

**INCH-POUND**

**FQ/PD 07-03B  
with changes per  
PM SPE ECP 10-  
0005**

20 August 2010  
SUPERSEDING

**FQ/PD 07-03B**  
13 November 2009

## **PURCHASE DESCRIPTION**

### **PERSONAL ARMOR X SMALL ARMS PROTECTIVE INSERT**

This document is approved for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This purchase description covers an X Small Arms Protective Insert (XSAPI) worn by ground troops. When placed in the Outer Tactical Vest (OTV) / Improved Outer Tactical Vest (OTV / IOTV) pocket of the Interceptor Body Armor (IBA) the insert will provide ballistic protection from specific 5.56 mm and 7.62 mm rounds. The IBA is a system that also provides hand gun and fragmentation protection and includes detachable neck and groin ballistic protection.

1.2 Classification. The inserts shall be of one type and in the following sizes:

X-small, Small, Medium, Large, and X-large (see 6.9)

#### 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this performance requirement. 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 issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see paragraph 6.2).

## SPECIFICATIONS

### FEDERAL

MIL-DTL-32075 - Label: For Clothing, Equipage, and Tentage (General Use).

### DEPARTMENT OF DEFENSE

TOP 10-2-210 - Ballistic Testing of Hard Body Armor Using Clay Backing  
FQ/PD 07-05D - Body Armor, Multiple Threat, Improved  
MIL-STD-662F - V<sub>50</sub> Ballistic Test for Armor (18 DEC 97)  
MIL-STD-810(G) - Environmental Engineering Considerations and Laboratory Tests

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document 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

Program Executive Office – Soldier, US Army, Fort Belvoir

Drawing Numbers:

2-6-0588; Enhanced Small Arms Protective Insert, Size; X-small  
2-6-0589; Enhanced Small Arms Protective Insert, Size; Small  
2-6-0590; Enhanced Small Arms Protective Insert, Size; Medium  
2-6-0591; Enhanced Small Arms Protective Insert, Size; Large  
2-6-0592; Enhanced Small Arms Protective Insert, Size; X-large

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 the documents that are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of the documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME Y14.5M - Dimensioning and Tolerancing (DoD adopted)

(Application for copies should be addressed to the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017-2392).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D-792 - Specific Gravity and Density of Plastics by Displacement  
ASTM D-2563 - Standard Recommended practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts  
ASTM D-2584 - Ignition Loss of Cured reinforced resins  
ASTM D-2863 - Measuring the Minimum Oxygen Concentration to Support Candle Like Combustion of Plastics (Oxygen Index)  
ASTM D-3951 - Standard Practice for Commercial Packaging  
ASTM E29 - Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959).

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 over TOP and TOP takes precedence over MIL-STD-662F. However, for V<sub>50</sub> testing, MIL-STD-662F takes precedence over TOP. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

3.1 First Article. When specified (see paragraph 6.2), samples shall be subjected to first article inspection (see paragraph 6.3) in accordance with paragraph 4.2.1.

3.2 Standard Sample. Standard color samples, when furnished, are solely for guidance and information to the contractor (see paragraph 6.4).

3.3 Construction. The materials selected by the contractor shall be capable of meeting all the performance, operational and environmental requirements specified herein.

3.3.2 XSAPI Cover. Face XSAPI cover materials used to mitigate frontal spall, increase durability and decrease environmental deterioration of the underlying components shall be in a configuration as to cover the entire front and back outer surface and sides. There shall be no visible peeling of the tab formed on the covering to XSAPI joining area.

3.3.3 Assembly of Components by Bonding. There shall be no evidence of under adhered areas or components. No excess bonding agent will smear, clump or be visible on the exposed surfaces of the finished XSAPI.

3.4 Production Data. The following information determined during production shall be made a matter of record and shall be furnished on request to the contracting official. This data shall be identified with the serial number of the body armor.

- a. All weight, thickness and dimensional measurements taken from a sampling.
- b. When requested, material compliance forms signed by the contractor, each sub-contractor or material supplier.
- c. Operational, ownership and environmental test data generated by the contractor on the XSAPI.
- d. Ballistic performance test data generated under all first article, conformance and validation testing as described in paragraph 4.9.
- e. For traceability every XSAPI must be durably marked in such a fashion as to be traceable from production through to the ballistic test records for that lot of XSAPIs. The serial number will be marked on the outside face within 1 inch of the lower edge of the ceramic component before it is fired. It will be marked by inscribing, embossing, or with high temperature resistant inorganic ink or after firing with permanent marking to a maximum depth of 0.010 inch so that the serial number will be legible when the spall cover is stripped mechanically or by the use of a solvent. Solvents, fuels and other liquids shall not affect the serial number markings. It is desirable to have the ceramic cores marked to be traceable by radiographic analysis as well. If inscribed, it will be done on the outer 0.25 inches of the plate.

3.5 Workmanship. The finished XSAPI shall conform to the quality of product established by this performance 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 official.

3.6 Operating Requirements. Each XSAPI will satisfy the following user-oriented requirements (see paragraph 4.6).

3.6.1 Ease of Insertion. The XSAPI shall be able to easily slide into and out of the Body Armor, Multiple Threat; CO/PD 00-02-G, Outer Tactical Vest (OTV); FQ/PD 07-05-D, Improved Outer Tactical Vest (IOTV). No obtrusive or abrasive coverings shall be applied to any of the XSAPI surfaces. No special training, equipment or tools will be required to insert the XSAPI into the carrier pouch (see paragraph 4.6.1).

3.6.2 Weight. The finished XSAPI will not exceed the following weights;

The threshold maximum weights:

- a. X-Small: 4.18 lbs.
- b. Small: 5.23 lbs.
- c. Medium: 6.00 lbs.

- d. Large: 6.88 lbs.
- e. X-Large: 7.81 lbs.

The objective maximum weights:

- a. X-Small: 3.80 lbs.
- b. Small: 4.75 lbs.
- c. Medium: 5.45 lbs.
- d. Large: 6.25 lbs.
- e. X-Large: 7.10 lbs.

3.6.3 Dimensional measurements. The XSAPI shall conform to all measurements, tolerances, radius and edge chamfers cited in drawings from paragraph 2.2.2 (see paragraph 4.6.3 and 4.6.4).

3.6.4 Thickness. The XSAPI in finished form will have uniform thickness throughout. The tolerance of the thickness shall not exceed 1/8 inch between any two measurements (para. 4.6.4).

3.6.5 XSAPI Color. All areas of the XSAPI shall be colored Desert Sand 500 as specified in paragraph 4.6.5.

3.6.6 Labels/markings. (See paragraph 4.6.6)

3.6.6.1 Orientation Labels. Permanent labels or markings shall be placed on the back-face of the XSAPI clearly displaying the “TOP” orientation. Orientation marking will be  $1.25 \pm 0.25$  inches from its respective edge. A permanent label or marking shall be centered on the front of the XSAPI,  $3.0 \pm 0.25$  inches from the top clearly displaying “STRIKE FACE”. All characters will be 0.50 inch height (see Figure A and B below and paragraph 4.6.6).

3.6.6.2 Performance Labels. A permanent label or marking shall be displayed on the back-face clearly displaying “XSAPI ” (next line) “Rev. B” with 0.25 inch height characters. The marking will be displayed on the center of the XSAPI,  $2.5 \pm 0.25$  inches from the top edge (see Figure A and B below and paragraph 4.6.6).

3.6.6.3 Complete XSAPI Markings. The manufacturer’s contract number and nomenclature shall be permanently and legibly marked on the upper mid-center back face. The letters “U.S.” shall be applied  $4.0 \pm 0.25$  inches below the top edge and centered on the XSAPI in characters 1.0 inch high. The size identification of the XSAPI shall be clearly displayed centered on the front surface 1.5 inches below the top edge in all capital characters 0.5 inch high (i.e. MEDIUM). The words “HANDLE WITH CARE” shall be printed in characters 0.5 inch high at  $6.5 \pm 0.25$  inches below the top edge and centered on the front face surface. All markings shall conform to type IV, class 9 of MIL-DTL-32075. The fastness for the class 9 label shall be as specified for class 5 labels. A list in duplicate of the serial numbers used for each XSAPI production lot shall be furnished to the contracting officer at the time of delivery. The front side of the XSAPI shall have a letter height to width ratio of approximately 1:0.75 (see paragraph 4.6.6).

A Unique Identification (UID) label will conform to the specifications below:

Nothing in this document supersedes applicable laws and regulations unless a specific exemption has been obtained. Prior to full rate production, the manufacturer will supply the contracting officer with a sample UID label. The manufacturer is required to comply with the current versions of Military Standard 130 and the Department of Defense Guide to Uniquely Identifying Items, and the following criteria.

1. Color: Label/Tag will be black with white Human Readable and Machine Readable Information (HRI) and (MRI).
2. HRI shall consist of: Commercial and Government Entity (CAGE) code of activity applying the tag/label, Lot Number, Serial Number, Date of Production, National Stock Number (NSN) and Design Code. HRI will meet requirements of the latest version of MIL-STD-130.
3. MRI shall consist of one ECC 200 compliant Data Matrix code containing: CAGE code of activity applying the tag/label, Lot Number, Serial Number, Date of Production, NSN, and Design Code. The tag/label shall comply with the latest version of MIL-STD-130, ANSI MH10.8.2, and Items #4 and #5 below. To prevent automated read errors, the Government will not allow other 1D or 2D codes to be printed on this label. This does not restrict contractor from using other HRI and MRI on labels not associated with the UID label/tag.
4. Data Matrix Construct: The Data Matrix shall be encoded per MIL-STD-130 using only the data identifiers (DI) and criteria shown below. The following DI sequence shall be maintained in the order listed below:

Cage=17V followed by cage code

Lot=1T followed by lot number

Serial number=S followed by serial number

Date of production = 16D followed by production date, YYYYMMDD

National stock number=N followed by the NSN.

Part number = 1P followed by design code (the design code may be up to 13 alpha-numeric characters (plus only dashes "-" as special characters))

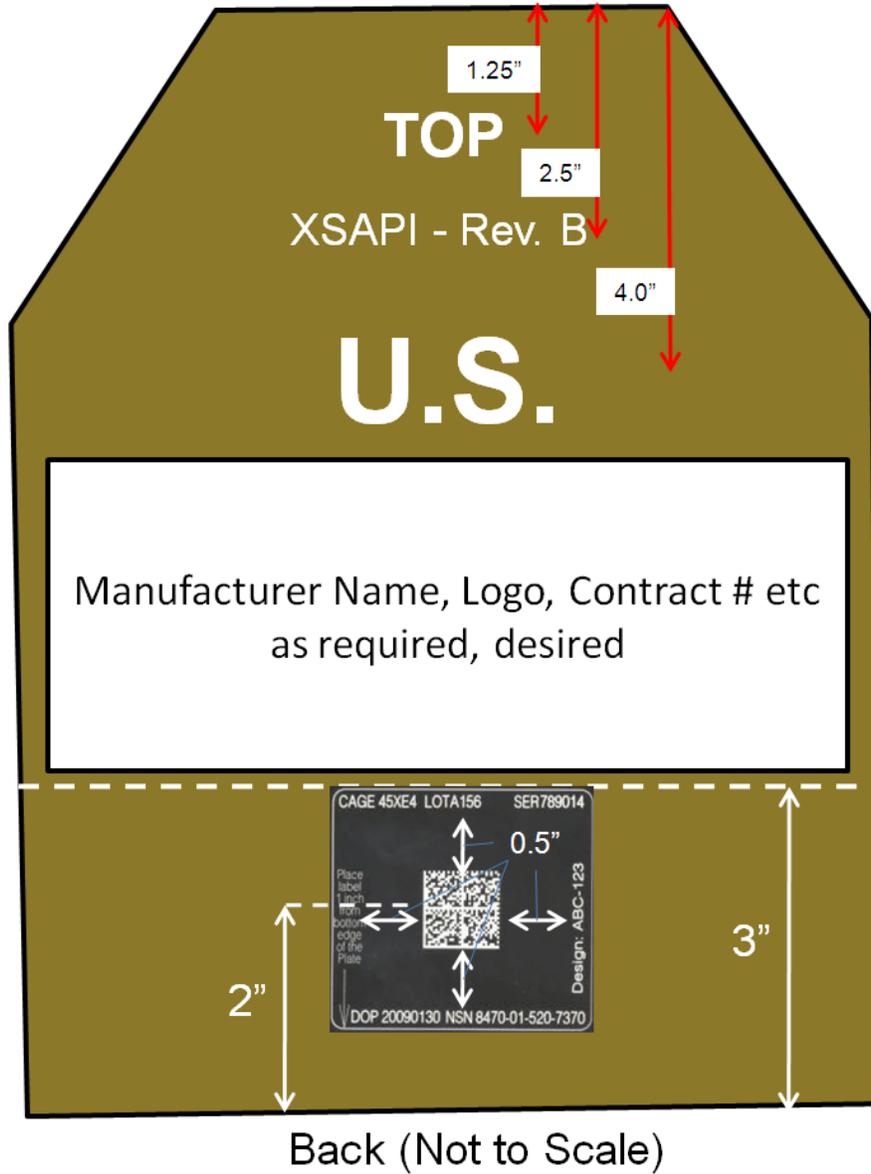
Construct Example:

]>RS06GS17V52969GS1TE034GSS328185GS16D20080215GSN8470-01-520-7370GS1PABC-123RSEOT

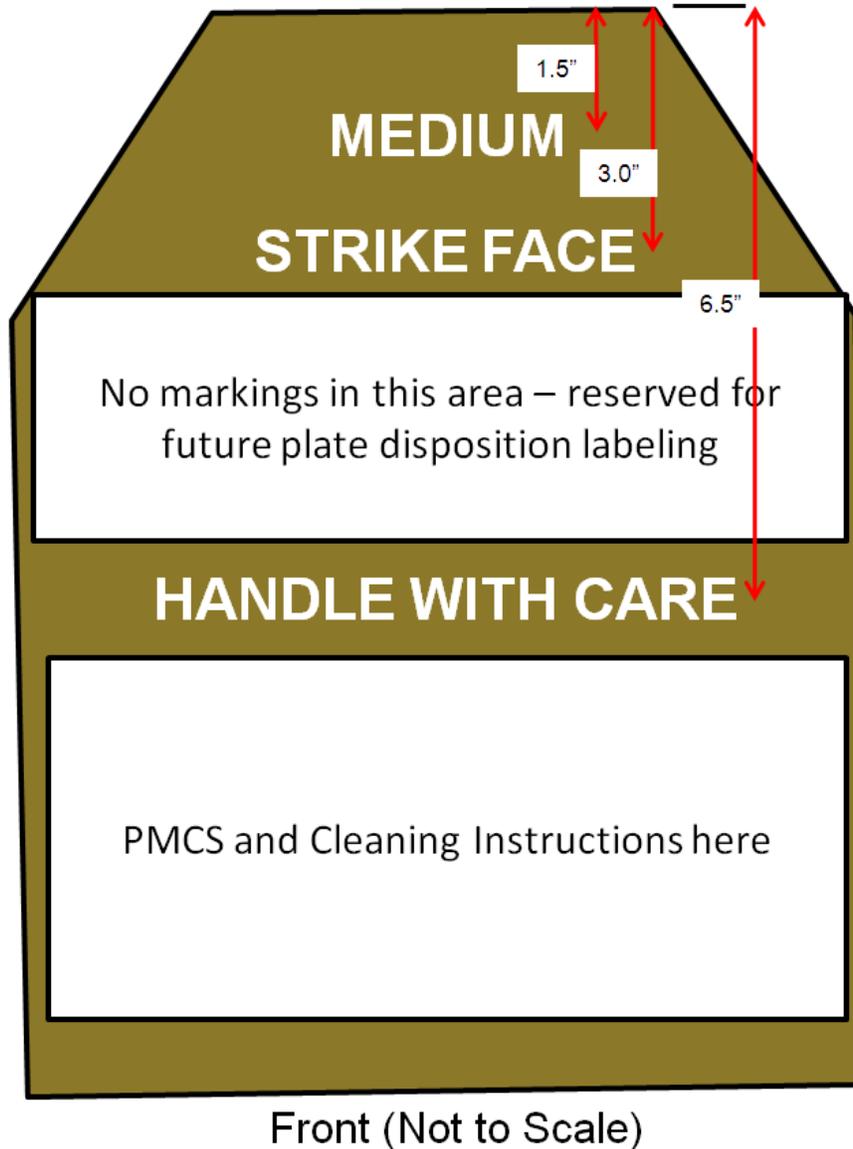
5. Data Matrix Geometry: Data Matrix codes shall be a square ECC200 matrix per ISO 16022. Individual Cell size (element size) of the code shall be between 0.020 and 0.023 inches. A quiet zone of 0.5 inches of Black label/tag material is required around the Data Matrix code.
6. Verification: Data Matrix code quality will be graded to ISO 15415 with a certified verifier and meet a minimum passing grade per the latest release of MIL-STD-130. AS9132 and

AIM DPM grading platforms will not be allowed for this project. Contractor must provide the contracting officer with at least two verification reports per plate size for each lot. If using laminates or overcoats the label must be verified after placing the laminate or overcoat on the label or tag. No exceptions are allowed. Proof of Verification is subject to inspection at the time of shipment.

7. Validation: Validation checks of the UID must be performed on a routine basis. Contractor is responsible for encoding the UID per above guidelines (#4 and 5) and the latest revision of MIL-STD-130. Proof of Validation is subject to inspection at the time of shipment.
8. Placement of the UID label/tag: The center of the Data Matrix code on an x and y axis will hereinafter be referred to as the centerline of the UID label/Tag. The UID label/tag will be placed on the back side (opposite the strike face) of the item. The centerline of the UID label/tag will be left-right centered on the item, positioned 2 inches from the bottom edge. A tolerance of  $\pm 0.25$  inches in each direction will be allowed. The entire plate area within 3.0 inches of the bottom of the plate must be clear of any other labels or markings at all times. Additional non UID information and logos required by this product description must appear above the 3-inch featureless zone. Placement of a sample label is shown below.



**FIGURE A: Back Side Label and UID placement with “quiet zone” distances**



Front (Not to Scale)  
**FIGURE A: Front Side Label Placement**

PMCS and Cleaning instructions, in a font no smaller than Arial size 8, will be printed on a label located as on the above drawing and will read as below:

**Preventative Maintenance Checks and Services (PMCS):** The XSAPI plate is considered to be unserviceable if any of the following conditions are present:

1. Outer Cover is damaged exposing the ceramic tile material
2. Plate is cracked and you hear loose pieces rattling around when shaken
3. Creaking or squeaking of ceramic tile heard when plate twisted by hand
4. Composite backing is delaminating (backing material plies are separating)

5. Cracking of the ceramic tile is felt or heard as you firmly pinch the outer 1/2” perimeter of the plate
6. Plate has been hit by a bullet or fragment

### **Cleaning Procedures**

CAUTION: Do not machine wash or dry. Failure to follow these instructions may degrade your plate’s (XSAPI/ESAPI/ESBI) performance against ballistic threats.

1. Remove loose dirt and lint from the outer surface of the plate using a cloth or soft bristle brush (Never use a stiff bristle brush)
2. Wet the plate in a sink or shower using warm, not hot, water
3. Apply mild detergent to the soiled areas and scrub with a cloth or soft bristle brush. Badly soiled areas may be scrubbed with hand soap. Scrub only long enough to remove soil.
4. Heavy grease/oil stains may be pre-spotted with a dry cleaning solvent and detergent mixture and scrubbed with a soft brush
5. Rinse the plate with warm water until all suds are completely gone
6. Let the insert air dry away from heat or open flame

3.6.7 Health and Safety. The XSAPI will be non-hazardous (non-explosive and have no toxicological or electromagnetic radiation effects) to the individual wearing the XSAPI or troops in the surrounding area (see paragraph 4.6.7).

3.6.7.1 Flammability. Demonstrate that XSAPIs will not combust, explode or drip melted materials when impacted with defined threats or when subjected to elevated temperatures of 250 degrees Fahrenheit for ten (10) minutes (see paragraph 4.6.7.1).

3.6.7.2 Personnel Hazard Inspection. Visually inspect that XSAPIs are free of sharp edges, foreign materials, burrs or any other conditions that may cause an injury to the user. Demonstrate that the XSAPI will not cause injury to the user or surrounding troops when ballistically tested (see paragraph 4.9). Any component of the XSAPI that can cause personnel injury will not be acceptable (see paragraph 4.6.7.2).

3.6.7.3 Magnetic Influence. There shall be no magnetic influence on a compass at any distance from the XSAPI (see paragraph 4.6.7.3).

3.7 Ownership and Support. (See paragraph 4.7)

3.7.1 Durability. The XSAPI will be able to withstand two drops using a moment arm fixture (See Figure 1) at a height of 48.0-inches onto a concrete surface without any detrimental effects to ballistic performance, major surface characteristics or physical properties. A  $10.0 \pm 0.1$  lbs weighted object shall be attached to the rear surface of the XSAPI/shoot pack sample (see paragraph 4.7.1). The weight of the moment arm and straps shall be  $8.5 \pm 0.5$  lbs.

3.8 Operating Environment Requirements. Unless otherwise stated ballistic validation testing will be performed with threat “e” in paragraph 3.9.3. Ballistic performance will not be degraded from exposure to the environmental conditions specified in paragraph 4.8.

3.8.1 Weatherometer Resistance. The finished XSAPI after being subjected to the weatherometer resistance testing shall exhibit no evidence of cracking, blistering, color change, separation of edging (if used) or ballistic degradation (see paragraph 4.8.1).

3.8.2 Temperature extreme. The XSAPI shall be both structurally and ballistically functional within the temperature ranges of  $-55 \pm 5$  degrees to  $+155 \pm 5$  degrees Fahrenheit. (see paragraph 4.8.2).

3.8.3 Fluid Resistance. The XSAPI shall maintain structural and ballistic integrity after contamination with Jet Propellant 8 (JP-8), oil, and immersion in salt water for a period of two (2) hours each at 70 degrees  $\pm$  10 degrees Fahrenheit (see paragraph 4.8.3.).

3.8.4 Altitude. The XSAPI shall meet all performance requirements from sea level to 15,000-foot equivalent pressure altitude. No structural, visible, operational degradation or safety hazard shall occur when the insert is exposed to a pressure change equivalent to a change in altitude from 40,000 to 15,000-feet in 17 minutes (see paragraph 4.8.4).

3.8.5 Fungus. The XSAPI shall neither support fungus growth nor experience damage due to the presence of fungus spores or adjacent fungus growth (see paragraph 4.8.5).

3.8.6 Temperature Shock. The XSAPI shall meet all performance requirements after exposure to temperature changes between the high and low operating temperature extremes within a 5-minute period (see paragraph 4.8.6).

3.9 Performance Requirements. (See paragraph 4.9)

3.9.1 Area of Coverage. The XSAPI will provide uniform materials coverage throughout the entire surface area of the XSAPI. If backing materials are used, the backing materials must extend from edge to edge to provide uniform thickness throughout the entire surface area of the XSAPI. The XSAPI shall have uniform areal density throughout the entire surface area. “Patches”, “clamps”, materials with partial coverage of the XSAPI surface area shall not be acceptable. Any cuts with open gap and/or slits on any materials used in XSAPI are not allowed.

3.9.2 Required  $V_{50}$  Ballistic Limit. The XSAPI will yield the minimum  $V_{50}$  ballistic limit measurements at 0-degree obliquity with the specified test projectiles as per Appendix A. The classified threat code to specific threat round correlation chart and other details are provided in a classified enclosure separately provided to those vendors with proper security clearances and facility clearance through DSS.

3.9.3  $V_0$  Ballistic Resistance. The XSAPI, when tested in conjunction with the simulant (see paragraph 6.10) will provide ballistic resistance as specified as below and in Appendix A.

The classified threat code to specific threat round correlation chart and other details are provided in a classified enclosure separately provided to those vendors with proper security clearances and facility clearance through DSS.

3.9.4 Back Face Deformation. The XSAPI back face deformation shall be tested in accordance with and meet the requirements of paragraph 4.9.2, 4.9.9.3 and 4.9.9.4.

3.9.5 Spall, Debris and Residual Penetrator. The XSAPI will be designed to mitigate injury to the wearer or surrounding individuals from frontal spall, penetrator and/or armor debris ejecta when tested against the required threats (see paragraph 4.9.9.5).

#### 4. VERIFICATION

4.1 Verification Alternatives. Alternative test methods, techniques or equipment including the application of cost effective sampling procedures may be proposed by the contractor. Acceptable alternative verification approaches shall be identified in the contract or amended into the contract.

4.2 Classification of Testing. The testing requirements specified herein are categorized as First Article Testing (FAT) and Lot Acceptance Testing (LAT) as specified in Table I.

4.2.1 First Article Testing (FAT). Unless otherwise specified in the contract or purchase order, the XSAPI supplier is responsible for all FATs and LATs herein. The government reserves the right to perform any of the tests set forth in this specification where such tests are deemed necessary to ensure supplies and services conform to prescribed requirements. When a FAT is required, it includes all of the verifications listed in paragraphs 4.6, 4.7, 4.8, and 4.9 (see Table I) unless otherwise specified in the contract.

4.2.2 Lot Acceptance Testing (LAT). LAT of XSAPI shall include those examinations and tests from paragraphs 4.6, 4.7, 4.8 and 4.9 as defined in the contract or by the procuring activity (see paragraph 6.2). See Table I, "Requirements and Verifications" for requirements and frequencies of inspection.

4.2.3 First Article Testing (FAT) and Lot Acceptance Testing (LAT).

**Table I. Requirements and Verifications**

<b>CHARACTERISTICS</b>	<b>REQUIREMENT PARAGRAPH</b>	<b>VERIFICATION PARAGRAPH</b>	<b>First Article Testing (FAT)</b>	<b>Lot Acceptance Testing (LAT)</b>
<b>Operating Requirements</b>	<b>3.6</b>	<b>4.6</b>		
Ease of Insertion	3.6.1	4.6.1	X	X**
Weight	3.6.2	4.6.3	X	X**
Dimensional measurements	3.6.3	4.6.4	X	X**
Thickness	3.6.4	4.6.5	X	X**
XSAPI Color	3.6.5	4.6.6	X	CoC
<b>Labels/markings</b>	<b>3.6.</b>	<b>4.6.7</b>		
Orientation Labels	3.6.6.1	4.6.7	X	X**
Performance Labels	3.6.6.2	4.6.7	X	X**
Complete Insert Markings	3.6.6.3	4.6.7	X	X**
<b>Health and Safety</b>	<b>3.6.7</b>	<b>4.6.8</b>		
Flammability	3.6.7.1	4.6.8.1	X	CoC
Personnel Hazard	3.6.7.2	4.6.8.2	X	CoC
Magnetic Influence	3.6.7.3	4.6.8.3	X	X**
<b>Ownership and Support</b>	<b>3.7</b>	<b>4.7</b>		
Durability	3.7.1	4.7.1	X	NA
<b>Operating Environment Requirements</b>	<b>3.8</b>	<b>4.8</b>		
Weatherometer Resistance	3.8.1	4.8.1	X	NA
Temperature extreme	3.8.2	4.8.2	X	NA
Fluid Resistance	3.8.3	4.8.3	X	NA
Altitude	3.8.4	4.8.4	X	NA
Fungus	3.8.5	4.8.5	CoC***	NA
Temperature Shock	3.8.6	4.8.6	X	NA
<b>Performance Requirements</b>	<b>3.9</b>	<b>4.9</b>		
Area of Coverage	3.9.1	4.9	X	NA
Req. V <sub>50</sub> Ballistic Limit	3.9.2	4.9	X	NA
V <sub>0</sub> Ballistic Resistance	3.9.3	4.9	X	X
Transient (Back-face) Deformation	3.9.4	4.9	X	X
Spall, Debris and Residual Penetrator	3.9.5	4.9	X*	NA

Notes:

- X - testing required
- CoC - certificate of conformance to include data
- \* - government reference
- \*\* - test or inspection to be performed at vendor facility
- \*\*\* - the government may elect to perform testing at their discretion
- NA - not applicable

4.3 Order of Testing. Performing the various testing (operating, ownership & support, operating environment, and performance) can occur in any order.

4.4 Verification Methods. The types of verification methods included in this section are visual inspection, dimensional measurements, sample tests, component properties analysis and similarity to previously approved or previously qualified designs.

4.4.1 Verification Using Standard Samples. Use standard samples to verify colors with visual inspections.

4.5 Responsibility for Compliance. Production items shall meet all requirements specified in section 3. The supplier shall establish and maintain documented procedures for inspection and testing activities in order to verify that the specified requirements for the product are met. The required inspection, testing and the records to be established shall be detailed in a quality plan available to the government as specified in the contract or procuring activity. The inspection set forth in this specification shall become part of the contractor's overall inspection procedures or quality system. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection as part of the 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.

4.6 Operating Requirements. Complete each test in this paragraph.

4.6.1 Insertion. One barehanded person shall demonstrate insertion of the XSAPI into the OTV or IOTV front or back pocket without tools or special aids. Perform insertion into government furnished carrier in a maximum of 30 seconds.

4.6.2 Weight. Take physical weight measurements of all XSAPI s to ensure that weights do not exceed those presented in paragraph 3.6.2. The finished XSAPI s shall be weighed to the nearest 0.01 pound.

4.6.3 End Item Dimensions. Take physical measurements of all XSAPI to show that all measurements conform to dimensions and tolerances in Drawings (Para. 2.2.2). Two length and two width measurements shall be made and conform to the tolerances specified in the drawings. The measurements specified herein shall be made for each XSAPI. The length measurements should be taken at the two chamfered edges. The first width measurement shall be no further than 1.0 inches away from the bottom edge. The second width measurement shall be no closer than 7.0 inches from the first measurement location.

4.6.4 Thickness. Measure thickness in seven locations, approximately near the center (at least 3.5 inches from any edges) and near each of the six corners (1/4 to 1 inch from the edge) with a deep throat micrometer and record to the nearest 0.01 inch. (see paragraph 2.2.2 and paragraph 3.6.4).

4.6.5 XSAPI Color. Visually inspect the XSAPIs for similarity to the standard sample color of Desert Sand 500 as specified by the contract.

4.6.6 Instruction labels. Visually inspect for legible, permanent labels on the front and back face surfaces. Visually inspect that labels contain written instructions and/or orientation directions.

4.6.7. Health and safety. Complete the verifications in this paragraph.

4.6.7.1 Flammability. Observe that the XSAPI does not melt, drip, combust or explode when impacted in ballistic testing. Ballistic testing at the elevated temperature is reserved for first article testing when required.

4.6.7.2 Personnel Hazard. Visually inspect that the items are free of conditions that will cause potential injury to the user. All the material comprising the end item shall be examined by the Government to assess non-explosive, toxicological, and electromagnetic radiation effects. The Contractor shall provide Material Safety Data Sheets (MSDS) to the Government for all materials comprising the end item.

4.6.7.3 Magnetic Influence. The XSAPI shall be tested for magnetic influence using magnetic and lensatic compasses. The XSAPI shall not cause any deviation of the compass needle.

4.7 Ownership and Support Requirements. Perform the verification in this paragraph.

4.7.1 Durability. Demonstrate durability by performing drop test analysis. Attach XSAPI/shoot pack with a strap, belt or other non-obstructive retaining device to the front surface of a  $10.0 \pm 0.1$  lb. weighted object. The weight of the moment arm and straps shall be  $8.5 \text{ lbs} \pm 0.5 \text{ lbs}$ . The weighted object (clay is a recommended material) will be contoured to the back XSAPI/shoot pack surface. The shoot pack, as described in paragraph 6.10, shall be placed in between the XSAPI and weighted object. A fixture similar to that in Figure 1 has shown to provide accurate and reproducible results and should be securely mounted to the floor. At a minimum, the drop height shall be 48.0 inch. (90 degrees from horizontal) (16 ft/sec) from the flat hardened surface (stiffness of at least  $3 \times 10^6$  psi and a mass much greater than the moving components (e.g. concrete slab)) and with the XSAPI strike face pointing down, drop the weighted fixture two (2) times. Impacts will occur as near as possible to the center of the XSAPI face (not an edge). A radiographic image of the XSAPI will be inspected to identify any cracks, delaminations or indentations on the XSAPI surface. Perform ballistic testing in accordance with paragraph 3.9.3 for threat "e". The first test shot will be taken at the most severely damaged area of the XSAPI specimen as identified by the x-ray image. If no damage is visible the first shot will be taken at the impact site of the test. The second test shot will be located at least 1.5 inches from any edge surface and 5.0 to 6.0 inches from the first impact.

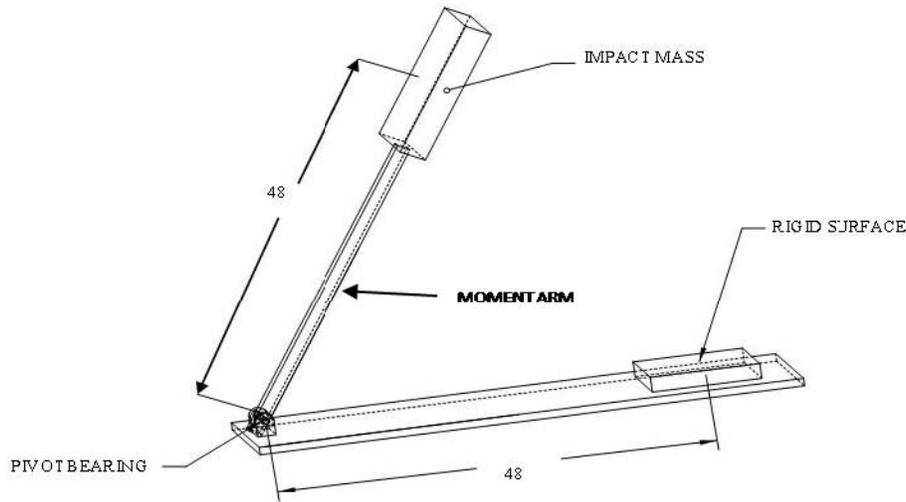


Figure 1. Proposed Durability Apparatus

**4.8 Operating Environment Requirements.** Perform each verification in this paragraph then perform ballistic testing in accordance with paragraph 3.9.3 for threat “e”. The number of tests required for this demonstration will be specified in the contract as a pre production item.

**4.8.1 Weatherometer Resistance.** The XSAPI shall be tested for weather resistance in accordance with AATCC Test Method #169 with the following modifications. Upon completion of the test, the XSAPI shall be visually examined and failure to meet any of the requirements in paragraph 3.8 shall constitute a test failure.

Modifications to AATCC Test Method # 169:

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.

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.

The irradiance level shall be  $0.55 \pm 0.01$  watts/square meter/nanometer (W/sq.m/nm) bandpass at 340 nanometers.

The glass filter combination shall be quartz inner filter and a borosilicate type “S” outer filter.

The relative humidity shall be  $50 \pm 5$  percent during the light cycle and not lower than 95 percent during the dark cycle.

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%+RH)	10°C (50%RH)
* As a guide only; adjust to achieve required relatively humidity		

The test specimens (XSAPI) 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.

After the XSAPI have been tested in the weatherometer and after passing visual examination tests, the XSAPI shall be tested to establish a  $V_0$  ballistic resistance against threat e at 0 degree obliquity within  $24 \pm 0.50$  hours after removal from the weatherometer. Testing shall be conducted in accordance with paragraph 3.9.3 for  $V_0$ .

**4.8.2 Temperature Extreme.** The finished XSAPI shall be heated in an oven operating at  $155 \pm 5$  degrees Fahrenheit for a minimum of 6 hours (Ref. MIL-STD-810G). Pre-conditioning and post-conditioning radiographic images shall be taken of the XSAPI samples. The test specimen shall then be ballistically tested in accordance to with paragraph 3.9.3 for threat e. Subject XSAPI (different to those subjected to high temperatures) to cold exposure at minus (-)  $55 \pm 5$  degrees Fahrenheit for minimum 6 hours then ballistically test in accordance with paragraph 3.9.3 for threat e. After each exposure XSAPI will be examined for evidence of delamination, component separation, blistering or any other visual defects. The ballistic tests shall be completed within 30 minutes after each exposure.

**4.8.3 Fluid Resistance.** Conduct this test at fluid and ambient temperatures between 60 - 80 degrees Fahrenheit. Contaminate XSAPI in one of the following containers of fluid. At least one XSAPI will be subjected to contamination to each of the three fluids; 30 weight lubricating oil of commercial grade SE or better, commercial grade JP-8 and salt water. For lubricating oil and JP-8, place the XSAPI face down in a pan filled with 0.50-inch of fluid for two hours with a 20 (Twenty) pound weighted object on top of the XSAPI. For salt-water contamination test, submerge the XSAPI in a container for a minimum of 2 hours. XSAPIs shall be held vertically to drip dry for 5 minutes. Pre-conditioning and post-conditioning digital radiographs shall be taken of the XSAPI samples. The test specimen shall be ballistically tested in accordance with paragraph 3.9.3 for threat "e" within 30 minutes after each exposure.

**4.8.4 Altitude Test.** Place the XSAPI in an ambient air pressure chamber to simulate a 40,000-foot altitude. The air pressure then shall be changed to simulate a 15,000-foot altitude. When

the air pressure reaches the simulated 15,000-foot level, a complete visual inspection will be performed. The change rate of the ambient air pressure is 1,500 to 2,000 ft/min. The test specimen shall be ballistically tested in accordance with paragraph 3.9.3 for threat “e”.

4.8.5 Fungus Test. Verification of compliance with the fungus requirement will be performed through the use of certified materials and coupon sampling. A fungus test may be performed on all non-certified materials at the discretion of the government. The results of those tests will be for government reference. Tests will be performed in accordance with Method 508.4 of MIL-STD-810G. A sample of each non-certified material will be placed in the fungus test chamber for 28 days. No ballistic tests are required. The amount of fungus growth should support a grade of 2.5 or less, as specified in MIL-STD-810G.

4.8.6 Temperature Shock. Tests will be performed in accordance with method 503.3 of MIL-STD-810G using +120 and -25 degree Fahrenheit for the extreme temperatures. Pre-conditioning and post conditioning digital radiographs shall be taken of the XSAPI samples. The test item will be stabilized at the appropriate temperature for a minimum of two hours before cycling to the other temperatures. The test specimen shall be ballistically tested in accordance with paragraph 3.9.3 for threat “e”.

4.9 Performance Requirements. Complete each test in this paragraph.

4.9.1 Ballistic Test Criteria. For all  $V_{50}$  BL and  $V_0$  acceptance tests the following minimum information is required by the government to validate performance:

1. Armor description including, thickness, sizes, weights of all component and areal density of XSAPI system and design code.
2. Test projectile threat code, weight and reference weight.
3. Temperature and humidity measurements.
4. Yaw angle.
5. Angles of target obliquity.
6. All velocity measurements of each test shot used to test the XSAPI (regardless of whether that particular velocity was used in the  $V_{50}$  or  $V_0$  determination). Ensure proper drag table for each threat is used to calculate impact velocity.
7. PP (Partial Penetration; with shoot pack ply count as applicable) and CP (Complete Penetration) next to each shot velocity as determined.
8. Back Face Deformation measurements in mm with significant digits recorded only to the accuracy of the measuring device.
9. Spall/debris ejection count (when required).
10. Name of organization/company performing tests.
11. Type of gun barrel, caliber, propellant type, propellant weight, twist rate, and gun barrel serial number.
12. Calculated  $V_{50}$  BL. In a situation where the  $V_{50}$  BL or  $V_0$  data sheet would compromise the Security Classified Guide for Armor Materials, the data sheet should exclude the specific projectile used during testing.
13. Shoot pack weight and total ply count.
14. Clay drop temperatures, locations, depth, and clay box number.

15. Remarks or Notes for all testing anomalies, unfair hits, etc.
16. All shot locations.
17. Revision #/level of all ballistic test software used by test lab (i.e. FARO software including smoothing function, etc)

4.9.2 Projectile Velocity Determination. Projectile velocity measurements methods that utilize either contact screens or radar will be used. Contact screen methods that employ either high velocity lumiline screens or electrical contact screens activated by a passing projectile opening or closing a circuit are preferred. An electric counter type chronograph calibrated to microseconds, will also be used in conjunction with the contact screen method. Doppler radar capable of accurately measuring the projectile striking and residual velocities can also be used. Personnel conducting ballistic testing should be properly trained in velocity measurement determination using the Doppler radar equipment. Radiographic equipment calibrated to capture the projectile at calibrated time intervals of flight may also be used.

4.9.3 Weapon Mounting Configuration. 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. Spacing between triggering devices is a function of the expected velocity of the projectile being fired. In many instances, physical restriction, such as short overall distance from muzzle to test sample dictates the spacing of the triggering devices. The last pair of triggering devices shall be placed at least four (4) ft (122 cm) in front of the test sample and should be protected from possible damage resulting from fragments.

4.9.4 Environmental Test Conditions. All ballistic tests shall be performed in a standard atmosphere of  $68 \pm 10$  degree Fahrenheit and  $50 \pm 20\%$  relative humidity. Temperature and humidity measurements shall be recorded before the beginning of days test firings and a minimum of every two hours thereafter.

4.9.5 Projectile Yaw. Projectile yaw shall be measured for each firing by yaw cards, flash radiograph or photography. Any round for which yaw is determined to be greater than 3.0 degrees shall be disregarded in the calculation of the ballistic limit. The measurement system employed should be capable of measuring yaw within an accuracy of 1.0 degree.

4.9.6 V<sub>50</sub> BL. See Appendix A.

4.9.7 PP and CP for V<sub>50</sub>. Complete and partial penetrations will be determined based on the definitions provided in paragraph 6.6.

4.9.8 V<sub>50</sub> Test Sample Mounting. Unless otherwise stated the following conditions shall be performed during V<sub>50</sub> testing. The XSAPI shall be secured to the clay-mounting block with the impact side perpendicular to the line-of-flight of the projectile. Testing will be performed in accordance with MIL-STD-662F except partial and complete penetrations will be determined based on definitions provided in paragraph 6.6.

4.9.9 Ballistic  $V_0$  Testing. Ballistic  $V_0$  testing of XSAPI shall be conducted on a recurring basis per paragraph 3.9.3 and procedures specified in the contract (see paragraph 6.2).

4.9.9.1  $V_0$  Determination for Acceptance. For  $V_0$ , the minimum velocities as stated in Appendix A will be the requirement.

4.9.9.2 Impact Location. See Appendix A.

4.9.9.3 Back Face Deformation (BFD) Measurement.

The back of the XSAPI test specimen will be attached to a block of non-hardening, oil-based molding clay so that no movement of the test samples occurs before, during or after the ballistic event. The clay material fixture shall be in the form of a single block at least 5.5 inches thick and 24 x 24 inches in length and height with 0.75 inch plywood backing. The clay shall be conditioned for at least 3.0 hours and worked thoroughly to remove any voids. A new clay conditioned block shall be used for each XSAPI sample. The clays consistency shall be such that depression of  $25 \pm 3$ mm in depth is obtained when a  $1 \text{ kg} \pm 10 \text{ gm}$  ( $2.2 \text{ lb} \pm 0.35 \text{ oz}$ ) cylindrical steel mass,  $44.5 \pm 0.5 \text{ mm}$  ( $1.75 \pm 0.02 \text{ in}$ ) in diameter and having a hemispherical striking end, is dropped from a height of  $2 \text{ m} \pm 2 \text{ cm}$  ( $6.56 \text{ ft} \pm 0.8\text{-in}$ ) onto one of its square faces. During the three drop tests for each block, the center of each impact location shall be at least 76 mm (3 in) from a previous impact site and from any edge. A guide tube or other means may be used as required to assure that the striking end of the cylindrical mass impacts the backing material squarely at the desired location. The depressions will be measured with an instrument capable of  $\pm 0.1$ mm accuracy. The calibration drop indentations will be filled with temperature conditioned clay prior to conduct of the  $V_0$  test shots.

Before ballistic testing the clay material will be contoured to the back face curvature provided by the XSAPI. This buildup will use additional clay backing material conditioned in the same manner as the clay material fixture. Both the soft fragmentation protection and XSAPI will be strapped or taped to the curved surface of the clay material. Back face deformations in the clay will not exceed 43.0 mm max, without incurring penalty points, (Paragraph 3.9.4) when measured from the original undisturbed surface of the backing material to the lowest point of the depression. All BFD measurements will be conducted at 0 degree obliquity only. Indentation measurements will utilize laser scanner measurement instruments, which provide a means to accurately establish the difference between the original undisturbed clay surface and the deepest point of BFD signature. The perpendicular distance between the original surface and the deepest point of depression, with reference to the original surface, will be measured after impact. Back face deformation will be the difference between the two measurements. Deformations will be recorded in mm to the nearest tenth digit following standard ASTM E29 “Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications” (“Five-even” rule)(Rounding Method) (i.e.  $43.050 = 43.0$ ,  $43.051 = 43.1$  and  $47.950 = 48.0$ ).

The laser scanner measurement instruments must be certified by ATEC and use a software package capable of meeting the following requirements:

- Uniform sample: 0.5mm
- Wrap with Auto Noise Reduction

- Clean function w/ smooth option
- Fill holes (curvature based hole filling)
- Remove intersecting triangles
- Remove spikes at 10%
- 3D Compare to find deepest point

The software package must be able to remove and fill cracks in the clay if the deepest point falls within a crack with an area  $< 0.7 \text{ mm} \times 0.7 \text{ mm}$ .

4.9.9.4 Test Sample Mounting. The framed clay block shall be rigidly fixtured in a manner which will resist, without movement, the anticipated force of the ballistic impacts. The XSAPI test sample shall be secured in the vertical position, perpendicular to the projectile line of flight. The frame supports must be capable of retaining the sample and withstanding shock resulting from ballistic impact by threat “e” and “x” on the test sample. The test sample mounting shall be capable of adjustment for moving the sample in the vertical or horizontal positions so that the point of impact can be located anywhere on the sample and rotation on the vertical axis so that zero degree and thirty degree obliquity impacts can be achieved anywhere on the sample. Mark intended shot locations on the actual plate. For LAT only, small “windows” may be cut in the shoot pack front Cordura cover to expose the aim points marked on the actual plate.

4.9.9.5 Spall, Debris and Residual Penetrator. Witness sheets for determining potential injuries to the wearer will be mounted around the front, sides, top and bottom of the XSAPI test sample. The witness inserts shall be a 2024-T3 or 2024-T4 aluminum alloy sheet, 0.020-inch thick and approximately 12.0 x 12.0 inches size. The witness sheets should be assembled into a box configuration with the open ended side placed within 0.50 inch from the front of the XSAPI sample. The front sheet will be place 12.0 to 14.0 inches away from the front of the XSAPI sample. A hole at least 3.0-inches diameter will be made in the front sheet to allow for undisturbed passage of the projectile. The XSAPI will be placed in the carrier or a representative carrier fabricated with the same material before spall testing. The projectile impact point should be no closer than 6.0 and no further than 7.0 inches from any witness sheet surface. The witness sheet box shall be repositioned after each shot. Perforations in the surrounding witness sheets will be counted and documented. The only spall perforations counted will be those closer to the XSAPI specimen than the lines created by a 60 degree angle as measured from perpendicular to the point of impact to the witness sheet box. A perforation is any crack or hole which permits light passage when a 60 watt, 110 volt bulb is placed behind the witness panel. The spall count will be recorded for Government reference.

## 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's 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 body armor XSAPI is intended for use by ground combat troops. The XSAPI when inserted into the fragment protective vest carrier will provide protection from certain small arms fire. The XSAPI is part of a protective system, which includes a soft fragmentation and handgun tactical vest. The XSAPI shall be used in conjunction with the soft under garment as a total armor ensemble.

6.2 Acquisition Requirements. Acquisition documents must specify the following:

- a. Title, number and date of this specification and amendments.
- b. Special provisions for verification inspection of equipment (see paragraph 1.1).
- c. Issue of DODISS to be cited in the solicitation and if required the specific issue of individual documents (see paragraph 2.3).
- d. When first article is required (see paragraphs 3.1, 4.2.1 and 6.3).
- e. Packaging requirements (see paragraph 5.1).
- f. Contractually approved ballistic packages / design code to include package name, complete description, and FAT acceptance letter.
- g. FAT and LAT testing requirements.

6.3 First article. When a first article is required, it shall be inspected and approved under the appropriate provisions of FAR 52.209. 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 also include specific instructions in acquisition documents regarding arrangements for selection, inspection, and approval of the first article.

6.4 Standard Color Samples. Standard color samples are available from the contracting officer.

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

6.6 Definitions. The following definitions are provided to assist in understanding the test procedures;

Over-Velocity. Striking velocity that is higher than the specified threat requirement.

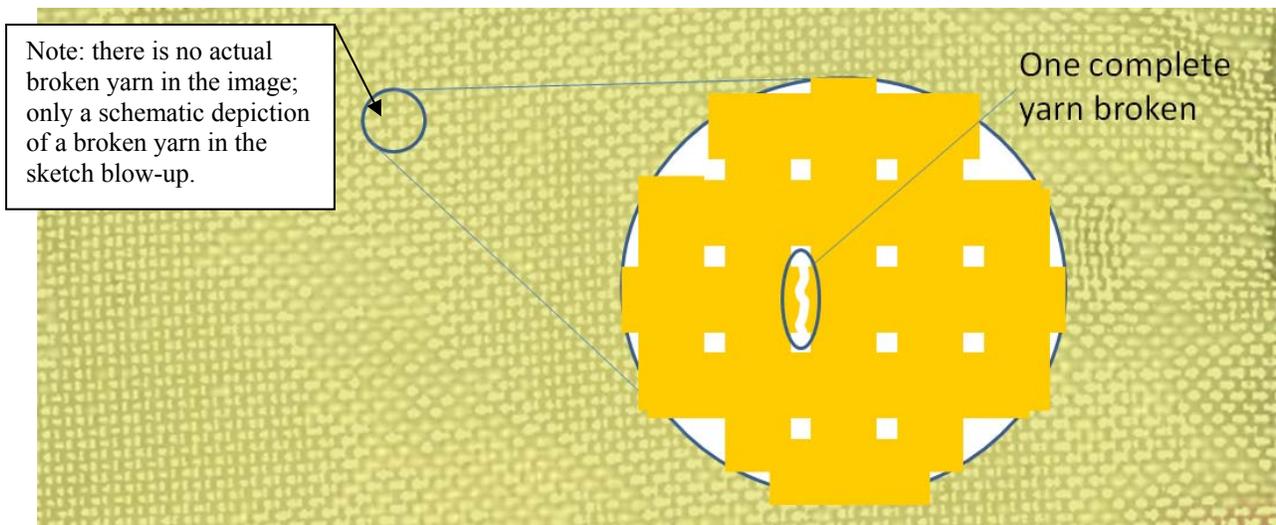
Under-Velocity. Striking velocity that is lower than the specified threat requirement.

Fair Impact. Impact of an unyawed bullet of the specified bullet type, velocity and obliquity ( $\pm 3$  degrees) except an impact which violates shot spacing or edge distance (see Appendix A) shall be an unfair impact.

Complete Penetration (CP) for  $V_{50}$  Testing. A complete penetration occurs when the impacting projectile or any fragment thereof, or any fragment of the test specimen perforates the rear surface of the XSAPI.

Complete Penetration (CP) for  $V_0$  Testing. There are two categories: a “Plate complete” in which the armor plate is completely penetrated and a “System complete” in which the entire body armor system is completely penetrated (armor plate and carrier/shoot pack).

1. Complete penetrations of the plate will have occurred when the projectile, fragment of the projectile or fragment of the armor material penetrates the entire plate and is imbedded or passes into the soft under garment used behind the XSAPI, resulting in the penetration of the first ply of the soft armor component at the impact point (minimum of one complete yarn broken of the first ply – see below schematic). Paint or fibrous material that are emitted from the back of the test specimen and rests on the outer surface of the under garment are not considered complete penetrations.



2. Complete penetrations of the system will have occurred when the projectile, any fragment of the projectile or any fragment of the test specimen penetrates the entire plate and all plies of the shoot pack and is imbedded or passes into the clay backing used behind the armor plate and carrier/shoot pack.

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

Areal Density (AD). A measure of the weight of the armor per unit area, usually expressed in pounds per square foot ( $\text{lb}/\text{ft}^2$ ) or kilograms per square meter ( $\text{kg}/\text{m}^2$ ) of surface area.

Obliquity. Angle, in degree, between the line-of-flight of the bullet and a line normal to the surface of the armor. A projectile's line-of-flight which is perpendicular to the surface of the armor strikes at zero (0) degrees of obliquity.

Spall. Fragmentation of the bullet or target material which is projected from the impact surface or rear surface of the target.

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.

V<sub>50</sub> Ballistic Limit (BL). In general, the velocity at which the probability of penetration of an armor material is 50 percent.

6.7 Government Loaned Property. Contact the contracting official for the loan of the property listed in paragraph 3.6.1.

6.8 Drawings and Materials. See Paragraph 2.

6.9 National Stock Numbers.

X-SMALL	8470-01-547-9555
SMALL	8470-01-547-9722
MEDIUM	8470-01-547-9726
LARGE	8470-01-547-9779
X-LARGE	8470-01-547-9780

6.10 Simulant/Surrogate Shoot Pack. A Simulant/Surrogate Shoot Pack system of fielded body armor may be used to represent the ballistic resistant materials of the OTV or IOTV (see CO/PD 00-02G, FQ/PD 07-05D). The surrogate shoot pack system will consist of (1) a ballistic filler packet specified by the contract and (2) a ballistic filler carrier with XSAPI pocket. The baseline ballistic filler packet will be 15 x 15 inches in size consisting of an approved ballistic shoot pack package. The ballistic packet will be stitched diagonally across the 4 corners with a 5-inch line of 50 TEX Aramid thread at 5 to 10 stitches per inch. The ballistic filler carrier will have an XSAPI pocket capable of holding the largest XSAPI stitched on the face fabric. Both the face fabric and the pocket cover will consist of 500 denier 7.5 oz. / sq. yd. solid green or black colored, urethane back coated, textured nylon, Cordura. The XSAPI pocket will be stitched on three sides to the face fabric with nylon or polyester thread. The top edge of the pocket will have a minimum of 5 inches of not less than 0.5 inch wide hook and loop fastener centered and stitched at the top. The ballistic filler carrier back cover will consist of 500 denier, solid green or black colored, 7.5 oz. / sq. yd. urethane back coated, textured nylon, Cordura. The front and back filler carrier covers will be stitched together on 3 sides with nylon or polyester thread to form a pocket to hold the ballistic filler packet. The fourth side will remain unstitched but will have a minimum of 5 inches of not less than 0.5 inch hook and loop fastener centered and stitched to the top.

## Appendix A

### V<sub>50</sub> Ballistic Limit Measurements

V<sub>50</sub> ballistic limit testing of XSAPIs shall be conducted on a recurring basis per paragraph 3.9.2 and 4.9 of FQ/PD and procedures specified in the contract (see paragraph 6.2) and MIL-STD-662. The XSAPI will yield the minimum V<sub>50</sub> ballistic limit measurements at 0 degree obliquity with the specified test projectiles as listed in Table 1 below for the 1<sup>st</sup> shot on the XSAPI. The 2<sup>nd</sup> and 3<sup>rd</sup> shots will yield separate V<sub>50</sub> ballistic limit measurements at 0-degree obliquity with the specified test projectiles as listed in Table 1 below for government reference. The suggested starting velocities for the 2<sup>nd</sup> and 3<sup>rd</sup> shot V<sub>50</sub> ballistic limit measurements will be those listed in Table 1.

Ballistic limit measurements will be performed on the actual XSAPI (three (3) shots maximum per XSAPI in accordance with MIL-STD-662F). However each shot number (1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> shot) on the XSAPI will be part of a separate V<sub>50</sub> ballistic limit measurement set. Shot spacing should be no closer than 1.0-inch from an edge and each subsequent shot shall be spaced at least 5.0-inches from any previous shot. Second and third shots should be placed in an area unaffected by any previous shot. The V<sub>50</sub> will be determined when tested in conjunction with the simulant (see paragraph 6.10). Complete penetrations occur when the impacting projectile or any fragment thereof, or any fragment of the test specimen perforates the rear surface of the XSAPI. Partial penetrations occur for any fair impact where a complete penetration does not occur (see paragraph 4.9 and 6.6).

V<sub>50</sub> Calculation: The arithmetic mean of three (3) Partial Penetration (PP's) and three (3) Complete Penetrations (CP's) within a 125 ft/sec velocity spread or four (4) Partial Penetration (PP's) and four (4) Complete Penetrations (CP's) within a 150 ft/sec velocity spread yield the minimum allowable V<sub>50</sub> BL determination that will be accepted as reliable test results. If 6 partial penetrations occur that are above the minimum V<sub>50</sub>, the plate demonstrates a V<sub>50</sub> above the minimum, the plate passes, and that V<sub>50</sub> test is terminated. All shots velocities and their average are recorded (this is not, however, the official V<sub>50</sub>).

### V<sub>0</sub> Ballistic Resistance

Ballistic V<sub>0</sub> testing of XSAPI shall be conducted on a recurring basis per paragraph 3.9.3 and 4.9.9 and procedures specified in the contract (see paragraph 6.2). For V<sub>0</sub>, the minimum velocities as in Table 1 below will be the requirement. The ballistic V<sub>0</sub> testing of XSAPI shall have a minimum of 3 impacts (2 impacts at 0 degree obliquity and 1 impact at 30 degree obliquity). The first two shots must be fired at 0 degree obliquity and the third shot at 30 degrees obliquity (for e, x, and y threats).

Shot spacing shall have the first fair hit impact (0 degrees obliquity) will be between 0.75 to 1.25 inches for threat a, b, f, and y, and 1.00 to 1.50 inches for threat e and x, from any edge. For threats e, x and y the second impact at zero degrees obliquity (see Figure A-1) will be 5.0-6.0 inches from the first impact location and located at the ballistically weakest point of the insert (e.g. triple point or seam, if any). For threats a, b, and f the second impact at zero degrees

obliquity (see Figure A-1) will be 3.0-6.0 in. from the first impact location and located at the ballistically weakest point of the insert (e.g. triple point or seam, if any). The distance between second and all subsequent shots will be between 3.0 – 4.0 inches for threats a, b and f (see Figure A-2) and 5.0–6.0 inches for threats e, x and y (see Figure A-1). All shots after the first shot must be a minimum of 1.5 inches from any edge. Back face deformation measurements, per paragraph 3.9.4 and 4.9.9.3, will only be taken for shots taken at 0 degrees obliquity.

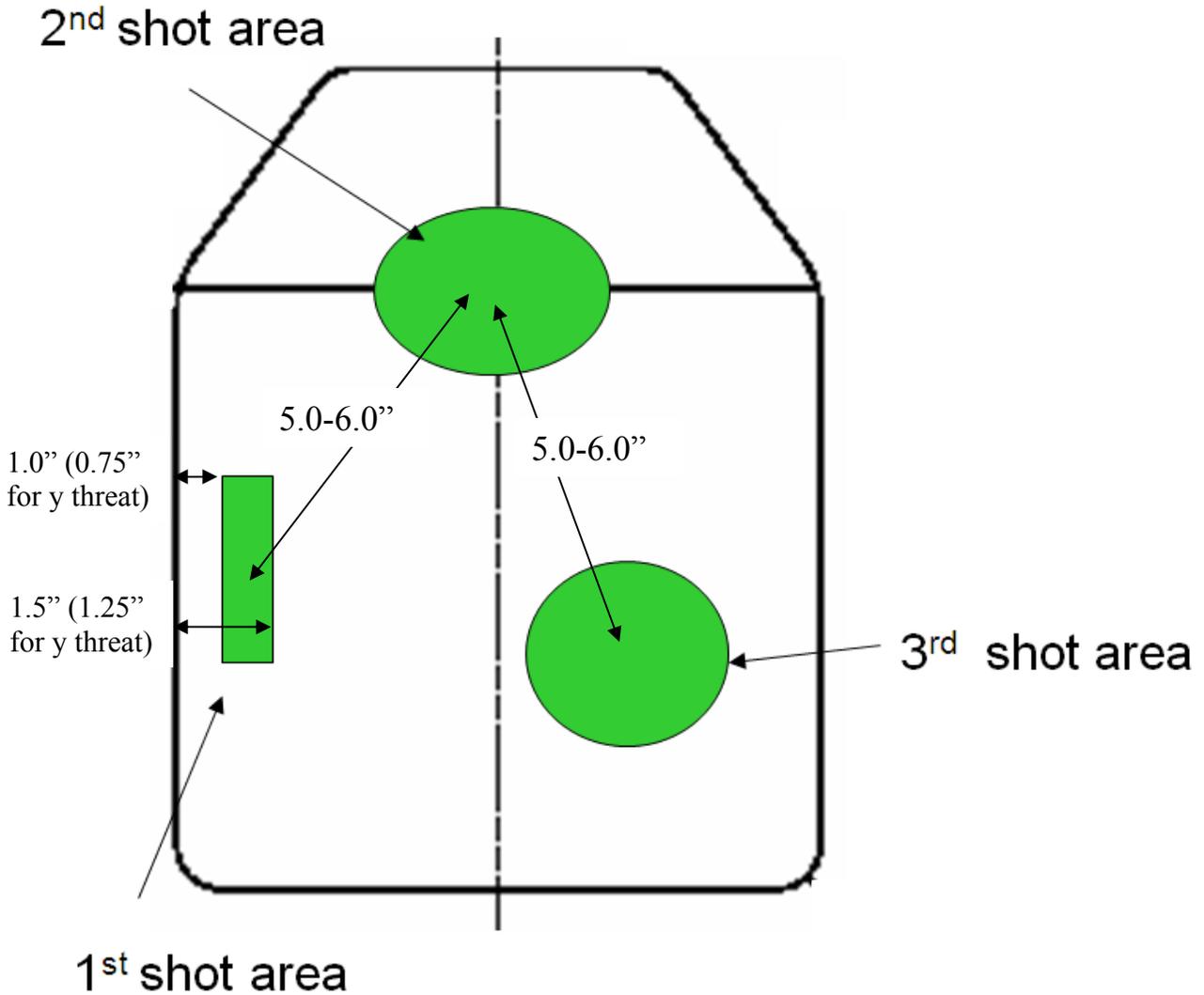


Figure A-1: Shot pattern for threats e, x and y

Figure above: General  $V_{50}$  and  $V_0$  testing shot patterns for uniform material design (other patterns IAW the shot spacing requirements above are possible at the discretion of the government – i.e. mirror image opposite the vertical centerline).

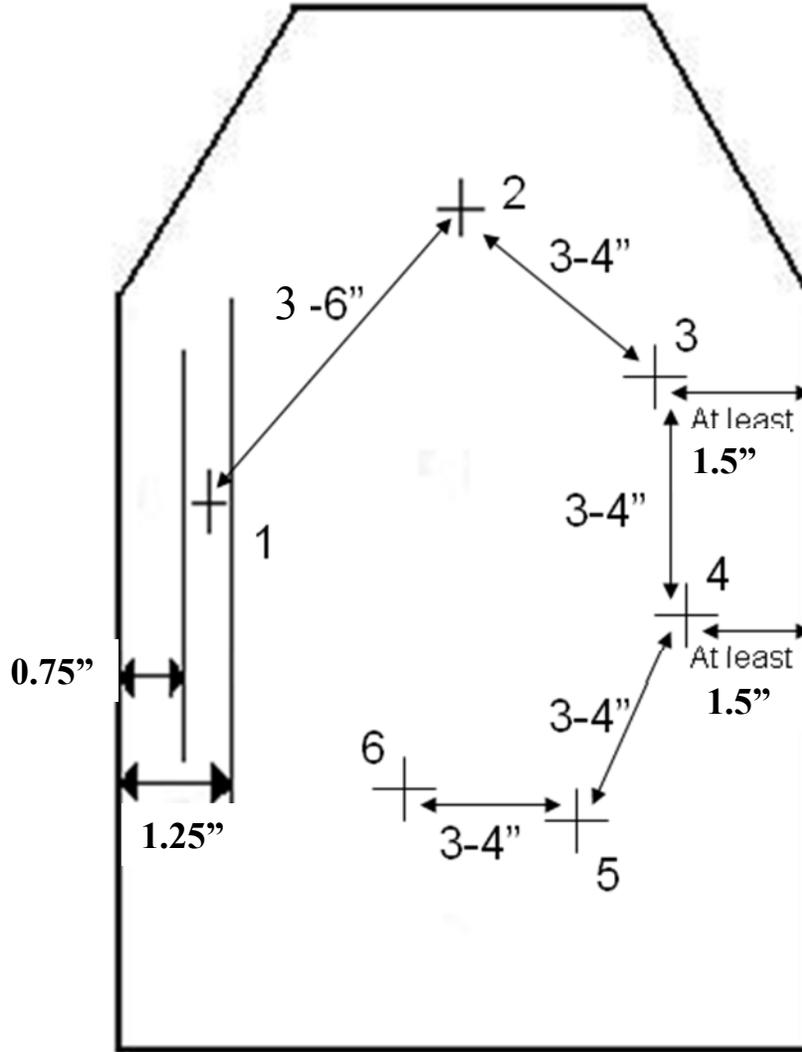


Figure A-2: Shot pattern for threats a, b and f

Complete and partial penetrations for  $V_0$  testing – see 6.6 for complete definitions.

Ballistic test results will be scored per FAT Protocol (Appendix B) and LAT Protocol (Appendix C) for each shot on the XSAPI.

**Table 1: Threat Codes, Descriptions, and Required Velocities**

Threat Code	*V <sub>50</sub> Minimum 1 <sup>st</sup> Shot Required Velocity (ft/s)	V <sub>0</sub> Required Velocity and Tolerance (ft/s)	Shots (V <sub>0</sub> )	Obliquity (V <sub>0</sub> )
<b>a</b>		2,750 +50	6	1-5 0 degree 6 <sup>th</sup> 30 degree
<b>b</b>		2,750 +50	6	1-5 0 degree 6 <sup>th</sup> 30 degree
<b>f</b>		2,400 +50	6	1-5 0 degree 6 <sup>th</sup> 30 degree
<b>d</b>	3,000			
<b>e</b>		2,700 +50	3 (3 <sup>rd</sup> Government ref.)	1-2 0 degree 3 <sup>rd</sup> 30 degree
<b>x</b>	3,200	3,050 +50	3 (3 <sup>rd</sup> Government ref.)	1-2 0 degree 3 <sup>rd</sup> 30 degree
<b>y</b>		3,350 +50	3	1-2 0 degree 3 <sup>rd</sup> 30 degree

\* V<sub>50</sub> 1<sup>st</sup> shot, 2<sup>nd</sup> and 3<sup>rd</sup> shot velocities are for government reference only.  
 - Suggested starting velocities for d threat 2<sup>nd</sup> and 3<sup>rd</sup> shot respectively: 3000, 3300  
 - Suggested starting velocities for x threat 2<sup>nd</sup> and 3<sup>rd</sup> shot respectively: 3100, 3200

**Appendix B**

First Article Test (FAT) Protocol – XSAPI – FQ/PD 07-03

TEST	Threat a V <sub>0</sub> 2750+50	Threat b V <sub>0</sub> 2750+50	Threat f V <sub>0</sub> 2400+50	Threat d V <sub>50</sub> only 3000	Threat e V <sub>0</sub> 2700+50	Threat x V <sub>0</sub> 3050+50	Threat y V <sub>0</sub> 3350+50	# of Items
Ambient V <sub>50</sub>	NA	NA	NA	(3000) 3S, 3M, 3L, 1XL		(3200) 3XS, 3S, 3M, 1 XL	NA	20
Ambient V <sub>0</sub>	1 XL	1 L	1 L		1 L	4XS, 4S, 5M, 5L, 4XL	1XS, 1M,1XL	29
Impacted V <sub>0</sub>	NA	NA	NA		1 M	NA	NA	1
Oil Soak V <sub>0</sub>	NA	NA	NA		1 S	NA	NA	1
JP-8 V <sub>0</sub>	NA	NA	NA		1 XL	NA	NA	1
Saltwater V <sub>0</sub>	NA	NA	NA		1 L	NA	NA	1
Weathered V <sub>0</sub>	NA	NA	NA		1 XS	NA	NA	1
Altitude V <sub>0</sub>	NA	NA	NA		1 L	NA	NA	1
High Temp V <sub>0</sub>	NA	NA	NA		1 XL	NA	NA	1
Low Temp V <sub>0</sub>	NA	NA	NA		1 S	NA	NA	1
Temp shock, V <sub>0</sub>	NA	NA	NA		1 M	NA	NA	1

The Contractor shall provide a total of **93 FAT samples** to the Government for First Article Testing as indicated below:

58 samples: First Article Testing

25 samples (five of each size): FAT contingency / spares

5 samples (one of each size): Government record (DCMA)

5 samples (one of each size): Government record (PM SPE/TMD)

**93 FAT Samples**

X-small: 16  
Small: 19  
Medium: 21  
Large: 20  
X-large: 17

Government samples will be retained as the manufacturing standard. Upon satisfactory completion of FAT, all FAT samples will be returned to the Contractor – except Government record plates.

Pass/Fail criteria:

- (1) One or more Catastrophic Failures on all threats  $V_0$  testing constitutes FAT failure.
- (2) One or more  $V_{50}$  testing Failures on all threats constitutes FAT failure.
- (3) A Limited Failure rate higher than 16.0 points constitutes FAT failure.

Definitions ( $V_0$  testing):

Limited Failure for threat a, b, f, and y:

- Complete penetration of hard armor (XSAPI) and partial penetration of soft armor (IOTV or shoot pack) on any shots, count as 1.0 point
- Back face deformation  $>43.0$  mm, but  $< 48.0$  mm on any shots, count as 1.0 point

Catastrophic Failure for threat a, b, f and y:

- Complete penetration of both hard armor (XSAPI) and soft armor (shoot pack) on any shots
- Back face deformation  $\geq 48.0$  mm on first three shots

Limited Failure for threat e and x:

- Complete penetration of hard armor (XSAPI) and partial penetration of soft armor (IOTV or shoot pack) on 1<sup>st</sup> shot, count as 1.0 point
- Complete penetration on both hard armor (XSAPI) and soft armor (IOTV or shoot pack) on 2<sup>nd</sup> shot – count as 1.5 points
- Back face deformation  $> 43.0$  mm, but  $< 48.0$  mm on 1<sup>st</sup> shot, count as 1.0 point
- Back face deformation  $> 43.0$  mm on 2<sup>nd</sup> shot, count as 1.0 point

Catastrophic Failure for threat e and x:

- Complete penetration of both hard armor (XSAPI) and soft armor (IOTV or shoot pack) on 1<sup>st</sup> shot
- Back face deformation  $\geq 48.0$  mm on 1<sup>st</sup> shot



## Appendix C

### XSAPI Lot Acceptance Test (LAT) Protocol – FQ/PD 07-03

#### **LAT REQUIREMENTS**

Lot size	Sampling	Threat e	Threat x
		V0, 2700 +50	V0, 3050 +50
26-150	3	2	1
151- 1200	5	3	2
1201-3200	8	4	4
> 3200	13	7	6

The contractor shall provide 3 contingency plates in addition to the plates above for each LAT.

#### **DEFINITIONS**

##### Penalty Points for threat e and x:

- Complete penetration of hard armor (XSAPI) and partial penetration of soft armor (IOTV or shoot pack) on 1<sup>st</sup> shot, count as 1.0 point
- Complete penetration on both hard armor (XSAPI) and soft armor (IOTV or shoot pack) on 2<sup>nd</sup> shot – count as 1.5 points
- Back face deformation > 43.0 mm, but < 48.0 mm on 1<sup>st</sup> shot, count as 1.0 point
- Back face deformation > 43.0 mm on 2<sup>nd</sup> shot, count as 1.0 point

##### Catastrophic Failure for threat e and x:

- Complete penetration of both hard armor (XSAPI) and soft armor (IOTV or shoot pack) on 1<sup>st</sup> shot
- Back face deformation  $\geq$  48.0 mm on 1<sup>st</sup> shot

### **LAT ACCEPTANCE / ADDITIONAL TEST / REJECTION CRITERIA**

Sample size	Number of Penalty Points		
	Lot acceptance	Additional Test	Lot rejection
3	$\leq 1.5$	2.0 – 4.5	> 4.5
5	$\leq 3.0$	3.5 – 7.5	> 7.5
8	$\leq 4.5$	5.0 – 12.0	> 12.0

- All LAT Testing shall be 3-shot, V0 Testing of each insert – 3<sup>rd</sup> shot (30 degree obliquity) is for government reference only
- If one or more catastrophic failures (deformations AND penetrations) occur during LAT Testing the lot shall be rejected
- If the total number of Penalty points (deformations AND penetrations) which occur during LAT Testing exceeds the maximum allowable, penalty points, the lot shall be rejected
- If the total number of penalty points (deformations AND penetrations) which occur during LAT Testing is greater than that allowable for lot acceptance, but less than the maximum allowable for Additional Test, the lot shall not be accepted, but shall be eligible for Additional Test
- If the total number of penalty points (deformation AND penetrations) which occur during LAT testing does not exceed that allowable for acceptance, the lot shall be accepted.

**ADDITIONAL TEST REQUIREMENTS**

Original sample size – LAT test (1)	Additional samples – Additional test (2)	Total Max possible points	Max allowed limited failure (3)
3	5	28.0	<b>4.5</b>
5	8	45.5	<b>7.5</b>
8	13	73.5	<b>12.0</b>
(1) All additional tests shall be 3-shot, V0 testing – 3 <sup>rd</sup> shot (30 degree obliquity) is for government reference only (2) Use LAT LOT Test Requirements table for threat e and x testing distribution (3) Maximum allowable of LAT Lot Test or cumulative total of LAT Lot Test AND Additional Test			

The contractor shall provide 3 contingency plates in addition to the additional test samples for each LAT.

**ADDITIONAL TEST ACCEPTANCE/REJECTION CRITERIA**

- All Additional Tests shall be 3-shot, V0 tests of each insert. 3<sup>rd</sup> shot (30 degree obliquity) is for government reference only
- If one or more catastrophic failures (deformations AND penetrations) occur during Additional Tests the lot shall be rejected
- If the total number of penalty points (deformations AND penetrations) which occur during LAT AND ADDITIONAL TESTING exceeds the maximum allowable penalty points the lot shall be rejected
- If the total number of penalty points (deformations AND penetrations) which occur during LAT AND ADDITIONAL TESTING does not exceed the maximum allowable penalty points the lot shall be accepted

**SUBMISSION, REVIEW, ACCEPTANCE/REJECTION OF LOT TESTS**

- All lot test samples that are selected by the onsite DCMA QAR will be sent by the DCMA QAR to the third party testing facility using DD Form 1222, Request For and Results Of Tests.
- Upon completion of the required ballistic testing, the results will be provided to the vendor and to COTR and their designated representatives for review and approval/rejection IAW the above criteria. No production lot will be released for shipment by the vendor until approval by the COTR or their representative is accomplished.
- The approval, additional testing requirement, or rejection of each lot will be provided to the DCMA QAR, who will take the appropriate action.

Government reserves the right to change/modify this XSAPI LAT protocol in accordance to FQ/PD 07-03.

## Appendix D V<sub>0</sub> Test Contingency Matrix

			Shot 1								
Velocity →			Over	Over	Over	Fair	Fair	Fair	Under	Under	Under
	↓	Result	Catastrophic	Penalty Pts	No Penalty Pts	Catastrophic	Penalty Pts	No Penalty Pts	Catastrophic	Penalty Pts	No Penalty Pts
Shot 2	Over	Penalty Pts	1	1	1	2, 4	2, 6	2, 3	2, 4	2, 6	1
	Over	No Penalty Pts	1	1	1	2, 4	2, 4	2, 4	2, 4	2, 5	1
	Fair	Penalty Pts	1	1	1	2, 4	2, 4	2, 4	2, 4	2, 5	1
	Fair	No Penalty Pts	1	1	1	2, 4	2, 4	2, 4	2, 4	2, 5	1
	Under	Penalty Pts	1	1	1	2, 4	2, 5	2, 5	2, 4	2, 5	1
	Under	No Penalty Pts	1	1	1	2, 4	2, 5	2, 5	2, 4	2, 5	1

Notes:

- 1 no second shot; re-test on new plate
- 2 continue second shot
- 3 wait until end of testing and tally total points - if vendor fails, re-test; if vendor passes then no need to re-test
- 4 data valid
- 5 shoot second plate & compare total penalty points with first plate - pick plate with most penalty points or catastrophic
- 6 shoot second plate and add points; only consider 1st shot points on first plate, compare 1<sup>st</sup> plate to 2<sup>nd</sup> plate total penalty points - pick plate with most penalty points or catastrophic

NO TESTS:

- If the “edge strip” is impacted (indicating a shot too close to the edge), the plate will be a “No test” (rationale – the plate can only pass)
- If the 2<sup>nd</sup> shot is not within the specified shot spacing the plate will be a “No test” (rationale – the plate can only pass)
- NO BFD Reading, then measure with another FARO arm; data is still valid.
- Shoot pack sticking – if silicon spray is used, remove immediately afterwards (scrape surface clay and dispose of).