4

Performance Verification and Safety Tests

This chapter describes the tests and inspections required to verify performance of the PageWriter Touch cardiograph following a service event.

This chapter includes the following information:

Required Testing Levels

The Performance Verification Tests verifies proper operation of the cardiograph following a service event. The level of testing required corresponds to the type of service performed.

NOTE   Installation and Preventive Maintenance are not considered service events since the cardiograph is designed to be installed and maintained by the user. Service Events are divided into two categories: Repairs and Upgrades. Repairs are then further divided into External repairs and Internal repairs.

External Repairs

External repairs consist of repairs or replacements of one or more items. Repair or replacement of these items does not require you to open the cardiograph case, therefore only a limited number of tests are necessary to verify performance post-repair. External repairs that involve the PIM, PIM data cable, and PIM lead set require an ECG simulation test to verify proper ECG signal path.

The typical external repairs include:

- PIM
- Patient leads
- PIM data cable
- Labels
- Batteries
- Paper tray
- AC power cord
- Main fuse (in power entry assembly)
- PCMCIA card
- PCMCIA modem
- Barcode reader
- Cart
- External cables

Refer to Table 4-1 for the required test blocks that must be performed after any external repair occurs.

Internal Repairs

If the case was opened, regardless of the repair, you must perform additional Performance Verification Tests. Refer to Table 4-1 for the required test blocks that must be performed after any internal repair.

Upgrades

Most cardiograph upgrades are installed by the user, and are not considered service events. The only exception is a software upgrade. Refer to Table 4-1 for the required test blocks that must performed after these upgrades.

Table 4-1   Tests Required

Service Event		Test Blocks Required
Repairs	External Repairs not involving the patient module (battery, fuse, labels, or cart).	**1** Visual Inspection **2** Power On test **3** Functional tests specific to components repaired
	External repairs where the cardiograph case is not opened, but involving the patient module, patient lead set, or patient data cable.	**1** Visual Inspection **2** Power On test **3** ECG simulation test **4** Functional tests specific to components repaired
	Internal repairs where the cardiograph case is opened.	**1** Visual Inspection **2** Power On test **3** ECG simulation **4** Safety tests S1, S2, and S3, plus functional tests specific to components repaired
Upgrades	Software Upgrades (via external PCMCIA slot)	**1** Power On test

Test and Inspection Matrix

The following Test and Inspection Matrix describes the various test blocks, expected test results, and what you need to document on the service record.

Table 4-2   Test and Inspection Matrix

Test Block Name	Test or Inspection to Perform	Expected (Passing) Test Results	What to Record on a Service Record
Visual Inspection (V)	■ Perform visual inspection	■ If there is no apparent wear, damage, or corrosion the visual inspection passes	V:P (pass) V:F (fail)
Power On (PO)	■ Power on the unit ■ Watch display for error codes ■ See Chapter 5, "Diagnostics and Troubleshooting" for a list of codes	■ If the display shows the PageWriter Touch splash screen followed by the R/T ECG screen, the Power On test passes	PO:P (pass) PO:F (fail)
Individual Functional Tests	From within Service Mode, the following tests can be run:		
Printer Test (P)	■ Perform Printer Test ■ See "Printer Test" on page 3-30	As described in the test procedure	P:P (pass) P:F (fail)
Diskette Drive Test (FDD)	■ Perform Diskette Drive Test ■ See "Diskette Drive Test (FD)" on page 4-10	If the message **FDD Test Completed. Media Size [*x*] bytes. No Error** appears, where [*x*] is approximately 140000, the Diskette Drive test passes	FDD:P (pass) FDD:F (fail)
Touch Screen Display Test (TD)	■ Perform the Touch Screen and Screen Image tests ■ See "Maintaining the Touch Screen" on page 3-18 and "Screen Test" on page 3-26	As described in the test procedure	TD:P (pass) TD:F (fail)
Keyboard Test (K)	■ Perform the Keyboard test. ■ See "Keyboard Test (K)" on page 4-12	As described in the test procedure	K:P (pass) K:F (fail

Table 4-2   Test and Inspection Matrix *(continued)*

Test Block Name	Test or Inspection to Perform	Expected (Passing) Test Results	What to Record on a Service Record
Modem Test (M)	■ Perform the Modem Test. ■ See "Modem Test (M)" on page 4-13	As described in the test procedure	M:P (pass) M:F (fail)
PC Card Test (PCC)	■ Perform the PC Card Test. ■ See "PC Card Test (PCC)" on page 4-13	If the message **0001 PC Card Test completed. Media Size [*x*] bytes. No Error** appears, and [*x*] is the correct media size, then the PCC test passes	PCC:P (pass) PCC:F (fail)
Barcode Reader Test (BR)	■ Perform the Barcode Test. ■ See "Barcode Reader Test" on page 3-28	As described in the test procedure	BR:P (pass) BR:F (fail)
Magnetic Card Reader Test (MCR)	■ Perform the Magnetic Card Reader Test ■ See "Barcode Reader Test" on page 3-28	As described in the test procedure	MCR:P (pass) MCR:F (fail)
ECG Simulation (ECG)	■ Connect a 12-Lead Patient Simulator to the lead set and print a 12 lead ECG ■ Visually analyze the printout	If there is trace activity in all 12 leads with no notable distortion or noise, and cal pulses of proper duration and amplitude, then the ECG Simulation passes	ECG:P (pass) ECG:F (fail)
Safety (S1)	Protective earth resistance	Maximum impedance $\leq$ 200 milli Ω x1	Example: S1:P/100
Safety (S2)	Equipment leakage current	SF Maximum leakage current $\leq$ 1000 uA	Example: S2:P/999
Safety (S3)	Leads leakage current ■ Source (Normal condition) ■ With Mains on applied part (Single Fault Condition)	$\leq$ 10 uA x1 $\leq$ 50 uA x3	Example: S3:P/5/20

Test Equipment

The following test equipment is required to perform the complete set of Performance Verification tests:

- ECG Simulator

- Electrical Safety Tester

- Software Upgrade Kit (CompactFlash Card with PCMCIA adapter). Order part number 453563479701 through your Philips authorized service parts supplier.

Performance Verification Tests

Visual Inspection (V)

Before beginning the inspection, press the On/Standby button to put the cardiograph in Standby mode, and turn the AC power switch to the off position. Unplug the power cord from the wall outlet. Inspect the cardiograph external surfaces for the following:

- Worn or damaged power cord

- Loose or missing hardware

- Mechanical damage

- Evidence of liquid spill

- Worn printer drive gear

- Worn printer roller

- Corroded or damaged reusable electrodes, if present

- Damaged patient leads

- Dirt/paper residue on the thermal print head

- Frayed or damaged wiring

- Visible touch screen damage

- Replace any damaged or missing items.

- Clean the Patient Interface Module (PIM) and the lead wires as necessary. See "Cardiograph and PIM Cleaning" on page 3-2 for more information.
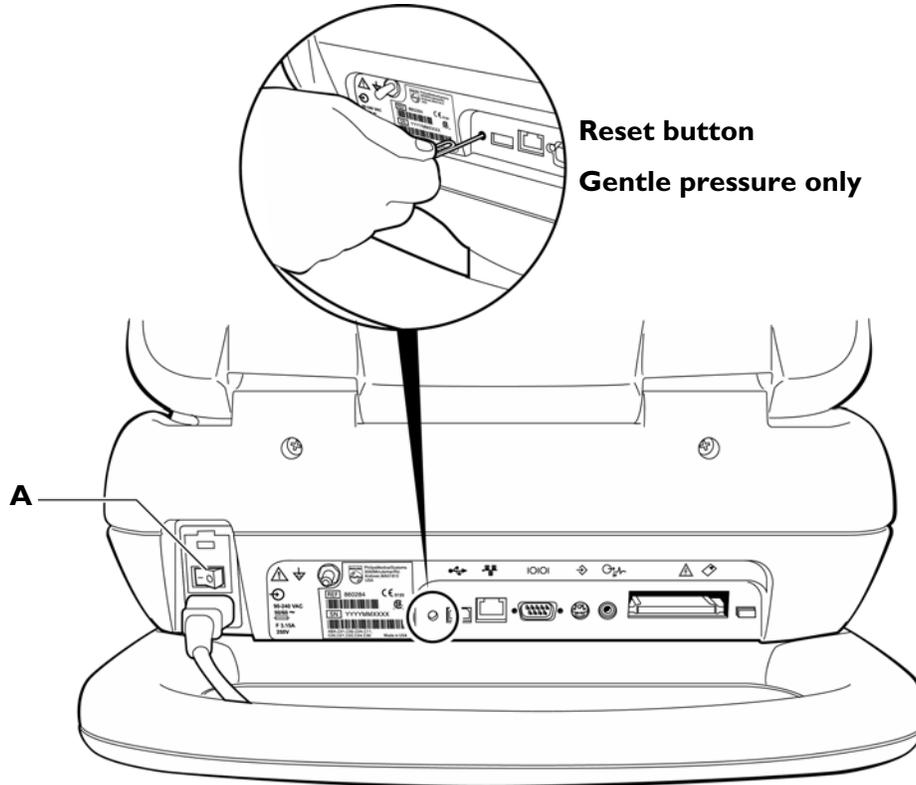
Power On Test

Reboot the cardiograph to process a completed Power On test.

To reboot the cardiograph:

▶ Using a paper clip or other item with a small tip, gently press the Reset button located next to the USB port in the back of the cardiograph. Wait approximately 40 seconds for the cardiograph to reboot.

Figure 4-1   Rebooting the Cardiograph

A AC Power Switch

If the cardiograph does not reboot:

1 Turn the AC power switch to the Off position.

Check that the AC power indicator light (front of the cardiograph) is not lit.

2 Open the battery door and remove both batteries.

3 Wait 40 seconds, then insert both batteries at the same time. Ensure that both batteries are fully seated in the battery compartment.

4 Turn the AC power switch to the On position.

A successful reboot displays the PageWriter Touch software identification screen, followed by the R/T (real-time) ECG screen. If an error code displays during power on, the reboot test failed.

The following self-tests are automatically performed during reboot:

- RAM

- Software CRC Test

- Flash Memory: onboard CompactFlash (CF) and internal CompactFlash (CF)

- PIM Status

- PCMCIA Detect

- AVL/Battery Voltage Test

Individual Functional Tests

The following tests are accessed from the Service Utility. For more detailed information on these tests, see Chapter 5, "Diagnostics and Troubleshooting."

Some basic maintenance tests are available on the Configuration screens under the **Maintenance** tab. For more information on these maintenance tests, see "Maintenance Tests" on page 3-24.

Accessing the Service Utility

To launch the Service Utility:

1 Press the On/Standby button to put the cardiograph in Standby.

NOTE   Entering the Service Utility will require full reboot of cardiograph. Any unsaved patient data will be lost.

2 Perform a soft reset by gently pressing the Reset button adjacent to the USB connector on the rear panel of the cardiograph.

After approximately 40 seconds, the PageWriter Touch software identification screen appears, followed by an audible beep.

3 Quickly, while the splash screen is displayed, press and hold down the left *CTRL* and *SHIFT* keys together and tap the touch screen.

NOTE   The splash screen disappears after five seconds, so if you miss it, you must reset the cardiograph again.

An Access Code window appears. If the Access Code window does not appear, try the left *CTRL-SHIFT-touch* sequence again.

4   Type the access code. Enter the factory default access code **0000** (zeros). The Service Utility screen appears. For more information on the features available in the Service Utility, see "Using the Service Utility" on page 5-2.

Figure 4-2   PageWriter Touch C.01.02 Service Utility Screen

Printer Test (P)

To test the printer

1   From the Service Utility, select **Printer Test** from the **Diagnostic Tests** drop-down list (upper right side of screen).

The Printer Test window appears with the message Printing Test Page.... The printer test page prints

2   Perform steps 5 and 6 of "Printer Test" on page 3-30.

Diskette Drive Test (FD)

The diskette drive test writes and reads from a diskette inserted in the drive. Insert a diskette before you start the test, and verify that the diskette is not write protected.

To test the drive

1   Insert a blank diskette in the cardiograph drive.

2   From the Service Utility, select **Floppy Drive Test** from the **Diagnostic Tests** drop-down list (upper right side of screen).

3   Touch **Start**. If the drive test fails, the message **0001 FDD Test Failed** appears on the screen.

Touch Screen Display Test (TD)

The touch screen display test consists of two separate tests:

- Touch calibration

- Screen test

Complete these tests to verify proper touch screen display performance after repair or replacement of the display assembly.

Touch Calibration

The Touch Calibration tests include: Force Calibration and the Touch Calibration (diagnostic) test. Recommended use of these tests for maintenance and diagnostic purposes is described below.

Table 4-3   Touch Calibration Test Recommendations

Test	Recommended Use...
Force Calibration	- Perform this test first - Routine touch screen calibration when the cardiograph is used in a different setting (seated or standing) or by users of significantly different height - To improve overall touch screen performance when items on the touch screen are difficult to select

Table 4-3   Touch Calibration Test Recommendations *(continued)*

Test	Recommended Use...
Touch Calibration (diagnostic)	■ Perform this test second ■ When calibration is not improved after the Force Calibration test (items are still difficult to select on the touch screen) ■ When the cross hairs on the Force Calibration screen are difficult to select ■ When the results of the touch screen calibration need to be reviewed by Philips Response Center representatives to identify a technical problem

To calibrate the touch screen with the Force Calibration (diagnostic) test:

1   From the Service Utility, select **Screen Test** from the **Diagnostic Tests** pull-down menu (upper right side of screen).

2   Touch **Force Calibration**. A white screen appears with a cross hair.

3   Perform steps 5 and 6 of "Touch Screen Calibration" on page 3-18.

To calibrate the touch screen with the Touch Calibration (diagnostic) test:

1   From the Service Utility, select **Screen Test** from the **Diagnostic Tests** pull-down menu (upper right side of screen).

2   Touch **Touch Calibration**.

3   Perform steps 5 through 8 of "Touch Calibration" on page 3-25.

Screen Test

The Screen Test is used to verify the quality of the color displayed on the touch screen.

To perform the screen test:

1   From the Service Utility, select **Screen Test** from the **Diagnostic Tests** pull-down menu (upper right side of screen).

2   Touch **Screen Test**. A blank gray screen appears.

3   Perform steps 5 through 10 of "Screen Test" on page 3-26.

PIM Test

This test is used to confirm that the Patient Interface Module (PIM) is communicating with the cardiograph. This test can be performed when the cardiograph displays PIM error messages when the PIM patient data cable is securely attached to the RJ-11 receptacle on the right side of the cardiograph.

To perform the PIM test:

1 From the Service Utility, select **PIM Test** from the **Diagnostic Tests** pull-down menu (upper right side of screen).

The PIM Test window appears with the message **Accessing PIM....** The PIM Test results appear in the window.

2 Touch **OK**. If the message **PIM Test Passed** appears, the PIM is communicating properly with the cardiograph.

If the message **PIM Test Failed** appears, it may indicate a problem with the PIM or with the PIM data cable. Contact the nearest Philips Response Center (see page 1-32).

Keyboard Test (K)

To test the keyboard:

1 From the Service Utility, select **Keyboard** from the **Diagnostic Tests** drop-down list (upper right side of screen).

2 Touch **Start**. The Keyboard Test window appears.
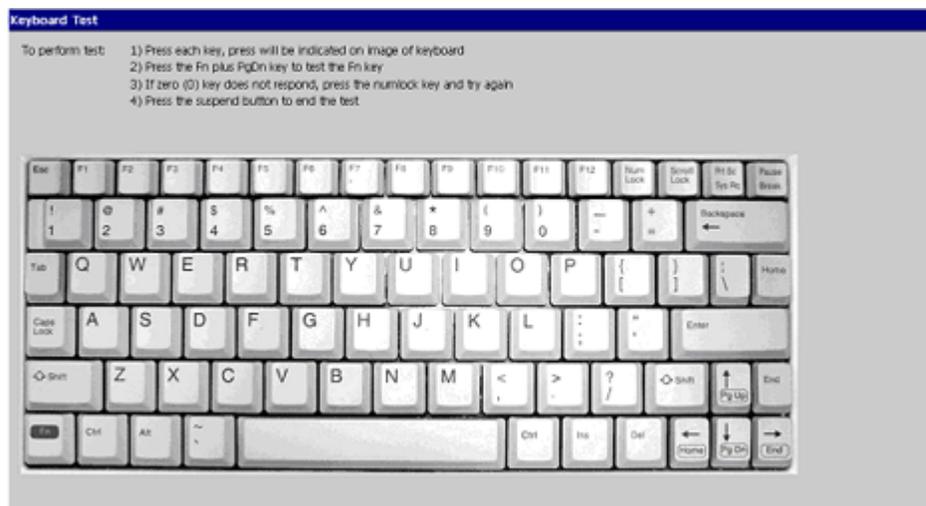
3 Press each key on the keyboard. If a key is highlighted, the key is registered.

NOTE   The keyboard layout displayed on the test screen may be slightly different than the actual cardiograph keyboard.

4 Follow the instructions on the screen to test the *FN* or *ALT* keys.

NOTE   The *Num Lock* key is not functional and will not highlight.

5 After all keys are highlighted, select **Done**.

6   Select **Close**.The test is not successful if one or more keys is not recognized when you press them.

Modem Test (M)

To test the modem:

1   Insert an approved modem card in to the PC card slot located in the back of the cardiograph.

2   From the Service Utility, select **Fax/Modem Test** from the **Diagnostic Tests** drop-down list (upper right side of screen).

3   Touch **Start**. The Modem test performs the following checks to verify if the modem is compatible with the cardiograph:

– Modem recognition

– ROM and firmware verification

The test is not successful if the modem is not properly recognized, or if the ROM or firmware verification fails.

PC Card Test (PCC)

To perform the PC Card test:

1   Insert a blank PC card (CF card with PCMCIA adapter) in the PC slot located in the back of the cardiograph.

2   From the Service Utility, select **PC Card Test** from the **Diagnostic Tests** drop-down list (upper right of screen).

3   Touch **Start**. The cardiograph will detect and report the media size of the card. If the test fails, the message **PC Card Test failed** appears.

USB Drive (Storage) Test

To perform the USB Drive (Storage) test:

1   Insert a blank USB memory stick into the USB connector located on the rear of the cardiograph.

2   From the Service Utility, select **USB Drive (Storage)** from the drop-down list (upper right of screen).

3   Touch **Start**. The cardiograph will detect and report the media size of the inserted stick. If the test fails, the message **USB Drive Test failed** appears.

Barcode Reader Test (BR)

The Barcode Reader test is used with the optional barcode reader. The barcode reader is used to enter Patient ID information by scanning a barcode.

This test can be used to confirm that the barcode reader is accurately scanning barcode data.

For details on performing the test, see "Barcode Reader Test" on page 3-28. For details on calibrating the barcode reader, see "Calibrating the Barcode Reader" on page 3-21.

To test the barcode reader:

1   Plug the optional barcode scanner into the barcode scanner connector ( ) located on the bacj of the cardiograph.

2   From the Service Utility, select **Barcode Reader** from the **Diagnostic Tests** drop-down list (upper right side of screen).

3   Touch **Start**. The cardiograph prompts the user to scan a test barcode pattern. Any barcode can be used for this test.

4   Perform steps 5 through 8 of "Barcode Reader Test" on page 3-28.

5   Compare the text displayed on the screen to the actual text beneath the barcode.

A failed test is one in which the displayed text does not match the actual barcode.

ECG Simulation (ECG)

Taking an ECG using a 12-lead ECG simulator allows you to verify areas of operation that the extended self-test cannot check including:

■   Integrity of the patient leads

■   Accuracy of the paper speed (not available on all simulators)

■   Accuracy of the gain settings (not available on all simulators)

The recorded ECG trace should look similar to the one shown in Figure 4-3. Trace differences may result from differences in simulators, simulators settings, and from differences in configuration and control settings on the cardiograph.

Figure 4-3   Simulated 12-Lead ECG
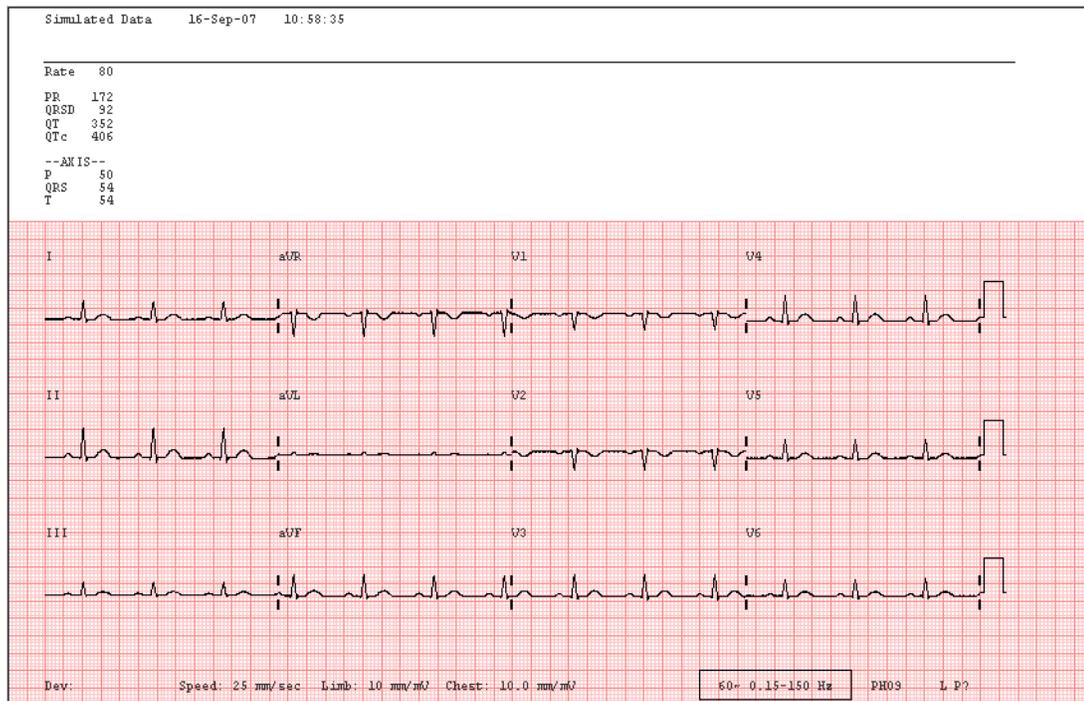
To make a simulated ECG recording:

1   Connect the PIM lead wires to the simulator.

2   Touch the **R/T ECG** button. Verify that all lead wires are connected by observing the display for flat lines.

3   Firmly pull each lead wire tight, and then look for excessive noise on the display (may be indicated by yellow or orange waveforms).

Check the leads map to be sure that an ❌ does not appear next to any electrodes.

Figure 4-4   Lead Off Symbol (Red X)
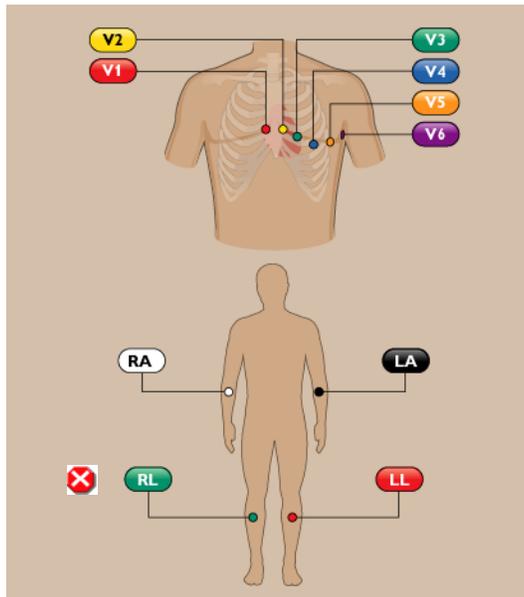
4   Touch the **Auto** button, then **Continue** to print an Auto ECG. Depending on how the cardiograph is configured, the ECG may print automatically, or it may appear on the Preview screen only. Touch the **Print** button on the Preview screen to print the ECG.

5   Verify the following on the printed ECG:

–   Trace activity for all 12 leads. Confirms integrity for all patient electrodes and leadwires. Noise should measure less than one (1) mm, with no baseline wander.

–   No gross distortion of complexes or calibration pulses (for example, no overshoot).

–   Duration for calibration pulses for correct paper speed. With cardiograph set to record at 25 mm/sec, the calibration pulse should measure 5mm (calibration pulse duration is 200 ms).

–   Calibration pulse amplitude is correct.

NOTES   ▪ An arrhythmia simulator is not an acceptable tool for verifying computerized ECG analysis. The analysis software is biased to process human ECG data.

▪ Noise may be an artifact of poor connections to the simulator or position of the cables. If noise appears, check the connectors or adjust the cable drape.
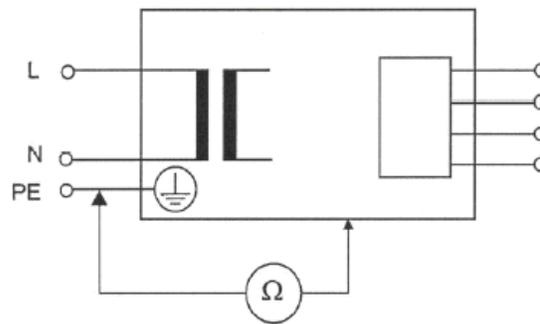
Safety Tests

This section includes tests that verify the electrical safety of the cardiograph.

Test Notes

- Use the recommended procedures specified by the manufacturer of the safety analyzer in use.

- Test both Normal and Reverse polarity line connections for each test, and record the worst-case value.

- If a ground reference point is necessary for the testing, use the metal grounding stud on the back of the cardiograph.

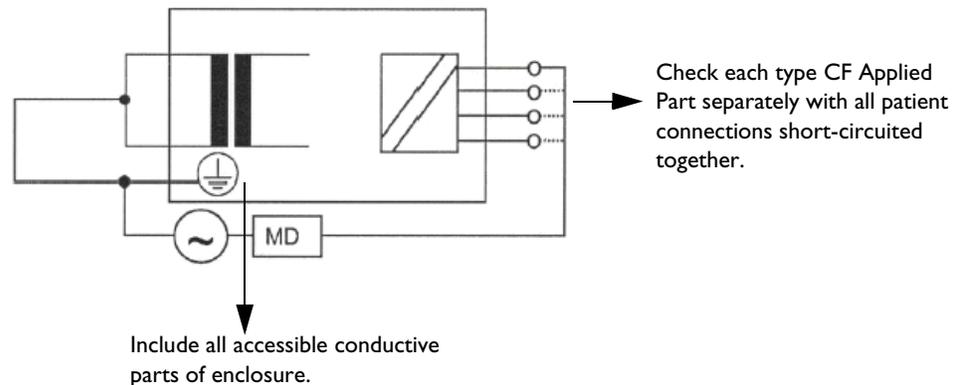## Safety Test S1 - Protective Earth Resistance

- Applicable to Class 1, type B, BF, CF

- Max. resistance = 200 mOhms for instruments with removable powercords

- Current source = 200 mA or greater

- Reference: VDE 0751

Safety Test S2 - Equipment Leakage
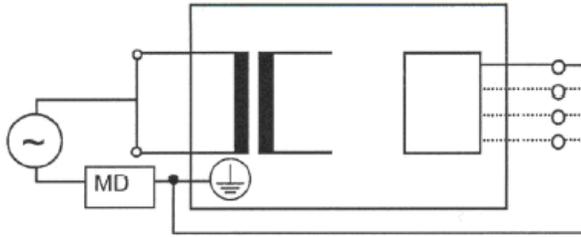
- Applicable to Class 1 and 2, type B, BF, CF.
  - For Class 1: Protective Earth conductor is not connected. S = open. Measure equivalent leakage current to mains part from all Applied Parts and enclosure in parallel. Measures grounded and ungrounded metal parts.
- Maximum leakage current = 1000 uA.
- Reference: VDE 0751.

Safety Test S3 - Leads Leakage Current

Check each type CF Applied Part separately with all patient connections short-circuited together.

Include all accessible conductive parts of enclosure.

CF

- Applicable to Class 1 and 2, type CF
- Measures equivalent leakage current to mains part and enclosure from all Applied Parts in parallel
- Maximum leakage current CF = 50/100 uA. Tested separately (50 uA) or together (100 uA)