



H.P. WHITE LABORATORY, INC.

TEST PROCEDURE

**BALLISTIC/RIOT HELMET
FACE SHIELDS**

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1.0 BACKGROUND

- 1.1 Helmets intended for use by law enforcement officers should provide some level of protection from a broad range of threats including those incurred during high speed pursuit, falls from motorcycles, assault with blunt instruments and bullet impacts.
- 1.2 Law enforcement helmets, whether characterized as ballistic, riot or crash helmets, are usually equipped with a protective face shield. However, in most instances, the face shields do not provide the same type or level of protection as the host helmet. This differing protection is more a reflection of what is attainable with transparent materials than a real variation between threats to the face and threats to remaining areas of the officer's head.
- 1.3 Law enforcement helmets usually provide a much greater level of protection than do the face shields attached to those helmets. Acceptance of this disparity has discouraged development of face shields to the extent that no standard known to H.P. White Laboratory, Inc. provides a procedure for evaluating face shields for levels of protection equal to the levels of protection of the host helmet.
- 1.4 This standard recognizes that, within practical limitations, existing face shield materials may not satisfy the most stringent levels of protection required of helmets, but those requirements are included in this standard with the hope that by so doing, the user will demand, and the supplier develop, improved face shields.

2.0 SCOPE

- 2.1 The scope of this testing procedure is limited to evaluating the ballistic resistance of a face shield to penetration by bulletted ammunition AND the resistance of a face shield to impacting with weapons of opportunity available to rioters.

3.0 DISCUSSION

- 3.1 To the maximum extent possible, this procedure relies on materials, techniques and processes currently used in the testing of similar commodities.
- 3.2 The Ballistic Resistance Testing of face shields of this standard is conducted with bullet types and velocities used by National Institute of Justice standards for evaluating body armor, NIJ-STD-0101, and ballistic resistant materials, NIJ-STD-0108.

- 3.3 The procedure of this standard used to evaluate the resistance of face shields to non-ballistic (riot) threats are GENERALLY those used by National Institute of Justice standards for evaluating Riot Helmets and Face Shields, NIJ-STD-0104.02.
- 3.4 Inasmuch as the effect on the neck (whiplash) of impacting of the face shield is not related to the resistance of the face shield, nor can that effect be fairly attributed to the face shield, measurements of that effect are, in the interest of test economy, not included in this standard.
- 3.5 These procedures require the face shield to resist excessive back face deformation as well as penetration.
- 3.6 The headform used by this procedure to evaluate the protection levels of face shields is a modification of the headform specified by NIJ-STD-0104.02.
- 3.7 This test procedure is intended to evaluate the resistance of a face shield to a SINGLE impacting. However, to insure the construction of all locations satisfies the requirements of this standard, the procedures require multiple test trials. In the interest of test economy, multiple shots MAY be conducted on a single sample.
- 3.8 The procedures of this standard are intended to evaluate the protection offered by a specific visor design (Design Certification). Provisions for follow-on evaluation of the continued compliance of production units (Quality Control) are not within the scope of this standard.

4.0 APPLICABLE STANDARDS

- 4.1 The latest revisions of the following documents apply to the materials and procedures of this standard.
- 4.1.1 ANSI/SAAMI Z299.1-1992, Voluntary Industry Performance Standards for Pressure and Velocity of Rimfire Sporting Ammunition for the use of Commercial Manufacturers.
- 4.1.2 ANSI/SAAMI Z299.3-1993, Voluntary Industry Performance Standards for Pressure and Velocity of Centerfire Pistol and Revolver Ammunition for the use of Commercial Manufacturers.
- 4.1.3 ANSI/SAAMI Z299.4-1992, Voluntary Industry Performance Standards for Pressure and Velocity of Centerfire Rifle Sporting Ammunition for the use of Commercial Manufacturers.

4.1.4 ANSI/SAAMI Z299.2-1992, Voluntary Industry Performance Standards for Pressure and Velocity of Shotshell Ammunition for the use of Commercial Manufacturers.

4.1.5 NIJ-STD-0101.03, Ballistic Resistance of Police Body Armor.

4.1.6 NIJ-STD-0104.02, Riot Helmets and Face Shields.

4.1.7 NIJ-STD-0106.01, Ballistic Helmets.

5.0 GLOSSARY OF TERMS

- 5.1 DEFORMATION - Dynamic (temporary) or permanent reduction of linear distance between inside of face shield and headform.
- 5.2 DEFORMATION, EXCESSIVE - Deformation which results in contact between face shield and headform sensor(s).
- 5.3 MODEL - A specific design of face shield whose shape, materials or construction differ from any other face shield. (Note: Variations in shape to accommodate differing head sizes do not constitute a change in model.)
- 5.4 PENETRATION - Any portion of the projectile material which passes through the face shield or ANY loss of the face shield material into the protected area shall be classified as a penetration.
- 5.5 SHOT, FAIR - An unyawed projectile of the specified construction and specified velocity impacting at the specified angle of obliquity and intended shot impact location on the sample, except -
- 5.5.1 An otherwise fair shot, but yawed projectile, which produces a penetration or excessive deformation shall be declared a fair shot.
- 5.5.2 An otherwise fair shot, projectile striking at a greater angle of obliquity than that specified which produces a penetration or excessive deformation shall be declared a fair shot.
- 5.5.3 An otherwise fair shot, projectile striking at less than the specified velocity which produces a penetration or excessive deformation shall be declared a fair shot.
- 5.5.4 An otherwise fair shot, projectile striking at velocities greater than the specified maximum which DOES NOT penetrate NOR produce excessive back-face deformation shall be declared a fair shot.

- 5.5.5 Any otherwise fair shot whose center of impact is within 1.0-inch of the edge of the test sample and which does not penetrate nor excessively deform the test sample shall be declared a fair shot.
- 5.6 SHOT, UNFAIR - Any of the following categories of shots shall be declared unfair and shall not be used in evaluating the test samples.
- 5.6.1 Any penetrating or excessive deformation shot at velocities greater than the maximum specified.
- 5.6.2 Any non-penetrating at velocities less than the minimum specified.
- 5.6.3 Any non-penetrating shot which is yawed more than 3-degrees.
- 5.6.4 Any non-penetrating shot whose striking angle of obliquity is more than 3-degrees.
- 5.6.5 Any otherwise fair shot which penetrates or excessively deforms a test sample which strikes that sample within 1.0-inch of the edge of the sample (center of impact to edge).
- 5.6.6 Any otherwise fair shot which penetrates or excessively deforms a test sample which has been previously impacted with one or more prior shots.

6.0 TEST SAMPLING

- 6.1 Face shields submitted for testing in accordance with this standard shall be complete product assemblies as offered for sale by the manufacturer including, but not necessarily limited to, a host helmet with suspension and face shield mounting. Unit and departmental logos and markings requested by the customer are exempted.
- 6.2 Each model of face shield shall be required to resist one fair impact of the specified threat in each of four locations. While one face shield may be used to complete the four shot requirement, unfair impacts may require additional samples of the same face shield model to complete the test.

7.0 TEST PROCEDURE (GENERAL)

- 7.1 Unless otherwise specified, testing is to be conducted with test samples which have been mounted on the host helmet and thoroughly temperature conditioned at +70° (±5°) Fahrenheit for a minimum of 4.0-hours. Samples will be tested in an environment with an ambient air temperature of +70° (±5°) Fahrenheit within 30.0-minutes of removal from temperature conditioning equipment. Samples not completely tested within the 30.0-minute requirement will be reconditioned for a minimum of 1.0-hour at the specified conditioning temperature.

7.1.1 Extreme Hot/Cold Testing may be requested by end-product users and manufacturers to replicate expected field conditions and operating temperatures. Should such OPTIONAL hot and/or cold testing be required, face shield samples will be thoroughly conditioned at +120 degrees Fahrenheit and/or -20 degrees Fahrenheit for a minimum period of 4-hours prior to testing and all testing completed within 10-minutes of removal of the test sample from the conditioning environment. Face Shield samples not completely tested within the 10.0-minute requirement will be reconditioned for a minimum of 1.0-hour at the specified hot and/or cold conditioning temperatures. The test environment and headform shall be maintained at +70° (±10°) Fahrenheit for the Extreme Temperature Tests.

8.0 TEST PROCEDURE (BALLISTIC)

- 8.1 The face shield sample and host helmet shall be positioned on a rigidly mounted headform complying with Figure 1 to produce zero degree obliquity impacts with the line-of-fire at 16.4-feet (5-meters) from the muzzle of the test barrel. The manufacturer installed mounting system of the face shield, and only that system, shall be used to mount the face shield. The helmet strapping system shall be adjusted to insure proper "snug" fitting on the headform.
- 8.1.1 Prior to Ballistic Testing, a witness panel consisting of 0.001 inch aluminum foil shall be positioned 2 inches behind the protected side of the face shield. If the face shield is curved, the witness panel shall likewise be curved, so that all points of the witness panel are 2 inches behind the rear surface of the face shield.
- 8.2 One shot of the appropriate threat level (see Table I) shall be fired at each of four locations of the face shield at an impacting angle of zero degrees of obliquity on the horizontal centerline (±1/4") in the center of the left and right halves and on the vertical centerline (±1/4") in the center of the upper and lower halves.
- 8.2.1 Testing will continue until one fair shot has been fired at each location providing no penetrations are recorded and the back-face deformation of each shot complies with the requirements of Paragraph 10.0.
- 8.3 The manufacturer may elect to either use a separate sample for each of the required four shots, or reduce the sample size by conducting two or more shots on the same sample.
- 8.4 Should the results of the first shot produce a penetration or excessive back-face deformation, testing shall be terminated and the face shield model design declared not-in-compliance with the ballistic resistance requirements of this standard.

- 8.5 Should the results of the first shot comply with the penetration and deformation requirements of this standard, testing shall proceed in accordance with either 8.5.1 or 8.5.2.
- 8.5.1 In the interest of test economy, the second, third and fourth shots may be fired on the same sample; however, should the results of shots two, three or four on this sample prove to be unsatisfactory, the results of the failing shot shall be declared "unfair" and the test sample replaced with a previously untested sample for the remainder of the four shot test, including the shot declared "unfair" (see Paragraph 8.7).
- 8.5.2 A previously untested sample may be used to conduct each, or any two of the remaining three shots (see Paragraph 8.7).
- 8.6 The strapping system of the helmet shall be inspected after each shot and adjusted to insure proper mounting on the headform.
- 8.7 The data of all shots - fair and unfair - shall be reported, but only the first shot on any sample shall be used to fail the design, i.e., any shot BEYOND THE FIRST SHOT ON ANY SAMPLE which does not comply with Paragraph 10.0 shall be declared "unfair" (see Paragraph 3.7).

9.0 TESTING (IMPACT)

- 9.1 Prior to Impact Testing, electrically conductive tape shall be applied to the protected side of the face shield in alignment with the headform sensor. Electrical leads from this tape and the headform sensor shall be used with oscilloscope circuitry intended to confirm or deny contact between the sensor and the face shield (excessive deformation) and to determine the elapsed time of that contact.
- 9.2 The test sample and host helmet shall be mounted on a rigidly fixtured headform complying with Figure 1 to produce zero degree obliquity impacts with a freely falling impact weight. The strapping system of the helmet, and only that system, shall be used to insure proper mounting on the headform.
- 9.2.1 The impact weight shall be a steel cylinder 1.77 inches in diameter with a hemispherical impact end weighing 2.2 pounds (Light Threat) or 6.6 pounds (Heavy Threat).
- 9.3 One Drop Test shall be conducted at each of the four required locations on the face shield using the appropriate drop weight and height (see Table II).
- 9.3.1 Testing will continue until one fair impact has been made at each location, providing no failures are recorded (see Paragraph 11.0).
- 9.4 The manufacturer may elect to either use a separate sample for each of the required four impacts, or reduce the sample number by conducting two or more impacts on the same sample.

- 9.5 Should the results of the first impact produce a result which is not in compliance with Paragraph 11.0, testing shall be terminated and the model design declared not-in-compliance with the impact resistance requirements of this standard.
- 9.6 Should the result of the first drop impact comply with the requirements of Paragraph 11.0, testing shall proceed in accordance with either 9.6.1 or 9.6.2.
- 9.6.1 In the interest of test economy, the second, third and fourth Drop Impact Test may be made on the same sample, however, should the result of drops two, three or four on this sample prove to be unsatisfactory, the results of the failing drop shall be declared "unfair" and the test sample replaced with a previously untested sample for the remainder of the four Drop Test (see Paragraph 9.8).
- 9.6.2 A previously untested sample may be used to conduct each, or any two of the remaining three shots (see Paragraph 9.8).
- 9.7 The strapping system of the helmet shall be inspected after each shot and adjusted to insure proper mounting on the headform.
- 9.8 The data of all drops - fair and unfair - shall be reported, but only the first drop on any sample shall be used to fail the design, i.e., any drop BEYOND THE FIRST DROP ON ANY SAMPLE which does not comply with Paragraph 11.0 shall be declared "unfair" (see Paragraph 3.7).

10.0 ACCEPTABILITY (BALLISTIC)

- 10.1 Penetration by any fair shot shall deny compliance of the design with the ballistic penetration requirements of this standard.
- 10.2 Deformation by any fair non-penetrating shot sufficient to cause contact between the visor and headform shall deny compliance of the design with the ballistic deformation requirements of this standard.
- 10.3 Design compliance with the ballistic resistance requirements of this standard shall be denied by any fair shot which penetrates or excessively deforms the test sample REGARDLESS of the number of other shots which do comply with those requirements.

11.0 ACCEPTABILITY (IMPACT)

- 11.1 Deformation of the face shield which results in any measurable contact between the face shield and headform sensor shall deny compliance with the impact resistance requirements of this standard.
- 11.2 Any complete perforation of the face shield shall deny compliance with the impact resistance requirements of this standard.

- 11.3 Any loss of material (spalling) from the inside surface of the face shield shall deny compliance with the impact resistance requirements of this standard.
- 11.4 Design compliance with the impact resistance requirements of this standard shall be denied by any fair impact which produces spalling or excessively deforms the test sample REGARDLESS of the number of other impacts which do comply with those requirements.

12.0 DATA

- 12.1 Prior to initiating these test procedures, the test face shield(s) will be visually inspected. Recorded data of that inspection will include, but not necessarily be limited to, the following:
 - 12.1.1 Manufacturer, Model Number, Serial Number and Lot Number.
 - 12.1.2 Description including:
 - 12.1.2.1 Size.
 - 12.1.2.2 Material.
 - 12.1.2.3 Weight.
 - 12.1.2.4 Mounting System.
 - 12.1.2.5 Labelling.
 - 12.1.2.6 Any visual differences or discrepancies in the face shields of a multi-shield submission
 - 12.1.3 Level of protection claimed by the manufacturer.
- 12.2 The test data records shall include, but not necessarily be limited to, the following:
 - 12.2.1 Level of protection being tested.
 - 12.2.2 Manufacturer and Lot Number of the test sample.
 - 12.2.3 Velocity and impact location of each shot (if applicable).
 - 12.2.4 "Penetration" or "Non-Penetration" of each shot (if applicable).
 - 12.2.5 "Fair" or "Unfair" characterization for each shot.
 - 12.2.6 Location of each Drop Test impact.
 - 12.2.7 Kinetic Energy and momentum of each Drop Test.
 - 12.2.8 Elapsed time of any contact between sample and headform.

12.2.9 Environmental conditions and temperature conditioning of the test samples.

12.2.10 Post Test, black and white photographs of all tested samples.

13.0 REPORTING

13.1 The Final Report of testing shall include a narrative of the test, including the identity of the party authorizing the test, the results of testing, and the data records of Paragraph 12.0, above.

13.2 Appended to the Final Report shall be a statement from the testing agency certifying or denying compliance of the performance of the DESIGN with the applicable requirements of this standard (if appropriate).

TABLE I. BALLISTIC PROTECTION/THREAT LEVELS

Level (a)	Test Ammunition			Required Bullet Velocity (fps)		Required Shots (b)
	Caliber	Bullet		Minimum	Maximum	
		Weight (gr)	Type			
I	.22 LR	40	Lead	1050	1100	4
	.38 Special	158	RN Lead	850	900	4
IIA	9x19mm	124	FMJ	1090	1140	4
	.357 Magnum	158	JPS	1250	1300	4
II	9x19mm	124	FMJ	1175	1225	4
	.357 Magnum	158	JPS	1395	1445	4
IIIA	9x19mm	124	9x19mm	1400	1450	4
	.44 Magnum	240	SWC-GC	1400	1450	4
III	7.62x51mm	150	Ball, M80	2750	2800	4
IV	.30-06	166	AP	2850	2900	4
V	Special Category (c)		-	-	-	4

(a) NIJ-STD-0108 and NIJ-STD-0101

(b) One (1) shot in each quadrant fired either as one (1) shot per visor or as multiple shots on a lesser number of visors.

(c) This procedure may be used to test the resistance of other bulletted ammunition or fragment simulators conforming to MIL-P-46593A.

TABLE II. DROP IMPACT TEST REQUIREMENTS

Level of Threat	Drop				Required Drops Per design (a)
	Weight (lbs.)(b)	Height (in)	Kinetic Energy (in-lbs.)(c)	Momentum (lb-sec)(c)	
Light	2.2	31.5	69.3	0.89	4
Heavy	6.6	118.1	779.5	5.17	4

(a) One at each of four locations. May be conducted on the same or differing samples, but only first drop on any sample can fail design.

(b) Steel cylinder, 1.75 inch diameter, with hemispherical impacting end.

(c) All values are theoretical, insofar as it is assumed that the potential energy is wholly-transformed into kinetic energy, disregarding that portion of the potential energy actually transformed into friction, heat, sound, etc.

