

6

Calibration and Verification

Terms

BP test volume repair fixture. Equipment with four separate 100cc, 250cc, and two 500cc linearity volume cylinders. Referred to in this procedure as “Test Volume”.

Calibration. Process to change the outputs of the UUT that are out of range. After saving, the changes become permanent until the next calibration.

Pneumatic test assembly. Equipment that connects the UUT, the pressure meter, the squeeze bulb, and the BP test volume repair fixture.

Spot LXi Service Tool. Software package to verify and calibrate the Spot LXi device.

Service computer. Computer with the repair software loaded and ready to operate.

Functional Tests. Process to check the outputs of the UUT.

UUT. Unit under test.

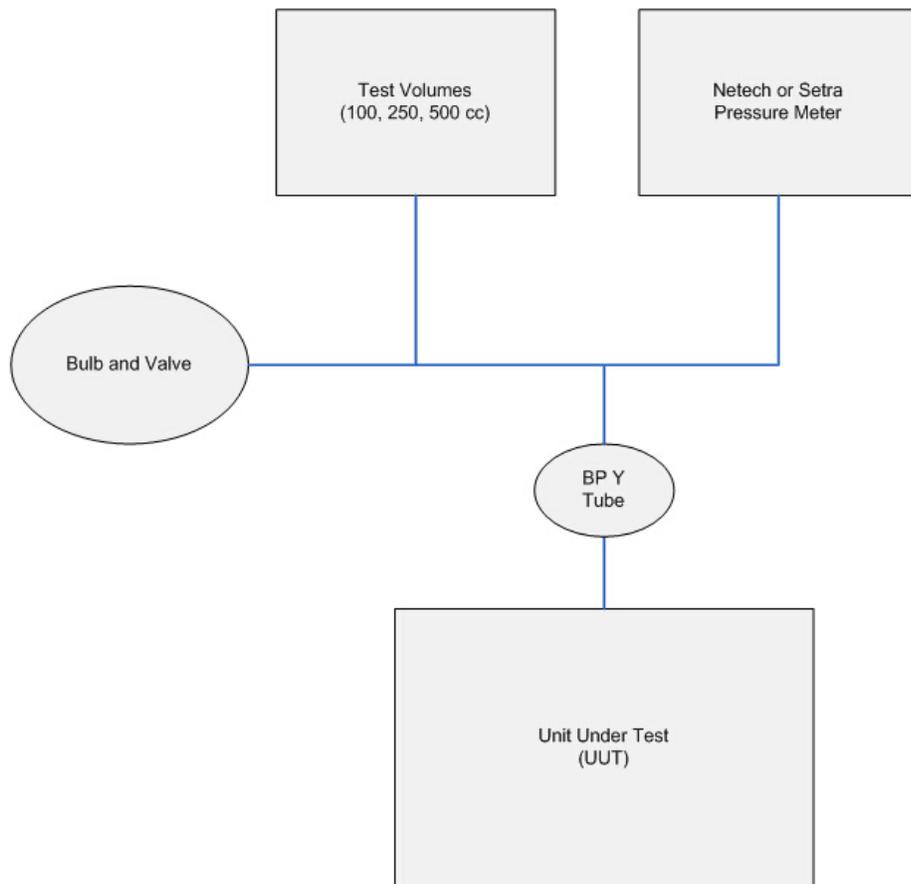
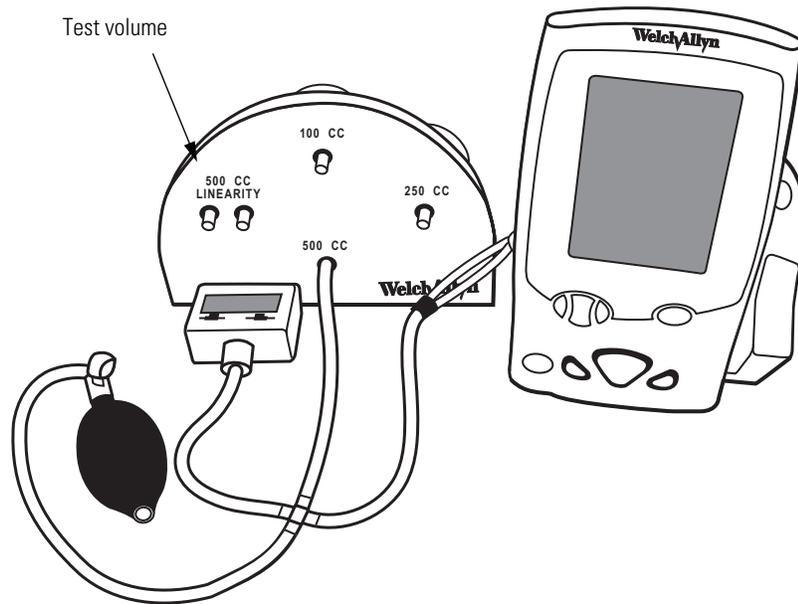
Required Test Equipment

Description	Part Number	Qty
Power supply, 0-10 Volts, 2 amps capacity or better, fine voltage adjustment required		
Digital multi meters (DMM)		2
Battery simulator connector, 24 inch or shorter		
Patch cords- banana plug to banana plug, Red, 18 AWG, 24 inch or shorter		3
Patch cords- banana plug to banana plug, Black, 18 AWG, 24 inch or shorter		2
USB Cable, 2.0/5-Pin Mini-B Cable		
Calibrated pressure meter		
PC running Spot Lxi Service Tool (Ver 3.0 or greater)	4500-905	
9600 Plus Temperature Calibration Tester	01802-110	
Nellcor-approved SpO2 simulator, <i>for devices with Nellcor option</i>	SRC-MAX	
Masimo SpO2 Tester, <i>for devices with Masimo option</i>	1795	
Thermometer Calibration Key, Optional	06138-000	
Blood pressure two-tube hose with Y fitting	5082-183	
Blood pressure two-tube hose (standard cuff)	4500-30	
BP test volume repair fixture (includes items below) Note This is the new Test Volume needed for passing the NIBP Linearity Test	407672	
BP test volume repair fixture. Must have at least the following volume cylinders: 100cc, 250cc, and 500cc		
Squeeze bulb with bleeding screw		
Square (4-way) tube fitting connector		
12-inch (30.5 cm) tubing with .25-inch (6.35 mm) ID		4

Pneumatic test assembly setup

1. Connect the squeeze bulb with bleed screw to a square (4-way) tube fitting connector, a calibrated pressure meter, a test volume, and to a blood pressure two-tube, Y-fitting hose as shown in [Figure 1](#) on page 51.

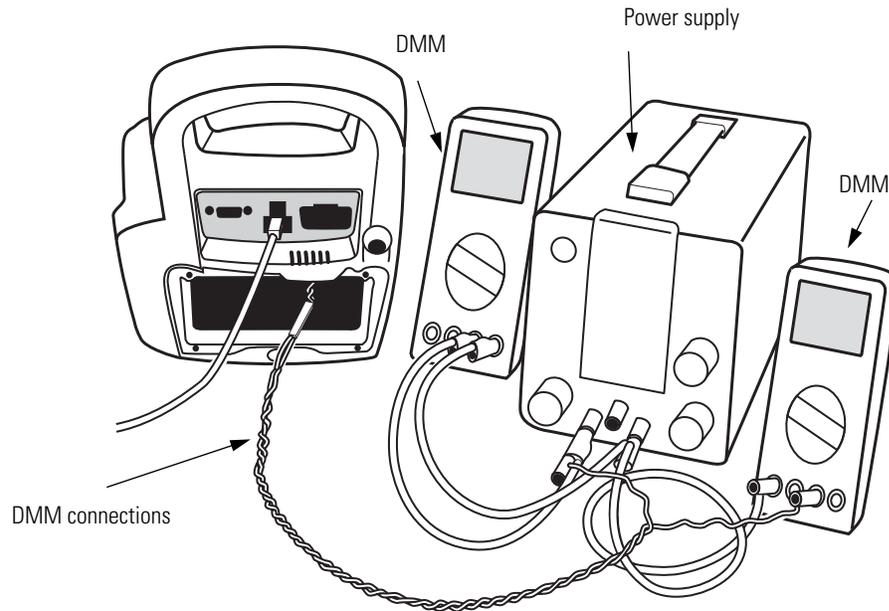
Figure 1. Pneumatic test assembly setup



Power Supply Test Setup

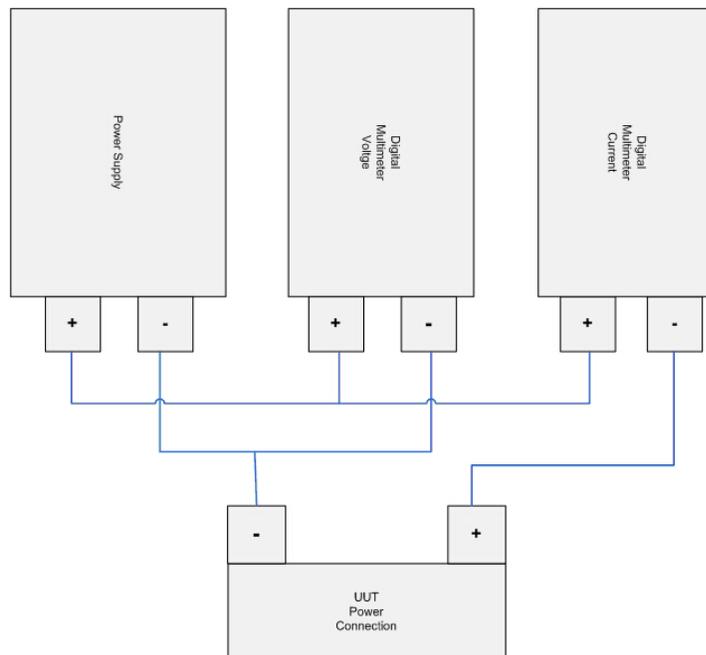
1. Connect the power supply to the Battery Simulator connector, banana plug patch cords, digital multi meter (DMM) for voltage monitoring, DMM for current monitoring.

Figure 2. Power Supply Test Setup



Test the power supply output as shown in [Figure 3](#). Observe the correct polarity.

Figure 3. Power Supply



2. Turn on the power supply and adjust to 6.5 +/- 0.1V DC before connecting the UUT. Turn off power supply.
3. Disconnect the UUT battery and connect the external power supply to the UUT, using the Battery Simulator. Observe the correct polarity.



Caution DO NOT connect the Spot LXi AC power adapter to the UUT power connection port. This will result in damage to the UUT, AC power adapter, or the Battery Simulator power supply.

4. Turn on the Power Supply.

Note All tests and verification in this procedure require battery voltage input adjusted to 6.5V DC; Except as called out in the Voltage Calibration section.

Battery Removal / Power Shutdown

Removal of the UUT battery, or power shutdown of the Battery Simulator external power supply, will require reset of the date and time prior to any further testing, calibration, or verification activities.

Time & Date Reset:

1. Power on the UUT in configuration mode by pressing the **Check** and **Power On** buttons on the UUT. Hold the **Check** button until the UUT beeps twice. The UUT screen displays any POST errors detected.

Figure 4. POST Errors Detected



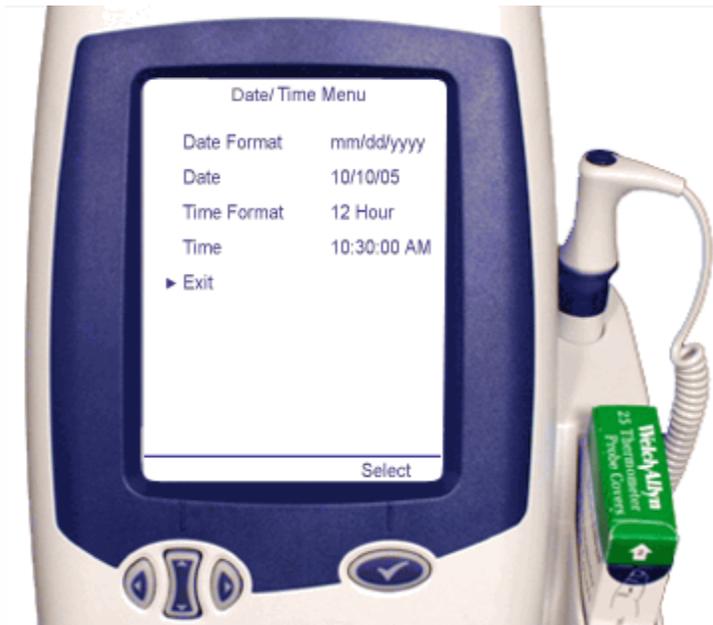
2. Click the **Check** button on the UUT. The Configuration Menu opens.
3. Scroll to **Date/Time** on the UUT Configuration Menu and select.

Figure 5. Date/Time Menu

4. Scroll to **Date** on the UUT and select. Using the navigation keys, adjust the correct date and select. Scroll to **Time** and select. Using navigation keys, adjust the correct time and select.

Figure 6. Set Date, Set Time

5. Scroll to **Exit** and select.

Figure 7. Exit Menu

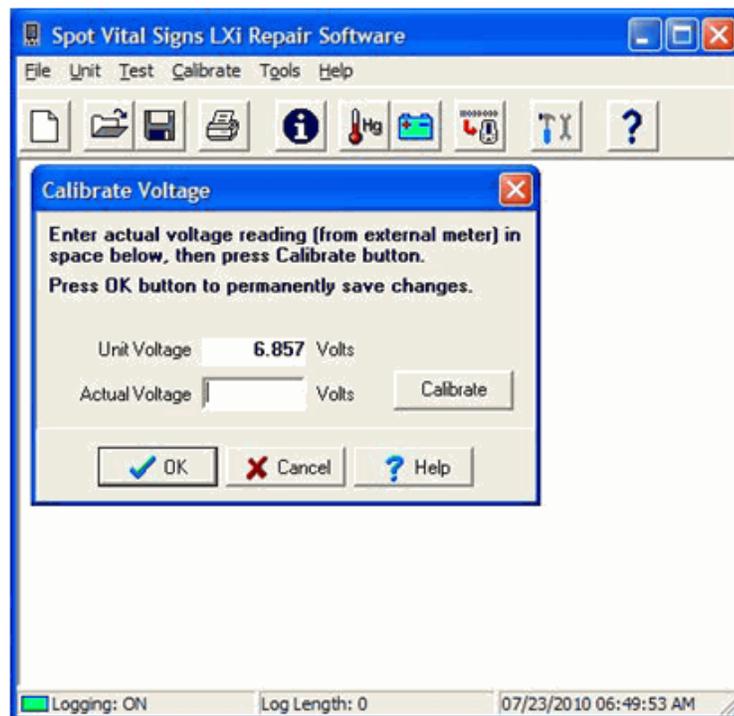
6. Reset the UUT using the power button. Do NOT turn off the power supply. The next power up of the UUT screen displays the correct date and time without errors.

Voltage Calibration

1. Remove the battery from the UUT. Connect the UUT to a Battery Simulator with the external power supply set to 6.5 +/- 0.1V DC. (Follow the steps in "[Power Supply Test Setup](#)" on page 52.)
2. Connect the service PC running the Spot Lxi Service Tool to the UUT with the USB Cable. Open the Spot LXi Service tool from the PC.
3. Power on the UUT in configuration mode by pressing the **Check** and **Power On** buttons on the UUT. Hold the **Check** button until the UUT beeps twice.

Figure 8. Configuration Menu

4. Verify the power supply is at $6.5 \pm 0.1V$ DC at the battery connector simulator leads.
5. Verify that the UUT is connected and communicating with Spot Lxi Service Tool.
Select Unit > Information. The Unit information window opens. Click **OK** to close.
6. Select **Calibrate > Voltage** on the service computer. The UUT screen goes blank.

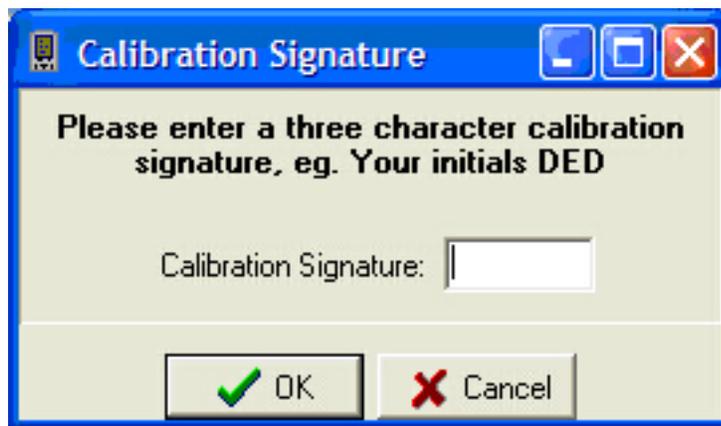
Figure 9. Calibrate Voltage

7. Carefully adjust the power supply to $5.5 \pm 0.1V$ DC at the battery connector simulator leads. A fine voltage adjustment will be needed to make this adjustment.

Note Do not adjust power supply below 5.5V DC or the UUT will go into shutdown mode.

8. Read the voltage on the DMM that is connected to the battery simulator leads.
9. Enter this voltage reading into the **Actual Voltage** field and click the **Calibration** button.
10. Click the **OK** button to accept the inputs. Click **Yes** to make the changes permanent.
11. Enter your initials in the Calibration Signature field and click **OK**. The UUT resets and powers up in normal mode.

Figure 10. Calibration Signature Field



Note After "Reset" and power up, the UUT detects the low 5.5V DC supply setting and goes into auto shutdown. Adjust power back to 6.5V DC.

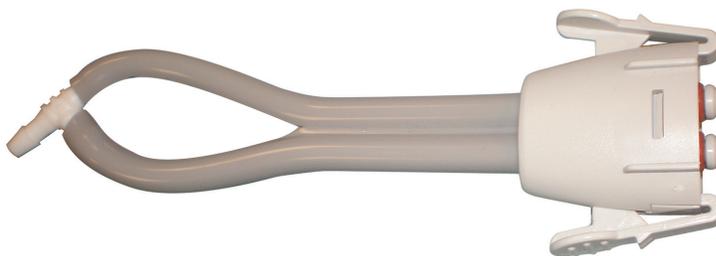
Pressure verification test

Spot LXi devices require annual calibration.

Note If this is a new NIBP board, go to "[NIBP board Initialization](#)" on page 62 and carefully follow the instructions to initialize this board.

1. Connect the UUT to the pneumatic test assembly using the two-tube blood pressure hose with the Y-fitting.

Figure 11. Blood Pressure Hose with Y-fitting



2. Connect the test volume hose to the 500cc cylinder.

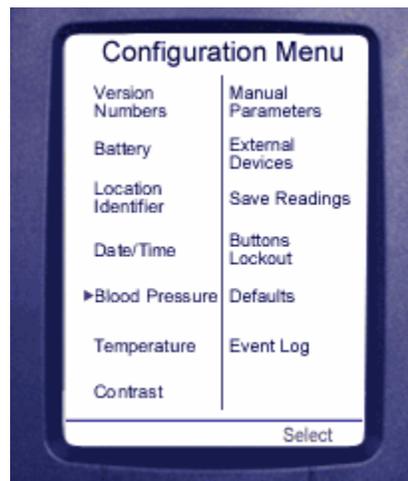
- Power on the UUT in configuration mode by pressing the **Check** and **Power On** buttons on the UUT. Hold the **Check** button until the UUT beeps twice. The configuration screen displays.

Figure 12. Configuration Menu



Scroll to Blood Pressure and select it

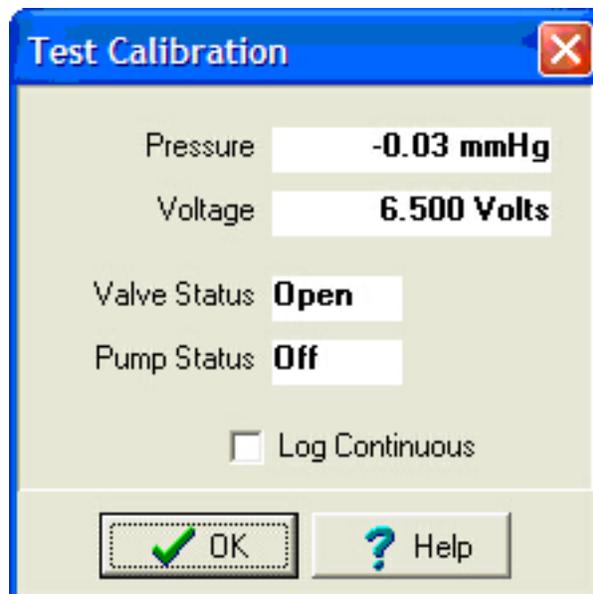
Figure 13. Blood Pressure Menu



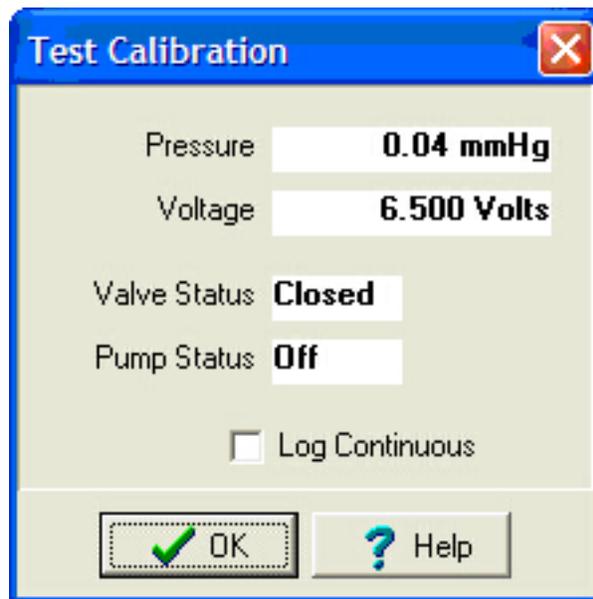
Select **BP Calibration Check**.

Figure 14. BP Calibration Check

4. Open the Spot LXi Service Tool on the service computer and select **Test > Calibration**. A Test Calibration box displays on the screen.

Figure 15. Test Calibration with Open Valve

5. Verify the pressure is at or near zero and the voltage is within 0.2V DC of the power supply (6.5V DC). Verify the valve status is open and the pump status is off.
6. Select **Close Valve** on the UUT. The valve status changes to closed.

Figure 16. BP Calibration Check Close Valve**Figure 17. Test Calibration with Closed Valve**

7. Select **Start Cuff Inflation**. The pump starts inflating the cuff. Verify the pump status is on and the pressure is rising.

Figure 18. Start Cuff Inflation

8. Inflate the pressure up to 250 mmHg. Select the **Stop Pump** on the UUT to stop the inflation. Fine tune the pressure reading to 250 mmHg with the squeeze bulb.

Figure 19. Fine Tune the Pressure Reading to 250 mmHg

9. Check the reading on the pressure meter against reading on the UUT.
 - a. Verify the pressure on the UUT is within the pressure tolerance in the table. Use the squeeze bulb to fine tune the pressure at each inflation pressure limit. If the pressure is within tolerance, go to the next inflation pressure.

Inflation pressure	Pressure tolerance	Inflation pressure	Pressure tolerance
250 mmHg	+/- 2.0 mmHg	50 mmHg	+/- 1.0 mmHg
150 mmHg	+/- 1.5 mmHg	0 mmHg	+/- 1.0 mmHg

- b. If all readings are within specification, go to [“Functional tests”](#) on page 67.
- c. If the UUT is not within the pressure tolerance, open the valve to bleed pressure to zero. Select **Calibrate > Pressure** on the repair software. Proceed to [“Blood pressure calibration”](#) on page 63. UUT needs calibration.
- d. If replacement of the NIBP board is required, first proceed to [“NIBP board Initialization”](#) on page 62 and then proceed to [“Blood pressure calibration”](#) on page 63.

Blood pressure calibration

Note Complete the voltage calibration before beginning a blood pressure calibration.

If all readings were within specifications during [“Pressure verification test”](#) on page 57, skip this section and go to [“Functional tests”](#) on page 67.

NIBP board Initialization

Note All New NIBP Boards must be initialized before calibration.

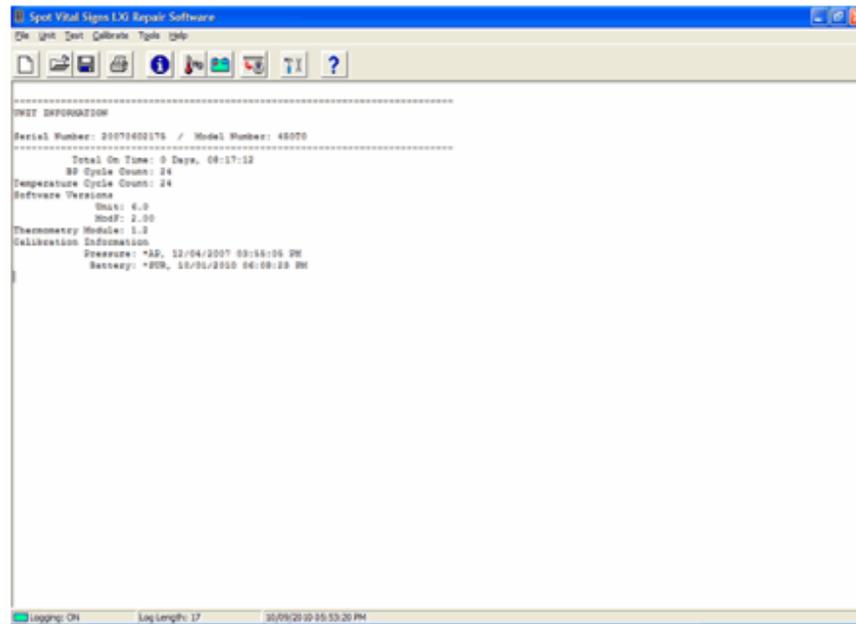
1. Power on the UUT in configuration mode by pressing the **Check** and **Power On** buttons on the UUT. Hold the **Check** button until the UUT beeps twice. The configuration screen displays.

Figure 20. Configuration Menu



- Open the Spot LXi Service Tool on the service computer and select **Calibrate > Reset Defaults**. The Reset Defaults window displays.

Figure 21. Reset Defaults Window



- Click **Reset > Initialize > OK**. The NIBP board is initialized.
- Perform the "Voltage Calibration" on page 55 before proceeding to "Blood pressure calibration".

Blood pressure calibration

- Power on the UUT in configuration mode by pressing the **Check** and **Power On** buttons on the UUT. Hold the **Check** button until the UUT beeps twice.

Figure 22. Blood Pressure Menu



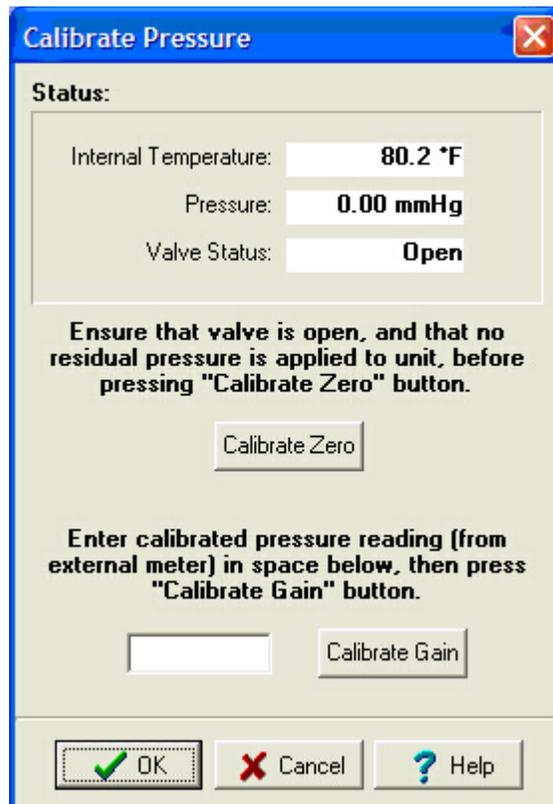
- The configuration screen displays, scroll to **Blood Pressure** and select it. Select **BP Calibration Check**.

Figure 23. BP Calibration Check



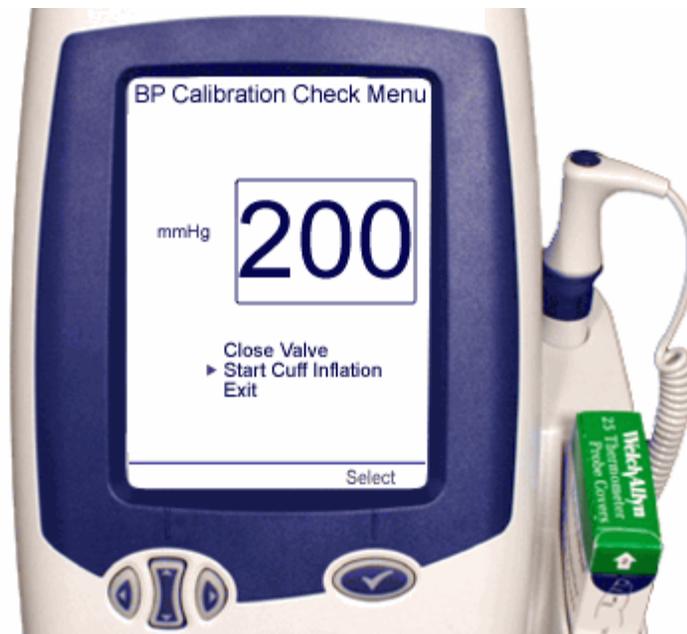
- Open the Spot LXi Service Tool on the service computer and select **Calibrate > Pressure**. The Calibrate Pressure window opens.

Figure 24. Calibrate Pressure Window

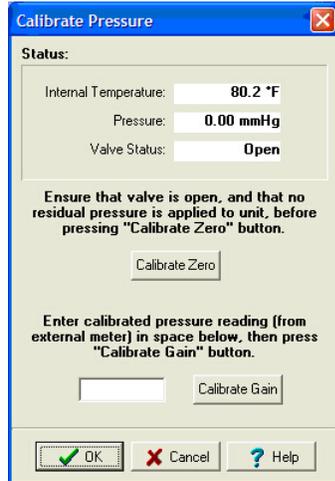


4. Connect the UUT to the pneumatic test assembly using the two-tube blood pressure hose with the Y-fitting. (See “Blood Pressure Hose with Y-fitting” on page 57.)
5. Connect the pneumatic test assembly hose to the 500cc cylinder of the test volume and verify the following:
 - the pressure is at zero mmHg,
 - the bleed screw on squeeze bulb is closed,
 - valve on UUT is in the open state.
6. On the Spot LXi Service Tool select **Calibrate Zero button**. 
7. Close Valve on the UUT and use the squeeze bulb to manually inflate the UUT to 200 mmHg. Let stabilize.

Figure 25. Fine Tune the Pressure Reading to 200 mmHg



8. Enter the pressure meter reading in the **Calibration Gain** field on the service computer. Be as precise as possible. If pressure meter has resolution of 1.00 mmHg make sure it reads 200.00 without switching to 199.00 or 201.00. Enter 200.00 in **Calibration Gain** field.

Figure 26. Calibration Gain Field

Calibrate Pressure

Status:

Internal Temperature: 80.2 °F

Pressure: 0.00 mmHg

Valve Status: Open

Ensure that valve is open, and that no residual pressure is applied to unit, before pressing "Calibrate Zero" button.

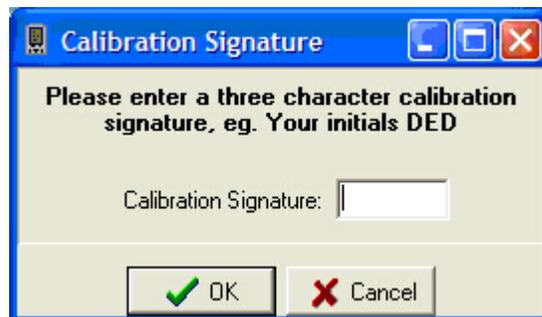
Calibrate Zero

Enter calibrated pressure reading (from external meter) in space below, then press "Calibrate Gain" button.

Calibrate Gain

OK Cancel Help

9. Click **Calibrate Gain** on the service computer.
10. Click **OK** to accept the inputs. Click **Yes** to make the changes permanent.
11. Enter your initials in the **Calibration Signature** field and click **OK**. The UUT resets and powers up in normal mode.

Figure 27. Calibration Signature Field

Calibration Signature

Please enter a three character calibration signature, eg. Your initials DED

Calibration Signature:

OK Cancel

12. Blood Pressure calibration is complete.

Functional tests

Note Perform the Functional Tests sequentially. Fill out the “[Service Work Checklist](#)” on page 111 with the Calibration and Functional Test data obtained as you perform these steps.

Each test is software driven. Selecting the Test button begins the test.

Connect the correct Test Volume cylinder called out in the procedure (in parenthesis below) or the test will fail.

Test specification details:

Leak test	6mm maximum in 15 seconds with a volume of (100cc) at 250 mmHg
Dump test	From 260 to less than 15 mmHg in 10 seconds or less with a volume of (500 cc)
Inflation test	From 5 to 210 mmHg in 7 seconds or less with a volume of (250 cc)
Valve control test	From 160 mmHg with a volume of (100 cc) Open the valve for the following time intervals and pressure drops: <ul style="list-style-type: none"> • 10 msec = 4 to 12 mmHg • 15 msec = 4 to 15 mmHg • 25 msec = 4 to 25 mmHg
Inflation linearity	Connect a standard cuff hose between the UUT and the 500cc Linearity input on the Test Volume and inflate. <ul style="list-style-type: none"> • Measure the pressure at 6, 9, and 12 seconds and compare to the expected readings at these intervals. • Also check the noise level at 7, 10, and 13 seconds into the inflation step.

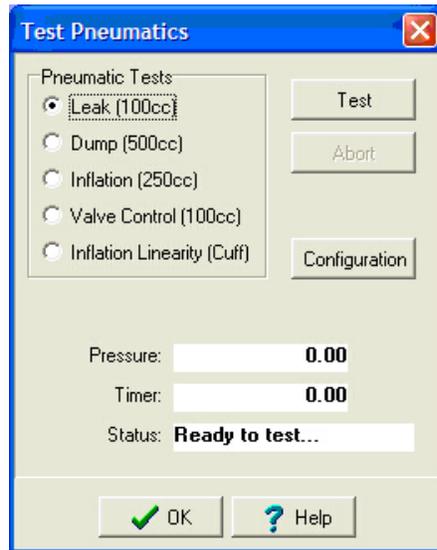
Functional test steps:

1. If the UUT is connected to the Battery Simulator, set the external power supply to 6.5 +/- 0.1V DC.

Note The Spot LXi AC power adapter should NOT be connected to the UUT.

If the UUT is NOT connected to the battery simulator, connect the Spot LXi AC power adapter to the UUT.

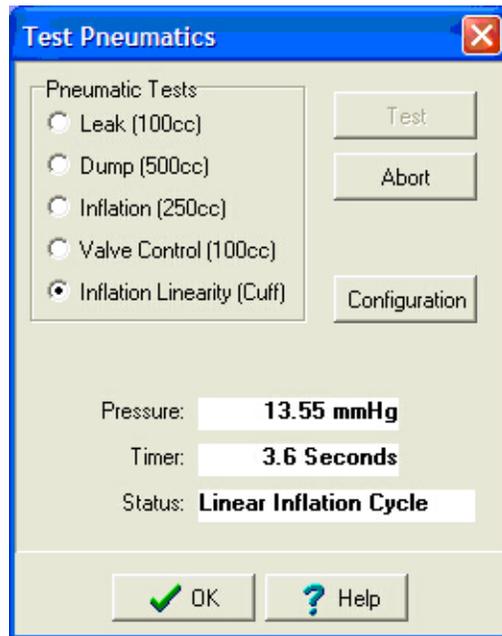
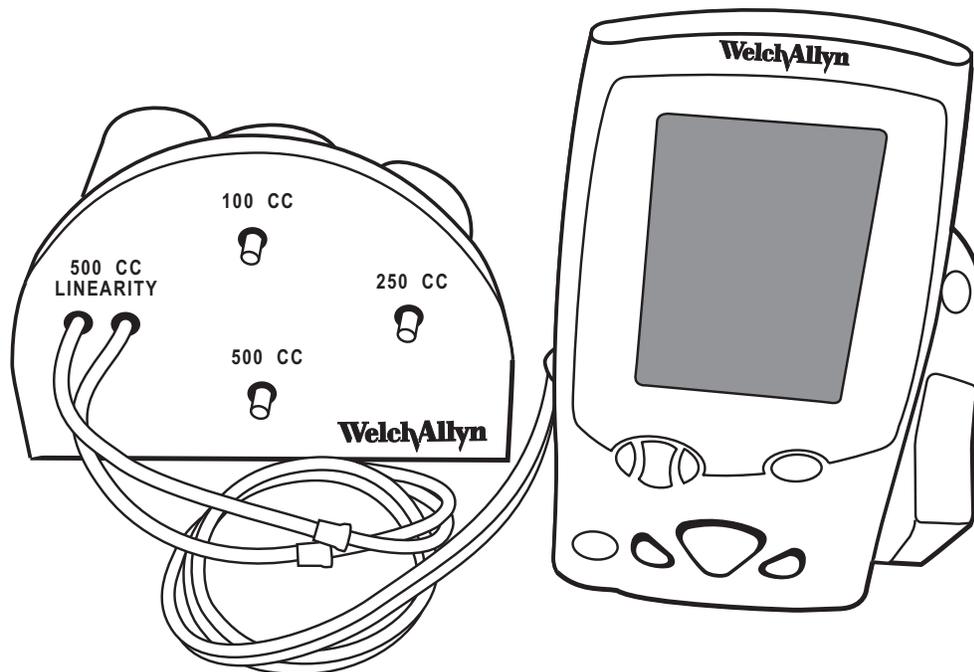
2. Power on UUT in normal mode.
3. Connect the UUT to the pneumatic test assembly using the two-tube blood pressure hose with the Y-fitting. (See “[Blood Pressure Hose with Y-fitting](#)” on page 57.) Verify that the bleed valve on the squeeze ball is closed.
4. Open the Spot LXi Service Tool on the service computer and select **Test > Pneumatics**. The Test Pneumatics window opens.

Figure 28. Test Pneumatics Window

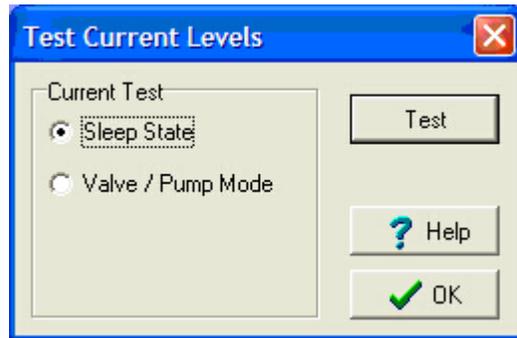
- a. Connect the test specific cylinder in parenthesis; (100cc), (500cc), (250cc)
- b. Sequentially select each pneumatic test, starting with "Leak (100cc)". Click **Test**. A successful test will display "Passed".

Figure 29. Passed Leak Test

- c. Perform each of the tests listed after connecting the test specific cylinder. The "Inflation Linearity (Cuff)" test may use the 500cc cylinder in place of the adult cuff.

Figure 30. Inflation Linearity Cuff Test**Figure 31. Inflation Linearity 500cc Cylinder**

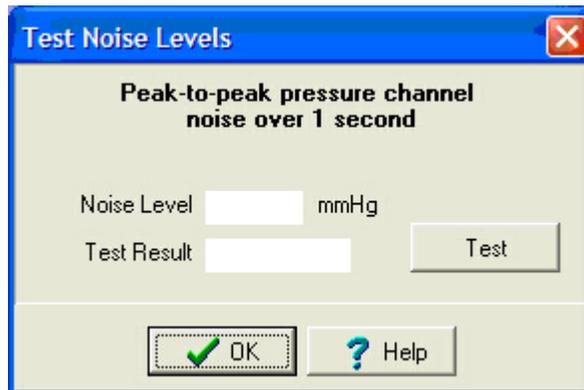
- d. Click **OK** after completing the last test to close the **Pneumatics** test window.
5. On the Spot LXi Service Tool select **Test > Current Levels**. Perform the tests listed. The Test Current Levels window opens.

Figure 32. Test Current Levels Window

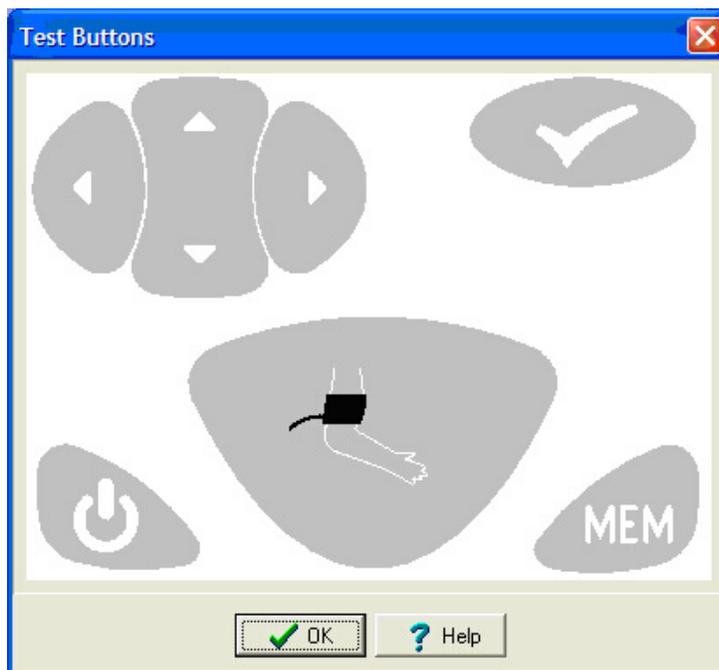
- a. **Sleep State > Test**, screen is off and the UUT is idle. Verify that the current is less than 500 mA. Click **OK** after completing the measurement.

Figure 33. Sleep State

- b. **Valve/pump Mode > Test**, the UUT is fully active with the valve closed and the pump running. Verify that the current is less than 2.0 amperes in this state. Click **OK** after completing the measurement.
 - c. Normal Mode; screen is lit, but the UUT is inactive. The UUT current draw is less than 1.25 amperes in this state.
 - d. Click **OK** after completing the last test to close the **Test Current Levels** window.
6. On the Spot LXi Service Tool select **Test > Noise Levels > Test**. The **Test Noise Levels** window opens.

Figure 34. Test Noise Levels Window

- a. The Test Noise Levels test measures the amount of noise on the UUT A-D pressure channel. The sample is 1 second in length with 0 mmHg applied. The maximum allowed noise is .050 mmHg.
 - b. Click **OK** after completing the test to close the **Test Noise Levels** window.
7. On the Spot LXi Service Tool select **Test > Buttons**. The **Test Buttons** window opens.

Figure 35. Test Buttons

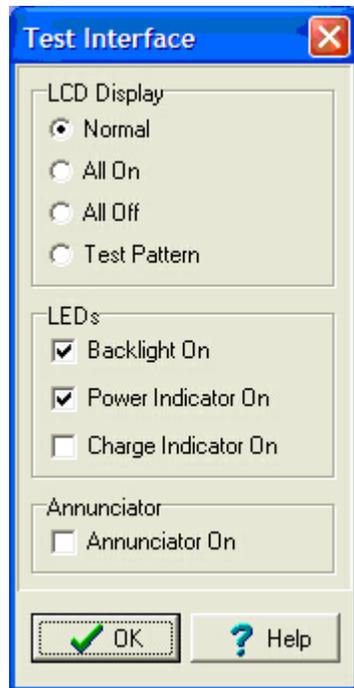
- a. Press each button on the UUT and verify the appropriate button lights on the Spot LXi Service Tool window.

Figure 36. UUT Buttons



- b. Click **OK** after completing the test to close the **Buttons Test** window.
- 8. On the Spot LXi Service Tool select **Test > Interface**. The **Test Interface** window opens.

Figure 37. Test Interface Window



- a. Perform all commands in this test, verifying the screen on the UUT responds correctly with each command:

Normal	
All On	
All Off	
Test Pattern	
Backlight On/Off, = blank dark UUT display screen	

Power Indicator On/Off	
Charge Indicator On/Off	
Enunciator On/Off, Toggles enunciator tone on and off.	

Figure 38. Normal



Figure 39. All On



Figure 40. All Off



Figure 41. Test Pattern



Figure 42. Backlight On/Off**Figure 43. Power Indicator On/Off****Figure 44. Charge Indicator On/Off**

- b. Click **OK** after completing the tests to close the **Test Interface** window.

To perform the over pressure test:

1. Verify that the UUT is in normal mode.
2. Re-install the pneumatic test assembly with the 250cc cylinder connected.
3. On the Spot LXi Service Tool select **Unit >Status**. A **Unit Status** window displays.

Figure 45. Unit Status Window

The screenshot shows the 'Unit Status' window with the following information:

- Status Information** | POST Errors
- Unit Status:**
 - Powerup Mode: **Configuration**
 - Charge State: **Battery**
 - Battery Level: **Above 6.15 Volts**
- ModF Status:**
 - Module State: **Dumping**
- Hardware/Patient States:**
 - Valve Status: **Open**
 - Pump Status: **Off**
 - Malfunction (E11): **No**
- Safety States:**
 - Over Pressure: **No**
 - Autozero Failure: **Yes**
 - Battery Failure: **No**
 - Ambient Out Of Range: **No**
 - Unrecoverable POST: **No**
 - Residual Pressure Failure: **No**
- Cuff Pressure: **0.00 mmHg**
- Log Status Information (circled in blue)

Buttons at the bottom: **OK** (with a green checkmark) and **Help** (with a question mark).

4. Check the **Log Status Information** box in the lower right hand corner of the Spot LXi Service Tool. The Event logs display in rapid succession.
5. Immediately initiate a blood pressure reading. As the pressure increases, start applying additional pressure with the squeeze bulb.
6. Increase the pressure to the UUT until an E10 error displays.
7. Uncheck the **Log Status Information** box and click **OK** after completing the test to close the **Unit Status** box.

Scroll through the event log to locate the last 'no' answer, directly followed by the first 'yes' answer in the column labeled over pressure.

Figure 46. Event Log

Battery Level	State	Valve State	Pump State	E11	Over Pressure	ModF Status
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	On	No	No	No
ATT_LEVEL_1	Inflating	Closed	Off	No	No	No
ATT_LEVEL_1	Inflating	Closed	Off	No	No	No
ATT_LEVEL_1	Dumping	Open	Off	No	Yes	No
ATT_WARN	Dumping	Open	Off	No	Yes	No
ATT_WARN	Dumping	Open	Off	No	Yes	No
ATT_WARN	Dumping	Open	Off	No	Yes	No

8. Scroll to the right to see the mmHg pressure that these events occurred.
9. Select the higher pressure reading when the E10 error occurred. Verify the pressure is between 296 and 329 mmHg.

Note The following tests are for verification only. There is no updating of calibration parameters.

Temperature Functional Check

Temperature test setup

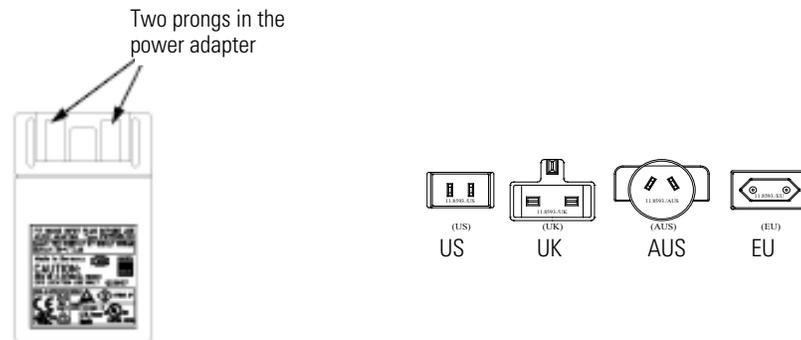
The 9600 Plus Calibration Tester takes approximately 20 minutes to heat to the lowest setting. When testing several thermometers at all three temperatures, it is recommended to test all probes at one Calibration Set Point Temperature before proceeding to the next Calibration Set Point Temperature.

To further expedite testing start at the lowest Calibration Set Point Temperature. The 9600 Plus Calibration Tester does not have an internal fan, this causes a longer cool down time than warm up time.

Refer to the 9600 Plus Calibration Tester Directions for Use manual for specific information regarding the LCD window or the control buttons.

1. Choose the proper mains plug insert and slide it over the two prongs in the power converter.

Figure 47. Power Adapter and Mains Plug Inserts



2. Plug the power adapter into the 9600 Plus Calibration Tester and the opposite end into a wall outlet.
3. Place the 9600 Plus Calibration Tester on a level surface away from sunlight, drafts, and other sources of heat or cold.
4. Observe the Set Point Mode in the upper left hand corner of the LCD display. If the unit displays a "D", it is in Default Mode and will heat to the lowest Set Point Temperature. If you do not want to conduct testing at this Set Point Temperature, press and hold the **Temperature Selection** button to select the desired setting. The temperature display will flash before staying on continuously to indicate the 9600 Plus Calibration Tester has stabilized and is ready for use.

Changing the Calibration Set Point Temperature on the 9600 Plus Calibration Tester

To scroll from one set point to the next, press and hold the **Temperature Selection** button (up/down button) until a beep is heard. The newly selected set point appears in the upper left corner of the LCD display. The device's current temperature is displayed, starts to flash, and continues flashing until the cavity reaches the equilibrium at the new set point.

Welch Allyn SureTemp Plus Thermometers



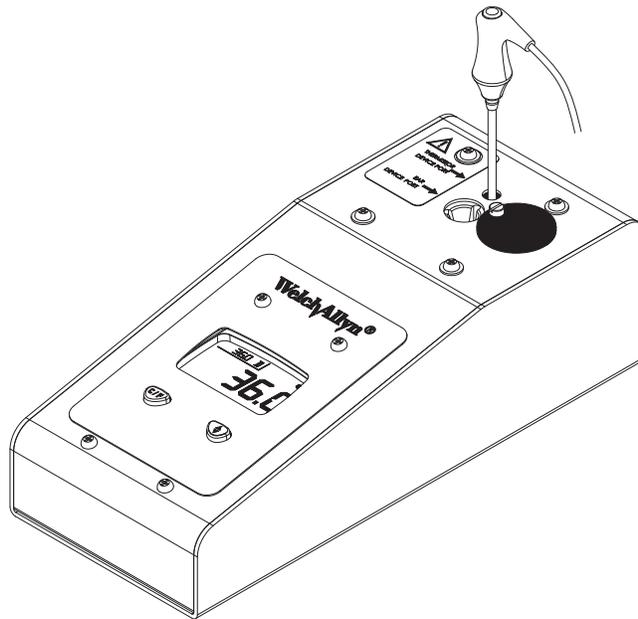
Caution Store thermometers for testing in the same room as the 9600 Plus Calibration Tester for approximately 30 minutes prior to testing to allow for thermal accommodation.

To begin functional verification of the SureTemp Plus thermometer:

1. Verify that the UUT is ON and is operating in normal mode.
2. Remove the thermometer probe from the probe well and clean it with either a 70% isopropyl alcohol solution, or a 10% chlorine bleach solution. Let the thermometer air dry. Do not apply a probe cover.
3. Verify that the blue (oral) probe well is in place.

Insert the thermometer into the 9600 Plus Calibration Tester device thermistor device port (small port).

Figure 48. 9600 Plus Calibration Tester with the Welch Allyn SureTemp Plus Thermometer



4. Verify that the thermometer enters Monitor Mode, (approximately one minute), the snail symbol and "Monitor" are displayed on the UUT display.

Figure 49. Temperature Monitor Mode



5. After the UUT enters "Monitor" mode wait for approximately one minute or until the temperature on the thermometer is stable for ten seconds.
 - a. Verify that the UUT thermometer's temperature reading is within the temperature tolerance in the table.

Calibration Set Point Temperature	Temperature tolerance
96.8°F (36.0°C)	+/- 0.2°F (+/- 0.1°C)
105.8°F (41.0°C)	+/- 0.2°F (+/- 0.1°C)

- b. When verifying several UUT thermometers at both temperatures, it is recommended to verify all UUT thermometers at one Calibration Set Point Temperature before proceeding to the next Calibration Set Point Temperature.

- c. Changing the Calibration Set Point Temperature (9600 Plus Calibration Tester):

To scroll from one set point to the next, press and hold the **Temperature Selection** button (up/down button) until a beep is heard. The newly selected set point appears in the upper left corner of the LCD display. The device's current temperature is displayed, starts to flash, and continues flashing until the cavity reaches the equilibrium at the new set point.

To begin functional verification of SureTemp Plus without thermometer (Optional):

If the UUT fails the temperature verification using the SureTemp Plus thermometer; then perform this separate functional test of the UUT temperature circuitry.

1. Remove probe and probe well completely.
2. Insert calibration key (part number 06138-000) and replace probe well.

Figure 50. Calibration Key and Probe Well



3. Insert and then remove probe from probe storage channel to reset thermometer.

Figure 51. Reset Thermometer

4. Wait for display test, and then observe display.
5. Display should read $36.3^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$ or $97.3^{\circ}\text{F} \pm 0.2^{\circ}\text{F}$.

Figure 52. Temperature Display in F°

6. Remove calibration key and install probe well.
7. If the UUT temperature circuitry verified successfully and the temperature verification failed using thermometer probe; then replace SureTemp Plus thermometer probe.

Braun ThermoScan Pro 4000



Caution Store thermometers for testing in the same room as the 9600 Plus Calibration Tester for approximately 30 minutes prior to testing to allow for thermal accommodation.

To begin functional verification of the Braun ThermoScan PRO 4000 thermometer:

1. Clean the probe tip with a cotton swab slightly moistened with isopropyl alcohol, remove excess alcohol with a clean cotton swab, and let air dry for 5 minutes. Do not use any chemical other than alcohol to clean the probe window.
2. Place the Braun ThermoScan Pro 4000 in Calibration Mode using the following steps.
 - a. Push and release the **I/O mem** button to turn the product on. The display shows symbols and functions. The Braun ThermoScan Pro 4000 performs an automatic self check. After a few seconds you hear a beep and see two dashed lines, a sound symbol, and ° C or ° F on the display.

Figure 53. Braun Self Check



- b. Push the **I/O mem** button again and keep it pressed for the following steps:
 - After approx. 3 seconds the "OFF" symbol flashes on the display (keep pressing the button).
 - When you hear a beep, release the button immediately.
 - The Braun ThermoScan Pro 4000 is now in calibration check mode and the display is flashing and showing the "CAL" symbol.
 - Apply a new probe cover. Insert the Braun ThermoScan Pro 4000 into the 9600 Plus Calibration Tester ear device port (large port). Place the probe firmly into the ear device port.

Figure 54. Braun Ear Device Port

3. Wait approximately three seconds, press the thermometer **start** button, and watch for the “Exac Temp” light to flash.

Figure 55. Press Start Button

4. Leave the thermometer in the 9600 Plus Calibration Tester until you hear a beep. Remove the Pro 4000 Thermometer from the 9600 Plus Calibration Tester and read the temperature in the thermometer's display.
 - a. Verify that the UUT thermometer's temperature reading is within the temperature tolerance in the table.

Calibration Set Point Temperature	Temperature tolerance
96.8°F (36.0°C)	+/- 0.2°F (+/- 0.1°C)
105.8°F (41.0°C)	+/- 0.2°F (+/- 0.1°C)

- b. Wait one full minute before taking another reading with the same thermometer. Repeated measurements in short sequence may cause higher readings.
 - c. When verifying several UUT thermometers at both temperatures, it is recommended to verify all UUT thermometers at one Calibration Set Point Temperature before proceeding to the next Calibration Set Point Temperature.
 - d. Changing the Calibration Set Point Temperature (9600 Plus Calibration Tester):

To scroll from one set point to the next, press and hold the **Temperature Selection** button (up/down button) until a beep is heard. The newly selected set point appears in the upper left corner of the LCD display. The device's current temperature is displayed, starts to flash, and continues flashing until the cavity reaches the equilibrium at the new set point.
5. The Braun ThermoScan PRO 4000 thermometer will exit CAL mode after four minutes.

To begin functional verification of the Braun ThermoScan PRO 4000 thermometer Down Load:

1. Clean the probe tip with a cotton swab slightly moistened with isopropyl alcohol, remove excess alcohol with a clean cotton swab, and let air dry for 5 minutes. Do not use any chemical other than alcohol to clean the probe window.
2. Insert the Braun ThermoScan PRO 4000 thermometer into the UUT and wait for the "Exac Temp" light to go out.

Figure 56. Braun Exac Temp Light

3. Remove the Braun ThermoScan PRO 4000 thermometer from the UUT.
4. Apply a new probe cover. Insert the Braun ThermoScan Pro 4000 into the 9600 Plus Calibration Tester ear device port (large port). Place the probe firmly into the large port. See (Figure 54) "Braun Ear Device Port" on page 83. The temperature selection is non-specific for this particular test.
5. Wait approximately three seconds, press the thermometer **Start** button, and watch for the "Exac Temp" light to flash. See "Braun Exac Temp Light".
6. Leave the thermometer in the 9600 Plus Calibration Tester until you hear a beep. Remove the Pro 4000 Thermometer from the 9600 Plus Calibration Tester and read the temperature in the thermometer's display.
7. Insert the Braun ThermoScan PRO 4000 thermometer into the UUT (should be on and in normal mode). The reading from the Braun ThermoScan PRO 4000 thermometer should transfer automatically to the UUT display. Verify this action.

Changing the Calibration Set Point Temperature

To scroll from one set point to the next, press and hold the Temperature Selection button until a beep is heard. The newly selected set point appears in the upper left corner of the LCD display. The device's current temperature is displayed, starts to flash, and continues flashing until the cavity reaches the equilibrium at the new set point.

To begin functional verification of the Masimo SpO2

Use the "Masimo Tester" to verify the Masimo SpO2 functionality.

Figure 57. Masimo Tester

1. With the UUT OFF, orient the Masimo Tester such that the mini-D connector mates with the SpO2 connector on the UUT; or use appropriate Masimo extension cable to connect the Masimo Tester and UUT.
2. Power ON the Spot LXi UUT and confirm the SpO2 reading in the Display Window is $81\% \pm 3\%$ and the pulse reading is $61 \text{ bpm} \pm 1 \text{ bpm}$.

Figure 58. SpO2 Reading

3. Place the thumb and index finger on the gray buttons on either side of the Masimo Tester connector or extension cable connector; press the buttons firmly, and gently pull to remove the tester.

Note The functionality of the SpO2 module is not adjustable. If the SpO2 is not functioning properly, or the SpO2 and pulse performance cannot be verified against the calibrated simulator, contact Welch Allyn Technical Support [page iv](#).

To begin functional verification of the Nellcor SpO2

Use a Nellcor-approved SpO2 simulator (SRC-MAX) to verify the Nellcor SpO2 functionality.

Figure 59. Nellcor SpO2 Simulator



1. With the UUT ON and completely booted, orient the simulator such that the connector mates with the SpO2 connector on the UUT; or use appropriate Nellcor extension cable to connect the simulator and UUT.

Note The UUT MUST be powered on prior to connecting the Nellcor SpO2 simulator.

2. On the Nellcor simulator change the SpO2 percentage from default 75% to 90%.
3. Confirm the SpO2 reading in the Display Window is $90\% \pm 1\%$ and the pulse reading is $60 \text{ bpm} \pm 1 \text{ bpm}$.

Figure 60. SpO2 Reading and Pulse Reading

4. Remove the simulator by placing the thumb and index finger on either side of the simulator connector or extension cable connector; press the buttons firmly and gently pull to remove.

Note The functionality of the SpO2 module is not adjustable. If the SpO2 is not functioning properly, or the SpO2 and pulse performance cannot be verified against the calibrated simulator, contact Welch Allyn Technical Support [page iv](#)