

METRIC

MIL-PRF-32518

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PERFORMANCE SPECIFICATION  
INTERIOR HEAD IMPACT PROTECTION  
FOR USE IN U.S. ARMY MILITARY VEHICLE INTERIORS



Comments, suggestions, or questions on this document should be addressed to the Commander, U.S. Army Tank-Automotive and Armaments Command, ATTN: RDTA-SIE-ES-SI, MS-268, Warren, MI 48397-5000, or emailed to [usarmy.detroit.rdecom.mail.tardec-standardization@mail.mil](mailto:usarmy.detroit.rdecom.mail.tardec-standardization@mail.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

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## 1. SCOPE

1.1 Scope. This specification covers all U.S. Army military vehicle interior head impact protective components and materials intended for purposes of providing energy absorption for head injury protection of military vehicle occupants (mounted crew/warfighter). The intent of the requirements stated in this document are to generate interior head impact protective vehicle component designs and material selection, which are capable of withstanding the vehicle operating and storage conditions, as well as the high velocity, multi-directional forces associated with blast, crash and rollover events. The contractor should design and fabricate vehicle specific interior head impact protective components and materials which are capable of complying with the vehicle specific operating, storage mission related conditions including consideration for blast, crash and rollover and interior fire related events. This document should be used in conjunction with the vehicle specific detailed performance specification which entails requirements tailored to the intended vehicle specific design, protection location(s) and associated geometry. The vehicle detailed performance specification and associated contractual documents supersede the requirements stated herein, according to vehicle specific mission requirements. Where vehicle specific requirements are absent, the requirements of this document should apply.

1.2 Classification. U.S. Army vehicle interior head impact protective components and materials should be identified according to the following types.

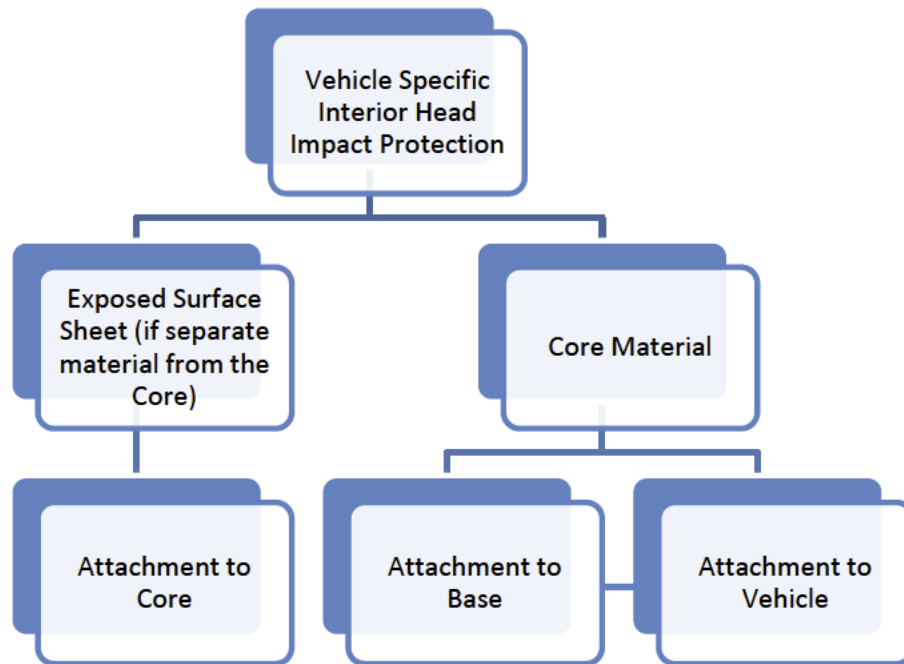
1.2.1 Types. U.S. Army vehicle interior head impact protective components and materials types are as follows:

a. Type I, large overhead head impact protection. Interior head impact protection located in vehicle position, above the shoulder of 5<sup>th</sup> percentile female and over 23225.76 square millimeters (36 Square inches) total accumulative, continuous or discontinuous surface area.

b. Type II, large lower head impact protection. Interior head impact protection located in vehicle position below the shoulder position of 5<sup>th</sup> percentile female with a total accumulative continuous or discontinuous surface area over 23225.76 square millimeters (36 Square inches).

c. Type III, small head Impact protection. Interior head impact protection located anywhere in vehicle position having a total accumulative continuous or discontinuous surface area under 23225.76 square millimeters (36 Square inches).

1.3 Work breakdown. A work breakdown structure accurately depicts the components and materials for vehicle interior head impact protection. The work breakdown structure should be in accordance with MIL-STD-881 'Work Breakdown Structures for Defense Materiel Items'. Figure 1 below depicts the work breakdown structure of a typical vehicle interior head impact protective component. Interior head impact protection component design is dictated by the specific vehicle application and intended purpose. Therefore the vehicle specific design and materials may widely differ, and should comply with the performance requirements stated herein, although tailored to conform to vehicle specific applications, geometry and conditions. Detailed definitions for work breakdown structure are located in the definition Section 6 of this specification.



**FIGURE 1 Interior head impact protection work breakdown structure**

## 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 of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

### 2.2 Government documents.

#### FEDERAL STANDARDS

FED-STD-4	Glossary of Fabric Imperfections
FED-STD-313	Material Safety Data, Transportation Data, and Disposal Data for Hazardous Materials Furnished to Government Activities
FED-STD-595	Colors Used in Government Procurement

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

#### DEPARTMENT OF DEFENSE (DoD) STANDARDS

MIL-STD-810	DoD Test Method Standard, Environmental Engineering Considerations and Laboratory Tests
MIL-STD-881	Work Breakdown Structures for Defense Materiel Items

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MIL-STD-889	Dissimilar metals
MIL-STD-1472	DoD Design Criteria Standard, Human Engineering
MIL-STD-1487	Glossary of Cloth Coating Imperfections
TT-C-492	Coating Compound, Paint Anti-Sweat

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

## DEPARTMENT OF DEFENSE (DoD) INSTRUCTION

Instruction Number 5230.24 Distribution Statements on Technical Documents

(Copies of this document is available online at <http://www.dtic.mil/whs/directives/corres/pdf/523024p.pdf>).

## TECHNICAL MANUALS

TM 10-8470-204-10	Technical Manual Operator's Manual for Advanced Combat Helmet (ACH)
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(Copies of this document is available from [www.peosoldier.army.mil](http://www.peosoldier.army.mil) )

## CODE OF FEDERAL REGULATIONS

29 CFR 1910	Occupational Safety and Health Standard, including 1910.1000 Subpart Z toxic and hazardous substances and 1910.1200 hazard communication
29 CFR 1990	Identification classification and regulation of potential occupational carcinogens
40 CFR 355	List of Extremely Hazardous Substances and Their Threshold Planning Quantities – (Appendixes A & B)
40 CFR 372.65	Specific Toxic Chemical Listings – (Subpart D)
40 CFR Parts 150-180	Protection of the Environment
49 CFR 171-178	Hazardous Materials Regulations
40 CFR 60	Determination of volatile Matter content, water content, density, volume solids and weight solids of surface coatings – (Appendix A, Method 24)
49 CFR 571.201	Standard No. 201 Laboratory Test Procedure for Occupant Protection in Interior Impact
49 CFR 571.208	Standard No. 208 Occupant Crash Protection
49 CFR 571.302	Standard No. 302 Flammability of Interior Materials

(Copies of these documents are available at [www.ecfr.gov/](http://www.ecfr.gov/)).



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## FEDERAL MOTOR VEHICLE SAFETY STANDARDS

TP201U-01

Laboratory Test Procedure for TP201U-01 Occupant Protection in Interior Impact Upper Interior Head Impact Protection.

(Copies of this document are available from <http://www.nhtsa.gov/Vehicle+Safety/Test+Procedures> or from Federal Motor Vehicle Safety Standards and Regulations U.S. Department of Transportation 400 7th Street SW, Room 6111 Mail Code: NSA-30 Washington DC 20590)

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

## AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM D123	Standard Terminology Relating to Textiles
ASTM D747	Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
ASTM D751	Standard Test Method for Coated Fabrics
ASTM D1308	Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1424	Standard Test Method for Tearing Strength of Fabrics, Fabrics by Falling-Pendulum (Elmendorf-Type) Apparatus
ASTM D1776	Standard Practice for Conditioning and Testing Textiles
ASTM D3574	Standard Test Methods for Flexible Cellular Materials - Slab, Bonded, and Molded Urethane Foams
ASTM D3775	Standard Test Method for Warp (End) and Filling (Pick) Count of Woven Fabrics
ASTM D3776	Standard Test Method for Mass per Unit Area (Weight) of Fabric
ASTM D4060	Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D4966	Standard Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Tester Method)
ASTM D5034	Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM E162	Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
ASTM E662	Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
ASTM E800	Standard Guide for Measurement of Gases Present or Generated During Fires
ASTM E1354	Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter

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ASTM F1342/F1342M      Standard Test Method for Protective Clothing Material  
Resistance to Puncture

(Copies of these documents are available at <http://www.astm.org/> ).

### AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

AATCC Test Method 8      Colorfastness to Crocking  
AATCC Test Method 118      Oil Repellency: Hydrocarbon Resistance Test

(Copies of these documents are available from <http://www.aatcc.org>).

### AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ASME Y14.24      Types and Applications of Engineering Drawings -  
Engineering Drawing and Related Documentation Practices

(Copies of these documents are available from <http://www.asme.org/>

### INTERNATIONAL ORGANIZATION FOR STANDARDS

ISO/IEC 17025      General Requirements for the competence of testing and  
calibration laboratories

(Copies of these documents are available from [www.iso.org](http://www.iso.org) or [www.ansi.org](http://www.ansi.org) or ANSI Customer Service Department, 25 W. 43rd Street, 4th Floor, New York, NY 10036.)

2.4 Order of precedence. In the event of a conflict between this specification and the references cited herein, the text of this specification takes precedence. In the event of conflict between this specification and the vehicle specific detailed specification and contractual requirements, the vehicle specific detailed specification and contractual documents takes precedence. In the event of a conflict between Section 3 and Section 4 of this specification, Section 3 should take precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.5 Technical document markings requirements. All technical documents relative to the requirements stated in this document, should be properly marked according to the specific application contract(s). Distribution statements are required to be placed on all technical documents whether they are classified or unclassified, and should comply with the requirements according to DoD Instruction Number 5230.24.

## 3. REQUIREMENTS

3.1 First article. When the first prototype and production model are fabricated, they shall be subjected to first article inspection in accordance with Table I, of this specification.

3.2 Materials. The contractor shall select materials capable of meeting all of the operational and environmental requirements specified herein. Materials shall be capable of performing their mission while in a nuclear, biological, radiological and chemical environment. The materials shall be capable of being removed and replaced after exposure to NBRC.

3.2.1 Material safety requirements. Material Safety Data Sheets shall be provided to the Government procuring agency in accordance to FED-STD-313; 'Material Safety Data and Disposal Data for Hazardous Materials Furnished to Government Activities.'

3.2.2 Dissimilar metals. Dissimilar metals shall not be used in intimate contact with one another unless protected against corrosion. Dissimilar metals and methods of protection are defined in MIL-STD-889, "Dissimilar metals".

3.2.3 Hazardous material requirements. The use of toxic chemicals, hazardous substances, or ozone-depleting chemicals shall be avoided. The material shall not contain Class I or Class II ozone-depleting substances; asbestos, beryllium, radioactive materials, cadmium (electroplating processes), hexavalent chromium (electroplating, and coatings processes), or other highly toxic or carcinogenic materials. The U.S. Environmental Protection Agency maintains an online list of toxic chemicals and hazardous substances.

a. 29 CFR 1990; 'Identification classification and regulation of potential occupational carcinogens'

b. 40 CFR Chapter 1, Part 60 Appendix A, Method 24; 'Determination of volatile Matter content, water content, density, volume solids and weight solids of surface coatings'

c. 40 CFR 355, Appendixes A & B; 'List of Extremely Hazardous Substances and Their Threshold Planning Quantities'

d. 40 CFR 372.65 Subpart D; 'Specific Toxic Chemical Listings',

e. 49 CFR 171-178; 'Hazardous Materials Regulations'.

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

3.3 Technical data package requirements. All contractor technical data packages shall be submitted, in writing, to the Government procuring agency. The technical data packages shall include drawings in accordance with ASME Y14.24. The drawing type (as defined by ASME Y14.24), is identified by the Government procuring agency as specified in the vehicle specific detailed performance specification. The design geometry of Type I, Type II and Type III components and materials shall conform to the *vehicle specific* design data and requirements according to the vehicle specific detailed performance specification or purchase description and associated Computer Aided Design (CAD) and/or drawings.

3.3.1 Units of measure requirements. Unit of measure requirements have changed, Army must be converted to metric or SI measurements as they are revised on normal schedules or new publications developed, AR 25-30 pp 2-1, h (4) AND 15 USC section 205a and Executive Order 12770. This does *not* preclude the use of SAE units used in parenthesis following the metric units.

3.3.2 Weight requirements. Weight shall be reported in metric units of measure (e.g. kilograms). Document the scale calibration and calibrate the scale according to the United States Department of the Interior, Bureau of Reclamation procedure for calibrating balances or scales. The weight of vehicle interior head impact protective components and materials shall be minimized to the extent possible, while maintaining the intended form, fit and function performance requirements. The interior head impact protective component(s) shall comply with vehicle specific

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design (i.e. CAD and/or drawings) weight requirements in accordance with the vehicle detailed performance specification. When vehicle specific weight requirements are not available, the interior head impact protective components shall not exceed Threshold; 0.680 kilograms (1.5 lbs.) per 0.0929 square meters (1 square foot) and an Objective of 0.227 kilograms (0.5 lbs.) + 0.090 kilograms (+ 0.2 lbs.) per 0.0929 square meters (1 square foot).

3.3.3 Dimensional requirements. Vehicle interior head impact protective materials and components shall comply with the dimensional requirements stated in the vehicle specific design requirements in accordance with the vehicle detail performance specification. Exposed surface corners and edges shall have a minimum radius of 5 millimeter +2/-1 (0.1969 inches +0.1181/-0.0394), unless otherwise specified in the vehicle specific Detailed Performance Specification and design data.

3.4 Test laboratories requirements. Test and evaluation of US Army military vehicle interior head impact protective components and materials shall be conducted using an accredited laboratory according to ISO/IEC 17025; General requirements for the competence of testing and calibration laboratories or a Government laboratory with equivalent internal assessment.

3.5 Vehicle targeting.

3.5.1 Vehicle interior head impact protective components and materials; vehicle specific design requirements. Vehicle specific blast, crash and roll-over modeling and simulation and CAD, shall be used to identify the location, size and shape and properties of the interior impact protection components. Careful consideration of the vehicle specific interface geometry and attachment surfaces shall be made to determine the optimal attachment method. Use a durable material which shall reduce the possibility of an impact protection material from being cut or damaged by sharp edges and corners during impact without reducing the overall HIC(d). The contractor shall design and fabricate vehicle specific interior head impact protective components which are capable of complying with the vehicle specific operating, storage mission related conditions including consideration for blast, crash and rollover and interior fire related events. U.S. Army vehicle interior head impact protective components and materials shall comply with the requirements stated in the vehicle specific detailed specification for vehicle level blast, crash and rollover test and evaluation performance.

3.5.2 Vehicle test target locations. Vehicle specific head impact target locations shall be identified prior to testing using modeling and simulation when available. Physical, in-vehicle targeting shall be used when modeling and simulation is not available and to confirm targeting locations prior to conducting SSII (head impact) testing. The Contractor shall identify the vehicle target locations in writing and submit for concurrence by the Procuring Government Agency Subject Matter Expert.

3.6 Head impact. Interior head impact protection Type I, II and III, shall comply with the performance requirements specified herein, when impacted by the Free Motion Head form (FMH) at any speed up to and including 24kph (15mph). The dimensions (e.g. thickness) and materials properties of the exposed surface shall not degrade energy absorption performance of the head impact protection beyond the HIC(d) criterion stated in the following paragraphs.

3.6.1 Head impact criterion (HIC). All U.S. Army vehicle interior head impact protective components and materials shall provide energy attenuation as measured by HIC(d) (the resultant of the calculation), not to exceed as a threshold 1000 HIC(d) and as an objective not to exceed 700

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HIC(d) when evaluated in-vehicle position, testing without the use of an ACH. The FMH and test equipment used for head impact testing and methods shall comply with the requirements stated in FMVSS 49 CFR 571 201; Standard No.201; 'Occupant Protection in Interior Impact', and TP201U-01 'Laboratory Test Procedure for FMVSS 201U'. Material selection and evaluation methods using an FMVSS FMH and a rigid sample test fixture may be used to down-select materials prior to conducting vehicle-level head impact testing and verification.

3.6.2 HIC(d) calculation. HIC(d) shall be calculated in accordance with TP201U-01.

3.7 Flammability, smoke and toxicity (FST) requirements.

3.7.1 Fire resistance requirements for vehicle interior head impact protective components and materials. Type I large overhead vehicle interior head impact protective materials and components shall comply with the requirements stated in Sections 3.7.1 through 3.7.10 of this document, unless otherwise specified in the vehicle specific detailed performance specification. When textile/fabrics are selected as exposed surface sheet material, the fire resistance requirements for Type I shall comply with Section 3.7.5 in lieu of Sections 3.7.3 and 3.7.4 of this document. Type II vehicle interior head impact protective components and materials shall comply with the fire resistance requirements as stated in the vehicle specific detailed performance specification in accordance with vehicle specific mission requirements. When vehicle specific detailed performance fire resistance requirements are not available, Type II materials shall comply with the requirements of Type I materials in accordance with the requirements stated in this document. Type III, vehicle interior head impact protective components or materials such as; knobs, handles, rollers, fasteners, clips, grommets, rub strips, pulleys and small electrical parts, as well as adhesives and bonding agents, shall comply with TP-302-03 *Laboratory Test Procedure for FMVSS 302 Flammability of Interior Materials*, and in accordance with MIL-STD-1180. All Type I, II and III components and materials shall comply with the smoke and toxicity requirements stated in this document.

3.7.2 Fire related egress and mounted crew in-vehicle time requirements. Egress time is the time allotted for the mounted warfighter to safely exit a vehicle. Materials selected for use as vehicle interior head impact protection shall be fire resistant; with the intent to achieve the mission and vehicle specific mounted warfighter egress time requirements during a vehicle interior fire related event, in accordance with the vehicle specific detailed performance specification. To achieve the requirements stated herein, fire resistant material selection shall be based upon the material type criteria (Type I, II or III) in accordance with this document, Section 1.2.1, and fire resistance requirements in accordance with this document, Section 3.7.

3.7.3 Heat release rate requirements. The materials used for Type I vehicle interior head impact protective components and materials, with the exception of fabrics and textiles, shall be tested and evaluated in accordance with ASTM E1354. Heat release shall be in a 300-second period tested at heat flux of  $50\text{kW/m}^2$ . Average (minimum 3 samples) heat release rates for each time interval; ignition-60sec, ignition-180sec and ignition-300 sec shall be less than  $60\text{kW/m}^2$ . The Average Peak Heat Release Rate of a minimum of 3 samples shall be less than  $85\text{kW/m}^2$ . No melting, dripping or pooling is permitted.

3.7.4 Surface flammability of materials requirements. The materials other than fabrics/textiles used for Type I vehicle interior head impact protective components and materials shall comply with the Radiant Panel Index maximum of 30. Radiant Panel Index shall be calculated using ASTM E162.

3.7.5 Flame resistance of fabrics and textiles requirements. Fabrics/textiles used Type I and Type II vehicle interior head impact protective components and materials shall not exceed a char length over 63.5 millimeters (2.5-inches) when tested and evaluated per ASTM D6413. No melting, dripping or pooling is permitted. Smoke and toxicity requirements shall comply with requirements in accordance with Sections 3.7.6 through 3.7.10 of this document.

3.7.6 Smoke density and obscuration requirements. Vehicle interior head impact protective components and materials shall comply with Maximum Smoke Density  $D_m < 200$  flaming and non-flaming modes in 240 seconds (4 minutes). The test shall be conducted for a total of 20 minutes and measurements taken at time intervals of; ignition (within 30 seconds), 1, 5, 10 minutes and at end of test (20 minutes). No dripping, melting or pooling shall be evident. ASTM E662 states the specific optical density of smoke generated by solid materials at  $25\text{kW/m}^2$  heat flux, shall be used for test and evaluation purposes. Fasteners are not required but are acceptable for use in this test.

3.7.7 Gas toxicity requirements. Selection of vehicle interior head impact protective components and materials shall avoid selection of materials which generate toxic gases. The contractor shall submit data documenting the gasses generated from materials when exposed to fire and clearly identify the toxic gases generated when materials are tested in accordance with this document Section 3.7.9.

3.7.8 AIPH toxicity clearance requirements. IAW AR 40-5 and DA PAM 70-3, the Contractor shall obtain a toxicity clearance IAW the Army Institute of Public Health's (AIPH), Toxicology Portfolio, Toxicity Evaluation Program (TEP). The toxicity clearance shall include both, a clearance of the Type I, II and III materials final chemical formulations and clearance of the Type I, II or III materials final chemical formulations pyrolysis and combustion products. The toxicity clearance shall be obtained on each specific Type I, II and III application or use condition. New uses or change in interior head impact protective components and materials; Type I, II and III formulations shall require a new toxicity clearance be obtained.

3.7.9 Toxicity test and evaluation requirements. Type I, II and III materials shall be tested and evaluated in accordance with ASTM E662 for closed chambers, at heat flux of  $25\text{ kW/m}^2$  and analyzed in accordance with ASTM E800. Test shall be conducted in the flaming and non-flaming mode. Direct sampling and immediate analysis of the gases shall be conducted by an accredited test laboratory. FTIR (Fourier-Transform InfraRed) method of measurement shall be used unless prior written consent from the Government procuring agency. When alternate measurement methods such as Draeger tubes are used, measurements shall be conducted in intervals to allow for plotting of the data. The quantity and span of the intervals shall not degrade the integrity of the test nor influence the test results. The following gases shall be recorded; CO, CO<sub>2</sub>, HCl and HCN. Additional gases identified which are specific to the product being tested and evaluated shall be identified and tested to ensure all potential hazardous gases for the specific material(s) tested and analyzed.

3.7.10 Toxic and hazardous substance requirements. Type I, II and III materials shall comply with the requirements in accordance with 29 CFR 1990.1000 Subpart Z'.

3.8 Durability requirements. When the requirements and standards specifically call-out a particular type of material (e.g. textile fabrics, composites, metallics), only those standards which align with the selected exposed surface material shall be used. Compliance with the requirements of this document allows the designer to select materials which are best suited for the specific



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vehicle application while maintaining design integrity. Durability requirements and test specifications may vary dependent upon the materials selected.

3.8.1 Exposed surface durability requirements. The exposed surface of U.S. Army vehicle interior head impact protective components and materials shall be selected to resist exposure to hazards such as abrasion, tear, and puncture which may be expected in the vehicle specific application. The exposed surface materials shall be tested and evaluated according to the methods which are tailored to the type of material selected in accordance with the requirements stated in this document Section 3.8 for durability, and in accordance with the vehicle specific detailed performance specification.

3.8.2 Flexible cellular (foam) material durability requirements. Flexible Cellular (Foam) may be selected as energy attenuating core material, as well as for the exposed surface of the vehicle interior head impact protective components and materials. Test and evaluation of foam materials shall be in accordance with ASTM D3574 – slab, bonded and molded urethane foams. Other test methods stated in ASTM D3574 standard do not apply.

3.8.3 Flexible cellular (foam) tear resistance requirements. Flexible Cellular (Foam) tear strength shall be greater than 222.0 N (50 lbs.), evaluated in accordance with ASTM D1424 or as otherwise specified in the vehicle specific detailed performance specification.

3.9 Textile/fabric (less FST requirements) requirements

3.9.1 Textile/fabric exposed surface material. Textile/Fabric shall be free of fabric imperfections as defined in FED-STD-4 and MIL-STD-1487. ASTM may be used as a reference for fabric/textile terminology. Coated fabrics/textiles shall comply with ASTM D751. Textile/Fabric exposed surfaces shall be colorfast to crocking in accordance with AATCC Test Method 8.

3.9.2 Textile/fabric warp and fill requirements. Textiles/fabrics shall comply with the requirements according to ASTM D3775.

3.9.3 Fabric weight requirements. Fabric weight shall be evaluated per ASTM D3776. A fabric weight minimum of 0.3118 kilograms/0.84 square meters (11.0 oz./sq. yd.) and maximum of 0.304 kilograms/0.84 square meters (10.73 oz./sq. yd.).

3.9.4 Fabric thickness requirements. The minimum fabric thickness shall be greater than 0.48 millimeter (0.019 in) and no greater than 2.0 millimeter (0.079 in), evaluated in accordance with ASTM D1777.

3.9.5 Fabric breaking strength requirements. Fabric breaking strength requirements. Breaking strength shall be greater than 226.8 kilograms (2224.1 N or 500 lbs.) warp and 204.1 kilograms (2001.5 N or 450.0 lbs.) fill, evaluated in accordance with ASTM D5034.

3.9.6 Fabric tear strength requirements. Fabric tear strength shall be greater than 222.4 N (50 lbs. force), evaluated in accordance with ASTM D1424 by falling-pendulum type (Elmendorf) apparatus.

3.9.7 Fabric/textile abrasion resistance requirements. Fabric/textile exposed surfaces shall be resistant to abrasion for a minimum of 1000 cycles when tested in accordance with ASTM D4966.

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3.9.8 Fabric/textile resistance to puncture requirements. Fabric/textile exposed surfaces shall be resistant to puncture for a minimum of 1000 cycles when tested in accordance with ASTM F1342.

3.10 Metallic exposed surface.

3.10.1 Metallic exposed surface durability requirements. Exposed surfaces comprised of metallic materials shall not degrade the energy attenuating performance of the vehicle interior head impact protective components and materials. The requirements for metallic exposed surface durability are based upon Aluminum Alloy Type 5052. The Aluminum exposed surface material shall comply with the requirements stated in ASTM B209 for Type 5052 with thickness of 0.50 to 1.27 millimeters (0.020-0.050-inches). Other metallic materials may be selected by the designer so long as the material selected complies with or exceeds the requirements stated in this document or as otherwise specified in the vehicle specific detailed performance specification.

3.10.2 Metallic exposed surface paint and coating. The exposed surface shall be black using FED-STD-595 for color and finish texture. Coatings used for surfaces shall comply with the requirements stated in TT-C-492 (when coating is used for surface). Coatings shall be selecting which comply with 40 CFR Chapter 1, Part 60 Appendix A, Method 24. Coated exposed surface materials shall be resistant to abrasion for a minimum of 1000 cycles, when tested in accordance with ASTM D4060.

3.11 Composite material requirements. Composite exposed surfaces shall be free of defects and imperfections and shall comply with SAE R-423 CMH-17-2G Volume 2 and ASTM D4762. Test methods shall be selected by the contractor relative to the vehicle specific composite materials with concurrence by the procuring Government agency. The composite material shall resist surface degradation due to abrasion due to contact to surfaces such as an uncovered ACH. The composite surface sheet shall also resist rupture, puncture or tear due to contact with soldier gear, weapons and basic issue items. The specific component designs are vehicle specific and shall be tailored for which vehicle they are intended.

3.12 Environmental requirements.

3.12.1 Environmental and climatic requirements. U.S. Army vehicle interior head impact protective components and materials shall comply with the requirements stated in this document, Sections 3.12.1 through 3.12.6 and in accordance with MIL-STD-810, unless otherwise stated in the vehicle specific detailed performance specification.

3.12.2 Vibration requirements. U.S. Army vehicle interior head impact protective components and materials shall comply with MIL-STD-810, Method 514.6 Annex E. This is a combined temperature cycling with vibration schedule. Procedure I - General Vibration, Operational Ground Category 20 Ground Vehicles, for Installed Materiel in wheeled tracked/trailer, Annex D, Test I/III, Annex C, Category 4 shall be used in lieu of availability of vehicle specific vibration profiles. All methods of attachment shall be capable of retaining the components, sub-components and materials in place during and after testing.

3.12.3 Environmental temperature basic hot requirements. U.S. Army vehicle interior head impact protective components and materials shall comply with MIL-STD-810, Environmental Temperature Basic *Hot* A2, Method 501.5. MIL-STD-810 Part I Annex C; & D1 Climatic Categories are assumed. Vehicle specific designed components shall be tested in vehicle design position, or using a laboratory fixture which duplicates the orientation and attachment constraints of



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the vehicle. The sample shall be capable of staying retained with no sagging, cracking or deformation. All methods of attachment shall be capable of retaining the components, sub-components and materials in place during and after testing.

3.12.4 Environmental temperature basic cold requirements. U.S. Army vehicle interior head impact protective components and materials shall comply with MIL-STD-810, Environmental Temperature Basic *Cold* C1 Method 502.5. MIL-STD-810 Part I Annex C; & D1 Climatic Categories are assumed. Table C-I Basic Cold C1 Storage and Transit/Operational Conditions shall be used for worst case test and evaluation. Vehicle specific designed components shall be tested in vehicle design position, or using a laboratory fixture which duplicates the orientation and attachment constraints of the vehicle. The U.S. Army vehicle interior head impact protective components and materials shall be capable of staying retained with no sagging, cracking or deformation. All methods of attachment shall be capable of retaining the components, sub-components and materials in place during and after testing.

3.12.5 Water resistance requirements. U.S. Army vehicle interior head impact protective components and materials located in the vehicle which may expose it to rain and water shall comply with MIL-STD-810 for exposure to rain. It shall be capable of staying retained with no sagging, cracking or deformation. All methods of attachment shall be capable of retaining the components, sub-components and materials in place during and after testing.

3.12.6 Resistance to fungus requirements. U.S. Army vehicle interior head impact protective components and materials shall comply with MIL-STD-810G Method 508.6 Fungus. Water used for testing shall be in accordance with MIL-STD-810G Water Purity. Fungi used for testing shall be selected in accordance with Table 508.6-I. Exceptions to the fungus selections required in this document shall be in accordance with the vehicle program specific performance specification. Pre-existing surrogate test results of equivalent requirements stated herein may be considered for verification of compliance to the requirements stated in this section for fungus, with the written concurrence of the Government procuring agency.

3.12.7 Resistance to chemicals requirements. U.S. Army vehicle interior head impact protective components and materials shall be resistant to chemicals as tested and evaluated in accordance with ASTM D1308 and AATCC Test Method 118. 3.13 Engineering requirements.

3.13.1 Human factors engineering requirements. U.S. Army vehicle interior head impact protective components and materials shall comply with the following requirements, and in accordance with MIL-STD-1472.

3.13.2 Installation and removal tools requirements. U.S. Army vehicle interior head impact protective components and materials shall be capable of being installed and removed in an operational environment *without* the aid of “special tools”. This means using *commercial off the shelf tools*, i.e., common hand tools in accordance with MIL-STD-1472.

3.13.3 Attachment requirements. The methods selected for use in attaching U.S. Army vehicle interior head impact protective components and materials to the vehicle interior, shall not detach during vehicle operations, storage or during underbody blast, crash and rollover impact events. The attachment method shall retain the components during and post head impact testing in accordance with Section 3.6.1, and during environmental testing in accordance with Section 3.12.

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3.13.4 Threaded fasteners. When fasteners are used for purposes of attaching the Type I, II or III subassembly materials together, or for attachment to the vehicle, fasteners shall comply with the fastener and torque requirements in accordance with MIL-STD-1472.

3.13.5 Bonded Attachment Methods. Bonding surfaces shall be prepared according to the adhesive manufacturer's instructions and shall be free from dirt, grease or other contaminants which may interfere with proper bonding. Adhesives shall be allowed proper cure time as specified by the manufacturer. Adhesives shall be capable of holding the weight and forces of the interior head impact component and materials with continued retention during vehicle storage, operation, and in vehicle blast, crash and rollover events.

3.14 Workmanship requirements. Materials shall be free from defects which would adversely affect the performance or maintainability and safety of individual components or the overall assembly. Finished items and parts shall not exhibit poor material and processing such as seams, laps, laminations, cracks, visible steps, sharp edges, nicks, scratches, burrs, deformations, and missing operation which may affect serviceability, functioning, operations, appearance or safety. Hammering to shape, salvage operations (including repair by welding) or other similar practices shall not be permitted shall not be permitted without prior approval of the Government contracting officer.

#### 4. VERIFICATION

4.1 Verification. Verification of Section 3 requirements are matrix in Table I.

TABLE I: Requirement/verification cross reference matrix

METHOD OF VERIFICATION			CLASSES OF VERIFICATION						
1 - Analysis			A - Design						
2 - Demonstration			B - First article						
3 - Examination			C - Conformance						
4 – Test									
Para	Requirement Number	Verification In Accordance With Paragraph	Verification Methods				Verification Class		
			1	2	3	4	A	B	C
3.1	First article	4.3			X	X		X	X
3.2	Materials	4.4			X	X			X
3.2.1	Material safety	4.4.1			X				X
3.2.2	Dissimilar metals	4.4.2	X		X		X		X
3.2.3	Hazardous material	4.4.3	X		X				X
3.2.4	Recycled, recovered, environmentally preferable, or bio based materials	4.4.4			X				X
3.3	Technical data package	4.5	X	X	X	X	X	X	X

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3.3.1	Units of measure	4.6			X				X
3.3.2	Weight	4.7			X				X
3.3.3	Dimensions	4.8			X				X
3.4	Test laboratories	4.9			X				X
3.5.1	Vehicle interior head impact protective components and materials; vehicle specific design requirements	4.10	X		X	X	X	X	X
3.5.2	Vehicle test target locations	4.11	X	X		X	X	X	X
3.6	Head impact	4.12	X	X		X	X	X	X
3.6.1	Head impact criterion (HIC)	4.13	X		X	X		X	X
3.6.2	HIC(d) calculation	4.14	X					X	X
3.7.1	Fire resistance for vehicle interior head impact protective components and materials	4.17	X	X		X	X		X
3.7.2	Fire related egress and mounted crew in-vehicle time	4.18	X	X		X	X		X
3.7.3	Heat release rate	4.19	X	X		X	X		X
3.7.4	Surface flammability of materials	4.15	X			X			X
3.7.5	Flame resistance of fabrics and textiles	4.16	X	X		X	X	X	X
3.7.6	Smoke density and obscuration	4.20	X	X		X	X	X	X
3.7.7	Gas toxicity	4.21	X	X		X	X	X	X
3.7.8	AIPH toxicity clearance	4.22	X	X		X	X	X	X
3.7.9	Toxicity test and evaluation	4.23	X	X		X	X	X	X
3.7.10	Toxic and hazardous substance	4.24	X	X		X	X	X	X
3.8	Durability	4.25	X	X		X	X	X	X
3.8.1	Exposed surface durability	4.26	X	X		X	X	X	X
3.8.2	Flexible cellular (foam) material durability	4.27	X	X		X	X	X	X
3.8.3	Flexible cellular (foam) tear resistance	4.28	X	X		X	X	X	X
3.9.1	Textile/fabric exposed surface material	4.29	X	X		X	X	X	X
3.9.2	Textile/fabric warp and fill	4.30	X	X		X	X	X	X
3.9.3	Fabric weight	4.31	X	X		X	X	X	X
3.9.4	Fabric thickness	4.32	X	X		X	X	X	X

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3.9.5	Fabric breaking strength	4.33	X	X		X	X	X	X
3.9.6	Fabric tear strength	4.34	X	X		X	X	X	X
3.9.7	Fabric/textile abrasion resistance	4.35	X	X		X	X	X	X
3.9.8	Fabric/textile resistance to puncture	4.36	X	X		X	X	X	X
3.10.1	Metallic exposed surface durability	4.37	X	X		X	X	X	X
3.10.2	Metallic exposed surface paint and coating	4.38	X	X		X	X	X	X
3.11	Composite material	4.39	X	X		X	X	X	X
3.12.1	Environmental and climatic	4.40	X	X		X	X	X	X
3.12.2	Vibration	4.41	X	X		X	X	X	X
3.12.3	Environmental temperature basic hot	4.42	X	X		X	X	X	X
3.12.4	Environmental temperature basic cold	4.43	X	X		X	X	X	X
3.12.5	Water resistance	4.44	X	X		X	X	X	X
3.12.6	Resistance to fungus	4.45	X	X		X	X	X	X
3.12.7	Resistance to chemicals	4.46	X	X		X	X	X	X
3.13.1	Human factors engineering	4.47	X	X	X	X	X	X	X
3.13.2	Installation and removal tools	4.48		X					X
3.13.3	Attachment Method	4.49		X				X	X
3.14	Workmanship	4.50			X			X	X

4.2 Validation. Validation for all items in Table I shall be in the form of documentation sent from the contractor(s) to the Government procuring agency citing the program number, contract number, verification being performed, test method(s), references used and results. The contracting officer (KO) or designated representative shall be allowed to observe any or all processes and paperwork for compliance with this specification.

4.3 First article inspection. The KO shall determine if the first article complies with the all listed requirements in Table I. If a requirement does not apply to the article, it will be so noted in the KO's report to the manufacture and primary interested parties.

4.4 Materials verification. Verify the sample for compliance with listed all references (from each component) of an assembled item.

4.4.1 Material safety verification. Verify each Safety Data Sheets (SDS) and/or Material Safety Data Sheets (MSDS) has been prepared for an assembled item and is in compliance with MIL-STD-313 prior to shipment of an item by a contractor.

4.4.2 Dissimilar metals verification. The contractor shall submit, in writing to the Government Procuring Agency documentation and supporting data to verify the design and documentation is conformance to MIL-STD-889.

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4.4.3 Hazardous materials. The contractor shall submit, in writing to the Government Procuring Agency documentation and supporting data for Government examination and analysis of the documentation to verify the contractor is in conformance with 29 CFR 1990, 40 CFR Chapter 1, Part 60, 40 CFR 355, 40 CFR 372.65, and 49 CFR 171-178.

4.4.4 Recycled, recovered, environmentally preferable, or bio based materials verification. Examine and analyze the recycled, recovered, environmentally preferable, or bio based materials documentation to verify the contractor is in conformance with the operational and maintenance requirements and is economically advantageous to life cycle costs.

4.5 Technical data package verification. Verify the contractor has coordinated and has approved by the Government engineering activity drawing packages prior to the start of production. If the Type I, II or III fails to meet this verification, the item drawing(s) shall be rejected and the contractor shall make the necessary drawing modifications until they comply with the contractual requirements prior to production.

4.6 Units of measure verification. Examine all documents generated required from the contractor for compliance. If not in compliance inform the contractor of the new requirement and all future documentation shall contain metric units. However, this does not preclude the use of SAE measurements put in parenthesis ( ) behind the metric unit. Until industry switches to metric bolts and fasteners, it must be specified as SAE ½ inch because there is a significant size different to an M13 bolt.

4.7 Weight verification. Documents verifying the certification of a scale (weighing) by a government approved facility shall be examined for compliance.

4.8 Dimensions verification. Dimensional data will be examined for conformance to the dimensional requirements for drawings and/or Computer Aided Design (CAD). Again, the dimensions shall be in the form of metric units.

4.9 Test laboratories verification. Examine the test laboratory certification for conformance prior to commencement of test and evaluation.

4.10 U.S. Army vehicle interior head impact protective components and materials vehicle specific design verification. The contractor shall provide the Government Procuring Agency Subject Matter Expert, documentation to verify the vehicle specific blast, crash, roll-over modeling, simulation and CAD, has been used to identify the location, size, shape and properties of the U.S. Army vehicle interior head impact protective components and materials. The design and material selections provided in writing by the contractor to the Government Procuring Agency, shall be verified by the Government Procuring Agency, prior to releasing the design for fabrication, test, evaluation and fielding. Verify the U.S. Army vehicle interior head impact protective components and materials comply with the requirements stated in the vehicle specific detailed specification for vehicle level blast, crash and rollover test and evaluation performance verification.

4.11 Vehicle test target locations. Verify in-vehicle CAD head impact target locations are identified using modeling and simulation or verify physical, in-vehicle targeting has been used when modeling and simulation is not available. The contractor shall clearly identify and shall submit, in writing to the Government Procuring Agency Subject Matter Expert, the vehicle target locations. The Contractor shall receive concurrence with the vehicle target locations, in writing from the Government Procuring Agency as verification of conformance to requirements stated in this document.

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4.12 Head impact verification. Verify the U.S. Army vehicle interior head impact protective components and materials; Type I, II and III can withstand the Free Motion Head form (FMH) impact at any speed up to and including 24kph (15mph) as measured using HIC(d).

4.13 Head impact criterion verification. Verify the dimensions and material properties of U.S. Army vehicle interior head impact protective components and materials; Type I, II and III so they do not show degradation of energy absorption performance using the criterion in accordance with this document, Sections 4.13 a-b and Section 4.14. The Contractor shall provide documentation and supporting data as verification to compliance with requirements.

a. The FMH and test equipment used for head impact testing and methods shall comply with the requirements stated in FMVSS 49 CFR 571 201; Standard No.201 and TP201U-01.

b. Verification of HIC(d) requirements shall be conducted using components mounted in the specific vehicle for head impact testing and verification.

4.14 HIC(d) calculation verification. Verify HIC(d) calculations in accordance with TP201U-01.

4.15 Surface flammability of materials. Verify the test and evaluation methods are in accordance with ASTM E162. Verify no melting, dripping or pooling occurs and the sample does not exhibit rapid flame progression and flashing.

4.16 Flame resistance of textiles. Verify fabrics/textiles used for the exposed surface of Type I U.S. Army vehicle interior head impact protective components and materials do not exceed a char length over 63.5 millimeters (2.5-inches) when tested and evaluated per ASTM D6413. Verify no melting, dripping or pooling occurs and the sample does not exhibit rapid flame progression and flashing.

4.17 Fire Resistance for interior head impact protective components and materials. Verify the contractor's proper identification of Type I, Type II and Type III interior head impact protective components and materials and test and evaluation methods are according to the material Type identified.

4.18 Fire resistant component and material selection for mounted crew vehicle egress and in-vehicle time requirements. Verify material selection is in compliance to the fire resistance requirements stated in this document, Section 3.7 through material verification of test and evaluation documentation and supporting data.

4.19 Heat release rates. Verify the materials used Type I U.S. Army vehicle interior head impact protective components and materials are tested and evaluated in accordance with ASTM E1354. Verify heat release in a 300-second period test using a heat flux source of 50kW/m<sup>2</sup>. Average (minimum 3 samples) heat release rates for each time interval from ignition, and to 60 sec, and to 180 sec and, to 300 sec shall be less than 60kW/m<sup>2</sup>. Verify the Average peak heat release rate with a minimum of 3 samples is less than 85kW/m<sup>2</sup>. Verify there is no melting, dripping or pooling of material when tested.

4.20 Smoke density and obscureness. Fasteners are not required for this test. Verify adhesives are tested as part of the sample assembly if applicable to vehicle specific application. Verify the materials used for U.S. Army vehicle interior head impact protective components and materials shall comply with the following:

- a. Verify procedures in ASTM E662 at 25 kW/m<sup>2</sup> heat flux, is used for test and evaluation purposes.
- b. Verify maximum smoke density for flaming and non-flaming modes of Dm <200 in 240 seconds (4 minutes).
- c. Verify the test is conducted for a total of 20 minutes.
- d. Verify smoke density measurements are taken at time intervals of; ignition (within 30 seconds), 1 minute, as specified in "a" above, then, 5, 10 and 20 minutes (the end of test).
- e. Verify there is no dripping, melting or pooling is evident on the material being tested.

4.21 Gas toxicity. Verify documentation submitted by the Contractor identifies toxic gases generated by materials as tested in accordance with the requirements stated in this document Section 3.7.9.

4.22 AIPH toxicity clearance. Verify the contractor has obtained a toxicity clearance IAW the Army Institute of Public Health's (AIPH), Toxicology Portfolio, Toxicity Evaluation Program (TEP), AR 40-5 and DA PAM 70-3. Verify the toxicity clearance shall include; a clearance of the Type I, II and III materials final chemical formulations, final chemical formulations pyrolysis, combustion products and a clearance. Verify the toxicity clearance is obtained for each (old or new) specific Type I, II and III application or use condition.

4.23 Toxicity test and evaluation. Verify Type I, II and III materials are tested and evaluated in accordance with ASTM E662 for closed chambers, at heat flux source of 50 kW/m<sup>2</sup> and the results analyzed in accordance with ASTM E800. Verify tests are conducted in the flaming and non-flaming mode. Verify the sampling and immediate analysis of the gases shall be conducted by an accredited test laboratory. Verify the FTIR (Fourier-Transform Infrared) method of measurement is used unless prior written consent was obtained from the Government procuring agency. If the Draeger tubes (or other approved methods) are used, measurements are collected at consistent and enough intervals to allow for plotting of the data. The quantity and span of the intervals will not degrade the integrity of the test nor influence the test results. Verify the following gases are recorded; CO, CO<sub>2</sub>, HCl and HCN. Verify any additional gases identified which are specific to the product being tested and evaluated are identified and tested to ensure no hazardous gases for the specific material(s) are present.

4.24 Toxic and hazardous substances. Verify Type I, II and III materials comply with the requirements in accordance with 29 CFR 1990.1000 Subpart Z.

4.25 Durability. Verify the correct standards and requirements are used according to the type of material selected for use in U.S. Army vehicle interior head impact protective components and materials (e.g. textile fabrics, composites, metallic) and are in compliance with the associated criterion thereof as stated in this document Section 3.8, or unless otherwise specified in the vehicle specific detailed performance specification.

4.26 Exposed surface durability. Verify plastics are not selected or used as exposed surface materials due to the potential of plastics to melt and drip when exposed to fire or verify documentation of a fire resistant plastic with written concurrence by the Government procurement agency.

4.27 Flexible cellular (foam) material durability. If used, verify test and evaluation of foam materials in the U.S. Army vehicle interior head impact protective components and materials,



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comply with ASTM D3574 – slab, bonded and molded urethane foams’. Verify other test methods stated in ASTM D3574 standard are not used.

4.28 Flexible cellular (foam) tear resistance. Verify ASTM D1424 is used and the flexible cellular (foam) tear strength is greater than 222.0 N (50 lbs.).

4.29 Textile/fabric exposed surface material. Verify textile/fabric shall be free of fabric imperfections as defined in FED-STD-4 and MIL-STD-1487. Verify coated fabrics/textiles comply with ASTM D751. Verify documentation for textile/fabric exposed surfaces conform to colorfast to crocking in accordance with AATCC Test Method 8. NOTE: ASTM D123 may be used as a reference for fabric/textile terminology.

4.30 Textile/fabric warp and fill. Verify textiles/fabrics comply with the requirements in ASTM D3775.

4.31 Fabric weight. Verify fabric weight has been evaluated per ASTM D3776 with a minimum weight of a minimum being 0.312 kilograms/0.84 square meters (11.0 oz./sq. yd.), maximum of 0.304 kilograms/ 0.84 square meters (12.0 oz./sq. yd.).

4.32 Fabric thickness. Verify minimum fabric thickness is greater than 0.48 millimeter (0.019 in) and not greater than 2.0 millimeter (0.079 in), accordance with ASTM D1777.

4.33 Fabric breaking strength. Verify fabric breaking strength requirements through review of documentation and supporting data is in compliance with the requirements stated in Section 3.9.5 of this document.

4.34 Fabric tear strength. Verify fabric tear strength is greater than 222.4 N (50 lbs. force), in accordance with ASTM D1424.

4.35 Fabric/textile abrasion resistance. Verify fabric/textile exposed surfaces are resistant to abrasion for a minimum of 1000 cycles according to ASTM D4966.

4.36 Fabric/textile resistance to puncture. Verify fabric/textile exposed surfaces are resistant to puncture for a minimum of 1000 cycles when tested with procedures in ASTM F1342.

4.37 Metallic exposed surface durability. Verify exposed surfaces comprised of metallic materials do not degrade the energy attenuating performance of U.S. Army vehicle interior head impact protective components and materials. If there are exposed metallic surfaces, ensure Aluminum Alloy Type 5052 or equivalent is used. Verify the thickness of this material is 0.50 to 1.27 millimeters (0.020-0.050-inches). NOTE: Equivalent materials must exceed the requirements of Aluminum Alloy Type 5052.

4.38 Metallic exposed surface paint and coating. For painted surfaces, verify surface colors are as specified in FED-STD-595. If coatings are used for surfaces, verify the color is in compliance with the requirements stated in TT-C-492 or coatings comply with 40 CFR Chapter 1, Part 60 Appendix A, Method 24. Verify painted or coated exposed surface materials are tested with procedures in ASTM and are resistant to abrasion for a minimum of 1000 cycles.

4.39 Composite material. Verify exposed composite surfaces are free of defects, imperfections and in compliance with SAE R-423 CMH-17-2G and ASTM D4762. Verify test methods selected by the contractor, for the vehicle specific composite materials are approved prior to testing. Verify the composite material is resistant to surface degradation due to abrasion due to contact to surfaces such as an uncovered ACH. Verify the exposed composite surface is also



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resistant to rupture, puncture or tear due to contact with soldier gear, weapons and basic issue items for a minimum of 1000 cycles.

4.40 Environmental and climatic. Verify U.S. Army vehicle interior head impact protective components and materials comply with the US Army military detailed vehicle specific performance requirements or purchase description and MIL-STD-810.

4.41 Vibration. Verify methods of attachment of U.S. Army vehicle interior head impact protective components and materials are capable of retaining the components, sub-components and materials in place during and after testing and comply with MIL-STD-810, Method 514.6 Annex E. Verify this is a combined temperature cycling with vibration schedule. Procedure I - General Vibration, Operational Ground Category 20 Ground Vehicles, for Installed Materiel in wheeled tracked/trailer, Annex D, Test I/III, Annex C, Category 4 is used in lieu of vehicle specific vibration profiles. Verify production intent components are tested in vehicle orientation in-vehicle or using a laboratory fixture which duplicates the orientation and attachment constraints of the vehicle. Verify the sample is retained with no sagging, cracking or deformation.

4.42 Environmental temperature basic hot. Verify U.S. Army vehicle interior head impact protective components and materials shall comply with MIL-STD-810 Environmental Temperature Basic *Hot* A2 Method 501.5. MIL-STD-810, Part I Annex C; & D1 Climatic Categories are assumed. Verify production intent components are tested in vehicle orientation in-vehicle or using a laboratory fixture which duplicates the orientation and attachment constraints of the vehicle. Verify the sample is retained with no sagging, cracking or deformation.

4.43 Environmental temperature basic cold. Verify Type I, Type II and Type III U.S. Army vehicle interior head impact protective components and materials comply with MIL-STD-810 Environmental Temperature Basic *Cold* C1 Method 502.5. MIL-STD-810, Part I Annex C; & D1 Climatic Categories are assumed. Table C-I Basic Cold C1 Storage and Transit/Operational Conditions shall be used for worst case test and evaluation. Verify production intent components are tested in vehicle orientation in-vehicle or using a laboratory fixture which duplicates the orientation and attachment constraints of the vehicle. Verify the sample is retained with no sagging, cracking or deformation.

4.44 Water resistance. Verify U.S. Army vehicle interior head impact protective components and materials comply with MIL-STD-810 for exposure to rain. Verify retention with no sagging, cracking or deformation. Verify attachment of components, sub-components and materials remain place during and after testing

4.45 Resistance to fungus. Verify all interior head impact protection comply with MIL-STD-810G Method 508.6, for fungus. Verify water used for testing is in accordance with Table 508.6-I, MIL-STD-810G for water purity. If pre-existing test results of equivalent procedures, verify the written concurrence of the Government procuring agency

4.46 Resistance to chemicals. Verify the procedures and results of exposed surfaces and materials are resistant to chemicals in accordance with ASTM D1308 and AATCC Test Method 118.

4.47 Human factors engineering. Verify U.S. Army vehicle interior head impact protective components and materials comply with the requirements in MIL-STD-1472.

4.48 Installation and removal tools. Verify all U.S. Army vehicle interior head impact protective components and materials are capable of being installed and removed in a test and an

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operational environment using only *commercial off the shelf tools* in accordance with MIL-STD-1472.

4.49 Attachment and Fasteners. Attachment methods shall comply with Section 3.13.3 as verified by Sections 3.6 and Section 3.12 requirements. If fasteners are used for attaching the Type I, II or III subassembly and/or materials together, or for attachment to the vehicle, verify fasteners comply with the fastener and torque requirements in accordance with MIL-STD-1472.

4.50 Workmanship. Verify finished items and parts do not exhibit poor material and processing such as seams, laps, laminations, cracks, visible steps, sharp edges, nicks, scratches, burrs, deformations, and missing operation which may affect serviceability, functioning, operations, appearance or safety. Verify hammering to shape, salvage operations (including repair by welding) or other similar practices are not used without prior approval of the Government contracting officer.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order. When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Service of Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

6.1 Disclaimer. This document and the requirements herein do not purport to address all of the potential safety concerns, if any, associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type and grade (see 1.2.1).
- c. When first article is required (see 3.1).
- d. Contractor to make material selection(s) IAW cited sources outline in this specification. (See 3.2).
- e. Whether lot A or B testing is required.
- f. Packaging requirements (see 5.1).

6.3 Contractor orders. All test reports and supporting documentation should be submitted to the Government procuring agency in writing and should entail the following minimum information:

- a. Contractor's company name, address, DUNS number, cage code

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b. Contractor's point of contact, name, address, office telephone, mobile telephone and email address

c. Laboratory name, accreditation certification entity, and address

d. Material – name, type, manufacturer (name, address, point of contact)

e. Date of test and date of report

f. Test report number

g. Sample identifier (number)

h. Sample configuration inspection results

i. Pass or fail status according to contractual requirement(s)

j. Test specification, test title and test description.

k. Laboratory test observations and remarks.

l. Authorized laboratory signature and certification the test results are obtained after testing, in accordance with accredited laboratory test procedures and accurate to the best of the laboratory test entities capabilities.

m. Exceptions to the minimum radius requirement should be requested in writing by the contractor with concurrence in writing by the Government procuring agency.

n. Concurrence of the vehicle target locations by the procuring Government procuring agency, in writing, should be obtained by the contractor prior to testing.

o. A minimum of 3 samples of design intent and dimensionally representative of in-vehicle production intent configuration should be used for purposes of Head Impact test and evaluation. Material test samples should be configured according to the requirements of this document per the specific test section and in accordance with the test method being used for test and evaluation. The contractor should provide replacement samples for inspection failure results, unless otherwise agreed upon, in writing by the Government procuring agency.

p. A bill of material of all subsystem components should also be provided by the contractor, in writing, to the Government procuring agency, stating the component and material nomenclature, manufacturers name, address, cage code or DUNS number, material type or model, material description, part number (if applicable).

q. Any photographs of the test set-up and equipment, and videos of the head impact tests should be collected and submitted as part of the test and evaluation report. Exceptions to this requirement should be communicated in writing with concurrence by the Government procuring agency.

r. The contractor should comply with all document marking requirements in accordance with the contract, including distribution statements, export control and International Traffic in Arms Regulations when transferring data electronically. Electronic transfer includes transfer of information via email, CD, or web-based systems such as "Safe".

s. Limiting heat release of materials used for U.S. Army vehicle interior head impact protective components and materials, safeguard against the use of materials which emit high levels of heat when burning as well as from materials with relatively low levels of heat release overall all,

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yet emit large amounts of heat over a short duration. The use of such materials may allow fire to spread rapidly throughout the vehicle and pose a risk of burn injury to mounted warfighter. The contractor should provide a written test report in accordance with the requirements stated in this document.

**6.4 Qualification.** With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. In the event that procurement of product is not possible or products are not available, substitute products should be identified and subject to approval of use by the Government procurement contracting officer (KO). Information pertaining to qualification of products may be obtained from (insert name, mailing address, and email of qualifying activity). An online listing of products qualified to this specification may be found in the qualified products database (QPD) at <https://assist.dla.mil>.

#### 6.5 Acronym definitions

AATCC	American Association of Textile Chemists and Colorists
ACH	Advanced Combat Helmet
AFES	Automatic Fire Extinguishing Systems
ASTM	American Society of Test and Materials
CAD	Computer Aided Design
CFR	Code of Federal Regulations
COTS	Commercial Off the Shelf
DoD	Department of Defense
DUNS	Data Universal Numbering system developed and regulated by Dun & Bradstreet for assigning unique numeric identifier to a business entity.
FED – STD	Federal Standard
FMH	Full Motion Head form
FMVSS	Federal Motor Vehicle Safety Standards
FOUO	For Official Use Only
FST	Flammability (flame), Smoke and Toxicity
HEAT	High explosive antitank munitions
HIC or HIC(d)	Head Injury Criterion
MIL-STD	Military Standard
RPG	Rocket Propelled Grenade
TDP	Technical Data Package
TM	Technical Manual

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6.6 Definitions

<u>Term</u>	<u>Definition</u>
Analysis	An element of verification that uses established technical or mathematical models or simulations, algorithms, charts, graphs, circuit diagrams, or other scientific principles and procedures to provide evidence that stated requirements were met.
Char length	<i>n</i> —in measuring flame resistance of textiles, the distance from the fabric edge, which is directly exposed to the flame to the furthest point of visible fabric damage after a specified tearing force has been applied. (Standard Test Method for Flame Resistance of Textiles )
Combustible Hazards	Flammable materials which may ignite as a result of an ignition event from an initiating hazard.
Component(s)	Interdependent elements and materials or set of elements and materials which make up a larger system as an integrated whole.
Configuration	Design features of the U.S. Army vehicle interior head impact protective components and materials.
Conformance	Complying with the stated process or objective.
Core Material	Combination of elements which provide energy attenuating properties
Demonstration	An element of verification that involves the actual operation of an item to provide evidence the required functions were accomplished under specific scenarios. The items may be instrumented and performance monitored.
Design	Examining a part or end item to drawing(s) or other graphical representation specifications in accordance with MIL-STD-31000A. This is to ensure a part or end item is made or functions according to the requirement(s).
DUNS	Data Universal Numbering system
Egress Time	The time allotted for the mounted warfighter to safely exit a vehicle.

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Examination	An element of verification that is generally nondestructive and typically includes the use of sight, hearing, smell, touch, and taste; simple physical manipulation; and mechanical and electrical gauging and measurement.
Exposed Surface Sheet	The outward facing face which is open to the vehicle interior and faces away from the vehicle attachment surface.
Fire Resistance	Property of a subsystem, component or material to withstand fire, preventing flash burning, rapid flame progression, melting, pooling and dripping
First article	First article includes pre-production models, initial production samples, test samples, first lots, pilot models, and pilot lots. It may be necessary to test a first article for conformance with specification requirements prior to regular production on a contract.
Government Procuring Agency	United States Government entity (e.g., US Army, TACOM) for which the contracting officer awards Government the contract(s) for the procurement (purchase) of goods and services on behalf of the public authority.
Improved Explosive Device	A homemade bomb constructed and deployed in ways other than in conventional military action. It may be constructed of conventional military explosives, such as an artillery round, attached to a detonating mechanism. Roadside bombs are a common use of IEDs. (Wikipedia)
Initiating Hazards (fire)	Initiating hazards are hazards that manifest directly or indirectly, an ignition event. An initiating hazard needs to have two conditions to be met; 1) an ignition hazard and 2) a fuel hazard to result in an ignition event. If one or the other is prevented, ignition will not occur. (SFPE FRA 6.5.1.3)
U.S. Army vehicle interior head impact protective components and materials	Components and materials which are designed with energy attenuating (absorbing) properties used to prevent potential mounted crew head injuries due to impacts of the mounted crew's head with the U.S. Army vehicle interior during blast, crash and roll-over events.

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Material(s)	The combination of substances (chemical, biological) which create properties unique to the substance combination.
Special Tools	Tools not commonly available or considered commercial-off-the-shelf
Technical Data Package	Documents the geometric and physical properties of the interior head impact protection including all applicable Geometric Dimensioning and Tolerances, specifications and standards.
Test	An element of verification in which scientific principles and procedures are applied to determine the properties or functional capabilities of items.
Vehicle Specific U.S. Army vehicle interior head impact protective components and materials	Energy attenuating components and materials tailored to a unique US Army tracked or wheeled conveyance.
Vehicle Targeting	The process of identifying potential areas of the vehicle interior which may pose a potential risk of head injury to the mounted warfighter.

6.7 Subject term (keyword listing).

Blast  
Crash  
Rollover  
Trim  
Vehicle  
Velocity



## APPENDIX A

## FIRE RESISTANCE

## A.1 SCOPE

A.1.1 Scope. The primary purpose of including fire resistance requirements in this document, are to improve the mounted warfighter's survivability by providing vehicle interior head impact protective components and materials which are less likely to become involved in rapid, high heat fire progression when exposed to flame.

A.1.2 Applicability. This document provides test, evaluation and criteria for the selection of interior U.S. Army military vehicle head impact protective components and materials based upon their resistance to fire conditions which may potentially occur in theater and non-theater situations. Properties which are measured to assess flammability include; ease of ignition (flashing), flame spread progression, heat release rates, toxic gas emissions and smoke density and obscureness. Examples of Type I, II and II interior head impact protective components and materials which shall be considered applicable to this standard include; overhead roof protection, sidewall protection, hatch opening ring edge protection, brackets and equipment fixture. Designers shall exercise due care in understanding of test methods and results in making judgments for component and material selection(s). The test and evaluation methods stated in this document are small-scale reaction-to-fire test methods intended to be used for purposes of design and material selection. These test methods do not necessarily predict the behavior of the components and materials in actual vehicle fire conditions. Subsequently, the requirements stated in this document do not, by itself, incorporate all of the fire-related threats; conditions and safety concerns which may potentially occur based on the specific vehicle design and intended use.

A.1.3 Accurate prediction. Accurate prediction of crew survivability from fires is difficult particularly in military cases because of the complex enemy threats, sources of initiating hazards, the proximity and location of combustible materials which may act as fuel for the initiated fire, and variable thermal environs. Initiating hazards can result in an ignition event which has the potential to cause injury to the mounted warfighter. Initiating hazards, as defined by The Fire Protection Research Foundation; 'Guidance Document for Incorporating Risk Concepts into NFPA Codes and Standards', states. Initiating hazards are hazards that manifest directly or indirectly, an ignition event. An initiating hazard needs to have two conditions to be met; a) an ignition hazard and b) a fuel hazard to result in an ignition event. If one or the other is prevented, ignition will not occur. (SFPE FRA)" (Rose, 2007) Military related ignition hazards defined here as; "Any object that emits sufficient heat to ignite combustibles, based on proximity and ignitability..." (Rose, 2007). These may include; penetration of armor by IED's (Improvised Explosive Devices) at varying levels of explosive force, RPG's (Rocket Propelled Grenade), other propellants, high explosive antitank (HEAT) munitions, kinetic energy rounds, hot spall from the aforementioned explosives, internal combustion engines, heating and air conditioning, electronics and electrical distribution failures, combustible liquids and lubricants, matches and smoking materials etc.

A.1.4 Combustible hazards. Combustible hazards pertain to flammable materials which may ignite as a result of an ignition event from an initiating hazard. FST resistant interior impact protection reduces the potential risk of becoming a combustible hazard source thus reducing or eliminating the potential for injury to the warfighter due to; fire progression, heat, material hot



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liquid melting, dripping and pooling, toxic gases, smoke inhalation and smoke obscuration. Fire extinguishing devices are provided in US military vehicles in the event of flammable materials ignite, allows the mounted warfighter to manage small, slow-growth fires inside the vehicle. There may be some cases however, in which the fire extinguisher becomes inaccessible or the warfighter is disabled. U.S. military vehicles are also equipped with an Automatic Fire Extinguishing Systems (AFES). AFES are intended to extinguish large liquid fuel or fuel vapor initiated fire in the event a fuel tank is compromised and ignites. These systems are the first line of defense protecting the warfighter from fire related injuries. Minimizing or eliminating combustible ignition sources further reduces the risk of fire related injuries to the mounted warfighter and is needed for situations which extend beyond the intended use of the fire extinguishing system or when the fire extinguishing system is inaccessible, delayed or disabled.

A.1.5 Interior head impact protective components and materials. Interior head impact protective components and materials used for U.S. Army military vehicles including the exposed surface, energy attenuating core material, attachment and bonding agents shall be fire resistant and have properties which result in low smoke generation and low toxic gas emissions in accordance with the requirements as stated in this specification. The components and materials shall be selected with the intent to minimize or prevent, potential burn related injuries to the mounted warfighter as a result of combustion of interior head impact protective components and materials related to interior military vehicle fires. Fire resistant components and materials may reduce rapid flame progression, prevent burns due to melting and dripping of heated materials. Therefor the warfighter may be allotted more time to manage exterior threats and interior fires.

**Bibliography**

Rose, S. F. (2007). *Guidance Document for Incorporating Risk Concepts into NFPA Codes and Standards*. Quincy, MA U.S. A: The Fire Protection Research Foundation, Battelle.  
*Standard Test Method for Flame Resistance of Textiles* . ASTM International. ASTM.

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Custodian:  
Army – AT

Preparing activity:  
Army – AT

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