CANCELLED !!!

MIL-STD-1843 (USAF)
08 February 1985

MILITARY STANDARD

RELIABILITY-CENTERED MAINTENANCE

FOR

AIRCRAFT, ENGINES AND EQUIPMENT

AMSC NO. F3447

AREA MNTY
1. This Military Standard is approved for use by the Department of the Air Force, and is available for use by all Departments and agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: HQ AFLC/MMEM, Wright-Patterson AFB, OH 45433, by using the self-addressed Standardization Document Improvement proposal (DD Form 1426) appearing at the end of this document or by letter.
MIL-STD-1843 (USAF)

FOREWORD

This standard establishes the methodology and decision logic for the USAF Reliability-Centered Maintenance (RCM) program. It forms the basis for developing the preventive maintenance actions needed to provide safe, reliable equipment that assures mission accomplishment at reasonable cost.

Although the primary purpose of preventive maintenance is to assure that inherent (designed) reliability is sustained, preventive maintenance by itself may not produce the reliability required to meet mission requirements. Therefore, this standard considers equipment redesign as an option to improving equipment reliability when it is economically feasible to do so.

The focus is on reliability, safety and mission accomplishment at reasonable cost. This standard, when conscientiously applied, forces a vigorous examination of these three factors and prevents indiscriminate actions which are not cost effective.
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Example of identification data worksheet</td>
<td>56</td>
</tr>
<tr>
<td>10</td>
<td>Example of failure mode effects and criticality analysis worksheet</td>
<td>57</td>
</tr>
<tr>
<td>11</td>
<td>Example of systems/equipment analysis - FSI worksheet</td>
<td>58</td>
</tr>
<tr>
<td>12</td>
<td>Example of damage tolerant structure analysis - SSI worksheet</td>
<td>59</td>
</tr>
<tr>
<td>13</td>
<td>Example of durability structure analysis - SSI worksheet</td>
<td>60</td>
</tr>
<tr>
<td>14</td>
<td>Example of nonsignificant item analysis (other items) worksheet</td>
<td>61</td>
</tr>
<tr>
<td>15</td>
<td>Example of RCM analysis update worksheet</td>
<td>62</td>
</tr>
</tbody>
</table>
MIL-STD-1843 (USAF)

CONTENTS - Continued

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Logic progression for functional failures having evident mission effects</td>
<td>22</td>
</tr>
<tr>
<td>4</td>
<td>Logic progression for functional failures having evident nonmission economic effects</td>
<td>23</td>
</tr>
<tr>
<td>5</td>
<td>Logic progression for functional failures having hidden function safety effects</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>Logic progression for functional failures having hidden function mission effects</td>
<td>25</td>
</tr>
<tr>
<td>7</td>
<td>Logic progression for functional failures having hidden function nonmission economic effects</td>
<td>26</td>
</tr>
<tr>
<td>8</td>
<td>RCM structural maintenance program development logic</td>
<td>32</td>
</tr>
</tbody>
</table>

APPENDIX A APPLICATION AND TAILORING GUIDE

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.</td>
<td>General</td>
<td>43</td>
</tr>
<tr>
<td>10.1</td>
<td>Scope</td>
<td>43</td>
</tr>
<tr>
<td>20.</td>
<td>REFERENCED DOCUMENTS</td>
<td>43</td>
</tr>
<tr>
<td>30.</td>
<td>DEFINITIONS (not applicable)</td>
<td>43</td>
</tr>
<tr>
<td>40.</td>
<td>GENERAL REQUIREMENTS</td>
<td>43</td>
</tr>
<tr>
<td>40.1</td>
<td>The RCM Program</td>
<td>43</td>
</tr>
<tr>
<td>40.1.1</td>
<td>Application of RCM</td>
<td>44</td>
</tr>
<tr>
<td>40.1.1.1</td>
<td>The RCMA</td>
<td>45</td>
</tr>
<tr>
<td>40.1.1.2</td>
<td>Applicability and effectiveness criteria</td>
<td>46</td>
</tr>
<tr>
<td>40.1.1.3</td>
<td>Analysis criteria for nonsignificant items</td>
<td>46</td>
</tr>
<tr>
<td>40.1.2</td>
<td>Audit provisions</td>
<td>47</td>
</tr>
<tr>
<td>40.1.3</td>
<td>Support required of other programs and activities</td>
<td>47</td>
</tr>
<tr>
<td>40.2</td>
<td>Preventive maintenance</td>
<td>48</td>
</tr>
<tr>
<td>40.3</td>
<td>Responsible organizations</td>
<td>48</td>
</tr>
</tbody>
</table>

APPENDIX B RCM DOCUMENTATION

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.</td>
<td>GENERAL</td>
<td>50</td>
</tr>
<tr>
<td>10.1</td>
<td>Scope</td>
<td>50</td>
</tr>
<tr>
<td>20.</td>
<td>REFERENCED DOCUMENTS (not applicable)</td>
<td>50</td>
</tr>
<tr>
<td>30.</td>
<td>DEFINITIONS (not applicable)</td>
<td>50</td>
</tr>
<tr>
<td>40.</td>
<td>GENERAL REQUIREMENTS</td>
<td>50</td>
</tr>
<tr>
<td>40.1</td>
<td>RCMA documentation</td>
<td>50</td>
</tr>
<tr>
<td>40.2</td>
<td>Contractual considerations</td>
<td>50</td>
</tr>
<tr>
<td>50.</td>
<td>DETAILED REQUIREMENTS</td>
<td>50</td>
</tr>
<tr>
<td>50.1</td>
<td>Documenting the analysis</td>
<td>50</td>
</tr>
</tbody>
</table>
### CONTENTS

<table>
<thead>
<tr>
<th>Paragraph</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SCOPE</td>
<td>-1</td>
</tr>
<tr>
<td>1.1 Scope</td>
<td>-1</td>
</tr>
<tr>
<td>1.2 Application</td>
<td>-1</td>
</tr>
<tr>
<td>1.3 Numbering system</td>
<td>-1</td>
</tr>
<tr>
<td>1.4 Method of Reference</td>
<td>-1</td>
</tr>
<tr>
<td>2. REFERENCED DOCUMENTS</td>
<td>-2</td>
</tr>
<tr>
<td>2.1 Government documents</td>
<td>-2</td>
</tr>
<tr>
<td>2.1.1 Specifications, standards and handbooks</td>
<td>-2</td>
</tr>
<tr>
<td>2.1.2 Other Government documents, drawings, and publications</td>
<td>-2</td>
</tr>
<tr>
<td>2.2 Source of documents</td>
<td>-2</td>
</tr>
<tr>
<td>3. DEFINITIONS</td>
<td>-3</td>
</tr>
<tr>
<td>3.1 Definitions of terms and acronyms used in this standard</td>
<td>-3</td>
</tr>
<tr>
<td>4. GENERAL REQUIREMENTS</td>
<td>-10</td>
</tr>
<tr>
<td>4.1 Logistic Support Analysis (LSA) and Reliability-Centered Maintenance (RCM) interface</td>
<td>-10</td>
</tr>
<tr>
<td>4.1.1 System/equipment design</td>
<td>-10</td>
</tr>
<tr>
<td>4.2 RCMA procedures</td>
<td>-10</td>
</tr>
<tr>
<td>5. DETAILED REQUIREMENTS</td>
<td>-11</td>
</tr>
<tr>
<td>5.1 Tasks</td>
<td>-11</td>
</tr>
<tr>
<td><strong>Tasks</strong></td>
<td></td>
</tr>
<tr>
<td>101 Reliability-Centered maintenance analysis for aircraft and engine systems and equipment</td>
<td>-12</td>
</tr>
<tr>
<td>102 Reliability-Centered maintenance analysis for aircraft and engine structures</td>
<td>-31</td>
</tr>
<tr>
<td>6. NOTES</td>
<td>-42</td>
</tr>
<tr>
<td>6.1 Intended use</td>
<td>-42</td>
</tr>
<tr>
<td>6.2 Contractual requirements</td>
<td>-42</td>
</tr>
<tr>
<td>6.3 Data requirements</td>
<td>-42</td>
</tr>
</tbody>
</table>

### FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. RCM logic - aircraft and engine systems and equipment</td>
<td>-14</td>
</tr>
<tr>
<td>2. Logic progression for functional failures having evident safety effects</td>
<td>21</td>
</tr>
</tbody>
</table>

iv
1. SCOPE

1.1 Scope. This document, which is based on the Airline/Manufacturer Maintenance Program Planning Document MSG-3, outlines the procedures for developing preventive maintenance requirements through the use of Reliability-Centered Maintenance Analysis (RCMA) for Air Force aircraft and engine systems, aircraft and engine structures and equipment, including peculiar and common Support Equipment (SE) Communications and Electronics (C-E) equipment, vehicles, weapons and other similar equipment items.

1.2 Application. This standard applies to all phases of acquisition and life-cycle support for designated Air Force systems and equipment. The RCMA tasks contained in this standard are used to develop preventive maintenance requirements, as specified in MIL-STD-5096 (USAF) for Air Force weapon systems/equipment being developed and those already fielded. The tasks shall also be used to update the initial RCMA and analyze newly discovered failure modes. Appendix A contains additional application and tailoring guidelines.

1.3 Numbering System. Two distinct RCMA tasks are provided in Section 5. The tasks are numbered sequentially as they are introduced with the first task being 101 and the second task 102. Task 101 contains RCMA procedures for aircraft and engine systems and equipment. Task 102 contains RCMA procedures for aircraft and engine structures. Each task has its own explanatory material and decision logic diagrams and can be used independently. A glossary of terms and definitions used in the RCMA tasks is provided in Section 3. Additional terms and definitions can be found in MIL-STD-721 and MIL-STD-1629.

1.4 Method of Reference. When specifying the tasks of this standard as requirements, both the standard and the specific task description number(s) are to be cited. Application guidance and rationale for selecting tasks to fit the needs of a particular Reliability Centered Maintenance (RCM) program are included in Appendix A.
MIL-STD-1843 (USAF)

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this standard to the extent specified herein.

Specifications:

Military:


Standards:

MIL-STD-721 Definitions of Terms for Reliability and Maintainability
MIL-STD-1388-1 Logistic Support Analysis
MIL-STD-1530 (USAF) Aircraft Structural Integrity Program, Airplane Requirements
MIL-STD-1629 Procedures for Performing A Failure Mode, Effects and Criticality Analysis
MIL-STD-1783 (USAF) Engine Structural Integrity Program (ENSIP)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this standard to the extent specified herein.

DODD 4151.16 DOD Equipment Maintenance Program
DODD 5000.1 Major System Acquisitions
DODD 5000.39 Acquisition and Management of Integrated Logistic Support for Systems and Equipment
AFR 80-13 Aircraft Structural Integrity Program

2.2 Source of documents. Copies of listed military standards, specifications and associated documents listed in the Department of Defense Index of Specifications and Standards (DODISS), should be obtained from the Department of Defense (DOD) Single Point, Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia PA 19120. Copies of all other listed documents should be obtained from the contracting activity or as directed by the contracting officer.
3. DEFINITIONS

3.1 Definitions of terms and acronyms used in this standard. The terms/acronyms listed in this military standard are in accordance with the definitions in MIL-STD-721 and MIL-STD-1823, with the exceptions and addition of the following:

3.1.1 Accidental damage. Physical deterioration of an item caused by contact or impact with an object or influence which may/may not be a part of the aircraft, or by improper manufacturing or maintenance practices.

3.1.2 Aircraft Structural Integrity Program (ASIP). The Air Force ASIP is a time-phased set of required actions performed at the optimum time during the life cycle (design through phase-out) of an aircraft system to ensure the structural integrity (strength, rigidity, damage tolerance, durability and service life capability) of the aircraft.

3.1.3 Age exploration. A systematic evaluation of an item based on analysis of collected information from in-service experience, development tests or scientific handbooks. It assesses the item's resistance to a deterioration process with respect to increasing age.

3.1.4 Condemn. The removal from service of an item which cannot be economically repaired or reworked.

3.1.5 Damage tolerance. The ability of the airframe and engine structure to resist failure due to the presence of flaws, cracks, or other damage for a specified period of un repaired usage.

3.1.6 Damage tolerance analysis. Application of engineering principles to determine periods of safe un repaired service usage in the presence of assumed structural defects.

3.1.7 Damage tolerance critical part. A part whose structural failure could cause loss of aircraft. This implies that the safety-of-flight structure that is sized by damage tolerance requirements and meets the criteria for critical part selection is included in the damage tolerance critical parts list.

3.1.8 Direct adverse effect on operating safety.

   a. Direct: To be direct it must achieve its effect by itself, not in combination with other functional failures (no redundancy exists and is minimum essential equipment).

   b. Adverse Effect on Safety: Implies that the consequences of failure are extremely serious or possibly catastrophic and could cause the loss of aircraft or injury to personnel or extensive damage to equipment.

   c. Operating: Means the time from engine/equipment start for the purpose of maintenance or a mission to engine/equipment shutdown.

3.1.9 Durability. The ability of the structure to resist cracking, corrosion, thermal degradation, delamination, wear and effects of foreign object damage for the entire design service life.
3.1.10 
**Durability analysis.** Application of engineering principles to determine the period of service usage which would degrade the structure below functional or economic limits.

3.1.11 
**Durability critical part.** Structure, which is not safety-of-flight or is not sized by damage tolerance requirements, but is sized by durability requirements and meets the criteria for critical parts selection.

3.1.12 
**Durability structure.** Structure which is not practical to design or does not qualify as damage tolerant; its reliability is protected by discard limits which remove items from service before failures are expected.

3.1.13 
**Engine Structural Integrity Program (ENSIP).** The ENSIP is a time-phased set of required actions performed at the optimum time during the life cycle (design through phase-out) of an aircraft engine, to ensure the structural integrity (strength, rigidity, damage tolerance, durability, and service life capability) of the engine.

3.1.14 
**Engine structural maintenance plan.** A plan resulting from the Engine Structural Integrity Program (ENSIP) analyses and testing which identified the inspection requirements and life limits for engine structure components.

3.1.15 
**Environmental damage/deterioration.** Physical deterioration of an item's strength or resistance to failure as a result of interaction with climate or environment.

3.1.16 
**Equipment.** All articles of a capital nature needed to outfit an individual organization. For the purpose of this standard, the term refers to aircraft, engines, peculiar and common Support Equipment (SE), Communication and Electronics (C-E) equipment, vehicles, weapons, and other similar items.

3.1.17 
**Failure.** The event, or inoperable state, in which any item or part of an item does not, or would not, perform as previously specified.

3.1.18 
**Failure cause.** The specific reason(s) why an item failed.

3.1.19 
**Failure criticality.** A relative measure of the consequences of a failure mode and its frequency of occurrence.

3.1.20 
**Failure effect.** The consequence(s) a failure mode has on the operation, function, or status of an item. Failure effects are classified as local effects, next higher level, and end effects.

3.1.21 
**Failure mode.** The manner by which a failure is observed. Generally describes the way the failure occurs and its impact on equipment operation.

3.1.22 
**Force structural maintenance plan.** A plan required by AFR 80-13 which identifies the inspection and modification requirements and the estimated economic life of the airframe structure.

3.1.23 
**Function.** The normal characteristic actions of an item.
3.1.24 Functional check. A quantitative check to determine if functions of an item perform within specified limits.

3.1.25 Functional failure. How an item failed to perform its designed function.

3.1.26 Functional Significant Item (FSI). Those items other than structures judged to be relatively important from a safety, reliability, or economic standpoint.

3.1.27 Hidden function.
   a. An item whose function is normally active and whose failure is not evident to the operating crew during performance of normal duties.
   b. An item whose function is normally dormant and whose readiness to perform, prior to it being needed, is not evident to the operating crew during performance of normal duties.

3.1.28 Inherent level of reliability and safety. That level which is built into the unit and therefore inherent in its design. This is the highest level of reliability and safety that can be expected from a unit, system, or aircraft if it receives effective maintenance. To achieve higher levels of reliability generally requires modification or redesign, or operation at a derated level of performance.

3.1.29 Inspection. An examination of an item against a specified standard.

3.1.30 Inspection - detailed. An intensive visual check of a specified detail, assembly, or installation. It searches for evidence of structural irregularity using adequate lighting and, where necessary, inspection aids such as mirrors, hand lens, etc. Surface cleaning and elaborate access procedures may be required.

3.1.31 Inspection - directed. A collective term which includes all inspections established as a result of the RCMA process.

3.1.32 Inspection - external surveillance. A visual check that will detect obvious unsatisfactory conditions/discrepancies in externally visible structure and components. It may also include internal structure which is visible through quick opening access panels/doors. Workstands, ladders, etc., may be required to gain proximity.

3.1.33 Inspection - internal surveillance. A visual check that will detect obvious unsatisfactory conditions/discrepancies in internal structure and components. This type of inspection applies to obscured structure and installations which require removal of fillets, fairings, access panels/doors, etc.

3.1.34 Inspection - general visual. A collective term which includes the external surveillance inspection, internal surveillance inspection, and the walk-around check.

3.1.35 Inspection - Non-Destructive (NDI). An intensive check of a specific location similar to the detailed inspection except for the following differences. The check requires some special technique such as radiographic, eddy current, dye penetrant, high-powered magnification, etc., and may require disassembly procedures.
3.1.36 Inspection - walk around check. A visual check conducted from ground level to detect obvious discrepancies.

3.1.37 Item. Any level of hardware assembly (i.e., system, subsystem, module, accessory, component, unit, part, including tubing, electrical wiring, mounting hardware, etc.).

3.1.38 Lead-the-force. A system of scheduling a specified number of aircraft on an accelerated basis to accrue flying hours ahead of the main body of the force, to identify weaknesses in structures, systems, engines, and components so that problems/failures may be anticipated in advance of the bulk of the force.

3.1.39 Lubrication and servicing. The internal or external application of fluids, oils, or grease to an item for the purpose of maintaining its inherent design operating capabilities.

3.1.40 Mission reliability. The ability of an item to perform its required function for the duration of a specified mission.

3.1.41 Mission effects. Failure effects which preclude the completion of the aircraft mission. These failures cause delays, cancellations, ground or flight interruptions, high drag coefficients, flight envelope restrictions, etc.

3.1.42 Nonmission effects. Failure effects which do not prevent mission success or equipment operation, but whose correction may or may not be economically desirable due to added labor and material cost for repair (including loss-of-use cost due to maintenance downtime).

3.1.43 Normal operating crew duties. Those duties which are inherent in the normal operation of the aircraft to include the following:

   a. Preflight check list by operating crew.

   b. Monitoring of cockpit and/or system instrumentation, by operating crew.

   c. Recognition of abnormalities or failures by the operating crew through the use of normal physical senses (i.e., odor, noise, vibration, temperature, visual observation of damage or failure, changes in physical input force requirements, etc.).

3.1.44 Normal operating crew monitoring. Any monitoring of system operation accomplished by the operating crew during their normal duties. This includes monitoring of instrumentation of systems normally used daily and of systems required to be checked by the crew on a regular basis.

3.1.45 Operational check. A task to determine that an item is fulfilling its intended purpose. This check does not require quantitative tolerances. This is a failure finding task.

3.1.46 Other structure. Structure which is judged not to be a structural significant item. "Other Structure" is defined both externally and internally.
3.1.47 Probability of mission success. The likelihood that the weapon system will complete the scheduled mission without experiencing on-equipment failure or performance degradation which would result in an abort or mission deviation.

3.1.48 Reliability-Centered Maintenance (RCM). RCM is a disciplined logic or methodology used to identify preventive maintenance tasks to realize the inherent reliability of equipment at a minimum expenditure of resources.

3.1.49 Reliability-Centered Maintenance Analysis (RCMA). The analysis process utilized to identify preventive maintenance requirements for aircraft and engine systems and equipment consistent with RCM principles.

3.1.50 Restoration. Maintenance Tasks (on/off the equipment) necessary to return an item to a specific standard.

3.1.51 Safety-coded functional significant item. An FSI whose failure or secondary damage resulting from the failure has a direct adverse effect on operating safety.

3.1.52 Scheduled maintenance inspection. Preventive-maintenance tasks identified by an RCMA and scheduled to be accomplished at specified intervals.

3.1.53 Significant item (SI). A collective term which includes functional significant items and structural significant items.

3.1.54 Special inspections. Any inspection resulting from failure indication, overstress or severe weather flight occurrence, fleet data, similar failures, etc.

3.1.55 Structural assembly. One or more structural elements which together provide a basic structural function.

3.1.56 Structural detail. The lowest functional level in an aircraft structure. A discrete region or area of a structural element, or a boundary intersection of two or more elements.

3.1.57 Structural element. Two or more structural details which together form an identified manufacturer's assembly part.

3.1.58 Structural function. The mode of action of aircraft structure. It includes acceptance and transfer of specified loads in items (details/elements/assemblies) and provides consistently adequate aircraft response and flight characteristics.

3.1.59 Structural Significant Item - (SSI). A structural detail, structural element, or structural assembly which is judged significant because the consequence of its failure could be a reduction in aircraft/engine residual strength or function to the extent that safety or mission is adversely impacted.

3.1.60 Tasks - maintenance. An action or set of actions, including inspection and determination of condition required to achieve a desired outcome which restores an item to or maintains an item in serviceable condition.

3.1.61 Threshold. The specific value of a usage parameter (operating cycles, operating hours, etc.) at which the first inspection of some particular level or method should be conducted.
3.1.62 Definition of acronyms used in this standard.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD</td>
<td>Accidental Damage</td>
</tr>
<tr>
<td>AFLC</td>
<td>Air Force Logistics Command</td>
</tr>
<tr>
<td>AFSC</td>
<td>Air Force Systems Command</td>
</tr>
<tr>
<td>ASIP</td>
<td>Aircraft Structural Integrity Program</td>
</tr>
<tr>
<td>CDRL</td>
<td>Contract Data Requirements List</td>
</tr>
<tr>
<td>C-E</td>
<td>Communications - Electronics</td>
</tr>
<tr>
<td>DID</td>
<td>Data Item Description</td>
</tr>
<tr>
<td>DOD</td>
<td>Department of Defense</td>
</tr>
<tr>
<td>DODISS</td>
<td>Department of Defense Index of Specifications and Standards</td>
</tr>
<tr>
<td>ED</td>
<td>Environmental Deterioration</td>
</tr>
<tr>
<td>ENSIP</td>
<td>Engine Structural Integrity Program</td>
</tr>
<tr>
<td>FFM</td>
<td>Function Failure Mode</td>
</tr>
<tr>
<td>FMECA</td>
<td>Failure Mode Effects and Criticality Analysis</td>
</tr>
<tr>
<td>FSI</td>
<td>Functional Significant Item</td>
</tr>
<tr>
<td>IOT &amp; E</td>
<td>Initial Operational Test and Evaluation</td>
</tr>
<tr>
<td>LSA</td>
<td>Logistic Support Analysis</td>
</tr>
<tr>
<td>MDC</td>
<td>Maintenance Data Collection</td>
</tr>
<tr>
<td>MDR</td>
<td>Materiel Deficiency Report</td>
</tr>
<tr>
<td>MDS</td>
<td>Mission Design Series</td>
</tr>
<tr>
<td>NDI</td>
<td>Nondestructive Inspection</td>
</tr>
<tr>
<td>PMRT</td>
<td>Program Management Responsibilities Transfer</td>
</tr>
<tr>
<td>RCM</td>
<td>Reliability-Centered Maintenance</td>
</tr>
<tr>
<td>RCMA</td>
<td>Reliability-Centered Maintenance Analysis</td>
</tr>
<tr>
<td>SE</td>
<td>Support Equipment</td>
</tr>
</tbody>
</table>
y. SI - Significant Item
z. SPM - System Program Manager
aa. SPO - System Program Office
ab. SSI - Structural Significant Item
ac. USAF - United States Air Force
4. GENERAL REQUIREMENTS

4.1 Logistics Support Analysis (LSA) and Reliability-Centered Maintenance (RCM) Interface: The LSA, which is conducted during program initiation and full scale development phase of the weapon system or equipment, is described in MIL-STD-1388-1. As an integral part of the LSA process, the RCMA is conducted to identify preventive maintenance requirements. The RCMA is documented in the LSA record or equivalent format approved by the requiring authority.

4.1.1 System/equipment design. Except under certain conditions it is extremely difficult and costly to change system or equipment design once production of hardware begins. The ease or difficulty of preventive maintenance is directly related to hardware design. Maintainability and costs for maintainability shall be primary considerations in the design of equipment. Hidden function designs whose failure would have significant safety, mission or economic impact should be eliminated or minimized. The RCM design evaluation shall be accomplished in conjunction with MIL-STD-1388-1, Task Section 300. These requirements apply to both design of new equipment and design modifications for existing equipment.

4.2 RCMA procedures. The RCMA procedures contained in this document are used for both new procurement and in-service programs. The procedures include: identifying the Significant Items (SIs); accomplishing a Failure Mode Effects and Criticality Analysis (FMECA) for each SI; identifying required preventive maintenance tasks by submitting FMECA data to a decision logic; and establishing the task intervals. The analysis must be fully documented to provide a basis from which to monitor the effectiveness of the preventive maintenance program and to establish an audit trail of all RCM decisions. Application guidance for completing each of these procedural steps is provided in Appendix A.
5. DETAILED REQUIREMENTS

5.1 **Tasks.** The detailed tasks for performing the RCMA are described in Task 101 and Task 102 as follows:
MIL-STD-1843 (USAF)

TASK 101

RELIABILITY-CENTERED MAINTENANCE ANALYSIS
FOR
AIRCRAFT AND ENGINE SYSTEMS AND EQUIPMENT

101.1 Purpose. To identify both field and depot level preventive maintenance requirements for aircraft and engine systems and equipment.

101.2 Analysis method. The procedures for determining both field and depot preventive maintenance requirements for aircraft and engine system and equipment are described below. The decision logic diagram is applied to each significant item (system, subsystem, module, component, accessory, unit, part, etc.) using the technical data available. Principally, the evaluations are based on the item's functional failures and failure causes. The method is to:

a. Identify the Functionally Significant Items (FSIs). Selection of the FSIs usually begins at the system level descending as necessary through the part level. All items whose known or anticipated failure could adversely affect safety and mission success or have significant economic effects must be included in the list of FSIs. FSIs are those items whose failure meets one of the following criteria.

(1) Could affect safety.

(2) Could result in severe damage or equipment loss.

(3) Could degrade or negate mission accomplishment (including survivability provisions).

(4) Could have a significant economic impact.

(5) Could have one or more of the above effects in combination with another item failure (hidden function).

(6) Could have secondary consequences leading to one or more of the above effects.

(7) Could have one or more of the above effects due to environmental deterioration or accidental damage.

b. Identify "Other Items". During the identification process for FSIs some items may be recognized as not meeting the criteria for an FSI, but past experience with like or similar items and recommendations for unique items may indicate a maintenance task is desirable. These nonsignificant items are categorized as other items and are dispositioned separately in the decision logis (ref: see analysis criteria for nonsignificant items in Appendix A).

c. Accomplish a FMECA analysis on each FSI in accordance with MIL-STD-1629, Task 103. All predictable and potential failure modes and causes should be fully considered in the FMECA including those for environmental deterioration and accidental damage.
d. Utilizing the RCM decision logic (see figure 1), identify the tasks to be accomplished. If no applicable and effective task can be identified, redesign of equipment is required in the safety effects categories, redesign may be required in the mission effects categories, and redesign may be desirable in the nonmission economic effects categories.

(1) Failures with direct adverse mission effects that cannot be prevented through preventive maintenance compromise the ability of the equipment to accomplish its intended functions. Since equipment (weapon systems) may have multiple capabilities and a failure(s) may not affect all of them or affect them all to the same degree, redesign must be considered within the total set of equipment capabilities and mission scenarios. Redesign is required to allow full mission capability. If the equipment (weapon system) after the failure has partial mission capabilities, redesign must be weighed against the degree and criticalness of the mission impact to determine if the use of program resources for redesign is warranted.

(2) Failures with nonmission economic effects that are not preventable through preventive maintenance will not compromise safety, or mission, however, the economic penalties to allow items to fail may be so severe that it would be more advantageous to redesign.

e. Identify the intervals for task development.

f. Identify the recommended level of maintenance for accomplishing the tasks.

101.2.1 Task analysis. Prior to applying the RCM decision logic to an item, the FSI, its function, functional failure, failure mode, failure effect and any additional data pertinent to the item, i.e., manufacturer's part number, a brief description of the item, expected failure rate, hidden functions, redundancies, etc. will be documented in accordance with Appendix B. The documentation is designed to meet user requirements, and will be included as part of the total RCM documentation for the item. The following procedure provides a logic path for each functional failure. Each functional failure and failure mode must be processed through the logic so that a judgment can be made as to the necessity of a task. The resultant tasks and intervals will be included in the preventive maintenance program.

101.2.2 Logic diagram. The decision logic diagram (figure 1) is used for analysis of systems and equipment items. The logic flow is designed whereby the user begins analysis at the top of the diagram and answers the "YES" or "NO" questions which dictate direction of analysis flow. The decision logic has three levels.

a. The first level (questions 1 and 2) categorize the FSIs and other items. The logic for other items leads to appropriate tasks and intervals based on past experience and/or manufacturers' recommendations. No further analysis is required for "other items". The logic for FSIs leads to the second and third level questions.

b. The second level (questions 3, 4, 5, 6 and 7) requires evaluation of each functional failure for determination of the ultimate effect category, i.e., evident safety, mission or nonmission economic effects or hidden safety, mission or nonmission economic effects.
FIGURE 1. RCM logic - aircraft and engine systems and equipment.
PART 2

FIGURE 1. RCM logic - aircraft and engine systems and equipment. - Continued
FIGURE 1. RCM logic - aircraft and the systems and equipment - Continued
c. The third level (questions A through F or A through E as applicable) then takes the failure modes for each functional failure into account for selecting the specific type of tasks for each FSL.

Once the user enters level 3 (the task selection section) parallelizing and default logic has been introduced. Regardless of the answer to the first question regarding lubrication/servicing the next task selection question must be asked in all cases. When following the hidden or evident safety effects paths or mission effects paths, all subsequent questions must be asked. In the remaining nonmission economic effects paths, a "YES" answer subsequent to the first question will allow exiting the logic.

101.2.2.1 Default logic. In the absence of adequate information to answer "YES" or "NO" to questions in the third level, default logic dictates a "NO" answer be given and the subsequent question be asked. As "NO" answers are generated the only choice available is the next question, which in most cases provides a more conservative, stringent and/or costly route.

101.3 Procedures. Step by step instructions to guide the analyst through the RCM decision logic are provided below. As a minimum, data items expressed in paragraph 101.2.1 will be considered. Additional data, when available, will be utilized in the analysis process (i.e., Maintenance Data Collection (MDC) data (DO56), Maintenance Requirements Data System data (G098), Materiel Deficiency Reports (MDRs), and Technical Order Improvement Reports (AFTO Forms 22)).

101.3.1 First level (categorization of items).

a. FSIs versus "Other Items".

**Question 1:** Is this item being evaluated as an FSI?

A "YES" answer indicates the item will be categorized as functionally significant and directs the analyst to the second level of the decision logic, question 3 (101.3.2.a).

A "NO" answer to this question means the item is not a functional significant item and directs the analyst to categorize it as "Other Item" and proceed to question 2 (101.3.1.b).

b. Requirements for nonsignificant items. Question 2 must be asked of each "Other Item".

**Question 2:** Is this item similar to existing items?

A "YES" answer indicates the item is similar to existing items. Tasks selected will be based on past experience with like or similar equipment.

A "NO" answer indicates the item is unique and past data is not available. Tasks selected will be based on manufacturer's recommendations.
Tasks resulting from question 2 must be kept to a minimum but may include items necessary to meet minimum requirements for the comfort and morale of the flight crew, passengers, operators, etc. Further analysis of these items is not required (Ref: see analysis criteria for nonsignificant items in Appendix A).

101.3.2 Second level (consequence of failure).


Question 3: Is the occurrence of a functional failure evident to the operating crew during the performance of normal duties?

This question asks if the operating crew will be aware of the loss (failure) of the function during performance of their normal operating duties. Question 3 must be asked for each functional failure of the item being analyzed. The intent is to segregate the evident and the hidden functional failures.

A "YES" answer indicates the functional failure is evident; proceed to question 4 (101.3.2.b). A "NO" answer indicates the functional failure is hidden; proceed to question 6 (101.3.2.d).

b. Direct adverse effect on safety.

Question 4: Does the functional failure or secondary damage resulting from the functional failure have a direct adverse effect on operating safety?

For a "YES" answer the functional failure or secondary damage resulting from functional failure must have a direct adverse effect on operating safety.

Direct: To be direct the functional failure must achieve its effect by itself, not in combination with other functional failures (no redundancy exists and it is a minimum essential equipment item).

Adverse effect on safety: This implies that the consequences are extremely serious or possibly catastrophic and might cause injury to personnel or extensive damage to equipment.

Operating: This is defined as the time interval from the moment of aircraft/equipment start for the purpose of maintenance or mission to aircraft/equipment shutdown.

A "YES" answer indicates that this functional failure must be treated within the safety effects category and tasks must be developed in accordance with paragraph 101.3.3.1. A "NO" answer indicates the effect is not safety related and question 5 (101.3.2.c) must be asked.

c. Direct adverse effect on mission.

Question 5: Does the functional failure have a direct adverse effect on mission capability?
This question asks if the functional failure could have an adverse effect on mission capability such as:

1. Requiring correction prior to next mission.
2. Compromising the mission flexibility, i.e., altitude restriction, non-icing restriction, weight restriction, etc.

This question is asked of each evident, non-safety functional failure. Functional failures of items which generate "YES" answers to this question are normally minimum operational equipment or mission essential equipment type items.

If the answer to this question is "YES", the effect of the functional failure has an adverse effect on mission capability, and task selection will be handled in accordance with 101.3.3.2.

A "NO" answer indicates that there is a nonmission economic effect and task selection must be handled in accordance with 101.3.3.3.

d. Hidden functional failure safety effect.

Question 6: Does the combination of a hidden functional failure and one additional failure of a system related or back-up function have an adverse effect on operating safety?

This question is asked of each hidden functional failure which has been identified in question 3. The question takes into account failures in which the loss of one hidden function (whose failure is unknown to the operating crew) alone does not affect safety; however, in combination with an additional functional failure (system related or intended to serve as a back-up) has an adverse effect on operating safety.

If a "YES" answer is determined, there is a safety effect and task development must be handled in accordance with 101.3.3.4. A "NO" answer indicates that the effect is not safety related and question 7 (101.3.2.e) must be asked.

e. Hidden functional failure mission effect.

Question 7: Does the combination of a hidden functional failure and one additional failure of a system related or backup function have an adverse effect on mission capability?

This question takes into account failures in which the loss of the one hidden function (whose failure is unknown to the operating crew) alone would not affect mission success; however, in combination with an additional functional failure (system or backup related) would cause the mission to be altered or aborted.

A "YES" answer indicates there is a mission effect and task selection must be handled in accordance with 101.3.3.5. A "NO" answer indicates that there is an economic effect and task selection should be handled in accordance with 101.3.3.6.
101.3.3 Third level (effect categories). Once the applicable second level questions are answered, the user is directed to one of the six effects categories:

a. Evident safety effects.
b. Evident mission effects.
c. Evident nonmission economic effects.
d. Hidden safety effects
e. Hidden mission effects.
f. Hidden nonmission economic effects.
101.3.3.1 Evident safety effects. The evident safety effects category must be approached with the understanding that tasks are required to assure safe operation. All questions in this category must be asked. If no effective tasks result from this category analysis, then redesign is mandatory. Figure 2 illustrates the logic progression for functional failures that have evident safety effects.

FIGURE 2. Logic progression for functional failures having evident safety effects.
101.3.3.2 Evident mission effects. The evident mission effects category must be approached with the understanding that tasks are required to assure mission success. All questions in this category must be asked. If no effective tasks result from this category analysis, a redesign may be required depending on the extent of impact a failure would have on mission success (see paragraph 101.2.d.(1)). Figure 3 illustrates the logic progression for functional failures that have evident mission effects.

**Figure 3.** Logic progression for functional failures having evident mission effects.
101.3.3.3 Evident nonmission economic effects. The evident nonmission economic effects category indicates tasks are desirable if the cost is less than the cost of repair. Analysis of the failure modes through the logic requires the first question (lubrication/servicing) to be answered. Either a "YES" or "NO" answer to question "A" requires movement to the next level; from this point on a "YES" answer will complete the analysis and the resultant tasks will satisfy the requirements. If all answers are "NO", no task has been generated. If economic penalties are severe, a redesign may be desirable (see paragraph 101.2.d.2). Figure 4 illustrates the logic progression for functional failures that have evident nonmission economic effects.

FIGURE 4. Logic progression for functional failures having evident nonmission economic effects
101.3.3.4 Hidden function safety effects. The hidden function safety effect requires tasks to assure the availability necessary to avoid the safety effects of multiple failures. All questions must be asked. If there are no tasks found effective, then redesign is mandatory. Figure 5 illustrates the logic progression for functional failures that have hidden function safety effects.

FIGURE 5. Logic progression for functional failures having hidden function safety effects
101.3.3.5 Hidden function mission effects. The hidden function mission effect category requires tasks to assure the availability necessary to avoid the mission effects of multiple failures. All questions must be asked. If no effective tasks result from this category analysis, the extent of impact a failure may have on mission success could make redesign a requirement (see paragraph 101.2.d.(1)). Figure 6 illustrates the logic progression for functional failures that have hidden function mission effects.

![Logic progression for functional failures having hidden function mission effects](image)

**FIGURE 6.** Logic progression for functional failures having hidden function mission effects.
101.3.3.6 Hidden function nonmission economic effects. The hidden function nonmission economic effect category indicates that tasks are desirable to assure the availability necessary to avoid the economic effects of multiple failures. Movement of the failure modes through the logic requires the first question (lubrication/servicing) to be answered. Either a "YES" or "NO" answer requires movement to the next level; from this point on, a "YES" answer will complete the analysis and the resultant tasks will satisfy the requirements. If all answers are "NO", no tasks have been generated. If economic penalties are severe, a redesign may be desirable (see paragraph 101.2.4(2)). Figure 7 illustrates the logic progression for functional failures that have hidden function nonmission economic effects.

**Figure 7.** Logic progression for functional failures having hidden function nonmission economic effects.
101.3.3.7 Third level (task development). Task development is handled in a similar manner for each of the effect categories. For task determination, it is necessary to apply the failure modes for the functional failure to the third level of the logic diagram. There are seven possible task resultant questions in the effect categories.

a. **Lubrication/servicing (all categories).**

**Question A:** Is a lubrication or servicing task applicable and effective?

This task includes any act of lubricating or servicing for the purpose of maintaining inherent design capability.

Applicability criteria: The replenishment of the consumable must reduce the rate of functional deterioration.

Effectiveness criteria - safety: The task must reduce the risk of failure.

Effectiveness criteria - mission: The task must reduce the risk of failure.

Effectiveness criteria - nonmission-economic: The task must be cost-effective.

b. **Operating crew monitoring.** (evident functional failure categories only).

**Question B:** Is the ability to detect degradation of the function by normal operating crew monitoring applicable and effective?

This task includes any monitoring of system operation accomplished by the operating crew members during their normal duties, i.e., monitoring of instrumentation of items normally used daily and of items required to be checked by the crew on a daily basis. Crew consists of qualified air crew members or operators/maintenance personnel who are performing duties in the operation/maintenance of aircraft or equipment.

Applicability criteria: Reduced resistance to failure must be detectable and rate of reduction in failure resistance must be predictable. Indicators that annunciate failures at the time of occurrence are not applicable.

Effectiveness criteria - safety: The monitoring must be part of the normal duties of the operating crew and reduce the risk of failure to assure safe operation.

Effectiveness criteria - mission: The monitoring must be part of the normal duties of the operating crew and reduce the risk of failure to assure mission success.
Effectiveness criteria - nonmission economic: The monitoring must be part of the normal duties of the operating crew.

c. Operational check. (hidden functional failure categories only)

Question B: Is a check to verify operation applicable and effective?

A task to determine if an item is fulfilling its intended purpose. Quantitative measurements are not taken since this is a failure finding task.

Applicability criteria: Verification of operation must be possible.

Effectiveness criteria - safety: The task must ensure adequate availability of the hidden function to reduce the risk of multiple failures.

Effectiveness criteria - mission: The task must insure adequate availability of the hidden function to reduce risk of multiple failures.

Effectiveness criteria - nonmission economic: The task must ensure adequate availability of the hidden function in order to avoid economic effects of multiple failures and must be cost-effective.

d. Inspection/functional check. (all categories)

Question C: Is the ability to detect degradation of the function by on-equipment or off-equipment task(s) applicable and effective?

Applicability criteria: Reduced resistance to failure must be detectable and rate of reduction in failure resistance must be predictable.

Effectiveness criteria - safety: The task must reduce the risk of failure to assure safe operation.

Effectiveness criteria - mission: The task must reduce the risk of failure to assure mission success.

Effectiveness criteria - nonmission economic: The task must be cost-effective, i.e., the cost of the task must be less than the cost of the failure.

e. Restoration. (all categories)

Question D: Is a restoration task to reduce failure rate applicable and effective?

This task includes work (on/off the aircraft/equipment) necessary to return the item to a specific standard.

Applicability criteria: The item must show functional degradation characteristics at an identifiable age and a large proportion of units must survive to that age. It must be possible to restore the item to a specific standard of failure resistance.
Effectiveness criteria - safety: The task must reduce the risk of failure to assure safe operation.

Effectiveness criteria - mission: The task must reduce the risk of failure to assure mission success.

Effectiveness criteria - nonmission economic: The task must be cost-effective, i.e., the cost of the task must be less than the cost of the failures prevented.

f. **Condemn.** (all categories)

**Question F:** Is a condemn task to avoid failures or to reduce the failure rate applicable and effective?

This task includes the removal from service of an item at a specified life limit.

Condemn tasks are normally applied to so-called single celled parts such as cartridges, canisters, engine disks, durability structural members, etc.

Applicability criteria: The item must show functional degradation characteristics at an identifiable age and a large proportion of units must survive to that age.

Effectiveness criteria - safety: A safe-life limit must reduce the risk of failure to assure safe operation.

Effectiveness criteria - mission: A safe-life limit must reduce the risk of failure to assure mission success.

Effectiveness criteria - nonmission economic: An economic-life limit must be cost-effective, i.e., the cost of the task must be less than the cost of the failures prevented.

g. **Combination.** (safety categories only)

**Question F:** Is there a task or combination of tasks which is applicable and effective?

Since this is a safety category question and a task is required, all possible avenues must be analyzed. The most effective task or combination of tasks must be selected.

h. **Combination (mission categories only)**

**Question F:** Is there a task or combination of tasks which is applicable and effective?

For the mission category, a review of all applicable tasks is necessary to assure mission success. From this review the most effective task or combination of tasks must be selected.
101.4 Setting preventive maintenance task frequencies/interals. Determine whether real and applicable data is available which suggest an effective interval for task accomplishment. Appropriate information may consist of one or more of the following:

a. For acquisition programs, prior knowledge from other aircraft and engine systems/equipment which shows that a scheduled maintenance task has produced substantial evidence of being effective and economically worthwhile.

b. For acquisition programs, manufacturer's test data which indicate that a scheduled maintenance task will be effective for the item being evaluated.

c. For in-service programs, available experience, D056, G096 and MDR data, and AFTO Forms 22 will be utilized to determine intervals.

If there is no prior knowledge from similar aircraft and engine systems/equipment or if there is insufficient similarity between the previous and current systems, the task interval/frequency can only be established initially by experienced personnel using good judgment and operating experience in concert with accurate data (reliability, redundancy, dispatch, etc.).

101.4.1 Threshold sample. The threshold sample is an examination of a specified number of items in order to verify design calculations while attaining in-service experience with the items.

101.4.1.1 Recommended list of significant items. At the time of the RCM Review, there may be provided a recommended list of safety, mission and economic significant items for which threshold samples are necessary to ensure that the designed levels of safety, mission success and economy are maintained. Threshold "windows" may be established for these items. The threshold "windows" are established taking full recognition of:

a. The design of the item under study, the results of development testing and prior service experience.

b. The results of previous sampling programs on similar items.

c. The fact that samples may be available from parts prematurely removed at virtually all ages. This means that knowledge of the condition of the parts may be available over the complete time span from initial operation to the highest operational time accumulated.

If such evidence from unscheduled removals is unavailable or insufficient, then sufficient samples must be removed before the high time unit exceeds the upper threshold (maximum limit in terms of hours/cycles) to produce the necessary evidence. Industry experience may be used to provide the evidence to fulfill the threshold requirements.
MIL-STD-1843 (USAf)

TASK 102

RELIABILITY-CENTERED MAINTENANCE ANALYSIS FOR AIRCRAFT AND ENGINE STRUCTURES

102.1 Purpose. To determine both field and depot level preventive maintenance requirements for aircraft and engine structures.

102.2 Analysis method. This section contains analysis procedures which are used to determine preventive maintenance tasks for aircraft and engine structures. The process is designed to relate the preventive maintenance program to consequences of structural item failure, the structure's susceptibility to damage, and the degree of difficulty involved in detecting such damage. Once this is established, the effectiveness of several levels of inspection and accomplishment intervals are evaluated and the results compared. Finally, based on the most effective combination, a maintenance program is determined. The final program will assure the continued structural integrity of the equipment. The analysis is conducted within the framework of the applicable regulations as they relate to the contents of preventive maintenance programs and as defined in the logic diagram (see figure 8).

102.2.1 Aircraft structures. The structure of the aircraft consists of all load carrying members. These include wings, empennage, fuselage, engine mountings, landing gear, flight-control surfaces, and related points of attachment. The actuating portions of items such as landing gear, flight controls, doors, etc., will be treated as systems/components and will be analyzed in accordance with Task 101.

102.2.2 Engine structures. The structure of the engines consists of all load carrying members. These include main engine frames, bearing and bearing support structures, main rotor shaft, compressor and turbine disks, fan/compressor, combustion and turbine outer cases, engine to airframe mountings, and ground handling mountings.

102.3 Assessment. The aircraft/engine is assessed at various levels according to its functional contribution. The purpose of this assessment is to promote inspections at the highest level of assembly consistent with the results of deterioration process ratings. See the glossary for definitions (Section 3).

102.3.1 Structural Significant Items (SSIs) and other structure: The RCMA for structures applies to two categories of structure, i.e., SSIs and other structure. SSIs include structural details, structural elements, or structural assemblies which are judged significant because the consequence of their failure could be a reduction in aircraft/engine residual strength or function to the extent that safety or mission is adversely impacted. "Other Structure" include structural items that are not judged to be significant (see analysis criteria for nonsignificant items in Appendix A).

a. The manufacturer in providing the initial designation of SSIs should consider such design information as:

(1) The structural significance.
FIGURE 8. RCM structural maintenance program development logic.
FIGURE 8. RCM structural maintenance program development logic. - Continued
MIL-STD-1843 (USAF)

(2) The damage tolerance requirements.

(3) The durability requirements.

(4) The failure rate.

(5) The susceptibility to environmental deterioration and accidental damage.

(6) Type of material and manufacture assembling procedures.

b. The manufacturer provides for each item:

(1) A standardized means of identifying and locating each item (geometric bounds, zone/alphanumeric sequence, etc.).

(2) Item nomenclature and description.

(3) Illustrations for each SSI.

102.4 Maintenance program development for structure. The scheduled maintenance program is based on an assessment of structural design information, service experience with similar structure, and pertinent test results.

102.4.1 Failure Mode Effects and Criticality Analysis (FMECA). A FMECA will be accomplished for each SSI in accordance with MIL-STD-1629, Task 103, and documented per instructions in Appendix B. Where there is an overlap of the analysis with other engineering programs such as ASIP and ENSIP, described in paragraph 102.4.2 below, maximum use will be made of that data to prevent duplication of effort. The FMECA and ASIP/ENSIP analyses will complement each other in the maintenance program development.

102.4.2 Aircraft Structural Integrity Program (ASIP)/Engine Structural Integrity Program (ENSIP). The assessment of airframe structure for selection of maintenance will utilize the ASIP as defined and outlined in AFR 80-13 and MIL-STD-1530 (USAF). For engine structures, the ENSIP, MIL-STD-1783 (USAF), will provide an assessment and plan for maintenance action. The requirement to accomplish an ASIP/ENSIP damage tolerant/durability analysis for each SSI has been incorporated in the logic diagram (see figure 8).

102.4.3. Maintenance tasks for structural significant items. For damage tolerant critical SSIs the preventive maintenance tasks will be based on the Force Structural Maintenance Plan and Engine Structural Maintenance Plan as applicable. For durability critical SSIs the preventive maintenance tasks will be based on the FMECA, Force Structural Maintenance Plan/Engine Structural Maintenance Plan and on the basis of ratings of the susceptibility to durability, environmental deterioration and accidental damage.

102.4.3.1 SSIs covered by Force Structural Maintenance Plan. All the airframe and engine structural damage tolerance critical parts which require scheduled inspection are listed in the Force Structural Maintenance Plan. The flight hours for the initial inspection, reinspection interval and inspection methods will be provided in the plan.
102.4.3.2 **SSIs not covered by Force Structural Maintenance Plan.** Each durability SSI is rated separately for its susceptibility to each of the three deterioration processes:

a. Durability.

b. Environmental deterioration.

c. Accidental damage.

On the basis of the above ratings, special inspections or maintenance schedules for the deterioration processes will be established.

102.4.3.3 **Overlay inspection requirements.** Determine the inspection requirements for each SSI according to the RCM logic (figure 8). Consolidate tasks and document the results.

102.4.3.4 **Other structures.** Establish appropriate maintenance tasks based on:

a. Past experience, and/or

b. Manufacturer's recommendations for new materials and/or concepts.

102.5 **Rating SSIs not covered by Force Structural Maintenance Plan.**

a. The SSIs are assessed with respect to their detectability and susceptibility (likelihood of damage) to durability, environmental deterioration and accidental damage. Emphasis is placed on providing guidelines for rating SSIs rather than defining a specific procedure.

b. Ratings are established to rank the importance of a particular condition or influence as it affects each SSI. As a general guideline, a sufficient number of rating values should be assigned to provide the relative degradation level. Each rating system is customized to the equipment analyzed.

102.5.1 **Rating durability.** Structures may be degraded by a number of causes including the following: fatigue cracking, corrosion, thermal degradation, delamination, wear and the effects of foreign object damage. The maintenance program to control durability must provide assurance of timely detection of degradation in the fleet before it exceeds functional impairment and/or economic limits.

102.5.2 **Rating environmental deterioration.** Environmental deterioration is characterized by structural deterioration caused by an adverse environment. The occurrence may or may not be time/usage dependent. For example, deterioration resulting from a breakdown in a surface protection system is more probable as the calendar age increases; conversely, corrosion resulting from a leaking toilet tank seal is treated as a randomly occurring, discrete event.

102.5.2.1 **Controlling environmental deterioration.** The maintenance program to control environmental deterioration must provide assurance of timely detection of damage in the fleet before it exceeds applicable regulatory requirements. The ratings for environmental deterioration assessment are based on an item's susceptibility to environmentally influenced damage. The ratings are introduced into the logic diagram as shown in figure 8.
102.5.2.2 Effectiveness and durability of surface protection. The susceptibility assessment must judge the potential effectiveness and durability of surface protection systems with respect to the anticipated environment and the likelihood of damage from one or more sources, including:

a. Exposure to a deteriorating environment such as cabin condensation, galley spillage, toilet spillage, cleaning fluids, etc.

b. Contact between dissimilar materials (potential for galvanic activity).

c. Breakdown of surface protection systems; for example, chipped paint, with resultant corrosion of metallic materials, or fluid incursion into permeable non-metallic materials, etc.

102.5.3 Rating accidental damage. Accidental damage is characterized by the occurrence of some discrete event which reduces the inherent level of residual strength. The event has an equal probability of occurrence at any time in the life of the equipment. Sources of damage include any influence outside of the aircraft/engine and its systems (see susceptibility assessment 102.5.3.2 for source reference).

102.5.3.1 Accidental damage control. The maintenance program to control accidental damage must provide a high probability of timely detection of damage in the fleet before it exceeds applicable regulatory requirements. The accidental damage ratings are based on the items susceptibility to accidently induced damage.

102.5.3.2 Susceptibility assessment. The susceptibility assessment consists of judging the frequency of exposure to and the location of damage from one or more sources including:

a. Ground handling equipment.

b. Cargo handling equipment.

c. Manufacturing deficiencies.

d. Improper maintenance and/or operating procedures.

e. Rain, hail, etc.

f. Bird strike.

g. Runway debris.

h. Spillage.

i. Lightning strike.

j. Flight overstress occurrence.
102.6 Rating systems.

102.6.1 Durability rating. The durability rating is used in defining the inspection program for durability dominated SSIs in relation to the design service life for the aircraft/engine. The rating numbers can be associated directly with inspection intervals. The durability can be rated on the basis of durability analysis, durability test results for design loads and the effects of operational loads. The rating number will be established on the ratio of the durability life to the design service life, i.e., if the durability analysis life ratio is less than two times the design service life, the durability rating is 1. When test results are available, the rating number for durability test life takes precedence over rating by analysis.

<table>
<thead>
<tr>
<th>Durability Rating</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durability Analysis Life Ratio</td>
<td>Less than 2.0</td>
<td>2.0 to 4.0</td>
<td>4.0 to 8.0</td>
<td>Greater than 8.0</td>
</tr>
<tr>
<td>Durability Test Life Ratio</td>
<td>Less than 1.0</td>
<td>1.0 to 2.0</td>
<td>2.0 to 4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Operational Usage Life Ratio</td>
<td>More severe by factor of 2.0</td>
<td>More severe by factor of 1.5 to 2.0</td>
<td>Equals design usage</td>
<td>Less severe by factor of 2.0</td>
</tr>
</tbody>
</table>

102.6.2 Environmental deterioration rating. Having taken due account in design of material, corrosion resistance and protective treatments, including drainage provisions, susceptibility to corrosion is assessed with respect to environment and structural configuration. The effect of the environment can be rated as follows:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Type of Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Toilet or galley spillage; battery electrolyte</td>
</tr>
<tr>
<td>2</td>
<td>Some types of hydraulic oils; microbiological bacteria; runway water; runway compounds; cabin condensate water; alkaline or acidic dust</td>
</tr>
<tr>
<td>3</td>
<td>Other types</td>
</tr>
</tbody>
</table>

37
102.6.2.1 Stress corrosion rating. After considering structural configuration effects, stress corrosion can be rated as follows:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Materials sensitive to stress corrosion and subject to built-in stress, also additional assembly built-in stress, interference fit bushings or fasteners</td>
</tr>
<tr>
<td>2</td>
<td>Materials sensitive to stress corrosion but not subject to significant built-in stress</td>
</tr>
<tr>
<td>3</td>
<td>Materials not sensitive to stress corrosion</td>
</tr>
</tbody>
</table>

102.6.2.2 Final corrosion rating. The final corrosion rating is the lower of the rating values (most severe criteria) determined for the environmental and stress corrosion rating assessments. The corrosion rating is used in defining the inspection program for corrosion dominated SSI in relation to the design target corrosion life for the aircraft. The rating numbers can be associated directly with inspection thresholds/intervals.

102.6.3 Accidental damage rating. Structure may be damaged in a random manner by a number of causes including the following:

a. Rain erosion.
b. Hail, bird strike, lightning strike.
c. Foreign objects.
d. Spillage.
e. Manufacturing imperfections.
f. Ground handling.
g. Human error during assembly and maintenance.
h. Flight overstress occurrence.

102.6.3.1 Accidental damage assessment. An assessment is made of the likelihood of a candidate being subject to damage by virtue of its location in relation to the most dominant random failure mode and to the expected frequency of exposure to such damage. For example, areas around main door apertures and at wing leading edges would be assessed as being more susceptible to impact damage than the upper part of a fuselage. The vulnerability of an item to accidental damage can be rated as follows:
The criticality of each item is used in conjunction with the susceptibility assessment to determine its inspection requirements.

102.7 Inspection requirements. The ultimate objective of a structural inspection is the timely detection of deterioration. The inspection must meet the detection requirements from each of the preceding durability, environmental, and accidental damage assessments. Full account should be taken of all applicable inspections occurring in the fleet. During initial analysis of structure, inspection intervals are determined, based on:

a. Operator experience.
b. Manufacturer proposals.
c. Considerations of systems analysis requirements.

102.7.1 Inspection levels and methods. Using the logic diagram, applicable and effective inspection tasks are selected for each deterioration process of the SSL. The levels and methods considered as possible choices are:

a. Walk around check.
b. External surveillance.
c. Internal surveillance.
d. Detailed inspection.
e. Special inspection.
f. Nondestructive Inspection (NDI).

102.7.2 Lead-the-force/age exploration. The oldest aircraft/engine or the aircraft/engine with the highest number of flight hours in the fleet are most likely to show the effects of time dependent damage first. Therefore, structural inspections of lead the force aircraft have the greatest potential for damage detection. The probability that lead the force inspections will detect damage which has occurred in the fleet is a function of:

a. The number of aircraft inspected.
The inspection method and repeat interval.

The age or flight hours, for each aircraft/engine in the fleet.

The operating environment for lead-the-force aircraft/engines.

By accounting for this probability, the benefits from lead-the-force inspections can be applied to all aircraft/engines in the fleet.

102.7.3 Inspection thresholds. The inspection threshold for each structural inspection task is a function of the source of damage as follows:

a. Normal operational usage damage: The inspection requirements for the airframe are established in the Force Structural Maintenance Plan. The plan is compiled from durability and damage tolerance analyses, test results, and past experience. For the engine, inspection requirements and life limits are provided in the Engine Structural Maintenance Plan.

b. Environmental deterioration: The initial inspection threshold for all levels of inspection is based on operator's and manufacturer's experience with similar structures. An age exploration program to establish an initial threshold for time/usage dependent damage sources may be considered, if effective. For time/usage independent sources of damage, the initial threshold may be equivalent to the repeat inspection interval.

c. Accidental damage: The initial inspection threshold for all levels of inspection is based on operator and manufacturer experience with similar structures. The initial threshold may be equivalent to the repeat inspection interval.

102.7.4 Repeat inspection intervals. After the initial inspection threshold has been reached and the inspection conducted, the repeat interval sets the period until the next inspection.

a. Normal operational usage damage: The repeat interval for SSI inspections will be determined by the Force Structural Maintenance Plan developed in the ASIP and the Engine Structural Maintenance Plan developed in the ENSIP. It establishes the maximum interval for each method of inspection based on the requirement to provide sufficient probability of damage detection for each item. Changes in the operating environment can significantly affect structural and thermal damage to both aircraft structure and engine structure. Baseline operating environment and subsequent changes must be known, analyzed and accounted for in subsequent lead-the-force and the remaining fleet inspection plans. Supplemental lead-the-force inspections may be used in conjunction with other fleet maintenance to provide the required detectability level.

b. Environmental deterioration and accidental damage: The repeat interval should be based on operator and manufacturer experience with similar structures. Target values for scheduled maintenance check intervals should be a consideration.
102.8 Reporting of inspection results.

a. The Prime Weapon System Program Director will implement a satisfactory system for the effective collection and dissemination of service experience from the structural program.

b. The reporting process is required by existing regulations for the reporting of the occurrences of failures, malfunctions or defects.
6. NOTES

6.1 Intended use. Specifications conforming to the requirements of this standard are intended for use as military standardization documents and are listed in the DODISS.

6.2 Contractual requirements. To assure complete application of this standard, invitations for bids, requests for proposals and contractual statements of work should include all of the requirements stated in section 4, GENERAL REQUIREMENTS, and section 5, DETAILED REQUIREMENTS.

6.3 Data requirements. When this standard is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below will be developed as specified by an approved Data Item Description (DD Form 1664) delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DAR 7-104.9 (n) (2) are invoked and the DD Form 1423 is not used, the data specified below will be delivered by the contractor in accordance with the contract or purchase order requirements.

<table>
<thead>
<tr>
<th>Paragraph</th>
<th>Data requirement title</th>
<th>Applicable DID no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 4.2</td>
<td>Reliability Centered Maintenance Analysis</td>
<td>DI-R-3522</td>
</tr>
<tr>
<td>b. Appendix B</td>
<td>Reliability Centered Maintenance Analysis</td>
<td>DI-R-3522</td>
</tr>
</tbody>
</table>

(Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)
MIL-STD-1843 (USAF)

APPENDIX A

APPLICATION AND TAILORING GUIDE

10. GENERAL

10.1 Scope. This Appendix provides application and tailoring guidance to aid the procuring activity in generating the contractual requirement for the Reliability-Centered Maintenance Analysis (RCMA).

20. REFERENCED DOCUMENTS

Military Specifications

<table>
<thead>
<tr>
<th>DODD 4151.16</th>
<th>DOD Equipment Maintenance Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>DODD 5000.1</td>
<td>Major System Acquisitions</td>
</tr>
<tr>
<td>DODD 5000.39</td>
<td>Acquisition and Management of Integrated Logistic Support for Systems and Equipment</td>
</tr>
<tr>
<td>MIL-STD-1388-1</td>
<td>Logistic Support Analysis</td>
</tr>
</tbody>
</table>

30. DEFINITIONS

Not applicable

40. GENERAL REQUIREMENTS

40.1 The RCM Program.

a. As described in DOD Directive 4151.16, the RCM Program comprises three major elements: equipment design guidelines, preventive maintenance program development, and continuing review and update of preventive maintenance requirements. In line with these elements, the RCM Program has the following objectives:

   (1) To establish design priorities or guidelines that ease preventive maintenance.

   (2) To ensure realization of the inherent equipment safety and reliability levels.

   (3) To restore equipment safety and reliability to their inherent levels when deterioration has occurred.

   (4) To obtain the information necessary for design improvement of those items whose inherent reliability proves inadequate.

   (5) To accomplish these goals at the least expenditure of resources.

b. The RCM Program is concerned with identifying those practices that enhance preventive maintenance and those that hinder it. The program seeks to develop design guidelines for use during initial equipment design or modification to ensure a design that is compatible with preventive maintenance. For fielded equipment it identifies redesign needs when the equipment design significantly impacts effective preventive maintenance.
c. The RCM Program includes a systematic approach for identifying and developing preventive maintenance tasks for specific end item equipment from a disciplined application of the decision logic process. RCM requires a critical examination of the equipment's design to identify potentially significant items as related to safety, readiness, and economics. A failure mode and effects analysis, a decision logic process, and operation data and experience (from similar or the same equipment) are applied to evaluate and classify the consequences of failure of each significant item according to failure severity and to identify applicable and effective maintenance tasks, for preventing item failures or for identifying failed hidden function items. The objective is to develop a minimum preventive maintenance program that includes only those tasks necessary to preserve safety and operating reliability economically and to ensure acceptable economy of operations maintenance and logistic support when the maintenance action may not have an impact on safety or reliability.

d. The RCM concept further requires that after an RCM program initially has been placed in operation, it shall be monitored continually over the useful life of the equipment through an organized information system. Continued management attention is necessary to confirm, through operational experience, the effectiveness and economy of the initially specified maintenance actions and task intervals, and to make adjustments using real operational data generated on the equipment. The maintenance program shall be monitored for possible modifications due to product improvements, changes in mission assignments, operational scenarios, and other related functions and maintenance programs.

40.1.1 Application of RCM.

a. The RCM Program shall be the basis for establishing the sustaining preventive maintenance programs for all equipment. It is applicable during all phases of equipment acquisition and life-cycle support. It applies to all levels of maintenance. It is further the means for justifying new or modified preventive maintenance tasks and for the continuing evaluation of existing tasks.

b. RCM methodology may be tailored to address unique features of different equipment items.

c. Partial application or waiver of RCM may be elected when shown to be more cost effective than a full program. Equipment complexity, inventory quantities, scheduled phaseout, and the cost of establishing and sustaining an RCM Program are possible factors which may justify a limited application or waiver. For new equipment, the analysis should be included as part of the Logistic Support Analysis (LSA) required by DOD Directive 5000.39 and documented in the LSA records defined in MIL-STD-1388-1.

d. RCM shall be applied to systems and equipment already fielded as soon as practicable. RCM also shall be applied to modifications of these systems and equipment.

e. For new systems, RCM design guidelines shall be provided to the equipment designers during concept exploration. Application of RCM methodology shall be started before Milestone II and a preventive maintenance program established before
Milestone III. The RCM Program shall be developed sufficiently for adequate initial operational support, complementary with contract support, before Milestone III. Milestones are defined in DOD Directive 5000.1. Refinement of the RCM Program shall be continued in parallel with equipment deployment, making adjustments as operational data and experience are accumulated.

40.1.1.1 The RCMA. The RCMA procedures contained in the basic document and guidance for completing each segment is provided as follows.

a. Identifying Significant Items (SIs). The first step in identifying the SIs is to develop a functional breakdown of the end item to be analyzed. Consideration is then given to the failure rate and the impact the failure of each item will have on the next higher assembly or system in the breakdown. SIs are those items whose failure could affect air or ground safety have a mission impact, or be relatively important from an economic standpoint.

b. Failure Mode Effects and Criticality Analysis (FMECA). The FMECA is accomplished for each SI in accordance with MIL-STD-1629, Task 103. Maximum use is made of FMECA data resulting from requirements of other system engineering programs to preclude duplicate effort. The FMECA is a systematic evaluation and documentation, by item failure mode analysis, of the potential impact of each functional or hardware failure on personal or system safety, mission success, system performance, maintainability and maintenance requirements. The completeness of the FMECA is the key to the quality of the resulting preventive maintenance program.

c. RCM decision logic. Two different decision logic diagrams are presented in Section 5, one for the aircraft and engine systems and equipment procedures (Ref: Task 101) and one for the aircraft and engine structure procedures (Ref: Task 102). Both are designed to identify applicable and effective preventive maintenance tasks to prevent the undesirable consequences of failure.

(1) Aircraft and engine systems and equipment decision logic. The decision logic for aircraft and engine systems and equipment contains a series of questions that are answered "YES" or "NO". The answers, which are based on the FMECA, experience data, etc., lead to the specific preventive maintenance tasks. The first level questions categorize FSIs and other items (Ref: See analysis criteria for nonsignificant items in paragraph 40.1.1.3). The decision logic for other items leads to the identification of maintenance tasks based on experience with like or similar items or manufacturers' recommendations for unique items. The path for FSIs leads to the second level of the decision logic. The second level questions consider the failure consequences for each FSI and categorize them based on their severity. The third and last level questions focus on evaluation of proposed tasks for FSIs to circumvent failure. In those cases where a yes or no answer is not evident, default logic is used. The default logic specifies what path to follow if the answer to a question is uncertain. In the event no applicable and effective task can be identified, redesign of equipment is required in the safety effects categories; redesign may be required in the mission effects categories depending upon the extent of impact a failure would have on mission success; and redesign may be desirable in the nonmission effects categories.
(2) Aircraft and engine structure decision logic. The decision logic for aircraft and engine structure contains a combination of "YES" or "NO" questions and procedural processes. The structure is first categorized as being either Structural Significant Items (SSIs) or other structure. The logic for other structure leads to appropriate maintenance tasks based on experience and/or manufacturer's recommendations. The logic for SSIs incorporates the Aircraft Structural Integrity Program (ASIP) and Engine Structural Integrity Program (ENSIP) damage tolerant structure/durability structure analysis. Preventive maintenance tasks for damage tolerant critical SSIs are based solely on the applicable ASIP/ENSIP analysis. Durability critical SSIs are rated for durability, environmental deterioration, and accidental damage. The logic for durability structure then focuses on evaluating proposed tasks for the timely detection of deterioration. Redesign criteria are included in decision logic for durability SSIs and are included in the ASIP/ENSIP analysis for damage tolerant SSIs.

d. Determining preventive maintenance task intervals. The FMECA or decision logic process does not directly consider the preventive maintenance task intervals. Since the frequency greatly determines the amount of work expended in a maintenance program much emphasis should be placed on intervals to minimize costs. However, safety and mission reliability must not be compromised when selecting the task intervals. Initial intervals are based on the FMECA and decision logic along with developmental and qualification test data, Initial Operational Test and Evaluation (IOT&E) data, and experience with like or similar equipment. Economic considerations may support accomplishing a task earlier than scheduled when an item is accessible due to other maintenance or extended down time for phase inspection, depot maintenance etc; these actions are termed opportunistic maintenance. Following the RCMA, intervals may be changed based on operational experience and age exploration data.

e. RCMA documentation. The accomplishing agency must provide complete documentation of the RCMA and the results. Documentation is required to provide input into the LSA record as identified in paragraph 4.1 of the basic standard. It is also needed to provide a means of tracking RCM decisions throughout the life cycle of the equipment. Instructions for documenting the RCMA are exemplified in the Appendix B. Updates/changes to the RCMA will be fully documented and made part of the documentation package.

40.1.1.2 Applicability and effectiveness criteria. Applicability depends on the failure characteristics of the item. Thus an inspection for deterioration can be applicable only if the item has characteristics that make it possible to define a deteriorated condition. Similarly, an age-limit preventive maintenance task will be applicable only if the failures at which the task is directed are related to age. Effectiveness is a measure of the results of the task. The task objective, however, depends on the failure consequences involved. A proposed task might appear useful if it promises to reduce the overall failure rate, but it could not be considered effective if the purpose in applying it was to avoid functional failures altogether.

40.1.1.3 Analysis criteria for nonsignificant items. Incorporated in the decision logic diagrams are provisions for developing preventive maintenance tasks for nonsignificant items. These are categorized as "Other Items" in the decision logic. It is recognized
that SIs consist of only a small portion of the total items in a weapon system. It would not be prudent to totally disregard all nonsignificant items when developing a preventive maintenance program. Preventive maintenance tasks for other items should not significantly increase the overall cost of maintenance and they should be held to a minimum. Examples of maintenance tasks for these items include opportunistic maintenance tasks and general visual inspection tasks. Opportunistic maintenance tasks include tasks planned for accomplishment during extended down time for phase inspections, depot maintenance etc. Opportunistic maintenance may also include scheduling tasks on internal components when they are accessible due to other maintenance, i.e., inspection, repair or replacement of internal engine components during engine teardown, inspection of surrounding structural components during internal structural maintenance, etc. General visual inspection tasks include walk-around inspections and general external inspections for obvious defects. General inspections are similar to walk-around inspections, except they include inspection of areas that cannot be seen from the ground. The general inspection tasks can supplement the tasks directed at SIs. They are both easy to perform and cost-effective.

40.1.2 Audit provisions.

a. For a preventive maintenance program, whether based on RCM or another concept (from currently fielded systems), to remain viable requires continuing iterative evaluations over the life of the equipment, taking into account equipment modifications, operational experience, operational scenario and mission changes. Audit procedures shall be established to document:

1. The preventive maintenance concept selection; the maintenance program development.

2. Iterative changes to the maintenance program and reasons for those changes.

3. Investment and operating costs to establish and sustain the maintenance program.

4. Operational, technical and resource benefits expected and derived from the program.

b. It may not always be practical to establish full audit procedures and documentation due to the costs of establishing and maintaining the audit process, or because of major complexities introduced by changes to other maintenance programs, equipment modifications or operational changes. The basis for declining to establish full audit procedures shall be documented.

40.1.3 Support required of other programs and activities. An RCM plan for a particular item of equipment or type of equipment generally cannot stand alone. It must be supported or supplemented by design development efforts such as reliability and maintainability, configuration management, quality assurance and maintenance-related activities or integrated logistics support. Many of these capabilities and procedures already may be in place but may require modification to accommodate RCM. Examples are:

a. Field and depot-level data systems, including critical component tracking.
b. Maintenance-level of repair analysis programs.

c. Fault detection and location procedures and equipment, diagnostics and nondestructive inspection and tests.

d. Accelerated service testing and sample lot inspection programs and failure modes effects and criticality analysis.

40.2 Preventive maintenance.

a. The purpose of preventive maintenance is to avoid failure of equipment, that is, to sustain the inherent reliability designed and manufactured into that equipment. No maintenance action or function is capable of improving inherent reliability. Improvements in inherent reliability can be attained only through redesign.

b. Inspection, repair or rework, and replacement are the basic types of maintenance tasks or actions available for planning a preventive maintenance program. Consideration of an item's life limit or durability is essential to developing an effective preventive maintenance plan. That consideration introduces the time element into the maintenance tasks available, which are as follows:

(1) Inspection, including test and measurements, at specified intervals to identify potential failures and to forestall a failure.

(2) Inspection at specified intervals to identify a failed hidden item.

(3) Rework or replacement of items of known deterioration or wear out characteristics at or preceding expiration of specified operating intervals to avoid failure.

(4) Rework or replacement of items at specified intervals whose failure must be avoided, whose wear out characteristics have not been identified, but when acceptable safety factors on those wear out characteristics have been established that limit the possibility of failure.

c. Preventive maintenance does not include unscheduled maintenance tasks that result from discrepancies discovered by the scheduled maintenance tasks or during normal operation.

40.3 Responsible organizations. Organizations responsible for the development/maintenance of the RCM program are:

a. Acquisition programs: RCM programs for systems/equipment during acquisition will be developed by the AFSC system program office with participation from the AFLC prime system program manager, the using command, and prime manufacturer.

b. Fielded programs: RCM programs for systems/equipment after Program Management Responsibilities Transfer (PMRT) will be developed/maintained by the prime system program manager (or Item Manager) with participation from using commands and the prime manufacturer.
40.3.1 Program development administration. The AFSC System Program Office (SPO) is directly responsible for the administration of RCM for weapon systems and equipment under development. However, AFLC and MAJCOM participation is encouraged as early as possible to assure adequacy of the analysis and the documented data. It is recognized that they will later be required to approve the RCMA and the proposed maintenance program resulting from it. The AFLC System Program Manager (SPM) is directly responsible for the administration of RCM for in-service systems and equipment.
MIL-STD-1843 (USAF)

APPENDIX B

RCM DOCUMENTATION

10. GENERAL

10.1 Scope. This appendix describes the requirements for RCM documentation. Example worksheets on which to document the analysis are identified with instructions for completing each one.

20. REFERENCED DOCUMENTS

Not applicable.

30. DEFINITIONS

Not applicable.

40. GENERAL REQUIREMENTS

40.1 RCM documentation. As established in paragraph 4.2 of the basic standard, the RCM must be documented not only to provide input into the LSA record, but also to provide a means of tracking RCM decisions for sustaining efforts throughout the life cycle of the equipment. After the initial RCM, there must be follow-on provisions to keep the preventive maintenance requirements current. Future changes in the preventive maintenance requirements, due to experience data, modification programs, etc., will require revising the RCM documentation to reflect these changes. The RCM will be documented on approved RCM worksheets. Examples of the worksheets are identified in figures 9 through 15. Completed worksheets shall be included in the RCM work package and provided to the procuring activity when required by the Contract Data Requirements List, DD Form 1423.

40.2 Contractual considerations. The contractor has the option to document the analysis in the format prescribed in this appendix or to develop their own format for documenting the analysis. Figures 9 through 15 identify the preferred format for documenting the RCM. Documentation containing the same information but arranged differently is acceptable.

50. DETAILED REQUIREMENTS

50.1 Documenting the analysis. The example worksheets are structured to correspond closely to the analysis procedures (see figures 9 through 15). They augment the RCM by further distinguishing the analysis requirements and portraying the analysis in a logical sequence. The following is a description of the example worksheets and instructions for completing each one. The worksheets are discussed in the order they will be used in the analysis. Worksheet block numbers 1 through 10 are header blocks and are standard for all the worksheets. Instructions for completing these blocks are provided only in the instructions for the worksheet titled Example of Identification data. These instructions will apply to all worksheets.

a. Example of Identification Data Worksheet (see figure 9). This worksheet is used to identify each item to be analyzed. Each item is categorized by checking the appropriate FSI, SSI, or Other Item block at the top of the worksheet. The other item
designation is included to identify items other than significant items that may require preventive maintenance tasks. The category selected will signify what additional worksheets must be completed for an item. Complete the numbered blocks for the identification data worksheets as follows:

1. Block 1. Enter the revision number if applicable.

2. Block 2. Enter the Mission Design Series (MDS) of the end item under analysis.

3. Block 3. Enter the system/subsystem nomenclature.

4. Block 4. Enter the name and office symbol of the preparing activity, the preparer's signature and the date prepared.

5. Block 5. Enter the work unit code for the system/subsystem under analysis.

6. Block 6. Enter the reference drawing number for the system/subsystem under analysis.

7. Block 7. Enter the name and office symbol of the reviewing activity, the reviewer's signature and the date reviewed.

8. Block 8. Enter the indenture level. The indenture level is the item level which identifies or describes the relative complexity of the assembly or function. The level progresses from the more complex (system) to the simpler (part) divisions.

9. Block 9. Enter the part number of the system/subsystem under analysis.

10. Block 10. Enter the name and office symbol of the USAF representative approving the document and the date approved.

11. Block 11. Enter the item identification number. This is a number assigned to each item being analyzed. It is used to provide ease of tracking the item through the analysis.

12. Block 12. Enter the item nomenclature.

13. Block 13. Enter the item part number.

14. Block 14. Enter the item work unit code.

15. Block 15. Enter the aircraft/equipment zone from approved zone diagram if applicable.

16. Block 16. Enter the item functional description. This may include a brief description of the function(s) of each item denoting input/output tolerances or values, vibration or stress limits, and any other potentially limiting factors. All hidden functions must be identified.
(17) Block 17. Enter the compensating provisions for the item. This includes any redundancies, protection devices, fail-safe features or fail indication devices.

b. Example of Failure Mode Effects and Criticality Analysis (FMECA) Worksheet (see figure 10). With exception of header block numbers 1 through 10, this worksheet will be completed in accordance with the instructions provided in MIL-STD-1629, Task 103, Failure Mode Effects and Criticality Analysis.

c. Example of System/Equipment Analysis-FSI Worksheet (see figure 11). This worksheet is used to document the decision logic process, the resulting preventive maintenance tasks, and the task intervals for each FSI.

(1) Block 11. Enter the item identification number from the identification data worksheet for the item.

(2) Block 12. Enter the item nomenclature.

(3) Block 13. Enter the Function Failure Mode (FFM) code from the FMECA worksheet. The code consists of a number, a letter and a number. This code is used to track each function, failure and mode through the decision logic process.

(4) Block 14. Enter the applicable "Y" or "N" answer to the yes or no questions on the aircraft and engine systems and equipment decision logic diagram. Blocks for answering the second and third level questions are provided. The failure consequences block is used to answer the second level questions 3 through 7. The remaining effects category blocks are used to answer the third level questions A through F or A through E as applicable. A "yes" answer to question 3 signifies the functional failure is evident and the appropriate evident effects category is determined by answering questions 4 and 5. A "no" answer to question 3 signifies the functional failure is hidden and the appropriate hidden effects category is determined by answering questions 6 and 7. This block requires entries for each functional failure identified on the FMECA worksheet.

(5) Block 15. Enter the task number and the task description. The first task description, which relates to the failure mode, is designated number 1; subsequent task descriptions are designated numbers 2, 3, 4, etc. The task number sequence is repeated for each FFM code.

(6) Block 16. Enter the task interval.

(7) Block 17. Enter the level of maintenance for the task, i.e., organization, intermediate or depot.

d. Example of Damage Tolerant Structure Analysis - SSI Worksheet (see figure 12). This worksheet is used to document the preventive maintenance tasks for damage tolerant SSIs from the aircraft and engine structure decision logic process.

(1) Block 11. Enter the identification number from the identification data worksheet for the item.

(2) Block 12. Enter the item nomenclature.
(3) Block 13. Check the appropriate accessibility block for the item, i.e., EXT for external or INT for internal.

(4) Block 14. Enter the FFM code from the FMECA worksheet. The code consists of a number, a letter and a number. This code is used to track each function, failure and mode through the decision logic process.

(5) Block 15. Enter the task number and the task description. As indicated in the block 15 header and the decision logic diagram, tasks for damage tolerant structure are identified from the ASIP/ENSIP analysis. The first task description, which relates to the failure mode, is designated number 1; subsequent task descriptions are designated numbers 2, 3, 4, etc. The task number sequence is repeated for each FFM code.

(6) Block 16. Enter the applicable type of exposure to environmental deterioration and the environmental deterioration rating (see Task 102 paragraph 102.6.2). Enter the applicable "Y" or "N" answers to the yes or no environmental deterioration decision logic questions 1 through 5.

(7) Block 17. Enter the level of maintenance for the task, i.e., organization, intermediate, or depot.

   e. Example of Durability Structure Analysis-SSI Worksheet (see figure 13). This worksheet is used to document the preventive maintenance tasks for durability SSIs from the aircraft and engine structure decision logic process.

   (1) Block 11. Enter the identification number from the identification data worksheet for the item.

   (2) Block 12. Enter the item nomenclature.

   (3) Block 13. Check the appropriate accessibility block for the item, i.e., EXT for external or INT for internal.

   (4) Block 14. Enter the FFM code from the FMECA worksheet. The code consists of a number, a letter and a number. This code is used to track each function, failure and mode through the decision logic process.

   (5) Block 15. Check the appropriate basis block for rating durability, i.e., analysis, test or usage, and enter the resulting rating (see Task 102 paragraph 102.6.1.).

   (6) Block 16. Enter the applicable type of exposure to environmental deterioration and the environmental deterioration rating (see Task 102 paragraph 102.6.2). Enter the applicable "Y" or "N" answers to the yes or no environmental deterioration decision logic questions 1 through 5.
(7) Block 17. Enter the appropriate potential cause of accidental damage and the accidental damage rating (see Task 102 paragraph 102.6.3). Enter the applicable "Y" or "N" answers to the yes or no accidental damage decision logic questions 1, 2 and 3.

(8) Block 18. Enter the task number and the task description. The first task description, which relates to the failure mode is designated number 1; subsequent task descriptions are designated numbers 2, 3, 4, etc. The task number sequence is repeated for each FFM code.

(9) Block 19. Enter the task interval.

(10) Block 20. Enter the level of maintenance for the task, i.e., organization, intermediate, or depot.

f. Example of Nonsignificant Item Analysis (Other Item) Worksheet (see figure 14). This worksheet is used to document the preventive maintenance tasks for items that do not meet the criteria for a significant item. These items are termed "Other Items" in the decision logic diagram for aircraft and engine systems and equipment and "Other Structure" in the decision logic for aircraft and engine structure.

(1) Block 11. Enter the identification number from the identification data worksheet for the item.

(2) Block 12. Enter the item nomenclature.

(3) Block 13. Enter the applicable "yes" or "no" answer to the question "is the item similar to existing items."

(4) Block 14. Enter the task number and a description of the task based on experience data for like or similar items. The first task is designated number 1 and subsequent tasks are designated 2, 3, 4, etc.

(5) Block 15. Enter the task number and description of task based on recommendations from the manufacturer for unique items. The first task is designated number 1 and subsequent tasks are designated 2, 3, 4, etc.

(6) Block 16. Enter the task interval.

(7) Block 17. Enter the level of maintenance for the task, i.e., organization, intermediate, or depot.

g. Example of RCM Analysis Update Worksheet (see figure 15). This worksheet is used to annotate changes in the preventive maintenance requirements that result from the evaluation of experience data, modification programs, etc. Use of this worksheet will preclude repeating the information from the initial analysis documents when making a change during the RCM sustaining phase. However, when an SI requires complete accomplishment of the RCMA during the sustaining phase, the applicable worksheets (figure 9 through 14) must be completed.
(1) Block 11. Enter the identification number from the identification data worksheet for the item.

(2) Block 12. Enter the item nomenclature.

(3) Block 13. Enter the rationale that justifies the change in the preventive maintenance task.

(4) Block 14. Enter the affected task number from the applicable analysis worksheet (figure 11 through 14) and the new task description. If an existing task is being deleted and no new task is required, enter "Deleted".

(5) Block 15. Enter the task interval.

(6) Block 16. Enter the level of maintenance for the task, i.e., organization, intermediate or depot.
FIGURE 10. Example of failure mode effects and criticality analysis worksheet.
### SYSTEM / EQUIPMENT ANALYSIS - FSI

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>REVISION NO</td>
<td>MOD</td>
<td>SYSTEM / SUBSYSTEM NOMENCLATURE</td>
<td>PREPARED BY</td>
<td>WORK UNIT CODE</td>
<td>REFERENCE DRAWING</td>
<td>REVIEWED BY</td>
<td>INDENTURE LEVEL</td>
<td>SYSTEM / SUBSYSTEM PART NUMBER</td>
<td>APPROVED BY</td>
</tr>
<tr>
<td>DATE</td>
<td>DATE</td>
<td>DATE</td>
<td>DATE</td>
<td>DATE</td>
<td>DATE</td>
<td>DATE</td>
<td>DATE</td>
<td>DATE</td>
<td>DATE</td>
</tr>
</tbody>
</table>

#### FIGURE 11. Example of system/equipment analysis - FSI worksheet,

<table>
<thead>
<tr>
<th>ITEM IDENT NO</th>
<th>ITEM NOMENCLATURE</th>
<th>DECISION LOGIC ANSWERS (Y or N)</th>
<th>TASKS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITEM NO</td>
<td>F</td>
<td>F</td>
<td>SAFETY EFFECTS</td>
<td>MISSION EFFECTS</td>
</tr>
<tr>
<td>M</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TASKS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERVAL</td>
<td>LEVEL OF MAINT</td>
</tr>
</tbody>
</table>

MIL-STD-1849 (USAF) APPENDIX B

CANCELLED!!!
FIGURE 12. Example of damage tolerant structure analysis - SSI worksheet.
**FIGURE 13.** Example of durability structure analysis - SSI worksheet.
**MIL-STD-1843 (USAF)**

**APPENDIX B**

**FIGURE 14. Example of nonsignificant item analysis (other items) worksheet.**

<table>
<thead>
<tr>
<th>NONSIGNIFICANT ITEM ANALYSIS (OTHER ITEMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. REVISION NO.</td>
</tr>
<tr>
<td>4. WORK UNIT CODE</td>
</tr>
<tr>
<td>7. ITEM IDENT</td>
</tr>
<tr>
<td>10. TASK INTERVAL</td>
</tr>
<tr>
<td>13. TASK INTERVAL</td>
</tr>
<tr>
<td>16. TASK INTERVAL</td>
</tr>
</tbody>
</table>

CANCELLED !!!
### RCM Analysis Update

<table>
<thead>
<tr>
<th>NO.</th>
<th>1. SYSTEM IDENTIFICATION</th>
<th>2. REFERENCE DRAWING</th>
<th>3. WORK UNIT CODE</th>
<th>4. WORK UNIT PART NUMBER</th>
<th>5. SYSTEM SUBSYSTEM PART NUMBER</th>
<th>6. TASK LIST</th>
<th>LEVEL</th>
<th>TASK INTERVAL</th>
<th>TASKS</th>
<th>RATIONALE FOR CHANGE</th>
<th>ITEM DESCRIPTIVE</th>
<th>7. PART NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CANCELLED !!!**
CUSTODIAN:
Air Force - 26

PREPARING ACTIVITY:
Air Force - 26
(Project MNTY-F005)

REVIEW ACTIVITIES:
Air Force - 11, 13, 14, 15,
17, 70, 71, 80, 82, 84, 95, 99.

USER ACTIVITIES:
NOTICE OF CANCELLATION

MIL-STD-1843 (USAF)
NOTICE 1
August 9, 1995

MILITARY STANDARD

RELIABILITY-CENTERED MAINTENANCE
FOR
AIRCRAFT, ENGINES AND EQUIPMENT

MIL-STD-1843 (USAF), dated 8 February 1985, is hereby canceled without replacement.

Preparing activity:
   Air Force - 10

Agent:
   OSD - SO

(Project ILSS-0058)

AMSC N/A

AREA ILSS

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.