

PHYSICAL MEASUREMENT PROTOCOLS

*It is essential that **ALL TECHNICIANS FOLLOW THE PROTOCOL AS WRITTEN**, since even a seemingly unimportant omission or variation in technique can make a significant difference in the measurements recorded. If you must deviate from the protocol it is important that you send a request for assistance via the LABS helpdesk for instructions on how to proceed.*

5.1.1 Blood Pressure (BP) & Resting Heart Rate

BP equipment must be inspected and validated on a weekly basis as detailed in the equipment's user manual. The operator needs to be trained and certified. All BP readings should be recorded on the right arm that has been bared from the shoulder. Long sleeves must be pushed up or removed to avoid interference with the cuff.

If for any reason (e.g., mastectomy, arterial-venous fistula, lymph dissection, or other reason) the patient's blood pressure cannot be measured using the right arm then take the measurement using the left arm. If blood pressure cannot be measured using either arm, record -5 (not done) for both diastolic and systolic values.

Materials Needed:

- Welch Allyn Spot Vital Signs monitor 4200B
- Regular adult arm, large adult arm, and thigh blood pressure cuffs
- Gullick II Tape Measure (model 67020)
- Dark-colored cosmetic pencil is also helpful for marking the skin when finding the location of the arm circumference measurement.

Preparation:

The proper cuff size must be used to avoid under- or over-estimating BP when using indirect methods of measurement. To determine the proper cuff size, the operator must measure the arm circumference at the midpoint of the right arm. The midpoint of the arm is the point located half-way between the elbow and shoulder.

With the patient standing and holding the arm bent at the elbow with hand resting lightly on hip, fingers forward with thumb pointing to the rear, the arm length is measured from the acromion (or bony extremity of the shoulder girdle) to the olecranon (or the tip of the elbow), with a tape measure, allowing the tape to hang freely over the olecranon. The midpoint is marked on the dorsal surface. (A cosmetic pencil may be used to make this mark and can be easily removed later). The patient should then relax the arm along the side of the body. Pull an appropriate amount of tape out of the housing. Ensure that tape is in contact with but not indenting soft tissues. Align the tape at zero "zero line", along side of the tape graduations. Place one end of the tape around the mark on patient's arm. Wrap the tape around the patient's arm. Care must be taken to keep the tape horizontal. Pull on the end of the tensioning mechanism until the calibration point can be seen.

Calibration Point: When you pull slightly harder and harder on the tensioning device, two colored beads will be seen, separated by a silver disk separating the two beads. When you see one of the two, you are at the "calibration point". ***Four ounces is approximately equal to the force required to lift a stack of U.S. quarters. If the beads start to disappear into the end cap of***

the tensioning device, you are using too much force.

Cuff size is then determined from the chart below. The sizes for cuffs overlap to provide flexibility in cuff-size selection. The first choice for cuff should always be for the larger size. Because it is often difficult to fit a cuff correctly on an obese person's upper arm, an incorrect fit can result in readings that are too high or too low. If a participant's upper arm circumference indicates use of the thigh cuff, but the arm is too short for the cuff, or the cuff does not remain secured when inflated, the long arm cuff or a conical (curved) thigh cuff should be used.

If it is not possible to take an upper arm blood pressure due to cuff size, and the patient's arm circumference is between 32-44 cm, a forearm blood pressure is acceptable if calculated using the following equation (Pierin 2004):

$$\begin{aligned} \text{systolic pressure} &= 33.2 + (0.68 \times \text{forearm systolic pressure}) \\ \text{diastolic pressure} &= 25.2 + (0.59 \times \text{forearm diastolic pressure}) \end{aligned}$$

The patient's arm circumference and equation must be written on the paper LABS collection form if using this method. The re-calculated blood pressure is acceptable for both the Research Coordinators Assessment Form (RCAB, RCAF) and the 400 Meter Corridor Walk Eligibility form (WEF).

If the patient does not meet the arm circumference criterion (32-44cm), the forearm measurement is not acceptable and blood pressure must be recorded as -5 (not done).

NOTE: *Cuff size must be determined at each visit.*

CUFF SIZE INDICATED BY MEASURED ARM CIRCUMFERENCE

CUFF SIZE (cm)	ARM CIRCUMFERENCE (cm)
11 (Regular)	25.3-34.4cm
12 (Large)	32.1-43.4cm
13 (Thigh)	40.7-55.0

Measurement:

1. The measurement of heart rate and BP should be performed after the patient has been seated quietly, with feet flat on the floor, in an erect but comfortable posture for at least five minutes, and for at least thirty minutes since the patient has smoked or consumed caffeine-containing beverages.

2. Place the blood pressure cuff, as determined in the arm measurement procedure, around the bare upper right (or left, if right can not be used) arm so that the midpoint of the length of the bladder lies over the brachial artery and the mid-height of the cuff is at heart level. The lower edge of the cuff, with its tubing connections, should be placed about one inch above the natural crease across the inner aspect of the elbow. The cuff is wrapped snugly about the arm, with the palm of the patient's hand turned upward. The wrapped cuff should be secured firmly by applying pressure to the locking fabric fastener over the area where it is applied to the cuff.

3. Record the blood pressure on the data collection instrument.

HEART RATE

4. Record the heart rate on the data collection instrument. Note: Heart Rate is determined as an adjunct to the blood pressure measurement.
5. Remove the cuff and store the equipment safely after the last reading.

5.1.2 Heart Rate (HR) (Polar Heart Monitor/Manual instructions)

Special note: Prior to using the Polar Heart Monitor, it is important to read the entire instructions as outlined in the user manual.

I. Setting Alarm with lower limit and upper limit on the wrist unit:

Before using the wrist unit, make sure that the heart rate limits and alarm is set. **You should make sure that it is set with a lower limit of 40 and upper limit of 135 before each 400 meter walk test.**

1. In the Time of Day display, press the front button until **ZONE** is displayed. Wait for three seconds to enter the target zone alarm setting.
2. **BEEP** is displayed for two seconds. **ON** or **OFF** is flashing. Press the front button to select **ON**. Wait until **OK?** is displayed. To approve your choice press the front button. The wrist unit goes to the manual setting of the heart rate limits.
3. **HIGH** is displayed for two seconds: When (-)/(+) is on the display, change the upper limit to 135.
4. When the desired value is on the display, wait until **OK?** is displayed. Press the front button to approve your choice.
5. **LOW** is displayed for two seconds: When (-)/(+) is on the display, change the lower limit to 40.
6. When the desired value is on the display, wait until **OK?** is displayed. Press the front button to approve your choice.

II. How to wear the transmitter:

1. Moisten the two grooved electrode areas on the back of the transmitter.
2. Attach one end of the transmitter to the elastic strap. Secure the strap around the patient's chest, just below the chest muscles, adjusting the strap length to fit snugly and comfortably. Attach the strap to the other end of the transmitter – see *diagram below or the instructions included with the monitor.*



3. Check that the wet electrode areas are firmly against the patient's skin and that the Polar logo is in a central, upright position.

III. Measuring resting heart rate:

1. Have the patient wear the wrist unit and the transmitter.
2. In the Time of Day display, press the front button to enter the menu. EXE (exercise) is displayed.
3. After three seconds the wrist unit goes into exercise mode and the stopwatch starts. The stopwatch is displayed and the outline of the heart symbol will flash until the patient's heart rate is detected.
4. The patient's heart rate and the heart symbol will appear within 15 seconds. A flashing heart symbol indicates an ongoing heart rate measurement. The heart symbol flashes at the pace of your heart.

NOTE:

- Please allow sufficient time for signal pick up.
- If the wrist unit does not receive your heart rate, the stopwatch keeps running and the flashing heart frame symbol disappears. Check that the transmitter electrodes are wet and the strap is snug enough.

IV. Measuring Average Heart Rate

1. In the Time of day display press the front button until **FILE** is displayed.
2. Wait for three seconds to enter the file. Total exercise duration is displayed.
3. Press the front button. The average heart rate of the session is displayed.

V. Maintenance

- The Polar Heart Rate Monitor is water resistant and can be cleaned using mild soap and water solution. Dry it carefully with a soft towel. NEVER USE ALCOHOL or any abrasive material, such as steel wool or cleaning chemicals. This may damage the electrodes. The straps provided with the monitor should also be cleaned between each use by washing it with mild soap or dipping it in alcohol. Allow it to drip dry.
- Never store the transmitter wet. Sweat and moisture can keep its electrodes wet and the transmitter activated, which shortens the battery lifespan.
- Store your heart rate monitor in a cool and dry place. Do not store it in any kind of non-breathing material, such as a plastic bag if it is wet.
- Keep your heart rate monitor out of extreme cold and heat. The operating temperature is 14 °F to 122 °F/ -10 ° C to +50 ° C.
- Do not expose the heart rate monitor to direct sunlight for extended periods, such as by leaving it in a car.

VI. Interference during exercise

Electromagnetic Interference may occur near high voltage power lines, motor-driven exercise equipment, cell phones or when walking through electric security doors. Details are provided in the Polar User Manual.

VII. Measuring Heart Rate Manually:

If you are unable to measure heart rate using the pulse monitor, the resting heart rate may be measured indirectly by placing the fingertips on a pulse site. To determine the number of beats per minute, take the resting pulse rate for a full minute, or for 30 seconds and then multiply by two. One of the points at which the resting pulse can be accurately measured by palpation is at the radial pulse on the wrist, in line with the base of the thumb. Place the tips of your index and middle fingers (not the thumb, which has a pulse of its own) over the artery and lightly apply pressure.

5.1.3 Neck Circumference

Materials Needed:

- Gulick II Tape Measure (model 67020)

Preparation:

All patients are being asked to have this measurement taken over bare necks. Explain the procedure to the patient. Ask the patient to remove only the clothing necessary to complete the measurement, such as turtle necks or other high collar shirts. Every measure should be taken to protect the patient's sense of dignity.

Measurement:

1. Verify that the patient is standing erect, weight split between feet, arms at side with feet together

2. Pull an appropriate amount of tape out of the housing.
3. Visually assess the midpoint between the patient's chin and clavicle. Have patient hold tape at midpoint. Take the neck measurement in horizontal plane. Ensure tape is snug, but not indenting soft tissues.
4. Align the tape at zero along side of the tape graduations. You will want to pull gently on the end of the tensioning mechanism until the calibration point can be seen. Have the patient inhale and exhale normally. When they exhale take the measurement. Warn the patient that they may experience slight discomfort from the slight pressure that you will add to get an accurate measurement.
5. Release the tape measure and repeat the above steps. If the two measures are within 2 cm of each other, the measurement is complete. Record both measurements on the **Data Collection Form**. If the two measures are not within 2 cm of each other, a third measurement should be taken and recorded on the form.

5.1.4 **Waist Circumference**

Materials Needed:

- Gulick II Tape Measure (model 67020)
- Washable marker or cosmetic pencil

Preparation:

Explain the procedure to the patient. Ask the patient to remove only the clothing necessary to complete the measurement in non-restrictive garments (i.e., girdles, control top panty hose, etc.). Every measure should be taken to protect the patient's sense of dignity.

Measurement:

1. Have the patient stand erect with their abdomen relaxed, arms at sides and feet together.
2. Face the patient. The waist measurement should be taken around the abdomen horizontally at the midpoint between the highest point of the iliac crest (hip bone) and lowest part of the costal margin (ribs) in the mid-axillary line – imagine a vertical line going through the patient's head and into their feet, standing erect. Mark the midpoint on both sides of the patient using a washable marker or cosmetic pencil. It may be helpful to have the patient identify these reference points.
3. Pull an appropriate amount of tape out of the housing. Ensure that tape is in contact with, but not indenting soft tissues.
4. Align the tape at zero "zero line", along side of the tape graduations. Place one end of the tape on the mark made on the patient's right side. Have the patient secure that end of the tape to the mark by placing your finger tip on the end of the tape in order to secure it on the mark. Wrap the tape around the patient's waist, making sure that the tape is horizontal and crosses over the mark on the left side of the patient, until the tape reaches the secured end of the tape.

5. Pull on the end of the tensioning mechanism until both colored beads can be seen. Note that this is more tension than what is used for the neck, which is measured using the calibration point on the tape measure.
6. When the tape is positioned in the horizontal plane at the correct height, ensure that the zero end of the tape is below measurement value.
7. Ask the patient to keep their arms at their sides and breathe naturally. After the patient exhales, read the measurement next to the tape's "zero line" and record the circumference to the nearest 0.1 centimeter.
8. Release the tape measure and repeat the above steps. If the two measures are not within 2 cm of each other, a third measurement must be taken and recorded on the form.

5.1.5 Body Composition

Materials Needed:

- Tanita Scale
- Printer/Paper for printer

Preparation:

Because Tanita's body composition analyzers send a weak electrical current through the body, patients who have a pacemaker or other internal electronic medical device are excluded from this measurement. The weak electrical signal may cause such internal devices to malfunction.

Patients are also excluded from the body composition measurement if they exceed 600 lbs. or if they refuse to remove shoes/wear hospital gown during the analysis.

Measurement:

1. The Tanita scale should always be used on a flat, stable surface.
2. Ask patient to remove shoes and socks/hose. Because the body composition analyzer uses a minor electric current to measure impedance, best results will be observed when measurement is taken in bare feet. Poor contact between the feet and electrodes may produce an error message. Also, the sole of the feet should be free of excess dirt, as this may act as a barrier to the electric current. ***Please note that if there are calluses on the soles of the feet accurate measurement may still be possible. Place 0.5cc of saline or water in the center of each electrode. This will act as a conductive material and may allow the current to pass freely through a thin barrier.***
3. Press the [ON/OFF] key to turn on the Power. Adjust measurements by pressing [kg/lb] if needed, to record patient's weight in lbs.

4. You will then be prompted to enter patient's clothes weight. **For the purposes of LABS-2, the patients clothes weight must be listed as 0 lbs.**
5. Select either standard male or standard female. *LABS will not be using the athletic male or athletic female settings from the four listed gender and body types.*
6. Enter patient's age.
7. After age is entered, the arrow will automatically advance to height. Using Feet and Inches, measurement is made to the First Decimal Place by 0.5 inch increments, example 5 ft. 7.5 inches, press the [5] [7] [.] [5] keys and for 6 ft 0 inches, press [6] [0] [.] [0] keys. When using the lb. mode, height will automatically round up or down to the nearest .5 inch or whole number. **Note that coordinators will collect the height from the LABS-1 Pre-Operative Evaluation Form. If height is missing from that form, coordinators should measure the height of the patient as outlined in the LABS-1 MOP.**
8. After entering the above data, the flashing arrow will appear next to STEP ON, after the LCD displays "8888".
10. Patient should be asked to step slowly onto the weighing platform. If the patient's inner thighs are touching (which is very likely), a thin piece of cardboard or towel should be placed between the thighs because touching legs may affect the measure. Heels should be placed directly on top of the posterior electrodes, while the front part of the foot needs to be in contact with the anterior electrodes.
11. After weight stabilizes, impedance measurement is taken. This is denoted by four "bubbles" which appear on the bottom half of the LCD. As the measurement is being taken, the bubbles will begin to disappear one by one. **The patient must remain on the platform until the final bubble has disappeared and the display emits a short beep.**
12. Weight and percent body fat will be displayed on the LCD and detailed results will print out. It is suggested that you print this report twice; with one copy being given to the patient and the other being kept in the patients research file for reference at later visits. The weight and percent body fat will remain on the screen for ten seconds before returning to gender and body type screen.
13. If all measurements are complete, press the [ON/OFF] key to turn off the power.
14. After each use, the weighing platform should be cleaned with alcohol pads or appropriate disinfectant. Follow directions for cleaning the platform as outlined in the instruction manual provided with your equipment.

Repeating the Measurement:

If the value is below the baseline or follow-up cut point (see below), the body fat % measurement must be repeated. The repeat measurement value should be recorded on the appropriate LABS-2 form regardless of whether it is the same or different from the original measurement. Copies of both measurement printouts should be placed in the research chart (indicate on each printout which is the original and which is the repeat).

For all LABS-2 primary bariatric surgeries, a body fat % of **less than 40%** must be repeated. The

repeat measurement should be recorded on the LABS-2 form.

For all LABS-2 subsequent surgeries, revisions or reversals and follow-up appointments, a body fat % of **less than 25%** must be repeated. The repeat measurement should be recorded on the LABS-2 form.

When repeating the body fat measurement:

- 1) check to make sure that the soles of the feet are free of excess dirt, as this may act as a barrier to the electric current.
- 2) If there are calluses on the soles of the feet, place 0.5cc of saline or water in the center of each electrode. This will act as conductive material and may allow the current to pass freely through a thin barrier.
- 3) If it appears that the skin of a participant's inner thighs are touching, a thin piece of cardboard or towel should be placed between the participant's thighs. Tanita customer service has indicated that the electrical current that measures body fat % flows up one leg, across the trunk and back down the opposite leg. It is possible that the electrical current may not complete its full path if inner thighs are not separated.
- 4) Make sure that heels are placed directly on top of the posterior electrodes, while the front part of the foot is in contact with the anterior electrodes.

REFERENCES

- Pierin, A. M.G., Alavarce, D. C., Gusmao, J. L., Halpern, A. & Mion, D. Jr. Blood pressure measurement in obese patients: comparison between upper arm and forearm measurements. *Blood Pressure Monitoring* 2004; 9(3):101-105.