INCH-POUND
AR/PD 14-01 Rev C
Amendment 1
20 JUN 2019

Supersedes
AR/PD 14-01 Rev C
29 MAR 2019

PURCHASE DESCRIPTION

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

1. 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).

1.2.1 Types.

Type I - One (1) hole for Night Vision Device (NVD) mount
Type II - No hole for NVD mount

1.2.2 Classes.

Class 1 - X-Back Retention System
Class 1A - Right-Handed X-Back Retention System
Class 1B - Left-Handed X-Back Retention System

Class 2 - H-Back Retention System
Class 2A - Right-Handed H-Back Retention System
Class 2B - Left-Handed H-Back Retention System

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.

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

SCHEDULE OF SIZES
Extra-Small (XS)
Small (SM)
Medium (MD)
Large (LG)
Extra-Large (XL)
Double Extra-Large (2X)

NOTE: Due to low tariff, the Extra-Small (XS) and Double Extra-Large (2X) First Article Test (FAT) will be handled on a case-by-case basis. Direct all XS and 2X FAT inquiries to the Contracting Officer (KO).

1.3.1 Helmet sizing. Soldier head size distribution for the 5th to the 95th percentile for the ACH Gen II is Small (6%), Medium (48%), Large (42%), and Extra-Large (4%).

2. APPLICABLE DOCUMENTS

2.1 General. The Sections 3 and 4 specify the documents listed in this section. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in Sections 3, 4, and 5 of this specification, whether or not they are listed.

2.1.1 Government documents.

2.1.2 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 cited in the solicitation or contract.

COMMERCIAL ITEM DESCRIPTIONS

A-A-55301	Webbing, Textile, Textured or Multifilament Nylon
A-A-59826	Thread, Nylon

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-32075 dated October 17, 2000	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-2104J	Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service
MIL-PRF-372E w/ Amendment 2	Cleaning Compound, Solvent (For Bore of Weapons)
MIL-PRF-46170E	Hydraulic Fluid, Rust Inhibited, Fire Resistant, Synthetic Hydrocarbon Base, NATO Code No. H-544
MIL-PRF-6083G	Hydraulic Fluid, Petroleum Base, for Preservation and Operation

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-662F	V50 Ballistic Test for Armor
MIL-STD-810 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
MIL-STD-3027	Testing of Body Armor

(Copies of these documents are available online at http://quicksearch.dla.mil)

2.1.3 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
2-1-2566	Suspension System

U.S. ARMY PRODUCT MANAGER SOLDIER PROTECTIVE EQUIPMENT, FORT BELVOIR, VA

53-032-001	Drawing - Enhanced Night Vision Goggle (ENVG) III Hot Shoe, Female
53-031-001	Drawing - ENVG III Quick Release, Female
53-025-001	Drawing - ENVG III Hot Shoe, Male
53-030-001	Drawing - ENVG III Quick Release, Male

SPE-HPT-19150-6310-003	IHPS Retention System S/M
SPE-HPT-19150-6310-004	IHPS Retention System L/XL
SPE-HPT-19150-6310-006	IHPS Retention System, Left Handed, S/M
SPE-HPT-19150-6310-005	IHPS Retention System, Left Handed, L/XL
SPE-HPT-19150-6310-007	IHPS Retention System, S-M H-Back
SPE-HPT-19150-6310-008	IHPS Retention System, L/XL, H-Back

Soldier Protection System (SPS) Interface Control Document (ICD) Version 1.3
ENVG III Helmet Mount Assembly (ICD) Version 1.0.0

PURCHASE DESCRIPTIONS

AR/PD 17-06	Purchase Description for the Integrated Head Protection System Helmet Retention System

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

OTHER GOVERNMENT DOCUMENTS AND PUBLICATIONS

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 online at http://www.nhtsa.dot.gov/cars/rules/standards.)

FEDERAL ACQUISITION REGULATION

FAR 52.209-3	First Article Approval—Contractor Testing

(Copies of documents are available online at https://www.acquisition.gov/content/52209-3-first-article-approval-contractor-testing)

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NRR Calculation	Methods for Calculating and Using Reduction Ratings

(Copies of documents are available online at http://www2a.cdc.gov/hp-devices/hp_srchpg01.asp)

NATIONAL INSTITUTE OF JUSTICE (NIJ)

NIJ Standard 0106.01 Ballistic Helmets

(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)

TECHNICAL MANUALS

TM 10-8470-204-10 Technical Operators Manual for the 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.)
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)

2.1 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 Evaluation Procedure 1	- Gray Scale for Color Change
AATCC Evaluation Procedure 2	- Gray Scale for Staining
AATCC Evaluation Procedure 8	- AATCC 9-Step Chromatic Transference Scale
AATCC Evaluation Procedure 9	- Visual Assessment of Color Difference of Textiles
AATCC Test Method 8	- Colorfastness to Crocking: Crockmeter 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

(Copies are available online at http://www.aatcc.org.)

AMERICAN NATIONAL STANDARDS INSTITUTE

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

(Copies are available online at http://webstore.ansi.org/ansidocstore.)

ASTM INTERNATIONAL

ASTM D76	-	Standard Specification for Tensile Testing Machines for Textiles
ASTM D523	-	Standard Test Method for Specular Gloss
ASTM D910	-	Standard Specification for Aviation Gasolines
ASTM D975	-	Standard Specification for Diesel Fuel Oils
ASTM D1149	-	Standard Test Methods for Rubber Deterioration
ASTM D1655	-	Standard Specification for Aviation Turbine Fuels
ASTM D1776	-	Standard Practice for Conditioning and Testing Textiles
ASTM D1777	-	Standard Test Method for Thickness of Textile Materials
ASTM D3359	-	Standard Test Methods for Measuring Adhesion by Tape Test
ASTM D6413	-	Standard Test Method for Flame Resistance of Textiles (Vertical)
ASTM E4	-	Practices for Force Verification of Testing Machines
ASTM E18	-	Standard Test Method for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E29	-	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
ASTM E140	-	Standard Harness Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, and Scleroscope Hardness
ASTM E384	-	Standard Test Method for Knoop and Vickers Hardness of Materials
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 online at https://www.astm.org/.)

OTHER PUBLICATIONS

INFORMA HEALTHCARE

Repeat Insult Patch Test - Modified Draize Procedure – Principles and Methods of Toxicology, A Wallace Hayes (editor).

(Copies are available online at https://www.crcpress.com/,)

Visual Guide of Colors Used in Military Items Color Card

(Copies of document are available from the Contracting Activity.)

2.2 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. REQUIREMENTS

3.1 First Article Testing (FAT) and Lot Acceptance Testing (LAT) conformance inspections.

3.1.1 FAT. All authorized production of CSI Personal Protective Equipment (PPE) such as the ACH Gen II shall be preceded by FAT that is inspected and approved under the appropriate provisions of FAR 52.209-3. FAT samples shall be subjected to first article inspection in accordance with 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 LAT. Lots shall only be produced in a single size and type, and all Lots shall be subjected to LAT. LAT samples representing full production quality shall be subjected to LAT in accordance with 4.4. Samples will be examined for the defects specified in 4.10.1 and subjected to the tests indicated in 4.9, TABLE VIII. Acceptance criteria for each inspection is stated herein. 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 with the hole for attachment of the NVD for the Type I (shell with one hole), while the unfinished shell for Type II shall consist of the raw shell only. The unfinished shell for both Type I and Type II shall include benchmarks in accordance with 3.3.5.1 and 3.3.5.3.

b. Finished shell. A finished shell shall include the shell, any primer, coating, and texturing aggregate, any attachment hole (Type I), 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), any bracket integration components (not including the bracket itself or the bracket bolt), a complete suspension system, and a complete retention system (see 6.10 for Integrated Head Protection System (IHPS) Retention System (RS) sizing and associated National Stock Numbers (NSN)).

3.3 Shell design and shape. The ACH Gen II shall consist of a ballistic protective shell, suspension system, and boltless retention system.

3.3.1 Area of coverage and Shape.

3.3.1.1 Area of coverage. The projected coverage area of a finished helmet shall be equal to or greater than the ACH per drawings 2-1-2515, 2-1-2516, 2-1-2517, 2-1-2518, and 2-1-2576 and all subsidiary drawings and parts lists. The presented area at five locations from a three-dimensional scan of the exterior of a finished helmet shall be used to confirm the area of coverage equal to or greater than the ACH area of coverage at the same five locations. Testing shall be in accordance with 4.10.2.

3.3.1.2 Shell shape. The measurements to establish shell shape shall be taken on the inside of an unfinished shell surface only and compared against the Contractor supplied Computer Aided Design (CAD) file (*.sldprt). Contractor submitted and approved drawings become contract reference and shall not be changed without prior Government review and written approval. The outside surface is defined by the inside surface plus the thickness as

specified in 3.3.4.1. The helmet system shall work in conjunction with the currently used National Institute of Justice (NIJ) 0106.01 headform as well as the U.S. Department of Transportation Federal Motor Vehicle Safety Standard (DOT FMVSS) 218 headform sizes B, C, and D. Testing shall be in accordance with 4.10.3.

3.3.2 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 of ballistic material, 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.

3.3.3 Processing procedures. The Contractor shall use processing procedures and methods capable of providing uniform properties. 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 materials other than thermoplastic composites is not permitted. Plans to remold thermoplastic materials or correct cosmetic imperfections, which fall within the acceptable criteria detailed in this specification, shall be submitted to the Government for 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 (TDP), Dry Layup, Production Process Package, etc.) shall not be altered by the Contractor without additional written approval from the Government. Such plans that receive 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. Inspection shall be in accordance with 4.10.1.

3.3.4 Shell thickness and uniformity.

3.3.4.1 Shell thickness. The maximum thickness for the helmet shell shall not exceed 0.500-inch regardless of the nominal thickness of the shell. Thickness variations in the shell shall be gradual. For Type I helmets, shell thickness in the area of the NVD bracket shall be of a thickness to accommodate and assure appropriate function of the NVD Front Bracket Kit (see 6.7). Shell thickness in this localized area for Type I helmets may have non-gradual variations as needed to accommodate the NVD hardware, when required by type and class. Testing shall be in accordance with 4.10.4.

3.3.4.2 Shell uniformity. The shell thickness shall not vary by more than 0.100-inch over the entire surface of the shell. For Type I helmets, shell thickness may vary by greater than 0.100-inch in the area of the NVD bracket as needed to meet requirements in 3.3.4.1 and 3.12.1. Testing shall be in accordance with 4.10.4.

3.3.5 Helmet 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. Benchmarks of any shape or type are acceptable on unfinished shells and shall be clearly visible. Inspection shall be in accordance with 4.10.5.

3.3.5.1 Benchmarks – unfinished shell. Benchmarks on an unfinished shell are required for FAT. Benchmarks on unfinished shells are for non-ballistic testing only; benchmark types used on unfinished shells may differ from those used on finished shells and finished helmets (e.g., using drilled holes as benchmarks). Testing shall be in accordance with 4.10.5.

3.3.5.2 Benchmarks - finished shell, periphery. Benchmarks on a finished shell are required for FAT and LAT. Contractors may place benchmarks on the helmet shell, integrally molded edge trim, or on a one-piece molded construction. The benchmarks must be clearly visible. If an integrally molded edging is used (as defined in 3.3.6) 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 one-piece molded edging is used, and the edging covers any portion of previous benchmarks from an unfinished shell, periphery benchmarks may be located on the bonded one-piece molded edging and shall be at least 0.200 (+0.05 / -0.00) inch long. If a bonded one-piece cut to length 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. Inspection shall be in accordance with 4.10.1 and 4.10.5.

3.3.5.3 Benchmark, crown. The crown benchmark shall only reside on the interior of the unfinished shell, finished shell, and the finished helmet, and shall be a "+" with each leg measured from the intersection of the "+" being 0.250-inches (± 0.125-inches) long with one leg of the "+" pointing toward the front of the helmet, one to the rear, and one each to the left and right sides of the helmet. The center point of the "+" shall be located at the intersection of the sagittal and coronal planes. Inspection shall be in accordance with 4.10.5.1.

3.3.6 Benchmarks - integrally molded edging. If integrally molded edging is used, periphery benchmarks may be located on the lower or outer surface of the integrally molded edging. There shall not be a length requirement for benchmarks but the benchmarks shall be visible. The shape of benchmarks on finished helmets will be at the discretion of the Contractor and acceptable as long as they are visible. Inspection shall be in accordance with 4.10.1 and 4.10.5.

3.3.7 Benchmarks - bonded edging. If a bonded edging is used, the benchmarks shall be 0.500-inches (± 0.250-inches) long extending upward from the finished shell edge on the outer surface. Inspection shall be in accordance with 4.10.1 and 4.10.5.

3.4 Integration and compatibility.

3.4.1 Integration and compatibility for NVD interface. The Type I helmet shall provide a means to attach and allow proper functionality of NVDs that utilize the A3297317 and A3297318 (the PM SPE NVD bolt and nut) and 51-1979-005 and 51-1982-005 (the PM SMS universal hardware). One-hole perforation is acceptable, without additional perforations of the helmet shell Inspection shall be in accordance with 4.10.1, 4.10.8.3, 4.10.9.1, and 4.10.14.

3.4.2 NVD attachment hole (Type I helmet). For the Type I helmet, the Contractor shall bear the responsibility for the hole placement. The Contractor shall develop a template for the hole placement using NVD Bracket Kits cited in 3.12. The diameter of the hole shall be 0.200 (±0.010) inch. The hole shall be drilled orthogonal to the shell surface (± 1°), and the location of the hole shall be 0° (± 1°) relative to the front of the helmet using the coordinate system defined in drawings 2-1-2515, 2-1-2516, 2-1-2517, 2-1-2518, and 2-1-2576. The application of coating and aggregate shall not impact this hole diameter and tolerance requirement. When required by type and class, 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, when required by type and class, 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, 4.10.3 and 4.10.4.

3.4.3 NVD hardware. The NVD attachment hole serves as an attachment point for optical devices on the helmet. The NVD bracket shall attach to the helmet shell via this attachment hole, and no more than one size of attachment hardware shall be required to ensure a secure mount for all listed NVD brackets to all helmet sizes. All NVD hardware delivered with or separate from helmet production Lots shall meet the 9mm Full Metal Jacket (FMJ) Round Nose Projectile (RNP) Resistance to Penetration (RTP) hardware ballistic testing requirements as specified in 3.4.3.1 and 3.4.3.2. All Type I ACH Gen II production Lots delivered without NVD hardware must be preceded by a successful FAT demonstrating that the produced design is ballistically compatible with existing, ballistically qualified hardware. The hardware or in the case of Type I helmet only deliveries the helmet in conjunction with Government furnished NVD hardware must meet the RTP criteria set forth for Production Verification Testing (PVT) and for Lot Verification Testing (LVT) as outlined in Appendix A.

3.4.3.1 NVD hardware PVT. During PVT, the NVD hardware (or the helmet with Government furnished NVD hardware in the case of helmet only FAT) shall have a Lower Confidence Level (LCL) of 90 percent (90%) for a 90% Probability of No Penetration (P(nP)) when impacted with a 124-grain, 9mm FMJ RNP. The 9mm FMJ RNP shall impact at 1,400 feet per second (ft/sec) (+50 ft/sec, -0 ft/sec) at zero degrees plus or minus five degrees (0° (± 5°)) obliquity. The LCL for P(nP) is calculated using the Clopper-Pearson method and combines all shots under standard ambient environment condition. Testing shall be in accordance with 3.7.2, 3.11.9, and 4.10.1.1, and 4.10.10.1.2.2.

3.4.3.2 NVD hardware LVT. NVD hardware may be qualified as hardware Lots, separate from helmet Lots. For LVT of NVD hardware Lots or helmet Lots, the NVD hardware shall resist penetration from a 124-grain, 9mm FMJ RNP at 1,400 ft/sec (+50 ft/sec, -0 ft/sec) at 0° (± 5°) obliquity under standard ambient environment conditions. Testing shall be in accordance with 4.10.10.3.

3.4.4 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 0.500-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, 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 .0625-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 0.130-inch, for both inside and outside surfaces. The edging shall be the same color as the exterior of the finished shell (see 3.4.5). The edging shall be the same color as the exterior of the finished shell. Testing shall be in accordance with 4.10.1 and 4.10.6.1.

3.4.4.1 Edging adhesion. The edging shall remain firmly attached to the finished shell when tested as specified in 4.10.4.

3.4.4.2 Edging adhesion after heat aging. The edging shall not peel back more than 0.25-inch. For structural or integrally molded edging, the edging shall not move down more than 0.125-inch. Testing shall be in accordance with 4.10.6.2.

3.4.5 Coating. Coating shall be applied to the exterior of the helmet shell including the outside of the edging. The coating helmets shall conform to MIL-DTL-64159 (either Type is permissible), color Foliage Green 504. 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), or 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 previously 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), or 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 Foliage Green 504. 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. When required by type and class, hardware exposed on the exterior and interior of the shell (e.g., screw heads) shall not be coated. Testing shall be in accordance with 4.10.1.

3.4.5.1 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 3.3.2) 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 in accordance with 4.10.1, TABLE IX.

3.4.5.2 Adhesion of coating. The coating, when cut into squares, shall not lift more than 50% 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 4.10.7.

3.4.5.3 Infrared reflectance. The texturing and Foliage Green 504 color coating (for the finished shell) shall meet the spectral reflectance requirements of TABLE I. The infrared reflectance requirement is replicated from MIL-DTL-64159 for Foliage Green 504. Testing shall be in accordance with 4.10.7.1.

TABLE I. Spectral reflectance limits for Foliage Green 504.

Wavelength Nanometers (nm)	% Reflectance Min	Max
600	8	18
620	8	18
640	8	20
660	10	26
680	10	26
700	12	28
720	16	30
740	16	30
760	18	32
780	18	34
800	20	36
820	22	38
840	24	40
860	26	42

3.4.5.4 Specular gloss. The outer surface of the finished shell shall have a specular gloss as specified in TABLE II. The specular gloss requirement is replicated from MIL-DTL-64159 for Foliage Green 504. Testing shall be in accordance with 4.10.7.2.

TABLE II. Specular gloss for Foliage Green 504.

Specular gloss for Foliage Green 504	Minimum	Maximum
60 degree	-	1.0
85 degree	-	3.5

3.5 Retention system operating requirements. The Government shall evaluate the retention systems during FAT and LAT per AR/PD 17-06. The helmet retention system shall be in accordance with all requirements specified in the Product Manager Soldier Protective Equipment (PM SPE) Purchase Description AR/PD 17-06. The design shall be the same as the IHPS RS. The retention system shall not be attached to the outer surface of the helmet. The Government will provide the retention system specifications.

3.5.1 Retention system intended use. The retention system shall allow the user to easily don and doff the helmet and provide adjustment to allow for proper fit of the helmet. The retention system shall be compatible with male and female Soldier hair styles authorized in AR 670-1, Wear and Appearance of Army Uniforms and Insignia. Testing shall be in accordance with 4.10.8.

3.5.2 Retention system adjustment. The retention system shall allow for quick and convenient adjustment of its size and level of tightness with one or both hands, with and without Army Combat Gloves. When using one hand, the desired objective is that it takes less than two seconds per strap, and while using two hands, the desired objective is that it takes less than five seconds to properly adjust all four helmet straps. This capability must be inherent to all webbing straps that ultimately attach to the finished shell and while wearing Army Combat Gloves. The

straps of the retention system shall be capable of being adjusted while wearing the helmet. Testing shall be in accordance with 4.10.8.

3.5.3 Static pull Strength. No component of the retention system shall fail; the retention system closure device shall not release (open), and the webbings shall not slip when subjected to a load of 150 pound-force (lbf) when tested in accordance with 4.10.8.1.

3.5.4 Dynamic pull strength. No component of the retention system installed in a helmet shall fail when subjected to a 25 ft/sec drop when tested in accordance with 4.10.8.2.

3.5.5 Helmet stability. The retention system shall keep the helmet in the proper "as worn" condition throughout operational use. This includes activities like running, jumping, prone shooting, and airborne free-fall. The helmet must maintain proper positioning when used with NVDs and other situational awareness improvement equipment, which adds weight in certain regions of the helmet. Testing shall be in accordance with 4.10.8.3.

3.6 Suspension system.

3.6.1 Suspension system design. The helmet shall utilize a modular pad suspension system consisting of a series of pads that act as the suspension system between the Soldier (wearer's) head and the 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). Samples shall be examined for the defects specified in 4.10.1. Mandatory source for this component shall be in accordance with 6.12. All helmet types and classes specified in 1.2 shall use this mandatory source.

3.6.2 Suspension system compatibility. The suspension system must be compatible with the NVD and retention system designs, tactical headset and communication system components (see 6.7). Testing shall be in accordance with 4.10.9.1.

3.6.3 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 (3) layers shall be permanently joined around the perimeter to prevent disassembly. The shapes of the pads shall meet the shapes shown in Drawing 2-1-2566 with a tolerance of ± 0.125-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 in accordance with 4.10.9.1 and 4.10.9.2.

3.6.3.1 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 in accordance with 4.10.9.3 and 4.10.9.7.

3.6.3.2 Padding layer material. The padding material shall provide standoff, comfort, protection, and stability. The padding material shall not increase in weight by more than 3.0 percent when immersed in salt water. 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 4.10.9.4.

3.6.3.3 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 4.10.1 and 4.10.9.5. It is desirable that the outer material interface with the currently fielded hook disk (see 6.11). The color shall be Foliage Green 504 for all helmet classes. The outer material shall interface with hook disk. Testing shall be in accordance with 4.10.1, 4.10.9.5, and 4.10.9.7.

3.6.3.4 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 their original shape and thickness. Testing shall be in accordance with 4.10.9.6.

3.6.4 Suspension system attachment material.

3.6.4.1 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.

3.6.4.2 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.

3.6.4.3 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 attachment 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. At a minimum, enough attachment material shall be installed to allow the smallest pad to be placed anywhere inside the shell and have at least 50% of the pad's surface in contact with the attachment material. Alternate plans for attachment material coverage that achieve the above criteria shall be submitted for Government written approval prior to implementation. Such plans that receive written Government approval shall become part of the documented suspension system design. Testing shall be in accordance with 4.10.1 and 4.10.9.8.1.

3.6.4.4 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 of 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 adhesion between the hook disk and the outer material on the pad shall be a minimum of 2.0 pounds per inch. 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 4.10.9.8.2.

3.6.5 Colorfastness. The inner layer material, outer layer material, and attachment material shall exhibit colorfastness to laundering, crocking, perspiration (acid and alkaline), and water. The materials shall meet or exceed the requirements listed in

3.6.6TABLE III. Testing shall be in accordance with 4.10.9.9.

TABLE III. Inner and outer material colorfastness.

Characteristic	Requirement
Colorfastness to Laundering (1 cycle) (minimum) Color Change Staining 1/	 3 3
Colorfastness to Crocking (minimum) Dry Wet	 3 3
Colorfastness to Perspiration (acid and alkaline , minimum) Color Change Staining 1/	 3 3
Colorfastness to Water (minimum) Color Change Staining 1/	 3 3

1/ Polyester, Nylon.

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 V_{50} Ballistic Protection Limits (V_{50} BL(P)). The finished helmet shall be capable of providing the minimum V_{50} BL(P)s listed in

3.7.2TABLE IV 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 4.10.10.1, 4.10.10.2, and 4.10.10.3 under the following conditions:

a. Ambient (see 4.6 and 4.10.10.6.1)

b. Extreme hot (see 4.10.10.6.1)

c. Extreme cold (see 4.10.10.6.1)

d. After immersion in seawater (see 4.10.10.6.2), tested at ambient temperature

e. After exposure in weatherometer (see 4.10.10.6.3), tested at ambient temperature

f. After accelerated aging (see 4.10.13.13), tested at ambient temperature

TABLE IV. Minimum V_{50} BL (P)s.

Projectile 1/	Minimum V_{50} BL(P) at 0° (±5°) Obliquity (ft/sec)
2-grain RCC 2/	4200
4-grain RCC	3475
16-grain RCC	2475
64-grain RCC	1750
17-grain FSP 3/	2200

1/ V50 ballistic limit testing shall be performed in accordance with 4.10.10.3.
2/ Right Circular Cylinders shall be in accordance with FIGURE 1.
3/ Fragment Simulating Projectile – MIL-DTL-46593 with the exception of Hardness Testing per ANSI/ASQ Z1.4, Special Inspection Level S-3.

3.7.3 RTP – 9mm. The finished helmet, including any NVD hardware, when required by type and class, exposed on the outside of the shell, shall be resistant to penetration from a 9mm FMJ RNP bullet with a nominal mass of 124 grains in accordance with NIJ 0106.01, Ballistic Helmets, at 1400 (+50, -0) feet per second (ft/sec) at 0° (±5°) obliquity when tested in accordance with 4.10.10.1, 4.10.10.1.2, and 4.10.10.4 under the following environmental conditions.

a. Ambient (see 4.6 and 4.10.10.6)

b. Extreme hot (see 4.10.10.6.1)

c. Extreme cold (see 4.10.10.6.1)

d. After immersion in seawater (see 4.10.10.6.2), tested at ambient temperature

3.7.3.1 FAT 9mm RTP helmet requirement.

3.7.3.1.1 FAT part A: There shall be no complete penetrations in the first twenty-two impacts (helmet shell, eleven helmets required). At least four impacts shall be in each of the four environmental conditions. The three remaining helmets will be subjected to each condition specified (high temperature, low temperature, and seawater). Testing shall stop if one complete penetration occurs in the first twenty-two impacts and the design does not meet the 9mm RTP requirement for the finished helmet.

3.7.3.1.2 FAT part B: If there have been no complete penetrations in the first twenty-two impacts as specified in Part A, then testing will continue in accordance with the FAT matrix as specified in APPENDIX A.

3.7.3.1.3 RTP testing on the helmet shall meet a P(nP) with 90% LCL for 9mm RTP testing in accordance with TABLE V when the LCL is calculated using the Clopper-Pearson method. The aggregate condition will be determined by combining all shots including the first twenty-two (22) impacts. Other conditions will be determined by combining all shots that include the stated condition (i.e. all front, all ambient medium, etc.). Testing shall be in accordance to 4.10.10.1.2.1.

TABLE V. RTP Lower Confidence Levels (LCL).

Conditions	LCL (P(nP) / Confidence)	Allowable complete penetrations
Aggregate	96 / 90	3
Size	89 / 90	2
Environment	89 / 90	2
Location	89 / 90	2
Size by Location	71 / 90	1
Environment by Location	71 / 90	1
Size by Environment	71 / 90	1

3.7.3.2 FAT, RTP NVD hardware requirement. For Type I helmets, NVD hardware RTP testing on the helmet will be calculated separately from the helmet RTP. 9mm RTP hardware testing shall meet a 90% P(nP) with 90% LCL when the LCL is calculated using the Clopper-Pearson method. Testing shall be in accordance with 4.10.10.1.2.2.

3.7.3.3 LAT, RTP requirement.

3.7.3.3.1 LAT part A: There shall be no complete penetrations in the first five impacts. Testing shall stop if one complete penetration occurs in the first twenty-two impacts and the design does not meet the 9mm RTP requirement for the finished helmet.

3.7.3.3.2 LAT Part B: If there have been no complete penetrations in the first five (5) 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 4.10.10.4.

3.7.4 Ballistic transient deformation (BTD). BTD shall be used for Government reference.

3.7.4.1 Ballistic transient deformation - FAT. BTD shall be measured during RTP testing for Government reference under the environmental conditions specified in 3.10 at 1400 (+50, -0) feet per second at 0° (±5°) obliquity. An Upper Tolerance Limit (UTL) for BTD shall be calculated and used for Government reference as described in APPENDIX B. The Government reserves the right to purchase additional helmets for use in additional BTD evaluation. Testing shall be in accordance with 4.10.10.1.3 and 4.10.10.5.

3.7.4.2 Ballistic transient deformation – LAT. During LAT, BTD shall be measured during RTP testing for Government reference. Testing shall be in accordance with 4.10.10.1.3 and 4.10.10.5.

3.8 Weight. The maximum weight of the finished helmet system, as described in 3.2c, shall not exceed the weights listed in TABLE VI. This requirement applies to all helmet Types as defined in 1.2. Each helmet system size, Small (SM), Medium (MD), Large (LG), Extra-Large, (XL), and Double Extra-Large (2X), shall have its own category of weight as shown on TABLE VI. During FAT, a minimum of five (5) finished helmets of each size (SM through XL) shall be tested. During LAT, all sample-finished helmets shall be tested. Testing shall be in accordance with 4.10.11.

TABLE VI. Weights.

Helmet system size	Finished helmet maximum weight (lbs.)
SM	2.49
MD	2.60
LG	2.81
XL	3.29
2X	3.40

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 and impact sites. Blunt impact protection testing on the helmet shall meet a Probability of under Limit (P(uL)) with 90% LCL for blunt impact testing in accordance with

3.10TABLE VII when the LCL is calculated using the Clopper-Pearson method. A measurement shall be considered under the limit if it is not in excess of 150g, where g is gravitational acceleration due to earth's gravity at sea level. Greater impact protection (i.e., lower g) is desired as an objective. Following blunt impact testing, there shall be no damage to any part of the retention system or suspension system. Also, there shall be no physical damage to the helmet shell that degrades ballistic performance such as delamination of ballistic material, ply separation, or shell fracture. If the finished shell has a cosmetic inner or outer layer, separation of the ballistic material from the cosmetic layer because of blunt impact testing shall not be considered a defect. If physical damage such as the previously detailed 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 4.10.10.4. 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 0.20-inch present after blunt impact testing. If deemed necessary (excluding the 0.20-inch indentation requirement), the Government will analyze the damage and conduct a non-invasive imaging scan (i.e., Computed tomography (CT) Scan) of the sample to confirm the damage. Each affected area with damage (visually obvious damage or visually borderline damage confirmed by non-invasive imaging scan) will be impacted with a 9mm projectile and a partial or complete penetration will be documented as described in 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. BTD may be measured for Government reference. If more than twenty-two impacts are required, RTP testing on the helmets shall meet a minimum of 90% P(nP) with 90% LCL for 9mm RTP testing when the LCL is calculated using the Clopper-Pearson method. If twenty-two (22) impacts or less 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 ballistic data does not meet a 90% P(nP) with 90% LCL or if there is one or more complete penetrations. Testing shall be in accordance with 4.10.12.

TABLE VII. Blunt impact protection Lower Confidence Levels (LCL).

Conditions	LCL (P(uL) / Confidence) 1st impact | 2nd impact	Impacts Over 150g Allowed 1st impact | 2nd impact
Aggregate	90/90 | 80/90	11 | 26
Size	81/90 | 73/90	4 | 7
Environment	81/90 | 75/90	6 | 9
Location	79/90 | 69/90	2 | 4

3.11 Operating environment. All helmet components shall be constructed such that they can withstand various environmental extremes without degradation. When the helmet or associated components exhibit signs of degradation, additional testing (to include, but not limited to CT Scan) may be completed by the Government to confirm requirements have been met.

3.11.1 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 4.10.4, 4.10.11, and 4.10.13.1.

3.11.2 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 4.10.4 and 4.10.13.2. Additionally, the requirements of 3.7.1(e) shall be met after weatherometer exposure (see 3.7.1).

3.11.3 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 4.10.13.3 (see 6.9 for field agent NSNs).

DEET insect repellent, Personal Application, O-I-503 Type II, Concentration A

a. Gasoline, ASTM D910

b. Motor Oil, MIL-PRF-2104

c. Hydraulic fluid, petroleum base, MIL-PRF-6083

d. Fire resistant hydraulic fluid, MIL-PRF-46170

e. Fuel Oil, Diesel, ASTM D975

f. Turbine Fuel, Aviation, F-24, MIL-STD-3004, ASTM D1655

g. Rifle Bore Cleaning Compound, MIL-PRF-372

h. Lubricating Oil, Semifluid, Weapons (LSA)

i. Lubricating Oil, Arctic, Weapons

j. Face paint, Camouflage

3.11.4 Flame resistance. The finished shell shall be self-extinguishing with no after-flame greater than 2.0 seconds. Flaming before the withdrawal of the flame source is permitted according to ASTM D6413. There shall be no melting or dripping. It is desired, however, that the finished shell be ignition resistant. Testing shall be in accordance with 4.10.13.4.

3.11.5 High temperature storage and use. The finished shell shall exhibit no structural, visible, 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 4.10.4 and 4.10.13.5.

3.11.6 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 4.10.4 and 4.10.13.6.

3.11.7 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 4.10.4 and 4.10.13.7.

3.11.8 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 (Fahrenheit (F) or Celsius (C)) at the 40,000 feet equivalent pressure should be -62ºF (± 5ºF)/-52ºC (±3ºC). 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 4.10.4 and 4.10.13.8.

3.11.9 Vibration. All finished helmet components including the finished shell, suspension system components, retention system, and Type I NVD hardware shall exhibit no structural, visible, operational degradation, or physical damage 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 4.10.13.9.

3.11.10 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 0.20-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 in accordance with 4.10.13.10.

3.11.11 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 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 in accordance with 4.10.13.11.

3.11.12 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 and 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 in accordance with 4.10.13.12.

3.11.13 Accelerated aging and shelf life. The finished shell shall suffer no structural, visible, or operational degradation to the finished shell when subjected to accelerated aging and shelf life exposure according to the test method in ASTM D1149. 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 4.10.4 and 4.10.13.13. The requirements of 3.7.1 (f) shall be met after accelerated aging exposure.

3.12 Integration/compatibility. The ACH GEN II shall fully integrate with the components listed below. Testing shall be in accordance with 4.10.14.

a. ENVG Bracket Kit (Type I helmets only) (see 3.4.1)

b. NVD Front Bracket Kit (see 6.7, Type I helmets only)

c. ACH Covers (see 6.10):

d. Helmet Band (see 6.10)

e. Eyewear Retention Strap (see 6.10)

f. NAPE Pad (see 6.10)

3.12.1 Integration with ENVG/NVD bracket. For Type I helmets, the finished helmet shall accommodate and assure appropriate function of the ENVG/NVD Front Bracket Kit (see 6.7). Proper integration may be achieved via the shell thickness as defined in 3.3.4.1, or may be achieved using a separate material or item. Any NVD bracket integration solutions shall be included in the finished helmet weight. If a separate material or item is used, the item shall be delivered as part of the finished helmet. Integration with the NVD Bracket shall not interfere with the use of ACH Covers as referenced in 3.12 or other items as specified in 3.12, and when tested in accordance with 4.10.4.

3.13 Ownership and support.

3.13.1 Finished helmet identification. The finished helmet shall be marked on the inside crown surface area with the applicable size lettering using the letters S, M, L, XL, or XXL as applicable using a “molded-in” process. Letters shall be at least 0.5-inch in height. The finished helmet shall have an additional label(s), either directly stamped on the inside of the finished helmet or a label (such as a pressure sensitive label), that provides the item nomenclature, contract number, NSN, size, Contractor’s name and Commercial and Government Entity (CAGE) code, manufacturing month and year, and Lot number. If the Government has not assigned an NSN at the time of FAT, the label shall include a dummy NSN as a placeholder. If a laser-edged label is used, it shall conform to Type IV, Class 5 of MIL-DTL-32075, with exceptions noted in this document. Characters are preferred to be a minimum of 1/8-inch high. Smaller size characters are acceptable as long as they are easily readable from a distance of two (2) feet. The characters shall be well defined, clearly legible, and shall show no signs of smearing, bleeding, or offsetting. The label shall be well-adhered to the finished helmet. Bumps or air bubbles under the labels are acceptable as long as they do not impede the legibility of the text or do not present a concern of causing the label to peel off. The helmets shall contain a unique serial number. The serial number shall correspond to traceability information. Traceability information shall enable the manufacturer to determine the mold, press, date of finished helmet 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 finished helmet shall also be marked with Machine Readable Information (MRI). The finished helmet shall be marked with a MRI Item Unique Identification (IUID) 2D data matrix in accordance with MIL-STD-130, Construct #2. Finished helmets shall be permanently marked for identification regardless of use, maintenance, or storage and shall be located or manufactured so as to prevent obliteration. Contractors shall implement the use of metallic foils as labels only with prior approval of the Government. Testing shall be in accordance with 4.10.1 and 4.10.15.1.

3.13.2 Finished helmet traceability. The Contractor shall maintain traceability records for all component parts used to manufacture the finished helmet. All component parts Lot identification shall be traceable through to the finished helmet Lot number and contract number. Sub-contractor’s component part lot information shall enable traceability to the raw materials used in the component part. Each finished helmet Lot shall consist of only one product variant (size and color, etc.). Records shall be maintained and readily available for Government review and audit verification. Serialization is a requirement under this contract, therefore, with individual serial numbers, the traceability requirements listed above shall be traceable via the individual serial number. Every finished helmet shall be durably marked in such a fashion as to be traceable from production through to the ballistic test records for that Lot. The Contractor shall ensure that the serial number is indelible after exposure to mechanical stripping or by the use of a solvent. The Contractor shall ensure that solvents, fuels, and other liquids do not diminish the serial number markings. Testing shall be in accordance with 4.10.15.2.

3.13.3 Washability (launderability) and colorfastness. All components of the finished helmet shall meet washability (launderability) and colorfastness requirements. The finished shell with hook material installed shall be washable. No component shall show any signs of structural, visible, operational degradation, or physical damage as a result of twenty (20) washings. Additionally, none of the labels shall become illegible because of the washings. Testing shall be in accordance with 4.10.15.3.

3.13.4 Service life. The finished helmet performance shall not degrade under normal usage for a period of five (5) years. Testing shall be in accordance with 4.10.16.

3.13.5 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 in accordance with 4.10.17.

3.13.6 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 NSN. The Government will assign a 12 digit UPC for each helmet and component for each size and type. 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 4.10.18.

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

3.14.1 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 maintaining 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 in accordance with 4.10.19.

3.14.2 Toxicity. The finished shell shall not present a dermal health hazard when used as intended and when tested as specified in 4.10.20.

3.14.3 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 or 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). Testing shall be in accordance with 4.10.21. 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.

3.15 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 IX. End item visual defects. During FAT, five (5) finished helmets of each size shall be examined for visual defects. During LAT, all LAT samples (excluding contingency samples not tested) shall be examined for visual defects. There shall be no critical defects. The accept/reject criteria for major defects and minor defects shall be as defined in the contract. Fabrication of the finished product shall ensure quality workmanship and safety of the user. Manufacturing practices shall be capable of consistently yielding a product that conforms to all requirements in this purchase description and internal specifications for the product and its components. Materials shall be produced and integrated to extend durability and provide consistency of appearance throughout life of the product. Material layers shall not contain contaminant levels demonstrated to negatively affect system

performance. Contaminants include, but are not limited to, foreign objects or debris from the manufacturing process and the environment, any media not associated with the TDP, loose fragments of component materials or adhesives, operator elements not part of component materials, and cleaning residue. The Contractor shall ensure that the finished product, all subcomponents, and parts are free of defects shown to affect product serviceability, appearance, or performance such as: scaling, burrs, frayed edges, material tears, torn edges, stains, holes and other imperfections. This section is applicable to all material or components of the product whether furnished by the Prime Contractor or by any of their suppliers or subcontractors. Deviations in acceptable manufacturing procedures and/or the quality of materials used shall immediately be reported to the KO or his designee. Contractors shall not make repairs to the helmet unless as otherwise authorized, in writing, by the Government.

3.16 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

4. VERIFICATION

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

a. FAT (see 4.3)

b. LAT (see 4.4)

4.2 Responsibility for compliance. All items shall meet the requirements of Section 3 and test methods of Section 4 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 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. The U.S. Army Test and Evaluation Command (ATEC) will conduct all FAT as required by Army Regulation 73-1.

4.4 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 VIII).

4.6 Standard ambient conditions. Examinations, inspections, and testing shall be conducted in standard ambient conditions of 68^{o}F (±10^{o}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 method 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. If the verification method involves averaging, rounding shall take place after averaging unless otherwise specified.

4.9 Requirements and verifications. TABLE VIII delineates performance requirements verified through visual methods, including physical measurements to determine that no deficiencies exist.

TABLE VIII. Requirements and verifications.

Characteristic	Requirement paragraph	Verification paragraph	First Article Testing (FAT) 1/	Lot Acceptance Testing (LAT) 1/
Shell design and shape	3.3, 3.3.1.1, 3.3.1.2	4.10, 4.10.2, 4.10.3	x	2/
Shell construction	3.3.2, 3.3.3	4.10.1	x	2/
Shell thickness and uniformity	3.3.4	4.10.4	x	2/
Benchmarks	3.3.5, 3.3.5.1, 3.3.5.2, 3.3.6, 3.3.7	4.10.3	x	2/
Crown Benchmark	3.3.5.3	4.10.5.1	x	-
Integration and compatibility	3.4	4.10.1, 4.10.9.1, 4.10.14	x	-
NVD attachment hole, as required by type and class	3.4.2	4.10.1, 4.10.3, 4.10.4	x	2/
Edging	3.4.4	4.10.1, 4.10.6, 4.10.6.1	x	2/
Edging adhesion	3.4.4.1	4.10.6.2	x	x 3/
Edging adhesion after heat aging	3.4.4.2	4.10.6.3	x	2/
Coating	3.4.5	4.10.1	x	2/
Shell Surface Preparation	3.4.5.1	4.10.1	x	2/
Adhesion of Coating	3.4.5.2	4.10.7	x	x 3/
Infrared Reflectance	3.4.5.3	4.10.7.1	x	2/
Specular Gloss	3.4.5.4	4.10.7.2	x	2/
Retention System	3.5, 3.5.5	AR/PD 17-06	x	2/
Retention System Intended Use and Adjustment	3.5.1, 3.5.2	4.10.8, 4.10.8.3	x	2/
Retention System Static Pull Strength	3.5.3	4.10.8.1	x	2/
Retention System Dynamic Pull Strength	3.5.4	4.10.8.2	x	2/
Suspension System	3.6	4.10.1, 4.10.9, 4.10.9.1	x	2/
Pad Construction	3.6.3	4.10.9.2	2/	2/
Inner Layer Material	3.6.3.1	4.10.9.3, 4.10.9.7	x	2/
Padding Layer Material	3.6.3.2	4.10.9.4	x	2/

Characteristic	Requirement paragraph	Verification paragraph	First Article Testing (FAT) 1/	Lot Acceptance Testing (LAT) 1/
Outer Layer Material	3.6.3.3	4.10.1, 4.10.9.5, 4.10.9.7	x	2/
Pad Compression Durability	3.6.3.4	4.10.9.6	x	2/
Suspension System Attachment	3.6.4.1	4.10.1	x	2/
Attachment Material Shape	3.6.4.2	4.10.1	x	2/
Attachment Material Coverage	3.6.4.3	4.10.1, 4.10.9.8.1	x	2/
Attachment Material Durability	3.6.4.4	4.10.9.8.2	x	2/
Colorfastness	3.6.5	4.10.9.9	x	2/
Fragmentation Protection – Minimum V_{50} Ballistic Protection Limits (V_{50} BL(P))	3.7.1	4.10.10.1, 4.10.10.2, 4.10.10.3	x	x 4/
Resistance to Penetration – 9mm	3.7.3	4.10.10.1, 4.10.10.1.2, 4.10.10.4	x	x 4/
FAT, RTP Requirement	3.7.3.1	4.10.10.1.2, 4.10.10.1.2.1	x	-
FAT, RTP NVD Hardware Requirement, when required by type and class	3.7.3.2	4.10.10.1.2, 4.10.10.1.2.2	x	x 4/
LAT, RTP Requirement	3.7.3.3	4.10.10.4	-	x 4/
Ballistic Transient Deformation - FAT	3.7.4, 3.7.4.1	4.10.10.1.3, 4.10.10.5	X 5/	-
Ballistic Transient Deformation - LAT	3.7.4.2	4.10.10.2, 4.10.10.5	-	x 4/, 5/
Weight	3.8	4.10.11	x	x
Blunt Impact Protection	3.9	4.10.12	x	x 3/
Seawater Resistance	3.11.1	4.10.4, 4.10.10.7.5, 4.10.13.1	x	2/
Weatherometer Resistance	3.11.2	4.10.4, 4.10.13.2	x	2/
Field Agent Resistance	3.11.3	4.10.13.3	x	2/
Flame Resistance	3.11.4	4.10.13.4	x	2/
High Temperature Storage and Use	3.11.5	4.10.4, 4.10.13.5	x	2/
Cold Temperature Storage and Use	3.11.6	4.10.4, 4.10.13.6	x	2/
Temperature Shock	3.11.7	4.10.4, 4.10.13.7	x	2/
Altitude	3.11.8	4.10.4, 4.10.13.8	x	2/
Vibration	3.11.9	4.10.13.9	x	2/
Impact Resistance	3.11.10	4.10.13.10	x	2/
Compression Resistance (top to bottom)	3.11.11	4.10.13.11	x	2/
Compression Resistance (side to side)	3.11.12	4.10.13.12	x	2/
Accelerated Aging/Shelf Life	3.11.13	4.10.4, 4.10.13.13	x	2/
Integration and Compatibility	3.12	4.10.9.1, 4.10.14	x	2/
Integration with NVD Bracket	3.12.1	4.10.9.1, 4.10.15	x	2/
Marking of Finished Helmet Shell	3.13.1	4.10.1, 4.10.15.1	x	x 3/
Finished helmet traceability	3.12.2	4.10.15.2	x	2/

Characteristic	Requirement paragraph	Verification paragraph	First Article Testing (FAT) 1/	Lot Acceptance Testing (LAT) 1/
Washability (Launderability)	3.13.2	4.10.15.3	x	2/
Service Life	3.13.4	4.10.16	x	2/
Shelf Life	3.13.3	4.10.17	x	2/
Barcode Label	3.13.5	4.10.1, 4.10.18	x	2/
Safety	3.14.1	4.10.19	x	2/
Toxicity	3.14.1	4.10.20	x	2/
Hazardous Materials	3.14.2	4.10.21	x	2/
Workmanship	3.15	4.10.1	x	x 3/

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 test such items to verify conformance to requirements. CoCs and the associated test data shall be attached to the DD1222, Request for and Results of Tests, when samples are forwarded for LAT.
3/ The rate for LAT for edging adhesion, adhesion of coating, blunt impact protection (Ambient condition only), retention system static pull, pad water absorbency, marking and barcode label, are shown in APPENDIX A.
4/ Ballistic testing for LAT shall be in accordance with 4.10.10.1.3.
5/ BTD and CT Scanning shall be used for Government reference

4.10 Methods of inspection.

4.10.1 Visual examination. The completed end item shall be examined for the defects listed in TABLE IX. The helmet shall be examined from a distance of approximately 2-feet.

TABLE IX. End item visual defects.

Examination	Defect	Classification		
		Critical	Major	Minor
Helmet shell and finished helmet	Any fabric fibers visibly cut or raised on the shell body (inside) up to 1/2-inch area.			X
	Any fabric fibers visibly cut or raised on the shell body (inside) over 1/2-inch area up to 3/4-inch area.		X	
	Any fabric fibers visibly cut or raised on the shell body (inside) over 3/4-inch area.	X		
	Any surface dent, depression, or area not smooth.			X
	Any delamination– Defined as a separation between ballistic material layers		X	
	Any blister or bubble – Defined as skin separation from the ballistic material.			X
	Any blister or bubble – Over 1/4-inch area up to 1/2-inch area and over 1/32-inch in height up to 1/16-inch in height.		X	
	Any evidence of cracking.	X		
	Any evidence of dry spot, any area of non-resin flow or other molding deficiency.		X	
	Any fabric gap, any pit except those specified as in 3.3.2.		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 in 3.3.2 (exterior only).			X
	Any unauthorized patching, repair, or reworking.	X		
	Any evidence of metallic fasteners.	X		
	Any benchmark omitted or obliterated.			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
	Evidence of cut blisters.		X	
	Ballistic material showing signs of being visibly cut, gauged, or raised.		X	
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	

Examination	Defect	Classification		
		Critical	Major	Minor
	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 1. Ends overlapped 2. 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	Small handling induced defects such as scuffed areas and blemishes.			X
	Defects such as peeling, blistering, or flaking, foreign matter appearing on or embedded in the finish. Up to 1/4-inch area and 1/32-inch in height.			X
	Defects such as peeling, blistering, or flaking, foreign matter appearing on or embedded in the finish. Over 1/4-inch area up to 1/2-inch area and over 1/32-inch in height up to 1/16-inch in height.		X	
	Finish wet or tacky to the touch.		X	
	Coating furrows, flakes, or peels when scratched with a fingernail.		X	
	Is not a smooth, uniform coating (i.e., paint 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
	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
	Evidence of cut blisters.		X	
	Any unauthorized repair.	X		
Suspension System Assembly and Attachment Material	Pads not as specified herein, or not in correct number or shape.	X		
	Evidence or burn marks on the pad sealed outer flange.	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, one (1) or two (2), still enabling adequate pad engagement.			X

Examination	Defect	Classification		
		Critical	Major	Minor
	Any suspension system attachment components and hook material omitted, more than two (2).		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
	Suspension system attachment material or hook disk coverage inadequate.			X
	Any required component omitted		X	
	Any component misplaced or not assembled.		X	
	Suspension system not easily attached, removed, or reattached to helmet.		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 open seam. Separation of inner and outer layer materials and plastic inside is not sealed.		X	
	Attachment material not of uniform shape		X	
	Any attachment material in the ear area		X	
Retention System	Any component incorrectly installed on helmet (e.g., wrong side or backwards – no ability to correct)		X	
	Any required component omitted.		X	
	Any sharp edge or burr.		X	
	Any hole, cut, tear, or smash in webbing.		X	
	Webbing not firmly or tightly woven, edges frayed or scalloped.		X	
	Webbing possessing multiple floats.		X	
	Webbing possessing abrasion mark, broken or missing yarns, slub, or broken end or pick.		X	
	Any hole, cut, tear, or smash in materials other than webbing.		X	
	Any mend, yarn, or patch.		X	
	Any raw edge (any edge not securely caught in stitching or treated as to prevent fray – such as hot knife treatment)			X
	Any webbing joint not securely stitched		X	
	Thread ends longer than 1/4-inch			X
	Stitch tension loose, resulting in loose bobbin or top thread.			X

Examination	Defect	Classification		
		Critical	Major	Minor
	Stitch tension excessively tight, resulting in puckering material			X
	Stitching ends not secured.			X
	Thread breaks, skipped stitches, or run-offs not overstitched.		X	
	Bartack or box-x, if any, omitted.		X	
	Bartack or box-x, if any, not as specified or not in specified location.		X	
	Stitch margin or gage not within specified tolerance.			X
	Box, box-x and stitching dimensions not within specified tolerance.			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	
	Marking of Packaging: omitted, incorrect, illegible, or not as specified.		X	

4.10.1.1 NVD 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. Failure to meet the requirements of 3.4.3.1or 3.4.3.2 shall constitute test failure.

4.10.2 Area of coverage. Testing personnel shall measure the projected area of coverage specified in 3.3.1.1 with appropriate measuring equipment accurate to 0.01. The outside surface of the finished helmet shall be checked at five (5) different locations (right and left sides based on sagittal plane and front and rear benchmarks, front and rear based on coronal plane and side benchmarks, and top centered on crown benchmark). The presented area of the five views establish the area of coverage for comparison against the same five views of the ACH.

4.10.3 Shell design and shape. The dimensions and shape specified in 3.3, 3.3.1, and 3.3.1.2 that define the shape and any hole, as required by type and class, 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.

4.10.4 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 (3) 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 (1) thickness shall be taken at the approximate top center and the other four (4) measurements shall be taken randomly, one (1) each in the lower sections identified in 4.10.10.3.3. For Type I helmets, the measurement in the front section shall be taken in an area away from the NVD mount but within

the front section. For verification of shell thickness, requirements in the operating environments of sections 3.9, 3.11.2, and 3.11.4-3.11.7, 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 3.3.4.1, 3.3.4.2, 3.9, 3.11.2, 3.11.4-3.11.7, and 3.11.12 shall constitute test failure.

4.10.5 Benchmarks. The unfinished and finished shell shall be visually examined for the presence of the required benchmarks. Any benchmark not in conformance with 3.3.5 shall be cause for test failure.

4.10.5.1 Crown Benchmark. The Government shall inspect the unfinished shell by visual examination for the presence of the required benchmarks. Testing personnel shall measure the size of the benchmarks with appropriate equipment accurate to 0.01-inch. Any benchmark not in conformance with 3.3.5.3 shall be cause for test failure.

4.10.6 Edging.

4.10.6.1 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-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-inches. Any non-conformance with the requirements of 3.4.4 shall constitute test failure.

4.10.6.2 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 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 3.4.4.1 shall be considered a test failure.

4.10.6.3 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 cooling to room temperature. Use a sharp knife, cut through the edging along the inner or outer corner for a distance of 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 (1) 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 60 minutes (+10 minutes), and measure the amount of peeling back of the tab to determine conformance to the requirement in 3.4.4.2. 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 (2) 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 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 (2) different locations on the helmet, and the two (2) results shall be averaged. Any nonconformance to the requirements specified in 3.4.4.2 shall be considered a test failure.

4.10.7 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^{o} ($\pm 5^{o}$) angle to the surface tangent along the line being cut. The cuts shall completely penetrate the coating. These lines shall be crossed with three (3) additional perpendicular lines 0.0625-inch to 0.125-inch apart. This procedure produces four (4) squares, which shall be inspected visually for any coating lifting. For FAT, three (3) finished shells of each size small through extra-large shall be tested and three (3) random locations shall be tested per sample. Failure to meet the requirements of 3.4.5.2 shall constitute test failure.

4.10.7.1 Infrared reflectance test. Spectral reflectance data shall be obtained from 600 to 860 nanometers (nm) at 20 nm intervals on a spectrophotometer relative to the polytetrafluoroethylene (PTFE) family of compounds, the preferred white standard. Other white reference materials may be used provided they are calibrated to absolute white or vitrolite tiles. The spectral bandwidth shall be less than 20 nm at 860 nm. Reflectance measurements shall be made by either the monochromatic or polychromatic mode of operation. When the polychromatic mode of operation is used, the spectrophotometer shall operate with the specimen diffusely illuminated with the full emission of a continuous source that simulates either The International Commission on Illumination (CIE), CIE Source A or CIE Source D65. The specimen shall be viewed at an angle no greater than 10° from normal, with the specular component included. Measurements shall be taken on a minimum of three (3) different areas and the data averaged. The diameter for standard aperture size used in the color measurement device shall be 1.0- to 1.25-inches or larger Photometric accuracy of the spectrophotometer shall be within 1% and wavelength accuracy within two (2) nm. Any color having spectral reflectance values falling outside the limits at four (4) or more of the wavelengths specified shall be considered a test failure.

4.10.7.2 Specular gloss. Verification shall be in accordance with ASTM D523. Any non-conformance to the requirements of 3.4.5.4 shall constitute a failure.

4.10.8 Retention system design. The retention system shall be examined. Any non-conformance with the requirement of 3.5 shall be cause for test failure.

4.10.8.1 Retention system static pull strength. For Type I and Type II helmets, testing shall be in accordance with the requirements of AR/PD 17-06. Non-conformance with the requirement of 3.5.3 shall constitute test failure.

4.10.8.2 Retention system dynamic pull strength. For Type I and Type II helmets, testing shall be in accordance with the requirements of AR/PD 17-06. Non-conformance with the requirement of 3.5.4 shall constitute test failure.

4.10.8.3 Helmet stability. While wearing the helmet and Army Combat Gloves, adjust retention system to desired level of tightness. The Soldier (wearer) should be able to attain and maintain a snug, comfortable fit. Inspection shall be in accordance with 3.5.5. Failure to meet the requirements specified in 3.5.5 shall be cause for test failure.

4.10.9 Suspension system. Verification for the pad suspension system consists of several tests.

4.10.9.1 Suspension system compatibility. An integration and compatibility demonstration shall be conducted which demonstrates that the helmet and associated components are integrated and compatible with items NVD (reference section 3.4.1), retention system (3.5). Failure to meet the requirements specified in 3.6.2 and 3.14 shall constitute test failure.

4.10.9.2 Pad construction, dimensions, and shape. The pads shall be examined for conformance to the thickness and shape requirements specified in 3.6.3.4 and for conformance to Drawing 2-1-2566. 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. One (1) pad of each shape from each of six (6) suspension system pad sets shall be measured. Any nonconformance to the requirements specified in 3.6.3 shall be cause for test failure.

4.10.9.3 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 3.6.3.1 shall constitute a test failure.

4.10.9.4 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 4-inches but not exceeding 6-inches for a minimum of 12 hours. The salt water shall meet the composition specified in 4.10.13.1. Once the pad is removed from the water, shake it by hand for a minimum of 1 minute and a maximum of 2 minutes in various orientations to remove bulk water. Alternately, one (1) side of the pad may be placed on a dry paper towel for up to 2 minutes to blot. Each other side of the pad may be placed on another dry paper towel for up to 2 minutes. A side may be placed on the paper towel only once. The pad shall then be allowed to air dry for 24 hours (± 1 hour) in an ambient environment of 70^{o}F (± 2^{o}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 3.6.3.2 shall constitute test failure.

4.10.9.5 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 five (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 3.6.3.3 and 3.6.4.4 shall constitute a test failure.

4.10.9.6 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-inch during each cycle at the rate of 12 (± 1) inches 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 3.6.3.4 shall constitute failure of the test.

4.10.9.7 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 7500K (± 200) illumination of 100 (±20) foot candles, and shall be a good match to the standard sample under incandescent A illuminant with a color temperature of 2856K (± 200). Any nonconformance with the requirements of 3.4.5.3, 3.4.5.4, 3.6.3.1, or 3.6.3.3 shall be cause for test failure.

4.10.9.8 Attachment material.

4.10.9.8.1 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 percentage of the pad that is in contact attachment material shall be calculated for each placement location. Any non-conformance with the requirements of 3.6.4.3 shall be cause for test failure.

4.10.9.8.2 Suspension system attachment – adhesion and durability. Three (3) finished helmets from each size shall be tested. The attachment material shall remain adhered to the helmet shell after 22 removal and installation cycles of suspension system components. 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 non-conformance with the requirements of 3.6.4.4 shall constitute test failure.

4.10.9.9 Colorfastness. Test the inner layer material, outer layer material, and attachment material in accordance with the test methods listed in 3.6.5. Failure to meet the requirements of 3.6.5 shall constitute test failure.

TABLE X. Colorfastness test methods.

Characteristic	Requirement paragraph	Test method
Colorfastness to Laundering (1 cycle) Color Change Staining	3.6.5 & TABLE III	AATCC-61, Test 2A 1/, 2/
Colorfastness to Crocking Dry Wet	3.6.5 & TABLE III	AATCC-8 3/
Colorfastness to Perspiration (acid and alkaline) Color Change Staining	3.6.5 & TABLE III	AATCC-15 1/, 2/
Colorfastness to Water Color Change Staining	3.6.5 & TABLE III	AATCC-107 1/, 2/

1/ Only the stain on the nylon and cotton fibers of the color transfer cloth shall be evaluated.
2/ Rated using the AATCC Evaluation Procedure 1, Gray Scale for Color Change and AATCC Evaluation Procedure 2, Gray Scale for Staining.
3/ Rated using the AATCC Evaluation Procedure 8, AATCC 9-Step Chromatic Transference Scale

4.10.10 Ballistic protection. The ballistic resistance testing shall be conducted in accordance with MIL-STD-662, NIJ 0106.01, and ITOP 4-2-805, Projectile Velocity and Time of Flight Measurements, except as specified in 4.10.10.1 through 4.10.10.5. 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 determining any of the ballistic resistance requirements.

4.10.10.1 Ballistic resistance (FAT). Ballistic resistance testing for FAT shall include the requirements of 3.7.1, 3.7.3, 3.7.4 and shall be in accordance with the FAT test matrix specified in APPENDIX A.

4.10.10.1.1 Ballistic resistance (FAT) – 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 FSP after weatherometer exposure and after accelerated aging (see the FAT matrix in APPENDIX A). If the V_{50} BL (P) test for each specific test set meets or exceeds the values specified in 3.7.1 the specific test shall be considered met.

4.10.10.1.2 Ballistic resistance (FAT) – 9mm. The finished helmet shall be resistant to penetration from a 9mm FMJ RNP.

4.10.10.1.2.1 RTP – Finished helmet. Twenty-two 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 22 impacts meet the criterion specified in 3.7.3.1, then the remaining portion of the 9mm RTP (specified in APPENDIX A) will be conducted. Shots shall be distributed among the four (4) helmet locations with only two (2) shots per helmet as specified in 4.10.10.4.3. A total of 48 RTP determinations on the finished helmets shall be made for each of the four (4) required environmental conditions, resulting in a total of 192 RTP determinations.

A RTP determination shall be defined as a shot taken at the helmet. If the requirements of 3.7.3.1 are met, the FAT for 9mm RTP shall be considered met.

4.10.10.1.2.2 RTP – NVD Hardware. Six (6) RTP determinations on the hardware shall be made for the each of the four (4) environmental conditions (ambient, hot, cold and seawater). A RTP determination shall be defined as a shot taken at the hardware on the helmet. If the requirements of 3.7.2.2 are met, the FAT for hardware 9mm RTP shall be considered met.

4.10.10.1.3 Ballistic resistance – BTD. A BTD is the resulting imprint in the headform clay from a RTP test impact. BTDs resulting from RTP test impacts shall be distributed among the four (4) helmet locations with only two (2) shots per helmet as specified in 4.10.10.4.3. BTD will be measured for all 9mm RPT test impacts made on the shell of the helmet. BTD will not be measured for the 9mm hardware impacts. The BTD measurements will be recorded and used for Government reference, in accordance APPENDIX B.

4.10.10.2 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, and 9mm ambient condition RTP. Production lots shall meet or exceed the requirements of 3.7.1 and 3.7.3, in accordance with the LAT test matrix in APPENDIX A, with the following exceptions:

a. For 9mm RTP testing, penetrations will be classified as critical defects (see 3.7.3.3 – LAT Testing).

b. The accept/reject criteria for 9mm impacts are the number of helmets that fail to stop any of the hardware or helmet 9mm impacts. For 9mm shell RTP 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 9mm V0 shot sequence (same shot sequence as the helmet that incurred the complete penetration) to complete the required test matrix. Penetration data from all valid impacts will be used for accept/reject calculations. BTD data will be used for Government reference.

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

4.10.10.3 Ballistic V_{50} test method for RCC and FSP. The suspension system, retention system, and any NVD hardware shall be removed from the helmet prior to conditioning and testing. The finished shell shall be conditioned as specified in 4.10.10.6, 4.10.10.6.1, 4.10.10.6.2 and 4.10.10.6.3 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.

4.10.10.3.1 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 (± 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.

4.10.10.3.2 Witness plate mounting for 9mm RTP for NVD 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 front 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 NVD hardware) of the headform shall be void of clay in front of the witness plate (rear of headform) and approximately 1-inch in back of the witness plate. Clay shall be placed up to approximately 1.5-inches in front of the guard plate to prevent fragments from ricocheting after impact with the guard plate. Complete and partial penetrations will be determined based on the impressions left on an aluminum witness plate. The witness plate will be 0.020-inches (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.

4.10.10.3.3 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 (4) 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 (see 7) 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°

4.10.10.3.4 Projectile impact location for V_{50} testing. Two (2) fair impacts, randomly placed, shall be fired in each section, except that one (1) of the two (2) 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 (for the side section) less than 0.375-inches above the earflap. If two (2) 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.

4.10.10.3.5 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 further analyses to be conducted on the fragments.

4.10.10.3.6 V_{50} BL(P) calculation – FAT. The V_{50} BL (P) for each helmet shell shall be the average of at least 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 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 10 nor the 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 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.

4.10.10.3.7 V_{50} 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 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 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 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 (3) conditions apply, the test shall be declared inconclusive.

4.10.10.4 Ballistic test method for RTP – 9mm. Testing shall be conducted with finished helmets of the appropriate size shell, suspension system, and retention system including retention clips firmly attached. Testing shall be in accordance with NIJ 0106.01 with the following exceptions. The finished helmet shall be conditioned as specified in 4.10.10.6 and 4.10.10.6.1 as required. If the requirements of 3.7.3 and 3.7.3.1 are met, the FAT for 9mm RTP on the helmet shell shall be considered met. If the requirements of 3.7.3 and 3.7.3.3 are met, the LAT for the 9mm RTP on the helmet shell shall be considered met. The pad suspension system shall be arranged inside the helmet as shown in the “standard pad configuration” arrangement in Technical Manual (TM) 10-8470-204-10, Operator's Manual for Advanced Combat Helmet (ACH), WP 0005 (7 pad configuration with oblong/oval pads in the vertical pad configuration), with the following exceptions (this configuration shall be known as the “ballistic pad configuration”):

a. The trapezoidal pads will be centered over the mid-sagittal plane of the helmet, with the widest edge of the trapezoid placed at the helmet’s edge and the narrowest edge of the trapezoidal pad will be closest to the crown.

b. The oval/oblong pads will be vertically oriented and centered over the retention system attachment points, with the corners of the pad touching the corners of the trapezoidal pads (that are closest to the crown) without compressing either pad. For some sizes, the entire side of the oval/oblong pad will touch the side of the trapezoidal pad.

c. The circular crown pad will be centered over the Crown Benchmark. When unable to center the crown pad over the crown benchmark, place the crown pad such that it is touching

the corners of the two (2) front oblong pads. Place all pads (except the circular crown pad) such that the edge of each pad flange is flush with the rim of the finished helmet.

d. This pad placement shall be verified and adjusted as necessary prior to each test shot. This pad configuration allows for the mitigation of pad encroachment into the clay headform. Projectile velocity and time of flight measurements shall be in accordance with ITOP 4-2-805. Testers shall translate instrument velocity into strike velocity at the target and shall use the strike velocity for ballistic requirements. Testers may alter the distances shown in FIGURE 6 of NIJ 0106.01. Failure to meet the requirements of 3.7.3 shall constitute test failure.

4.10.10.4.1 Headform for 9mm testing. Either an NIJ headform or the Multi-Sized Headforms (MSHF) may be used for 9mm RTP testing. If the NIJ headform is used, the headform for 9mm testing (RTP) 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.

4.10.10.4.1.1 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. The cap crease will be aligned near the middle of the headform to ensure the cap is evenly pulled over the headform. Picture 2 (see 7) illustrates the installation of the cap onto the headform.

4.10.10.4.1.2 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.

4.10.10.4.1.3 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 6.11) 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 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 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.

4.10.10.4.1.4 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 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 (3) 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 mm ± 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 45 minutes after removing from the conditioning chamber. If testing of any one (1) helmet exceeds 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.

4.10.10.4.1.5 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.

4.10.10.4.2 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. 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 coronal and mid-sagittal planes of the headform (NIJ or MSHF) to ensure the helmet is aligned on the headform properly. Retention System straps will be pulled by one (1) 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. 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.

4.10.10.4.2.1 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.

4.10.10.4.3 RTP impact locations and procedure. The following locations and procedures shall be followed for RTP testing.

a. Each finished helmet shall sustain no more than two (2) impacts with the following four (4) defined shot locations:

(1) 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).

(2) An impact on the coronal plane shall be 50 mm (+5 mm, -0 mm) above the earflap and in the center of the clay headform coronal channel (±5mm).

(3) 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 NVD hole).

(4) An impact on the mid-sagittal plane shall be 75 mm (+5mm, -0mm) from the rear edge of the finished helmet.

b. For each test, mount the shell in the “as-worn” configuration, with the suspension and retention system in place on the headform. For the fastener test, the helmet shall be rotated to align with the slot.

c. 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.

d. 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.

4.10.10.5 Ballistic transient deformation (BTD). For projectiles fired during RTP testing, BTD measurements shall be recorded and used for Government reference.

4.10.10.5.1 Headform. The BTD shall be measured on a headform as described in 4.10.10.4.1.

4.10.10.5.2 Test procedure.

4.10.10.5.2.1 Mounting and measurement. The finished helmet shall be mounted on the headform in the as-worn position. 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 4.10.10.4.1.5. 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.

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

4.10.10.5.2.3 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. 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.

4.10.10.5.2.4 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, and no additional testing is required for BTD. However, if required for RTP, a new (untested) helmet is required to undergo the full V_0 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 shell and hardware tests.

4.10.10.5.2.5 Criteria. Each projectiles penetration determination shall be compared to the requirements of 3.7.3. Each projectile's depression measurement shall be recorded for Government reference. 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 4.10.10.5.2 in preparation for the next shot.

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

4.10.10.6 Condition methods.

4.10.10.6.1 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 4.10.10.4. 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 1 hour if the helmet has been out of conditioning for 1 hour or less. If the helmet has been out of conditioning for over 1 hour, the helmet shall be reconditioned for 24 (+24, -0) hours. Failure to meet the requirements specified in 3.7.1 and 3.7.3 shall constitute test failure.

4.10.10.6.2 Ballistic resistance (seawater). The finished shell or finished helmet shall be immersed in seawater as specified in 4.10.13.1 at a minimum depth of 3-feet. After immersion for 3 hours (+1 hour), it shall be removed, wiped dry, excess water squeezed from the pads and tested. Testing shall take place within 2 hours after removal from seawater. The finished helmet shall then be ballistically tested in accordance with 4.10.10.3 and 4.10.10.4. Failure to meet the requirements specified in 3.7.1 and 3.7.3 shall constitute test failure.

4.10.10.6.3 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 3.11.2, then the finished helmet shall be ballistically tested in accordance with 4.10.10.3 within 96-hours after removal from the weatherometer. Failure to meet the requirements specified in 3.7.1 shall constitute test failure.

4.10.10.7 Procedures. The following procedures apply to ballistic testing.

4.10.10.7.1 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:

a. Contractor identification

b. Lot numbers and quantities

c. Item specification number

d. Armor description including model number and serial number (if applicable)

e. Weights of all components

f. Test projectile with exact nomenclature

g. Test date, temperature, and humidity measurements

h. Yaw angle

i. Angles of target obliquity

j. Velocity measurements of each test shot used to test the armor (regardless of whether that particular velocity was used in the V_{50} RTP 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

k. Location of shot

l. Description of test setup (distances from velocity measuring devices to target)

m. Name of company/organization performing tests

n. Type of gun barrel, weapon caliber and propellant type and weight

4.10.10.7.2 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 method shall be used to calculate the actual striking velocity and, where appropriate, actual residual velocity.

4.10.10.7.3 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.

4.10.10.7.4 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.

4.10.10.7.5 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.

4.10.11 Weight examination. The finished helmet or system shall be weighed on a scale accurate to 0.001-pound (lb) or better for conformance to the weight requirements in section 3.8. If necessary, weights shall be rounded to the nearest 0.001 lb in accordance with the rounding method of ASTM E29. 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.

4.10.12 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:

a. Each helmet shall be tested with the suspension system arranged standard inside the finished helmet. For example: If using a seven (7) pad configuration: “standard pad configuration” arrangement in TM 10-8400-204-10, 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.

b. 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.

c. The environmental conditionals shall be ambient (see 4.5), cold 14^{o}F (± 5^{o}F), and hot 130^{o}F (± 5^{o}F). Helmets shall be conditioned for a minimum of 12-hours prior to test.

d. The hot and cold environmental impacts shall be conducted within 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 15 minutes before removal for another test.

e. Water immersion testing is not required.

f. The impact anvil used for all tests shall be the hemispherical anvil.

g. Helmet shall be fitted to the appropriate size DOT (FMVSS 218) headform (B, C, and D).

h. Each helmet shall be impacted two (2) times at seven (7) locations. These include the front, back, left side, right side, left nape, right nape, 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.

i. Two (2) successive impacts shall be made at each location. The second impact shall be made no sooner than 1 minute and no later than 2 minutes after the first.

j. 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.

k. Ensure that no plastic components (ladder-locks) are caught between the helmet shell and the headform prior to testing.

l. Helmet Position Index (HPI) shall be as follows:

(1) Size Small: 2.0-inches

(2) Size Medium: 2.5-inches

(3) Size Large: 2.3-inches

(4) Size Extra-Large: 2.8-inches

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	25-45 degrees off vertical
Rear	5-30 degrees off vertical
Left / right side	10-30 degrees off vertical
Crown	± 35 degrees off horizontal
Left / right nape	Zero degrees off vertical, rolled 15 to 35 degrees left or right

4.10.13 Environmental test methods.

4.10.13.1 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 0.001 pound. The shell shall then be immersed in a laboratory seawater solution containing 3% sodium chloride and 0.5% 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 0.001 pound. A weight increase in excess of that allowed in paragraph 3.11.1 shall constitute failure. The shell shall be visually examined for the defects specified in 3.11.1 and any nonconformance with 3.11.1 shall constitute test failure.

4.10.13.2 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.

a. 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% (± 5%) during the light cycle and not lower than 95% during the dark cycle.

(6) The control set points shall be as follows:

Table XIII. Control Set Points.

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

* As a guide only; adjust to achieve required relative humidity (see 5. above)
Percent (%)
Ten degrees (10°)

(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.

(8) After the shell has been tested in the weatherometer, the helmet shall be examined for the defects listed in 3.11.2. Thickness measurements shall be tested in accordance with 4.10.4. Any nonconformance to the requirements of 3.11.2 shall constitute test failure. After passing the requirements of 3.11.2, the shell shall be tested against the requirements of 3.7.1 for 0° (±5°) obliquity only. Testing shall be conducted in accordance with 4.10.10.3.

4.10.13.3 Field Agent Resistance. The finished shells shall be conditioned at standard ambient conditions for a minimum of twenty-four (24)-hours prior to testing.

a. 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 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 3.11.3. Failure to meet any requirement shall constitute test failure.

b. 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.

4.10.13.4 Flame Resistance. The flame resistance of the finished shell shall be determined in accordance with the applicable methods, definitions, and equipment identified in ASTM D6413 with the following exceptions:

a. The flame resistance of the finished shell shall be determined in accordance with the applicable methods, definitions, and equipment identified in ASTM D6413 with the following exceptions:

(1) The end-item specimen shall be a finished shell as opposed to a textile specimen.

(2) Char length and afterglow will not be measured.

(3) 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.

(4) Modify paragraph 9, Sampling, to reference sampling at random locations within four 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 four (4) finished shells, one (1) of each size, will be tested.

(5) Modify paragraph 11; Flame will be immediately removed from specimen after 12 seconds.

(6) Modify calculation, paragraph 12.1, to calculate the average after-flame of four (4) helmets, two (2) samples per helmet, for both the edge and shell tests.

b. Any non-conformance with the requirements of 3.11.4 shall constitute test failure.

4.10.13.5 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 4.10.10.3.3. Before and after thickness measurements are to be taken at the same five random locations. The thickness criterion is specified in 3.11.4. The helmet shall be visually examined for the requirement of 3.11.4. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.10.6.3 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 3.11.4 shall constitute test failure.

4.10.13.6 Cold Storage and Use. The finished helmet shall be subjected to a conditioning of 24-hours (± 1 hr) at -60ºF (± 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 4.10.10.3.3. 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 3.11.6. The helmet shall be visually examined for the requirement of 3.11.6. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.10.7 on the sample. The adhesion of coating test 3 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 3.11.6 shall constitute test failure.

4.10.13.7 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 4.10.10.3.3. Before and after thickness measurements are to be taken at the same five (5) random locations. The thickness criterion is specified in 3.11.7. The helmet shall be

visually examined for the requirement of 3.11.7. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.10.6.3 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 3.11.7 shall constitute failure of the test.

4.10.13.8 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 -62ºF (± 5ºF)/ -52ºC (± 3 ºC). 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 3.11.7. 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 4.10.10.3.3. Before and after thickness measurements are to be taken at the same five (5) random locations. The thickness criterion is specified in 3.11.7. The helmet shall be visually examined for the requirement of 3.11.7. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.10.6.3 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 3.11.7 shall constitute test failure.

4.10.13.9 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 3.11.9 shall constitute test failure.

4.10.13.10 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 3.11.10. Measure the depth of any indentation in the finished shell. Any nonconformance with the requirements of 3.11.10 shall constitute test failure.

4.10.13.11 Compression Resistance (top to bottom). The finished shell with or 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. After a period of 24 hours (± 1 hour) from the last cycle, again measure and record the height dimension for Government reference. One (1) shell from each size shall be tested. Failure to meet the requirements of paragraph 3.11.11 shall constitute failure of the test.

4.10.13.12 Compression Resistance (side to side). The finished shell with or 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 successfully used method is shown in FIGURE 5. Note that FIGURE 5 shows 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 3.11.12 shall constitute failure of the test.

4.10.13.13 Accelerated Aging/Shelf Life. A finished shell shall be subjected to accelerated aging conditioning in general accordance with ASTM D1149-07, with the following modifications. Shell thickness shall be measured, before and after conditioning, in accordance with 4.10.4. 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°C ± 1°C (104°F ± 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 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 mPa ± 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.

e. After conditioning, the finished shell shall undergo visual inspection for defects as listed in 3.11.13. 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 0. After passing the visual inspection requirements, the finished shell shall undergo V_{50} BL(P) testing for 17-grain projectile at 0° (±5°) obliquity at ambient conditions. V_{50} BL(P) testing shall be conducted in accordance with paragraph 4.10.10.3.6. Any non-conformance with the requirements of 3.11.13 shall constitute a test failure.

4.10.14 Integration and Compatibility. An integration and compatibility demonstration shall be conducted which demonstrates that the finished helmet is integrated and compatible as specified in 3.12.1 and 3.13.1. Failure to meet the requirements of 3.12.1 or 3.13.1 shall constitute test failure.

4.10.15 Ownership and Support.

4.10.15.1 Finished helmet identification. The Government shall verify finished helmet identification visually and with electronic devices, such as the Honeywell 4600g scanner, to confirm MRI as applicable. Failure to meet the requirements of 3.13.1 shall constitute test failure.

4.10.15.2 Finished helmet traceability. The Government shall verify marking of finished helmet visually. Failure to meet the requirements of 3.13.2 shall constitute test failure.

4.10.15.3 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 3.13.3 shall constitute test failure.

4.10.16 Service life. The Contractor shall provide the Service Life validation as described in the contract. Failure to meet the requirements of 3.13.4 shall constitute test failure.

4.10.17 Shelf Life. The Contractor shall provide data that shows all the components and materials used in the finished helmet meet the requirements of 3.13.5.

4.10.18 Barcode label. The Government shall verify the barcode label visually and with a scanner (such as Honeywell 4600g) as applicable. Failure to meet the requirements of 3.13.6 shall constitute test failure.

4.10.19 Health/Safety. A demonstration shall be conducted or documentation, to include Material Safety Data Sheets, provided to verify that the finished helmet meets the health and safety requirements specified in 3.14.1. 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.

4.10.20 Toxicity. The Contractor shall provide documentation to verify that the finished helmet meets the health and safety requirements specified in 3.14.2. The Contractor shall furnish information, which verifies that the finished product is composed of materials, which are safely used commercially or provide sufficient toxicity data to ensure safety during prolonged, direct skin contact. Failure to meet 3.14.2 shall constitute test failure.

4.10.21 Hazardous materials. The Contractor shall provide documentation to verify that the finished helmet meets the health and safety requirements specified in 3.14.3. The Contractor shall not employ the use of hazardous materials requiring special disposal procedures or that can be exposed to personnel and the environment during any operations or maintenance procedures (to include fabrication, transportation, setup, or tear-down) or that can be exposed because of damage to the equipment. The Contractor shall employ environmentally acceptable substitute materials and processes that do not degrade operational

function and maintain effectiveness. The Contractor shall ensure control of any hazardous materials (as defined by OSHA) to levels below OSHA Permissible Exposure Limits. The ACH Gen II (all materials and processes) shall not present any uncontrolled health hazard throughout the life-cycle of the item. The Contractor shall provide a written Health Hazard Assessment/Toxicity Report, which verifies that the finished product is composed of materials, which are safely used commercially or provide sufficient toxicity data to ensure safety during prolonged, direct skin contact. Failure to meet 3.14.3 shall constitute test failure.

5. 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. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory with the exception of 6.3 and 6.12.)

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:

a. Title, number, and date of this specification

b. 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 2.1.2 and 2.2)

c. Types, Classes, and sizes required (see 1.2)

d. When FAT is required, (see 3.1.1), the item will be tested and should be a First Article sample. The KO should include specific instructions in acquisition documents regarding arrangement for examinations, quantity, and testing and approval.

e. Packaging requirements (see 5).

6.3 First Article. The first article should be a pre-production sample (see 3.1.1). The Contracting Officer will specify the appropriate type of first article and the number of units to be furnished. The KO 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. When acceptance criteria requires material conditioning, materials should be conditioned in accordance with ASTM D1776.

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 (V_0). 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 a 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 hardware is still intact, the determination of a partial (PP) or complete penetration will be made based on whether it appears that 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. For an impact where the hardware is still intact but is removed from the helmet by the impact (pushed through helmet), the shot is not valid, and a retest will be started on a new (untested) helmet. Such observations will be considered a minor conformational incompatibility between the hardware and the helmet. If the test proves inconclusive due to an excessive number of invalid shots, the hardware will be considered potentially ballistically viable but conformationally incompatible with the helmet.

6.5.3.3 Complete Penetration (V_{50}). 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% 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.

6.6 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.

6.6.1 Yaw Measurement System.

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

(1) 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.

(2) 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.

(3) 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 effect 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.

(4) 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.

b. 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 NVD Front Bracket Kit. The NSN for the NVD Front Bracket Kit referenced in 3.3.4.1 is NSN 5340-01-509-1467.

6.8 Tactical headset and communication system components. Bose T5 (NSN 5965-01-612-5328), the Tactical Communication and Protective System (TCAPS) INVISIO® X50 system (NSN5965-01-619-0258), Silynx and Peltor (multiple NSN depending on configuration, see https://www.3m.com or https://www.silynxcom.com/nsn-info/).

6.9 Field Agents NSNs referenced in 3.11.3:

a. DEET insect repellent, Personal Application, O-I-503 Type II, Concentration A, NSN 6840-01-284-3982

b. Turbine Fuel, Aviation, F-24, MIL-STD-3004D, ASTM D1655-11b, NSN 9310-00-359-2026

c. Rifle Bore Cleaning Compound, MIL-PRF-372E(2), NSN 6850-00-224-6656

d. Lubricating Oil, Semifluid, Weapons (LSA), NSN 9150-00-935-6597

e. Lubricating Oil, Arctic, Weapons, NSN 9150-00-292-9689

f. Face paint, Camouflage, NSN 6850-01-493-7309

6.10 Clothing and individual equipment listed in 3.11:

ACH covers, including but not limited to the following NSNs:
8415-01-521-8357, 8415-01-521-8360, 8415-01-515-4289, 8415-01-515-4290, 8415-01-619-2461, 8415-01-619-2467, 8415-01-619-2469, 8415-01-592-2218, 8415-01-592-2220, 8415-01-592-2223, 8415-01-641-7116, 8415-01-641-7119, 8415-01-641-7121

Integrated Heed Protection System (IHPS) Retention System (RS), NSN by size:

Size	NSN
Small/Medium (SM/MD) IHPS RS	8470-01-672-0777
Large/Extra Large (LG/XL) IHPS RS	8470-01-672-0796
Left Handed SM/MD IHPS RS	8470-01-672-0741
Left Handed LG/XL IHPS RS	8470-01-672-2260
Right Handed SM/MD H-Back IHPS RS	8470-01-672-0763
Right Handed LG/XL H-Back IHPS RS	8470-01-672-2292
Left Handed SM/MD H-Back IHPS RS	8470-01-672-2305
Left Handed LG/XL H-Back IHPS RS	8470-01-672-0705

Eyewear Retention Strap, NSN 8470-01-110-9981

Helmet Band, NSN 8415-01-110-9981

NAPE Pad, including but not limited to the following NSNs:
8470-01-568-1028, 8470-01-568-1023, 8470-01-584-1750, 8470-01-584-1839

6.11 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.

The manufacturer of the currently fielded Hook Disk is 3M p/n SJ3572, multiple lengths and widths are available (see https://www.3m.com).

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

6.12 Mandatory Sources.

The mandatory source for the Suspension Systems/Retention Systems is National Industries for the Blind, 1310 Braddock Place, Alexandria, VA 22314

6.13 Subject term (key word) listing.
Ballistic
Body Armor
Headgear
Combat Helmet

7. FIGURES AND PICTURES

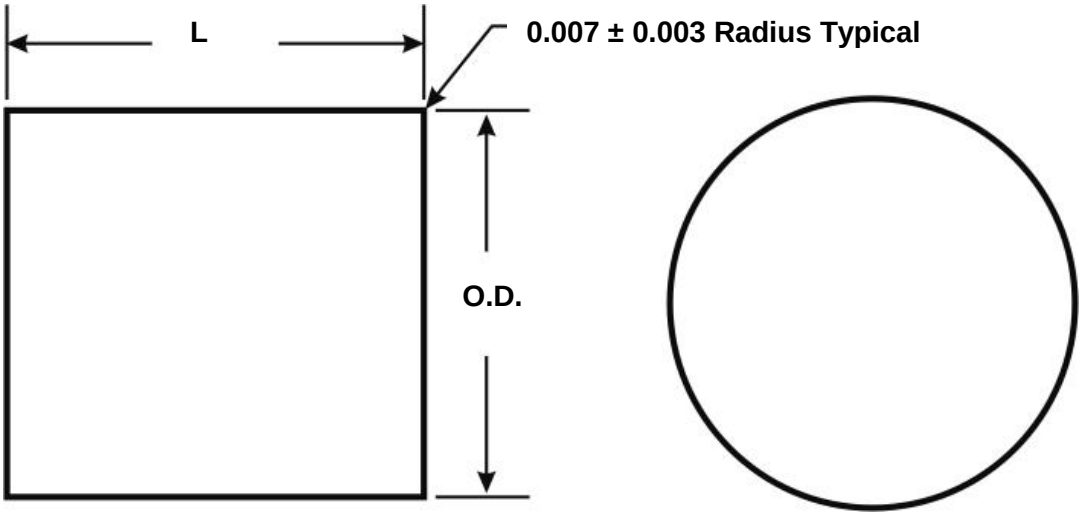

FIGURE 1. Right circular cylinder.

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).

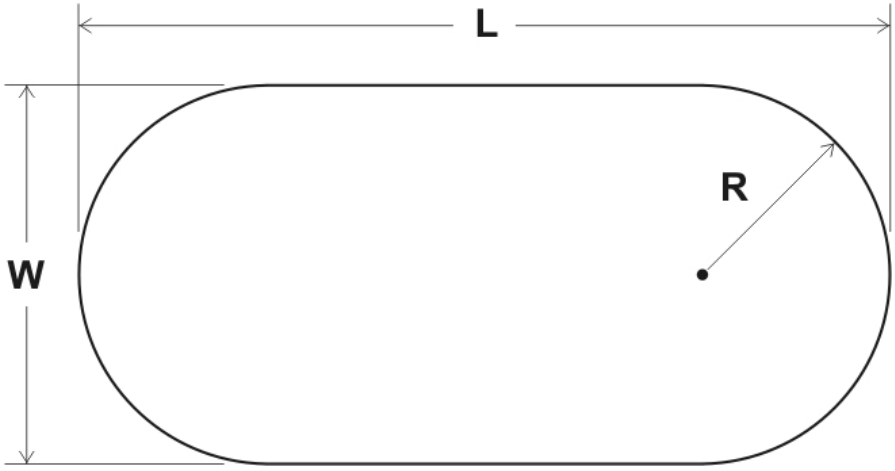

FIGURE 2. Hook disk elongated.

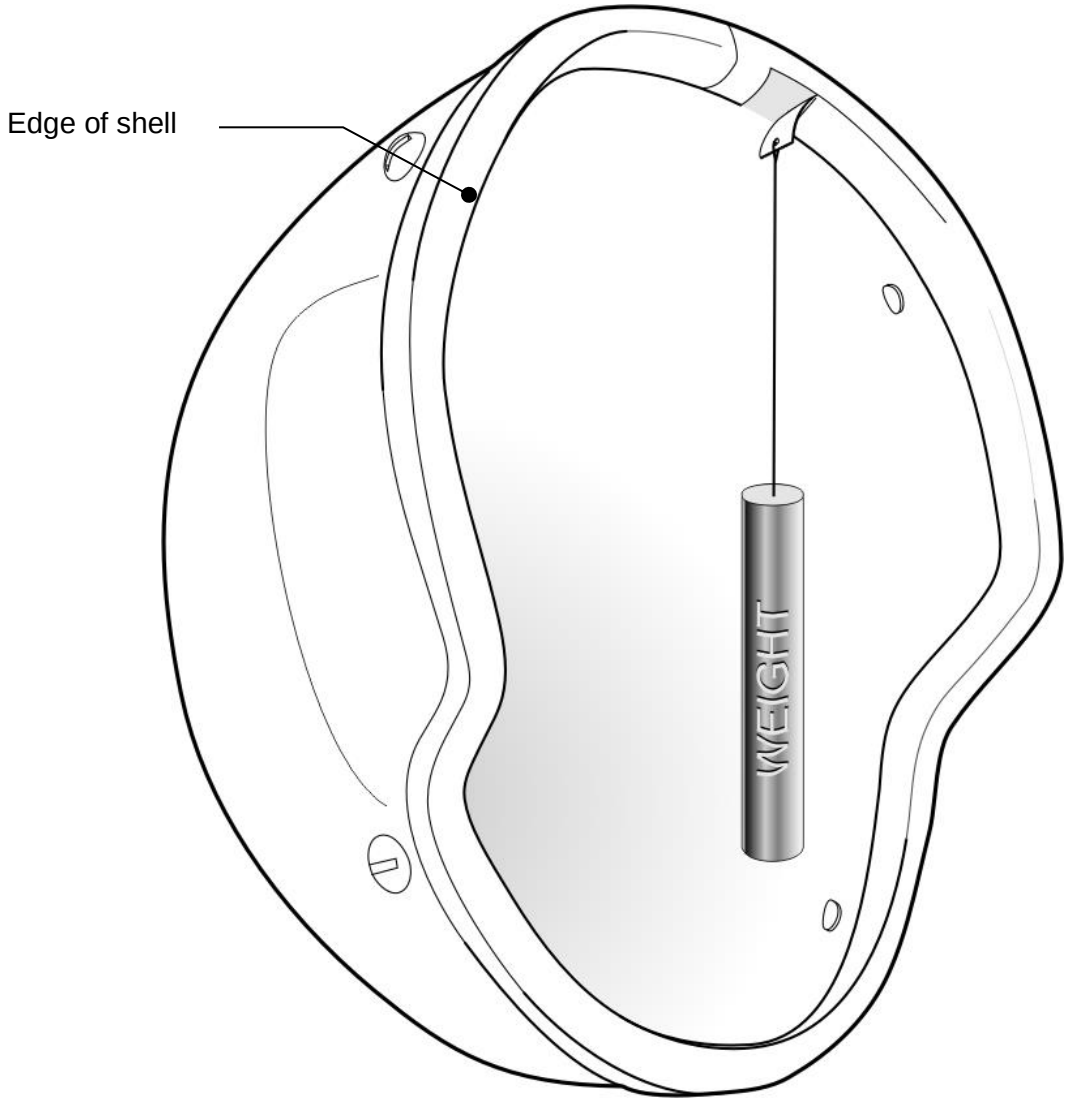

FIGURE 3A. Rubber edge adhesion test.

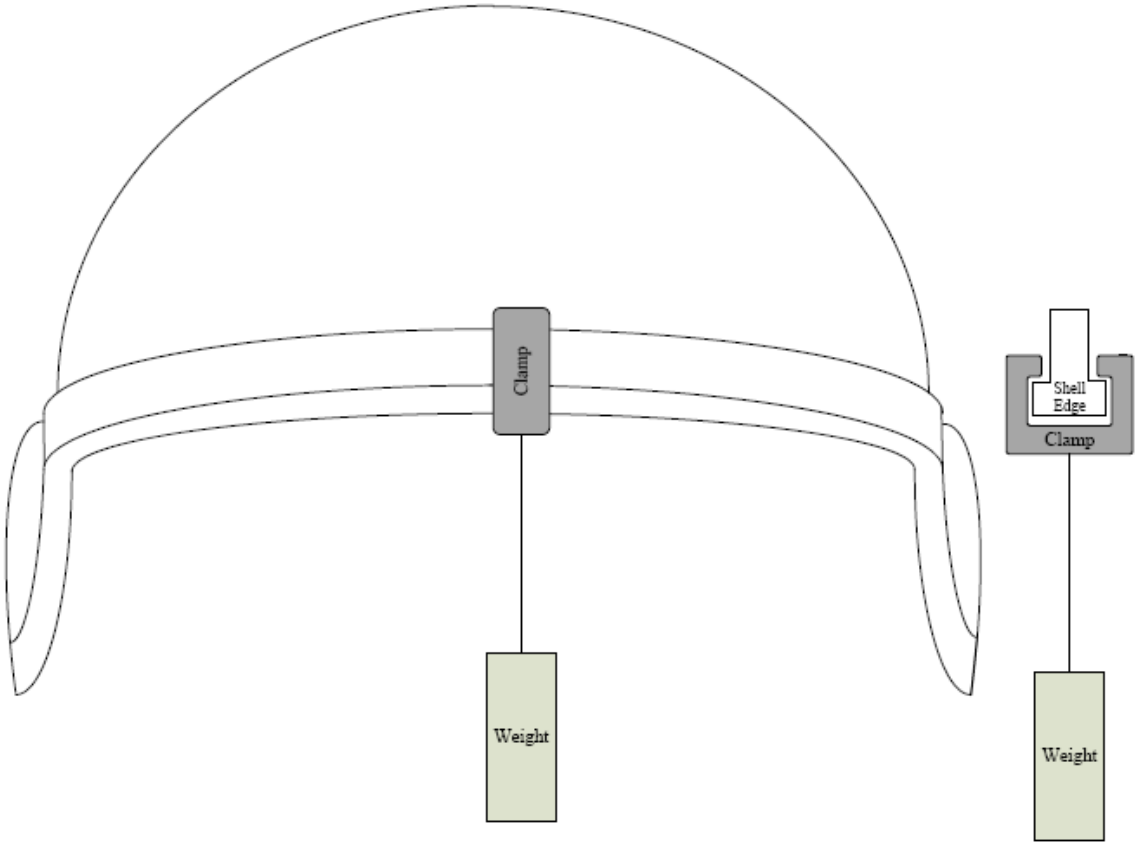

FIGURE 3B. Structural edge adhesion test.

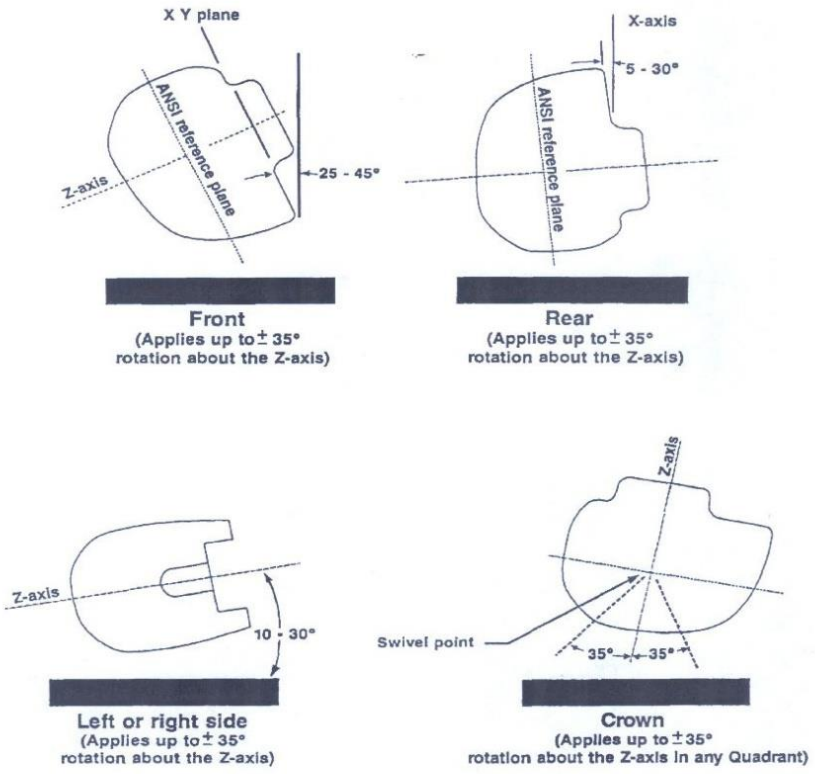

FIGURE 4. Blunt impact test locations.

FIGURE 5. Jig – Side to side compression resistance.

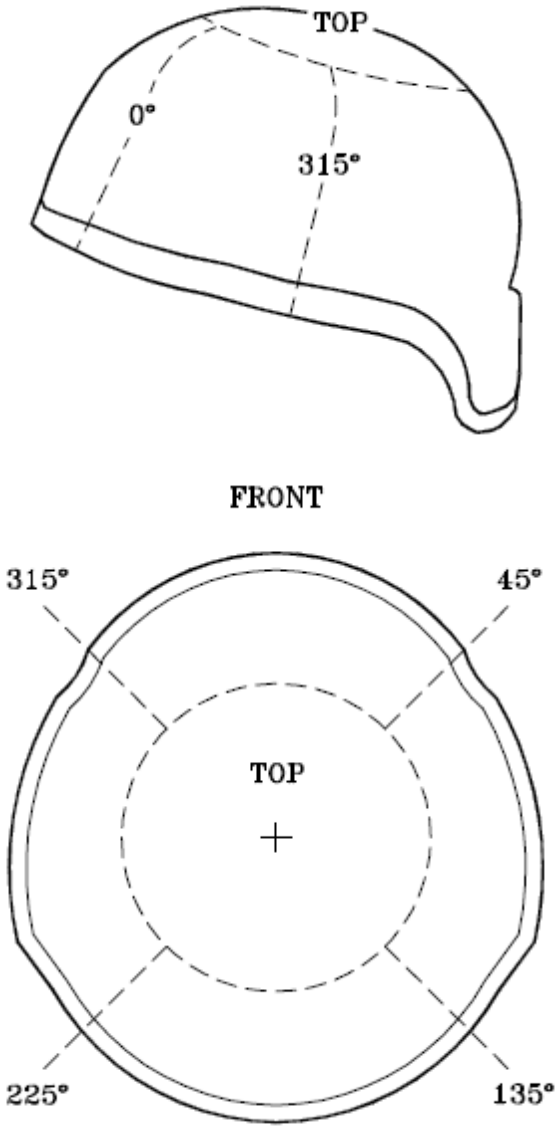

FIGURE 6. Helmet sections.

Picture 1. Headform: Hardware Ballistic Test.

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

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APPENDIX A

FIRST ARTICLE (FAT) AND LOT ACCEPTANCE TESTING (LAT) PROTOCOL FOR THE SECOND GENERATION ADVANCED COMBAT HELMET (ACH GEN II)

A.1 Scope. This document contains information as applicable to FAT requirements and LAT requirements for the 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 retention system with chinstrap and nape strap. 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. This Appendix is a mandatory part of the specification. The information contained herein is mandatory and intended to ensure product compliance.

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

Type I –ACH Gen II (One Hole for NVD Mount, No Holes for Retention System)
Class 1A - Right-Handed X-Back Retention System, Suspension System
Class 1B - Left-Handed X-Back Retention System, Suspension System

Type II –ACH Gen II (No Hole for NVD Mount, No Holes for Retention System)
Class 2A - Right-Handed H-Back Retention System, Suspension System
Class 2B - Left-Handed H-Back Retention System, Suspension System

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

SCHEDULE OF SIZES

Extra-Small (XS)
Small (SM)
Medium (MD)
Large (LG)
Extra-Large (XL)
Double Extra-Large (2X)

Note: Due to low tariff, the Extra-Small and Double Extra-Large (2X) FAT will be handled on a case by case basis. Direct all XS and 2X FAT inquiries to the KO.

A.4 TDP. Prior to FAT submittal, the contractor shall provide a 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:

a. Design nomenclature

b. Material configuration

(1) Type of material used, supplier, thickness, and areal density

(2) Build sheet/Cut patterns

(3) Dry Layup and assembly

(4) Orientation/sequence of layers of the design

(a) 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 homogeneity. 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 a given 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 KO 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.

A.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.

A.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

A.4.2 Requirements and Verifications.

TABLE A-I. Requirements and verifications.

Characteristic	Requirement Paragraph	Verification Paragraph	FAT 1/	LAT 1/	FAT Sample Size
THE TESTS BELOW REQUIRE UNFINISHED SHELLS					
Shell Design and Shape	3.3	4.10.3	X	2/	1 each size
Shell Construction	3.3.2	4.10.1	X	2/	1 each size
Shell Thickness and Uniformity	3.3.4	4.10.4	X	2/	1 each size
Benchmarks – Unfinished Shell	3.3.5.1	4.10.5	X	2/	1 each size
Crown Benchmark	3.3.5.3	4.10.5.1	X	-	1 each size
Shell Surface Preparation	3.4.5	4.10.1	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.					

1/ An "x" in the column designates that the test is performed. Sampling rate is specified in 4.3 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.

For FAT, certain tests shall be administered in a prescribed order with the same suspension system.

Characteristic	Requirement Paragraph	Verification Paragraph	FAT 1/	LAT 1/	FAT Sample Size
TESTS BELOW REQUIRE FINISHED SHELLS FOR DESTRUCTIVE / INVASIVE TESTING					
Infrared Reflectance	3.4.5.3	4.10.7.1	X	2/	1 of any size (Medium)
Specular Gloss	3.4.5.4	4.10.7.2	X	2/	1 of any size (Large)
Fragmentation protection – Minimum V_{50} Ballistic Protection Limits (V_{50} BL(P))	3.7.1	4.10.10.1, 4.10.10.1.3, 4.10.10.3	X	X 3/	14 Small 17 Medium 15 Large 14 Extra-Large (Includes contingencies)
Seawater Resistance	3.11.1	4.10.4, 4.10.10.7.5, 4.10.13.1	X	2/	1 each size
Weatherometer Resistance	3.11.2	4.10.4, 4.10.13.1	X	2/	1 of any size (Large)
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					

1/ An "x" in the column designates that the test is performed. Sampling rate is specified in 4.3 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 4.10.10.2.

Characteristic	Requirement Paragraph	Verification Paragraph	FAT 1/	LAT 1/	FAT Sample Size
TESTS BELOW REQUIRE COMPLETE SUSPENSION AND RETENTION SYSTEMS					
Suspension System	3.6	4.10.1	X	2/	1 complete suspension system
Pad Construction	3.6.3	4.10.9.2	X	2/	6 complete suspension systems
Padding Layer Material	3.6.3.1, 3.6.3.2	4.10.9.3, 4.10.9.4	X	X	1 complete suspension system
Outer Layer Material	3.6.3.2	4.10.1, 4.10.9.5, 4.10.9.7	X	2/	1 complete suspension system
Pad Compression Durability	3.6.3.3	4.10.9.6	X	2/	1 complete suspension system
Retention system	3.5	AR/PD 17-06	X	2/	6 complete retention systems
The tests above require at least six (6) **Complete Suspension Systems** and six (6) **Complete Retention Systems**.					

1/ An “x” in the column designates that the test is performed. Sampling rate is specified in 4.3 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.

For FAT, certain tests shall be administered in a prescribed order with the same suspension system.

Characteristic	Requirement Paragraph	Verification Paragraph	FAT 1/	LAT 1/	FAT Sample Size
TESTS BELOW REQUIRE COMPLETE HELMETS FOR VISUAL / NON-INVASIVE INSPECTIONS					
Benchmarks	3.3.5	4.10.4	X	2/	1 each size
Benchmarks – Finished Shell	3.3.5.2	4.10.4	X	2/	1 each size
Night Vision Device Hole 5/	3.4.2	4.10.1, 4.10.1.1	X	2/	1 Helmet of Each Size (with samples of hardware)
Edging	3.4.3.2	4.10.1, 4.10.6	X	2/	1 Helmet of Each Size
Coating	3.4.5	4.10.1	X	2/	CoC
Attachment Material Shape	3.6.4.2	4.10.1	X	2/	1 Helmet of Each Size
Attachment Material Coverage	3.6.4.3	4.10.1, 4.10.9.8.1	X	2/	1 Helmet of Each Size
Weight	3.8	4.10.11	X	X	5 Helmets of Each Size
Integration / compatibility	3.12	4.10.14	X	2/	1 Helmet of Each Size
Marking of Finished Helmet Shell	3.13.1	4.10.1, 4.10.15.1	X	X 4/	1 Helmet of Each Size
Service Life	3.13.4	4.10.16	X	2/	Contractor data as required
Shelf Life	3.13.5	4.10.17	X	2/	Contractor data as required
Safety	3.14.1	4.10.19	X	2/	Contractor data as required
Toxicity	3.14.2	4.10.20	X	2/	Contractor data as required
Hazardous materials	3.14.3	4.10.21	X	2/	Contractor data as required
Workmanship	3.15	4.10.1	X	X	5 Helmets of Each Size

The tests above shall be performed on Helmet samples prior to the Destructive / Invasive tests. Multiple visual / non-invasive inspections may be conducted on a single helmet. The tests above require at least five (5) finished helmets of each size. An additional three (3) finished helmets of each size are required for contingencies for non-ballistic testing, for **a total of eight (8) finished helmets per size**.

1/ An "x" in the column designates that the test is performed. Sampling rate is specified in 4.3 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.

4/ The LAT Testing table below in Section A.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.

5/ Applies to Type I helmets only.

For FAT, certain tests shall be administered in a prescribed order with the same suspension system.

Characteristic	Requirement Paragraph	Verification Paragraph	FAT 1/	LAT 1/	FAT Sample Size
TESTS BELOW REQUIRE COMPLETE HELMETS FOR DESTRUCTIVE / INVASIVE TESTS					
Edging adhesion	3.4.4.1	4.10.6.2	X	X 4/	1 Helmet of Each Size
Edging Adhesion After Heat Aging	3.4.4.2	4.10.6.3	X	2/	1 Helmet of Each Size
Adhesion of coating	3.4.5.2	4.10.7	X	X 4/	3 Helmets of Each size
Static Pull Strength	3.5.3	4.10.8.1	X	2/	1 Medium Finished Helmet
Dynamic Pull Strength	3.5.4	4.10.8.2	X	2/	7 Medium Finished Helmets
Resistance to Penetration – 9mm	3.7.3	4.10.10.1.2, 4.10.10.4	X	X 3/	27 of each Size (includes contingencies)
Ballistic Transient Deformation	3.7.4	4.10.10.1.2.2, 4.10.10.5	X 5/	X 3/ 5/	
NVD Hardware Resistance to Penetration – 9mm 6/	3.7.3.2	4.10.10.1.2.2	X	X 3/	3 Helmets of Each Size
Blunt Impact Protection	3.9	4.10.12	X	X 4/	6 Helmets of Each Size
Field agent resistance	3.11.3	4.10.13.3	X	2/	Any 1 Helmet
Flame resistance	3.11.4	4.10.13.4	X	2/	1 Helmet of Each Size
High temperature storage and use	3.11.5	4.10.1, 4.10.13.5	X	2/	Any 1 Helmet
Cold Temperature Storage and Use	3.11.6	4.10.1, 4.10.13.6	X	2/	Any 1 Helmet
Temperature Shock	3.11.7	4.10.1, 4.10.13.7	X	2/	Any 2 Helmets
Altitude	3.11.7	4.10.1, 4.10.13.8	X	2/	Any 1 Helmet
Vibration	3.11.8	4.10.13.9	X	2/	1 Helmet of Each Size
Impact Resistance	3.11.9	4.10.13.9	X	2/	1 Helmet of Each Size
Compression Resistance (top to bottom)	3.11.11	4.10.13.11	X	2/	1 Helmet of Each Size
Compression Resistance (side to side)	3.11.12	4.10.13.12	X	2/	1 Helmet of Each Size
Accelerated Aging / Shelf Life	3.11.13	4.10.1, 4.10.13.13	X	2/	1 Medium Helmet
Washability	3.13.3	4.10.15.3	X	2/	Any 1 Helmet
The destructive tests above require Two Hundred (200) Complete Finished Helmets The required size breakdown for Complete ACH Gen II = 53 Small, 55 Medium, 46 Large, 46 X-Large Note: The above number of helmets include required contingencies and applies to Type I helmets. Different helmet Types may require a corresponding quantity adjustment.					

1/ An “x” in the column designates that the test is performed. Sampling rate is specified in 4.3 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 4.10.10.2.

4/ The LAT Testing table below in Section A.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.
5/ BTD is for Government reference.
6/ Applies to Type I helmets only.

For FAT, certain tests shall be administered in a prescribed order with the same suspension system.

Characteristic	Requirement Paragraph	Verification Paragraph	FAT 1/	LAT 1/	FAT Sample Size
TESTS BELOW REQUIRE BULK MATERIAL FOR DESTRUCTIVE TESTS					
Inner Layer Material	3.6.3.1	4.10.9.2 and 4.10.9.7	X	2/	5 Yards of Inner Layer Material
Outer Layer Material	3.6.3.3	4.10.9.4 and 4.10.9.7	X	2/	5 Yards of Outer Layer Material
Attachment Material Durability	3.6.3.4	4.10.9.8.2	X	2/	3 Yards of Attachment Material
Colorfastness	3.6.5	4.10.9.9	X	2/	5 Yards of Inner Layer Material 5 Yards of Outer Layer Material 3 Yards of Attachment Material
The tests above require at least five (5) yards of inner layer material, five (5) yards of outer layer material, and three (3) yards of 1.0-inch width attachment material					

1/ An “x” in the column designates that the test is performed. Sampling rate is specified in 4.3 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.

A.5 Hardware Impact Criterion.

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

a. 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.

b. 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:

c. 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. Additional testing will be conducted in accordance with paragraphs A and B specified below and the requirements document.

A.6 Ballistic FAT.

TABLE A-II. Helmet test matrix.

Type of Test	**Environmental Conditions**					
V_{50} 1/	**Ambient**	**Hot**	**Cold**	**Seawater**	**Weatherometer**	**Accelerated Aging**
2-grain RCC *4200 FPS min*	1 V_{50} Size: 2S	1 V_{50} Size: 2M	1 V_{50} Size: 2L	1 V_{50} Size: 2XL	-	-
4-grain RCC *3475 FPS min*	1 V_{50} Size: 2XL	1 V_{50} Size: 2S	1 V_{50} Size: 2M	1 V_{50} Size: 2L	-	-
16-grain RCC *2475 FPS min*	1 V_{50} Size: 2L	1 V_{50} Size: 2XL	1 V_{50} Size: 2S	1 V_{50} Size: 2M	-	-
17-grain FSP *2200 FPS min*	1 V_{50} Size: 2M	1 V_{50} Size: 2L	1 V_{50} Size: 2XL	1 V_{50} Size: 2S	1 V_{50} Size: 2L	1 V_{50} Size: 2M
64-grain RCC *1750 FPS min*	1 V_{50} Size: 4L	1 V_{50} Size: 4XL	1 V_{50} Size: 4M	1 V_{50} Size: 4S	-	-
V_0						
9mm RTP 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/	3 shots 3 helmets **Sizes:** 1S, 1M 1L, 0XL	3 shots 3 helmets **Sizes:** 0S, 1M 1L, 1XL	3 shots 3 helmets **Sizes:** 1S, 0M 1L, 1XL	3 shots 3 helmets **Sizes:** 1S, 1M, 0L, 1XL	-	-

1/ This matrix provides for a total of fifty-two (52) finished shells. An additional two (2) Small, three (3) Medium, one (1) Large, and two (2) Extra-large finished shells are required for contingency, which results in a total of sixty (60) finished shells.

2/ This matrix provides for a total of 192 shots. The required quantity of helmets to attain 192 shots with 2 impacts per helmet is 96 helmets. An additional three (3) finished helmets per size are required for contingency, resulting in a total of 108 finished helmets.

3/ This matrix provides for a total of 12 shots. The required quantity of helmets to attain 12 shots is 12 helmets. Type II helmets do not require 9mm RTP Hardware testing. 9mm RTP Hardware shall share contingency helmets with 9mm RTP Shell test samples.

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.

For Type I helmets, the total number of helmets required for the ballistic portion of FAT (including contingencies) is 169 based on the following makeup: S: 41; M: 44; L: 43; XL: 41. For Type II helmets, the 9mm RTP Hardware helmets are not required, resulting in 157 total helmets based on the following makeup: S: 38; M: 41; L: 40; XL: 38.

V_{50} FAT Criteria:

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 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 V_{50}, and there are no complete penetrations at or below the minimum required V_{50} 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 4.10.10.5.2.4 on testing progression.

V_{50} 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 FAT Criteria:

TABLE A-III. 9mm FAT RTP 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***	**Back***	Right	Front	Left	Front	Crown	Back
	#2	**Left***	**Front***	Crown	Back	Crown	Back	Right	Front
	#3	Crown	Back	Left	Front	**Right***	**Front***	Crown	Back
	#4	Right	Front	Crown	Back	Crown	Back	Left	Front
	#5	Crown	Back	Right	Front	Left	Front	Crown	Back
	#6	Left	Front	Crown	Back	Crown	Back	Right	Front
Medium	#1	Crown	Back	Left	Front	Right	Front	**Crown***	**Back***
	#2	Right	Front	**Crown***	**Back***	Crown	Back	Left	Front
	#3	Crown	Back	**Right***	**Front***	Left	Front	Crown	Back
	#4	Left	Front	Crown	Back	Crown	Back	Right	Front
	#5	Crown	Back	Left	Front	Right	Front	Crown	Back
	#6	Right	Front	Crown	Back	Crown	Back	Left	Front
Large	#1	Crown	Back	Right	Front	Left	Front	Crown	Back
	#2	Left	Front	Crown	Back	Crown	Back	Right	Front
	#3	Crown	Back	Left	Front	Right	Front	Crown	Back
	#4	Right	Front	Crown	Back	**Crown***	**Back***	Left	Front
	#5	Crown	Back	Right	Front	**Left***	**Front***	Crown	Back
	#6	Left	Front	Crown	Back	Crown	Back	Right	Front
X-Large	#1	Crown	Back	**Left***	**Front***	Right	Front	Crown	Back
	#2	Right	Front	Crown	Back	Crown	Back	Left	Front
	#3	Crown	Back	Right	Front	Left	Front	**Crown***	**Back***
	#4	Left	Front	Crown	Back	Crown	Back	**Right***	**Front***
	#5	Crown	Back	Left	Front	Right	Front	Crown	Back
	#6	Right	Front	Crown	Back	Crown	Back	Left	Front

RTP Acceptance Criteria for Finished Helmet (9mm).
The acceptance requirement for RTP (V_0) testing 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 at least 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. The shots for Part A are shown in TABLE A-III in bold text with an asterisk.

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 3.7.3.1 and 3.7.4.1).

For RTP testing, there will be twenty-five (25) separate calculations done for the Lower Confidence Level (LCL). These twenty-five (25) calculations will include all sizes and conditions for each test type (i.e., for calculating the LCL on the crown location, the data will consist of sizes S, M, L, and XL from the Ambient, Hot, Cold, and Seawater subtests). The LCL shall be calculated using the Clopper-Pearson method. The calculations are as follows:

1. RTP for all one hundred ninety-two (192) shots, including the first twenty-two (22) shots (Aggregate) – One (1) calculation
2. RTP in each of the four (4) locations (Front, Rear, Crown, Side) - Four (4) calculations
3. RTP in each of the four (4) environmental conditions (Ambient, Hot, Cold, Seawater) – Four (4) calculations
4. RTP in each of the four (4) sizes (Small, Medium, Large, Extra-Large) – Four (4) calculations
5. RTP in each the four (4) conditions in each of the three (3) cross conditions (Size by Location, Environment by Location, Size by Environment) – Twelve (12) calculations

The LCLs for each RTP calculation shall meet the LCLs as defined in TABLE A-V.

TABLE A-IV. Statistical analysis requirement.

Resistance to Penetration (RTP)	
Analysis Method	X_{RTP}% P(nP)* with 90% Lower Confidence Limit *where P(nP) is the Probability of no Penetration
Ballistic Transient Deformation (BTD)	
Analysis Method	Upper Tolerance Limit (UTL) as calculated per APPENDIX B for Government reference

TABLE A-V. RTP Lower Confidence Levels (LCL).

Conditions	LCL (X_{RTP}% P(nP) / % Confidence)	Allowable Complete Penetrations per Sub-Condition
Aggregate	96 / 90	3
Size	89 / 90	2
Environment	89 / 90	2
Location	89 / 90	2
Size by Location	71 / 90	1
Environment by Location	71 / 90	1
Size by Environment	71 / 90	1

The BTD during RTP impacts will be measured and recorded for Government reference.

The 9mm hardware RTP shot matrix shall be as shown in TABLE A-VI.

TABLE A-VI. 9mm NVD hardware RTP shot matrix

Condition	Helmet	Size
Ambient	1	S
	2	M
	3	L
Hot	1	M
	2	L
	3	XL
Cold	1	S
	2	L
	3	XL
Seawater	1	S
	2	M
	3	XL

V_{50} LAT Criteria:

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 ft/sec. In cases where the velocity spread is greater than 125 fps, 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 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 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 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 LAT Testing:

Testing will be conducted in accordance with the lot testing matrix. The RTP requirement is shown in the accept/reject criterion specified below.

The helmet-based sampling rate for 9mm RTP LAT follows the recommendations of ANSI Z1.4 special inspection level number three (S-3) with an acceptance quality limit of 1.5. The hardware-based sampling rate for 9mm RTP hardware testing follows the recommendations of ANZI Z1.4 special inspection level number two (S-2) with an acceptance quality limit of 1.5. The table below provides the sampling rate for all selected lot tests.

TABLE A-VII. LAT – helmet quantities

Lot Size	9mm RTP (Helmet) 1/	9mm RTP (NVD Hardware) 2/	17-grain FSP V_{50} 3/	Blunt Impact	Edging Adhesion	Coating Adhesion	Static Pull Strength	Water Absorbency*	Barcode Label / Marking**	Contingency	Total
≤ 500	8	8	2	2	1	2	1	~	~	5	24
501 - 1200	8	13	2	3	2	3	1	~	~	6	28
1201 - 3200	8	13	3	3	3	4	1	~	~	6	32

*Pads used for the water absorbency test will be taken from the V_{50} 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 two (2) shots per helmet. Each helmet shall be shot in two (2) of four (4) shot locations with only one (1) shot per location. The shot locations must follow the set shot order contained in the LAT plan.
2/ 9mm RTP tsting os for Type I helmets only. If a vendor chooses to qualify larger quantity hardware lots separately from helmet lots, they may follow othe requirements identified in the Integrated Head Protection System Purchase Description – AR/PD 17-02.
3/ Test conducted at 0° (±5°) obliquity at ambient conditions. One V50 BL(P) shall be determined for each V50 sample helmet. If multiple helmet shells are required to determine the V_{50} BL (P), contingencies may be used to augment the testing for a given sample shell. Use of multiple shells to determine a single V50 BL(P) shall not change the number of V50 BL(P) determinations used to determine lot acceptance.

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

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-VIII. LAT – accept/reject criteria.

Lot Size	LAT - Accept/Reject Criteria (minor defects)											
	9mm RTP (Helmet)		9mm BTD (Helmet)		9mm RTP (NVD Hardware) 1/		17-grain V_{50} (Shell)		Blunt Impact (1st Drop)		Blunt Impact (2nd Drop)	
	Accept	Reject	Accept	Reject	Accept	Reject	Accept	Reject	Accept	Reject	Accept	Reject
≤ 500	0	1	N/A; Government Reference		1	2	0	1	0	1	1	2
501 - 1200	0	1			1	2	0	1	1	2	1	2
1201 - 3200	0	1			1	2	0	1	1	2	1	2

1/ Applies to Type I helmets only

TABLE A-IX. LAT – accept/reject criteria

	LAT - Accept/Reject Criteria									
	Static Pull (Retention System)		Edging Adhesion		Paint Adhesion		Suspension System Water Absorbency		Barcode Label / Marking**	
Lot Size	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.

APPENDIX B

BALLISTIC TRANSIENT DEFORMATION UPPER TOLERANCE LIMIT ANALYSIS

B.1. Scope. This appendix describes the procedure for UTL analysis of 9 mm BTD FAT and LAT data. For FAT, the purpose of this analysis is twofold: (a) to check for statistical differences between test conditions, and (b) to establish baseline BTD performance of the helmet design for Government reference. For LAT, the purpose of this analysis is to monitor the lot production of the approved helmet design for continued performance to the FAT baseline for Government reference. This Appendix is a mandatory part of the specification.

B.1.1 Combat helmets do not demonstrate uniform BTD performance across all helmet locations; thus, no UTL analysis of combat helmet performance by environment across all sizes and locations or by size across all environments and locations shall be conducted.

B.1.2 In some cases, combat helmet BTD performance is uniform enough by location across all helmet sizes and environmental conditions to be examined together. In other cases, the data cannot be aggregated.

B.1.3 If statistically significant differences exist in helmet BTD performance, as measured by the guidelines provided within this appendix, the data cannot be aggregated across size by environment and location. In some cases of statistically significant difference, the data must be examined by location and size across all environments. In other cases of statistically significant difference, the data must be examined by location and environment across all sizes.

B.1.4 In case of significant differences both by size and by environment, compute separate UTLs for Location by Size across all Environments as well as separate UTLs for Location by Environment across all Sizes.

B.2. Transient Deformation Determination. BTD UTL shall be determined for each impact location. BTD values will be determined by comparing the differences in the elevation of the pre-shot clay surface at the intended impact location to the surface of the clay after the impact has been made. For BTD measurements the following requirements must be met. Deviation from these requirements requires explicit approval from PM SPE.

B.2.1 A laser scanning device will be used in accordance with the most recent revision of ATC Materials and Measurements Test Branch (MMTB) IOP 002: Measurement of Back-Face Deformation using Faro Quantum Laser Scan Arm and Geomagic Qualify for Helmets (RPS Alignment).

B.2.2 The method used to determine BTD values shall be in accordance with the most recent revision of MMTB IOP 002.

B.2.3 The pre-shot and post-shot scans will then be analyzed in accordance with the most recent revision of MMTB IOP 002 to determine the maximum BTD of depression made by the impact. In making this determination, any clay surrounding the impression that has been raised above the original level of the surface (cratering) will be ignored. The BTD value will be recorded as the number of digits specified in accordance with the most recent revision of MMTB IOP 002. The BTD value will be reported in millimeters to the nearest tenth digit following standard ASTM E29 “Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications” (rounding method paragraph 6).

B.3. Combined Sides. BTD protocol contained in this purchase description for FAT and LAT assumes that the continuous BTD data for the side location can contain the combined data from both the right and left side. This assumption will be assessed during data evaluation. Analysis of Variance (ANOVA) on the FAT BTD data from the left and right shot locations shall be used to determine whether the data from the two sides can be combined. For this analysis, a significant difference means a 1.67% or lower chance that the observed differences are random (α=0.0167, Type I error rate ≤5%). If a particular helmet design demonstrates a statistically significant difference in performance between the left and right sides, then the Government may elect to alter the protocol described by this purchase description to allow a two-fold increase in the number of side shots taken for the left and for the right. This will allow the left and right sides to undergo the same statistical evaluation with the same criteria as the other locations – despite the inability to combine the sides.

B.3.1 The factors in the ANOVA are the side (left versus right), helmet size, environmental conditioning, and all of their two-way interactions. Please note that the data from the other shot locations must be excluded while validating the assumption that sides can be combined. If any of the model terms associated with the side factor are significant, then the sides cannot be combined.

B.3.2 The global null hypothesis under test in an ANOVA framework is that none of the groups (in this case, specific combinations of side, helmet size, and environmental condition) has a significantly different mean. Using a three factor ANOVA with interactions, the analysis will test this hypothesis for each of the factors and their two-way interactions.

B.3.3 The ANOVA procedure can be broken into three steps.

B.3.3.1 In the first step, the variability in the BTD data is partitioned into a sum of squares, components attributable to each factor or interaction and to the unexplained variation. Type III (or marginal) sum of squares should be calculated for each variable in the main effect plus two-way interactions ANOVA model.

B.3.3.2 In the second step of the ANOVA procedure, the individual sum of squares for each factor or interaction is compared to the sum of squares for the error. This step gives an F-value for each factor or interaction. The F-values in the ANOVA table, shown in TABLE B-I, are ratios of factor sums of squares to the error sum of squares weighted by the degrees of freedom available for testing each factor or interaction. In TABLE B-I, a is the number of side conditions examined (left and right). The number of size conditions examined is b (small, medium, large, and extra-large). The number of environmental conditions examined is c (cold, ambient, hot, and seawater immersion). The number of replicate groups with discrete conditions of size (h), environment (f), and location (p) is g, and l represents a particular replicate group (h,f,p). The number of replicates in a particular replicate group is R. The total number of observations is N.

B.3.3.3 In the third step of the ANOVA procedure, the individual F-values for each factor or interaction of interest (side, side and size, and side and environment) are compared to the critical F-values provided in TABLE B-I. These critical values are at the 1.67% significance level (α=0.0167, Type I error rate ≤5%). If the calculated F-value exceeds the critical F-value for the side factor or either of the associated interaction terms (side by size or side by environment), then the side data cannot be combined. See APPENDIX B; paragraph B.3 for actions to take under this circumstance. If the calculated F-value is equal to or less than the critical F-value for the side factor or either of the associated interaction terms (side by size or side by environment), then performance analysis of FAT may begin with no additional testing and no changes the test matrices contained in this purchase description is required.

TABLE B-I. ANOVA table for side shots.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	Critical Value
Side (A)	$a-1=1$	SSA	$MSA=\frac{SSA}{1}$	$\frac{MSA}{\text{MSE}}$	F(0.0167, 1, 16) **7.140**
Size (B)	$b-1=3$	SSB	$MSB=\frac{SSB}{3}$	$\frac{MSB}{\text{MSE}}$	N/A
Environment (C)	$c-1=3$	SSC	$MSC=\frac{SSC}{3}$	$\frac{MSC}{\text{MSE}}$	N/A
Side · Size (A·B)	$(a-1)(b-1)=3$	SSAB	$MSAB=\frac{SSAB}{3}$	$\frac{MSAB}{\text{MSE}}$	F(0.0167, 3, 16) **4.596**
Side · Environment (A·C)	$(a-1)(b-1)=3$	SSAC	$MSAC=\frac{SSAC}{3}$	$\frac{MSAC}{\text{MSE}}$	F(0.0167, 3, 16) **4.596**
Size · Environment (B·C)	$(b-1)(c-1)=9$	SSBC	$MSBC=\frac{SSBC}{9}$	$\frac{MSBC}{\text{MSE}}$	N/A
Pure Error	$\sum_{l=1}^{g}(R_l-1)=16$	SSPE	$MSPE=\frac{SSPE}{16}$	N/A	N/A
Error	$N-abc=16$	SSE	$MSE=\frac{SSE}{16}$	N/A	N/A
Total $N=\sum_{h}\sum_{f}\sum_{p}R_{hfp}$	$N-1=47$	SST	N/A	N/A	N/A

B.4. Analysis Methods for Significant Factors. An ANOVA using all of the BTD data from FAT shall be used to determine if helmet size or environmental conditioning is significant. This analysis assumes that shot location will always be a significant factor and treats the combined left and right sides as a single location. If the analysis in paragraph B.3 of APPENDIX B indicates that the sides must be treated as separate locations, TABLE B-II must be modified accordingly. If the calculated F-value for any factor of interest is greater than the critical value listed, that factor is significant. The ANOVA can be broken into three steps.

B.4.1 In the first step, the variability in the BTD data is partitioned into a sum of squares, components attributable to each factor or interaction and to the unexplained variation. Type III (or marginal) sum of squares should be calculated for each variable in the main effect plus two-way interactions ANOVA model.

B.4.2 In the second step of the ANOVA procedure, the individual sum of squares for each factor or interaction is compared to the sum of squares for the error. This step gives an F-value for each factor or interaction. The F-values in the ANOVA table, shown in TABLE B-II, are ratios of factor sums of squares to the error sum of squares weighted by the degrees of freedom available for testing each factor or interaction.

B.4.3 In the third step of the ANOVA procedure, the individual F-values for each factor or interaction of interest are compared to the critical F-values provided in TABLE B-II. This establishes which factors are critical and which are not.

TABLE B-II. ANOVA table for analysis of significant factors

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	Critical Value
Location (A)	$a-1=3$	SSA	$MSA=\frac{SSA}{3}$	$\frac{MSA}{\text{MSE}}$	N/A
Size (B)	$b-1=3$	SSB	$MSB=\frac{SSB}{3}$	$\frac{MSB}{\text{MSE}}$	F(0.0125, 3, 128) **3.763**
Environment (C)	$c-1=3$	SSC	$MSC=\frac{SSC}{3}$	$\frac{MSC}{\text{MSE}}$	F(0.0125, 3, 128) **3.763**
Location · Size (A·B)	$(a-1)(b-1)=9$	SSAB	$MSAB=\frac{SSAB}{9}$	$\frac{MSAB}{\text{MSE}}$	N/A
Location · Environment (A·C)	$(a-1)(b-1)=9$	SSAC	$MSAC=\frac{SSAC}{9}$	$\frac{MSAC}{\text{MSE}}$	N/A
Size · Environment (B·C)	$(b-1)(c-1)=9$	SSBC	$MSBC=\frac{SSBC}{9}$	$\frac{MSBC}{\text{MSE}}$	F(0.0125, 9, 128) **2.468**
Pure Error	$\sum_{l=1}^{g}(R_l-1)=128$	SSPE	$MSPE=\frac{SSPE}{128}$	N/A	N/A
Error	$N-abc=128$	SSE	$MSE=\frac{SSE}{128}$	N/A	N/A
Total $N=\sum_{h}\sum_{f}\sum_{p}R_{hfp}$	$N-1=191$	SST	N/A	N/A	N/A

B.5. FAT UTL Reporting Requirements. The results of the significant factors analysis determines what UTL calculations to perform on FAT data. If neither size nor environment are significant and the two-way interaction between size and environment also is not significant, then a 90/90 UTL for each location across all sizes and environments shall be calculated and reported. If neither size nor environment are significant and the two-way interaction between size and environment is significant, then a 90/90 UTL for each location by size across all environments and a 90/90 UTL for each location by environment across all sizes shall be calculated and reported. If size is significant and environment is not significant, then a 90/90 UTL for each location by size across all environments shall be calculated and reported. If size is not significant and environment is significant, then a 90/90 UTL for each location by environment across all sizes shall be calculated and reported. TABLE B-III details these calculation guidelines. Note that if both size and environment are significant no UTLs shall be calculated; see paragraph B.1.4 of APPENDIX B.

TABLE B-III. UTL reporting flowchart.

UTL Details					Significant Factors	
UTL Factor(s)	*Effective Sample Size*	*Number of Calculations*	*k*	*UTL*	*Size*	*Environment*
Location	48	4	1.602	90/90	NO	NO
Location and Size	12	16	2.043	90/90	YES	YES
Location and Environment	12	16	2.043	90/90		
Location and Size	12	16	2.043	90/90	YES	NO
Location and Environment	12	16	2.043	90/90	NO	YES

B.5.1 Cluster Analysis. Cluster analysis (additional testing) may be conducted to ensure a large enough sample size if size and/or environment are significant factors. If the Government elects to conduct cluster analysis, twenty-four (24) additional shots shall be taken for each UTL selected by the Government for additional testing. These additional shots will be combined with the corresponding FAT shots for a final sample size of 36. The 90/90 UTL shall be calculated using a *k*-value of 1.618 as solved by Equation 2 where *N* is 36, *n* is 36, *l* is 1, and z_p is 1.2815516. The UTL calculation shall use the standard deviation from the sample of 36 in place of the pure error, using degrees of freedom of 35 for the standard deviation calculation.

B.6. UTL Calculation. When calculating the sample mean and pure error in order to compute the UTL, calculate both the mean and pure error to six significant digits. This is to prevent the rounding of these intermediate quantities from affecting the reported UTL. The final result (the UTL) is then reported to one decimal place as specified in APPENDIX B paragraph B.2.3. The formula for BTD UTL is given in the following general equation:

$$UTL_{\mathrm{X}_{BTD}/\mathrm{Y}} \approx \overline{BTD} + k \cdot s \qquad \text{(Equation 1)}$$

In Equation 1, $\overline{BTD}$ is the average BTD for all shots for the evaluated conditions. For example, the average BTD on a particular helmet location across all environments and sizes or the average BTD for a particular helmet location and size across all environments, et cetera. Also in Equation 1, *k* is a constant calculated using Equation 2, and *s* is the estimate of the pure error (see Equation 5).

For FAT, *k* is equal to 1.602 when the sides can be combined and the reporting requirements require the calculation of UTL by location. For all other UTL calculations where the sides can be combined, *k* is equal to 2.043; see TABLE B-III. The *k* constant is calculated by numerically solving:

$$\frac{1}{2^{\frac{N-l}{2}}\Gamma\left(\frac{N-l}{2}\right)}\int_0^{\infty}\left[\Phi\left(\sqrt{n}\left(\frac{k_1^*\sqrt{x}}{\sqrt{N-l}}-z_p\right)\right)\right]^l e^{-\frac{x}{2}}x^{\frac{N-l}{2}-1}\,dx = 1-\alpha \quad \text{(Equation 2)}$$

In Equation 2, N is the total number of shots (192 for FAT), l is the number of groups (4 for Location, 16 for Location by Size or Location by Environment during FAT), n is number of shots per group (48 for Location, 12 for Location by Size or Location by Environment during FAT), α is one minus the confidence (α = 1 – 0.90 = 0.1), z_p is inverse of the standard normal distribution for the standard normal cumulative distribution for a given population probability (z_p = 1.2815516 for 90%), Φ is the normal cumulative distribution function, and Γ is the gamma function where $\Gamma(v) = (v-1)!$. For all conditions, the level of confidence is equal to 90%.

The pure error degrees of freedom (*DFPE*) is found by:

$$DFPE = \sum_{l=1}^{g}(R_l\text{-}1). \quad \text{(Equation 3)}$$

In Equation 3, *l* is a replication group, *g* is the number of replication groups, and R_l is the number of replicates in the l^{th} group. For FAT, DFPE is equal to 128.

The pure error (*s*) can be found by:

$$s = \sqrt{\frac{SSPE}{DFPE}}. \quad \text{(Equation 4)}$$

In Equation 4, the pure error sum of squares (*SSPE*) is found by the following equation:

$$SSPE = \sum_{h=1,f=1,p=1,t=1}^{N}\left(BTD_{hfpt} - \overline{BTD}_{hfp}\right)^2. \quad \text{(Equation 5)}$$

In Equation 5, *h* is helmet size (1 = small, 2 = medium, 3 = large, and 4 = extra-large); *f* is environment (1 = cold, 2 = ambient, 3 = hot, and 4 = seawater immersion); *p* is location (1 = crown, 2 = back, 3 = sides, and 4 = front); *t* is replications (3); *N* is the total number of shots (192); BTD_{hfpt} is the observed ballistic transient deformation for a particular size, environment, location, and replication; and $\overline{BTD}_{hfp}$ is the average ballistic transient deformation for all replications of a particular size, environment, and location.

Lastly, the mean squared pure error (*MSPE*) is found by:

$$MSPE = \frac{SSPE}{DFPE}. \quad \text{(Equation 6)}$$

B.6.1 If required by the guidelines in TABLE B-III, the location calculation shall be conducted across all sizes and environments. This results in four total calculations. 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 side locations only.

B.6.2 If required by the guidelines in TABLE B-III, the location and size calculation shall be conducted across all environments. This results in sixteen total calculations. These sixteen (16) calculations will include all conditions for each test type (i.e., for calculating the UTL on the crown location for the size small helmet, the data will consist of results from the Ambient, Hot, Cold, and Seawater subtests). These calculations are as follows:

(1) Calculation for deformations in the front location size small only.
(2) Calculation for deformations in the rear location size small only.
(3) Calculation for deformations in the crown location size small only.
(4) Calculation for deformations in the side locations size small only.
(5) Calculation for deformations in the front location size medium only.
(6) Calculation for deformations in the rear location size medium only.
(7) Calculation for deformations in the crown location size medium only.
(8) Calculation for deformations in the side locations size medium only.
(9) Calculation for deformations in the front location size large only.
(10) Calculation for deformations in the rear location size large only.
(11) Calculation for deformations in the crown location size large only.
(12) Calculation for deformations in the side locations size large only.
(13) Calculation for deformations in the front location size extra-large only.
(14) Calculation for deformations in the rear location size extra-large only.
(15) Calculation for deformations in the crown location size extra-large only.
(16) Calculation for deformations in the side locations size extra-large only.

B.6.3 If required by the guidelines in TABLE B-III, the location and environment calculation shall be conducted across all sizes. This results in sixteen total calculations. These sixteen (16) calculations will include all conditions for each test type (i.e., for calculating the UTL on the crown location for the ambient temperature condition, the data will consist of results from the size S, M, L, and XL subtests). These calculations are as follows:

(1) Calculation for deformations in the front location ambient condition only.
(2) Calculation for deformations in the rear location ambient condition only.
(3) Calculation for deformations in the crown location ambient condition only.
(4) Calculation for deformations in the side locations ambient condition only.
(5) Calculation for deformations in the front location cold condition only.
(6) Calculation for deformations in the rear location cold condition only.
(7) Calculation for deformations in the crown location cold condition only.
(8) Calculation for deformations in the side locations cold condition only.
(9) Calculation for deformations in the front location hot condition only.
(10) Calculation for deformations in the rear location hot condition only.
(11) Calculation for deformations in the crown location hot condition only.
(12) Calculation for deformations in the side locations hot condition only.
(13) Calculation for deformations in the front location seawater immersion condition only.
(14) Calculation for deformations in the rear location seawater immersion condition only.
(15) Calculation for deformations in the crown location seawater immersion condition only.
(16) Calculation for deformations in the side locations seawater immersion condition only.

APPENDIX C

CHANGES

Page/Section/Paragraph	Change
PD Name	Amendment “1”
Page Headings	Added a header “AR/PD 14-01 Rev C Amendment 1”
p.4	Corrected Retention System drawing numbers
Appendix C	Added Appendix C/ Change Table