INCH-POUND

AR/PD 14-01 with
30 September 2015

SUPERSEDING
Not Applicable

Purchase Description

HELMET, ADVANCED COMBAT, SECOND GENERATION (ACH GEN II)

Record of Revisions

REV	CHANGED BY	REVISED PAGE(S)	DESCRIPTION	DATE (D/M/Y)	Approval
-	PM SPE	-	Purchase Description for the acquisition of an Second Generation Advanced Combat Helmet (ACH Gen II)	30/09/15	AWM

MILITARY INTERESTS:

Custodians:
Army – PM SPE

Preparing activity:
Army – PM SPE

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using ASSIST online database at:

https://assist.daps.dla.mil/quicksearch/

1.0 SCOPE

1.1 Scope. This document covers the performance and verification requirements for the Second Generation Advanced Combat Helmet (ACH Gen II), a ballistic shell, suspension system, and retention system with chinstrap and nape strap. The ACH Gen II is a Critical Safety Item (CSI).

1.2 Classification. The helmet assembly will be of the following Types and Classes as specified (see 6.2).

Type I – Advanced Combat Helmet Gen II (One Hole for Night Vision Goggle Mount)
Class 1 – Retention System, Suspension system, Tan 499

Type II – Advanced Combat Helmet Gen II (No Hole for Night Vision Goggle Mount)
Class 1 – Retention System, Suspension system, Tan 499

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be used in improving this document should be addressed to: Product Manager – Soldier Protective Equipment, Program Executive Office – Soldier, US Army, 10170 Beach Road, Building 328T, Fort Belvoir, Virginia 22060.

AMSC N/A FSC 8470

1.3 Schedule of Sizes. The helmet assembly is constructed in the following sizes:

SCHEDULE OF SIZES
Extra-Small (XS)
Small (S)
Medium (M)
Large (L)
Extra-Large (XL)
Double Extra-Large (XXL)

Note: Due to low tariff, the Extra-Small and Extra Extra-Large (XXL) First Article Test (FAT) will be handled on a case by case basis. Direct all XS and XXL FAT inquiries to the Contracting Officer.

1.3.1 Helmet Sizing. The size Small through Extra-Large must fit the 5th to the 95th percentile of all Soldiers. Soldier head size distribution for the 5th to the 95th percentile for the Army combat helmet is Small (2%), Medium (40%), Large (50%), and Extra-Large (8%). Soldier head size distribution for the ACH Gen II must not increase the use of larger sized helmets. Increased use of smaller sized helmets is desirable. This requirement will be examined through user evaluations and must be in accordance with 4.10.1.

2.0 APPLICABLE DOCUMENTS

2.1 General. This section lists documents specified in sections 3, 4, and 5 of this purchase description. This section does not include documents cited in other sections of this purchase description or recommended for additional information or as examples. Document users are cautioned that they must meet all specified requirements in the documents cited in sections 3, 4, and 5 of this purchase description, whether or not they are listed.

2.2 Government Documents.

2.2.1 Specifications, Standards, and Handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the solicitation and at the time of contract award.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-32075 - Label: For Clothing, Equipage and Tentage (General Use)
MIL-DTL-46593B W / Amendment 1 - Projectile, Calibers .22, .30, .50, and 20mm Fragment-Simulating
MIL-DTL-64159B - Camouflage Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant
MIL-DTL-83133H W/ Amendment 2-Turbine Fuel, Aviation, Kerosene Types JP-8 (NATO F-34), NATO F-35, and JP-8 + 100(NATO F-37)
MIL-PRF-372E W/ Amendment 2-Cleaning Compound, Solvent (For Bore of Weapons)
MIL-PRF-2104J - Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service
MIL-PRF-6083G - Hydraulic Fluid, Petroleum Base, for Preservation and Operation
MIL-PRF-46170E - Hydraulic Fluid, Rust Inhibited, Fire Resistant, Synthetic Hydrocarbon Base, NATO Code No. H-544

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-662F - V_{50} Ballistic Test for Armor
MIL-STD-810G W/Amendment 1-Environmental Engineering Considerations and Laboratory Tests
MIL-STD-1916 Notice 2 - DoD Preferred Method for Acceptance of Product
MIL-STD-3004D - Quality Assurance/Surveillance for Fuels, Lubricants, and Related Products

(Copies of documents are available online at http://assist.daps.dla.mil or from the Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government Documents, Drawings, and Publications. The following Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation or contract.

DRAWINGS

U.S. ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND, NATICK SOLDIER CENTER

2-1-2515	- Helmet Shell, Advanced Combat, Small
2-1-2516	- Helmet Shell, Advanced Combat, Medium
2-1-2517	- Helmet Shell, Advanced Combat, Large
2-1-2518	- Helmet Shell, Advanced Combat, Extra Large
2-1-2576	- Helmet Shell, Advanced Combat, Extra, Extra Large
07-99-121	- Improved Retention System (XS), Advanced Combat Helmet
07-99-101	- Improved Retention System (S-XL), Advanced Combat Helmet

(Copies of drawings, publications, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity.)

PURCHASE DESCRIPTIONS

AR/PD 12-01	- Improved Retention System

(Copies of this document are available by contacting the Contracting Officer.)

DEPARTMENT OF TRANSPORTATION FEDERAL MOTOR VEHICLE SAFETY

DOT FMVSS 218 - Department of Transportation Federal Motor Vehicle Safety Standard No.218 Motorcycle Helmets

(Copies of documents are available on line at http://www.nhtsa.dot.gov/cars/rules/standards. The complete text of all Federal Motor Vehicle Safety Standards and other NHTSA regulations can be found in Title 49 of the Code of Federal Regulations (CFR). Title 49 of the CFR is published in seven volumes; the fifth volume (Parts 400-999) is where these regulations can be found. Copies of this volume can be obtained for a cost from the U. S. Government Printing Office, Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328.

NATIONAL INSTITUTE OF JUSTICE (NIJ)

NIJ Standard 0106.01	- Ballistic Helmets
NIJ Standard 0101.06	- Ballistic Resistance of Body Armor

(Copies of documents are available online at https://www.ncjrs.gov/pdffiles1/nij/077182.pdf and http://www.ojp.usdoj.gov/nij/pubs-sum/223054.htm or from the National Institute of Justice, 810 Seventh St. NW, Washington, DC 20531

U.S. ARMY DEVELOPMENTAL TEST COMMAND, ABERDEEN PROVING GROUND, MD

ITOP 04-2-805 - FR/GE/UK/US Projectile Velocity and Time-Of-Flight Measurement

(Copies of documents are available by sending to Commander, US Army Test and Evaluation Command, ATTN: AMSTE-TM-T, Aberdeen Proving Ground, MD 21105-5055)

2.3 Non-Government Standards and Other Publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents are those cited in the solicitation or contract.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC Test Method 8	- Colorfastness to Crocking: Crock meter Method
AATCC Test Method 15	- Colorfastness to Perspiration
AATCC Test Method 61	- Colorfastness to Laundering: Accelerated
AATCC Test Method 107	- Colorfastness to Water
AATCC Test Method 143	- Appearance of Apparel and Other Textile End Products after Repeated Home Laundering
AATCC Test Method 169	- Weather Resistance of Textiles: Xenon Lamp Exposure
AATCC Test Method 195	- Liquid Moisture Management Properties of Textile Fabrics
AATCC Evaluation Procedure 9	- Visual Assessment of Color Difference of Textiles

(Copies of documents are available on line at www.aatcc.org or from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709-2215.)

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI/ASQ Z1.4 - Sampling Procedures and Tables for Inspection by Attributes

(Copies of documents are available online at http://www.ansi.org/ or from the American National Standards Institute, 1819 L Street, 6th floor, Washington, DC or at http://asq.org/index.aspx or from the American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D76 - Standard Specification for Tensile Testing Machines for Textiles

ASTM D910	- Standard Specification for Aviation Gasolines
ASTM D975	- Standard Specification for Diesel Fuel Oils
ASTM F1358	- Standard Test Method for Effects of Flame Impingement on Materials Used in Protective Clothing Not Designated Primarily for Flame Resistance

(Copies of documents are available on line at www.astm.org or from the ASTM INTERNATIONAL, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19426-2959.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.4 Order of Precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3.0 REQUIREMENTS

3.1 First Article/Lot Acceptance.

3.1.1 First Article. Sample(s) shall be subjected to FAT as specified in 4.3 and 6.3. All requirements are listed singularly (i.e., by themselves). In some cases, verification is performed on a test item that has been previously subjected to another verification test.

3.1.2 Lot Acceptance. Single size lots shall be subjected to Lot Acceptance Testing (LAT). Samples will be examined for the defects specified in 4.10.1 and subjected to the tests indicated in 4.9, Table IV. Acceptance criteria shall be specified in the contract. Unless noted otherwise, all LAT will be conducted under ambient conditions.

3.2 Unfinished Shell, Finished Shell, and Finished Helmet. The following definitions shall apply in this document.

a. Unfinished Shell. An unfinished shell shall include the raw shell only and attachment holes. The shell shall not include primer, paint [coating], edging, edging adhesive, and suspension system attachment material. The unfinished shell shall include benchmarks.

b. Finished Shell. A finished shell shall include the shell, any primer, coating, and texturing aggregate, all attachment holes (Type I only), and any edging and adhesive to hold the edging on.

c. Finished Helmet. A finished helmet includes the finished shell plus all suspension system attachment material (i.e., hook disks or hook tape), a complete suspension system,

and a complete retention system including any attaching hardware, assembled in the standard configuration.

3.3 Shell Design/Shape. The shape of the finished shell when measured without surface finish and edging, shall have the same shape as shown on drawings 2-1-2515, 2-1-2516, 2-1-2517, 2-1-2518, 2-1-2576, and all subsidiary drawings and parts lists. These Government drawings are for guidance only. Once the Offeror submitted drawings are approved; they become a part of the contract and no deviation will be allowed without documented Government approval. The measurements for the shape of the helmet shall be taken to the inside surface only. The outside surface is defined by the inside surface plus the thickness as specified in 3.3.2.1. Testing shall be conducted in accordance with 4.10.2.

3.3.1 Shell Construction. Upon removal from the mold, the outer and inner surfaces of the unfinished shell, excluding the bottom edge, shall be finished smooth and even. Both the inside and outside surfaces of the shell shall be free from any hole, void, delamination, blister, cracking, crazing, dry spot, area of non-resin flow and any pit greater than 0.125-inch diameter or the depth of one ply of the ballistic material, whichever is less, in order to provide a smooth continuous surface. If fabric construction is used, there shall be no exposed ends of the fabric fiber showing. There shall be no raised fibers, raised pleats, raised wrinkles, or raised creases longer than 1 inch on the interior or exterior surfaces. Processing procedures and methods capable of providing uniform properties shall be used. Patching or repair of any ballistic material shall not be performed after the material has been molded without documented Government approval. Remolding of helmet shells made with Thermoplastic is permitted. Remolding of helmet shells made with materials other than Thermoplastic composites is not authorized. Plans to correct cosmetic imperfections, which fall within the acceptable criteria detailed above, shall be submitted for Government written approval prior to implementation; plans submitted for approval shall include a detailed description of all tools, materials and methods necessary to produce the helmet shell. All submitted and approved manufacturing, production plans, and other required contracting documents and processes (i.e., Technical Data Package, Dry Layup, Production Process Package, Quality Validation Plan, etc.) shall not be altered by the contractor without additional written approval. Such plans that achieve written Government approval shall become part of the documented production process. Cosmetic improvements shall not degrade ballistic material properties. More than one material (hybrid construction) may be used to achieve best combination performance requirements listed in the document. Testing shall be conducted in accordance with 4.10.1.

3.3.2 Shell Thickness and Uniformity. The following dimensional criteria are based on an unfinished shell. Testing shall be conducted as required in 3.10 in accordance with 4.10.3.

3.3.2.1 Shell Thickness. The maximum thickness for the helmet shell shall not exceed 0.490-inch regardless of the nominal thickness of the shell. Thickness variations in the shell shall be gradual.

3.3.2.2 Shell Uniformity. The shell thickness shall not vary by more than 0.100-inch over the entire surface of the shell.

3.3.3 Benchmarks. The unfinished and finished shell shall have benchmarks located at the front, crown, left side, right side, and rear locations on the interior and exterior of the shell as shown on drawings 2-1-2515, 2-1-2516, 2-1-2517, 2-1-2518, and 2-1-2576. The benchmarks shall be clearly visible. Testing shall be conducted in accordance with 4.10.4.

3.3.3.1 Benchmarks – Unfinished Shell. Benchmarks on an unfinished shell are required for FAT. Benchmarks shall be located on both the inside and outside periphery of the shell. The periphery benchmarks shall extend 0.500 (+ 0.250 / -0.00) - inch upward from the shell edge. A benchmark shall be located on the inside crown of the unfinished shell. The crown benchmark shall be a "+" with each leg measured 0.250 (± 0.125) - inch long from the intersection of the "+" with one leg of the "+" pointing toward the front of the shell, one to the rear, and one each to the left and right sides of the shell.

3.3.3.2 Benchmarks - Finished Shell. Benchmarks on a finished shell are required for FAT. If an integrally molded edging is used (as defined in 3.3.5) and the edging covers any portion of previous benchmarks from an unfinished shell, periphery benchmarks may be located on the integrally molded edging and shall be at least 0.200 (+0.05 / -0.00) – inch long. If a bonded edging is used and the benchmarks are located at the periphery of the shell, the benchmark length shall extend a distance of 0.500 (+0.250 / -0.375) – inch up beyond the top edge of the edging. The crown benchmark shall only reside on the interior of the finished shell. The crown benchmark shall be an "+" with each leg measured 0.250 (± 0.125) - inch long from the intersection of the "+" with one leg of the "+" pointing toward the front of the shell, one to the rear, and one each to the left and right sides of the shell. The benchmarks shall be clearly visible on a coated shell.

3.3.4 Attachment Holes. Holes to attach components to the helmet shell shall be made before application of the coating (see 3.3.6). There shall be no delamination greater than 0.125-inch from the edge of the hole or other damage of the shell material as a result of making the hole. Any fraying (i.e., uncut material attached at the edge of the hole) as a result of making the hole shall not be at a length of more than 0.125-inch. Additionally, the hardware shall pass through the hole freely and not be impeded or obstructed by any frayed material. Finished helmets shall be examined for conformance in accordance with 4.10.1, 4.10.1.1, and 4.10.2.

3.3.4.1 Retention System Holes. Holes for the retention system, after application of the coating, shall be of the diameter as shown on drawings 2-1-2515, 2-1-2516, 2-1-2517, 2-1-2518, and 2-1-2576. The retention system hardware must pass through the holes freely without obstruction, by hand. Testing shall be in accordance with 4.10.1, 4.10.1.1, and 4.10.2.

3.3.4.2 Night Vision Device (NVD) Hole. The Contractor shall bear the responsibility of the hole placement for the Type I (one hole) helmet. The Contractor shall develop a template for the hole placement for Type I using NVD Bracket Kits cited in 3.11. The diameter for Type I holes shall be 0.200 (±0.010)-inch. The application of coating and aggregate shall not impact this hole diameter and tolerance requirement. Testing shall be conducted in accordance with 4.10.1, 4.10.1.1, and 4.10.2.

3.3.5 Edging. The finished shell shall have a firmly bonded, structural, or an integrally molded edging that protects the periphery of the finished shell from delamination, wear, cuts, tear, and infiltration of environmental elements and fluids. An integrally molded edging is co-molded at the time of shell molding, not applied in an operation subsequent to shell molding. The edging itself shall not be susceptible to cutting, wear, or tear. The edging shall completely cover the bottom edge of the shell and extend up the sides a minimum of 0.30-inch of the finished shell. If the edging is a non-integral component of the molded shell, then the edging shall consist of a one-piece molded construction or one piece cut to length. If the edging is cut to length, the cut end shall be placed at the rear center of the shell and the butt ends shall not overlap and any gap between the ends shall not exceed 0.060-inch. The edging shall be firmly and completely attached to the finished shell, i.e., there shall be no unbounded areas. The edging shall be rounded at the corners with a minimum radius of 1/16-inch. A corner shall be defined as the transition between the edge of the shell and the inside of the shell and the edge of the shell and the exterior of the shell, i.e., the "lower" part of the edging. The standoff of the applied edging from the shell (the sides as opposed to the edge or rim) shall be a maximum of 0.125-inch, for both inside and outside surfaces. The edging shall be the same color as the exterior of the finished shell (see 3.3.6). Testing shall be conducted in accordance with 4.10.1 and 4.10.5.1.

3.3.5.1 Edging Adhesion. The edging shall remain firmly attached to the finished shell when tested as specified in 4.10.5.2.

3.3.5.2 Edging Adhesion After Heat Aging. The edging shall not peel back more than 0.25-inch. For structural and/or integrally molded edging, the edging shall not move down more than 0.125-inch. Testing shall be conducted in accordance with 4.10.5.3.

3.3.6 Coating. Following the surface preparation specified in 3.3.6.1 and after application of suitable primer, if used, a minimum of two coats of coating shall be applied to the exterior of the helmet shell including the outside of the edging. The coating for Tan 499 helmets shall conform to MIL-DTL-64159B (either Type is permissible), color Tan 499. The coating shall completely and uniformly cover the shell surface and the outside of the edging. After drying, no cracks, scuffed areas, blemishes such as peeling, blistering or flaking, foreign matter appearing on or embedded in the finish shall be visible in the coating. The coating shall be applied in accordance with the manufacturer's instructions that has been reviewed and Government approved prior to production. The bottom and inside edges of the edging are not required to be coated. The outside of the edging requires coating. After drying, no cracks, scuffed areas, blemishes (such as peeling, blistering or flaking), foreign matter embedding in or appearing on the finish shall be visible on the coating. While coating is not required for the interior helmet shell, if applied, it shall be Tan 499. If the interior of the helmet is not fully painted and if the line between the painted and unpainted surface is not covered by the edging or occurs on the edging, the line between the unpainted surface and the painted surface must be uniform from helmet to helmet with a clean smooth edge without bleed over or other observable workmanship flaws. The coating shall be completely cured (not be wet or tacky to the touch) at time of final packaging. Hardware exposed on the exterior and interior of the shell (e.g., screw heads) shall not be coated. Testing shall be conducted in accordance with 4.10.1.

3.3.6.1 Shell Surface Preparation. Prior to the application of any coating to the surface of the unfinished shell, the unfinished shell shall be appropriately prepared in order to meet the requirements for finish provided by the coating manufacturer. Permissible surface gaps and pits on the outside surface (and inside surface if painted) of the finished shell (see 3.3.1) may be filled with suitable materials (such as Acryl-Green Spot Putty) to provide a smooth and continuous surface. The rework of defects affecting ballistic material, such as filling blisters of any size, is not permitted. If surface preparation includes abrading, then the ballistic material shall show no signs of being visibly cut, gouged, or raised. Before application of the final coating the surface shall be free of any contaminants including dust, oil, grease, or any other foreign matter. Testing shall be conducted in accordance with 4.10.1.

3.3.6.2 Adhesion of Coating. The coating, when cut into squares, shall not lift more than 50 percent of the coverage of any square. A slight unevenness of the edges of any square shall not be considered cause for test failure. Testing shall be in accordance with 4.10.6.

3.4 Retention System and Attaching Hardware. The helmet retention system and attaching hardware shall be in accordance with all requirements specified in the Product Manager Soldier Protective Equipment (PM SPE) Purchase Description (PD), AR/PD 12-01.

3.4.1 Retention System Attachment Points. Four (4) attaching points shall be used for the chinstrap/nape strap, two on the front half of the helmet and two on the rear half, each symmetric about the helmet mid-sagittal centerline. The attaching points shall use the holes referenced in 3.3.4.1. The attaching points shall be in accordance with drawings 2-1-2515, 2-1-2516, 2-1-2517, 2-1-2518, and 2-1-2576. Testing shall be in accordance with 4.10.7.

3.4.2 Static Pull Strength. Requirements shall be met in accordance with AR/PD 12-01. Testing shall be in accordance with 4.10.7.1.

3.4.3 Dynamic Pull Strength. Requirement shall be met in accordance with AR/PD 12-01. Testing shall be in accordance with 4.10.7.2.

3.5 Suspension System. The helmet shall utilize a modular pad suspension system consisting of a series of pads that act as the suspension system between the wearer's head and the helmet shell. The pads shall possess means of easy attachment, removal, and reattachment to the inside helmet shell. The pad suspension system shall attach, remove, and reattach to the helmet shell via hook tape disks permanently adhered to the inside of the helmet shell. The pads shall remain firmly in place when attached. The ease of attachment of the pads and the ability to attach the pads where the wearer desires (i.e. in a variety of locations) shall permit accommodations among different sized and shaped heads. There are three (3) different pad shapes that form the suspension system, round, trapezoidal, and oblong. A complete pad suspension kit shall consist of seven (7) pads as follows: one (1) round pad (crown), two (2) trapezoidal pads (front and back), and four (4) oblong pads (distributed around the perimeter to achieve comfort and stability). Drawing 2-1-2566 shows the shapes and dimensions of the pads. The shape of the pad shall meet the shapes shown in Drawing 2-1-2566 with a tolerance of (± 1/8 inch). The 3/4-inch thick pad set shall be made up of all 3/4-inch thick pads and shall be within 0.0625 inch of the nominal thickness. Testing shall be conducted in accordance with 4.10.8.1. Samples shall be

examined for the defects specified in 4.10.1. Mandatory source for this component shall be in accordance with 6.8.

3.5.1 Pad Construction. The pad shall have at least three basic layers or be designed in such a way as to function in three ways: an inner layer shall contact the wearer's head, a padding layer shall provide the standoff, comfort, protection and stability, and an outer material layer which attaches the pad to the hook disk inside the helmet shell. The three layers shall be permanently joined around the perimeter to prevent disassembly. Testing shall be conducted in accordance with 4.10.8.2.

3.5.1.1 Inner Layer Material. The inner material that contacts the wearer's head shall wick moisture away from the wearer's head and absorb it. The color of the inner material shall be Foliage Green 504 for all helmet classes. Testing shall be conducted in accordance with 4.10.8.1, 4.10.8.2, 4.10.8.5, and 4.10.10.1.

3.5.1.2 Padding Layer Material. The padding material shall provide standoff, comfort, protection, and stability. The padding material shall not absorb or hold moisture when tested in accordance with 4.10.8.4. If the pad has increased in weight more than 3 percent (3%) then the result shall constitute test failure. The pad may consist of multiple layers. Thickness of this layer shall provide for the bulk of the overall pad thickness required. Testing shall be in accordance with 4.10.8.2.

3.5.1.3 Outer Layer Material. The outer material shall be made of a loop-type material and allow the pad to be attached to the inside of the helmet shell. The material shall have an average peel strength no less than 2.8 pounds per inch of width when tested in accordance with 4.10.8.6. It is desirable that the outer material interface with the currently fielded hook disk (3M p/n SJ3572). The color shall be Foliage Green 504 for all helmet classes. The outer material shall interface with hook disk. Testing shall be conducted in accordance with 4.10.8.1, 4.10.8.2, and 4.10.10.1.

3.5.2 Pad Compression Durability. The pads shall be constructed such that they can withstand multiple compressions without failing. Each pad shape and thickness shall be subjected to repeated 1/4-inch compressions and show no signs of degradation. Degradation includes, but is not limited to, the structure of the pad losing its resiliency, not returning to its original shape, and thickness. There shall be no physical damage to any of the pad components. Physical damage includes, but it is not limited to, breakage of threads (if used), seams, or closures, damage to any of the components such that they do not return to its original shape and thickness. Testing shall be in accordance with 4.10.8.3.

3.6 Suspension System Attachment Material (Hook Material).

3.6.1 Suspension System Attachment. The attachment material shall possess means of easy attachment, removal, and reattachment of the suspension system to the finished shell with no special tools required. The suspension system shall remain firmly in place when attached. Testing shall be in accordance with 4.10.1.

3.6.2 Attachment Material Shape. Attachment material shape is at the discretion of the contractor. Shape uniformity is required. Testing shall be in accordance with 4.10.1.

3.6.3 Attachment Material Coverage. Any means to attach a suspension system component to the inside of the shell shall be applied to the inner surface of the shell and shall interface with the outer material of the suspension system. No attachment material shall be installed in the ear dome area of the finished shell. Additionally, no attachment material shall cover any molded-in markings. An adequate amount of hook material shall be installed on the interior of the finished helmet to allow movement of the suspension system components into any position and to allow securing of the helmet cover and retention system. Testing shall be conducted in accordance with 4.10.1 and 4.10.9.1.

3.6.4 Attachment Material Durability. Attachment material for the affixing of suspension systems to the interior surface of the helmet must be durable. If an adhesive mechanism is used, no attachment material should have air bubbles, or gaps between the affixed surface and the finished shell. At no time shall removal of any suspension system component off the finished helmet cause the attachment material to become separated from the finished helmet. The attachment mechanism shall firmly affix the attachment interface to the inner surface of the finished helmets with no lifting of attachment material on any contours within the finished helmets. The attachment material shall remain affixed to the helmet shell after twenty-two (22) cycles of installation and removal of suspension system components. At no time shall removal of any suspension system component cause the attachment material to become separated from the finished shell. Testing shall be in accordance with 4.10.9.2 and 4.10.9.3.

3.6.5 Colorfastness. The hook material shall exhibit colorfastness to laundering, crocking, perspiration, and water. The materials shall meet or exceed the requirements listed in Table I. Testing shall be conducted in accordance with 4.10.10.

Table I. Inner and Outer Material Colorfastness

Colorfastness to Laundering (1 cycle)	
Color Change	Grade 3 or better
Staining	Grade 3 or better
Polyester, Nylon	Grade 3 or better
Colorfastness to Crocking	
Dry	Grade 3 or better
Wet	Grade 3 or better
Colorfastness to Perspiration	
Color Change	Grade 3 or better
Staining	Grade 3 or better
Polyester, Nylon	Grade 3 or better
Colorfastness to Water	
Color Change	Grade 3 or better
Staining	Grade 3 or better
Polyester, Nylon	Grade 3 or better

3.7 Ballistic Protection. The finished helmet shall provide ballistic protection (fragmentation and 9mm projectiles). Protection shall meet the requirements set forth in this document throughout the entire surface area of the finished helmet unless specified otherwise in this document.

3.7.1 Fragmentation Protection – Minimum V50 Ballistic Protection Limits (V_{50} BL(P)). The finished helmet shall be capable of providing the minimum V_{50} BL(P)s listed in Table II at 0^o ($\pm 5^o$) obliquity against the specified right circular cylinder (RCC) and Fragment Simulating Projectile (FSP) projectiles when tested in accordance with 4.10.11.1, 4.10.11.1.1, 4.10.11.2, and, 4.10.11.3 under the following conditions:

a. Ambient (see section 4.6 and 4.10.11.6.1)
b. Extreme hot (see section 4.10.11.6.1)
c. Extreme cold (see section 4.10.11.6.1)
d. After immersion in seawater (see section 4.10.11.6.2), tested at ambient temperature
e. After exposure in weatherometer (see section 4.10.11.6.3), tested at ambient temperature
f. After accelerated aging (see section 4.10.14.13), tested at ambient temperature

Table II. Minimum V_{50} BL (P)s

Projectile	Minimum V_{50} BL(P) at 0° (±5°) Obliquity (ft/sec)
2-grain RCC 1/	4200
4-grain RCC	3475
16-grain RCC	2475
64-grain RCC	1750
17-grain FSP 2/	2200

1/ Right Circular Cylinders shall be in accordance with Figure 1.
2/ Fragment Simulating Projectile – MIL-DTL-46593B with Amendment 1, 11 August 2008, with the exception of Hardness Testing per ANSI/ASQ Z1.4, Special Inspection Level S-3.

V_{50} ballistic limit testing shall be performed in accordance with 4.10.11.3.

3.7.2 Resistance to Penetration (RTP) – 9mm. The finished helmet, including any hardware exposed on the outside of the shell, shall be resistant to penetration from a 9mm Full Metal Jacketed Round Nose (FMJ RN) bullet with a nominal mass of 124 grains in accordance with NIJ 0106.01 at 1400 (+50, -0) feet per second (ft/sec) at 0^o ($\pm 5^o$) obliquity when tested in accordance with 4.10.11.1, 4.10.11.1.2, and 4.10.11.4 under the following environmental conditions.

a. Ambient (see section 4.6)
b. Extreme hot (see section 4.10.11.6.1)
c. Extreme cold (see section 4.10.11.6.1)
d. After immersion in seawater (see section 4.10.11.6.2), tested at ambient temperature

3.7.2.1 First Article Testing (FAT), 9mm Resistance to Penetration (RTP) Helmet Requirement.

FAT Part A: There shall be no complete penetrations in the first twenty-two (22) impacts (helmet shell, eleven (11) helmets required). At least four (4) impacts shall be in each of the four (4) environmental conditions. The three (3) remaining helmets will be subjected to each condition specified (high temperature, low temperature, and seawater). Should there be ≥ one (1) complete penetration in the first twenty-two (22) impacts then testing will be stopped and the design does not meet the 9mm RTP requirement for the finished helmet.

FAT Part B: If there have been no complete penetrations in the first twenty-two (22) impacts as specified in Part A, then testing will continue in accordance with the FAT matrix as specified in Appendix A. The RTP requirement will then be determined by combining all shots for a particular subtest (i.e., all 9mm RTP/Ballistic Transient Deformation (BTD) tests will be used in the calculation regardless of shot location), including the first twenty-two (22) impacts.

RTP testing on the helmet shall meet a 90% Probability of no Penetration (P(nP)) with 90% Lower Confidence Level (LCL) for 9mm RTP testing when the LCL is calculated using the Clopper-Pearson method. Testing shall be in accordance to 4.10.11.1.2.1.

3.7.2.2 First Article Testing (FAT), Resistance to Penetration (RTP) Hardware Requirement. Hardware RTP testing on the helmet will be calculated separately from the helmet RTP. 9mm RTP hardware testing shall meet a 90% Probability of no Penetration (P(nP)) with 90% Lower Confidence Level (LCL) when the LCL is calculated using the Clopper-Pearson method. Testing shall be in accordance with 4.10.11.1.2.2.

3.7.2.3 Lot Acceptance Testing (LAT), RTP Requirement.

LAT Part A: There shall be no complete penetrations in the first five (5) impacts (finished helmet) for a lot size ≤ 1200 or ten (10) impacts (finished helmet) for a lot size of 1201 – 3200. Should there be ≥ one (1) complete penetration in the first five (5) or ten (10) impacts (based on lot size) then testing will be stopped and the lot does not meet the 9mm RTP requirement for the finished helmet.

LAT Part B: If there have been no complete penetrations in the first five (5) or ten (10) impacts as specified in Part A, then testing will continue in accordance with the LAT matrix specified in Appendix A. The RTP requirement will then be based on the accept/reject criterion specified in the LAT section of Appendix A. Testing shall be in accordance to 4.10.11.4.

3.7.3 Ballistic Transient Deformation (BTD).

3.7.3.1 Ballistic Transient Deformation - FAT. BTD of the finished helmet imprinted in the clay shall not result in a 90% Upper Tolerance Limit (UTL) with 90% Confidence calculation in excess of 0.63-inch (16.0 mm) against 9mm projectile under the environmental conditions specified in 3.7.2 at 1400 (+50, -0) feet per second at 0° (±5°) obliquity for shots made to the right side, left side, and crown. Shots made to the front and back shall not result in a 90% UTL with 90% Confidence calculation that exceeds 1.0-inch (25.4 mm). Testing shall be conducted in

accordance with 4.10.11.1.3 and 4.10.11.5. The evaluation methodology for 90/90 UTL are in Appendix A.

3.7.3.2 Ballistic Transient Deformation – LAT. BTD of the finished helmet imprinted in the clay shall not result in an X% UTL with Y% Confidence calculation in excess of 0.63-inch (16.0 mm) against 9mm projectile under ambient conditions at 1400 (+50, -0) feet per second at 0° (±5°) obliquity for shots made to the right side, left side, and crown. Shots made to the front and back shall not result in an X% UTL with Y% Confidence calculation that exceeds 1.0-inch (25.4 mm). Testing shall be conducted in accordance with 4.10.11.2 and 4.10.11.5. The evaluation methodology for 90/90 UTL are in Appendix A.

All four (4) and if necessary five (5) calculations must not exceed the 16.0 mm (Crown, Right, and Left side locations) or 25.4 mm (Front and Rear locations) requirement for acceptance.

An Analysis of Variance (ANOVA) will also be used to determine whether the left and right sides can be combined for the UTL calculations. If supported by ANOVA results, the combined sides calculation will be performed every time. Separate side calculations will only be done if sides cannot be combined.

The BTD requirement will be based on X% UTL with Y% Confidence based on the number of helmets tested. The methodology is delineated below as well as in the accept/reject criteria found in the LAT section of Appendix A.

3.8 Weight. The maximum weight of the helmet system, as described in section 3.2c, shall not exceed the weights listed in Table III. Upon contract award, the finished helmet maximum weight per size proposed to and accepted by the Government shall then become the new maximum weight (W). All FAT and LAT finished helmets shall be equal to or below the new maximum weight requirement. Each helmet system size, Small (S), Medium (M), Large (L), Extra Large, (XL), and Double Extra Large (XXL), shall have its own category of weight as seen below in Table III. Five (5) of each helmet system size of S through XL shall be tested. Testing shall be conducted in accordance with 4.10.12.

Table III. Weights

Helmet System Size	Finished Helmet Maximum Weight (lbs)	Finished Helmet Maximum Weight (lbs)
S	$\leq W_S$	2.499
M	$\leq W_M$	2.601
L	$\leq W_L$	2.813
XL	$\leq W_{XL}$	3.298
XXL	$\leq W_{XXL}$	3.400

3.9 Blunt Impact Protection. The finished helmet shall provide non-ballistic impact protection to the wearer by reducing acceleration of the head during low velocity blunt impact events at various temperatures. As a threshold, for each size helmet, and for all tests including

the various impact sites and temperatures specified, the first impacts shall meet a 90% probability of accelerations not exceeding 150G (gravitational constant) with a 90% Lower Confidence Level. Second impacts shall meet a 90% probability of accelerations not exceeding 150G with an 80% Lower Confidence Level. Calculations will comprise of all first or all second impacts (as appropriate) including all conditions and shell sizes. The Clopper-Pearson methodology will be used for these calculations. Greater impact protection, i.e. fewer G, is desired as an objective. There shall be no physical damage to the helmet shell that degrades ballistic performance such as delamination, ply separation, or shell fracture. If physical damage such as the above criteria is evident on the inside surface of any finished helmet, additional testing shall be conducted. The Government will conduct a 9mm RTP test approximately at the center of the damage on the mirrored location of the finished helmet exterior of each damaged location and in accordance with section 4.10.11.4. An impact that is off the center of the damage shall be considered a fair shot with a result of a complete or partial penetration. Additionally, there shall be no indentation on the exterior of the helmet shell in excess of 0.15-inch present after blunt impact testing. If deemed necessary (excluding the 0.15-inch indentation requirement), the Government will analyze the damage and conduct a non-invasive imaging scan (i.e., CT Scan) of the sample to confirm the damage. Each affected area will be impacted with a 9mm projectile and a Partial or Complete Penetration will be documented as described in sections 6.5.2 and 6.5.3.1. Only the front, crown, right side, left side, and rear locations shall be included in the analysis. The Government reserves the right to impact the nape location after all locations on a helmet have been tested. Additionally, BTD may be measured for Government reference. If more than twenty-two (22) impacts are required, RTP testing on the helmets shall meet a 90% Probability of no Penetration (P(nP)) with 90% Lower Confidence Level (LCL) for 9mm RTP testing when the LCL is calculated using the Clopper-Pearson method. If less than twenty-two (22) impacts are required, 100% of the impacts must result in partial penetrations to meet the requirement. The helmet will fail the blunt impact test if the data does not meet a 90% P(nP) with 90% LCL or if there is one or more complete penetrations as described previously. Additionally there should be no damage to any part of the retention system or pad system. Testing shall be in accordance with 4.10.13.

3.10 Operating Environment. All helmet components shall be constructed such that they can withstand various environmental extremes without degradation.

3.10.1 Seawater Resistance. There shall be no structural, visible or operational degradation to the finished shell when subjected to immersion in seawater. The finished shell shall show no evidence of softening, peeling, blistering, cracking, delamination, or increase in weight of greater than three (3) percent over dry weight or increase in thickness greater than 6.0 percent when tested in accordance with 4.10.3, 4.10.12, and 4.10.14.1.

3.10.2 Weatherometer Resistance. The finished shell shall experience no structural, visible, or operational degradation to include evidence of cracking, blistering, delamination, ply separation, separation of edging, increase in thickness greater than 6.0 percent, finish defects, or ballistic degradation when tested in accordance with 4.10.3 and 4.10.14.2. Additionally, the requirements of 3.7.1 (e) shall be met after weatherometer exposure (see 3.7.1)

3.10.3 Field Agent Resistance. The finished shell, when exposed or subjected to the following agents shall show no evidence of softening, peeling, delamination, ply separation, or tackiness. Testing shall be in accordance with 4.10.14.3.

1. DEET insect repellent, Personal Application, NSN 6840-01-284-3982, O-I-503 Type II, Concentration A
2. Gasoline, ASTM D910
3. Motor Oil, MIL-PRF-2104J
4. Hydraulic fluid, petroleum base, MIL-PRF-6083G
5. Fire resistant hydraulic fluid, MIL-PRF-46170E
6. Fuel Oil, Diesel, ASTM D975
7. Turbine Fuel, Aviation, F-24, NSN 9310-00-359-2026, MIL-STD-3004D, ASTM D1655-11b
8. Rifle Bore Cleaning Compound, NSN 6850-00-224-6656, MIL-PRF-372E(2)
9. Lubricating Oil, Semifluid, Weapons (LSA), NSN 9150-00-935-6597
10. Lubricating Oil, Arctic, Weapons, NSN 9150-00-292-9689
11. Face paint, Camouflage, NSN 6850-01-493-7309

3.10.4 Flame Resistance. The finished shell shall be self-extinguishing with no after-flame greater than 2.0 seconds (Threshold), 0.5 seconds (Objective). Flaming before the withdrawal of the flame source is permitted according to ASTM D 6413. There shall be no melting or dripping. It is desired, however, that the finished shell be ignition resistant. Testing shall be conducted in accordance with 4.10.14.4.

3.10.5 High Temperature Storage and Use. The finished shell shall exhibit no structural, visible, or operational degradation or physical damage when subjected to elevated temperature exposure. The finished shell shall exhibit no cracking, delamination, separation of plies, distortion, softening, change in thickness greater than 6.0 percent, or other deterioration. The paint (coating) shall suffer no degradation or deterioration. Testing shall be in accordance with 4.10.3 and 4.10.14.5.

3.10.6 Cold Temperature Storage and Use. The finished shell shall exhibit no structural, visible, or operational degradation or physical damage when subjected to low temperature exposure. The finished shell shall exhibit no cracking, delamination, separation of plies, distortion, softening, change in thickness greater than 6.0 percent, or other deterioration. The paint (coating) shall suffer no degradation or deterioration. Testing shall be in accordance with 4.10.3 and 4.10.14.6.

3.10.7 Temperature Shock. The finished shell shall exhibit no structural, visible, or operational degradation or physical damage when subjected to temperature shock, hot to cold, and cold to hot. The finished shell shall exhibit no cracking, delamination, separation of plies, distortion, softening, increase in thickness greater than 6.0 percent, or other deterioration. The paint (coating) shall suffer no degradation or deterioration. Testing shall be in accordance with 4.10.3 and 4.10.14.7.

3.10.8 Altitude. The finished shell shall exhibit no structural, visible, or operational degradation, or physical damage when subjected to altitudes from sea level to 15,000 feet

equivalent pressure and 40,000 feet equivalent pressure. The test temperature at the 40,000 feet equivalent pressure should be -62°F (± 5°F)/-52°C (±3°C). The finished shell shall exhibit no cracking, delamination, separation of plies, distortion, softening, increase in thickness greater than 6.0 percent, or other deterioration. Testing shall be in accordance with 4.10.3 and 4.10.14.8.

3.10.9 Vibration. All finished helmet components including the finished shell, suspension system components, retention system, and hardware shall exhibit no structural, visible, operational degradation or physical damage when subjected to vibration. There shall be no structural, visible or operational degradation to the finished helmet when subjected to vibration. Minor coating and edging scuffing, marring or wear marks are acceptable. No helmet parts shall become loose or disassembled when subject to vibration. "Loose" shall be defined as not meeting the original adhesion, tightness, or torque (as applicable) as when manufactured or assembled. Testing shall be in accordance with 4.10.14.9.

3.10.10 Impact Resistance. The finished helmet shall resist physical damage from impacts. The finished shell material (not including the finish) shall show minimal signs of structural damage such as delamination, ply separation, shell fracture, or indentation, when subjected to a 40 foot-pound (ft-lb) impact. Any resulting indentation in the shell shall be less than 0.15-inch in depth. Damage to the finished shell that may degrade ballistic performance such as delamination, ply separation, or shell fracture shall be subject to additional 9mm RTP ballistic testing with the impact to be located approximately on the center of the damage. A complete penetration will constitute test failure. The exterior shall exhibit no flaking, peeling, loss of adhesion, or other failure of the finish except within a 2.0-inch radius around the center point of impact. Testing shall be conducted in accordance with 4.10.14.10.

3.10.11 Compression Resistance (top to bottom). The finished shell shall be resistant to repeated compressions in the top to bottom direction. The top of the finished shell may be lightly sanded to remove aggregate so to obtain a good measurement. There shall be no dimensional change in excess of 0.020-inch immediately (within 5-minutes) following compressions when compared to the pretest dimension. Additionally, the finished shell shall exhibit no visible delamination, ply separation, or distortion after the compressions. Testing shall be conducted in accordance with 4.10.14.11.

3.10.12 Compression Resistance (side to side). The finished shell shall be resistant to repeated compressions in the side to side direction. The sides of the finished shell may be lightly sanded to remove aggregate so as to obtain a good measurement. There shall be no dimensional change in excess of 0.200-inch immediately (within 5 minutes) following compressions and 0.125-inch after 24 (±1) hours when compared to the pretest dimension. Additionally, the finished shell shall exhibit no visible delamination, ply separation, or distortion after the compressions. Testing shall be conducted in accordance with 4.10.14.12.

3.10.13 Accelerated Aging/Shelf Life. The finished shell shall suffer no structural, visible, or operational degradation to the finished shell when subjected to accelerated aging/shelf life exposure according to ASTM D1149 paragraph 5 test apparatus. The finished shell shall exhibit no evidence of cracking, blistering, delamination, ply separation, separation of edging, increase in thickness great than 6.0 percent, finished defects, or ballistic degradation when tested in

accordance with 4.10.3 and 4.10.14.13. The requirements of 3.7.1 (f) shall be met after accelerated aging exposure.

3.11 Integration/Compatibility. The finished helmet system shall be designed to be worn as an integrated system; all components that comprise the finished helmet system shall be physically and functionally compatible with all other components, as well as with the Soldier who will be wearing it. The finished helmet system shall be compatible with all current fielded clothing and individual equipment likely to be worn, carried, or used by the Soldier. Testing shall be conducted in accordance with 4.10.15.

a. NVG (Type I – One Hole Configuration) Front Bracket Kit (NSN 5340-01-509-1467)
b. ACH Covers including but not limited to: NSN (8415-01-521-8806, 8415-01-521-8808, 8415-01-559-0105, 8415-01-515-4286, 8415-01-515-4288, 8415-01-580-0064, 8415-01-580-0038 and 8415-01-580-0074)
c. Helmet Band (NSN 8415-01-110-9981)
d. Eyewear Retention Strap (NSN 8470-01-110-9981)
e. NAPE Pad including but not limited to: NSN (8470-01-568-1028, 8470-01-568-1023, 8470-01-584-1750, and 8470-01-584-1839)

3.12 Ownership and Support.

3.12.1 Marking of the Finished Helmet Shell. The finished helmet shell shall be marked on the inside crown surface area with the applicable size lettering using the letters XS, S, M, L, XL, or XXL as applicable using a "molded-in" process. Letters shall be at least 0.5-inch in height. In addition, the finished shell shall have an additional label(s), either directly stamped on the inside of the finished shell or a label (such as a pressure sensitive label), that provides the item nomenclature, contract number, national stock number (NSN), size, contractor's name and cage code, lot number, and traceability information. The traceability information may be contained in a separate label from the rest of the information. If a stamped label is used, it shall conform to Type IV, Class 5 of MIL-DTL-32075. If a label is used, characters shall be a minimum of 1/8-inch high. The characters shall be well defined, clearly legible, shall show no signs of smearing, bleeding, or offsetting. The label shall be well-adhered to the shell and shall contain no air bubbles or wrinkles. The helmets shall also contain a unique serial number. The serial number shall correspond to traceability information. Traceability information shall enable the manufacturer to determine the mold, press, and date of shell manufacture and lot information on all materials used in the helmet assembly. The serial number shall allow the contractor to access that information in their records. In addition to the Human Readable Information (HRI) described above, the helmet shell shall also be marked with Machine Readable Information (MRI). The helmet shell shall be marked with a MRI Item Unique Identification (IUID) 2D data matrix. Refer to MIL-STD-130N(1), Construct #2 for an example. Label formatting does not need to conform directly to MIL-STD-130N(1), Construct #2, however shall have the same MRI available through the UID. Helmet shells shall be permanently marked for identification regardless of use, maintenance or storage and shall be located or manufactured so as to prevent obliteration. Metal markings shall not be used. Testing shall be conducted in accordance with 4.10.1.

3.12.1.1 Traceability. The Contractor shall maintain Traceability Records for all component parts used to manufacture the End Item Product. When purchased as an end item helmet assembly, all Component parts Lot Identification shall be traceable via each helmet's Serial Number. When purchased separately, all component parts Lot Identification shall be traceable via the component part Lot Number. Subcontractor's Component part Lot information shall enable Traceability to the raw materials used in the Component part. Each helmet lot shall consist of only one size of helmets. A helmet lot can be made from multiple lots of ballistic material, where a lot of ballistic material is defined as an individual roll of ballistic material. However, in the case where any additional ballistic material is left over from the production run of a helmet lot, that material may only be used in the next consecutive helmet lot. Records shall be maintained and readily available for Government reference. For End Item Products identified with individual Serial Numbers, the Traceability requirements listed above shall be traceable via the individual Serial Number.

3.12.2 Washability (Launderability)/Colorfastness. All components of the finished helmet shall meet washability (launderability) and colorfastness requirements.

3.12.2.1 Washability (Launderability). The finished shell with hook material installed shall be washable. No component shall show any signs of structural, visible, or operational degradation or physical damage as a result of twenty (20) washings. Additionally, none of the labels shall become illegible as a result of the washings. Testing shall be conducted in accordance with 4.10.16.1.

3.12.3 Shelf Life. The minimum shelf life of the finished shell shall be five (5) years. The finished shell shall suffer no degradation in performance after storage for a period of five (5) years. Testing shall be conducted in accordance with 4.10.16.2.

3.12.4 Barcode Label. Each finished helmet or individual component (when purchased separately) shall have a pressure sensitive bar-coded label attached to the outside package. The bar code element shall be a 13 digit national stock number (NSN). There shall be a twelve digit Universal Product Code (UPC) assigned for all NSNs by the Government. The initials "UPC" shall appear beneath the code. The bar codes for the NSN and UPC shall be medium to high density, clearly legible and readable by scanner. Testing shall be in accordance with 4.10.1.

3.13 Health/Safety. The finished helmet shall be safe for human use and not contain any harmful materials.

3.13.1 Safety. The finished helmet shall be designed so that under all conditions of normal use and under a likely fault condition, including human error, it protects against the risk of hazards. The potential for injury while assembling, donning/doffing, clearing and maintain the helmet system shall be eliminated or minimized to the maximum extent. There shall be no loose parts that would be susceptible to snagging. Testing shall be conducted in accordance with 4.10.17.

3.13.2 Toxicity. The finished shell shall not present a dermal health hazard when used as intended and when tested as specified in 4.10.17.

3.13.3 Hazardous Materials. Contractors shall utilize hazardous materials at an absolute minimum, consistent with operational requirements. These materials include those that can be exposed to personnel or to the environment during any operational or maintenance procedures, or exposed as a result of damage to the equipment, or requiring special disposal procedures (to include fabrication, transportation, and setup/tear-down). Environmentally acceptable substitutes shall be used whenever possible without degrading operational function and maintaining cost effectiveness. Hazardous material exposure to personnel shall be controlled to levels below the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs). The following shall be included when designing the helmet system:

a. Avoid the use of materials that cause skin irritation or allergies;
b. Utilize materials that are resistant to dirt, fungus, bacterial growths, etc; and
c. Allow for easy cleaning and/or replacement of parts that could present health hazards to the wearer.

Testing shall be conducted in accordance with 4.10.17.

3.14 Workmanship. The finished shell shall conform to the quality of product established by this specification. Quality of product is further described as the absence of defects as defined in 4.10.1 Visual Examination and Table V (End Item Visual Defects). Utmost care shall be taken during fabrication to ensure quality workmanship and safety of the service person using the item. Deviations in acceptable manufacturing procedures and/or quality of materials being used shall immediately be reported to the contracting officer or his designee. Contractors shall not make repairs to the helmet unless as otherwise authorized, in writing, by the Government.

4.0 VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

1. First Article Testing (see 4.3)
2. Lot Acceptance Testing (see 4.4)

4.2 Responsibility for Compliance. All items shall meet the requirements of Section 3.0 and test methods of Section 4.0 of this specification. The absence of any inspection requirement shall not relieve the contractor of the responsibility of ensuring that all items submitted to the Government for acceptance comply with all requirements of the contract, including this specification. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material. If there is a conflict between the stated requirements and the ANSI/ASQ Z1.4 standard, the more restrictive standard shall apply.

4.3 First Article Testing (FAT). When specified (see 6.3), sample(s) shall be subjected to FAT in accordance with 4.9 and 4.10. Unfinished shells, finished shells and finished helmets used for FAT shall be randomly selected.

4.4 Lot Acceptance Testing (LAT). The sampling selection for LAT (production lot testing) shall be performed in accordance with ANSI/ASQ Z1.4, as defined by the contract, except where otherwise specified. Finished shells and finished helmets used for LAT shall be randomly selected with sizes comprising the presented lot.

4.5 Demonstration Verification. In some cases, the performance requirement specified in Section 3 is verified through observation and operation to verify that the properties, characteristics, and parameters of the item meet the functional requirements specified in the applicable paragraphs of Section 3. Pass or fail are simple accept or reject indications of function performance since no quantitative values exist or are difficult to measure (see Table IV).

4.6 Standard Ambient Conditions. Examinations, inspections, and testing shall be conducted in standard ambient conditions of 68°F (±10°F), a relative humidity of 50% (±20%), and site atmospheric pressure unless otherwise specified herein.

4.7 Component and End Item Inspection. In accordance with Section 4, components and end items shall be tested in accordance with all the requirements of referenced documents unless otherwise excluded, amended, modified, or qualified in this document or applicable procurement documents. The Government reserves the right to inspect all components and end items to determine conformance to requirements.

4.8 Rounding and Evaluation of Data. If a rounding rule is not specified for a particular verification in this document or any referenced document and the measurement device used is

capable of accuracy beyond that specified in the verification section of this document the following rounding methodology shall be used. Measurements shall be made with equipment accurate to at least one decimal place beyond specified place value in the requirement. The value shall be recorded as the number of digits reported by the device but evaluated as pass or fail (accept or reject) after rounding to the place value of the requirement in accordance with ASTM E29 "Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications" (Rounding Method paragraph 6). If the verification method involves averaging, rounding shall take place after averaging unless otherwise specified.

4.9 Requirements and Verifications. Table IV delineates performance requirements verified through visual methods, including physical measurements to determine that no deficiencies exist.

Table IV. Requirements and Verifications

Characteristic	Requirement Paragraph	Verification Paragraph	First Article Testing 1/	Lot Acceptance1/
Shell Design/Shape	3.3	4.10.2	x	2/
Shell Construction	3.3.1	4.10.1	x	2/
Shell Thickness and Uniformity	3.3.2 3.3.2.1 3.3.2.2	4.10.3	x	2/
Benchmarks	3.3.3 3.3.3.1 3.3.3.2	4.10.4	x	2/
Attachment Holes	3.3.4 3.3.4.1 3.3.4.2	4.10.1, 4.10.1.1, 4.10.2	x	2/
Edging	3.3.5	4.10.1, 4.10.5.1	x	2/
Edging Adhesion	3.3.5.1	4.10.5.2	x	x 4/
Edging Adhesion after Heat Aging	3.3.5.2	4.10.5.3	x	2/
Coating	3.3.6	4.10.1	x	2/
Shell Surface Preparation	3.3.6.1	4.10.1	x	2/
Adhesion of Coating	3.3.6.2	4.10.6	x	x 4/
Retention System and Attaching Hardware	3.4	AR/PD 12-01	x	2/
Retention System Attachment Points	3.4.1	4.10.7	x	2/
Retention System Static Pull Strength	3.4.2	4.10.7.1	x	2/
Retention System Dynamic Pull Strength	3.4.3	4.10.7.2	x	2/
Suspension System	3.5	4.10.1, 4.10.8.1	x	2/
Pad Construction	3.5.1	4.10.8.2	2/	2/

Characteristic	Requirement Paragraph	Verification Paragraph	First Article Testing 1/	Lot Acceptance1/
Inner Layer Material	3.5.1.1	4.10.8.1, 4.10.8.2, 4.10.8.5, 4.10.10.1	x	2/
Padding Layer Material	3.5.1.2	4.10.8.2 4.10.8.4		
Outer Layer Material	3.5.1.3	4.10.8.1, 4.10.8.2, 4.10.8.6, 4.10.10.1		
Pad Compression Durability	3.5.2	4.10.8.3		
Suspension System Attachment	3.6.1	4.10.1		
Attachment Material Shape	3.6.2	4.10.1	x	2/
Attachment Material Coverage	3.6.3	4.10.1, 4.10.9.1	x	2/
Attachment Material Durability	3.6.4	4.10.9.2, 4.10.9.3	x	2/
Colorfastness	3.6.5	4.10.10	x	2/
Fragmentation Protection – Minimum V_{50} Ballistic Protection Limits (V_{50} BL(P))	3.7.1	4.10.11.1, 4.10.11.1.1, 4.10.11.2, 4.10.11.3	x	x 3/
Resistance to Penetration – 9mm	3.7.2	4.10.11.1, 4.10.11.1.2, 4.10.11.4	x	x 3/
First Article Test (FAT), RTP Requirement	3.7.2.1	4.10.11.4	x	-
FAT, RTP Hardware Requirement	3.7.2.2	4.10.11.1.2 4.10.11.1.2.2	x	x 3/
Lot Acceptance Test (LAT), RTP Requirement	3.7.2.3	4.10.11.4	-	x 3/
Ballistic Transient Deformation - FAT	3.7.3.1	4.10.11.1.3, 4.10.11.5	x	-
Ballistic Transient Deformation - LAT	3.7.3.2	4.10.11.1.3, 4.10.11.2, 4.10.11.5 Annex A	-	x 3/
Weight	3.0	4.10.12	x	x
Blunt Impact Protection	3.9	4.10.13	x	x 4/
Sea Water Resistance	3.10.1	4.10.3, 4.10.12, 4.10.14.1	x	2/

Characteristic	Requirement Paragraph	Verification Paragraph	First Article Testing 1/	Lot Acceptance1/
Weatherometer Resistance	3.10.2	4.10.3, 4.10.14.2	x	2/
Field Agent Resistance	3.10.3	4.10.14.3	x	2/
Flame Resistance	3.10.4	4.10.14.4	x	2/
High Temperature Storage and Use	3.10.5	4.10.3, 4.10.14.5	x	2/
Cold Temperature Storage and Use	3.10.6	4.10.3, 4.10.14.6	x	2/
Temperature Shock	3.10.7	4.10.3, 4.10.14.6	x	2/
Altitude	3.10.8	4.10.3, 4.10.14.8	x	2/
Vibration	3.10.9	4.10.14.9	x	2/
Impact Resistance	3.10.10	4.10.14.10	x	2/
Compression Resistance (top to bottom)	3.10.11	4.10.14.11	x	2/
Compression Resistance (side to side)	3.10.12	4.10.14.12	x	2/
Accelerated Aging/Shelf Life	3.10.13	4.10.3, 4.10.14.13	x	2/
Integration/Compatibility	3.11	4.10.15	x	2/
Marking of Finished Helmet Shell	3.12.1	4.10.1	x	x 4/
Washability (Launderability)	3.12.2.1	4.10.16.1	x	2/
Shelf Life	3.12.3	4.10.16.2	x	2/
Barcode Label	3.12.4	4.10.1	x	2/
Safety	3.13.1	4.10.17	x	2/
Toxicity	3.13.2	4.10.17	x	2/
Hazardous Materials	3.13.3	4.10.17	x	2/
Workmanship	3.14	4.10.1	x	x 4/

1/ An "x" in the column designates that the test is performed. Sampling rate is specified in 4.4 for LAT unless otherwise specified in the contract and LAT Table.

2/ Certification of Conformance (COC) provided for LAT shall certify that the design and materials have not changed since approval of FAT and shall be complete with test data/results. Likewise, a CoC provided for FAT shall certify that the design and materials have not changed since approval of FAT for that item and shall be complete with test data/results. Conformance shall be verified by test, inspection, demonstration, or analysis, on the end item assembly or lower level as appropriate. Supporting data will be available for Government review. The Government reserves the right to inspect or test such items to verify conformance to requirements.

3/ Ballistic testing for LAT shall be in accordance with 4.10.11.2.

4/ The rate for LAT for edging adhesion, adhesion of coating, blunt impact protection (Ambient condition only), retention system static pull and dynamic strength, pad water absorbency, marking and barcode label, are shown in Annex A.

For First Article Testing (FAT), certain tests shall be administered in a prescribed order with the same set(s) of pads.

a. Test Set 1: Take two (2) pad sets, subject them to the high temperature test. Allow pads to reach ambient temperature. Then subject both of the pad sets to the pad compression test. Finally, take the pad sets and subject them to the water absorption test. After the water absorption test remove the outer fabric and inspect the inner pad for degradation.

b. Test Set 2: Take two (2) pad sets, subject them to the cold temperature test. Allow pads to reach ambient temperature. Then subject both of the pad sets to the pad compression test. Finally, take the pad sets and subject them to the water absorption test. After the water absorption test remove the outer fabric and inspect the inner pad for degradation.

c. Test Set 3: Take two (2) pad sets, subject them to the temperature shock test. Allow pads to reach ambient temperature. Then subject both of the of the pad sets to the pad compression test. Finally, take the pad sets and subject them to the water absorption test. After the water absorption test remove the outer fabric and inspect the inner pad for degradation.

d. Test Set 4: Take two (2) pad sets, subject them to the altitude test. Allow pads to reach ambient temperature and pressure. Then subject both of the pad sets to the pad compression test. Finally, take the pad sets and then subject them to the water absorption test. After the water absorption test remove the outer fabric and inspect the inner pad for degradation.

e. Test Set 5: Take five (5) pad sets, subject one set each to high temperature test, the cold temperature test, the temperature shock test, and the altitude test (i.e., one set undergoes the hot temperature test, the cold temperature test, the temperature shock test, and the altitude test). Allow pads to reach ambient temperature and pressure between each test and after the final test. After final test subject all five (5) of the pad sets to the pad compression test. Subject all five (5) of the pad sets to the non-ballistic impact protection test (one helmet of each size). After the non-ballistic test remove the outer fabric and inspect the inner pad for degradation.

Tests not specifically listed above shall be tested independently. However, the Government reserves the right to reuse a previously tested pad set for a subsequent test.

4.10 Methods of Inspection.

4.10.1 Visual Examination. The completed end item shall be examined for the defects listed in Table V.

Table V. End Item Visual Defects.

Examination	Defect	Classification		
		Critical	Major	Minor
Helmet shell	Any fabric fibers visibly cut or raised on the shell body (inside or outside).			X
	Any surface dent, depression, or area not smooth.			X
	Any delamination or blister.		X	
	Any evidence of cracking.	X		
	Any evidence of dry spot, any area of nonresin flow or other molding deficiency.		X	
	Any fabric gap, any pit except those specified as (see 3.5.1).		X	
	Any raised pleat or wrinkle, or any raised crease (groove) 1-inch or longer.		X	
	Any permissible gap or pit not resin filled as specified (see 3.5.1) (exterior only).			X
	Any unauthorized patching, repair or reworking.	X		
	Any evidence of metallic fasteners.	X		
	Any benchmark omitted or obliterated. 1/			X
	Any attaching hole exhibiting delamination or other damage of the shell material.		X	
	Any attaching hole exhibiting fraying (uncut material attached at the edge of the hole).			X
	Air bubbles under suspension system attachment components and hook material.			X
	Suspension system attachment components and hook material incorrect color.			X
	Any suspension system attachment components and hook material omitted.			X
	Any suspension system attachment components or hook disk becoming separated from the helmet shell by removal of a suspension system component or pad.			X
	Suspension system attachment components and hook material firmly attached to the inside surface of helmet with no lifting at any contours			X

Examination	Defect	Classification		
		Critical	Major	Minor
	Suspension system attachment material or hook disk coverage inadequate.			X
	Attachment material shape is not uniform			X
	NOTE: Criteria apply to interior and exterior of helmet except as noted. Shell is examined prior to coating.			
Edging	Not completely covering bottom periphery and sides as specified except for the gap at the rear of the helmet if the piece is cut to length.			X
	Any cut, tear, or hole.			X
	Any area not adhered to the shell			X
	NOTE: An area shall be considered not adhered if it can be pulled away from the shell with the thumb or finger.			
	If piece is cut to length - Ends overlapped - Gap between ends in excess of 0.060-inch			 X X
	Butt joint not in rear of helmet			X
	Not correct color			X
Finish (coating) On exterior, Color on interior	Any cracks, scuffed areas, blemishes such as peeling, blistering or flaking, foreign matter appearing on or embedded in the finish.			X
	Finish wet or tacky to the touch.		X	
	Coating furrows, flakes, or peels when scratched with a fingernail.		X	
	Blemish, such as peeling, blistering, or flaking.		X	
	Is not a smooth, uniform coating (i.e., run or sag affecting an area more than one square inch).			X
	Does not completely and uniformly cover the shell surface and the outside of the edging.			X
	Is not of the specified thickness.		X	
	Foreign matter embedded in or appearing on the finish, such as dirt, stain, oil, or grease.			X
	Color of exterior finish not as specified.		X	
	Interior color of shell not as specified.		X	
	The line between the unpainted surface and the painted surface is not uniform from helmet to helmet with a clean smooth edge without bleed over or other observable workmanship flaws.		X	
	Texturing aggregate overrun extending beyond edge into interior surface of the helmet.			X

Examination	Defect	Classification		
		Critical	Major	Minor
	Not uniformly applied to the helmet's outside surface including the outside of the edging.			X
	Hardware exposed on the exterior and interior of the shell.			X
	Evidence of cut blisters.		X	
	Ballistic material showing signs of being visibly cut, gauged, or raised.		X	
	Any unauthorized repair.		X	
Suspension System Assembly	Pads not specified herein, damaged in any way, or not in correct number or shape.	X		
	Any required component omitted		X	
	Any component misplaced or not assembled.		X	
	Easy attachment, removal, and reattachment of the suspension system to the finished shell with no special tools. The suspension system shall remain firmly in place.		X	
	Color of any component not as specified.		X	
	Any hole, cut, tear, or smash.			X
	Any material not firmly or tightly woven, edges frayed or scalloped.			X
	Any material with multiple floats.			X
	Any material with abrasion mark, broken or missing yarns, slub, or broken end or pick, or multiple floats (if applicable).			X
	Any mend, yarn, or patch.			X
	Any raw edge (note that raw edge not securely caught in stitching shall be classified as open seams).			X
	Any open seam (If the pad has been stitched note that a seam shall be classified as an open seam when one or more stitches joining a seam are broken or when two or more consecutive or runoff stitches occur. If the pad has been RF welded, note that a seam shall be classified as an open seam when the weld is not complete).			X
	Stitch tension loose, resulting in loose bobbin or top thread.			X
	Stitch tension excessively tight, resulting in puckering material.			X
	Stitching ends not secured.			X

Examination	Defect	Classification		
		Critical	Major	Minor
	Thread breaks, skipped stitches, or run-offs not overstitched.			X
Marking	Shell: omitted, incorrect, illegible, or not as specified.		X	
	Pads: omitted, incorrect, illegible, or not as specified.		X	
	Retention System: omitted, incorrect, illegible, or not as specified.		X	
	Barcode: omitted, incorrect, illegible, or not as specified.		X	

1/ The helmet shall be examined from a distance of approximately two (2) feet.

4.10.1.1 Attachment Hole. Presence of any delamination at the attachment hole shall be measured with appropriate measuring equipment accurate to 0.015-inch. Measure any uncut material (fraying) with appropriate measuring equipment to 0.015-inch. Demonstrate that the hardware passes through the hole freely. Any non-conformance shall constitute a defect consistent with 4.10.1. Failure to meet the requirements of 3.3.4.2 shall constitute test failure.

4.10.2 Shell Design/Shape. The dimensions and shape specified in 3.3 that define the shape and holes of the helmet, shall be measured with appropriate measuring equipment to 0.010 - inch to demonstrate conformance with the specified drawings. The shape is considered compliant if 50% of the points are within the tolerance shown on the drawing for each size. An unfinished shell shall be used, unless otherwise specified.

4.10.3 Shell Thickness and Uniformity. The thickness of the uncoated helmet shell shall be measured with appropriate measuring equipment to the nearest 0.002-inch at five (5) different locations. All locations shall be marked before each measurement is taken. To determine a thickness at a location, three (3) measurements shall be made at the location and the results averaged. However, if the variation among the three measurements is greater than 2.0%, then that set of measurements shall be discarded and the location re-measured three (3) more times, a new variance, and average calculated. One thickness shall be taken at the approximate top center and the other four measurements shall be taken randomly, one each in the lower sections identified in 4.10.11.3.3. For verification of shell thickness, requirements in the operating environments of sections 3.10.1, 3.10.2, and 3.10.5-3.10.8, before and after testing thickness measurements shall be taken on the same five (5) locations and the thickness determined in the same way as stated above. Failure to meet the requirements of 3.3.2.1, 3.3.2.2, 3.10.1, 3.10.2, 3.10.5-3.10.8, and 3.10.13 shall constitute test failure.

4.10.4 Benchmarks. The unfinished and finished shell shall be visually examined for the presence of the required benchmarks. Any benchmark not in conformance with 3.3.3 shall be cause for test failure.

4.10.5 Edging.

4.10.5.1 Edging Dimensions. The width of the edging shall be measured with appropriate measuring equipment accurate to 0.025-inch at five (5) different locations. The locations shall be random along the edging, but two (2) locations can be closer than 2.0 inches. The standoff of the edging shall be measured with appropriate measuring equipment accurate to 0.010-inch at five (5) different locations. The locations shall be random along the edging, but no two (2) locations shall be closer than 2.0 inches. Any non-conformance with the requirements of 3.3.5 shall constitute test failure.

4.10.5.2 Edging Initial Adhesion. The adhesion of the edging shall be determined by manual and visual inspection of the edges of the edging on both the outside and inside of the helmet. The test specimen shall have had the edging applied for a minimum of twenty-four (24) hours. A section or area of the edging shall be considered unbound when the edge can be rolled back on itself and away from the helmet by the thumb or finger. Any nonconformance to the requirements specified in 3.3.5.1 shall be considered a test failure.

4.10.5.3 Edging Adhesion After Heat Aging. Condition the finished shells in a circulating air oven at 160°F (± 5°F) for 4-hours (± 0.5 - hour). Remove and allow to cool to room temperature. Use a sharp knife, cut through the edging along the inner or outer corner for a distance of two (2) inches. See Figure 3A. Note that Figure 3A shows the inner corner cut. An outer corner cut would be similar, but on the outside edge of the shell. At one end of the cut, make another cut through and across the outer side of the edging and peel it back to form a tab approximately 0.5-inches in length. Attach a 1.5 pound weight to the tab and arrange the helmet and weight so that the pull is at right angles to the plane of the glue line being tested and the weight hangs vertically. Make suitable gauge marks on the specimen for the measurement of the amount of peeling during the test. Allow the weight to hang for a minimum of sixty (60) minutes (+10 minutes), and measure the amount of peeling back of the tab to determine conformance to the requirement in 3.3.5.2. The measurement shall be made from the starting gauge mark to the farthest extent that the edging becomes unbounded. The test shall be performed at two (2) different locations on the helmet, and the two results shall be averaged. For structural type edgings, attach a C-clamp device as shown in Figure 3B to the helmet. Ensure that device, when pulling in the downward direction, bears on the edging only and is not tightened to clamp on the shell itself. It may be necessary to remove adhesive or sealant that is on the shell that is not directly between the shell and the edging so that the clamp bears directly on the edging. Attach a 1.5 pound weight to the tab and arrange the helmet and weight so that the pull is at right angles to the plane of the glue line being tested and the weight hangs vertically. Make suitable gauge marks on the specimen for the measurement of the amount of movement during the test. Allow the weight to hang for sixty (60) minutes (+10 minutes), and measure the amount of movement of the edging. The measurement shall be made from the starting gage mark to the farthest extent that the edging moves. The test shall be performed at two different locations on the helmet, and the two results shall be averaged. Any nonconformance to the requirements specified in 3.3.5.2 shall be considered a test failure.

4.10.6 Coating Adhesion. Cut three (3) parallel, straight lines 0.0625-inch to 0.125-inch apart in any direction with a sharp scribe, razor, or knife held at 30° (± 5°) angle to the surface tangent

along the line being cut. The cuts shall completely penetrate the coating. These lines shall be crossed with three additional perpendicular lines 0.0625 to 0.125 inch apart. This procedure produces four squares, which shall be inspected visually for any coating lifting. For First Article Testing, three (3) finished shells of each size shall be tested and three (3) random locations shall be tested per sample. Failure to meet the requirements of 3.3.6.2 shall constitute test failure.

4.10.7 Retention System Design. The retention system shall be examined. Any non-conformance with the requirement of 3.4 shall be cause for test failure.

4.10.7.1 Retention System Static Pull Strength. Testing shall be in accordance with the requirements of AR/PD 12-01. Non-conformance with the requirement of 3.4.2 shall constitute test failure.

4.10.7.2 Retention System Dynamic Pull Strength. Testing shall be in accordance with the requirements of AR/PD 12-01. Non-conformance with the requirement of 3.4.3 shall constitute test failure.

4.10.8 Suspension System - Pads. Verification for the pad suspension system contains several tests.

4.10.8.1 Pad Dimensions and Shape. The pads shall be examined for conformance to the thickness and shape requirements specified in 3.5. Each pad shall be measured to verify its thickness. The pad thickness shall be measured at five (5) random locations. An additional measurement is to be taken in the center of the pad by cutting a hole through the center large enough for the measuring instrument to be inserted. If the pad has a fabric material on either the pad inner material or the pad outer material, that material shall be removed prior to measurement. Each thickness measurement shall be within 0.0625 inch of the nominal thickness. The shape of the pad shall meet the shapes shown in Drawing 2-1-2566 with a tolerance of (± 1/8 inch). Any nonconformance to the requirements specified in 3.5 shall be cause for test failure. Six (6) pad sets of each size shall be measured.

4.10.8.2 Pad Construction. The pads shall be examined for conformance to the requirements specified in 3.5.1, 3.5.1.1, 3.5.1.2 and 3.5.1.3. Any nonconformance to the specified requirements shall constitute a test failure.

4.10.8.3 Pad Compression Durability Test. The finished pad shall be subjected to cyclic compressions on a constant rate of extension (CRE) machine in accordance with ASTM Test Method D76 except that the machine shall be used in the compression mode as follows: Position the pad on the base platen of the machine and orientated so that inner material will contact the moving top platen. The moving platen shall have a flat face surface large enough so that the entire face of the pad is compressed. Cycle the moving head such that the pad is compressed a minimum of 0.25 inches during each cycle at the rate of 12 (± 1) inch per minute while the moving head is in contact with the pad. The cycle shall include a period of 15-seconds where the moving head is not in contact with the pad. Cycle the pad for 6,570 (± 10) cycles. Examine the pad and then carefully remove the fabric (if pad designed with fabric) from the coated foam.

Examine the coating on the foam (if pad designed with coating). Failure of the pad to meet the requirements of 3.5.2 shall constitute failure of the test.

4.10.8.4 Water Absorbency. One (1) pad of each shape and thickness shall have the inner and outer material carefully removed so as not to damage the padding material. The pad shall be weighed to the nearest centigram. The pad shall be completely immersed in salt water to a depth greater than four inches but not exceeding six inches for a minimum of twelve (12) hours. The salt water shall meet the composition specified in 4.10.14.1. Once the pad is removed from the water, shake it by hand for a minimum of one (1) minute and a maximum of two (2) minutes in various orientations to remove bulk water. Alternately, one side of the pad may be placed on a dry paper towel for up to two (2) minutes to blot. Each other side of the pad may be placed on another dry paper towel for up to two (2) minutes. A side may be placed on the paper towel only once. The pad shall then be allowed to air dry for twenty-four (24) hours (+/- 1 hour) in an ambient environment of 70°F (± 2°F) and 65% (± 2%) relative humidity on a screen rack or other device to allow drying off all sides of the padding. The rack may be angled to facilitate dripping of any bulk water. As an alternative, the inner and outer material may be left on the pad instead of removing the material. The pad (with or without the inner and outer material) may be rinsed with fresh water after removal from the salt water. Any non-conformance with the requirements of 3.5.1.2 shall constitute test failure.

4.10.8.5 Moisture Wicking Test. Testing shall be done in accordance with the AATCC Test Method described in Concept 2 Consumer Technical Supplement. Any non-conformance with the requirements of 3.5.1.1 shall constitute a test failure.

4.10.8.6 Suspension System and Attachment Material Adhesion. With 2-inch wide by 6-inch long Outer Pad Material laying face-up on hard surface, place a 1-inch wide by 5-inch long strip of hook material face-down on top of loop fabric such as to engage the materials. Roll a 5 pound (lb) circular weight back and forth 5 times on top of the attachment material. Use either calibrated push-pull scale or a testing machine in accordance with ASTM D76 in order to peel the engaged hook and loop apart for 3 inches at a rate of 6 inches per minute. Make five (5) separate determinations, each using separate (new) attachment material specimens. Record the maximum peel value registered by the push-pull scale or the D76 machine. Non-conformance with the requirements of 3.5.1.3 shall constitute a test failure.

4.10.9 Attachment Material.

4.10.9.1 Attachment Material Coverage. The finished helmet shall be visually inspected. Additionally, the smallest suspension system component shall be placed at five (5) random locations in the finished helmet while no other pads are inside the shell. The area of the pad that is in contact with the attachment material shall be measured. Any non-conformance with the requirements of 3.6.3 shall be cause for test failure.

4.10.9.2 Suspension System Attachment - Adhesion. Using a finished shell without hook material and other attachment means to affix the suspension system to the interior surface of the helmet, apply hook material/attachment means to the inside surface of a finished shell per manufacturer's instructions (if provided). The hook material/attachment means and helmet shall

sit for a period of twenty-four (24) (± 1) hours. Peeling up of the hook material/attachment means shall be cause for a test failure. Three (3) finished shells from each size shall be tested and all suspension system component sizes shall be tested (if there are two or more of a component size, only one component needs to be tested). The hook material shall remain adhered to the helmet shell after twenty-two (22) removal/installations of suspension system components. Any non-conformance with the requirements of 3.6.4 shall constitute test failure.

4.10.9.3 Self-Stick Adhesive Attachment Material Helmet Adhesion. Die cut minimum five (5) self-stick attachment material and place on the inside of the finished shell allowing a minimum of fifteen (15) hours or overnight curing time at room temperature to set-up maximum bond to interior of shell. Place the five (5) smallest shaped suspension system components with representative knit loop tape onto separate helmet material. Press each suspension system component firmly into each piece of attachment material. Allow 2-hours engagement time and slowly pull each suspension system component off each piece of attachment material. Evidence of any attachment material lifting, curling or other disturbance of adhesive or coating used on the attachment material, delamination of the shell, or any nonconformance with the requirements of 3.6.4 shall be cause for test failure.

4.10.10 Colorfastness. Test the attachment material of the finished helmets in accordance with the test methods listed in Table X. Failure to meet the requirements of 3.6.5 shall constitute test failure.

TABLE X Colorfastness Test Methods

1 Colorfastness to Laundering (1 cycle) Color Change Staining Polyester Nylon	1 1 AATCC-61, Option A
1 Colorfastness to Crocking Dry Wet	1 AATCC-8
1 Colorfastness to Perspiration Color Change Staining Polyester Nylon	1 1 AATCC-15
1 Colorfastness to Water Color Change Staining Polyester Nylon	1 1 AATCC-107

4.10.10.1 Visual Shade Matching (All Classes). The color and appearance of the material shall match the standard sample when viewed using the AATCC Evaluation Procedure 9, Option A, with sources simulating artificial daylight D75 illuminant with a color temperature of 7500°K (±200°K) illumination of 100 (±20) foot candles, and shall be a good match to the standard sample under incandescent lamplight at 2856°K (±200°K).

4.10.11 Ballistic Protection. The ballistic resistance testing shall be conducted in accordance with MIL-STD-662F, NIJ 0106.01 and ITOP 4-2-805 except as specified in 4.10.11.1 through 4.10.11.5. Yaw shall not exceed 5^{o} for any projectile. No finished helmet shall be tested for at least 24-hours after molding. Multiple helmets may be used for the purpose of determining any of the ballistic resistance requirements.

4.10.11.1 Ballistic Resistance (First Article Testing). Ballistic resistance testing for FAT shall include the requirements of 3.7.1, 3.7.2, 3.7.3 and shall be in accordance with the FAT test matrix specified in Annex A.

4.10.11.1.1 Ballistic Resistance (First Article Testing) – Fragmentation. Using finished shells, one V_{50} BL (P) shall be determined for each condition (ambient, hot, cold, seawater) for each of the projectiles listed in 3.7.1. One V_{50} BL(P) shall be determined for 17-grain Fragment Simulating Projectile (FSP) after weatherometer exposure and after accelerated aging (see the FAT matrix in Annex A). If the V_{50} BL (P) test for each specific test set meets or exceeds the values specified 3.9.1, the specific test shall be considered met.

4.10.11.1.2 Ballistic Resistance (First Article Testing) – 9mm. The finished helmet shall be resistant to penetration from a 9mm Full Metal Jacketed Round Nose (FMJ RN).

4.10.11.1.2.1 Resistance to Penetration (RTP) – Finished Helmet. Twenty-two (22) RTP determinations on the finished helmet shall be made with at least four (4) impacts in each of the four (4) environmental conditions (ambient, high temperature, low temperature, and seawater). The three (3) remaining helmets will be subjected to the high temperature, low temperature, and seawater. If the results of the first twenty-two impacts (22) impacts meet the criterion specified in 3.7.2.1, then the remaining portion of the 9mm RTP (specified in Appendix A) will be conducted. Shots shall be distributed among the two (2) locations as specified in 4.10.11.4.3. A total of twenty-four (48) RTP determinations on the finished helmets shall be made for each of the four (4) required environmental conditions, resulting in a total of ninety-six (96) RTP determinations.

A RTP determination shall be defined as a shot taken at the helmet. If the requirements of 3.7.2.1 are met, the first article for 9mm RTP shall be considered met.

4.10.11.1.2.2 Resistance to Penetration (RTP) – Hardware. Seventeen (17) RTP determinations on the hardware shall be made for the ambient environmental condition. Sixteen (16) RTP determinations on the hardware shall be made for each of the remaining three (3) required environmental conditions (hot, cold, and seawater). A RTP determination shall be defined as a shot taken at the hardware on the helmet. Hardware shots; two (2) per helmet; shall be made on the helmet retention system hardware. If the requirements of 3.7.2.2 are met, the FAT for 9mm RTP shall be considered met.

4.10.11.1.3 Ballistic Resistance (FAT) – BTD. A BTD would be the resulting imprint in the clay from a RTP test. BTDs resulting from impacts shall be distributed among the two (2) locations as specified in 4.10.11.4.3. BTD will be measured for all 9mm impacts made on the

shell of the helmet. BTD will not be measured for the 9mm hardware impacts. If the requirements of 3.7.3.1 are met, the FAT for 9mm transient deformation shall be considered met.

4.10.11.2 Ballistic Resistance (LAT). Production finished helmet lots shall be ballistically tested for 17-grain FSP ambient V_{50} BL(P) at 0^o ($\pm 5^o$) obliquity, 9mm ambient condition RTP and BTD and they shall meet or exceed the requirements of 3.7.1, 3.7.2, and 3.7.3.2 with the following exceptions:

(1) For 9mm RTP testing, penetrations will be classified as critical defects (see 3.7.2.3 – LAT Testing).

(2) The accept/reject criteria for 9 mm impacts are the number of helmets that fail to stop any of the hardware or helmet 9 mm impacts. For 9 mm shell RTP/BTD impacts, if a complete penetration occurs then no following shots will be taken on that helmet. A complete penetration on a fair impact is valid and will be used for calculating penetration results. Additionally, a new (untested) helmet will be tested using the full 9 mm V_0 shot sequence (same shot sequence as the helmet that incurred the complete penetration) to complete the required test matrix. BTD and penetration data from all valid impacts will be used for accept/reject calculations.

The Government reserves the right to perform any of the testing set forth in this specification where such tests are deemed necessary to ensure the items conform to specified requirements.

4.10.11.3 Ballistic V_{50} Test Method for RCC and FSP. The suspension system, retention system, and any associated hardware shall be removed from the helmet prior to conditioning and testing. The finished shell shall be conditioned as specified in 4.10.11.6.1, 4.10.11.6.2, and 4.10.11.6.3 as required. Instrumental velocity shall be translated into strike velocity at the target and the strike velocity shall be used for ballistic requirements. Failure to meet the requirements of 3.7.1 shall constitute test failure.

4.10.11.3.1 Helmet Mounting and Witness Plate for V_{50} Testing. The finished shell shall only be rigidly secured on a test target mount with the impact side oriented to achieve the required obliquity. The securing method must be capable of retaining the finished shell and withstanding shock resulting from ballistic impact. The mount shall be capable of adjustment so that 0 and 45 degree obliquity impacts can be achieved anywhere on the sample. Any impact whose actual impact location is within a 0.5-inch radius of its original targeted locations shall be considered to meet the intended obliquity. If an impact is outside of the 0.5-inch radius it shall be considered an unfair impact and not used. The 0.5-inch radius shall not apply if the actual impact location or the original targeted impact location is within 0.375-inch of the ear flap crease. The witness plate shall be rigidly mounted inside the finished shell, 3 ($\pm$ 0.500) inches behind the area of impact. The witness plate shall be of sufficient size to be impacted by all fragments resulting from projectile penetration. The witness plate shall be 0.020-inch (0.51-mm) thick aluminum sheet of 2024-T3, 2024-T4, or 5052 alloy. A suitable guard plate shall be placed behind the witness plate, but not closer than 1.0-inch, to prevent all fragments resulting from a projectile penetration from impacting the opposite side of the finished shell.

4.10.11.3.2 Witness Plate Mounting for 9mm RTP for Hardware. The test item will be placed onto a metal headform with Roma Plastilina No. 1, a non-hardening, oil-based modeling clay filled in the coronal or mid-sagittal channel for the purpose of securing the witness plate firmly in the rear of the coronal or mid-sagittal channel and securing a guard plate firmly in the front of the coronal or mid-sagittal channel. The mid-sagittal or coronal channel (depending if the shot is on the front or rear hardware) of the headform shall be void of clay in front of the witness plate (rear of headform) and approximately 1-in. in back of the witness plate. Clay shall be placed up to approximately 1.5-in. in front of the guard plate to prevent fragments from ricocheting after impact with the guard plate. PICTURE 1 portrays the headform setup for a rear hardware shot. Complete and partial penetrations will be determined based on the impressions left on an aluminum witness plate. The witness plate will be 0.020-in. (0.51-mm) thick sheets of 2024-T3, 2024-T4 or 5052-H38 aluminum alloy. The witness plate will be rigidly mounted, parallel to the reference plane between the rear of the headform coronal channel and clay. The witness plate will be of sufficient size to be impacted by all fragments resulting from penetration.

4.10.11.3.3 Helmet Sections for V_{50} Testing. A finished shell for all testing shall be divided into five (5) sections with markings made on the outside surface of the shell. The top section shall be a 5.0-inch diameter circle with location of the top benchmark as the center. The 5 inches shall be measured along the contour of the helmet on the outside of the shell. The four bottom sections are formed by dividing the lower portion (below the 5-inch diameter circle) of the helmet into four (4) sections. The zero degree mark is placed in the front center of the helmet and the angular orientation proceeds in a counterclockwise progression as viewed from the top of the helmet. The sides of the bottom sections shall be formed by drawing lines from lower edge of the shell to the location of the crown benchmark. The top of the bottom sections is a line 1-inch above the edge (line) of the top section (areas of top and lower sections overlap by 1-inch). The specific locations for sections are shown in Table XI. Figure 6 depicts the sections.

Table XI. Sections

Section	Helmet Section Set A
Top	5 inch diameter circle about crown benchmark
Front	45° to 315°
Right side	45° to 135°
Back	135° to 225°
Left side	225° to 315°

4.10.11.3.4 Projectile Impact Location for V_{50} Testing. Two (2) fair impacts, randomly placed, shall be fired in each section, except that one of the two fair impacts in the top section will be placed within 1.0-inch of the benchmark at the crown of the helmet. An impact resulting in a complete penetration shall be considered unfair if it is within 1.5-inches of another impact, within 1.5-inches of the closest edge of any hole, within 1.0-inch of the edge of the helmet, and/or (for the side section) it is less than 0.375-inches above the earflap. If two fair impacts cannot be placed in a section, the second impact shall be placed on another helmet but not in the same location as the first impact. If an impact, unfair because of location, results in a partial penetration, it may be considered a fair impact. For 64-grain RCC V_{50}, only one (1) shot will be placed into each helmet section. All other requirements stated above are the same.

4.10.11.3.5 Guard Plate. A guard plate will be used behind the witness plate to attempt to stop any fragments which perforate the witness plate. This will allow for further analyses to be conducted on the fragments.

4.10.11.3.6 V50 BL(P) Calculation – FAT. The V_{50} BL (P) 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- feet per second. In cases where the velocity spread is greater than 150 feet per second, the V_{50} BL(P) 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 feet per second. 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 the required minimum V_{50} and there are no complete penetrations at or below the minimum required V_{50} velocity, and at least fourteen (14) fair shots have been made in the helmet(s) it shall be determined to have satisfied that specific threat condition requirement. Should none of these three (3) conditions apply, the test shall be declared inconclusive.

4.10.11.3.7 V50 BL(P) Calculation – LAT. The V_{50} BL (P) for each helmet shell shall be the average of at least six (6) 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 125 feet per second. In cases where the velocity spread is greater than 125 feet per second, the V_{50} BL(P) 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 with a velocity spread no greater than 150 feet per second. If neither the six (6) nor the ten (10) shot conditions can be satisfied, and at least five (5) partial penetrations at velocities in excess of the required minimum V_{50} and there are no complete penetrations at or below the minimum required V_{50} velocity, and at least ten (10) fair shots have been made in the helmet(s) it shall be determined to have satisfied that specific threat condition requirement. Should none of these three conditions apply, the test shall be declared inconclusive.

4.10.11.4 Ballistic Test Method for Resistance to Penetration – 9mm. Testing shall be conducted with finished helmets of the appropriate size shell, suspension system, and retention system including hardware firmly attached. Helmets need not have edging attached (see 3.3.5) or be coated (see 3.3.6). Testing shall be in accordance with NIJ 0106.01 with the following exceptions. The finished helmet shall be conditioned as specified in 4.10.11.6.1 and 4.10.11.6.2 as required. If the requirements of 3.7.2 and 3.7.2.1 are met, the FAT for 9mm RTP on the helmet shell shall be considered met. If the requirements of 3.7.2 and 3.7.2.3 are met, the LAT for the 9mm RTP on the helmet shell shall be considered met.

4.10.11.4.1 Headform for 9mm Testing. The headform for 9mm testing (RTP and BTD) shall conform to the headform specified in NIJ 0106.01 except it shall be modified to have slots in both the directions (coronal and mid-sagittal) and the depth of the clay channel shall be approximately 5.6 inches; NIJ 0106.01 requires only a slot in a single direction.

4.10.11.4.1.1 Rear Pad Support. A stocking wave cap made of Nylon 6 will be pulled over the headform before the helmet is mounted to provide support to the rear oblong helmet pad which covers the bolt that will be impacted. The cap crease will be aligned near the middle of the headform to ensure the cap is evenly pulled over the headform. PICTURE 2 illustrates the installation of the cap onto the headform.

4.10.11.4.1.2 Witness Plate. A device shall be used to protect the headform from penetrations resulting from crown shots. In addition to fixturing to hold witness plates in the coronal and mid-sagittal plane, the headform shall have fixturing to hold a witness plate parallel to the reference plane.

4.10.11.4.1.3 Clay. As an option, clay may be used in lieu of the witness plate. The channels (slots) in both the coronal and sagittal planes of the headform shall be packed with Roma Plastilina Number 1 (see 6.7) modeling clay, ensuring there are no voids, cavities, or depressions in the final contoured assembly. The clay shall be shaped to create an uninterrupted smooth surface matching the contour of the headform. Up to eight (8) headforms can be considered calibrated provided the headforms are conditioned within twelve (12) inches of the clay calibration box edge in the conditioning chamber. The headforms associated with that calibrated clay box, still remaining in the conditioning chamber, shall be considered calibrated for a maximum of four (4) hours. Clay shall be shaped to create an uninterrupted smooth surface matching the contour of the headform using the clay shaping and verification tools.

4.10.11.4.1.4 Clay Verification. The clay filled headform(s) and a 12-inch x 12-inch x 4-inch aluminum framed drop verification sample of the clay shall be simultaneously temperature conditioned for a minimum for four (4)-hours. Prior to the start of testing, the drop verification sample shall be drop tested to confirm its plasticity. A 2.2- pound, 1.75-inch diameter steel cylinder with a hemispherical end shall be dropped from a vertical height of 78.7 (±0.8) -inches with the hemispherical end impacting the clay surface at a zero degree (±5°) obliquity, at three locations whose center-to-center and center-to-edge of clay distance is not less than 3.0-inches. The depth of each of the three resultant depressions shall be 1.0 (± 0.1) - inch (25.4 ± 2.5mm). If the depth of the resultant depressions is outside the prescribed range, the conditioning temperature shall be adjusted as necessary to meet the above requirements. The depressions will be measured with a digital caliper capable of ±0.1mm accuracy.

Headforms utilizing clay shall be considered calibrated for a period not to exceed forty-five (45) minutes after removing from the conditioning chamber. If testing of any one helmet exceeds forty-five (45) minutes, another headform utilizing calibrated clay shall be used. The digital caliper will be mounted on a bridge that spans the breadth and rests on two parallel sides of the aluminum frame of the clay block. Before each set of measurements, the device will be calibrated (“zeroed”) using the edge of the aluminum frame to reference the original flat surface of the clay.

4.10.11.4.1.5 Clay Shaping/Verification Tools. To standardize the finishing process of clay packed headforms, specialty shaping and verification tools shall be used. Contact the PM SPE office to access tool prints.

4.10.11.4.2 Mounting. The finished helmet shall be mounted on the headform in the "as-worn" position so that the planar markings are parallel with the planar markings on the headform (for ballistic impacts on the coronal plane, the helmet may be tilted forward on the headform to accomplish the 22.5 mm requirement, but will only be tilted such that the impact will hit no further than 30.0 mm from the rear of the clay headform coronal channel. The measurement will be taken on the clay. If the initial mounting is greater than 22.5 mm from the rear of the clay headform coronal channel, there will be no adjustments made. Only the suspension/retention system shall be used to hold the helmet to the headform. Edge benchmarks and helmet section markings shall be parallel with the NIJ headform coronal and mid-sagittal planes to ensure the helmet is aligned on the headform properly. Retention System straps will be pulled (by one person) to the maximum allowable extent in the vertical position to achieve the required crown stand-off distance. A laser, or other suitable means, shall be used to locate the impact point on the helmet. The finished helmet shall be removed and a reference measurement made to determine the location of the front surface of the formed clay under the impact point using a laser scanning device in accordance with MIL-STD-3027 paragraph B.4.9.3. The finished helmet shall be remounted on the headform in the same location and manner as it was removed. Prior to testing, each helmet test sample will be inspected, ensuring that the test sample chinstrap is properly mounted into the helmet test sample. The clay packed headform shall be rigidly fixed in a manner which will resist the anticipated force from the ballistic impact of the test round fired without movement.

4.10.11.4.2.1 Test Item Mounting. The test item will be rotated to align with the mid-sagittal channel on the verified headform. Only the suspension system and retention system will be used to hold the helmet to the headform. The suspension system and retention system will be adjusted to insure a proper snug fit on the headform. For adjustable helmet suspension systems, strapping will be adjusted to the maximum allowable extent so as to achieve the minimum distance and airspace between the suspension crown, and the interior helmet shell surface.

4.10.11.4.3 RTP Impact Locations and Procedure. The following locations and procedures shall be followed for RTP testing.

1. Each finished helmet shall sustain no more than two (2) impacts with the following defined shot spacing:

    (a) An impact on the crown shall be at the approximate intersection of the Headform mid-sagittal and coronal planes (see Figure 6, NIJ 0106.01).
    (b) An impact on the coronal plane shall be 50 mm (+5 mm / -0 mm) above the earflap, however the impact will hit no less than 22.5 mm from the rear of the clay headform coronal channel.
    (c) An impact on the mid-sagittal plane in the front of the helmet shall be 85 mm (+5 mm / -0 mm) from the edge of the shell (ensuring the shot is at a minimum of 1.5 inches from the edge of the NVG hole).
    (d) An impact on the mid-sagittal plane shall be 75 mm (+5mm / -0mm) from the rear edge of the finished helmet.

2. For each test, mount the shell in the "as-worn" configuration, with the suspension and retention system in place on the headform. For ballistic impacts on the coronal plane, the helmet may be tilted forward on the headform to accomplish the 22.5 mm requirement, but will only be tilted such that the impact will hit no further than 30.0 mm from the rear of the clay headform coronal channel. The measurement will be taken on the clay. If the initial mounting is greater than 22.5mm from the rear of the clay headform coronal channel, there will be no adjustments made. For the fastener test, the helmet shall be rotated to align with the slot.

3. If any component of the retention system fails during the testing, it shall be replaced with a new retention system. The failure of the retention system shall not be considered test failure.

4. If witness plates are used, complete penetration is defined as in NIJ 0106.01 (passage of light thru the witness plate). If clay is used, complete penetration shall be defined as complete perforation of the shell by the projectile or fragment of the projectile as evidenced by the presence of that projectile, projectile fragment, or spall (fragments of the test helmet being impacted, excluding fibrous material, paint and epoxy particles emitted from the helmet surface) in the clay, or by a hole which passes thru the shell. All such results will be finalized by a Failure Scoring Conference (FSC). The FSC will consist of an Aberdeen Test Center (ATC) Test Officer, a PM SPE representative and an Army Evaluation Center (AEC) representative as an independent third party

4.10.11.5 Ballistic Transient Deformation (BTD). One (1) projectile shall be fired in the required impact locations. Each finished helmet with suspension systems installed in the appropriate finished helmet size shall be tested at two (2) prescribed locations. If the requirements of 3.7.3 are met, the FAT or LAT for BTD shall be considered met.

4.10.11.5.1 Headform. The BTD shall be measured on a headform as described in 4.10.11.4.1.

4.10.11.5.2 Test Procedure.

4.10.11.5.2.1 Mounting and Measurement. The finished helmet shall be mounted on the headform in the as-worn position (for ballistic impacts on the coronal plane, the helmet may be tilted forward on the headform to accomplish the 22.5 mm requirement, but will only be tilted such that the impact will hit no further than 30.0 mm from the rear of the clay headform coronal channel. The measurement will be taken on the clay. If the initial mounting is greater than 22.5 mm from the rear of the clay headform coronal channel, there will be no adjustments made). Only the suspension/retention system shall be used to hold the helmet to the headform. The suspension/retention system shall be adjusted to insure a proper fitting on the headform in accordance with test plan procedures. Mounting shall be conducted per section 4.10.11.4.2. For adjustable helmet suspension systems, the strapping shall be adjusted to the maximum allowable extent to achieve the minimum distance and airspace between the suspension crown and the interior helmet shell surface. A laser or other suitable means shall be used to locate the impact point on the helmet. The finished helmet shall be removed and a reference measurement made to determine the location of the front surface of the formed clay under the impact point. The

finished helmet shall be remounted on the headform in the same location and manner as it was removed.

4.10.11.5.2.2 Firing. The required projectile shall be fired at the location under test.

4.10.11.5.2.3 Dismounting and Measurement. The finished helmet shall be removed and a measurement made to determine the farthest extent of the clay depression (if any) as a result of the ballistic impact with respect to the original surface of the clay. FARO Laser scanning technology will be utilized to measure the maximum depression and the result shall be recorded. The maximum depression shall be recorded. In making this determination, any clay surrounding the impression that has been raised above the original level of the surface (cratering) shall be ignored. Measurements of the magnitude of the resultant depression (if any) shall be made from a point originating from a radius flush and consistent with the contour of the pre-shot clay surface.

4.10.11.5.2.4 Testing Progression. For a shot with a high velocity (except for the final shot) regardless of the results of the test (partial or complete penetration), the test will be declared "inconclusive" and repeated with a new (untested) helmet. If the last impact was a high velocity shot that was not a complete penetration, then the shot is valid for penetration only. The resultant BTD for the high velocity impact will not be used in the UTL calculations. However, a new (untested) helmet is required to undergo the full V0 9mm shot sequence (same sequence as the helmet that had a high velocity impact). For an impact with a low velocity that is not a complete penetration, the test will be declared "inconclusive" and repeated with a new (untested) helmet. When a new (untested) helmet is tested to replace an "inconclusive" helmet, the test shall be started from the beginning and two (2) shots shall be placed into the helmet. For an impact with a low velocity that is a complete penetration, then the shot is valid and a retest is not required. This progression applies to both RTP/BTD and hardware tests. All valid BTD and penetration data will be used in the acceptance calculations.

4.10.11.5.2.5 Criteria. Each projectiles penetration determination shall be compared to the requirements of 3.7.2. Each projectile's depression measurement shall be compared to the requirements of 3.7.3. The finished helmet retention/suspension system shall be inspected after each shot. A failure of the suspension/retention system, i.e. the chinstrap breaks, shall not be considered a test failure. Retightening of the retention system shall be allowed. Should the finished helmet be dismounted from the headform due to ballistic impact, the occurrence shall be noted, the helmet remounted, and testing continued without penalty. The finished helmet shall then be remounted in accordance with 4.10.11.5.2.1 in preparation for the next shot.

4.10.11.5.2.6 Data. Data for all fair and unfair shots shall be reported

4.10.11.6 Condition Methods.

4.10.11.6.1 Ballistic Resistance (Ambient, High, and Low Temperatures). For ambient temperature testing, the finished shells or finished helmets shall be subjected to an initial conditioning for a minimum of 24-hours at 68°F (± 10°F) and 50% relative humidity (± 20%). For high temperature testing, the finished helmets shall be subjected to an initial conditioning of

24 (+24, -0) hours at 160°F (± 10°F) in a conditioning chamber. For low temperature testing, the finished helmets shall be subjected to an initial conditioning of 24 (+24, -0) hours at minus 60°F (± 10°F) in a conditioning chamber. After conditioning, the finished helmet(s) shall be removed from the conditioning chamber and ballistic testing conducted in accordance with 4.10.11.4. During testing, the surface temperature shall be measured prior to each shot to ensure that the temperature is maintained within the specified range. No shot shall be taken outside the specified surface temperature range. If the surface temperature falls out of the specified range, the shell shall be reconditioned. As an alternative to measuring surface temperature, testing shall be conducted on a particular shell within 30-minutes after removal from the conditioning chamber without surface temperature measurement. Reconditioning shall be for a minimum of one (1) hour if the helmet has been out of conditioning for one (1) hour or less. If the helmet has been out of conditioning for over one (1) hour, the helmet shall be reconditioned for 24 (+24, -0) hours. Failure to meet the requirements specified in 3.7.1 and 3.7.2 shall constitute test failure.

4.10.11.6.2 Ballistic Resistance (Sea water). The finished shell or finished helmet shall be immersed in seawater as specified in 4.10.14.1 at a minimum depth of 3 feet. After immersion for three (3) hours (+1 hour), it shall be removed, wiped dry, excess water squeezed from the pads and tested. Testing shall take place within two (2) hours after removal from sea water. The finished helmet shall then be ballistically tested in accordance with 4.10.11.3 and 4.10.11.4. Failure to meet the requirements specified in 3.7.1 and 3.7.2 shall constitute test failure.

4.10.11.6.3 Ballistic Resistance (Weatherometer). After the finished shell or finished helmet has been exposed in the weatherometer and after passing the thickness and visual examinations in 3.10.2, then the finished helmet shall be ballistically tested in accordance with 4.10.11.3 within 96-hours after removal from the weatherometer. Failure to meet the requirements specified in 3.7.1 shall constitute test failure.

4.10.11.7 Procedures. The following procedures apply to ballistic testing.

4.10.11.7.1 Ballistic Test Reports. For all ballistic testing (V_{50} BL(P), 9mm RTP, and transient deformation), the following minimum information shall be required by the Government to validate performance:

1. Contractor identification
2. Contract number
3. Lot numbers and quantities
4. Item specification number
5. Armor description including model number and serial number (if applicable)
6. Weights of all components
7. Test projectile with exact nomenclature
8. Test date, temperature, and humidity measurements
9. Yaw angle
10. Angles of target obliquity
11. Velocity measurements of each test shot used to test the armor (regardless of whether that particular velocity was used in the V50 Resistance to Penetration or transient deformation determination). Both uncorrected (instrumental / measured) and corrected (striking)

velocities shall be reported. The corrected (strike) velocity shall be used for ballistic requirement. PP (Partial Penetration) and CP (Complete Penetration) next to each shot velocity as determine

12. Location of shot
13. Description of test setup (distances from velocity measuring devices to target)
14. Name of company/organization performing tests
15. Type of gun barrel, weapon caliber and propellant type and weight

4.10.11.7.2 Projectile Velocity Determination. Projectile velocity and time of flight measurements shall be in accordance with ITOP 04-2-805. Instrumental velocity shall be translated into strike velocity at the target and the strike velocity shall be used for ballistic requirements. Projectile velocity measurement methods shall employ either high velocity lumiline screens or electrical contact screens which either open or close an electrical circuit by passage of the projectile through the detector. Contact screens may consist of metallic foils separated by a thin insulating layer, or may consist of a circuit printed on paper with the circuit spacing such that the projectile passing through the screen will break the circuit. An electric counter type chronograph measuring to the nearest microsecond or as a minimum to the nearest 10 microseconds will be used with these measuring devices. As an alternative, radiographic equipment calibrated to capture the projectile at various time intervals of flight can be used. For all projectiles, velocity correction methodology shall be used to calculate the actual striking velocity and, where appropriate, actual residual velocity.

4.10.11.7.3 Weapon Mounting Configuration. For RCC and FSP testing, the spacing from the weapon muzzle to the first pair of triggering devices shall be sufficient to prevent damage from muzzle blast and obstruction from smoke in case optical devices are used.

4.10.11.7.4 Yaw Measurement System. A suitable system to ensure that yaw is within the specified tolerances shall be employed. The measurement system employed should be capable of measuring yaw to within an accuracy of 1.0-degree. A system known to work is described in 6.6.

4.10.11.7.5 Test Area Conditions. All ballistic tests shall be performed in a standard ambient atmosphere unless otherwise specified. Temperature and humidity measurements shall be recorded before the beginning of days test firings, every 2-hours thereafter (during active testing), and at the conclusion of testing.

4.10.12 Weight Examination. The finished helmet or system shall be weighed on a scale accurate to 0.001-pound (lb) for conformance to the weight requirements in sections 3.0 and 3.10.1. Any non-conformance shall be cause for test failure. The Government will perform weight testing on all helmets selected for Lot testing. The results of this testing shall be documented and transcribed onto LAT documentation required for Lot acceptance. Additionally, the Contractor shall perform 100% weight inspection of completed helmets.

4.10.13 Blunt Impact Protection. The blunt impact protection for the complete finished helmet shall be determined in accordance with DOT FMVSS 218 with the following exceptions:

1. Each helmet shall be tested with the suspension system arranged standard inside the finished helmet. (For example: If using a 7 pad configuration: "standard pad configuration" arrangement in TM 10-8400-304-10, WP 0005; with the oblong/oval pads in the vertical pad configuration. The modified pad configuration for 9mm ballistic testing is not used for blunt impact testing).
2. Six (6) helmet samples of each size shall be required: two (2) each for testing after exposure to each of the three (3) environmental condition.
3. The environmental conditionals shall be ambient (see 4.6), cold 14°F (± 5°F), and hot 130°F (± 5°F). Helmets shall be conditioned for a minimum of twelve (12)-hours prior to test.
4. The hot and cold environmental impacts shall be conducted within five (5) minutes after the finished helmets are removed from the environmental conditioning chamber. Helmets shall be returned to the conditioning chamber and exposed for at least fifteen (15) minutes before removal for another test.
5. Water immersion testing is not required.
6. The impact anvil used for all tests shall be the hemispherical anvil.
7. Helmet shall be fitted to the appropriate size DOT (FMVSS 218) headform (sizes B, C, and D).
8. Each helmet shall be impacted two (2) times at seven (7) locations. These include the front, back, left side, right side, lower left rear, lower right rear, and the crown. The headform shall be oriented as described in Table XII for each particular impact site. Additionally, Figure 4 shows the orientation of all locations except the left and right nape.
9. Two (2) successive impacts shall be made at each location. The second impact shall be made no sooner than one (1) minute and no later than (2) minutes after the first.
10. The velocity for all impact shall be 10 (±0.3) feet per second (FPS). If the velocity is lower than 9.7 FPS, then the impact shall be considered unfair and a retest shall be conducted. If the velocity is higher than 10.3 FPS and the results of the impact meet the requirements of 3.9 with no interior visual damage, then the impact shall be considered fair. If the velocity is higher than 10.3 FPS and the results of the impact do not meet the requirements of 3.9, then the impact shall be considered unfair and a retest shall be conducted.
11. Ensure that no plastic components (ladder-locks) are caught between the helmet shell and the headform prior to testing.
12. Helmet Position Index (HPI) measurements will be supplied in a separate document.

Additional testing when required, shall follow section 3.9. Failure of any helmet to meet the requirement of 3.9 shall constitute failure of the test.

TABLE XII. Headform Orientation for Impact Testing

Impact site	Headform base orientation
Front	40-45 degrees off vertical
Rear	5-30 degrees off vertical
Left / right side	10-30 degrees off vertical

Crown	± 35 degrees off vertical
Left / right nape	Zero degrees off vertical, rolled 15 to 35 degrees left or right

4.10.14 Environmental Test Methods.

4.10.14.1 Seawater Immersion – Weight and Visual Examination. The finished shell, clean and free of dirt or other foreign matter, shall be exposed to standard ambient conditions for a minimum of three (3)-hours and then weighed to the nearest 0.01-pounds. The shell shall then be immersed in a laboratory seawater solution containing 3 percent sodium chloride and 0.5 percent magnesium chloride at standard ambient conditions for a minimum of 16 hours at a minimum depth of 3-feet. The shell shall be removed, wiped of excess moisture, and kept at standard ambient conditions for twelve (12) (± 0.5) - hours and weighed again to the nearest 0.01-pounds. A weight increase in excess of that allowed in paragraph 3.10.1 shall constitute failure. The shell shall be visually examined for the defects specified in 3.10.1 and any nonconformance with 3.10.1 shall constitute test failure.

4.10.14.2 Weatherometer Resistance. After the finished shell has been exposed in the weatherometer in accordance with AATCC Method 169, except as modified below, the finished shell shall be examined visually.

Modification to AATCC Method 169:

1. The test apparatus shall be a Xenon weatherometer with reflective panels. The apparatus shall be equipped with an automatic light monitor and shall be capable of automatically controlling irradiance, temperature, and humidity. The apparatus shall be maintained in accordance with manufacturer's recommendations.
2. The weathering test cycle shall be 40-minutes of light, 20-minutes of light with water spray on the specimen, 60-minutes of light, 60-minutes of darkness with no spray. The test cycle shall be repeated until the total energy exposure is equal to 100 kilojoules per square meter.
3. The irradiance level shall be 0.55 (± 0.01) watts/square meter/nanometer (W/sq. m/nm) bandpass at 340 nanometers.
4. The glass filter combination shall be quartz inner filter and a borosilicate type "S" outer filter.
5. The relative humidity shall be 50 percent (± 5 percent) during the light cycle and not lower than 95 percent during the dark cycle.
6. The control set points shall be as follows:

	Dark Cycle	Light Cycle
Black panel	38°C	77°C
Conditioning Water	40°C	53°C
Wet bulb depression *	0°C (95 percent RH)	10°C (50 percent RH)

* As a guide only; adjust to achieve required relative humidity (see 5. above)

7. Place the finished shell inside the weatherometer. After the required exposure period, the specimen shall be removed from the apparatus and allowed to dry and condition at ambient conditions. Any area of the shell may be tested due to the light reflecting off the panels used in the weatherometer.

After the shell has been tested in the weatherometer, the helmet shall be examined for the defects listed in 3.10.2. Thickness measurements shall be tested in accordance with 4.10.3. Any nonconformance to the requirements of 3.10.2 shall constitute test failure. After passing the requirements of 3.10.2, the shell shall be tested against the requirements of 3.7.1 for 0° (±5°) obliquity only. Testing shall be conducted in accordance with 4.10.11.3.

4.10.14.3 Field Agent Resistance. The finished shells shall be conditioned at standard ambient conditions for a minimum of twenty-four (24)-hours prior to testing. The test procedure is as follows:

1. With a clean cloth, remove any mold release, dirt, or foreign matter from the exterior of the shell.
2. Mark an area of at least 2.5 inches square on the test specimen's surface.
3. Apply a liberal amount of the agent specified to the shell sufficient to cover the total marked area for a minimum period of twenty-four (24)-hours. Only the exterior of the shell is tested. The area shall remain wet with the agent for a minimum of twenty-four (24)-hours. If the agent appears to be close to drying out during the test period, the agent shall be reapplied. It may be useful to use an absorbent pad saturated with the agent to maintain the wetting of the shell.
4. At the end of the test period, remove any excess agent from the test specimen by dabbing with a dry cloth.
5. Visually examine the test specimen for conformance to requirements in 3.10.3. Failure to meet any requirement shall constitute test failure.

More than one test may be done on any one shell providing the specified test agent does not come in contact or contaminate another agent during the test period. If more than one test is done on any one shell, the application of any agent shall be a minimum of 2-inches away from any other agent.

4.10.14.4 Flame Resistance. The flame resistance of the finished shell shall be determined in accordance with the applicable methods, definitions, and equipment identified in ASTM 6413 with the following exceptions:

a. The end-item specimen shall be a finished shell as opposed to a textile specimen.
b. Char length and afterglow will not be measured.
c. Test Cabinet as described in paragraph 6.1 shall not be used. Instead, tests shall be performed in a laboratory fume hood with air turned off.
d. Modify paragraph 9, Sampling, to reference sampling at random locations within four (4) inches of the crown benchmark and along the outer edge of the shell. The edge and shell shall be tested at two (2) non-overlapping locations for each helmet tested. A minimum of three (3) finished shells will be tested.

e. Modify paragraph 11; Flame will be immediately removed from specimen after 12 seconds.
f. Modify calculation, paragraph 12.1, to calculate the average after-flame of three (3) helmets, two (2) samples per helmet, for both the edge and shell tests.

Any non-conformance with the requirements of 3.10.4 shall constitute test failure.

4.10.14.5 Hot Storage and Use. The finished helmet shall be subjected to a conditioning of 24 hours (± 1 hr) at 160°F (± 10°F) in a circulating air test chamber. The test specimen shall be allowed to cool to ambient temperature. The test specimen shall then be removed from the test chamber and visually examined. Thickness measurements are to be performed at five (5) random locations, one in each section. Prior to beginning the test, the five (5) random locations shall be selected. At those locations the coating and texturing aggregate shall be abraded/removed such that an accurate measurement is taken. Helmet sections are defined in 4.10.11.3.3. Before and after thickness measurements are to be taken at the same five random locations. The thickness criterion is specified in 3.10.5. The helmet shall be visually examined for the requirement of 3.10.5. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.10.6 on the sample. The adhesion of coating test shall not be conducted within one inch of the area used to conduct the thickness measurement. As an alternative, an additional uncoated shell may be used to determine change in thickness. Failure to meet the requirements of 3.10.5 shall constitute test failure.

4.10.14.6 Cold Storage and Use. The finished helmet shall be subjected to a conditioning of 24-hours (± 1 hr) at minus 60°F (± 10°F) in a test chamber. The test specimen shall be allowed to cool to ambient temperature. The test specimen shall then be removed from the test chamber and visually examined. Helmet sections are defined in 4.10.11.3.3. Thickness measurements are to be performed at five (5) random locations, one in each section. Prior to beginning the test, the five (5) random locations shall be selected. At those locations the coating and texturing aggregate shall be abraded/removed such that an accurate measurement is taken.

Before and after thickness measurements are to be taken at the same five (5) random locations. The thickness criterion is specified in 3.10.6. The helmet shall be visually examined for the requirement of 3.10.6. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.10.6 on the sample. The adhesion of coating test shall not be conducted within one inch of the area used to conduct the thickness measurement. As an alternative, an additional uncoated shell may be used to determine change in thickness. Failure to meet the requirements of 3.10.6 shall constitute test failure.

4.10.14.7 Temperature Shock. The finished helmet shall be subjected to an initial conditioning of a minimum of 24-hours at 160°F (± 10°F) in a conditioning chamber. The test specimen shall then immediately be put in a conditioning chamber at minus 60°F (± 10°F) for a minimum of 24-hours (+24 hours). A second finished helmet shall be subjected to an initial conditioning of a minimum of 24-hours (+24 hours) at minus 60°F (± 10°F) in a conditioning chamber. The test specimen shall then immediately be put in a conditioning chamber at 160°F (± 10°F) for a minimum of 24-hours (+24 hours). Then the test specimen set shall be removed from the conditioning chamber and allowed to return to room temperature. Once at room temperature, the

test specimen shall be visually inspected. Thickness measurements are to be performed at five (5) random locations, one (1) in each section. Prior to beginning the test, the five random locations shall be selected. At those locations the coating and texturing aggregate shall be abraded/removed such that an accurate measurement is taken. Helmet sections are defined in 4.10.11.3.3. Before and after thickness measurements are to be taken at the same five (5) random locations. The thickness criterion is specified in 3.10.7. The helmet shall be visually examined for the requirement of 3.10.7. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.10.6 on the sample. The adhesion of coating test shall not be conducted within one inch of the area used to conduct the thickness measurement. As an alternative, an additional uncoated shell may be used to determine change in thickness. Failure to meet the requirements of 3.10.7 shall constitute failure of the test.

4.10.14.8 Altitude Test. Place the finished helmet in an ambient air pressure chamber and vary the pressure in the chamber. Starting at ambient pressure, lower the pressure to simulate a 40,000 feet (± 300 feet) altitude. The test temperature at the 40,000-feet equivalent pressure should be -62°F (± 5°F)/ -52°C (± 3 °C). Hold the pressure for a minimum of 1-hour. Then raise the pressure to simulate a 15,000 feet (± 300 feet) altitude. Hold the pressure for a minimum of 1-hour. Then pressurize the chamber and inspect for the requirements of 3.10.8. The change rate of the air pressure is not less than 1,500 feet per minute and no more than 2,000 feet per minute. Thickness measurements are to be performed at five (5) random locations, one in each section. Prior to beginning the test, the five (5) random locations shall be selected. At those locations the coating and texturing aggregate shall be abraded/removed such that an accurate measurement is taken. Helmet sections are defined in 4.10.11.3.3. Before and after thickness measurements are to be taken at the same five (5) random locations. The thickness criterion is specified in 3.10.8. The helmet shall be visually examined for the requirement of 3.10.8. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.10.6 on the sample. The adhesion of coating test shall not be conducted within 1 inch of the area used to conduct the thickness measurement. As an alternative, an additional uncoated shell may be used to determine change in thickness. Failure to meet the requirements of 3.10.8 shall constitute test failure.

4.10.14.9 Helmet Vibration Test. The finished shell, suspension system, and retention system shall be tested in accordance with MIL-STD-810, Method 514.6G(1), Procedure II (Loose Cargo Transportation). The vibration test shall approximate the various environments to which the helmet shall be subjected. Failure to meet the requirements of 3.10.9 shall constitute test failure.

4.10.14.10 Impact Resistance. The test apparatus shall consist of a fixed ball release tester equipped with an electromagnetic device or similar apparatus capable of releasing at a minimum an 8.0-pound solid sphere that has a density between iron and steel, hereon referred to as the impactor. The apparatus shall be designed such that the finished shell is subjected to only one impact. Position the finished shell on a fixture or jig with a hard surface so that the helmet shell is in the as-worn position and the shell apex (crown) is aligned with the center of the impactor. The shell shall be fully supported along its rim by the hard surface or fixture. The hard surface or fixture shall extend at least 1.0-inch beyond the edge of the finished shell to ensure that it is supported. Drop the impactor from a height of 5.0-feet (+0.5 feet, -0.0 feet). After the impact, examine the finished shell for requirements in paragraph 3.10.10. Measure the depth of any

indentation in the finished shell. Any nonconformance with the requirements of 3.10.10 shall constitute test failure.

4.10.14.11 Compression Resistance (top to bottom). The finished shell without the edging or an unfinished shell shall be tested on a CRE machine in accordance with ASTM Test Method D76 except that the machine shall be used in the compression mode as follows: Use a fixture or jig to completely support the test specimen around its periphery. The fixture or jig shall extend at least 1.0-inch beyond the edge of the finished shell on the same plane as the edge (not up the sides of the test specimen) to ensure that it is supported. Position and center the test specimen on the jig on the base platen of the machine so that the test specimen is in the as-worn position and the planes (see drawings 2-1-2515, 2-1-2516, 2-1-2517, 2-1-2518, and 2-1-2576) are parallel to the platen. While in this position, measure and record and mark the maximum height reading of the test specimen at its apex to the nearest 0.001-inch. Using a 2.50-inch diameter flat anvil, compress the shell at its vertex at the rate of 12.0 inches per minute until a compressive force of 400-pounds is reached. Release the applied force to 5.0-pounds and repeat testing for 24 additional cycles. Within 5 minutes of the completion of the last cycle, again measure and record the height dimension in the same manner as above. One (1) shell from each size shall be tested. Failure to meet the requirements of paragraph 3.10.11 shall constitute failure of the test.

4.10.14.12 Compression Resistance (side to side). The finished shell without the edging or an unfinished shell shall be tested on a CRE machine in accordance with ASTM Test Method D76, except that the machine shall be used in the compression mode per the following. Measure, record and mark the maximum shell width dimension of the test specimen to the nearest 0.001-inch. Using a 2.50-inch diameter flat anvil position the test specimen so that the highest width dimension is aligned with the center of the top anvil. Suitable means shall be made to keep the test specimen in position so long as the means does not add to the structural rigidity of the shell. A method successful used is shown in Figure 5. Note that Figure 5shows a finished shell – unfinished shells are permitted. Compress the test specimen at the rate of 12 inches per minute until a force of 300-pounds is reached. Release the applied force to 5.0-pound and repeat testing for 24 additional cycles.

Within five (5) minutes of the completion of the last cycle, again measure and record the height dimension in the same manner as above. After a period of 24 hours (± 1 hour) from the last cycle, again measure and record the height dimension. One (1) shell from each size shall be tested. Failure to meet the requirements of paragraph 3.10.12 shall constitute failure of the test.

4.10.14.13 Accelerated Aging/Shelf Life. A finished shell shall be subjected to accelerated aging conditioning in general accordance with ASTM D 1149-07, with the following modifications. Shell thickness shall be measured, before and after conditioning, in accordance with 4.10.3. The finished shell may be lightly sanded at the measuring locations to remove aggregate so to obtain a good measurement.

a. The finished shell shall be conditioned in the ozone chamber for four (4) hours at temperature of 40 ± 1°C (104 ± 2°F).
b. A 30 lbs weight shall be applied to the finished shell during conditioning. Position and support the finished shell so that it is in the as-worn position (see drawing 2-1-2569).

Apply the weight on the shell apex. No additional tensile strain during conditioning is required.

c. Introduce ozone after temperature conditioning at a minimum ozone level of 50 ± 5 mPa partial ozone pressure for seventy-two (72) hours.
d. After conditioning, the finished shell must remain at ambient atmospheric conditions for twenty-four (24) hours prior to testing.

After conditioning, the finished shell shall undergo visual inspection for defects as listed in 3.10.13. Inspection for change of shell thickness shall be done by measuring the shell thickness before and after conditioning. Thickness measurements shall be obtained in accordance with paragraph 4.10.3. After passing the visual inspection requirements, the finished shell shall undergo V50 BL(P) testing for 17-grain projectile at 0° (±5°) obliquity at ambient conditions. V50 BL(P) testing shall be conducted in accordance with paragraph 4.10.11.3.6. Any non-conformance with the requirements of 3.10.13 shall constitute a test failure.

4.10.15 Integration and Compatibility. An integration and compatibility demonstration shall be conducted which demonstrates that the finished helmet is integrated and compatible as specified in 3.11. Failure to meet the requirements of 3.11 shall constitute test failure.

4.10.16 Ownership and Support.

4.10.16.1 Washability. The finished shell with hook material installed shall be washed in accordance with the hand washing method of AATCC Test Method 143 (wash temperature III) except that a soft bristle brush shall be used and an appropriate size pail shall be used.

The finished shell with attachment material shall be allowed to air dry (screen dry) between washings in accordance with AATCC Test Method 143. At the conclusion of the washings, each component shall be visibly inspected. Any non-conformance with the requirements of 3.12.2.1 shall constitute test failure.

4.10.16.2 Shelf Life. The Contractor shall provide data that shows all the components and materials used in the finished helmet meet the requirements of 3.12.3.

4.10.17 Health/Safety. A demonstration shall be conducted or documentation provided to verify that the finished helmet meets the health and safety requirements specified in 3.13.1, 3.13.2, and 3.13.3. Additionally, the contractor must furnish information, which certifies that the finished product is composed of materials, which have been safely used commercially or provide sufficient toxicity data to show compatibility with prolonged, direct skin contact.

5.0 PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order. When actual packaging of materiel is to be performed by Department of Defense (DoD) personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency,

or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6.0 NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory with the exception to 6.8).

6.1 Intended Use. The finished helmet is intended for use by ground troops and parachutists to provide ballistic and impact protection to the head.

6.2 Acquisition Requirements. Acquisition documents should specify the following:

1. Title, number, and date of this specification
2. Issue of Department of Defense Index of Specifications and Standards (DODISS) to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3)
3. Types, Classes, and sizes required (see 1.2 and 1.3)
4. When FAT is required, (see 3.1.1), the item will be tested and should be a First Article sample. The contracting officer should include specific instructions in acquisition documents regarding arrangement for examinations, quantity, and testing and approval.
5. Packaging requirements (see 5.1).

6.3 First Article. When a first article is required, it shall be inspected and approved under the appropriate provisions of FAR 52.209-4. The first article should be a pre-production sample. The contracting officer should specify the appropriate type of first article and the number of units to be furnished. The contracting officer should include specific instructions in all acquisitions documents regarding arrangements for selection, inspection, and approval of the first article.

6.4 Acceptance criteria. Acceptance criteria shall be as specified in the contract or purchase order.

6.5 Definitions. The following definitions are provided to assist in understanding the test procedures:

6.5.1 Fair impact. A projectile that impacts the helmet at yaw not exceeding 5° from the intended angle of incidence and in a permitted location (not close to hole, edge, or in area of delamination) shall be considered a fair impact.

a) Any otherwise FAIR impact which does not comply with shot-to-shot or shot-to-edge minimum distance requirements, which is NOT a complete penetration, shall also be a FAIR impact.

b) Any otherwise FAIR impact, which impacts at an excessive velocity regardless of result (partial or complete penetration), will be declared “inconclusive” and repeated with a new (untested) helmet. However, if the final impact is a high velocity shot that generates a partial penetration that shot is valid and a retest is not required.

c) Any otherwise FAIR impact, which impacts at a velocity lower than specified and IS a complete penetration, shall also be a FAIR impact.

6.5.2 Partial penetration (PP). Any fair impact that is not a complete penetration shall be considered a partial penetration.

6.5.3 Complete penetration (CP).

6.5.3.1 Complete Penetration – Clay Filled Headform (V0). A complete penetration (CP) occurs when a complete perforation of the shell by the projectile or fragment of the projectile as evidenced by the presence of that projectile, projectile fragment, or spall in the clay, or by a hole which passes through the shell. Non-metallic material such as paint, fibrous materials, edging, or edging adhesion resin that are emitted from the helmet and rests on the outer surface of the clay impression are not considered a complete penetration.

6.5.3.2 Hardware Complete Penetration – Witness Plate Headform (RTP). Following the completion of each hardware shot, inspection of the witness plate and hardware will be made. A complete penetration (CP) occurs when the hardware fractures or separates and the impacting projectile or any fragment thereof, or any fragment of the hardware perforates the witness plate resulting in a crack or hole which permits light passage. Examples of hardware fracture are bolt shaft breaking off from outer bolt head (or outer nut), bolt shaft and inner nut (or inner bolt head) breaking off from outer bolt head (or outer nut), inner nut (or inner bolt head) separating from bolt shaft (threads fail), or fragment of hardware separating from bolt shaft or inner nut (or inner bolt head). If the witness plate is broken and the retention system hardware is still intact, then the determination of a partial or complete penetration will be made based on whether it appears the fragments went around the hardware, through the helmet, in or around the helmet bolt hole and/or the helmet shell/edging; these would be considered a partial penetration. Fragments (projectile or outer component of hardware) which go around the helmet shell/edging and perforate the witness plate will not be considered complete penetrations. If the hardware is still intact but was removed from the helmet by the impact and perforates the witness plate, this will not be ruled a complete penetration since it was caused by helmet hole elongating/fracturing.

6.5.3.3 Complete Penetration (V50). A complete penetration (CP) occurs when the impacting projectile or any fragment thereof, or any fragment of the finished shell perforates the witness plate resulting in a crack or hole which permits light passage. A break in the witness plate by the finished helmet deformation is not scored as a complete penetration. If it is unclear, then the shot will be called a Misfire and repeated on the next shot location.

6.5.4 Obliquity. A measure, normally in degrees, of the extent to which the impact of a projectile on an armor material deviates from a line normal to the target. Thus, a projectile fired perpendicular to an armor surface is at 0° obliquity.

6.5.5 Yaw. Projectile yaw is the angular deviation of the longitudinal axis of the projectile from the line of flight at a point as close to the impact point on the target as is practical to measure. The point of impact shall be located on the test sample and shall be positioned to line up with the previously determined line of flight of the projectile.

6.5.6 Velocity Spread. The velocity spread is computed by subtracting the lowest velocity used in the V_{50} BL (P) calculation from the highest velocity used in the calculation. Also known as "Range of Results".

6.5.7 V_{50} BL (P). In general, the velocity at which the probability of armor penetration is 50 percent by a given projectile. The V_{50} BP(L) is defined as the average of an equal number of highest partial penetration velocities and the lowest complete penetration velocities which occur within a specified velocity spread.

6.5.8 Zone of mixed results. The velocity difference between the highest velocity PP and the lowest velocity CP, when there is a PP at a higher velocity than a CP.

6.6 Yaw measurement system. The suggested yaw measurement system is the yaw card system described as follows:

a. The yaw card shall be placed directly in front of the test sample. (The yaw card will be devoid of any markings.) Kodak photographic paper, single weight, kodabromid (or equal), may be used for the yaw card. If photographic paper is used, the emulsion side shall face the test sample.
b. After the test, the yaw card shall be carefully measured to determine the largest dimension of the projectile. An optical magnification device with a magnification between 5X and 10X may be used for marking this measurement.
c. In the event that any shot fired indicates yaw greater than as specified in this document, it shall not be used and the barrel shall be rechecked for affect on yaw as follows: fire five (5) shots, if three (3) shots exhibit yaw, discard the barrel, and if one or more shots exhibit yaw, investigate cause and correct.
d. In case of dispute concerning a particular barrel, yaw shall be measured by a photographic measurement system using a multi-flash light source to determine projectile velocity and yaw.

A yaw card made of a stiff material from which the projectile may punch a clean hole may be used immediately in front of the target to measure the degree of yaw of each projectile. An accurate yaw measurement (comparison) will be made only if a visible observation of the projectile profile signature indicates yaw is present. If accurate yaw measurement (comparison) indicates yaw in excess of the tolerance, corrective actions shall be taken.

6.7 Suggested Sources.

Roma Plastilina No 1 clay can be purchased from Sculpture House (Standard Clay Mines), 100 Camp Meeting Road, Skillman, NJ, 609-446-2986.

A manufacturer and part for the inner material to consider is YKK (Knit uncoated loop tape p/n SC-MEC 20).

YKK USA, Inc.
c/o Diversified Marketing Group
109 Forrest Ave.
Narberth, PA 19072

A manufacturer and part for the hook material to consider is YKK (Extruded Powerhook FE-Polyester p/n 020453)

YKK USA, Inc.
c/o Diversified Marketing Group
109 Forrest Ave.
Narberth, PA 19072

6.8 Mandatory Sources.

The mandatory source for the Suspension Systems/Retention Systems is:

National Industries for the Blind
1310 Braddock Place
Alexandria, VA 22314

6.9 Subject term (key word) listing.

Ballistic
Body Armor
Headgear
Combat Helmet

7. FIGURES and PICTURES

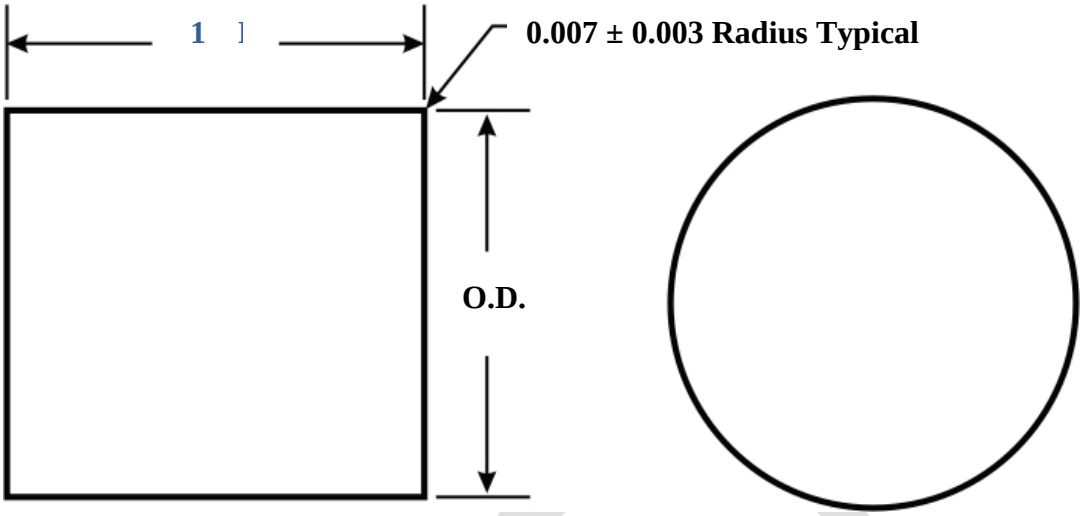

Figure 1. Right Circular Cylinder

Weight (Grains)	* Outside Diameter (OD) (inches)	Length (L) (inches)
2 (± 0.10)	0.111 (± 0.001)	0.111
4 (± 0.15)	0.134 (± 0.001)	0.147
16 (± 0.5)	0.219 (± 0.001)	0.221
64 (± 1.0)	0.344 (± 0.001)	0.355

NOTES:

1. * O.D. is nominal diameter of drill rod as furnished.
2. Adjust length (L) to meet the indicated weight (grains).
3. Material is AISAI 4340 heat treated to Rockwell "C" hardness of 29 (± 2).

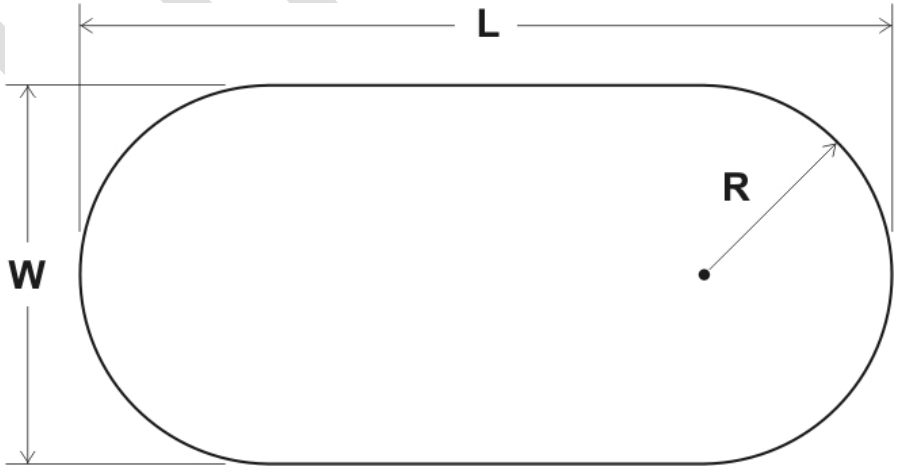

Figure 2. Hook Disk Elongated.

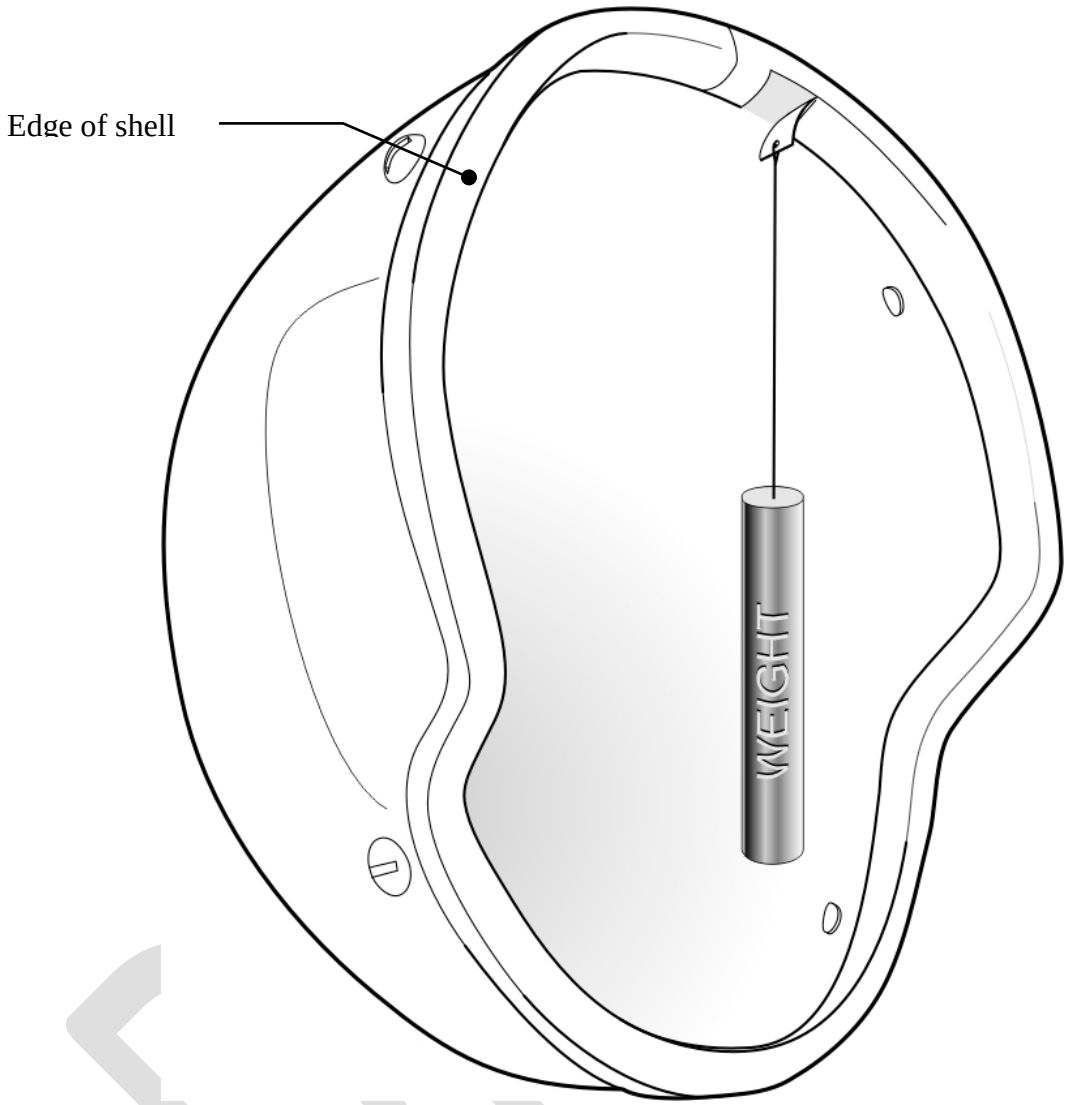

Figure 3A. Rubber Edge Adhesion Test.

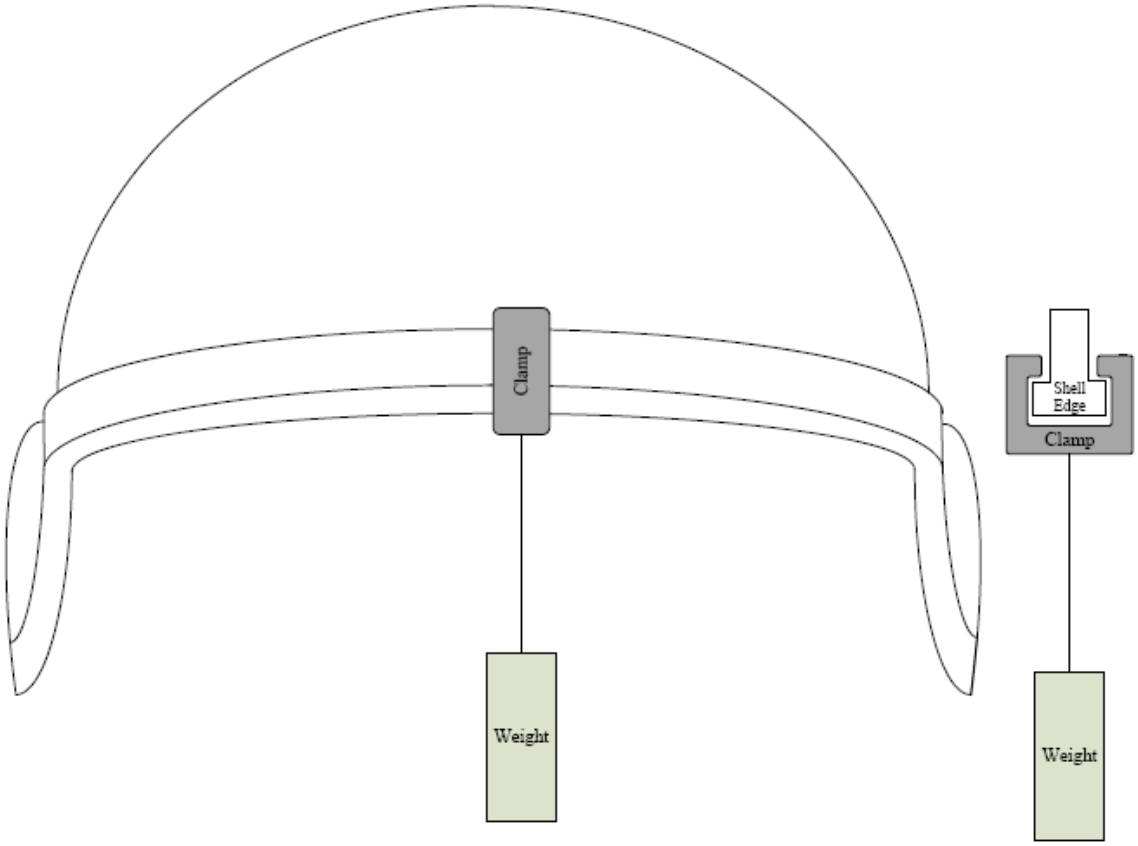

Figure 3B. Structural Edge Adhesion Test (keep this one).

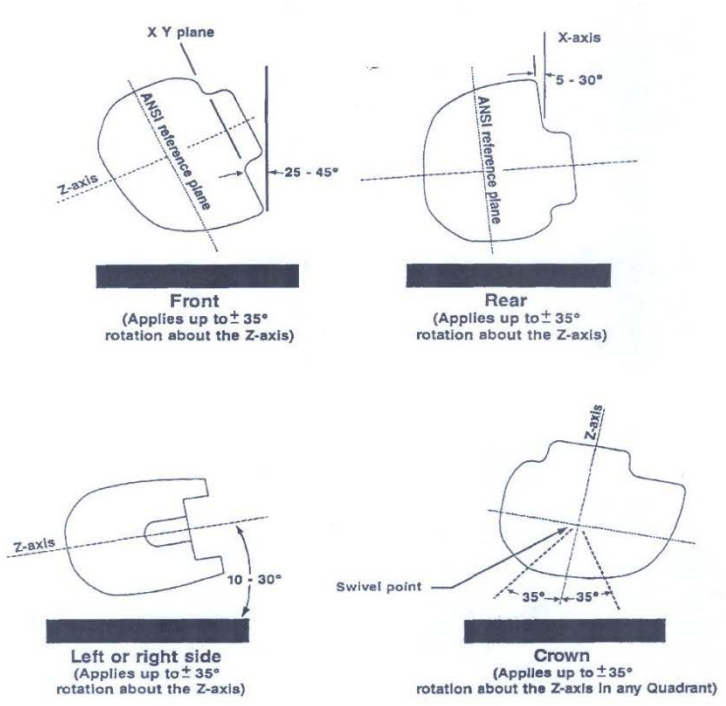

Figure 4. Blunt Impact Test Locations.

Figure 5. Jig – Side to Side Compression Resistance.

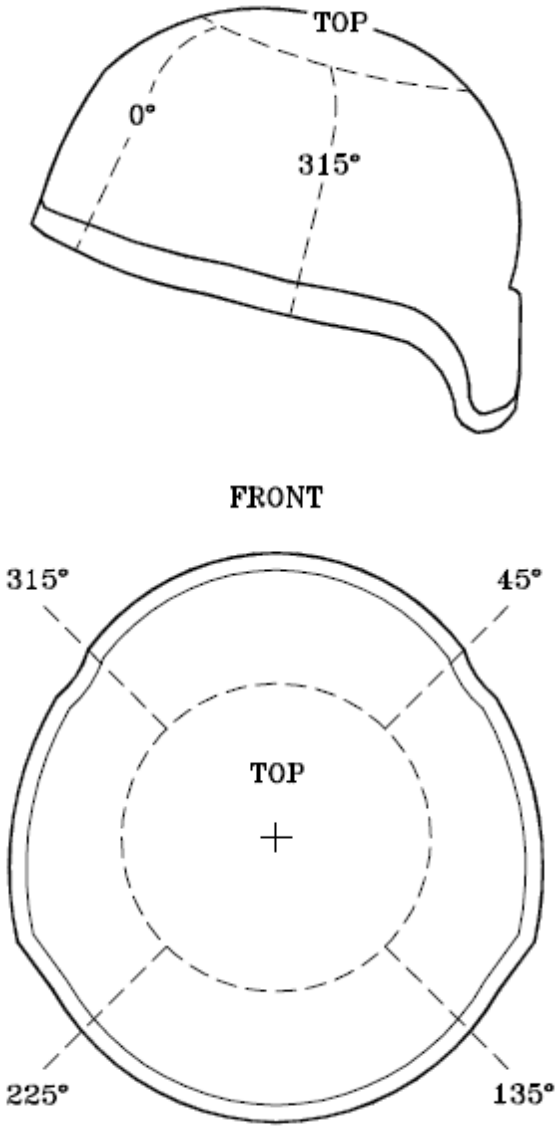

Figure 6. Helmet Sections.

PICTURE 1. Headform: Hardware Ballistic Test

PICTURE 2. Headform: Rear Pad Support for Ballistic Hardware Testing

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ANNEX A

FIRST ARTICLE AND LOT ACCEPTANCE TESTING PROTOCOL FOR THE ADVANCED COMBAT HELMET (ACH)

1. Scope. This document contains information as applicable to First Article Test (FAT) requirements and Lot Acceptance Test (LAT) requirements for the Advanced Combat Helmet Generation II (ACH Gen II). The FAT requirements assume a uniformity of design across all sizes. The ACH Gen II is a protective helmet consisting of a ballistically protective shell, suspension system, and 4-point chinstrap/napestrap retention system. Unless otherwise stated herein, all requirements and verification methods shall be those prescribed in the contract and associated attachments, including Purchase Description AR/PD 14-01.

2. Classification. The helmet assembly will be of the following Types and Classes as specified (see 6.2).

   Type I –Advanced Combat Helmet Gen II (No Hole for Night Vision Goggle Mount)
   Class 1 – Retention System, Suspension system, Tan 499

   Type II –Advanced Combat Helmet Gen II (One Hole for Night Vision Goggle Mount)
   Class 1 – Retention System, Suspension system, Tan 499

3. Schedule of sizes. The helmet assembly is constructed in the following sizes.

   SCHEDULE OF SIZES

   Extra-Small (XS)
   Small (S)
   Medium (M)
   Large (L)
   Extra-Large (XL)
   Extra Extra-Large (XXL)

   Note: Due to low tariff, the Extra-Small and Extra Extra-Large (XXL) FAT will be handled on a case by case basis. Direct all XS and XXL FAT inquiries to the Contracting Officer.

4. Technical Data Package. Prior to FAT submittal, the contractor shall provide a Technical Data Package (TDP) for each helmet design, per size submitted to the Government. If more than one design is to be utilized, a separate and complete TDP shall be submitted for each design. At a minimum, the following must be included in the TDP:

   1. Design nomenclature

   2. Material configuration
      a. Type of material used, supplier, thickness, and areal density
      b. Build sheet/Cut patterns

c. Dry Layup and assembly
d. Orientation/sequence of layers of the design

3. Standard temperature/pressure range and time for processing.

If the design is homogenous across all sizes, the contractor shall submit a molded shell (size medium) and an assembled dry layup (size medium) to the Government. If the design changes per size, it must be defined by providing a molded shell and a separate dry layup for each individual size to the Government. If a deviation in design per size exists, the contractor shall justify that ballistic verification and non-ballistic verification testing during FAT can still be conducted with the assumption of overall design uniformity. If the contractor has not provided this information or the Government does not conclude design uniformity as intended by this Purchase Description, the Government will develop a separate FAT plan to qualify each size by design. At least one finished helmet of each size represented by design are to be submitted to the Government.

The Government will treat all information provided as Proprietary Information and deem it close hold with restricted access. This information is required by the Government in order to baseline and maintains configuration management of each helmet/shell design submitted for FAT. The contractor shall minimize or eliminate the use of proprietary material in the design. The contractor shall disclose all proprietary materials to enable Government to maintain configuration control.

Approval by the Government of the TDP, and written authorization for FAT submittal by the contracting officer will authorize the contractor to submit their design for FAT. Approval of the TDP does not relieve the contractor from meeting any of the requirements specified herein. Any changes to the TDP or helmet/shell manufacturing process shall require re-approval.

4.1 Dry Layup Evaluation. Dry Lay ups for each design will be examined prior to production of any test items (shell) or in order to visually ensure the items exhibit uniform areal density (no unnecessary overlap/underlay, uniform material lengths and thicknesses, etc). Shell dry layups shall not be pressed together and covered. Each material/ply of material shall be supplied so the Government can compare the design in accordance with the build sheet. Visual end item inspection shall take place to ensure there are no rips, tears, cuts, blistering or separation between the materials.

4.1.1 Dry Layup Technical Documentation. If applicable, technical documentation at a minimum shall contain the following information:

a. Build Sheet
b. Design Nomenclature
c. Material Types, Model/Part Numbers, Nomenclatures, Suppliers, etc.
d. Thickness of Materials, Number of Plies, Weave, Denier, Weight
e. Areal Density
f. Construction Process

5. Requirements and Verifications.

Table A-1 Requirement and Verifications

Characteristic	Requirement Paragraph	Verification Paragraph	FAT 1/	LAT 1/	FAT Sample Size
THE TESTS BELOW REQUIRE UNFINISHED SHELLS					
Shell Design/Shape	3.3	4.10.2	X	2/	1 each size
Shell Construction	3.3.1	4.10.1	X	2/	1 each size
Shell Thickness and Uniformity	3.3.2	4.10.3	X	2/	1 each size
The tests above can be performed on the same one (1) set of **unfinished shells** = 1 Small, 1 Medium, 1 Large and 1 Extra Large. Samples of the appropriate hardware are also needed for verification to PD requirements.					

Characteristic	Requirement Paragraph	Verification Paragraph	FAT 1/	LAT 1/	FAT Sample Size
THE TESTS BELOW REQUIRE FINISHED SHELLS WITHOUT HOOK MATERIAL					
Attachment Material Durability	3.6.4	4.10.9.2, 4.10.9.3	X	2/	3 each size for 4.10.9.2 and 1 each size for 4.10.9.3
Seawater Resistance	3.10.1	4.10.3, 4.10.12, 4.10.14.1	X	2/	1 each size
Weatherometer Resistance	3.10.2	4.10.3, 4.10.14.2	X	2/	Any 1 Size
The tests above require at least six (6) **Finished Shells without Attachment Material** of each size = 6 Small, 6 Medium, 6 Large and 6 Extra Large Additional hook material is required for the Attachment Material Durability Test. Note: Alternatively, these tests can be performed, witnessed and verified by DCMA QAR.					

Characteristic	Requirement Paragraph	Verification Paragraph	FAT 1/	LAT 1/	FAT Sample Size
THE TESTS BELOW REQUIRE COMPLETE SUSPENSION SYSTEMS AND RETENTION SYSTEMS					
Suspension System	3.5	4.10.1, 4.10.8.1	X	2/	1 complete suspension system

Pad Construction	3.5.1	4.10.8.2	X	2/	1 complete suspension system
Inner Layer Material	3.5.1.1	4.10.8.1, 4.10.8.2, 4.10.8.5, and 4.10.10.1	X	2/	1 complete suspension system
Padding Layer Material	3.5.1.2	4.10.8.2 4.10.8.4	X	X	1 complete suspension system
Outer Layer Material	3.5.1.3	4.10.8.1, 4.10.8.2, 4.10.8.6, and 4.10.10.1	X	2/	1 complete suspension system
Pad Compression Durability	3.5.2	4.10.8.3	X	2/	1 complete suspension system
The tests above require at least six (6) **Complete Suspension Systems**. (includes contingencies)					

Characteristic	Requirement Paragraph	Verification Paragraph	FAT 1/	LAT 1/	FAT Sample Size
THE TESTS BELOW REQUIRE COMPLETE HELMETS FOR VISUAL / NON-INVASIVE INSPECTIONS					
Benchmarks	3.3.3	4.10.4	X	2/	1 each size
Attachment Holes	3.3.4	4.10.1, 4.10.1.1, 4.10.2	X	2/	1 Helmet of Each Size (with samples of hardware)
Night Vision Goggle Holes	3.3.4.2	4.10.1, 4.10.1.1, 4.10.2	X	2/	1 Helmet of Each Size (with samples of hardware)
Edging	3.3.5	4.10.1, 4.10.5.1	X	2/	1 Helmet of Each Size
Coating	3.3.6	4.10.1	X	2/	CoC
Shell Surface Preparation	3.3.6.1	4.10.1	X	2/	QAR verification
Retention system	3.4	4.10.7	X	6/	6/
Attachment Material Shape	3.6.2	4.10.1	X	2/	1 Helmet of Each Size
Attachment Material Coverage	3.6.3	4.10.1, 4.10.9.1	X	2/	1 Helmet of Each Size
Weight	3.0	4.10.12	X	X	5 Helmets of Each Size
Integration / compatibility	3.11	4.10.15	X	2/	1 Helmet of Each Size

Marking of Helmet Shell	3.12.1	4.10.1	X	X 4/	1 Helmet of Each Size
Shelf Life	3.12.3	4.10.16.2	X	2/	Contractor data as required
Safety	3.13.1	4.10.17	X	2/	Contractor data as required
Toxicity	3.13.2	4.10.17	X	2/	Contractor data as required
Hazardous materials	3.13.3	4.10.17	X	2/	Contractor data as required

The tests above shall be performed on Helmet samples prior to the Destructive / Invasive tests.

The tests above require at least five (5) **Complete Finished Helmets** of each size.

Characteristic	Requirement Paragraph	Verification Paragraph	FAT 1/	LAT 1/	FAT Sample Size
THE TESTS BELOW REQUIRE COMPLETE HELMETS FOR DESTRUCTIVE / INVASIVE TESTS					
Edging adhesion	3.3.5.1	4.10.5.2	X	X 4/	1 Helmet of Each Size
Edging adhesion of edging after heat aging	3.3.5.2	4.10.5.3	X	2/	1 Helmet of Each Size
Adhesion of coating	3.3.6.2	4.10.6	X	X 4/	3 Helmets of Each size
Static Pull Strength	3.4.2	4.10.7.1	X	2/	1 Medium Finished Helmet
Dynamic Pull Strength	3.4.3	4.10.7.2	X	2/	7 Medium Finished Helmets
Colorfastness	3.6.5	4.10.10	X	2/	5 Yards of Attachment Material
Fragmentation protection – Minimum V50 Ballistic Protection Limits (V_{50} BL(P))	3.7.1	4.10.11.1.1, 4.10.11.2, 4.10.11.3	X	X 3/	60 Finished Shells (3.2b) – 14 Small 17 Medium 15 Large 14 X-Large

Resistance to Penetration – 9mm	3.7.2	4.10.11.1.2, 4.10.11.4	X	X 3/	96 Finished Helmets (3.2c) – 24 of each Size
Ballistic Transient Deformation	3.7.3	4.10.11.1.3, 4.10.11.5	X	X 3/	
Blunt Impact Protection	3.9	4.10.13	X	X 4/	6 Helmets of Each Size
Field agent resistance	3.10.3	4.10.14.3	X	2/	Any 1 Helmet
Flame resistance	3.10.4	4.10.14.4	X	2/	Any 3 Helmets
High temperature storage and use	3.10.5	4.10.3, 4.10.14.5	X	2/	Any 1 Helmet
Cold Temperature Storage and Use	3.10.6	4.10.3, 3.0.1.1	X	2/	Any 1 Helmet
Temperature Shock	3.10.7	4.10.3, 4.10.14.6	X	2/	Any 2 Helmets
Altitude	3.10.8	4.10.3, 4.10.14.8	X	2/	Any 1 Helmet
Vibration	3.10.9	4.10.14.9	X	2/	1 Helmet of Each Size
Impact Resistance	3.10.10	4.10.14.10	X	2/	1 Helmet of Each Size
Compression Resistance (top to bottom)	3.10.11	4.10.14.11	X	2/	1 Helmet of Each Size
Compression Resistance (side to side)	3.10.12	4.10.14.12	X	2/	1 Helmet of Each Size
Accelerated Aging / Shelf Life	3.10.13	4.10.14.13	X	2/	1 Medium Helmet
Washability	3.12.2.1	4.10.16.1	X	2/	Any 1 Helmet
The destructive tests above require Three Hundred and Five (305) **Complete Finished Helmets** The required size breakdown for Complete Advanced Combat Helmets = 72 Small, 86 Medium, 76 Large, 71 X-Large Note: The above number of helmets include required contingencies.					

1/ An "x" in the column designates that the test is performed. Sampling rate is specified in 4.4 for LAT unless otherwise specified in the contract and Lot Acceptance Table.

2/ Certification of Conformance (COC) provided for LAT shall certify that the design and materials have not changed since approval of FAT and shall be complete with test data / results. Conformance shall be verified by test, inspection, demonstration, or analysis on the end item assembly or lower level as appropriate. Supporting data shall be available for Government

review. The Government reserves the right to inspect or test such items to verify the validity of the certification.

3/ Ballistic testing for LAT shall be in accordance with 4.10.11.2.

4/ The LAT Testing table below in Section 5 identifies the rate of LAT for edging adhesion, adhesion of coating, blunt impact protection, pad water absorbency, marking and barcode label shall be as specified in the contract or purchase order. For LAT, blunt impact protection test is conducted at ambient conditions only.

For First Article Testing (FAT), certain tests shall be administered in a prescribed order with the same suspension system.

5/ See Ballistic Tables below.

6/ See AR/PD 12-01 for requirements, verifications, and sample quantities.

6. Hardware Impact Criterion (Type I).

A fair shot for hardware testing shall be described as follows:

1) Should the entire projectile be contained within the diameter of the item (i.e., head or nut of the hardware) upon impact the shot will be deemed fair.

2) If the tip of the projectile impacts within the radius of the intended item (i.e., head or nut of the hardware) minus 0.05-in. uncertainty (i.e., R – 0.05-in., where R is the radius of the intended hardware impact) and there is a favorable or unfavorable result (i.e., partial penetration or complete penetration), then the shot will be deemed fair.

An unfair shot for hardware testing shall be described as follows:

3) If the distance off the center of the intended item (i.e., head or nut of the hardware) is in excess of that specified in paragraph 2, then the test (regardless of result) shall be deemed unfair and declared a “no-test”. The test shall be repeated on an untested helmet/hardware combination. No more than two hardware impacts can be conducted on a single helmet. Additional testing will be conducted in accordance with paragraphs A and B specified below and the requirements document.

7. First Article Ballistic Testing (Department of Defense Protocol):

Table A-2 Helmet Test Matrix

Type of Test	**Environmental Conditions**					
V50 1/	**Ambient**	**Hot**	**Cold**	**Seawater**	**Weatherometer**	**Accelerated Aging**
2-grain RCC *4200 FPS min*	1 V50 Size: 2S	1 V50 Size: 4M	1 V50 Size: 2L	1 V50 Size: 2XL	-	-
4-grain RCC *3475 FPS min*	1 V50 Size: 2XL	1 V50 Size: 2S	1 V50 Size: 2M	1 V50 Size: 4L	-	-
16-grain RCC *2475 FPS min*	1 V50 Size: 2L	1 V50 Size: 3XL	1 V50 Size: 3S	1 V50 Size: 2M	-	-
17-grain FSP *2200 FPS min*	1 V50 Size: 2M	1 V50 Size: 2L	1 V50 Size: 2XL	1 V50 Size: 2S	1 V50 Size: 2L	1 V50 Size: 2M
64-grain RCC *1750 FPS min*	1 V50 Size: 3L	1 V50 Size: 5XL	1 V50 Size: 5M	1 V50 Size: 5S	-	-
V0						
9mm RTP/BTD Shell 2/ *1400 +50 FPS*	48 shots 24 helmets **Sizes:** 6S, 6M, 6L, 6XL	48 shots 24 helmets **Sizes:** 6S, 6M, 6L, 6XL	48 shots 24 helmets **Sizes:** 6S, 6M, 6L, 6XL	48 shots 24 helmets **Sizes:** 6S, 6M, 6L, 6XL	-	-
9mm RTP Hardware 3/ (Type I)	17 shots 9 helmets **Sizes:** 2S, 3M 2L, 2XL	16 shots 8 helmets **Sizes:** 2S, 2M 2L, 2XL	16 shots 8 helmets **Sizes:** 2S, 2M 2L, 2XL	16 shots 8 helmets **Sizes:** 2S, 2M, 2L, 2XL	-	-

1/ This matrix provides for a total of 60 helmets.

2/ This matrix provides for a total of 192 shots. The required quantity of helmets to attain 96 shots with 2 impacts per helmet is 96 helmets.

3/ This matrix provides for a total of 65 shots. The required quantity of helmets to attain 65 shots with 2 impacts per helmet is 33 helmets.

To account for misfires and anomalies during testing causing the Government to discount a shot, contingency helmets are required if an additional helmet is needed to complete the shot sequence.

Note: Helmets labeled for specific tests may be used for other tests if there are not enough contingencies available.

Total number of helmets required for the ballistic portion of FAT (including contingencies) is 205 based on the following makeup: S: 48; M: 54; L: 54; XL: 49.

V50 FAT Criteria:

The V50 BL(P) 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 feet per second. In cases where the velocity spread is greater than 150 feet per second, the V50 BL(P) shall be the average of at least 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 feet per second. If neither the ten nor the 14 shot conditions can be satisfied, and at least seven partial penetrations at velocities in excess of the required minimum V50, and there are no complete penetrations at or below the minimum required V50 velocity, and at least 14 fair shots have been made in the helmet(s) shall be determined to have satisfied that specific threat condition requirement. Should none of these three conditions apply, the test shall be declared INCONCLUSIVE.

Fair Hit/No Test Criteria. See Section 6.5.1 on Fair Hit criteria and Section 4.10.11.5.2.4 on testing progression.

V50 Acceptance Criteria.
The acceptance requirement (minimum V_{50} requirement) for the 2-grain, 4-grain, 16-grain, 17-grain, and 64-grain testing is provided in Table A-2 Helmet Test Matrix.

9mm RTP/BTD FAT Criteria:

Table A-3 9mm FAT RTP/BTD Helmet Test Matrix

Size	Helmet	Ambient		Hot		Cold		Seawater	
		Shot 1	Shot 2	Shot 1	Shot 2	Shot 1	Shot 2	Shot 1	Shot 2
Small	#1	Crown	Left	Right	Back	Back	Left	Crown	Front
	#2	Right	Front	Crown	Front	Left	Right	Back	Crown
	#3	Back	Crown	Left	Back	Crown	Back	Front	Back
	#4	Left	Front	Front	Back	Back	Front	Left	Crown
	#5	Front	Back	Crown	Right	Front	Crown	Front	Left
	#6	Crown	Back	Front	Crown	Crown	Front	Right	Back
Medium	#1	Right	Back	Back	Left	Crown	Front	Crown	Left
	#2	Crown	Front	Left	Right	Back	Crown	Right	Front
	#3	Left	Back	Crown	Back	Front	Back	Back	Crown
	#4	Front	Back	Back	Front	Left	Crown	Left	Front
	#5	Crown	Right	Front	Crown	Front	Left	Front	Back
	#6	Front	Crown	Crown	Front	Right	Back	Crown	Back
Large	#1	Back	Left	Crown	Front	Crown	Left	Right	Back
	#2	Left	Right	Back	Crown	Right	Front	Crown	Front
	#3	Crown	Back	Front	Back	Back	Crown	Left	Back
	#4	Back	Front	Left	Crown	Left	Front	Front	Back
	#5	Front	Crown	Front	Left	Front	Back	Crown	Right
	#6	Crown	Front	Right	Back	Crown	Back	Front	Crown
X-Large	#1	Crown	Front	Crown	Left	Right	Back	Back	Left
	#2	Back	Crown	Right	Front	Crown	Front	Left	Right
	#3	Front	Back	Back	Crown	Left	Back	Crown	Back
	#4	Left	Crown	Left	Front	Front	Back	Back	Front
	#5	Front	Left	Front	Back	Crown	Right	Front	Crown
	#6	Right	Back	Crown	Back	Front	Crown	Crown	Front

RTP/BTD Acceptance Criteria for Finished Helmet (9mm).
The acceptance requirement for Resistance to Penetration (V_0) testing and Ballistic Transient Deformation (BTD) is specified below.

FAT Part A: There shall be no complete penetrations in the first twenty-two (22) impacts (helmet shell, eleven (11) helmets required). At least four (4) impacts shall be in each of the four (4) environmental conditions. The three (3) remaining helmets will be subjected to each condition specified (high temp, low temp, and seawater). Should there be ≥ one (1) complete penetration in the first twenty-two (22) impacts then testing will be stopped and the design will have not met the 9mm RTP requirement.

FAT Part B: If there have been no complete penetrations in the first twenty-two (22) impacts as specified in Part A, then testing will continue in accordance with the FAT matrix specified above. The statistical requirements/methodologies mentioned below would then be used to determine if the requirement has been met (see 3.7.2.1 and 3.7.3.1).

Table A-4 Statistical Analysis Requirement

Resistance to Penetration (RTP)	
Analysis Methodology	90% P(nP)* with 90% Lower Confidence Limit
Ballistic Transient Deformation (BTD)	
Analysis Methodology	90% Upper Tolerance Limit (UTL) with 90% Confidence
	*where P(nP) is the Probability of no Penetration

The RTP requirement will then be determined by combining all shots for a particular subtest (i.e., all 9mm RTP/BTD tests will be used in the calculation regardless of shot location), including the first twenty-two (22) impacts. RTP testing on the helmet shall meet a 90% Probability of no Penetration (P(nP)) with 90% Lower Confidence Level (LCL) for 9mm RTP testing when the LCL is calculated using the Clopper-Pearson method.

For BTD testing, there will be four (4) separate calculations done for the Upper Tolerance Limit (UTL). These four (4) calculations will include all sizes and conditions for each test type (i.e., for calculating the UTL on the crown location, the data will consist of sizes S, M, L, and XL from the Ambient, Hot, Cold, and Seawater subtests). These calculations are as follows:

(1) Calculation for deformations in the Front location only.
(2) Calculation for deformations in the Rear location only.
(3) Calculation for deformations in the Crown location only.
(4) Calculation for deformations in the Right and Left Side locations** only.

**If the BTD measurements from the side locations form two distinct distributions, then separate BTD UTL calculations will be conducted for each side location. This will be determined by conducting both a t-test on the means and the Brown-Forsyth test for equal variances on the standard deviations using a significance level of 0.1 in both tests.

All four (4) and if necessary five (5) 90% UTL with 90% Confidence calculations must not exceed the 16.0 mm (Crown, Right, and Left side locations) or 25.4 mm (Front and Rear locations) requirement for acceptance.

V50 LAT Criteria:

The V50 BL (P) for each helmet shell shall be the average of at least six (6) 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 125 ft/sec. In cases where the velocity spread is greater than 125 fps, the V50 BL(P) 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 with a velocity spread no greater than 150 fps. If neither the six nor the ten shot conditions can be satisfied, and at least five partial penetrations at velocities in excess of the required minimum V50 AND there are NO complete penetrations at or below the minimum required V50 velocity AND at least ten (10) fair shots have been made into the helmet(s), the helmet(s) shall be determined to have satisfied that specific threat condition requirement. Should none of these three conditions apply, the test shall be declared INCONCLUSIVE.

Accept/Reject Criteria.

Acceptance criterion is specified in the Accept/Reject Tables below except as noted below each table.

9mm RTP/BTD LAT Testing:

LAT Part A: There shall be no complete penetrations in the first five (5) impacts (finished helmet) for a lot size ≤ 1200 or ten (10) impacts (helmet shell) for a lot size of 1201 – 3200. Should there be ≥ one (1) complete penetration in the first five (5) or ten (10) impacts (based on lot size) then testing will be stopped and the lot will have not met the 9mm RTP requirement.

LAT Part B: If there have been no complete penetrations in the first five (5) or ten (10) impacts as specified in Part A, then testing will continue in accordance with the lot testing matrix above. The RTP requirement will then be based on the accept/reject criterion specified below.

The table below provides the sampling rate for selected Lot tests.

Table A-5 Lot Acceptance Testing – Helmet Quantities

Lot Size	Lot Acceptance Testing (number of helmets required)										
	9mm RTP/BTD (Helmet) 1/	9mm RTP (Hardware) 2/	17-grain FSP V50 3/	Blunt Impact	Edging Adhesion	Paint Adhesion	Static Pull Test (Ret. System)	Pad Water Absorbency *	Barcode Label / Marking**	Contingency	Total
≤ 500	8	5	2	2	1	2	1	~	~	7	28
501 - 1200	13	5	2	3	2	3	1	~	~	8	37
1201 - 3200	13	8	3	3	3	4	1	~	~	9	44

*Pads used for the water absorbency test will be taken from the V50 helmets

≤ 500 – One (1) pad set shall be tested

501 – 1200 – Two (2) pad sets shall be tested

1201 – 3200 – Three (3) pad sets shall be tested

**Barcode labels and helmet markings will be checked on all helmets submitted for LAT. No additional helmets are required for these tests.

1/ An RTP/BTD test consists of multiple shots made into one helmet. Shot locations will be randomized for each helmet and the randomization matrix will be provided in the LAT test plan.

2/ RTP testing on hardware will consist of two (2) shots per helmet on a front and rear bolt.

3/ Test conducted at 0° (±5°) obliquity at ambient conditions. Multiple helmet shells may be required to determine the V50 BL (P).

More than one test may be conducted on a single helmet with the approval of the Contracting Officer.

These combined quantities are derived per PM SPE and Director, Operational Test & Evaluation (DOT&E) LAT requirements.

Normal Inspection
Switching Rules do not apply
No additional testing

Table A-6a Lot Acceptance Testing – Accept/Reject Criteria

Lot Size	LAT - Accept/Reject Criteria (minor defects)										
	9mm RTP (Helmet)		9mm BTD (Helmet)	9mm RTP (Hardware)		17-grain V50 (Shell)		Blunt Impact (1st Drop)		Blunt Impact (2nd Drop)	
	Accept	Reject	UTL Calculation*	Accept	Reject	Accept	Reject	Accept	Reject	Accept	Reject
≤ 500	1	2	Reference Table Below	0	1	0	1	0	1	1	2
501 - 1200	1	2		0	1	0	1	1	2	1	2
1201 - 3200	1	2		1	2	0	1	1	2	1	2

*The calculations for acceptance will be conducted for each of the following grouping IAW with the UTL table below:

(1) Calculation for deformations in the Front location only.
(2) Calculation for deformations in the Rear location only.
(3) Calculation for deformations in the Crown location only.
(4) Calculation for deformations in the Right and Left Side locations only.**

**If the BTD measurements from the side locations form two distinct distributions, then separate BTD UTL calculations will be conducted for each side location. This will be determined by conducting both a t-test on the means and the Brown-Forsyth test for equal variances on the standard deviations using a significance level of 0.1 in both tests. All four (4) and if necessary five (5) UTL calculations must not exceed the 16.0 mm (Crown, Right, and Left side locations) or 25.4 mm (Front and Rear locations) requirement for acceptance.

Table A-6b Lot Acceptance Testing – Accept/Reject Criteria

Lot Size	LAT - Accept/Reject Criteria									
	Static Pull (Retention System)		**Edging Adhesion**		**Paint Adhesion**		**Suspension System Water Absorbency**		**Barcode Label / Marking****	
	Accept	Reject	Accept	Reject	Accept	Reject	Accept	Reject	Accept	Reject
≤ 500	0	1	1	2	1	2	1	2	×	×
501 - 1200	0	1	1	2	1	2	1	2	×	×
1201 - 3200	0	1	1	2	1	2	1	2	×	×

**Any failures resulting from the Barcode Label or Helmet Marking tests will result in the Government withholding acceptance of such Lots until Government approval of the corrective actions taken on the subject helmet lot.

Static Pull (Retention System) – One (1) result less than 150lbs is equivalent to one (1) minor defect.
Edging Adhesion – One (1) nonconforming result is equivalent to one (1) minor defect.
Paint Adhesion – One (1) nonconforming result is equivalent to one (1) minor defect.
Pad Water Absorbency – One (1) nonconforming result is equivalent to one (1) minor defect.

Table A-6c Lot Acceptance Testing – 9mm X/Y BTD UTL Determination Criteria

Lot Size	**Process for (X/Y) UTL Determination**
≤ 500	1. Calculate a 85/90 BTD UTL for every location using the four (4) shots. 2. If the 85/90 UTL is below the limit for that location, the helmet passes for that location. 3. If all locations pass for BTD UTL, the lot passes. 4. If the location UTL is above the limit, calculate a 60/90 UTL using the four shots. 5. If the 60/90 UTL is above the limit, the helmet (and the lot) fails. If the 60/90 UTL is below the limit, shoot an additional three (3) helmets in that shot location. 6. If the additional shots are needed from either the back or front, repeat the full 9mm V0 shot sequence (crown/back or side/front) on each of the three (3) helmets. If the additional shots are needed from either the side or crown, shoot only those locations on each helmet. All valid BTD and penetration data will be used for locations. 7. Calculate a 80/90 UTL using all seven (7) shots for that location. If the 80/90 UTL is below the limit, the helmet (and lot) passes. If it is above the limit, the helmet and lot fail.
> 500	1. Calculate a 80/90 BTD UTL for every location. 2. If the 80/90 UTL is below the limit for that location, the helmet passes for that location. 3. If all locations pass for BTD UTL, the lot passes; if not, the lot fails.