

PERFORM Operating Document

Use and Cleaning Procedures for Manual and Automatic Aneroid Sphygmomanometers

PC-POD-CP-002-v03

Revision History

Version	Reason for Revision	Date
03	Removed summary section, removed table of contents, removed definition of terms section, removed relevant documents section, added some measurement precisions throughout document, removed section entitled "Procedure using the Accutorr V-Mindray automated blood pressure system during exercise", updated reference list, removed appendix (training record form).	December 20, 2021

I. Introduction

1.1 Background

The content of this PERFORM Operating Document (POD) provides guidelines for the safe use and cleaning procedures of sphygmomanometers of both manual and automatic systems at the PERFORM Center, Concordia University. Manual and automatic aneroid sphygmomanometers are systems used to accurately measure arterial blood pressure (BP) at rest and during exercise. Due to the scarcity in evidence-based research on how to properly measure BP, our team met on several occasions to come to a consensus on the guidelines on which to base the current POD. The recommendations used in the present POD are mainly based on the Canadian Hypertension Education Program (CHEP) and are considered Grade D evidence (weakest evidence, based on low power, imprecise studies or expert opinion alone). On occasion, where guidelines differed, the team came to a

consensus on which guideline to follow, keeping in mind the context in which the guidelines will be used.

1.2 Purpose

The objectives of the current POD are to 1) outline the procedure of using both manual and automatic aneroid sphygmomanometer systems; and 2) provide a set of standard practices for the safe operation of the systems at the PERFORM Centre, Concordia University.

1.3 Scope

This POD applies to all users and supervisors using the manual and automatic aneroid sphygmomanometer systems at the PERFORM Centre, Concordia University. Any other document other than this POD is out of scope for this operating procedure.

1.4 Responsibility

It is the responsibility of all users and supervisors to ensure that this POD is followed.

2. Pre-measurement Procedure

- 2.1 Take note of BP measurement if participant has had a prior evaluation.
- 2.2 If participant is prescribed anti-hypertensive medication, ask if they have already taken their medication.
- 2.3 Participants should refrain from smoking cigarettes, eating, exercising, or ingesting caffeine for at least 30 minutes preceding the measurement.^{1,4}

3. Blood pressure protocol at rest

There are numerous protocols used for the measurement of blood pressure both at rest and during exercise. These protocols will be determined by the users.

3.1 Procedure using manual aneroid sphygmomanometers at rest

- 3.1.1 Measurements should be taken with a sphygmomanometer known to be accurate (i.e., well maintained and calibrated).^{2,3,4,7}
- 3.1.2 Explain measurement procedure to participant. Instruct participant to relax and to not talk during measurements.^{2,3,7}

- 3.1.3 Participants should be seated quietly for at least 5 minutes in a chair with arm bare, back supported, both feet flat on the floor, legs uncrossed and their arms supported at heart level.^{1,2,4,3,5,7}
- 3.1.4 Determine appropriate cuff size for participant.^{1,2} The bladder length should encircle at least 80% of the upper arm^{1,2,5} and/or the cuff's index line (i.e., edge of cuff) falls within the cuff range line limit.
- 3.1.5 Palpate brachial artery with index and middle finger.¹
- 3.1.6 Place the cuff so that the lower edge is 2-3 cm above the elbow crease and the bladder is centered over the brachial artery.^{4,7} Wrap cuff firmly and evenly around participant's bare upper left arm at heart level (tight enough so that two fingertips can be slipped under the top edge of the cuff^{4,5}), as lower position or loose fitting will result in an erroneously higher systolic and diastolic blood pressure.^{1,2,4}
- 3.1.7 Determine the pulse-obliteration pressure to estimate systolic pressure.
 - 3.1.7.1 Close the sphygmomanometer valve on the bulb.⁴
 - 3.1.7.2 While palpating the radial pulse, rapidly inflate cuff to 80 mmHg and then slow the inflation rate to 10 mmHg every 2-3 seconds taking note of the reading at which the pulse disappears.⁴
 - 3.1.7.3 Once the pulse disappears, deflate the cuff at a rate of 2 mmHg per second, noting when the pulse reappears. This confirms the obliteration pulse.⁴
- 3.1.8 Place the stethoscope earpieces in your ears so that the earpieces point away from you. Place stethoscope bell or diaphragm above antecubital space over the brachial artery.² Bell and diaphragm side of chest piece appear equally effective in assessing BP.¹ The stethoscope should not touch the cuff or its tubing.
- 3.1.9 Quickly inflate cuff pressure to 20-30 mmHg above pulse obliteration pressure²
- 3.1.10 Release the cuff pressure approximately 2-3 mmHg per second^{1,4}.
- 3.1.11 Read the systolic level – the first appearance of a clear tapping sound (phase I Korotkoff) – and the diastolic level – the point at which the sounds disappear (phase V Korotkoff). If Korotkoff sounds persist as the level approaches 0 mmHg, then the point of muffling of the sound is used (phase IV) to indicate the diastolic pressure.^{1,2}
- 3.1.12 Record values to the nearest 2 mmHg on the manometer as well as the arm used (i.e. left or right arm).^{2,3,4}

- 3.1.13 Take two BP measurements on the left arm with the participant in the same position at intervals of at least 1 minute.^{3,4} The average of those readings should be used to represent the participant's blood pressure.^{3,4} If there is a >5 mmHg (or >6 mmHg for a manual reading) difference between the first and second readings, additional (1 or 2) readings should be obtained, and then the average of these multiple readings is used.³
- 3.1.14 Repeat on right arm.^{3,4}
- 3.1.15 BP should be measured in both arms on at least one visit and if one arm has a consistently higher pressure, that arm (i.e. reference arm) should be subsequently used for BP measurement and interpretation.^{1,2,7}

NOTE: If systolic BP is ≥ 160 mmHg and/or diastolic is ≥ 90 mmHg, wait 5 minutes and re-do measurement.⁵ If measurement still exceeds this value, do not proceed with the active portions of the assessment (i.e., any activity that elevates heart rate above resting values).⁵ As well, if BP is $< 80/50$ mmHg do not proceed with the active portions of the assessment.⁵

NOTE: In the case of arrhythmia, additional readings with auscultation may be required to estimate the average systolic and diastolic pressure. Isolated extra beats should be ignored. Note the rhythm and pulse rate.

3.2 Procedure using the Accutorr® V-Mindray automated blood pressure system at rest

- 3.2.1 Identify the brachial artery.
- 3.2.2 Place appropriate cuff on participants left arm 1 inch above the antecubital fossa (align the artery index marker with brachial artery).
- 3.2.3 Turn on Accutorr® V device by pressing the power button (grey circular button) located in the lower left hand corner.
- 3.2.4 Press the “Demarrer PNI” to start test.
- 3.2.5 Record systolic and diastolic values.

4. Blood Pressure Protocol During Exercise

4.1 Procedure using a manual aneroid sphygmomanometers during exercise

- 4.1.1 Explain measurement procedure to participant. Instruct participant to relax arm and to not talk during measurements.^{2,3} Also, instruct the participant

to avoid grasping the handlebars or handrails of the exercise apparatus during the BP measurement.

- 4.1.2 Determine appropriate cuff size for participant, if not already done.^{1,2} The bladder within the cuff should encircle at least 80% of the upper arm^{1,2} and/or the cuff's index line (i.e., edge of cuff) falls within the cuff range line limit.
- 4.1.3 Place the cuff on the participant's reference arm so that the lower edge is 3 cm above the elbow crease and the bladder is centered over the brachial artery.^{2,3} Wrap cuff firmly around reference arm.
- 4.1.4 Participant must sit/stand quietly for 5 minutes on the exercising equipment (if this is pre-exercise measurement).
- 4.1.5 Place the stethoscope earpieces in your ears so that the earpieces point away from you.
- 4.1.6 Limit arm movement during BP measurement by stabilizing the participant's arm (i.e., place and hold the participant's arm firmly between your arm and trunk (if using treadmill) OR place the back of his/her hand on your shoulder (if using bike).
- 4.1.7 Palpate the radial pulse with index and middle finger.
- 4.1.8
- 4.1.9 Place bell or diaphragm of the stethoscope gently over brachial artery.² The stethoscope should not touch the cuff or its tubing. Bell and diaphragm side of chest piece appear equally effective in assessing BP.¹
- 4.1.10 Inflate the cuff well above (50-80 mmHg) the anticipated value or reading obtained during the previous stage of the exercise, keeping in mind that systolic BP increases with exercise.
- 4.1.11 Position the manometer so that it is at eye level and can be read easily.
- 4.1.12 Release the cuff pressure approximately 2 mmHg per heart beat² or 2-5 mmHg per second.¹
- 4.1.13 Read the systolic level – the first appearance of a clear tapping sound (phase I Korotkoff) – and the diastolic level – the point at which the sounds disappear (phase V Korotkoff).^{1,2}
- 4.1.14 Record values to the nearest 2 mmHg on the manometer.^{2,3}

4.1.15 Once the diastolic BP is reached, the cuff can be deflated quickly all the way to zero.

NOTE: BP measurement should be taken once at each stage of the exercise test.

4.2 Procedure using SunTech® Tango+

Refer to PC-POD-CP-004 entitled “Use and Cleaning of Ultima™ CardiO2 Metabolic Systems – Exercise Testing”.

5 Safety and effectiveness considerations

Consider the following safety and effectiveness issues prior to using the SunTech® Tango+ monitor:

5.1 SunTech® Tango+

- 5.1.1 Use SunTech® Tango+ only with adult participants.
- 5.1.2 SunTech® Tango+ device is defibrillator protected.

5.2 Warnings and Contraindications

For safety reasons working alone should be avoided. Someone should always be within call when a laboratory procedure is being performed.

- 5.2.1 DO NOT USE THE MONITOR IF it has failed its diagnostic self-test or if it displays a greater than zero pressure with no cuff attached. The values displayed by such a unit may be inaccurate.
- 5.2.2 DO NOT USE ON NEONATES, CHILDREN, and participants known to be readily susceptible to bruising.
- 5.2.3 DO NOT ATTACH THE CUFF to a limb being used for IV infusions as the cuff inflation can block the infusion, causing harm to the participant.
- 5.2.4 DO NOT USE IN THE PRESENCE OF FLAMMABLE anesthetics; this could cause an explosion.
- 5.2.5 DO NOT IMMERSE the monitor in any fluid, place fluids on top of, or attempt to clean the unit with any liquid detergents or cleaning agents.

This may cause an electrical hazard. If any of these situations occur, please contact the supervisor of Cardio-Pulmonary Suite at ext. 4009.

- 5.2.6 **DO NOT MAKE REPAIRS YOURSELF:** No repair should be undertaken or attempted by anyone not having been service trained by SunTech® Medical or having a thorough understanding of the repair and operation of automatic blood pressure equipment.

6. Cleaning

6.1 Welch Allyn® cleaning/disinfecting procedures:

To avoid the build-up of organic debris, and other pathogenic microorganisms on the blood pressure instruments that can often cause cross contamination, each measuring device should be cleaned after every use by applying the following steps:

NOTE: Work should be carried out in a well-ventilated area, and ingestion and inhalation of the vapor should be avoided.

- 6.1.1 Wear gloves to avoid direct skin contact.
- 6.1.2 Remove the cuff from the sphygmomanometer.
- 6.1.3 Wipe the aneroid gauge, inflation bulb, and valve with slightly dampened cloth or alcohol pad.
- 6.1.4 One-Piece Blood Pressure Cuff:
 - Remove the bladder from cuff.
 - Block the tube(s) with accessory #5082-163.
 - Place the hook and loop fasteners in the closed position.
 - Safely clean the cuffs with a damp cloth (70% alcohol or 0.5% bleach solution) or wash in warm-water (60°C maximum) with mild detergent.
 - Disinfect one-piece cuff using glutaraldehyde-type liquid disinfectants by following instructions for use provided with the glutaraldehyde product.
 - Air dry completely.
 - Hold the manometer in a vertical position to check the precision of the manometer, after disinfection.
 - Check that the pointer stands still at 0 on the scale. If the pointer is below or above 0, device must be recalibrated.

- Reassemble components

6.1.5 Two-Piece Cuff Blood Pressure Cuff and Bladder:

- Remove the bladder from cuff.
- Safely clean the cuffs with a damp cloth or wash in warm water (60°C maximum) with mild detergent.
- Disinfect two-piece cuff and bladder using glutaraldehyde-type liquid disinfectants by following instructions for use provided with the glutaraldehyde product.
- Air dry completely.
- Hold the manometer in a vertical position to check the precision of the manometer, after disinfection. Check that the pointer stands still at 0 on the scale. If the pointer is below or above 0, device must be recalibrated.
- Reassemble components.

NOTE: Prolonged use of the glutaraldehyde-type liquid disinfectants for the cuffs may cause discoloration.

NOTE: Do not use glutaraldehyde-type liquid disinfectants on the aneroid gauge.

6.2 *Accutorr®V-Mindray cleaning/disinfecting procedures:*

NOTE: Make sure to shut down the monitor and disconnect all power cords from the outlet before cleaning.

6.2.1 Monitor:

6.2.1.1 Wear gloves to avoid direct skin contact.

6.2.1.2 The exterior surfaces of the equipment may be cleaned with a clean, soft cloth dampened with either of the following cleaning solutions:

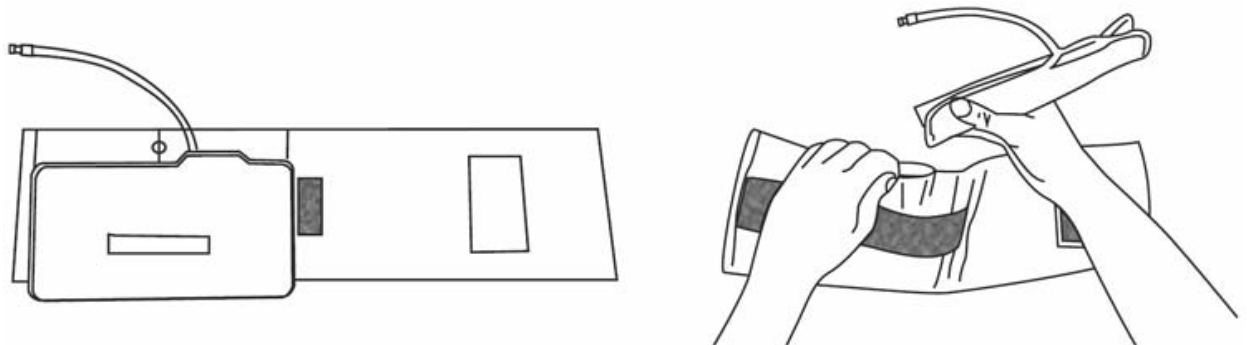
- Mild soap (diluted)
- Isopropyl alcohol or ethanol (70%)

6.2.2 Blood Pressure Cuff:

6.2.2.1 Wear gloves to avoid direct skin contact.

- 6.2.2.2 Disconnect the cuff from the device.
- 6.2.2.3 Remove the bladder (i.e., inflation bag) before cleaning and disinfecting the cuff.
- 6.2.2.4 Hand wash the cuff with mild detergent and warm tap water.
- 6.2.2.5 Clean the bladder with a damp cloth.
- 6.2.2.6 Air dry the cuff thoroughly after washing.
- 6.2.2.7 The cuff can be disinfected with a damp cloth with 70% ethanol or 70% isopropanol.
- 6.2.2.8 Replace the bladder after cleaning and disinfecting the cuff, as follows:

1. Place the bladder on the top of the cuff (see figure below)
2. Roll the bladder lengthwise and insert it into the large opening.
3. Hold the hose and the cuff and shake the complete cuff until the bladder is in position.
4. Thread the hose from inside the cuff, and out through the small hole under the internal flap.



6.3 Pulse Oximetry Cables (DOC-10 and DS-100A Durasensor) for Accutorr® V:

- 6.3.1 Wipe all surfaces of the sensor and cable with 70% isopropyl alcohol. If low-level disinfection is required, use 1:10 bleach solution.
- 6.3.2 Saturate a clean, dry gauze pad with cleaning solution. Wipe all surfaces of the sensor and cable with this gauze pad.
- 6.3.3 Saturate another clean, dry gauze pad with sterile or distilled water. Wipe all surfaces of the sensor and cable with this gauze pad.
- 6.3.4 Dry the sensor and cable by wiping all surfaces with a clean, dry gauze pad.

NOTE: Do not expose connector pins to cleaning solution as this may damage the sensor.

6.4 SunTech®Tango+ cleaning/disinfecting procedures

6.4.1 Monitor:

- 6.4.1.1 Disconnect the power supply from the monitor.
- 6.4.1.2 Wipe the device with a soft, damp cloth to remove surface dust and dirt.

NOTE: The SunTech® Tango+ is not sterilizable. Do not immerse the monitor in any fluid or attempt to clean with any liquid detergents, cleaning agents, or solvents.

6.4.2 Blood Pressure Cuff:

- 6.4.2.1 Use a mild medical grade disinfectant on the cuff sleeve and inside of the cuff between patients. Periodically, remove the bladder, machine wash the shell of the cuff in cold water and line dry.

7 REFERENCES

¹ ACSM's Guidelines for exercise testing and prescription / American College of Sports Medicine; senior editor, Gary Liguori; associate editors, Yuri Feito, Charles Fountaine, Brad A. Roy. – 2022. 11th ed. p. 62.

- ² The 2014 Canadian Hypertension Education Program (CHEP) Recommendations for Blood Pressure Measurement, Diagnosis, Assessment Risk, Prevention and Treatment of Hypertension. *Canadian Journal of Cardiology* 2014; Accepted In-Press.
- ³ Pickering TG, Hall JE, Appel LJ, et al. Recommendations for blood pressure measurement in humans and experimental animals. *Hypertension*. 2005;45(1):142-61.
- ⁴ Williams JS, Brown S, Conlin PR. Blood-Pressure Measurement. *N Eng J Med*. 2009;360(5): e6.
- ⁵ CSEP-PATH Physical Activity Training for Health. 2nd Edition; 2019:16.
- ⁶ 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults. *Journal of the American College of Cardiology*. 2018;71(19):e130-e248.
- ⁷ 2020 Hypertension Highlights. A Practical Guide Informed by the Hypertension Canada Guidelines for the Diagnosis, Risk Assessment, Prevention, and Treatment of Hypertension.