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**Maintenance**

**AEROSPACE EQUIPMENT STRUCTURAL  
MAINTENANCE**

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This instruction implements AFPD 21-1, *Managing Aerospace Equipment Maintenance* and provides policy, guidance and direction necessary to establish and support the Corrosion Prevention and Control, Nondestructive Inspection (NDI) and Advanced Composites maintenance functions in the US Air Force. HQ Air Force Materiel Command (HQ AFMC/DR) is the headquarters point of contact for this program. This program is executed through the establishment of an Aerospace Structural Materials Sustainment Office (ASMSO) assigned to Air Force Materiel Command, Air Force Research Laboratory (AFRL), Materials Directorate, located at Wright-Patterson AFB OH. The ASMSO manages three separate offices, collocated with Air Force production maintenance functions. This instruction applies to all Air Force units. Records Disposition: Maintain and dispose of records created as a result of processes prescribed in this publication in accordance with AFMAN 37-139, "Records Disposition Schedule."

**SUMMARY OF REVISIONS**

**This document is substantially revised and must be completely reviewed.**

Revisions include transfer of all responsibilities for aircraft battle damage repair (ABDR) to AFI 21-101, *Maintenance Management of Aircraft*; deletion of references to IWSM; changes references from HQ USAF/LGMM to ILMM, deletion of responsibilities for Secretary of the Air Force (SAF/AQP); deletion of responsibilities for HQ USAF/XOOT; redesignation of the Aircraft Structures Single Manager to a new Aerospace Structural Materials Sustainment Office (ASMSO); redesignation of the Corrosion Control and Prevention, NDI and Advanced Composites System Support Manager to AF Offices; creation of NDI advisory boards, deletion of references to specific details for conducting Corrosion Prevention Advisory Boards (CPAB); change references from Wright Laboratory to responsibilities for HQ AFMC/DR and AFRL/CC; and deletion of references and responsibilities for Aeronautical Systems Center; transfer references to career field education and training requirements from AETC to HQ USAF/ILMM through Utilization & Training Workshops (U&TW); designates naming of aircraft policy and responsibility to HQ USAF/ILMM and MAJCOMs.

**Section A—Responsibilities****1. HQ USAF/ILMM will:**

- 1.1. Establish policy for overall guidance for the Air Force Corrosion Prevention and Control, NDI and Advanced Composites Programs.
- 1.2. Conduct a U&TW to resolve all training issues for each program, at least every four years.
- 1.3. Assign management responsibility of this document to AFRL/MLSS.
- 1.4. Sponsor an annual program manager review to assess overall program effectiveness.
- 1.5. Establish policy to staff requests for naming of aircraft from MAJCOMs to HQ USAF/CV for final approving authority.

**2. HQ AFMC/DR will:**

- 2.1. Support program advocacy and resolution of issues related to the Corrosion Prevention and Control, NDI and Advanced Composites programs through sponsorship into senior level approval boards (i.e. Mission Element Boards, Logistics Board of Advisors, etc.) as required.

**3. Air Force Research Laboratory (AFRL/CC) will:**

- 3.1. Establish and maintain an Aerospace Structural Materials Sustainment Office (ASMSO).
- 3.2. Establish or identify test protocols and evaluation parameters for new materials, processes and equipment to determine suitability for Air Force use.
- 3.3. Determine state-of-the-art technologies and assess their benefit to the Air Force.
- 3.4. Research and transition environmentally compliant materials and processes to the field.
- 3.5. Serve as central information function to recommend best quality products.
- 3.6. Serve as liaison to the Air Force Office of Scientific Research on corrosion, NDI and advanced composites related research efforts.
- 3.7. Support MAJCOM, ALC and Single Manager requests for field tests, command/agency surveys, inspection and resolution of materials-related, in-service equipment problems.
- 3.8. Ensure RDT&E is conducted to improve and validate advanced composite repair techniques including, contingency repairs, large area defects, Low Observable (LO) composite repair inspection, NDI methods and equipment, and component sensing methods.
- 3.9. Ensure RDT&E is conducted to screen, evaluate, qualify and approve new processes and equipment for detecting, identifying, preventing and controlling corrosion of emerging materials, processes and equipment.
- 3.10. Ensure environmental, safety, occupational, and health concerns and cost/risk tradeoffs are included in the implementation of policies and responsibilities.

**4. ASMSO will:**

- 4.1. Establish and manage Air Force Corrosion Prevention and Control, NDI and Advanced Composites sustainment offices which serve as the Air Force main customer support function for the MAJCOMs, ALCs and field activities.
- 4.2. Provide integrated solutions to sustainment issues (i.e., improving techniques for detecting and evaluating corrosion damage in hidden or inaccessible structural areas, and under protective and LO coating systems) by conducting periodic meetings, integrated process teams, or other forums to cross-flow corrosion prevention and control, NDI and advanced composites information.
- 4.3. Create a cadre of experts in corrosion prevention and control, NDI and advanced composites to be readily accessible to MAJCOMs, ALCs and field activities.
- 4.4. Ensure the Air Force NDI office provides engineering support to the item manager for centrally procured NDI equipment.
- 4.5. Ensure materials and process technologies have been sufficiently field-tested prior to transfer.
- 4.6. Support the transition of corrosion prevention and control, NDI, and advanced composites technologies to users.
- 4.7. Ensure system acquisitions are reviewed and monitored for sustainment feasibility and present recommendations to cognizant authority during design, prototyping, and initial fielding.
- 4.8. Establish a process to review research and development programs to ensure they meet user needs in the corrosion prevention and control, NDI, and advanced composites areas.
- 4.9. Establish and manage a process to exchange corrosion prevention and control, NDI, and advanced composites technology with other DOD components and civilian industry.
- 4.10. Develop a plan for execution of all functional program responsibilities in collaboration with users, on an annual basis, to ensure all relative priorities are addressed.
- 4.11. Develop standardized guidelines for establishing CPAB and NDI Advisory Board charters that address the roles of participants and describes detailed procedures for conducting reviews.
- 4.12. Develop and publish in the most cost-effective manner all significant activities and pertinent information needed to manage and help promote the AF NDI, Corrosion Prevention and Control and Advanced Composites programs.
- 4.13. Manage policies and procedures for the Air Force Corrosion Prevention and Control, NDI and Advanced Composites programs.

## **5. MAJCOMs will:**

- 5.1. Assign Command Manager(s) for Corrosion Prevention and Control, NDI and Advanced Composites to manage the command functional programs.
- 5.2. Participate in weapon system Corrosion Prevention and NDI Advisory Boards and conferences and Aircraft Structural Maintenance and NDI U&TWs.
- 5.3. Support the single manager in timely reviews of weapon-system-specific technical data.
- 5.4. Establish the requirement for, and participate in, command-wide surveys and base assessments.
- 5.5. Participate with ASMSO to conduct field-testing of materials, processes and equipment prior to implementation.

- 5.6. Maintain the AF-approved NDI certification/recertification program for all applicable field units.
- 5.7. Coordinate all naming of aircraft requests through appropriate MAJCOM/CC and forward to HQ USAF for CV approval. Send name and justification to HQ USAF/ILMM, 1030 AF Pentagon, Washington DC 20330-1030.

### ***Section B—Nondestructive Inspection (NDI)***

**6. Purpose:** NDI program assesses structural integrity of aerospace systems and equipment by detecting defects, i.e., cracks, voids, delaminations and foreign objects, and measuring material properties such as material thickness, corrosion, bonding and composition. The program supports all functions that acquire, modify or maintain aerospace systems.

6.1. Air Logistics Centers (ALCs) will:

- 6.1.1. Designate a manager to execute the ALC NDI Program.
- 6.1.2. Ensure field NDI subject matter experts (SMEs) support the verification of all new or modified NDI procedures before publication and distribution.
- 6.1.3. Determine/develop critical NDI task certification lists.
- 6.1.4. Develop and conduct training for all NDI methods and equipment to create a quality ALC workforce with practical experience.
- 6.1.5. Provide training for field units on new equipment and procedures, as required.
- 6.1.6. Assist the AF NDI Office in determining NDI equipment needs based on weapon system NDI requirements.
- 6.1.7. Notify the single manager of changes to centrally procured equipment and recommend procedures to weapon-system-specific T.O.s.
- 6.1.8. Review and coordinate on all changes to NDI facilities, equipment, materials, and processes at the ALC.
- 6.1.9. Participate in NDI advisory boards, NDI IPTs, and AF NDI Working Groups as needed to support the resolution of field and depot related issues.
- 6.1.10. Maintain the AF approved certification/recertification program for all applicable ALC production centers.

6.2. Single Managers will:

- 6.2.1. Ensure NDI requirements are documented and validated by Aircraft Structural Integrity Program (ASIP), Engine Structural Integrity Program (ENSIP) and ALC NDI engineering staff.
- 6.2.2. Ensure field NDI SMEs support the verification of all new or modified NDI procedures before they are published and distributed.
- 6.2.3. Ensure that specialized and supplemental weapon system/item NDI training is made available for unique NDI procedures on their weapon systems.
- 6.2.4. Ensure that NDI procedures are developed, validated, and incorporate into weapon system specific tech data. An AF Level III certified NDI person should review the techniques and procedures.

- 6.2.5. Ensure sustainment issues, lessons learned and demonstrated field maintenance procedures are incorporated in the design phase of new weapon systems, modifications and upgrades.
  - 6.2.6. Evaluate the impact of probability of detection (POD) results on inspection intervals.
  - 6.2.7. Coordinate all major changes to NDI technical data and procedures as a result of material changes, mishaps, etc., with the appropriate ALC, NDI engineering and ASIP/ENSIP staff.
  - 6.2.8. Develop critical NDI task list and related technical order procedures for development of critical inspection training after coordination with MAJCOMs, ASIP/ENSIP, and NDI managers.
  - 6.2.9. Maintain NDI technical order accuracy, i.e. new centrally procured equipment for all weapon systems and engines.
  - 6.2.10. Establish and maintain weapon-system requirements for facilities, tooling and equipment, including master NDI reference standards.
  - 6.2.11. Conduct NDI Advisory Boards as required to resolve weapon system issues and action items.
  - 6.2.12. Provide to the AF NDI Office all currently collected cost and manpower investment data needed to assess total cost of ownership for each weapon system.
- 6.3. AF NDI Office will:
- 6.3.1. Manage the Air Force NDI Program for HQ USAF.
  - 6.3.2. Provide engineering assistance to the MAJCOMs, ALCs and single managers as requested.
  - 6.3.3. Support the ALC managers during the review of all new and major revisions to technical data.
  - 6.3.4. Participate in applicable U&TWs.
  - 6.3.5. Conduct pertinent POD studies and forward results to single managers and ALCs.
  - 6.3.6. Participate in NDI Advisory Boards and conduct NDI IPTs and AF NDI Working Groups as needed to support the resolution of field and depot-related issues.
  - 6.3.7. Ensure equivalency and standardization between civilian and military formal training programs.
  - 6.3.8. Establish an AF wide certification/recertification program that incorporates an acceptable commercial or military standard, as appropriate.
  - 6.3.9. Represent the AF in coordinating joint NDI sustainment activities throughout DOD, other government agencies and/or industry.
  - 6.3.10. Establish NDI technical equipment requirements with the assistance/ coordination of the ALCs.
  - 6.3.11. Accomplish assessments of all field and ALC NDI functions at the request of MAJCOM functional manager or at least every five years.
  - 6.3.12. Manage Technical Order (TO) 33B-1-1, *NDI Methods*, to ensure its publication, accuracy and currency.

- 6.3.13. Provide sole engineering support for acquisition, repair and maintainability of centrally procured equipment, and be the engineering authority for centrally procured equipment to promote standardization and prevent proliferation of NDI equipment.
- 6.3.14. Establish a “family concept” for procurement of NDI materials to ensure performance compatibility.
- 6.3.15. Evaluate new equipment before procurement to ensure adequate field-testing is accomplished prior to its acquisition.
- 6.3.16. Ensure NDI equipment is environmentally safe, deployable, able to detect defects, provides high statistical POD testing capabilities, and incorporates new design concepts.
- 6.3.17. Prepare instructions/guidelines for conducting NDI procedures in order to promote standardization and eliminate proliferation of NDI process techniques.

### ***Section C—Advanced Composites***

**7. Purpose:** The Advanced Composites Program addresses supportability issues of aerospace systems with advanced composite materials. The program supports all functions that acquire, modify or maintain aerospace systems.

#### 7.1. Air Logistics Centers (ALC) will:

- 7.1.1. Designate a manager to execute the ALC Advanced Composites Program.
- 7.1.2. Develop and conduct training for appropriate advanced composite repairs and ALC equipment.
- 7.1.3. Assist the AF Advanced Composites Office in determining advanced composite equipment needs, based on weapon system requirements.
- 7.1.4. Review all major changes to weapon-system-specific advanced composite repair T.O.s and technical data, at the request of the single manager.
- 7.1.5. Develop and maintain laboratory support capability to test material shelf life, material properties, and certification of materials.
- 7.1.6. Establish a “clearing house” for system-specific composite materials.
- 7.1.7. Review and coordinate on all changes in advanced composite facilities, equipment, materials, and processes used at the ALC.
- 7.1.8. Ensure corrosion prevention and control, NDI and advanced composites supportability concerns are addressed during the acquisition process and ensure these AF supportability functions are represented at the Preliminary Design Review (PDRs) and Critical Design Reviews (CDRs) for each system.

#### 7.2. Single Managers will:

- 7.2.1. Ensure that advanced composites training is available for unique advanced composites on specific weapon systems.
- 7.2.2. Ensure sustainment issues, lessons learned and demonstrated field maintenance procedures are incorporated in the design phase of new weapon systems, modifications and upgrades.

- 7.2.3. Coordinate all major changes of advanced composites technical data and procedures as a result of material changes, mishaps, etc., with the appropriate ALC advanced composites engineering and ASIP/ENSIP staff.
  - 7.2.4. Maintain advanced composites technical order accuracy for all weapon systems.
  - 7.2.5. Establish and maintain weapon-system requirements for facilities, tooling and equipment.
  - 7.2.6. Ensure hazardous-material handlers and mishap-recovery personnel receive material handling training in conjunction with system-specific training.
  - 7.2.7. Provide to the AF Advanced Composites Office all currently collected cost and manpower investment data needed to assess total cost of ownership for each weapon system.
- 7.3. AF Advanced Composites Office will:
- 7.3.1. Manage the Air Force Advanced Composites Program for HQ USAF.
  - 7.3.2. Provide engineering assistance to the MAJCOMs, ALCs and single managers as requested.
  - 7.3.3. Support the ALC managers in the review of all new and major revisions to technical data.
  - 7.3.4. Participate in the applicable U&TW.
  - 7.3.5. Provide technical data/information to support advanced-composites training.
  - 7.3.6. Develop facility, tooling and equipment requirements for advanced composites.
  - 7.3.7. Support the single manager in the development of guidelines for the safe handling of advanced-composites to users such as field units, depot centers, training functions, and special investigations. OPR: IERA/RSHI (Brooks AFB TX)
  - 7.3.8. Support the single manager with engineering technical support for design, redesign, analysis, and composite repair processes.
  - 7.3.9. Manage Technical Order 1-1-690, *General Advanced Composite Repair Manual*, to ensure its publication, accuracy and currency.
  - 7.3.10. Assist ALC NDI manager and AF NDI Office in development of methods, equipment and technical data to detect defects in advanced composite structures.
  - 7.3.11. Assist the single manager and Aircraft Battle Damage Repair (ABDR) Program Office in supporting deployable rapid-repair capability for advanced composite structures.
  - 7.3.12. Conduct assistance visits as required to identify and resolve advanced-composites-related issues initiated by field units and ALCs.
  - 7.3.13. Assess the viability of emerging technologies and assist the transition of technology to improve field and ALC supportability of advanced composites.
  - 7.3.14. Represent the AF in coordinating joint Advanced Composites sustainment activities throughout DOD, other government agencies and/or industry.

***Section D—Corrosion Prevention and Control***

**8. Purpose:** Ensure structural integrity of aerospace systems and equipment by preventing, detecting and controlling the damage and effects of corrosion. The program supports all functions that acquire, modify or maintain aerospace systems.

8.1. Air Logistics Centers (ALC):

8.1.1. Assist the Corrosion Prevention and Control Office in determining corrosion equipment needs based on weapon-system requirements.

8.1.2. Designate a manager to execute the ALC Corrosion Prevention and Control Program.

8.1.3. Develop and conduct training for corrosion prevention and control to create a quality ALC workforce with practical experience.

8.1.4. Review all major changes to weapon-system-specific corrosion prevention and control T.O.s and technical data, at the request of the single manager.

8.1.5. Review and coordinate on all corrosion prevention and control facilities, equipment, materials, and processes used at the ALC.

8.1.6. Participate in CPABs and support the single manager in timely reviews of weapon-system-specific technical data.

8.2. Single Managers will:

8.2.1. Develop and issue engineering and technical data that consolidates paint schemes, materials requirements, and marking diagrams for their weapon systems.

8.2.2. Maintain accuracy of technical data for all aspects of the weapon system.

8.2.3. Conduct CPAB, at a minimum, once a year and track/resolve all action items.

8.2.4. Ensure sustainment issues, lessons learned and demonstrated field-maintenance procedures are incorporated in the design phase of new weapon systems, modifications and upgrades.

8.2.5. Coordinate all major changes of corrosion prevention and control technical data and procedures as a result of material changes, mishaps, etc., with the appropriate ALC advanced composites engineering and ASIP/ENSIP staff.

8.2.6. Ensure that specialized and supplemental corrosion prevention and control training is available for their weapon systems.

8.2.7. Establish and maintain weapon system requirements for facilities, tooling and equipment.

8.2.8. Provide to the AF Corrosion Prevention and Control Office all currently collected cost and manpower investment data needed to assess total cost of ownership for each weapon system.

8.3. AF Corrosion Prevention and Control Office will:

8.3.1. Manage the Air Force Corrosion Prevention and Control Program for HQ USAF.

8.3.2. Provide engineering assistance to the MAJCOMs, ALCs and single managers as requested.

8.3.3. Ensure the best available technologies are considered for Air Force applications.

- 8.3.4. Survey MAJCOM corrosion prevention and control operations/programs at request of the MAJCOM functional manager, or at least once every 5 years.
- 8.3.5. Perform technical and engineering site assistance visits to address specific field and ALC requests.
- 8.3.6. Conduct a worldwide conference to crossflow/resolve corrosion prevention and control issues with Air Force structural maintenance and ALC personnel.
- 8.3.7. Support the ALC managers during the review of all new and major revisions to technical data.
- 8.3.8. Participate in the applicable U&TW.
- 8.3.9. Provide technical expertise and data to single managers for determining wash/rinse cycles on all systems, subsystems and equipment.
- 8.3.10. Review and validate master facilities requirement documents.
- 8.3.11. Provide cognizant engineering support for: TO 1-1-8, *Application and Removal of Organic Coatings, Aerospace and Non-Aerospace Equipment*; TO 1-1-686, *Desert Storage Preservation and Process Manual For Aircraft, Aircraft Engines, and Aircraft Auxiliary Power Unit Engines*; TO 1-1-689, *Avionics Cleaning and Corrosion Prevention/Control*; TO 1-1-691, *Aircraft Weapon Systems Cleaning and Corrosion Control*; and TO 1-1-4, *Exterior Finishes, Insignia and Markings, Applicable to USAF Aircraft*.
- 8.3.12. Co-chair all CPABs and assist weapon-system single managers and ALC Corrosion Managers in tracking/resolving action items.
- 8.3.13. Conduct weapon system surveys when requested by the single manager or as stated in the CPAB charter.
- 8.3.14. Represent the AF in coordinating joint Corrosion Prevention and Control sustainment activities throughout DOD, other government agencies and/or industry.

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**Attachment 1****GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

AFPD 21-1, *Managing Aerospace Equipment Maintenance*

***Abbreviations and Acronyms***

**ALC**—Air Logistics Center

**CPAB**—Corrosion Prevention Advisory Board

**DOD**—Department of Defense

**IPT**—Integrated Product Team

**MAJCOM**—Major Command

**POD**—Probability of Detection

**RDT&E**—Research, Development, Training, and Evaluation

**SME**—Subject Matter Expert

***Terms***

**Advanced Composites**—Composite materials consisting of two or more distinct components. Advanced composites are made by embedding high strength and high stiffness fibers within a resin, metal or ceramic matrix.

**Aerospace Vehicles**—All Air Force aircraft, missiles and drones.

**Aircraft Structural Integrity Program (ASIP)**—A program applied to an aircraft system to improve design, prevent structural failures, give a basis for corrective action, and predict operational life expectancy of the weapon system.

**Aerospace Structural Materials Sustainment Office (ASMSO)**—The functional management office for the Air Force Corrosion Prevention and Control, Nondestructive Inspection (NDI), and Advanced Composites Programs.

**Clearing House**—A central site used for purchasing large quantities of materials, repackaging these materials into smaller lots and distributing them to field units.

**Corrosion**—The deterioration of material due to electromechanical or chemical attack resulting from exposure to natural or induced environmental conditions or from the destructive attack of fungi or bacteria.

**Corrosion Prevention**—The process to preclude corrosion by proper material choice and design.

**Corrosion Prevention Advisory Board (CPAB)**—A board of subject matter experts in the fields of aerospace materials, aircraft structural maintenance, depot and fielded production. The board reviews contractual requirements, prepares design guidance for the system, and periodically surveys contractor activities to provide whatever technical guidance is necessary to ensure the contractor conforms to the goals of the program.

**Corrosion Program**—A planned and organized effort to prevent, detect, and control corrosion in order to reduce corrosion damage to any weapon system, aerospace or ground equipment.

**Engine Structural Integrity Program (ENSIP)**—An organized and disciplined approach to the structural design, analysis, qualification, production and the life management of aerospace vehicle engines.

**Level III NDI**—An individual with the skills and knowledge to interpret standards, select the method and technique for a specific inspection, and prepare and verify the adequacy of procedures. Only individuals with level III certification have the authority to approve NDI.

**Advisory Boards**—A board of subject matter experts in the fields of aerospace materials, aircraft structural maintenance, depot and fielded production. The board reviews contractual requirements, prepares design guidance for the system, and periodically surveys contractor activities to provide whatever technical guidance is necessary to ensure the contractor conforms to the goals of the program.

**Low Observable (LO)**—A technology used to minimize the detection of aerospace vehicles.

**Nondestructive Inspection (NDI)**—A process to determine the quality, integrity, properties, materials, and components without damaging or impairing their serviceability. This is done primarily by using liquid penetrant, magnetic particle, eddy current, ultrasonic and radiographic methods.

**Paint Facility**—A specially constructed facility with proper ventilation, breathable air system, lighting, waste disposal system and environmental control to permit chemical/mechanical stripping and repainting of systems and equipment.

**Single manager**—The generic title for a designated Air Force Materiel Command System Program Director (SPD), Product Group Manager (PGM) or Material Group Manager (MGM).

**System Program Director (SPD)**—An individual who is ultimately responsible and accountable for decisions and resources in overall program management of a military system. The SPD is the single person, identified in a Program Management Directive (PMD), who is charged with all cost, schedule, performance, and sustainment aspects of a directed acquisition program. The SPD's primary customer is the using major command.

**Utilization and Training Workshop (U&TW)**—A forum and quality control tool to determine and manage career field education and training requirements as they apply to mission needs IAW AFM 36-2245, *Managing Career Field Education and Training*.