

# THE DINAMAP® DIFFERENCE

## A GUIDE TO OUR NIBP TECHNOLOGY

### OUR TECHNOLOGICAL ADVANTAGES

#### THE OSCILLOMETRIC METHODOLOGY

Oscillometry is the most commonly used means of indirect blood pressure measurement in automated devices. It is based on the principle that pulsatile blood flow through an artery creates oscillations of the arterial wall. Oscillometric devices utilize a blood pressure cuff to sense these oscillations that appear as tiny pulsations in cuff pressure. By measuring and analyzing at various cuff pressures the amplitude (which changes based on the pressure within the cuff) and frequency of these pulsations (which is dependent on the patient's heart rate), oscillometric devices can non-invasively determine blood pressure and pulse rate.

Although most blood pressure technologies utilize some variant of the Oscillometric Method, there are differences in how it is implemented. These differences are typically related to cuff inflation and deflation and the process used to measure and validate pulsations. The purpose of this document is to outline how DINAMAP® Technology implements Oscillometry and to illustrate our technological advantages.

#### THE ANATOMY OF A DINAMAP® NIBP DETERMINATION

A typical DINAMAP® determination consists of the following steps (please refer to diagram on page 4):

1. A cuff is placed on an extremity and inflated to a target inflation pressure. This pressure is dependent on the patient type and the initial target pressure preset in Manual Mode or about 30 mmHg above the previous Systolic Pressure in Automatic Mode. In order to accurately determine Systolic Pressure, the target inflation pressure must be high enough to occlude the underlying artery.



### **ADVANTAGE: BLOOD PRESSURE CUFF SIZING**

One of the most important factors in ensuring the accuracy of a blood pressure reading is cuff sizing. The American Heart Association recommends that cuff bladder width and length be 40% and 80% respectively of the arm circumference. We offer a choice of six adult/pediatric and five neonatal blood pressure cuff sizes all of which are tested to ensure accurate measurement. Each cuff is clearly labeled with the appropriate range of arm circumference to allow the user to easily select the correct cuff.

### **ADVANTAGE: SYSTOLIC SEARCH CAPABILITIES**

If the initial inflation pressure is not high enough to occlude the artery, the Systolic Search feature incorporated into DINAMAP® Technology recognizes the lack of a systolic pressure and immediately re-inflates the cuff to search and identify systolic. This enhances the speed of the monitor while ensuring patient comfort especially in Hypertensive situations. Typically, competitive technologies will proceed through the entire determination cycle and then re-inflate the cuff until systolic is found.

2. Once at the desired target inflation pressure, the blood pressure cuff is deflated incrementally in steps (stepped-deflation) between 5 to 10 mmHg (depending on the cuff pressure and the device being used) to a pressure below the patient's diastolic pressure.

### **ADVANTAGE: STEPPED-DEFLATION**

Oscillometric technologies only receive a sample when there is a pulse present. In a given time, fewer samples are received for lower pulse rates than for higher. Some competitive technologies deflate the cuff continuously in a linear or fixed-rate bleed (linear-deflation). The problem is that at lower pulse rates, this can produce oscillometric profiles that are under-sampled and can contribute to errors in blood pressure accuracy and at higher pulse rates, time is wasted while over-sampling extends determination time which can contribute to patient discomfort. With stepped-deflation, the deflation rate is based on the patient's pulse which results in a constant number of samples for all pulse rates -- no more or no less than the number needed for an accurate and comfortable determination.

3. At each step during the deflation process, the monitor measures two consecutive pulsations in cuff pressure. If their amplitude differs by no more than an acceptable small amount and the time interval between them matches previous time intervals, then the pulsations are averaged and stored along with the corresponding cuff pressure. The cuff is then deflated to the next step. If either of the above criteria is not met, the cuff pressure is maintained until two consecutive pulsations are detected that do. Eventually, if the cuff is maintained at one pressure step for longer than one minute or the determination time exceeds two minutes, the monitor will timeout with an error code. This patented process of finding two matched pulsations of relatively equal amplitude and frequency at each step rejects artifact due to patient movement or other deviation from ideal conditions (e.g. cuff disturbances) and greatly enhances the overall accuracy of the monitor.



Diagram 1A - Without Motion Artifact

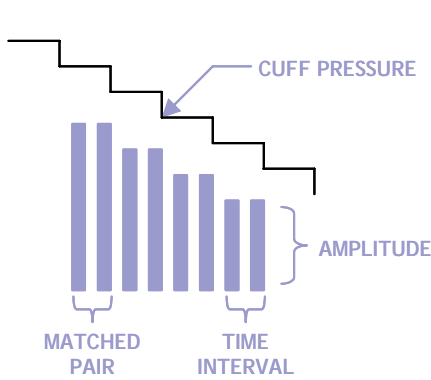
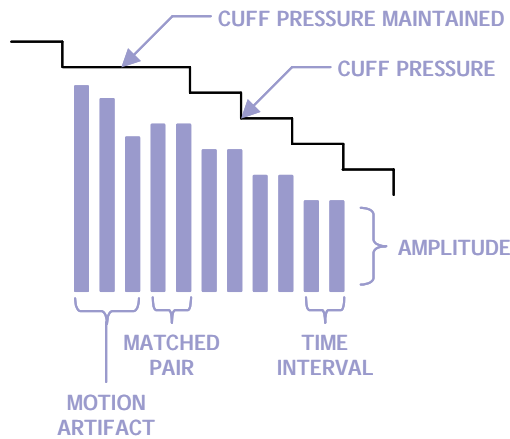


Diagram 1B - With Motion Artifact



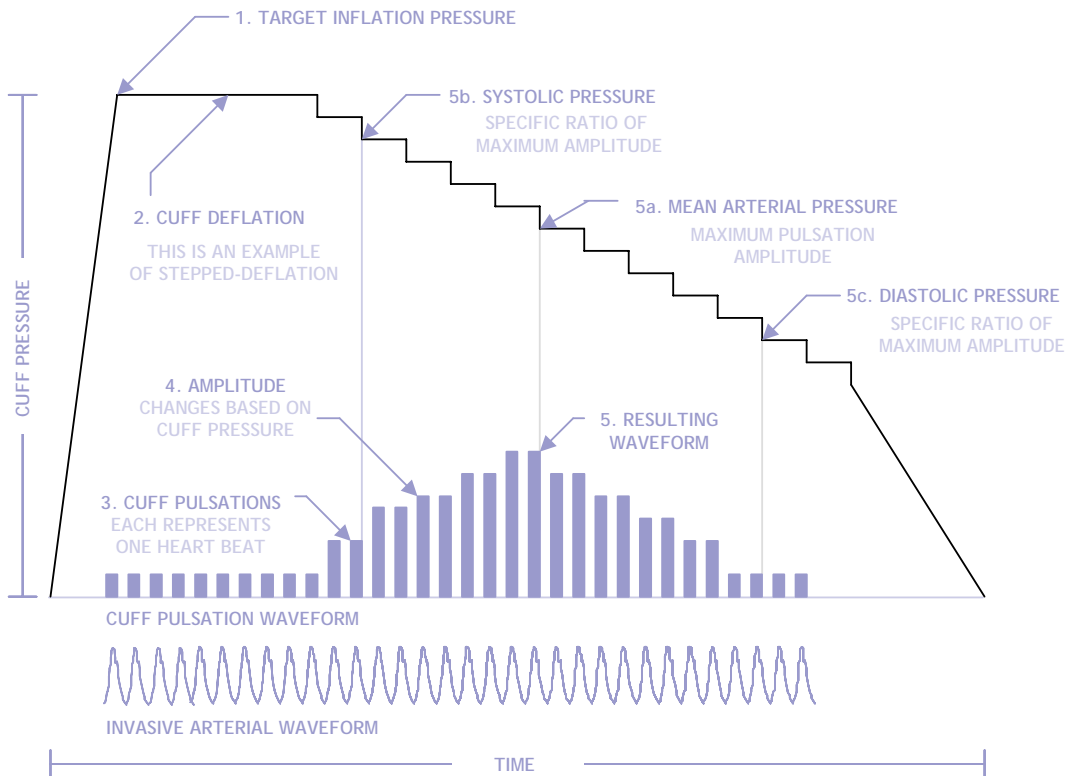
4. As the blood pressure cuff is deflated and greater flow is established beyond the cuff, the amplitude of the pulsations begins to change. The time interval between the pulsations, however, remains the same (again, because they correspond to the patient's pulse rate).

#### ADVANTAGE: TWO-TUBE INFLATE/MONITOR SYSTEM

When a patient's blood pressure is very low (e.g. Shock), the amplitude of the cuff pulsations become very small and difficult to measure. Under these conditions, it is essential that no dampening of the cuff pulsation signal occurs. Otherwise, the accuracy and length of the determination and thus, patient comfort, may be affected or the device may not make a determination at all. Competitive monitors utilize a single-tube inflate/monitor system, where the pump and pressure transducer are connected to the same pneumatic line. As a result, signal amplitude can be reduced by energy lost in pushing air back through the pump to the transducer. DINAMAP® Technology, on the other hand, employs a two-tube inflate/monitor system where cuff inflation is achieved through one of the tubes and pulsation are sensed through the other. This system ensures that no dampening of the cuff pulsation signal occurs.

5. At the end of the determination, the pattern of changes in the amplitude of the pulsation versus cuff pressure is analyzed to determine blood pressure. Our algorithm first determines the oscillation amplitude at Mean Arterial Pressure (MAP) which is the lowest cuff pressure at which maximum pulsation amplitudes are sensed (assume that it is equal to a value of 1). Next, it reviews the oscillation data obtained at cuff pressures above MAP and finds the pressure at which the oscillation amplitude is about 0.50, this is Systolic Pressure. Finally, it reviews the oscillation data for cuff pressures below MAP and finds the pressure at which the oscillation amplitude is about 0.625, this is Diastolic Pressure. Since these points (mean arterial pressure, systolic and diastolic) don't always occur exactly at a pressure step, the algorithm may need to interpolate cuff pressures and oscillation amplitudes between pressure steps.





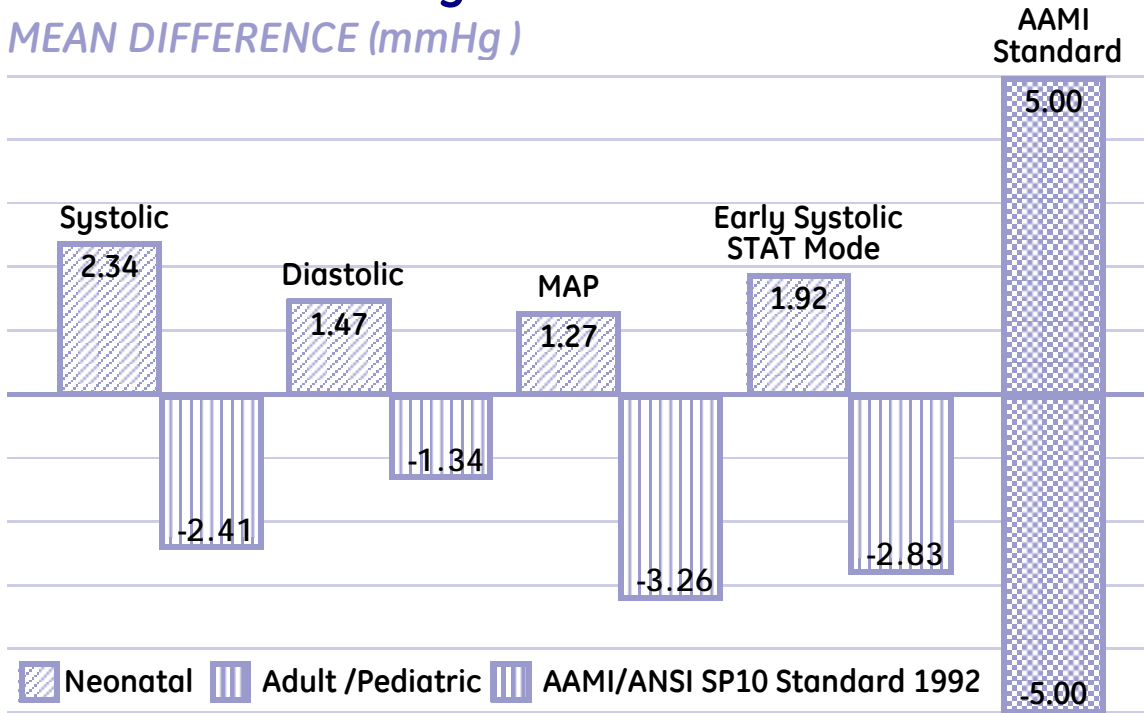
## TECHNOLOGY DEFINES THE DINAMAP® DIFFERENCE

Based on the technological advantages outlined in this document and protected by over 30 patents, DINAMAP® Technology has set the standard for accuracy and reliability in non-invasive blood pressure determination; whether it be in the monitoring of Hypertensive Patients, Hypotensive Patients or in the presence of Motion Artifact. To support our accuracy statements, we typically refer to independent or third-party clinical studies which provide an unbiased assessment of a device's accuracy. Since its introduction in 1976, there have been many independent clinical studies published which have described the operation and accuracy of DINAMAP® Technology. Most of these studies show that, with attention to proper use, accuracy of the DINAMAP® Technology is well within published standards as compared to a centrally placed arterial catheter. This is why thousands of satisfied customers worldwide trust DINAMAP® Technology for blood pressure measurement accuracy, dependability, and reliability each and every day.



# DINAMAP Accuracy

MEAN DIFFERENCE (mmHg)



THE DINAMAP® DIFFERENCE – IT'S WHAT'S INSIDE THAT COUNTS.  
FOR MORE INFORMATION, PLEASE CONTACT YOUR LOCAL SALES REPRESENTATIVE.

