Report No. D-2011-088

August 1, 2011

Inspector General
United States Department of Defense

Ballistic Testing for Interceptor Body Armor Inserts Needs Improvement

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Acronyms and Abbreviations

ANSI	American National Standards Institute
ASQ	American Society for Quality
BFD	Back Face Deformation
COPD	Contract Purchase Description
COR	Contracting Officer's Representative
COTR	Contracting Officer's Technical Representative
DCMA	Defense Contract Management Agency
DOT&E	Director, Operational Test and Evaluation
ESBI	Enhanced Side Ballistic Inserts
ESAPI	Enhanced Small Arms Protective Insert
FAR	Federal Acquisition Regulation
FAT	First Article Test
FPS	Feet per Second
GAO	Government Accountability Office
IBA	Interceptor Body Armor
IG	Inspector General
LAT	Lot Acceptance Test
mm	millimeters
PEO	Program Executive Office
PM SEQ	Program Manager Soldier Equipment
QAR	Quality Assurance Representative
RDECOMAC	Research, Development and Engineering Command Acquisition Center
SAPI	Small Arms Protective Insert
XSAPI	Next Generation Small Arms Protective Insert

INSPECTOR GENERAL
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August 1, 2011

MEMORANDUM FOR COMMANDING GENERAL, PROGRAM EXECUTIVE OFFICE SOLDIER
DIRECTOR, DEFENSE CONTRACT MANAGEMENT AGENCY
AUDITOR GENERAL, DEPARTMENT OF THE ARMY

SUBJECT: Ballistic Testing for Interceptor Body Armor Inserts Needs Improvement (Report No. D-2011-088)

We are providing this report for your information and use. We determined that ballistic testing and quality assurance for Interceptor Body Armor inserts did not have proper controls to ensure that the ballistic inserts met contract requirements. Consequently, the Army cannot be sure that the appropriate level of protection has been achieved. This is the fourth in a series of Interceptor Body Armor reports in response to a congressional request. We considered management comments on a draft of this report when preparing the final report.

The Army comments conformed to the requirements of DoD Directive 7650.3. As a result of discussions with Program Manager Soldier Equipment officials and the subsequent management comments, we revised draft Recommendation B. The Army comments were responsive to all recommendations, and no further comments are required.

We appreciate the courtesies extended to the staff. Please direct questions to me at (703) 604-9071 (DSN 664-9071).

Bruce A. Burton
Deputy Assistant Inspector General
Acquisition and Contract Management

Results in Brief: Ballistic Testing for Interceptor Body Armor Inserts Needs Improvement

What We Did

We are performing a series of Interceptor Body Armor audits in response to a congressional request. This audit evaluated product quality assurance for seven Army contracts, valued at $2.5 billion, for ballistic inserts awarded between 2004 and 2006. Specifically, we determined whether the results for First Article Tests (FATs) and Lot Acceptance Tests (LATs) met contract requirements and whether quality assurance personnel performed the product quality surveillance in accordance with contract requirements.

What We Found

The Army Program Manager Soldier Equipment (PM SEQ) could provide only limited assurance that approved ballistic materials for approximately 5 million inserts on seven contracts met the contract requirements. This occurred because PM SEQ did not consistently enforce the requirements for testing the body armor ballistic inserts. Specifically on two contracts, PM SEQ did not conduct all the required tests because they had no protection performance concerns on these inserts. On all seven contracts, PM SEQ did not always use the correct size ballistic insert for FATs, use a consistent methodology for measuring the proper velocity, or enforce the humidity and temperature requirements. In addition, PM SEQ did not require weathered and altitude tests on six of the seven contracts.

PM SEQ officials indicated that neither the size of the ballistic insert nor the humidity and temperature would affect the test results. The proper velocity was not always calculated because the contracts did not define the process for determining the velocity, and the weathered and altitude tests were eliminated to expedite FAT in support of the urgent wartime requirement for the ballistic inserts.

Defense Contract Management Agency (DCMA) Phoenix personnel did not use an appropriate random sampling methodology to select a statistically representative sample for the LATs. This occurred because DCMA personnel believed that their sampling process provided a representative sample. As a result, the LAT results cannot be relied on to project identified deficiencies to the entire lot.

Because we did not conduct any additional testing, we could not conclude that ballistic performance was adversely affected by inadequate testing and quality assurance.

What We Recommend

Program Executive Officer Soldier should

- revise the COPD to clearly define the point at which velocity is to be measured;
- perform the weathered and altitude tests as required by the COPD; and
- perform a risk assessment on two lots, to determine whether the ballistic inserts will perform as intended.

Management Comments and Our Response

The Deputy for Acquisition and Systems Management responded for the Assistant Secretary of the Army for Acquisition, Logistics and Technology and agreed with the recommendations. As a result of his comments we revised Recommendation B. The planned actions meet the intent of the recommendations.

Recommendations Table

Management	Recommendations Requiring Comment	No Additional Comments Required
Commanding General, Program Executive Office Soldier		A.1, A.2, A.3, B

Table of Contents

Introduction 1

Objectives 1
Background 1
Quality Assurance 3
Internal Control Weaknesses Were Identified 4

Finding A. Limited Assurance Obtained From Ballistic Insert Testing 5

Testing Process for IBA Ballistic Inserts 6
Ballistic Inserts Were Not Tested Consistently 7
Critical Decisions Were Not Documented 12
Contractor Employees Performed Inherently Governmental Functions 14
The Chief Scientist Had Too Much Oversight Responsibility 15
Management Actions 16
Conclusion 18
Management Comments on the Finding and Our Response 18
Recommendations, Management Comments, and Our Response 19

Finding B. Improvements Needed for IBA Insert Test Sample Selection Process 21

DCMA Quality Assurance Process 21
LAT Sample Selection 21
DCMA Sampling Methodology May Not Identify Defects 22
Damaged Sample Items Were Replaced With Nondefective Items 23
Management Actions 23
Recommendation, Management Comments, and Our Response 24

Appendices

A. Scope and Methodology 26
Observation of DCMA Sample Ballistic Insert Selection 26
Use of Computer-Processed Data 27
Use of Technical Assistance 27
B. Prior Coverage 28
C. Request From Congresswoman Slaughter 30
D. Memorandum to DCMA Regarding Body Armor Sampling 32
E. DCMA Response 34

Table of Contents (cont'd)

Management Comments

Department of the Army Comments 39

Introduction

Objectives

The overall objective of our audit was to evaluate the product quality assurance for seven Army ballistic insert contracts. Specifically, we determined whether the ballistic test results for First Article Tests (FATs) and Lot Acceptance Tests (LATs) met contract requirements. Further, we determined whether quality assurance personnel performed product quality surveillance in accordance with contract requirements. See Appendix A for a discussion of scope and methodology and prior coverage.

Background

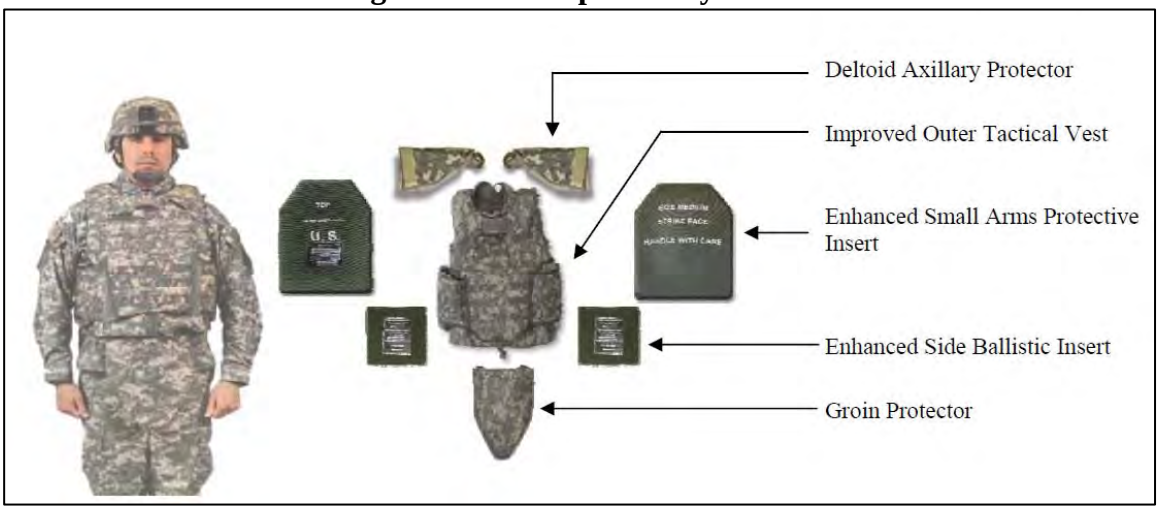
This is the fourth in a series of reports issued in relation to a request from Congresswoman Slaughter (see Appendix B). DoD Inspector General (IG) Report No. D-2008-067, "DoD Procurement Policy for Body Armor," March 31, 2008, identified 13 contracts that did not have documentation on first article testing. In a June 23, 2008, letter, Congresswoman Slaughter requested that the DoD IG conduct a further review of the 13 contracts. DoD IG Report No. D-2009-047, "DoD Testing Requirements for Body Armor," January 29, 2009, addressed FATs for 1 of the 13 contracts. DoD IG Report No. D-2010-029, "DoD Contractor Qualifications and Selection Criteria for Body Armor Contracts," December 21, 2009, addressed the contractor qualifications and selection criteria of those 13 contracts. Six of the 13 contracts were addressed in DoD IG Report No. D-2011-030, "Ballistic Testing and Product Quality Surveillance for the Interceptor Body Armor - Vest Components Need Improvement," January 3, 2011. This report addresses the remaining 7 of the 13 Army contracts valued at $2.5 billion, awarded to six contractors for ballistic inserts.[1]

Interceptor Body Armor Ballistic Inserts

Interceptor Body Armor (IBA) is a modular body armor system that consists of an outer tactical vest, ballistic inserts, and components that increase the area of coverage. Ballistic inserts include front and back Small Arms Protective Inserts (SAPIs) or Enhanced Small Arms Protective Inserts (ESAPIs) and Enhanced Side Ballistic Inserts (ESBIs). IBA increases survivability by stopping or slowing bullets and fragments and reducing the number and severity of wounds. Figure 1 shows the IBA system components.

[1] DoD IG Report No. D-2009-047, "DoD Testing Requirements for Body Armor," January 29, 2009, addressed the FATs for one of the remaining seven contracts (W91CRB-04-D-0040). This report addresses the LATs for contract W91CRB-04-D-0040.

Figure 1. Interceptor Body Armor



Source: Army Program Executive Office Soldier

Contracts for Ballistic Inserts

The Army Research, Development and Engineering Command Acquisition Center (RDECOMAC) awarded seven contracts, valued at $2.5 billion, to six contractors from January 2004 to December 2006 for IBA ballistic inserts. Table 1 provides an overview of products purchased, the quantities of products purchased, and the dollar value of each.

Table 1. Army Contracts for Small Arms Protective Ballistic Inserts

Contractor	Product	Contract Number	Maximum Quantity	Contract Value
ArmorWorks	SAPI/ESAPI	W91CRB-04-D-0040	829,000	$461,000,000
Simula[2]	SAPI/ESAPI	W91CRB-04-D-0042	829,000	461,000,000
Cercom	SAPI/ESAPI	W91CRB-04-D-0043	829,000	424,470,000
Composix	SAPI	W91CRB-04-D-0044	829,000	362,120,000
Armacel Armor	SAPI/ESAPI	W91CRB-04-D-0045	829,000	204,460,000
Ceradyne	ESBI	W91CRB-06-C-0002	100,000	70,000,000
ArmorWorks	ESBI	W91CRB-06-D-0029	891,000	543,070,000
Total			**5,136,000**	**$2,526,120,000**

To meet the increasing demands for IBA, the Army anticipated awarding multiple contracts. In 2004, RDECOMAC awarded five contracts for a total value of about $1.9 billion for SAPIs. Four of these contracts were modified to produce ESAPIs. The Army also awarded two contracts for ESBIs and carriers, for approximately $613 million, in 2006.

[2] Simula was later bought out by BAE Systems

Quality Assurance

Standards

Defense Federal Acquisition Regulation Supplement, Subpart 246.102, "Policy," requires DoD departments and agencies to conduct audits to ensure that the quality of products and services meets contractual requirements.

The contract purchase description (COPD) stated that LATs shall be conducted in accordance with the American National Standards Institute (ANSI)/American Society for Quality (ASQ) Standard ANSI/ASQ Z.1.4. ANSI/ASQ Z.1.4 states:

> When appropriate, the number of units in the sample shall be selected in proportion to the size of sub-lots or sub-batches, or parts of the lot or batch, identified by some rational criterion. The units from each part of the lot or batch shall be selected at random, as defined in ANSI/ASQ- A3534-2-1993.

ANSI/ASQ A3534-2-1993, "Drawing of Samples," defines "random" as ensuring that all items have the same probability of selection.

Oversight

The RDECOMAC, Program Executive Office Soldier (PEO Soldier), and Defense Contract Management Agency (DCMA) were responsible for overseeing the seven contracts. RDECOMAC provides acquisition and contracting support.

PEO Soldier, a component of TACOM Life Cycle Management Command, develops and fields equipment to U.S. troops. PEO Soldier ensures that the soldier and everything he or she wears or carries work together as an integrated system. The result is an overall systematic design that enhances the soldier's ability to accomplish individual and collective tasks, improves quality of life, builds confidence, and saves lives.

A division of PEO Soldier, the Program Manager Soldier Equipment (PM SEQ) develops, fields, and sustains equipment to advance warfighting capabilities. PM SEQ procures, adapts, or develops sensors, lasers, clothing, other equipment, and survivability items. PEO Soldier was responsible for the technical aspects of the seven body armor contracts, such as developing and coordinating the product descriptions and specifications, as well as scoring the FAT and LAT results.

On July 8, 2009, PM SEQ was restructured and renamed Project Manager Soldier Protection and Individual Equipment. PM SEQ was the name of the division at the time the contracts were awarded; therefore, we refer to Project Manager Soldier Protection and Individual Equipment as PM SEQ. To oversee the contracts, PM SEQ designated the chief scientist as the contracting officer's technical representative (COTR). The COTR is primarily responsible for monitoring and verifying the contractor's compliance with the contract's technical requirements.

DCMA, a DoD combat support agency, provides contract management services, covering pre-award and post-award activities. DCMA is responsible for ensuring contractor compliance with contractual terms and conditions, ranging from cost and schedule analysis to on-site surveillance. DCMA was responsible for inspection and acceptance of the ballistic inserts at the contractors' manufacturing facilities. After inspection, a DCMA quality assurance representative (QAR) at the contractor's facility selected and shipped the ballistic insert samples for lot acceptance testing.

Requirements

Federal Acquisition Regulation (FAR) Part 46, "Quality Assurance," prescribes policies and procedures to ensure that supplies and services acquired under Government contract conform to the contract's quality and quantity requirements. The FAR further states that quality requirements include inspection, acceptance, and warranty. The IBA COPD provided the requirements for the material, design, FAT, LAT, and inspections for the hard armor inserts. In addition, the COPD specified the environmental conditions, ballistic threats, quantities, and ballistic insert sizes that the test lab must follow when conducting a FAT. The ballistic threats are A, B, C, and D.[3] The SAPI was designed to provide protection from A, B, and C, while the ESAPI was designed to defeat an additional threat, D.

The COPD also specifies when a fair shot occurs during the testing. According to the COPD, the projectile must strike the ballistic insert at the required location and within the required velocity range to be valid. The required location of the projectile impact was between 0.75 and 1.25 inches from the edge of the ballistic insert. The required velocity range depended on the ballistic threat used during testing. The COPD contained a scoring system to determine acceptance or rejection of the test. In general, the accumulation of more than six penalty points resulted in a failed FAT or LAT.

Internal Control Weaknesses Were Identified

DoD Instruction 5010.40, "Managers' Internal Control Program Procedures," July 29, 2010, requires DoD organizations to implement a comprehensive system of internal controls that provides reasonable assurance that programs are operating as intended and to evaluate the effectiveness of the controls. We identified internal control weaknesses in quality assurance processes over the Army IBA Program. PM SEQ did not ensure adequate oversight of FAT or LAT processes or adequately review, approve, or document FAT and LAT results. We will provide a copy of the report to the senior officials at the Army and DCMA.

[3] The specific ballistic threats are sensitive, so we refer to the threats as A, B, C, and D.

Finding A. Limited Assurance Obtained From Ballistic Insert Testing

PM SEQ did not consistently enforce the requirements for testing the body armor ballistic inserts. Specifically,

- PM SEQ approved two designs that did not have valid V_{50} tests.[4] On two of seven contracts, PM SEQ procured and distributed 85,144 ESAPIs and 6,884 ESBIs from the designs. PM SEQ officials indicated that they did not have concerns about the protection performance on these designs.

- PM SEQ did not always use the correct size ballistic insert for the FATs. On the four SAPI/ESAPI contracts we reviewed,[5] 33 of 34 ESAPI FATs used at least one incorrect size ballistic insert. DoD IG Report No. D-2009-047, "DoD Testing Requirements for Body Armor," January 29, 2009, noted that for contract W91CRB-04 D-0040, test labs tested the wrong size insert multiple times on 18 of 21 FATs. A PM SEQ project engineer claimed that performance was not dependent on size, that contractors made all ballistic inserts from the same material, so they would have the same ballistic performance.

- PM SEQ did not require a consistent methodology for measuring and recording velocity for all seven contracts. We identified 617 tests where velocity loss was not applied to determine strike velocity. In 63 of the 617 tests, additional testing would have been required had velocity loss been applied. This occurred because the COPD did not explicitly define how to calculate velocity or apply velocity loss value.

- PM SEQ did not require FAT weathered and altitude tests on six of seven contracts.[6] The Director, Technical Management, claimed weathered and altitude tests take a week to complete, thus substituting with ambient tests expedited FATs to support an urgent wartime operational requirement for ballistic inserts.

- PM SEQ did not require adherence to humidity and temperature requirements on 655 FATs and LATs for the seven contracts. The chief scientist claimed that a humidity deviation, either too high or too low, would not affect ballistic performance.

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[4] V_{50} testing determines the velocity at which a complete or partial penetration of the armor is equally likely to occur.

[5] Two of the seven contracts were for ESBIs, which were only produced in one size. First article testing for contract W91CRB-04-D-0040 was addressed in DoD IG Report No. D-2009-047, "DoD Testing Requirements for Body Armor," January 2009.

[6] We did not review the FATs for contract W91CRB-04-D-0040; they were reviewed under DoD IG Report D-2009-0047.

- PM SEQ did not prepare or maintain documentation on two of seven contracts to support acceptance of one FAT and one LAT. In addition, PM SEQ did not document changes to test procedures. This occurred because PM SEQ did not provide adequate oversight of IBA contracts.

A contributing factor to testing issues was that PM SEQ placed too much oversight responsibility on the chief scientist, who served as COTR for at least 28 IBA contracts, contracting officer's representative (COR) for at least 4 test lab contracts, and master scorer for at least 13,202 IBA ballistic tests.

PM SEQ did not meet contract requirements for executing ballistic tests; therefore, the Army cannot be sure that ballistic inserts met the COPD. PM SEQ developed the COPD to provide an appropriate level of protection for warfighters. As a result, the Army lacks assurance that 5.1 million ballistic inserts acquired through the seven contracts provide appropriate protection.

Testing Process for IBA Ballistic Inserts

After contract award and before the contractor begins full rate production, RDECOMAC requires a FAT to ensure that the selected contractor can manufacture ballistic inserts to the contract requirements. RDECOMAC can waive a FAT if the contractor previously furnished the same approved product that met all contract requirements. Additionally, RDECOMAC requires a new FAT if the contractor makes any changes to the approved model/materials or manufacturing processes during the course of the contract. During the production phase, RDECOMAC requires LATs to detect random defects before Government acceptance. PM SEQ is responsible for preparing the technical requirements and provides RDECOMAC the product quality requirements, such as testing and inspection, for incorporation in the contracts. Further, PM SEQ is responsible for reviewing all ballistic tests results to determine whether the inserts were tested in accordance with the contract requirements detailed in the COPD.

Ballistic testing is conducted to ensure that the ballistic inserts provide the required protection before issuing them to warfighters. The test requirements the ballistic inserts must meet are detailed in the COPD. During testing, ballistic inserts are attached to a clay block, also referred to as clay backing material, which substitutes for a soldier's body mass.

The COPD divides ballistic testing into two categories: V_0 Ballistic Resistance and V_{50} Ballistic Limit. The COPD required 13 V_0 tests and 4 V_{50} tests for the ballistic inserts. V_0 testing is conducted by shooting a specific projectile at a given velocity at a ballistic panel to determine whether the armor provides full protection. The required velocities for the projectiles are detailed in the COPD. One of the parameters that should be considered when measuring V_0 results is back face deformation (BFD); the depth of the crater left in the clay for each partial penetration represents the blunt force trauma inflicted on the wearer, which can contribute to injury, incapacitation, or death. The BFD should not exceed 1.70 inches, or about 43 millimeters (mm). V_0 results are based on

three shots, two at 0 degree obliquity[7] and one at 30 degree obliquity. V_{50} testing determines the velocity at which a complete or partial penetration of the armor is equally likely to occur. V_{50} results are based on a minimum of six shots; three complete penetrations and three partial penetrations, also known as Average V_{50}.

The COTR devised the V_0+ test, which combined the V_0 resistance to penetration and the V_{50} ballistic limit tests. The V_0+ test procedure extended the V_0 by shooting three additional shots on a single ballistic insert at an elevated velocity. The objective velocities for the additional three shots were at or above the V_{50} velocity requirement. The COTR accepted this V_0+ test as evidence that the design met both the V_0 and the V_{50} requirements if all shots were partial penetrations, the first three shots met the BFD requirements, and the average velocity of all six shots was higher than the V_{50} requirement. Table 2 presents the volume of ballistic inserts tested.

Table 2. First Article and Lot Acceptance Tests for Army Contracts

Contract	Product	First Article Testing		Lot Acceptance Testing	
		Tests	Inserts	Tests	Inserts
W91CRB-04-D-0040	SAPI/ESAPI	N/A	N/A	364	2,036
W91CRB-04-D-0042	SAPI/ESAPI	26	440	393	2,219
W91CRB-04-D-0043	SAPI/ESAPI	5	55	38	246
W91CRB-04-D-0044	SAPI	1	24	9	48
W91CRB-04-D-0045	SAPI/ESAPI	2	39	53	204
W91CRB-06-C-0002	ESBI	2	44	69	606
W91CRB-06-D-0029	ESBI	8	150	296	1,672
Total		**44**	**751**	**1,222**	**7,031**

Ballistic Inserts Were Not Tested Consistently

PM SEQ did not enforce compliance of ballistic testing according to the requirements in the COPD. The tests we reviewed were incomplete, executed with the wrong size ballistic insert, or performed in environmental test conditions outside of the range specified by the COPD. In addition, PM SEQ did not apply a consistent methodology when evaluating the ballistic tests.

Invalid Test Results

On two of the seven contracts, PM SEQ did not conduct all of the V_{50} tests required in the COPD. According to the COPD, any failure to meet or exceed the V_{50} requirements at threat A, B, or C will result in the failure of the design.

- PM SEQ passed 16 ESAPI FAT designs for contract W91CRB-04-D-0042. Of those designs, PM SEQ accepted one without a valid V_{50} test or equivalent V_0+ test. The

[7] Obliquity is a measure, normally in degrees, of the extent to which the impact of a projectile on an armor material deviates from a line normal to the target.

FAT conducted on February 10, 2005, did not have a valid test for either threat A or C. For both threats, the projectiles did not reach the required velocity for the test to be valid. PM SEQ procured 85,144 ESAPI ballistic inserts, valued at $59.7 million, from the design. PM SEQ accepted these ballistic inserts even though the test lab did not perform the test in accordance with the COPD.

- PM SEQ awarded contract W91CRB-06-D-0029 to ArmorWorks, and on December 19, 2006, a FAT was conducted on ESBI design MP2S1. Even though this FAT passed, it did not have a valid test for threat B because the velocities of the projectiles did not meet the COPD requirement. The test lab entered incorrect velocities into the FAT scoring summary sheet, and PM SEQ used those velocities to validate the test, but the recorded velocities on the actual test results were lower. On June 14, 2007, design MP2S1 was retested and passed a FAT that met the requirements in the COPD. However, at that time, PM SEQ had already accepted 6,884 ESBIs of design MP2S1.

PM SEQ representative did not have concerns about the protection performance of the two designs because the ballistic inserts were engineered to handle a threat over and above the threat experienced in theater. Although these designs did not fail testing, the tests were not based on COPD requirements.

Incorrect Ballistic Insert Sizes Tested for FATs

PM SEQ did not ensure that FATs included the correct sizes for all four SAPI/ESAPI contracts.[8] The SAPI/ESAPI ballistic inserts were made in extra-small, small, medium, large, and extra-large sizes. Of 34 FATs, 33 were not conducted in accordance with the COPD requirements to test different size ballistic inserts. Of 558 ballistic inserts tested during the 34 FATs, 167 (30 percent) were not the required size. Table 3 identifies, by contract, the number of FATs that contain an incorrect size ballistic insert and the total number of ballistic inserts tested that contain an incorrect size ballistic insert.

Table 3. Contracts With FATs That Used Ballistic Inserts of an Incorrect Size

Contract	FATs	FATs With Incorrect Size Ballistic Inserts	Total Ballistic Inserts Tested	Incorrect Size Ballistic Inserts
W91CRB-04-D-0042	26	26	440	146
W91CRB-04-D-0043	5	4	55	9
W91CRB-04-D-0044	1	1	24	4
W91CRB-04-D-0045	2	2	39	8
Total	**34**	**33**	**558**	**167**

[8] Two of the seven contracts were for ESBIs, which were only produced in one size. One of the seven contracts, W91CRB-04-D-0040, was addressed in DoD IG Report No. D-2009-047, "DOD Testing Requirements for Body Armor," January 29, 2009.

DoD IG Report No. D-2009-047, "DoD Testing Requirements for Body Armor," January 29, 2009, noted that for contract W91CRB-04 D-0040, design MP2S2, the insert size was wrong many times during 18 of the 21 FATs but only one retest was conducted. Lab personnel initially tested a small, medium, and large insert at threat D under ambient conditions instead of testing an extra-small, large, and extra-large insert, as required by the test plan.

Reduction of Extra-Small Ballistic Inserts Tested

The COPD required the test labs to use five extra-small ballistic inserts during FATs. PM SEQ's implementation of the V_0+ test and elimination of the weathered testing reduced the number of extra-small ballistic inserts tested from five to one.

Inserts Accepted Without Any Ballistic Testing

PM SEQ procured and distributed 10,316 ESAPIs whose testing was incomplete. Contract W91CRB-04-D-0042, PM SEQ approved six designs for production of extra-small ballistic inserts without having that size tested. One of those six designs received FAT approval without the contractor even submitting an extra-small ballistic insert for testing. PM SEQ ultimately procured 2,412 extra-small ESAPIs from four of these six designs.

Another design from contract W91CRB-04-D-0042 did not receive FAT approval for production of small ESAPI ballistic inserts. PM SEQ procured 3,238 small ballistic inserts from 13 lots of this design. In addition, the Master Lot Report did not differentiate between two possible ESAPI designs for 43 other lots. Because the two FATs approved different sizes, PM SEQ procured and distributed 4,666 small ESAPIs from FATs that did not include tests or approval for this size.

Effect of Ballistic Insert Size on Performance

A PM SEQ Project Engineer stated that ballistic insert performance is not dependent on its size. He emphasized that all ballistic inserts are manufactured from the same material and, therefore, they would all have the same ballistic performance. However, a staff specialist with Live Fire Test and Evaluation for the Director, Operational Test and Evaluation (DOT&E) stated that:

> For reasons of adopting best practices and concern over the potential issues of performance differences related to insert size, the Army with DOT&E's support, changed lot requirements to be of homogeneous size. Subsequent to adopting this policy there are indications that performance differences exist based on insert size.
>
> I believe the composition of all insert sizes is identical. It is possible though for insert size to affect performance. Recent testing shows that, in some cases, back-face deformations are higher for large and extra large designs from specific contractors.

DOT&E is currently evaluating this correlation in Phase II of their IBA standardization process. Regardless, PM SEQ should not approve a ballistic insert size unless it

conforms to the COPD requirements. The COPD required PM SEQ to test ballistic insert sizes under particular conditions, and deviating from those requirements decreased assurance that ballistic inserts can meet the intended level of protection.

Inconsistent Calculations of Velocity

PM SEQ did not require a consistent methodology for measuring and recording velocity on the test results sheets for all seven contracts. The test labs subjected ballistic inserts to ballistic threats within a range of velocities specified in the COPD. To determine the velocity at impact (or strike velocity), the test lab reduced the measured velocity by the amount of velocity lost between the measuring device and the point of impact. If the strike velocity was outside the range specified in the COPD, the test labs should have tested another ballistic insert. However, the test labs inconsistently incorporated velocity loss into the final recorded velocity. This occurred because the COPDs did not explicitly define how to calculate velocity or how to apply the velocity loss.

Of approximately 13,000 test shots we reviewed, we identified 89 shots that would have been outside the required velocity range if the test labs had properly accounted for the velocity loss in their recorded velocity measurement. This resulted in 55 ballistic inserts that PM SEQ should have required a retest.

The significance of correctly applying the velocity loss calculation was demonstrated in a July 25, 2005, FAT for contract W91CRB-04-D-0042. The acceptable velocity range required by the COPD was between 2,850 and 2,900 feet per second (FPS). The test lab incorrectly subtracted a velocity loss of 6 FPS from the measured velocity of 2,907 FPS instead of the 7 FPS it had listed on its FAT scoring sheet. This math error resulted in the test lab recording an over-velocity shot of 2,901 FPS, which rendered the test invalid. If the test lab had correctly applied the velocity loss of seven FPS, the original shot would have been within the acceptable velocity (2,900 FPS), and PM SEQ would have awarded 1.5 points for the limited failure to the original shot on this ballistic insert. These additional penalty points would have resulted in the failure of the FAT. Instead, the test lab tested another ballistic insert, which resulted in a passing score. This allowed PM SEQ to pass the FAT and accept 33,696 ESAPI ballistic inserts of this design at a cost of $24 million.

The point at which velocity is measured should not be open to interpretation. To avoid inaccurate test results and inconsistency in calculating the strike velocity, PM SEQ must specifically define a standardized procedure for calculating the velocity of projectiles and the values of velocity loss to be applied per threat, because a deviation of 1 FPS can alter the acceptance or rejection of a lot or design.

Weathered and Altitude Tests Not Performed

PM SEQ did not require weathered and altitude tests, as specified in the COPD, for six of the seven contracts and 43 out of 44 FATs. The COPD included criteria for weathered and altitude environmental testing on every FAT. The weathered test subjected a ballistic insert to moisture and light, which strained the ballistic inserts beyond the ambient test.

Table 4 shows that one weathered and altitude test was performed for 1 of 44 FATs on one of six contracts.

Table 4. Weathered and Altitude Tests Not Performed

Contracts	Product	Number of FATs	Number of FATs Missing Weathered and Altitude Tests
W91CRB-04-D-0040	ESAPI	N/A*	N/A*
W91CRB-04-D-0042	ESAPI	26	26
W91CRB-04-D-0043	ESAPI	5	5
W91CRB-04-D-0044	SAPI	1	1
W91CRB-04-D-0045	ESAPI	2	2
W91CRB-06-C-0002	ESBI	2	2
W91CRB-06-D-0029	ESBI	8	7
Total		**44**	**43**

*We did not review the FATs for contract W91CRB-04-D-0040; they were reviewed under DoD IG Report D-2009-0047.

PM SEQ routinely eliminated or substituted these tests with ballistic inserts shot at ambient conditions to expedite FATs. The PM SEQ Director, Technical Management, stated that weathered and altitude tests normally take a week to complete. According to the director, the intent of substituting the weathered and altitude tests with ambient tests was to expedite FATs in support of the urgent wartime operational requirement for IBA.

The director asserted that an additional reason that they did not conduct weathered and altitude tests was because the ceramic ballistic inserts are solid structures that are not sensitive to reduced pressure and moisture. PM SEQ offered no evidence that failure to conduct these tests did not affect the results of ballistic testing. PM SEQ made the decision to meet the urgent operational need to supply soldiers with ballistic inserts. However, the ballistic inserts are a significant part of the soldier's protection system. Although we cannot predict the impact an additional week for testing would have on warfighters' protection, substitution of the weathered and altitude tests with the less stringent ambient tests decreases assurance that the ballistic inserts will meet the intended level of protection.

Humidity and Temperature Out of Range

PM SEQ did not require adherence to the appropriate humidity and temperature conditions dictated by the COPD on all seven contracts. According to the COPD, the acceptable environmental temperature range for testing was between 58 and 78 degrees Fahrenheit. The acceptable relative humidity for testing was between 40 and 60 percent. Of 1,266 FATs and LATs we analyzed, PM SEQ accepted the results of 655 (52 percent) with humidity measurements or temperatures outside the acceptable range.

Of 1,266 FATs and LATs we analyzed, PM SEQ accepted the results of 655 (52 percent) with humidity measurements or temperatures outside the acceptable range.

The PM SEQ Chief Scientist said that a change in humidity, regardless of being too high or low, should not affect ballistic performance. However, PM SEQ included these requirements in new Next Generation Small Arms Protective Insert (XSAPI) contracts. We question why the requirement was included in XSAPI contracts if the environmental conditions were not significant. In addition, although the chief scientist and the specialist did not believe the test conditions would affect results, they provided no evidence to support their opinion. As long as the humidity and temperature ranges remain in the contract, PM SEQ should ensure that testing complies with those requirements.

PM SEQ Justification on Inconsistent Testing

The chief scientist and Director, Technical Management, stated they made test procedure changes to make the process more efficient by saving time or eliminating redundancies. They claimed they disregarded certain tests because they had no impact on ballistic performance and because, for some tests, no specific requirements existed. The Director, Technical Management, emphasized that ballistic inserts were over engineered to handle a threat above and beyond what was experienced in theater, both in caliber and velocity, which would compensate for the variability in test procedures.

PM SEQ provided no documentation to support its decisions to deviate or make processes more efficient or its decisions that certain tests had no impact. Without documentation, we cannot validate PM SEQ decisions. We did not test ballistic inserts; therefore, we cannot conclude how deviations affected ballistic performance.

Critical Decisions Were Not Documented

PM SEQ did not prepare or maintain documentation to support critical decisions regarding the passing or accepting of one FAT and one LAT. FAR 46.104, "Contract Administration Office Responsibilities," requires the contract administration office to maintain suitable performance records reflecting decisions regarding the acceptability of the products, processes, and requirements. Without adequate documentation, PM SEQ cannot support that the body armor purchased on the subject contracts complies with requirements set forth in the contracts to ensure the safety of warfighters. These two undocumented FAT and LAT resulted in the procurement of 34,236 inserts at a cost of $24.5 million.

PM SEQ Did Not Document Changes to FAT Score

PM SEQ did not properly document and support its decision to use an alternative method for measuring BFD. For contract W91CRB-04-D-0042, PM SEQ passed the FAT on July 25, 2005, with a score of 6 and issued a FAT approval letter. In general, the accumulation of more than 6 points results in a failed FAT. We determined that this FAT should have failed with a score of 7. One ballistic insert (No. 882251) had a BFD of 45 mm, and according to the COPD, 1 additional point should have been added to the FAT score. However, PM SEQ did not apply the point to this ballistic insert, and the FAT passed.

The chief scientist provided a copy of the FAT with a sticky note displaying a mathematical formula used to reduce the BFD measurement to "42-43 mm." The chief scientist stated that he used an offset-correction technique to adjust the BFD from a failing 45 mm to a passing 42-43 mm. We do not consider the sticky note on the FAT scoring sheet as supporting documentation. There is no documentation to support why this ballistic insert did not incur the additional point, which would have resulted in a failed FAT.

The ballistic performance of insert 882251 was tested under low-temperature conditions. The COPD called for testing low-temperature conditions with threat D on a small ballistic insert.[9] The chief scientist asked for supplemental testing, performed on July 25, 2005, on three additional ballistic inserts for this design to ensure that the design met ballistic standards. The test lab tested one medium ballistic insert against threat D, but only shot it once instead of three times, as required by the COPD. The test lab tested the other two ballistic inserts against threats that were not required for FAT approval purposes. In addition, the supplemental tests only used ambient conditions and not the required low temperature. Although the ballistic inserts passed, the test lab did not replicate the original test conditions. Consequently, these supplemental tests did not increase confidence that this design could provide protection in low-temperature conditions.

There is no documentation to support why this ballistic insert did not incur the additional point, which would have resulted in a failed FAT.

PM SEQ Did Not Document Contested LAT

PM SEQ did not properly document and support its decision to overturn a potential catastrophic failure as defined by the COPD. PM SEQ accepted ballistic inserts on contract W91CRB-04-D-0040 although a LAT had a BFD of 48 mm. PM SEQ officials did not adequately document their decision to accept the lot even though the COPD considers a BFD of 48 mm to be a catastrophic failure. The chief scientist claimed that the lot did not fail because the shot was too close to the edge. The COPD requires that the first shot be between .75 and 1.25 inches from an edge. PM SEQ did not document the incident.

The test lab conducted the LAT on lot 0935-MD2S2 on March 28, 2007. The first shot on the second ballistic insert, serial number 0426675, resulted in a BFD of 48 mm. The contractor determined that the shot was too close to the edge and elected to have another ballistic insert tested immediately. The contractor shipped the ballistic insert in question to the chief scientist for inspection. The chief scientist indicated that he and others at PM SEQ agreed and requested that a product manager at PM SEQ review the data. However, PM SEQ staff did not take any photographs of the contested ballistic insert or document its serial number.

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[9] Threat D is a ballistic threat considered a more robust surrogate for the actual threat encountered in theater.

On March 29, 2007, an additional ballistic insert was tested and achieved a passing score. Based on this test, PM SEQ accepted and distributed the lot. Figure 2 contains a photograph of the ballistic insert, taken by the contractor and provided to us by PM SEQ. However, there were no identifiable serial numbers or tile numbers to indicate that the ballistic insert in question was the same as the one in the photograph. We asked to see the ballistic insert, but PM SEQ staff could not locate it.

Figure 2. Photograph of the Contested Ballistic Insert

Source: Army Program Executive Office Soldier

In instances that involve a disputed test, PM SEQ should maintain adequate documentation in the event that future questions are raised. Documentation should include photographs, x-rays, serial numbers, or the actual item, as appropriate.

Contractor Employees Performed Inherently Governmental Functions

PM SEQ allowed a contractor employee to perform an inherently governmental function. Specifically, the contractor employee sent an e-mail to the contractor, PM SEQ, DCMA Phoenix, and RDECOMAC personnel approving lot 0930-MD2S2 and rejecting lot 0935-MD2S2.

As discussed earlier, lot 0935-MD2S2 was contested by the contractor to the chief scientist, a Government official. The chief scientist instructed a support contractor employee to "review the data and make the call." The contractor employee reversed his initial opinion and sent an e-mail to DCMA Phoenix approving the lot. The contractor employee should not have approved the lot. The lack of PM SEQ review resulted in the contractor performing an inherently governmental function, which is a violation of FAR 2.101, "Definitions of Words and Terms," and FAR 7.503(c)(12)(v), "Inherently Governmental Functions, Policy."

As noted in FAR 2.101, inherently governmental functions do not normally include gathering information for—or providing advice, opinions, recommendations, or ideas to—Government officials. A contractor can be used to perform the tests and report the test results to PEO Soldier. However, FAR 2.101 includes the making of value judgments as an inherently governmental function. FAR 7.503(c)(12)(v) states that administering contracts, including accepting or rejecting contractor products, is an inherently governmental function, but Government personnel must perform the value judgment leading to the decision of whether the test results in the acceptance or rejection of the lots.

PM SEQ implemented new procedures for scoring ballistic test results. Two PM SEQ personnel will independently score the test results, then the master scorer or Director, Technical Management, will independently review and score the test. The master scorer will compare the results against the other two scoring results, resolve any inconsistencies, and issue a final determination to retest, accept, or reject a lot.

The Chief Scientist Had Too Much Oversight Responsibility

The PM SEQ Chief Scientist served as the COTR on at least 28 IBA contracts from 2004 to 2008. The 28 contracts, worth $5 billion, were awarded to 12 different contractors located in seven different states. As the COTR, the chief scientist's responsibilities included monitoring and verifying contractor compliance with contract technical requirements and maintaining communications with the contractors.

In addition to his duties as the COTR for the IBA contracts, the chief scientist was the COR for at least four test lab contracts during this same period. The COR has similar yet more expansive responsibilities than the COTR. As the COR on the test lab contracts, the chief scientist was responsible for maintaining details on the contractors' progress and submitting monthly certifications to the contracting officer that the work performed and materials purchased were within the scope of the contract. He was also responsible for advising the contracting officer of any problems and for providing monthly reports on the contractors' compliance with contract requirements as detailed in the surveillance plan.

The chief scientist was also the master scorer of all IBA ballistic tests from 2004 to 2008. The master scorer is responsible for reviewing all ballistic test data, calling for retests when the initial test is not compliant with the COPD, and reviewing scores from two

other ballistics scorers. The master scorer ultimately decides whether to accept the IBA components for further manufacturing and distribution or to reject them. On the seven ballistic insert contracts we reviewed, the test labs conducted 13,204 IBA ballistic tests and recorded the data for the master scorer to review, comprising:

- 7 preliminary design models consisting of 236 shots onto 145 ballistic inserts,
- 44 FATs consisting of 1,308 shots onto 751 ballistic inserts, and
- 1,222 LATs consisting of 11,658 shots onto 7,031 ballistic inserts.

The chief scientist also had other duties and responsibilities, as documented in his position descriptions, including:

- evaluating lab research,
- providing scientific and technical counsel,
- conducting theoretical and experimental studies,
- speaking at institutions of higher education and military conferences,
- improving compatibility with warrior combat clothing, equipment, and weapon systems, and
- representing the U.S. Army in the North Atlantic Treaty Organization.

As the COTR, COR, master scorer, and chief scientist, one person had control over multiple key aspects of IBA procurement and quality assurance.

The COTR and COR appointment memoranda prohibited the chief scientist from taking any actions that involved a change in unit price, total price, quantity, quality, delivery, or other terms and conditions of the contract. However, DoD IG Report No. D-2009-047, "DoD Testing Requirements for Body Armor," January 29, 2009, disclosed that the COTR made an unauthorized change to contract W91CRB-04-D-0040 by instructing the test labs to deviate from the COPD and use an offset-correction technique (a mathematical formula used to adjust the BFD). The PM SEQ COTR communicated this change by e-mail to the test lab without approval from the contracting officer. The report also noted that PM SEQ officials were present at the test lab for only 4 of 21 FATs for contract W91CRB-04-D-0040.

The extent of the COTR, COR, master scorer, and chief scientist responsibilities indicates a heavy workload covering a variety of duties for one person. This heavy workload may have contributed to the testing issues and the lack of documentation needed to support critical decisions regarding the COPD requirements.

Management Actions

Since the award of these contracts, PM SEQ has taken corrective actions in response to prior audits by the DoD IG, the Government Accountability Office (GAO), and the Army Audit Agency (AAA), as well as conditions identified in this report. In August 2009, PM SEQ established an Executive Director for Quality, Process, and Compliance, with responsibility for verifying and implementing improved management controls, including

development of tools for recording key information, events, and decisions. The Executive Director also ensures that decisions are reviewed as changes occur in requirements, contractor performance, technological advances, and the operational environment.

PM SEQ updated the test operating procedures for ballistic testing of IBA inserts using clay backing. PM SEQ also updated the purchase description for ESAPIs. PEO Soldier issued the final test plan for IBA improvements, analysis plans for ESAPIs in inventory and theater, an analysis plan for ESAPIs and XSAPIs, and a purchase description for XSAPIs in response to prior audits. In addition, PM SEQ has created a database for all FATs; LATs; DD 250s, "Material Inspection and Receiving Reports"; waivers; and other pertinent information for the 28 contracts assessed in the DoD IG Report No. D-2008-067, "DoD Procurement Policy for Body Armor," March 31, 2008, as well as future contracts. This database was used for official test and scoring data beginning in 2008.

In December 2010, PM SEQ issued a standard operating procedure that requires an Army representative to be present for all FATs and LATs and instituted a three-tier scoring system. PM SEQ hired three civilian engineers to the scoring team. PM SEQ also has hired/promoted a senior systems engineer and a senior quality engineer. The team and supporting engineers have since been assigned COR responsibilities. As a result of these changes, the master scorer duties and COR duties were divided among multiple individuals; PM SEQ now has seven test scorers, two of which are master scorers. The master scorer develops a recommendation for the contracting officer, and the contracting officer issues the final approval letter to the contractor and to DCMA to authorize production. Further, appointment letters for CORs outlined contracting officers' monitoring and administrative responsibilities related to body armor contracts, to include maintaining files of all contract-related documents. Therefore, we are not making a recommendation related to the Chief Scientists' level of oversight responsibility.

In addition, the U.S. Army Test and Evaluation Command established the Data Authentication Group to act as an advisory committee to the Body Armor Working Integrated Product Team and U.S. Army Test and Evaluation Command Science Team. The Data Authentication Group will offer advice on the suitability of the data for analysis and evaluation in accordance with U.S. Army Test and Evaluation Command Pamphlet 73-1, Appendix N, September 2004, for Aberdeen Test and Evaluation Center Data Authentication Groups. The Data Authentication Group met routinely during testing to perform its charter mission. The U.S. Army Test and Evaluation Command will validate the use of commercial labs for LATs. Currently, the U.S. Army Test and Evaluation Command is evaluating two test laboratories.

The Assistant Secretary of the Army for Acquisition, Logistics and Technology established an independent team of personnel from the U.S. Army Materiel Command Quality Federation to observe testing and to provide an independent assessment of IBA test procedures. This team observed testing of inventory and theater IBA ballistic inserts and made recommendations to improve test procedures.

In November 2009, the Secretary of the Army announced that the National Research Council would perform an independent assessment of ongoing IBA testing:

> The purpose of the NRC assessment is to ensure that the Army maintains the highest standards for testing processes and protocols, thus addressing concerns raised by the GAO about current testing procedures.

According to a GAO report, GAO-10-119, October 2009, *Warfighter Support: Independent Expert Assessment of Army Body Armor Test Results and Procedures Needed Before Fielding*, the Army has taken significant steps to conduct tests in a controlled environment. For example, the Army has implemented the consistent documentation of testing procedures using audio, video, and other electronic means and extensive efforts to maintain proper temperature and humidity in the test lanes. Furthermore, the Army has spent about $10 million over the last few years upgrading the existing facilities with state-of-the-art capability to support research and development and production qualification testing for body armor.

In consideration of management actions taken, we limited our recommendations to encompass only those issues not already addressed by the Army.

Conclusion

Regardless of how the IBA inserts are engineered, variations in test procedures reduce assurance that PM SEQ procured ballistic inserts that conform to contract requirements. PM SEQ cannot predict the impact on safety for FATs conducted using the incorrect ballistic insert size and LATs conducted outside of the required temperature range because the effect of these variables was not determined. PM SEQ did not consistently enforce COPD requirements for testing and accepting IBA inserts on all seven contracts.

Consequently, the Army cannot be sure that ballistic inserts meet COPD requirements. As a result, the Army lacks assurance that 5.1 million ballistic inserts acquired through the seven contracts provide appropriate protection. We did not test ballistic inserts purchased through the seven contracts; therefore, we could not conclude whether the deviations affected ballistic performance.

Management Comments on the Finding and Our Response

Management Comments

The Deputy Assistant Secretary of the Army for Acquisition and Systems Management stated that the U.S. Army conducts rigorous and extensive testing of body armor to ensure that it meets U.S. Army standards and is safe for use in combat. The U.S. Army's test strategy requires that inserts pass various extreme operating environments, Ballistic Limit testing (V_{50} test) and Resistance to Penetration testing (V_0 test) during first article testing. Resistance to Penetration testing is also performed during lot acceptance testing

to verify that the product that passed first article testing maintains its demonstrated quality level. The Army's test requirements verify that body armor meets U.S. Army and DoD standards before being issued to soldiers. Every soldier's ballistic insert is scanned prior to deployment and rescanned during his or her mid-tour leave as part of continuous surveillance testing after acceptance. The plates identified as having cracks or internal flaws are removed from inventory and destroyed.

Additionally, the DOT&E standardized first article testing by issuing a hard body armor standard protocol for ballistic testing on April 27, 2010. The protocol establishes standard testing references, procedures, and analytical processes for hard body armor testing. The Army began using this protocol on May 4, 2010. This protocol is now a common standard in body armor testing across DoD.

Our Response

We appreciate the management comments. We agree that PEO Soldier has taken numerous actions to improve the quality assurance process since the award of these contracts. We agree that incorporating the DOT&E standardized FAT protocol for hard body armor ballistic testing into the contract will assist PM-SEQ personnel in ensuring compliance with contract terms and conditions. We urge diligence as the protocol can only be effective if it is closely followed.

Recommendations, Management Comments, and Our Response

A. We recommend that the Commanding General, Program Executive Officer Soldier:

1. Revise the contract purchase description for Interceptor Body Armor inserts to clearly define strike velocity as the velocity measurement used for fair shot determination decisions.

Management Comments

The Deputy Assistant Secretary of the Army for Acquisition and Systems Management responded for the Commander, PEO Soldier. He agreed and stated that PEO Soldier issued both the ESAPI and the XSAPI purchase descriptions in 2010. Projectile velocity determination is defined in Appendix D in both documents, and a paragraph has been added to both documents to define over and under velocities, fair impacts, and complete penetrations.

2. Require that weathered and altitude tests are performed and documented in accordance with the contract purchase description for Interceptor Body Armor inserts.

Management Comments

The Deputy Assistant Secretary of the Army for Acquisition and Systems Management responded for the Commander, PEO Soldier. He agreed and stated that DOT&E incorporated the resistance test and altitude test into the hard armor protocol on April 27, 2010, and they are DoD standard tests for first article testing of ballistic inserts.

3. Perform a risk assessment of lot 0935-MD2S2, contract W91CRB-04-D-0040, to determine whether any of the Interceptor Body Armor inserts may not perform as required by the contract purchase description.

Management Comments

The Deputy Assistant Secretary of the Army for Acquisition and Systems Management responded for the Commander, PEO Soldier. He agreed and stated that the Army will perform a risk assessment of lot 0935-MD2S2, contract W91CRB-04-D-0040, to determine whether any of the IBA inserts will not perform as required by the contract purchase description. The risk assessment will be completed no later than October 2011.

Our Response

Comments from the Deputy Assistant Secretary of the Army for Acquisition and Systems Management are responsive, and the actions meet the intent of the recommendations.

Finding B. Improvements Needed for IBA Insert Test Sample Selection Process

DCMA Phoenix's sample selection processes did not result in a statistically representative sample for LATs, and, at one location, the QAR used an inappropriate methodology to replace defective items within samples. Specifically, the QARs did not use an appropriate statistical random sampling methodology to select the sample for the LATs. This occurred because the QARs incorrectly believed that selecting the IBA inserts from different stacks or pallets resulted in a random sample and provided every ballistic insert the same probability of selection. As a result, PM SEQ cannot assure with statistical accuracy that the IBA inserts meet the requirements in the contracts to ensure the safety of warfighters.

DCMA Quality Assurance Process

According to its Web site, DCMA provides a full spectrum of contract services, including product and quality assurance services, to ensure products are delivered on time, at projected cost, and meet performance requirements. DoD Components generally delegate these responsibilities to DCMA in writing through the contract. According to three of the seven contracts, DCMA Phoenix was responsible for inspecting the ballistic inserts at BAE Systems and ArmorWorks manufacturing plants.

LAT Sample Selection

The LAT sample selection process begins when contractor personnel notifying DCMA QARs that a lot is ready for a LAT. Depending on the lot size, the QAR selects three, five, or eight samples. Figure 3 shows examples of lots ready for sample selection.

The QAR selects the samples and observes as a contractor employee verifies that weight and dimensions comply with contract requirements. The contractor employee records the serial numbers on the DD 1222, "Request for and Result of Tests," and the QAR signs it. The QAR then sends the samples and the DD 1222 to the applicable test lab for LATs.

Figure 3. Hard Body Armor Lots Ready for Sample Selection

Source: Auditor Photographs

DCMA Sampling Methodology May Not Identify Defects

DCMA Phoenix QARs did not use an appropriate sample selection process for selecting of ballistic inserts, and their method did not ensure that all items in the lot had the same probability of being selected for testing. This negated the sample test results and diminished the possibility the test labs would identify defects during LATs. In April 2010, we interviewed two QARs responsible for overseeing the BAE Systems and ArmorWorks contracts to identify the sampling methodology used to select ballistic inserts for LATs.

Both QARs selected the required number of ballistic inserts for LATs by pointing to and removing them from different stacks or pallets. Our observation[10] of the process for contracts W91CRB-09-D-0002 and M67854-06-D-3072 confirmed that this was the method the QARs followed to select the ballistic inserts from different stacks. The method of pointing to and removing the inserts from the stacks or pallets did not ensure selection of a representative sample for the LATs. The QARs incorrectly believed that pointing to and removing sample ballistic inserts from different stacks or pallets was random and provided the same probability of selection. However, the sampling methodology the QARs used was subject to potential bias, deliberate or unintentional, in the sample selection.

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[10] See Appendix A for details on our observation.

The purpose of the LATs was to identify defects that occurred during the manufacturing process and to ensure that ballistic inserts were consistently meeting the COPD requirements. To be effective, the LAT needed to rely on a statistically derived process that resulted in the selection and testing of a representative sample to ensure the product met the contract requirements. The statistically derived representative sample must be selected through a very specific and defined methodology where the outcome is not predictable or biased. This means all items in the population have the same probability of being selected. The sampling methodology that DCMA Phoenix QARs used did not provide a statistically derived representative sample. Without a representative sample, the Government cannot rely on the LAT results.

Damaged Sample Items Were Replaced With Nondefective Items

The QAR for ArmorWorks stated that the vendor x-rayed every ballistic insert selected for a LAT because there were instances of the test lab receiving damaged or cracked ballistic inserts. When we asked what happened when the x-ray identified a cracked ballistic insert, the QAR responded that she would select another ballistic insert from the lot, which the contractor would then x-ray. If the new ballistic insert was free from cracks, the QAR would substitute it in place of the cracked ballistic insert. The QAR did not consider the omission of the cracked ballistic insert as a defect in the sample.

The replacement of the defective ballistic inserts in the LAT sample had serious implications. This action voided the representative sample, and no inference could be made from the LAT to the overall lot.

Management Actions

When informed of our concerns about the replacement of the ballistic inserts, the Director, DCMA, initiated a review of the issue in April 2010. DCMA stated that the replacement of the defective ballistic inserts occurred only at ArmorWorks. DCMA Phoenix research revealed two nonconformance reports since October 2007 that affected two lots: one for an October 2007 ESBI contract and the other for a May 2008 ESAPI contract. In both instances, the QAR replaced a single ballistic insert in the sample. DCMA emphasized that the contractor did not identify any cracks on either of these two ballistic inserts during the x-ray process. However, the cracked ballistic insert constitutes a defective sample and would be considered to have failed physical inspection as well as ballistic testing. DCMA's treatment of the cracked plate found on the x-ray was an improper treatment of a sample item.

The Deputy Director, DCMA, stated that DCMA Phoenix contacted the customers and apprised them of the two lots containing the replaced ballistic inserts. A U.S. Marine Corps representative stated the inserts associated with the lot tested in October 2007 had been removed from inventory. The Deputy Director, DCMA, also stated that DCMA will work with BAE Systems and ArmorWorks to review their in-process statistical management controls for lots presented for LAT. In addition, he stated DCMA Phoenix would take corrective action concerning the statistical sampling requirements for the hard

armor contracts and provide training to quality assurance personnel on proper sampling techniques. Further, he stated DCMA Phoenix would work with other DCMA IBA contract management offices to address standardization of surveillance plans based on customer requirements and recent agency policy changes. The Deputy Director also indicated that the Technical Team Chief and Team Leader would increase random surveillance of QAR LAT processes.

On April 21, 2010, the Deputy Director, DCMA, informed the DoD IG that DCMA had taken action to mitigate the increased risk from the faulty LAT sample selection. On June 22, 2010, the DCMA Deputy Director formally responded to a memorandum issued by the audit team regarding the deficiency of the DCMA sampling process (see Appendices C and D). The DCMA Deputy Director expanded on his previous comments regarding the corrective actions taken on the ballistic insert sampling process. He stated that the QARs will use a temporary solution to select random samples while DCMA develops a more permanent random number generator. The Deputy Director also provided additional details on the training and surveillance plans that will be provided to the entire DCMA Quality Assurance workforce. Finally, DCMA is working to develop a standard Body Armor Quality Assurance Letter of Instruction and a standard Government Contract Quality Assurance surveillance plan for body armor procurements. As a result of these corrective actions we did make a recommendation on the sampling process to DCMA.

In April 2011, PM SEQ officials advised the audit team that contract M67854-06-D-3072 is a Marine Corps contract and that the Army did not purchase any ballistic inserts from this contract. Consequently, we contacted U.S. Marine Corps Logistics Command regarding M67854-06-D-3072 (lot MSP0258-AMTS1). The Team Leader, Armor and Load Bearing Team, responded that based on our audit work, the team became aware of the finding in April 2010 and took steps at that time to remove the affected Enhanced Side-Small Arms Protective inserts from inventory. The team leader provided documentation from U.S. Marine Corps Logistics Command indicating that 930 of 984, or 95 percent, affected inserts had been recovered.

Recommendation, Management Comments, and Our Response

Revised Recommendation

As a result of discussions with PM SEQ officials and the subsequent management comments, we revised draft Recommendation B to remove the risk assessment on the lot for contract M67854-06-D-3072.

B. We recommend that the Commanding General, Program Executive Office Soldier, perform a risk assessment of the lot for contract W91CRB-09-D-0002 as a result of Defense Management Contract Agency Phoenix's improper treatment of a sample item.

Management Comments

The Deputy Assistant Secretary of the Army for Acquisition and Systems Management responded for the Commander, PEO Soldier. He agreed and stated that the Army will perform a risk assessment of contract W91CRB-09-D-0002 (lot 1051) no later than October 2011.

Our Response

Comments from the Deputy Assistant Secretary of the Army for Acquisition and Systems Management are responsive, and the actions meet the intent of the recommendation.

Appendix A. Scope and Methodology

We conducted this performance audit from March 2009 through March 2011 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

We conducted this audit at the following DoD and contractor sites: Office of the Director, Operational Test and Evaluation, Washington, D.C.; RDECOMAC, Aberdeen Proving Ground, Maryland; Army PEO Soldier, Fort Belvoir and Haymarket, Virginia; DCMA Phoenix, Arizona; ArmorWorks, Phoenix, Arizona; and BAE Systems, Phoenix, Arizona.

We interviewed contracting officials at RDECOMAC, program office personnel at PM SEQ, QARs from DCMA Phoenix, and key personnel at BAE Systems and ArmorWorks. We also interviewed a staff specialist from Live Fire Test and Evaluation, Office of the Director, Operational Test and Evaluation. To eliminate duplicate efforts and obtain additional evidence, we coordinated with personnel from GAO, Army Audit Agency, Defense Criminal Investigative Services, DoD IG Joint and Southwest Asia Operations, and Quantitative Methods and Analysis Directorate.

We collected and reviewed documents obtained for the seven contracts between the contract award date of August 19, 2004, and June 30, 2008, from RDECOMAC, PM SEQ, DCMA, BAE Systems, and ArmorWorks. We evaluated the quality assurance process for ballistic inserts to determine whether it was adequate.

We obtained and reviewed the ballistic tests for 7 preliminary design models, 44 FATs, and 1,222 LATs, which included 7,928 ballistic inserts. We also obtained an understanding from PM SEQ of how its personnel evaluated the ballistic test results. We analyzed the ballistic test results to determine whether preliminary design models, FATs, and LATs met contract requirements. We also compared the test results with the referenced COPDs.

We toured the BAE Systems and ArmorWorks manufacturing facilities for their production of ballistic inserts and observed the responsibilities each DCMA Phoenix QAR performed throughout the process. We reviewed the FAR, contract documents, purchase descriptions, and DCMA surveillance plans and quality assurance procedures.

Observation of DCMA Sample Ballistic Insert Selection

DCMA Phoenix QARs were responsible for sampling ballistic inserts from contracts W91CRB-06-D-0029, W91CRB-04-D-0040, and W91CRB-04-D-0042 for LATs. We observed sampling for contracts W91CRB-09-D-0002 and M67854-06-D-3072, which were not within the scope of the audit. RDECOMAC and Marine Corps Systems Command awarded the contracts for production of ESAPIs, XSAPIs, and ESBIs.

Although the contracts were not within the scope of the audit, the sample selection process was similar to the three contracts included in our review.

Use of Computer-Processed Data

We used computer-processed data to fulfill our objectives and perform this audit. We relied on ballistic test data prepared by independent National Institute of Justice-certified labs, which were obtained from PM SEQ officials, Government contractors, and DCMA personnel. We were unable to assess the reliability of the computer-processed ballistic test results. The test labs manually entered the test data into ballistic test result forms as the test was conducted. All tests were performed prior to the initiation of this audit, thus we were unable to observe the data capture process. As such, we were unable to measure the potential for human error during the transfer of data. However, to support our audit results, we pursued all material test data anomalies and concerns through discussions with the appropriate officials from PM SEQ, the Office of the Director, Operational Test and Evaluation, and the contractors. Those items we identified which could not be adequately justified were deemed material and are discussed in this report. We also observed the testing process at one of the National Institute of Justice-certified labs. We determined that the information system controls were not significant to the audit objectives and that it was not necessary to evaluate the effectiveness of information system controls in order to obtain sufficient appropriate evidence.

Use of Technical Assistance

The Technical Director, DoD IG Quantitative Methods and Analysis Division, helped us review the quality assurance process used for the IBA ballistic insert contracts. In addition, he advised us on the validity of the DCMA sampling process used for the LATs at BAE Systems and ArmorWorks.

Appendix B. Prior Coverage

This audit is the fourth in a series of reports in response to a request from Congresswoman Slaughter and addresses the seven ballistic insert contracts. The first report determined whether the Enhanced Small Arms Protective Inserts first article testing criteria for Army contract W91CRB-04-D- 0040 was in accordance with the contract. The second report focused on the contractors' backgrounds and qualifications. The third report focused on ballistic testing and quality surveillance for vest component contracts.

During the last five years, the GAO, DoD IG, and the Army have issued 12 reports related to IBA. Unrestricted GAO reports can be accessed at http://www.gao.gov. Unrestricted DoD IG reports can be accessed over the Internet at http://www.dodig.mil/audit/reports. Unrestricted Army reports can be accessed from .mil and gao.gov domains over the Internet at https://www.aaa.army.mil/.

GAO

GAO Report No. GAO-10-119, "Independent Expert Assessment of Army Body Armor Test Results and Procedures Needed Before Fielding," October 16, 2009

GAO Report No. GAO-07-662R, "Defense Logistics: Army and Marine Corps's Individual Body Armor System Issues," April 26, 2007

GAO Report No. GAO-05-275, "Actions Needed to Improve the Availability of Critical Items during Current and Future Operations," April 8, 2005

DoD IG

DoD IG Report No. D-2011-30, "Ballistic Testing and Product Quality Surveillance for the Interceptor Body Armor - Vest Components Need Improvement," January 3, 2011

DoD IG Report No. D-2010-029, "DoD Contractor Qualifications and Selection Criteria for Body Armor Contracts," December 21, 2009

DoD IG Report No. D-2010-027, "Army's Management of the Operations and Support Phase of the Acquisition Process for Body Armor," December 8, 2009

DoD IG Report No. D-2009-047, "DoD Testing Requirements for Body Armor," January 29, 2009

DoD IG Report No. D-2008-067, "DoD Procurement Policy for Body Armor," March 31, 2008

Army Audit Agency

Army Audit Agency Report No. A-2011-0082-ALA, "Implementing Body Armor Recommendations," April 15, 2011

Army Audit Agency Report No. A-2011-0081-ALA, "Body Armor Requirements Determination," March 21, 2011

Army Audit Agency Report No. A-2009-0130-FFD, "Body Armor Requirements," June 8, 2009

Army Audit Agency Report No. A-2009-0086-ALA, "Body Armor Testing: Program Executive Office, Soldier," March 30, 2009

Appendix C. Request From Congresswoman Slaughter

COMMITTEE ON RULES

LOUISE M. SLAUGHTER
CONGRESS OF THE UNITED STATES
28TH DISTRICT, NEW YORK

June 23, 2008

The Honorable Claude M. Kicklighter
Inspector General
U.S. Department of Defense
400 Army Navy Drive
Suite 1000
Arlington, VA 22202

Dear Mr. Kicklighter:

Thank you for taking the time to come in on Friday, June 20th and give me an update on your investigations into the Army's body armor procurement strategies. I am pleased to hear that you are expanding your investigation to look into the body armor sustainability, as well as into the deficiencies in contracts that were investigated in your March 31st, 2008 report.

I want to follow up with a couple of requests that I made during our meeting. I asked that you further look into the contracts that were identified in your report as not having documentation that support proper first article testing. You indicated that your team would be able to conduct this investigation and I eagerly await your findings.

In addition, I would like information on how those contracts were issued. Specifically, I request that you look into the background of the contracting firms, the criteria for awarding these contracts and the contractor's qualifications for being awarded these contracts, and whether or not they have any inappropriate connections to Army contracting officials. I ask that you report on any instances where a contract was inappropriately awarded and the Army's rationale for such an award. I also ask that you report on whether the contractors demonstrated an ability to successfully produce quality body armor for our soldiers in the field. I would also like this information for the criteria, qualifications, and any inappropriate connections for contracts awarded to any private testing facilities as well.

Thank you for taking the time to address these questions as well as those asked in my June 20th letter to you. As I have said before, it is critical that these questions are fully answered so that our men and women in the battlefield can be confident in their equipment to save their lives. I look forward to seeing your response to my original letter by Friday, June 27th 2008. If you have any questions, please feel free to contact me or [redacted].

Sincerely,

Louise Slaughter

Louise M. Slaughter
Member of Congress

Appendix D. Memorandum to DCMA Regarding Body Armor Sampling

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
400 ARMY NAVY DRIVE
ARLINGTON, VIRGINIA 22202-4704

May 14, 2010

MEMORANDUM FOR DIRECTOR, DEFENSE CONTRACT MANAGEMENT AGENCY
PROGRAM EXECUTIVE OFFICER SOLDIER

SUBJECT: Quality Assurance Issue Identified During the Audit of the DOD Body Armor Contracts (Project No. D2008-D000CD-0256.003)

In March 2009, we initiated an audit in response to Congresswoman Louise M. Slaughter's request that we review 13 body armor contracts that the Army awarded from June 2004 through July 2006. The primary audit objective was to review the quality assurance process for ballistic test data related to first article tests, lot acceptance testing (LAT), and product surveillance.

During our recent visit to the Defense Contract Management Agency (DCMA)–Phoenix, an issue came to our attention that required immediate action. The purpose of the visit was to observe how the DCMA quality assurance specialist (QAS) selects the samples of body armor plates for LAT. We observed the process of two contractors: ArmorWorks and BAE Systems. On April 14, 2010, two auditors and the Director, Quantitative Methods Directorate, met with DCMA–Phoenix officials to discuss the methodology used for sampling.

In a meeting with DCMA–Phoenix officials, the QAS for ArmorWorks stated that ArmorWorks x-rays every plate selected for LAT. The QAS explained that ArmorWorks started the x-ray procedure because there have been instances of the testing laboratory receiving damaged or cracked plates. We asked the QAS what happens if the x-ray identifies a cracked plate. The QAS responded that she would select another plate from the lot, which ArmorWorks would then x-ray. If the new plate has no cracks, the QAS would substitute it for the cracked plate. The QAS did not consider the cracked plate as a defect in the sample.

The process of replacing defective plates in the LAT sample described by the QAS has serious implications. The purpose of LAT is to identify defects that may occur during the manufacturing process and ensure that finished components consistently meet the contract requirements. LAT relies on a statistically derived process that results in the selection and testing of a representative sample from the lot. The removal and replacement of a defective plate from a LAT sample voids a representative sample, and no inference can be made from the LAT on the quality of the overall lot. This significantly limits the Government's ability to identify defective plates and to ensure that the plates meet the contract requirements. The end result is that defective or cracked plates could be issued to the field.

On April 16, 2010, the DOD IG discussed this issue with the Program Executive Officer Soldier and the Deputy Director, DCMA. The Program Executive Officer Soldier and the Deputy Director, DCMA, both indicated that they would conduct a review to address our concerns because of the potential implications.

On April 21, 2010, the Deputy Director, DCMA, provided the DOD IG the results of the review and a list of proposed corrective actions (Attachment). The review determined that there were two lots in which the QAS replaced a single plate in the sample. However, neither of the plates were cracked.

In addition to the actions outlined in the Deputy Director, DCMA, comments, we recommend the Director, DCMA; improve the sample selection process by implementing a viable statistical sampling methodology standard for all body armor contracts. The sampling methodology must eliminate any potential biases, deliberate or unintentional, and include:

- Procedures to ensure that when a defect is identified during the sample selection for LATs, the plates are not removed, and DCMA should apprise the DOD IG on procedures implemented to ensure sample integrity;
- A plan for continuous review of the manufacturers in-process statistical management controls for lots presented for LAT;
- Training on a continuous basis for all QAS's to include statistical and non-statistical sampling and how to randomize and select a random sample. A copy of the training materials and procedures for communicating questions and concerns to DCMA statistical sampling experts should be provided to all QASs;
- Details on how the surveillance plan will be standardized and incorporated into DCMA standard operating procedures;
- Standardized operating procedures for the random oversight of QASs LAT sample selections identifying when it will begin and the frequency of oversight; and
- Standardized operating procedures for the random review of the body armor manufacturing process identifying when it will begin and the frequency of review.

Please provide a status update within 30 days of implementing the actions outlined in this memorandum.

If you have any specific questions or need additional information about this memorandum, contact Mr. Richard B. Jolliffe at (703) 604-9201 (DSN 664-9201) (richard.jolliffe@dodig.mil).

Mary L. Ugone
Deputy Inspector General
for Auditing

Attachment:
As Stated

Appendix E. DCMA Response

DEFENSE CONTRACT MANAGEMENT AGENCY
6350 WALKER LANE, SUITE 300
ALEXANDRIA, VIRGINIA 22310-3241

IN REPLY
REFER to DCMA-Q

JUN 22 2010

MEMORANDUM FOR DEPARTMENT OF DEFENSE INSPECTOR GENERAL, DEPUTY INSPECTOR GENERAL FOR AUDITING

SUBJECT: DCMA Response to Quality Assurance Issue Identified During the Audit of DOD Body Armor Contracts (Project No. D2008-D000CD-0256.003)

We have attached the Headquarters, Defense Contract Management Agency response to subject recommendation.

The DCMA External Audit Liaison point of contact is [redacted]

Michael E.Shields, Jr.
Executive Director
Quality Directorate
Defense Contract Management Agency

DEFENSE CONTRACT MANAGEMENT AGENCY'S RESPONSE TO INSPECTOR GENERAL IDENTIFIED QUALITY ASSURANCE ISSUES DURING THE AUDIT OF DOD BODY ARMOR CONTRACTS (PROJECT NO. D2008-D000CD-0256.003) DATED May 14, 2010

Recommend DCMA improve sample selection process by implementing a viable statistical sampling methodology standard for all body armor contracts. The sampling methodology must eliminate all potential biases, deliberate or unintended.

DCMA response: DCMA has provided a link to a random number generator tool for the DCMA Orlando personnel to use when selecting random samples. The tool, which is already in use in Orlando, is located on the web at http://www.random.org/. DCMA-Q is attempting to locate or develop a more permanent random number generator for use by the entire DCMA Quality Assurance workforce.

DCMA-Q will provide specific training to address sampling methodology to include procedures to ensure that when a defect is identified during the sample selection for LATs (Lot Acceptance Test), the plates are not removed and DCMA should apprise the DOD IG on procedures implemented to ensure sample integrity.

DCMA response: DCMA Headquarters Quality Assurance Directorate (DCMA-Q) Senior QA Specialists will conduct a net meeting with all CMO director's, QA group Chiefs, Team Leaders and QA specialists to discuss the necessity to assure suppliers do not conduct any further processing or screening of samples selected for LAT testing. The only processing to occur after selection is packaging and shipping. This will further be a component part of QA training offerings QUAL101 for non-journey level QAS and QUAL201 for all journey level QAS.

DCMA-Q will provide specific training to address sampling methodology to include a plan for continuous review of the manufacturer's in-process statistical management controls for lots presented for LAT.

DCMA response: DCMA will require, where contractually specified, on-going Process Reviews of manufacturer's statistical process controls for lots presented for LAT. This will be accomplished by amending the current Government Contract Quality Assurance Planning Instruction.

DCMA-Q will provide specific training to address sampling methodology to include training on a continuous basis for all QAS's to include statistical and non-statistical sampling and how to randomize and select a random sample. A copy of the training materials and procedures for communicating questions and concerns to DCMA statistical sampling experts should be provided to all QAS's.

DCMA response: DCMA-Q will provide web based sampling training to the DCMA QA workforce on 14 July 2010. Sampling is already a module in the Training package for QUAL101 but will be further strengthened to assure training in the use of valid statistical sampling tools (i.e., Random Number Generators). Random number generator tools will be provided and made available in the Product Examination Instruction.

DCMA-Q will provide specific training to address sampling methodology to include details on how the surveillance plans will be standardized and incorporated into DCMA standard operating procedures.

DCMA response: DCMA is currently participating in an IPT to provide for the generation of a standard Body Armor Quality Assurance Letter of Instruction (QALI) for the body armor customers to include with contracts for Body Armor. DCMA CMO's who are currently cognizant of body armor contracts are working together to produce a standard GCQA surveillance plan for body armor procurements. DCMA Critical Safety Item instruction currently provides for minimum frequencies and intensities for identified critical characteristics and processes for non-aviation critical safety items. GCQA planning instruction requires adjustments in scope, frequency and intensity of surveillance based on supplier performance. Both the GCQA surveillance plan and QALI will be reviewed by DCMA-Q Senior QA Specialist for appropriateness prior to adoption and forwarding (QALI).

DCMA-Q will provide specific training to address sampling methodology to include standard operating procedures for the random oversight of QAS's LAT sample selections identifying when it will begin and the frequencies of oversight.

DCMA response: At DCMA Phoenix, Technical Team Chief and Team Leader will increase surveillance of QAS LAT process by randomly witnessing all future body armor LAT sample selections. This review of the random LAT sampling process has already begun on other product procurements in the plant. There are no active body armor contracts at this time. Because there is a newly assigned QA specialist the frequency currently is each lot. After confidence has been established, the random frequency will be once in three lots of body armor submitted for LAT. DCMA is releasing an instruction for First Line Supervisors (FLS) review of QAS performance. This FLS review is required to be appropriately risk based in terms of how often and how much of the QAS's work will be reviewed. All processes performed including statistical sampling will be done annually as a minimum.

DCMA-Q will provide specific training to address sampling methodology to include standardized operating procedures for the random review of the body armor manufacturing process identifying when it will begin and the frequency of review.

DCMA response: DCMA COO QA will begin the conduct of Quality Systems Reviews at select high-risk suppliers in FY 2011. They will provide for random review of body armor supplier's manufacturing and quality systems. The frequency will be established and defined in the COO standard operating procedure for Quality System Reviews.

DCMA Recommendation: An improvement in the acquisition of these and like items would be to require the supplier to conduct the ballistic tests on each lot of product produced, in a properly established test environment, in accordance with the ballistic testing procedures, and to submit for government testing only knowingly conforming (including ballistic capability) product. The government-selected samples would then be representative of a lot of product the supplier's quality system has assured conforms to contract quality and technical requirements.

FACT SHEET

SUBJ: **OIG DoD BODY ARMOR AUDIT AT DCMA-PHOENIX**

BACKGROUND: On 14 April 2010, personnel from the OIG DoD Audit Team visited DCMA-Phoenix staff regarding their ongoing research on DoD Body Armor Contracts. Specifically, OIG DoD personnel requested overviews of the ESAPI quality assurance processes for both body armor contractors within DCMA-Phoenix cognizance: BAE and Armorworks LLC. The OIG DoD personnel also requested vendor visits to witness sampling procedures. DCMA-Phoenix provided the attached brief and exchanged dialog.

The resident Quality Assurance Specialist (QAS) for Armorworks LLC presented the overview of the Lot Acceptance Testing (LAT) sampling process. The QAS indicated that after she pulls 5 samples for ballistic testing, the vendor's in-process procedure is to X-ray these samples. (This "x-ray" screening process is neither a DCMA pre-testing process nor a requirement within the associated contract(s), it is a process put in place by Armorworks LLC in Oct '07 due to perceived damage to their product caused by in-transit mis-handling, while enroute to NIJ labs for ballistic testing.) The QAS noted if the x-ray process identifies an anomaly, then she replaced the sample with another from the same lot. The company generates a Nonconformance Report (NCR), removes the plate, subsequently evaluated by Armorworks, and then the plate is destroyed.

The OIG DoD team questioned statistical validity of this replacement process. The QAS' rationale for this sampling process was that she felt she would knowingly be submitting potentially nonconforming product for testing if the abnormality was not replaced. Through follow on discussions, the QAS now has a complete understanding of the statistical impact of this sampling technique.

IMPACT/ACTION: The primary impact is the inadvertent statistical skewing during the LAT sampling process. This issue is restricted to ArmorWorks LLC only. DCMA-Phoenix research revealed two NCRs since October 2007, and is isolated with the following two lots: October 2007 MC Side-SAPI and May 2008 DSCP E-SAPI contract. In both instances, a single plate was replaced in the sample (one for one only). It should be emphasized, that there were **NO CRACKS** identified on either of these two plates during the x-ray process.

1. M67854-06-D-3072, Quantity Shipped 492 sets (2 Side SAPIs per set)
2. SPM1C1-08-D-1023, Quantity Shipped 547 each
3. The QAS understands the error, and ceased the LAT process cited herein on 14 April 2010

19 April 2010

4. DCMA-Phoenix requested and received copies of the x-rays and listing of serial numbers of plates for the two lots in question; these are available upon request and are proprietary. Excerpts of both NCRs are cited below for reference purposes.
5. Both of Armorwork's NCRs cite "no risk to the user". According to the President of Armorworks, Armorworks made this determination based upon their internal ballistic testing conducted in 2002.
6. Further, NCRs indicate anomalies "resin build up "and "resin shadowing". DCMA - Phoenix does not have the technical expertise to make determination of impact (if any) on ballistic performance and defer to the applicable service's engineering support activities.

GO FORWARD PLAN:

1. DCMA-Phoenix has contacted the customers (Army PEO Soldier, MARCORSYSCOM PMICE, DLA) apprising them of current status, and provided fact sheets.
2. DCMA-Phoenix will work with both BAE and Armorworks LLC to review their in-process statistical management controls for lots presented for LAT
3. DCMA-Phoenix will take action to better define the statistical sampling requirements referenced in the body armor contracts. At that time we will provide refresher training to QA personnel on proper sampling techniques and procedures.
4. DCMA-Phoenix will work with other DCMA Body Armor CMOs to address standardization of surveillance plans based on customer requirements and recent agency policy changes.
5. Technical Team Chief and Team Leader will increase surveillance of QAS LAT process by randomly witnessing all future body armor LAT sample selections.
6. DCMA Industrial Specialist will conduct periodic review of the manufacturing process
7. We will be forwarding the surveillance plans for both vendors to OIG DoD.

ARMORWORK LLC NCR SUMMARY:

1. NCR # 4375, contract number M67854-06-D-3072, Tile Lot # MSP0146-C3P2S1, 6x8inch Marine side plates, Serial #41-SHK31051, 10/15/07: Unit completed Final Inspection and was selected for ballistic testing. X-ray inspection revealed an indication. Destructive evaluation revealed resin shadow. No risk to user. Unit Scrapped.

2. NCR # 6003, contract number SPM1C1-08-D-1023, Tile Lot # D0051-MP2S2, DSCP E-SAPI, Serial # 30-M2ENL22895, 5/21/08 Unit was selected as ballistic test sample, but multiple x-rays revealed an unidentifiable artifact resembling an eraser sized hole in the upper half of the unit. Destructive evaluation revealed resin buildup. No risk to end user. Unit Scrapped.

19 April 2010

Department of the Army Comments

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY OF THE ARMY
ACQUISITION LOGISTICS AND TECHNOLOGY
103 ARMY PENTAGON
WASHINGTON DC 20310-0103

SAAL-SMS

MAY 26 2011

MEMORANDUM FOR U.S. ARMY AUDIT AGENCY

SUBJECT: Official Army Position, Department of Defense Inspector General (DoDIG) Draft Report, 21 April 2011, Improvements Needed On Ballistic Testing for Interceptor Body Armor Inserts (Project No. D2008-D000CD-0256.003)

1. Reference memorandum, DoDIG, 21 April 2011, subject: Improvements Needed on Ballistic Testing for Interceptor Body Armor Inserts (Project No. D2008-D000CD 0256.003).

2. The Office of the Assistant Secretary of the Army (Acquisition, Logistics and Technology) is submitting comments in response to the subject draft DoDIG report in accordance with the referenced memorandum.

3. There are four recommendations in the draft report and the Army concurs with all four of the recommendations. Program Executive Office, Soldier has already completed actions in response to Recommendations A1 and A2. Recommendations A3 and B will be implemented no later than 31 October 2011. Additional comments are provided at Enclosure 1.

4. The point of contact is [redacted]

R. Mark Brown
Major General, GS
Deputy for Acquisition and
Systems Management

Encls

Comments
DODIG Draft Report
Improvements Needed On Ballistic Testing for Interceptor Body Armor Inserts
D2008-D000CD-0256.003

Finding A: Limited Assurance Obtained From Ballistic Insert Testing

Additional Facts: ASA(ALT) is providing additional facts to add clarity and balance to the draft report. The U.S. Army conducts rigorous and extensive testing of body armor to ensure that it meets U.S. Army standards and is safe for use by Soldiers in combat. The U.S. Army performs a multi-tier test strategy to verify body armor performance prior to acceptance and issue to Soldiers. The U.S. Army's comprehensive test strategy encompasses a First Article Test (FAT), Lot Acceptance Test (LAT), and continuous surveillance testing after acceptance. During FAT, the plates are subjected to and must pass tests in various extreme operating environments, and must also pass both Ballistic Limit testing (V_{50} Test) and Resistance to Penetration testing (V_0 Test). Resistance to Penetration (V_0) testing is also performed during LAT to verify that the product which passed FAT maintains its demonstrated quality level. The Army's test requirements verify that body armor meets U.S. Army and DoD standards before being issued to Soldiers. The third level of testing is continuous surveillance of the plates. In 2008, PEO Soldier deployed a Nondestructive Test Equipment (NDTE) system to detect internal cracks to body armor plates and ensure there is no degradation in body armor performance over time. Every Soldier's ballistic plate is scanned prior to deployment and rescanned during their mid-tour leave. As of 30 April 2011, 2.7 million plates had been through the NDTE scanning process and 135,010 (5.0%) failed the inspection process due to cracks or flaws. The plates identified as having cracks or internal flaws are removed from inventory.

Additionally, a common standard in body armor testing is now in place across the Department of Defense (DoD). The Office of the Director, Operational Test and Evaluation (DOT&E) standardized First Article Testing by issuing a hard body armor standard protocol for ballistic testing on 27 April 2010. The objective of the protocol is to establish DoD-wide, statistically-derived test methods for hard body armor. Further, the protocol establishes standard testing references, protocols, procedures, and analytical processes for hard body armor testing. The Army began using this protocol for FAT on 4 May 2010.

Recommendations and Comments:

Recommendation A. Recommend that the Commanding General, Program Executive Officer Soldier:

1. Review the contract purchase descriptions for Interceptor Body Armor inserts to clearly define strike velocity as the velocity measurement used for fair shot determination decisions.

Final Report Reference

U.S. Army Management Action: Concur, action completed. Both the Enhanced Small Arms Protective Insert (ESAPI) Purchase Description (PD), CO/PD 04-19D dated 04 May 2010 and X Small Arms Protective Insert (XSAPI) PD, FQ/PD 07-03B dated 20 August 2010 include an Appendix D table that defines fair and unfair shots in relation to velocity for shot 1 and 2. Ballistic test criteria are defined in paragraph 4.9.1 within both documents. Projectile velocity determination is defined in paragraph 4.9.2 within both documents. Paragraph 6.6 has been added to both documents to define over and under velocities, fair impacts, and complete penetrations.

2. Require that weathered and altitude tests are performed and documented in accordance with the contract purchase description for interceptor Body Armor inserts.

U.S. Army Management Action: Concur, action completed. The weatherometer resistance test and altitude test has been incorporated into the Hard Armor protocol by DOT&E dated 27 April 2010 and is a Department of Defense standard test for the First Article Testing of ballistic inserts.

3. Perform a risk assessment of lot 0935-MD252, contract W91CRB-04-D-0040 to determine whether any of the Interceptor Body Armor inserts may not perform as required by the contract purchase description.

U.S. Army Management Action: Concur. The Army will perform a risk assessment of lot 0935-MD252, contract W91CRB-04-D-0040 to determine whether any of the Interceptor Body Armor inserts may not perform as required by the contract purchase description. The risk assessment will be completed NLT October 2011.

Finding B: Improvements Needed for IBA Insert Test Sample Selection Process

Revised 24-25

Recommendation B. Recommend that the Commanding General, Program Executive Officer Soldier, perform a risk assessment of the two lots for contracts W91CRB-09-D-0002 (lot 1051) and M67854-06-D-3072 (lot MSP0258-AMTS1) as a result of Defense Management Contract Agency Phoenix's improper treatment of a sample item.

U.S. Army Management Action: Partially concur. The Army will perform a risk assessment of W91CRB-09-D-0002 (lot 1051), NLT October 2011. However, contract number M67854-06-D-3072 is a Marine Corps contract that the Army did not use to purchase ballistic inserts. Therefore, the recommendation to perform a risk assessment of the lot from this contract should be redirected to the Marines.

Inspector General
Department of Defense