

MSHA Course of Instruction Certified Person; Maintenance and Calibration - CPDM

Dust Rule Outline

- Dust Rule Overview
- Person Certified in Sampling with CPDM Overview
- Person Certified in Maintenance and Calibration of CPDM Overview

Dates of Implementation

- Effective February 1, 2016
 - DOs, ODOs and Part 90 Miners must be sampled quarterly with a Continuous Personal Dust Monitor (CPDM)
 - 15 valid representative samples collected on consecutive normal production shifts required from each DO and ODO every calendar quarter. ODOs shall be sampled after DOs are completed and, if more than one type of ODO is present on the MMU, each is sampled during separate time periods
 - 5 valid representative samples on consecutive work days from each part 90 miner required each calendar quarter
 - The District Manager may require additional groups of 15 valid representative samples when information indicates the operator has not followed the approved ventilation plan for an MMU
- Effective August 1, 2016
 - Respirable coal mine dust standard for underground and surface - 1.5 mg/m^3
 - For a Part 90 Miner and Intake Air - 0.5 mg/m^3

General Sampling

- Sampling is full shift, portal-to-portal
- When sampling shifts longer than 12 hours, the CPDM must be switched out before the start of the 13th hour
- Miners expected to wear CPDM must be trained on CPDM prior to wearing it and retrained every 12 months
 - The importance of monitoring dust concentrations and properly wearing the CPDM
 - Clip-on sample inlet assembly should be attached to the miner's lapel or pocket
 - Inlet is not to be obstructed by clothing
 - How to display information screens and what the information is
 - How to start and stop second sampling runs
- Operator must keep record of the training for 24 months after completion of the training
 - Includes: date of training, name of miner, and subject trained

Duties – Certified Person; Sampling

- Program the CPDM for compliance sampling
- Ensure the miner(s) being sampled are properly wearing the CPDM at all times
- Monitor concentrations and status conditions at mid-shift or more frequently
 - Assure sampling device is in correct location
 - Assure CPDM is operating properly
 - Assure work environment remains in compliance with applicable standard
- Transmit compliance samples to MSHA electronically within 24 hours of the end of each sampling shift
 - Also note any samples that were not taken on a normal work shift

Duties – Certified Person; Sampling

(Continued)

- Shall provide each part 90 miner a paper record of the sample run within an hour after the start of the miner's next work shift **(90.210(c))**
- Must check CPDM within 3 hours before the sampling shift to assure operational readiness **(70.205)**
 - If not in proper working order, arrange for or conduct appropriate procedures to put CPDM into working condition
 - *In the event that a unit were to fail the preoperational check during the pre-shift warm-up period, the operator would either use another CPDM for sampling, or notify the District Manager orally and in writing that sampling will not occur because a CPDM is not available
 - Checks Includes:
 - Required cleaning
 - Installation of a new filter

*** Responsibility of the operator which the certified person; sampling or maintenance and calibration can complete**

Duties – Certified Person; Sampling - CPDM

(Continued)

- Except for Part 90 Miners, within 12 hours of the end of a sampling shift post the dust data card with the mine ID number, shift length, location sampled, equivalent concentration reported, and status conditions encountered (if any are recorded by the CPDM) **(70.211(c))**
 - Do not post dust data card for part 90
- Dust data card posted must remain posted until an MSHA report covering these respirable dust samples is received*
- Ensure that the data transmitted to MSHA is kept for at least 12 months*

*** Responsibility of the operator which the certified person; sampling or maintenance and calibration can complete**

Duties – Certified Person; Sampling

(Continued)

- Upon request from the District Manager (DM), the operator must submit the date and time any sampling required by the rule is scheduled to start. This information must be submitted at least 48 hours before the scheduled sampling* (70.201(f))
- Regarding the transmission of samples by the certified person to MSHA, all samples collected are to fulfill regulatory requirements unless the sample has been identified in writing to the District Manager prior to the sampling shift as a sample to be used for some other purpose

* Responsibility of the operator which the certified person; sampling or maintenance and calibration can complete

Duties – Certified Person; Sampling



Not permitted to perform calibrations
(is allowed to perform flow audit, not flow calibration)



Not permitted to open CPDM case



.msha file must not be altered in any way and shall be maintained for at least 12 months

(70.210(f))



Certification in sampling with the CPDM is required in order to collect samples with CPDM

(70.202(a))

Duties – Certified Person; Maintenance and Calibration - CPDM

(Continued)

- Performs maintenance and calibrations as recommended by the manufacturer (70.204)
- Permitted to open CPDM case for maintenance



NOT permitted to perform sampling with the CPDM

Duties – 30 CFR

- To be certified in sampling or maintenance and calibration, you must complete the MSHA course of instruction and pass the exam for the respective certification
- Persons certified in sampling or maintenance and calibration must be recertified every 3 years by passing a MSHA examination (70.203(c))
- MSHA may revoke the certification if there is a failure to properly carry out the required sampling procedures (70.203(d))
- Both Sampling and Maintenance and Calibration certified persons may clean the CPDM including the flow line, grit pot, and mass transducer



This course DOES NOT certify for sampling using the Coal Mine Dust Personal Sampling Unit (CMDPSU)

Maintenance Outline

- PDM3700 Overview
- PDM3700 Features
- Charging
- Status Codes
- Troubleshooting
- Cleaning and Changing Filters
- Cleaning the Cyclone and Inlet Tubing
- Items to Remember

What is the PDM3700?

- An accurate, wearable personal dust monitor for miners that incorporates real-time particulate monitoring that measures respirable coal mine dust mass concentration, shift exposure, and accumulated exposure in real time. This real time measurement of respirable dust particles will permit the user to take actions to lower total dust exposure
- The mass measurement is a filter- based direct mass monitoring instrument using proprietary Tapered Element Oscillating Microbalance (TEOM) and momentum compensation technologies
- Approved by the Secretary of Labor and the Secretary of Health and Human Services to collect respirable coal mine dust samples

Description of PDM Operation

- Continuously draws air through a body mounted inlet and uses a cyclone to separate respirable fractions of dust which enter the instrument
- Dust is deposited on a tapered element oscillating microbalance (TEOM) filter that changes in frequency as more dust is accumulated on the filter. The change in frequency permits near real time measurement of the respirable dust concentration of the work environment of the miner wearing the unit
- Suitable for area monitoring of respirable dust in mg/m^3 . Reports cumulative information to the miner in numeric and graphical formats
- Provides end-of-shift exposure (shift-average exposure) and can help identify operations with highest dust generation

Features

- There are two types of primary programming
 - **Programming of the PDM with the use of a PC.** This programming is used for compliance sampling. This type of programming cannot be stopped or altered once the PDM starts up unless the PDM is reconnected to a PC
 - **Manual programming of the PDM.** This type of programming can be used for engineering or informational sampling purposes
- A primary sampling program entered manually into the PDM can be started and stopped at will for targeted measurements of respirable dust concentrations
- At the end of the sampling run, a person certified in sampling with the CPDM can download detailed respirable dust exposure and other environmental information to a PC for further analysis

Features

(Continued)

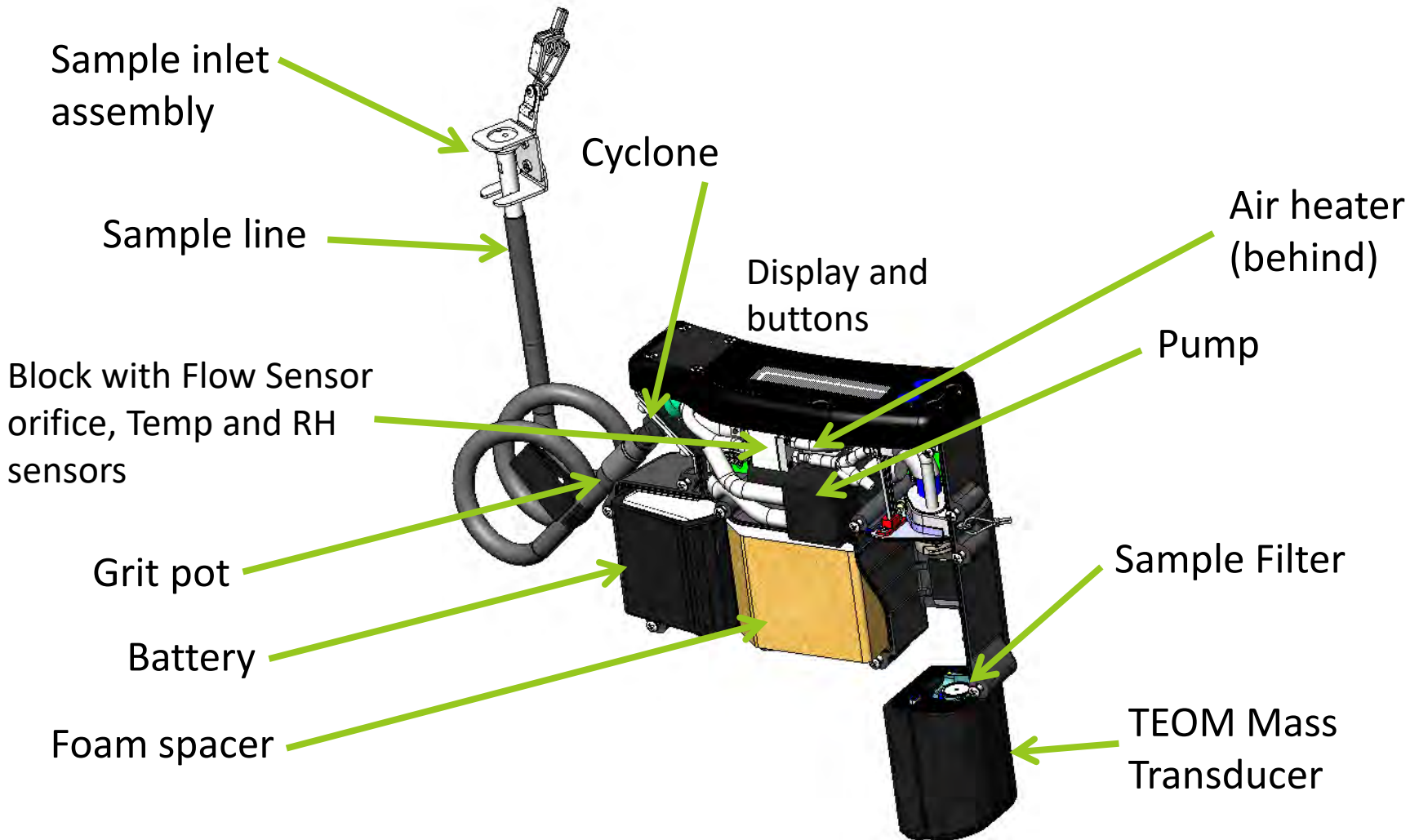
- Built-in sensors help detect possible tampering, track ambient pressure, temperature, humidity, filter differential pressure, and tilting
- Computer-controlled pump maintains volumetric flow rate at 2.2 liters per minute at mine temperature and pressure
- No miner intervention required to operate
- Certified intrinsically safe by MSHA

Features

(Continued)

- Run time of 12 hours providing unit is connected to charger during warm up
- Battery recharging time of 6 hours
- Heated internal sample line removes excess moisture
- Measures concentration of respirable dust without regard to composition
- Display has bright, large characters for easy readability

Main System Components



Purpose

- The CPDM unit is a device designed to provide a continuous readout of respirable coal mine dust concentrations during the work shift
- Only current approved CPDM unit is the PDM3700



General Information

- Provides near real-time analysis
 - Last 15-minute average for short samples
 - Last 30-minute average for full-shift samples
- Digital readout
 - Flow control system maintains operating flow at 2.2 lpm and total filter loading to 6 inches Hg (Uses Higgins Dewell instead of 10-mm Dohr-Oliver dust cyclone)
- Weighs approximately 4.4 lbs
- Stores sample data for future download and analysis
- Includes label certifying approval from MSHA/NIOSH

PDM Unit and Computer Connections

- Connect PDM unit to charging unit



- Connect charging unit to serial port on computer with RS232 Cable or via a RS232/USB adapter (use of USB adapter requires loading of the driver software)



Charging PDM Unit

Charger Lights

■ Red

- Solid: Charging
- Flashing: Problem with charger or connection

■ Green

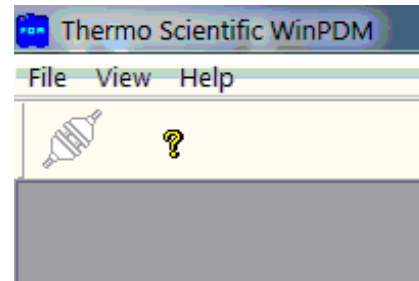
- Solid: Fully charged
- Flashing: 80% charged minimum



Keep PDM unit on charge when not in use. If PDM unit is not used within 3 months, run down PDM unit and recharge. Do not charge in environment below 32°F (0°C) or above 176°F (80°C)

Opening WinPDM

- Use of WinPDM software requires Windows operating system
- Click button on top left corner of screen
- Choose connection type COM1 and click “OK” (when using USB adapter multiple COM ports are presented)



Information to Get Started

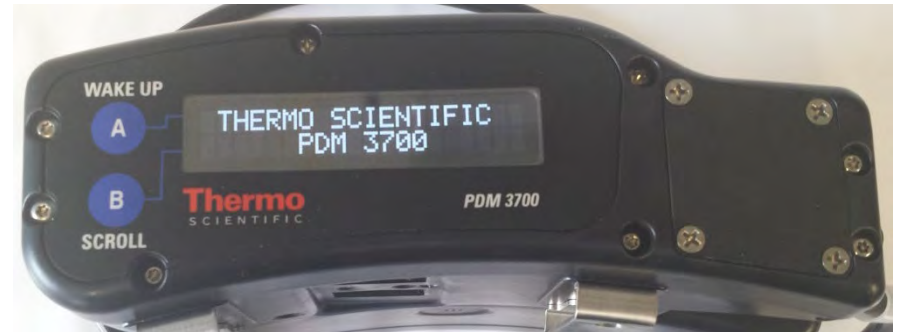
2 Buttons

A is the “wake up” button
(blank screen)

B is the “scroll” button



When not programmed the PDM displays idle screen: serial number and firmware version



Warm-up Time

- PDM unit will automatically start a warm-up period of up to 35 minutes prior to ANY sampling type's start time
- Keep PDM connected to charger during warm up to insure 12 hour sample time
- During warm-up period, the PDM will display the wearer ID and the time remaining until sampling starts
- The ambient temperature of the PDM warm-up location should be as close as possible to the ambient temperature of the location where the sampling period will end



If the PDM has been running recently, the warm-up period may be shorter than 35 minutes

Blinking "S"

(Upper Right Corner)



Status Condition Encountered



Status Screen

- Indicates a status condition encountered
- "S" remains for sample duration
- "S" restarts blinking if new status condition is logged

View Status Codes

Press **A** and **B** together

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



Press **B** until you see

(A) VIEW STATUS
(B) MORE OPTIONS...



Press **A** to view status

PDM3700 Firmware Status Codes

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

Troubleshooting

(Diagnostic Failure during Warm-Up Period)

- View cause of failure
 - Press **A** and **B** together
 - Press **B** twice to scroll until “View Failures” option is displayed
 - Press **A** to view failures
- Flashing “DIAGNOSTIC FAILURE” will stop if condition causing failure is corrected before end of warm-up period



PDM MUST NOT be operated in an area of the mine where permissible electrical equipment is required, if the case is cracked, one or more screws are missing or the MSHA approval label is missing or illegible

View Failures

Press **A** and **B** together

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



Press **B** until you see



Press **A** to view failures

Troubleshooting

(Diagnostic Failure at end of Warm-Up Period)

- Sample run will not start
- Identify diagnostic failure
 - Press **A** to wake up
 - Press **B** to scroll and identify diagnostic failure
- Attach PDM unit to charger and start WinPDM program
- Start “Instrument Diagnostics”
 - First series of tests with pump and heaters off
 - Second series of tests with pump and heaters on

Troubleshooting

(Diagnostic Failures along with WinPDM Instrument Diagnostics)

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

Maintenance and Calibration

The following slides discuss procedures involved in verifying the calibration of the PDM3700 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.

- “Daily or after each use” - If a unit is not used on any given day the daily maintenance will not be required
- The term “or as necessary” refers to any condition that may occur that would require additional maintenance or calibrations to be conducted on the unit or any condition that would cause the mine operator to question the reliability of the unit to perform as approved;

Examples:

- Status codes referring to any potential maintenance or calibration issue
- Unit’s charge not lasting a full shift
- Unit is damaged

These are only a few examples of what might cause a mine operator to question the reliability of the unit. The mine operator must determine on a case by-case-basis whether a condition requires additional maintenance and/or calibration of the unit.

The manufacturers requirements for maintenance and calibration are minimums. The mine operator may conduct addition maintenance and calibrations any time there is a need.

Maintenance and Calibration

(continued)

Daily

- Charge the internal battery pack before each use, or as necessary
- Clean the grit pot after each use, or as necessary
- Clean the mass transducer area and sample flow lines after each use, or as necessary
- Replace the TEOM filter after each use, or as necessary



These maintenance procedures can be conducted by either a person certified in sampling or a person certified in maintenance and calibration

Maintenance and Calibration

(continued)

Monthly

- Perform a flow audit once per month, or as necessary
- Clean the cyclone and inlet tubing once per month, or as necessary



The flow audit may be performed by either a person certified in sampling or a person certified in maintenance and calibration. The cleaning of the cyclone and inlet tubing may **ONLY** be performed by a person certified in maintenance and calibration

Maintenance and Calibration

(continued)

Annual

- KO audit once a year, or as necessary
- Tilt audit once a year, or as necessary



These audits must be conducted by a person certified in maintenance and calibration

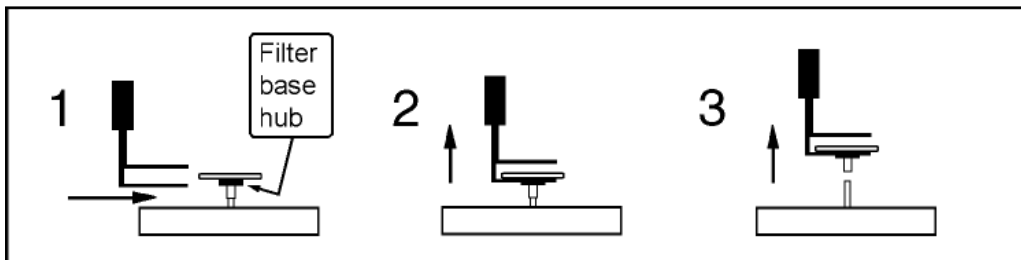
Changing Filters

(Removal)

1. Locate the TE handle on the left side of the PDM3700 and slide the handle all the way to the right to unlock the mass transducer and then pull the mass transducer out of the unit.
2. Carefully insert the lower fork of the filter exchange tool into the filter change notch 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.
3. Gently pull straight up from the tapered element (TE) lifting the filter from the TE.

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.

Filter change notch



Changing Filters

(Installation)

1. Clean the exchange tool with canned air or a clean cloth. Use it 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. Do not touch the filter with your fingers.
2. Lightly place the hub of the filter onto the tip of the tapered element, then slide the tool toward the notch and remove.
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.
4. Rotate the mass transducer 90° and press again. Repeat 2 more times, rotating the transducer 90° and applying the filter tool each time.
5. Install the mass transducer back into the PDM3700 unit.



Cleaning PDM Unit

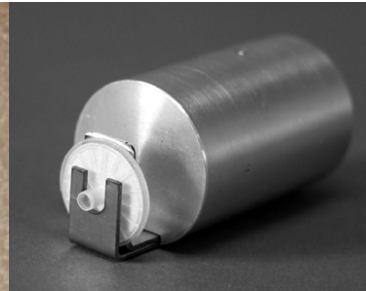
- The manufacturer requires the use of standard commercial canned air for cleaning a PDM
 - If using anything else, ensure the air is purified and free of any oil mist, such as compressor generated
- Isopropyl alcohol is suggested when cleaning anything that requires an alcohol swab

Cleaning PDM Unit

(Continued)

Remove

- Mass transducer
- TEOM filter
- Grit pot

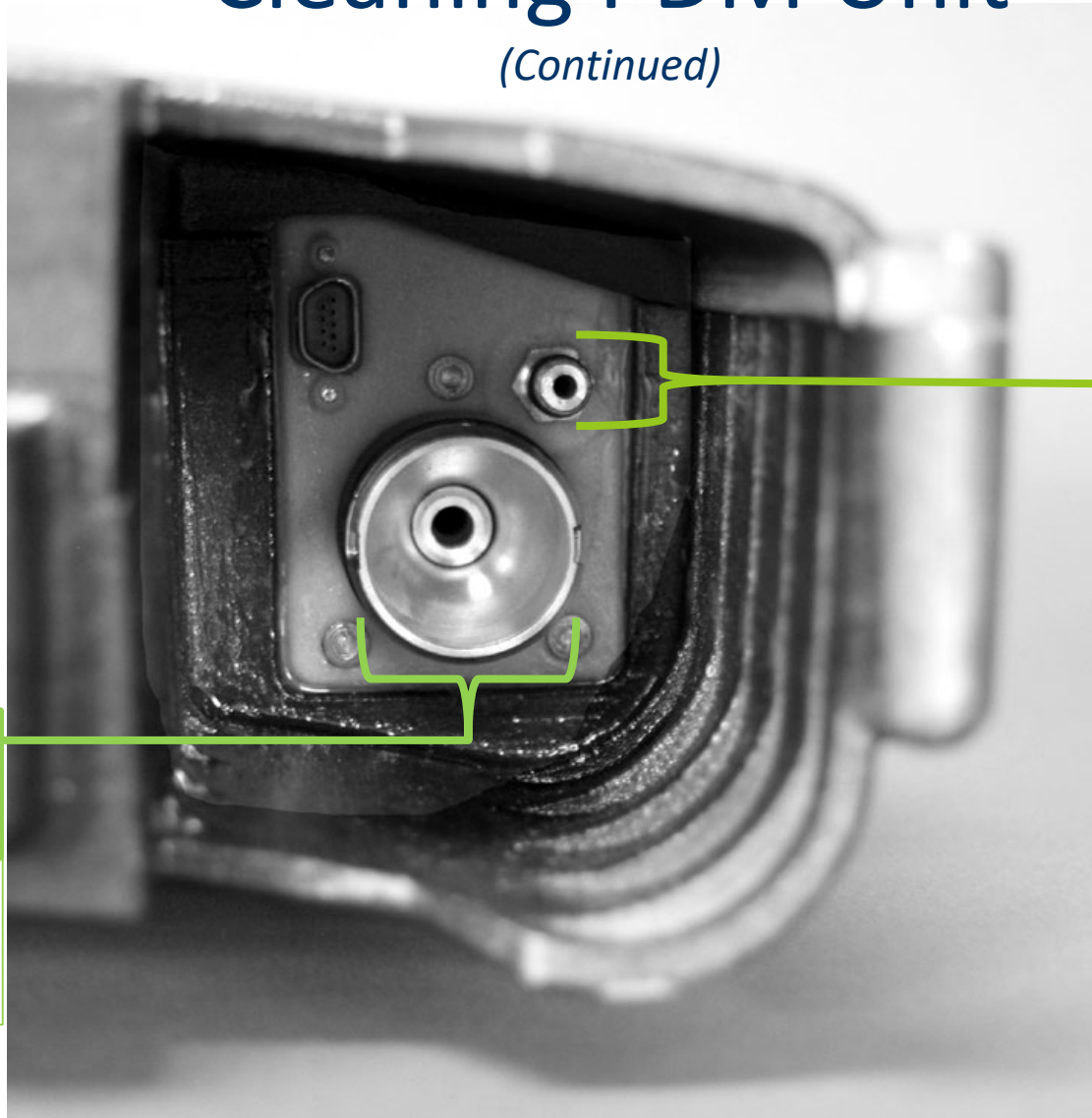


Spray compressed (canned) air inside (daily):

- Grit pot
- Sample inlet
- Cyclone Nozzle
- Housing of mass transducer, but not the connecting port
- Bell where mass transducer is installed (bell-shaped inlet)

Cleaning PDM Unit

(Continued)



Bell-shaped
inlet

OK TO
SPRAY

Filter
loading
pressure
sensor

DO NOT
SPRAY

This will
damage the
sensor and
disable PDM

Cleaning CPDM Unit

(Continued)

Wipe with alcohol:

- Mass transducer
- Bell-shaped inlet
- Grit pot



Manufacturer requires that components listed above be cleaned daily or after each use

Cleaning the Sample Inlet Assembly, Sample Line, and Mass Transducer

(Daily)

1. Disconnect the sample line from the inlet assembly. Use care to ensure that the tubing does not break during removal.
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.
5. Use silicone lubricant to lightly coat o-rings on bell-shaped inlet and return tube.

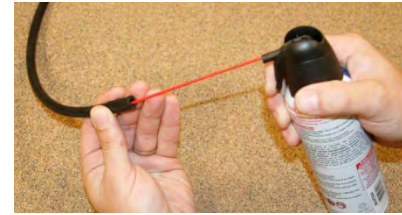
Disconnect
here



Cleaning the Sample Inlet Assembly, Sample Line, and Mass Transducer

(continued)
(Daily)

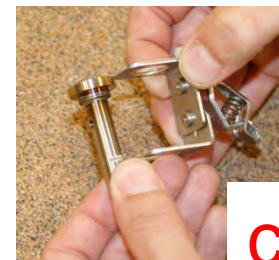
6. Direct a stream of air through the end of the sample line removed from the sample inlet assembly and through the sample inlet on the sample inlet assembly (bracket).



a



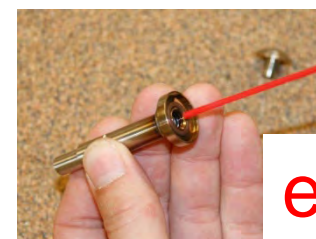
b



c



d



e

- Disassembly of the sample inlet assembly
 - a. Loosen screws on rear of bracket
 - b. Open sample inlet assembly bracket
 - c. Slide out sample inlet assembly
 - d. Remove sample inlet cap using tool provided
 - e. Clean sample inlet

Cleaning the Sample Inlet Assembly, Sample Line, and Mass Transducer

(continued)
(Daily)

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 base of the sample inlet assembly (instrument inlet).

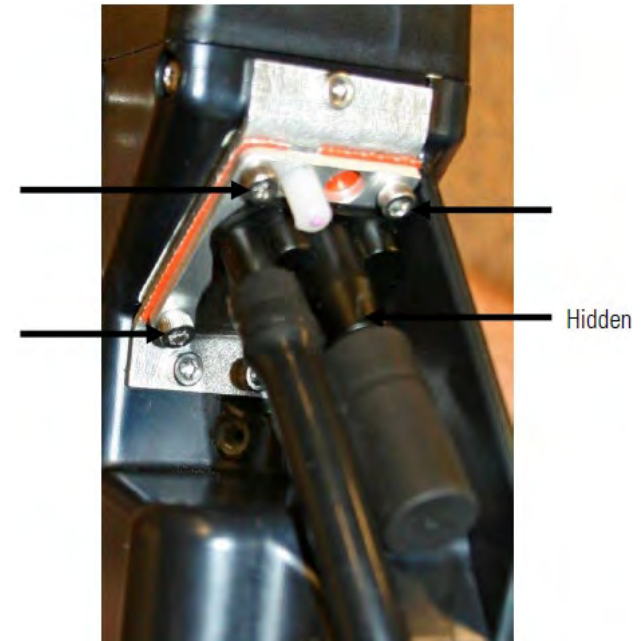


Make sure to inspect the O-ring in the top of inlet for damage

Cleaning the Cyclone and Inlet Tubing

(Monthly)

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



Cleaning the Cyclone and Inlet Tubing

(Continued)

(Monthly)

5. Install the sample line onto the sample inlet assembly.
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 (to be discussed in a later section).

Items to Remember

- **Use appropriate software**

WinPDM 7.52 (or higher) software should be installed on the computer. Version 7.7 (or higher) firmware should be installed on the PDM unit. All computer versions (Software or Firmware) should be the most up-to-date, only the manufacturer can install or upgrade the firmware

- **Wipe down connectors**

Always wipe down the connectors on the PDM unit and charging bracket to obtain a good connection. Using an isopropyl alcohol soaked cotton swab is recommended

- **Never use acetone to wipe down or clean any PDM part.**

Items to Remember

(Continued)

■ Install mass transducer properly

Firmly press the mass transducer into the unit while securing the latch and then check to make sure the mass transducer does not slide out of the PDM unit

■ Program accurate computer information

Make sure your computer's date and time are accurate when programming the PDM unit by computer, since the PDM unit uses this information to start sampling (this is important when there are time zone changes and daylight savings time changes)

Items to Remember

(Continued)



Note the mass transducer has a separate serial number that should be recorded along with the date the K0 audit was performed on it. A K0 audit is recommended by the manufacturer to be performed at least annually

Items to Remember

(Continued)

- **Running a Manual Start**

(Manual start, instead of programming by computer)

- **PDM unit remembers last programmed information**

This can affect information such as time, temperature, etc. If information needs changed, program the PDM unit to run a sample ahead of time

- **Locked PDM unit screen**

Connect the PDM unit to charger and computer, and run the WinPDM software to unlock the PDM unit

Items to Remember

(Continued)


- If inlet is immersed in water
- **Note: this procedure may reduce the damage to the mass transducer, however the success will depend on time and contamination level (not covered by warranty).**
 - Remove and empty by shaking the mass transducer of water immediately. Reinstall mass transducer
 - Run clean water through the PDM unit as soon as possible (Do not immerse the PDM unit into water). Running clean water through the inlet may not be possible when in a mine
 - Remove and empty the mass transducer once again and reinstall
 - Next, let the PDM unit run for a long time (many hours) to work the water through and dry the PDM unit (the unit may run while on the charging unit)



As soon as possible use canned air to spray out the mass transducer and sample path

Items to Remember

(Continued)

- PDM Serial Number will be displayed on the top display panel by pressing the  button while the PDM is charging

PDM Flow Audit, Leak Check, and Calibration

Outline

- Flow Audit
- Sample Path Leak Check
- Case Leak Check
- Calibration

Flow Audit

- Flow Audits are to be performed once a month or as necessary
- Verifies the flow rate is within the accepted range
 - $2.2 \pm 2.5\%$ (2.145 – 2.255) lpm (Manufacturer's specification)
- 30 CFR Part 74 requires that a CPDM's flow rate be within 5% of the calibrated flow for 95% of samples up to 12 hours in duration

Flow Audit

(Continued)

(Monthly)

- Materials needed for Flow Audit
 - Flow meter
 - Flow audit inlet tubing adapter (if necessary)

Flow Audit Steps

(Monthly)

1. Disconnect the sample line from the sample inlet assembly (inlet bracket).
2. Install one end of the tubing adapter (if necessary to connect) into the sample line from the inlet assembly (bracket) and the other end of the tubing adapter into the tubing that is attached to the flow meter.



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.

Flow Audit Steps

(Continued)

(Monthly)

5. Start a sample run on the PDM3700 unit. 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.
6. Wait 10 minutes to allow the flow rate to stabilize, then check the flow rate readings 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 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.



If flow is outside acceptable range, a person certified in maintenance and calibration should perform a flow calibration

Leak Checks

- Tool/materials needed for this procedure include:
 - Leak check adapter (leak check suction cup)
 - Inlet plug
- Two types of leak checks:
 - Sample Path
 - Case
- Leak checking must be performed periodically and anytime the PDM case is opened for maintenance. Other examples include:
 - Cleaning the cyclone and inlet tubing
 - Performing a flow calibration
- The sample path leak check must be performed before the case leak check is performed

Leak Check Steps

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.



3.

Leak Check Steps

(Continued)



4. Insert sample line plug in open end of sample tubing. Step 4: Inlet plug inserted into the sample line.
5. Prior to the start of the leak check, locate the pump exhaust muffler. 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.



t Muffler



Step 5: Putty placed over exhaust muffler.

Leak Check Steps

(Continued)

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. Select “OK.”



Step 7: Inlet adapter attached to the sample line.

Leak Check Steps

(Continued)

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. 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.
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. Remove the leak check putty from the exhaust muffler.
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.



Step 8: Inlet adapter attached to the battery compartment vent.

Sample Path Leak Check Troubleshooting

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

1



- 1 Grit Pot – Not seated, needs lubrication, torn or punctured.

2



- 2 Mass transducer O-rings –Needs silicone lubrication, torn or damaged.

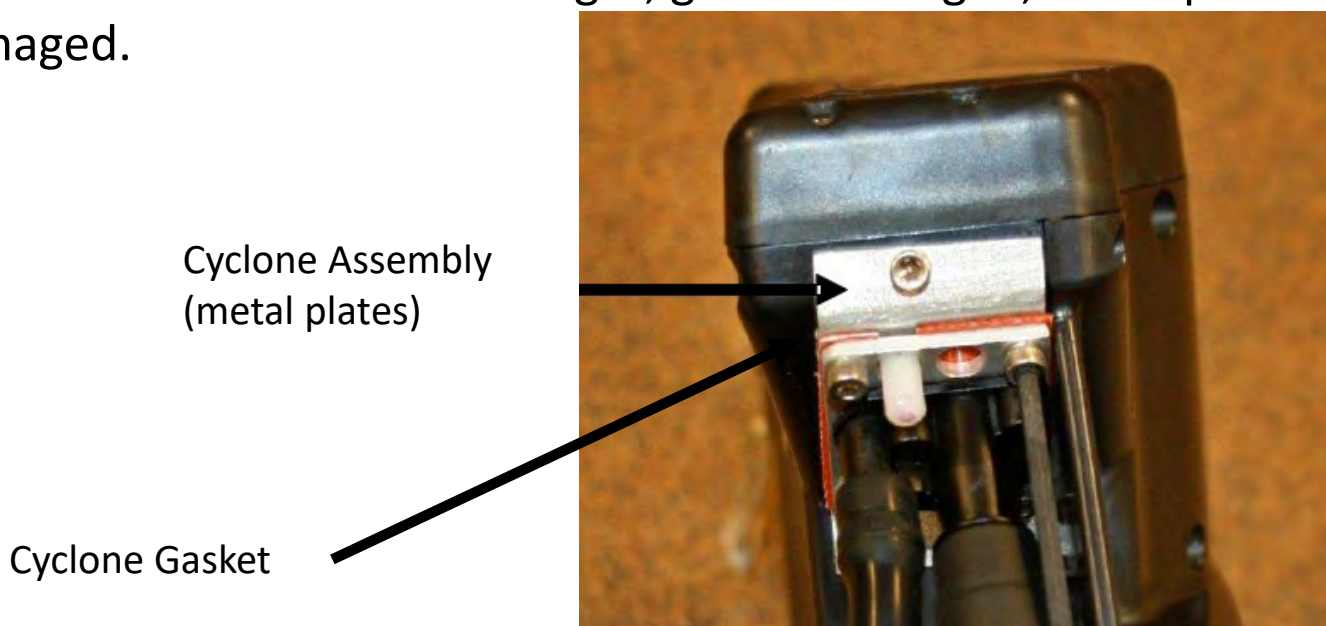


Use silicone compound for lubrication (never use petroleum based grease)

Sample Path Leak Check Troubleshooting

(Continued)

- 3 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.

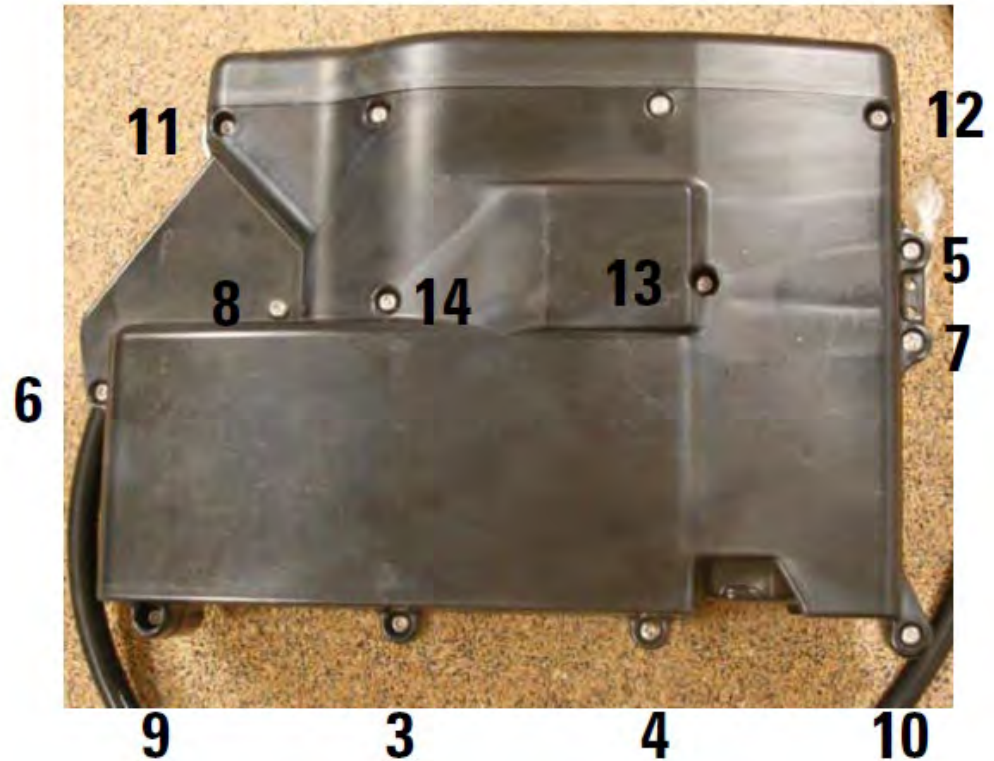
Case Leak Check Troubleshooting

(Continued)

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

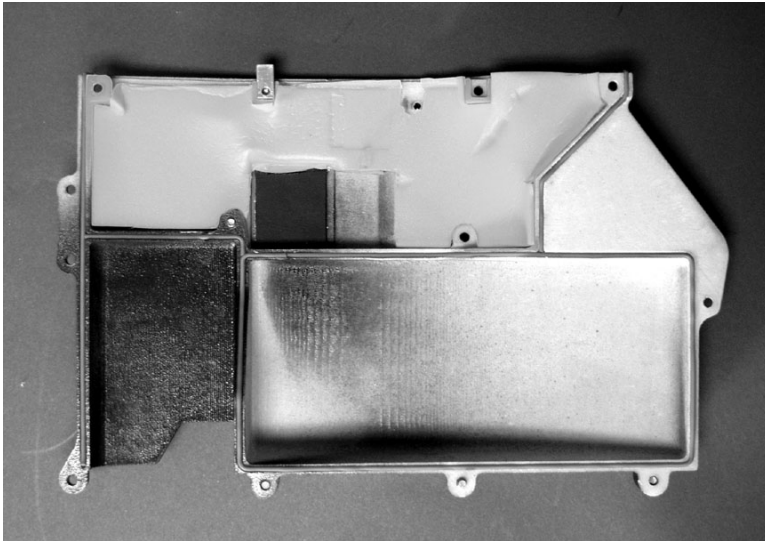
1

Case screws –
Screws missing or
not tightened to 6
in-lbs per sequence
shown



Case Leak Check Troubleshooting

(Continued)



2

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

Flow Calibration

- Tool/materials needed for this procedure:
 - Flow meter
 - Tubing adapter (if necessary)
 - Flow meter tubing (if necessary)
 - Flow calibration kit (59-010019)
 - Black (0.033-inch) orifice
 - Red (0.028-inch) orifice
- Flow calibration must be conducted if the flow audit fails
- Sample path leak check must be performed prior to a flow calibration

Flow Calibration Steps

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.



Flow Calibration Steps

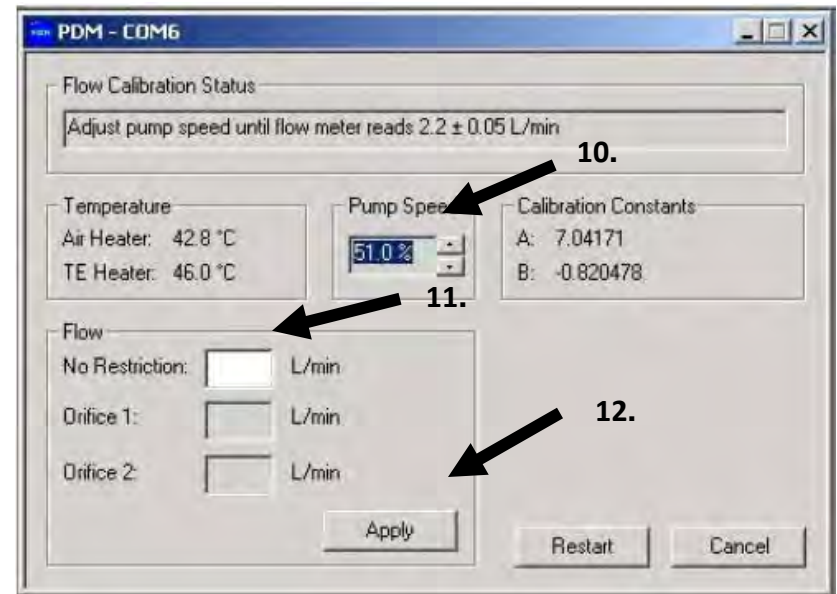
(Continued)

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 (if necessary to connect) into the sample line.
8. Install the other end of the tubing adapter (if necessary to connect) into the tubing that is attached to the flow meter (if necessary to connect).
9. Select the OK button. The Flow Calibration screen will display with the “Pump Speed” box active.

Flow Calibration Steps

(Continued)

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. Adjust pump speed until the flow meter reads 2.2 lpm.
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.



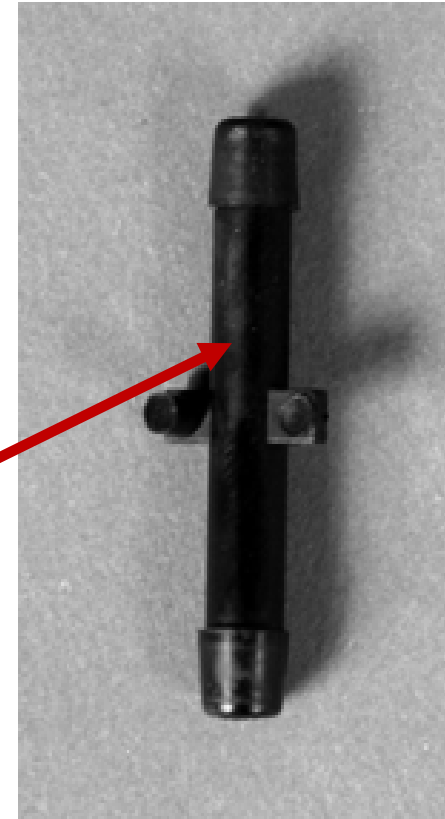
Flow Calibration Steps

(Continued)

13. A warning/confirmation will display “Attach black orifice inline between flow meter and sample tube”*
14. Remove the tubing adapter (if necessary to connect) from the sample line.

Note: The pump speed is not adjusted after step 10; which is before attaching orifices

Orifice

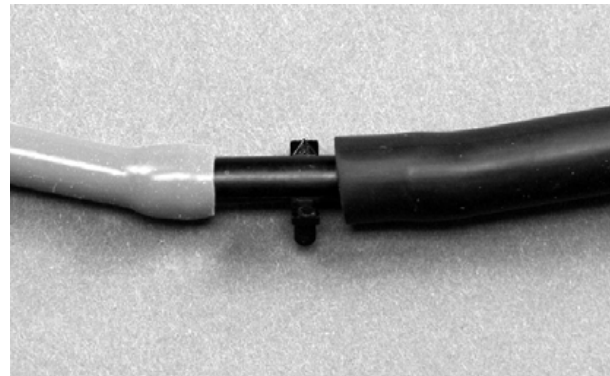


*Manual needs revised

Flow Calibration Steps

(Continued)

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.



Step 15: Sample line connected to the flow meter via the orifice.

Flow Calibration Steps

(Continued)

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.

Flow Calibration Steps

(Continued)

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 flow meter tubing (tubing that is attached to the flow meter).
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.

Flow Calibration Steps

(Continued)

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.
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 line and flow meter tubing.
28. Install the sample line onto the sample inlet assembly (inlet bracket).

NOTE: MSHA recommends conducting another flow audit to verify the flow calibration.

PDM

K0 Audit and Tilt Audit

K0 Audit

- K0 number is the calibration constant
- The K0 Number must be audited once per year or as necessary
- Always use a new filter when doing a K0 Audit
- Make sure the PDM is upright during the audit



PDM in upright position

Tools and Materials for K0 Audit

- K0 Audit kit (tweezers, weights)
- Alcohol swab

K0 Audit Steps

(Annually)

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.



KO Audit Steps

(Continued)
(Annually)

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. Use small tweezers to add the weight to the filter.



Step 4: Mass transducer removed with weight placed on the filter.

Before adding any weights, make sure the tweezers and screwdriver are clean and use the alcohol swab to clean the weights.

K0 Audit Steps

(Continued)

(Annually)

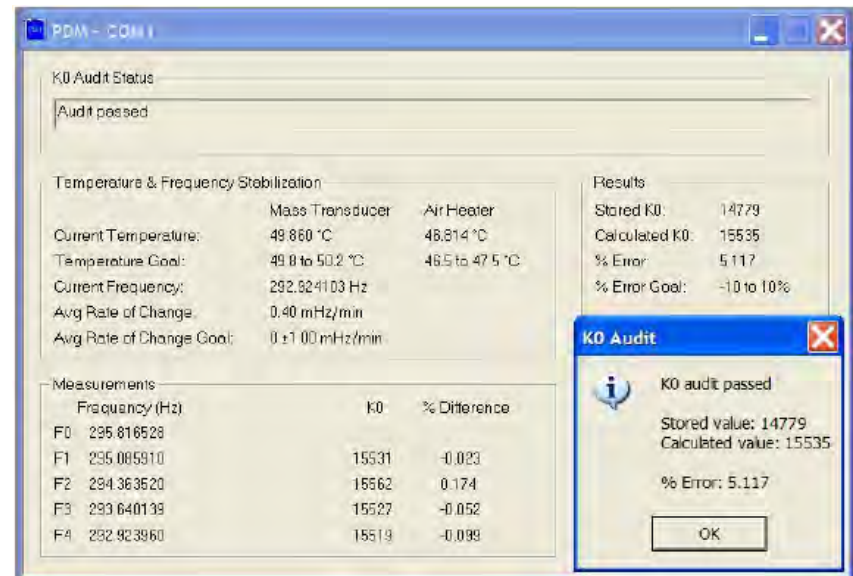
5. The computer will prompt to add three more weights. Place the weights consecutively as shown below.



K0 Audit Steps

(Continued)
(Annually)

6. After the final weight has been added, a % error will be displayed. The acceptable error limit is $\pm 10\%$. If the results are greater than $\pm 10\%$, repeat the audit. If the audit continues to fail, contact Thermo for support.



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

K0 Audit

(Continued)

(Annually)

- Note the mass transducer has a separate serial number that should be recorded along with the date when the last K0 audit was performed. The mass transducer must have a K0 audit performed annually as recommended by the manufacturer to be used for collecting respirable coal mine dust samples

Tilt Sensor Audit

The tilt sensor must be audited once per year or as necessary.

Tilt Sensor Audit Steps

(Annually)

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.



Tilt Sensor Audit Steps

(Continued)

(Annually)

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 (Display facing up). Place on a vibration-free table and support instrument so it does not move during test.



Tilt Sensor Audit Steps

(Continued)

(Annually)

5. When prompted, position the instrument on the right side (mass transducer) as shown.



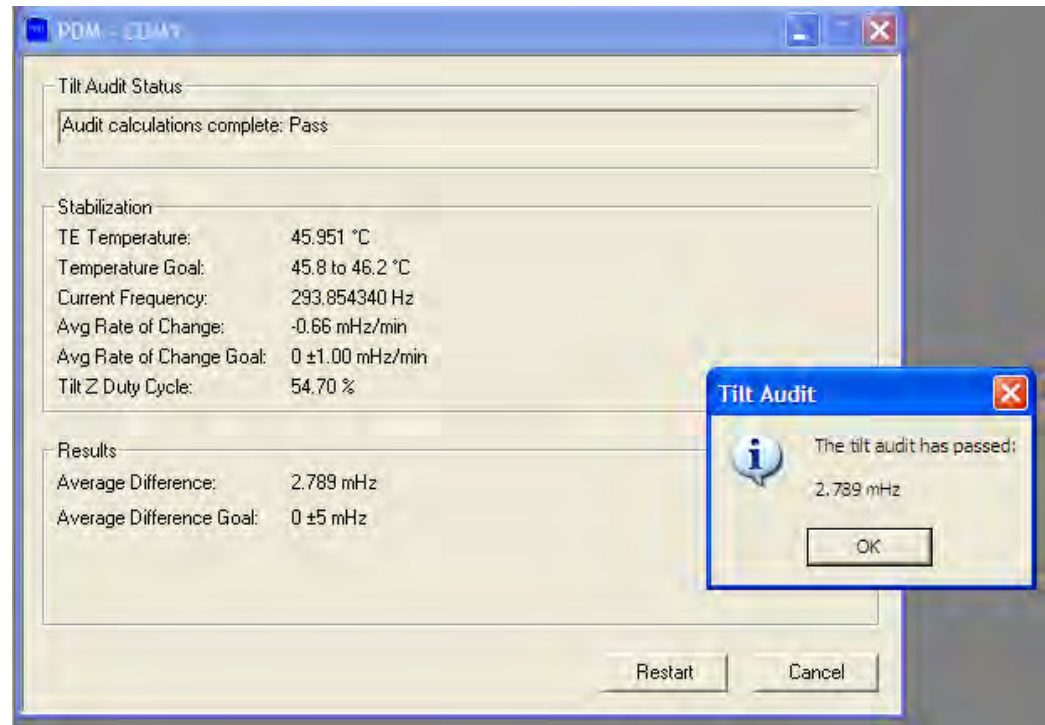
Step 5: Right Side

NOTE: In WinPDM Versions 7.5 and above, the battery connector side is excluded from the tilt audit.

Tilt Sensor Audit Steps

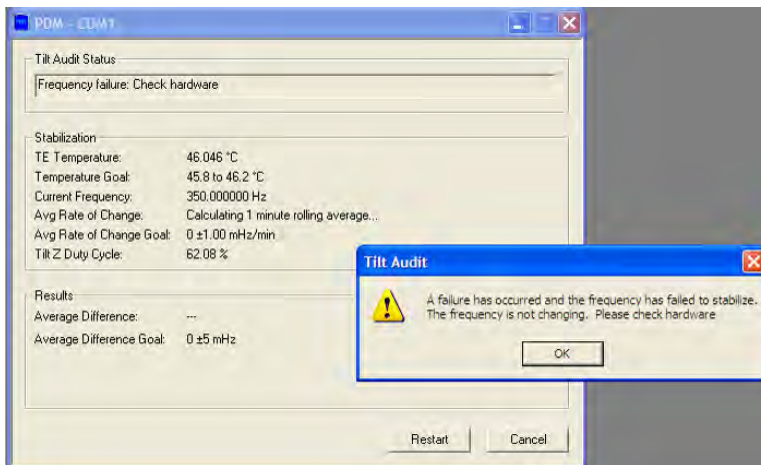
(Continued)

6. When complete, the computer will indicate a pass or fail status.



Tilt Sensor Audit Steps

(Continued)



If the Tilt Audit fails make sure the PDM is held stable and make sure there was a filter installed in the mass transducer. Retest if the audit initially fails.

PDM Periodic Maintenance and Related Tasks

Periodic Maintenance and Related Tasks

- In addition to regularly scheduled maintenance, the unit may require other maintenance, including:
 - Replacing the battery pack
 - Replacing the Pump
 - Lubricating Mass Transducer O-Rings
 - Flow Calibration (Previously covered in PDM Flow Audit, Leak Check, and Calibration section)

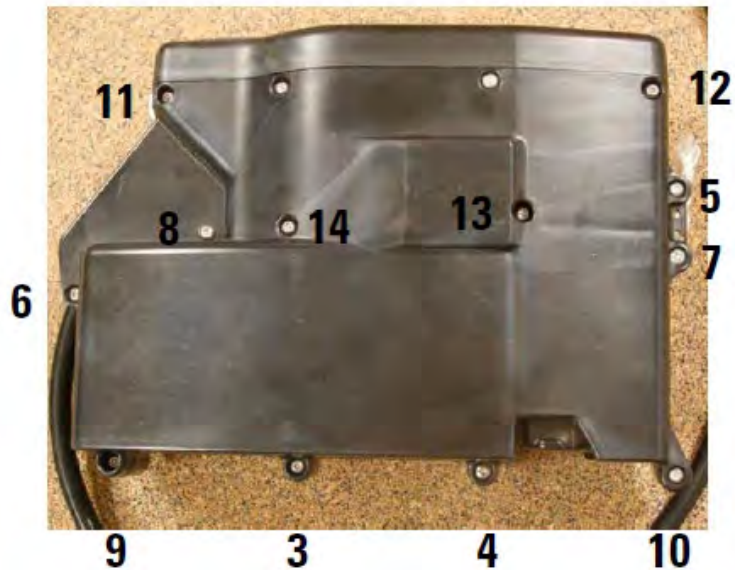
Opening PDM3700 Case and Removing the Cover Panel

Some of the maintenance procedures require the user to open the case and remove the front cover panel of the PDM case.

1. Remove the mass transducer from the PDM3700 unit and place it on a flat surface so that the front is accessible.
2. Using the Phillips screwdriver, remove the screw from location 12 first(next slide). 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.
3. Remove the cover panel.

Opening PDM3700 Case and Removing the Cover Panel

(Continued)



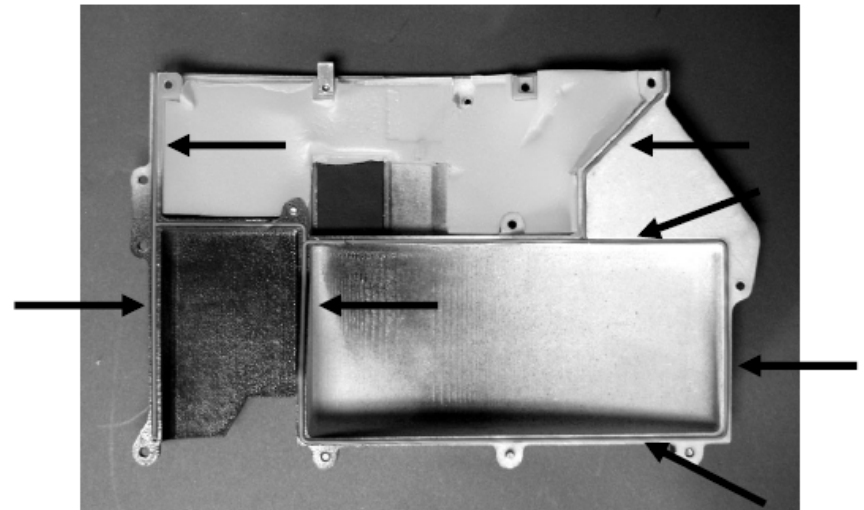
Cover Panel Screws



Top Display Screws

Installing PDM3700 Cover Panel

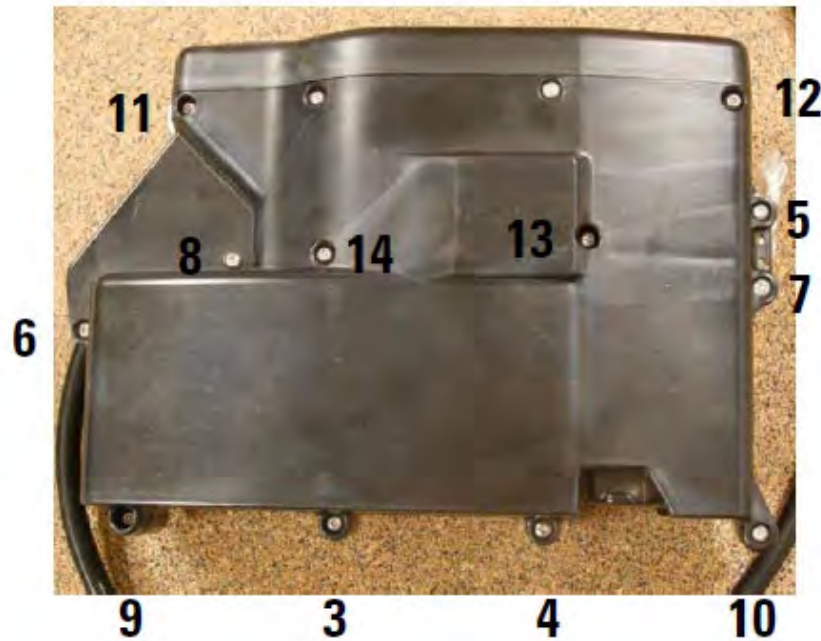
1. Inspect the gasket and sealing surface to ensure they are clean and free of defects. Replace the gasket, if necessary. Install the gasket.
2. Install the front cover onto the PDM3700 case. Ensure that the two screw holes on the top of the cover panel are aligned with the screw holes on the top of the PDM3700.
3. Verify that all portions of the cover panel gasket are seated properly.



Cover gasket checkpoints

Installing the PDM3700 Cover Panel

(Continued)

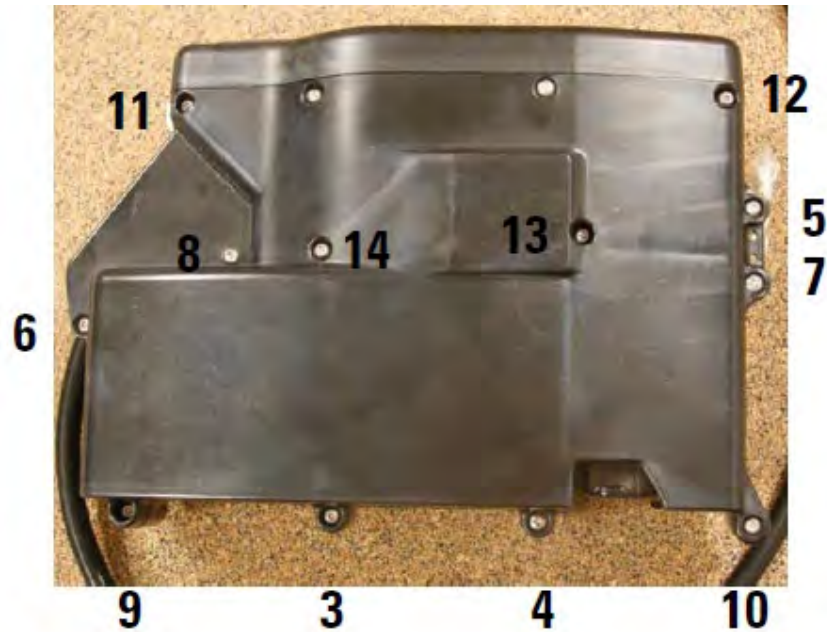


4. Install the screws in locations 1 and then 2 and tighten until snug. Do not overtighten. These will be tightened to the proper torque specification at a later step. Press down on back of cover panel, aligning holes 3 and 4. Put a screw into either location 3 or 4 and again, tighten until snug. Torque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

Installing the PDM3700 Cover Panel

(Continued)

5. Install the remaining screws into the cover panel to get them started in numerical order (a cross-pattern) as shown. Then, tighten until seated in numerical order (a cross-pattern) as shown. Finally, torque the screws to 6-in. lbs in numerical order (a cross-pattern) as shown.
6. Perform a sample path and case leak check*.



*Manual needs revised

Replacing the Battery Pack

1. Remove the PDM3700 cover panel (Opening PDM3700 Case and Removing the Cover Panel).
2. Locate the battery pack assembly in the bottom of the unit.
3. Carefully remove the battery pack “A” from the PDM3700 unit. Press the small tab on the wire connection to disconnect the battery wires.
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 mass transducer O-rings and lubricate them if necessary (refer to Lubricating the Mass Transducer O-Rings).

Replacing the Battery Pack

(Continued)

7. Install the PDM3700 cover panel (refer to Installing the PDM 3700 Cover Panel).
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.
12. Perform a sample path (line) leak check and a case leak check.

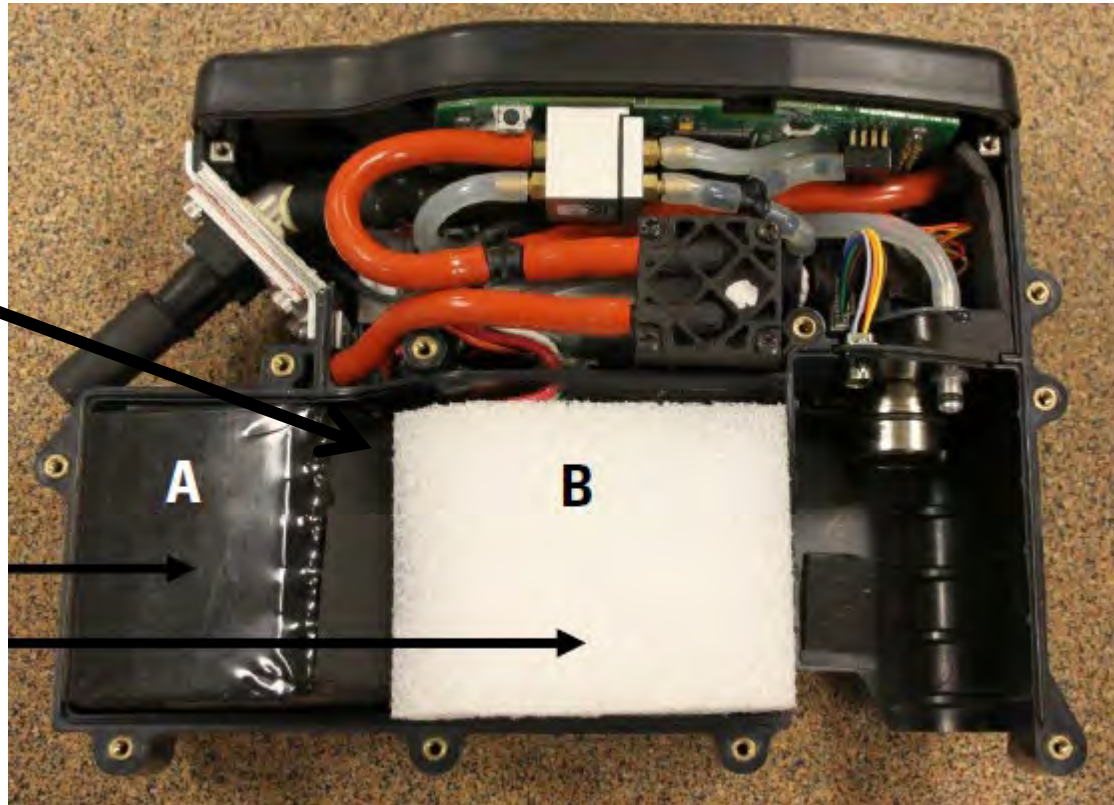
Replacing the Battery Pack

(Continued)

Wire
Connector
(Step 3)

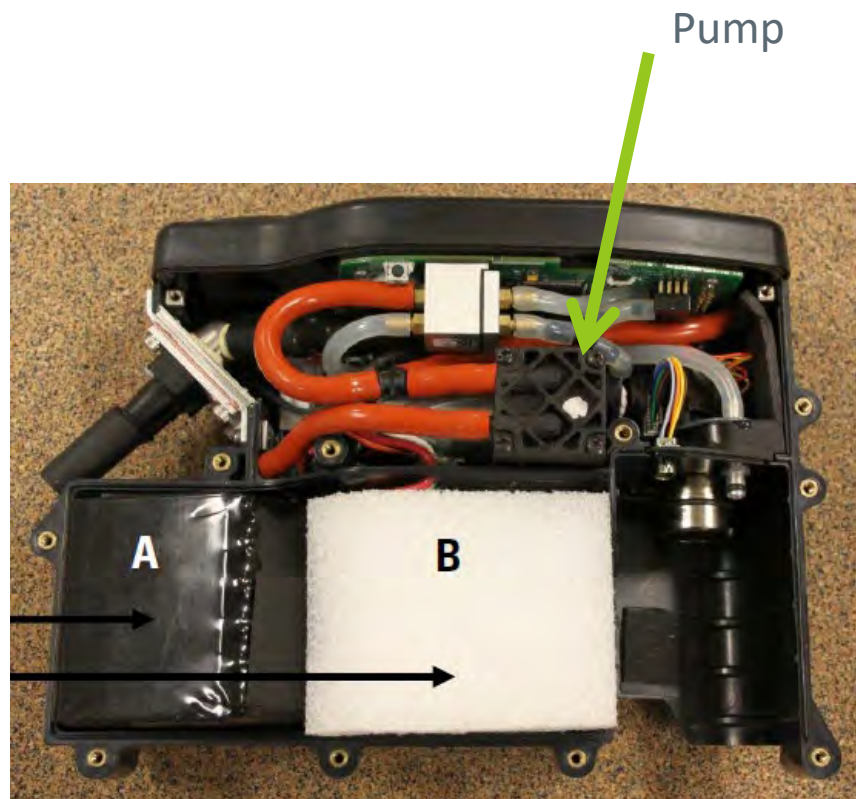
Battery Pack
(Step 2)

Foam Spacer



Replacing the Pump

Contact Thermo Fisher Scientific if the pump needs replaced.



Lubricating Mass Transducer O-Rings

1. Remove the PDM3700 cover panel (refer to “Opening PDM3700 Case and Removing the Cover Panel”).
2. Locate the mass transducer chamber of the PDM3700 and the two O-rings in the top of the chamber.
3. Using the cotton swab, apply the silicone compound to the O-rings.
4. Install the PDM 3700 cover panel (refer to “Installing the PDM 3700 Cover Panel”) and perform a sample path and case leak check*.



*Manual needs revised

MSHA Website

www.msha.gov