INCH-POUND
AR/PD 10-03 A
20 August 2010
SUPERSEDING
AR/PD 10-03
11 July 2010

PURCHASE DESCRIPTION

PERSONAL ARMOR
X-SIDE BALLISTIC INSERT (XSBI)

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 the X - Side Ballistic Insert (XSBI) worn by ground troops. When placed in the Outer Tactical Vest (OTV) (w/ add-on carriers) / Improved Outer Tactical Vest (OTV / IOTV) (as a component of the Interceptor Body Armor (IBA) system) the insert will provide ballistic protection from specific 5.56 mm and 7.62 mm rifle rounds.

1.2 Classification. The inserts shall be of one size (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 in sections 2.2 or 2.3.

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_{50} Ballistic Test for Armor (18 DEC 97)
MIL-STD-810 (G)	- Environmental Engineering Considerations and Laboratory Tests
MIL-STD-130	-DoD Standard Practice – Identification Marking of US Military Property

(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

Drawing Numbers:

2-6-270: Enhanced Side Ballistic Insert (XSBI has identical dimensions)

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 (see paragraph 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).

AMERICAN NATIONAL STANDARD/AMERICAN SOCIETY FOR QUALITY (ANSI/ASQ)

ANSI/ASQ Z1.4-2008 – Sampling Procedures and Tables for Inspection by Attributes

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_{50} 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 and testing (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 XSBI Cover. XSBI 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. The cover, including all edges, shall be free of cuts, holes, tears, abraded areas, wrinkles, or creases. There should be no visible peeling of the cover before or after any operating environment conditioning.

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 XSBI.

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. Data generated during inspection or other protocols per quality system/quality validation plan. This includes, but is not limited to, weight, thickness and dimensional measurements.

b. Supplier lot information and traceability for all component parts identified in the technical data package. This shall include 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 XSBI.

d. Ballistic performance test data generated under all first article, conformance and validation testing as described in paragraph 4.9.

e. For traceability, every XSBI must be durably marked in such a fashion as to be traceable from production through to the ballistic test records for that lot of XSBIs. 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 XSBI 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 XSBI will satisfy the following user-oriented requirements (see paragraph 4.6).

3.6.1 Ease of Insertion. The XSBI shall be able to easily slide into and out of the Improved Outer Tactical Vest (IOTV) (FQ/PD 07-05). No obtrusive or abrasive coverings shall be applied to any of the XSBI surfaces. No special training, equipment or tools will be required to insert the XSBI into the carrier pouch (see paragraph 4.6.1).

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

The ***threshold*** maximum weight:

XSBI (one size): 3.0 lbs.

The ***objective*** maximum weight (ESBI weight):

XSBI (one size): 2.55 lbs.

3.6.3 Dimensional measurements. The XSBI shall conform to all measurements, tolerances, radii, and rounds cited in drawings from paragraph 2.2.2 (see paragraph 4.6.3 and 4.6.4).

3.6.4 Thickness. The XSBI 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 XSBI Color. All areas of the XSBI 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. A permanent label or marking shall be centered on the front of the XSBI, 4.0 ± 0.25 inches from the top clearly displaying "STRIKE FACE". All characters will be 0.50 inch height (see Figure 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 "XSBI " with 0.25 inch height characters. The marking will be displayed on the center of the XSBI, 1.25 ± 0.25 inches from the top edge (see Figure A below and paragraph 4.6.6).

3.6.6.3 Complete XSBI Markings. The manufacturer's contract number and nomenclature shall be permanently and legibly marked on the upper mid-center back face of the XSBI. The letters "U.S." shall be applied 2.0 ± 0.25inches below the top edge and centered on the XSBI in characters 1.0 inch high. The words "HANDLE WITH CARE" shall be printed in characters 0.5 inch high at 6.5 ± 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 XSBI production lot shall be furnished to the contracting officer at the time of delivery. The front side of the XSBI shall have a letter height to width ratio of approximately 1:0.75 (see Figures 1 and 2 below and paragraph 4.6.6).

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

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 FAT and LAT. 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 2.0 inches from the bottom edge. A tolerance of ± 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.

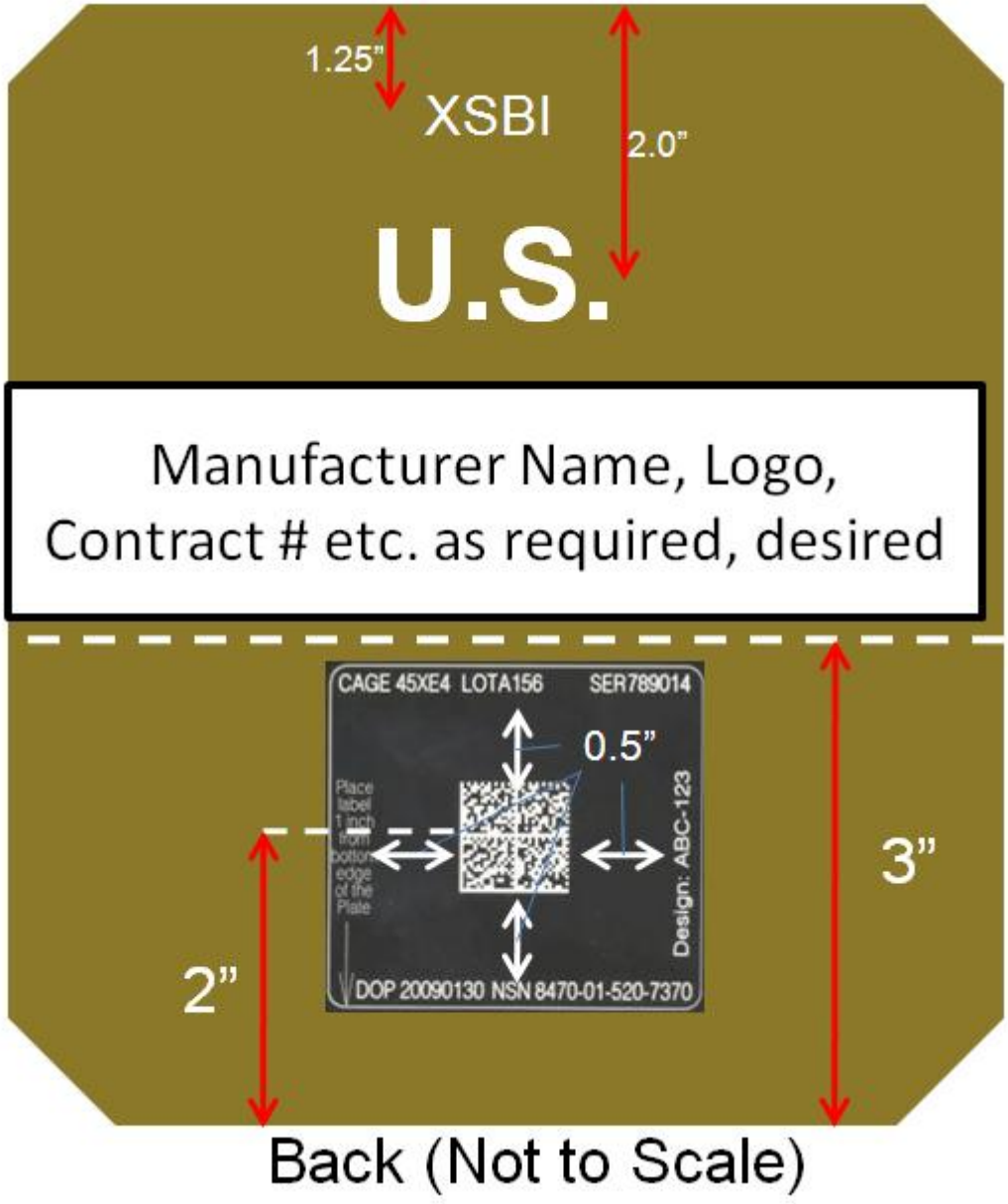


FIGURE 1: Back Side Label and UID placement with "quiet zone" distances

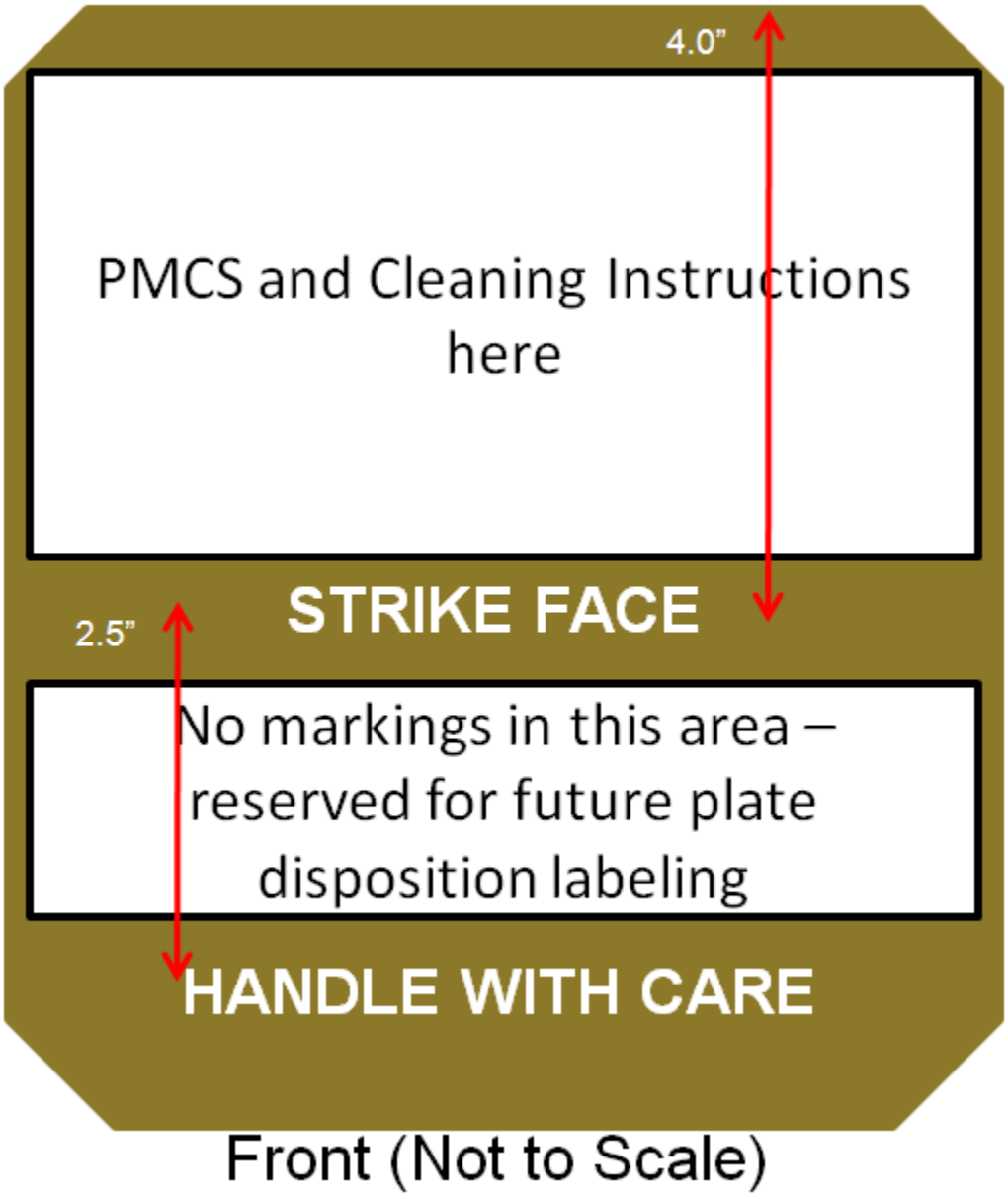


FIGURE 2: Front Side Label Placement

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: Again, 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.

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

1. Outer Cover is damaged exposing the ceramic tile material ("100 MPH" or duct tape can be used for field-expedient repairs)
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 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 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 XSBI will be non-hazardous (non-explosive and have no toxicological or electromagnetic radiation effects) to the individual wearing the XSBI or troops in the surrounding area (see paragraph 4.6.7).

3.6.7.1 Flammability. Demonstrate that XSBIs 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 XSBIs are free of sharp edges, foreign materials, burrs or any other conditions that may cause an injury to the user. Demonstrate that the XSBI will not cause injury to the user or surrounding troops when ballistically tested (see paragraph 4.9). Any component of the XSBI 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 XSBI (see paragraph 4.6.7.3).

3.7 Ownership and Support. (See paragraph 4.7)

3.7.1 Durability. The XSBI will be able to withstand two drops from a free fall height of 48.0±0.5 inches (from the strike face) onto a concrete surface without any detrimental effects to ballistic performance, major surface characteristics or physical properties (see paragraph 4.7.1).

3.8 Operating Environment Requirements. Unless otherwise stated ballistic validation testing will be performed with threats "e" and "x" in paragraph 3.9.3. Ballistic performance will not be degraded from exposure to the environmental conditions specified in paragraph 4.8. Spall cover shall maintain conformance to paragraph 3.3.2 even after exposure to environmental conditions.

3.8.1 Weatherometer Resistance. The finished XSBI 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 XSBI shall be both structurally and ballistically functional within the temperature ranges of –55 ± 5 degrees to +155 ± 5 degrees Fahrenheit. (see paragraph 4.8.2).

3.8.3 Fluid Resistance. The XSBI 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 (+15 min) each at 70 ± 10 degrees Fahrenheit (see paragraph 4.8.3.).

3.8.4 Altitude. The XSBI shall meet all performance requirements from sea level to 15,000-feet 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 at a rate of 1500-2000 ft/min (see paragraph 4.8.4).

3.8.5 Fungus. The XSBI 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 XSBI 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 XSBI will provide uniform materials coverage throughout the entire surface area of the XSBI. 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 XSBI. The XSBI shall have uniform areal density throughout the entire surface area. "Patches" (material that only covers a portion of the area of coverage), "clamps" (holding the material together), or materials with partial coverage of the XSBI surface area shall not be acceptable. Any cuts with open gaps and/or slits on any materials are not allowed. The government has the option to reject plates with certain imperfections visible in radiographic images (x-rays).

3.9.2 Required V_{50} Ballistic Limit. The XSBI 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 the Defense Security Service (DSS).

3.9.3 V_0 Ballistic Resistance. The XSBI, when tested in conjunction with the simulant (see paragraph 6.10), will provide ballistic resistance as specified 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 XSBI back face deformation shall be tested in accordance with and meet the requirements of paragraph 4.9.9.2, 4.9.9.3, 4.9.9.3.1 and 4.9.9.4.

3.9.5 Spall, Debris and Residual Penetrator. The XSBI 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 XSBI 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 XSBI shall include those applicable examinations and tests from paragraphs 4.6 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

CHARACTERISTICS	REQUIREMENT PARAGRAPH	VERIFICATION PARAGRAPH	First Article Testing (FAT)	Lot Acceptance Testing (LAT)
Operating Requirements	**3.6**	**4.6**		
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**
XSBI Color	3.6.5	4.6.6	X	CoC
Labels/markings	**3.6.**	**4.6.7**		
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**
Health and Safety	**3.6.7**	**4.6.8**		
Flammability	3.6.7.1	4.6.7.1	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**
Ownership and Support	**3.7**	**4.7**		
Durability	3.7.1	4.7.1	X	NA
Operating Environment Requirements	**3.8**	**4.8**		
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
Performance Requirements	**3.9**	**4.9**		
Area of Coverage	3.9.1	4.9	X	NA
Req. V_{50} Ballistic Limit	3.9.2	4.9	X	NA
V_0 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 XSBI into the IOTV side plate 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 XSBI s to ensure that weights do not exceed those presented in paragraph 3.6.2. The finished XSBIs shall be weighed to the nearest 0.01 pound.

4.6.3 End Item Dimensions. Take physical measurements of all XSBI 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 to confirm the plate meets the tolerances specified in the drawings. The measurements specified herein shall be made for each XSBI. Length and width measurements shall be taken at the edges of the two chamfers (or rounds).

4.6.4 Thickness. Measure thickness in five locations, approximately near the center (at least 3.25 inches from any edge) and near each of the four corners (1/4 to 1 inch from the edge) with a deep throat micrometer and/or dial caliper and record to the nearest 0.01 inch. (see paragraph 2.2.2 and paragraph 3.6.4).

4.6.5 XSBI Color. Visually inspect the XSBIs 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 XSBI does not melt, drip, combust or explode when impacted in ballistic testing (para. 3.6.7.1). 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 XSBI shall be tested for magnetic influence using magnetic and lensatic compasses. The XSBI 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. At a height of 48.0±0.5 inches (measured from the strike face) above the flat hardened surface (stiffness of at least 3×10^6 psi and a mass much greater than the moving components (e.g. concrete slab)) and with the XSBI strike face facing the hardened surface (parallel to the surface), drop the XSBI two (2) times. The impact will occur as near as possible to the center of the XSBI strike face (not an edge). A radiographic image of the XSBI will be inspected to identify any cracks, delaminations or indentations on the XSBI surface. Perform ballistic testing in accordance with paragraph 3.9.3 for threats "e" and "x." The first test shot will be taken at the most severely damaged area of the XSBI specimen as identified by the x-ray image no closer than 1.5 inches from any edge. If no damage is visible the first shot will be taken vicinity of the impact location (center of the strike face). The second test shot will be located 1.5+0.75 inches from any edge and 4.0 to 5.0 inches from the first impact.

4.8 Operating Environment Requirements. Perform each verification in this paragraph then perform ballistic testing in accordance with paragraph 3.9.3. 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 XSBI shall be tested for weather resistance in accordance with AATCC Test Method #169 with the following modifications. Upon completion of the test, the XSBI 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/namometer (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^{o}C	77^{o}C
Conditioning Water	40^{o}C	53^{o}C
Wet bulb depression*	0^{o}C (95%+RH)	10^{o}C (50%RH)
* As a guide only; adjust to achieve required relatively humidity		

The test specimens (XSBI) 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 XSBI have been tested in the weatherometer and after passing visual examination tests, the XSBI shall be tested to establish a V_0 ballistic resistance 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.

4.8.2 Temperature Extreme. The finished XSBI shall be heated in an oven operating at 155 $\pm$ 5 degrees Fahrenheit for 6 hours (+1 hour) (Ref. MIL-STD-810G). Pre-conditioning and post-conditioning radiographic images shall be taken of the XSBI samples. The test specimen shall then be ballistically tested in accordance with paragraph 3.9.3. Subject XSBI (different to those subjected to high temperatures) to cold exposure at minus (-) 55 $\pm$ 5 degrees Fahrenheit for 6 hours (+1 hour) then ballistically test in accordance with paragraph 3.9.3. After each exposure XSBI 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 XSBI in one of the following containers of fluid. At least one XSBI 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, the XSBI will be strike-face down in a pan filled with 0.50-inch of fluid for two (2) hours (+15 min) with a twenty (20) pound weighted object on top of the XSBI. For salt-water contamination test, submerse the XSBI in a container for two (2) hours (+15 min). XSBIs shall be held vertically to drip dry for 5 minutes. Pre-conditioning and post-conditioning digital x-rays shall be taken of the XSBI samples. The test specimen shall be ballistically tested in accordance with paragraph 3.9.3 within 30 minutes after each exposure.

4.8.4 Altitude Test. Place the XSBI 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.

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 but the government reserves the right to fail the XSBI design due to excessive fungus growth. Tests will be performed in accordance with Method 508.6 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 503.5 of MIL-STD-810G Procedure I-A (ambient, cold, hot, ambient) using-25 and +120 degrees Fahrenheit for the extreme temperatures. Pre-conditioning and post conditioning digital x-rays shall be taken of the XSBI samples. The test item will be stabilized at the appropriate temperature for two (2) hours (+30 min) before cycling to the other temperatures. The test specimen shall be ballistically tested in accordance with paragraph 3.9.3.

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 Design code, size, dimensions, thickness, weights of all XSBI plates.
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 XSBI (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 of plate and/or system) 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 or specified soft armor backing design, weight and total ply count.
14. Clay type, 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, drag calculation software, etc)
18. Time and date of clay calibration drops and ballistic shots.
19. Photos of clay calibration drop locations, ballistic impact locations on the plate, and any anomalies.

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 ± 10 degree Fahrenheit and 50 ± 20% relatively 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 x-ray 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_{50} BL. See Appendix A.

4.9.7 PP and CP for V_{50}. Complete and partial penetrations will be determined based on the definitions provided in paragraph 6.6.

4.9.8 V_{50} Test Sample Mounting. Unless otherwise stated the following conditions shall be performed during V_{50} testing. The XSBI shall be secured to the clay-mounting block with the front plane of the clay box 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 XSBI 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 Clay Box and Mold Measurement.
The back of the XSBI test specimen will be attached to a block of non-hardening, oil-based modeling 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 XSBI sample. The clays consistency shall be such that a depression of 25 ± 3mm in depth is obtained when a 1 kg ± 10 gm (2.2 lb ± 0.35 oz) cylindrical steel mass, 44.5 ± 0.5 mm (1.75 ± 0.02 in) in diameter and having a hemispherical striking end, is dropped from a height of 2 m ± 2 cm (6.56 ft + 0.8-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 4.0 inches from any previous impact site and from any edge of the clay block. 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. Depressions and BFDs will be measured with instruments capable of ± 0.4mm accuracy. The calibration drop indentations will be filled with temperature conditioned clay prior to conduct of the V_0 test shots. The clay boxes will be numbered so as to be recognized by an overhead camera. Any portion of the clay "torso mold" will not be adhered to any portion of the clay block that has last been smoothed or worked with a "putty knife" or "flexible blade." Before ballistic testing, the built-up clay material or "torso

mold" will be contoured to the back-face curvature provided by the XSBI. This buildup will use additional clay backing material conditioned in the same manner as the clay material fixture. Both the shoot pack and XSBI will be strapped or taped to the curved surface of the clay material.

4.9.9.3.1 Back Face Deformation (BFD) Measurement.
Back face deformations in the clay are measured from the original undisturbed surface of the clay backing material to the post-impact surface with the reference direction perpendicular to the front surface (facing the line-of-fire) of the box. 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 post-impact surface. The BFD measurement is the maximum-distance-length, which is the length of the longest line segment parallel to the reference direction between the pre-impact clay surface and the post-impact (BFD) clay surface, where the reference direction is defined to be perpendicular to the front surface (facing the line-of-fire) of the box containing the clay backing material. 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., 44.050 = 44.0, 44.051 = 44.1 and 47.950 = 48.0). Additional information can be found in TOP 10-2-210 para. 4.9.3.

The laser scanner measurement instruments and associated software must be approved for use by ATEC. Prior to changes to this software, research will be conducted and the results will be vetted through the Testing Integrated Process Team (IPT) and Product Manager prior to implementation:

-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 have the tolerances set such that areas of discontinuity less then 0.7mm x 0.7mm are not included.

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 XSBI 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 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. Small "windows" shall be cut in the shoot pack's front Cordura cover to expose the aim points marked on the actual plate. Edge "witness" strips (or similar) shall be

used on all V_0 edge shots. Edge "witness" strips may be adhered to the XSBI prior to environmental conditioning if necessary (exceptions can be made if the edge strip fails to adhere to the plate, especially on environmentally conditioned samples). The witness strip edge closest to the center of the XSBI shall be placed 0.85 inches from the edge of the XSBI (at the XSBI surface) to account for ½ diameter of the 0.30 caliber projectile as the "point of impact" (projectile tip) can be no closer than 1.0 inches from the edge. There shall be a minimum 3.0 inch radius of unpenetrated (no yarns broken) soft armor backing (shoot pack) around the intended point of impact.

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 XSBI 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 XSBI sample. The front sheet will be placed 12.0 to 14.0 inches away from the front of the XSBI 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 XSBI 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 XSBI 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 hard body armor plate XSBI is intended for use by ground combat troops. The XSBI, when inserted into the fragment protective vest carrier, will provide protection from certain small arms fire. The XSBI is part of a protective system, which

includes a soft armor fragmentation and handgun tactical vest. The XSBI shall be used in conjunction with the soft armor vest 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 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 shall be a pre-production sample. The contracting officer shall 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.

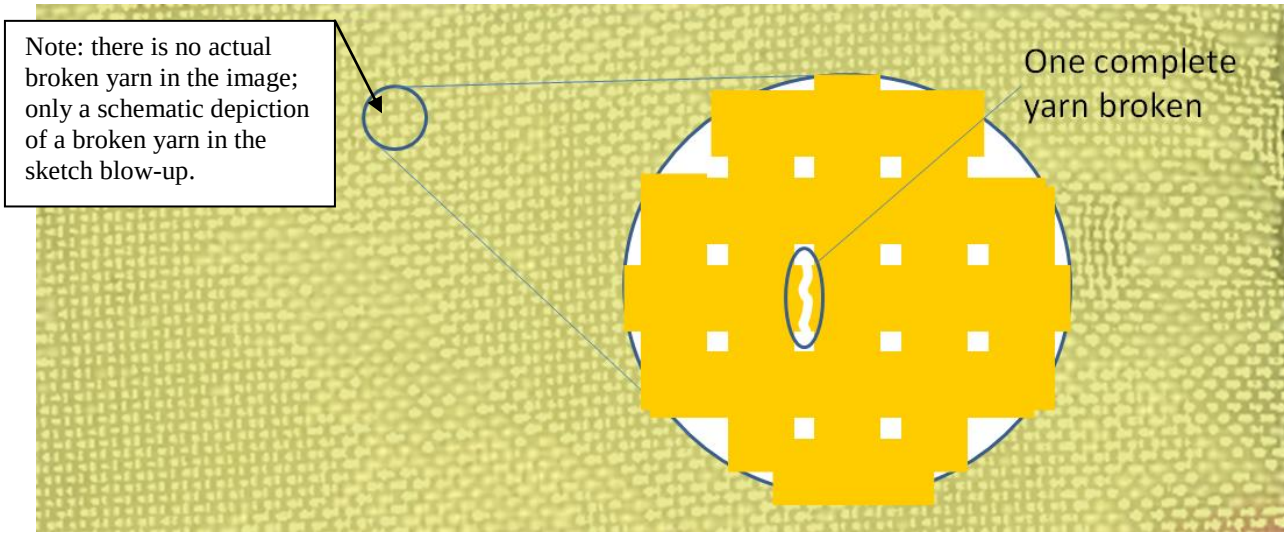
Under-Velocity. Striking velocity that is lower than the specified threat requirement.

Fair Impact. Impact of an unyawed bullet of the specified bullet type, velocity and obliquity (± 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 XSBI.

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 (hard armor (plate) and soft armor (carrier/shoot pack)).

1. Plate complete. 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 directly behind the impact point on the XSBI, resulting in the penetration of the first ply of the soft armor component (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. System complete. 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 directly behind the impact point on the XSBI and soft armor/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 (lb/ft^2) or kilograms per square meter (kg/m^2) of surface area.

Obliquity. The angle, in degrees, between the line-of-flight of the bullet and a line perpendicular to the front surface (facing the line-of-fire) of the clay box. A projectile's line-of-flight which is perpendicular to the surface of the clay box 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_{50} 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.

XSBI – TBD (Management Control Number/NSLIN for the XSBI: 8470-01-F00-8658, DA704J)

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 00-02, FQ/PD 07-05). The surrogate shoot pack system will consist of (1) a ballistic filler packet specified by the contract and (2) a ballistic filler carrier with pocket for the ballistic insert (XSBI). 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 XSBI pocket capable of holding the largest XSBI stitched on the face fabric. Both the face fabric and the pocket cover will consist of 500 denier 7.5 oz. / sq. yd. urethane back coated, textured nylon, Cordura. The XSBI 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, 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_{50} Ballistic Limit Measurements

V_{50} ballistic limit testing of XSBIs shall be conducted as per paragraph 3.9.2 and 4.9 of this AR/PD and procedures specified in the contract (see paragraph 6.2) and MIL-STD-662. The XSBI will yield the minimum V_{50} ballistic limit measurements at 0 degree obliquity with the specified test projectiles as listed in Table II below. For "e" and "x" threat, the 1st and 2nd shots will yield separate V_{50} ballistic limit measurements at 0-degree obliquity with the specified test projectiles as listed in Table II below. The 2nd shot V50 will be used for Government reference only.

Ballistic limit measurements will be performed on the actual XSBI (two (2) shots maximum per XSBI in accordance with MIL-STD-662F). Shot spacing should be no closer than 1.0 inches from an edge and each subsequent shot shall be spaced at least 4.0 inches from any previous shot. Second shots should be placed in an area unaffected by the previous shot. The V_{50} 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 XSBI. Partial penetrations occur for any fair impact where a complete penetration does not occur (see paragraph 4.9 and 6.6).

V_{50} Calculation: The arithmetic mean of three (3) Partial Penetration (PP's) and three (3) Complete Penetrations (CP's) within a 125 ft/s velocity spread or four (4) Partial Penetration (PP's) and four (4) Complete Penetrations (CP's) within a 150 ft/s velocity spread yield the minimum allowable V_{50} BL determination that will be accepted as reliable test results.
If 6 partial penetrations occur that are above the minimum V_{50}, the plate demonstrates a V_{50} above the minimum, the plate passes, and that V_{50} test is terminated. All shots' velocities are recorded.

V_0 Ballistic Resistance

Ballistic V_0 testing of XSBI 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_0, the minimum velocities as in Table II below will be the requirement. The ballistic V_0 testing of XSBI shall have a minimum of 1 impact (2nd shot V_0 impacts on plate are for government reference only). All shots shall be fired at 0 degree obliquity for all threats.

Shot spacing shall have the first fair hit impact (0 degrees obliquity) will be between 1.0 to 1.5 inches from any edge for shot pattern "A" and between 2.0 and 2.5 inches from an edge for shot pattern "B." The second impact at zero degrees obliquity will be 4.0-5.0 inches from the first impact location and located as per the two separate shot patterns (Figures A and B). Tested plates will alternate between the two shot patterns (pattern on a No Test shall be repeated on a new plate). 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, 4.9.9.3 and 4.9.9.3.1, will only be taken for shots taken at 0 degrees obliquity.

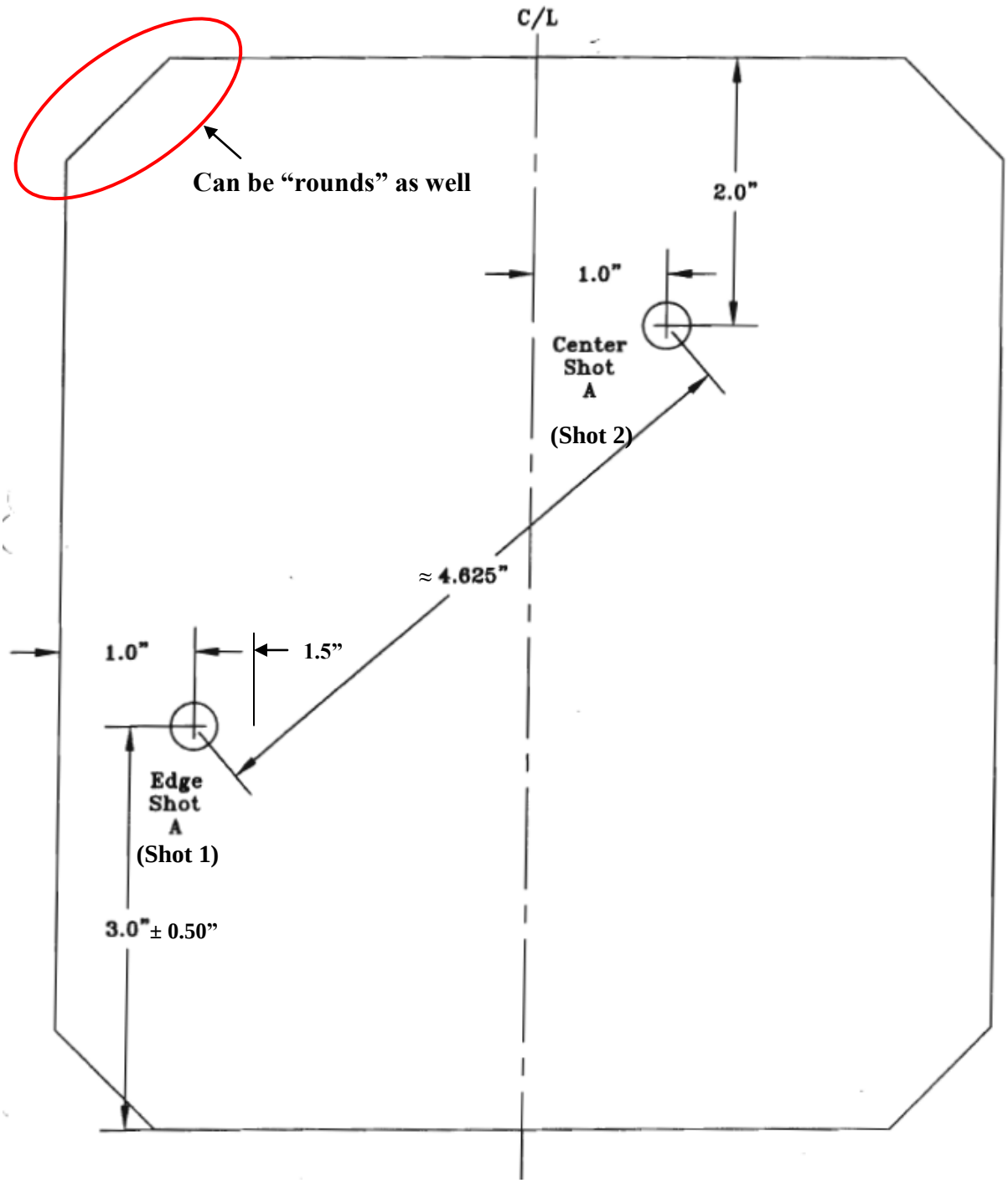


Figure A: Shot pattern "A" (not to scale)

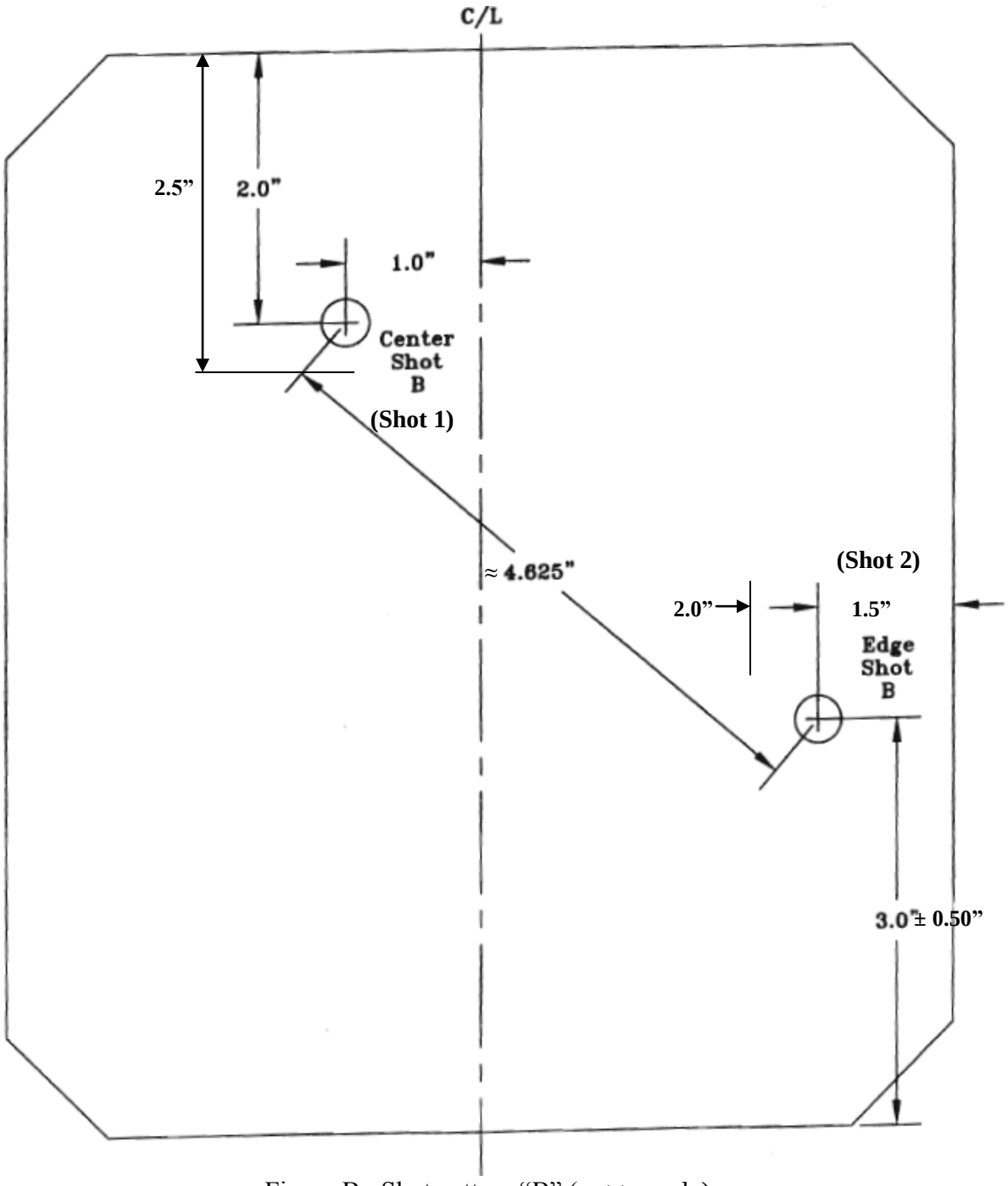


Figure B: Shot pattern "B" (not to scale)

Figures 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, etc).

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 the applicable shot(s) on the XSBI.

Table II: Threat Codes, Descriptions, and Required Velocities

Threat Code	V_{50} Minimum Required Velocity (ft/s)	V_0 Required Velocity and Tolerance (ft/s)	Shots (V_0)	Obliquity (V_0)
e	1st shot – 2,850 2nd shot - Gov't Reference (1st and 2nd shot individual V_{50}s)	2,700 +50	2 (2rd shot Government reference.)	Shots 1 and 2 at 0 degree
x	1st shot – 3,200 2nd shot - Gov't Reference (1st and 2nd shot individual V_{50}s)	3,050 +50	2 (2nd shot Government reference)	Shots 1 and 2 at 0 degree

Appendix B

First Article Test (FAT) Protocol – XSBI

Table 1 – FAT Testing Protocol

TEST	Threat e V_0 2,700+50 ft/s	Threat x V_0 3,050+50 ft/s
Ambient V_{50}	10ea (2850min*)	10ea (3,200min*)
Ambient V_0	13ea	13ea
Impacted V_0	1ea	1ea
Oil Soak V_0	1ea	1ea
JP-8 Soak V_0	1ea	1ea
Saltwater V_0	1ea	1ea
Weathered V_0	1ea	1ea
High Temp V_0	1ea	1ea
Low Temp V_0	1ea	1ea
Temp Cycle V_0	1ea	1ea
Altitude V_0	1ea	1ea

*Requirement for 1st shot V_{50} only. If all six shots exceed V_{50} minimum requirements, with no complete penetrations occurring, the requirement is considered met.

The Contractor shall provide a total of **76 FAT XSBI samples** to the Government for First Article Testing as indicated below and a minimum of two UID verification reports.

64 samples: First Article Testing
10 samples : FAT contingency / spares
1 sample: Government record (DCMA)
1 sample: Government record (PM SPE/TMD)
76 FAT Samples

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.

FAT will be conducted according to the matrix provided above. No first shot complete penetrations (CPs) of the system (plate and shoot pack) will be allowed for any of the V_0 subtests. This will ensure that there is 90 percent confidence that the design has 90 percent probability of no first shot system penetrations with threats "e" and "x." Any first shot system complete on a V_0 subtest constitutes a FAT rejection (see Table 2 below for data inclusion criteria). For BFD, the arithmetic mean of the BFD measurements for the first shot is calculated as well as the Upper Tolerance Limit (UTL). The 90 percent UTL at 90 percent confidence provides the estimated BFD measurement below which 90 percent of BFD measurements will occur, with 90 percent confidence. The BFD UTLs are calculated for the first shot by combining shot locations and environmental conditions for each individual threat. Any design whose first shot; calculated by threat; 90 percent UTL on BFD with 90 percent confidence exceeds 44.0 mm constitutes a FAT rejection. Refer to Table 2 below for data inclusion criteria for evaluation.

Table 2 – FAT Data Inclusion Criteria for Velocity Anomalies

	Test Result		**Evaluator Accepts or Rejects for Inclusion in Analysis**		**Proceed to next data point for that plate?**
Impact Velocity	**Penetration**	**BFD**	**Penetration**	**BFD**	
Acceptable	No Penetration (PP and CP)	Measured	Include as success	Include	Yes
Acceptable	Complete System Penetration (CC)	Not measured	Include as failure	Not measured	Yes
Too High	No Penetration (PP and CP)	Measured	Not included	Not included	No
Too High	Complete System Penetration (CC)	Not Measured	Not included	Not included	No
Too Low	No Penetration (PP and CP)	Measured	Not included	Not included if ≤ 44.0mm Included if > 44.0mm	No
Too Low	Complete System Penetration (CC)	Not measured	Include as failure	Not measured	No

NO TESTS:

- If the "edge strip" is impacted by the incoming projectile (indicating a shot too close to the edge), the plate will be a "No test" (rationale – the plate can only pass)
- If the clay sticks to the shoot pack in the BFD location as the shoot pack is removed and the BFD result is above 44.0 mm, test shall be considered a "No test". Rationale: Resulting BFD would inadvertently skew the reading due to clay removal from/lifting off the surface. If the testing is using statistical sampling of BFDs, all instances of clay sticking to the shoot pack that in one way or another skews the BFD reading should be noted and if the plate design fails due to high BFD, these cases need to be retested.

NOTES:

If silicone spray is used, remove immediately afterwards (scrape off and dispose surface clay).

Definitions (V_0 testing):

Critical defects for threats "e" and "x":

- Complete penetration of both hard armor (XSBI) and soft armor (IOTV or shoot pack) on 1st shot

Accept / Reject criteria:

1) One or more critical defects during V_0 testing will constitute FAT rejection.
2) First shot 90 percent UTL on BFD with 90 percent confidence exceeding 44.0 mm constitutes FAT rejection for either threat "e" or "x."

**Technical Data Package(s) and Dry Lay-up(s) must be provided to the contracting officer in order to gain approval to conduct FAT.

Appendix C

XSBI Lot Acceptance Test (LAT) Protocol

LAT REQUIREMENTS

Table 1 – LAT Testing Protocol

Lot size	ANSI/ASQ Z1.4 Code Letter	Sample Size*	Threat "x"	Threat "e"	LAT Reject Rate
			V_0 - 3,050+50	V_0 - 2,700+50	
≤ 150	C	7	5	2	4
151 - 500	D	10	8	2	5
501 - 3200	E	15	13	2	7
> 3200	F	22	20	2	9

*Sample size based on ANSI/ASQ Z1.4 Special Inspection Level "S-3". Switching rules do not apply and zero (0) critical defects allowed. Defects are divided into critical defects and minor defects as below. The contractor shall provide 3 contingency plates in addition to the plates above and a minimum of two UID Verification reports for each LAT. Testers shall cut small "windows" in the shoot pack cover to expose the actual aim point on the XSBI and use edge "witness" strips (or similar) on all threat "e" and "x" V_0 edge shots. All LATs shall be 2-shot, V_0 Testing of each insert – 2nd shot (0 degree obliquity) is for government reference only. Given the sample sizes with threat "e" V_0 adds an additional 2 samples per LAT, the accept/reject criteria are interpolated from Table II-A of ANSI/ASQ Z1.4 which correlates to the LAT rejection at the minor defect rates shown in Table 1 above.

NO TESTS:

- If the "edge strip" is impacted by the incoming projectile (indicating a shot too close to the edge), the plate will be a "No test" (rationale – the plate can only pass)
- If the clay sticks to the shoot pack in the BFD location as the shoot pack is removed and the BFD result is above 44.0 mm, test shall be considered a "No test". Rationale: Resulting BFD would inadvertently skew the reading due to clay removal from/lifting off the surface. If the testing is using statistical sampling of BFDs, all instances of clay sticking to the shoot pack that in one way or another skews the BFD reading should be noted and if the plate design fails due to high BFD, these cases need to be retested.

NOTES:

If silicone spray is used, remove immediately afterwards (scrape off and dispose surface clay).

DEFINITIONS:

Critical defects:

- Complete penetration of both hard armor (XSBI) and soft armor (IOTV or shoot pack) on 1st shot
- Back face deformation ≥ 48.0 mm on 1st shot

Minor defects:

- Complete penetration of hard armor (XSBI) and partial penetration of soft armor (IOTV or shoot pack) on 1st shot
- Back face deformation > 44.0mm and < 48.0mm on 1st shot

Accept / Reject Criteria

- One or more critical defects during testing will constitute LAT rejection.
- A minor defect rate equal to or higher than allowed by Table 1, as calculated by using a linear interpolation from Acceptance Quality Limit (AQL) of 15, constitutes LAT rejection.

LAT ACCEPTANCE / REJECTION CRITERIA

Table II-A—Single sampling plans for normal inspection (Master table)

(See 9.4 and 9.5)

Sample size code letter	Sample size	Acceptance Quality Limits, *AQLs*, in Percent Nonconforming Items and Nonconformities per 100 Items (Normal Inspection)																												
		0.010	0.015	0.025	0.040	0.065	0.10	0.15	0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5	10	15	25	40	65	100	150	250	400	650	1000
		Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re
A	2																		1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	30 31
B	3																		2 3	3 4	5 6	7 8	10 11	14 15	21 22	30 31	44 45
C	5																		3 4	5 6	7 8	10 11	14 15	21 22	30 31	44 45	
D	8																		5 6	7 8	10 11	14 15	21 22	30 31	44 45		
E	13																		7 8	10 11	14 15	21 22	30 31	44 45			
F	20																		10 11	14 15	21 22						
G	32																		14 15	21 22							
H	50																		21 22								
J	80																										
K	125																										
L	200																										
M	315																										
N	500																										
P	800																										
Q	1250																										
R	2000																										

LAT

↓ = Use the first sampling plan below the arrow. If sample size equals, or exceeds, lot size, carry out 100 percent inspection.

↑ = Use the first sampling plan above the arrow.

Ac = Acceptance number.

Re = Rejection number.

ANSI / ASQ Z1.4 - Acceptable Quality Limits

11

SINGLE NORMAL PLANS

CODE LETTERS

Table I—Sample size code letters

(See 9.2 and 9.3)

Lot or batch size			Special inspection levels				General inspection levels		
			S-1	S-2	S-3	S-4	I	II	III
2	to	8	A	A	A	A	A	A	B
9	to	15	A	A	A	A	A	B	C
16	to	25	A	A	B	B	B	C	D
26	to	50	A	B	B	C	C	D	E
51	to	90	B	B	C	C	C	E	F
91	to	150	B	B	C	D	D	F	G
151	to	280	B	C	D	E	E	G	H
281	to	500	B	C	D	E	F	H	J
501	to	1200	C	C	E	F	G	J	K
1201	to	3200	C	D	E	G	H	K	L
3201	to	10000	C	D	F	G	J	L	M
10001	to	35000	C	D	F	H	K	M	N
35001	to	150000	D	E	G	J	L	N	P
150001	to	500000	D	E	G	J	M	P	Q
500001	and	over	D	E	H	K	N	Q	R

10

ANSI / ASQ Z1.4 Inspection Levels - Sample Size Code Letters

SUBMISSION, REVIEW, ACCEPTANCE/REJECTION OF LATs

- 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 COR and their designated representatives for review and acceptance/rejection IAW the above criteria. No production lot will be released for shipment by the vendor until approval by the COR or their representative.
- The acceptance, additional testing requirement, or rejection of each lot will be provided to the DCMA QAR, who will take the appropriate action.

Appendix D

XSBI UTL Protocol – For Government Reference Only

Data acquired during LAT testing (Appendix C) will be utilized to calculate the Upper Tolerance Limit (UTL)

Table 1 – LAT Testing Protocol

Lot size	ANSI/ASQ Z1.4 Code Letter	Sample Size*	Threat "x"	Threat "e"
			V_0-3,050+50	V_0- 2,700+50
≤ 150	C	5	5	2
151 - 500	D	8	8	2
501 - 3200	E	13	13	2
> 3200	F	20	20	2

*Sample size based on ANSI/ASQ Z1.4 Special Inspection Level "S-3". Switching rules do not apply and zero (0) critical defects allowed. The contractor shall provide 3 contingency plates in addition to the plates above and a minimum of two UID Verification reports for each LAT. Testers shall cut small "windows" in the shoot pack cover to expose the actual aim point on the XSBI and use edge "witness" strips (or similar) on all threat "e" and "x" V_0 edge shots. All LATs shall be 2-shot, V_0 Testing of each insert – 2nd shot (0 degree obliquity) is for government reference only.

For threat "x", the arithmetic mean of the BFD measurements for the first shot will be calculated as well as the Upper Tolerance Limit (UTL). The 80 percent UTL at 90 percent confidence provides the estimated BFD measurement below which 80 percent of BFD measurements will occur, with 90 percent confidence. The BFD UTL will be calculated for the first shot only by combining shot locations for threat "x" only. Threat "e" BFD will be collected for Government reference only. Refer to Table 2 below for data inclusion criteria for evaluation.

Table 2 – LAT Data Inclusion Criteria for Velocity Anomalies

	Test Result		Evaluator Accepts or Rejects for Inclusion in Analysis		Proceed to next data point for that plate?
Impact Velocity	Penetration	BFD	Penetration	BFD	
Acceptable	No Penetration (PP and CP)	Measured	Include as success	Include	Yes
Acceptable	Complete System Penetration (CC)	Not measured	Include as failure	Not measured	Yes
Too High	No Penetration (PP and CP)	Measured	Not included	Not included	No
Too High	Complete System Penetration (CC)	Not Measured	Not included	Not included	No
Too Low	No Penetration (PP and CP)	Measured	Not included	Not included if ≤ 44.0mm Included if > 44.0mm	No
Too Low	Complete System Penetration (CC)	Not measured	Include as failure	Not measured	No

NO TESTS:

- If the "edge strip" is impacted by the incoming projectile (indicating a shot too close to the edge), the plate will be a "No test" (rationale – the plate can only pass)
- If the clay sticks to the shoot pack in the BFD location as the shoot pack is removed and the BFD result is above 44.0 mm, test shall be considered a "No test". Rationale: Resulting BFD would inadvertently skew the reading due to clay removal from/lifting off the surface. If the testing is using statistical sampling of BFDs, all instances of clay sticking to the shoot pack that in one way or another skews the BFD reading should be noted and if the plate design fails due to high BFD, these cases need to be retested.

NOTES:

If silicone spray is used, remove immediately afterwards (scrape off and dispose surface clay).

CODE LETTERS

Table I—Sample size code letters

(See 9.2 and 9.3)

Lot or batch size	Special inspection levels				General inspection levels		
	S-1	S-2	S-3	S-4	I	II	III
2 to 8	A	A	A	A	A	A	B
9 to 15	A	A	A	A	A	B	C
16 to 25	A	A	B	B	B	C	D
26 to 50	A	B	B	C	C	D	E
51 to 90	B	B	C	C	C	E	F
91 to 150	B	B	C	D	D	F	G
151 to 280	B	C	D	E	E	G	H
281 to 500	B	C	D	E	F	H	J
501 to 1200	C	C	E	F	G	J	K
1201 to 3200	C	D	E	G	H	K	L
3201 to 10000	C	D	F	G	J	L	M
10001 to 35000	C	D	F	H	K	M	N
35001 to 150000	D	E	G	J	L	N	P
150001 to 500000	D	E	G	J	M	P	Q
500001 and over	D	E	H	K	N	Q	R

10

ANSI / ASQ Z1.4 Inspection Levels - Sample Size Code Letters