INCH-POUND
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PURCHASE DESCRIPTION

PERSONAL ARMOR, ENHANCED 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 Enhanced Small Arms Protective Insert (ESAPI) worn by ground troops. When placed in the Outer Tactical Vest (OTV) pocket of the Multiple Threat Body Armor (MTBA) / Interceptor Body Armor the insert will provide ballistic protection from specific 5.56 mm and 7.62 mm ball and AP rounds. The MTBA 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 (see paragraph 6.2):

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

FQ/PD 07-05 - Body Armor, Multiple Threat, Improved
MIL-STD-662 - V_{50} Ballistic Test for Armor
MIL-STD-810 - 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 No.	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

(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. 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 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. It is encouraged that recycled material be used when practical as long as they meet all requirements.

3.3.1 Molding. If molding is required then the material shall be molded into the required configuration without breaking or damaging the material. Processing procedures and methods capable of providing uniform properties and products in the complete structure shall be used. No patching shall be performed after the material has been molded.

3.3.2 ESAPI Cover and Edge Strips. Face ESAPI cover materials used to mitigate frontal spall, increase multi-hit, durability and decrease environmental deterioration of the underlying components shall be in a configuration as to cover the entire front outer surface, sides and a minimum of 1.0-inch on the back surface. There shall be no visible peeling of the tab formed on the covering to ESAPI joining area. Edge strip (if used) shall be cut to go around the entire periphery of the ESAPI and overlap the outer edges of the ESAPI by 0.50 - 0.75-inch. Edge strips if used in conjunction with a spall shield will be placed on the outer surface of the spall shield.

3.3.3 Assembly of Components by Bonding. All components requiring bonding will be thoroughly cleaned of all foreign matter. Surfaces to be bonded will be properly prepared in a manner which insures a bond capable of meeting all operational, environmental and performance requirements. The adhesives will be applied uniformly over the entire contact areas of the components to be joined. When bonding components, uniform suitable pressure shall be applied

over the entire surface area. 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 ESAPI.

3.3.4 Nonmagnetic Materials. All materials used in manufacturing the ESAPI shall be nonmagnetic.

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 measurement taken from a sampling of finished ESAPI.

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 ESAPI.

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

e. For traceability every ESAPI must be durably marked in such a fashion as to be traceable from production through to the ballistic test records for that lot of ESAPIs. 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. It is desirable to have the ceramic cores marked to be traceable by radiographic analysis as well.

3.5 Workmanship. The finished ESAPI 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 ESAPI will satisfy the following user-oriented requirements (see paragraph 4.6).

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

3.6.2 Insertion Using Protective Hand Gear. The ESAPI shall be easily inserted or removed by troops wearing either cold weather or chemical protective hand wear (see paragraph 4.6.2).

3.6.3 Weight. The finished ESAPI will not exceed the following 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.

3.6.4 Dimensional measurements. The ESAPI shall conform to all measurements, tolerances, radius and edge chamfers provided in Drawings (Para. 2.2.2) (except that thickness shall not exceed 1 inch) and paragraph 4.6.4 and 4.6.5.

3.6.5 Thickness. The ESAPI in finished form will have uniform thickness throughout .The tolerance of the thickness shall not exceed 1/8 inches between any two measurements (para. 4.6.5).

3.6.6 ESAPI Color. All areas of the ESAPI shall be colored Foliage Green as specified in paragraph 4.6.6.

3.6.7 Labels/markings. (see paragraph 4.6.7)

3.6.7.1 Orientation Labels. Permanent labels or markings shall be placed on the back-face of the ESAPI clearly displaying the "TOP" orientation. Orientation marking will be approximately 1.25-inch. from it's respective edge. A permanent label or marking shall be centered on the front of the ESAPI, 4.5-inch from the top clearly displaying "STRIKE FACE". All characters will be 0.50-inch height (see paragraph 4.6.7).

3.6.7.2 Performance Labels. A permanent label or marking shall be displayed on the back-face clearly displaying "7.62 mm APM2 Protection" 0.25-inch height characters. The marking will be displayed on the center of the ESAPI approximately 3.0-inch from the top edge (see paragraph 4.6.7).

3.6.7.3 Complete ESAPI Markings. The manufacturer's contract number and nomenclature shall be permanently and legibly marked on the upper mid-center back face (approximately 6.0 inches down from the upper edge). A Unique Identification (UID) label that is in compliance with MIL-STD 130M, 2 Dec 2005, shall be permanently and legibly marked or affixed on the mid-center back face approximately 0.5 -inch below the printed marking. The data elements contained on the UID label are:

a. Block 17V: Manufacturer's CAGE Code.

b. Block S: Plate Serial Number

c. Block 1T: Date of Manufacture and Lot Number
(YYYY/MM/DD//XXXXXXX)

d. Block 30P: NSN

FIGURE A: SAMPLE UID CONSTRUCT II LABEL

The letters "U.S." shall be applied approximately 0.5-inch above the printed identification markings and centered on the ESAPI in characters 1.0-inch high. The size identification of the ESAPI shall be clearly displayed centered on the front surface 3.0-inch below the top edge in all capital characters 0.50-inch high (i.e. SIZE MEDIUM). The words "HANDLE WITH CARE" shall be printed in characters 0.50-inch high at approximately 2.0-inch below the markings "STRIKE FACE" 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 ESAPI production lot shall be furnished to the contracting officer at the time of delivery. The front side of the ESAPI shall have a letter height to width ratio of approximately 1:0.75 (see paragraph 4.6.7).

3.6.8 Health and Safety. The ESAPI will be non-hazardous (non-explosive and have no toxicological or electromagnetic radiation effects) to the individual wearing the ESAPI or troops in the surrounding area (see paragraph 4.6.9).

3.6.8.1 Flammability. Demonstrate that ESAPIs will not combust, explode or drip melted materials when impacted with defined threats or subjected to elevated temperatures of 250 degrees Fahrenheit for ten (10) minutes (see paragraph 4.6.8.1).

3.6.8.2 Personnel Hazard Inspection. Visually inspect that ESAPIs are free of sharp edges, foreign materials, burrs or any other conditions that may cause an injury to the user. Demonstrate that the ESAPI will not cause injury to the user or surrounding troops when ballistically tested (see paragraph 4.9). Any component of the ESAPI that can cause personnel injury will not be acceptable (see paragraph 4.6.8.2).

3.6.8.3 Magnetic Influence. There shall be no magnetic influence on a compass at any distance from the ESAPI. (See paragraph 4.6.8.3).

3.7 Ownership and Support. (see paragraph 4.7)

3.7.1 Durability. The ESAPI will be able to withstand two drops at a height of 48.0-inches on to a concrete or cement surface without any detrimental effects to ballistic performance, major surface characteristics or physical properties. A ten (10) pound weighted object shall be attached to the rear surface of the ESAPI sample (see paragraph 4.7.1).

3.8 Operating Environment Requirements. Unless otherwise stated ballistic validation testing will be performed with threat "d." (7.62 mm APM2) in paragraph 3.9.3 only. Ballistic performance will not be degraded from exposure to the environmental conditions specified in paragraph 4.8.

3.8.1 Weatherometer Resistance. The finished ESAPI 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 ESAPI shall be both structurally and ballistically functional within the temperature ranges of - 60 degrees to + 160 degrees Fahrenheit. The ESAPIs shall also be able to resist structural and ballistic degradation when applied or temporally quartered on high temperature components (on top engine, exhaust or transmission components during transportation, rest period or quick departure scenarios) (see paragraph 4.8.2).

3.8.3 Fluid Resistance. The ESAPI shall maintain structural and ballistic integrity after contamination with diesel fuel and 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 ESAPI 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 in 17 minutes (see paragraph 4.8.4).

3.8.5 Fungus. The ESAPI 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 ESAPI 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 all sub-paragraphs in 4.9)

3.9.1 Area of Coverage. The ESAPI will provide uniform ballistic protection coverage and materials coverage throughout the entire surface area of the ESAPI (See paragraph 4.9). 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 ESAPI. The ESAPI shall have uniform areal density throughout the entire surface area. "Patches", "clamps", and materials with

partial coverage of the ESAPI surface area shall not be acceptable. Any cuts with open gap and/or slits on any materials used in ESAPI are not allowed.

3.9.2 Required V_{50} Ballistic Limit. The ESAPI will yield the minimum V_{50} ballistic limit measurements at 0-degree obliquity with the specified test projectiles.

a. NATO 7.62 x 51 mm M-80 Ball, V_{50} no less than 2,850 feet per second.
b. Soviet 7.62 mm x 54R Ball Type LPS, V_{50} no less than 2,850 feet per second.
c. U.S. 5.56 mm M855 Ball, V_{50} no less than 3,300 feet per second

Ballistic limit measurements will be performed on the actual ESAPI (three (3) shots maximum per ESAPI) in accordance with MIL-STD662. Shot spacing should be no closer than 1.0-inch from an edge and each subsequent shot shall be spaced at least 5.0-inch from any previous shot. Second and third shots should be placed in an area unaffected by any previous shot. If no unaffected areas can be found then a new ESAPI shall be employed. The V_{50} will be determined when tested in conjunction with the simulant (see 6.10). Partial and complete penetrations will be determined by projectile/armor debris on the soft under garment (see paragraph 4.9 and 6.6).

3.9.3 V_0 Ballistic Resistance. The ESAPI, when tested in conjunction with the simulant (see paragraph 6.10) will provide only partial penetrations even when challenged by 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, the third shot at 30-degrees obliquity. The ESAPI will not pass if any challenged shot causes complete penetrations (as defined in Para 6.6). The ESAPI when inserted in a nylon cordura carrier and tested in conjunction with the simulant (see paragraph 6.10) will be capable of defeating three impacts from each of the following threats:

a. NATO 7.62 x 51 mm M-80 Ball at 2,750 + 50 feet per second.
b. Soviet 7.62 mm x 54R Ball Type LPS at 2,750 + 50 feet per second.
c. U.S. 5.56 mm M855 Ball at 3,250 + 50 feet per second.
d. 7.62mm x 63 APM2 at 2850 + 50 feet per second (only two (2) impacts at 0 degree obliquity required)

Each ESAPI will survive three impacts from the same threat on one ESAPI each, except for d. (see paragraph 4.9).

3.9.4 Back Face Deformation. The ESAPI 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 ESAPI will be designed to mitigate personnel 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 Inspections. The inspections requirements specified herein are classified as First Article Inspection and Conformance Inspection as specified in Table I.

4.2.1 First article Inspection. Unless otherwise specified in the contract or purchase order, the ESAPI supplier is responsible for all first article and conformance inspections and tests herein. Except, as otherwise specified in the contract the contractor may use any facility suitable for evaluating performance of these inspection items. The government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements. When a first article inspection is required it includes all or part of the verifications listed in paragraphs 4.6, 4.7, 4.8, and 4.9 (see Table I).

4.2.2 Conformance Inspection. Conformance inspection for acceptance of ESAPI 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 and Production Acceptance.

First Article Testing. Ballistic V_0 test data generated for first article acceptance will employ the maximum shot space pattern identified in this performance specification. The first shot will be between 0.75 - 1.25-inch from an edge and the distance between subsequent shots will be between 5.0 - 6.0-inchs. Testing shall be in compliance with paragraph 3.9.

Production Testing. Production quality assurance ballistic testing shall consist of two shots each for the APM2 projectiles. Testing shall be in compliance with 3.9.3 and 3.9.4

Table I. Requirements and Verifications

CHARACTERISTICS	REQUIREMENT PARAGRAPH	VERIFICATION PARAGRAPH	FAT for initial production	CONFORMANCE Lot inspection
Operating Requirements	**3.6**	**4.6**		
Ease of Insertion	3.6.1	4.6.1	X	X
Insertion Using Protective Hand Gear	3.6.2	4.6.2	X	X
Weight	3.6.3	4.6.3	X	X
Dimensional measurements	3.6.4	4.6.4	X	X
Thickness	3.6.5	4.6.5	X	X
ESAPI Color	3.6.6	4.6.6	X	X
Labels/markings	3.6.7	4.6.7	X	X
Orientation Labels	3.6.7.1	4.6.7	X	X
Performance Labels	3.6.7.2	4.6.7	X	X
Complete Insert Markings	3.6.7.3	4.6.7	X	X
Health and Safety	**3.6.8**	**4.6.8**		

Flammability	3.6.8.1	4.6.8.1	X	COC
Personnel Hazard	3.6.8.2	4.6.8.2	X	COC
Magnetic Influence	3.6.9.3	4.6.8.3	X	COC
Ownership and Support	**3.7**	**4.7**		
Durability	3.7.1	4.7.1	X	COC
Operating Environment Requirements	**3.8**	**4.8**		
Weatherometer Resistance	3.8.1	4.8.1	X	COC
Temperature extreme	3.8.2	4.8.2	X	COC
Fluid Resistance	3.8.3	4.8.3	X	COC
Altitude	3.8.4	4.8.4	X	COC
Fungus	3.8.5	4.8.5	X	COC
Temperature Shock	3.8.6	4.8.6	X	COC

Performance Requirements	**3.9**	**4.9**		
Area of Coverage	3.9.1	4.9	X	X
Req. V_{50} Ballistic Limit	3.9.2	4.9	X	X
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	X

Note:

FAT "X"	- All first article test verifications shall be 100% inspection
Conformance lot "X"	- shall be in accordance with ANSI/ASQC Z1.4
COC	- Certificate of conformance

4.3 Order of Inspection. Perform operating requirements verification (paragraph 4.6) first followed by ownership and support verification (paragraph 4.7), operating environment verification (paragraph 4.8) and finally performance verification (paragraph 4.9).

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. Compare with naked eye in simulated light.

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 Verification. Complete each verification in this paragraph.

4.6.1 Insertion Demonstration. One barehanded person shall demonstrate insertion of the ESAPI into both OTV pockets without tools or special aids.

4.6.2 Insertion using Protective Hand Gear Operation Demonstration. Demonstrate ESAPI insertion and perform insertion into the OTV pocket while separately wearing standard Army cold weather gloves (NSNs 8415-01-319-5514, Shell and 8415-01-319-9042, Glove) and chemical protective hand wear (NSN 8415-01-033-3517). Perform insertion into government furnished carrier in a maximum of 30-seconds.

4.6.3 Weight Verifications. Take physical weight measurements of all ESAPI s to ensure that weights do not exceed those presented in paragraph 3.6.3. The finished ESAPI s shall be weighed to the nearest 0.01-pound.

4.6.4 Dimensional Measurements. Take physical measurements of all ESAPI 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 ESAPI. The length measurements should be taken at the two chamfered edges. The first width measurement shall be no further than 1.0-inch away from the bottom edge. The second width measurement shall be no closer than 7.0-inches from the first measurement location.
4.6.5 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 Para 2.2.2 and Para. 3.6.5).

4.6.6 ESAPI Color Inspection. Visually inspect the ESAPIs for similarity to the standard sample color of Foliage Green 504 as specified by the contract.

4.6.7 Instruction labels inspection. Visually inspect for legible, permanent labels on the front and back face surfaces. Visually inspect that labels contain clear written instructions and/or orientation directions. All markings must be visible in low light levels (i.e. moon light and filtered red or blue light).

4.6.8. Health and safety. Complete each verification in this paragraph.

4.6.8.1 Flammability Demonstration. Observe that the ESAPI 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.

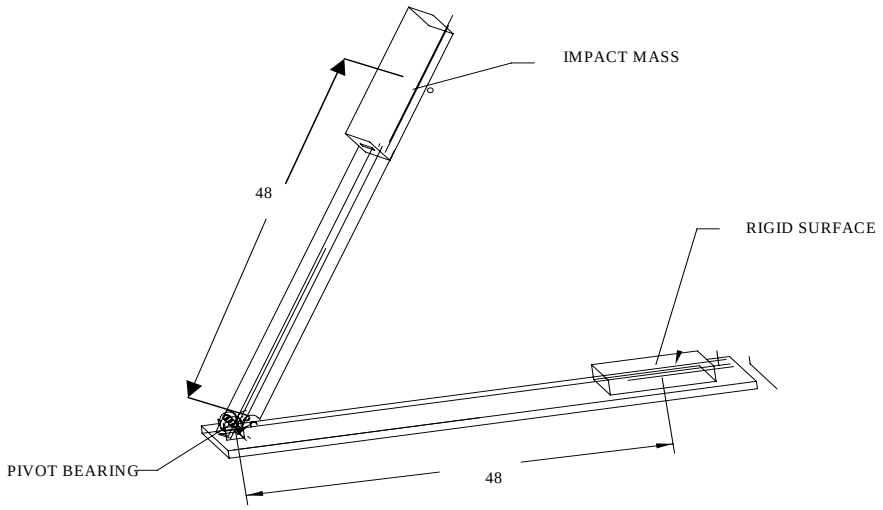
4.6.8.2 Personnel Hazard Inspection. Visually inspect that the items are free of conditions that will cause potential injury to the user.

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

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

4.7.1 Durability Demonstration. Demonstrate durability by performing drop test analysis. Attach ESAPI with a strap, belt or other non-obstructive retaining device to the front surface of a 10.0-pound weighted object. The weighted object (blunt trauma clay is a recommended material) will be approximately 18 x 18-inch size and contoured to the back ESAPI surface. A soft armor simulant as described in paragraph 6.10 shall be placed in between the ESAPI and weighted object. A fixture similar to that in Figure 1 has shown to provide accurate and reproducible results. At a minimum free fall height of 48.0-inch. (90-degrees from horizontal) (16-ft/sec) from 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 ESAPI strike face pointing down, drop the weighted fixture at least two (2) times. Impacts will occur at the center of the ESAPI face (not an edge). Radiography x-ray the ESAPI and identify any cracks, delaminations or indentations on the ESAPI surface. Perform ballistic testing in accordance with paragraph 3.9.3 for threat d. (7.62 x 63 mm APM2 at 2,850 +50 feet per second). The first test shot will be taken at the most severely damaged area of the ESAPI specimen as identified by the x-ray photograph. The second test shot will be located approximately 1.5-inches from any edge surface and 5.0-6.0 inches from the first impact.

Figure 1. Proposed Durability Apparatus



4.8 Operating Environment Requirements Verification. Perform each verification in this paragraph then perform ballistic testing in accordance with paragraph 3.9.3 for threat "d". 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 ESAPI shall be tested for weather resistance in accordance with AATCC Test Method #169 with the following modifications. Upon completion of the test, the ESAPI 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 ± 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 (ESAPI) 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 ESAPI have been tested in the weatherometer and after passing visual examination tests, the ESAPI shall be tested to establish a V_0 ballistic resistance against 7.62x63 mm APM2 at 0 degree obliquity within 24 ± 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 Verification. The finished ESAPI shall be heated in an oven operating at 155 ± 10 degrees Fahrenheit for minimum 6 hours. Pre-conditioning and post conditioning digital radiographs shall be taken of the ESAPI samples. The test specimen shall then be ballistically tested in accordance to with paragraph 3.9.3 for threat "d". Subject ESAPI (different to those subjected to high temperatures) to cold exposure at - 60 ± 10 degrees Fahrenheit for minimum 6 hours then ballistically test in accordance with paragraph 3.9.3 for threat "d". After each exposure ESAPI 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 Verification. Conduct this test at ambient temperatures between 60 - 80 degrees Fahrenheit. Contaminate ESAPI in one of the following containers of fluid. At least one ESAPI will be subjected to contamination to each of the three fluids; 30 weight lubricating oil of commercial grade SE or better, commercial grade diesel fuel and salt water. For lubricating oil and diesel fuel place ESAPI 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 ESAPI. For salt-water contamination test, submerse ESAPI in container for a minimum of 2 hours. ESAPI s shall be held vertically to drip dry for 5 minutes. Pre-conditioning and post conditioning digital radiographs shall be taken of

the ESAPI samples. The test specimen shall be ballistically tested in accordance with paragraph 3.9.3 for threat "d" within 30 minutes after each exposure.

4.8.4 Altitude Test. Place the ESAPI in an ambient air pressure chamber to simulate a 40,000-ft 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 - 2,000-ft/min. The test specimen shall be ballistically tested in accordance with paragraph 3.9.3 for threat "d".

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 will be performed on all non-certified materials. Tests will be performed in accordance with Method 508.4 of MIL-STD-810. A sample of each non-certified material will be placed in the fungus test chamber for 28 days. No ballistic tests are required.

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

4.9 Performance Requirements Verification. Complete each verification 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 exact materials, thickness, sizes, weights of all components and areal density of ESAPI system.
2. Test projectile with exact nomenclature.
3. Temperature and humidity measurements.
4. Yaw angle.
5. Angles of target obliquity.
6. Velocity measurements of each test shot used to test the ESAPI (regardless of whether that particular velocity was used in the V_{50} or V_0 determination).
7. PP (Partial Penetration) and CP (Complete Penetration) next to each shot velocity as determined.
8. Angle of spall/debris ejection.
9. Name of company performing tests.
10. Type of gun barrel, caliber and propellant used
11. 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.

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)-feet (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 $\pm$ 10% relatively humidity. Temperature and humidity measurements shall be recorded before the beginning of days test firings and every two hours thereafter.

4.9.5 Projectile Yaw Determination. 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_{50} BL Calculation. 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_{50} BL determination that will be accepted as reliable test results.

4.9.7 PP and CP Determination for V_{50}. Complete and partial penetrations will be determined based on the impressions left on the soft under garment. Both the insert and soft under garment will be mounted on the clay block.

4.9.8 V_{50} Test Sample Mounting. Unless otherwise stated the following conditions shall be performed during V_{50} testing. The ESAPI 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-662 except partial and complete penetrations will be determined based on impressions left on the soft under garment and/or holes on the rear surface of the ESAPI.

4.9.9 Ballistic Acceptance Testing. Ballistic acceptance testing of ESAPI 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 or full protection (no complete penetrations) the minimum velocities as stated in paragraph 3.9.3 will be the requirement. V_0 and ESAPI acceptance testing will be performed within the specifications of paragraph 4.9.9.

4.9.9.2 Impact Location. The first fair hit impact (0 degrees obliquity) will be between 0.75 - 1.25-inch. from any edge. The second impact (0 degrees) will be no further than 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 third impact (30 degrees) will be no further than 6.0 in. from the second impact.

4.9.9.3 Back Face Deformation Measurement. The back of the ESAPI 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 4.0-inches thick and 24 x 24 inches in length and height. The clay shall be conditioned for at least 3.0-hours at a temperature between 60 and 95 degrees Fahrenheit and worked thoroughly to remove any voids. 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-feet ± 0.8-in**)** onto one of its square faces. Before ballistic testing the clay material will be contoured to the back face curvature provided by the ESAPI. This buildup will use additional clay backing material conditioned in the same manner as the clay material fixture. Both the soft fragmentation protection and ESAPI will be strapped or taped to the curved surface of the clay material. Back-face deformations in the clay will not exceed 1.70-inches (43mm) max (Paragraph 3.9.3) when measured from the original undisturbed surface of the backing material to the lowest point of the depression. All Back Face Deformation measurements will be conducted at 0 degree obliquity only. Indentation measurements will utilize measurement devices (+/-0.1 mm accuracy) incorporating a fixed reference "guide" (See Figure 2) that can rest solidly upon two edges of the fixture, establishing the reference plane across the diameter of the indentation. The distance between the reference "guide" and original undisturbed surface will be measured at the point of intended impact prior to impact. The distance between reference "guide" and the lowest point of depression will be measured after impact. Back-face deformation will be the difference between the two measurements**.** (see Figure 2).

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 ESAPI 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 7.62x63 mm APM2 projectile 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 obliquity impacts can be achieved anywhere on the sample.

4.9.9.5 Spall, Debris and Residual Penetrator Determination. Witness sheets for determining potential injuries to the wearer will be mounted around the front, sides, top and bottom of the ESAPI test sample. The witness inserts shall be a 2024-T3 or 2024-T4 aluminum alloy sheet,

0.020 in. 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 ESAPI sample. The front sheet will be place 12.0 - 14.0-inches away from the front of the ESAPI 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 ESAPI 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 angle of spall ejection as measured from point of impact to the perforation closest to the ESAPI specimen will not exceed 60 degrees. The ESAPI will be capable of mitigating the vast majority of spall/debris ejecta as defined by the occurrence of no more than two (2) perforations per shot or no more than six (6) total perforations for the three shots.

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 ESAPI is intended for use by ground combat troops. The ESAPI when inserted into the fragment protective vest carrier will provide protection from certain small arms fire. The ESAPI is part of a protective system, which includes a soft fragmentation and handgun tactical vest. The ESAPI 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, 4.3.1 and 6.3).
e. Packaging requirements (see paragraph 5.1).

6.3 First article. When a first article is required, it shall be inspected and approved under the appropriate provisions of FAR 52.209. 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;

Fair Impact. Impact of an unyawed bullet of the specified bullet type, velocity and obliquity (± 3 degrees) except, during V0 Testing, -

1. An otherwise fair impact at excessive velocity which does not result in penetration or excessive back face deformation shall be a fair impact,
2. An otherwise fair impact at low velocity, which penetrates or generates excessive back face deformation, shall be a fair impact.
3. An impact which violates shot spacing or edge distance (paragraph 4.9.9.2) 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 ESAPI.

Complete Penetration (CP) for Acceptance Testing. Complete penetrations have occurred when the projectile, fragment of the projectile or fragment of the armor material is imbedded or passes into the soft under garment used behind the ESAPI. 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.

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. 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. The level of hazard of impact surface spall shall be determined in accordance with 4.9.9.5.

Yaw. Projectile yaw is the angular deviation of the longitudinal axis of the projectile from the line of flight at a point as close to the impact point on the target as is practical to measure.

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. For general information items have been produced to this specification using the following technical data:

MIL-C-44050 Cloth Ballistic, Aramid, Type II. Class 2
MIL-P-64153 Insert, Boron Carbide Ceramic (For Use in Armor Composites)
MIL-STD-662 Ballistic Acceptance Test Method for Personnel Armor Material
MIL-STD-810, Method 500.3., Procedures I, II and III. Pressure Change Tests
MIL-STD-810, Method 508.4., Fungus Test Procedures
MIL-STD-810, Method 503.3., Temperature Shock Test
National Institute of Justice Standard 0101.03 Ballistic Resistance of Police Body Armor

6.9 National Stock Numbers.

X-SMALL	8470-01-520-7360
SMALL	8470-01-520-7370
MEDIUM	8470-01-520-7373
LARGE	8470-01-520-7385
X-LARGE	8470-01-520-7392

6.10 Simulant/Surrogate Shoot-Pack. A Simulant/Surrogate Shoot-Pack system of OTV body armor may be used to represent the ballistic resistant materials of the OTV (see CO/PD 00-02). The surrogate shoot pack system will consist of (1) a ballistic filler packet and (2) a ballistic filler carrier with ESAPI pocket. The baseline ballistic filler packet will be 15 x 15 inches in size consisting of 28 plies, 600 denier KM2 style 706, 34 X 34 water repellent treated. 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 ESAPI pocket capable of holding the largest ESAPI 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 ESAPI 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.

6.11 Recycled, Recovered or Environmentally Preferable Materials. Re-cycled, recovered or environmentally preferable materials should be used to the maximum extent possible provided the materials meet or exceed all specified requirements and promote economically advantages life cycle costs.

6.12 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous edition were made. This was done as a convenience only and the Government assumes no liability whatsoever based on inaccuracies in these notations. Bidders and Contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last issue.

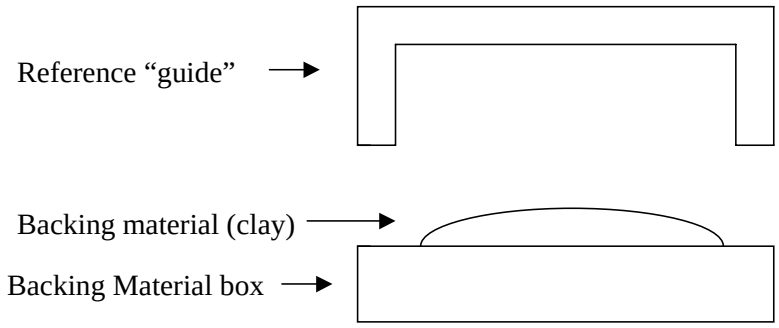
6.13 Subject Term (key word) Listing.

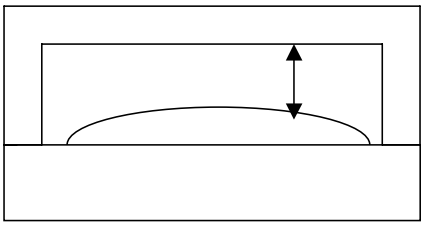
Small Arms
Armor
Tactical
Insert

EXAMPLE OF REFERENCE GUIDE

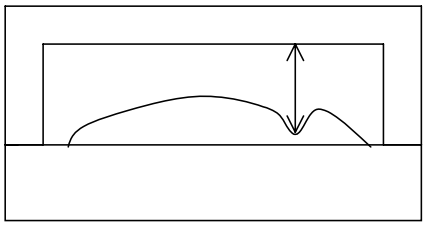
NOTE: Example of Reference Guide (For Information Only). See Paragraph 4.9.9.3, Back Face Deformation Measurement.

FIGURE 2





Measurement before impact



Measurement after impact