### DEA AND FBI BALLISTIC HELMET TESTING PROTOCOL



February 2024

#### 1. Scope

- 1.1. This standard specifies minimum performance requirements and test methods for ballistic helmets used by the FBI and DEA.
- 1.2. This standard is specific to ballistic helmets intended to protect against pistol-caliber threats.
- 1.3. The test methods documented herein were developed based on broadly available helmet designs. It is possible that an innovative or non-traditional helmet design may require additional or modified testing than specified within this standard.
- 1.4. This standard applies to one-piece, substantially uniform thickness helmet shells. Helmet designs with two or more shell components, as well as helmets with appliques may require a modified test standard. Any modified standard shall be supplied by the Government.
- 1.5. This standard is applicable for helmets intended for consideration of duty/service use within the DEA and FBI.
- 1.6. This standard may be utilized by independent ballistic laboratories or manufacturers seeking to test their ballistic helmets to the DEA and FBI standard.
- 1.7. Test standards may include values in either the International System of Units (metric) or U.S. Customary units (inch-pound). Test results may be expressed in either form, provided the units are adequately denoted.
- 1.8. The tests required by this standard have inherent hazards. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to comply with applicable regulatory requirements.

#### 2. References

The following references provide support for the requirements and procedures described in this standard.

- ATC Test Operation Procedure (TOP) 10-2-217A
- Federal Motor Vehicle Safety Standard 218 (FMVSS), Motorcycle Helmets (2015). Also referred to as "DOT-218"
- MIL-DTL-46593, Revision B Projectile, Calibers .22, .30, .50 and 20MM Fragment-Simulating (2023)

#### 3. Terms and Definitions

3.1. The following terms are applicable throughout this standard:

**Ambient Temperature Condition:** Test item is conditioned for a minimum of 24 hours at 68°F (+/- 10°F).

**Backface Deformation (BFD):** The indentation in the backing material caused by a projectile impact on the test item during testing.

**Ballistic Clay:** Roma Plastilina No.1 modeling clay at ambient temperature.

**Ballistic Resistance:** A characteristic of protective equipment (helmets) describing their ability to provide protection from projectiles.

**Basic Plane:** The plane passing through the ear openings and lower edges of the eye sockets.

**Complete Helmet:** A Complete Helmet shall consist of a finished shell, NVG shroud, side rails, suspension system and retention system. A Complete Helmet shall be an "as worn by the end user" condition.

**Conditioning:** A process that exposes an item, prior to testing, to a specified controlled environment or physical stresses, or both.

**Coronal Plane:** The plane perpendicular to the Basic plane and Mid-sagittal plane and passing through the centers of the ear openings.

**Fair Hit:** A test projectile impact that meets the specified requirements in a particular test method for impact location, spacing, and velocity.

**Fair Shot Velocity:** A test projectile shot resulting in a nominal impact velocity of 1,400 feet per second (fps) (+50/-25 fps).

**Finished Shell:** A Finished Shell shall include the ballistic shell material, edge banding (if applicable), with any designed attachment holes and any primer/paint/coating. The Finished Shell is not a Complete Helmet.

Hardware Shot: A fair hit impacting on a fastener.

**Headform:** For the purposes of this standard, the headforms used in testing shall be the Peepsite Generation 2 headforms. The Peepsite Generation 2 headforms consist of a set of five (5) separate headforms designed for different impact locations on a helmet (e.g., front, right, left, rear, and crown). The headforms require a corresponding mold, used to contour and press the ballistic clay into shape. The set of Peepsite Generation 2 headforms 2 headforms generally conform to size large helmets.

**Helmet Crown:** A 50mm radius from the approximate intersection of the Coronal plane and Mid-sagittal plane.

**High Temperature Condition:** Test item is conditioned for 24 hours (+/-2 hours) at  $140^{\circ}$ F (+/-  $10^{\circ}$ F). Once conditioned, and after removing the test item from the environmental chamber, there is no requirement to maintain the test item at the high temperature during testing.

**Low Temperature Condition:** Test item is conditioned for 24 hours (+/-2 hours) at negative (-)  $40^{\circ}F$  (+/-  $10^{\circ}F$ ). Once conditioned, and after removing the test item from the environmental chamber, there is no requirement to maintain the test item at the cold temperature during testing.

**Mid-cut:** Helmet design that offers protection to, approximately, the upper 1/3<sup>rd</sup> of the wearer's ear. The finished edge of the helmet should fall between the Reference plane and Basic plane.

**Mid-sagittal plane:** The plane perpendicular to the Basic plane and Coronal plane, bisecting the head front to rear.

**Next-to-Hardware Shot:** A fair hit impacting adjacent to a fastener. Shots will be directed to the portion of the fastener furthest from the finished edge of the helmet (closest to the crown). The primary strike point of these test shots is on the ballistic material immediately next to a fastener. Ideally, the edge of the test projectile would make minimal contact with the edge of the fastener.

**Reference Plane:** The plane approximately 60mm above, and parallel to, the Basic Plane.

Retention system: The equipment used to secure the ballistic helmet to the user's head.

**Saltwater mixture:** Tap water de-chlorinated with a chlorine neutralizer. Thereafter, synthetic "Instant Ocean Sea Salt<sup>1</sup>" or commercially available equivalent is added to achieve a salinity adjusted to a specific gravity of 1.020 - 1.023 as measured by a hydrometer.

**Shot-to-edge distance:** The distance from the center of the projectile impact to the nearest outer edge of the test item. For ballistic helmets, the outer edge is the edge of the Complete Helmet.

**Shot-to-shot distance:** The distance from the center of the projectile impact to the center of any other projectile impact on the test item.

**Suspension System:** The equipment and linkages that connect the ballistic helmet to the user's head. This can be padding and/or a support system, which provides a space between the Finished Shell and the user's head.

**Test Projectile:** 124gr 9mm (NATO) FMJ fired from a barrel with a rate of twist of 1:10" (+/- .25"). Acceptable test projectiles include (1) Federal Cartridge Company part number 706236 and (2) Remington part number 23558.

**Unfair hit:** A test projectile impact that does not meet the specified requirements in a particular test method for impact location, spacing, or velocity.

**Water Conditioned:** Complete helmet is fully immersed in saltwater mixture for 8 hours (+/-2 hours). Saltwater temperature shall be  $68^{\circ}F$  (+/-  $20^{\circ}F$ ). Weights may be placed in the helmet to keep a positively buoyant helmet submerged. Once conditioned, and after removing the helmets from the saltwater, the helmets shall be allowed to dry (crown up) for 24 hours (+/-2 hours) before conducting P-BFD testing. There is no requirement to maintain the helmets in a wet condition during testing.

#### 4. Test Items: Requirements and Utilization

4.1 All helmets shall be size Large<sup>2</sup> and of mid-cut design.

<sup>&</sup>lt;sup>1</sup> Instant Ocean Sea Salt, product number SS15-10.

<sup>&</sup>lt;sup>2</sup> Manufacturers offering a one-size-fits-all helmet shall ensure that the helmet accommodates the Peepsite Gen2 Headform.

- 4.2 A minimum of 16 sample helmets (14 Complete and 2 Finished Shells) are required for testing. Manufacturers seeking to test additional accessories (e.g., additional retention systems) may need to submit additional sample helmets.
- 4.3 The allocation of sample helmets is as follows:
  - 8 Complete Helmets for Penetration Backface Deformation (P-BFD) testing
  - 2 Finished Shells for Fragmentation testing
  - 2 Complete Helmets for Non-ballistic Impact testing
  - 1 Complete Helmet for Compression Resistance testing (also used for Retention Strength Static Strength testing)
  - 1 Complete Helmet for Retention Strength Dynamic Strength testing
  - 2 Complete Helmets as reserves

#### 5. Testing Process

- 5.1 Inspection All samples shall be inspected using the Inspection Checklist in Appendix A.
- 5.1.1 **Materials:** All helmet materials shall be corrosion resistant or have a corrosion resistant coating.
- 5.1.2 **Shell Finish:** The outer surface may be smooth or have a mild friction (textured) finish. The finish shall be evenly applied.
- 5.1.2.1 **Outer Surface:** A coating shall be applied uniformly to the outer surface of the finished shell extending to visible edging.
- 5.1.2.2 **Interior Surface:** A coating of the interior surface of the shell is allowed but not required. The interior surface shall be free of defects (e.g., wrinkles, blisters, delamination, cracks, peeling, etc.).
- 5.1.2.3 **Surface Quality Control:** There shall be no exposed fabric/fiber ends showing. Both the inner and outer shell shall be free from any hole (except as required to accommodate suspension, retention, and accessory mounting), delamination, blistering, cracks, depressions, peeling, or similar defects that prevent the surface from being smooth and continuous. Each helmet shell shall have no more than one (1) of any of the following flaws: raised fibers, pleats, folds, wrinkles, or creases longer than 25mm. Patching/repairs of the ballistic material cannot be performed after the ballistic shell material is molded.
- 5.1.3 **Construction:** If the finished shell is of multi-material construction (e.g., carbon fiber outer shell and ballistic inner shell) no separation of ballistic material from outer shell shall exceed a 1.5mm gap x 30mm in length and shall not extend more than 10mm into shell when measured from the finished edge. No more than one (1) such flaw per helmet is acceptable.
- 5.1.4 **Shape:** The shape of the finished helmet shall conform to the general shape of the human head.

#### 5.2 Weights and Measurements

5.2.1 Fourteen (14) complete helmets will be weighed individually, and weights recorded.

- 5.2.2 Two (2) complete helmets will be randomly selected, and the protective surface area of the outer shell shall be measured and recorded.
- 5.2.3 Two (2) finished shells will be selected, and the thickness of the shell will be recorded at five (5) separate locations. One (1) measurement location shall be from each of the five (5) sectioned areas of the helmet shell (e.g., front, right, rear, left, and crown).

#### 5.3 Perforation - Backface Deformation (P-BFD) Testing

- 5.3.1 Eight (8) complete helmets will be tested for P-BFD.
- 5.3.2 Two (2) complete helmets will be tested in each of the following conditioned states: Ambient temperature; High temperature; Low temperature; and Water conditioned.
- 5.3.3 Prior to helmet conditioning, the intended impact location for each test shot will be marked on the outside surface of the shell. Refer to Appendix B for shot placement locations. A horizontal line shall be marked at the required obliquity and distance from the finished edge of the helmet. For a shot to be fair, the test projectile must touch the marked horizontal line.
- 5.3.4 Water conditioned helmets will be inspected for corrosion prior to P-BFD testing. See Appendix A for Inspection Checklist.
- 5.3.5 Backface deformation (BFD) testing will be conducted concurrently with perforation testing. All P-BFD test shots not resulting in a failure shall be measured for BFD.
- 5.3.6 Prior to each test shot, the headform shall be measured with a FARO arm (or similar) before the test item is placed on the headform.
- 5.3.7 Prior to each test shot, the headform shall be prepared in accordance with Appendix C.
- 5.3.8 Only the helmet's retention system shall be used to secure the helmet to the headform. The retention system shall be made snug such that movement of the helmet on the headform is minimized.
- 5.3.9 The helmet fixture shall be positioned such that the impact surface of the test sample helmet is five (5) meters (+/- 30cm) from the muzzle of the test barrel. The helmet fixture shall be adjusted for each shot in accordance with the shot schedule found in Appendix B such that each shot impacts at approximately 90° (0° NATO) obliguity to the shell surface.
- 5.3.10 The helmet shall be removed from the headform, with testers being careful not to disrupt the impact site in the ballistic clay. Once removed from the headform, the helmet interior will be inspected for perforation.
- 5.3.11 Following the helmet inspection, the headform will be inspected for perforations in the ballistic clay. No fragments or debris shall be extracted from the ballistic clay until the BFD measurement is taken.
- 5.3.12 Following each test shot, the depth of any resulting BFD shall be measured to the nearest 0.1 mm (fractions rounded off) using a FARO arm (or similar). Any cratering effect on the

clay surface around the impact location will be ignored and only the measured depth, as compared to the pre-test shot scan, will constitute the BFD dimension.

- 5.3.13 For test shots impacting the shell or the hardware, a failure will have occurred if (1) a hole is created through the test item<sup>3</sup>, (2) the test projectile is visible from the wear face of the test item, or (3) any portion of a test projectile, or a fragment of a test projectile touches, is embedded in, passes into, or passes through the headform.
- 5.3.14 Non-metallic material including but not limited to paint, edging, fibers, resin, fragments of padding, Velcro pad retainers, plastic from buckles or similar material dislodged from the finished shell, suspension, or retention system of the test sample into the ballistic clay shall not constitute a failure.
- 5.3.15 For Next-to-Hardware shots, evidence of the test projectile, a fragment of the test projectile, fastener or fragment of the fastener in the ballistic clay having an aggregate weight more than 5.0 grains constitutes a penetration and a failure. Any fragment or combination of fragments weighing equal to, or less than 5.0 grains shall constitute a partial penetration and will not be considered a failure. As specified in 5.3.14, non-metallic material touching or lodged into the ballistic clay does not constitute a failure. Any non-metallic material present will not be added to the cumulative grain weight and will not constitute a failure.
- 5.3.16 An unfair shot will be shot again on a reserve helmet. However, an unfair shot velocity below 1,375 fps, which results in a perforation shall constitute a failure and will not be repeated.
- 5.3.17 Make-up test shots cannot be conducted in a location closer than 90mm to any other test impact on a reserve helmet. The shot location can have no evidence of damage from previous shots (delamination, folds, depressions). Make-up test shots shall be as close to the specified original location as possible and must maintain the same distance from the finished edge (e.g., 25mm, 60mm, or 90mm) as the original test shot. Make-up test shots on Hardware and Next-to-Hardware should be conducted last to ensure the helmet's retention system is as intact as possible for any other shots on the helmet.
- 5.3.18 Any persistent deformity to the interior of the helmet shell that would prevent the helmet from being mounted on the headform for additional testing may be reduced, at the discretion of the tester. Care must be taken to ensure that pads, liner material and retention straps are not damaged or moved from areas of the helmet that have not yet been tested.

#### 5.4 Fragmentation Testing

5.4.1 Ballistic limit testing, referred to as V50 BL(P) or simply "V50," will be conducted on two (2) helmets at ambient temperature.

<sup>&</sup>lt;sup>3</sup> Broken hardware, exposing the previously existing hole in the shell, does not constitute creating a hole in the test item.

- 5.4.2 The 17-grain fragment-simulating projectile (FSP) as described in MIL-DTL-46593, Revision B shall be used for the V50 testing. A mounting fixture and setup, similar to that described in Test Operations Procedure (TOP) 10-2-217A Ballistic Testing of Helmets for frag V50 testing<sup>4</sup> shall be used to conduct the testing. The helmet will be sectioned in a similar manner to that described in TOP 10-2-217A.
- 5.4.3 Minimum V50 velocity is 2,050 fps.
- 5.4.4 The following process shall be used to determine the V50 BL (P):
- 5.4.4.1 The V50 for each helmet shell shall be the average of at least ten (10) fair impact velocities consisting of an equal number of the lowest complete penetration and the highest partial penetration velocities provided that the velocity spread is not greater than 150 fps.
- 5.4.4.2 In cases where the velocity spread is greater than 150 fps, the V50 shall be the average of at least fourteen (14) fair impact velocities consisting of an equal number of the lowest complete penetration and the highest partial penetration velocities with a velocity spread no greater than 175 fps.
- 5.4.4.3 If neither the ten (10) nor the fourteen (14) shot conditions can be satisfied, and at least seven (7) partial penetrations at velocities in excess of 2,050 fps and there are no complete penetrations at or below 2,050 fps, and at least fourteen (14) fair shots have been made in the helmet(s), it shall be determined to have satisfied the threat condition requirement.
- 5.4.4.4 Should none of these three (3) conditions apply the sample has failed the V50 testing.
- 5.4.5 No more than three (3) shots per section are allowed. There may be no delamination overlap between shots.
- 5.4.6 If more than the two (2) designated helmets are required to generate sufficient shots for V50 determination, a reserve helmet may be used for the additional shots.
- 5.4.7 The range setup shall be similar to the penetration testing specifications; however, velocities shall be taken at the chronograph screens rather than impact velocities.

#### 5.5 Non-ballistic Impact Testing

- 5.5.1 Two (2) complete helmets at ambient temperature shall be tested in accordance with DOT-218, with the following variances: (a) impact velocity of 10 fps (+/- 3%) is achieved and (b) one (1) drop on each location is conducted.
- 5.5.2 All impacts shall be on a hemispherical anvil using a size large headform.
- 5.5.3 Drop locations shall be on or about the following: Mid-sagittal plane on front; intersection of the Reference plane and Mid-sagittal plane on the rear; Coronal plane both right and left sides with the anvil striking above any ear protrusions; Mid-sagittal and Coronal intersection (crown).

<sup>&</sup>lt;sup>4</sup> TOP 10-2-217, Section 3.3.5.2 describes the test fixture. Section 4.5 describes the general V50 test procedure. Section 4.5.3 describes the up and down evaluation method.

#### 5.6 Compression Resistance Testing

- 5.6.1 The helmet shall be resistant to compression from top to bottom. A sample helmet shall be shimmed such that the Coronal and Mid-sagittal planes are both approximately perpendicular to a flat testing surface (ex: helmet placed on floor, 3 x 150mm x 150mm x 19mm plywood blocks stacked under the brim). Shimming shall not restrict the flexing of the helmet. Shimming is intended only to maintain the orientation of the helmet for testing. The helmet should not be attached to any shim material. The shimming material should be reasonably rigid. Plywood blocks or similar material is acceptable.
- 5.6.2 A compressive force of 400 pounds shall be brought gently into contact with the helmet, but not applied to the helmet. The top to bottom dimension of the helmet shall be measured to the nearest mm. The load will then be applied to the crown of the helmet at a rate of 1.0 (+/-.10) inch/minute and maintained for 30 seconds. The helmet shall be subjected to the test force five (5) times in succession. The force application cycle shall be approximately 30 second intervals (+/-5 seconds) between each application of the test force. At the end of the fifth compression the top to bottom dimension will again be measured while the load remains applied to the helmet. The helmet top to bottom deflection must be less than or equal to 15mm. Following compression testing there shall be no visible delamination, ply separations, distortions, or similar damage to the helmet shell. If a helmet exceeds 15mm deflection it has failed.
- 5.6.3 The helmet shall be resistant to compression from side-to-side. The same sample helmet shall be shimmed such that the Coronal plane is perpendicular with the test surface and the Mid-sagittal plane is parallel with the test surface. A compressive force of 300 pounds shall be brought gently into contact with the side of the helmet at a rate of 1.0 (+/-.10) inch/minute. The side-to-side dimension of the helmet shall be measured to the nearest mm. The load will then be applied to the side of the helmet for 30 seconds. The helmet shall be subjected to the test force five (5) times in succession. The force application cycle shall be approximately 30 second intervals (+/-5 seconds) between each application of the test force. At the end of the fifth compression the side-to-side dimension will again be measured while the load remains applied to the helmet. The helmet side to side deflection must be less than or equal to 15mm. Following compression testing there shall be no visible delamination, ply separations, distortions, or similar damage to the helmet shell. If a helmet exceeds 15 mm deflection it has failed. Only one side-to-side compression test will be conducted, the side (right/left) onto which the load is applied is at the discretion of the tester.
- 5.6.4 The helmet shall be resistant to compression from front-to-back. The same sample helmet shall be shimmed such that the mid-sagittal plane is perpendicular to the testing surface and the coronal plane is parallel to it. A compressive force of 300 pounds shall be brought gently into contact with the front/back of the helmet at a rate of 1.0 (+/-.10) inch/minute. The front-to-back dimension of the helmet shall be measured to the nearest mm. The load will then be applied to the front/back of the helmet for 30 seconds. The helmet shall be subjected to the test force five times in succession. The force application cycle shall be approximately 30 second intervals (+/-5 seconds) between each application of the test force. At the end of the fifth compression the front-to-back dimension will again be measured while the load remains applied to the helmet. The helmet front-to-back deflection must be less than or equal to 15mm. Following compression testing there shall

be no visible delamination, ply separations, distortions, or similar damage to the helmet shell. If a helmet exceeds 15 mm deflection it has failed.

#### 5.7 Retention Buckle / Strap Strength Test

- 5.7.1 The helmet retention strap shall have adjustable straps to facilitate proper fitment. The chinstrap shall remain secure in the adjusted configuration.
- 5.7.2 One (1) complete helmet from Compression Resistance testing will be used for Static Strength testing, and one (1) complete helmet will be used for Dynamic Strength testing.
- 5.7.2.1 **Static Strength Testing:** Adjust the retention system to the ballistic headform dimensions. The helmet shall be securely held in a fixture similar to DOT-218, Section 571.218, figure 4 (retention system test device). The webbing shall be marked in a suitable manner such that slippage at the adjustment points may be verified. A load of 150 pounds shall be applied to the fastened chinstrap at a rate of 1.0 (+/-.10) inch/minute. The load shall be maintained for one minute (+/-5 seconds). A failure of any component of the retention system (e.g., the chinstrap buckle opens, the adjustments slip), will be deemed a failure of this assessment. The webbing is allowed to stretch, but fasteners are not allowed to slip.
- 5.7.2.2 **Dynamic Strength Testing:** One helmet at ambient temperature shall be tested in accordance with DOT-218, with the variance that an impact velocity of 25 fps (+/- 3%) is achieved. All impacts shall be on a hemispherical anvil using a size large headform. Drop locations shall be on or about the following: Reference plane and Mid-sagittal plane at both the front and rear; Reference plane and Coronal plane both right and left sides with the anvil striking above any ear protrusions; Mid-sagittal and Coronal intersection (crown). A failure of any component of the retention system (e.g., the chinstrap buckle opens, the adjustments slip), will be deemed a failure of this assessment. Straps shall not slip.

### APPENDIX A INSPECTION CHECKLIST

Manufacturer: Model Number: Sample ID:

	DEFECT	YES	NO	COMMENTS
	Bubbles			
	Cracking			
	Depressions			
	Exposed fibers			
Shell Finish	Folds			
	Peeling			
	Pleats			
	Sharp edges			
	Wrinkles			
Construction	Material separation			
	Folds			
	Gaps			
	Peeling			
Edging	Pleats			
	Separation			
	Sharp edges			
	Wrinkles			
Coatings	Blisters			
	Bubbles			
	Cracking			
	Delamination			
	Peeling			
	Wrinkles			
Water Conditioned	Corrosion Visible			

**Note:** Any "Yes" results require comments and documented photo.

### **APPENDIX B SHOT SCHEDULE**

SHOT ORDER	TEMP CONDITION	HEAD FORM	HELMET SAMPLE	SHOT ID	LOCATION DESCRIPTION
1		FRONT	- 1	1-1	Front, along the mid-sagittal plane, 25mm from edge
2		RIGHT		1-2	Right, along the coronal plane, 60mm from edge
3	3 4 5 6 AMBIENT 7	CROWN		1-3	Crown, right front 45°
4		LEFT		1-4	Left, along the coronal plane, 60mm from edge
5		REAR		1-5	Rear, along the mid-sagittal plane, 90mm from edge
6		RIGHT		1-6	Rear, next to right suspension bolt*
7		FRONT		2-1	Front, left 315°, 25mm from edge
8		RIGHT		2-2	Front, right 45°, 90mm from edge
9	9 10	CROWN	2	2-3	Crown, left 270°
10		LEFT		2-4	Rear, left 225°, 60mm from edge
11		REAR		2-5	Rear, on right rear suspension bolt*
12	_	FRONT	3	3-1	Front, along the mid-sagittal plane, 60mm from edge
13		RIGHT		3-2	Right, along the coronal plane, 25mm from edge
14		REAR		3-3	Rear, along the mid-sagittal plane, 60mm from edge
15		CROWN		3-4	Crown, Right Rear 135°
16	WATER CONDITIONED	LEFT		3-5	Left, along the coronal plane, 90mm from edge
17		REAR		3-6	Rear, next to left rear suspension bolt*
18		FRONT	4	4-1	Front, left 315°, 60mm from edge
19		RIGHT		4-2	Front, right 45°, 25mm from edge
20		REAR		4-3	Rear, right 135°, 90mm from edge
21		CROWN		4-4	Crown, Front 0°
22		LEFT		4-5	Rear, on left rear suspension bolt*

SHOT ORDER	TEMP CONDITION	HEAD FORM	HELMET SAMPLE	SHOT ID	LOCATION DESCRIPTION
23		LEFT	5	5-1	Left, along the coronal plane, 60mm from edge
24		REAR		5-2	Rear, along the mid-sagittal plane, 25mm from edge
25	25 26 27 28 HIGH TEMP.	RIGHT		5-3	Right, along the coronal plane, 60mm from edge
26		CROWN		5-4	Crown, Rear 225°
27		FRONT		5-5	Front, along the mid-sagittal plane, 90mm from edge**
28		LEFT		5-6	Front, next to left front suspension bolt*
29		REAR	6	6-1	Rear, left 225°, 90mm from edge
30		RIGHT		6-2	Rear, right 135°, 25mm from edge
31	31	FRONT		6-3	Front, right 45°, 60mm from edge
32		CROWN		6-4	Crown, 90°
33		FRONT		6-5	Front, on left front suspension bolt*
34		FRONT	7	7-1	Front, along the mid-sagittal plane, 60mm from edge
35		LEFT		7-2	Left, along the coronal plane, 25mm from edge
36		REAR		7-3	Rear, along the mid-sagittal plane, 60mm from edge
37		CROWN		7-4	Crown, front 315°
38	LOW TEMP.	RIGHT		7-5	Right, along the coronal plane, 90mm from edge
39		FRONT		7-6	Front, next to right front suspension bolt*
40		LEFT	8	8-1	Front, left 315°, 90mm from edge
41		REAR		8-2	Rear, Left 225°, 25mm from edge
42		RIGHT		8-3	Rear, Right 135°, 60mm from edge
43		CROWN		8-4	Crown, rear 180°
44		FRONT		8-5	Front, on right front suspension bolt*

\* For helmets with no visible hardware on the exterior of the ballistic shell, the Hardware test shots and Next-to-Hardware test shots will be made over the location of the mounting device for the retention system.

\*\* If the NVG shroud is mounted with hardware that passes through the helmet shell, this shot shall be on the mounting hardware nearest to the designated shot location.

### **APPENDIX C**

### **HEADFORM PREPARATION FOR TESTING**

Peepsite Generation 2 headforms shall be used for P-BFD testing.

The following sequence shall be followed preparing headforms for each shot:

- The headform shall be packed with ambient temperature Roma Italian Plastilina No.1 modeling clay. The clay must be packed such that no voids are present in the clay.
- The headform is then pressed in the mold. Any excess clay shall be removed, and the surface of the molded clay smoothed and inspected for deformities.
- The headform is then scanned using a FARO arm (or similar).
- The headform will then be validated at the approximate location of the intended shot. Validation shall be conducted at ambient temperature. For validation, a spherical steel mass, 63.5mm diameter and 1.045kg, shall be dropped from a height of 2.0 m onto the headform at the approximate location behind the intended shot location marked on the helmet. The headform is then scanned again using the FARO arm (or similar) and the resulting deformity depth recorded. To be valid for testing the depression must be 14mm (+/- 2mm, fractions rounded off to nearest mm).
- The headform is then remolded, the surface smoothed and inspected for deformities, and then scanned again by the FARO arm (or similar).
- The validated headform is then placed in a fixture for testing. The sample helmet is mounted on the headform using the retention system of the helmet and the headform adjusted for the shot.
- The sample helmet is then shot. Fair/unfair velocity for the shot is then determined.
- Penetration is then determined.
- The sample helmet is then carefully removed and the headform scanned by the FARO arm. The resulting BFD is then recorded.



DENOTES HARDWARE OR NEXT TO HARDWARE SHOT



### HELMET AREA IDENTIFICATION



**DENOTES FASTNER** 

HELMET AS VEIWED FROM ABOVE



# SHOT LOCATION P-BFD AMBIENT TEST







# SHOT LOCATION P-BFD WATER CONDITIONED







## SHOT LOCATION P-BFD HIGH TEMPERATURE CONDITIONED



HELMET AS VEIWED FROM ABOVE



## SHOT LOCATION P-BFD LOW TEMPERATURE CONDITIONED



HELMET AS VEIWED FROM ABOVE