



H.P. WHITE LABORATORY, INC.

TEST PROCEDURE

BALLISTIC RESISTANCE OF SHIN GUARDS

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1.0 INTRODUCTION

1.1 Background

- 1.1.1 Military and law enforcement personnel are provided a variety of items for personal protection, including shin protectors. While existing test procedures for these items are intended to ensure minimum levels of protection, no such procedure currently exists for evaluating the ballistic protection of shin guards expressly.

1.2 Description

- 1.2.1 The full range of existing shin guards varies with respect to the perceived threat, and the area to be protected.

- 1.2.2 The bodily area to be protected by a shin guard assembly may:

- 1.2.2.a be limited to the shin,
- 1.2.2.b include knee protection,
- 1.2.2.c include ankle protection, or
- 1.2.2.d include knee and ankle protection

- 1.2.3 The categories of threat for which shin guards are intended to offer protection are varied, and protection from one threat will not necessarily provide protection from another threat. These threats are:

- 1.2.3.a Ballistic, bulleted,
- 1.2.3.b Ballistic, fragmenting munition,
- 1.2.3.c Blunt impact, and
- 1.2.3.d Edged / pointed instruments.

1.3 Scope

- 1.3.1 The scope of this test procedure is limited to the evaluation of the resistance of shin guards to a bulleted ballistic threat. The general provisions of NIJ-STD-0101.04 have been used as a guide in the formulation of this test procedure.

1.4 Discussion

- 1.4.1 Protection from a bulleted, ballistic threat should include protection from bullet penetration, as well as blunt trauma from the backside deformation of the armor when impacted with a non-penetrating bullet.

- 1.4.2 While bullet penetration is to be perceived as an unacceptable condition, there is little, if any, data in the literature regarding acceptable limits of backface deformation of shin guards.

- 1.4.3 Accordingly, this test procedure is limited to the evaluation of shin guards to bullet penetration only. While clay backface deformation data (representing blunt trauma) shall be recorded, a pass/fail criterion for backface deformation is not promulgated herein. Such data are to be recorded for information purposes only.

2.0 DEFINITIONS

- 2.1 Ammunition – caliber 9mm Luger, 124 grain, FMJ (full metal jacket) at instrumental velocities of 1400-1460 feet per second.
- 2.2 Backface Deformation – a term commonly used to describe the trauma to the body inflicted by the deformation of armor material from a ballistic impact which does not penetrate the armor.
- 2.3 Clay Backing – non-hardening modeling clay conforming to the requirements of NIJ-STD-0101.04.
- 2.4 Compliance – no bullet penetrations of the test sample after five fair impacts.
- 2.5 Conditioning– the test sample shall be conditioned at 65 to 75 F, and 30-70 percent relative humidity, for a minimum of three hours prior to testing. The test sample shall be tested in the wet condition conforming to the requirements of NIJ-STD-0101.04.
- 2.6 Deformation, Depth – the maximum depth of deformation of the clay backing material, as measured from the original, undisturbed clay surface.
- 2.7 Impact, Fair - impact of the specified bullet (Paragraph 2.1) conforming with the specified velocity, obliquity, and shot spacing requirements, except that :
 - 2.7.1 an excessive velocity, non-penetrating impact, otherwise fair, shall be defined as a fair impact,
 - 2.7.2 an insufficient velocity, penetrating impact, otherwise fair, shall be defined as a fair impact, and
 - 2.7.3 a non-penetrating impact which does not comply with the minimum impact spacing requirement (Paragraph 2.9), otherwise fair, shall be defined as a fair impact.
- 2.8 Impact, Obliquity– the angle between the flight path of the bullet and the axis normal (perpendicular) to the tangent of the shin guard radius of curvature at the intended point of impact.
- 2.9 Impact, Spacing – The minimum distance between impacts, as well as between an impact and the edge of the shin guard assembly, shall be 2 inches. Distances shall be measured from the outside edge of disturbed impact areas.
- 2.10 Penetration – the presence of any portion of the bullet, or fragmentation of the test sample material, in the clay backing shall constitute penetration. All other results shall be defined as non-penetrating impacts.

3.0 PROCEDURES

3.1 Sampling

- 3.1.1 Shin guards submitted for testing in accordance with this test procedure shall be in a new, unused condition.
- 3.1.2 One shin guard per construction design shall be submitted for testing.
- 3.1.3 To preclude the top or bottom of the shin guard from contacting the test fixture, the shin guard shall not exceed 17 inches in length.
- 3.1.4 The shin guard shall be conditioned pursuant to the provisions of Paragraph 2.5 of this test procedure prior to testing.

3.2 Fixturing

- 3.2.1 The test sample shall be mounted on a test fixture conforming to the provisions of Figure I.
- 3.2.2 The fixture shall be rigidly mounted, and shall provide a range of rotation to ensure all impacts are zero degrees obliquity relative to the curved surface (Paragraph 2.8).
- 3.2.3 The fixture shall be filled with non-hardening, modeling clay conforming to the requirements of NIJ-STD-0101.04.
- 3.2.4 The rear surface of the shin guard is to be in intimate contact with the clay surface. There are to be no air-gaps within the clay, nor between the clay surface and the shin guard.
- 3.2.5 The test barrel fixturing shall include a laser with which the location of each impact can be determined.

3.3 Instrumentation

- 3.3.1 The test sample shall be positioned 16.4 feet forward of the muzzle of the test barrel.
- 3.3.2 Velocity screens shall be positioned 6.5 and 9.5 feet forward of the muzzle of the test barrel to compute instrumental bullet velocities 8.0 feet forward of the muzzle.

3.4 Test Sequence

- 3.4.1 The manufacturer, model, weight, overall dimensions, and general description of the test sample shall be recorded.
- 3.4.2 The first impact shall be made, and the following data recorded:
 - 3.4.2.a fair, or unfair, impact velocity (Paragraph 2.1)
 - 3.4.2.b fair, or unfair, impact location (Paragraph 2.9)
 - 3.4.2.c penetration or non-penetration (Paragraph 2.10)
 - 3.4.2.d depth of clay deformation (Paragraph 2.6)
- 3.4.3 The procedure of 3.4.2 shall be repeated until five fair impacts (Paragraph 2.7) have been obtained. If the required five fair impacts have not been obtained after a total of seven impacts, the test shall be declared inconclusive, and the entire test repeated on another sample.

4.0 COMPLIANCE

4.1 Compliance

- 4.1.1 Penetration by any fair impact shall constitute failure of the shin guard to comply with the requirements of this test procedure, regardless of the number of non-penetrating, fair impacts.
- 4.1.2 The maximum depths of all backface deformations associated with non-penetrating impacts shall be recorded for information purposes only.

TABLE I. BALLISTIC THREAT

Caliber	Bullet Velocity (fps)	Number Of Impacts	
		Required	Maximum
9mm Luger, 124 grain, FMJ	1400-1460	5	7

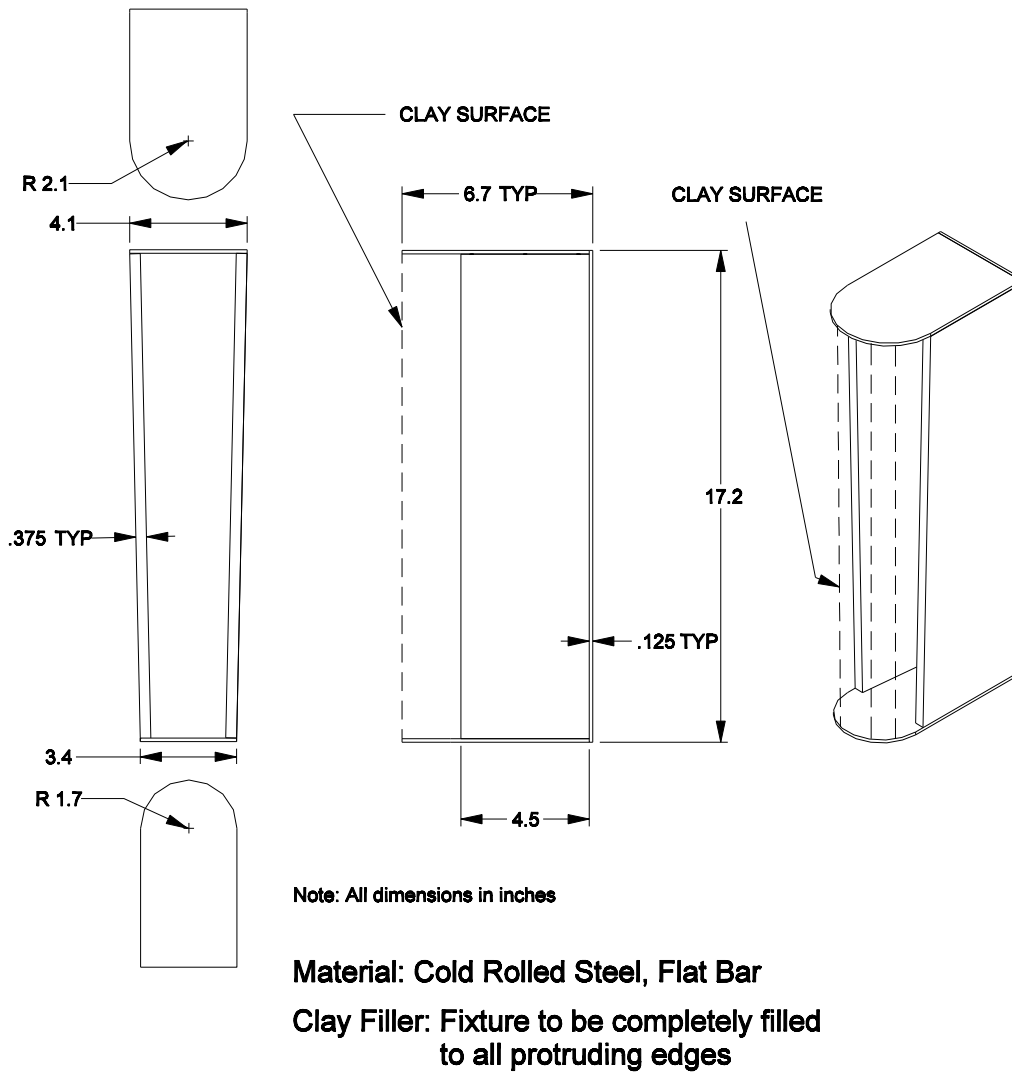


Figure 1. Shin Guard Holding Fixture