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Purchase Description (PD)

FOR

Enhanced Combat Helmet

VERSION 0.1

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Approved by:

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Arthur J Passagian
LtCol, USMC
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Date Signed

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Record of Change

Date	Paragraph	Comment	Approval

NOT MEASUREMENT SENSITIVE

PURCHASE DESCRIPTION

ENHANCED COMBAT HELMET (ECH)

This specification is approved for use by all Departments and Agencies of the Department of Defense (DoD).

1. SCOPE

1.1 Scope. This specification covers the performance and verification requirements for the Enhanced Combat Helmet (ECH), a protective helmet consisting of a ballistically protective shell, pad suspension system, and 4-point chinstrap/napestrap retention system. The ECH is compatible with, and is typically worn in conjunction with other components of infantry combat equipment such as Body Armor Systems, protective spectacles/goggles and/or prescription glasses, night vision equipment and a camouflage fabric helmet cover. The ECH may be used in lieu of the Light Weight Helmet (also known as LWH) for the U.S. Marine Corps and the Advanced Combat Helmet (also known as the ACH) for the U.S. Army.

1.2 Classification. The helmet will have two classes of retention systems. Each helmet consists of a finished shell, suspension system, retention system, and necessary attachment hardware (See Figure 2). The ECH will have a shape profile of the Army's Advanced Combat Helmet (ACH). The helmet assembly will be of the following classes as specified in 6.2.

Type:	Tactical Cut
Class I	X Back Retention System
Class II	H Back Retention System

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

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be used in improving this document should be addressed to: Marine Corps Systems Command, CESS, Attn: PM Infantry Combat Equipment, 2200 Lester Street, Quantico, VA 22134-6050

AMSC N/A

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 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 and 4 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 (see 6.2).

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-32075	- Label: For Clothing, Equipage and Tentage (General Use)
MIL-DTL-64159	- Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant
MIL-PRF-372D	- Cleaning Compound, Solvent (For bore of small arms and automatic aircraft weapons)
MIL-PRF-2104H	- Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service
MIL-PRF-6083F	- Hydraulic Fluid, Petroleum Base, for Preservation and Operation
MIL-PRF-46170D	- Hydraulic Fluid, Rust Inhibited, Fire Resistant, Synthetic Hydrocarbon Base, NATO Code No. H-544
MIL-DTL-46593B	- Projectile, Calibers .22, .30, .50, and 20mm Fragment-Simulating
MIL-DTL-83133F	- Turbine Fuels, Aviation, Kerosene Types, NATO F-34(JP-8), NATO F-35, and JP-8 + 100
MIL-STD-130	- DOD Standard Practice Identification Marking of U.S. Military Property

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-662F	- V_{50} Ballistic Test for Armor
MIL-STD-810G	- Environmental Engineering and Laboratory Tests

(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.

DRAWINGS

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

2-1-2515	- TBD
2-1-2516	- TBD
2-1-2517	- TBD

2-1-2518	- TBD
2-1-2519	- TBD
2-1-2566	- TBD
2-1-2510	- TBD
2-1-2558	- TBD
2-1-2560	- TBD
2-1-2562	- TBD

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

DEFENSE SUPPLY CENTER PHILADELPHIA

GL/PD-07-19 - Retention System, Advanced Combat Helmet (ACH)
2005 Visual Guide of Colors Used in Military Items Color Card

(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.)

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 (see 6.2).

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)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D-76	- Tensile Testing Machine for Textiles
ASTM D-910	- Gasoline, Aviation
ASTM D-975	- Oils, Diesel Fuel
ASTM D 523-89	- Standard Test Method for Specular Gloss
ASTM D 782-82	- Standard Method of Testing Shipping Containers in Revolving Hexagonal Drum (re-approved 1987)
ASTM D 1149-07	- Standard Test Methods for Rubber Deterioration – Cracking in an Ozone Controlled Environment
ASTM D 6413-08	- Standard Test Method for Flame Resistance of Textiles (Vertical Test)
ASTM E 4	- Standard Practices for Force Verification of Testing Machines
ASTM F 1291	- Standard Test Method for Measuring Thermal Insulation of Clothing Using a Heated Manikin

(Copies of documents are available on line at www.astm.org or from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19426-2959.)

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC-8	- Colorfastness to Crocking: AATCC Crocking Method
AATCC-15	- Colorfastness to Perspiration
AATCC 16	-Colorfastness to Light
AATCC-61	- Colorfastness to Laundering, Home and Commercial: Accelerated
AATCC-107	- Colorfastness to Water
AATCC-143	- Appearance of Apparel and Other Textile End Products after Repeated Home Laundering
AATCC-169	- Weather Resistance of Textiles: Xenon Lamp Exposure
AATCC Evaluation Procedure 9	- Visual Assessment of Color Difference of Textiles
AATCC Test Method	- Concept 2 Consumer Technical Supplement

(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.)

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/ safstan2.htm. The complete text of all Federal Motor Vehicle Safety Standards and other NHTSA regulations can be found in Title 49 of the Code of Federal Regulations (CFR). Title 49 of the CFR is published in seven volumes; the fifth volume (Parts 400-999) is where these regulations can be found. Copies of this volume can be obtained for a cost from the U. S. Government Printing Office, Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328.

NATIONAL INSTITUTE OF JUSTICE (NIJ)

NIJ Standard 0106.01	- Ballistic Helmets
NIJ 0101.03	- Ballistic Resistance of Police Body Armor

(Copies of documents are available on line at http://www.eeel.nist.gov/oles/Publications/ or from the National Institute of Standards, Office of Law Enforcement Standards, 100 Bureau Drive, M/S 8102, Gaithersburg, MD, 20899-8102, DC.)

International Organization of Standards

ISO/IEC 15415	- Data Matrix Symbol Quality

(Copies of documents are available on line at http://www.iso.org or from the ISO, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland.)

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)

(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. 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 Inspections/Tests

3.1.1 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.

3.1.2 Lot Acceptance. When specified (see 6.2), sample(s) shall be subjected to Lot Acceptance inspections (see 4.4 and 4.9 Table IX).

3.2 Materials, design, and manufacturing processes. Unless otherwise specified, the materials, design, and manufacturing processes shall be at the discretion of the contractor provided all articles submitted to the government meet the requirements of this specification.

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, paint (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 Figure 1 (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. The ECH assembly shall be in six sizes, X-Small, Small, Medium, Large, Extra-Large, and Extra Extra-Large. A complete helmet assembly consists of the following components and shall be in accordance with drawing 2-1-2560 (see Figure 2):

a. Helmet Shell
b. Suspension Hook Disks
c. Suspension Pads (3/4 or 1-inch thick)

d. Retention Assembly
e. Attaching Hardware
f. Edging, Finish, and Labels

3.4.1 Interchangeability. Components shall be interchangeable and modular such that replacement of any component with another like-sized unit shall have no detrimental effect on any of the requirements herein. Not all parts need be size specific, and it is desired that the minimum number of unique parts/assemblies capable of meeting the requirements of this specification be used. When purchased as a separate component, the Helmet Shell shall be complete with edging, finish, hook disks and labels. Verification shall be in accordance with 4.10.1.

3.5 Shell design/shape. The shape of the unfinished 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, and 2-1-2518 and all subsidiary drawings and parts lists. 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 paragraph 4.10.2.

3.5.1 Shell construction. The outer and inner surfaces of the helmet shell, including 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 helmet 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 (i.e. non-cosmetic repair of the helmet shell) shall not be performed after the material has been molded. Remolding helmet shells is not permitted. More than one material (hybrid construction) may be used to achieve best combination performance requirements listed in this document. Testing shall be conducted in accordance with paragraph 4.10.1.

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 0.500 inch 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 inch over the entire surface of the helmet. Testing shall be conducted in accordance with paragraph 4.10.3.

3.5.3 Benchmarks. Benchmarks per drawings 2-1-2562 on both the inside and outside periphery of the shell shall extend past the helmet shell edge or edging (if used) 0.50 (± 0.30) inch. The benchmarks shall be clearly visible. Verification shall be in accordance with paragraph 4.10.4.

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 0.1 times the diameter of the hole. 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, and 3.5.4.2 shall be conducted in accordance with 4.10.1 and 4.10.2.

3.5.4.1 Retention system holes. Holes for the Retention System shall be of the diameter as shown on drawings 2-1-2515, 2-1-2516, 2-1-2517, and 2-1-2518. Testing shall be in accordance with 4.10.2.

3.5.4.2 Night vision goggle (NVG) hole(s). The hole placement for will be according to the drawings 2-1-2515, 2-1-2516, 2-1-2517, and 2-1-2518 and will be adjusted to integrate the night vision goggle bracket within the tolerance specified on the drawing.. Testing shall be in accordance with 4.10.2.

3.5.5 Edging. The finished shell shall have a firmly bonded or an integrally molded edging that protects the periphery of the shell from delamination, wear, cuts, and tear. 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 inch. 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. Thickness of the wall of the edging against the sides (as opposed to the edge or rim) shall be a maximum of 0.070-inch. The edging shall be colored the same color as the exterior of the shell (see 3.5.6.3). Testing shall be conducted in accordance with paragraph 4.10.1 and 4.10.5.1.

3.5.5.1 Edging adhesion. The edging shall remain firmly attached to the finished shell when tested as specified in paragraph 4.10.5.2.

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 4.10.5.3.

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 color shall be Foliage Green 504. The coating shall completely and uniformly cover the shell surface and the outside of the edging. While coating is not required for the interior helmet shell, it shall be a color specified in 3.5.6.3. 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 and inside edge of the edging. 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 paragraph 4.10.1.

3.5.6.1 Outer 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 of the helmet shell (see 3.5.1) may be filled with suitable materials to provide a smooth and continuous surface. Cutting and filling of any blisters or other defects of the ballistic material of any size is not permissible. 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 paragraph 4.10.1.

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 paragraph 4.10.1.

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 in accordance with Table I. Verification shall be conducted in accordance with paragraph 4.5.

TABLE I. Sand texturing

Sieve No. (U.S. STD)	Percent cumulative
No. 40	0.5 maximum
No. 50	6.0 (± 3)
No. 70	34.0(± 5)
No. 100	82.0 (± 5)
No. 140	97.0 (+ 3, - 5)

The coating-sand mixture shall contain six pounds of sand to one base gallon of coating and shall be reduced to spraying consistency.

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 10 to 12 ounces of walnut shell flour per base gallon of coating. Verification shall be conducted in accordance with paragraph 4.5.

3.5.6.3 Color. The color of the outer surface of the helmet shell, edging and visible attachment hardware (if used) Foliage Green 504 of 2005 Visual Guide of Colors Used in Military Items Color Card (see 6.2, 6.3 and 6.5). The Foliage Green 504 shall conform to requirements in paragraphs 3.5.6.4 and 3.5.6.5. When the final exterior finish is applied after assembly, hardware will be coated with the helmet shell. However, when the helmet shell is finished before installation of the retention system, black hardware is permissible in lieu of Foliage Green. The interior helmet shell and the remainder of the edging shall be the same shade as the exterior, unless approved otherwise. The retention components shall be Coyote Brown 498 or Foliage Green 504 (see 6.2, and 6.3) as specified in the contract delivery order. Verification shall be conducted in accordance with paragraph 4.10.10.1.

3.5.6.4 Infrared reflectance. The texturing and Foliage Green 504 color coating (for the finished shell) and retention systems shall meet the spectral reflectance requirements of Table II and Table III, respectively, when verified in accordance with paragraph 4.10.10.2.

TABLE II – Infrared reflectance requirements for finished shell.

Wavelength(nm)	Foliage Green 504 Reflectance (%)	
	Min	Min
600	8	8
620	8	8
640	8	8
660	10	10

680	10	10
700	12	12
720	16	16
740	16	16
760	18	18
780	18	18
800	20	20
820	22	22
840	24	24
860	26	26

TABLE III – Infrared reflectance requirements for Retention System.

Wavelength(nm)	Coyote Brown 498 Reflectance (%)		Foliage Green 504 Reflectance (%)	
	Min	Min	Max	Max
600	8	8	48	20
620	8	8	18	20
640	8	8	20	22
660	8	10	26	24
680	10	10	26	24
700	14	12	28	24
720	16	16	30	28
740	20	16	30	34
760	30	18	32	44
780	40	18	34	50
800	45	20	36	56
820	42	22	38	/1
840	42	24	40	/1
860	42	26	42	/1

/1 No Requirement

3.5.6.5 Specular gloss. The outer surface of the finished shell shall have a specular gloss as specified in Table IV. Verification shall be conducted in accordance with paragraph 4.10.10.3.

TABLE IV – Specular gloss

Angle	Min	Max
60 degree	-	1.0
85 degree	-	3.5

3.5.6.6 Adhesion of coating. The coating, when cut into squares, shall not lift when tested in accordance with 4.10.6.

3.6 Retention system. The helmet retention system and hardware shall be from mandatory sources in accordance with 6.8 and will be delivered with either class according to the contract delivery order. Verification shall be conducted in accordance with paragraph 4.10.7.

3.6.1 Retention system attachment points. Four attaching points shall be used for the retention system, two on the front half of the helmet and two on the rear half, each symmetric about the helmet mid-sagittal centerline. Each leg of the retention system, as well as the chinstrap shall be independently adjustable. The chinstrap buckle shall be capable of being

mounted on the left or right sides. The chinstrap shall allow for quick and inexpensive replacement without tools. 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, and 2-1-2518. Testing shall be in accordance with 4.10.7.1.

3.6.2 Attaching Hardware. Unless otherwise approved, the retention components shall be attached to the helmet shell with four slotted truss head shoulder screws. Each screw length will be selected based on helmet and retention component thickness to ensure threads fully engage nuts, but such that the screw does not protrude into the interior of the helmet. Backing nuts and all other hardware used on the inside of the helmet (including the suspension/retention component itself) shall have a total thickness not greater than 0.25-inch when measured from the inside surface of the helmet shell. Hardware capable of withstanding and resisting impact from the 9mm FMJ RN is required. Verification is accordance to 4.10.1, 4.10.10.1 and 4.10.11.4.

3.6.3 Retention system static pull strength. The pull strength of the retention system shall be at least 150 lb., but less than 300 lb. Verification shall be in accordance with paragraph 4.10.7.2.1 and 4.10.7.2.2.

3.6.4 Retention system dynamic pull strength. No component of the retention system shall fail when subjected to a 25 ft/sec drop when tested in accordance with paragraph 4.10.7.2.1 and 4.10.7.2.3.

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 different pad shapes that form the suspension system, round, trapezoidal, and oblong. A complete pad suspension kit shall consist of seven pads as follows: one round pad (crown), two trapezoidal pads (front and back), and four oblong pads (distributed around the perimeter to achieve comfort and stability). Drawing 2-1-2566 shows the shapes and dimensions of the pads. There shall be two thicknesses of pads, 3/4–inch and 1-inch thick. The 3/4-inch thick pad set shall be made up of all 3/4-inch thick pads. The 1-inch pad set shall be made up of all 1-inch thick pads except the circular crown pad shall be 3/4-inch thick. Testing shall be conducted in accordance with 4.10.8.1. 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 as 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 4.10.8.2.

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 average wicking times to reach the 20mm and 30mm marks in each direction shall not exceed the times specified in the Table V The color of the inner material shall be Foliage Green 504 for all helmet classes. Testing shall be conducted in accordance with 4.10.8.1, 4.10.8.5, and 4.10.10.1.

Table V Inner Layer Wicking Requirements

Length and Direction	Maximum Time (seconds)
20mm (warp or machine direction)	10
30mm (warp or machine direction)	20
20mm (fill or cross-machine direction)	15
30mm (fill or cross-machine direction)	30

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 4.10.8.4. 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 4.10.8.2.

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 lbs per inch of width when tested in accordance with 4.10.9.4. 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 disc. Testing shall be conducted in accordance with 4.10.8.1, 4.10.8.2, 4.10.10.1.

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 1/4inches compressions and show no signs of degradation. Degradation includes, but is not limited to, the structure of the pad loosing 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 stiches (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 paragraph 4.10.8.3.

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). The exterior color (side facing the pad) of the hook disk shall be Black 357. Testing shall be conducted in accordance with 4.10.9.1 and 4.10.10.1.

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 4 may be acceptable and provide more coverage. An adequate number of hook disks shall be installed on the interior of the finished 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 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 4.10.9.1.

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. Test in accordance with 4.10.9.2 and 4.10.9.3.

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 lbs/inch of width. Testing shall be in accordance with 4.10.9.4.

3.9 Ballistic protection. The helmet shell shall provide ballistic protection from fragments, 9mm projectiles, and small arms. 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 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 TableVI at 0° obliquity against the specified projectiles when tested in accordance with 4.10.11, and Classified Annex A 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

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

Projectile	V_{50} BL(P) (ft/sec)	
	0° Obliquity	45° Obliquity
2-grain RCC 1	5670	Gov't Ref
4-grain RCC 1/	4700	Gov't Ref
16-grain RCC 1/	3340	Gov't Ref
64-grain RCC 1/	2360	Gov't Ref
17-grain FSP 2/	2970	Gov't Ref
Small Arms	Defined in the Classified Annex A	

1/ Right Circular Cylinders (RCC) shall be in accordance with Figure 3.
2/ Fragment Simulating Projectile (FSP) – MIL-DTL-46593B.

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

3.9.2 Resistance to penetration. The helmet shell shall meet the following resistance to penetration requirements.

3.9.2.1 Resistance to penetration– 9mm. The helmet shell, including any hardware exposed on the outside of the shell, shall be resistant to penetration from a 9 mm Full Metal Jacketed Round Nose (FMJ RN) bullet with a nominal mass of 124 grains in accordance with NIJ 0106.01 at 1400 (+ 50 –0) ft/sec at 0° obliquity when tested in accordance with 4.10.11, 4.10.11.1.2, and 4.10.11.4 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

3.9.2.2 Resistance to penetration – Small arms. Defined in Classified Annex A

3.9.3 Ballistic transient deformation. Ballistic transient deformation of the shell shall not cause a deformation in clay (see 4.10.11.4.1.2) in excess of 0.63 inch (16.0 mm) against 9mm projectile under the environmental conditions specified in 3.9.2.1 at 1400 (+ 50 – 0) ft/sec 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 with small arms threats outlined in the Classified Annex A will be conducted for Government reference only. Testing shall be conducted in accordance with paragraph 4.10.11, 4.10.11.1.4, 4.10.11.5 and Classified Annex A

3.10 Weight. The threshold maximum weight of the finished helmet (complete helmet assembly) shall not exceed the weights listed in Table VII. The finished helmet shall be weighed with the 3/4 inch thick pads. Finished helmets weighing less than the weights in Table VII are desired. Five of each helmet size shall be tested. Testing shall be conducted in accordance with paragraph 4.10.12.

TABLE VII. Weight

Size	Maximum Weight (pounds)
Extra-Small (XS)	2.82
Small (S)	2.94
Medium (M)	3.06
Large (L)	3.31
Extra-Large (XL)	3.88
Extra Extra-Large (XXL)	4.00

3.11 Bump or blunt impact protection. The finished helmet shall provide non-ballistic impact protection to the wearer by reducing acceleration of the head during low velocity blunt impact events at various temperatures. As a threshold, for each size helmet 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 inches 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 paragraph 4.10.13.

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

3.12.1 Seawater resistance. There shall be no structural, visible or operational degradation to the finished shell when subjected to immersion in seawater. The finished shell shall show no evidence of softening, peeling, blistering cracking, delamination, or increase in weight of greater than three percent over dry weight or change in thickness greater than 2.5 percent when tested in accordance with paragraph 4.10.14.1, 4.10.1, 4.10.3 and 4.10.12. Also, the requirements of 3.9.1 (d) and 3.9.2. (d) shall be met after Seawater exposure (see 3.9.1).

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 4.10.14.2 and 4.10.3. 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 paragraph 4.10.14.3.

1. DEET insect repellent, NSN 6840-01-284-3982, O-I-503E
2. Gasoline, ASTM D-910
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 D-975
7. Turbine Fuel, Aviation, JP-8, MIL-T-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
12. Foam cleaner, SOT0-10FC00NA05
13. Reactive Skin Decontamination Lotion (RSDL), NSN 6505-01-507-5074
14. Bleach, NSN 6850-01-014-1324
15. Hypochlorous Acid (HTH), NSN 6810-00-255-8471
16. Sorbet Decontamination System (M100-SDS) A-200-SiC-10005S, NSN 4230-01-466-9095

Chemical Name	CAS Number
Alumina	1344-28-1
Carbon Powder	7440-44-0
Silicon Dioxide	1314-23-4
Sodium Oxide	1313-59-3

17. M291 and M259 Decontamination Kits
    a. M291, NSN 6505-01-276-1905
    b. M259, NSN 6850-01-357-8456

Chemical Name	CAS Number
Synthetic Graphite	7440-44-0
Strong Base Anion Exchange Polymer, Hydroxide ION	9017-79-2
Strong Acid Cation Exchange Polymer Hydrogen Ion	65405-46-1
Silica, Amorphous	7631-86-9

3.12.4 Flame resistance. The finished shell shall be self-extinguishing with no after-flame. Flaming before the withdrawal of the flame source is permitted according to ASTM D 6413. There shall be no melting or dripping. Finished shells shall undergone simulated wear and tear shall be tested as government reference only. It is desired, however, that the finished

shell be ignition resistant. Testing shall be conducted in accordance with paragraph 4.10.14.4.

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 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 paragraph 4.10.14.5 and 4.10.3. Also, the requirements of 3.9.2.1 (b) and 3.9.2.1(b) shall be met after Seawater exposure (see 3.9.1).

3.12.6 Cold temperature storage and use. All helmet components including the finished 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 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 paragraph 4.10.14.6 and 4.10.3. Also, the requirements of 3.9.2.1 (c) and 3.9.2.2(c) shall be met after Seawater exposure (see 3.9.1).

3.12.7 Temperature shock. All helmet components including the finished 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, change in thickness greater than 2.5 percent, or other deterioration. The paint 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 paragraph 4.10.14.7 and 4.10.3.

3.12.8 Altitude. All helmet components including the finished 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 approximately -60°F (± 5°F)/-52°C (± 3 °C). 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 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 paragraph 4.10.14.8 and 4.10.3.

3.12.9 Vibration. All helmet components including the finished 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. Test in accordance 4.10.14.9

3.12.10 Impact resistance. The finished helmet shall resist physical damage from impacts. The shell material (not including the finish) shall show no signs of structural damage such as delamination, ply separation, or shell fracture or indentation, when subjected to a 40 ft-lb. 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 paragraph 4.10.14.10.

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 paragraph 4.10.14.11.

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 paragraph 4.10.14.12.

3.12.13 Salt Fog. The All helmet components including the finished shell, retention system, and hardware shall be capable of operating without degradation in an environment where there is a 5percent (+/-1percent) concentration of salt fog. Testing shall be conducted in accordance with paragraph 4.10.14.13.

3.13 BLANK

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 XS, S, M, L, XL, or XXL as applicable using a "molded-in" process. Letters shall be at least 0.5 inch in height. In addition, the shell shall have an additional marking, 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, part or identifying number, lot number and serial number. The helmet shell shall be marked with a machine readable Item Unique Identification (IUID) 2D data matrix in accordance with MIL-STD-130. 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 paragraph 4.10.1 and 4.10.17.

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 paragraph 4.10.1.

3.14.3 Marking of retention assemblies. Retention system and components must be suitably marked for identification so as to ensure legibility after storage and use. When part of the helmet system, a visible area on the retention assembly shall be labeled in accordance with MIL-DTL-32075, Type IV. It shall be clearly marked with the size (or abbreviation letters, X-S, S, M, L, X-L, XX-L) as appropriate. When procured as an individual component the parts shall be placed in a snug fitting heat sealable plastic bag. Each bag shall have a paper label inserted into it, with the item nomenclature, contract number, national stock number (NSN), contractor's name, and size in accordance with MIL-DTL-32075, Type VIII, Class 5. If separable sub-components are intended to be used with more than one size, then all applicable sizes or range of sizes (or all sizes) shall be listed. Testing shall be conducted in accordance with paragraph 4.10.1.

3.14.4 Barcode label. Each finished helmet or individual component (when purchased separately) shall have a pressure sensitive bar-coded label attached to the outside package. The bar code element shall be a 13 digit national stock number (NSN). There shall be a twelve digit Universal Product Code (UPC) assigned for all NSNs by the Government. The initials "UPC" shall appear beneath the code. The bar codes for the NSN and UPC shall be medium to high density, clearly legible and readable by scanner (Motorola - Model # MC9090 or simular). Testing shall be conducted in accordance with paragraph 4.10.1.

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

3.14.5.1 Washability. The finished shell with hook disks (without pads) installed shall be washable. The shell and retention system shall not 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 paragraph 4.10.15.1.

3.14.5.2 Colorfastness. The textile materials (including, but not limited to, fabric, webbing, thread) used in the retention system and hook disks (without pads) shall exhibit colorfastness to laundering, crocking, perspiration, and water. The materials shall meet or exceed the requirements listed in Table VIII Test in accordance with 4.10.10.

Table VIII. Inner and Outer Material Colorfastness

Colorfastness to Laundering	
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

3.14.6 Accelerated Aging /Shelf Life. The finished helmet shall suffer no degradation in performance after undergoing testing in accordance to ASTM D 1149. Testing shall be conducted in accordance with paragraph 4.10.15.2.

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. Verification shall be conducted in accordance with paragraph 4.10.16.

3.15.2 Toxicity. The finished helmet shall not present a dermal health hazard when used as intended and verified as specified in 4.10.16.

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

Verification in accordance with paragraph 4.10.16.

3.16 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. Lot Acceptance inpections (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 4.9 and 4.10. Helmets used for first article testing shall be randomly selected from among sizes specified on the delivery order.

4.4 Lot acceptance inspection. The sampling inspection for conformance inspections (production lot inspections) shall be performed in accordance with ANSI/ASQC 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 4.10.1 and subjected to the tests indicated in the Lot acceptance inspection column in 4.9, Table IX. Acceptance criteria shall be specified in the contract (see 6.4). Unless otherwise specified, a certificate of compliance will be acceptable as evidence that certain requirements are met (see note 2/ of Table IX).

4.5 Certificate of Compliance. When certificates of compliance are submitted the government reserves the right to inspect or test such items to determine the validity of the certification.

4.6 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 VII).

4.7 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 % (± 30%) and site atmospheric pressure unless otherwise specified herein.

4.8 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.

4.9 Requirements and verifications. Table IX delineates performance requirements verified thru visual methods, including physical measurements to determine that no deficiencies exist. Furthermore, the helmet shall be manufactured in accordance with the contractor's own drawings and documents.

TABLE IX. Requirements and Verifications

Characteristic	Requirement Paragraph	Verification Paragraph	First Article Testing 1/	Lot Acceptance 1/
Interchangeability	3.4.1	4.10.1	x	2/
Shell Design/Shape	3.5	4.10.2	x	2/
Shell construction	3.5.1	4.10.1	x	2/
Shell thickness and uniformity	3.5.2	4.10.3	x	2/
Benchmarks	3.5.3	4.10.4	x	2/
Attachment holes	3.5.4	4.10.1, 4.10.2	x	2/
Retention system holes	3.5.4.1	4.10.2	x	2/
Night vision goggle holes	3.5.4.2	4.10.2	x	2/
Edging	3.5.5	4.10.1, 4.10.5.1	x	2/
Edging adhesion	3.5.5.1	4.10.5.2	x	x 4/
Edging adhesion of edging after heat aging	3.5.5.2	4.10.5.3	x	2/
Coating	3.5.6	4.10.1	x	2/
Outer surface preparation	3.5.6.1	4.10.1	x	2/
Texturing of coating	3.5.6.2	4.10.1	x	2/
Sand texturing	3.5.6.2.1	4.5	x	2/
Walnut shell flour texturing	3.5.6.2.2	4.5	x	2/
Color	3.5.6.3	4.10.10.1	x	2/
Infrared reflectance	3.5.6.4	4.10.10.2	x	2/
Specular gloss	3.5.6.5	4.10.10.3	x	2/
Adhesion of coating	3.5.6.6	4.10.6	x	x 4/
Retention system	3.6	4.10.7	x	2/
Retention system attachment points	3.6.1	4.10.7.1	x	2/
Attachment hardware	3.6.2	4.10.1, 4.10.10.1, 4.10.11.4	x	2/
Retention system static pull strength	3.6.3	4.10.7.2.1, 4.10.7.2.2	x	2/
Retention system dynamic pull strength	3.6.4	4.10.7.2.1, 4.10.7.2.3	x	2/
Pad suspension system	3.7	4.10.8.1	x	2/
Pad construction	3.7.1	4.10.8.2	x	2/
Inner layer material	3.7.1.1	4.10.8.1, 4.10.8.5, 4.10.10.1	x	2/
Padding layer material	3.7.1.2	4.10.8.2	x	2/
Padding layer material	3.7.1.2	4.10.8.4, 4.10.8.2	x	x 4/

TABLE IX. Requirements and Verifications – Continued

Characteristic	Requirement Paragraph	Verification Paragraph	First Article Testing 1/	Lot Acceptance 1/
Outer layer material	3.7.1.3	4.10.8.1, 4.10.8.2, 4.10.10.1, 4.10.9.4	x	2/
Pad compression durability	3.7.2	4.10.8.3	x	2/
Hook disks	3.8	4.10.9.1, 4.10.10.1	x	2/
Hook disk shape and coverage	3.8.1	4.10.9.1	x	2/
Hook disk durability	3.8.2	4.10.9.2, 4.10.9.3,	x	2/
Hook/loop adhesion	3.8.3	4.10.9.4	x	2/
Fragmentation protection – (V50 BL(P))	3.9.1	4.10.11, 4.10.11.3	x	x 3/
Resistance to penetration – 9mm	3.9.2.1	4.10.11, 4.10.11.1.2, 4.10.11.4	x	x 3/
Resistance to penetration – Small Arms	3.9.2.2	Classified Annex A	x	x3/
Ballistic Transient Deformation	3.9.3	4.10.11, 4.10.11.1.4.1. 2, 4.10.11.1.4, 4.10.11.5	x	x 3/
Weight	3.10	4.10.12	x	x
Blunt impact protection	3.11	4.10.13	x	x 4/
Seawater resistance	3.12.1	4.10.12, 4.10.14.1, 4.10.3, 4.10.1	x	2/
Weatherometer resistance	3.12.2	4.10.14.2, 4.10.3	x	2/
Field agent resistance	3.12.3	4.10.14.3	x	2/
Flame resistance	3.12.4	4.10.14.4	x	2/
High temperature storage and use	3.12.5	4.10.3, 4.10.14.5	x	2/
Cold temperature storage and use	3.12.6	4.10.3, 4.10.14.6	x	2/
Temperature shock	3.12.7	4.10.3, 4.10.14.7	x	2/
Altitude	3.12.8	4.10.3, 4.10.14.8	x	2/
Vibration	3.12.9	4.10.14.9	x	2/
Impact resistance	3.12.10	4.10.14.10	x	2/
Compression resistance (top to bottom).	3.12.11	4.10.14.11	x	2/

TABLE VIIIX. Requirements and Verifications – Continued

Characteristic	Requirement Paragraph	Verification Paragraph	First Article Testing 1/	Lot Acceptance 1/
Compression resistance (side to side).	3.12.12	4.10.14.12	x	2/
Salt Fog	3.12.13	4.10.14.13	x	2/
Marking of helmet shell	3.14.1	4.10.1, 4.10.17	x	x 4/
Marking of pad suspension	3.14.2	4.10.1	x	x 4/
Marking of Retention Assemblies	3.14.3	4.10.1	x	2/
Barcode label	3.14.4	4.10.1	x	x4/
Washability	3.14.5.1	4.10.15.1	x	2/
Colorfastness	3.14.5.2	4.10.10	x	2/
Accelrated Aging /Shelf Life	3.14.6	4.10.15.2	x	2/
Safety	3.15.1	4.10.16	x	2/
Toxicity	3.15.2	4.10.16	x	2/
Hazardous Materials	3.15.3	4.10.16	x	2/

1/ An "x" in the column designates that that 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 shall be provided certifying that the design and materials of the helmet have not changed since approval of FAT. The government reserves the right to inspect or test such items to verify the validity of the certification.
3/ Ballistic testing for lot acceptance shall be in accordance with 4.10.11.2.
4/ The rate for 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, the 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.

Test Set 1: Take 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.

Test Set 2: Take 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.

Test Set 3: Take 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.

Test Set 4: Take 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.

Test Set 5: Take 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 5 of the pad sets to the pad compression test. Subject all 5 of the pad sets to the non-ballistic impact protection test one helmet of each size one helmet of each size. After the non-ballistic test remove the outer fabric and inspect the inner pad for degradation.

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

4.10. Methods of Inspection.

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

TABLE X. End item visual defects

Examination	Defect	Classification		
		Critical	Major	Minor
	Wrong specified hardware or hardware length		X	
Helmet shell	Any fabric fibers visibly cut or raised on the shell body.			X
	Any permissible gap or pit not resin filled as specified (see 3.5.1) (exterior only).			X
	Any unauthorized patching, repair or reworking.		X	
	Any evidence of metallic fasteners.		X	
	Any benchmark omitted or obliterated. 1/			X
	Any attaching hole exhibiting delamination or other damage of the shell material.		X	
	Any attaching hole exhibiting fraying (uncut material attached at the edge of the hole).		X	
	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 fingernail.			
	If piece cut to length - ends overlapped - gap between ends in excess of 0.100 inch (if piece cut to length).			X
	Butt joint not in rear of helmet.			X
	Not correct color			X
Finish(coating) on exterior, Color on interior	Any scuffed area or scratch.			X
	Finish wet or tacky to the touch.		X	
	Coating furrows, flakes, or peels when scratched with fingernail.		X	

TABLE X. End item visual defects - Continued

Examination	Defect	Classification		
		Critical	Examination	Defect
Finish (coating) on exterior, Color on interior (continued)	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	
Suspension assembly (Pads)	Pads not as specified herein, damaged in any way, not correct number and 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

TABLE X. End item visual defects - Continued

Examination	Defect	Classification		
		Critical	Examination	Defect
Suspension assembly (Pads) (continued)	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.			
Marking	Shell: omitted, incorrect, illegible, or not as specified.		X	
	Pads: omitted, incorrect, illegible, or not as specified.		X	
	Retention System: omitted, incorrect, illegible, or not as specified.		X	
	Barcode: omitted, incorrect, illegible, or not as specified.		X	

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

4.10.2 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 accurate to within 0.01 inches to demonstrate conformance with the specified drawings. An unfinished shell shall be used. Any nonconformance with the requirements of 3.5 shall constitute test failure.

4.10.3 Shell thickness and uniformity. The thickness of the unfinished shell shall be measured with appropriate measuring equipment to the nearest 0.001 inch at five 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 4.10.11.3.2. For verification of shell thickness requirements in the operating environments of sections 3.12.1, 3.12.2, and 3.12.5 through 3.12.8 before and after testing thickness measurements shall be taken on the same five 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.

4.10.4 Benchmarks. Measure the length of the benchmarks with appropriate measuring equipment accurate to 0.05 inches. Any non-conformance with paragraph 3.5.3 shall constitute a failure.

4.10.5 Edging

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

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

4.10.5.3 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 hour). Remove and allow to cool to room temperature. Use a sharp knife, cut through the edging along the inner or outer corner for a distance of 2 inches. See Figure 4. Note that Figure 4 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 gage marks on the specimen for the measurement of the amount of peeling during the test. Allow the weight to hang for a minimum of one 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 gage mark to the farthest extent that the edging becomes unbounded. The test shall be performed at two different locations on the helmet, and the two results shall be averaged. Any nonconformance to the requirements specified in 3.5.5.2 shall be considered a test failure.

4.10.6 Coating adhesion. Cut three 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°) 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 lifted. Lifting of any coating resulting in the loss of more than 50% 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 finished helmets of each size shall be tested and three random locations are to be tested per sample.

4.10.7 Retention system design. The helmet retention system shall be visually examined for the correct class of retention system. Any nonconformance with the requirements of 3.6 shall be cause for test failure.

4.10.7.1 Retention system attachment point. The helmet retention system shall be examined. Any nonconformance with the requirements of 3.6.1 shall be cause for test failure.

4.10.7.2 Retention System Pull Tests

4.10.7.2.1 Test apparatus. A testing machine conforming to ASTM E 4, "Practices for Force Verification of Testing Machines" shall be used. The helmet shall be rigidly attached to the testing machine base with either a clamp or headform device. The headform and its orientation shall replicate the human head and face, and balance the load among the four points of attachment. The chin strap shall be attached to a grip that simulates the jaw. The grip shall consist of two cylinders of 0.25 inches. diameter, rigidly spaced 3.0 inches. apart with a length of approximately 1.50 inches. to accommodate the chin strap.

4.10.7.2.2 Static pull strength test. Affix the helmet to the base of the test machine, and connect the simulated jaw to the chin strap. Apply a load at the rate of 1.0 inches./minute until the strap fails. Failure shall consist of breakage or release of the retention system. Record the peak load as the pull strength. Record the mode of failure for information purposes only. Any non-conformance with paragraph 3.6.3 shall constitute a failure.

4.10.7.2.3 Dynamic pull strength test. Mount the finished helmet on the apparatus in accordance with 4.10.14 of Defense Supply Center Philadelphia, purchase Description, Advanced Combat Helmet., CO/PD-05-04. The helmet shall be dropped at 25 ft/sec onto a hemispherical anvil once on each of the locations in accordance with 4.10.14 of Defense Supply Center Philadelphia, purchase Description, Advanced Combat Helmet., CO/PD-05-04. Separate helmets, pads, and retention systems may be used for each impact. The helmet shall then be inspected. Failure to meet the requirements of paragraph 3.6.4 shall constitute failure of the test.

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

4.10.8.1 Pad Dimensions and Shape. The pads shall be examined for conformance to the thickness and shape requirements specified in 3.7. Each pad shall be measured to verify its thickness. The pad thickness shall be measured at five 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 inches of the nominal thickness (3/4 or 1 inch). The shape of the pad shall meet the shapes shown in Drawing 2-1-2566 with a tolerance of + 1/8 inch, - 0 inches, i.e. the pads can exceed the shapes shown in Drawing 2-1-2566 by up to 1/8 inch, but shall be no smaller than the outline shown in Drawing 2-1-2566. Any nonconformance to the requirements specified in 3.7 shall be shall be cause for test failure. Six pad sets of each size are to be measured.

4.10.8.2 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.

4.10.8.3 Pad compression durability test. The finished pad shall be subjected to cyclic compressions on a constant rate of extension (CRE) machine in accordance with ASTM Test Method D-76 Standard Specification for Tensile Testing Machines for Textiles 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 ($\pm$ 1) inch/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 6570 $\pm$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.

4.10.8.4 Water absorbency. One 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 4.10.14.1. 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 two 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°F (± 2°) and 65 (± 2%) relative humidity on a screen rack or other device to allow drying off all sides of the padding. The rack may be angled to facilitate dripping of any bulk water. As an alternative, the inner and outer material may be left on the pad instead of removing. The 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%, it shall constitute test failure.

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

4.10.9 Hook disk and loop

4.10.9.1 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.

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

4.10.9.3 Self-stick adhesive hook tape helmet adhesion. Die cut minimum 5 self-stick hook discs and place on inside of finished shell allowing minimum of 15 hours 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 discs. Press each pad firmly into each hook disc. Allow 2 hours engagement time and slowly pull each loop pad off each hook disc. Evidence of any hook disk lifting, curling or other disturbance of adhesive or coating used on the hook disc, delamination of the shell, or any nonconformance with the requirements of 3.8.2 shall be cause for test failure.

4.10.9.4 Hook/loop adhesion. With 2 inch wide by 6 inch long loop tape laying face-up on hard surface place a 1 inch wide by 5 inch long strip of hook tape face-down on top of loop tape such as to engage the tapes. Roll a 5 pound circular weight back and forth 5 times on top of hook tape. Use either calibrated push-pull scale or testing machine in accordance with ASTM D76 Standard Specification for Tensile Testing Machines for Textiles in order to peel

engaged hook and loop apart 3 inches at a rate of 6 inches/minimal. Make five separate determinations, each using separate (new) hook and loop tape 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.

4.10.10 Colorfastness. Test the retention system and hook disks (without pads) of the finished helmets in accordance with the test methods listed in Table XI. Failure to meet the requirements of 3.14.5.2 shall constitute test failure.

Table XI. Colorfastness test methods

Colorfastness to Laundering Color Change Staining Polyester Nylon	AATCC-61, Test 2A
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

4.10.10.1 Color The color and appearance of the material shall match the standard sample when viewed using AATCC Evaluation Procedure 9, Option A, under sources simulating artificial daylight D75 illuminant with a color temperature of 7500 (± 200) K with illumination of 100 (± 20) foot candles. Failure to meet the requirements as specified in section 3.5.6.3 of this document shall constitute test failure.

4.10.10.2 Infrared reflectance test. Obtain spectral reflectance data from 600 to 860 nm relative to a barium sulfate standard, the preferred white reference standard. Other white reference materials may be used, providing they are calibrated to absolute white. The spectral bandwidth at 860 nm shall be less than 26 nm. Reflectance measurements may be made by either the monochromatic or polychromatic mode of operation. When the polychromatic mode is used, the spectrophotometer shall operate with the specimen diffusely illuminated with the full emission of a source that simulates CIE Source A or CIE Source D65. View the specimen at an angle no greater than 10 degrees from normal, with specular component included. Photometric accuracy of the spectrophotometer shall be within 1% and wavelength accuracy within 2-nm. The standard aperture size used in the color measurement device shall be 1.0 to 1.25 inches in diameter. Take measurements on a minimum of three different areas and average the data. Any non-conformance to the requirements of section 3.5.6.4 shall constitute a failure.

4.10.10.3 Specular Gloss. Verification shall be in accordance with ASTM D 523-89, Standard Test Method for Specular Gloss. Any non-conformance to the requirements of section 3.5.6.5 shall constitute a failure.

4.10.11 Ballistic protection. The ballistic resistance shall be conducted in accordance with MIL-STD-662 and NIJ 0106.01 except as specified in 4.10.11.1 thru 4.10.11.5. 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.

4.10.11.1 Ballistic resistance. Ballistic resistance testing for the first article shall include the requirements of 3.9.1, 3.9.2 and 3.9.3.

4.10.11.1.1 Ballistic resistance– 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 RCC 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. Test method is according to paragraph 4.11.10.3. V_{50} BL (P)s at 45° obliquity against the specified right circular cylinder (RCC) and Fragment Simulating Projectile (FSP) projectiles listed in Table VI when tested in accordance with 4.10.11.3 under ambient conditions are also required. The results of 45° obliquity are for government reference only.

4.10.11.1.2 Ballistic resistance – 9mm resistance to penetration (RTP). Five 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 the specified locations. If the requirements of 3.9.2.1 are met, the first article for 9mm RTP shall be considered met. Test method is according to paragraph 4.10.11.4.

4.10.11.1.3 Ballistic resistance – Small Arms. Shall be verified according to the Classified Annex A.

4.10.11.1.4 Ballistic resistance– Transient deformation. Five passing transient deformation determinations for each of the projectiles listed in 3.9.3 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 specified locations. Test method is according to paragraph 4.10.11.5

4.10.11.2 Ballistic resistance (Lot Acceptance 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, 3.9.2.1, 3.9.3 and those outlined in the Classified Annex A. The government reserves the right to perform any of the testing set forth in this specification where such tests are deemed necessary to ensure the items conform to specified requirements.

4.10.11.3 V50 Ballistic test method. 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 4.10.11.6 as required. Failure to meet the requirements of 3.9.1 shall constitute test failure.

4.10.11.3.1 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 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 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 plate shall be placed behind the witness plate, but not closer than 1.0 inch, to prevent all fragments resulting from a projectile penetration from impacting the opposite side of the finished shell.

4.10.11.3.2 Helmet sections. A finished shell for all testing shall be divided into five 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 five inches shall be measured along the contour of the shell 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 shell into four sections. The zero degree mark is placed in the front center of the shell and the angular orientation proceeds in a counterclockwise progression as viewed from the top of the shell. 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 XII. Figure 8 depicts the sections.

TABLE XII. Sections

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

4.10.11.3.3 Fragmentation V50 ballistic limit projectile impact location.. Place two fair impacts (one for the 64-grain and 9mm projectiles), randomly into each section, except that one of the two fair impacts in the TOP section shall be within 1 inch of the center crown point. 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 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. 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 inches 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. The location of each shot on the helmet shall be reported.

4.10.11.3.4 V_{50} BL(P) calculation. The V_{50} BL (P) for each finished shell shall be the average of at least 10 fair impact velocities consisting of an equal number of the lowest complete penetration and the highest partial penetration velocities provided that the velocity spread is not greater than 125 ft/sec. In cases where the velocity spread is greater than 125 fps, the V_{50} BL(P) shall be the average of at least 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 fps. If neither the ten nor the fourteen shot conditions can be satisfied, and at least seven partial penetrations at velocities in excess of the required minimum V_{50} and there are no complete penetrations at or below the minimum required V_{50} velocity, and at least 14 fair shots have been made in the shell(s) then it shall be determined to have satisfied that specific threat condition requirement. Should none of these three conditions apply, the test shall be declared inconclusive.

4.10.11.4 Ballistic test method for resistance to penetration – 9mm. Testing shall be conducted with finished helmets with 3/4 inch thick pads of the appropriate helmet size. Shells 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 finished shell shall be conditioned as specified in 4.10.11.6.1, 4.10.11.6.2 and 4.10.11.6.3 as required. The pad suspension system shall be arranged inside the helmet as shown in the "standard pad configuration" arrangement in drawing 2-1-2559 (7 pad configuration with the oblong/oval pads in the vertical pad configuration). The distances shown in Figure 6 of NIJ 0106.01 may be altered. Failure to meet the requirements of 3.9.2.1 shall constitute test failure.

4.10.11.4.1 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.)

4.10.11.4.1.1 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.

4.10.11.4.1.2 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.

4.10.11.4.1.3 Clay Verification. The clay filled headform(s) and a 12 inch x 12 inch x 4 inch wood 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 to impact the clay surface at a zero degree obliquity, with its hemispherical end, 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.

4.10.11.4.2 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. The suspension/retention system shall be adjusted to insure a proper "snug" fitting on the headform. For adjustable helmet suspension systems, the test agency will adjust the suspension system strapping to the maximum allowable extent so as to achieve the minimum distance and airspace between the suspension crown and the interior helmet shell surface.

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

1. Each finished helmet shell shall sustain five impacts with shot spacing as follows:
   (a) One impact on the crown (at the approximate intersection of the mid-sagittal and coronal planes) (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 approximately 50 mm above the earflap).
   (c) Two total impacts in the mid-sagittal plane (one impact on the front and one on the back approximately 50 and 75 mm from the edge of the shell, respectively).
   (d) One of the shots identified in (b) or (c) above shall be on one of the front or rear fasteners.
2. For each test, mount the shell in the "as-worn" configuration, with the suspension and chinstrap/napestrap systems in place on the headform.
3. If any component of the retention system fails during the testing, it shall be replaced with a new retention system. The failure of the retention system shall not be considered test failure.
4. If witness plates are used, complete penetration is defined as in NIJ 0106.01 (passage of light thru the witness plate when using a 60-W 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 in the clay, or by a hole which passes thru the shell. In the case of the fastener test, any evidence of the projectile, fragment of the projectile, or fragment of the shell, projectile, or fastener, in the clay shall be considered a complete penetration. Complete penetration as defined above shall be cause for test failure.
5. In the case of the fastener test, the helmet shall be rotated to align with the slot. Alternatively, a headform made entirely of clay or a headform with a slot in the required direction may be used.

4.10.11.5 Ballistic transient deformation. One projectile shall be fired into the five required impact locations. One finished helmet with 3/4 inch thick pads of the appropriate helmet size shall be tested at each of the five prescribed locations.

4.10.11.5.1 Headform. The ballistic transient deformation shall be measured with a headform as described in 4.10.11.4.1. As an option, combining resistance to penetration – 9mm testing including fastener testing with transient deformation testing in a single test is authorized .

4.10.11.5.2 Test Procedure.

4.10.11.5.2.1 Mounting and Measurement. The finished helmet shall be mounted on the headform in the as-worn position. 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.

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

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

4.10.11.5.2.4 Testing Progression. Additional shots within one or more of the defined locations as specified in 4.10.11.4.3 may be necessitated as a result of the first shot being declared "unfair". Should one or more of those additional shots be declared a "penetration", those shots shall be declared "unfair" as well. If there has been no prior fair shot penetration, a penetration by a second shot at any location shall cause the testing of that helmet to be declared "inconclusive". Testing of any location declared "inconclusive" should be repeated with a new (untested) helmet sample. Once testing of a helmet sample has been initiated, testing shall continue until all required locations have been impacted, regardless of the pass/fail results of those shots.

4.10.11.5.2.5 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 paragraph 4.10.11.5.2.1 in preparation for the next shot.

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

4.10.11.6 Conditioning Methods

4.10.11.6.1 Ballistic resistance (ambient, high, and low temperatures). For ambient temperature testing, the finished shells shall be subjected to an initial conditioning for a minimum of 24 hours at 70°F (± 10°F). For high temperature testing, the finished shells 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 shells 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 shell(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.

4.10.11.6.2 Ballistic resistance (Seawater). The finished shell shall be immersed in seawater as specified in 4.10.14.1 at a minimum depth of 3 ft. After immersion for a minimum of 3 hours, it shall be removed, wiped dry, and tested. Testing shall take place within 2 hours after removal from salt water. The finished shell shall then be ballistically tested in accordance with 4.10.11.3 and 4.10.11.4. Failure to meet the requirements specified in 3.9.1 and 3.9.2 shall constitute test failure.

4.10.11.6.3 Ballistic resistance (weatherometer). After the finished shell has been exposed in the weatherometer and after passing the weight and visual examinations in 3.12.2, then the finished shell shall be ballistically tested in accordance with 4.10.11.3 within 48 hours after removal from the weatherometer. Failure to meet the requirements specified in 3.9.1 shall constitute test failure.

4.10.11.7 Procedures. The following procedures apply to ballistic testing.

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

1. Contractor identification.
2. Contract number.
3. Lot numbers and quantities.
4. Item specification number.
5. Armor description including model number and serial number .
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} or transient deformation determination). Both uncorrected (measured) and corrected (striking) velocities shall be reported.
12. PP (Partial Penetration) and CP (Complete Penetration) next to each shot velocity as determined.
13. Location of shot.
14. Description of test setup (distances from velocity measuring devices to target).
15. Name of company/organization performing tests.
16. Type of gun barrel, weapon caliber and propellant type and weight.

4.10.11.7.2 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 ft/sec. 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.

4.10.11.7.3 Weapon mounting configuration. For RCC and FSP testing, the spacing from the weapon muzzle to the first pair of triggering devices shall be sufficient to prevent damage from muzzle blast and obstruction from smoke in case optical devices are used. Recommended distances can be found in USATECOM TOP 4-2-805.

4.10.11.7.4 Yaw measurement system. A suitable system to ensure that yaw is within the specified tolerances shall be employed. The measurement system employed should be

capable of measuring yaw to within an accuracy of 1.0 degree. A system known to work is described in 6.6.

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

4.10.12 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.

4.10.13 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 helmet samples of each size shall be required: two each for testing after exposure to each of the three environmental conditions.
3. The environmental conditions shall be ambient, cold 14°F (± 5°F), and hot 130°F (± 5°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 XIII for each particular impact site. Additionally, Figure 4 shows the orientation of all locations except the left and right nape.
9. Two successive impacts shall be made at each location. The second impact shall be made no sooner than one minute after the first and no later than two 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 XIII. 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

4.10.14 Environmental test methods

4.10.14.1 Seawater immersion - weight and visual examination. The finished shell, clean and free of dirt or other foreign matter, shall be exposed to standard ambient conditions for a minimum of 3 hours and then weighed to the nearest 0.5-ounce. 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 (+ 0.5) 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 0.50-ounce. 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.

4.10.14.2 Weatherometer resistance. After the finished shell has been exposed in the weatherometer in accordance with AATCC Method 169, except as modified below, the 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 relatively 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 paragraph 4.10.11.3.

4.10.14.3 Field agent resistance.

The finished shells shall be conditioned at standard ambient conditions for a minimum of 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 two inches away from any other agent.

4.10.14.4 Flame resistance. The flame resistance of the finished shell shall be determined in accordance with ASTM D 6413 with the following exceptions:

1. The test specimen shall be suspended in the chamber such that the burner flame impinges the crown at 90° to the flame, approximately 2 inches away from the crown, and somewhere along the rim of the helmet. The distance between the base of the burner and the specimen should be approximately 1.5 inches.
2. The flame shall be adjusted so that the tip of the inner cone of the flame impinges on the test specimen's surface (total flame height is approximately 3 inches). Each test specimen should be tested in a different location than the previous sample.
3. The test specimen shall be exposed to the flame for a minimum of 12 seconds and then the flame shall be removed and any after-flame, after-glow, melting, or flame propagation shall be noted.
4. Three finished shells shall be tested.

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

4.10.14.5 Hot storage and use. The finished shell 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 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 4.10.11.3.2. 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 4.10.6 on the sample. The adhesion of coating test shall not be conducted within one inch of the area used to conduct the thickness measurement. As an alternative, an additional uncoated shell may be used to determine change in thickness. Failure to meet the requirements of 3.12.5 shall constitute test failure.

4.10.14.6 Cold storage and use. The finished shell shall be subjected to a conditioning of 24 hours (± 1 hr) at minus 60°F (± 10°F) in a test chamber. The test specimen shall be allowed to cool to ambient temperature. The test specimen shall then be removed from the test chamber and visually examined. Helmet sections are defined in 4.10.11.3.2. 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 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 3.12.6. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.10.6 on the sample. The adhesion of coating test shall not be conducted within one inch of the area used to conduct the thickness measurement. As an alternative, an additional uncoated shell may be used to determine change in thickness. Failure to meet the requirements of 3.12.6 shall constitute test failure.

4.10.14.7 Temperature shock. The finished shell 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 - 60°F (± 10°F) for a minimum of 24 hours. A second finished shell shall be subjected to an initial conditioning of a minimum of 24 hours at - 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 4.10.11.3.2. Before and after thickness measurements are to be taken at the same five random locations. The thickness criteria specified in 3.12.7 are based on a point to point comparison and not an average. The helmet shall be visually examined for the requirement of 3.12.5. and 3.12.6 Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.10.6 on the sample. The adhesion of coating test shall not be conducted within one inch of the area used to conduct the thickness measurement. As an alternative, an additional uncoated shell may be used to determine change in thickness. Failure to meet the requirements of 3.12.7 shall constitute failure of the test.

4.10.14.8 Altitude test. Place the finished shell 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 ft (± 300 ft) altitude. Hold the pressure for a minimum of 1 hour. Then raise the pressure to simulate a 15,000-ft (± 300 ft) 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 1,500 ft/min. to 2,000 ft/min. 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 4.10.11.3.2. Before and after thickness measurements are to be taken at the same five random locations. The thickness criteria specified in 3.12.8 are based on a point to point

comparison and not an average. The helmet shall be visually examined for the requirement of 3.12.5. Adhesion of coating shall be determined by conducting an adhesion of coating test in accordance with 4.10.6 on the sample. The adhesion of coating test shall not be conducted within one inch of the area used to conduct the thickness measurement. As an alternative, an additional uncoated shell may be used to determine change in thickness. Failure to meet the requirements of 3.12.8 shall constitute test failure.

4.10.14.9 Vibration test. Testing shall in accordance with MIL-STD-810, Method 514.5, Procedure I. 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.

4.10.14.10 Impact resistance. The test apparatus shall consist of a fixed ball release tester equipped with an electromagnetic device or similar apparatus capable of releasing a minimum 8-lb. 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 finished helmet 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-ft. 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.

4.10.14.11 Compression resistance (top to bottom). The finished shell without the rubber edging shall or an unfinished shell be tested on a constant rate of extension (CRE) machine in accordance with ASTM Test Method D-76 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 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, and 2-1-2518) 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 inch/minute until a compressive force of 400 lb is reached. Release the applied force to 5 lb. 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 ($\pm$ 1 hour), again record the height dimension. One shell from each size shall be tested. Failure to meet the requirements of paragraph 3.12.11 shall constitute failure of the test.

4.10.14.12 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 D-76, 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 inch/minute until a force of 300 lb. is reached. Release the applied force to 5 lb. 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 measure record the height dimension. One shell from each size shall be tested. Failure to meet the requirements of paragraph 3.12.12 shall constitute failure of the test.

4.10.14.13 Salt Fog. Salt fog testing will be conducted to determine the effectiveness of protective coatings and finishes on the UUT (unit under test) and to determine the effects of salt deposits on the physical aspects.

The following procedure will be conducted for this test:

1. Prepare a salt fog chamber – the salt fog should be generated from a 5 ± 1 percent saline (NaCl) solution produced by dissolving 5 parts of salt in 95 parts (by weight) of distilled water at 95 ± 3°F (35 ± 1.5°C).
2. Suspend the UUT horizontally in the salt fog chamber.
3. Condition the UUT for 24 hours in the salt fog chamber.
4. Remove the UUT, inspect for damage or material deterioration, photograph UUT and record data at 24 hours. The chamber temperature should be maintained at 95 ± 3°F (35 ± 1.5°C).
5. Let the UUT sit at room temperature for 24 hours, inspect for damage or material deterioration, photograph UUT and record data at 48 hours.
6. Repeat steps (b) through (e) once.
7. Examine for any issues.

The following information will be recorded for this test:

1. UUT Number.
2. Temperature and humidity data.
3. Results of inspections.
4. Photographs
5. Results of each functional test / examination.
7. Other relevant observations.

4.10.15 Ownership and support.

4.10.15.1 Washability. The finished shell with hook disks (without pads) 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.. 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 3.14.5.1 shall constitute test failure.

4.10.15.2 Accelerated Aging / Shelf Life. Testing shall be in accordance to ASTM D 1149 Any non-conformance with the requirements of 3.14.6 shall constitute test failure.

4.10.16 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. A certificate of conformance is required. The Government reserves the right to inspect such items to determine the validity of the certification.

4.10.17 IUID. The 2D data matrix mark quality shall be determined in accordance with data matrix symbol quality standard ISO/IEC 15415. The mark shall be scanned to ensure encoding using the applicable machine-readable information (MRI) protocol data qualifiers in MIL-STD-130N, Table VI.

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 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, color, 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. When Lot Acceptance testing is required (see 3.1.3), the item will be tested and should be a production sample. The contracting office should include specific instruction in acquisition documents regarding arrangement for examinations, quantity, and testing and approval.
6. Packaging requirements (see 5.1).

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

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

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

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

a) Any otherwise fair impact which does not comply with shot-to-shot or shot-to-edge minimum distance requirements, which is NOT a complete penetration, shall also be a fair impact.
b) Any otherwise fair impact, which impacts at an excessive velocity 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.

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 V50 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.

6.5.9 **For Government reference testing only.** Test items are subject to DT testing for program technology demonstration.

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 shall 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 shots, if three 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 Suspensions Systems is:

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

6.9 Retention System Part Numbers

Description	Size	P/N	NSN
X-Back Retention Assembly	X-Small, Small	TBD	
	Medium, Large	TBD	
	X-Large	TBD	
	XX-Large	TBD	
H-Back Retention Assembly	X-Small, Small	TBD	
	Medium, Large	TBD	
	X-Large	TBD	
	XX-Large	TBD	

6.10 Subject term (key word) listing.

Body Armor
Headgear
Helmet
Ballistic

MILITARY INTERESTS:

Custodians: **Preparing activity:**

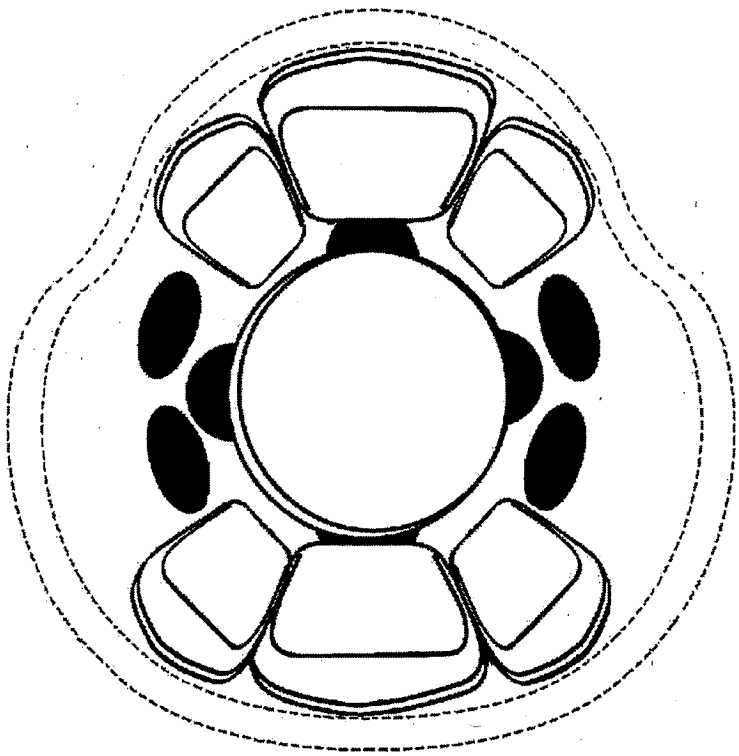


FIGURE 1. Standard helmet pad configuration.

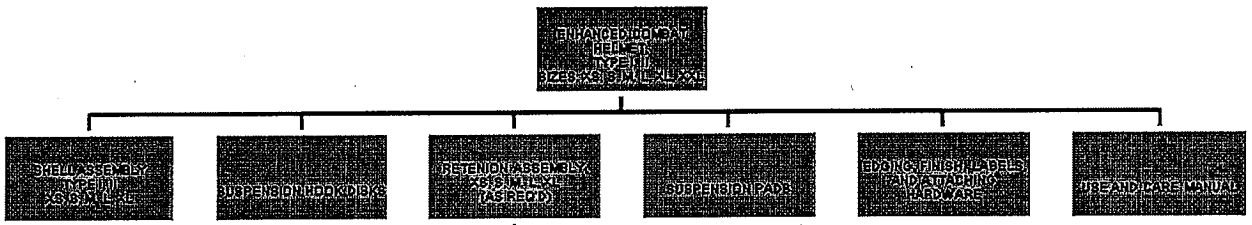
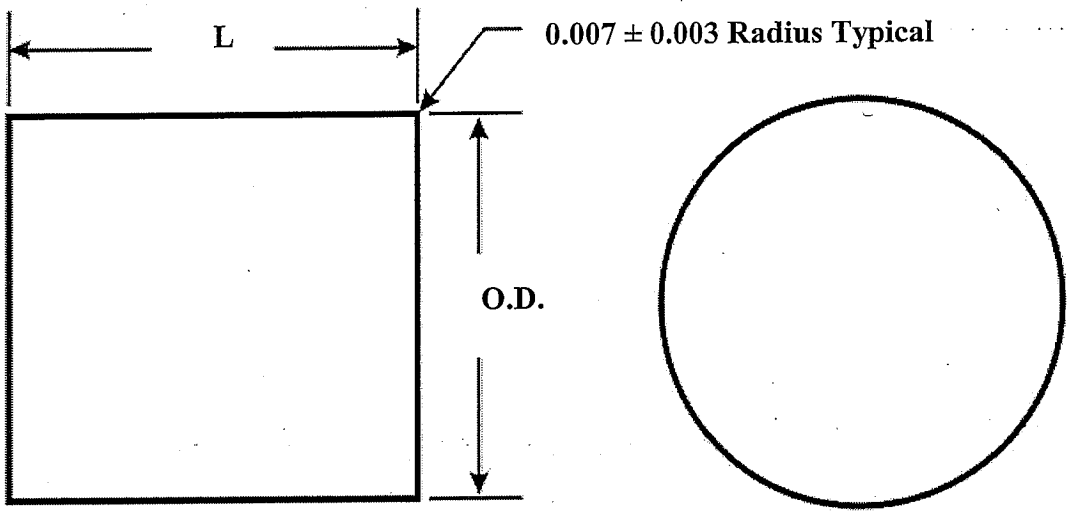


FIGURE 2. Enhanced combat helmet top level assembly.



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 3. Right circular cylinder.

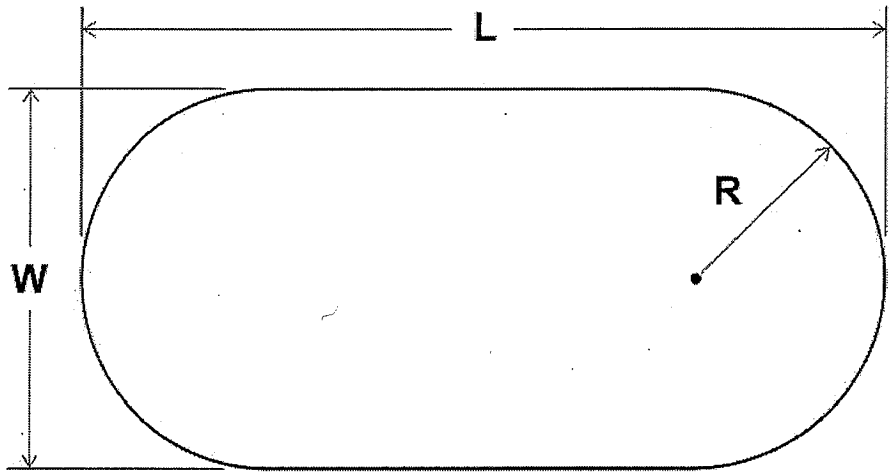


FIGURE 4. Hook disk elongated.

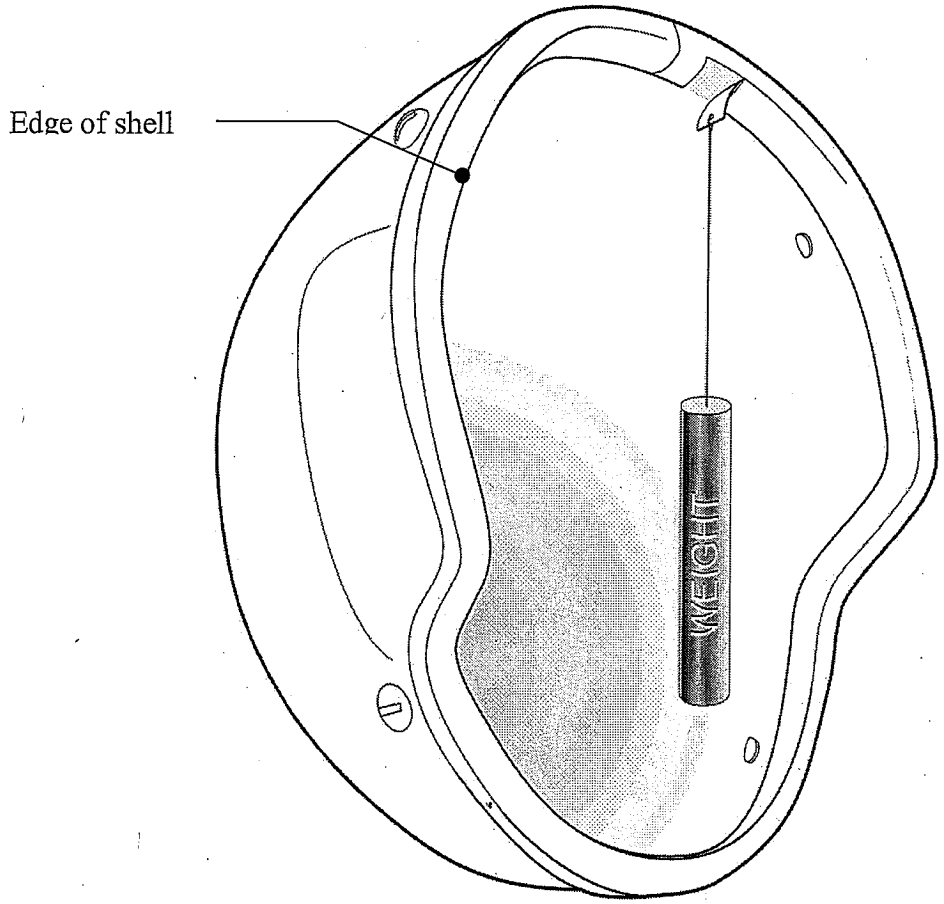


FIGURE 5. Rubber edge testing.

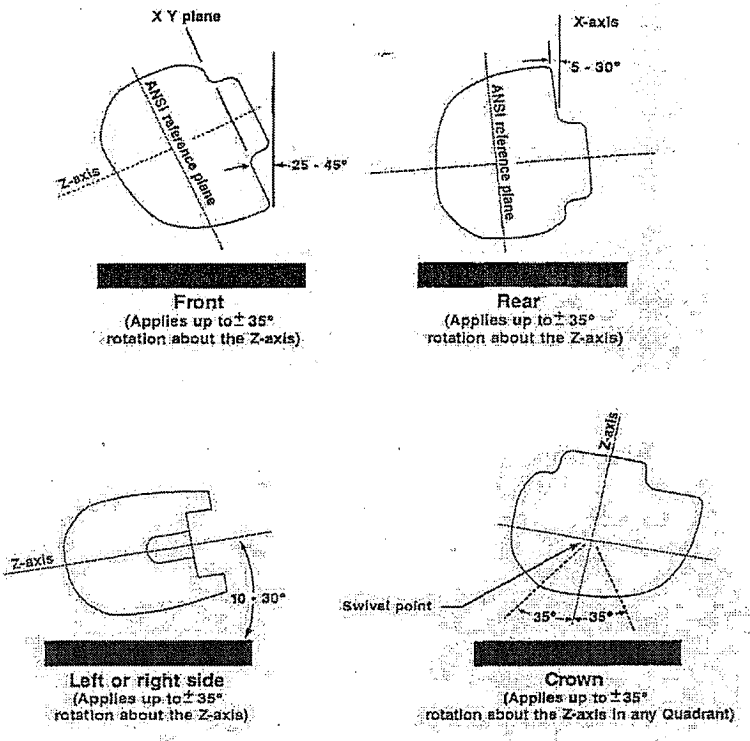


FIGURE 6. Blunt impact test locations.

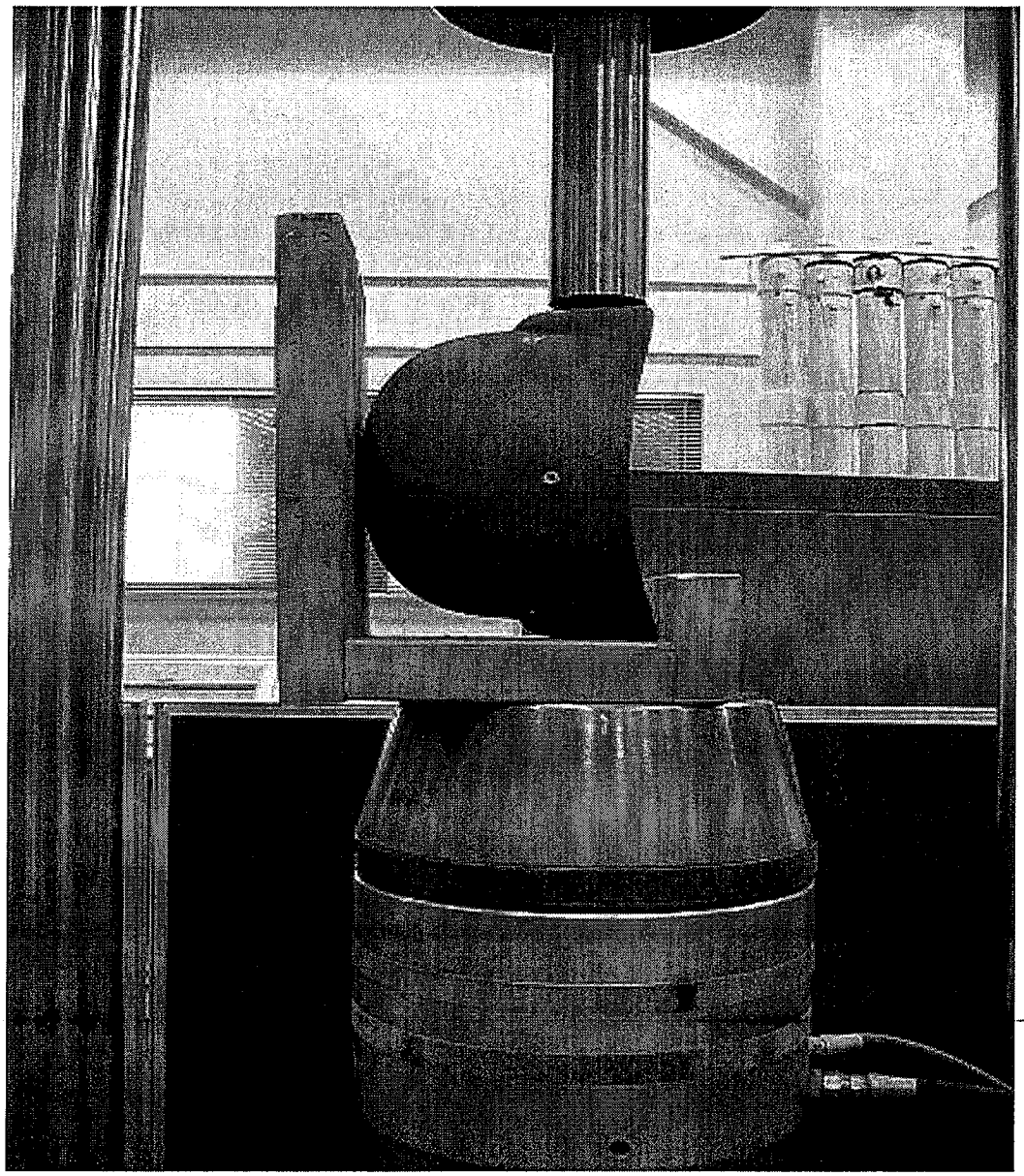


FIGURE 7. Jig for side to side compression resistance.

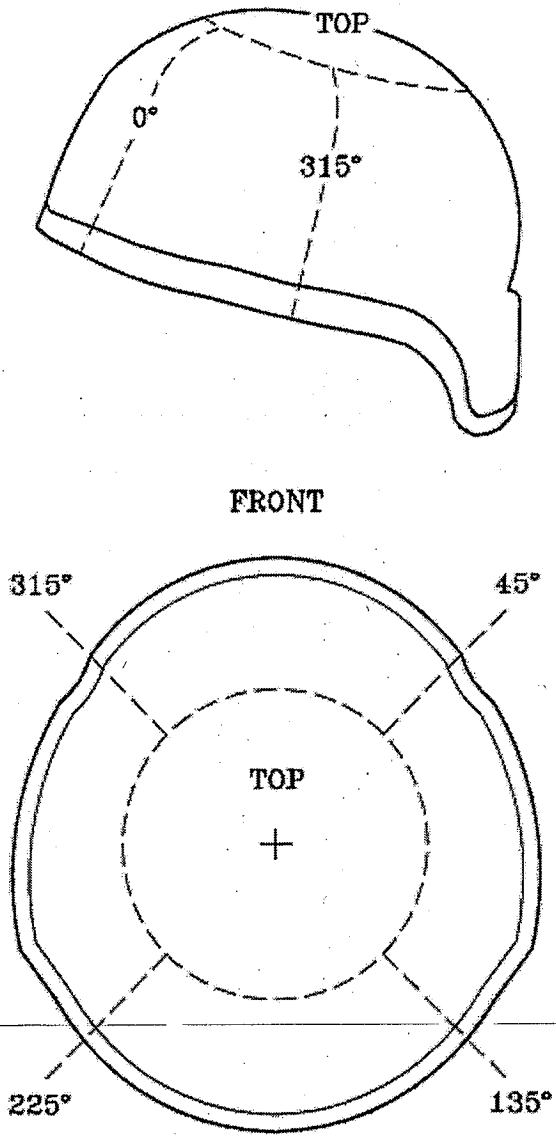


FIGURE 8. Helmet sections.