FLUKE®
Biomedical

DPM1B

Pneumatic Transducer Tester

Operators Manual

PN 2572314
March 2006

Warranty and Product Support

Fluke Biomedical warrants this instrument against defects in materials and workmanship for one full year from the date of original purchase. During the warranty period, we will repair or, at our option, replace at no charge a product that proves to be defective, provided you return the product, shipping prepaid, to Fluke Biomedical. This warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification by other than Fluke Biomedical. IN NO EVENT SHALL FLUKE BIOMEDICAL BE LIABLE FOR CONSEQUENTIAL DAMAGES.

Only serialized products and their accessory items (those products and items bearing a distinct serial number tag) are covered under this one–year warranty. PHYSICAL DAMAGE CAUSED BY MISUSE OR PHYSICAL ABUSE IS NOT COVERED UNDER THE WARRANTY. Items such as cables and non-serialized modules are not covered under this warranty.

Recalibration of instruments is not covered under the warranty.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state, province to province, or country to country. This warranty is limited to repairing the instrument to Fluke Biomedical's specifications.

Warranty Disclaimer

Should you elect to have your instrument serviced and/or calibrated by someone other than Fluke Biomedical, please be advised that the original warranty covering your product becomes void when the tamper-resistant Quality Seal is removed or broken without proper factory authorization. We strongly recommend, therefore, that you send your instrument to Fluke Biomedical for factory service and calibration, especially during the original warranty period.

Notices

Unpacking and Inspection

Follow standard receiving practices upon receipt of the instrument. Check the shipping carton for damage. If damage is found, stop unpacking the instrument. Notify the carrier and ask for an agent to be present while the instrument is unpacked. There are no special unpacking instructions, but be careful not to damage the instrument when unpacking it. Inspect the instrument for physical damage such as bent or broken parts, dents, or scratches.

Technical Support

For application support or answers to technical questions, either email techservices@flukebiomedical.com or call 1-800- 648-7952 or 1-425-446-6945.

Claims

Our routine method of shipment is via common carrier, FOB origin. Upon delivery, if physical damage is found, retain all packing materials in their original condition and contact the carrier immediately to file a claim. If the instrument is delivered in good physical condition but does not operate within specifications, or if there are any other problems not caused by shipping damage, please contact Fluke Biomedical or your local sales representative.

Standard Terms and Conditions

Refunds and Credits

Please note that only serialized products and their accessory items (i.e., products and items bearing a distinct serial number tag) are eligible for partial refund and/or credit. Nonserialized parts and accessory items (e.g., cables, carrying cases, auxiliary modules, etc.) are not eligible for return or refund. Only products returned within 90 days from the date of original purchase are eligible for refund/credit. In order to receive a partial refund/credit of a product purchase price on a serialized product, the product must not have been damaged by the customer or by the carrier chosen by the customer to return the goods, and the product must be returned complete (meaning with all manuals, cables, accessories, etc.) and in "as new" and resalable condition. Products not returned within 90 days of purchase, or products which are not in "as new" and resalable condition, are not eligible for credit return and will be returned to the customer. The Return Procedure (see below) must be followed to assure prompt refund/credit.

Restocking Charges

Products returned within 30 days of original purchase are subject to a minimum restocking fee of 15 %. Products returned in excess of 30 days after purchase, but prior to 90 days, are subject to a minimum restocking fee of 20 %. Additional charges for damage and/or missing parts and accessories will be applied to all returns.

Return Procedure

All items being returned (including all warranty-claim shipments) must be sent freight-prepaid to our factory location. When you return an instrument to Fluke Biomedical, we recommend using United Parcel Service, Federal Express, or Air Parcel Post. We also recommend that you insure your shipment for its actual replacement cost. Fluke Biomedical will not be responsible for lost shipments or instruments that are received in damaged condition due to improper packaging or handling.

Use the original carton and packaging material for shipment. If they are not available, we recommend the following guide for repackaging:

- Use a double–walled carton of sufficient strength for the weight being shipped.
- Use heavy paper or cardboard to protect all instrument surfaces. Use nonabrasive material around all projecting parts.
- Use at least four inches of tightly packed, industry-approved, shock-absorbent material around the instrument.

Returns for partial refund/credit:

Every product returned for refund/credit must be accompanied by a Return Material Authorization (RMA) number, obtained from our Order Entry Group at 1-800-648-7952 or 1-425-446-6945.

Repair and calibration:

To find the nearest service center, goto www.flukebiomedical.com/service or

In the U.S.A.:
Cleveland Calibration Lab
Tel: 1-800-850-4606
Email: globalcal@flukebiomedical.com

Everett Calibration Lab
Tel: 1-800-850-4606
Email: service.status@fluke.com

In Europe, Middle East, and Africa:
Eindhoven Calibration Lab
Tel: +31-402-675300
Email: ServiceDesk@fluke.com

In Asia:
Everett Calibration Lab
Tel: +425-446-6945
Email: service.international@fluke.com

Certification

This instrument was thoroughly tested and inspected. It was found to meet Fluke Biomedical's manufacturing specifications when it was shipped from the factory. Calibration measurements are traceable to the National Institute of Standards and Technology (NIST). Devices for which there are no NIST calibration standards are measured against in-house performance standards using accepted test procedures.

WARNING

Unauthorized user modifications or application beyond the published specifications may result in electrical shock hazards or improper operation. Fluke Biomedical will not be responsible for any injuries sustained due to unauthorized equipment modifications.

Restrictions and Liabilities

Information in this document is subject to change and does not represent a commitment by Fluke Biomedical. Changes made to the information in this document will be incorporated in new editions of the publication. No responsibility is assumed by Fluke Biomedical for the use or reliability of software or equipment that is not supplied by Fluke Biomedical, or by its affiliated dealers.

Manufacturing Location

The DPM1B Pneumatic Pressure Transducer is manufactured in Everett, WA, U.S.A.

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DPM1B Pneumatic Transducer Tester

Introduction

This document is the Operators manual for the DPM1B Pneumatic Transducer Tester (hereafter "the Tester"). It contains general information about the Tester, a description of its components and instructions or documentation required to service the unit. If a problem develops, the user should contact Fluke Biomedical. **The user should never attempt to service the unit before consulting with Fluke Biomedical service personnel.**

Safety

The Tester draws only 7 mA of current during operation; however, it is often connected to electrical equipment. Follow the manufacturer's electrical safety guidelines for equipment attached to the Tester.

⚠Caution

To avoid possible damage to the Tester:

- **Do not connect Tester to a sterile environment unless a new sterile filter is used.**
- **Do not allow any liquid into the pressure port of the transducer. Use the provided filter between the Tester and liquid.**

Manual Objectives

- Information about the design of the the Tester to enable the user to understand its use.
- Detailed guidance for maintaining and storing the unit.
- Procedures for setting up and operating the Tester.

Summary of Features

The Tester is a hand-held pressure measuring device, designed as an aid in the performance testing and troubleshooting of pneumatic or hydraulic systems. A liquid crystal display (LCD) reading indicates pressures manually generated from an internal chamber.

Testing blood pressure transducers is easy: Simply connect a BP transducer to the luer lock fitting on the Tester and create any series of pressures between ±300 mmHg. Pressures can then be compared directly between the Tester and the manometer or monitors under test.

The Tester has the following features:

- Easy-to-read liquid crystal display (LCD)
- Capable of measuring and generating positive and negative pressures
- Lightweight and portable
- Operates with air or liquid
- An easily accessible knob for zeroing the unit
- LO BAT displayed on the LCD when the battery is low. The batteries can be accessed and replaced externally

Applications

Many hospital and laboratory instruments measure pressure for diagnostic purposes. Mercury and water manometers, sphygmomanometers, and blood pressure monitors are some of these devices. Maintenance and calibration of these instruments requires a device capable of both generating and measuring pressure. The Tester was designed to fit this requirement, particularly in the area of blood pressure transducers.

The Tester was designed to improve and simplify the measurements necessary for determining the accuracy of any direct blood pressure monitoring system. Vacuum (negative) and positive pressures from -300 to +300 mmHg can be generated within the Tester and applied to a system under test. The pressure delivered by the pneumatic transducer tester is indicated on a liquid crystal display for quick comparison to the monitor.

The accuracy of mercury or water manometers can be verified with the Tester. Pressures can be applied simultaneously to the manometer to be tested and the

Tester using a Y-connector. Pressure is applied to the system as normal, usually with a squeeze bulb. The results can be compared between the Tester and the manometer under test.

Testing Capabilities

Verifying the proper operation of a blood pressure transducer can be a tedious and time-consuming task. Usually a mercury or water manometer is used to generate known values of pressure while the transducer's response is monitored. A malfunctioning transducer shows up when comparing the output of the manometer versus the output of the transducer. Unfortunately, manometers can add significant errors themselves, because of the difficulty in interpreting the liquid level in the column. This affects the calibration of and subsequent determination of the liquid height.

The critical nature of invasive blood pressure measurement requires a properly calibrated monitoring system capable of linear operation over a wide range of pressure levels. Pressures at the catheter tip should be accurately transmitted through the connective tubing and stopcocks to the transducer-sensing diaphragm. In a properly operating system, distention of the diaphragm will generate an output voltage proportional to the applied pressure. Occasionally, one or more of the elements involved in this process will malfunction causing inaccurate indications of blood pressure on the monitor. Very often these errors can be attributed to a transducer with a nonlinear response or shifted sensitivity.

Specifications

Pressure Measurement Range	±300 mmHg
Pressure Generation Range	±300 mmHg
Accuracy	±1 % of reading or ±1 mmHg (Whichever is greater)
Temperature Performance	
Operating	10 ° to 40 °C 50 ° to 104 °F
Storage	-20 ° -to 60 °C -4 ° to 140 °F
Overpressure	Not to exceed 1000 mmHg
Voltage Requirements	One 9 V alkaline battery
Battery Life	60 hours continuous use

Display	0.5 " (1.3 cm) LCD with LO BAT indicator
Dimensions	5.8 " x 3.6 " x 1.5 " (14.6 cm x 15.9 cm x 3.8 cm)
Weight	10 oz. (260 g)

Tester Familiarization

The Tester incorporates a highly accurate digital pressure meter and pneumatic pressure-generating cylinder into a small, hand-held package for determining the accuracy of most blood pressure measurement systems.

Front Panel

The Tester incorporates a specially designed pressure cylinder and precise solid-state transducer for generating and measuring static pressure from -300 to +300 mmHg. The following items are identified in Fgure 1:

- ON/OFF Switch: Used to power the Tester.
- Thumbwheel: Used to regulate the pressure and pressure value displayed on the LCD.
- Luer Lock: Built-in to provide the external connection for stopcocks or pressure fittings.
- ZERO Knob: Adjusts LCD reading to zero.
- Liquid Crystal Display (LCD): Illuminated when the Tester is powered. Displays LO BAT when batteries are low.

Note

When the Tester is first powered ON, the display may take a few seconds to settle to zero.

Back Panel

The back panel of the Tester houses the storage compartment for the 9V alkaline battery.

Accessories

Table 1. Accessories

Accessory	Fluke Part #
DPM1B Operators Manual	2572314
Acrodisc Filter	2212678
4-way stopcock	2242666

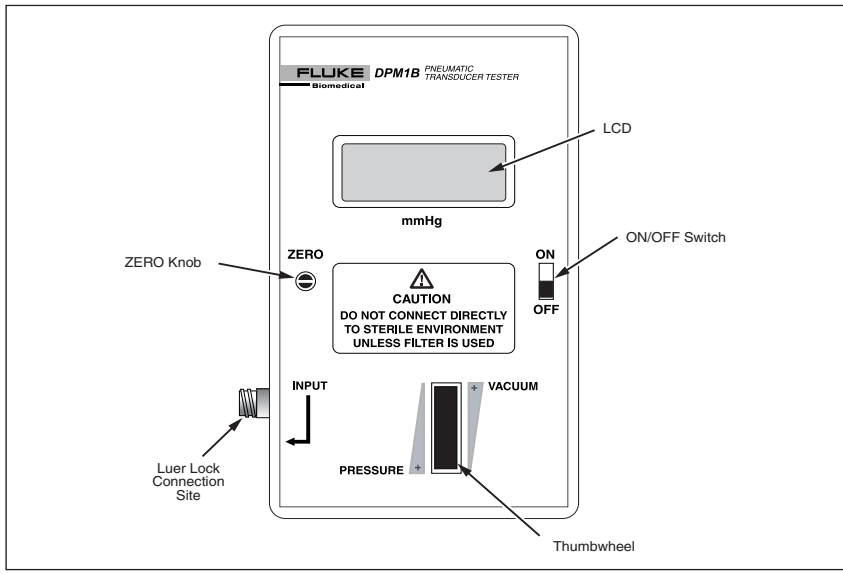

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Figure 1. DPM1B Front Panel

Operation Overview

When operating according to the instructions given in this section, the Tester produces and displays a pressure for comparison to the displayed pressure on the monitor the blood pressure transducer under test is connected to. A conversion table is found in *Multiplication Factor* section that quickly provides the multiplication factors to compare various units of measure.

Operating the DPM1B

Occasionally a blood pressure transducer under test may not have the sensitivity specified by the manufacturer of the monitor the transducer under test is connected to. By matching gain adjustments on the monitor, deviations in sensitivity can usually be compensated for. A transducer that is not performing as specified, however, could have other problems, and sensitivity measurements can be an early indication of performance deterioration.

Setup

1. Connect the Tester transducer, monitor, and 2 stopcocks as shown in Figure 2.

Note

The stopcock connecting the Tester to the transducer is used to vent the system to the atmosphere. The other stopcock is used to fill the transducer dome with liquid.

2. Ensure that the testing medium is homogeneous before beginning any test. The transducer testing can be accomplished using either an air or liquid-fill system.

Note

Do not mix air and liquid in any part of the system; inaccurate readings could result.

⚠Caution

To avoid damage to the Tester, do not allow any liquid into the pressure port of the transducer. Use the filter provided between the liquid and the Tester.

⚠Caution

Do not connect the Tester to a sterile environment unless a new sterile filter is used.

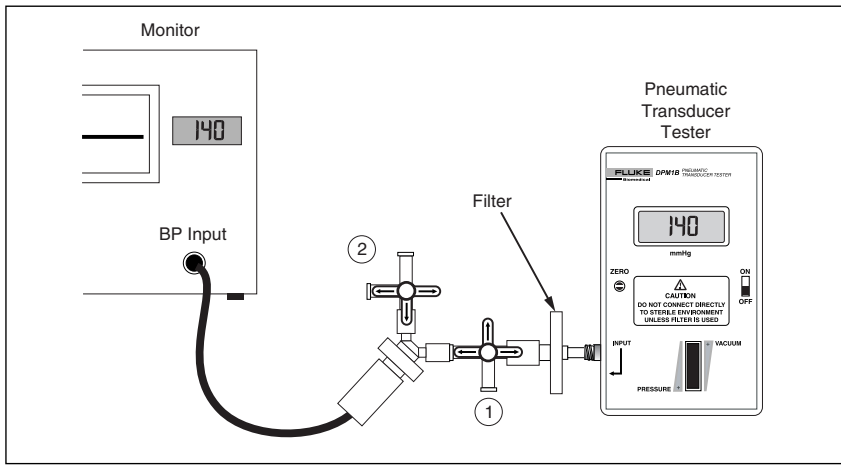

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Figure 2. DPM1B to Monitor Setup

3. When the system is to be filled with liquid, position Stopcock 1 as shown in Figure 2.
4. Attach a liquid-filled syringe to the top port of Stopcock 2.
5. Position the valve on Stopcock 2 so that the syringe can be used to fill the system with liquids. (Turn the valve on the stopcock so that the two opposing end arrows point straight up and down and the middle arrow points toward the Tester, as depicted in Figure 2.)
6. After filling the system, position both Stopcocks as shown in Figure 2.
7. Remove syringe from top part of Stopcock 2.

Proceed to the section labeled *Zeroing the Monitor*.

Zeroing the Monitor and Tester

Properly zeroing the measurement system is important to accurately determine transducer sensitivity.

1. Position the valve on Stopcock 1 as shown in Figure 4.
2. Press the **ZERO** or **BALANCE** control on the monitor.
3. Turn the Tester **ON** using the **ON/OFF** switch on the front panel.

Note

Allow approximately 3 minutes warm-up time before taking readings; this allows the electronics to stabilize in the Tester.

4. Zero the Tester by turning the **ZERO** knob on the front panel of the Tester (See Figure 1 for location of **ZERO** knob).
5. When the monitor has zeroed, reposition the valve of the stopcock as shown in Figure 3.

Pressure Measurement

1. Position the stopcock as shown in Figure 4.
2. Move the thumbwheel of the Tester to change the static pressure generated. See Figure 1 for location of thumbwheel. The thumbwheel is rotated down for positive pressure or up for vacuum pressures.
3. Observe the LCD.
4. Compare the LCD reading on the Tester to the monitor reading to determine the accuracy of the measurement system.

Note

If the system appears to be losing pressure, carefully check all fittings and connections.

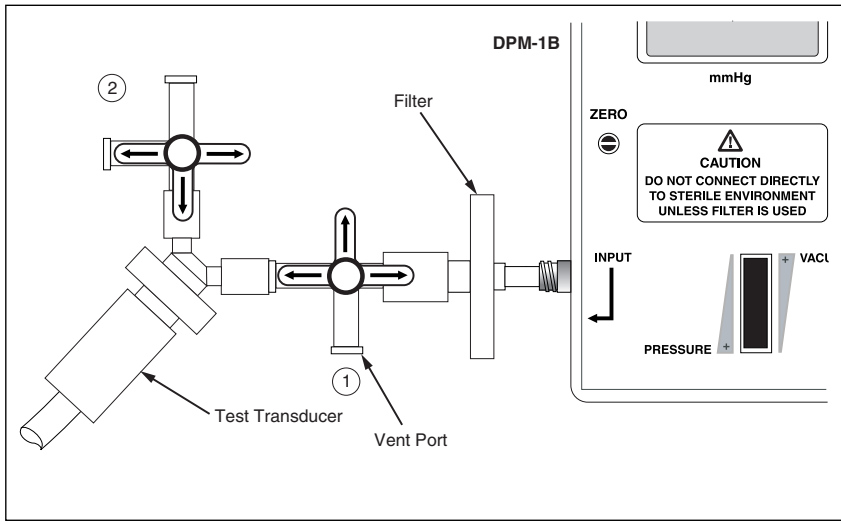

Figure 3. DPM1B Vented to Atmosphere

To interpret the results, proceed to the following three sections:

- Testing Transducer Linearity
- Transducer Sensitivity Test
- Testing Other Devices

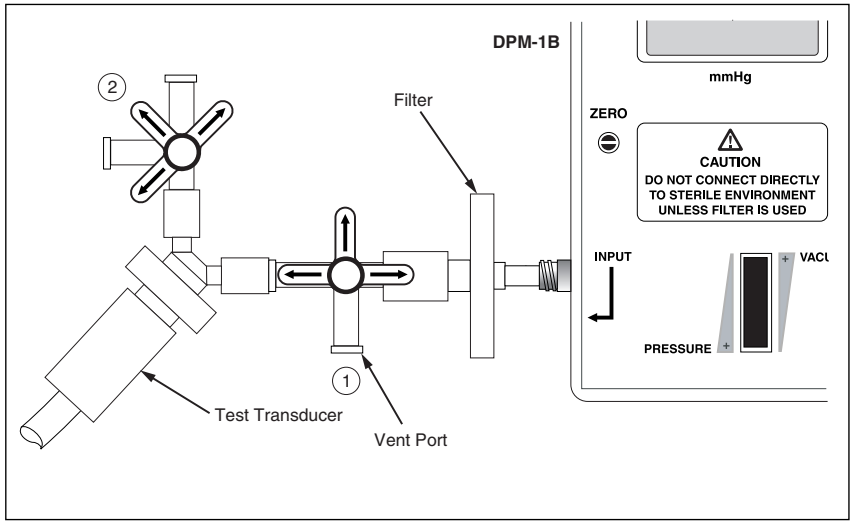

Figure 4. DPM1B Configured to Apply Pressure to Transducer

Testing Transducer Linearity

Several measurements are required to determine if a transducer is linear over a range of pressure. See Figure 5 for a sample plot of transducer linearity determined by using the Tester Pneumatic Transducer Tester.

1. Test the transducer for linear operation in the range of +20 to +190 mmHg, for example, by taking measurements in increments of 10 mmHg from 20 mmHg to 190 mmHg (as depicted in Figure 5).
2. Plot the resulting pressures by placing the Tester readings in one axis and the monitor readings in the other axis.
3. Draw a line through the plotted points. A straight line indicates that the transducer operates linearly; a curved line indicates that the transducer operates nonlinearly.
4. Compare the actual pressure measurements with the transducer manufacturer's specifications for linear operation.

Transducer Sensitivity Test

Only one measurement is required to determine whether or not a transducer under test meets the manufacturer's specified sensitivity. The Tester is used to generate a known pressure (generally 100 mmHg or higher works best). The excitation voltage of the transducer is determined from the manufacturer's specifications. Transducer sensitivity is calculated as follows:

1. Apply 100 mmHg to the transducer as indicated by the Tester LCD reading.
2. Record the pressure registered on the pressure monitor
3. Calculate the minimum and maximum pressure readings by using the transducer's sensitivity tolerance specifications.

   For example: For a 100 mmHg applied pressure with a 1% tolerance, the minimum and maximum readings are 99 mmHg and 101 mmHg, respectively.
4. Compare the readings from Step 2, along with the results from Step 3. If the readings from Step 2 are within the range calculated in Step 3, the transducer is within the manufacturer's specifications.

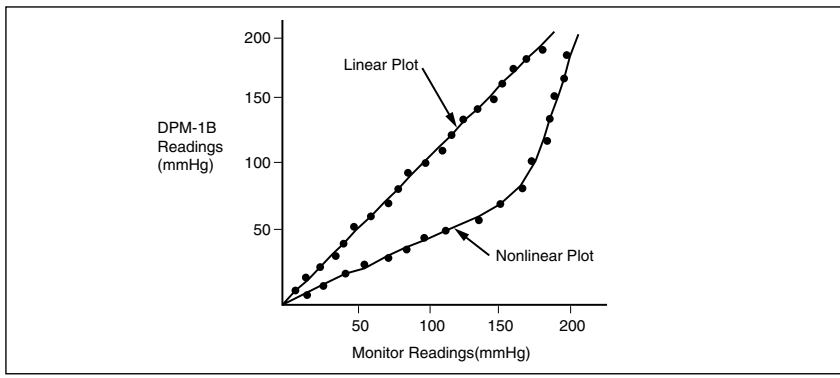

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Figure 5. Sample Plot of Transducer Linearity Using the DPM1B

Testing Other Devices

A variety of pressure-measuring and pressure-generating devices can be tested using the Tester. The Tester can be used as a pressure standard to easily test water manometers, mercury manometers, and sphygmomanometers.

Set up the system as described in the section titled *Pressure Measurement*. Substitute the system to be tested for the transducer.

Use the Tester to measure pressure only. The Tester is not designed to generate the high pressures required by some of these instruments.

Multiplication Factors

Table 2. Multiplication Factors

from / *to*	PSI lb/in^2	in Hg @0 °C	in H_20 @20 °C	mmHg @0 °C	mm H_20 @4 °C	ATM	TORR
PSI lb/in^2	1	0.49118	3.6062 $\times10^{-2}$	1.9337 $\times10^{-2}$	1.4223 $\times10^{-3}$	14.696	1.9337 $\times10^{-2}$
in Hg @0 °C	2.0359	1	7.3419 $\times10^{-2}$	3.9368 $\times10^{-2}$	2.8959 $\times10^{-3}$	29.920	3.9368 $\times10^{-2}$
in H_20 @20 °C	27.73	13.620	1	0.53622	3.9440 $\times10^{-2}$	407.52	0.53622
mmHg @0 °C	51.714	25.401	1.8649	1	7.3558 $\times10^{-2}$	760.00	1
mm H_20 @4 °C	703.05	345.32	25.353	13.595	1	1.0332 $\times10^{4}$	13.595
ATM	6.8045 $\times10^{-2}$	3.3422 $\times10^{-2}$	2.4538 $\times10^{-3}$	1.3158 $\times10^{-3}$	9.6788 $\times10^{-5}$	1	1.3158 $\times10^{-3}$
TORR	51.714	25.401	1.8649	1	7.3558 $\times10^{-2}$	760.00	1

Maintenance

Cleaning Outside Surfaces

The DPM1B outside surfaces can be cleaned with a cloth dampened with water and mild detergent or alcohol.

Battery Replacement

The battery compartment of the Tester is found in the rear panel of the tester. Slide the compartment cover to expose the battery holder. Replace with one 9 volt alkaline battery.