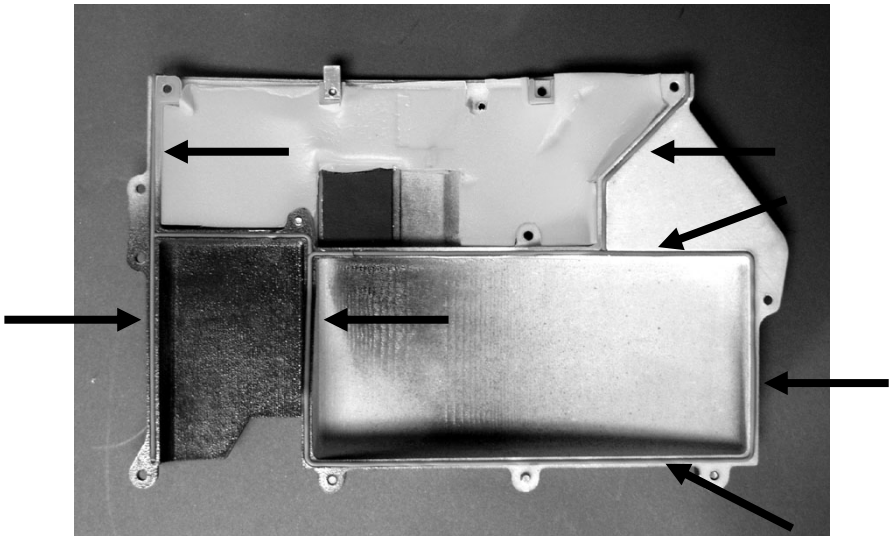


Figure 5–32. Cover panel gasket checkpoints

4. Install the screws in locations 1 and then 2 and tighten until snug (Figure 5–33). Do not overtighten. These will be tightened to the proper torque specification at a later step. Press down on back of cover panel, aligning holes 3 and 4. Put a screw into either location 3 or 4 and again, tighten until snug. Torque the screws to 6-in. lbs, respectively on location 1 and then 2.

5. Install the remaining screws into the cover panel to get them started in a cross-pattern as shown in Figure 5–33. Then, tighten until seated in a cross-pattern as shown in Figure 5–33. Finally, torque the screws to 6-in. lbs in a cross-pattern as shown in Figure 5–33.

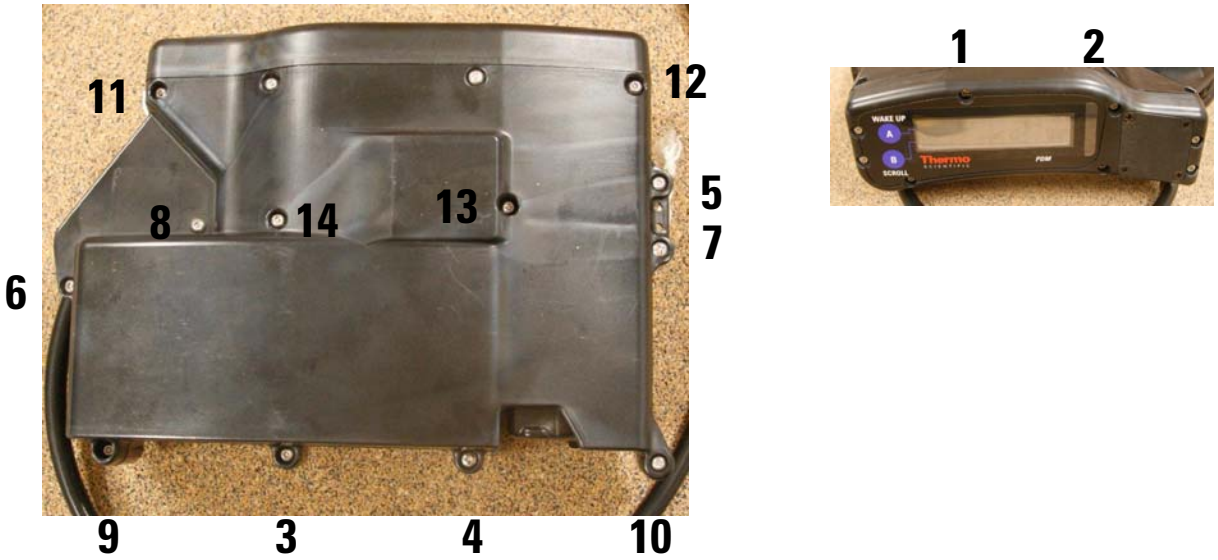


Figure 5–33. Cover panel screws

6. Perform a case leak check.

Performing Sample Path and Case Leak Checks

Periodically, or if the cover panel has been removed for maintenance, perform a case leak check on the PDM3700 unit. Tool/materials needed for this procedure include the case leak check suction cup, sample line plug, and exhaust port leak check putty (Figure 5–34).

Note When performing leak checks, only use the putty supplied by Thermo Fisher Scientific. ✳

Figure 5–34. Leak check putty

WARNING Whenever the PDM3700 case is opened for maintenance, you must perform a case leak check after reassembling the case. The system must pass the case leak check prior to operating the instrument. Correct the leak and re-test the instrument if the leak check does not initially pass. Do not operate the instrument if the system does not pass the case leak check. ▲

Note When performing a case leak check, a sample path leak check must be performed first. If the sample path leak check fails, fix the sample path leak prior to continuing. The entire process is described below. ✳

To perform a case leak check:

1. Disconnect the sample line from the sample inlet assembly.

2. Connect the PDM3700 unit to its charger and start the WinPDM software.

3. When in the PDM – COM1 screen, select the "Leak Check" button to display the Leak Check Routines screen (Figure 5–35).

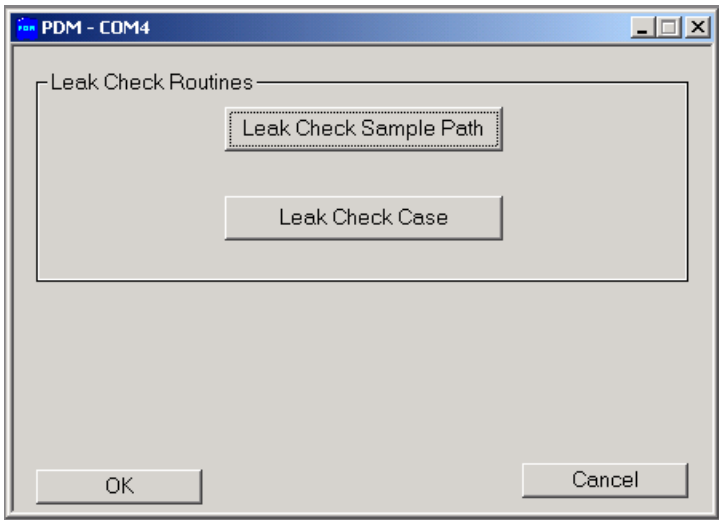


Figure 5–35. Leak check screen

4. Insert sample line plug in open end of sample tubing (Figure 5–36).

Figure 5–36. Insert sample line plug into tubing

5. Prior to the start of the leak check, locate the pump exhaust muffler (Figure 5–37). When the sample path leak check starts, the pump will start to run until a proper vacuum level is achieved in the flow line and the pump is turned off. At this time press a portion of leak check putty onto the pump exhaust muffler. Press firmly, but not so that putty gets stuck in the exhaust muffler opening (Figure 5–38).

Figure 5–37. Pump exhaust muffler

Figure 5–38. Placing the leak check putty

6. When the process is complete, a leak check passed or failed message is displayed on the screen. Remove the leak check putty. If the leak check fails, refer to the Troubleshooting section for information about leak failures.

7. After the sample path leak check passes, select the "Leak Check Case" button. A Warning/Confirmation screen will display with a "Place the inlet adapter in the inlet" message. Install the case leak check suction cup into the sample line (Figure 5–39). Select "OK."

Figure 5–39. Leak check suction cup installed in sample line

8. Another Warning/Confirmation screen will display with a "Attach the inlet adapter to the PDM" message. Install the suction cup side of the leak check suction cup onto the battery compartment vent that is located below the communication connections on the PDM3700 (Figure 5–40 and Figure 5–41). Select the "OK" button. As with the flow path leak check, the pump will start and draw a vacuum. When the pump stops, press leak check putty firmly onto the exhaust muffler.

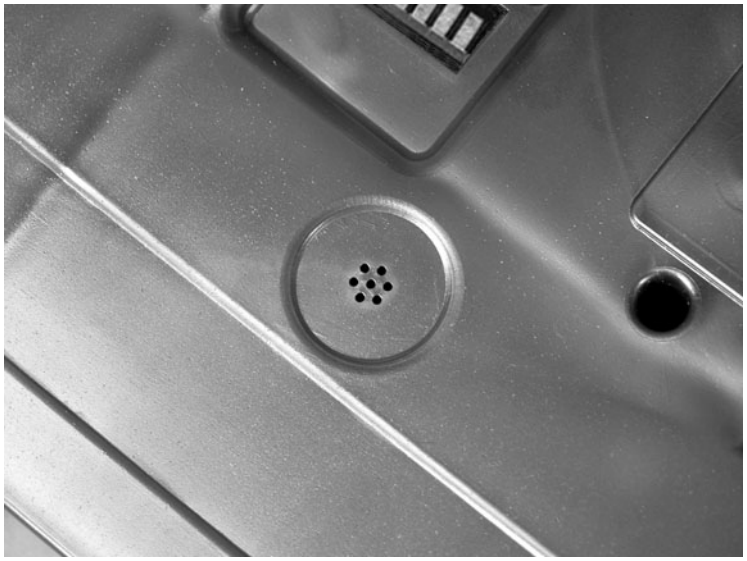


Figure 5–40. Battery compartment vent

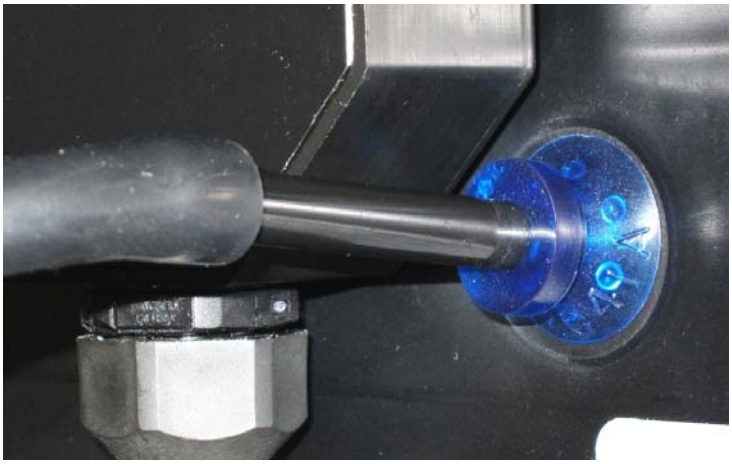


Figure 5–41. Leak check suction cup installed on battery vent

9. The Calibrate/Audit screen will display with a "Performing case check" message. The PDM3700 unit will perform the case leak check and display a pass or fail message on the Calibrate/Audit screen (Figure 5–42). Remove the leak check putty from the exhaust muffler.

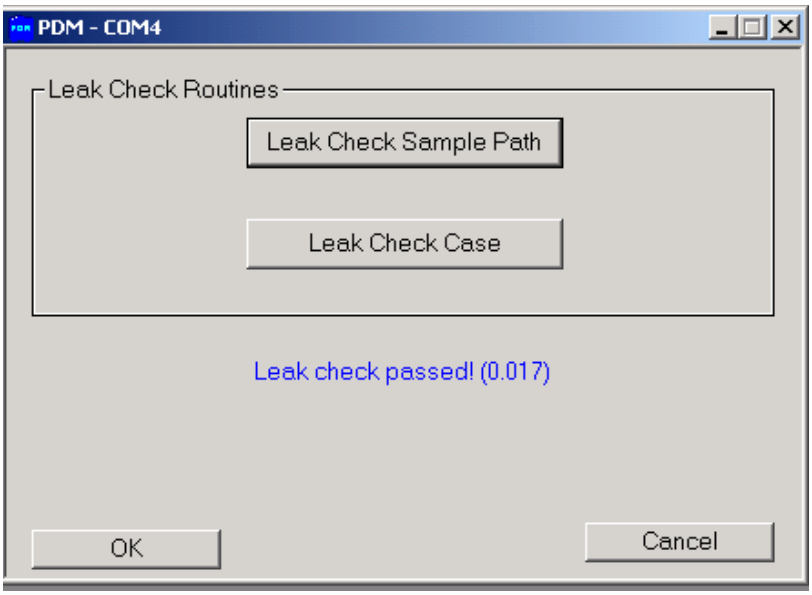


Figure 5–42. Leak check screen with a "passed" message

10. If the leak check passes, remove the case leak check suction cup from the battery compartment vent and remove the case leak check suction cup from the sample line. Return to normal operation. If the leak check fails, refer to the Troubleshooting section.

WARNING Do not operate the PDM3700 if its case is damaged or otherwise compromised. ▲

Replacing the Battery Pack

The PDM3700 has one battery pack assembly that should be replaced when its capacity diminishes. Tool/materials needed for this procedure include a Phillips screwdriver with torque adjustment.

WARNING The battery pack (PN: 56-010897-2300) is designed with specific individual battery cells. These battery cells are not user replaceable. The battery packs may be replaced only by MSHA certified individuals pursuant to 30 CFR Parts 70, 71 & 90. All charging of these battery packs shall take place while installed in the PDM3700 and in fresh air in Battery Charging stations as defined in 30 CFR 75.340 or fresh air above ground. ✳

WARNING Whenever the PDM3700 case is opened for maintenance, you must perform a case leak check after reassembling the case. The system must pass the case leak check prior to operating the instrument. Correct the leak and re-test the instrument if the leak check does not initially pass. Do not operate the instrument if the system does not pass the case leak check. ▲

CAUTION Refer to Section 1 for a comprehensive list of cautions and warnings for the battery pack assemblies. ▲

Note. This procedure requires removal of the cover panel of the unit. While the case is disassembled, you should check/lubricate the mass transducer O-rings. Refer to "Lubricating the Mass Transducer O-rings" later in this section for more information.

To replace the battery pack assemblies:

1. Remove the PDM3700 cover panel (refer to the instructions earlier in this chapter for information on opening the case).

2. Locate the battery pack assembly in the bottom of the unit (Figure 5–43).

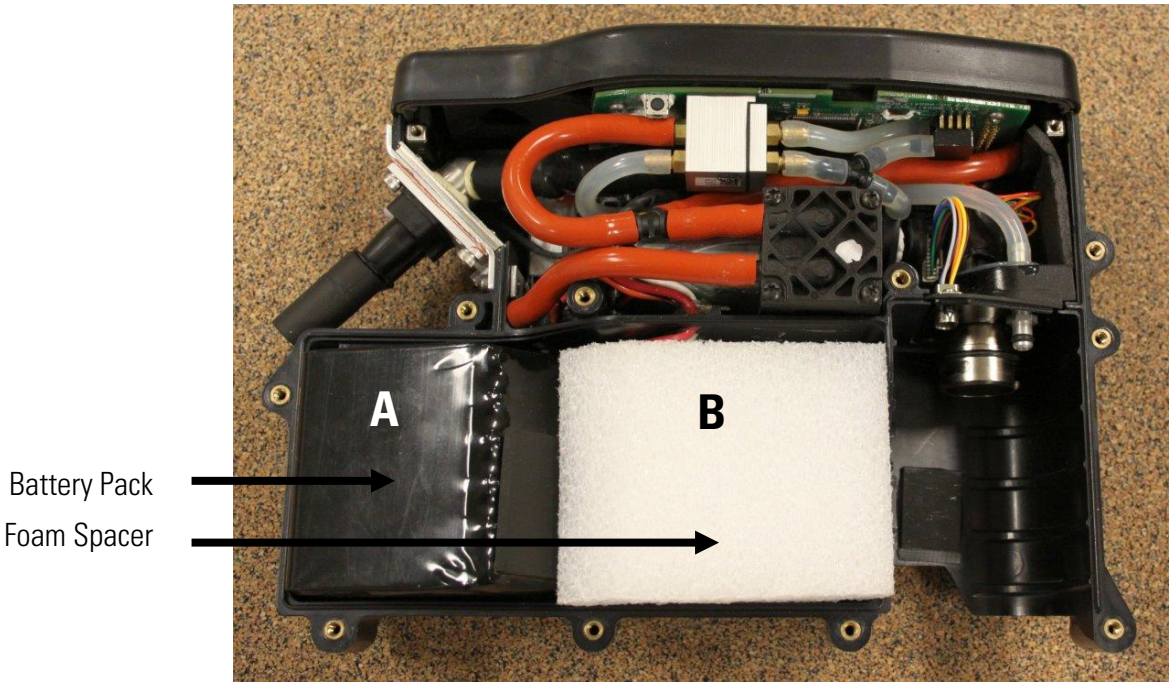


Figure 5–43. PDM3700 with cover panel removed

3. Carefully remove the battery pack "A" from the PDM3700 unit. Press the small tab on the wire connection to disconnect the battery wires (Figure 5–44 and Figure 5–45).

Equipment Damage When moving the battery pack to access the wire connections, be sure to minimize stress on the wires and connectors. ▲

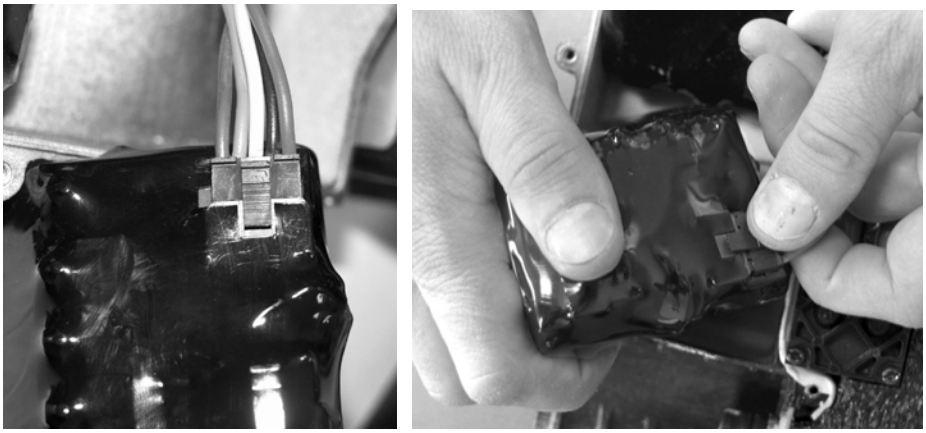


Figure 5–44. Battery connector

Figure 5–45. Removing the battery connector

4. Inspect the battery pack and the PDM3700 unit's case for damage.

5. Install a new battery pack assembly into the PDM3700 unit.

6. Check the mass transducer O-rings and lubricate them, if necessary.

7. Install the PDM3700 cover panel (refer to the instructions earlier in this chapter for information on opening the case).

8. Install the mass transducer into the PDM3700 unit.

9. Press the "A" ("WAKE UP") button on the top panel of the PDM3700 unit to ensure that the display screen appears.

10. If the display screen does not appear, open the case and double-check the battery connections. Reassemble the case, and press the "A" ("WAKE UP") button again. If the display screen does not appear, contact Thermo Fisher Scientific.

11. Properly dispose of the used PDM3700 battery packs. Recycling is the preferred method of disposal. Contact Thermo Fisher Scientific for further information. Do not dispose of the battery packs in fire or heat.

CAUTION Always properly dispose of the PDM3700 battery packs (recycling is preferable, contact Thermo Fisher Scientific for further information). Do not dispose of the battery packs in fire or heat. ▲

12. Perform a sample line leak check and a case leak check.

Lubricating the Mass Transducer O-rings

If it becomes difficult to install the mass transducer, lubricate the two O-rings located inside the top of the mass transducer section. Because this procedure is easier to complete with the cover panel removed, check the mass transducer O-rings while replacing the battery pack assemblies (or as necessary). Tool/materials needed for this procedure:

- Phillips screwdriver
- Cotton swab
- Silicone compound.

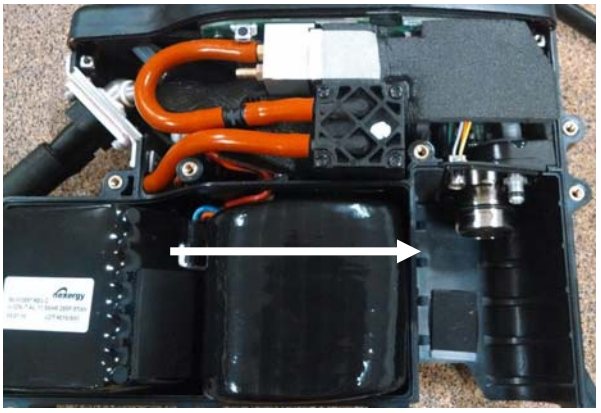
WARNING Whenever the PDM3700 case is opened for maintenance, you must perform a case leak check after reassembling the case. The system must pass the case leak check prior to operating the instrument. Correct the

leak and re-test the instrument if the leak check does not initially pass. Do not operate the instrument if the system does not pass the case leak check. ▲

To lubricate the mass transducer O-rings:

1. Remove the PDM3700 cover panel (refer to the instructions earlier in this chapter for information on opening the case).

2. Locate the mass transducer chamber of the PDM3700 and the two O-rings in the top of the chamber (Figure 5–46 and Figure 5–47).



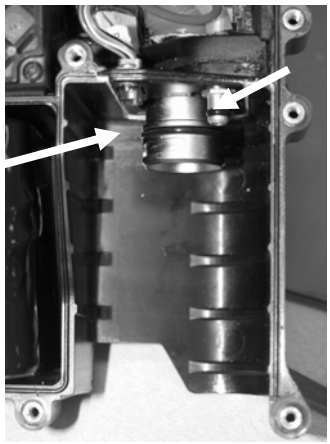


Figure 5–46. Mass transducer chamber

Figure 5–47. Mass transducer O-rings

3. Using the cotton swab, apply the silicone compound to the O-rings.

4. Install the PDM3700 cover panel (refer to the instructions earlier in this chapter for information on opening the case) and perform a leak check.

Performing a Flow Calibration

If the monthly flow audit fails, perform a flow calibration. Tool/materials needed for this procedure:

- Flow meter
- Tubing adapter
- Flow calibration kit (59-010019)
    - Red (0.028-inch) orifice
    - Black (0.033-inch) orifice
- Other adapters or tubing as required (to use customer flow meters these instructions need to be adjusted accordingly)

Note These instructions are given for one type of flow calibration device that requires the supplied tubing adapters. Other flow calibration devices may need other adapters or no adapters at all. Modify these instructions as necessary based on the flow calibration device being used. ✳

To perform a flow calibration:

1. Install a new TEOM filter.

2. Disconnect the sample line from the sample inlet assembly.

3. Perform a sample path leak check.

4. Connect the PDM3700 unit to its charger and start the WinPDM software.

5. When in the PDM – COM1 screen, select the "Flow Calibrations" button to display the Flow Calibration screen (Figure 5–48).

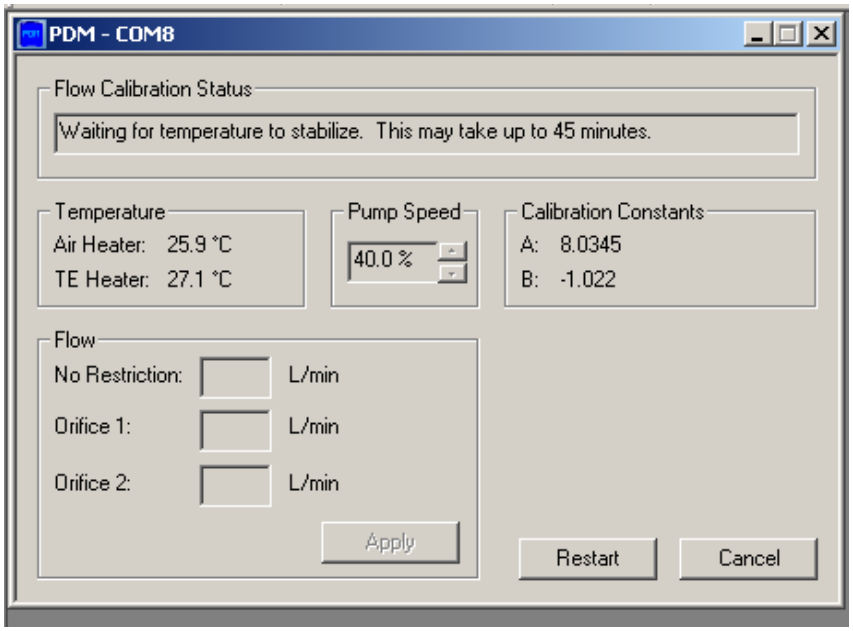


Figure 5–48. Calibration/audit screen

6. In the Flow Calibration screen, the Air Heater and TE Heater must stabilize before a flow calibration can be performed. A Warning/Confirmation screen displays the "Connect flow meter to sample tube inlet" message when the flow calibration can begin.

7. Install the tubing adapter into the sample line (Figure 5–49).

8. Install the other end of the tubing adapter into the tubing that is attached to the flow meter (Figure 5–49).

Figure 5–49. Install tubing adapter into the sample line

9. Select the OK button. The Flow Calibration screen will display with the "Pump Speed" box active (Figure 5–50).

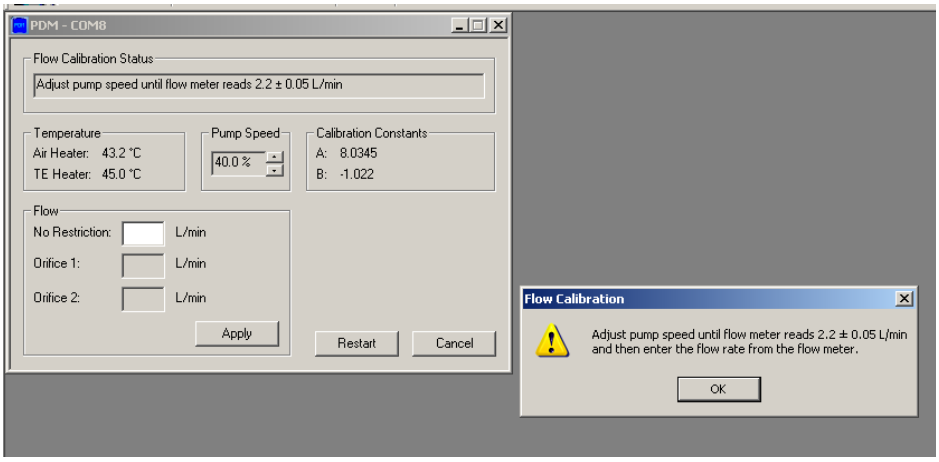


Figure 5–50. Flow calibration screen with pump speed box

10. Increase or decrease the flow rate reading on the flow meter by clicking on the small black arrows located to the right of the "Pump Speed" box (Figure 5–51). Adjust pump speed until the flow meter reads 2.2 lpm.

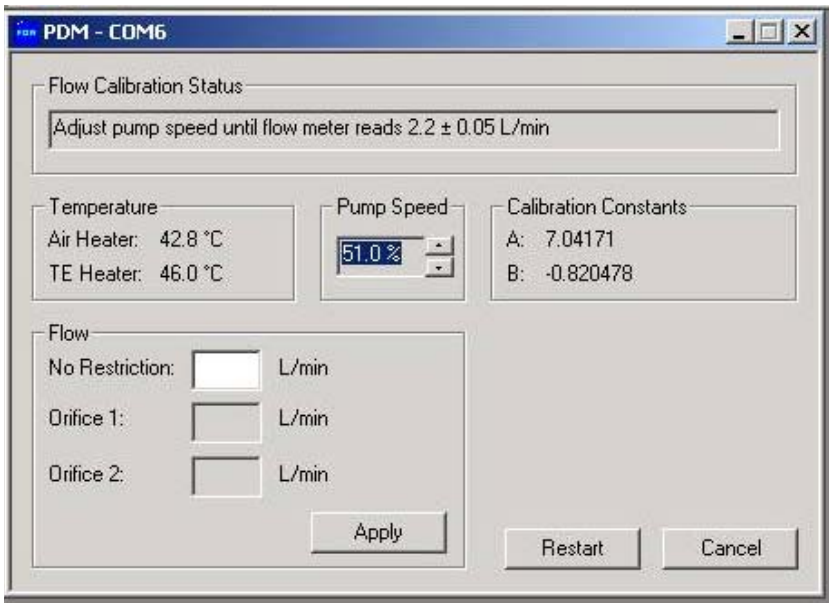


Figure 5–51. Flow rate calibration active display

11. When the flow rate reading on the flow meter matches 2.2 lpm, record the flow rate reading (from the flow meter) into the “No Restriction” (lpm) white box. Wait 2-3 minutes to ensure the flow meter is stable.

12. Select the “Apply” button. The PDM3700 unit will begin the flow calibration routine and will display a “Please wait, gathering data” message on the Flow Calibration screen.

13. A Warning/Confirmation screen will display with an “Attach orifice” message.

14. Remove the tubing adapter from the sample line.

15. Locate the black (0.033-inch) orifice. Install one end of the orifice into the sample line then install the other end into the tubing that is attached to the flow meter (Figure 5–52 and Figure 5–53).

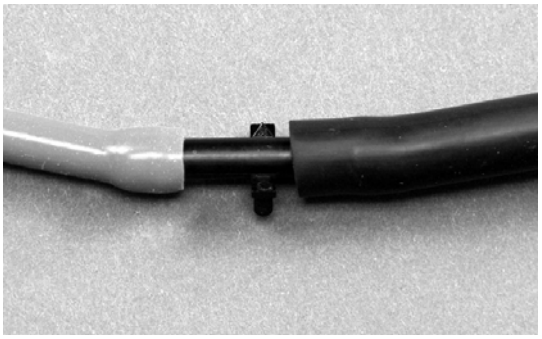


Figure 5–52. Flow calibration orifices

Figure 5–53. Black orifice installed in sample line and flow meter tubing

16. When in the Warning/Confirmation screen with an “Attach orifice” message, select the “OK” button. The Flow Calibration screen will display with the Pump Speed white box active.

17. Do Not adjust the pump speed. Enter the Orifice 1 flow rate from the flow meter (typically 2.0 lpm).

18. Select the “Apply” button. The PDM3700 unit will continue the flow calibration routine and will display a “Please wait, gathering data” message on the Calibrate/Audit screen.

19. A Warning/Confirmation screen will display with a “Attach red orifice inline between flow meter and sample tube” message.

20. Remove the black orifice from the sample line and flow meter tubing.

21. Install the red orifice into the sample line then install the other end of the orifice into the tubing that is attached to the flow meter (Figure 5–54).

Figure 5–54. Red orifice installed

22. When in the Warning/Confirmation screen with an "Attach red orifice to the inlet" message, select the "OK" button. The Flow Calibration screen will display with the Pump Speed white box active.

23. Do Not adjust the pump speed. Enter the Orifice 2 flow rate from the flow meter (typically 1.8 lpm).

24. Select the "Apply" button. The PDM3700 unit will continue the flow calibration routine and will display a "Please wait, gathering data" message on the Flow Calibration screen.

25. The PDM3700 unit will perform the remainder of the flow calibration routine and display a "Flow calibration complete" message on the Flow Calibration screen (Figure 5–55).

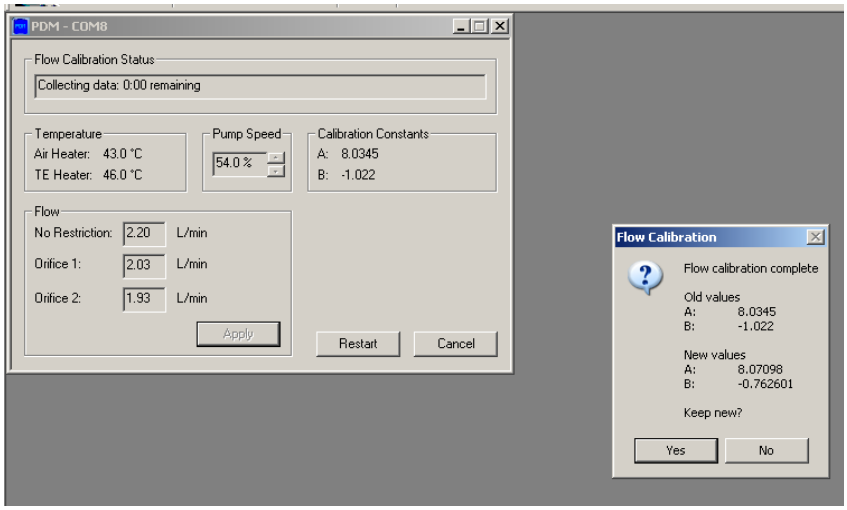


Figure 5–55. Screen with a "Flow calibration complete" message

26. Select the “Yes” button to accept the new flow values or the “No” button to keep the old values. Press the “Restart” button to perform a new calibration or the “Cancel” button to exit.

27. Remove the red orifice from the sample tubing and flow meter tubing.

28. Install the sample line onto the sample inlet assembly.

Note Care must be taken when reinstalling the sample tube onto the sample inlet to prevent cracking, gouging, or otherwise damaging the tubing. ✳

Chapter 6
Troubleshooting

This section provides user troubleshooting information. For any issues not addressed or further assistance, you may reach our Technical Support team from 8:00-6:00 pm ET by calling 866-282-0430 (US/Canada) or 508-520-0430 (International) and selecting #2 from the voice prompts. The Technical Support team can also be contacted via email at:

epm.technicalsupport@thermofisher.com

Start Up Diagnostics

During instrument warm-up, the PDM3700 continuously monitors the operating status for unexpected conditions. If any fault conditions are flagged the screen will flash 'DIAGNOSTIC FAILURE'. To view the cause of the fault, press the A and B buttons, press 'B' to scroll until the 'View Failures' options is displayed. Press 'A' to view the failure(s).

The flashing DIAGNOSTIC FAILURE' alert will stop if the condition causing the failure is corrected before the end of the warm-up period. For instance, 'TE Not Present' is most likely caused by a missing mass transducer. Installing a mass transducer will clear this fault condition.

A Programmed Shift or Primary Sample Run WILL NOT start if a DIAGNOSTIC FAILURE is present at the end of the warm-up period. Press 'A' 'Wake up' then 'B' 'Scroll' to identify the diagnostic failure that prevented the shift from starting.

To assist in correcting the Start Up Diagnostics Failure, it may be helpful to use the Instrument Diagnostics function of WinPDM to diagnose the problem.

Instrument Diagnostics

During instrument warm-up, the PDM3700 continuously monitors the operating status for unexpected conditions. If any fault conditions are flagged the screen will flash 'DIAGNOSTIC FAILURE'. To view the cause of the fault, press the A and B buttons, press 'B' to scroll until the 'View Failures' options is displayed. Press 'A' to view the failure(s).

A Programmed Shift or Primary Sample Run WILL NOT start if a DIAGNOSTIC FAILURE is present at the end of the warm-up period. Press 'A' 'Wake up' then 'B' 'Scroll' to identify the diagnostic failure that prevented the shift from starting.

Below is a list of the possible diagnostic failures along with the associated WinPDM Instrument Diagnostic.

PDM3700 Diagnostic Failure	WinPDM Instrument Diagnostics
AIR TEMP FAILURE	AIR TEMP
AMBIENT PRES FAILURE	AMBIENT PRES
AMBIENT TEMP FAILURE	AMBIENT TEMP
CLOCK FAILURE	CLOCK
DIFFERENTIAL PRESSURE	DIFFERENTIAL PRESSURE
FREQUENCY FAILURE	FREQUENCY
NO MASS TRANSDUCER	NO MASS TRANSDUCER
RH SENSOR FAILURE	RH SENSOR
RH TEMP FAILURE	RH TEMP
TE TEMP FAILURE	TE TEMP
FLOW RATE FAILURE	FLOW RATE (VOLTS)
TILT Z FAILURE	TILT Z DUTY CYCLE

If a diagnostic failure is encountered, the diagnostics function in WinPDM can be used to diagnose the problem.

1. Connect the PDM instrument to the charger and connect the charger to the computer.

2. Start WinPDM.

3. Click on the Communications button in WinPDM and verify communications.

4. Click on the Diagnostics button on the main WinPDM screen.

The diagnostics runs two different tests. The first series of tests is done with the pump and heaters off. If failures are detected be sure to note the type and the reading.

After a short time the computer will prompt to start the second series of tests. Again, note the type and readings associated with any failures. This information will assist the service department in diagnosing any problems.

The following is a list of possible causes for various conditions.

Pump and Heaters OFF Test

WinPDM Instrument Diagnostics	Cause	Solution
AIR TEMP	Defective/Disconnected Sensor	Check connection.
AMBIENT PRES	Defective Sensor	Contact TFS service
AMBIENT TEMP	Defective/Disconnected Sensor	Check connection.
CLOCK	Defective Component	Contact TFS service
DIFFERENTIAL PRESSURE	Defective Sensor	Contact TFS service
FREQUENCY	Mass Transducer not installed. Filter not installed Mass Transducer damaged	Install Mass Transducer Check for filter Contact TFS service
NO MASS TRANSDUCER	Mass Transducer not installed	Install Mass Transducer
RH SENSOR	Defective Sensor	Contact TFS service
RH TEMP	Defective Sensor	Contact TFS service
TE TEMP	Defective/Disconnected Sensor	Confirm Mass Transducer installed
FLOW RATE (VOLTS)	Board Defective	Contact TFS service
TILT Z	Defective Component	Contact TFS service
BATTERY VOLTS	Charger Off Battery Low Charger Defective Battery Defective	Turn Charger On Charge Battery Change Charger Change Battery

Pump and Heaters ON Test

WinPDM Instrument Diagnostics	Cause	Solution
AIR TEMP	Heater Defective	Contact TFS service.
AMBIENT PRES	Defective Sensor	Contact TFS service
AMBIENT TEMP	Defective/Disconnected Sensor	Check connection.
CLOCK	Defective Component	Contact TFS service
DIFFERENTIAL PRESSURE	Filter missing or needs to be changed. Flow blocked Defective Sensor	Change filter. Clean sample line. Contact TFS service
FREQUENCY	Mass Transducer not installed. Filter not installed Mass Transducer damaged	Install Mass Transducer Check for filter Contact TFS service
NO MASS TRANSDUCER	Mass Transducer not installed	Install Mass Transducer
RH SENSOR	Defective Sensor	Contact TFS service
RH TEMP	Defective Sensor	Contact TFS service
TE TEMP	Heater Defective	Contact TFS service
FLOW RATE (VOLTS)	Pump	Contact TFS service
TILT Z	Defective Component	Contact TFS service
BATTERY VOLTS	Charger Off Battery Low Charger Defective Battery Defective	Turn Charger On Charge Battery Change Charger Change Battery

Leak Testing

The leak test is split into two separate sections:

- Sample Path – Instrument Plumbing
- Case – Battery Compartment

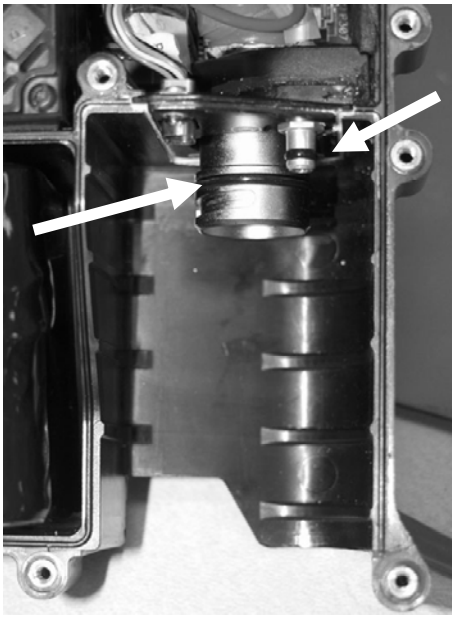
In order to perform a case leak check the instrument must first pass the sample path leak check. See the Maintenance section for directions to perform the leak tests.

Sample Path – Instrument Plumbing

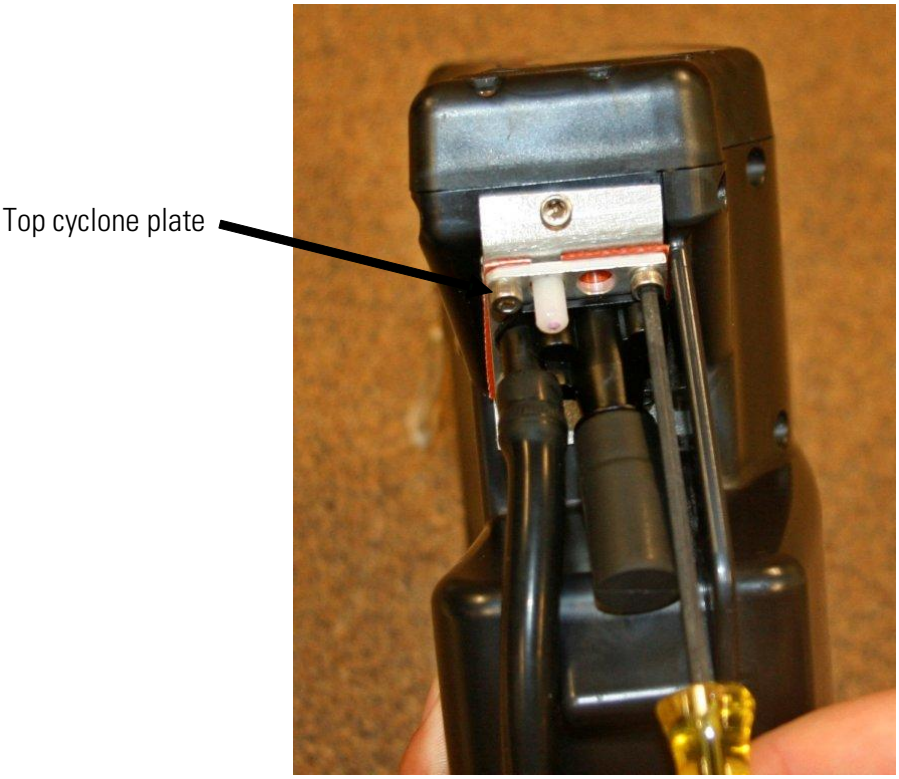
The most common sources of a leaking sample path, in order of most likely to cause leak:

Grit Pot – not seated, needs lubrication, torn or punctured

Mass transducer o-rings – needs silicone lubrication, torn or damaged



Cyclone gasket – screws not tight, gasket damaged, metal plates damaged

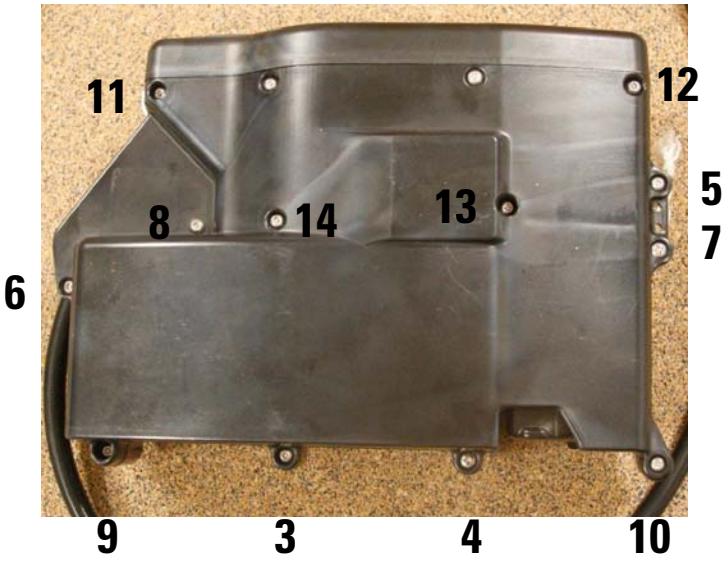


If there is a problem with the attachment of the cyclone plate and gasket assembly, contact Thermo Fisher Scientific technical support for information.

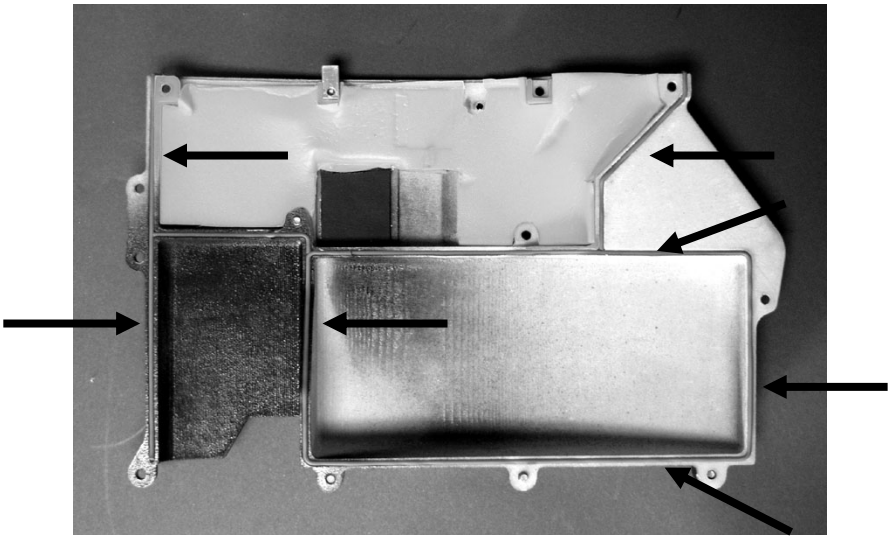
Case – Battery Compartment

The most common sources of a leaking battery compartment, in order of most likely to cause a leak:

Case screws – screws missing, not tightened to 6-in. lbs per the sequence shown in the following illustration.



Cover Panel – cracked or damaged cover panel, o-ring gasket missing/damaged



Appendix A
Parts and Consumables

Table A–1 lists the replacement parts for the PDM3700.

Table A–1. PDM3700 Parts and Consumables

Description	Part Number
PDM Parts	
Mass Transducer	54-010901
Battery assembly, PDM3700	56-010897-2300
O-ring kit, PDM3700 (3 O-rings)*	59-009961-0001
Cyclone grit pot*	30-009596
Hose Clamp Kit, PDM3700*	116729-00
Charger Parts	
Interface assembly, charger, PDM3700	55-010924-0001
Cable, RS232 m/f 10 ft	07-000587
Fuse, 2A time delay *	04-003268
Cord, power, detachable (for charger input power)	07-000593
Charger assembly, PDM3700	57-010925-3700
Cable, USB to serial, 6 ft	07-010239
Accessories	
Overlay, Display peel-away (pkg of 5) *	59-010234-0005
Filter, PDM3700 box of 20*	57-009727-0020
Filter, PDM3700 box of 1000*	57-009727-1000
Rugged carry case	34-009958
Documentation	
Manual, operation PDM3700 (printed copy)	42-009904-3700
Quick Start Guide (laminated)	42-009911-3700
Software packet, PDM3700 (WinPDM)	59-009905

Description	Part Number
Tools	
Filter tool assembly, PDM3700*	55-009885
K0 audit kit	59-010020
Flow calibration kit (includes orifice set)	59-010019
Leak check kit (suction cup, adapter, inlet plug and leak check putty)	59-010237
Leak check putty	30-012303
Sample Inlet Assembly (Figure A-1)	
Inlet/tubing assembly*	55-012085
Inlet	37-012084
Inlet mounting bracket	38-012094
Sealing screw	35-012093
Inlet o-ring*	22-000485-1012
Inlet screws*	21-003721-0003
Inlet bracket clip attachment	55-012278
Sample tubing*	32-006785-0001
Sample tubing, 50 ft roll	32-006785-0050
Tubing clip*	30-012091
Inlet spanner tool	30-012264

*Recommended spare parts to have on hand

Note The PDM 3700 is supplied with tubing of extra length (38 ± 0.5”) and must be trimmed before first use by the operator to meet agency requirements (35–37”). The tubing must be checked prior to use each day and may be trimmed due to breakage or fraying, but must always be between 35–37” during use. If the tubing is shorter than 35” it must be replaced. To measure the tubing, remove from the instrument and lay on a flat surface. Straighten the tubing and measure the total length without stretching the overall tubing length. ▲

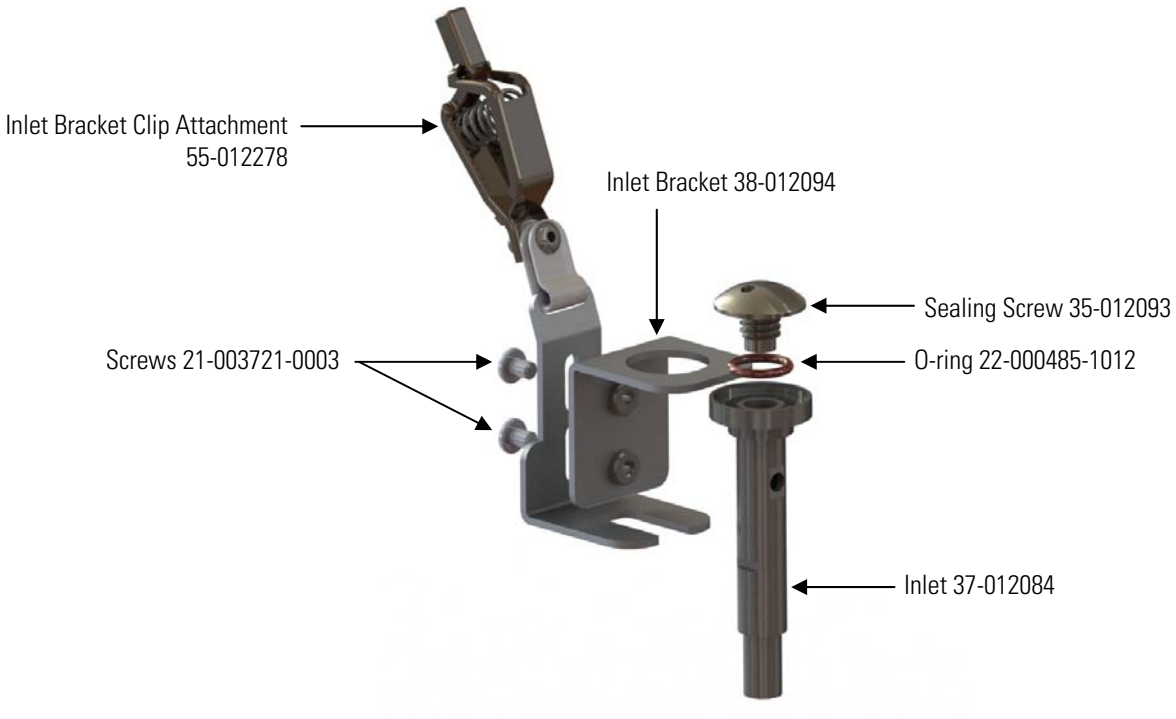


Figure A–1. Sample Inlet Assembly

Figure A–2. Completed Sample Tube and Sample Inlet Assembly