

*Audit*



*Report*

CORROSION PREVENTION PROGRAMS WITHIN THE SERVICES  
FOR TRACKED AND WHEELED VEHICLES

Report No. 98-079

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February 20, 1998

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

SUBJECT: Audit Report on Corrosion Prevention Programs Within the Services for  
Tracked and Wheeled Vehicles (Report No. 98-079)

We are providing this audit report for your information and use. Because this report contains no findings or recommendations, no written comments were required, and none were received.

We appreciate the courtesies extended to the audit staff. Questions on the audit should be directed to Mr. Michael E. Simpson, Audit Project Manager, at (703) 604-8972, or e-mail [Msimpson@DODIG.OSD.MIL](mailto:Msimpson@DODIG.OSD.MIL) or Julius L. Hoffman, Team Leader, at (703) 604-8976, or e-mail [JHoffman@DODIG.OSD.MIL](mailto:JHoffman@DODIG.OSD.MIL). See Appendix B for the report distribution. The audit team members are listed on the inside back cover.

*David K. Steensma*

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## Office of the Inspector General, DoD

Report No. 98-079  
(Project No. 7AG-0020)

February 20, 1998

### Corrosion Prevention Programs Within the Services for Tracked and Wheeled Vehicles

#### Executive Summary

**Introduction.** Corrosion degradation of DoD weapon systems and equipment represents an important cost-of-ownership issue. Current costs, resulting from corrosion, are difficult to establish, but they are estimated to be significant. The Deputy Under Secretary of Defense for Logistics tasked each Service to review the long-term investment strategy to determine how to maximize the potential of dehumidified preservation as a maintenance technology. The review was to include a detailed economic analysis highlighting weapon systems and locations that would benefit most from dehumidification as a maintenance technology. The Army, the Air Force, and the Marine Corps responded by stating that they were either considering dehumidification or that current programs were sufficient to deter corrosion.

**Audit Objectives.** Audit objectives were to determine the adequacy of planning for corrosion prevention and control for tracked and wheeled systems acquired by the Services and to determine whether corrosion prevention and control programs are used as part of maintenance planning and life-cycle costs. We did not review new maintenance technologies used to reduce the cost of ownership because of limited audit resources.

**Audit Results.** All the Services have corrosion prevention policies and procedures in place to minimize corrosion on their tracked and wheeled vehicles. The extent to which the policies and procedures are effective varies among the Services based on the emphasis placed on corrosion prevention. The three Army acquisition program managers that we visited took action to ensure that systems in production were receiving corrosion protection. The Army location that we visited had an effective corrosion prevention program. The Navy had suspended corrosion prevention methods at one of the four locations that we visited, but it is now taking steps to follow the current regulations. The Air Force has an in-depth corrosion prevention program that was effective at the four locations that we visited. The Marine Corps has a very active corrosion prevention program. The policies and procedures for corrosion control were effective for the systems and locations reviewed.

**Management Comments.** We provided a draft of this report to management. Because the report contained no findings or recommendations, comments were not required, and none were received. Therefore, we are publishing this report in final form.

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## **Part I - Audit Results**

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## **Audit Background**

Efforts to protect U.S. Defense assets against corrosion have been ongoing since the first American militias were formed nearly 400 years ago. Since then, many methods of preservation have been used, but corrosion still continues to reduce DoD readiness and increase its maintenance costs. Corrosion degradation of DoD weapon systems and equipment represents an important cost-of-ownership issue. Current costs are difficult to establish, but they are estimated to be significant. All Services have corrosion prevention policies and procedures in place to minimize corrosion on their wheeled and tracked vehicles. The extent to which the policies and procedures are effective varies among the Services, based on the emphasis placed on corrosion prevention. In addition, the Deputy Under Secretary of Defense for Logistics tasked each Service to review the long-term investment strategy to determine how to maximize the potential of dehumidified preservation as a maintenance technology. The review was to include a detailed economic analysis, which highlighted the weapon systems and locations that would benefit most from dehumidification as a maintenance technology. The Services responded by stating that they were either considering dehumidification or that current programs were sufficient to deter corrosion.

## **Audit Objectives**

Audit objectives were to determine the adequacy of planning for corrosion prevention and control for tracked and wheeled systems acquired by the Services and to determine whether corrosion prevention and control programs are used as part of maintenance planning and life-cycle costs. We did not review new maintenance technologies used to reduce the cost of ownership because of limited audit resources.

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## Corrosion Prevention Programs Within the Services

All the Services have corrosion prevention policies and procedures in place to minimize corrosion on their wheeled and tracked vehicles. The extent to which the policies and procedures are effective varies among the Services, based on the emphasis placed on corrosion prevention. While our scope was limited to systems and locations within each Service, the policies and procedures for corrosion control appeared to be effective. The three Army acquisition program managers that we visited took action to ensure that systems in production were receiving corrosion protection. The one Army location that we visited had an effective corrosion prevention program. The Navy had suspended corrosion prevention methods at one of four organizations that we visited, but it is now taking steps to follow the current regulations. The Air Force has an in-depth program to deal with corrosion prevention, and it appears to be effective at the four locations that we visited. The Marine Corps has a very active corrosion prevention program.

### Corrosion Prevention in the Army

**Acquisition Planning-Tracked Systems.** We visited three Army programs currently in production. The Program Managers for the M1A2 Main Battle Tank and the M109A6 Paladin Self-Propelled Howitzer had taken action to ensure corrosion prevention. For example, the M1A2 Main Battle Tank paint is resistant up to level 2 corrosion. The Paladin is constructed of aluminum, and the contractor is required to include corrosion prevention and control as a discipline in the manufacture of components, subassemblies, and deliverable end items.

We visited Fort Hood, Texas, to inspect equipment located there. The 1st Cavalry Division and the 4th Infantry Division at Fort Hood followed Technical Manual 10/20 Series, Preventive Maintenance Checks and Services. Each unit has an Operations Officer and a Maintenance Officer who are responsible for the use and maintenance of tracked and wheeled vehicles assigned to each unit.

The Maintenance Officer develops the preventive maintenance checks and services program, which is based on Technical Manual 10/20, and the Operations Officer ensures that preventive maintenance checks and services are performed by adhering to locally established procedures.

**M1A1 Main Battle Tank and M109A6 Paladin Self-Propelled Howitzer.** We checked 58 M1A2 Main Battle Tanks and 54 M109A6 Paladins at Fort Hood, Texas, and we saw no visual signs of rust or corrosion. Preventive maintenance checks are accomplished at least weekly.

**Acquisition Planning-Family of Medium Tactical Vehicles.** The first 7,199 vehicles in the Family of Medium Tactical Vehicles acquisition program

## Corrosion Prevention Programs Within the Services

were protected for a 10-year period. The Army is spending another \$2.5 million to have the standard cab shell and air drop cab shell hot-dip galvanized. The process will extend the corrosion protection for the Family of Medium Tactical Vehicles beyond the 10-year requirement specified in the original contract. The additional corrosion protection was added when field reports noted severe corrosion problems for units in the Pacific. Hot-dip galvanizing is to begin with production number 7,200 and should help to correct the corrosion problem in the Pacific.

**Army Corrosion Initiatives.** The Team Materials, Environment, Packaging, and Special Processes Division is undertaking accelerated corrosion test initiatives, including marine corrosion exposure tests on coatings and current state-of-the-art tests for repairing fielded systems, and is developing a relational database for corrosion issues. The War Reserve Command at Rock Island, Illinois, uses dehumidified warehouses in Europe for storing war reserve assets and also plans to dehumidify ships used for the propositioned afloat program.

**Conclusion.** The Army is not experiencing corrosion problems for two of the systems reviewed and is addressing potential corrosion problems by designating the Army Tank-automotive and Armaments Command as the corrosion prevention-and-control lead.

## **Corrosion Prevention in the Navy**

The Naval Facilities Engineering Command is responsible for maintaining civil engineer support equipment and prepositioned war reserve material stock in a state of readiness. Corrosion can be a serious problem for the Navy because corrosion is mostly caused by the presence of water and condensation. Salt water and acid rain also make vehicles more susceptible to corrosion and rust. Therefore, an effective corrosion prevention-and-control program is very important to the Navy. We randomly selected 411 vehicles located at two Navy Construction Battalion Centers and 153 vehicles at two Navy public works centers for our review. We visually inspected the interior and exterior of the vehicles for rust and other signs of corrosion.

**Construction Battalion Center-Port Hueneme.** We inspected 129 vehicles, which included 4x4 trucks, stake trucks, dump trucks, and truck tractors at the Navy Construction Battalion Center-Port Hueneme. Our review showed that 68 of the vehicles that we inspected contained surface rust. The rust was extensive on drive shafts, transfer cases, differentials, and exhaust systems. In 1989, Port Hueneme discontinued its dehumidification program for wheeled vehicles in wartime storage because of high maintenance costs. In addition, Port Hueneme did not inspect wheeled vehicles in storage. As a result, vehicles have remained in storage for up to 2 years without being maintained. Port Hueneme is currently preparing new maintenance procedures to ensure that vehicles in storage are properly maintained.

**Construction Battalion Center-Gulfport.** We inspected 282 vehicles at the Navy Construction Battalion Center-Gulfport. Gulfport personnel applied undercoating to its vehicles before placing them in storage. Inspections showed

that the vehicles showed no signs of rust or corrosion. The vehicles are adequately maintained because Gulfport officials are using the preservation techniques recommended in Naval Facilities Engineering Command Publication-90, "Preservation, Packaging, Packing of Naval Facilities Engineering Command Technical Material," September 1989, which establishes policy to protect equipment against deterioration and damage during handling, shipping, and storing; requires that protection be applied to equipment to prevent corrosion; and recommends several methods of corrosion control, including protective coatings, preservatives, and packing techniques. The Navy uses preservatives such as thin-film solvents, petroleum-based hot applications, and rust-inhibiting oils. The vehicles also receive one of three levels of corrosion protection. Level A provides protection from the most severe conditions, while levels B and C provide protection for equipment during shipping, handling, and storing.

**Public Works Centers-Norfolk and San Diego.** We inspected 153 vehicles at Navy Public Works Centers-Norfolk and San Diego, including passenger vans, panel vans, compact pickup trucks, and maintenance and utility trucks. We saw no signs of corrosion or rust on any of the 153 vehicles. The public works centers apply undercoating in accordance with Naval Facilities Engineering Command Publication-90 to prevent corrosion and rust, and the vehicles undergo maintenance checks every 3,000 miles.

**Conclusion.** Overall, when the Navy uses its preservation, protection, and storage methods, they are effective in preventing deterioration and corrosion of vehicles. The Construction Battalion Center-Gulfport and the Norfolk and San Diego public works centers apply protective coatings on wheeled vehicles and perform periodic inspections as a method of corrosion prevention and control. However, the Port Hueneme Construction Battalion Center did not use the preservation techniques required to prevent rust and corrosion, and it also did not perform periodic inspections or maintenance on vehicles in the storage facilities. As a result, rust is present on the vehicles, and potential also exists for corrosion. Currently, Port Hueneme is working to establish maintenance procedures to prevent rust and corrosion for vehicles in storage facilities.

## Corrosion Prevention in the Air Force

The Air Force uses commercial off-the-shelf purchasing for general purpose vehicles and light trucks. Warner Robins Air Force Base is the central acquisition agency for purchasing Air Force vehicles. Each air base identifies its vehicle requirements, which are forwarded to Warner Robins for procurement. The vehicles and trucks contain the standard commercial corrosion protection used by the automobile companies. The standard commercial corrosion coverage states that the contractor shall provide the chassis manufacturer's commercial corrosion coverage. The coverage is for at least 5 years or 100,000 miles. The Air Force purchases special purpose vehicles that have commercial off-the-shelf chassis with unique or special equipment attached to the chassis. The Air Force also purchases medium and heavy commercial trucks and tractors. The Air Force obtains its tactical

## Corrosion Prevention Programs Within the Services

vehicles from the Army, which includes corrosion protection for the tactical vehicles in the purchasing contracts.

The Air Combat Command's Top Wheels Program focuses on the care and appearance of military vehicles. The purpose of the program is to instill pride of ownership in vehicle operators and maintenance personnel at all command levels. The program states that the Air Force will train and license the minimum number of personnel to operate, inspect, and maintain Air Force vehicles. Each base had programs and procedures in place to ensure that the vehicles are well maintained and thoroughly inspected for corrosion.

**Vehicle Control and Top Wheels Programs.** Langley, Hill, Ellsworth, and Eglin Air Force Bases operate Vehicle Control Officer and Top Wheels programs. The Vehicle Control Officer Program requires a Vehicle Control Officer to be appointed to each user unit. Air Force Policy Directive 24-3 states that the Air Force will train and license the minimum number of personnel to operate, inspect, and maintain Air Force vehicles and to track their qualifications. The bases also use a Champion Wheels/Top Wheels Program that establishes standards for vehicle interior, exterior, and engine compartments. The purpose of the program is to enhance and maintain a high appearance standard for the vehicle fleet. The Vehicle Control Officer ensured that the vehicles are inspected at least once a year by using no-notice inspections, Commander's roll-bys, and a Champion Wheels/Top Wheels Program. The Vehicle Control Officer provided each vehicle operator with a maintenance checklist, which identifies major and minor vehicle discrepancies that may lead to corrosion damage. Each year, the unit Commander checks the vehicles personally and notes any discrepancies, which are later corrected by the maintenance or the paint organizations.

**Vehicle Inspections.** We inspected 741 vehicles at Langley, Ellsworth, Eglin, and Hill Air Force Bases.

**Langley.** We inspected 123 vehicles such as sedans, pick-up trucks, and dump trucks at Langley Air Force Base. In addition, we reviewed the no-notice inspection data for the vehicles. The no-notice inspection data rated the vehicles as outstanding, excellent, and satisfactory.

**Ellsworth.** We inspected 124 vehicles of various types including U-Drive vans, snowplows, pick-up trucks, ambulances, and buses at Ellsworth Air Force Base. The inspections revealed 13 vehicles with paint damage, 3 vehicles with scratches, and 7 vehicles with normal wear and tear. The remaining vehicles were in good condition. We also reviewed the results from the no-notice inspections for 119 vehicles. Only 7 vehicles had an unsatisfactory rating, 30 vehicles had a satisfactory rating, and 82 had an outstanding rating.

**Eglin.** We inspected 280 vehicles, including various types of vans, pick-up trucks, sedans, buses, and fire trucks at Eglin Air Force Base. The vast majority of vehicles were in good condition. The visual inspections revealed 19 vehicles with chipped paint, 8 vehicles with bed rust, and 2 vehicles with minor rust.

**Hill.** We inspected 214 vehicles of various types, including sedans, station wagons, pick-up trucks, vans, 5-ton trucks, and refuelers at Hill Air Force Base. The majority of the vehicles were in good condition, showing no rust, dents, or scratches; 45 vehicles showed signs of rust, but only 8 had a serious rust problem. Also, 14 vehicles showed signs of paint damage.

**Conclusion.** The Air Force had an effective corrosion prevention and control program in place at the locations that we visited. The program began with the initial purchase of general purpose vehicles with the standard commercial corrosion protection. The corrosion prevention and control then continued throughout the life of Air Force vehicles with various programs, including a Champion Wheels/Top Wheels Program, the Vehicle Control Officer Program, Commander's roll-bys, and no-notice inspections. While the number of locations that we visited was limited, the policies and procedures that the Air Force used were effective.

### Corrosion Prevention in the Marine Corps

Corrosion prevention and control are among the main concerns of commanders at all levels in the Marine Corps. Marine Corps tactical and ground support equipment is particularly susceptible to corrosion and other moisture damage because of its assigned missions and geographic locations. Also, the operating tempo, salt-laden operating environment, aging equipment, and the environmental constraints on many Marine Corps installations cause corrosion to valuable warfighting equipment. Vehicles returning from Desert Shield and Desert Storm displayed high levels of corrosion problems.

**Camp Lejuene.** We inspected 258 pieces of equipment, including the MK155, M105 and M101A3 trailers, M817 dump trucks, and tanks. We looked for rust contamination on the equipment selected for the administrative storage program. We also inspected for rust contamination on operational equipment belonging to 8th Bravo Company of the 8th Motor Transport Battalion. The equipment is stored in dehumidified and non-dehumidified buildings and open areas for about 30 months. No corrosion problems were present for equipment stored in dehumidified or non-dehumidified buildings; however, equipment stored outside showed signs of corrosion, which, according to officials, was not a major concern at the time. The equipment is painted with a chemical-agent-resistant coating and a corrosion control coating before it is sent to administrative storage.

**Corrosion Prevention and Control Initiatives.** The Naval Surface Weapons Center is conducting a research and development program for the Marine Corps to reduce corrosion of combat and tactical equipment and associated maintenance burdens. The program is directed toward validating existing corrosion prevention methods, using coatings, and identifying corrosion-resistant materials. The program is also developing an accelerated test to permit rapid screening of better materials and in-service evaluation of new materials and procedures.

## Corrosion Prevention Programs Within the Services

In addition, the Marine Corps has established a corrosion prevention and control program to combat corrosion for tactical and ground support equipment. The program's working group identifies and assesses current and projected corrosion problems in the Marine Corps and is presently evaluating many preservatives that could extend the equipment's life cycle.

**Conclusion.** The Marine Corps is researching ways to implement corrosion prevention and controls in its systems. In addition to the corrosion control coating and the chemical-agent-resistant coating programs, the inspect-and-repair-only-as-necessary program is also used to control or minimize equipment corrosion.

## **Part II - Additional Information**

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## Appendix A. Audit Process

### Scope and Methodology

This program audit was conducted from December 1996 through December 1997, in accordance with the auditing standards issued by the Comptroller General of the United States, as implemented by the Inspector General, DoD. We concentrated on the Services' wheeled and tracked vehicles to complete our objectives and to determine what each Service was doing to prevent corrosion. For the Army, we selected M1A1 tanks, Family of Medium Tactical Vehicles, and M109A6 Paladins to determine the corrosion prevention programs used during the acquisition process. In addition, we selected one location within the Army to randomly inspect 112 tracked systems to determine whether it had a corrosion problem.

For the Navy, the Air Force, and the Marine Corps, we judgmentally selected locations and then randomly selected vehicles to inspect at each location. We selected four Navy locations, four Air Force bases, and one Marine Corps location. We inspected 564 vehicles at the Navy locations, 736 vehicles at the Air Force locations, and 258 vehicles at the Marine Corps location. Vehicles inspected included sedans, station wagons, vans, pick-up trucks, 1.5-ton trucks, 2-ton trucks, 5-ton trucks, tractors, trailers, refuelers, tankers, dump trucks, fire trucks, snowplows, snow blowers, fork lifts, ambulances, buses, flat-beds, cranes, cargo trucks, jeeps, bobtails, and wreckers. We also interviewed maintenance personnel.

**Computer-Processed Data and Statistical Sampling Procedures.** We did not use computer-processed data or statistical sampling procedures for this audit.

**Contacts During the Audit.** We visited or contacted individuals and organizations within the DoD. Further details are available on request.

### Management Control Program Review

**Requirement for Management Control Review.** DoD Directive 5010.38, "Management Control (MC) Program," August 26, 1996, requires DoD organizations to implement a comprehensive system of management controls to provide reasonable assurance that programs are operating as intended and to evaluate the adequacy of the controls.

**Scope of Review of the Management Control Program.** We reviewed the adequacy of management controls over the implementation of regulations dealing with corrosion prevention. We did not assess the adequacy of management's self-evaluation because we did not identify a material weakness.

**Adequacy of Management Controls.** The Services' management controls of policies and procedures dealing with corrosion prevention were adequate at the locations that we visited. We identified no material management control weaknesses in the area of corrosion prevention.

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## **Appendix B. Report Distribution**

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House Subcommittee on National Security, Committee on Appropriations  
House Committee on Government Reform and Oversight  
House Subcommittee on Government Management, Information, and Technology,  
Committee on Government Reform and Oversight  
House Subcommittee on National Security, International Affairs, and Criminal Justice,  
Committee on Government Reform and Oversight  
House Committee on National Security

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