Audit Report

OFFICE OF THE INSPECTOR GENERAL

MILITARY SPECIFICATIONS FOR CRITICAL THREADED PRODUCTS

Report No. 94-043 February 24, 1994

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Acronyms

AIA	Aerospace Industries Association
ATCOM	Aviation and Troop Command
DISC	Defense Industrial Supply Center
DLA	Defense Logistics Agency
DPRO	Defense Plant Representative Office
FSPP	Flight Safety Parts Program
OIG	Office of the Inspector General

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
400 ARMY NAVY DRIVE
ARLINGTON, VIRGINIA 22202-2884

February 24, 1994

MEMORANDUM FOR ASSISTANT SECRETARY OF THE NAVY (FINANCIAL MANAGEMENT)
ASSISTANT SECRETARY OF THE AIR FORCE (FINANCIAL MANAGEMENT AND COMPTROLLER)
DIRECTOR, DEFENSE LOGISTICS AGENCY
AUDITOR GENERAL, DEPARTMENT OF THE ARMY

SUBJECT: Audit Report on Military Specifications for Critical Threaded Products (Report No. 94-043)

We are providing this audit report for your review and comments. The report discusses use of revised military specifications in DoD contracts for class 3 threaded products. The House Committee on Armed Services requested in the National Defense Authorization Act for Fiscal Year 1994 that the final report be provided by March 1, 1994. We considered Army, Navy, and Defense Logistics Agency comments in preparing this report.

DoD Directive 7650.3 requires that audit recommendations be resolved promptly. The Navy comments to the draft of this report were fully responsive. The Army and the Defense Logistics Agency comments were not responsive, and the Air Force did not provide comments in time to meet the reporting requirement. We will consider any Air Force comments received as comments on the final report unless additional comments are provided. Based on management comments, we deleted a draft finding, renumbered a recommendation, and redirected a recommendation to the Army Program Executive Officer, Aviation. We request the Army, the Air Force, and the Defense Logistics Agency to provide final comments on the unresolved recommendations by April 25, 1994.

We appreciate the courtesies extended to the audit staff. If you have any questions on this audit, please contact Mr. Richard Jolliffe, Program Director, at (703) 692-2999 (DSN 222-2999). Appendix F lists the distribution of this report. The audit team members are listed inside the back cover.

Robert J. Lieberman
Assistant Inspector General
for Auditing

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Office of the Inspector General, DoD

Report No. 94-043 **February 24, 1994**
(Project No. 3CA-5010)

MILITARY SPECIFICATIONS FOR CRITICAL THREADED PRODUCTS

EXECUTIVE SUMMARY

Introduction. This audit of military specifications for critical class 3 threaded products was performed to address House Committee on Armed Services concerns that the Military Departments were not utilizing revised military specifications. Class 3 threaded products include nuts and bolts and other parts used for aerospace applications requiring very high fatigue and stress levels.

On July 25, 1991, the Air Force, as the DoD preparing activity for class 3 threaded products specifications, issued revised military specifications, MIL-S-8879C and MIL-S-7742D. The revisions were to make thread inspection more stringent and thereby increase weapon systems safety and reliability. The Air Force revised the specifications based on evidence indicating that inspections did not adequately verify that threaded products in DoD inventories were acceptable.

Objectives. The original audit objective was to determine whether contracting officers were properly including the most recent revised class 3 thread military specifications in aerospace production and spare parts contracts. The original audit objective was expanded to assess how selected prime contractors applied the revised military specifications. The audit also evaluated the effectiveness of internal controls applicable to the objectives.

Audit Results. Contracting officers were not properly including the revised military specifications in aerospace production and spare parts contracts. Also, the prime contractors reviewed were not applying the revised military specifications. A draft finding on the implementation of a contractually required statistical process control system at the McDonnell Douglas Helicopter Company, Mesa, Arizona, facility was deleted from the report. We deleted the draft finding to allow time to analyze additional data from the contractor and the Defense Plant Representative Office at the Mesa facility and to meet a March 1, 1994, reporting deadline to the House Committee on Armed Services. The results of our review of the statistical process control system will be issued at a later date.

o DoD contracts did not contain the revised military specifications for class 3 threaded products. The revised military specifications were not incorporated in 18 of 19 aerospace production contracts reviewed and were not included in any of the 52 spare parts contracts reviewed. (However, 37 of the spare parts contracts specified comparable thread inspection methods.) For contracts without the revised military specifications or comparable inspection methods, DoD does not have assurance that class 3 threaded products conform to the military specifications that were revised to increase the quality of threads and weapon system safety and reliability (Finding A).

o The revised military specifications for class 3 threaded products are unclear as to the identification and inspection of safety critical and other thread categories. As

a result, prime contractors may categorize threads as safety critical when not necessary and may overestimate the implementation costs for the revised military specifications (Finding B).

Internal Controls. The audit identified material internal control weaknesses. The revised military specifications were not identified and included in DoD contracts. In addition, internal controls were not effective to verify that data bases used to prepare technical data packages were updated to reflect the revised military specifications. See Part I for the internal controls assessed and Part II for details on the weaknesses identified.

Potential Benefits of Audit. The report recommendations should produce future monetary benefits through reduced implementation costs for the revised military specifications. However, we could not quantify the potential monetary benefits. Appendix D summarizes the potential benefits resulting from the audit.

Summary of Recommendations. We recommended that the Military Departments and the Defense Logistics Agency issue written internal control objectives and verification techniques to substantiate the inclusion of the revised military specifications in all contracts containing class 3 threaded products. We recommended that the Army Program Executive Officer, Aviation, direct that a cost-benefit analysis be performed of contractor cost submissions to implement the revised military specifications for the UH-60 Blackhawk helicopter program. We also recommended that the Air Force modify the existing military specifications to require a single definition and identification method and clarify military specification language.

Management Comments. The Navy concurred with and was implementing recommendations directed to it. The Army generally concurred with the intent of the recommendations and stated that a memorandum had been sent to ensure that appropriate action was being taken with regard to the implementation of the latest version of military specifications. The Assistant Secretary of the Army (Research, Development, and Acquisition) requested that the recommendation concerning a detailed cost-benefit analysis for the UH-60 Blackhawk helicopter program be redirected to the Army Program Executive Officer, Aviation. The Defense Logistics Agency nonconcurred, stating that existing Defense Logistics Agency procedures were sufficient to verify that the most recent specifications were included in contracts. The Air Force did not provide comments on the draft of this report in time to meet the reporting requirement.

Audit Response. The Navy comments are fully responsive. The memorandum issued by the Army is not responsive to the intent of our recommendations. The Defense Logistics Agency response also failed to meet the intent of our recommendations. We continue to believe that implementation of the recommendations would improve Army and Defense Logistics Agency internal controls and verification techniques over the revised military specifications. Based on management comments, we renumbered the recommendations in Finding A to reflect that the Defense Logistics Agency is not required to review technical data bases, and we redirected the recommendation concerning the UH-60 Blackhawk helicopter program to the Program Executive Officer, Aviation. We request comments from the Army, the Air Force, and the Defense Logistics Agency by April 25, 1994.

Table of Contents

This report was prepared by the Contract Management Directorate, Office of the Assistant Inspector General for Auditing, DoD.

Part I - Introduction

Background

In 1991, the Military Departments took steps to increase reliability and safety of class 3 threaded products (threads) used in aerospace and high-technology applications. (See Appendix A for a glossary of thread terms.) The Military Departments maintain control over the quality of class 3 threads through military specification 8879 (MIL-S-8879) for threads with new designs and military specification 7742 (MIL-S-7742) for threads with existing designs. The Air Force serves as the DoD preparing activity for maintaining and revising MIL-S-8879 and MIL-S-7742.

Revisions MIL-S-8879A and MIL-S-7742B governed aerospace and high technology thread use for almost 2 decades. Both specifications provided for three methods (A, B, or C) of class 3 thread inspection. The inspection method depended on the degree of confidence desired by the part designer. Method A used simple inspection techniques. Methods B and C used more stringent inspection techniques when class 3 threads were used for safety critical applications.

In 1988, the Air Force revised MIL-S-8879A and MIL-S-7742B based on evidence that inspection techniques were not adequate. The Air Force determined that class 3 threads accepted by method A inspection did not conform to specifications. As a result, class 3 threads with insufficient strength and integrity were accepted. To avoid the possibility of nonconforming class 3 threads in the spare parts inventory, the Air Force strengthened inspection techniques and, in 1988, began requiring the revised MIL-S-8879B(USAF) and MIL-S-7742C(USAF) in appropriate Air Force contracts.

In 1991, the Army, the Navy, and the Air Force agreed to strengthen inspection techniques, resulting in the most current revisions, MIL-S-8879C and MIL-S-7742D. The 1988 and 1991 versions of the two military specifications eliminated the method A class 3 thread inspection and renamed the more stringent method B inspection for class 3 threads as Other Inspection. Method C class 3 thread inspection was renamed Safety Critical Inspection. The inspection selected depended on the end-use application of the class 3 thread.

Aerospace and fastener industry groups expressed concerns over certain requirements in the revised military specifications. The industry groups believed that the Other Inspection techniques were too stringent and were not cost effective for class 3 threads not intended for safety critical use.

Objectives

The original audit objective was to determine whether contracting officers were properly including the most recent military specifications for class 3 threads in aerospace production and spare parts contracts. The original audit objective was expanded to assess how selected prime contractors applied the revised military specifications. The audit also evaluated the effectiveness of internal controls applicable to the objectives.

Scope and Methodology

Judgmental Contract Selection and Audit Locations. To determine whether contracting officers were properly including the revised military specifications for class 3 threads in aerospace production and spare parts contracts, we judgmentally identified 19 applicable aerospace production contracts, valued at $10.8 billion, at 4 DoD procurement locations (2 Army, 1 Navy, and 1 Air Force). In addition, we judgmentally selected and reviewed 52 class 3 thread spare parts contracts, valued at $1.6 million, at the Defense Industrial Supply Center (DISC) and one Army location. The aerospace production contracts reviewed were judgmentally selected from contracts awarded from July 1991 (issue date of the revised military specifications) through May 1993, and through April 1993 for spare parts contracts. We reviewed contracting documents to determine whether they contained the revised military specifications and contractor identification of safety critical parts. In addition, we reviewed contractor cost proposal data to implement the revised military specifications.

The selected aerospace production and spare parts contracts were reviewed to determine:

- o whether the revised military specifications were included, and
- o if not included, to ascertain the reasons why the revised military specifications were not included.

We judgmentally selected 8 of the 19 aerospace production contracts for further review at 4 prime contractor manufacturing and assembly locations and their related Defense Plant Representative Offices (DPROs) to:

- o determine the present status of application of the revised military specifications, and
- o estimate the costs involved to improve inspection to the level of the revised military specifications.

At the four DoD procurement locations reviewed, we interviewed the applicable Government contracting and technical officials responsible for applying the military specifications. At the four prime contractor manufacturing and assembly locations reviewed, we interviewed applicable corporate managers, assessed local corporate policies and procedures, analyzed judgmentally selected threaded parts drawings, and reviewed prime contractor thread inspection capabilities and procedures in the production and receiving areas. We also reviewed statistical process control systems at the four prime contractor manufacturing and assembly locations to assess the contractor abilities to perform statistically based sampling of safety critical threads. Engineers, a cost analyst, and an industrial specialist from the Technical Assessment Division, Office of the Inspector General (OIG), DoD, provided technical assistance at the prime contractor manufacturing and assembly locations visited.

Audit Period and Standards. We performed this economy and efficiency audit from February through October 1993 in accordance with auditing standards issued by the Comptroller General of the United States, as implemented by the Inspector General, DoD. Accordingly, we included tests of internal controls considered necessary. We did not rely on any computer-processed data to perform the audit. Appendix E lists the organizations visited or contacted during the audit.

Internal Controls

Internal Controls Assessed. We evaluated internal controls covering the inclusion and implementation of the revised military specifications in DoD contracts and related areas. At each of the nine selected DoD locations (five procurement locations of the Military Departments and Defense Logistics Agency [DLA] and four DPROs), we analyzed the stated internal control objectives and reviewed the adequacy of the techniques used to accomplish the stated objectives. We also evaluated the implementation of the Federal Managers' Financial Integrity Act at the DoD procurement locations and the DPROs for the audit objectives. We reviewed the process established to notify contracting officers of revised military specifications and the process established to assess contractor implementation of the revised military specifications.

Internal Control Weaknesses Identified. The audit identified material internal control weaknesses as defined by Public Law 97-255, Office of Management and Budget Circular A-123, and DoD Directive 5010.38. Controls either were not established or were not effective to ensure that contracting officers and technical personnel were informed about revisions to applicable military specifications and assessed the need to include the revised military specifications in appropriate contracts. The internal control weaknesses had not been detected or reported under the Federal Managers' Financial Integrity Act program. Recommendation A.2., if implemented, will correct the weaknesses. We could not determine the monetary benefits to be realized by implementing the recommendation because quantifying the future impact of increased safety and reliability resulting from the revised military specifications was not possible.

See Appendix D for other potential benefits. A copy of the report will be provided to the senior official in charge of internal controls for the Military Departments and DLA.

Prior Audits and Other Reviews

Since 1990, the General Accounting Office issued two reports on specifications for threaded fasteners used by DoD.

General Accounting Office Report NSIAD-91-84 (OSD Case No. 8595), "Changes to Military Specifications for Testing Industrial Fasteners," December 21, 1990, stated that the Air Force followed applicable DoD regulations when initiating changes to the threaded fastener testing specifications. The Air Force and the Navy followed competitive procurement practices when procuring measuring gages to implement the new testing specifications. The report contained no recommendations.

General Accounting Office Report NSIAD-91-309 (OSD Case No. 8812), "Military Fasteners, Changes to Specifications Are Justified," September 30, 1991, concluded that the Air Force decision to revise MIL-S-8879A and MIL-S-7742B, based on aerospace accidents attributed to threaded fastener failure, was reasonable. The report contained no recommendations.

Other Matters of Interest

As part of the review of spare parts contracts at DISC, we observed that DISC was enacting adequate measures to eliminate the use of safety critical class 3 threads for non-safety critical applications. DISC action would eliminate expenditures for inspecting threaded products according to safety critical standards when such products were applied to non-safety critical uses. DISC was coordinating with Army, Navy, and Air Force personnel to develop separate national stock numbers for threaded product stocks that could be procured for both safety critical and non-safety critical applications. The separate numbering will allow DISC to procure threaded products based on their end use and will result in reduced costs for inspections. DISC estimated that costs for inspecting safety critical threads were 130 percent higher than inspection costs for non-safety critical threads.

Part II - Findings and Recommendations

Finding A. Incorporation of Revised Military Specifications in DoD Contracts

DoD contracting officers awarded contracts that did not contain revised military specifications developed to increase the quality of class 3 threads and, thus, the safety of weapon systems. Revised military specifications were not included in 18 of 19 aerospace production contracts and were not included in any of the 52 spare parts contracts. (However, 37 of the spare parts contracts did specify comparable thread inspection methods.) Contracting officers did not include revised military specifications in the contracts because internal controls were not established to verify that local data bases containing updated military specifications and standards were used to prepare contracts. Also, technical personnel incorrectly believed that the revised military specifications were not cost effective, that existing inspection procedures met the intent of the revised military specifications, or that the revised military specifications did not have to be included in contracts for ongoing programs. As a result, class 3 threads procured through aerospace production and spare parts contracts may not increase weapon system safety and reliability.

Background

Revising Military Specifications. After coordinating with the Army and the Navy, the Air Force issued revised military specifications for class 3 threads on July 25, 1991. On September 2, 1991, the revised military specifications were published in the DoD Index of Specifications and Standards. As cited in General Accounting Office Report NSIAD 91-309, the Air Force decision to change the specifications was reasonable, and the changes should be implemented. In addition, the report concluded that the Air Force followed applicable regulations for changing the specifications.

Military Specification Criteria. Federal Acquisition Regulation 46.103, "Contracting Office Responsibilities," requires contracting offices to obtain from the activity responsible any specifications for inspection, testing, and other contract quality requirements essential to ensure the integrity of the supplies or services. The military specifications are mandatory standards adopted by DoD and are listed in the DoD Index of Specifications and Standards. Federal Acquisition Regulation 10.006, "Using Specifications and Standards," provides that military specifications and standards are mandatory for use by DoD except for limited exceptions. Federal Acquisition Regulation 10.007, "Deviations," requires fully substantiated justifications when existing specifications do not meet the needs of an agency.

Air Force policy letter, "Screw Threaded Product Quality," December 8, 1987, requires organizations responsible for technical requirements to classify class 3 threads according to the consequence of their failure in the weapon systems, support equipment, or both.

Thread Application Categories. Threaded products can fall into one of two application categories, "other" or "safety critical," according to the consequence of the failure of the class 3 thread in a weapon system, in support equipment, or in both. Depending on the category assigned, the class 3 threads must then be inspected using either the Other Inspection for the class 3 threads in the other category, or Safety Critical Inspection for class 3 threads in the safety critical category.

Thread Application Category Assignment. According to the military specifications, the thread designer must specify the proper category in the thread designation, a general note, a referenced document, or the purchase order for the class 3 thread. According to the revised military specifications, the military engineering cognizant activity for the weapon system must approve all safety critical designations. In addition, when identifying a category is not feasible, the class 3 threads will automatically be assigned to the other category.

Army Flight Safety Parts Program. The Army flight safety parts program (FSPP), requires contractors to identify all flight safety parts and their associated critical characteristics to ensure safe operation throughout the weapon system life cycle. The Army defines a flight safety part as any part, assembly, or installation containing a critical characteristic whose failure, malfunction, or absence could cause loss of or serious damage to an aircraft, or serious injury or death to the occupants, or both. A critical characteristic is defined as any feature of a flight safety part that, if nonconforming, missing, or degraded, could cause failure or malfunction of the flight safety part. Under FSPP, contractors are required to identify all safety critical parts (including class 3 threads). FSPP also requires 100 percent inspection of all flight safety parts by the prime contractor, subcontractor, or parts supplier. Although FSPP requires that class 3 threads identified as safety critical meet the inspection methods of the safety critical category, FSPP does not require other threads to be inspected to the revised military specification requirements.

Aerospace Production Procurements

Incorporation of Revised Military Specifications. The review of 19 aerospace production contracts (Appendix B) at 4 DoD procurement locations showed that contracting offices did not include the revised military specifications into 18 contracts awarded after July 25, 1991. As a result, DoD does not have assurance that class 3 threads used in weapon systems or in the inventory conform to current specifications. Of the 18 contracts, 17 contained the outdated military specifications MIL-S-8879A and MIL-S-7742B. The outdated specifications were included in 10 of 11 Army contracts, all 6 Naval

Air Systems Command contracts, and 1 of the 2 Air Force contracts. The remaining Air Force contract did not include any version of the military specifications although military specifications were needed.

Army Aerospace Production Procurements. Of the 11 Army contracts reviewed, 10 did not contain the revised military specifications for class 3 threads. Only one of the seven Missile Command contracts included the revised military specifications, while none of the four Aviation and Troop Command (ATCOM) contracts reviewed included the revised military specifications.

Missile Command Procurements. The revised military specifications were not included in six of the seven Missile Command contracts because contracting officers and technical personnel were not aware of the revised military specifications and relied on data bases that did not reflect current military specifications. As a result, technical data packages submitted to contracting officers contained outdated military specifications. For example, the first two Stinger missile contracts awarded after the effective date of the revised military specifications did not contain MIL-S-8879C and MIL-S-7742D. The most recent Stinger missile contract, contract DAAH01-93-C-0264, awarded May 28, 1993, for 300 Stinger missiles, included the revised military specifications because the data base had been updated to reflect the revised military specifications. Technical representatives were unaware that the military specifications had been revised and stated that the first two Stinger contracts would have included the revised military specifications had the data base reflected the updated information.

ATCOM Procurements. The four ATCOM contracts showed that FSPP was used in lieu of the revised military specifications. ATCOM technical representatives stated that FSPP is a requirement in all ATCOM contracts and was sufficient to meet the intent of the revised military specifications.

Army UH-60 Blackhawk Helicopter Procurement. The most recent UH-60 Blackhawk helicopter contract, contract DAAJO9-92-C-0004, awarded on January 1, 1992, contained the outdated military specifications MIL-S-8879A and MIL-S-7742B. On July 29, 1992, the UH-60 Blackhawk helicopter contracting office at ATCOM requested United Technologies Corporation, Sikorsky Aircraft Division (Sikorsky), to review the revised military specifications and advise ATCOM of any costs associated with applying the revised military specifications. On August 19, 1992, Sikorsky responded with a rough order-of-magnitude cost estimate of $ * . ATCOM did not analyze Sikorsky's estimate; however, the ATCOM project manager determined that including the revised military specifications in the contract would not be cost effective, and did not pursue the matter further.

Evaluation of Sikorsky Cost Estimate. As part of our review of Sikorsky inspection methods for class 3 threads, we asked Sikorsky to support its rough order-of-magnitude cost estimate. Sikorsky responded on June 1, 1993, with a revised cost estimate of $ * to implement the

*Contractor confidential or proprietary data has been deleted.

revised military specifications. With assistance from the engineers from the Technical Assessment Division, OIG, DoD, we estimated the costs associated with applying the revised military specifications to be no more than $ * (Appendix C). Sikorsky's estimated costs for applying the revised military specifications were excessive due to the unclear wording of the specifications (Finding B).

Navy Aerospace Production Procurements. The six Naval Air Systems Command contracts contained the outdated military specifications for class 3 threads. Contracting officers and technical personnel stated either that they were unaware of the revised military specifications or that they believed including the revised military specifications was unnecessary when reprocuring existing weapon systems. However, none of the contract files for the six procurements included any justification exempting the revised military specifications, as required by Federal Acquisition Regulation 10.007.

Air Force Aerospace Production Procurements. Two Aeronautical Systems Center contracts did not contain the revised military specifications for class 3 threads. One contract awarded by the F-15 fighter aircraft systems program office did not refer to the military specifications at all, while the C-17 cargo aircraft contract contained the outdated military specifications.

F-15 Fighter Aircraft System Procurement. No military specifications for class 3 thread inspection were included in F-15 fighter aircraft production contract F33657-92-C-2102. The F-15 fighter aircraft systems program office contracting and technical representatives were aware of the revised military specifications, but had not attempted to change the original 1969 design specification to include any version of MIL-S-8879 or MIL-S-7742. The systems program office could not determine which version of the specifications, if any, were actually applied by McDonnell Douglas Aerospace-East. Our review of McDonnell Douglas Aerospace-East inspection methods showed that the company applied the outdated military specifications through a McDonnell Douglas Aerospace-East process specification. (A process specification is a production planning document used for general manufacturing operations.) The process specification on the F-15 fighter aircraft threads was not a contractual requirement. Therefore, McDonnell Douglas Aerospace-East was not contractually obligated to any version of the military specification for F-15 fighter aircraft production.

C-17 Cargo Aircraft System Procurement. Outdated military specifications were included in the C-17 cargo aircraft FY 1992 production contract F33657-92-C-0030, awarded in May 1993. In March 1993, the C-17 cargo aircraft systems program office estimated the cost to include the revised military specifications at $ * ; however, the estimate was superficial and lacked a reasonable estimation rationale. The systems program office subsequently requested a rough order-of-magnitude estimate from McDonnell Douglas Aerospace-West through an advance change notice. McDonnell Douglas Aerospace-West submitted its proposal estimate in September 1993.

*Contractor confidential or proprietary data has been deleted.

Conclusion. Because the Army, the Navy, and the Air Force are not complying with the requirements to include the revised military specifications in contracts, the Military Departments have no assurance that class 3 threads for aerospace production procurements and spare parts are subject to the more stringent testing requirements specified in MIL-S-8879C and MIL-S-7742D.

Spare Parts Procurements

Incorporation of Revised Military Specifications. Although DISC contracting officials had not included the revised military specifications in 46 spare parts contracts reviewed, comparable inspection methods were specified in 37 of the contracts. None of the six ATCOM spare parts contracts reviewed contained the revised military specifications.

DISC Spare Parts Procurements. The 46 spare parts contracts reviewed totaled $932,959. Of the 46 contracts, 29 were for external class 3 threads and 17 were for internal class 3 threads. The 46 contracts incorporated MIL-S-8879 and MIL-S-7742 in referenced thread drawings but did not specify which revision. Although DISC contracting officers did not include the revised military specifications in the spare parts contracts, inspection methods incorporated into 37 spare parts contracts for external class 3 threads and non-safety critical internal class 3 threads were comparable to the revised military specifications. However, 9 of the 46 spare parts contracts did not include acceptable inspection methods. Seven of the nine spare parts contracts with unacceptable inspection methods were for safety critical internal class 3 threads.

External Class 3 Threads. The revised military specifications allow the use of inspection methods specified in Federal Standard H28/20, "Screw Thread Gaging Systems for Dimensional Acceptability - Inch and Metric Screw Threads." In 27 of 29 external class 3 thread spare parts contracts reviewed, DISC specified the use of system 22 for inspection of other class 3 threads and system 23 for inspection of safety critical class 3 threads. Both system 22 and 23 inspection methods are equivalent to inspection methods required in the revised military specifications.

Internal Class 3 Threads. Of the 17 spare parts contracts for internal class 3 threads, 7 did not incorporate the proper level of inspection as required in the revised military specifications. The seven spare parts contracts for safety critical internal class 3 threads incorrectly specified system 22 inspection for inspection in the other category, rather than system 23, as required by the revised military specifications.

DISC Response to Finding. DISC representatives disagreed that the revised military specifications were not included in the 46 spare parts contracts. DISC stated that a standard statement in DISC threaded part drawings evokes the latest revision of all military specifications in effect on the invitation-for-bid date. However, we found that such a statement was in threaded part drawings for only 21 of the 46 spare parts contracts. In addition, 13 of the 21 threaded part

drawings included qualifying statements that established the precedence of the threaded part drawing when in conflict with the revised military specifications.

DISC disagreed that none of the seven internal class 3 thread spare parts contracts identified as deficient by the Inspector General, DoD, included safety critical threads. DISC stated that the internal class 3 thread safety critical designation was removed by an agreement between DISC and its customer engineering activities. However, DISC could not document any such agreement during the staffing of the draft report findings. In any event, such an agreement would contradict the intent of the revised military specifications.

ATCOM Spare Parts Procurements. Revised military specifications were not included in any of the six selected class 3 thread spare parts contracts, valued at $672,052, at ATCOM. The thread drawings did refer to military specifications but did not indicate which revision. In addition, we were unable to determine which inspection methods were required in four of the ATCOM spare parts contracts because a specific inspection method was not stated in the contracts. Two of the spare parts contracts (including one safety critical class 3 thread spare parts contract) specified inspection methods that did not meet the requirements of the revised military specifications.

Internal Controls For Revised Military Specifications

The Army, the Navy, and the Air Force lacked adequate internal controls to verify that contracting officers and program managers were informed of the revised military specifications. In addition, internal controls were not effective to verify that data bases used to prepare technical data packages were updated to reflect the revised military specifications. As a result, contracts awarded after the effective date of the revisions did not incorporate the revised military specifications. Thus, DoD does not have assurance that class 3 threads conform to revised military specifications developed to increase the quality of threads and weapon system safety and reliability.

Controls to identify and include the revised military specifications were not established within the Military Departments. Contracting officers and technical personnel were not informed of the revised military specifications. For example, the Naval Air Systems Command had not developed a system to include the revised military specifications in technical data packages for ongoing production procurements. Naval Air Systems Command personnel believed that including the revised military specifications was not necessary for the reprocurement of existing weapon systems or for contracts with weapon systems in the engineering and manufacturing development phases.

Recommendations, Management Comments, and Audit Response

Renumbered and Redirected Recommendations. Based on management comments, we are no longer directing draft Recommendation A.1.b. to the Defense Logistics Agency. As a result, draft Recommendation A.1.a. is renumbered A.1., draft Recommendation A.1.b. is renumbered A.2., and draft Recommendation A.2. is renumbered A.3. We redirected Recommendation A.3. to the Army Program Executive Officer, Aviation.

1. We recommend that the Assistant Secretary of the Army (Research, Development, and Acquisition); the Assistant Secretary of the Navy (Research, Development, and Acquisition); the Assistant Secretary of the Air Force (Acquisition); and the Director, Defense Logistics Agency, issue written internal control objectives and techniques that verify the inclusion of the revised military specifications in all FY 1992 and subsequent contracts containing class 3 threads, including those contracts for ongoing production procurements, or require written system program office justification based on cost-benefit analysis when the revised military specifications are not included.

2. We recommend that the Army, the Air Force, and the Navy verify that data bases used to prepare technical data packages reflect current specifications and standards.

Army Comments. The Army concurred with the intent and stated the Acting Assistant Secretary of the Army (Research, Development, and Acquisition) had issued a March 19, 1993, memorandum to all Army program executive officers requesting review of programs to ensure appropriate action was taken regarding implementation of the revised military specifications. The Army also stated that it would follow up on the memorandum to evaluate the need to strengthen management controls.

Audit Response. Although the Army concurred, the March 19, 1993, memorandum is not totally responsive to the recommendation. The memorandum called for either inclusion of the revised military specifications in new contracts (after March 1993) or assurance that equivalent quality and safety measures were fully implemented. The memorandum does not address our recommendation that all FY 1992 and subsequent contracts containing class 3 threads be reviewed to verify the inclusion of the revised military specifications. Also, the memorandum does not address a means, such as a cost-benefit analysis, to justify not including the revised military specifications. In addition, the memorandum does not address the need to verify that data bases used to prepare technical data packages reflect current specifications and standards.

The basis of the March 19, 1993, memorandum was the status of the revised military specifications in the UH-60 Blackhawk helicopter program. Interviews with UH-60 Blackhawk helicopter program management personnel in

July 1993 showed no inclination on the part of program management to perform a detailed cost/benefit justification even after issuance of the March 19, 1993, memorandum.

We believe the March 19, 1993, memorandum has resulted in the continued use of the FSPP as a substitute for the revised military specifications. The FSPP covers critical parts only, and does not require other threads to be inspected to the revised military specification requirements. Critical parts make up only a small percentage of all class 3 threads in a weapon system. The outdated military specifications allow the use of method A inspection, which allows dimensional nonconformity in parts not covered by the Army's FSPP. To clarify the situation, the Army should use the revised military specifications unless continued use of the outdated specification can be justified through system program office written analysis and approval.

We request the Army to provide additional comments on the final report on Recommendations A.1. and A.2.

Navy Comments. The Navy concurred and stated that it would issue a policy memorandum no later than January 31, 1994, requiring that current revisions to military specifications be cited in all contracts in accordance with provisions of the Federal Acquisition Regulation and DoD Instruction 5000.2. The Navy stated that program managers will be required to sign a written justification if the latest revisions to MIL-S-8879 and MIL-S-7742 are not included in the contract.

The Navy also concurred with the recommendation to verify the data bases. The Navy stated that the use of the DoD Index of Specifications and Standards will be re-emphasized in the preparation of detailed specifications and technical data packages.

Air Force Comments. Air Force management comments to the draft of this report were not provided in time to meet the reporting requirement. We will consider any Air Force comments received as comments on the final report unless additional comments are provided.

DLA Comments. DLA nonconcurred with the recommendation to issue internal control objectives to verify the inclusion of the revised military specifications. DLA stated that MIL-S-961 and MIL-S-962 insured inclusion of the latest revision for all military specifications in contracts. DLA stated that DISC has been assigned authority to assure compliance with MIL-S-961 and MIL-S-962 design configuration control statements that invoke the latest revisions on fastener military standards and specifications.

DLA also nonconcurred with the recommendation to verify data bases. DLA stated that internal controls over the currency of technical data in DLA procurements were already in place through current DLA regulations, policies, and procedures.

Audit Response. We consider the DLA comments on draft Recommendation A.1.a. to be nonresponsive. MIL-S-961 and MIL-S-962

control the general preparation and format of all military specifications. MIL-S-961 and MIL-S-962 do not address contract preparation, and do not verify the contractual inclusion of revisions to military specifications. Of the 46 DISC spare parts contracts reviewed, 35 included no direct reference to MIL-S-8879 or MIL-S-7742 in the basic contractual documents. The remaining 11 of the 46 DISC spare parts contracts did include a reference to MIL-S-8879 or MIL-S-7742 (without a revision letter) in the supplies section of the contract. However, the terminology of the inspection method (Method A, B, or C) indicated that the inspection method was drawn from the outdated MIL-S-8879A and MIL-S-7742B specifications. Therefore, DISC application of MIL-S-961 and MIL-S-962 was not adequate to ensure that all 46 DISC spare parts contract clauses reviewed contained the revised military specifications.

We request additional comments from DLA on Recommendation A.1.

3. We recommend that the Army Program Executive Officer, Aviation, direct that the cost-benefit analysis for the UH-60 Blackhawk helicopter program include a detailed review of prime contractor cost submissions to implement the revised military specifications.

Management Comments. We request comments on the final report from the Army Program Executive Office, Aviation, on Recommendation A.3.

Management Comments and Audit Response on the Finding

Navy Comments. The Navy agreed that existing contracting procedures did not meet the intent of the revised military specifications. However, the Navy stated that the finding inaccurately characterized the view of technical personnel toward the cost-effectiveness of the revised specifications, existing inspection procedures, and use in ongoing contracts. The Navy believed that the revised military specifications are not cost-effective unless properly tailored for the specific application.

Audit Response. We agree that the revised military specifications should be properly tailored to be cost-effective. We also believe that the finding accurately reflected the comments received from technical personnel from all the Military Departments as to why the revised military specifications were not included on individual contracts.

DLA Comments. DLA disagreed that the revised military specifications were not included in the 46 spare parts contracts. DLA stated that a subsequent DISC review of the 46 spare parts contracts concluded that the revised specifications were included in 34 contracts through application of a standard statement in DISC thread drawings evoking the latest revision of all military specifications.

DLA claimed that an additional six spare parts contracts invoked drawings under the design control of private-sector companies. DLA believed that the

drawings would be "universally accepted" to the revised military specifications unless the company supplying the part contractually took exception to the revised specifications.

DLA further disagreed that seven spare parts contracts for safety critical internal threads did not incorporate the proper level of inspection as required in the revised military specifications. DLA stated that the seven contracts involved safety critical parts, but that the parts did not have safety critical threads. DLA stated that the Military Departments had agreed that threads reconfigured after production would not carry safety critical designation and enclosed 1989 correspondence pertaining to the issue. DLA also enclosed spare part drawings it stated were used in the procurement of five of the seven spare parts contracts. DLA believed the drawings substantiated the use of a non-safety critical inspection method.

Audit Response. DLA did not identify which 34 spare parts contracts contained the standard statement in the threaded part drawings. As stated in the finding, our review of the 46 spare parts contracts indicated that only 21 of the 46 contractual threaded part drawings included a standard statement. However, 13 of the 21 threaded part drawings included qualifying statements that established the precedence of the threaded part drawing when in conflict with the revised military specifications.

As stated in Finding B, evidence of lack of implementation of the revised military specifications indicates strong contractor reluctance to incorporate the revisions unless contractually required. No evidence of universal acceptance of the revised specifications was found. DLA did not identify which six spare parts contracts were under the design control of private-sector companies, or whether companies supplying the parts took contractual exception to the revised military specifications. In any case, no requirement exists in any of the 46 DISC contracts to ensure implementation of the revised specifications.

Our review of the spare part drawings provided by DLA in its management comments indicated that the drawings were not those actually used in five of the seven spare parts contracts. The contractual drawings failed to specify any inspection method. The correspondence from the Military Departments and DLA included in the management comments was dated 2 years before the revised military specifications were issued. Provisions of the revised specification MIL-S-8879C contradict the DLA statement that threads reconfigured after production would not carry the safety critical designation. The MIL-S-8879C requirement 4.4.2.1.1 states that all threaded products must be inspected at the point of manufacture before any configuration change, and that the inspection method shall be in accordance with the application category (in this case, safety critical).

Finding B. Implementation of Revised Military Specifications

The revised military specifications for class 3 threads are unclear as to the identification and inspection of safety critical and other thread categories. The revised military specifications are unclear because the revised military specifications contain inconsistent definitions and methods for identifying safety critical threads and use the terms "inspect" and "measure" interchangeably while industry has separate interpretations for the two terms. As a result, prime contractors may categorize threads as safety critical when not necessary and may overestimate the implementation cost for the revised military specifications.

Identification of Safety Critical Class 3 Threads

Military Specification Definitions. The revised military specifications define safety critical class 3 threads twice, once in the glossary and once in the logic flowchart.

Glossary Definition of Safety Critical. Safety critical threads are defined in the glossary as, "An application in which failure of the thread itself, for the purpose of this specification, would result in hazardous and unsafe conditions. The designer specifies which characteristics are inspected and verified."

Logic Flowchart Definition of Safety Critical. The logic flowchart, "Typical Thread Classification Logic," is more detailed than the glossary definition. The logic flowchart provides that certain conditions must be met for a class 3 thread to be categorized as safety critical. The flowchart states that, if a single class 3 thread failure from tension would result in structural failure, loss of canopy, landing gear failure, foreign object damage to the engine, or subsystem failure, then the class 3 thread is safety critical. If any of the conditions are not met, then the thread has an other than safety critical application.

Identification Uncertainties. Prime contractors are not certain how to determine whether a class 3 thread is safety critical because of the differences between the two definitions.

Aerospace Industries Association Opinion. In March 1993, an Aerospace Industries Association (AIA) presentation to a joint Government-industry conference concluded that the logic flowchart should only be used as an

illustrative example. AIA believed the logic flowchart did not represent a definition, but an example of one approach to safety critical thread classification.

Prime Contractor Opinions. Representatives from two of the prime contractors reviewed, Sikorsky and McDonnell Douglas Aerospace-East, perceived the glossary reference and the logic flowchart as separate definitions for the identification of safety critical class 3 threads. The representatives claimed that, though the descriptions are similar, the logic flowchart would cause more class 3 threads to be labeled safety critical than the glossary definition. The third prime contractor, McDonnell Douglas Helicopter Company, was not aware of the revised military specifications. The fourth contractor, Bell Helicopter Textron, while aware of the revised military specifications, believed that the Bell Helicopter Textron procedure for identifying safety critical threads met or exceeded the intent of the glossary definition.

Air Force Opinion. The Aeronautical Systems Center, Air Force Materiel Command, the DoD preparing activity for class 3 threads, stated that the logic flowchart was never intended to be the sole definition of class 3 threads. The Air Force stated that the logic flowchart is to be used as an example of a typical logic sequence for the identification of safety critical class 3 threads.

OIG, DoD, Opinion. The separate definitions for identifying safety critical class 3 threads have led to misinterpretation of the revised military specification requirement by some prime contractors (see Identification of Safety Critical Class 3 Threads section in this finding). We agree with the AIA and Air Force positions that the logic flowchart is not to be used as the definition for safety critical class 3 threads, but only as an example.

Inspection of Safety Critical and Other Class 3 Threads

Inspection Procedures and Gaging Equipment. Prime contractors use two types of gaging equipment to inspect class 3 threads: indicating gages and attribute/fixed limit control gages (attribute gages). The traditional method for inspecting class 3 threads uses attribute gages, which qualitatively assess the thread characteristics to determine conformance. The American National Standard Institute states that indicating gages provide quantitative measurements, which can be compared to limit values in thread specifications to determine whether the characteristics conform to specifications.

Inspection Uncertainties. Prime contractors are not certain about which gaging equipment to use to meet the revised military specification requirements for thread inspection. The uncertainties stem from an unclear clause in the revised military specifications. The unclear clause, 4.4.2, found in both MIL-S-8879C and MIL-S-7742D, states, "Screw threads shall be inspected to

ensure their ability to assemble with mating parts and shall be measured to ensure dimensional compliance with characteristics that are selected based on application category."

AIA Opinion. AIA commented that use of both terms, "inspect" and "measure," results in inconsistencies as to the type of gaging to be used. AIA defined "inspect" as examining and testing supplies or services to determine whether they conform to specified requirements. AIA believed that the term "inspect" does not require quantifiable measurements. AIA further supported its position that the term "measure" requires a quantifiable examination of the thread. Obtaining quantifiable measurements requires the use of indicating gages.

Additionally, AIA stated in its 1992 Annual Report that the revised military specifications require all class 3 threads to be inspected with indicating gages to assure proper measurement of the attributes of the class 3 thread. However, AIA representatives expressed their desire to revise the military specifications to maintain the general use of attribute gages.

Prime Contractor Opinions. The four prime contractors reviewed believed that indicating gages must be used to comply with the wording of the revised military specifications. Only one of the four contractors primarily used indicating gages. The other three contractors primarily used attribute gages. However, the three contractors believed that their attribute gages could meet or exceed the intent of the revised military specifications.

Air Force Opinion. Officials at the Aeronautical Systems Center believed that the use of indicating gages is not mandatory as long as the methods used meet the requirements of the American National Standard Institute/American Society of Mechanical Engineers National Standard B1.3. The standard includes tables that list various types of gages and the thread characteristics these gages are capable of measuring. The Air Force officials believed that thread gages and measuring equipment are acceptable if the equipment can determine whether threads fall within the acceptable thread dimensions required in the revised military specifications.

OIG, DoD, Opinion. We agree with AIA that the wording of the specification must be clarified. Engineers from the Technical Assessment Division, OIG, DoD, examined the gaging equipment and inspection practices at the four prime contractor locations. The engineers stated that total replacement of the attribute gages with indicating gages was not necessary at the three prime contractor locations that used attribute gages. The revised military specifications should be worded consistently (either inspect or measure) and should encourage the use of new or more efficient methods of inspection.

Effect on Contractor Implementation Costs

Implementation costs for the revised military specifications may be overestimated by prime contractors because of the unclear wording of the revised military specifications. Two of the four prime contractors, Sikorsky and McDonnell Douglas Aerospace-East, provided the Government with cost estimates to implement the revised military specifications. The other two prime contractors, McDonnell Douglas Helicopter Company (McDonnell Douglas Helicopter) and Bell Helicopter Textron, had not developed cost estimates.

Safety Critical Class 3 Thread Identification. Sikorsky and McDonnell Douglas Aerospace-East used the revised military specification logic flowchart instead of the glossary definition to identify safety critical class 3 threads. Both prime contractors believed that the logic flowchart methodology would cause more class 3 threads to be classified as safety critical than those currently listed on contractual safety parts programs. The logic flowchart methodology would cause increased engineering analysis costs to identify safety critical threads. For example, in its cost estimate, Sikorsky incorporated increased engineering costs for implementing the revised military specifications. As a result, we believe additional costs were added to identify threads as safety critical when such costs were unnecessary. We estimated that using the glossary definition would greatly reduce estimated implementation costs at Sikorsky (Appendix C).

Gaging Requirements. Sikorsky already used indicating gages for inspecting class 3 threads. Sikorsky had a policy of "dedicated" gaging equipment for all quality control and production inspection. As a result, Sikorsky estimated $ * to $ * in extra gaging costs to comply with the revised military specifications. The other prime contractor that provided a cost estimate, McDonnell Douglas Aerospace-East, used attribute gages and estimated procurement costs of $ * for new indicating gages. McDonnell Douglas Helicopter and Bell Helicopter Textron, who both used attribute gages, did not prepare cost estimates. However, both McDonnell Douglas Helicopter and Bell Helicopter Textron stated that substantial costs would be incurred to replace existing attribute gages with indicating gages.

*Contractor confidential or proprietary data has been deleted.

Recommendation, Management Comments, and Audit Response

We recommend that the Assistant Secretary of the Air Force (Acquisition) modify the revised military specifications MIL-S-8879C and MIL-S-7742D to require a single definition and identification method for safety critical class 3 threaded products, and clarify the language in the revised military specifications to encourage the use of all efficient methods for thread inspection. Input from the other Defense Components and industry should be considered in developing the modification.

Management Comments. Air Force management comments were not received in time to meet the reporting requirement. Any Air Force comments received will be considered comments to the final report unless additional comments are received.

Part III - Additional Information

Appendix A. Glossary of Thread Terms

American National Standard Institute/American Society of Mechanical Engineers. Committees responsible for setting standards for threaded products. Their standards define system 21, system 22, and system 23, which are equivalent to inspection methods A, B (Other), and C (Safety Critical) defined in MIL-S-8879A and MIL-S-7742B.

Attribute Gages. Gages used to qualitatively assess thread characteristics to determine whether thread characteristics conform to specifications.

Class 3 Threads. Threads found on nuts and bolts and other threaded products, recommended for high temperature use and for applications requiring very high fatigue life and stress levels. Class 3 threads are found on nuts and bolts used in aircraft engine, air frame, missile, space vehicle and similar design areas where size and weight are critical.

Indicating Gages. Gages used to measure actual dimensions of individual thread characteristics. Also referred to as single element gages and used to inspect threads in Other and Safety Critical inspections.

Method A/System 21 Inspection. An inspection method used to determine whether a thread will assemble with another standard thread; the default method of inspection and verification under previous military specifications (MIL-S-8879A and MIL-S-7742B) for internal threads. The revised military specifications eliminated this method of inspection.

MIL-S-8879C and MIL-S-7742D. On July 25, 1991, revised changes to MIL-S-8879A and MIL-S-7742B were issued. The revised military specifications required more stringent verification and inspection of class 3 threads. MIL-S-8879C is used for threads in new DoD system designs, while MIL-S-7742D is used for reprocurement of class 3 threads currently in inventory.

Other Threads. Threads associated with failure consequences other than safety critical failure. Thread inspection is performed on a sample of each lot specified in the contract or purchase order.

Safety Critical Threads. Threads used for applications in which failure of the thread itself would result in hazardous and unsafe conditions. The designer specifies which thread characteristics are inspected and verified. Thread characteristics identified as safety critical require 100 percent inspection (or buyer-approved statistical process control system).

Statistical Process Control System. A system to manage and improve production performance through quality evaluation during the manufacturing process at the prime contractor or subcontractor facilities.

Appendix B. Summary of Contracts Reviewed

Aerospace Production Contracts

	Contracts Reviewed	Contracts Containing Revised Specifications	Total Value of Contracts Reviewed (billions)
ATCOM	4	0	$ 1.8
Missile Command	7	1	0.5
Naval Air Systems Command	6	0	7.1
Aeronautical Systems Center	2	0	1.4
Total	19	1	$10.8

Spare Parts Contracts

	Contracts Reviewed	Contracts Containing Revised Specifications	Contracts Containing Acceptable Inspection Methods	Total Value of Contracts Reviewed (millions)
DISC	46	0	37	$0.9
ATCOM	6	0	0	0.7
Total	52	0	37	$1.6

Appendix C. Evaluation of Sikorsky Aircraft Division Cost Estimate

On August 19, 1992, Sikorsky provided a rough order-of-magnitude estimate of $ * [1] to ATCOM for applying revised military specifications for class 3 threads. During our review, Sikorsky reduced the estimate from $ * to $ * .[2] Sikorsky further revised certain portions of its estimate that were presented to the OIG, DoD, on October 1, 1993. The auditors, with the assistance of engineers from the Technical Assessment Division, OIG, DoD, reviewed the revised Sikorsky cost estimate and concluded that Sikorsky costs associated with the revised military specifications should be no more than $ * .

The $ * consists of the amounts in the following table.

OIG, DoD, Cost Estimate

Cost Category	Cost Estimate*
Operation Sheet Update	$
Vendor Operation Sheet Update	
Training, Tool Design, Drawing Revision	
Additional Gaging (Hours)	
Drawing Revisions	
Administration Cost	
Engineering Training	
Quality Assurance Nonrecurring Gage Cost	
Quality Assurance Recurring Gage Cost	
Additional Gages	
Supplier Costs	
Subtotal (Including Overhead)	$
General and Administrative Expense (*)	
Subtotal	$
Profit (*)	
Total	$

[1]Represents nonrecurring costs of $ * and recurring costs of $ * (in 1993 dollars).

[2]Represents nonrecurring costs of $ * and recurring costs of $ * . The revised amount was broken down by manufacturing engineering, engineering, quality assurance, and supplier categories.

*Contractor confidential or proprietary data has been deleted.

Appendix D. Summary of Potential Benefits Resulting From Audit

Recommendation Reference	Description of Benefit	Amount and/or Type of Benefit
A.1.	Economy and Efficiency. Avoids unnecessary costs associated with safety issues and nonconforming class 3 threads.	Undeterminable.[1]
A.2.	Internal Controls. Validates that class 3 threads are subject to more stringent inspection and verification requirements.	Undeterminable.[1]
A.3.	Program Results. Provides a basis for determining the adequacy of contractor cost proposals for inclusion of the revised military specifications.	Undeterminable.[1]
B.	Economy and Efficiency. Clarifies the specific requirements of the revised military specifications and reduces contractor estimates associated with implementation of the revised military specifications.	Undeterminable.[2]

[1]Quantifying the future impact of increased safety and reliability resulting from the use of the revised military specifications is not possible.
[2]Quantifying the future impact of clarifying the military specifications is not possible.

Appendix E. Organizations Visited or Contacted

Office of the Secretary of Defense

Deputy Under Secretary of Defense for Acquisition and Technology, Washington, DC

Department of the Army

Assistant Secretary of the Army (Research, Development, and Acquisition), Washington, DC
Army Materiel Command, Alexandria, VA
  Armament, Munitions, and Chemical Command, Rock Island, IL
  Aviation and Troop Command, St. Louis, MO
  Missile Command, Redstone Arsenal, AL

Department of the Navy

Assistant Secretary of the Navy (Research, Development, and Acquisition) Washington, DC
Naval Air Systems Command, Arlington, VA

Department of the Air Force

Office of the Deputy Assistant Secretary of the Air Force (Contracting), Arlington, VA
Aeronautical Systems Center, Air Force Materiel Command, Wright-Patterson Air Force Base, OH

Defense Organizations

Headquarters, Defense Logistics Agency, Alexandria, VA
  Defense Industrial Supply Center, Philadelphia, PA
  Defense Contract Management Command, Alexandria, VA
    Defense Contract Management District North Central, Chicago, IL
      Defense Plant Representative Office, McDonnell Douglas Aerospace-East, St. Louis, MO
    Defense Contract Management District Northeast, Boston, MA
      Defense Plant Representative Office, United Technologies Corporation, Sikorsky Aircraft Division, Stratford, CT

Defense Organizations (cont'd)

Defense Contract Management District South, Marietta, GA
Defense Plant Representative Office, Bell Helicopter Textron, Fort Worth, TX
Defense Contract Management District West, El Segundo, CA
Defense Contract Management Area Operations, El Segundo, CA
Defense Plant Representative Office, McDonnell Douglas Helicopter Company, Mesa, AZ

Non-Defense Federal Organization

General Accounting Office, Washington, DC

Non-Government Organizations

Aerospace Industries Association, Washington, DC
Bell Helicopter Textron, Fort Worth, TX
Johnson Gage Company, Bloomfield, CT
McDonnell Douglas Aerospace-East, St. Louis, MO
McDonnell Douglas Helicopter Company, Mesa, AZ
Standard Pressed Steel Technologies, Jenkintown, PA
United Technologies Corporation, Sikorsky Aircraft Division, Stratford, CT

Appendix F. Report Distribution

Office of the Secretary of Defense

Under Secretary of Defense for Acquisition and Technology
Director of Defense Procurement

Department of the Army

Secretary of the Army
Assistant Secretary of the Army (Financial Management)
Assistant Secretary of the Army (Research, Development, and Acquisition)
Commander, Army Materiel Command
Commander, Army Aviation and Troop Command
Commander, Missile Command
Auditor General, Department of the Army

Department of the Navy

Secretary of the Navy
Assistant Secretary of the Navy (Financial Management)
Assistant Secretary of the Navy (Research, Development, and Acquisition)
Auditor General, Naval Audit Service

Department of the Air Force

Secretary of the Air Force
Assistant Secretary of the Air Force (Acquisition)
Assistant Secretary of the Air Force (Financial Management and Comptroller)
Auditor General, Air Force Audit Agency

Defense Agencies

Director, Defense Contract Audit Agency
Director, Defense Logistics Agency

Non-Defense Federal Organizations

Office of Management and Budget
National Security and International Affairs Division, Technical Information Center, General Accounting Office

Chairman and Ranking Minority Member of Each of the Following Congressional Committees and Subcommittees:

- Senate Committee on Appropriations
- Senate Subcommittee on Defense, Committee on Appropriations
- Senate Committee on Armed Services
- Senate Committee on Governmental Affairs
- House Committee on Appropriations
- House Subcommittee on Defense, Committee on Appropriations
- House Committee on Armed Services
- House Committee on Government Operations
- House Subcommittee on Legislation and National Security, Committee on Government Operations

Part IV - Management Comments

Department of the Army Comments

REPLY TO ATTENTION OF

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

24 JAN 1994

SARD-DE

MEMORANDUM FOR INSPECTOR GENERAL, DEPARTMENT OF DEFENSE (AUDITING), 400 ARMY NAVY DRIVE, ARLINGTON, VA. 22202-2884

SUBJECT: Draft Audit Report on Military Specifications for Critical Threaded Products (Project No. 3CA-5010)

I have reviewed the subject draft audit report for the Office of the Assistant Secretary of the Army (Research, Development and Acquisition). The attached comments are provided for your consideration for inclusion in the final report.

Point of contact for this action is LTC Mike Murphy, (703) 695-7616.

Stephen R. Burdt
Director for Program Evaluation

Attachment

Final Report Reference

FROM: OASA(RDA)/SARD-DE, Washington, D.C. 20310-0103,
LTC Murphy, DSN 225-7616

Draft Audit Report: Military Specifications for Critical Threaded Products (Project No. 3CA-5010)

Finding A. Incorporation of Revised Military Specifications in DoD Contracts.

Recommendation A1: That the ASA(RDA) issue written internal control objectives and techniques that:

a. Verify the inclusion of the revised military specifications in all FY92 and subsequent contracts containing class 3 threads (threaded products), including those contracts for ongoing production procurements, or require written system program office justification based on cost-benefit analysis when the revised military specifications are not included. Renumbered A.1.

b. Verify that data bases used to prepare technical data packages reflect current specifications and standards. Renumbered A.2.

OASA(RDA) Position: Concur with intent. Management controls must not be so burdensome and costly as to outweigh the benefit produced by the control. With this in mind, the Acting Assistant Secretary of the Army (Research, Development and Acquisition) sent a memorandum to all Program Executive Officers in March 1993 requesting that they review their programs in conjunction with the Army Materiel Command supporting technical organizations to ensure that appropriate action is being taken with regard to the implementation of the latest version of Military Specifications. (Copy attached).

The Director of Program Evaluation (SARD-DE) is in the process of following up on this memorandum to ensure that action has been taken. As a part of the follow-up, SARD-DE will evaluate the need to strengthen management controls in this area.

Recommendation A2. That the commander, Army Materiel Command, direct that the cost-benefit analysis for the UH-60 Black Hawk helicopter program include a detailed review of prime contractor cost submissions to implement the revised military specifications. Renumbered A.3. Redirected

OASA(RDA) Position: Partially concur. First, The Black Hawk Program Office reports to the Program Executive Officer, Aviation; not to the Commander, U.S. Army Materiel Command. Second, the Program Executive Officer, Aviation, was a recipient of the March 1993 memorandum cited above in which he was asked to review all programs for the latest specifications. As such, the PEO Aviation response will be factored into our review and evaluation of management controls. Additionally, the appropriateness of directing the PEO Aviation to have a cost-benefit analysis performed in the Black Hawk Program will be considered.

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, DC 20310-0103

SARD-DE

19 MAR 1993

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Use of Military Specifications

In December 1992, the Secretary of the Army received a letter from the * Company expressing concern that the Army continues to use outdated Military Specifications in its contracts. I am enclosing that letter, along with the Army's response. In this particular case, PEO Aviation had good cause for utilizing the former version of a Military Specification, augmented with the Flight Safety Parts Program requirements. The * Company was advised that the Army will reference the latest version of Military Specifications in new contracts, or otherwise ensure that quality/safety measures providing equivalent assurances are fully implemented.

Accordingly, addressees are asked to review their programs in conjunction with the Army Materiel Command's supporting technical organization to ensure appropriate action is being taken.

George E. Dausman
Acting Assistant Secretary of the Army
(Research, Development and Acquisition)

Enclosures

DISTRIBUTION:
COMMANDER, U.S. ARMY MATERIEL COMMAND
PROGRAM EXECUTIVE OFFICERS
ARMAMENTS
ARMORED SYSTEMS MODERNIZATION
AVIATION
COMBAT SUPPORT
COMMAND AND CONTROL SYSTEMS
COMMUNICATIONS SYSTEMS
INTELLIGENCE AND ELECTRONIC WARFARE
GLOBAL PROTECTION AGAINST LIMITED STRIKES
STANDARD ARMY MANAGEMENT INFORMATION SYSTEM
TACTICAL MISSILES

enclosure

*Privacy Act data has been removed.

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, DC 20310-0103

4 FEB 1993

*

Dear Mr. * :

I am responding to your letter to the Secretary of the Army, the Honorable Michael P. W. Stone, concerning the Army's use of specifications for Military Fasteners. Mr. Stone asked me to look into the matter personally and to thank you for your interest in this critical aspect of Army acquisition. The safety of our personnel remains our greatest concern.

I charge each of the Program Executive Officers with the responsibility of acquiring the finest available equipment for our soldiers in the field. Systems safety is a fundamental part of that responsibility. We utilize military specifications and standards, uniquely tailored for each program, as tools to arrive at the required level of safety. Where existing military specifications do not satisfy our safety requirements, we augment those specifications to meet the need. Our Flight Safety Parts Program, which is a requirement in the UH-60 multi-year contract you mentioned, was developed for just this purpose. The Directorate for Engineering at the Aviation and Troop Support Command has assured me that under this program, critical characteristics of all safety critical components, such as the spindle you have mentioned, are 100 percent inspected with both gaging and optical devices to unquestionably insure safety.

As new Army contracts are written they will call for the latest version of any specification to be referenced. However, there are instances, as in the UH-60 contract mentioned above, where an equivalent to the new specification is used. I do agree that it would be beneficial to verify that we have this protection for those contracts still referencing the former specifications. To this end, I will be forwarding a copy of your letter to all of my Program Executive Officers and asking them to review their program requirements from this perspective.

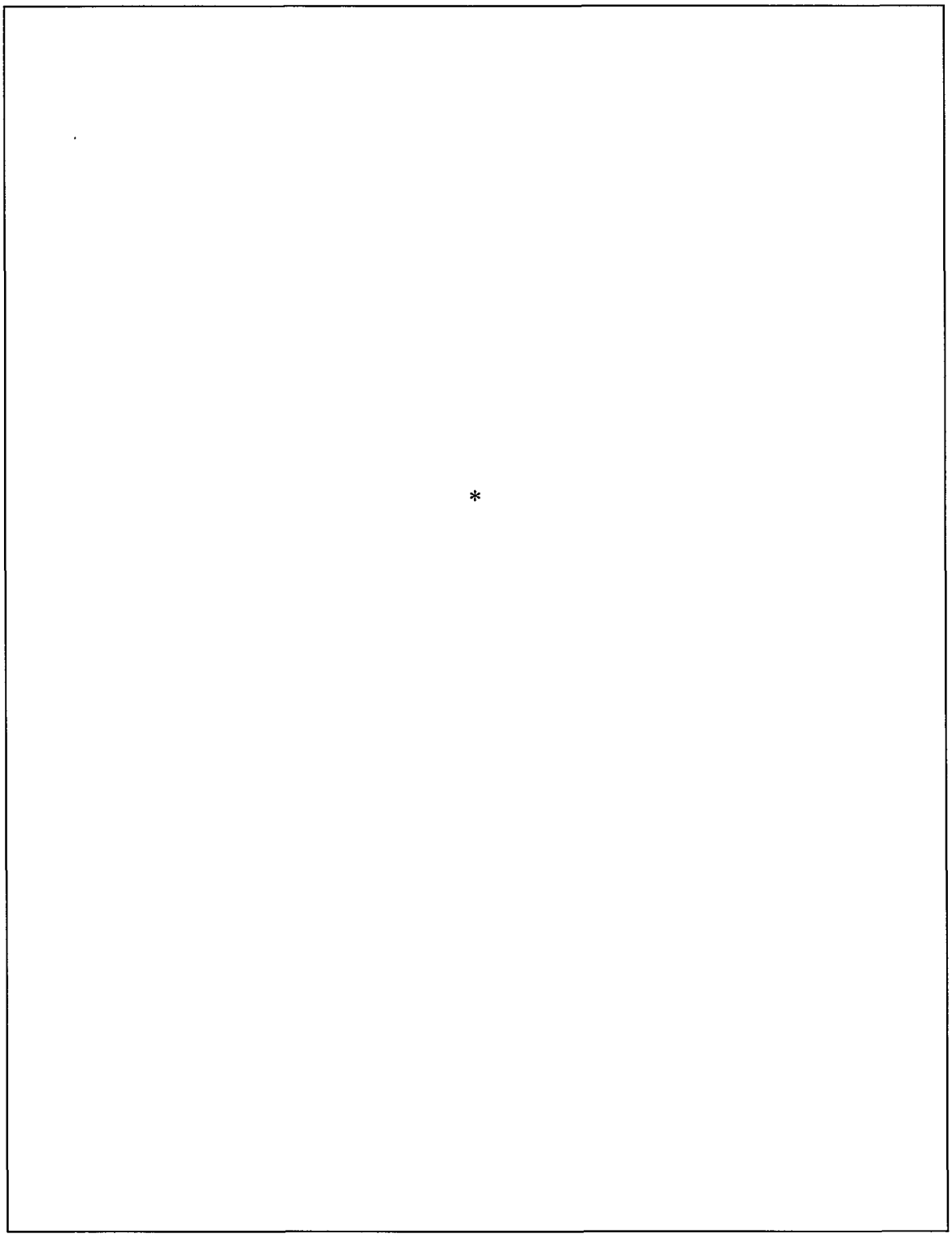
*Privacy Act data has been removed.

You can be assured that we in the United States Army are doing everything possible to safeguard our most precious resource, our soldiers, through the prudent application of standards and specifications. Thank you for sharing our concern for safety.

Sincerely,

George E. Dausman
Acting Assistant Secretary of the Army
(Research, Development and Acquisition)

CF:
Acting Secretary of the Army
Army Inspector General



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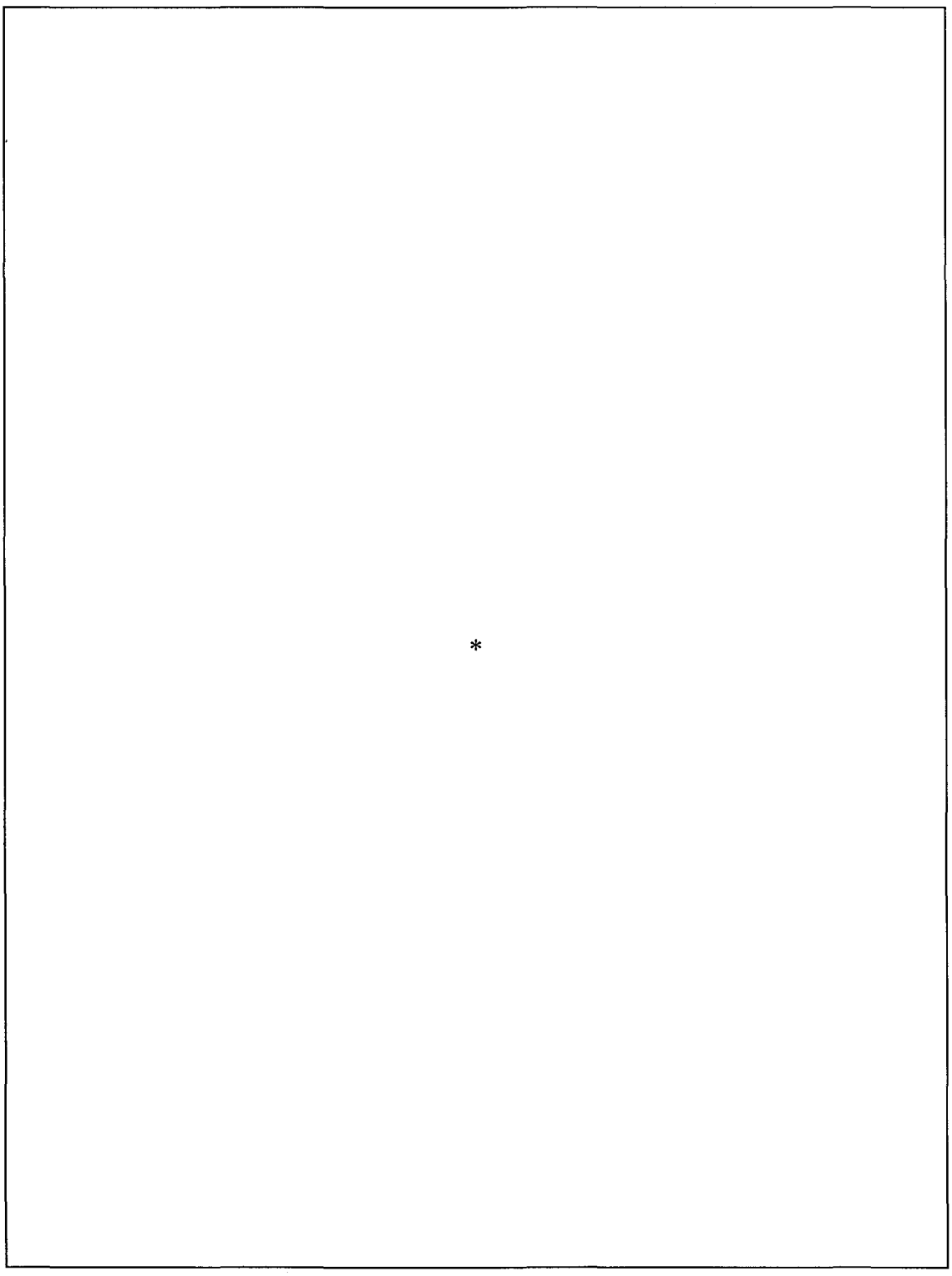

*Privacy Act data has been removed.

Department of the Navy Comments

DEPARTMENT OF THE NAVY
OFFICE OF THE ASSISTANT SECRETARY
(Research, Development and Acquisition)
WASHINGTON, D.C. 20360-1000

DEC 27 1993

MEMORANDUM FOR THE DEPARTMENT OF DEFENSE ASSISTANT INSPECTOR GENERAL FOR AUDITING

Subj: DRAFT AUDIT REPORT ON MILITARY SPECIFICATIONS FOR CRITICAL THREADED PRODUCTS (PROJECT NO. 3CA-5010)

Ref: (a) DODIG Memo of 24 Nov 93

Encl: (1) DON Response to Draft Audit Report

I am responding to the audit report forwarded by reference (a) concerning the use of military specifications for critical threaded products.

The Department of the Navy response is provided by enclosure (1). We generally agree with the draft report findings and recommendations. As outlined in the enclosed comments, the Department is planning to take specific action to ensure adequate management control for utilizing updated military specifications in preparing contracts.

E. B. Harshbarger
RADM, SC, USN
Deputy for Acquisition Policy,
Integrity and Accountability

Copy to:
NAVINSGEN
NAVCOMPT (NCP-53)

Final Report Reference

Department of the Navy Response

to

DODIG Draft Report of 23 November 1993

on

Military Specifications for Critical Threaded Products (Project No. 3CA-5010)

Finding A. DoD contracting officers awarded contracts that did not contain revised military specifications developed to increase the quality of class 3 threads and, thus, the safety of weapons systems. Revised military specifications were not included in 18 of 19 aerospace production contracts and were not included in any of the 52 spare parts contracts. (However, 37 of the spare parts contracts did specify comparable thread inspection methods.) Contracting officers did not include revised military specifications in the contracts because internal controls were not established to verify that local data bases containing updated military specifications and standards were used to prepare contracts. Also, technical personnel incorrectly believed that the revised military specifications were not cost effective, that existing inspection procedures met the intent of the revised military specifications, or that the revised military specifications did not have to be included in contracts for ongoing programs. As a result, class 3 threads received from aerospace production and spare parts contracts may not increase weapon system safety and reliability.

DON Position: The above finding inaccurately characterizes the view of technical personnel toward the cost effectiveness of the subject specifications, existing inspection procedures, and use in ongoing contracts. In fact, the revised military specifications are not cost effective unless properly tailored for the specific application. We agree that existing procedures, if not modified, do not meet the intent of the revised specifications. Revised specifications were not applied because existing contract requirements satisfied critical thread applications.

Recommendation A-1:

That ASN(RD&A) issue written internal control objectives and techniques that:

Renumbered A.1. a. Verify the inclusion of the revised military specifications in all FY 1992 and subsequent contracts containing class 3 threads, including those contracts for ongoing production procurements, or require written system program office justification based on cost-benefit analysis when the revised military specifications are not included.

Final Report Reference

DON COMMENTS ON DODIG DRAFT AUDIT REPORT NO. 3CA-5010 "AUDIT OF MILITARY SPECIFICATIONS FOR CRITICAL THREADED PRODUCTS," 24 NOVEMBER 1993.

Recommendation A-1 (Continued):

b. Verify that data bases used to prepare technical data packages reflect current specifications and standards. Renumbered A.2.

DON Position:

a. Concur. ASN(RD&A) will issue a policy memorandum, no later than 31 January 1994, requiring that current revisions to military specifications be cited in all contracts in accordance with provisions of the FAR and DoDINST 5000.2. This policy will re-emphasize that program engineers who develop contract requirements and technical data packages should utilize the DoD Index for Specifications and Standards (DODISS), the data base identifying the current military specification revision, when preparing detailed specifications. For those FY 92 and newer contracts, program managers will include the latest revision of MIL-S-8879 (Screw Threads, Controlled Radius Root With Increased Minor Diameter) and MIL-S-7742 (Screw Threads, Standard, Optimum Selected Series, General Specification for), if existing contract provisions do not satisfy critical safety and reliability requirements. Program managers will be required to prepare a written justification if the latest revision to MIL-S-8879 and MIL-S-7742 are not included in the contract.

b. Concur. The DoD Index for Specifications and Standards (DODISS) is the data base used by program engineers to identify the current military specification and standard revision. This publication is promulgated and maintained current by the Defense Printing Service, Philadelphia. As stated above, use of the DODISS will be re-emphasized in the preparation of detailed specifications and technical data packages.

Defense Logistics Agency Comments

DEFENSE LOGISTICS AGENCY
HEADQUARTERS
CAMERON STATION
ALEXANDRIA, VIRGINIA 22304-6100

IN REPLY REFER TO DDAI

21 JAN 1994

MEMORANDUM FOR ASSISTANT INSPECTOR GENERAL FOR AUDITING,
DEPARTMENT OF DEFENSE

SUBJECT: Draft Report on Military Specifications for Critical Threaded Products (Project No. 3CA-5010)

This is in response to your 24 November 1993 request.

3 Encl

JACQUELINE G. BRYANT
Chief, Internal Review Office

cc:
MM
AQP

TYPE OF AUDIT: AUDIT DATE OF POSITION:

PURPOSE OF INPUT: INITIAL POSITION

AUDIT TITLE AND NO: Draft Report on Military Specifications for Critical Threaded Products (Project No. 3CA-5010)

FINDING A (page 8): Incorporation of Revised Military Specifications in DoD Contracts. DoD contracting officers awarded contracts that did not contain revised military specifications developed to increase the quality of class 3 threads and, thus, the safety of weapon systems. Revised military specifications were not included in 18 of 19 aerospace production contracts and were not included in any of the 52 spare parts contracts. (However, 37 of the spare parts contracts did specify comparable thread inspection methods.) Contracting officers did not include revised military specifications in the contracts because internal controls were not established to verify that local data bases containing updated military specifications and standards were used to prepare contracts. Also, technical personnel incorrectly believed that the revised military specifications were not cost effective, that existing inspection procedures met the intent of the revised military specifications, or that the revised military specifications did not have to be included in contracts for ongoing programs. As a result, class 3 threads received from aerospace production and spare parts contracts may not increase weapon system safety and reliability.

DLA COMMENTS: Nonconcur. We disagree with the audit finding that 46 of the spare parts contracts did not include revised military thread specifications. On page 12, under the headings Spare Parts Procurements, DISC Spare Parts Procurements, a statement is made that " Although DISC Contracting officers did not include the revised military specifications in the spare parts contract ..." implies, or at least could be interpreted to imply that DISC did not invoke the latest revision of MIL-S-8879 or MIL-S-7742 in the 46 contracts reviewed. This implication is incorrect. DISC determined that of the 46 contracts reviewed 34 clearly invoked the latest revision of MIL-S-7742 or MIL-S-8879 (and other reference specifications) through the appropriate configuration design control process. This process involves the use of the statement "Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation." A similiar statement is used by industry in the preparation of non-government specifications and standards, as well as drawings and specifications prepared by Original Equipment Manufacturers.

Of the remaining 12 contracts, 6 of the contracts invoked drawings under the design control of private sector companies. DISC contacted the responsible design engineering personnel and confirmed that it is common practice in industry not to list the revision letter of reference specifications on the piece part drawings and that it is universally accepted that customers will automatically receive the latest revision unless the company supplying the part contractually takes exception to the latest revision.

Final Report Reference

Revised

Page 12

On page 12, under the headings Spare Parts Procurement, DISC Spare Parts Procurements a statement is made that "However, seven spare parts contracts for safety critical internal Class 3 threads did not incorporate inspection methods required in the revised military specifications." This statement is incorrect. These contracts did incorporate the required thread inspection methods. The issue here is that these contracts involve safety critical parts but these parts do not have safety critical threads. This is a very important distinction.

On page 13 under the heading, Internal Class 3 Threads, a statement is made that "The seven spare parts contracts for safety critical internal Class 3 threads incorrectly specified system 22 inspection for inspection in the other category rather than system 23, as required by the revised military specifications." Again, parts involved are safety critical but the threads are not and the Services have agreed that threads that are required to be altered after tapping will not carry the safety critical designation. Alterations such as self-locking deformations, holes for lock wires, castellated slots for safety wires etc. will not be considered to have safety critical threads even though the part itself is used in a safety critical application. The four parts involved in these seven contracts fall into this category. NSN 5310-00-810-1786 involving 4 contracts and NSN 5310-00-268-6049 involving 1 contract are the self-locking, deformed type parts. To substantiate our position on these 2 items, we have enclosed copies of drawings that the Services have authorized for use in procuring these parts (see enclosure 1)*. Review of the threaded notes will demonstrate that the inspection method used in DISC procurements matches those specified on the safety critical drawings. We have also included correspondence pertaining to this issue. (see enclosure 2).*

The rationale for making the distinction between safety critical threads is based upon the intent of MIL-S-8879 and MIL-S-7742. These two documents are specifically used for controlling the thread application categories depicted in paragraph 3.1 of these documents are "Safety Critical Threads" and "Other Threads." No distinction is made to safety critical parts. In paragraph 6.2.9 of these documents reference is made to "Failure of the thread itself." Not applying the safety critical thread designation on these items is based upon the fact that applying the very precise and costly inspections required by the safety critical thread designation would be wasteful since the thread is subsequently altered. Also, altering the thread itself confirms that the thread is not a critical feature.

Another of the four parts involved in the seven contracts, NSN 5310-00-638-5730 falls into the same altered threads category. In this case a drawing was not prepared since this item is controlled by an Original Equipment Manufacturer who alone, as the Design Control Activity, has the authority to designate technical requirements. The thread was not designated as safety critical by the OEM.

* Not enclosed.

Final Report Reference

The remaining item of the four parts involved with the seven contracts, NSN 5310-00-350-7265 involves a castellated nut nominated as a safety critical part by the Marine Corps. This part is covered by a 1943 Detroit Arsenal drawing that does not refer to either MIL-S-8879 or MIL-S-7742 for the threads. DISC challenged the nomination of this part as safety critical and based upon futher review the Marine Corps has withdrawn their designation.

Page 12 Revised

On page 13 under the heading DISC Response to Finding, a statement is made that "However, we found that such a statement was in thread drawings for only 17 of the 46 spare parts contracts." With regard to this statement, as stated earlier, DISC has established that 34 of the 46 contracts invoked the latest revision through design configuration control statements. Of the remaining 12 contracts, 6 did not appear to have these statements and 6 invoked private sector company drawings.

On page 13 under the heading DISC Response to Finding, the statement that "In any event, such an agreement would contradict the intent of the revised military specification" is incorrect. The intent of these specifications, and the only intent, pertains to designation of threads as safety critical or other. The intent of these specifications is not to address a safety critical part but rather the threads of a safety critical part. In other words, designating a part as safty critical is not enough to properly meet the intent of these specifications. One must address the thread feature itself. Obviously, if a safety critical part doesn't have threads, these specifications would not even be considered.

We also nonconcur with the finding that inspection methods comparable to the revised military specifications were included in 37 of the 46 contracts reviewed. All 46 contracts invoked thread inspection methods required by the revised specifications.

INTERNAL MANAGEMENT CONTROL WEAKNESSES:
(X) Nonconcur.
( ) Concur; however, weakness is not considered material.
( ) Concur; weakness is material and will be reported in the DLA Annual Statement of Assurance.

MONETARY BENEFITS: N/A
DLA COMMENTS:
ESTIMATED REALIZATION DATE:
AMOUNT REALIZED:
DATE BENEFITS REALIZED:

ACTION OFFICER: Thomas J. Ridgway, MMSLP, 46781, 18 Jan 94
REVIEW/APPROVAL: James J. Grady, Jr., Deputy Executive Director, Supply Management, MMSD, x70510, 18 Jan 94
COORDINATION: Anthony E. Broadnax, DDAI, x49607, 10 Jan 94
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DLA APPROVAL:

Final Report Reference

TYPE OF REPORT: AUDIT DATE OF POSITION:

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AUDIT TITLE AND NO: Draft Report on Military Specifications for Critical Threaded Products (Project No. 3CA-5010)

Renumbered A.1. Pages 13, 14

RECOMMENDATION A.1.a. (page 14): We recommend that the Assistant Secretary of the Army (Research, Development, and Acquisition); the Assistant Secretary of the Navy (Research, Development, and Acquisition); the Assistant Secretary of the Air Force (Acquisition); and the Director, Defense Logistics Agency, issue written internal control objectives and techniques that verify the inclusion of the revised military specifications in all FY 1992 and subsequent contracts containing class 3 threads, including those contracts for ongoing production procurements, or require written system program office justification based on cost-benefit analysis when the revised military specifications are not included.

DLA COMMENTS: Nonconcur. Inclusion of the latest revision of reference specifications is controlled by Military Standards, MIL-STD-961 and MIL-STD-962. In November 1992, DISC was assigned specification Preparing Activity authority for fastener military standards and specifications. DISC will assure compliance with MIL-STD-961/962 design configuration control statements that will invoke the latest revisions on these documents.

DISPOSITION:
( ) Action is ongoing. Estimated Completion Date:
(X) Action is considered complete.

INTERNAL MANAGEMENT CONTROL WEAKNESSES:
(X) Nonconcur.
( ) Concur; however, weakness is not considered material.
( ) Concur; weakness is material and will be reported in the DLA Annual Statement of Assurance.

MONETARY BENEFITS:
DLA COMMENTS:
ESTIMATED REALIZATION DATE:
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DLA APPROVAL: Barbara R. Farrell

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TYPE OF REPORT: AUDIT DATE OF POSITION:

PURPOSE OF INPUT: INITIAL POSITION

AUDIT TITLE AND NO: Draft Report on Military Specifications for Critical Threaded Products (Project No. 3CA-5010)

RECOMMENDATION A.1.b. (page 14): We recommend that the Assistant Secretary of the Army (Research, Development, and Acquisition); the Assistant Secretary of the Navy (Research, Development, and Acquisition); the Assistant Secretary of the Air Force (Acquisition); and the Director, Defense Logistics Agency, issue written internal control objectives and techniques that verify that data bases used to prepare technical data packages reflect current specifications and standards.

Renumbered A.2

DLA COMMENTS: Nonconcur. Controls that assure currency of technical data used in DLA procurements are already in place. DLA Regulation 4140.37, Advance Validation of Technical Data Required for DLA Procurement and DLA Manual 4130.3, Volume II, Part 5, Section VI, Validation of Technical Data provide the procedures and policies relative to the currency of technical data. At DISC, Staff Memorandum 4140.4 implement these 2 DLA documents.

DISPOSITION:
( ) Action is ongoing. Estimated Completion Date:
(X) Action is considered complete.

INTERNAL MANAGEMENT CONTROL WEAKNESSES:
(X) Nonconcur.
( ) Concur; however, weakness is not considered material.
( ) Concur; weakness is material and will be reported in the DLA Annual Statement of Assurance.

MONETARY BENEFITS:
DLA COMMENTS:
ESTIMATED REALIZATION DATE:
AMOUNT REALIZED:
DATE BENEFITS REALIZED:

ACTION OFFICER: Thomas J. Ridgway, MMSLP, x46781, 18 Jan 94
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