



Designation: E3003 – 20

Standard Practice for Body Armor Wearer Measurement and Fitting of Armor¹

This standard is issued under the fixed designation E3003; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice provides measurement and fit guidance for soft ballistic-resistant or stab-resistant body armor, or both, covering the torso. Proper measurement of the wearer and fitting of armor to that individual are necessary to obtain sufficient coverage of the torso and vital organs while allowing the full range of motion required for officer operations.

1.2 This practice is primarily directed toward law enforcement and corrections officers and addresses measurements for and fit of concealable (normal duty) body armor worn under or over the uniform for both male and female wearers. This practice addresses only body armor composed of front and back protective panels contained within a carrier that positions and holds the panels on the torso.

1.3 This practice can be used to train individuals on proper measurement techniques and to train wearers on proper fitting of body armor.

1.4 Measurement guidance is provided in Section 5 of this practice.

1.5 Guidance for use of a tape measure is provided in Section 6 of this practice.

1.6 Guidance for use of sizing vests is provided in Section 7 of this practice.

1.7 A personal armor fit assessment is provided in Section 8 for use by wearers.

1.8 *Units*—English units are specified in this practice to be consistent with measurement units used in the United States body armor community. Approximate values in SI units are given in parentheses.

1.9 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

¹ This practice is under the jurisdiction of ASTM Committee E54 on Homeland Security Applications and is the direct responsibility of Subcommittee E54.04 on Personal Protective Equipment (PPE).

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1.10 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

D5219 Terminology Relating to Body Dimensions for Apparel Sizing

E3005 Terminology for Body Armor

F1731 Practice for Body Measurements and Sizing of Fire and Rescue Services Uniforms and Other Thermal Hazard Protective Clothing

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *armhole, n*—in garment construction, the area of a garment through which the arm passes or into which a sleeve is fitted (Practice F1731 – 96 (2013)).

3.1.2 *body armor, n*—an item of personal protective equipment intended to protect the wearer from threats that may include ballistic threats, stabbing, fragmentation, or blunt impact (Terminology E3005).

3.1.2.1 *Discussion*—Law enforcement and corrections officers typically refer to body armor as a *vest*.

3.1.3 *cervicale, n*—the superior palpable point of the spine of the seventh cervical (C7) vertebra. (2012 Anthropometric Survey of U.S. Army Personnel: Methods and Summary Statistics (ANSUR II))³; the most protruding vertebrae at the back of the base of the neck. Refer to Fig. 1 and Fig. 2.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Gordon CC, Blackwell, C.L., Bradtmiller B, Parham, J.L., Barrientos, P., Paquette, S.P., Corner, B.D., Carson, J.M., Venezia, J.C., Rockwell, B.M., Mucher, M., and Kristensen, S. "2012 Anthropometric Survey of U.S. Army Personnel: Methods and Summary Statistics (ANSUR II)" NATICK/TR-15/007. U.S. Army Natick Soldier Research, Development, and Engineering Center, Natick, MA., Final Report October 2010 – April 2012, published December 2014. Available from DTIC ADA611869 (<https://apps.dtic.mil/dtic/tr/fulltext/u2/a611869.pdf>).

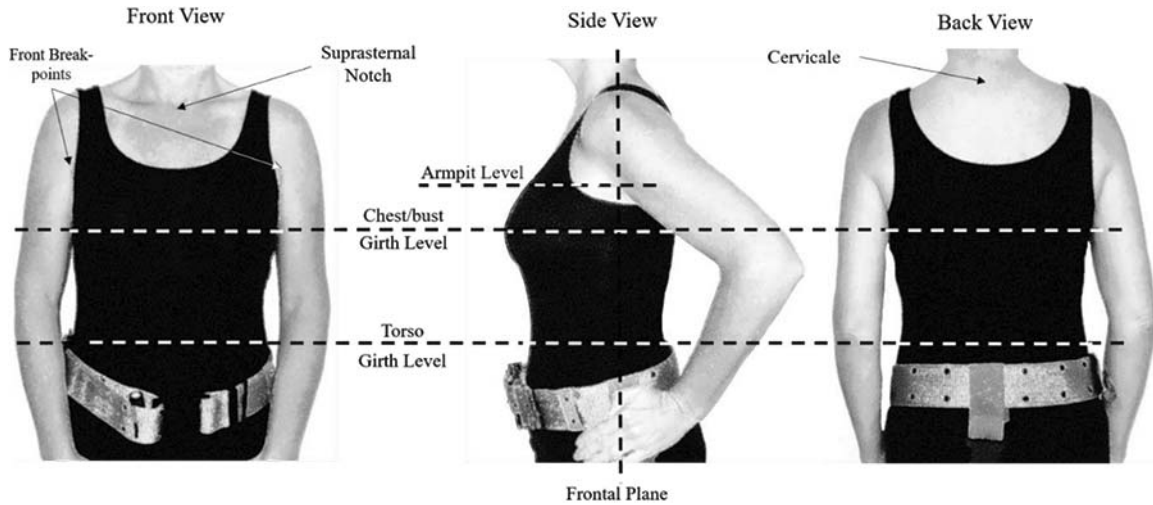


FIG. 1 Female Torso Body Landmarks

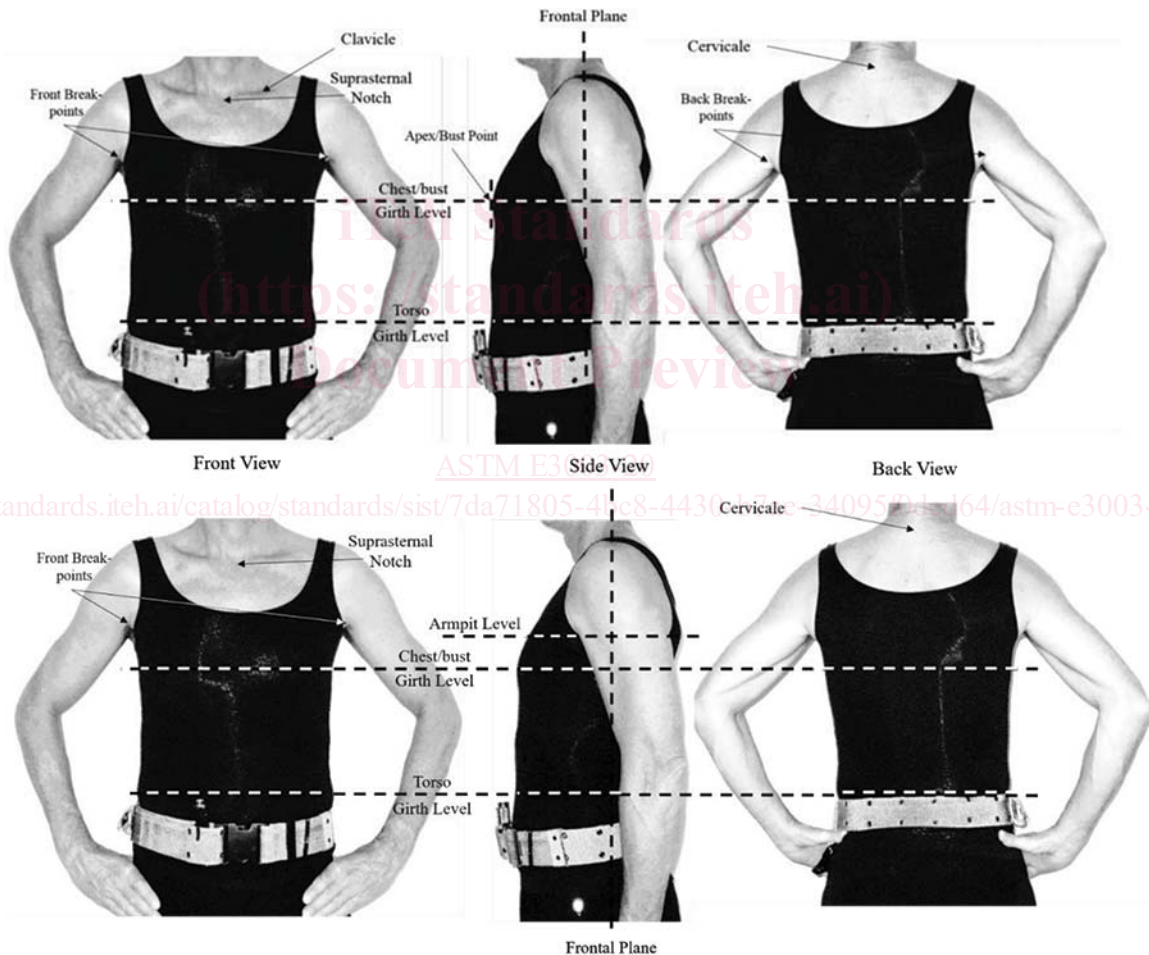


FIG. 2 Male Torso Body Landmarks

3.1.4 *chest/bust girth, n*—the horizontal circumference around the torso, taken under the arms and at the level of the apex (Terminology D5219). See Fig. 1 and Fig. 2 showing the location of this measurement.

3.1.5 *chest width, n*—the horizontal distance straight across the chest between the front break-points. Refer to Fig. 3 for the location of this measurement.

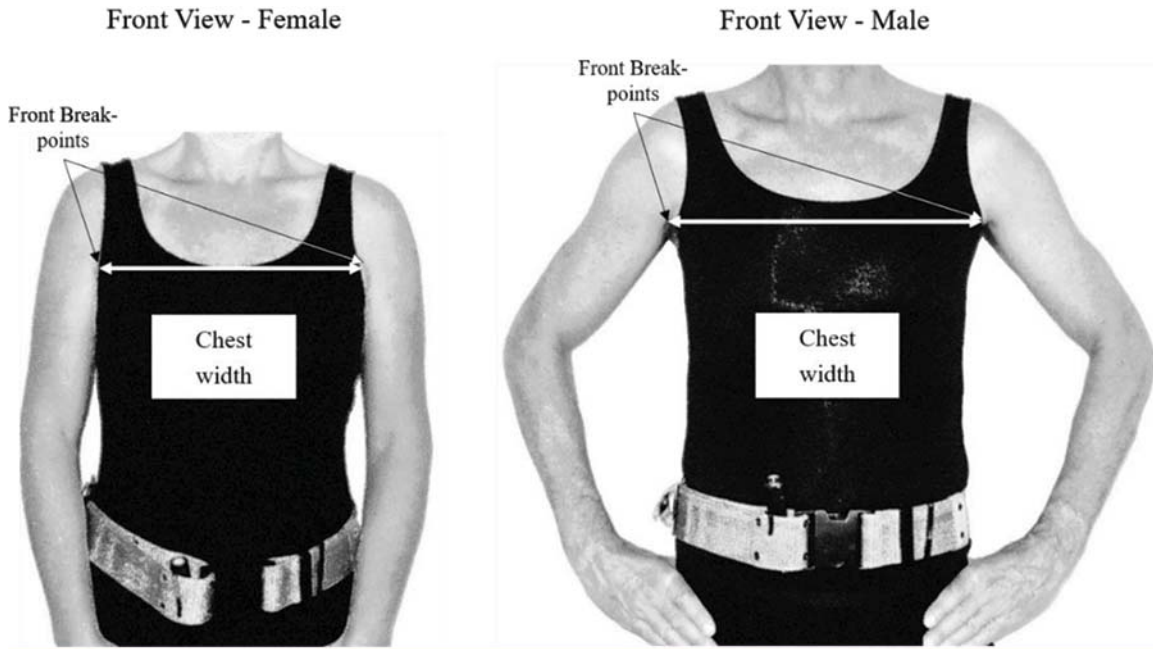


FIG. 3 Chest Width

3.1.6 *chest width, shooting stance, n*—the horizontal distance straight across the chest between the front break-points, taken while the wearer is in the shooting stance. See *shooting stance*.

3.1.7 *concealable armor, n*—vest designed to be worn under the shirt (uniform or undercover) or in a carrier that looks like a uniform shirt so that it is not easily seen (Terminology E3005).

3.1.8 *duty belt, n*—a belt worn around the waist by law enforcement and corrections personnel to which essential equipment is attached.

3.1.9 *fit, n*—the quality, state, or manner in which the length and closeness of clothing, when worn, relates to the human body (Practice F1731 – 96 (2013)); a characteristic of an

individual body armor relative to the wearer that encompasses coverage, comfort, and functionality.

3.1.10 *front break-point, n*—the location on the front of the torso where the arm separates from the torso (Terminology D5219). Refer to Fig. 1 and Fig. 2.

3.1.11 *front center length, n*—the vertical distance from the bottom of the suprasternal notch to the top of the duty belt. See Fig. 4 and Fig. 5 for the location of this measurement.

3.1.12 *shooting stance, n*—body and arm positioning of a shooter relative to the target when preparing to fire a handgun. For this standard, the shooting stance shall be hands together with both arms extended and parallel to the ground.

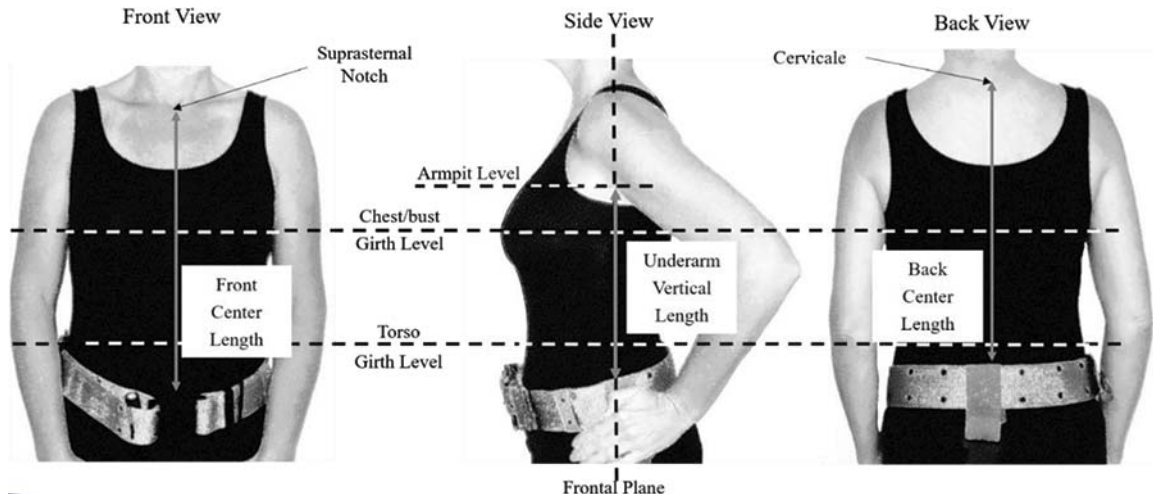


FIG. 4 Female Torso Vertical Measurements

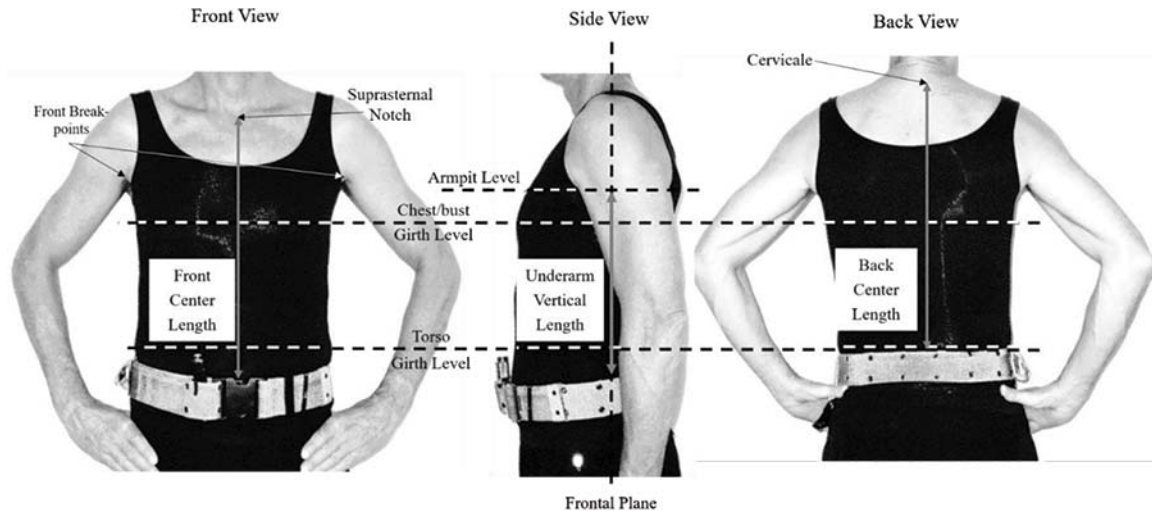


FIG. 5 Male Torso Vertical Measurements

3.1.13 *suprasternal notch, n*—the depression in the top of the sternum between its articulations with the two clavicles; called also jugular notch (Merriam-Webster); the notch at the top of the sternum. See Fig. 1 and Fig. 2.

3.1.14 *torso, n*—the human trunk (Practice F1731 – 96 (2013)).

3.1.15 *torso girth, n*—the largest horizontal circumferential measurement around the torso below the rib cage near the waist; this measurement is not necessarily the wearer’s belt size or waist size. See Fig. 1 and Fig. 2 for the location of this measurement.

3.1.16 *underarm vertical length, n*—the vertical distance between the armpit and the top of the duty belt measured while the wearer is seated. See Fig. 4 and Fig. 5 for the location of this measurement.

3.1.17 *vest, n*—a type of body armor intended to protect the wearer’s torso (Terminology E3005).

3.1.18 *waist, n*—in anatomy, the part of the body at the location between the lowest rib and hip identified by bending the body to the side (Practice F1731 – 96 (2013)).

4. Significance and Use

4.1 Properly sized and fitted body armor enhances the safety and performance of the wearer by providing protection while not restricting movement. Having body armor that fits well begins with appropriate and accurate measurements. The measurement guidance of this practice will facilitate consistency of measurement across the body armor industry and will help wearers understand proper measurements.

4.2 Accurate measurements do not necessarily result in well-fitting armor, so this practice goes a step further by providing a description of well-fitting armor along with a personal armor fit assessment that the wearer can do for himself/herself.

4.3 The measurement and fitting guidance specifically addresses officer-stated requirements for side overlap of front and back body armor panels, minimizing the armhole opening,

eliminating any “V” gap (or similar) between the front and back panels, and providing vertical coverage on the front torso from approximately the “2nd uniform shirt button to 2 to 3 finger widths above duty belt.” Those requirements were considered in the development of this practice and the definition of measurements that can be consistently made for any individual.

4.4 This practice describes measurements for the front, back, and sides of the wearer, in addition to girth measurements, to achieve proper sizing of front and back panels and proper fit of the complete armor.

4.5 This practice can be used to train individuals on proper measurement techniques and to train wearers on proper fitting of body armor.

5. Measurement Guidance

5.1 Apparatus:

5.1.1 *Chair for Seated Position Measurements*—The recommended chair is a rigid, non-adjustable chair, having a back and a flat, rigid seat, and resting on a flat surface. The chair should have no arm rests.

5.1.2 *Markers*—The use of markers to identify the location of relevant body landmarks on the wearer is recommended to facilitate the measurement process, and the markers should remain in place during all measurements. The remainder of the document refers to these markers; if the measurer chooses not to use the markers, he/she is responsible for accurately locating the body landmarks referred to.

5.1.2.1 *Chest/bust Girth Marker*—A length of stretchable cord, twine, narrow masking tape, or other thin material (for example, elastic) for encircling the torso and marking the chest/bust girth level. The ends of the material should be joined at the back of the body using removable clips, and the marker should be positioned appropriately across the front of the body by the wearer. The measurer should ensure that the marker is level horizontally around the body. See Fig. 4 or Fig. 5.

5.1.2.2 *Side Marker*—A length of cord, twine, narrow masking tape, or other thin material (could be elastic but need not be

stretchy) for marking the midpoint between the front and back break-points on one side of the body. The marker should be held vertically in place between the chest/bust girth marker and the duty belt. The measurer should ensure that the side marker is perpendicular to the chest/bust girth marker.

5.1.3 *Tape Measure*—The tape used shall be flexible and non-stretchable, have a length of at least 120 in. (3 m), with at least ¼-in. or mm divisions. An anthropometric tape is recommended, but a tailor’s tape may also be used. Prior to using any flexible tape for making measurements, a verification check is recommended to check that the tape has not stretched since the last use and may be done by comparing the flexible tape measure to a non-stretchable tape, such as a Lufkin model L610 steel tape or equivalent.

5.1.4 *Weighing Scale*—A bathroom scale shall be used for weighing, if weight is unknown, and the scale shall have the capability to be zeroed prior to weighing, shall provide weight in units of pounds or kilograms, shall indicate weight to at least the nearest pound or kilogram, and shall have weight capacity appropriate for the individual being weighed. If better quality than a bathroom scale is available, such as a medical or fitness scale, it is acceptable to use such a scale for measurements, given that the other requirements of this section are met.

5.2 *Measurement Skill, Accuracy, and Cautions:*

5.2.1 *Measurement Skill*—Individuals making measurements must have a complete understanding of this practice and demonstrate their ability to make accurate measurements. (Adapted from Practice **F1731** – 96 (2013).)

5.2.2 *Measurement Accuracy*—Measurement accuracy depends on (1) the skill of the individual doing the measuring, (2) the condition of the equipment being used for making measurements, and (3) the level of cooperation from the subject being measured. Reliable measurements can be made only when all of the above variables are controlled. (Adapted from Practice **F1731** – 96 (2013).) The body measurements described in this practice cannot be made accurately on oneself but require another individual as the measurer.

5.2.3 *Cautions:*

5.2.3.1 When measuring female officers, care should be taken to make appropriate measurements from behind with the wearer adjusting the tape over her chest.

5.2.3.2 When measuring officers and discussing their measurements, care should be taken to be sensitive to the desire for privacy of body measurements.

5.3 *Preparation for Measuring the Wearer:*

5.3.1 The type of clothing worn during measuring can influence the accuracy of the measurements, and the following clothing and equipment shall be worn during measuring:

5.3.1.1 Uniformed officers being measured for concealable body armor worn under the uniform shirt shall wear a snugly fitting T-shirt, duty pants, duty belt with their typical gear installed (for example, weapon, magazine pouch, restraints), inner belt (if normally worn), and keepers. The position of the duty belt on the wearer shall be as is typically worn, and the position should not be artificially adjusted. Females shall wear the type of bra that they usually wear on duty.

5.3.1.2 Uniformed officers being measured for concealable body armor worn over the uniform shirt in an outer carrier shall

wear the uniform shirt, a T-shirt (if normally worn), duty pants, duty belt with their typical gear installed (for example, weapon, magazine pouch, restraints), inner belt (if normally worn), and keepers. The position of the duty belt on the wearer shall be as is typically worn, and the position should not be artificially adjusted. Females shall wear the type of bra that they usually wear on duty.

5.3.1.3 Non-uniformed personnel (for example, special agents, detectives) being measured for concealable body armor worn under the outermost shirt shall wear a snugly fitting T-shirt, pants, and a belt that are representative of what is worn on duty. The position of the belt on the wearer shall be as is typically worn, and the position should not be artificially adjusted. Females shall wear the type of bra that they usually wear on duty.

5.3.2 Markers should be appropriately placed on the wearer. Refer to 5.1.2. The chest/bust girth marker should be put in place and positioned with the aid of the wearer, especially across the front of the body. The measurer should adjust the position properly on the sides and back.

5.3.3 All linear and circumferential measurements shall be taken to the nearest inch or centimeter.

5.3.3.1 Linear measurements should be rounded down to the nearest inch or centimeter.

5.3.3.2 Circumferential measurements should be rounded up to the nearest inch or centimeter.

NOTE 1—One centimeter is smaller than an inch and is sufficient for these measurements.

5.3.4 For all measurements, the wearer shall breathe normally without holding the breath and shall not hold in the stomach.

5.3.5 For all measurements requiring the wearer to be in a standing position, except chest width measurements, the wearer shall stand with feet shoulder width apart, facing forward, arms relaxed down at the sides, and looking straight ahead.

5.3.6 For all measurements requiring the wearer to be in a seated position, the wearer shall sit in a natural comfortable position, facing forward and looking straight ahead with feet apart flat on the floor and arms relaxed at sides. If the chair has arm rests, the individual being measured should not place either arm on the arm rests but have arms relaxed at the sides.

5.4 *Measuring the Wearer:*

5.4.1 *Weight*—The measurer shall record the wearer’s weight in pounds or kilograms and to the nearest pound or kilogram (for example, 125 lb or 57 kg) either by having the wearer specify his or her known weight or weighing the wearer. If the wearer needs to be weighed, the measurer shall ensure that the scale is set to zero initially and record the weight of the wearer to the nearest pound or kilogram. If the wearer is a uniformed officer and is being weighed, ensure that the officer removes the duty belt prior to being weighed.

5.4.2 *Height*—The measurer shall record the wearer’s height either by having the wearer specify his or her known height or measuring the wearer.

6. Procedures When Using a Tape Measure

6.1 *Chest/Bust Girth*—With the wearer’s arms raised slightly away from the sides, the measurer shall wrap the tape around the torso horizontally under the arms and aligned with the chest/bust girth marker. The measurer should stand behind the wearer to take the measurement, and the wearer should position the tape correctly across the front of the chest. Once the tape is in place, the wearer shall lower the arms to his or her sides, and the measurement shall be taken, ensuring that the tape is snug around the torso. Refer to [Fig. 1](#) and [Fig. 2](#) for the location of this measurement.

6.2 *Torso Girth*—With the wearer standing, the measurer shall wrap the tape around the torso at the largest circumference below the rib cage and near the waist, keeping the tape horizontally level. Once the tape is in place, the measurement shall be taken ensuring that the tape is snug around the torso and that the wearer is breathing normally and keeping the torso muscles relaxed. Refer to [Fig. 1](#) and [Fig. 2](#) for the location of this measurement.

6.3 *Chest Width*—With the wearer standing with arms down at sides, the measurer shall measure the horizontal distance straight across the front of the chest between the front break-points. Refer to [Fig. 3](#) for the location of this measurement.

6.4 *Chest Width, Shooting Stance*—With the wearer positioned in the shooting stance, the measurer shall measure the horizontal distance straight across the front of the chest at the front break-point.

6.5 *Underarm Vertical Length*—With the wearer in a seated position and the right arm slightly raised to the side, the measurer shall place a plastic ruler under the arm where the arm joins the torso, ensuring the ruler is horizontally level. The wearer shall lower the right arm trapping the ruler. The top of the ruler corresponds to the armpit location. The measurer shall measure the vertical length straight from the armpit to the top of the duty belt. Refer to [Fig. 4](#) and [Fig. 5](#) for the location of this measurement.

6.6 *Front Center Length – Standing*—The measurer shall measure vertically from the bottom of the wearer’s suprasternal notch to the top of the duty belt. Refer to [Fig. 4](#) and [Fig. 5](#) for this measurement location.

6.7 *Front Center Length – Seated*—The wearer shall be seated during this measurement. The measurer shall measure vertically, following the body, from the bottom of the wearer’s suprasternal notch to the top of the duty belt.

6.8 *Back Length*—The measurer shall measure the vertical distance from the top of the wearer’s cervicale (C7 vertebra) to the top of the duty belt in the back. See [Fig. 4](#) and [Fig. 5](#).

6.9 Documentation:

6.9.1 For each individual being measured, the following information shall be recorded on a data sheet: information about the wearer, the measurer, the specific body armor model or supplier, clothing worn during measurement, and the actual measurements. A sample data sheet for recording the above information for male wearers is provided in [Appendix X1](#). A

sample data sheet for recording the above information for female wearers is provided in [Appendix X2](#).

6.9.2 It is recommended that purchasers (agencies or individuals) require suppliers to perform measurements as specified in this practice and to provide a data sheet for each wearer containing the details shown in [Appendix X1](#) or [Appendix X2](#) as a part of the purchase agreement for body armor.

7. Procedures When Using a Sizing Vest

7.1 Introduce the individual being fitted for body armor to the sizing vests and the options for flat panel or shaped (that is, structured) vests.

7.1.1 Explanation should be given regarding flat panel and shaped vests and which may be more appropriate based on the body shape of the wearer.

7.2 The measurer will base the selection of the sizing vest on measurement of the torso girth, the chest/bust girth, or a combination of the two.

7.2.1 Measure the chest/bust girth of the individual according to [6.1](#).

7.2.2 Measure the torso girth of the individual according to [6.2](#).

7.3 Use the appropriate measurement(s) above and the manufacturer’s sizing vest instructions to select the sizing vest most likely to fit the individual.

7.4 Put the sizing vest on the individual, ensuring that the front panel and back panel are properly adjusted on the torso.

7.5 Check the Fit of the Sizing Vest on the Individual:

7.5.1 The top edge of the front panel at center front should be at the bottom of the suprasternal notch, and the top edge of the back panel at center back should be at the top of the wearer’s cervicale (C7 vertebra). Adjust the shoulder straps, as necessary.

7.5.2 With the wearer positioned in the shooting stance, the portion of the vest between the raised arms should touch the arms but not interfere with the shooting stance.

7.5.2.1 If the vest is too wide between the raised arms, step down to the next smaller sizing vest, and go back to [7.5.1](#).

7.5.2.2 If the vest is too narrow between the raised arms, step up to the next larger sizing vest, and go back to [7.5.1](#).

7.5.3 The front and back panels should overlap on the sides at least two inches, unless the agency mandates otherwise.

7.5.3.1 When the sizing vest has a width tape on the side, use the width tape to determine the panel width to achieve the required overlap.

7.5.3.2 When the sizing vest does not have a width tape on the side and the overlap needs to be adjusted, step up or down, as appropriate, to the next size back panel.

NOTE 2—It is acceptable to use a smaller front panel and a larger back panel and vice versa.

7.5.4 Document the front panel size and the back panel size on the manufacturer’s sizing form.

7.5.5 With the wearer in a seated position, use the length tape at the bottom front of the sizing vest and find where the tape and the duty belt meet.

7.5.5.1 In accordance with manufacturer’s sizing vest instructions, use the length tape value appropriately (for

example, add length tape value to sizing vest front panel). Document this as the front length measurement.

7.5.5.2 Have the officer stand and review the selected length to help him/her understand where coverage will end above the duty belt. Discuss the tradeoff between standing coverage and seated comfort.

7.5.6 With the wearer standing tall, use the length tape at the bottom back of the sizing vest and find where the tape and the duty belt meet. In accordance with manufacturer’s sizing vest instructions, use the length tape value appropriately (for example, add length tape value to sizing vest back panel). Document this as back length measurement.

7.5.7 Review the overall fit of the sizing vest with the wearer.

8. Personal Armor Fit Assessment

8.1 Overview:

8.1.1 The purpose of this assessment is to assist a wearer in determining how well his/her body armor fits. Proper fit is a balance of coverage, comfort, and functionality. For example, too little coverage may feel comfortable and allow great functionality but offer insufficient protection to the wearer. Performing the personal armor fit assessment helps the user evaluate this balance and will reveal issues that may not be otherwise obvious to the wearer.

8.1.2 The assessment should be performed by the wearer upon receipt of a new armor. Any observed problems noted during the assessment may be an indication that the armor has not been properly fitted for the officer, and problems should be brought to the attention of supervisors.

8.1.3 The assessment may be performed any time the wearer’s body measurements have significantly changed.

8.1.4 Well-fitting armor exhibits the characteristics listed below:

8.1.4.1 Does not restrict breathing.

8.1.4.2 Allows wearer to assume the shooting stance with minimal to no bicep rubbing or discomfort, tingling in arms or hands, or interference with arms.

8.1.4.3 Allows wearer to shoulder a long gun with minimal to no bicep rubbing or discomfort, tingling in arms or hands, or interference with arms.

8.1.4.4 Allows the wearer to perform typical officer movements (for example, squatting, sitting, kneeling, running) with minimal pinching at sides, pinching at the duty belt, or interference at neck or arms.

8.1.4.5 Allows the wearer to reach equipment located at the center back of the duty belt with minimal interference at the arm.

8.1.4.6 Has no gaps between the torso and the armor at the armhole (that is, armor is flush against the torso).

8.1.4.7 Has continuous coverage along the front armhole edge in the chest/bust area. Fig. 6 provides an example of lack of continuous coverage in this area.

8.1.4.8 When seated, has front panel coverage that vertically extends from the suprasternal notch at the base of the neck to the top of the duty belt.

NOTE 3—This vertical coverage when seated appears differently when standing; there is expected to be a small gap of less than 2 in. (5 cm)

between the front panel and the top of the duty belt when standing to allow the front panel to meet the top of the duty belt when seated. That 2-in. gap may be approximated by checking to see that the gap is no more than two to three finger widths. Fig. 7 provides an example of lack of vertical coverage on the torso front.

8.1.4.9 Has back panel coverage that vertically extends from the most prominent vertebra at the neck to near the top of the duty belt. Fig. 8 provides an example of lack of vertical coverage on the torso back.

NOTE 4—The bottom edge of the back panel should be level with the bottom edge of the front panel.

8.1.4.10 Has side coverage that vertically extends from within 3 in. (7.5 cm) of the armpit to near the top of the duty belt.

NOTE 5—The bottom edge on the sides should be level with the bottom edge of the front panel.

8.1.4.11 Has at least a 2-in. (5 cm) overlap of the front and back panels on both sides. Fig. 9 provides an example of lack of coverage on the side.

8.1.4.12 Has minimal to no gap between the armor edge and the biceps when the wearer is in the shooting stance.

8.1.4.13 Has no discontinuities at the upper and lower edges of the overlap of the front and back panels. Fig. 9 provides an example of such discontinuities.

8.2 Assessment Method:

8.2.1 Assessment categories are identified below, and detailed steps for assessing each item are included in the sample personal armor fit assessment form provided in Appendix X3:

8.2.1.1 Donning the armor with other duty gear;

8.2.1.2 Shooting stance with a handgun;

8.2.1.3 Shooting stance with a shoulder weapon;

8.2.1.4 Restraint operations;

8.2.1.5 Sitting position;

8.2.1.6 Vehicle operation, and;

8.2.1.7 Visual examination.

8.2.2 The wearer should perform each of the assessment steps identified in Appendix X3 and document his/her observations.



NOTE 1—The unprotected “triangle” at the bust is of concern.

FIG. 6 Example Armor Showing Lack of Continuous Coverage