Visual Test

To perform the visual test:

Step	
1	Inspect the system for obvious signs of damage. For example, cracks, cuts, or breakage.
2	Check all external cables and accessories for damage. For example, cuts, kinks, or wrong connections.
3	Ensure that all markings and labeling are legible. If the labels on the rear case are not legible, replace the rear case. If the serial number label is not legible, contact the Philips Customer Care Solutions Center or your local Philips representative to return the monitor for label replacement.
4	Check for any obstructions to mechanical parts. Ensure that the vents are free of dust. The expected test result is that the system has no obvious signs of damage or obstruction. **Note —** *Philips employees record this value as V:P or V:F.*

Power-On Self Test

To perform the power-on self test:

Step	
1	Plug the monitor into an AC power source and turn it on.
2	Make sure that the monitor starts up successfully as described in the following sequence: • The screen displays color bars for about five seconds. • The LCD turns off for three seconds, and the Charging LED lights. • The Philips screen appears for one second, and a startup tone sounds. • The main screen appears. **Note —** *If* **Enable New Patient Menu** *is set to* **Yes**, *the* **New Patient Menu** *appears.* The expected result is that the monitor starts up and displays the main (or appropriate) screen. If the LEDs do not function as expected, see “Power Problems” on page 4-3. If the display does not function as expected, see “Power Problems” on page 4-3 or “Display Problems” on page 4-4. If you do not hear a startup tone, or the monitor displays the **Speaker Malfunc** error message, see “Alarm Problems” on page 4-4. **Note —** *Philips employees record this value as PO:P or PO:F.*

Alarms Test

The following procedure tests the monitor's visual and audio alarms.

To perform this test, you need an NBP cuff and hose.

To test the monitor's alarms:

Step	
1	With the monitor turned on, make sure that all alarms are enabled (the monitor is not in Audio Pause or Audio Off mode).
2	Make sure the NBP alarm is enabled (the crossed bell icon does not appear in the NBP numeric pane).
3	Connect the NBP hose to the NBP input connector, but do not place the cuff on your arm.
4	Press the **NBP** key on the front panel.
5	Wait for the NBP module to cycle and check that an NBP error message appears and an alarm tone sounds.
6	If you do not get the results in step 5, see "Alarm Problems" on page 4-4.

SpO_2 Test

This test checks the performance of the SpO_2 measurement.

To perform this test, you need an adult SpO_2 sensor.

To perform the SpO_2 test:

Step	
1	Connect an adult SpO_2 sensor to the SpO_2 connector on the monitor. Ensure that the red LED in the sensor is lit.
2	Connect the other end of the sensor to your finger.
3	Verify that the SpO_2 value displayed on the monitor is between 95% and 100% (this assumes that you are healthy). If it is not, try the test again with a patient simulator.
4	If you still do not get the results in Step 3, see "SpO_2 Measurement Problems" on page 4-7.

Caution **A functional tester cannot be used to assess the accuracy of a pulse oximeter monitor. However, if there is independent demonstration that a particular calibration curve is accurate for the combination of a pulse oximeter monitor and a pulse oximeter sensor, then a functional tester can measure the contribution of a monitor to the total error of a monitor/sensor system. The functional tester can then measure how accurately a particular pulse oximeter monitor is reproducing that calibration curve.**

CO_2 Calibration Test

This test checks the calibration of the Microstream CO_2 gas measurement. The CO_2 calibration test is required after the first 1,200 hours of use or one year, whichever comes sooner. After the first calibration, calibrate after 4,000 hours of continuous use or every year, whichever comes sooner. In addition, perform the calibration tests when the instrument is repaired or when parts are replaced.

Note — Replace the CO_2 module after 20,000 hours of use.

Caution **If the initial calibration is performed before 720 hours of use, the module resets to require the next calibration after 1200 hours instead of after 4000 hours.**

This test uses calibration equipment that you can order. Refer to the documentation accompanying the calibration equipment for more details.

Warning **A monitor that is not calibrated at the recommended intervals may provide inaccurate results.**

Dispose of empty or partially empty calibration gas containers in accordance with the manufacturer's instructions and local regulations.

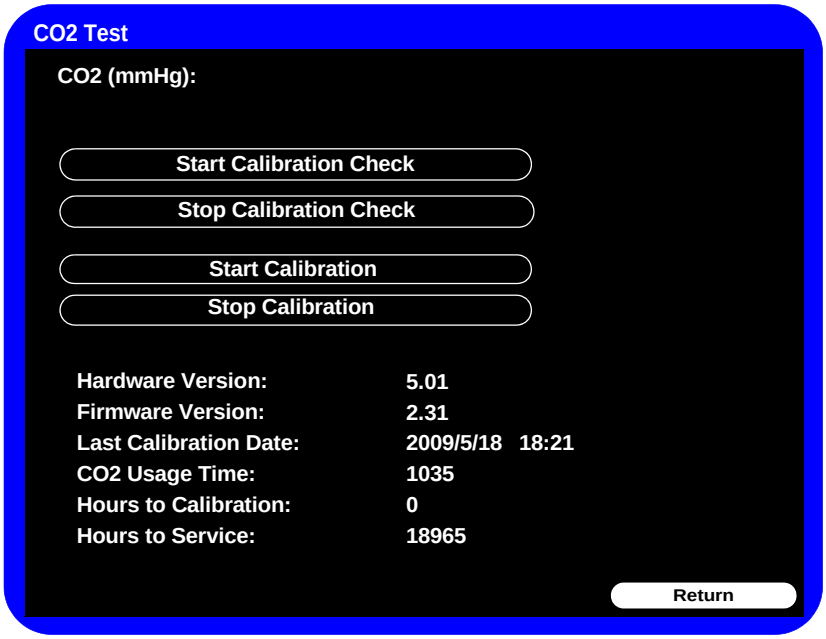
Required Test Equipment

- Electronic flowmeter, M1026-60144
- Gas calibration equipment:
  - Cal 1 gas 15210-64010 (5% CO_2)
  - Cal gas flow regulator M2267A
  - Cal tube 13907A

CO_2 Gas Measurement Calibration Check

To check the calibration of the CO_2 gas measurement:

Step	
1	Ensure that the CO_2 module is not in Standby mode. If necessary, turn on the CO_2 module by opening the **CO2 Waveform Menu** and setting **CO2 Hardware:** to **On**.
2	Open the **Maintenance** options in the **System Diagnostics** menu. See "Accessing the Maintenance Options" on page 3-14.

3	Rotate the wheel to highlight the **CO2 Test** button, and then press the wheel. The **CO2 Test** menu appears. 
4	Connect one end of the sampling line to the CO_2 inlet on the monitor and leave the other end unconnected.
5	In the **CO2 Test** window, rotate the wheel to highlight **Start Calibration Check** and press the wheel. A message to connect the gas to the CO_2 module appears.
6	Connect the other end of the sampling line to the gas controller equipment inlet with a 5% gas concentration.
7	Open the valve on the gas controller equipment to allow 5% CO_2 gas to flow into the monitor.
8	Rotate the wheel to highlight **OK** in the confirmation window and press the wheel to begin checking the calibration. **Note —** *The calibration check can take up to one minute to complete. The monitor checks the calibration and when the calibration check completes, the* **CO2 Test** *window displays a message. For example:* **CO2 calibration check successful. CO2 rate: 5.1.**
9	If the module is not in calibration, an error message appears. Calibrate the module. See “Calibrating the CO_2 Module” on page 3-19.
10	Turn off the flow of gas and rotate the wheel to highlight **Return** in the **CO2 Test** window. Press the wheel to exit the test.

Calibrating the CO_2 Module

Caution **Because the monitor uses the current date and time as the calibration date and time, ensure that the system date and time is set correctly.**

Note — The monitor always displays the CO_2 module's operating (usage) time in the **CO2 Test** window.

To calibrate the CO_2 module:

Note — Do not perform the initial calibration before 720 hours of use. If the initial calibration is performed before 720 hours of use, the module will reset, and then require its next calibration after 1,200 hours, instead of after 4,000 hours.

Step	
1	Connect one end of the sampling line (if not already connected) to the CO_2 inlet on the monitor and leave the other end unconnected.
2	In the **CO2 Test** window, rotate the wheel to highlight **Start Calibration** and press the wheel. A confirmation window appears telling you to connect the gas to the CO_2 module.
3	Connect the other end of the sampling line to the gas controller equipment inlet with a 5% gas concentration.
4	Open the valve on the gas controller equipment to allow 5% CO_2 gas to flow into the monitor.
5	Rotate the wheel to highlight **OK** in the confirmation window and press the wheel to begin calibrating. The monitor begins calibrating the CO_2 module and displays the calibration value when complete. **Note —** *The calibration process can take up to one minute to complete.*
6	Turn off the flow of gas and rotate the wheel to highlight **Return** in the **CO2 Test** window. Press the wheel to exit the test.
7	If the calibration is successful, the **Last Calibration Date** and **Hours to Calibration** in the **CO2 Test** window reset. To check this, re-open the **CO2 Test** window.
8	If the module is not able to calibrate itself, an error message appears. Replace the CO_2 module. See "Removing the SureSigns VM8 SE CO_2 Module" on page 5-10.

ECG/Respiration Performance

This test checks the performance of the ECG and respiration measurements.

To perform this test, you need:

- Patient simulator
- ECG patient cable

To perform the ECG test:

Step	
1	Connect the ECG patient cable to the ECG connector on the side of the monitor.
2	Configure the patient simulator to: • ECG sinus rhythm • HR = 80 bpm, or a rate of your choice
3	Connect the other end of the ECG patient cable to the patient simulator.
4	Verify that the displayed ECG wave and HR value (± 2 bpm) correlate to the values you selected on the patient simulator. For an HR of 80 bpm, the displayed value on the patient monitor should be between 78 – 82 bpm.
5	Redo the test, selecting several heart rates on the patient simulator: 160, 80, 100.
6	If you do not get the expected results, see “ECG/Respiration Measurement Problems” on page 4-8.

To perform the Respiration performance test:

Step	
1	Change the patient simulator configuration to: Respiration rate 40 rpm.
2	Verify that the displayed respiration waveform and respiration rate (± 2 rpm) are the same as the values you selected on the patient monitor: between 38 – 42 rpm.
3	If you do not get the expected results, see “ECG/Respiration Measurement Problems” on page 4-8.

Defib Sync Performance

The Defib Sync performance test checks the performance of ECG synchronization between the monitor and a defibrillator. This test needs to be performed only if this feature is in use as a protocol.

To perform this test, you need:

- Defibrillator with ECG sync cable
- Patient simulator

Note — The Defib Sync port outputs a pulse synchronized to the patient's ECG R wave. The Defib Sync output is not compatible with defibrillators requiring an analog ECG input. If you see a pulse instead of an ECG wave on your defibrillator display, the devices are not compatible.

Warning **To meet AAMI specifications, the peak of the synchronized defibrillator discharge should be delivered within 60 ms of the peak of the R wave. You must verify that your ECG/Defibrillator combination does not exceed the recommended maximum delay of 60 ms.**

Before using the system for cardioversion, ensure that your biomedical engineer tests the monitor and defibrillator together and trains users on the appropriate use of the Defib Sync system.

To test the Defib Sync:

Step	
1	Connect the patient simulator to the ECG connector on the monitor and the defibrillator to the Defib Sync output on the monitor.
2	Set the patient simulator to the following configuration: • HR = 100 bpm • ECG sinus rhythm
3	Turn on the defibrillator and check that the marker pulse is displayed on the defibrillator screen before the T-wave begins.
4	If you do not get the expected results, see “ECG/Respiration Measurement Problems” on page 4-8.

NBP Test

These tests check the performance of the non-invasive blood pressure measurement:

- NBP accuracy
- NBP calibration procedure (if required)
- NBP pneumatic leakage

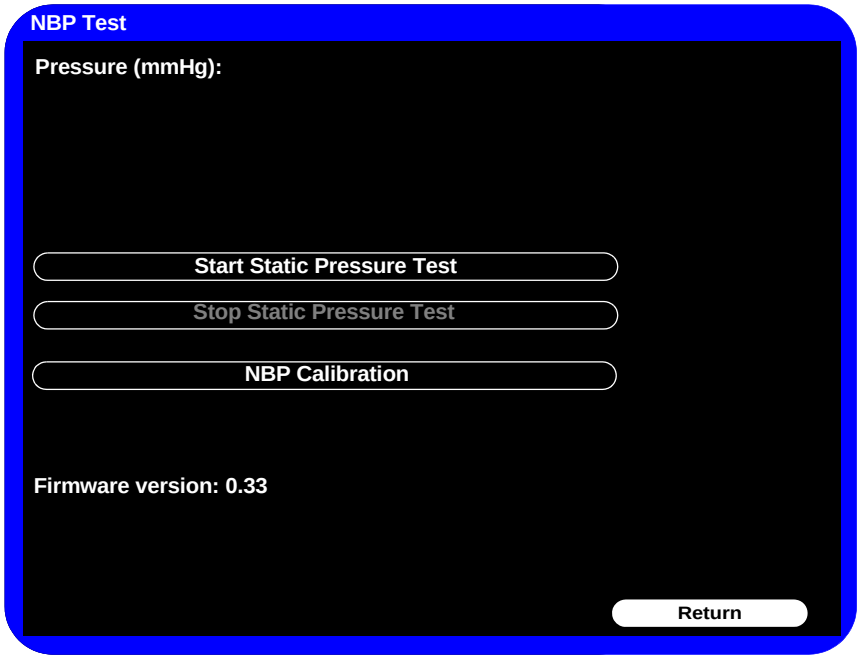
To perform these tests, you need:

- A reference manometer (includes hand pump and valve), accuracy 0.2% of reading
- An expansion chamber (volume 250 ml ± 10%)
- Appropriate tubing

NBP Accuracy

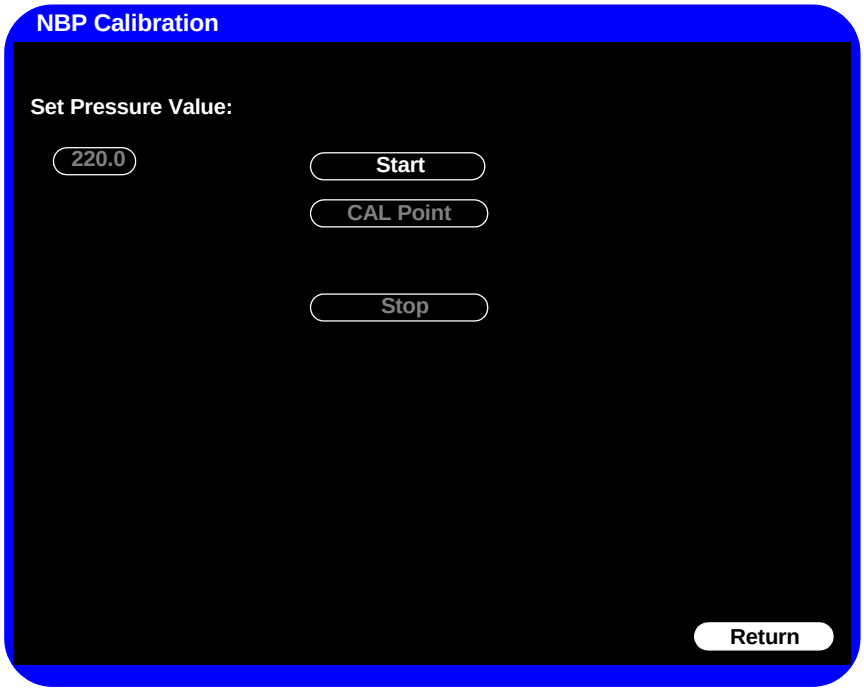
To test the NBP accuracy:

Step	
1	Connect the manometer and the pump with tubing to the NBP connector on the monitor.
2	Connect the tubing to the expansion chamber (250 ml cylinder).  **Expansion chamber** **Manometer** **SureSigns VM Patient Monitor**
3	Open the **Maintenance** options in the **System Diagnostics** menu. See “Accessing the Maintenance Options” on page 3-14.

4	Rotate the wheel to highlight **NBP Test**, and then press the wheel**.** The **NBP Test** window appears. 
5	Rotate the wheel to highlight the **Start Static Pressure Test** button, and then press the wheel to start the test.
6	Squeeze the manometer pump and apply a pressure of 280 mmHg.
7	Wait 10 seconds for the pressure to stabilize. Note the pressure displayed in the **NBP Test** window. It should be 280 mmHg ± 3 mmHg. **Note —** *Philips employees record this value as X1.*
8	Squeeze the manometer pump to apply a pressure of 150 mmHg to the monitor.
9	Wait 10 seconds for the pressure to stabilize. Note the pressure displayed in the **NBP Test** window. It should be 150 mmHg ± 3 mmHg. **Note —** *Philips employees record this value as X2.*
10	Rotate the wheel to highlight **Stop Static Pressure Test**, and then press the wheel.
11	If the difference between the manometer and displayed values is greater than 3 mmHg, calibrate the monitor (see “NBP Calibration Procedure” on page 3-24). If the results are as expected, proceed to the “Pneumatic Leakage Test” on page 3-25.

NBP Calibration Procedure

To calibrate the NBP module:

Step	
1	In the **NBP Test** window, rotate the wheel to highlight **NBP Calibration**, and then press the wheel. **Note —** *To stop the calibration process at any time, rotate the wheel to highlight* **Stop**, *and then press the wheel to stop calibration.* The **NBP Calibration** window appears.  **Note —** *If you are using a manual manometer, close the valve before continuing.*
2	Rotate the wheel to highlight the **Start** button, and then press the wheel to begin calibration. The monitor inflates the expansion chamber and displays the message, **Starting NBP calibration...**
3	Wait until the message, **Ready for calibration pressure point...**, appears.
4	Rotate the wheel to highlight the **Set Pressure Value** field, and then press the wheel.
5	Rotate the wheel until the value matches the value displayed on the manometer (in mmHg). Press the wheel to confirm the change.
6	Rotate the wheel to highlight **CAL Point**, and then press the wheel to save the calibration point.

7	Wait until the message **NBP calibration successful** appears. If the test fails, rotate the wheel to highlight **Stop** button, and then press the wheel to stop the test.
8	Rotate the wheel to highlight the **Return** button, and then press the wheel to exit the test.
9	To verify calibration, check the accuracy of the NBP (see "NBP Accuracy" on page 3-22).
10	If you do not get the expected results after several attempts, see "NBP Problems" on page 4-5.

Pneumatic Leakage Test

To check the pneumatic system and valve:

Step	
1	In the **NBP Test** window, rotate the wheel to highlight the **Start Static Pressure Test** button, and then press the wheel.
2	Squeeze the manometer pump to apply a pressure of 280 mmHg.
3	Wait 10 seconds for the pressure to stabilize. Note the pressure value in the **NBP Test** window. **Note —** *Philips employees record this value as P1.*
4	Wait 60 seconds for the pressure to stabilize. Note the pressure value in the **NBP Test** window. **Note —** *Philips employees record this value as P2.*
5	Calculate and document the leakage test value. The leakage test value should be less than or equal to 6 mmHg. **Note —** *Philips employees record this value as X3 (where X3 = P1 - P2).*
6	Rotate the wheel to highlight the **Stop Static Pressure Test** button, and then press the wheel to stop the process.
7	If the leakage test value exceeds 6 mmHg, check the test setup cuff and tubing, and then test again. If the test still fails, check the pneumatic tubing inside the monitor.
8	If you cannot eliminate the leak, see "NBP Problems" on page 4-5.

IBP Test (SureSigns VM6 and VM8 SE)

This test checks the performance of the invasive blood pressure measurement.

To perform this test, you need a patient simulator.

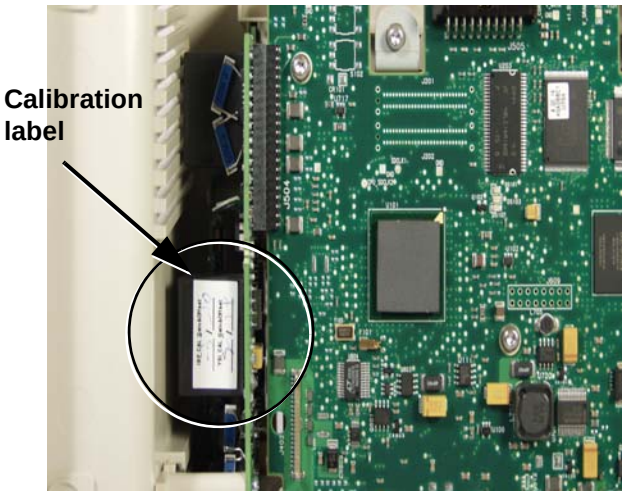
To perform the IBP test:

Step	
1	Connect the patient simulator to the IBP connector on the SureSigns VM6 or VM8 SE patient monitor.
2	Open the **Blood Pressure** menu and make sure that the **Display IBP** check box is selected Make sure that the IBP **Label** option selected is the same as the IBP measurement type selected on the patient simulator.
3	Ensure that the IBP waveform displays in one of the sectors on the monitor.**?** appears in the numeric IBP pane.
4	Set the patient simulator to *atmosphere* (**atm**). The monitor displays **IBP Zero Required** in the status pane.
5	Rotate the wheel to highlight the IBP waveform and then press the wheel to open the <*Pressure*> **Waveform Menu**.
6	Rotate the wheel to highlight the **IBP Zero** button and then press the wheel to begin zeroing the pressure. The <*Pressure*> **Waveform Menu** closes. The message, **IBP Zero - In Progress,** appears in the IBP Waveform pane.
7	Configure the patient simulator as P(static) = 200 mmHg. **Note —** *To configure the patient simulator to 200 mmHg, use the blood pressure menu on the monitor to set 0 – 300 on the scale menu.*
8	Ensure that the IBP waveform is at 200 mmHg.
9	Change the sweep speed to 25 mm/sec.
10	Wait for the displayed waveform and make sure that the IBP waveform corresponds to a steady pressure of 200 mmHg ± 5 mmHg.
11	If the value is outside these tolerances, check the sensor.
12	If you still do not get the expected results, see Chapter 4, “Troubleshooting.”

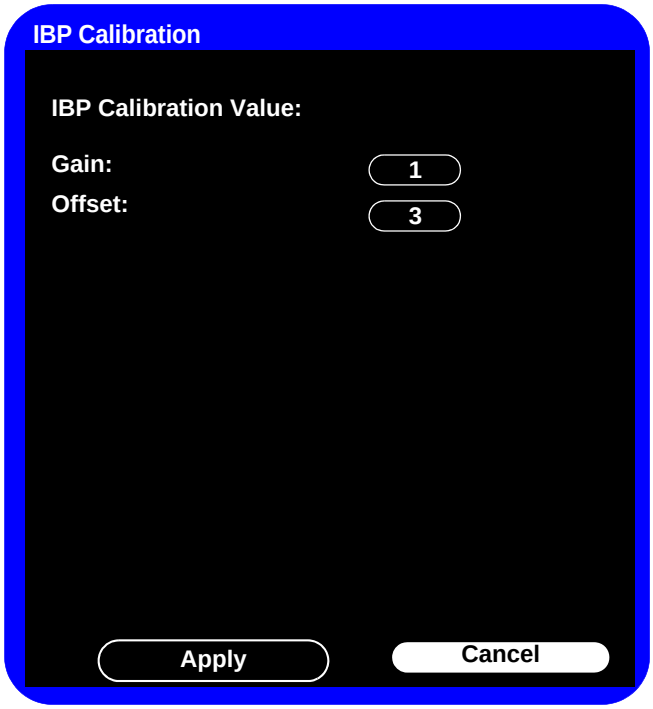
Calibrating IBP (SureSigns VM6 and VM8 SE)

If you replace the main board and/or front end assembly in the monitor, you must enter a new IBP calibration value into the main board (SureSigns VM6 and VM8 SE only).

The factory calibration gain/offset values for IBP are on a label on the front end board.



To calibrate IBP:

Step	
1	Open the **Maintenance** options in the **System Diagnostics** menu. See “Accessing the Maintenance Options” on page 3-14.
2	Rotate the wheel to highlight the **IBP Calibration** button, and then press the wheel. The **IBP Calibration** menu appears. 

3	Rotate the wheel to highlight **Gain**, and then press the wheel and rotate it to select a value from the menu.
4	Press the wheel to save the data.
5	Rotate the wheel to highlight **Offset**, and then press the wheel and rotate it to select a value from the menu.
6	Press the wheel to save the data.
7	After adding calibration values for both gain and offset, rotate the wheel to highlight **Apply**, and then press the wheel.
8	In the window that appears, rotate the wheel to highlight **OK**, and then press the wheel. The monitor restarts.

SureSigns VM4 Temperature Test

This test uses a fixed temperature value to check the performance of the temperature measurement on the SureSigns VM4 patient monitor.

To perform this test, you need:

- A SureSigns temperature probe
- A SureSigns temperature calibration key (part # 4535 640 33691)

To test the performance of the predictive temperature measurement:

Step	
1	Connect the temperature probe to the monitor.
2	Place the monitor in **Monitored** mode using the **Temperature** menu.
3	Remove the temperature probe and the probe well and disconnect the temperature probe connector from the monitor. **Note —** *A temperature probe error may be generated and an alarm may sound.*
4	Connect the SureSigns temperature calibration key to the temperature module.
5	Replace the temperature probe and the probe well. **Note —** *If temperature probe error was generated, the alarm stops.*
6	Remove the temperature probe from the probe well.
7	Wait for the monitor to display the static temperature value.
8	Check that the displayed temperature reads 36.3 ± 0.1°C (97.3 ± 0.2°F).
9	If the value is not within tolerance, see “Temperature Measurement Problems” on page 4-6.

SureSigns VM6 and VM8 SE Temperature Test

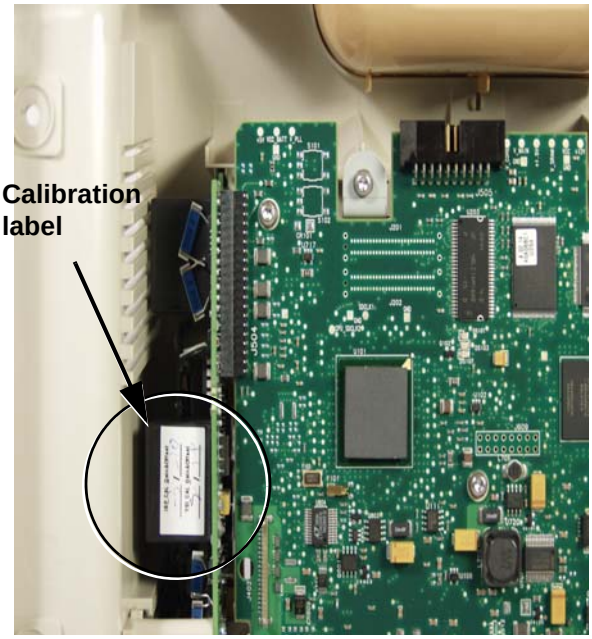
To perform this test, you need a patient simulator (with 0.1°C or 0.2°F).

To test the performance of the continuous temperature measurement:

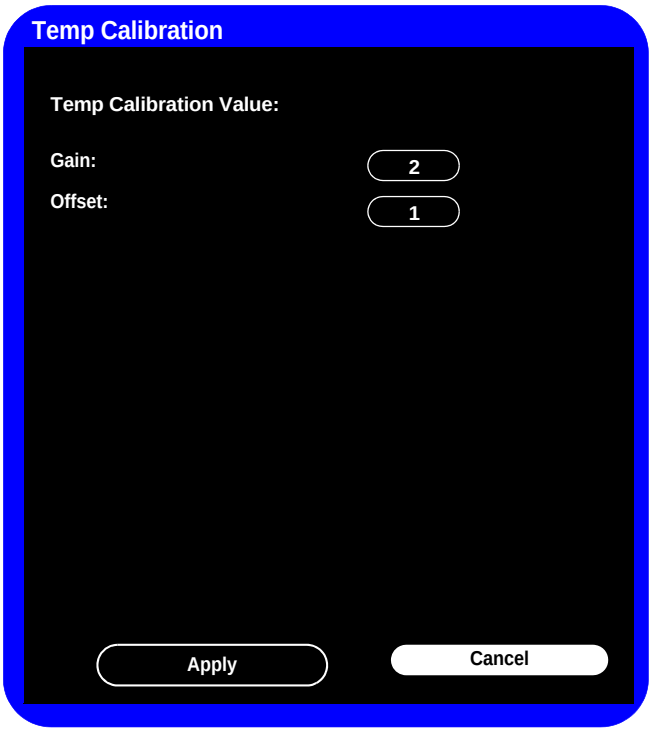
Step	
1	Connect the patient simulator to the temperature connector on the monitor or measurement server extension.
2	Configure the patient simulator to 40°C (100°F).
3	Wait for the monitor to display the static temperature value. The value should be 40°C ± 0.2°C (100°F ± 0.4°F).
4	If the value is not within tolerance, see “Temperature Measurement Problems” on page 4-6.

Calibrating the SureSigns VM6 and VM8 SE Temperature

If you replace the main board and/or front end assembly in the monitor, you must enter a new temperature calibration value into the main board (VM6 and VM8 SEonly). The factory calibration gain/offset values for temperature are on a label on the front end board.



To calibrate the temperature:

Step	
1	Open the **Maintenance** options in the **System Diagnostics** menu. See “Accessing the Maintenance Options” on page 3-14).
2	Turn the wheel to highlight the **Temp Calibration** button and press the wheel. The **Temp Calibration** menu appears. 
3	To calibrate the temperature, rotate the wheel to highlight **Gain**, and then press the wheel and rotate it to select a value from the menu.
4	Press the wheel to save the data.
5	Rotate the wheel to highlight **Offset**, and then press the wheel and rotate it to select a value from the menu.
6	Press the wheel to save the data.
7	After adding calibration values for both gain and offset, rotate the wheel to highlight **Apply**, and then press the wheel.
8	In the window that appears, rotate the wheel to highlight **OK**, and then press the wheel. The monitor restarts.

Safety Tests

Use the following safety test procedures to verify safe installation or service of the monitor. The setups and the acceptable ranges of values used for these tests are derived from local and international standards, but may not be equivalent. These tests are not a substitute for local safety testing where it is required for an installation or a service event. If you use the Metron Safety tester, perform the tests in accordance with your local regulations. For example, in Europe, use IEC 60601-1/IEC 60601-1-1 and in the United States, use UL60601-1. The Metron Report should print results with the names listed below, together with other data.

Note — Safety tests meet the standards of, and are performed in accordance with IEC 60601-1, Clause 19 (EN60601-1). The SureSigns VM patient monitors have been classified as Class I equipment.

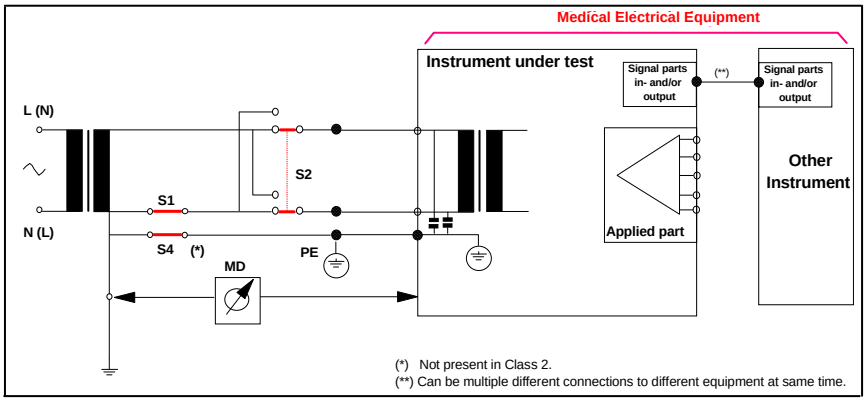
The monitor safety tests include:

- Enclosure leakage
- Ground integrity
- Patient leakage current with mains voltage

To perform these tests, you need a Multimeter.

Enclosure Leakage

S(1) Part 1: Enclosure Leakage Current - NC (normal condition)



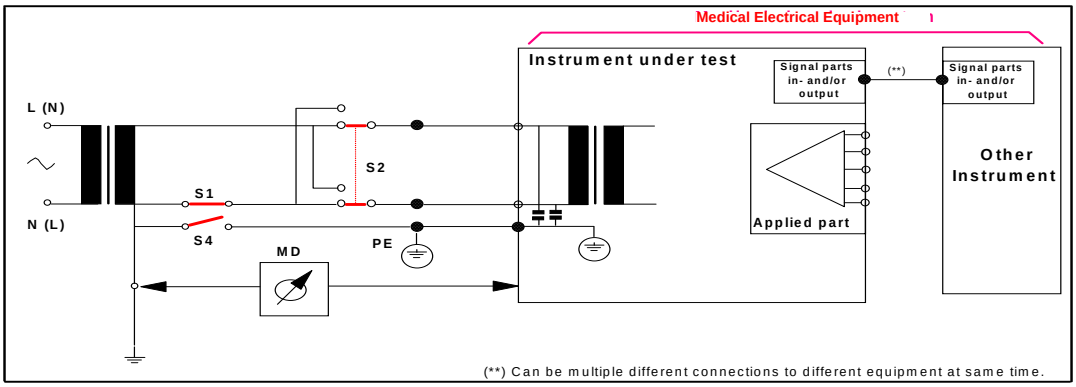
Expected Test Results

Normal condition maximum leakage current x1 ≤ 100µA

This measures leakage current of exposed metal parts of Instrument under Test (IUT) and between parts of the system within the **patient environment**; normal and reversed polarity using S2.

Safety test according to IEC 60601-1 / UL 60601-1

S(1) Part 2: Enclosure Leakage current - Single Fault (open earth)



Expected Test Results

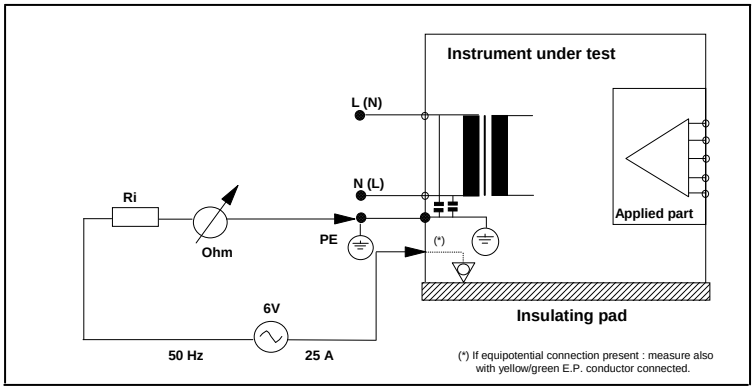
Single Fault maximum leakage current x2 ≤ 500µA (IEC 60601-1)

≤ 300µA (UL 60601-1)

This measures leakage current of exposed metal parts of Instrument under Test (IUT) with Protective Earth (PE) open circuit (S4 = open) and between parts of the system within the **patient environment**; normal and reversed polarity using S2.

Ground Integrity

S(2) Protective Earth Continuity



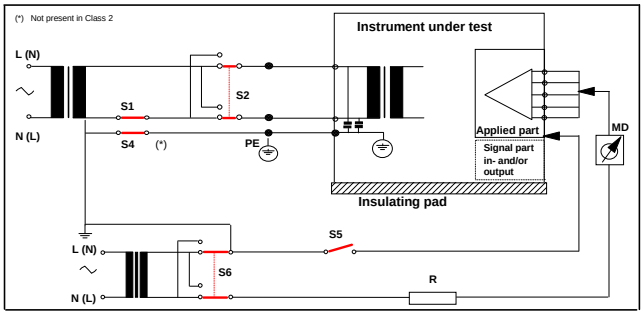
Expected Test Results

With mains cable, maximum impedance x ≤ 100 mOhms (IEC 60601-1 and UL 60601-1)

This measures impedance of Protective Earth (PE) terminal to all exposed metal parts of Instrument under Test (IUT), which are for safety reasons connected to the Protective Earth (PE). Test current 25 Amp applied for 5 to 10 seconds.

Patient Leakage Current With Mains Voltage

S(3) Patient Leakage current - Single Fault Condition (S.F.C.) mains on applied part



Expected Test Results

Maximum leakage current, x ≤ 50µA @ 250V (IEC60601-1 and UL 60601-1)

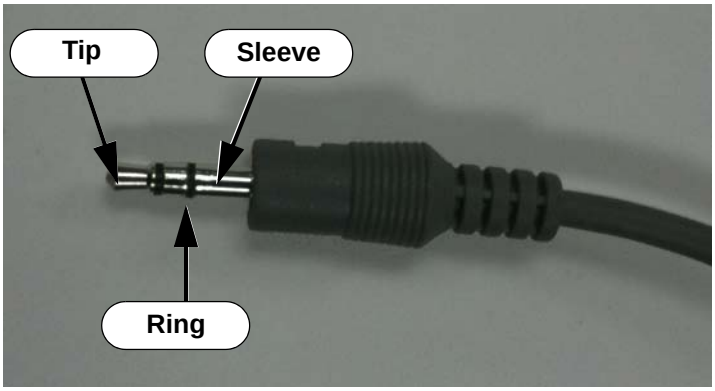
Measures patient leakage current from applied part to earth caused by external main voltage on applied part with switch S5 open and closed. Each polarity combination possible is tested using S2 and S6. This test is applicable for every measurement input.

Nurse Call Relay Test

If your facility uses the nurse call function on the monitor, perform the following procedure to test the nurse call alarm output relay.

The nurse call alarm output in the monitor uses a phone jack connector tip or ring and is capable of both normally closed and normally open relay operation.

The nurse call connector jack has three contacts that connect with those on a phono connector as shown in the following illustration.



- Tip — Relay normally open, closed for alarm
- Ring — Relay normally closed, open for alarm
- Sleeve — Common

To perform this test, you need:

- A patient simulator
- An ohmmeter
- A phono connector

To perform the nurse call relay test:

<table>
<tr><th>Step</th><th></th></tr>
<tr><td>1</td><td>Plug the phono connector into the Nurse Call connector on the back of the monitor.</td></tr>
<tr><td>2</td><td>Use the ohmmeter and simulator to verify relay operation as follows:
<table>
<tr><th>Condition</th><th>Phone Jack Connector Tip (Relay Normally Open)</th><th>Phone Jack Connector Ring (Relay Normally Closed)</th></tr>
<tr><td>Alarm</td><td>Closed</td><td>Open</td></tr>
<tr><td>No alarm</td><td>Open</td><td>Closed</td></tr>
</table></td></tr>
<tr><td>3</td><td>If the nurse call function does not work as expected, see Chapter 4, “Troubleshooting.”</td></tr>
</table>