INCH-POUND

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SUPERSEDING
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PURCHASE DESCRIPTION

HELMET, ADVANCED COMBAT (ACH)

Record of Revisions

REV	CHANGED BY	REVISED PAGE(S)	DESCRIPTION	DATE	Approval
-	PM SPE	Multiple	Update to incorporate historical change pages and other revisions from CO/PD 05-04	14/12/10	IAR

MILITARY INTERESTS:

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Army – PM SPE

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

1. SCOPE

1.1 Scope. This document covers the performance and verification requirements for the Advanced Combat Helmet, a protective helmet consisting of a ballistic protective shell, pad suspension system, and 4-point chinstrap/nape strap retention system. The ACH is a Critical Safety Item.

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

Type I – Advanced Combat Helmet (No Hole Night Vision Goggle Mount)
Class 1 - 3/4-inch thick pad system, Foliage Green 504
Class 2 - Light weight shell, 3/4-inch thick pad system, Foliage Green 504

Type II – Advanced Combat Helmet (One Hole for Night Vision Goggle Mount)
Class 1 - 3/4-inch thick pad system, Foliage Green 504
Class 2 - Light weight shell, 3/4-inch thick pad system, Foliage Green 504

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be used in improving this document should be addressed to: Project Manager – Soldier Equipment, Program Executive Office – Soldier, US Army, 10170 Beach Road, Building 325, Fort Belvoir, Virginia 22060.

AMSC N/A FSC 8470

1.3 Schedule of sizes. The helmet assembly is constructed in the following sizes (see 6.2).

SCHEDULE OF SIZES
Small
Medium
Large
Extra-Large
Extra Extra-Large
NOTE: size may be abbreviated as S, M, L, XL, or XXL

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4 and 5 of this specification. 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 documents cited in sections 3, 4 and 5 of this specification, whether or not they are listed.

2.2 Government documents.

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

DEPARTMENT OF DEFENSE SPECIFICATIONS

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

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-662	- V_{50} Ballistic Test for Armor
MIL-STD-810	- Environmental Engineering Considerations and Laboratory Tests
MIL-STD-1916	- Department of Defense Test Method Standard, DoD Preferred Method for Acceptance of Product

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

2.2.2 Other Government documents, drawings, and publications. The following other 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	- Helmet Pads
2-1-2510	- Retention System Assembly, Advanced Combat Helmet
PL2-1-2510	- Retention System Assembly, Advanced Combat Helmet
2-1-2565	- Chinstrap Tab Assembly
PL2-1-2565	- Chinstrap Tab Assembly

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

PURCHASE DESCRIPTIONS

GL/PD-07-19 - Retention System, Advanced Combat Helmet (ACH)
FQ/PD-06-35 – Fragmentation Helmet, Lightweight, USMC

(Copies of this document are available from; Defense Supply Center Philadelphia, ATTN: DSCP-FQSE, 700 Robbins Ave, Philadelphia, PA 19111, or by contacting the Contracting Officer.)

DEPARTMENT OF TRANSPORTATION FEDERAL MOTOR VEHICLE SAFETY

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

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

NATIONAL INSTITUTE OF JUSTICE (NIJ)

NIJ Standard 0106.01- Ballistic Helmets

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

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

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

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

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

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

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

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

AMERICAN NATIONAL STANDARDS INSTITUTE

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

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

ASTM INTERNATIONAL (ASTM)

ASTM D76	- Standard Specification for Tensile Testing Machines for Textiles
ASTM D910	- Standard Specification for Aviation Gasoline's
ASTM D975	- Standard Specification for Diesel Fuel Oils
ASTM F1358	- Standard Test method for effects of Flame Impingement on Materials Used in Protective Clothing Not Designated Primarily for Flame Resistance

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

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

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

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), sample(s) shall be subjected to first article inspection (see 4.3 and 6.2). 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. Sequencing of specific verifications is listed in Section 4, if applicable.

3.1.1 Lot Acceptance. Samples, in lots of a single size, shall be subjected to Lot Acceptance Testing (production lot inspections). Samples will be examined for the defects specified in 4.9.1 and subjected to the tests indicated in 4.8, Table V. Acceptance criteria shall be specified in the contract (see 6.4). Unless noted otherwise, all Lot Acceptance Testing will be conducted under ambient conditions.

3.2 Material and components. All materials and components shall be as specified herein or on the applicable drawings as well as the contactors own documentation and drawings.

3.3 Finished helmet, finished shell and unfinished shell. The following definitions shall apply in this document. A finished shell shall include the shell, any primer, coating, and texturing aggregate, all necessary attachment holes, and any rubber edging and adhesive to hold the edging on. A finished helmet includes the finished shell plus hook disks, a complete pad set, and a complete retention system including any attaching hardware assembled in the standard configuration. The standard configuration is the configuration shown in TM 10-8470-204-10, WP 0005 (7 pad configuration with oblong/oval pads in the vertical pad configuration). An unfinished shell shall include the raw shell only, drilled with attachment holes (no primer, paint [coating], texturing aggregate, rubber edging, rubber edging adhesive, or hook disks).

3.4 Design/construction. The helmet shall meet the design requirements of this specification and referenced drawings and parts lists.

3.5 Shell design/shape. The shape of the shell, prior to the application of any edging or finish, shall be as specified herein and shall have the same shape as shown on drawings 2-1-2515, 2-1-2516, 2-1-2517, 2-1-2518, and 2-1-2519 and all subsidiary drawings and parts lists. These Government drawings are for guidance and reference only. Offeror submitted and approved drawings will become contract reference, thus standard, and cannot be deviated from. The measurements shall be taken to the inside surface only. The outside surface is defined by the inside surface plus the thickness (see 3.5.2). Testing shall be conducted in accordance with 4.9.2.

3.5.1 Shell construction. Upon removal from the mold, the outer and inner surfaces of the shell, excluding the bottom edge, shall be finished smooth and even. If fabric construction is used, there shall be no exposed ends of the fabric fiber showing. Both the inside and outside surfaces of the shell shall be free from any hole, void, delamination, blister, cracking, crazing, dry spot, area of non-resin flow and any pit greater than 1/8-inch diameter or the depth of one ply of the ballistic material, whichever is less, in order to provide a smooth continuous surface. There shall be no raised fibers, raised pleats, raised wrinkles or raised creases longer than 1 inch on the interior or exterior surfaces. Processing procedures and methods capable of providing uniform properties shall be used. Patching or repair of any ballistic material shall not be performed after the material has been molded. Remolding shells is not permitted. Plans to correct cosmetic imperfections, which fall within the acceptable criteria detailed above, must be submitted for government written approval prior to implementation; plans submitted for approval must include a detailed description of all tools, materials and methods necessary and cannot be deviated from without additional written approval. Cosmetic improvements shall not degrade ballistic material properties. More than one material (hybrid construction) may be used to achieve best combination performance requirements listed in the document. Testing shall be conducted in accordance with 4.9.1.

3.5.2 Shell thickness and uniformity. The following dimensional criteria are based on an unfinished shell. The maximum thickness for the helmet shells shall not exceed 0.400-inches regardless of the nominal thickness of the helmet. Thickness variations in the helmet shall be

gradual. The shell thickness shall not vary by more than 0.100-inches over the entire surface of the helmet. Testing shall be conducted in accordance with 4.9.3.

3.5.3 Benchmarks. The helmet shell shall have raised benchmarks molded into the shell as shown on drawings 2-1-2515, 2-1-2516, 2-1-2517, 2-1-2518, and 2-1-2576 on the interior or exterior. However, the crown benchmark must only reside on the interior of the shell. For the benchmarks located at the periphery of the shell, their length shall extend up past the helmet shell edging (if used, see 3.5.5) a distance of 0.500 (+ 0.250 / - 0.375) - inch beyond the top edge of the edging. If no edging is used, the benchmarks shall be 0.500 (± 0.250) - inch long extending upward from the shell edge. The benchmark at the crown shall be an "x" with each leg measured from the intersection of the "x" 0.250 (± 0.125) - inch long with one leg of the "x" pointing toward the front of the helmet, one to the rear, and one each to the left and right sides of the helmet. The benchmarks shall be clearly visible on a coated shell. Testing shall be conducted in accordance with 4.9.4.

3.5.4 Attachment holes. Holes to attach components to the helmet shell shall be made before application of the coating (see 3.5.6). There shall be no delamination greater than 0.125-inch from the edge of the hole or other damage of the shell material as a result of making the hole. There shall be minimal fraying, (i.e. uncut material attached at the edge of the hole) as a result of making the hole. At a maximum, the length of the uncut material shall be 0.125 inch. Additionally, the hardware that passes thru the hole shall pass thru the hole freely and not be impeded or obstructed by any frayed material. Testing for 3.5.4.1, 3.5.4.2 and 3.5.4.3 shall be conducted in accordance with 4.9.1 and 4.9.2.

3.5.4.1 Retention system holes. Holes for the Retention System, after application of the coating, shall be of the diameter as shown on drawings 2-1-2515, 2-1-2516, 2-1-2517, 2-1-2518, and 2-1-2576. The Universal Retention System Hardware must pass through the holes freely, by hand. Testing shall be in accordance with 4.9.1 and 4.9.2.

3.5.4.2 Night vision goggle (NVG) hole(s). The hole placement for the Type II (one hole) ACH shall be the responsibility of the contractor. The contractor will develop a template for the hole placement for Type II using Night Vision Goggle Bracket Kits cited in 3.13. The diameter for Type II holes shall be 0.200 (+ 0.010) inches. Testing shall be in accordance with 4.9.1 and 4.9.2.

3.5.4.3 Eyewear retention strap holes. The eyewear retention strap will be attached using the holes cited in 3.5.4.1.

3.5.5 Edging. The shell shall have a firmly bonded or an integrally molded edging that protects the periphery of the shell from delamination, wear, cuts, and tear. If the edging is integrally molded, it must be repairable or replaceable. The edging itself shall not be susceptible to cutting, wear, or tear. The edging shall completely cover the bottom edge of the shell and extend up the sides a minimum of 0.30-inch of the helmet shell. If the edging is a non-integral component of the molded shell, then the edging shall consist of a one-piece molded construction or one piece cut to length. If the edging is cut to length, the cut end shall be placed at the rear center of the shell and the butt ends shall not overlap and any gap between the ends shall not

exceed 0.060-inches. The edging shall be firmly and completely attached to the shell, i.e. there shall be no unbounded areas. The edging shall be rounded at the corners with a minimum radius of 1/16-inch. A corner shall be defined as the transition between the edge of the shell and the inside of the shell and the edge of the shell and the exterior of the shell, i.e. the "lower" part of the edging. The standoff of the applied edging from the shell (the sides as opposed to the edge or rim) shall be a maximum of 0.070-inch, for both inside and outside surfaces. The edging shall be colored the same color as the exterior of the shell (see 3.5.6). Testing shall be conducted in accordance with 4.9.1 and 4.9.5.1.

3.5.5.1 Edging adhesion. The edging shall remain firmly attached to the shell when tested as specified in 4.9.5.2.

3.5.5.2 Edging Adhesion of edging after heat aging. The edging shall not peel back more than 0.25-inch when tested as specified in 4.9.5.3.

3.5.6 Coating. Following the surface preparation specified in 3.5.6.1 and after application of suitable primer, if used, a minimum of two coats of coating shall be applied to the exterior of the helmet shell including the outside of the edging. The coating for Foliage Green 504 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, foreign matter appearing on or embedded in the finish shall be visible in the coating. While coating is not required for the interior helmet shell, it shall be a subdued color. The coating shall be applied in accordance with the manufacturer's instructions. The final coat made to the exterior shall contain the texturing aggregate specified in 3.5.6.2 shall be applied uniformly on the exterior surface of the helmet shell including the outside of the edging, but not the bottom edge of the edging. The bottom and inside edges of the edging need not be coated. Hardware exposed on the exterior and interior of the shell, (e.g. screw heads) shall not be coated. Testing shall be conducted in accordance with 4.9.1.

3.5.6.1 Shell surface preparation. Prior to the application of any coating to the surface of the helmet shell, the 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 helmet shell (see 3.5.1) may be filled with suitable materials (such as Acryl-Green Spot Putty) to provide a smooth and continuous surface. The rework of defects affecting ballistic material, such as filling blisters of any size, is not permitted. If surface preparation includes abrading, then the ballistic material shall show no signs of being visibly cut, gouged, or raised. Before application of the final coating the surface shall be free of any contaminants including dust, oil, grease or any other foreign matter. Testing shall be conducted in accordance with 4.9.1.

3.5.6.2 Texturing of coating. Texturing aggregate incorporated in the final coat for the exterior of the helmet shall be silica sand or walnut shell flour in accordance with 3.5.6.2.1 or 3.5.6.2.2. The aggregate shall be uniformly applied to cover the entire exterior of the shell including the outside of the edging. Testing shall be conducted in accordance with 4.9.1.

3.5.6.2.1 Sand texturing. The aggregate for sand texturing shall be banded silica sand that is water washed and kiln dried, free of salts and deleterious matter, and containing not more than 1.5 percent of dirt or foreign matter. The sand aggregate shall be that known commercially as No. 70 and shall have a screen analysis with a Percent cumulative of 34.0 (± 5). The coating-sand mixture shall contain six (6) pounds of sand to one (1) base gallon of coating and shall be reduced to spraying consistency. Testing shall be conducted in accordance with 4.9.1.

3.5.6.2.2 Walnut shell flour texturing. The aggregate for walnut shell flour texturing shall be 40/100-mesh walnut shell flour. The coating-walnut shell flour mixture shall contain no less than 10-ounces and no more than12-ounces of walnut shell flour per base gallon of coating. Testing shall be conducted in accordance with 4.9.1.

3.5.6.3 Adhesion of coating. The coating, when cut into squares, shall not lift when tested in accordance with 4.9.6.

3.6 Retention system. The helmet retention system and hardware shall be in accordance with Defense Supply Center Philadelphia (DSCP) Purchase Description (PD) GL/PD-07-19.

3.6.1 Retention system attachment points. Four attaching points shall be used for the chinstrap/nape pad, two on the front half of the helmet and two on the rear half, each symmetric about the helmet mid-sagittal centerline. The attaching points shall use the holes referenced in 3.5.4.1. The attaching points shall be in accordance with drawings 2-1-2515, 2-1-2516, 2-1-2517, 2-1-2518, and 2-1-2576. Testing shall be in accordance with 4.9.7 and 4.9.11.4.

3.7 Pad suspension system. The helmet shall utilize a modular pad suspension system consisting of a series of pads that act as the suspension system between the wearer's head and the helmet shell. The pads shall possess means of easy attachment, removal, and reattachment to the inside helmet shell. The pad suspension system shall attach, remove, and reattach to the helmet shell via hook tape disks permanently adhered to the inside of the helmet shell. The pads shall remain firmly in place when attached. The ease of attachment of the pads and the ability to attach the pads where the wearer desires (i.e. in a variety of locations) shall permit accommodations among different size and shape heads. There are three (3) different pad shapes that form the suspension system, round, trapezoidal, and oblong. A complete pad suspension kit shall consist of seven (7) pads as follows: one (1) round pad (crown), two (2) trapezoidal pads (front and back), and four (4) oblong pads (distributed around the perimeter to achieve comfort and stability). Drawing 2-1-2566 shows the shapes and dimensions of the pads. The 3/4-inch thick pad set shall be made up of all 3/4-inch thick pads. Testing shall be conducted in accordance with 4.9.8.1. Mandatory source for this component shall be in accordance with 6.8.

3.7.1 Pad construction. The pad shall have at least three basic layers or be designed in such a way as to function in three ways: an inner layer shall contact the wearer's head, a padding layer shall provide the standoff, comfort, protection and stability, and an outer material layer which attaches the pad to the hook disk inside helmet shell. The three layers shall be permanently joined around the perimeter to prevent disassembly. Testing shall be conducted in accordance with 4.9.8.2.

3.7.1.1 Inner layer material. The inner material that contacts the wearer's head shall wick moisture away from the wearer's head and absorb it. The color of the inner material shall be Foliage Green 504 for all helmet classes. Testing shall be conducted in accordance with 4.9.8.1, 4.9.8.5, and 4.9.10.1.

3.7.1.2 Padding layer material. The padding material shall provide standoff, comfort, protection and stability. The padding material shall not absorb or hold moisture when tested in accordance with 4.9.8.4. It may itself consist of multiple layers. Thickness of this layer shall provide for the bulk of the overall pad thickness required. Testing shall be accordance with 4.9.8.2.

3.7.1.3 Outer layer material. The outer material shall be made of a loop-type material and allow the pad to be attached to the inside of the helmet shell. The material shall have an average peel strength no less than 2.8 pounds per inch of width when tested in accordance with 4.9.9.4. It is desirable that the outer material interface with the currently fielded hook disk (3M p/n SJ3572). The color shall be Foliage Green 504 for all helmet classes. The outer material shall interface with hook disk. Testing shall be conducted in accordance with 4.9.8.1, 4.9.8.2, and 4.9.10.1.

3.7.2 Pad compression durability. The pads shall be constructed such that they can withstand multiple compressions without failing. Each pad shape and thickness shall be subjected to repeated 1/4-inch compressions and show no signs of degradation. Degradation includes, but is not limited to, the structure of the pad losing its resiliency, not returning to its original shape, and thickness. There shall be no physical damage to any of the pad components. Physical damage includes, but it is not limited to, breakage of threads (if used), seams, or closures, damage to any of the components such that they do not return to its original shape and thickness. Testing shall be in accordance with 4.9.8.3.

3.8 Hook disks. Hook disks shall interface with the outer material of the pads and attach the pads to the inner surface of the helmets. The hook disks are attached to the inside of the helmet shell by means of a pressure sensitive adhesive. One side of the disk shall be comprised of a means to attach the pad and the other side shall be coated with a self-stick adhesive (pressure sensitive) (see Figure 2). The exterior color (side facing the pad) of the hook disk shall be Black 357. Testing shall be conducted in accordance with 4.9.9.1 and 4.9.10.1.

3.8.1 Hook disk shape and coverage. Hook disk shape is at the discretion of the contractor. Shapes with square corners (i.e. rectangular or square) or pointed corners are unacceptable since the square corners have a tendency to peel at the corners. Shapes shall have rounded corners. A circular shape, 1-7/8 - inch in diameter is known to be satisfactory. Alternatively, the shape shown in Figure 2 may be acceptable and provide more coverage. An adequate number of hook disks shall be installed on the interior of the shell to allow movement of the pads into any position and to allow securing of the helmet cover. At a minimum, enough hook disks shall be installed to allow the smallest pad to be placed anywhere inside the shell and have at least half (1/2) of the pad's surface in contact with hook disk. After installation, no hook disks should have air bubbles, or gaps between the hook disk and the shell. There should be no hook disks

installed in the ear dome area of the shell. Additionally, no hook disk shall cover any molded-in markings. Testing shall be conducted in accordance with 4.9.9.1.

3.8.2 Hook disk durability. At no time shall removal of any helmet pad cause the hook material to become separated from the helmet shell. The adhesive shall firmly attach the disk to the inner surface of the helmets with no lifting of the hook disks on any contours within the helmets. Testing shall be in accordance with 4.9.9.2 and 4.9.9.3.

3.8.3 Hook/loop adhesion. The adhesion between the hook disk and the outer material on the pad shall be a minimum of 2.8 pounds per inch of width. Testing shall be in accordance with 4.9.9.4.

3.9 Ballistic protection. The helmet shell shall provide ballistic protection from fragments as well as 9mm projectiles. Protection shall meet the requirements set forth in this document throughout the entire surface area of the helmet unless specified otherwise in this document.

3.9.1 Fragmentation protection - minimum V_{50} ballistic protection limits (V_{50} BL(P)). The helmet shell shall be capable of providing the minimum V_{50} BL(P)s listed in Table II at 0° obliquity against the specified right circular cylinder (RCC) and Fragment Simulating Projectile (FSP) projectiles when tested in accordance with 4.9.11, 4.9.11.1., and 4.9.11.1.1 under the following conditions:

a. ambient
b. extreme hot (160°F)
c. extreme cold (-60°F)
d. after immersion in seawater, tested at ambient temperature
e. after exposure in weatherometer, tested at ambient temperature
f. after accelerated aging, tested at ambient temperature

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

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

1/ Right Circular Cylinders shall be in accordance with Figure 1.
2/ Fragment Simulating Projectile – MIL-DTL-46593B with Amendment 1, 1 April 2006, with the exception of Hardness Testing per ANSI/ASQ Z1.4, Special Inspection Level S-3.

V_{50} ballistic limit testing shall be performed in accordance with 4.9.11.3. Multiple helmet shells may be required to determine the V_{50} BL (P) for a particular projectile, obliquity, and

environmental condition. Testing at 45 degree obliquity will be conducted for Government reference only for the threats in Table II.

3.9.2 Resistance to penetration – 9mm. The helmet shell, including any hardware exposed on the outside of the shell, shall be resistant to penetration from a 9mm Full Metal Jacketed Round Nose (FMJ RN) bullet with a nominal mass of 124 grains in accordance with NIJ 0106.01 at 1400 (+ 50) feet per second at 0° obliquity when tested in accordance with 4.9.11, 4.9.11.1.2, and 4.9.11.4 under the following environmental conditions:

a. ambient
b. extreme hot (160°F)
c. extreme cold (-60°F)
d. after immersion in seawater, tested at ambient temperature

3.9.3 Ballistic transient deformation. Ballistic transient deformation of the shell shall not cause a deformation in clay in excess of 0.63-inch (16.0 mm) against 9mm projectile under the environmental conditions specified in 3.9.2 at 1400 (+ 50) feet per second at 0° obliquity for shots made to the right side, left side, and crown. Shots made to the front and back shall not exceed 1.0-inch (25.4 mm). Testing shall be conducted in accordance with 4.9.11, 4.9.11.1.3, and 4.9.11.5.

3.10 Weight. The threshold maximum weight of the finished helmet shall not exceed the weights listed in Table III. The finished helmet shall be weighed with the 3/4-inch thick pads and Retention System installed. Finished helmets weighing less than the weights in Table III are desired. Five (5) of each helmet size shall be tested. Testing shall be conducted in accordance with 4.9.12.

TABLE III. Weight

Size	Class 1 Maximum Weight (lbs)	Class 2 Weight (lbs) Threshold / Objective
Small (S)	2.94	2.46 / 2.12
Medium (M)	3.06	2.56 / 2.21
Large (L)	3.31	2.77 / 2.39
Extra-Large (XL)	3.88	3.25 / 2.80
Extra Extra-Large (XXL)	4.00	3.35 / 2.89

3.11 Blunt impact protection. The finished helmet shall provide non-ballistic impact protection to the wearer by reducing acceleration of the head during low velocity blunt impact events at various temperatures. As a threshold, for each size shell with 3/4-inch thick pads, and for all tests including the various impact sites and temperatures specified as well as both first and second impacts, no individual acceleration shall exceed 150 G (gravitational constant). Greater impact protection, i.e. fewer G, is desired as an objective. There shall be no physical damage to the helmet shell such as delamination, ply separation, or shell fracture or indentation in excess of

0.15-inch present after impact testing. Additionally there should be no damage to any part of the retention system or pad system. Testing shall be in accordance with 4.9.13.

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

3.12.1 Sea water 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 3 percent over dry weight or increase in thickness greater than 2.5 percent when tested in accordance with 4.9.3 and 4.9.14.1.

3.12.2 Weatherometer resistance. There shall be no structural, visible or operational degradation to the finished shell when subjected to weatherometer exposure. The finished shell shall exhibit no evidence of cracking, blistering, delamination, and ply separation, separation of edging, increase in thickness greater than 2.5 percent, finish defects or ballistic degradation when tested in accordance with 4.9.3 and 4.9.14.2. Also, the requirements of 3.9.1 (e) shall be met after weatherometer exposure (see 3.9.1).

3.12.3 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. As an alternate, the unfinished shell (no coating or rubber edging) may be tested. Testing shall be conducted in accordance with 4.9.14.3.

1. DEET insect repellent, NSN 6840-01-284-3982, O-I-503 Type II, Concentration A
2. Gasoline, ASTM D910
3. Motor Oil, MIL-PRF-2104
4. Hydraulic fluid, petroleum base, MIL-PRF-6083
5. Fire resistant hydraulic fluid, MIL-PRF-46170
6. Fuel Oil, Diesel, ASTM D975
7. Turbine Fuel, Aviation, JP-8, MIL-DTL-83133
8. Rifle Bore Cleaning Compound, NSN 6850-00-224-6656, MIL-PRF-372
9. Lubricating Oil, Weapons (LSA), NSN 9150-00-935-6597
10. Lubricating Oil, Arctic, Weapons, NSN 9150-00-292-9689
11. Face paint, NSN 6850-01-493-7309

3.12.4 Flame resistance. The finished shell shall be self-extinguishing with no after-flame greater than 2.0 seconds (Threshold), 0.5 seconds (Objective). Flaming before the withdrawal of the flame source is permitted according to ASTM D 6413. There shall be no melting or dripping. It is desired, however, that the finished shell be ignition resistant. Testing shall be conducted in accordance with paragraph 4.9.14.4.

3.12.5 High temperature storage and use. All helmet components including the shell, pads, retention system, and hardware shall exhibit no structural, visible or operational degradation or physical damage when subjected to elevated temperature exposure. The shell shall exhibit no cracking, delamination, separation of plies, distortion, softening, change in thickness greater than

2.5 percent, or other deterioration. The paint (coating) shall suffer no degradation or deterioration. The retention system shall be operable (webbing slides, retention system can be cinched down, etc.) and shall have no cracked or damaged components. The pads shall have not have suffered any degradation or damage. Testing shall be in accordance with 4.9.3 and 4.9.14.5.

3.12.6 Cold temperature storage and use. All helmet components including the shell, retention system, and hardware shall exhibit no structural, visible or operational degradation or physical damage when subjected to low temperature exposure. The shell shall exhibit no cracking, delamination, separation of plies, distortion, softening, change in thickness greater than 2.5 percent, or other deterioration. The paint (coating) shall suffer no degradation or deterioration. The retention system shall be operable (webbing slides, retention system can be cinched down, etc.) and shall have no cracked or damaged components. The pads shall have not have suffered any degradation or damage. Testing shall be in accordance with 4.9.3 and 4.9.14.6

3.12.7 Temperature shock. All helmet components including the shell, retention system, and hardware shall exhibit no structural, visible or operational degradation or physical damage when subjected to temperature shock, hot to cold, and cold to hot. The shell shall exhibit no cracking, delamination, separation of plies, distortion, softening, increase in thickness greater than 2.5 percent, or other deterioration. The paint (coating) shall suffer no degradation or deterioration. The retention system shall be operable (webbing slides, retention system can be cinched down, etc.) and shall have no cracked or damaged components, or other deterioration. The pads shall have not have suffered any degradation or damage. Testing shall be in accordance with 4.9.3 and 4.9.14.7.

3.12.8 Altitude. All helmet components including the shell, the pads, retention system, and hardware shall exhibit no structural, visible or operational degradation or physical damage when subjected to altitudes from sea level to 15,000-feet equivalent pressure and 40,000-feet equivalent pressure. The test temperature at the 40,000-feet equivalent pressure should be -62^{o}F ($\pm$ 5^{o}F)/ -52^{o}C ($\pm$ 3 ^{o}C). The shell shall exhibit no cracking, delamination, separation of plies, distortion, softening, increase in thickness greater than 2.5 percent, or other deterioration. The paint (coating) shall suffer no degradation or deterioration. The retention system shall be operable (webbing slides, retention system can be cinched down, etc.) and shall have no cracked or damaged components, or other deterioration. The pads shall have not have suffered any degradation or damage. Testing shall be in accordance with 4.9.3 and 4.9.14.8.

3.12.9 Vibration. All helmet components including the shell, retention system, and hardware shall exhibit no structural, visible or operational degradation or physical damage when subjected vibration. There shall be no structural, visible or operational degradation to the finished helmet when subjected to vibration. Minor coating and edging scuffing, marring or wear marks are acceptable. No helmet parts shall become loose or disassembled when subject to vibration. "Loose" shall be defined as not meeting the original adhesion, tightness, or torque (as applicable) as when manufactured or assembled. Testing shall be in accordance with 4.9.14.9

3.12.10 Impact resistance. The finished helmet shall resist physical damage from impacts. The shell material (not including the finish) shall show minimal signs of structural damage such

as delamination, ply separation, or shell fracture or indentation, when subjected to a 40 feet per pound impact. Any resulting indentation in the shell shall be less than 0.150-inch in depth. No damage is desired. The exterior finish shall exhibit no flaking, peeling, loss of adhesion, or other failure of the finish except within a 2.0-inch radius around the center point of impact. Testing shall be conducted in accordance with 4.9.14.10.

3.12.11 Compression resistance (top to bottom). The unfinished shell (no coating or edging) shall be resistant to repeated compressions in the top to bottom direction. As an option, a finished shell may be used. If a finished shell is used, then the top of the shell may be lightly sanded to remove aggregate so to obtain a good measurement. There shall be no dimensional change in excess of 0.020-inch immediately (within 5-minutes) following compressions and 0.010-inch after 24 (± 1) - hours when compared to the pretest dimension. Additionally, the shell shall exhibit no visible delamination, ply separation, distortion after the compressions. Testing shall be conducted in accordance with 4.9.14.11.

3.12.12 Compression resistance (side to side). The unfinished shell (no coating or edging) shall be resistant to repeated compressions in the side to side direction. As an option, a finished shell may be used. If a finished shell is used, then the sides of the shell may be lightly sanded to remove aggregate so to obtain a good measurement. There shall be no dimensional change in excess of 0.125-inch immediately (within 5-minutes) following compressions and 0.100-inch after 24 (± 1) - hours when compared to the pretest dimension. Additionally, the shell shall exhibit no visible delamination, ply separation, distortion after the compressions. Testing shall be conducted in accordance with 4.9.14.12.

3.12.13 Accelerated Aging/Shelf Life. The finished shell shall suffer no structural, visible or operational degradation to the finished shell when subjected to accelerated aging/shelf life exposure according to ASTM D1149 paragraph 5 test apparatus. The finished shell shall exhibit no evidence of cracking, blistering, delamination and ply separation, separation of edging, increase in thickness greater than 2.5 percent, finish defects or ballistic degradation when tested in accordance with 4.9.3 and 4.9.14.14. The requirements of 3.9.1 (f) shall be met after accelerated aging exposure.

3.13 Integration/compatibility. The helmet system shall be designed to be worn as an integrated system; all components that comprise the helmet system shall be physically and functionally compatible with all other components, as well as with the soldier who will be wearing it. The helmet system shall be compatible with all fielded clothing and individual equipment likely to be worn, carried or used by the soldier. Testing shall be in accordance with 4.9.14.13. Representative interface requirements include but are not limited to the following list:

a. ACH NVG (Type II – One Hole Configuration) Front Bracket Kit (NSN 5340-01-509-1467)
b. ACH Covers including, but not limited to: NSN (8415-01-521-8806, 8415-01-521-8808, 8415-01-559-0105, 8415-01-515-4286, 8415-01-515-4288, 8415-01-580-0064, 8415-01-580-0038 and 8415-01-580-0074)
c. Helmet Band (NSN 8415-01-110-9981)
d. Eyewear Retention Strap (NSN 8470-01-487-1605)

3.14 Ownership and Support.

3.14.1 Marking of helmet shell. The helmet shell 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. In addition, the shell shall have an additional label(s), either directly stamped on the inside of the shell or a label (such as a pressure sensitive label), that provides the item nomenclature, contract number, national stock number (NSN), size, contractor's name and cage code, lot number and traceability information. The traceability information may be contained in a separate label from the rest of the information. If a stamped label is used, it shall conform to Type IV, Class 5 of MIL-DTL-32075. If a label is used, characters shall be a minimum of 1/8-inch high. The characters shall be well defined, clearly legible, shall show no signs of smearing, bleeding, or offsetting. The label shall be well-adhered to the shell and shall contain no air bubbles or wrinkles. The helmets shall also contain a unique serial number. The serial number shall correspond to traceability information. Traceability information shall enable the manufacturer to determine the mold, press, and date of shell manufacture and lot information on all materials used in the helmet assembly. The serial number shall allow the contractor to access that information in their records. In addition to the Human Readable Information (HRI) described above, the helmet shell shall also be marked with Machine Readable Information (MRI). The helmet shell shall be marked with a MRI Item Unique Identification (IUID) 2D data matrix in accordance with MIL-STD-130, Construct #2. Helmet shells shall be permanently marked for identification regardless of use, maintenance or storage and shall be located or manufactured so as to prevent obliteration. Metal markings shall not be used. Testing shall be conducted in accordance with 4.9.1.

3.14.1.1 Traceability. The Contractor shall maintain Traceability Records for all component parts used to manufacture the End Item Product. When purchased as end item helmet assembly, all Component parts Lot Identification shall be traceable via each helmet's Serial Number. When purchased separately all component parts Lot Identification shall be traceable via the component part Lot Number. Subcontractor's Component part Lot information shall enable Traceability to the raw materials used in the Component part. Each helmet lot shall consist of only one size of helmets. A helmet lot shall be made from the same lot of ballistic material. A lot of ballistic material can be used for multiple helmet lots. Consecutive helmet lots shall be made from consecutive lots of ballistic materials. Records shall be maintained and readily available for Government reference. For End Item Products identified with individual Serial Numbers, the Traceability requirements listed above shall be traceable via the individual Serial Number.

3.14.2 Marking of pad suspension system components. The pad suspension system shall be clearly marked by a permanent means. Each pad of the system shall be individually marked. Labeling shall conform to Type IV, Class 4 or Type VI, Class 4 of MIL-DTL-32075. The label shall indicate the item nomenclature, contract number, national stock number (NSN), contractor's name, size, lot number and traceability information. If a Type IV label is used, it shall be located on the back side of the pad on the outer material. If a Type VI label is used, it shall be located in the seam of the pad or otherwise attached so as not to interfere with the attachment of the pad to the hook disks. Traceability information shall enable the manufacturer to determine the date of pad manufacture and lot information on all materials used in the pad.

The pad suspension system shall be permanently marked for identification regardless of use, maintenance or storage. Each pad shall have a label with the thickness of the pad identified by a permanent means to each pad. Testing shall be conducted in accordance with 4.9.1.

3.14.3 Barcode label. Each finished helmet or individual component (when purchased separately) shall have a pressure sensitive bar-coded label attached to the outside package. The bar code element shall be a 13 digit national stock number (NSN). There shall be a twelve digit Universal Product Code (UPC) assigned for all NSNs by the Government. The initials "UPC" shall appear beneath the code. The bar codes for the NSN and UPC shall be medium to high density, clearly legible and readable by scanner. Testing shall be conducted in accordance with 4.9.1.

3.14.4 Washability (Launderabiltiy)/colorfastness. All components of the helmet shall meet washability (launderability) and colorfastness requirements.

3.14.4.1 Washability. The finished shell with hook disks installed and the pads shall be washable. No component shall show any signs of structural, visible or operational degradation or physical damage as a result of 20 washings. Also, none of the labels shall become illegible as a result of the washings. Testing shall be in accordance with 4.9.15.1.

3.14.4.2 Colorfastness. The textile materials (including, but not limited to, fabric, webbing, thread) used in the finished helmet (i.e. pads and hook disks) shall exhibit colorfastness to laundering, crocking, perspiration, and water. The materials shall meet or exceed the requirements listed in Table IV. Testing shall be in accordance with 4.9.10.

TABLE IV. Inner and Outer Material Colorfastness

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

3.14.5 Shelf Life. The minimum shelf life of all components and materials in the finished helmet shall be 5-years. The components and materials shall suffer no degradation in

performance after storage for a period of 5-years. Testing shall be conducted in accordance with 4.9.15.2.

3.15 Health/Safety. The finished helmet shall be safe to use and not contain any harmful materials.

3.15.1 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, cleaning 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 conducted in accordance with 4.9.16.

3.15.2 Toxicity. The finished helmet shall not present a dermal health hazard when used as intended and when tested as specified in 4.9.16.

3.15.3 Hazardous materials. Hazardous materials that can be exposed to personnel or the environment during any operational (to include fabrication, transportation, and setup/tear-down) or maintenance procedures, or exposed as a result of damage to the equipment, or requiring special disposal procedures, shall be kept to an absolute minimum, consistent with operational requirements. 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 OSHA Permissible Exposure Limits. The finished helmet shall not present any uncontrolled health hazard throughout the life-cycle of the item. 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 and etc.
c. Allow for easy cleaning and/or replacement of parts that could present health hazards to the wearer.

Testing shall be conducted in accordance with 4.9.16.

3.16 Instruction booklet. Each finished helmet shall be supplied with one copy of TM 10-8470-204-10. Testing shall be conducted in accordance with 4.9.1

3.17 Workmanship. The finished helmet shall conform to the quality of product established by this specification. Utmost care shall be taken during fabrication to ensure quality workmanship and safety of the service person using the item. Deviations in acceptable manufacturing procedures and/or quality of materials being used shall immediately be reported to the contracting officer or his designee. Except as otherwise specified herein, repairs are not allowed to be made to the helmet.

4. VERIFICATION

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

1. First article inspection (see 4.3)
2. Quality conformance inspection (see 4.4)

Unless otherwise specified, the contractor is responsible for the performance of all inspection requirements specified herein. The Government reserves the right to perform any of the inspections set forth where such inspections are deemed necessary to ensure the items conform to the specified requirements.

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 First article inspection. When specified (see 6.3), sample(s) shall be subjected to first article inspection in accordance with 4.8 and 4.9. Helmets used for first article testing shall be randomly selected from among the five (5) sizes.

4.4 Conformance inspection. The sampling inspection for conformance inspections (production lot inspections) shall be performed in accordance with ANSI/ASQ Z1.4, as defined by contract, except where otherwise indicated. Helmets used for conformance inspection testing shall be randomly selected with sizes comprising the presented lot. Samples selected shall be examined for the defects specified in 4.9.1 and subjected to the tests indicated in 4.8, Table V. Acceptance criteria shall be specified in the contract (see 6.4).

4.5 Demonstration Verification. In some cases, the performance requirement specified in section 3 is verified by observation and operation 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 V).

4.6 Standard ambient conditions. Examinations, inspections, and testing shall be conducted in standard ambient conditions of 77°F (+ 18°F)/ 25°C (+ 10°C) and a relative humidity of 50 percent (+30 percent) and site atmospheric pressure unless otherwise specified herein.

4.7 Component and end item inspection. In accordance with 4.1, 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 Requirements and verifications. Table V delineates performance requirements verified thru visual methods, including physical measurements to determine that no deficiencies exist.

TABLE V. Requirements and Verifications

Characteristic	Requirement Paragraph	Verification Paragraph	First Article Testing 1/	Lot Acceptance1/
Shell Design/Shape	3.5	4.9.2	x	2/
Shell construction	3.5.1	4.9.1	x	2/
Shell thickness and uniformity	3.5.2	4.9.3	x	2/
Benchmarks	3.5.3	4.9.4	x	2/
Attachment holes	3.5.4	4.9.1, 4.9.2	x	2/
Retention system holes	3.5.4.1	4.9.1, 4.9.2	x	2/
Night vision goggle holes	3.5.4.2	4.9.1, 4.9.2	x	2/
Eyewear retention strap holes	3.5.4.3	4.9.1, 4.9.2	x	2/
Edging	3.5.5	4.9.1, 4.9.5.1	x	2/
Edging adhesion	3.5.5.1	4.9.5.2	x	x 4/
Edging adhesion of edging after heat aging	3.5.5.2	4.9.5.3	x	2/
Coating	3.5.6	4.9.1	x	2/
Outer surface preparation	3.5.6.1	4.9.1	x	2/
Texturing of coating	3.5.6.2	4.9.1	x	2/
Adhesion of coating	3.5.6.3	4.9.6	x	x 4/
Retention system	3.6	4.9.7	x	2/
Retention system attachment points and hardware	3.6.1	4.9.7, 4.9.11.4	x	2/
Pad suspension system	3.7	4.9.8.1	x	2/
Pad construction	3.7.1	4.9.8.2	x	2/
Pad inner layer material	3.7.1.1	4.9.8.1, 4.9.8.5 4.9.10.1	x	2/
Pad padding layer material	3.7.1.2	4.9.8.1, 4.9.8.2	x	2/
Pad padding layer material Water absorbency	3.7.1.2	4.9.8.4	x	x 4/
Pad outer layer material	3.7.1.3	4.9.8.1, 4.9.8.2, 4.9.10.1	x	2/
Pad compression durability	3.7.2	4.9.8.3	x	2/
Hook disks	3.8	4.9.9.2, 4.9.10.1	x	2/
Hook disk shape and	3.8.1	4.9.9.1	x	2/

Characteristic	Requirement Paragraph	Verification Paragraph	First Article Testing 1/	Lot Acceptance1/
coverage				
Hook disk durability	3.8.2	4.9.9.2, 4.9.9.3,	x	2/
Hook/loop adhesion	3.8.3	4.9.9.4	x	2/
Fragmentation protection – minimum V_{50} ballistic protection limits (V_{50} BL(P))	3.9.1	4.9.11, 4.9.11.1	x	x 3/

TABLE V. Requirements and Verifications - Continued

Characteristic	Requirement Paragraph	Verification Paragraph	First Article Testing 1/	Lot Acceptance1/
Resistance to penetration – 9mm	3.9.2	4.9.11, 4.9.11.1.2, 4.9.11.4	x	x 3/
Ballistic Transient Deformation	3.9.3	4.9.11, 4.9.11.1.3, 4.9.11.5	x	x 3/
Weight	3.10	4.9.12	x	x
Blunt impact protection	3.11	4.9.13	x	x 4/
Sea water resistance	3.12.1	4.9.12, 4.9.14.1	x	2/
Weatherometer resistance	3.12.2	4.9.14.2	x	2/
Field agent resistance	3.12.3	4.9.14.3	x	2/
Flame resistance	3.12.4	4.9.14.4	x	2/
High temperature storage and use	3.12.5	4.9.3, 4.9.14.5	x	2/
Cold temperature storage and use	3.12.6	4.9.3, 4.9.14.6	x	2/
Temperature shock	3.12.7	4.9.3, 4.9.14.7	x	2/
Altitude	3.12.8	4.9.3, 4.9.14.8	x	2/
Vibration	3.12.9	4.9.14.9	x	2/
Impact resistance	3.12.10	4.9.14.10	x	2/
Compression resistance (top to bottom).	3.12.11	4.9.14.11	x	2/
Compression resistance (side to side).	3.12.12	4.9.14.12	x	2/
Integration/compatibility	3.13	4.9.14.13	x	2/
Marking of helmet shell	3.14.1	4.9.1	x	x 4/
Marking of pad suspension components	3.14.2	4.9.1	x	x 4/
Barcode label	3.14.3	4.9.1	x	x 4/
Washability	3.14.4.1	4.9.15.1	x	2/
Colorfastness	3.14.4.2	4.9.10	x	2/
Shelf Life	3.14.5	4.9.15.2	x	2/
Safety	3.15.1	4.9.16	x	2/
Toxicity	3.15.2	4.9.16	x	2/
Hazardous materials	3.15.3	4.9.16	x	2/
Instruction booklet	3.16	4.9.1	x	x

1/ An "x" in the column designates that the test is performed. Sampling rate is specified in 4.4 for conformance lot testing unless otherwise specified in the contract and LAT Table.
2/ Certification of Conformance (COC) provided for Lot Conformance 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 will be available for Government review. The Government reserves the right to inspect or test such items to verify conformance to requirements.
3/ Ballistic testing for conformance lots shall be in accordance with 4.9.11.2.
4/ The rate for conformance lot inspection for edging adhesion, adhesion of coating, blunt impact protection (Ambient condition only), pad water absorbency, marking and barcode label, are shown in Annex A.

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

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

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

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

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

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

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

4.9 Methods of Inspection.

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

TABLE VI. End item visual defects

Examination	Defect	Classification		
		Critical	Major	Minor
Helmet shell	Any fabric fibers visibly cut or raised on the shell body.			X
	Any surface dent, depression, or area not smooth.			X
	Any delamination or blister.		X	
	Any evidence of cracking.	X		
	Any evidence of dry spot, any area of nonresin flow or other molding deficiency.		X	
	Any fabric gap, any pit except those specified as (see 3.5.1).		X	
	Any raised pleat or wrinkle, or any raised crease (groove) 1-inch or longer.			X
	Any permissible gap or pit not resin filled as specified (see 3.5.1) (exterior only).			X
	Any unauthorized patching, repair or reworking.		X	
	Any evidence of metallic fasteners.		X	
	Any benchmark omitted or obliterated.			X
	Any attaching hole exhibiting delamination or other damage of the shell material.		X	
	Any attaching hole exhibiting fraying (uncut material attached at the edge of the hole).		X	
	Air bubbles under Hook Disk(s).			X
	Hook Disk(s) incorrect color.			X
	Any Hook Disk omitted.			X
	Any Hook Disk becoming separated from the helmet shell by removal of a Suspension Pad			X
	Hook Disks firmly attached to inside surface of helmet with no lifting at any contours			X
	Hook Disk coverage inadequate.			X
	NOTE: Criteria apply to interior and exterior of helmet except as noted. Shell is examined prior to coating.			
Edging	Not completely covering bottom periphery and sides as specified except for gap at rear of helmet if piece cut to length.			X
	Any cut, tear, or hole.			X
	Any area not adhered to shell.			X
	NOTE: An area shall be considered not adhered if it can be pulled away from			

	shell with the thumb or finger.			
	If piece cut to length - ends overlapped - gap between ends in excess of 0.100-inches (if piece cut to length).			X X
	Butt joint not in rear of helmet.			X
	Not correct color.			X
Finish (coating) on exterior, Color on interior	Any cracks, scuffed areas, blemishes such as peeling, blistering or flaking, foreign matter appearing on or embedded in the finish			X
	Finish wet or tacky to the touch.		X	
	Coating furrows, flakes, or peels when scratched with fingernail.		X	
	Blemish, such as peeling, blistering, or flaking.		X	
	Not a smooth, uniform coating (i.e., run or sag affecting an area more than one square inch).			X
	Not completely and uniformly cover the shell surface and the outside of the edging.			X
	Not of specified thickness.		X	
	Foreign matter embedded in or appearing on the finish, such as dirt, stain, oil, or grease.			X
	Color of exterior finish not as specified.		X	
	Interior color of shell not as specified.		X	
	Final coat not containing specified aggregate.		X	
	Texturing aggregate overrun extending beyond edge into interior surface of helmet.			X
	Not uniformly applied to the outside surface of the helmet shell including the outside of the edging.			X
	Hardware exposed on the exterior and interior of the shell, (e.g. screw heads) coated.			X
	Evidence of cut blisters.		X	
	Ballistic material showing signs of being visibly cut, gauged or raised.		X	
	Any unauthorized repair.		X	

TABLE VI. End item visual defects – Continued

Examination	Defect	Classification		
		Critical	Major	Minor
Suspension Assembly (Pads)	Pads not specified herein, damaged in any way, not in correct number or shape.	X		
	Any required component omitted.		X	
	Any component misplaced or not assembled.		X	
	Color of any component not as specified.		X	
	Any hole, cut, tear, or smash.		X	
	Any material not firmly or tightly woven, edges frayed or scalloped.			X
	Any material with multiple floats.			X
	Any material with abrasion mark, broken or missing yarns, slub, or broken end or pick, or multiple floats (if applicable).			X
	Any mend, yarn, or patch.			X
	Any raw edge (note that raw edge not securely caught in stitching shall be classified as open seams).			X
	Any open seam (If the pad has been stitched note that a seam shall be classified as an open seam when one or more stitches joining a seam are broken or when two or more consecutive or runoff stitches occur. If the pad has been RF welded, note that a seam shall be classified as an open seam when the weld is not complete).			X
	Stitch tension loose, resulting in loose bobbin or top thread.			X
	Stitch tension excessively tight, resulting in puckering material.			X
	Stitching ends not secured.			X
	Thread breaks, skipped stitches, or run-offs not overstitched.			X
	NOTE: Sewing defects apply only if item has sewing.			

TABLE VI. End item visual defects - Continued

Examination	Defect	Classification		
		Critical	Major	Minor
Marking	Shell: omitted, incorrect, illegible, or not as specified.		X	
	Pads: omitted, incorrect, illegible, or not as specified.		X	
	Retention System: omitted, incorrect, illegible, or not as specified.		X	
	Barcode: omitted, incorrect, illegible, or not as specified.		X	
Manual	Missing		X	

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

4.9.2 Shell design/shape. The dimensions and shape specified in 3.5 that define the shape and holes of the shell, shall be measured with appropriate measuring equipment to 0.01 inches 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. Any nonconformance with the requirements of 3.5 shall constitute test failure.

4.9.3 Shell thickness and uniformity. The thickness of the uncoated helmet shell shall be measured with appropriate measuring equipment to the nearest 0.001-inch at five (5) different locations. One dimension shall be taken at the approximate top center and the other four measurements shall be taken randomly, one each in the lower sections identified in 4.9.11.3.2. For verification of shell thickness, requirements in the operating environments of sections 3.12.1, 3.12.2, and 3.12.5-3.12.8, before and after testing thickness measurements shall be taken on the same five (5) locations. The thickness criteria are based on a point to point comparison and not an average. An unfinished shell shall be used. Failure to meet the requirements of 3.5.2, 3.12.1, 3.12.2, and 3.12.5-3.12.8 shall constitute test failure.

4.9.4 Benchmarks. The shell shall be visually examined for the presence of the required benchmarks. Any benchmark not in conformance with 3.5.3 shall be cause for test failure.

4.9.5 Edging

4.9.5.1 Edging dimensions. The width of the edging shall be measured with appropriate measuring equipment accurate to 0.025 inches at five (5) different locations. The locations shall be random along the edging, but no two (2) locations can be closer than 2.0-inches. Any nonconformance with the requirements of 3.5.5 shall constitute test failure.

4.9.5.2 Edging initial adhesion. The adhesion of the edging shall be determined by manual and visual inspection of the edges of the edging on both the outside and inside of the helmet. The test specimen shall have had the edging applied for a minimum of 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 3.5.5.1 shall be considered a test failure.

4.9.5.3 Edging Adhesion after heat aging. Condition the helmet shell in a circulating air oven at 160°F (± 5°F)/ 71°C (± 3°C) for 4-hours (± 0.5 - hours). Remove and allow to cool to room temperature. Use a sharp knife, cut through the edging along the inner or outer corner for a distance of 2-inches. See Figure 3. Note that Figure 3 shows the inner corner cut. An outer corner cut would be similar but on the outside edge of the shell. At one end of the cut, make another cut through and across the outer side of the edging and peel it back to form a tab approximately 0.5-inches in length. Attach a 1.5 pound weight to the tab and arrange the helmet and weight so that the pull is at right angles to the plane of the glue line being tested and the weight hangs vertically. Make suitable gauge marks on the specimen for the measurement of the amount of peeling during the test. Allow the weight to hang for a minimum of 1 hour, and measure the amount of peeling back of the tab to determine conformance to the requirement in 3.5.5.2. The measurement shall be made from the starting gauge mark to the farthest extent that the edging becomes unbounded. The test shall be performed at two (2) different locations on the helmet, and the two results shall be averaged. Any nonconformance to the requirements specified in 3.5.5.2 shall be considered a test failure.

4.9.6 Coating adhesion. Cut three (3) parallel, straight lines 0.0625 inch to 0.125 inch apart in any direction with a sharp scribe, razor, or knife held at 30° (± 5°) angle to the surface tangent along the line being cut. The cuts shall completely penetrate the coating. These lines shall be crossed with three additional perpendicular lines 0.0625 to 0.125 inch apart. This procedure produces four squares, which shall be inspected visually for any coating lifting. Lifting of any coating resulting in the loss of more than 50 percent of the coverage of any square shall constitute test failure. A slight unevenness of the edges of any square shall not be considered cause for test failure. For First Article Testing, three (3) finished helmets of each size shall be tested and three (3) random locations shall be tested per sample.

4.9.7 Retention system design. The helmet retention system shall be examined. Any nonconformance with the requirements of 3.6 or 3.6.1 shall be cause for test failure. Testing will be in accordance with GL/PD-07-19.

4.9.8. Pads. Verification for the pad suspension system contains several tests.

4.9.8.1 Pad Dimensions and Shape. The pads shall be examined for conformance to the thickness and shape requirements specified in 3.7. Each pad shall be measured to verify its thickness. The pad thickness shall be measured at five (5) random locations. An additional measurement is to be taken in the center of the pad by cutting a hole through the center large enough for the measuring instrument to be inserted. If the pad has a fabric material on either the pad inner material or the pad outer material, that material shall be removed prior to measurement. Each thickness measurement shall be within 0.0625 inch of the nominal thickness. The shape of the pad shall meet the shapes shown in Drawing 2-1-2566 with a tolerance of (± 1/8 inch). Any nonconformance to the requirements specified in 3.7 shall be shall be cause for test failure. Six (6) pad sets of each size shall be measured.

4.9.8.2 Pad Construction. The pads shall be examined for conformance to the requirements specified in 3.7.1, 3.7.1.1, 3.7.1.2 and 3.7.1.3. Any nonconformance to the specified requirements shall constitute a test failure.

4.9.8.3 Pad compression durability test. The finished pad shall be subjected to cyclic compressions on a constant rate of extension (CRE) machine in accordance with ASTM Test Method D76 except that the machine shall be used in the compression mode as follows: Position the pad on the base platen of the machine and orientated so that inner material will contact the moving top platen. The moving platen shall have a flat face surface large enough so that the entire face of the pad is compressed. Cycle the moving head such that the pad is compressed a minimum of 0.25 inches during each cycle at the rate of 12 (± 1) inch per minute while the moving head is in contact with the pad. The cycle shall include a period of 15-seconds where the moving head is not in contact with the pad. Cycle the pad for 6,570 (± 10) cycles. Examine the pad and then carefully remove the fabric (if pad designed with fabric) from the coated foam. Examine the coating on the foam (if pad designed with coating). Failure of the pad to meet the requirements of 3.7.2 shall constitute failure of the test.

4.9.8.4 Water absorbency. One (1) pad of each shape and thickness shall have the inner and outer material carefully removed so as not to damage the padding material. The pad shall be weighed to the nearest centigram. The pad shall be completely immersed in salt water to a depth greater than four inches but not exceeding six inches for a minimum of 12-hours. The salt water shall meet the composition specified in 4.9.14.1. Once the pad is removed from the water, shake it by hand for a minimum of 1-minute and a maximum of 5-minutes in various orientations to remove bulk water. Alternately, one side of the pad may be placed on a dry paper towel for up to 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 then shall be allowed to air dry for a maximum of 24-hours in an ambient environment of 70^{o}F (± 2^{o}F) and 65 (± 2) percent 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 pad (with or without the inner and outer material) may be rinsed with fresh water after removal from the salt water. If the pad has increased in weight more than 3 percent then the test shall constitute test failure.

4.9.8.5 Moisture wicking test. Testing shall be done in accordance with the AATCC Test Method described in Concept 2 Consumer Technical Supplement. Any non-conformance with the requirements of 3.7.1.1 shall constitute a test failure.

4.9.9 Hook disk and loop

4.9.9.1 Hook disks The finished helmet shall be visually inspected. Additionally, the smallest pad shape shall be placed at five random locations in the helmet while no other pads are inside the shell. The area of the pad that is in contact with hook disk(s) shall be measured. The area of the hook disk(s) that are in contact with the pad shall be measured. Any nonconformance with the requirements of 3.8 and 3.8.1 shall be cause for test failure.

4.9.9.2 Hook disk adhesion. Using a finished shell without disks, apply disks to the inside surface of a helmet per manufacturer's instructions (if provided). The disk and helmet shall sit for a period of 24 (± 1) - hours. After the required time frame, attempt to remove five (5) random disks from helmet shell by peeling up using fingernail. Peeling up of the hook disk shall be cause for a test failure. Three (3) finished helmet shells from each size shall be tested. Any nonconformance with the requirements of 3.8 shall be cause for test failure.

4.9.9.3 Self-stick adhesive hook tape helmet adhesion. Die cut minimum five (5) self-stick hook disks and place on inside of finished shell allowing minimum of 15-hours or overnight curing time at room temperature to set-up maximum bond to interior of shell. Place 5 finished oblong/oval pads (or the smallest shape) with representative knit loop tape onto separate helmet hook disks. Press each pad firmly into each hook disk. Allow 2-hours engagement time and slowly pull each loop pad off each hook disk. Evidence of any hook disk lifting, curling or other disturbance of adhesive or coating used on the hook disk, delamination of the shell, or any nonconformance with the requirements of 3.8.2 shall be cause for test failure.

4.9.9.4 Hook/loop 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 disk material face-down on top of loop fabric such as to engage the materials. Roll a 5-pound circular weight back and forth 5 times on top of hook disk material. Use either calibrated push-pull scale or testing machine in accordance with ASTM D76 in order to peel 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) hook and loop material specimens. Record the maximum peel value registered by the push-pull scale or the D76 machine. Non-conformance with the requirements of 3.8.3 shall constitute a test failure.

4.9.10 Colorfastness. Test any textile components of the finished helmets in accordance with the test methods listed in Table VII. Failure to meet the requirements of 3.14.4.2 shall constitute test failure.

TABLE VII. Colorfastness test methods

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

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

4.9.11 Ballistic protection. The ballistic resistance testing shall be conducted in accordance with MIL-STD-662, NIJ 0106.01 and ITOP 4-2-805 except as specified in 4.9.11.1 thru 4.9.11.5. Yaw shall not exceed 5° for any projectile. No helmet shell shall be tested for at least 24-hours after molding. Multiple helmets may be used for the purpose of determining any of the ballistic resistance requirements.

4.9.11.1 Ballistic resistance (First Article Testing). Ballistic resistance testing for the first article shall include the requirements of 3.9.1, 3.9.2 and 3.9.3.

4.9.11.1.1 Ballistic resistance (First Article Testing) – Fragmentation. One V_{50} BL (P) shall be determined for each condition (ambient, hot, cold, seawater) for each of the projectiles listed in 3.9.1. One V_{50} BL(P) shall be determined for 17-grain Fragment Simulating Projectile (FSP) after weatherometer exposure. If the V_{50} BL (P) test for each specific test set meets or exceeds the values specified 3.9.1, the specific test shall be considered passed. V_{50} BL (P)s at 45^{o} obliquity against the specified right circular cylinder (RCC) and FSP projectiles listed in Table II when tested in accordance with 4.9.11 and 4.9.11.3 under ambient conditions are also required. The results of 45^{o} obliquity are for Government reference only.

4.9.11.1.2 Ballistic resistance (First Article Testing) – 9mm resistance to penetration (RTP). Six (6) passing RTP determinations shall be made for each of the four required environmental conditions (ambient, hot, cold, seawater). A RTP determination shall be defined as a shot taken at the helmet. Said determinations shall be equally distributed among five (5) specified locations. Shot six (6) is specific to hardware. If the requirements of 3.9.2 are met, the first article for 9mm RTP shall be considered met.

4.9.11.1.3 Ballistic resistance (First Article Testing) – Transient deformation. Five (5) passing transient deformation determinations shall be made for each of the four required environmental conditions (ambient, hot, cold, seawater). A RTP determination shall be defined as a shot taken at the helmet. Said determinations shall be distributed among the five specified locations (see 4.9.11.4.3).

4.9.11.2 Ballistic resistance (Production Lot Testing). Production helmet lots shall be tested for 17 grain FSP 0 degree obliquity, ambient V_{50} BL(P), 9mm ambient condition resistance to penetration and transient deformation and shall meet or exceed the requirements of 3.9.1, 3.9.2, and 3.9.3. The Government reserves the right to perform any of the testing set forth in this specification where such tests are deemed necessary to ensure the items conform to specified requirements.

4.9.11.3 Ballistic test method for RCC and FSP. The suspension system, retention system, and any associated hardware shall be removed from the helmet prior to conditioning and testing. The helmet shall be conditioned as specified in 4.9.11.6 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 3.9.1 shall constitute test failure.

4.9.11.3.1 Helmet mounting and witness plate. The finished shell only shall be rigidly secured on a test target mount with the impact side orientated 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.

4.9.11.3.1.1 Witness plate mounting for 9mm RTP for hardware. The test item will be placed onto a metal headform with Roma Plastilina No. 1, a non-hardening, oil-based modeling clay filled in the coronal channel for the purpose of securing the witness plate firmly in the rear of the coronal channel and securing a guard plate firmly in the front of the coronal channel. The mid-

sagittal channel of the headform shall be void of clay in front of the witness plate (rear of headform) and approximately 1-in. in back of the witness plate. Clay shall be placed up to approximately 1.5-in. in front of the guard plate to prevent fragments from ricocheting after impact with the guard plate. See PICTURE 1. Complete and partial penetrations will be determined based on the impressions left on an aluminum witness plate. The witness plate will be 0.020-in. (0.51-mm) thick sheets of 2024-T3, 2024-T4 or 5052-H38 aluminum alloy. The witness plate will be rigidly mounted, parallel to the reference plane between the rear of the headform coronal channel and clay. The witness plate will be of sufficient size to be impacted by all fragments resulting from penetration.

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

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

4.9.11.3.1.1.3 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. The failure of non-ballistic features of the retention system will not be considered a test failure, but will be documented.

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

TABLE VIII. 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°

4.9.11.3.3 Projectile impact location. Two (2) fair impacts, randomly placed, shall be fired in each section, except that one of the two fair impacts in the top section will be placed within 1.0-inch of the benchmark at the crown of the helmet. An impact resulting in a complete penetration shall be considered unfair if it is within 1.5-inches of another impact, within 1.5-inches of the closest edge of any hole, within 1.0-inch of the edge of the helmet. If two fair impacts cannot be placed in a section, the second impact shall be placed on another helmet but not in the same location as the first impact. If an impact, unfair because of location, results in a partial penetration, it may be considered a fair impact.

4.9.11.3.4 V_{50} BL(P) calculation – FAT. The V_{50} BL (P) for each helmet shell shall be the average of at least ten (10) fair impact velocities consisting of an equal number of the lowest complete penetration and the highest partial penetration velocities provided that the velocity spread is not greater than 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 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 150 feet per second. If neither the ten 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) shall be determined to have satisfied that specific threat condition requirement. Should none of these three conditions apply, the test shall be declared inconclusive.

4.9.11.3.5 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 ten (10) fair impact velocities consisting of an equal number of the lowest complete penetration and the highest partial penetration velocities with a velocity spread no greater than 150 feet per second. If neither the six nor the ten shot conditions can be satisfied, and at least five (5) partial penetrations at velocities in excess of the required minimum V_{50} and there are no complete penetrations at or below the minimum required V_{50} velocity, and at least ten 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.

4.9.11.4 Ballistic test method for resistance to penetration – 9mm. Testing shall be conducted with finished helmets with 3/4- inch thick pads of the appropriate shell size. Helmets need not have edging attached (see 3.5.5) or be coated (see 3.5.6). Testing shall be in accordance with NIJ 0106.01 with the following exceptions. The helmet shall be conditioned as specified in 4.9.11.6.1, 4.9.11.6.2 and 4.9.11.6.3 as required. The pad suspension system shall be arranged inside the helmet as shown in the "standard pad configuration" arrangement in TM 10-8470-204-10, WP 0005 (7 pad configuration with the oblong/oval pads in the vertical pad configuration). Projectile velocity and time of flight measurements shall be in accordance with ITOP 4-2-805. Instrument velocity shall be translated into strike velocity at the target and the strike velocity shall be used for ballistic requirements. The distances shown in Figure 6 of NIJ 0106.01 may be altered. Failure to meet the requirements of 3.9.2 shall constitute test failure.

4.9.11.4.1 Headform for 9mm testing. The headform for 9mm testing (RTP and transient deformation) shall conform to the headform specified in NIJ 0106.01 except it shall be modified to have slots in both the directions (coronal and sagittal); NIJ 0106.01 requires only a slot in a single direction.

4.9.11.4.1.1 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 sagittal plane, the headform shall have fixturing to hold a witness plate parallel to the reference plane.

4.9.11.4.1.2 Clay. As an option, clay may be used in lieu of the witness plate. The channels (slots) in both the coronal and sagittal planes of the headform shall be packed with Roma Plastilina Number 1 (see 6.7) modeling clay, ensuring there are no voids, cavities, or depressions in the final contoured assembly. The clay shall be shaped to create an uninterrupted smooth surface matching the contour of the headform. Up to eight (8) headforms can be considered calibrated provided the headforms are conditioned within 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.

4.9.11.4.1.3 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 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 obliquity, at three locations whose center-to-center and center-to-edge of clay distance is not less than 3.0-inches. The depth of each of the three resultant depressions shall be 1.0 (± 0.1) - inch. 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 calibrated clay shall be considered calibrated for a period not to exceed 45 minutes after removing from the conditioning chamber. If testing of any one 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 measurement, the device will be calibrated ("zeroed") using the edge of the aluminum frame to reference the original flat surface of the clay.

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

4.9.11.4.2 Mounting. 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. Edge benchmarks and helmet section markings shall be aligned with the NIJ headform coronal and mid-sagittal planes to ensure the helmet is aligned on the headform and not tilted. Retention System straps will be pulled (by one person) to the maximum allowable extent in the vertical position to achieve the minimum distance between the suspension crown and the interior helmet shell surface without tilting the helmet to ensure consistent mounting of the helmet. A laser, or other suitable means, shall be used to locate the impact point on the helmet. The finished helmet shall be removed and a reference measurement made to determine the location of the front surface of the formed clay under the impact point using a laser scanning device in accordance with MIL-STD-3027 paragraph B.4.9.3. The finished helmet shall be remounted on the headform in the same location and manner as it was removed. Prior to testing, each helmet test sample will be inspected, ensuring that the test sample chinstrap is properly mounted into the helmet test sample. The clay packed headform shall be rigidly fixed in a manner which will resist the anticipated force from the ballistic impact of the test round fired without movement. For the hardware shots, the helmet test sample will be mounted on the headform and rotated so that the test sample rear fastener bolt of the retention system aligns with the center of the sagittal channel of the headform. Only the suspension system and the retention system will be used to hold the helmet to the headform.

4.9.11.4.3 RTP Impact locations and procedure. The following locations and procedures shall be followed for RTP testing.

Each finished helmet shell shall sustain five impacts with shot spacing as follows:

(a) One impact on the crown at the approximate intersection of the Headform mid-sagittal and coronal planes (see Figure 2, NIJ 0106.01).
(b) Two total impacts on the coronal plane, one impact on the right side and one on the left side 50 mm (+ 5mm -0mm) above the earflap.
(c) One impact shall be in the mid-sagittal plane in the front of the helmet 85 mm (+5mm -0mm) from the edge of the shell (ensuring the shot is at a minimum of 1.5 inches from the edge of the NVG hole).
(d) One impact shall be in the mid-sagittal plane 75mm (+5mm -0mm) from the edge of the shell in the rear of the helmet.
(e) Test progression shall be crown, rear, left, right and front.

2. The finished helmet shell shall sustain an impact on each of the two rear fastener (hardware) if hardware is included as part of the design.

3. For each test, mount the shell in the "as-worn" configuration, with the suspension and chinstrap/napestrap systems in place on the headform. For the fastener test, the helmet shall be rotated to align with the slot.

4. 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.

5. If witness plates are used, complete penetration is defined as in NIJ 0106.01 (passage of light thru the witness plate when using a 60-Watt light bulb). 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. In the case of the fastener test, a complete penetration occurs when the impacting projectile or any fragment thereof, or any fragment of the retention system hardware perforates the witness plate resulting in a crack or hole which permits light passage when a 60-watt, 110-volt bulb is placed proximate to the witness plate. All such results will be finalized by a Failure Scoring Conference (FSC). The FSC will consist of an ATC Test Officer, a PM SPE representative and a Developmental test Command (DTC) representative as an independent third party.

4.9.11.5 Ballistic transient deformation. One (1) projectile shall be fired into the five (5) required impact locations. One (1) finished helmet with 3/4-inch thick pads of the appropriate shell size shall be tested at each of the five (5) prescribed locations.

4.9.11.5.1 Headform. The ballistic transient deformation shall be measured with a headform as described in 4.9.11.4.1.

4.9.11.5.2 Test Procedure.

4.9.11.5.2.1 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 "snug" fitting on the headform. 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.

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

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

4.9.11.5.2.4 Testing Progression. For a shot with a high velocity (except for the final shot) regardless of the results of the test (partial or complete penetration), the test will be declared "inconclusive" and repeated with a new (untested) helmet. If the last impact was a high velocity shot that generated passing results, then the shot is valid. 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 testing to replace an "inconclusive" helmet, the test shall be started from the beginning and five 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.

4.9.11.5.2.5 Criteria. Each projectile's depression measurement shall be compared to the requirements of 3.9.3. Additionally, penetration by any fair shot shall constitute test failure. 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 4.9.11.5.2.1 in preparation for the next shot.

4.9.11.5.2.6 Data. Data for all shots, fair and unfair, shall be reported.

4.9.11.6 Conditioning Methods

4.9.11.6.1 Ballistic resistance (ambient, high, and low temperatures). For ambient temperature testing, the finished helmets shall be subjected to an initial conditioning for a minimum of 24-hours at 70°F (± 10°F). For high temperature testing, the finished helmets shall be subjected to an initial conditioning of a minimum of 24-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 a minimum of 24-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. 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 option 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. Failure to meet the requirements specified in 3.9.1 and 3.9.2 shall constitute test failure.

4.9.11.6.2 Ballistic resistance (sea water). The finished helmet shall be immersed in seawater as specified in 4.9.14.1 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 sea water. The finished helmet shall then be ballistically tested in accordance with 4.9.11.3 and 4.9.11.4. Failure to meet the requirements specified in 3.9.1 and 3.9.2 shall constitute test failure.

4.9.11.6.3 Ballistic resistance (weatherometer). After the finished helmet has been exposed in the weatherometer and after passing the weight and visual examinations in 3.12.2, then the finished helmet shall be ballistically tested in accordance with 4.9.11.3 within 48-hours after removal from the weatherometer. Failure to meet the requirements specified in 3.9.1 shall constitute test failure.

4.9.11.7 Procedures. The following procedures apply to ballistic testing.

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

1. Contractor identification.
2. Contract number.
3. Lot numbers and quantities.
4. Item specification number.
5. Armor description including model number and serial number (if applicable).
6. Weights of all components.
7. Test projectile with exact nomenclature.
8. Test date, temperature and humidity measurements.
9. Yaw angle.
10. Angles of target obliquity.
11. Velocity measurements of each test shot used to test the armor (regardless of whether that particular velocity was used in the V_{50} Resistance to Penetration or transient deformation determination). Both uncorrected (instrumental / measured) and corrected (striking) velocities shall be reported. The corrected (strike) velocity shall be used for ballistic requirement. PP (Partial Penetration) and CP (Complete Penetration) next to each shot velocity as determined.
12. Location of shot.
13. Description of test setup (distances from velocity measuring devices to target).
14. Name of company/organization performing tests.
15. Type of gun barrel, weapon caliber and propellant type and weight.

4.9.11.7.2 Projectile velocity determination. Appropriate equipment shall be used to measure the velocity of the projectile during testing. The equipment shall be capable of measuring the velocity to within 1-foot per second. Equipment known to work includes high velocity lumiline screens and electrical contact screens which either open or close an electric circuit upon passage of the projectile. 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 maximum to the nearest 10.0-microseconds shall be used with these measuring devices. Alternative methods, such as radiographic or radar equipment calibrated to capture the projectile at various time intervals of flight can be used if approved by the Government.

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

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

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

4.9.12 Weight examination. The finished helmet shall be weighed on a scale accurate to 0.01-pounds for conformance to the weight requirements in paragraph 3.10 and 3.12.1. Any non-conformance with the weight requirements in 3.10 and 3.12.1 shall be cause for test failure. Weight testing shall be performed 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.

4.9.13 Blunt impact protection. The blunt impact protection of the complete finished helmet shall be determined in accordance with DOT FMVSS 218 with the following exceptions:

1. Each helmet shall be tested with the pad suspension system arranged inside the helmet as shown in the “standard pad configuration” arrangement in TM 10-8400-204-10, WP 0005 (7 pad configuration with the oblong/oval pads in the vertical pad configuration).
2. Six (6) helmet samples of each size shall be required: two (2) each for testing after exposure to each of the three environmental conditions.
3. The environmental conditions shall be ambient (see 4.6), cold 14^{o}F ($\pm$ 5^{o}F), and hot 130^{o}F ($\pm$ 5^{o}F). Helmets shall be conditioned for a minimum of 12-hours prior to test.
4. The hot and cold environmental impacts shall be conducted within 5-minutes after the 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.
5. Water immersion testing is not required.
6. The impact anvil used for all tests shall be the hemispherical anvil.

7. Helmets shall be fitted to the appropriate size DOT (FMVSS 218) headform (sizes B, C, and D).
8. Each helmet shall be impacted two times at seven locations. These include the front, back, left side, right side, lower left rear, lower right rear, and the crown. The headform shall be oriented as described in Table IX for each particular impact site. Additionally, Figure 4 shows the orientation of all locations except the left and right nape.
9. Two (2) successive impacts shall be made at each location. The second impact shall be made no sooner than 1-minute after the first and no later than 2-minutes after the first.
10. The velocity for all impacts shall be 10 (± 0.3) - feet per second.

Failure of any helmet to meet the requirement of 3.11 shall constitute failure of the test.

TABLE IX. 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 vertical
Left / right nape	Zero degrees off vertical, rolled 15 to 35 degrees left or right

4.9.14 Environmental test methods

4.9.14.1 Seawater immersion - weight and visual examination. The finished shell, clean and free of dirt or other foreign matter, shall be exposed to standard ambient conditions for a minimum of 3-hours and then weighed to the nearest 0.01-pounds. The shell shall then be immersed in a laboratory seawater solution containing 3 percent sodium chloride and 0.5 percent magnesium chloride at standard ambient conditions for a minimum of 16 - hours at a minimum depth of 3-feet. The shell shall be removed, wiped of excess moisture, and kept at standard ambient conditions for 12 (± 0.5) - hours and weighed again to the nearest 0.01-pounds. A weight increase in excess of that allowed in paragraph 3.12.1 shall constitute failure. The shell shall be visually examined for the defects specified in 3.12.1 and any nonconformance with 3.12.1 shall constitute test failure.

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

Modifications to AATCC Method 169:

1. The test apparatus shall be either a test chamber Type 1A or 1B. Type 1B shall be equipped with a three-tiered inclined specimen rack. The apparatus shall be equipped with an automatic light monitor and shall be capable of automatically controlling irradiance, temperature, and humidity. The apparatus shall be maintained in accordance with manufacturer's recommendations.

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

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

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

7. Cut shell in half along the front to back axis. The test specimens shall be mounted on the outside of the rack. After the required exposure period, the specimen shall be removed from the apparatus and allowed to dry and condition at ambient conditions. As an option, complete shell may be placed in the weatherometer and only the half exposed to the bulbs shall be tested.

After the shell has been tested in the weatherometer, the helmet shall be examined for the defects listed in 3.12.2. Any nonconformance to the requirements of 3.12.2 shall constitute test failure. After passing the requirements of 3.12.2, the shell shall be tested against the requirements of 3.9.1 for 0° obliquity only. Testing shall be conducted in accordance with 4.9.11.3.

4.9.14.3 Field agent resistance.

The finished shells shall be conditioned at standard ambient conditions for a minimum of 24-hours prior to testing. The test procedure is as follows:

1. With a clean cloth remove any mold release, dirt, or foreign matter from the exterior of the shell.
2. Mark an area of at least 2.5-inches square on the test specimen's surface.
3. Apply a liberal amount of the agent specified to the shell sufficient to cover the total marked area for a minimum period of 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 3.12.3. Failure to meet any requirement shall constitute test failure.

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

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

a. The end-item specimen will be a finished shell as opposed to a textile specimen.
b. Char length and afterglow will not be measured.
c. Test Cabinet as described in paragraph 6.1 shall not be used. Instead, tests shall be performed in a laboratory fume hood with air turned off.
d. Modify paragraph 9, Sampling, to reference sampling at random locations within four (4) inches of the crown benchmark and along the outer edge of the helmet. The edge and shell shall be tested at two (2) non-overlapping locations for each helmet tested. A minimum of three (3) helmets will be tested.
e. Modify paragraph 11; Flame will be immediately removed from specimen after 12 seconds.
f. Modify calculation, paragraph 12.1, to calculate the average after-flame of three (3) helmets, two (2) samples per helmet, for both the edge and shell tests.

Any non-conformance with the requirements of 3.12.4 shall constitute failure of the test.

4.9.14.5 Hot storage and use. The finished helmet shall be subjected to a conditioning of 24-hours (± 1 hr) at 160°F (± 10°F) in a circulating air test chamber. The test specimen shall be allowed to cool to ambient temperature. The test specimen shall then be removed from the test chamber and visually examined. Thickness measurements are to be performed at five (5) random locations, one in each section. Prior to beginning the test, the five (5) random locations shall be selected. At those locations the coating and texturing aggregate shall be abraded/removed such that an accurate measurement is taken. Helmet sections are defined in 4.9.11.3.2. Before and after thickness measurements are to be taken at the same five random locations. The thickness criteria specified in 3.12.5 are based on a point to point comparison and not an average. The helmet shall be visually examined for the requirement of 3.12.5. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.9.6 on the sample. The adhesion of coating test shall not be conducted within one inch of the area used to conduct the thickness measurement. As an alternative, an additional uncoated shell may be used to determine change in thickness. Failure to meet the requirements of 3.12.5 shall constitute test failure.

4.9.14.6 Cold storage and use. The finished helmet shall be subjected to a conditioning of 24-hours (± 1 hr) at minus 60°F (± 10°F) in a test chamber. The test specimen shall be allowed to cool to ambient temperature. The test specimen shall then be removed from the test chamber

and visually examined. Helmet sections are defined in 4.9.11.3.2. Thickness measurements are to be performed at five random locations, one 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. Before and after thickness measurements are to be taken at the same five (5) random locations. The thickness criteria specified in 3.12.6 are based on a point to point comparison and not an average. The helmet shall be visually examined for the requirement of 3.12.5. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.9.6 on the sample. The adhesion of coating test shall not be conducted within one inch of the area used to conduct the thickness measurement. As an alternative, an additional uncoated shell may be used to determine change in thickness. Failure to meet the requirements of 3.12.6 shall constitute test failure.

4.9.14.7 Temperature shock. The finished helmet shall be subjected to an initial conditioning of a minimum of 24-hours at 160°F (± 10°F) in a conditioning chamber. The test specimen shall then immediately be put in a conditioning chamber at minus 60°F (± 10°F) for a minimum of 24-hours. A second finished helmet shall be subjected to an initial conditioning of a minimum of 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. 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 random locations, one 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 4.9.11.3.2. Before and after thickness measurements are to be taken at the same five (5) random locations. The thickness criteria specified in 3.12.7 are based on a point to point comparison and not an average. The helmet shall be visually examined for the requirement of 3.12.7. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.9.6 on the sample. The adhesion of coating test shall not be conducted within one inch of the area used to conduct the thickness measurement. As an alternative, an additional uncoated shell may be used to determine change in thickness. Failure to meet the requirements of 3.12.7 shall constitute failure of the test.

4.9.14.8 Altitude test. Place the finished helmet in an ambient air pressure chamber and vary the pressure in the chamber. Starting at ambient pressure, lower the pressure to simulate a 40,000 feet (± 300 feet) altitude. The test temperature at the 40,000-feet equivalent pressure should be -62°F (± 5°F)/ -52°C (± 3 °C). Hold the pressure for a minimum of 1-hour. Then raise the pressure to simulate a 15,000 feet (± 300 feet) altitude. Hold the pressure for a minimum of 1-hour. Then pressurize the chamber and inspect for the requirements of 3.12.8. The change rate of the air pressure is not less than 1,500 feet per minute and no more than 2,000 feet per minute. Thickness measurements are to be performed at five (5) random locations, one in each section. Prior to beginning the test, the five (5) random locations shall be selected. At those locations the coating and texturing aggregate shall be abraded/removed such that an accurate measurement is taken. Helmet sections are defined in 4.9.11.3.2. Before and after thickness measurements are to be taken at the same five (5) random locations. The thickness criteria

specified in 3.12.8 are based on a point to point comparison and not an average. The helmet shall be visually examined for the requirement of 3.12.8. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.9.6 on the sample. The adhesion of coating test shall not be conducted within 1-inch of the area used to conduct the thickness measurement. As an alternative, an additional uncoated shell may be used to determine change in thickness. Failure to meet the requirements of 3.12.8 shall constitute test failure.

4.9.14.9 Vibration test. Testing shall in accordance with MIL-STD-810, Method 514.6, 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 3.12.9 shall constitute test failure.

4.9.14.10 Impact resistance. The test apparatus shall consist of a fixed ball release tester equipped with an electromagnetic device or similar apparatus capable of releasing a minimum 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 minimum height of 5.0-feet. After the impact, examine the finished shell for requirements in paragraph 3.12.10. Measure the depth of any indentation in the finished shell. Any nonconformance with the requirements of 3.12.10 shall constitute test failure.

4.9.14.11 Compression resistance (top to bottom). The finished shell without the rubber edging or an unfinished shell shall be tested 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: 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 2-1-2519) 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), again record the height dimension. One (1) shell from each size shall be tested. Failure to meet the requirements of paragraph 3.12.11 shall constitute failure of the test.

4.9.14.12 Compression resistance (side to side). The finished shell without the rubber edging or an unfinished shell shall be tested 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 per the following. Measure, record and mark the maximum shell width dimension of the test specimen to the nearest 0.001-inch. Using a top 2.50-inch diameter flat anvil position the test specimen so that the highest width dimension is aligned with the center of the top anvil. Suitable means shall be made to keep the test specimen in position so long as the means does not add to the structural rigidity of the shell. A method successful used is shown in Figure 5. Note that Figure 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 5.0-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), again measure record the height dimension. One (1) shell from each size shall be tested. Failure to meet the requirements of paragraph 3.12.12 shall constitute failure of the test.

4.9.14.13 Integration/compatibility. An integration and compatibility demonstration shall be conducted which demonstrates that the finished helmet is integrated and compatible as specified in 3.13. Failure to meet the requirements of 3.13 shall constitute test failure.

4.9.14.14 Accelerated Aging/Shelf Life. A finished shell shall be subjected to accelerated aging conditioning in general accordance with ASTM D 1149-07, with the following modifications. Shell thickness shall be measured, before and after conditioning, in accordance with 4.9.3. The finished shell may be lightly sanded at the measuring locations to remove aggregate so to obtain a good measurement.

a. The finished shell shall be conditioned in the ozone chamber for 4 hours at temperature of 40 ± 1°C (104 ± 2°F).

b. A 30 lbs weight shall be applied to the finished shell during conditioning. Position and support the finished shell so that it is in the as-worn position (see drawing 2-1-2569). Apply the weight on the shell apex. No additional tensile strain during conditioning is required.

c. Introduce ozone after temperature conditioning at a minimum ozone level of 50 ± 5 mPa partial ozone pressure for 72 hours.

d. After conditioning, the finished shell must remain at ambient atmospheric conditions for 24 hours prior to testing.

After conditioning, the finished shell shall undergo visual inspection for defects as listed in 3.12.13. Inspection for change of shell thickness shall be done by measuring the shell thickness before and after conditioning. Thickness measurements shall be obtained in accordance with paragraph 4.9.3. After passing the visual inspection requirements, the finished shell shall undergo V50 BL(P) testing for 17-grain projectile at 0° obliquity. V50 BL(P) testing shall be conducted in accordance with paragraph 4.9.11.3.4. Any non-conformance with the requirements of 3.12.13 shall constitute a test failure.

4.9.15 Ownership and support.

4.9.15.1 Washability. The finished shell with hook disks 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 pads shall be washed both in accordance with the hand washing method and the machine washing method. For hand washing, the pads 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. For machine washing, the pads shall be washed in accordance with the machine washing method of AATCC Test Method 143 (wash temperature III, normal/sturdy cycle). Each component 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 3.14.4.1 shall constitute test failure.

4.9.15.2 Shelf Life. The contractor shall provide data that shows all the components and materials used in the helmet meet the requirements of paragraph 3.14.5.

4.9.16 Health/Safety. A demonstration shall be conducted or documentation provided to verify that the finished helmet meets the health and safety requirements specified in 3.15.1, 3.15.2, and 3.15.3. Additionally, the contractor must furnish information, which certifies that the finished product is composed of materials, which have been safely used commercially or provide sufficient toxicity data to show compatibility with prolonged, direct skin contact.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by 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.)

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

6.2 Acquisition requirements. Acquisition documents should specify the following:

1. Title, number and date of this specification.
2. Issue of DODISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
3. Types, Classes, and sizes required (see 1.2).

4. When first article inspection is required, (see 3.1), the item will be tested and should be a first article sample. The contracting officer should include specific instructions in acquisition documents regarding arrangement for examinations, quantity, and testing and approval.
5. Packaging requirements (see 5.1).
6. Helmet PDM approval requirements.

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

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

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

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

a) Any otherwise FAIR impact which does not comply with shot-to-shot or shot-to-edge minimum distance requirements, which is NOT a complete penetration, shall also be a FAIR impact.
b) Any otherwise FAIR impact, which impacts at an excessive velocity and is NOT a complete penetration, shall also be a FAIR impact.
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). A complete penetration occurs when the impacting projectile or any fragment thereof, or any fragment of the test specimen perforates the witness plate resulting in a crack or hole which permits light passage when a 60-watt, 110-volt bulb is placed proximate to the witness plate. If no witness plate is used, a complete penetration occurs if bullet or fragment evidence is found in the backing material (clay) or if a hole occurs thru the shell directly behind the point of impact.

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

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

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

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

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

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

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

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

6.7 Suggested Sources.

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

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

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

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

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

6.8 Mandatory Sources.

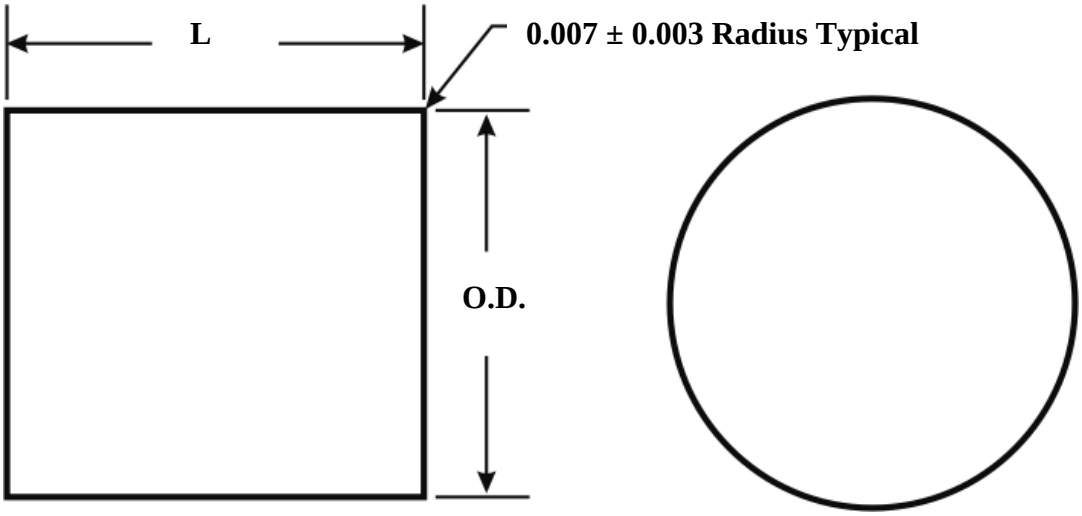
The mandatory source for the ACH Pad Suspension/Retention Systems is:

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

6.9 Subject term (key word) listing.

Ballistic
Body Armor
Headgear

7. FIGURES and PICTURES



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 1. Right circular cylinder.

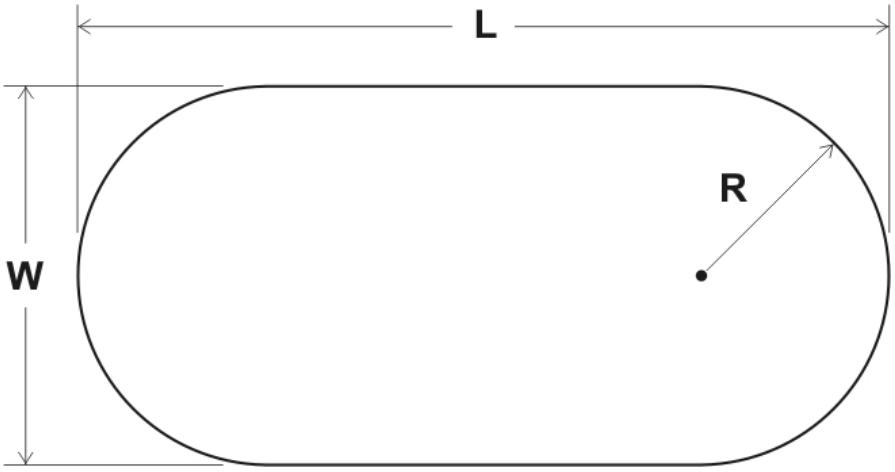


FIGURE 2. Hook disk elongated.

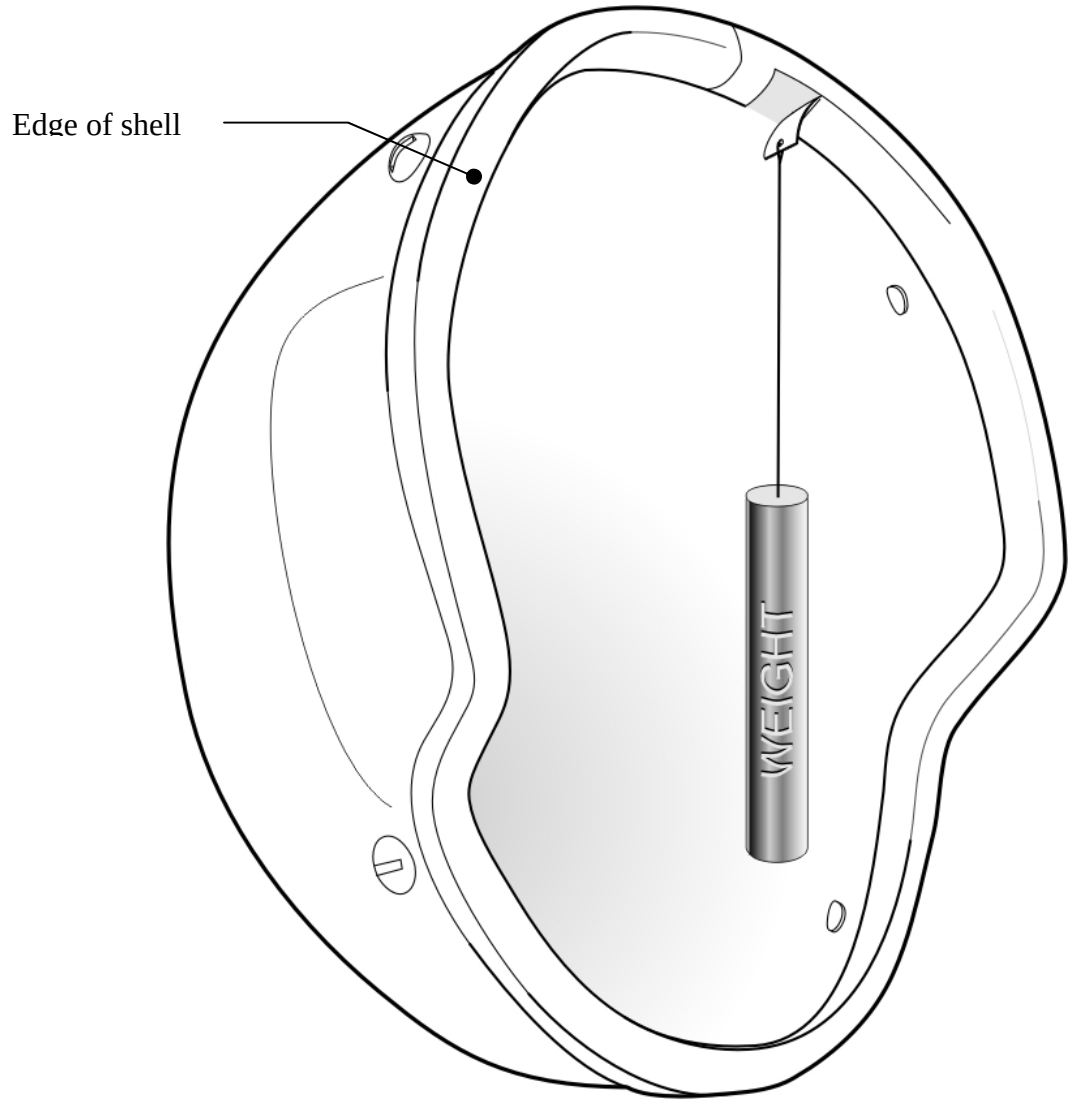


FIGURE 3. Rubber edge testing.

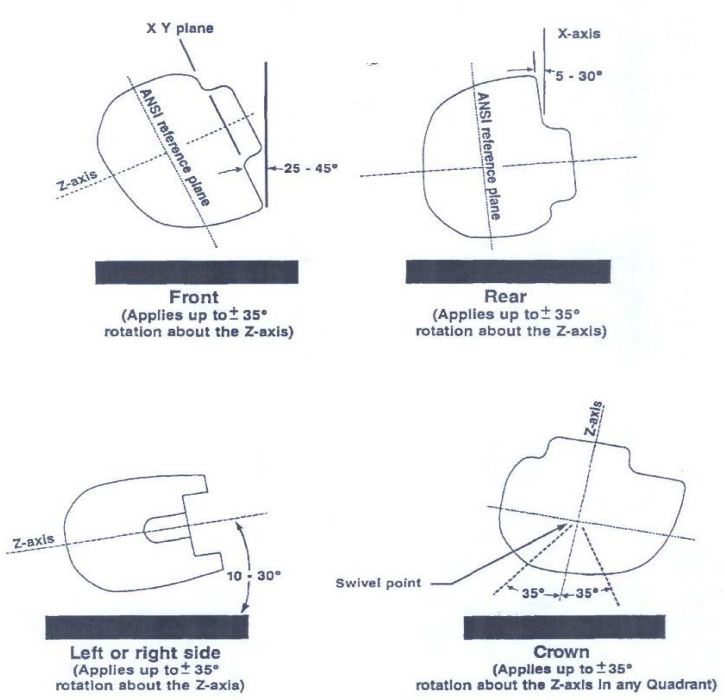


FIGURE 4. Blunt impact test locations.

FIGURE 5. Jig for side to side compression resistance.

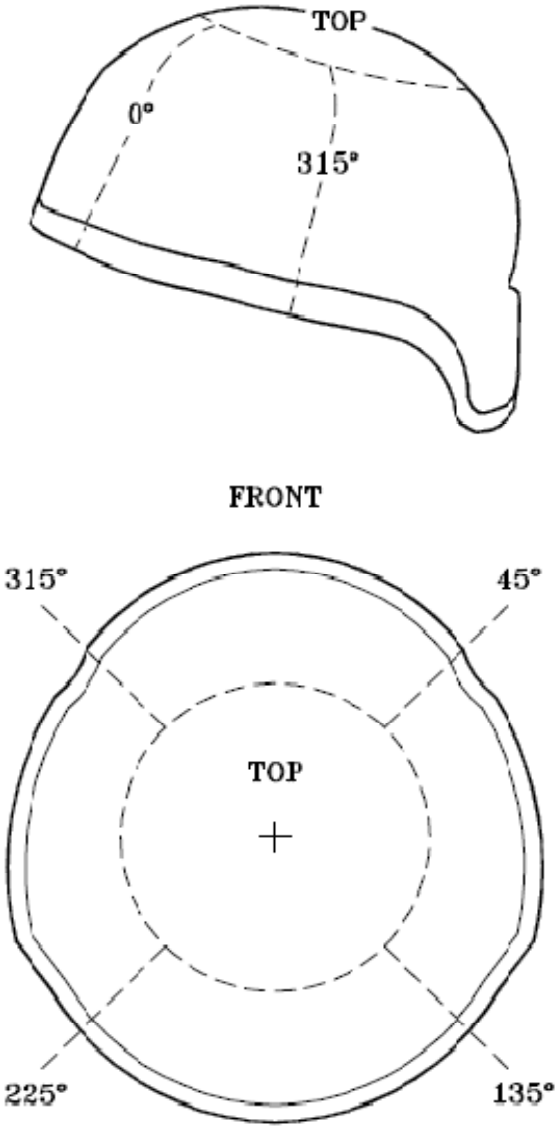


FIGURE 6. Helmet sections.

PICTURE 1. Headform: Hardware Ballistic Test

PICTURE2. Headform: Rear Pad Support

ANNEX A

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

1. Scope. This document contains information as applicable to First Article Sample requirements and Lot Acceptance Test requirements (LAT) for the Advanced Combat Helmet (ACH). The ACH is a protective helmet consisting of a ballistically protective shell, pad suspension system, and 4-point chinstrap/napestrap retention system. Unless otherwise stated herein, all requirements and verification methods shall be those prescribed in the contract and associated attachments, including Purchase Description AR/PD 10-02.

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

   Type I – Advanced Combat Helmet (No Hole Night Vision Goggle Mount)
   Class 1 - 3/4-inch thick pad system, Foliage Green 504
   Class 2 - Light weight shell, 3/4-inch thick pad system, Foliage Green 504

   Type II – Advanced Combat Helmet (One Hole for Night Vision Goggle Mount)
   Class 1 - 3/4-inch thick pad system, Foliage Green 504
   Class 2 - Light weight shell, 3/4-inch thick pad system, Foliage Green 504

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

SCHEDULE OF SIZES
Small
Medium
Large
Extra-Large
Extra, Extra-Large

NOTE: size may be abbreviated as S, M, L, XL or XXL.

4. Requirements and Verifications

Requirements and Verifications

Characteristic	Requirement Paragraph	Verification Paragraph	First Article Testing 1/	Lot Acceptance Testing 1/	FAT Sample Size
THE TESTS BELOW REQUIRE UNFINISHED SHELLS					
Shell design/shape	3.5	4.9.2	X	2/	1 each size
Shell construction	3.5.1	4.9.1	X	2/	1 each size
Shell thickness and uniformity	3.5.2	4.9.3	X	2/	1 each size
Attachment holes	3.5.4	4.9.1, 4.9.2	X	2/	1 each size (with samples of hardware)
Retention System holes	3.5.4.1	4.9.1, 4.9.2	X	2/	1 each size (with samples of hardware)
Night Vision Goggle holes	3.5.4.2	4.9.1, 4.9.2	X	2/	1 each size (with samples of hardware)
Eyewear Retention Strap holes	3.5.4.3	4.9.1, 4.9.2	X	2/	1 each size (with samples of hardware)
The tests above can be performed on the same one set of unfinished shells = 1 Small, 1 Medium, 1 Large and 1 Extra Large. Samples of the appropriate hardware are also needed for verification to PD requirements. Except the Retention System Holes which requires one set of finished shells without retention Systems attached = 1 Small, 1 Medium, 1 Large and 1 Extra Large. Samples of the appropriate hardware are also needed for verification to PD requirements.					

THE TESTS BELOW REQUIRE FINISHED SHELLS WITHOUT HOOK DISKS					
Hook disk durability	3.8.2	4.9.9.2, 4.9.9.3	X	2/	3 each size for 4.9.9.2 and 1 each size for 4.9.9.3
The tests above require 4 sets of Finished Shells without Hook Disks = 4 Small, 4 Medium, 4 Large and 4 Extra Large Also required for the tests are 80 Hook Disks. These tests can be performed, witnessed and verified by DCMA QAR.					

THE TESTS BELOW REQUIRE COMPLETE HELMETS FOR VISUAL / NON-INVASIVE INSPECTIONS					
Benchmarks	3.5.3	4.9.4	X	2/	1 each size
Edging	3.5.5	4.9.1, 4.9.5.1	X	2/	1 each size
Edging adhesion	3.5.5.1	4.9.5.2	X	X 4/	1 each size
Coating	3.5.6	4.9.1	X	2/	CoC
Outer surface preparation	3.5.6.1	4.9.1	X	2/	QAR verification
Texturing of coating	3.5.6.2	4.9.1	X	2/	CoC
Retention system	3.6	4.9.7	X	2/	1 each size
Pad Outer Layer Material	3.7.1.3	4.9.8.1, 4.9.8.2, 4.9.10.1	X	2/	1 Pad Set
Hook disks	3.8	4.9.10.1	X	2/	
Hook disk shape and coverage	3.8.1	4.9.9.1	X	2/	1 each size
Hook/loop adhesion	3.8.3	4.9.9.4	X	2/	2 in. wide x 6 in. long loop and 1 in. wide x 5 in. long hook
Weight	3.10	4.9.12	X	x	5 each size
Integration / compatibility	3.13	4.9.14.13	X	2/	1 each size
Marking of Helmet Shell	3.14.1	4.9.1	X	X 4/	1 each size
Marking of Pad Suspension components	3.14.2	4.9.1	X	X 4/	1 each size
Barcode label	3.14.3	4.9.1	X	X 4/	1 each size

Shelf Life	3.14.5	4.9.15.2	X	2/	Contractor data as required
Safety	3.15.1	4.9.16	X	2/	Contractor data as required
Toxicity	3.15.2	4.9.16	X	2/	Contractor data as required
Hazardous materials	3.15.3	4.9.16	X	2/	Contractor data as required
Instruction booklet	3.16	4.9.1	X	X	As required

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

THE TESTS BELOW REQUIRE COMPLETE HELMETS FOR DESTRUCTIVE / INVASIVE TESTS					
Edging adhesion of edging after heat aging	3.5.5.2	4.9.5.3	X	2/	1 each size
Adhesion of coating	3.5.6.3	4.9.6	X	X 4/	3 each size
Retention system attachment points and hardware	3.6.1	4.9.7, 4.9.11.4	X	2/	(See Static Pull and Dynamic Pull Strengths and Section 5)
Static Pull Strength	GL-PD-07-19 3.5.2.1	GL-PD-07-19 4.4.3	X	2/	1 Medium ACH
Dynamic Pull Strength	GL-PD-07-19 3.5.2.2	GL-PD-07-19 4.4.4	X	2/	7 Medium ACH (one for each impact location)
Pad suspension system	3.7	4.9.8.1	X	2/	6 pad sets
Pad Construction	3.7.1	4.9.8.2	X	2/	1 pad set

Pad Inner Layer Material	3.7.1.1	4.9.8.1, 4.9.8.5, 4.9.10.1	X	2/	2 yards of material
Padding Layer Material	3.7.1.2	4.9.8.1, 4.9.8.2	X	2/	(Captured in the 6 pad set tests)
Padding Layer Material Water Absorbency	3.7.1.2	4.9.8.4	X	X 4/	1 pad of each shape and thickness
Pad compression durability	3.7.2	4.9.8.3	X	2/	1 pad set
Fragmentation protection – minimum V50 ballistic protection limits (V50 BL(P))	3.9.1	4.9.11, 4.9.11.1	X	X 3/	60 Helmets required – 15 each size as described in the chart in Section 5.
Resistance to Penetration – 9mm	3.9.2	4.9.11, 4.9.11.1.2, 4.9.11.4	X	X 3/	
Ballistic transient Deformation	3.9.3	4.9.11, 4.9.11.1.3, 4.9.11.5	X	X 3/	
Blunt Impact Protection	3.11	4.9.13	X	X 4/	6 each size
Seawater resistance	3.12.1	4.9.12, 4.9.14.1	X	2/	1 each size
Weatherometer resistance	3.12.2	4.9.14.2	X	2/	Any 1 helmet
Field agent resistance	3.12.3	4.9.14.3	X	2/	Any 1 helmet
Flame resistance	3.12.4	4.9.14.4	X	2/	Any 3 helmets
High temperature storage and use	3.12.5	4.9.3, 4.9.14.5	X	2/	Any 1 helmet
Cold temperature storage and use		4.9.3, 4.9.14.6	X	2/	Any 1 helmet
3.12.6		4.9.3, 4.9.14.7	X	2/	Any 2 helmets
3.12.7	3.12.8	4.9.3, 4.9.14.8	X	2/	Any 1 helmet
Vibration	3.12.9	4.9.14.9	X	2/	1 each size
Impact resistance	3.12.10	4.9.14.10	X	2/	1 each size
Compression resistance (top to bottom).	3.12.11	4.9.14.11	X	2/	1 each size

Compression resistance (side to side).	3.12.12	4.9.14.12	X	2/	1 each size
Washability	3.14.4.1	4.9.15.1	X	2/	Any 1 helmet
Colorfastness	3.14.4.2	4.9.10	X	2/	5 yards of each material

The tests above require 138 Complete Advanced Combat Helmets, 2 sets of unfinished shells with no coating or edging and 26 separate Pad Sets (9 sets per the chart above, 13 sets for FAT tests a. – e. as detailed following Table V and 2 sets for contingency).

The required size breakdown for Complete Advanced Combat Helmets =

31 Small, 39 Medium, 31 Large and 31 Extra Large

The required size breakdown for unfinished shells =
2 Small, 2 Medium, 2 Large and 2 Extra Large

In addition, seven (7) yards length of Pad Inner Layer Material and five (5) yards length of each of Pad Outer Layer Material, Retention System Nylon Webbing and Cotton Webbings are needed.

1/ An "x" in the column designates that the test is performed. Sampling rate is specified in 4.4 for conformance lot testing unless otherwise specified in the contract and Lot Acceptance Table.
2/ Certification of Conformance (COC) provided for Lot Conformance 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 conformance lots shall be in accordance with 4.9.11.2.
4/ The LAT Testing table below in Section 5 identifies the rate of conformance lot inspection 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 conformance lot inspection, blunt impact protection test is conducted at ambient conditions only.

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

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

ACH FAT Testing:

ACH – First Article Testing Table – Ballistic Requirements (AR/PD 10-02)

Test	2 gr. V50	4 gr. V50	16 gr. V50	64 gr. V50	17 gr. FSP, V50	9mm RTP/BFD	Note / Samples
Requirement	4200 MIN	3475 MIN	2475 MIN	1750 MIN	2200 MIN	1400 +50 No penetration 0.63/1.00 inch	
Ambient 0° obliquity	S (M)	M (L)	L (XL)	XL (S)	S (M)	M (L)	12
High Temp 0° obliquity	M (L)	L (XL)	XL (S)	S (M)	M (L)	L (XL)	12
Low Temp 0° obliquity	L (XL)	XL (S)	S (M)	M (L)	L (XL)	XL (S)	12
Saltwater 0° obliquity	XL (S)	S (M)	M (L)	L (XL)	XL (S)	S (M)	12
Weather 0° obliquity					S (XL)		2
Ambient 45° obliquity	M (L)	L (XL)	XL (S)	S (M)	M (L)		10 – Gov. Reference

30 total tests – 30 helmet samples with 30 contingency samples (parenthesized) – total 60 helmets = S: 15; M: 15; L: 15; XL: 15

For FAT:

The V50 BL (P) for each helmet shell shall be the average of at least ten (10) fair impact velocities consisting of an equal number of the lowest complete penetration and the highest partial penetration velocities provided that the velocity spread is not greater than 125- feet per second. In cases where the velocity spread is greater than 125- feet per second, the V50 BL(P) shall be the average of at least 14 fair impact velocities consisting of an equal number of the lowest complete penetration and the highest partial penetration velocities with a velocity spread no greater than 150 feet per second. If neither the ten nor the 14 shot conditions can be satisfied, and at least seven partial penetrations at velocities in excess of the required minimum V50, and there are no complete penetrations at or below the minimum required V50 velocity, and at least 14 fair shots have been made in the helmet(s) shall be determined to have satisfied that specific threat condition requirement. Should none of these three conditions apply, the test shall be declared inconclusive.

LAT Testing:

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

Lot Size	*9mm V_0 ²	*17 grain FSP¹ V_{50}	9mm V_0 Retention System Hardware	Edging Adhesion	Adhesion of Coating	Blunt Impact Protection	Pad Water Absorbency	Marking	Contingency Helmets	Barcode Label	Total Samples Required
< 150	3	2	1	2	2	2	1	1	2	1	17
151 – 500	5	3	2	2	2	2	1	1	4	1	23
501 - 3200	9	4	3	2	2	2	1	1	6	1	31
3200 >	14	6	4	2	2	2	1	1	8	1	41

1/ test conducted at 0° obliquity at ambient conditions. Multiple helmet shells may be required to determine the V50 BL (P).
2/ An RTP/Transient Deformation Test consists of five (5) shots made into one helmet.
More than one test may be conducted on a single helmet with the approval of the Contracting Officer.

*These combined quantities are derived, per Lot Size, per ANSI/ASQ Z1.4, Special Inspection Level S-3.
Normal Inspection
Switching Rules do not apply
No additional testing

9mm V_0 RTP/Transient Deformation – No Complete Penetrations Allowed. No deformation results over the maximum specification limits allowed.
17 grain FSP – V50 results must be at or above the minimum specification.

For LAT:

The V50 BL (P) for each helmet shell shall be the average of at least six (6) fair impact velocities consisting of an equal number of the lowest complete penetration and the highest partial penetration velocities provided that the velocity spread is not greater than 125 ft/sec. In cases where the velocity spread is greater than 125 fps, the V50 BL(P) shall be the average of at least ten (10) fair impact velocities consisting of an equal number of the lowest complete penetration and the highest partial penetration velocities with a velocity spread no greater than 150 fps. If neither the six nor the ten shot conditions can be satisfied, and at least five partial penetrations at velocities in excess of the required minimum V50 AND there are NO complete penetrations at or below the minimum required V50 velocity AND at least ten (10) fair shots have been made into the helmet(s), the helmet(s) shall be determined to have satisfied that specific threat condition requirement. Should none of these three conditions apply, the test shall be declared INCONCLUSIVE.