

AD-A161 100 PRODUCT ASSURANCE MATERIEL DETERIORATION PREVENTION AND 1/1
CONTROL(U) ARMY MATERIEL DEVELOPMENT AND READINESS
COMMAND ALEXANDRIA VA 16 OCT 79 DARCOM-R-702-24

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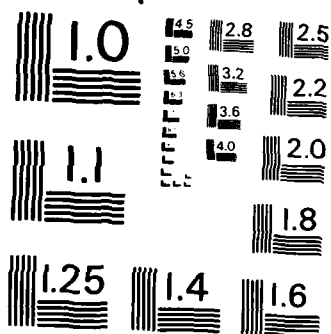
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16 October 1979

MATERIEL DETERIORATION PREVENTION AND CONTROL

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1. Purpose. This regulation establishes policy, procedures and responsibilities for the establishment and implementation of the Materiel Deterioration Prevention and Control (MADPAC) Program of the US Army Materiel Development and Readiness Command (DARCOM).
2. Scope. This regulation applies to Headquarters, DARCOM; DARCOM major subordinate commands, program/project/product managers (PM's); and separate installations and activities reporting directly to Headquarters, DARCOM.
3. Explanation of terms. Except as otherwise indicated, the terms used in this regulation are defined in AR 310-25 and MIL-STD-109.
 - a. Prevention of materiel deterioration. Action to preclude this deterioration of materiel including systems, subsystems, assemblies and components; and to retain the ability of such systems in fulfilling the functions for which they were intended, by:

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(1) Stressing the proper control requirements in the design selection of materials, finishes, and processes that will deter or resist deterioration.

(2) Applying protective coating systems during or after fabrication, construction, or corrective maintenance to reduce deterioration-susceptibility. Also, by maintaining paint systems, to preserve their protective qualities.

(3) Avoiding conditions that induce deterioration (for example, water retention, corrosive environments, and contact between dissimilar metals).

(4) Cleaning systems and equipment, and doing coating touch-ups as part of each deterioration inspection.

(5) Correcting deterioration immediately upon discovery and doing whatever is necessary to prevent further or similar deterioration.

(6) Providing protective packing, packaging, and preservation of equipment and components to reduce the risk of deterioration during shipment or storage.

b. Deterioration. The process of destroying a material or of changing its properties through a reaction with its environment. Deterioration may occur in an environment from natural, chemical, and physical causes or combinations thereof. Examples of deterioration are galvanic corrosion resulting from dissimilar metal contacts in the presence of moisture, the oxidation of metal at ambient and elevated temperatures, crevice corrosion in undrained sump areas and unsealed faying surfaces, degradation of elastomers by ozone attack, etched impairment of optical glass by microbiological agents, and degeneration of polymers by ultraviolet radiation.

c. Deterioration preventative. A substance (such as oil, plastic, paint, wrapping, or other surface treatment of a material) whose primary function is to prevent deterioration.

d. Deterioration program. A planned and organized effort to prevent and control deterioration, including corrosion, of any system, equipment, or support equipment susceptible to deterioration damage.

e. Deterioration susceptibility. The tendency for a given material, after it has been exposed over a period of time, to an operating or storage environment, to deteriorate and adversely affect a system or equipment; deterioration can generally be reduced by proper design to eliminate sump areas, to prevent contact between dissimilar metals, by reducing operating stresses, and by protecting surfaces (painting or chemical treatment).

f. Depot level material deterioration prevention and control. Work that is beyond the resources or capabilities of field level facilities (for example, structural repair, major repainting, etc.). Also, work that the commodity command has designated for depot maintenance.

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g. MADPAC specification. A document for use with Army research and development, procurement and production, and supply and maintenance efforts under the jurisdiction of organizational elements within the purview of this regulation. The document is designed to establish optimum requirements and procedures for deterioration prevention and control programs applicable to materiel systems and associated equipment. Appendix A will serve as a pattern upon which the contract-incorporated document will be based. However, the final acceptable version shall be reconciled to the basic requirements of the particular system, with assistance of the subordinate command deterioration prevention action office.

h. Materiel. Materiels, supplies and systems supplied under the cognizance of DARCOM.

4. Policy. An effective MADPAC Program will be established and maintained within DARCOM to:

a. Assure that materiel, including weapon systems, maintain satisfactory performance under environmental conditions encountered in storage and in Army tactical environments.

b. Insure maximum use of state-of-the-art technology in the prevention of deterioration. Particular attention is to be directed toward selecting deterioration-resistant materiels. Also, use adequate protective coating systems for critical parts and areas not readily accessible for inspection and repair.

c. Maintain cognizance of the physical, chemical, and biological causes of deterioration, and techniques for its prevention and control.

d. Provide for deterioration prevention reviews encompassing the areas of design, material selection, manufacturing processes, technical documentation, product assurance, field and depot maintainability operations, feedback data, and training requirements.

e. Provide for the analysis of in-house or contracted programs concerned with materials and processes applicable to the solution of problems in environmental deterioration.

f. Insure that all applicable contracts for Army systems and associated equipment contain requirements for a deterioration prevention program. Procurement activities will incorporate the proper deterioration prevention standards, specifications, design handbooks and packaging requirements in procurement documents. They will also require contractors to use state-of-the-art technology and use the experience from "lessons learned" in selecting the best materials, processes, and techniques for corrosion prevention and control.

g. Provide adequate staffing and funding for maintaining an effective program.

5. Responsibilities and functions. a. The Director of Product Assurance, Headquarters, DARCOM will:

(1) Be responsible for the Army Deterioration Prevention and Control Program for Materiel.

(2) Establish a DARCOM MADPAC Action Office.

(3) Establish and chair or have his representative chair the Materiel Deterioration Prevention and Control Central Steering Committee (MADPACCSC).

b. The Director of Development and Engineering, Headquarters, DARCOM will:

(1) Provide policy, procedures and guidance to insure that deterioration prevention is fully considered in all requirements documents and specifications during the development of Army materiel.

(2) Assure that proper emphasis is given to materiel deterioration prevention and control in assigned funding programs (6.3b, 6.4, 6.5).

c. The Director of Readiness, Headquarters, DARCOM shall fully support the MADPAC Program by introducing deterioration prevention procedures during New Equipment Training where applicable; and by providing policy and guidance to insure that all deterioration related field reports, i.e., Logistics Assistance Office (LAO) Flasher, Equipment Improvement Recommendation (EIR), Quality Deficiency Report (QDR), Field Maintenance Technician (FMT) Reports, are forwarded to the applicable directorates within the command and project/product managers and to the appropriate Deterioration Prevention Action Office (DPAO).

d. The Comptroller, Headquarters, DARCOM will provide technical guidance and support in the development of the budgets that support the MADPAC Program.

e. Chief, Product Improvement Office, Headquarters, DARCOM will insure that deterioration prevention is considered in all product improvement proposals, both from its standpoint of deterioration prevention of the kit(s) itself, as well as, compatibility of the new kit with the items to be improved.

f. The Chief, Office of Manufacturing Technology, Headquarters, DARCOM will insure that MADPAC is considered in all Manufacturing Methods and Technology (MMT) and Military Adaptation of Commercial Items (MACI) projects and production readiness reviews; and that MADPAC objectives are stressed in the Production Engineering and Planning (PEP) and the Value Engineering Programs. New MMT projects will be initiated, when appropriate, within the Production Engineering Measures (PEM) appropriations and activities.

g. Chief, Office of Laboratory and Development Command Management, Headquarters, DARCOM will assure that proper emphasis is given to materiel deterioration prevention and control in assigned funded programs.

h. The Director of the Army Materials and Mechanics Research Center will support the DARCOM MADPAC Action Office and assist in the MADPAC Program.

i. The US Army Materiel Systems Analysis Activity (AMSAA) will provide materiel deterioration information to the MADPAC program. These data will be specifically related to the deterioration (rust and corrosion) of currently fielded equipment in use by tactical units located throughout the world.

j. Chief, Office of Project Management, Headquarters, DARCOM will insure that all managers are cognizant of the provisions of the DARCOM MADPAC program.

k. The major subordinate commands will:

(1) Establish and maintain a MADPAC Program in the research and development phase, insure adequate documentation of these measures in the design for procurement and production, and during the storage, supply and operations use periods.

(2) Emphasize prevention and control of materiel deterioration in all product and production engineering programs.

(3) Investigate deterioration failures of major Army materiel and disseminate "lessons learned" information.

(4) Insure that all concerned personnel are instructed as to the causes, effects and techniques for prevention of materiel deterioration.

(5) Incorporate into all design and acquisition contracts the applicable MADPAC Program requirements.

(6) Exert continuing efforts in identifying areas of deficiency existing in deterioration prevention practices.

(7) Insure that all feedback data revealing unsatisfactory materiel conditions attributed to deterioration are forwarded to applicable directorates within the command and project/product managers.

(8) Plan, budget, and manage the facilities, materials, people and equipment needed to operate an effective program.

(9) Explore and adapt technical advancements in the prevention and control of deterioration to maximize service life, conserve resources, simplify control actions, and improve operational readiness. Specifically:

(a) Develop/use available nondestructive inspection (NDI) techniques for detecting deterioration under coated surfaces, in inclosed structural areas, and in composite or honeycomb types of materials.

(b) Work toward increasing the life expectancy of protective finishes, and use better materials, processes and finishes to treat and resist deterioration.

1. Program/project/product management offices will:

(1) Establish a MADPAC Program for their system in accordance with DARCOM policy and provide the applicable MADPAC Program requirements for incorporation in all applicable contracts for systems and associated equipment.

(2) Insure that deterioration prevention and control is a major consideration during all phases of the acquisition process.

(3) Assure that the prime systems contractor exhibits a capability in materiel deterioration prevention and control, and appoints a coordinator to represent the prime contractor and subcontractors on matters involving deterioration prevention (app A).

(4) Determine appropriate storage and ready conditions for their respective weapon systems and end items of equipment, and publish the resulting criteria/data in the applicable technical manuals.

(5) Take necessary action to eliminate deficiencies and prevent their recurrence.

(6) Review progress of the MADPAC Program during "in-process" reviews.

(7) Plan, budget and manage the facilities, materials, people and equipment needed to operate an effective program.

m. The depots will:

(1) Establish practices and procedures to insure continued MADPAC protection during manufacturing methods, overhaul procedures and other deterioration prevention and control matters.

(2) Pursue an aggressive program in all maintenance activities to prevent and control materiel deterioration in systems and equipment.

n. Materiel Deterioration Prevention and Control Central Steering Committee will:

(1) Consist of selected members from each major subordinate command, the US Army Material and Mechanics Research Center (AMMRC), the US Army Materiel System Analysis Activity (AMSAA), and Headquarters, DARCOM. Headquarters, DARCOM representatives with alternates will be mandatory for DRCDE, DRCPM, DRCPI, DRCMT, DRCMM, DRCPP, DRCRE and DRCPA.

(2) Serve as advisors to the Director of Product Assurance, on MADPAC policy, programs, and new technology.

6. Procedures. a. The Director of Product Assurance through the DARCOM MADPAC Action Office will:

(1) Manage and implement the MADPAC Program with advice from the MADPAC Central Steering Committee and the technical assistance of AMMRC.

(2) Assure that all major materiel acquisition programs are subject to a MADPAC Review in compliance with established policy.

b. The Director of AMMRC will:

(1) Review, analyze and monitor the MADPAC Program and otherwise assist in management functions as directed by the DARCOM MADPAC Action Office.

(2) Coordinate major subordinate command semiannual status reports and annual survey reports, review and analyze input, and forward to MADPAC Action Office with recommendations for action.

(3) Plan and schedule a DARCOM Triennial MADPAC Commandwide Survey to review condition of equipment, materials and conformance to DARCOM regulations. Collate and forward reports of findings to MADPAC Action Office along with recommendations for action.

(4) Establish and maintain a materiel deterioration information center to assist Army personnel and contractors via telephone and written contacts, pamphlets, design handbooks, etc. Disseminate technical information on materiel deterioration testing and control, training and technology.

(5) Collect information on deterioration failures of major Army materiel and disseminate "lessons learned" information in a DARCOM Quarterly Deterioration Summary publication.

(6) Assure that procurement specifications and standardization documents provide for MADPAC requirements.

(7) Provide DARCOM and non-DARCOM deterioration experts for consultation on local problems.

(8) Promote NDI techniques for detecting materiel deterioration. Develop testing procedures and quality assurance (QA) procedures. Review packaging and shipping methods.

(9) Collate and analyze data on deterioration/corrosion damage of Army materiel. Evaluate cost of deterioration control. Coordinate Army deterioration control activities and interchange information with Air Force, Navy, Marines and other Federal organizations. Sponsor and arrange for attendance at conferences and seminars.

(10) Coordinate a MADPAC Training Program for Army employees and contractors.

(11) Maintain contact with other services to facilitate the exchange of information dealing with MADPAC.

(12) Coordinate all matters pertaining to packaging with the Army Packaging Board that operates under the auspices of the Director of Materiel Management, Headquarters, DARCOM.

c. The major subordinate commands will:

(1) Establish a MADPAC program consistent with mission responsibilities covering all systems and equipment throughout their life cycle.

(2) Establish a Deterioration Prevention Action Office (DPAO) responsible for administering the MADPAC program for research and development as well as project/special item managed systems and to provide liaison with Director of Product Assurance, Headquarters, DARCOM.

(3) Plan, budget, and manage the MADPAC facilities, material, people and equipment needed to operate an effective MADPAC program.

(4) Emphasize MADPAC considerations in all phases of research and development, production engineering and full-scale production programs as well as during transit, storage, supply and field operations. Consider deterioration phenomena during design reviews (MIL-STD-1521A). Assure use of state-of-art technology. Appendix A provides a scope of work that may be included in Invitation for Bids (IFB) or Request for Proposal (RFP).

(5) Insure that all concerned personnel and contractors are instructed as to the cause, effects and methods for the prevention of materiel deterioration.

(6) Continue efforts in identifying areas of deficiency existing in deterioration prevention practices.

(7) Insure that all feedback data revealing unsatisfactory material conditions attributed to deterioration are forwarded by the DPAO to applicable directorates within the command and project/product managers.

(8) Insures that DPAO forwards MADPAC semiannual program summary reports, including feedback data and economic impact, to designated office.

(9) Include MADPAC consideration in host/tenant agreements to insure cooperation and effective use of available deterioration/corrosion facilities and personnel. Acquire funding for support and training in deterioration prevention.

(10) Nominate personnel to serve as Command representative on the DARCOM MADPACCSC.

(11) Keep abreast of MADPAC training requirements and forecasts needs to Director, AMMRC for action.

(12) Require an annual command survey to determine effectiveness of the MADPAC program. Report findings to appropriately designated office.

(13) Nominate personnel to assist AMSAA on survey of DARCOM equipment and to serve on DARCOM commandwide Triennial MADPAC Survey.

d. Subordinate command DPAO's will:

(1) Establish procedures and administer the Command MADPAC program plan for all efforts carried out under the jurisdiction of the command including in-house efforts, tenant activities, program/special item managed systems and other procured or manufactured materiel.

(2) Provide liaison with program/project/product managers, directors, Headquarters, DARCOM and AMMRC with respect to the DARCOM MADPAC program.

(3) As required, forward MADPAC semiannual summary reports including field problems and economic impact data to appropriate office for review and analyses. Determine costs of deterioration control.

(4) Request input from program managers, tenant activities and all command elements pertaining to deterioration problems anticipated or encountered, the status of the corrective action required and economic impact.

(5) Report status of MADPAC program to the Commander with recommendations for corrective action. Unresolvable actions will be forwarded to DARCOM, MADPAC Action Office for consideration.

(6) Follow up and report to DARCOM on compliance to DARCOM MADPAC Action Office recommendations.

(7) Conduct an annual subordinate command survey to determine effectiveness of the MADPAC Program and make recommendations to the Commander for improvement. Forward Annual Survey Report to designated office.

(8) Assist managers and others by providing training, consultants, trained personnel, data and facilities needed to maintain an effective program.

(9) Provide an adequate means of communication between managers and users. Insure proper dissemination of feedback data to design and acquisition communities.

(10) Insure that proper prevention and control measures are incorporated into depot level work packages and work specifications. Require each contractor to comply with pertinent standards, specifications, design handbooks and other technical documentation.

(11) Set up criteria for minimum environmental controls to prevent deterioration in items being stored or transported. Also set up a procedure to check periodically on how these control procedures are working.

(12) Evaluate each proposal for a new system, subsystem or equipment to insure incorporation of steps to prevent deterioration.

(13) Participate in technical symposia to introduce state-of-art into the MADPAC program.

e. Program/project/product manager will:

(1) Establish a MADPAC plan in accordance with DARCOM policy.

(2) Appoint a point-of-contact (POC) person for liaison with appropriate DPAO. Report MADPAC plan status and actions to appropriate DPAO, as requested. Include information on problems encountered, solutions, and economic impact data.

(3) Plan, budget, and manage the facilities, materials, personnel, and equipment needed to operate an effective MADPAC program.

(4) Insure that MADPAC is a major consideration during conceptual, definition, acquisition, and operational phases of new systems. Appendix A provides a scope of work that may be included in the IFB or the RFP.

(5) Assure that prime systems contractor exhibits a capability in materiel deterioration prevention and control, and appoints a coordinator to represent the prime contractor and subcontractor on matters involving deterioration.

(6) Determine appropriate storage and ready conditions for their respective weapon systems and end items of equipment, and publish the resulting criteria/data in the applicable technical manuals.

(7) Take necessary action to eliminate existing deficiencies and prevent their recurrence.

(8) Review progress of the MADPAC plan during the "in-process" review, RECAP's, and LOGCAP's.

f. AMSAA will gather materiel deterioration data on technical equipment in the field through Field Liaison visits to Army materiel users, under provisions of DARCOM-R 70-7.

g. The depots will:

(1) Establish a MADPAC plan for their installation in accordance with DARCOM policy.

(2) Appoint a POC for liaison with appropriate DPAO. Report MADPAC status and actions to appropriate DPAO, as requested. Include information on problems encountered, solution and economic impact data.

(3) Plan, budget and manage the facilities, material, personnel and equipment needed to operate an effective program.

h. MADPACCSC. This committee will consist of selected members from each subordinate command, AMMRC, AMSAA, and Headquarters, DARCOM and will:

(1) Serve as advisor to the Director of Product Assurance, on MADPAC policy, programs and new technology.

(2) Meet to discuss and solve materiel deterioration program problems; to exchange data and program information; and to assess new technology for reducing deterioration. It will also evaluate the effectiveness of the program and assist in formulating policy. It will initiate, plan and recommend objectives for the program.

(3) Meet at least once a year (more often, at the call of the chairman) at a location the chairman selects. The chairman may request the attendance of other representatives, managers, and specialists from laboratories and special activities, as well as those with specific functional expertise.

(4) Recommend action to resolve specific deterioration problems and work on special projects.

(5) Will call on the subordinate commands and AMMRC for engineering and technical advice on new and changing concepts, systems and equipment.

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(6) Insure that actions taken are consistent with goals and objectives of other related programs such as Care of Supplies in Storage (COSIS).

i. Information requirement. Information requirements generated by this directive are exempt from Requirements Control Symbol (RCS) by paragraph 7-2v, AR 335-15.

7. References. a. AR's 70-10, 70-15, 310-25, 702-3, 702-9, 702-10, and 702-11.

b. DARCOM-R's 70-7 and 702-14.

c. MIL-STD's 109 and 1521.

Appendix A

DETERIORATION PREVENTION

SCOPE OF WORK INPUTS

This appendix provides a scope of work that can be placed in the Invitation for Bids or the Request for Proposals and may be included in contracts in order to assure that the contractor establishes and maintains a MADPAC Program. Inputs should be reviewed and tailored as necessary to fit the particular contract and situation.

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Appendix A--Continued

1.0 Deterioration Prevention.

1.1 Deterioration prevention discipline. The contractor will establish a program as an integral discipline during the design and development of the weapon system and associated equipment. It will include design efforts, selection of materials and fabrication techniques for deterioration prevention, delineation of applicable finishes, and a test program to establish efficacy of deterioration prevention.

1.2 Deterioration prevention program plan and progress reports.

1.2.1 Deterioration prevention program plan. The program plan will encompass those requirements delineated by this Scope (see appendix B). The plan will be submitted within 90 days after contract award, and updated as necessary or by agreement between the contractor and the procuring agency.

1.2.2 Progress Reports. Progress reports will be submitted in conjunction with the technical reports submitted under Data Item S-4057, with the information segregated under a deterioration prevention section.

1.3 Management. A coordinator for deterioration prevention and control in the contractor's organization responsible for the contractor's and subcontractor's Deterioration Prevention and Control Program will be identified. Authority and responsibility of the coordinator will be delineated in the Deterioration Prevention Program Plan.

1.4 General Surveillance. The contractor shall:

1.4.1 Conduct a thorough and continuous examination of all systems and component parts to insure maximum use of plating, painting, chemical coating, metal treating, fungus control, cleaning, etc., consistent with the paragraphs and documents noted herein. Particular attention will be given to avoiding construction that promotes corrosion through the admission and retention of water, either directly or by condensation. Where inadequacies are encountered, best industry practice or advanced state-of-the-art technology will be considered but must receive procuring agency approval prior to implementation.

1.4.2 Be cognizant of the possibilities of deterioration caused by incompatibility of metals and materials, as delineated in this section, and endeavor to make corrections or provide means of separation if material changes are not practicable.

1.4.3 Monitor and inspect the deterioration prevention measures instituted by all subcontractors, making available to them all applicable information

Appendix A--Continued

and requiring their compliance to the same standard as set forth in this section.

1.4.4 Permit direct contacts of the procuring agencies' designees with all subcontractors, specifically regarding deterioration of materials and prevention measures, requiring complete cooperation of the subcontractors with the procuring agency.

1.5 Design Considerations. Contractor personnel will be completely cognizant of the long term storage requirements that are unique with the equipment. The following are design considerations that will be considered in insuring final system reliability:

1.5.1 Provide for a dry atmosphere, maintain 30 percent relative humidity or lower, fill and maintain with dry nitrogen.

1.5.2 Crevices, pockets, hollows, wells, etc., that may collect water, that are not self-draining, will be avoided or will be provided with suitable draining.

1.5.3 Provide for inspection and maintenance.

1.5.4 Use materials and finishes that provide the best resistance to atmospheric deterioration.

1.5.5 When possible, make mating construction from materials with suitable galvanic compatibility as defined in Tables X and XI of MIL-STD-186.

1.5.6 Insulate galvanic couples when they cannot be avoided in design.

1.5.7 Provide clean metal surfaces prior to application of protective finishes.

1.5.8 Seal joints.

1.5.9 Minimize high stress concentration features.

1.5.10 Use adherent, good quality organic coatings.

1.5.11 Use nonmetallic construction.

1.5.12 Use electrodeposited coatings with inherent oxidation resistance such as nickel and chromium plate or provide supplementary treatment for corrodible finishes.

1.5.13 Avoid hygroscopic materials.

Appendix A--Continued

1.6 Degree of protection required.

1.6.1 Hermetically Sealed Design. Protective finishing will be unnecessary for parts inclosed in or surfaces forming the interior of nonreparable, hermetically sealed assemblies or components. Finishing requirements do apply, however, to the external surfaces of such sealed packages.

1.6.2 Desiccated Design. The use of desiccated packaging will not be considered as the panacea for humidity or corrosion control. Parts and assemblies stored in desiccated areas will be finished by the normal finish requirements. When desiccant is included, provisions will be made for periodic inspection and replacement. The desiccant requirement will be to maintain a relative humidity of 30 percent or less at the design temperature extremes of storage. The desiccant will be in a container and out of direct contact with surfaces of functional parts.

1.6.3 Sealed Spaces. Every effort should be made to employ flat or o-ring gaskets, tape, barrier films, sealants (either curing or noncuring types), and paint to provide sealed joints for spaces for functioning components. An effective joint seal would consist of a flat or o-ring gasket, tape wrapped, and overcoated with paint. The use of gasket sealed spaces will not be considered as the panacea for humidity or corrosion control. Parts and assemblies will be finished by the normal finish requirements.

1.7 Finishes and surface treatments.

1.7.1 Finish Specification. Unless otherwise specified, the finishes for equipment, including repair parts, will be in accordance with MIL-STD-171 or MIL-STD-186. MIL-STD-171 is preferred. Finishes will be selected and referenced on drawings, in contracts, and item specifications by the appropriate finish numbers. Deviation from this standard requires prior approval from the procuring agency before incorporation into the design.

1.7.2 Government standard parts. Government standard parts purchased with protective finish do not normally require any additional finish or protection, however, dissimilar metal protection, moisture and fungus-proofing, and additional surface treatment of finishes will be applied if necessary to achieve conformity with the performance and topcoat paint color requirement.

1.7.3 Requirement conflict. The requirements as delineated in this section will take precedence; otherwise, MIL-STD-171 will apply in preference to all other referenced documents. Any other conflicts will be resolved by concurrence of the procuring activity.

1.8 Problematic areas. The contractor will take full cognizance of the following potential problem areas and will eliminate or minimize them, as applicable:

Appendix A--Continued

1.8.1 Magnesium alloys. Whenever the contractor determines that magnesium alloys are to be used in a component, subassembly, or assembly, the contractor will, in each instance, furnish sufficient justification for the use of these alloys and obtain procuring agency approval prior to design incorporation. When magnesium alloys are used, a long duration, protective system must be specified and regular inspection for corrosion must be provided without extensive disassembling of structures.

1.8.2 Moisture and fungus resistance. Materials used will be inherently moisture and fungus resistant. For materiel fabricated from materials not considered moisture and fungus resistant, supplemental protective coatings will be used that are resistant to damage or loss during the normal course of inspection, maintenance, or periodic tests. Conformal coatings per MIL-I-46058 and fungicidal varnish per MIL-V-173 or equivalent will be considered for permanent protection.

1.8.3 Polymeric and elastomeric components. Materiel fabricated from polymeric materials will exhibit a minimum of exudation and vaporization of corrosive or other deteriorating substances. Materiel fabricated from elastomeric materials will demonstrate maximum resistance to ozone degradation and aging. Polymeric and elastomeric materials must be consistent with performance and environmental requirements.

1.8.4 Galvanic Corrosion. A "galvanic couple," consisting of two metals differing in composition, in contact with each other and with a common electrolyte, provides accelerated corrosion. The metal with the stronger tendency to corrode (the more active metal) will function as the anode, while that with the lower tendency will function as the cathode. It is the galvanic activity that will be eliminated or lessened. Non-permissible galvanic couples, as defined in tables X and XI of MIL-STD-186, will not be used in intimate contact without suitable protection to circumvent galvanic corrosion. One of the following treatments will be applicable:

1.8.4.1 Either or both (of the metals) will be plated with a metal that will reduce the potential difference to an acceptable level; that is, form a "permissible couple."

1.8.4.2 An insulating elastomeric or plastic gasket will be interposed between the nonpermissible couple. In structural joints, interpose tape.

1.8.4.3 Insulating organic coatings or organic sealants will be applied to the surface of each metal. In structural joints, paint coatings and sealants will be applied to the surface of each metal. For components and threaded hardware, use corrosion inhibitor, sealants, or conformal coating.

Appendix A--Continued

1.8.5 Installation of fasteners. As a general practice, bolts, screws, and rivets shall be installed with wet, unthinned primer or sealing compound to seal capillaries and prevent localized corrosion due to moisture entrapment, particularly in structural parts. Rivets incorporated with capsules of zinc chromate or polysulfide sealant satisfy this requirement. For permanent installation, a locking material will be used. For adjustable fasteners, a non-drying paste or noncuring sealant will be used. The requirements of MIL-STD-403 cover this requirement satisfactorily.

1.8.6 Intergranular and stress corrosion. Preference will be given to metals that are resistant to both intergranular and stress corrosion especially for applications involving residual and induced stresses. All bending, forming, and shaping will be preformed on the metal in the annealed condition. Every effort will be made to use the lowest stress level practicable. Stress corrosion can occur in almost all metals and especially in the high hardness steel alloys. In damp corrosive environment, aluminum alloys pit badly and often intergranular attack does not show on the surface, making it difficult to detect before the part is completely destroyed. Brasses with more than 15 percent zinc are subject to a type of intergranular attack called "dezincification." Stainless steels of the 18-8 type are also susceptible to intergranular corrosion, if they have been exposed to temperatures in the range of 800 to 1500 degrees F, as occurs during welding. To reduce the possibility of both intergranular and stress corrosion attack, the following will be considered:

1.8.6.1 Use of the lowest strength level practicable in the particular metal.

1.8.6.2 Use of the most resistant materials and protective coatings.

1.8.6.3 Keep equipment dry; clean well after salt bath, soldering or welding.

1.8.6.4 Use of the 5000 or 6000 series aluminum alloys rather than the 2000 or 7000 series.

1.8.6.5 Use of brass compositions with less than 15 percent zinc, or admiralty brass.

1.8.6.6 Restricting the corrosion resistant steels to the stabilized alloys, 304L, 321, or 347, when welding or brazing is involved.

1.8.6.7 When bare surfaces are necessary, inherently resistant metals, whether solid or plated, such as titanium, 300 series types of stainless steel, nickel, chromium, gold or rhodium, will be selected.

1.8.6.8 Protective coatings such as paint, varnish, insulation compound, sealants, encapsulants, and conformal coatings will be used.

Appendix A--Continued

1.8.6.9 Handling will be avoided or, when handling, gloves will be worn.

1.8.7 Hydrogen embrittlement. Closely associated with stress corrosion is hydrogen embrittlement, a problem acutely damaging to high strength steels and nickel-base alloys, and titanium. Spontaneous cracking can occur in these metals due to hydrogen pick-up from acid cleaning, pickling, electroplating, or welding. If high hardness steel is not stress-relieved immediately after plating, fracture can occur almost immediately. Titanium is particularly subject to hydrogen embrittlement from the aforementioned processes. Acid cleaning, phosphating, wash primer, and electroplating are prohibited on high hardness steel parts (Rockwell C40 or higher). To reduce the possibility of hydrogen embrittlement, the following will be considered:

1.8.7.1 Avoid acid cleaning, pickling, and electroplating or select materials and processes to minimize the danger.

1.8.7.2 Use of organic coatings, or vacuum deposited metallic coating, or electroless coating processes instead of electroplating. If electroplating is necessary, the use of baths or other processes specially designed for low hydrogen pickup, or stress-relieve before plating and immediately after plating.

1.8.8 "Red Plague" corrosion. Special consideration will be given to eliminating "red plague" corrosion, a condition especially damaging to electrical wiring. The problem is galvanic and is most serious to small diameter copper wire plated with silver. Corrosion begins at pinholes or breaks in the silver plate when bridged with moisture introduced through or under the insulation. It seriously impairs fatigue life and electrical conductivity of the copper wire. The problem may be reduced by using a dual-plated wire consisting of 40 microinches of silver plate over 40 microinches of nickel plate. The problem has not been reported with tin-plated or nickel-plated wire. The avoidance of Teflon insulated, silver-plated copper wire will be emphasized and its use allowed only where high temperature service, low magnetic characteristics, or maximum solderability are definitely required. For normal application, tin-plated wire with polyalkene electrical insulation such as the MIL-W-81044 variety will suffice.

1.8.9 Lubricants. Silicone oils and greases will be avoided as lubricants but may be used for vibration damping and heat transfer media when inclosed in sealed assemblies. For general lubrication uses, such as lubricants for o-rings, apply grease per MIL-G-10924. The grease should not be used in exterior applications where sand and similar contamination are probable.

Appendix A--Continued

Solid film lubricants will be free of powdered carbon and graphite. For parts that can withstand a heat cure, an acceptable material is MIL-L-46010. For air-dry applications, use MIL-L-46147. Normally, protective finishes, i.e., phosphate or cadmium plate on steel, and anodize on aluminum alloys, will precede the dry-film lubricant application.

1.8.10 Antiseize materials. Powdered carbon and graphite are prohibited because of the high galvanic effect usually promoted by these materials. Normally, wet, unthinned, zinc chromate primer or zinc chromate paste provides sufficient lubricity to overcome seizing; however, grease or lubricating oil may be specified. For critical antiseize properties, solid film lubricant should be considered.

1.8.11 Tropic-proofing. Electronic components, particularly capacitors, resistors, transformers, and associated solder-coated surfaces, solder connections, terminals, metallic and plastic parts, will be given moisture and fungus resistance treatment such as the application of sealing compounds, potting materials, encapsulants, conformal coatings, or fungicidal varnishes where possible. Printed wiring assemblies will receive conformal coating. Specifications requiring the overcoating of solder joints with moisture or fungus-proofing varnish are often questioned. Experience in the tropics shows that moisture-proofing is definitely needed. Without it, solder corrodes severely. Heat shrinkable solder sleeves are satisfactory. Irradiated tubing is quite good as a tropic-proofing measure.

1.8.12 Structures. Deterioration of structural elements is not as critical as in electronic components; however, with time it can become critical; therefore, it is undesirable and will be prevented. The design of structural components will include methods to prevent collection of moisture. Paints will be applied to protect both interior and exterior surfaces. Two coats of primer paint are permissible on interior surfaces. High hardness steels will not be electroplated. When metallic coatings are required on high hardness steels, vacuum deposited cadmium or electroless nickel will be used. Avoid dissimilar metal contact. Insulate and seal joints. The structural elements include such electronic equipment as housings, covers, supports, brackets, cabinets, and chassis.

1.8.13 Electrical chassis. The chassis is generally aluminum. An anodize finish will be specified when painting is not feasible. Chemical film treatment is inadequate for aluminum as a final finish. When electrical bonding is required, the bond areas will be masked before the anodizing process or spot-faced after anodizing to remove the insulative oxide anodic layer. However, if anodizing is impractical for obtaining electrical continuity, the part may be chemically treated in accordance with the requirements of MIL-C-5541, Class 1A.

1.8.14 Electromechanical parts. Items such as relays, switches, potentiometers, motors, and generators will be designed with seals such as o-rings, etc., to minimize entrance of moisture and other contaminants. Techniques such as encapsulation or hermetic sealing will be used as much as possible. Moreover, all parts will be inherently corrosion resistant or plated, or provided with impervious organic protection. Because of the necessity for movement, it is difficult to prevent corrodents from entering in time; however, such precautions as the use of toggle boots and flexible seals are worthwhile.

1.8.15 Electrical contacts. For maximum reliability, corrosion resistant metals such as gold or rhodium will be employed on contacts. Gold plating alone will be not less than 0.0002 inch on contacts to insure freedom from pores or pinholes. With suitable underplating such as copper or nickel, the minimum gold thickness can be reduced to 0.00005 inch. A nickel undercoat is desirable to prevent diffusion of substrate metals.

1.8.16 Connectors. Moisture condensation and contact corrosion are the most frequent causes of failure of cable connectors and printed circuit connectors. New designs will have complete environmental sealing using a suitable dielectric, when connectors are mated. Cable connector housings are usually aluminum or steel that will be anodized or plated with an inherently corrosion resistant metal such as nickel.

1.8.17 Printed circuits. Printed circuit assemblies will be coated with moisture-proofing organics such as epoxy or polyurethane to prevent deterioration. However, the possibility of damage to delicate components by contraction of the conformal coating should be considered. Polyurethane shows less tendency in causing this type of damage.

1.8.18 Transformers. Like other metallic parts, transformers will be coated for protection against corrosion. Impregnation with varnish, or encapsulation, is the usual technique. Paint will be applied to metal housings.

1.8.19 Wire, cable, harnesses. Tin-plated or nickel-plated copper wire will be used where practical to avoid the "red plague" problem experienced with silver plated (Teflon insulated) wire. However, the use of nickel under the silver has been shown to minimize this problem.

1.8.20 Fasteners in electronic assemblies. Bolts, screws, nuts, washers and similar items to be used in electronic assemblies will be constructed, where possible, of corrosion resistant materials, e.g., nickel-plated brass or 300 series stainless steel. Corrosion of fasteners will be eliminated by such limited selection or by applying supplementary treatments on such

Appendix A--Continued

standard fasteners as steel plated with sacrificial cadmium. Nonmetallic fasteners represent an even greater improvement in this area of design.

1.8.21 Honeycomb construction. Bonded honeycomb construction will be protected against moisture intrusion and moisture condensation in the interior spaces. If moisture condensation in interior areas cannot be prevented, a more easily protected design such as a hollow, ribbed construction with free ventilation and paint finishes on interior surfaces will be considered.

1.8.22 Castings. Nonferrous castings to be pressurized in service will be impregnated. Impregnation reduces solution entrapment of subsequent anodizing treatments and increases the effectiveness of organic protective coatings. Impregnation should be considered as only part of the full protection to be provided.

1.8.23 Steel springs. Springs will preferably be given organic coatings, or be coated by vacuum deposition, or other nonhydrogen-producing processes (electroless plating) rather than electroplated. Organic coatings by the fluidized bed technique per RIAPD-636 will be given first consideration.

1.8.24 Steel Rollpins, spring pins, and inserts. Protective plating or organic coating will be provided these parts. Upon installation, a sealant or wet primer dip will be applied to further protect the parts, except for helicoil inserts. Helicoil inserts should be sealed at the time of fastener installation, according to 1.8.5.

1.8.25 Bearings. Steel ball and roller bearings will be plated where possible, packed with grease, or coated with corrosion deterrent films, and be provided with moisture seals where possible. In addition, an attempt will be made to seal against moisture intrusion at the bearing locations by housing with appropriate gaskets and sealants at bearing cover plates or the like.

1.8.26 Cables and chains. All steel control cables and chains will be specified to an austenitic grade of stainless steel to provide maximum resistance to rusting, or they will be protected by plating deposits of copper/nickel or copper/chromium.

1.8.27 Star washers. Star washers may be used for electrical contacts, provided the areas are protected after assembly.

1.8.28 Lock wire. Lock wire will be inherently corrosion resistant or will be plated or coated to prevent corrosion. Precautions will be taken to prevent galvanic attack of surfaces that may come in contact with lock wire. The use of stainless steel lock wire in contact with aluminum

Appendix A--Continued

and magnesium surfaces has been shown to be unsatisfactory.

1.8.22 Flammable materials. Flammable materials will not be used where they may be exposed to a spark or arc (unless they are provided with suitable protection to prevent a fire or explosive hazard).

1.8.30 Steel motor cases. Special attention will be given to the elimination of susceptible stress corrosion areas in steel motor cases. The design and the manufacturing processes will be chosen to allow a minimum of heat-affected area at welds, to eliminate entrapment of heat treating salts, and to minimize residual and applied stresses induced by fabrication. Special precaution will be taken to protect the skirt-dome areas of motor cases and the mounting ring-skirt area, especially in welded construction. Either paint, sealing compound, or potting compound will be applied at these vulnerable, hard-to-get-to crevices. Neglect of this problem area can produce catastrophic stress corrosion cracking.

1.8.31 Launcher structures. Corrosion of interior surfaces of square and round steel and aluminum tubing used in structural applications will be eliminated. The interior surfaces of open tubing will be given the treatment specified for exteriors where practicable. For closed tubing, the assemblies will be shown to be airtight or protective materials such as zinc primer, or corrosion preventive compound will be applied through appropriately drilled holes. After treatment, the access holes will be closed with cadmium plated self-tapping screws, installed with sealant such as wet zinc chromate primer.

1.8.32 Containers. Special attention will be given to the design and finishing of metal shipping and storage containers to eliminate surfaces that are inaccessible to finishing. "Hard-to-get-to" surfaces will be kept to a minimum and will be corrosion protected in accordance with the general schedule. Internal surfaces of reinforcement conduit, and faying surfaces of dovetailed construction are sources of corrosion problems. Procedures such as coating the parts prior to assembly, using weld-thru primer or continuous welding when the design is a welded assembly, or applying organic sealant are techniques to be considered.

1.8.33 Foam construction. Foam construction will be closed-cell to prevent retention of water. Polyurethane foam will be reversion resistant. Careful attention will be given to the foam material characteristics and control of the raw materials to insure compatibility with electronic parts, to avoid growth problems and component breakage.

1.8.34 PTV adhesive-sealants. Adhesive-sealants that omit acetic acid during

Appendix A--Continued

cure will be avoided. Methyl alcohol evolving materials such as MIL-A-46146 and MIL-R-47211, Type III will be first considered.

1.9.35 Potting compounds. Reversion prone potting materials will not be used. Reversion of polyurethane has been experienced in the potting of electrical connectors and in the sealing of fuel cells, both of which are attributed to poor moisture resistance. There are polyester urethanes and polyether urethanes available. The polyester urethanes are subject to degradation by water and high humidity but resistant to fuels and lubricating oils. The reverse is true of polyether urethane.

1.9.36 Parts identification. Electro-etching or vibropeening of identification numbers on parts will be avoided. This technique has been the cause of corrosion on many small parts such as stainless steel pins. Epoxy type printing ink per MIL-I-43553 is preferred; however, ink per TI-I-1795 is satisfactory when overcoated with varnish. Identification numbers may also be typewritten on clear pressure-sensitive tape with a second piece of tape over the first, installed, and overcoated with clear organic sealer to prevent edges from peeling.

1.9.37 Painting. The essential requirement will be to avoid a multiplicity of primers and topcoats in the equipment. One paint system (wash primer, primer, topcoat) will be selected and specified. On aluminum, MIL-C-5541 chemical treatment can be substituted for wash primer. Generally, wash primer D70-P-15326 will be applied first and followed by a primer and topcoat. Epox, primers, MIL-P-23377 and MIL-P-52192, have excellent resistance to both acids and alkali. One of these is the preferred primer for use. For interior applications, the primer can be used alone in two coats. Exterior surfaces are required to meet forest green camouflage requirements of AR 750-51. Application and quality control of paints will conform to the requirements in MIL-STD-166.

1.9 Deterioration prevention testing. The contractor will assure that each individual component, subassembly, assembly, and system is designed and/or protected to eliminate or limit to the fullest extent possible deterioration under long-term environmental or "standby" conditions.

1.9.1 The environmental conditions will either be simulated in laboratory type equipment and/or be conducted under actual field conditions, as size of equipment may dictate.

1.9.2 Environmental conditions will include humidity, temperature, salt atmosphere, rain, fungi attack, temperature shock, vibration, and/or any other environmental condition to which the equipment might be subjected.

Appendix A--Continued

1.9.3 All tests required for the corrosion prevention program will, where possible, be combined with other environmental tests that may be scheduled.

Appendix B

MADPAC PRODUCT ASSURANCE PROGRAM PLAN

MADPAC Program Plan. a. The plan will define the scope and depth of the contractor's efforts for prevention of materials deterioration and control based upon the contents of MIL-STD-1250 and MIL-HDBK-721 (MR) during the contract phase of the system.

b. The plan will include:

(1) Designation of the contractor's organizational element that will be responsible for management of the MADPAC Program.

(2) Establishment of a materials review effort to optimize materials selection for a particular application prior to design configuration and fabrication of any part or component.

(3) Evaluation of the manufacturing processes and materials treatments to insure that acceptable methods and procedures are being used from a deterioration prevention standpoint, taking into consideration the hazards of stress-corrosion cracking, hydrogen embrittlement, and/or other deteriorating conditions.

(4) A review and evaluation of protective finishes and coatings most relevant for the particular application prior to design utilization.

(5) Provisions for consultation between deterioration prevention specialists, unit engineers, and designers to insure close liaison between these elements in order to effect timely execution of deterioration prevention matters.

(6) Provisions for identifying vulnerable area design deficiencies or potential deterioration problems with any hardware, including the stipulation that any failure or potential failure traceable to deterioration will be reported.

(7) Provisions to insure the use of materials inherently moisture- and fungus-resistant, or adequate application of protective treatments; the use of polymeric materials that exhibit a minimum of exudation or vaporization of corrosive or otherwise detrimental substances and elastomeric materials with a maximum resistance to ozone degradation; avoidance of metal couples with a potential difference in excess of 0.10 volt ENF; protection designed to prevent electrolytic deterioration; a limitation on the use of silicone greases and/or graphite-containing dry-film lubricants.

Appendix B--Continued

(8) Periodic revisions of the MADPAC Program plan as more definitive design and engineering actions are formulated (in accordance with DD Form 1423).

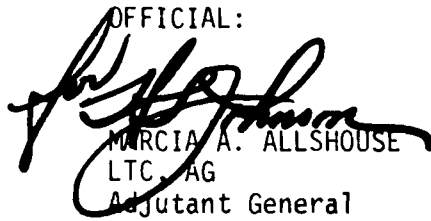
(9) Any additional program elements that in the contractor's judgement will enhance the effectiveness and efficiency of the MADPAC Program.

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The proponent agency of this publication is Headquarters, DARCOM Directorate for Product Assurance. Users are invited to send comments to the Commander, DARCOM, ATTN: DRCQA-E, 5001 Eisenhower Ave., Alexandria, VA 22333.

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