R Series®
Non-Invasive Blood Pressure (NIBP)

9650-0914-01 Rev. E

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Non-Invasive Blood Pressure Monitoring (NIBP) Indication of Use

The R Series system is indicated for the non-invasive measurement of arterial blood pressure for resting patients in critical care and in-hospital transport. The NIBP feature is indicated to measure blood pressure for patients from newborn (neonate) to adult.

NIBP Contraindications for Use

There are no known contraindications for the use of the NIBP monitor.

General Information

Federal (U.S.A.) law restricts this defibrillator to sale by or on the order of a physician.

Non-Invasive Blood Pressure (NIBP)

Product Description

The Non-Invasive Blood Pressure (NIBP) option on the R Series® unit gives you the ability to take a single blood pressure measurement, STAT measurements (automatically repeated measurements over a 5 minute period), or automatic measurements at repeating pre-selected intervals. The blood pressure information (including the patient's systolic, diastolic and mean blood pressure values) is shown on the R Series monitor in the NIBP display area, on the left side of the screen.

For R Series BLS/Plus models, the NIBP option can only be used while the unit is in Manual mode.

How To Use This Manual

This insert describes how to set up and use the R Series NIBP option. Important safety information relating to the general use of the R Series NIBP option appears in "Safety Considerations" on page 2.

Before attempting to use the NIBP option, you must read and understand all the information contained in the *R Series Operator's Guide*, which provides information that operators need for the safe and effective use and care of the R Series unit.

Thoroughly read the Safety Considerations and Warnings sections in both the *R Series Operator's Guide* and the relevant inserts before operating your R Series product.

SunTech CE Contact

Direct all cuff, hose, and NIBP questions with regards to the Declaration of Conformity with European Union Directives to the authorized representative for SunTech:

SunTech Medical, Inc.
5827 S. Miami Blvd, Suite 100
Morrisville, NC 27560 USA

Safety Considerations

General NIBP Safety

- Read the *R Series Operator's Guide* and this manual insert before use.
- Ensure that the R Series NIBP option is operated by qualified personnel only.
- Consult a physician for the proper interpretation of pressure measurements.
- Do not use on patients known to be susceptible to bruising.
- Use caution when using on elderly hypertensive patients, as such patients may be more susceptible to bruising.
- Route patient hoses carefully to avoid patient entanglement, strangulation or compression of hose.
- Do not select a cuff inflation pressure that exceeds the patient's expected systolic pressure by more than 30-40 mmHg (4.0-5.3 kPa). The factory-installed default adult cuff inflation pressure is 160 mmHg (21.3 kPa) for adult patients, 120 mmHg (16.0 kPa) for pediatric patients, and 90 mmHg (12.0 kPa) for neonatal patients.
- Keep patient, hose and cuff as still as possible during measurement. Patient movement or vibrations from outside sources, particularly moving vehicles, can degrade measurement accuracy.
- Check patient regularly for signs of skin irritation or impaired circulation in the monitored limb.
- Do not use the NIBP option on a patient when the R Series unit is connected to an ECG simulator.
- If an alarm occurs while the audible alarm indicators are disabled, alarms do not sound; rather only the visual alarm indicators are displayed.
- If the accuracy of measurements is suspect, first check the patient's vital signs by alternate means. Then check the cuff, hose and R Series NIBP option for proper functioning.
- The cuff, hose, and fitting are defibrillation-protected. Using the NIBP option introduces no risk for shock due to defibrillation. The cuff and hose are non-conductive. Using the NIBP option introduces no risk for burns due to electrosurgery.
- Cuff safety and effectiveness have not been proven on pregnant women.
- Do not attach the cuff to a limb being used for IV infusions or any other intravascular access, therapy or an arterio-venous (AV) shunt.The cuff inflation can temporarily block blood flow, potentially causing harm to the patient.
- Applying the cuff over a wound can cause further injury.
- For patients that have had a mastectomy, cuff should be applied to opposite arm.
- Blood pressure measurements can be affected by the position of the patient, physiologic condition, activity level, improper cuff size/application, environment and use outside of the operating instructions detailed in this manual.
- The NIBP module may not operate correctly if used or stored outside the relevant temperature or humidity ranges described in the specifications on page 28.

Cuff and Hose Safety

- Only use cuffs, hoses, and connectors supplied or specified by ZOLL.
- Ensure that the hose is not kinked or obstructed before taking measurement.

- Do not use damaged cuffs, hoses, or connectors.
- Ensure proper cuff selection and placement to avoid inaccurate measurements or patient injury.
- Position the cuff so it is level with the heart during measurement.
- Do not attach the cuff to a limb being used for IV infusion, SpO_2 monitoring, or other monitoring equipment. Cuff inflation might block the infusion, causing harm to the patient or inaccurate SpO_2 measurements.
- Do not repeat NIBP measurements (particularly STAT measurements) at intervals less than 3-5 minutes over an extended period of time. Rapidly repeating measurement can impair circulation in the monitored limb.
- Do not sterilize or immerse the cuffs or hoses.

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NIBP Intended Use

The ZOLL R Series NIBP option is intended to be used for the non-invasive measurement of arterial blood pressure for resting patients in critical care and in-hospital transport.

The R Series NIBP option is designed to measure blood pressure for adult patients (21 years of age and older) and for pediatric patients, as described in the following table:

Pediatric Subpopulation	Approximate Age Range
Newborn (neonate)	Birth to 1 month of age
Infant	1 month to 2 years of age
Child	2 to 12 years of age
Adolescent	12-21 years of age

What Can I Do With the NIBP Option?

With the NIBP option you can do the following in **MONITOR**, **PACER**, or **DEFIB** (**ON** for BLS/Plus units, then select **Manual**) mode:

- Take a single blood pressure measurement.
- Take a STAT measurement (as many measurements – up to 10 – as possible within 5 minutes).
- Take repeated measurements at user-programmable intervals.
- Immediately abort any measurement in progress by pressing one button.
- Set the cuff inflation pressure to adjust automatically based on the previously measured systolic value.
- Display systolic, diastolic and mean blood pressure on the screen.
- Configure alarms to go off when the unit detects blood pressure values above or below user-programmable limits.
- Display a history of NIBP measurements taken in the last 4 hours.

How Do I Use the NIBP Option?

To take safe and accurate blood pressure measurements using the R Series NIBP option, you must perform the following steps, each of which corresponds to a subsequent section in this document. Read each section carefully before you use the R Series NIBP option.

1. Select the proper size cuff.
2. Connect the hose to the R Series unit and to the cuff.
3. Apply the cuff to the patient.
4. Display the NIBP menu.
5. Select the correct patient type (if the current setting is not appropriate).
6. Set the cuff inflation pressure (if the current setting is not appropriate).
7. Configure alarms (if the current settings are not appropriate).
8. Take blood pressure measurement(s).
9. Read the display.

WARNING! Do not use the NIBP option without proper training. Setting initial inflation pressure too high can result in serious injury to the patient. Patient movement, very low pulse volume, or vibration from outside sources can influence the accuracy of blood pressure measurements.

How Does the NIBP Option Work?

The patient blood pressure cuff and hose connect to the R Series unit through the NIBP connector on the rear panel of the unit. The **NIBP** button ( ) on the front panel of the R Series allows you to initiate and terminate non-invasive blood pressure measurements, whose values display in the NIBP area of the monitor. You can also initiate and terminate Auto or STAT mode measurements using the softkeys on the NIBP menu.

The ZOLL R Series NlBP Option non-invasively measures arterial blood pressure and pulse rate in resting adult, neonate and pediatric patients. By incorporating the SunTech Medical Advantage OEM BP A+ R-wave Motion Tolerance Module into the R Series Defibrillator/Monitor/Pacemaker devices, the option facilitates the ability to monitor and assess the physiological characteristics of the indicated patient populations.

The NIBP module measures the oscillometric pulses transmitted through the blood pressure cuff and hose, and calculates the blood pressure measurements accordingly. The pressure measurement cycle takes approximately 30 seconds and proceeds as follows:

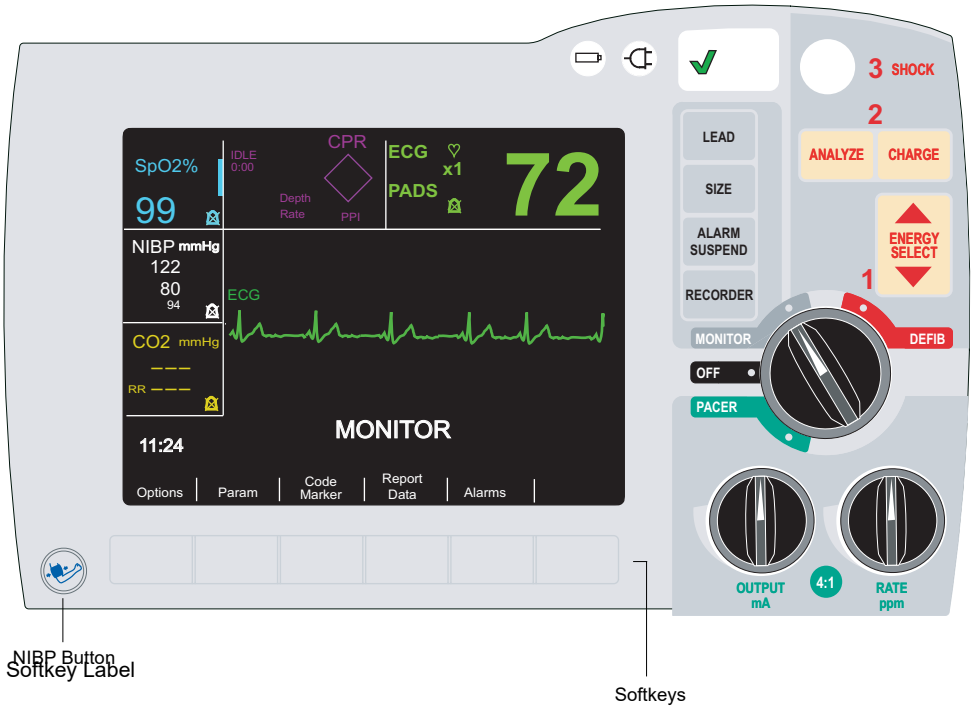
1. The cuff inflates to a preconfigured pressure (configured default value for adult patients is 160 mmHg), above the patient's systolic blood pressure, to occlude blood flow through the arteries in the monitored limb.
2. The cuff deflates incrementally, allowing blood to flow through the cuff and into the monitored limb.
3. As blood flows past the partially deflated cuff, it produces pressure oscillations that are transmitted to the R Series unit through the hose.
4. The R Series unit measures the oscillometric pulses and uses them to calculate the corresponding systolic, diastolic, and mean blood pressure, as well as the patient's pulse rate.
5. The NIBP option automatically adjusts the blood pressure measurement procedure in response to certain error conditions such as:

Condition	Adjustment/Response
The unit cannot detect systolic pressure	The unit automatically increases the cuff inflation pressure and completes the blood pressure measurement
The unit cannot detect systolic, diastolic or mean pressure after 3 minutes	The unit aborts the blood pressure measurement and deflates the cuff
The unit detects a fault	The unit displays a corresponding error message on the monitor and aborts the measurement

How Do I Read the Display?

After each measurement, the NIBP display area displays measured systolic, diastolic, and mean blood pressure values.

To facilitate quick reaction in emergency situations, you can control certain NIBP features by pressing the NIBP button ( ) at the lower left-hand corner of the unit. To access other NIBP features, you must press a softkey with the appropriate softkey label.

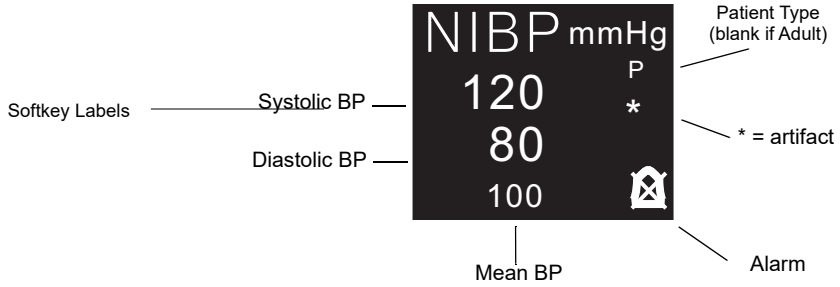


Note: Depending on the options included in your R Series unit, your display may differ slightly from the illustrations in this insert.

The NIBP display area on the left side of the monitor screen consists of:

NIBP Display Area

- Symbols that represent the status of blood pressure measurements.
- Numbers that represent the measurement values (refer to the following figure).



When taking a reading, the screen will display only the current cuff pressure.

The symbols below show the current status or action being taken.

Display Symbols	Status
NIBP	Idle, or taking a single measurement
STAT alternating with NIBP	Taking a STAT measurement
AUTO alternating with NIBP	Taking an Auto measurement
	Alarms enabled
	Alarms disabled
P	Pediatric Patient Type
N	Neonatal Patient Type
*	Artifact indicator

The artifact indicator is shown when the R Series unit detects artifact in the signal. Under such circumstances, the displayed pressure values may be inaccurate. Perform additional blood pressure measurements before taking clinical action. If you repeatedly obtain artifact, use alternate techniques to obtain blood pressure prior to taking clinical action.

Note that the R Series default unit of measure is millimeters of mercury (mmHg), but you can configure the R Series to display kilopascals (kPa). Refer to the *R Series Configuration Guide* for information on configuring alternate units of measure.

Preparing to Take Measurements

The following sections describe how to prepare to take measurements.

Selecting the Proper Size Cuff

The NIBP option comes with a cuff that inflates to cut off the patient's blood flow and then deflates slowly to allow the blood flow to resume gradually. To take accurate measurements, you must use the proper sized cuff. Bladder length should be at least 80 percent of the limb circumference, while the cuff width should be equal to 40 percent of the limb circumference.

Select the appropriate size cuff for the patient from the following table:

Limb Circumference	Cuff
38 to 50 cm (14.96 to 19.69 in.)	Thigh
31 to 40 cm (12.20 to 15.75 in.)	Large Adult
23 to 33 cm (9.06 to 12.99 in.)	Adult
17 to 25 cm (6.69 to 9.84 in.)	Small Adult
12 to 19 cm (4.72 to 7.48 in.)	Child
8.0 cm to 15.0 cm (3.1 to 5.9 in.)	Neonate #5
7.0 to 13.0 cm (2.8 to 5.1 in.)	Neonate #4
6.0 to 11.0 cm (2.4 to 4.3 in.)	Neonate #3
4.0 to 8.0 cm (1.6 to 3.1 in.)	Neonate #2
3.0 to 6.0 cm (1.2 to 2.4 in.)	Neonate #1

Caution You must use the 3 m hose when making neonatal NIBP measurements with the R Series. The 3 m hose (ZOLL Part No. 8000-0662) is standard on R Series units. Do not use the 1.5 m hose when making neonatal NIBP measurements; the cuff may not inflate, causing the unit to abort the NIBP measurement.

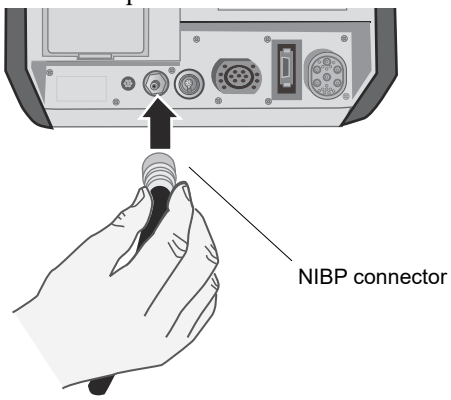
You can order additional cuffs and hoses from ZOLL Medical Corporation. See “NIBP Accessories” on page 24.

Connecting the Hose

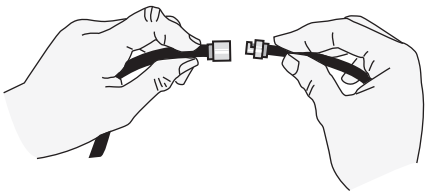
The NIBP option comes with a hose that has a plastic connector on one end and a metal connector on the other end; you must attach the hose to both the R Series unit rear panel using the metal connector and the cuff’s hose using the plastic connector. The cuff has its own short length of hose with a connector on the end. This connector fits into the end of the hose that is not connected to the R Series unit.

To connect the hose:

1. Insert the metal connector on the NIBP hose into the NIBP connector at the back of the R Series unit and push the connector until it snaps into place.



2. Insert the plastic connector on the NIBP hose into the cuff hose connector, and twist the connectors until they lock into place.



You can now apply the cuff to the patient.

Applying the Cuff to the Patient

Using a cuff that is too small or is loosely applied results in values higher than the patient's actual blood pressure. Using a cuff that is too large results in values lower than the patient's actual blood pressure.

To apply the cuff to the patient:

1. Ensure the patient is sitting or lying down with the limb relaxed, extended, and placed on a smooth surface for support. If the patient is seated, they should have legs uncrossed, feet flat on the floor and back and arms supported. The patient should be comfortable, relaxed as much as possible and not talking during the NIBP measurement.
2. Place the cuff 2 to 5 cm above the elbow crease or 5 to 10 cm (1.9 to 3.9 in.) above the knee crease. The middle of the cuff should be at the level of the right atrium of the heart (heart level).

Caution Do not place the NIBP cuff on the same arm/leg as an SpO_2 sensor. Inflation of the cuff causes the SpO_2 monitor to read incorrectly. Also, do not attach the cuff to a limb being used for IV infusion. Cuff inflation might block the infusion, causing harm to the patient.

Caution Ensure that the cuff is at the same level as the right atrium of the heart. If the cuff is located below the patient's right atrium, the blood pressure measurements display false high readings. If the cuff is located above the patient's right atrium, the blood pressure measurements display false low readings.

3. Adjust the cuff so that the artery marker on the cuff is over the artery, pointing to the hand or foot.
4. Check that the cuff ends between the range lines marked on the cuff. If not, use a different size cuff.
5. Wrap the deflated cuff snugly around the limb without impeding blood flow.
6. Ensure that the hose is routed to avoid kinking or compression.

You can now access the NIBP features.

Accessing NIBP Features

Unless you are sure that the NIBP patient type, cuff inflation and alarm settings are appropriate for the patient, display the NIBP menu before you take a blood pressure measurement. When you first turn on the R Series unit, the NIBP settings are at their default values.

While the factory-installed default settings are appropriate for most adult patients, do not assume the settings are at their default. A previous user may have:

- Changed the settings (if you did not turn on the R Series unit).
- Reconfigured the default settings.

Use the default settings unless they are clearly inappropriate for the patient. Any changes to these settings remain in effect until either the settings are again changed, or for 10 seconds after the R Series unit is turned off. If you have not received training on setting NIBP features, do not use the NIBP option.

To facilitate quick reaction during emergency situations, you can directly access many NIBP features without displaying the NIBP menu (see the following table).

WARNING! **Do not start NIBP measurements unless you are sure that the cuff inflation and alarm settings are appropriate for the patient. Incorrect settings can result in patient injury or inaccurate measurements.**

Task	Action
Taking a single measurement	Press the **NIBP** button ( ).
Taking STAT measurements	Press and hold the **NIBP** button ( ) for two seconds (if the NIBP Button Press and Hold configuration option is set to NIBP STAT), or see the next section, “Displaying the NIBP Menu.”
Taking automatic measurements	Press and hold the **NIBP** button ( ) for two seconds (if the NIBP Button Press and Hold configuration option is set to NIBP AUTO), or see the next section, “Displaying the NIBP Menu.”
Aborting measurement in progress	Press the **NIBP** button.
Changing NIBP settings	See “Displaying the NIBP Menu” on page 12.

Displaying the NIBP Menu

Unless it is an emergency situation where quick reaction is essential, you should always check that the cuff inflation and alarm settings are set properly before taking a measurement. You can display the NIBP menu without leaving MONITOR, DEFIB or PACER mode. BLS/Plus units must be in Manual mode to display the NIBP menu.

To display the NIBP menu:

1. Press the **Param** softkey.

   If the **Param** softkey label is not displayed, press the **Return** softkey until it is displayed. The R Series unit displays the Parameter menu:

2. Press the **NIBP** softkey.

   The R Series unit displays the NIBP menu:

- **NIBP Stat**: Take a STAT blood pressure measurement, as many as possible (up to 10) in 5 minutes.
- **NIBP Auto**: Take an automatic blood pressure measurement at regular intervals (the default is 30 minutes)
- **NIBP PT. Type**: Select the patient type of Adult, Pediatric, or Neonatal
- **Settings**: Adjust the settings for Cuff Inflation or Auto Interval.
- **Trend**: View the patient trend data.

Selecting the Patient Type

On R Series units, you can select a patient type for NIBP measurements: adult, pediatric, or neonate. The patient type setting determines the default cuff inflation pressure, as well as default alarm limits for high/low systolic, diastolic and mean blood pressure values.Unless configured otherwise, the R Series defaults to adult patient mode when initially powered on. See the *R Series Configuration Guide* for more information.

Note: When you change the patient type setting, the unit clears any currently displayed NIBP values from the display. You must reinitiate NIBP measurement to display new blood pressure values.

To change the Patient Type setting:

1. Press the **NIBP PT. Type** softkey from the NIBP menu. If the **NIBP PT. Type** softkey label is not displayed, see “Displaying the NIBP Menu” above.

   The R Series displays the NIBP Patient menu. The current patient type setting is highlighted.

2. Press the **NIBP Adult**, **NIBP Ped**, or **NIBP Neonate** softkey to select the appropriate patient type setting.

   The unit displays a Patient Type indicator in the NIBP display area (“P” for pediatric mode, or “N” for neonatal mode, blank for adult mode), and automatically updates the default cuff inflation pressure and default alarm settings accordingly.

Note: If you press the **Return** softkey, the R Series unit returns to the NIBP menu without changing the patient type setting.

Selecting Cuff Inflation Settings

Before taking a measurement, ensure that the cuff inflation settings are appropriate for the patient. To measure a patient’s blood pressure, the cuff begins the measurement cycle by inflating to a pressure higher than the patient’s systolic blood pressure. This value is called the *cuff inflation pressure*. During an NIBP measurement, the R Series unit may increase the cuff inflation pressure over the initial value to obtain a systolic reading.

By default, the cuff inflation pressure for the first measurement after power-up is set as follows:

- 160 mmHg (21.3 kPa) for adult mode
- 120 mmHg (16.0 kPa) for pediatric mode
- 90 mmHg (12.0 kPa) for neonatal mode

Use the default setting unless it is clearly inappropriate. Any changes to this setting remain in effect until either the setting is changed or 10 seconds after the R Series unit is turned off (returning the setting to its default).

As a safety feature, the cuff can never be inflated to more than 300 mmHg (40.0 kPa) in adult or pediatric mode, and 150 mmHg (20.0 kPa) in neonatal mode.

Setting Cuff Inflation Pressure

Before taking a measurement, check that the cuff inflation pressure is appropriate for the patient. The cuff inflation pressure options are:

Adult	Pediatric	Neonatal
120 mmHg (16.0 kPa)	80 mmHg (10.7 kPa)	60 mmHg (8.0 kPa)
140 mmHg (18.7 kPa)	90 mmHg (12.0 kPa)	70 mmHg (9.3 kPa)
160 mmHg (21.3 kPa)	100 mmHg (13.3 kPa)	80 mmHg (10.7 kPa)
180 mmHg (24.0 kPa)	110 mmHg (14.7 kPa)	90 mmHg (12.0 kPa)
200 mmHg (26.7 kPa)	120 mmHg (16.0 kPa)	100 mmHg (13.3 kPa)
220 mmHg (29.3 kPa)	130 mmHg (17.3 kPa)	110 mmHg (14.7 kPa)
240 mmHg (32.0 kPa)	140 mmHg (18.7 kPa)	120 mmHg (16.0 kPa)
260 mmHg (34.7 kPa)	150 mmHg (20.0 kPa)	130 mmHg (17.3 kPa)

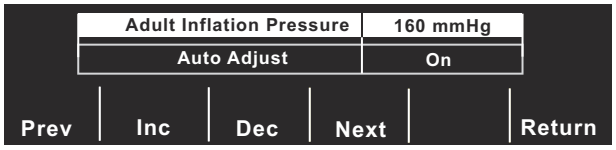
See the *R Series Configuration Guide* for information on reconfiguring the cuff inflation pressure default setting.

WARNING! Do not set cuff inflation pressure too high, particularly for neonatal, pediatric, or frail patients. Serious injury can result.

To set the cuff inflation pressure:

1. Press the **Settings** softkey, then the **Cuff Inflation** softkey from the NIBP menu. If the **Cuff Inflation** softkey is not displayed, see “Displaying the NIBP Menu” on page 12.

   The R Series unit displays the Cuff Inflation menu:



2. Press the **Next** softkey if “Inflation Pressure” is not highlighted.
3. Press the **Inc** or the **Dec** softkey to select cuff inflation pressure.
4. Press the **Return** softkey to return to the NIBP menu.

The cuff inflation pressure is set.

Auto Adjust

The R Series unit automatically adjusts the cuff inflation pressure for all subsequent measurements to 30 mmHg (4.0 kPa) greater than the systolic value of the previous measurement. This default setting is called *Auto Adjust*. For example, the cuff inflates to 180 mmHg for the first measurement and the unit obtains a systolic reading of 110 mmHg. For the next measurement, the cuff inflates to 140 mmHg (i.e., 110 + 30 = 140).

If the Auto Adjust feature is set to OFF, the selected cuff inflation pressure is used for all measurements. If the Auto Adjust feature is set to ON, the selected cuff inflation pressure is used for the first measurement only.

Turning Off Auto Adjust

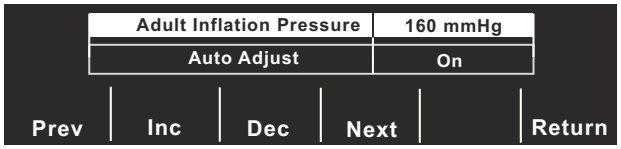
You should turn off the Auto Adjust feature in situations where the R Series unit might inflate the cuff to levels that can cause discomfort or harm to the patient. For example, when the patient is:

- being transported over a very bumpy road
- moving the monitored arm
- a small child

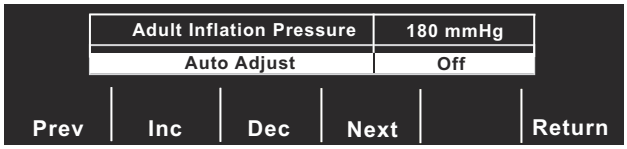
When you turn the Auto Adjust feature off, the R Series unit repeats the same cuff inflation pressure for every measurement. Because this method does not readjust to the patient's previously measured blood pressure, do not use fixed cuff inflation pressures unless you have received the proper training.

To turn off Auto Adjust:

1. Press the **Cuff Inflation** softkey from the NIBP menu.
   If the **Cuff Inflation** softkey is not displayed, see "Displaying the NIBP Menu" on page 12.
   The R Series unit displays the Cuff Inflation menu:



2. Press the **Next** softkey until Auto Adjust is highlighted.
3. Press the **Inc** softkey until Auto Adjust is set to OFF:



4. Press the **Return** softkey to return to NIBP menu.

The R Series unit repeats the selected cuff inflation pressure for every measurement.

Setting Alarms

The R Series NIBP option includes blood pressure alarms for the measurements shown in the following table.

Before taking a measurement, ensure that all the NIBP alarms settings are appropriate for the situation. See the *R Series Operator's Guide* for instructions on setting alarms. When an NIBP or heart rate alarm is triggered, the unit automatically initiates a single blood pressure measurement. See the *R Series Configuration Guide* for instructions on how to enable/disable this automatic measurement.

Patient Type	Alarm Parameter		Default Setting	Range (increments of 5)
Adult	Systolic	High	160 mmHg (21.3 kPa)	80-260 mmHg (10.7-34.7 kPa)
		Low	90 mmHg (12.0 kPa)	40-140 mmHg (5.3-18.7 kPa)
	Diastolic	High	110 mmHg (14.7 kPa)	50-200 mmHg (6.7-26.7 kPa)
		Low	50 mmHg (6.7 kPa)	25-100 mmHg (3.3-13.3 kPa)
	Mean	High	130 mmHg (17.3 kPa)	60-220 mmHg (8.0-29.3 kPa)
		Low	60 mmHg (8.0 kPa)	30-120 mmHg (4.0-16.0 kPa)
Pediatric	Systolic	High	145 mmHg (19.3 kPa)	80-160 mmHg (10.7-21.3 kPa)
		Low	75 mmHg (10.0 kPa)	35-140 mmHg (4.7-18.7 kPa)
	Diastolic	High	100 mmHg (13.3 kPa)	50-130 mmHg (6.7-17.3 kPa)
		Low	35 mmHg (4.7 kPa)	20-100 mmHg (2.7-13.3 kPa)
	Mean	High	110 mmHg (14.7 kPa)	60-140 mmHg (8.0-18.7 kPa)
		Low	50 mmHg (6.7 kPa)	30-120 mmHg (4.0-16.0 kPa)
Neonate	Systolic	High	100 mmHg (13.3 kPa)	60-130 mmHg (8.0-17.3 kPa)
		Low	50 mmHg (6.7 kPa)	25-120 mmHg (3.3-16.0 kPa)
	Diastolic	High	70 mmHg (9.3 kPa)	30-105 mmHg (4.0-14.0 kPa)
		Low	30 mmHg (4.0 kPa)	20-100 mmHg (2.7-13.3 kPa)
	Mean	High	80 mmHg (10.7 kPa)	35-110 mmHg (4.7-14.7 kPa)
		Low	35 mmHg (4.7 kPa)	30-105 mmHg (4.0-14.0 kPa)

When the R Series unit is turned on, all alarm functions are disabled, and the alarm limits are set to their default values for the selected patient type. Any changes to these settings remain in effect until either the settings are changed for the patient type or for 10 seconds after the R Series unit is turned off. You can configure the default alarm limits at power-up; see the *R Series Configuration Guide* for more information.

Setting Alarm Limits

You can change all the alarm limits using standard R Series procedures. See the *R Series Operator's Guide* for instructions on setting alarm limits.

You can set the alarm limits using the Auto function, or you can choose your own limits (see the preceding table). The Auto function sets the high limit to 30 mmHg (4.0 kPa) above and the low limit to 20 mmHg (2.7 kPa) below the last measurement.

Enabling, Disabling, and Suspending Alarms

You can activate and deactivate all NIBP alarms, as well as disable audible NIBP alarm indicators, using standard R Series procedures; refer to the *R Series Operator's Guide* for instructions.

Changing the status of one NIBP alarm automatically sets all the other NIBP alarms to the same status. For example, if you enable the systolic alarm, all other NIBP alarms are automatically activated. Similarly, if you deactivate the diastolic alarm, all other NIBP alarms are automatically deactivated. Activating or deactivating NIBP alarms or disabling audible NIBP alarm indicators does not affect the status of other R Series alarms.

Suspending an NIBP alarm disables the audible indicators until after the completion of the next measurement. All visual alarm indicators remain active.

Triggering NIBP Measurements

You can configure the R Series unit to take a single NIBP measurement after the heart rate alarm is triggered and/or the NIBP alarm is triggered. See the *R Series Configuration Guide for* further details.

Setting Motion Tolerance

You can configure the R Series unit to compensate for motion tolerance during patient movement, such as on a moving stretcher. The motion tolerance option is not supported for neonatal patients. See the *R Series Configuration Guide* for details on how to change this setting.

Taking Measurements

This section describes how to take each type of measurement (a single measurement, a STAT measurement, or an automatic measurement). You can take any type of measurement whether you are in MONITOR, DEFIB or PACER mode (ON for BLS/Plus models, in Manual mode only) except in the following cases:

- The defibrillator is charged or charging.
- The previous measurement occurred within 30 seconds in automatic interval measurement mode.

To immediately abort any measurement in progress and deflate the cuff, press the NIBP button. As a safety feature, the R Series unit does not take measurements within 30 seconds of another completed measurement when in automatic interval measurement mode.

If the R Series unit finds a fault, a message displays on the screen. See "Troubleshooting" on page 25 for a list of NIBP display messages and their corresponding corrective action.

WARNING! **If the R Series unit takes a measurement but detects the presence of artifact in the signal (denoted by "*" in the NIBP display area), the measurement may not be accurate. Under such circumstances, perform additional blood pressure measurements. If you repeatedly obtain artifact, use alternate techniques to determine blood pressure prior to taking clinical action.**

When reading the blood pressure values on the display, keep in mind that the following conditions can influence NIBP measurements:

- Position of the patient
- Position of the cuff relative to the patient's heart
- Physical condition of the patient
- Patient limb movements
- Convulsions or tremors
- Very low pulse volumes
- Premature ventricular beats
- Vibrations in the cuff or hose caused by moving vehicles
- Improper cuff size or application

WARNING! **Do not begin NIBP measurements unless the patient type setting is appropriate for the patient. Taking NIBP measurements on a pediatric or neonatal patient while the unit is in adult mode can result in inaccurate measurements and injury to the patient. Taking NIBP measurements on an adult patient while in pediatric or neonatal mode can result in inaccurate measurements.**

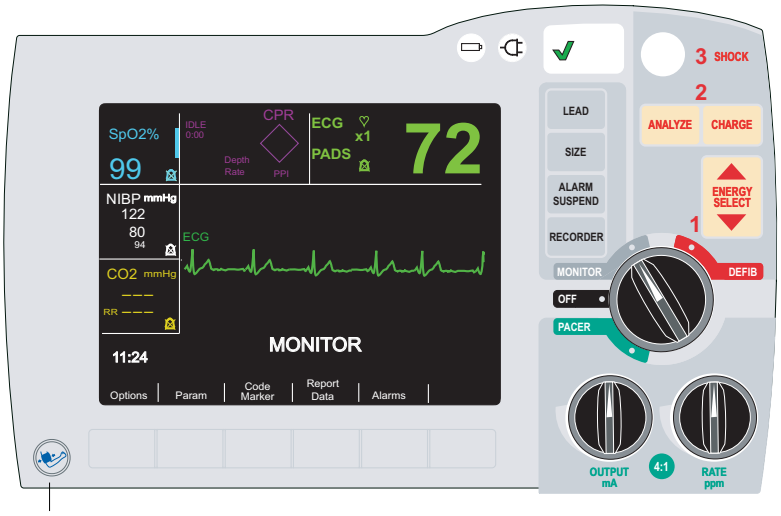
Taking a Single Measurement

You can take a single measurement by pressing the NIBP button ( ) unless the R Series defibrillator is charged or charging.

Caution Make sure that no measurement is being taken when you start a new measurement. If you press the NIBP button while the R Series unit is taking a measurement, the measurement aborts immediately and the cuff deflates.

Caution Before taking the first measurement, a period of at least 5 minutes should elapse to give time for blood pressure stabilization.

To take a single measurement, press the NIBP button on the R Series front panel.



NIBP Button

The R Series unit takes one blood pressure measurement.

Taking STAT Measurements

You can set the R Series unit to take a STAT measurement, which consists of the unit taking as many blood pressure measurements as possible (up to 10) in five minutes. When the R Series unit finishes taking a measurement and the cuff deflates, it immediately starts another measurement.

Whenever practical, allow several minutes between STAT measurement sequences to restore full circulation to the monitored limb. Before initiating STAT measurements, allow the cuff pressure to deflate below 15 mmHg which will reset the adult mode safety pressure timer. In order to meet adult safety regulations, the safety timer will time out if the pressure does not drop down below 15 mmHg within 180 seconds regardless of how many measurements are performed within that time period.

WARNING! **Repeated use of STAT measurements on the same patient over a short time interval can affect blood pressure readings, limit circulation to the limb, and cause injury to the patient.**

You cannot set the R Series unit to take STAT measurements while the defibrillator is charged or charging. Charging the defibrillator aborts all STAT measurements and deflates the cuff.

Starting STAT Measurements

To start STAT measurements, either:

- Press the **NIBP** button ( ) and hold for two seconds (if the unit is configured to do so), or
- Press the **NIBP Stat** softkey.

  If the **NIBP Stat** softkey label is not displayed, see “Displaying the NIBP Menu” on page 12.

If the R Series unit is configured to automatically generate strips, it prints a history of the STAT measurements at the end of the 5-minute period.

Caution Before taking the first measurement, a period of at least 5 minutes should elapse to give time for blood pressure stabilization.

Aborting STAT Measurements

You can abort STAT measurements at any time. Doing so terminates the current measurement and all subsequent measurements.

To abort STAT measurements, either:

- Press the **NIBP** button ( ), or
- Press the **NIBP Stat** softkey.

  If the **NIBP Stat** softkey label is not displayed, see "Displaying the NIBP Menu" on page 12.

The R Series unit immediately aborts all measurements, and the cuff deflates.

Taking Automatic Measurements

You can set the R Series unit to automatically take a series of measurements at selected intervals. For example, if you set the R Series unit to take an automatic measurement with an interval of 15 minutes, it immediately takes a measurement, waits 15 minutes, takes another measurement, waits another 15 minutes, and so on.

To take automatic measurements at set intervals, you must:

1. Set the measurement interval (if not set to desired value).
2. Start automatic measurements.

Setting the Measurement Interval

Before you take automatic measurements, ensure that the measurement interval is properly set. The measurement interval is the time period between when one measurement starts and the next measurement starts. The measurement interval options (in minutes) are: 2.5, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 30, 45, 60, 90, and 120.

When you turn on the R Series unit, the measurement interval is set to the default value of 30 minutes. To change the default, see the *R Series Configuration Guide*.

To set measurements intervals:

1. Press the the **Settings** softkey, then the **Auto Interval** softkey from the NIBP menu.

   If the **Settings** softkey is not displayed, see "Displaying the NIBP Menu" on page 12.

   The R Series unit displays the Auto Interval menu:

2. Press the **Inc** or the **Dec** softkey to scroll through the interval options.

3. Press the **Return** softkey to select the desired measurement interval and return to NIBP menu.

The measurement interval sets and remains until 10 seconds after the R Series unit is turned off, or the value is reset.

Starting Automatic Measurements

To start automatic measurements, either:

- Press the **NIBP** button ( ) and hold for 2 seconds (if the unit is configured to do so), or
- Press the **NIBP Auto** softkey. If the **NIBP Auto** softkey label is not displayed, see "Displaying the NIBP Menu" on page 12.)

The R Series unit takes a measurement, and repeats subsequent measurements at the selected interval.

Note that if the defibrillator is charged or charging when the R Series unit is about to take an automatic measurement, it aborts the blood pressure measurement. All subsequent automatic measurements take place at their scheduled time.

Note: If it is necessary to replace the battery of the R Series unit and AC power is not connected during an automatic NIBP interval, the interval will be extended by the time it takes to replace the battery up to 10 seconds.

Caution Before taking the first measurement, a period of at least 5 minutes should elapse to give time for blood pressure stabilization.

Taking an Additional Measurement

You can take an immediate measurement between the automatic measurements except when:

- The R Series unit is currently taking a measurement.
- The defibrillator is charged or charging.

To take an additional measurement, press the **NIBP** button ( ).

The R Series unit takes an extra measurement without altering the timing of the other measurements. It does not start a new automatic measurement unless 30 seconds have elapsed since the end of the previous completed measurement cycle. If the extra measurement completes less than 30 seconds before a scheduled measurement, the R Series unit omits the scheduled measurement.

Aborting a Single Measurement

When the R Series unit is taking automatic measurements, you can stop a single blood pressure measurement by pressing the **NIBP** button.

The R Series unit immediately stops taking the measurement and deflates the cuff, but takes all subsequent automatic measurements at their selected interval.

Stopping All Automatic Measurements

You can stop all upcoming blood pressure measurements. If the R Series unit is taking a measurement, it completes the current measurement, but does not take any subsequent measurements.

To stop automatic measurements, simply press the **NIBP Auto** softkey. (If the NIBP Auto softkey label is not displayed, see “Displaying the NIBP Menu” on page 12.)

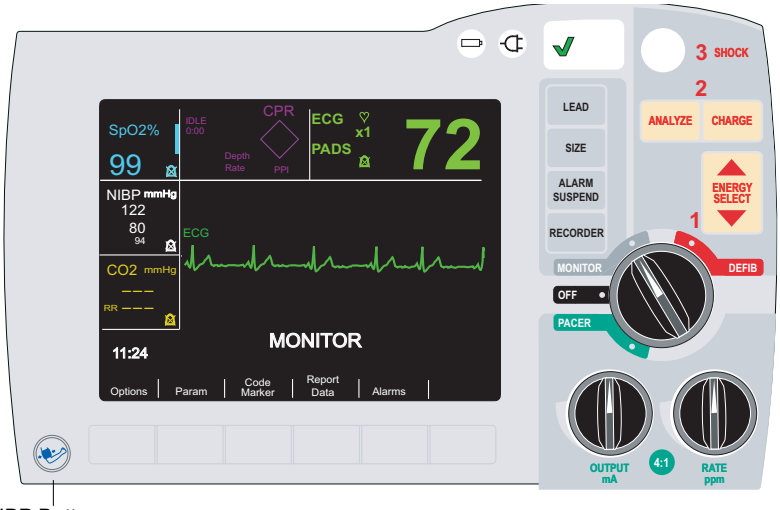
Aborting Measurements

You can immediately abort a blood pressure measurement at any time whether you are in MONITOR, DEFIB or PACER mode (ON for BLS/Plus models, in Manual mode only).

To abort the current measurement:

- Press the **NIBP** button ( ) on the R Series front panel.
  The R Series unit immediately stops taking the measurement, displays the *NIBP MEAS ABORTED* message, and deflates the cuff.

WARNING! **Make sure that a measurement has already started before attempting to abort. If you press the NIBP button while a measurement is not being taken, the R Series unit starts a new measurement.**



Note that:

- If you press the NIBP button while taking a STAT measurement, the R Series unit terminates all subsequent measurements.
- If you press the NIBP button while the R Series unit is taking an automatic measurement, it aborts the current measurement, deflates the cuff, and takes all subsequent measurements at the set interval.

Viewing Trend Data

To view the patient's trend data over the past 4 hours, press the **Trend** softkey. The time, HR/PR, and readings will be displayed.

TIME	HR/PR	SpO2 %	NIBP mmHg SYS	DIA	M	
11:22	92	99	127	81	96	
11:27	91	99	127	81	96	
11:32	91	98	126	72	99	
11:37	92	99	126	73	100	
11:42	72	98	86	65	72	*
11:47	86	99	88	54	65	
11:52	87	97	81	53	62	
11:57	91	98	125	72	99	
12:02	92	99	127	81	96	

Print | Older | Newer | Return

Measurements with alarm values are highlighted; an asterisk (*) shows measurements that contain artifact.

Press **Older** to view previous entries if available; press **Newer** to return to newer entries. The screen updates automatically during automatic or STAT measurements.

Press the **Print** softkey to print the displayed measurements.

Press the **Return** softkey to return to the main menu.

The patient's trend data is cleared when the R Series unit remains off for more than 10 seconds.

Printing Data

A strip recorder is provided with the R Series unit to document events and data. See the "Recorder Operation" section of the *R Series Operator's Guide* for instructions on how to record data. If you have already taken NIBP measurements, press the RECORDER button to print a stripchart that includes the following values for the currently displayed measurement:

- Systolic blood pressure
- Diastolic blood pressure
- Mean blood pressure
- Pulse rate
- Time of measurement

Checkout Procedure

Perform the following checkout procedure daily to ensure that the NIBP option is functioning properly. This daily checkout procedure also ensures that medical personnel maintain familiarity with the proper use of the NIBP option.

For more specific instructions on how to accomplish each step listed below, refer to the related section in this manual.

Perform the daily checkout procedure as follows:

1. Select the proper size cuff, as described in “Selecting the Proper Size Cuff” on page 8.
2. Connect the hose to the R Series unit and to the cuff, as described in “Connecting the Hose” on page 9.
3. Apply the cuff to a human test subject, as described in “Applying the Cuff to the Patient” on page 10.
4. Set the cuff inflation pressure (if current setting is not appropriate), as described in “Setting Cuff Inflation Pressure” on page 14.
5. Take a blood pressure measurement.

   During cuff inflation, inspect cuff, hoses, and connectors for air leakage. If a leak is present, correct, replace, or service item.
6. Verify that the unit displays no error messages.
7. Verify that the displayed blood pressure values are correct.
8. With alarms enabled, verify that the patient alarms are functional by adjusting the high and low limits and repeating the above blood pressure measurement. Check that the unit:
   - emits a continuous audio tone, and
   - highlights the alarming parameter’s value and flashes the alarm symbol on the display.
9. Visually inspect hose, hose connector, and cuffs for signs of damage. If damaged, replace the damaged item.

Cleaning or Disinfecting the Hose and Reusable Cuffs

Follow your local protocols for cleaning or disinfecting the equipment.

Cleaning prodecure

You can clean the hose and reusable cuffs by applying a damp cloth or brush to the surface; air dry before use.

Disinfecting procedure

It is recommended to disinfect the equipment after each use.

Important: Before disinfecting, ensure that no liquid enters tubing by using a plug or taping off.

1. Spray the cuff with Quaternary Ammonium until soaked.
2. Leave to soak for at least 10 minutes.
3. Rinse with distilled water, ensuring that liquid does not enter tube connector. Air dry.

NIBP Accessories

The following accessories can be used with the R Series NIBP option:

NIBP CUFFS		
Cuffs	**Limb Circumference**	**REF**
Thigh (Reusable)	38 to 50 cm (14.96 to 19.69 in.)	8000-1654
Large Adult (Reusable)	31 to 40 cm (12.20 to 15.75 in.)	8000-1653
Adult (Reusable)	23 to 33 cm (9.06 to 12.99 in.)	8000-1651
Small Adult (Reusable)	17 to 25 cm (6.69 to 9.84 in.)	8000-1650
Child (Reusable)	12 to 19 cm (4.72 to 7.48 in.)	8000-1655
Neonate #5 (Disposable)	8.0 cm to 15.0 cm (3.1 to 5.9 in.)	8000-0644
Neonate #4 (Disposable)	7.0 to 13.0 cm (2.8 to 5.1 in.)	8000-0643
Neonate #3 (Disposable)	6.0 to 11.0 cm (2.4 to 4.3 in.)	8000-0642
Neonate #2 (Disposable)	4.0 to 8.0 cm (1.6 to 3.1 in.)	8000-0641
Neonate #1 (Disposable)	3.0 to 6.0 cm (1.2 to 2.4 in.)	8000-0640

NIBP HOSES		
Hoses	**Length (m)**	**REF**
Air hose with pneumatic fittings	3 m (9.8 ft.)	8000-0662
Air hose with pneumatic fittings	1.5 m (4.9 ft.)	8000-0655

Troubleshooting

The following table lists the error messages and problems associated with the NIBP option and the associated corrective action(s). Read this section carefully. For further assistance, call ZOLL Technical Service at 1-800-348-9011. International customers should call the nearest authorized ZOLL Medical Corporation representative.

Message/Symptom	Problem	User Action
--- (dashed lines in NIBP field)	No NIBP measurement has been taken. The last measurement taken has expired after 120 minutes. The patient type has been changed.	None, normal operation. Repeat NIBP measurement.
CALIBRATE NIBP	NIBP calibration is incomplete or failed	Recalibrate NIBP. (See the *R Series Service Manual* for details).
NIBP COMM ERROR	There is a communication problem with the NIBP module.	Cycle power and retry. If problem persists, return for service.
NIBP FAULT	No communication from the NIBP module. NIBP module failed self-test.	Cycle power, and retry. If the problem persists, return for service.
NIBP MEAS ABORTED	Cuff inflation pressure is set too high for attached cuff. Inflation is too fast. R Series is unable to find systolic value for 180 seconds. Defibrillator is charged or charging. User initiated abort.	Verify that you are using proper size cuff. Check for cuff and hose blockages. Confirm that the unit was not charging. If the problem persists, return for service.
NIBP NOT READY	The defibrillator is charged or charging in progress. NIBP module is performing power-up self-test.	Wait until the unit discharges before taking the next measurement. Wait for more than 10 seconds after power-up before taking blood pressure measurements.
NIBP OUT OF RANGE	The data from the NIBP module is out of range.	Measure patient's blood pressure with other equipment. Check cuff fit and positioning. Switch cuff to other arm. If problem persists, return for service.
REPEAT NIBP MEAS	The unit exceeded the maximum number of inflation attempts. The unit exceeded the 180-second measurement time limit.	Check cuff and hose. Repeat NIBP measurement.
REPEAT NIBP MEAS alternating with *CHECK CUFF/HOSE*	Blood pressure cuff or hose is not installed correctly. Cuff or hose is faulty. Hose kinked or disconnected. Inflation rate too fast or too slow.	Check cuff connection to hose. Check hose connection to unit. Check for kinked hose or air leaks in the hose. If problem persists, replace cuff then hose.

Message/Symptom	**Problem**	**User Action**
REPEAT NIBP MEAS alternating with *NIBP ARTIFACT*	The unit is unable to detect systolic, diastolic or mean blood pressure due to excessive motion or vibration.	Take a single blood pressure measurement. Keep patient as still as possible. Insulate patient, cuff and hose from vibrations as much as possible.
REPEAT NIBP MEAS alternating with *NIBP SIGNAL WEAK*	There is a weak or no oscillometric signal.	Check cuff fit and positioning. Check hose connection to unit. Check for kinked hose. Increase cuff inflation pressure if clinically appropriate.
SYSTEM FAULT	Communication problem with the NIBP module.	Cycle power, and retry. If problem persists, return for service.
NIBP box displays a large “X”	Communication problem with the NIBP module.	Cycle power, and retry. If problem persists, return for service.
NIBP M.T. OFF	The NIBP motion tolerance feature is not functioning properly.	If problem persists, return for service.
False high reading	Cuff too small. Cuff not centered over brachial artery. Cuff too loose. Patient’s limb below level of heart.	Select larger cuff. Readjust cuff. Reapply cuff or select smaller cuff. Raise patient’s limb to heart level.
False low reading	Cuff too large. Limb above level of heart.	Select smaller cuff. Lower patient’s limb to heart level.

Specifications

Principle of Operation	Oscillometric
Warm-up Time	Operational in less than 10 seconds
Regulatory Standards	IEC 80601-2-30: 2018 IEC 81060-2:2013
NIBP Measurement Range	Systolic Adult: 40 – 260 mmHg; 5.3 – 34.6 kPa Pediatric: 40 – 160 mmHg; 5.3 – 21.3 kPa Neonatal: 40 – 130 mmHg; 5.3 – 17.3 kPa Diastolic Adult: 20 – 200 mmHg; 2.7 – 26.7 kPa Pediatric: 20 – 120 mmHg; 2.7 – 16.0 kPa Neonatal: 20 – 100 mmHg; 2.7 – 13.3 kPa Mean Adult: 30 – 220 mmHg; 4.0 – 29.3 kPa Pediatric: 30– 133 mmHg; 4.0 – 17.7 kPa Neonatal: 30 – 110 mmHg; 4.0 – 14.6 kPa
NIBP Measurement Accuracy	Per AAMI SP10 +/- 5 mmHg (0.7 kPa) mean difference; 8 mmHg (1.1 kPa) standard deviation[a b]
NIBP Measurement Resolution	1 mmHg; 0.13 kPa
NIBP Measurement Cycle Time	Typical: 30 seconds Worst Case: 180 seconds
Pulse Rate Range	30 – 220 pulses per minute
Pulse Rate Accuracy	±2% or ±3 bpm, whichever is greater
Pulse Rate Resolution	1 bpm (beats per minute)
Alarm Limits	Systolic Adult High 80 – 260 mmHg; Low 40 – 140 mmHg; High 10.7 – 34.7 kPa Low 5.3 – 18.7 kPa Pediatric High 80 – 160 mmHg; Low 35 – 140 mmHg; High 10.7 – 21.3 kPa Low 4.7 – 18.7 kPa Neonatal High 60 – 130 mmHg; Low 25 – 120 mmHg; High 8.0 – 17.3 kPa Low 3.3 – 16.0 kPa Diastolic Adult High 50 – 200 mmHg; Low 25 – 100 mmHg; High 6.7 – 26.7 kPa Low 3.3 – 13.3 kPa Pediatric High 50 – 130 mmHg; Low 20 – 100 mmHg; High 6.7 – 17.3 kPa Low 2.7 – 13.3 kPa Neonatal High 30 – 105 mmHg; Low 20 – 100 mmHg; High 4.0 – 14.0 kPa Low 2.7 – 13.3 kPa Mean Adult High 60 – 220 mmHg; Low 30 – 120 mmHg; High 8.0 – 29.3 kPa Low 4.0 – 16.0 kPa Pediatric High 60 – 140 mmHg; Low 30 – 120 mmHg; High 8.0 – 18.7 kPa Low 4.0 – 16.0 kPa Neonatal High 35 –110 mmHg; Low 30 – 105 mmHg; High 4.7 – 14.7 kPa Low 4.0 – 14.0 kPa

Operating Time (with SpO_2, $EtCO_2$ and NIBP options)	For a new, fully charged lithium ion battery pack at 20°C (68°F): • 90 defibrillator discharges at maximum energy (200 J), or • 2.75 hours minimum of continuous ECG monitoring and blood pressure measurements once every 5 minutes, or 2.25 hours of continuous ECG monitoring/pacing at 60 mA, 70 beats per minute.
Environmental	Operating Temperature: 0° to 40° C (32º to 104º F) Storage Temperature: -20° to 60° C (-4º to 140º F) Humidity: 5 to 95% relative humidity, non-condensing
Electromagnetic Immunity	AAMI DF-80; EN 61000-4-3: 2002, 10 V/m
Operating Pressure	594 to 1060 mBar

[a] Blood pressure measurements determined with this device are equivalent to those obtained by a trained observer using the cuff/stethoscope auscultation method, within the limits prescribed by the American National Standard, Electronic or Automated Sphygmomanometers (AAMI SP10). To receive a copy of the report containing the AAMI SP10 test results, contact ZOLL Technical Support at (800) 348-9011 or (978) 421-9655.

[b] This device was clinically investigated to the requirements of IEC 81060-2:2013.