

GLOSSARY

Section 1. Abbreviations

A_i	- Availability, Inherent (or intrinsic)
A_o	- Availability, Operational
CBM	- Condition-based Maintenance
CM	- Corrective Maintenance
CND	- Cannot Duplicate
FEA	- Finite Element Analysis
FMEA	- Failure Modes and Effects Analysis
FMECA	- Failure Modes, Effects, and Criticality Analysis
FD	- Fault Detection
FD&I	- Fault Detection and Isolation
FTA	- Fault Tree Analysis
LCC	- Life Cycle Cost
LRU	- Line Replaceable Unit
MA	- Maintenance Action
MTBCF	- Mean Time Between Critical Failure
MTBD	- Mean Time Between Demand
MTBDE	- Mean Time Between Downing Events
MTBF	- Mean Time Between Failure
MTBM	- Mean Time Between Maintenance
MTTF	- Mean Time To Failure
MTTR	- Mean Time To Repair
NDE	- Nondestructive Evaluation
NDI	- Nondestructive Inspection
O&M	- Operation and Maintenance
O&S	- Operating and Support

- PM - Preventive Maintenance
- pdf - Probability Density Function
- R/R - Remove and Replace
- RAC - Reliability Analysis Center
- RBD - Reliability Block Diagram
- RCM - Reliability-Centered Maintenance
- RTOK - Retest OK
- R&M - Reliability and Maintainability
- TTF - Time to Failure

Section 2. Terms

ACTIVE TIME: That time during which an item is in an operational inventory.

ADMINISTRATIVE TIME: That element of delay time, not included in the supply delay time.

AFFORDABILITY: Affordability is a measure of how well customers can afford to purchase, operate, and maintain a product over its planned service life. Affordability is a function of product value and product costs. It is the result of a balanced design in which long-term support costs are considered equally with near-term development and manufacturing costs.

ALIGNMENT: Performing the adjustments that are necessary to return an item to specified operation.

AVAILABILITY: A measure of the degree to which an item is in an operable and committable state at the start of a mission when the mission is called for at an unknown (random) time. (Item state at start of a mission includes the combined effects of the readiness-related system R&M parameters, but excludes mission time).

AVAILABILITY, INHERENT (A_i): The percentage of time that a system is available for use based only on its inherent reliability and maintainability characteristics. Usually defined by the following steady-state equation:

$$A_i = \frac{MTBF}{MTBF + MTTR}$$

AVAILABILITY, OPERATIONAL (A_o): The percentage of time that a system is available for use based on its operational reliability and maintainability, and logistics factors, such as delay times. Usually defined by the following steady-state equation:

$$A_o = \frac{MTBM}{MTBM + MDT}$$

CALIBRATION: A comparison of a measuring device with a known standard and a subsequent adjustment to eliminate any differences. Not to be confused with alignment.

CANNOT DUPLICATE (CND): A situation when a failure has been noted by the operator but cannot be duplicated by maintenance personnel attempting to correct the problem. Also see Retest OK.

CHECKOUT: Tests or observations of an item to determine its condition or status.

COMPONENT: Within a product, system, subsystem, or equipment, a component is a constituent module, part, or item.

CONDITION-BASED PM: Maintenance performed to assess an item's condition and performed as a result of that assessment. Some texts use terms such as predictive maintenance and on-condition. The definition of condition-based PM used herein includes these concepts. In summary, the objectives of condition-based PM are to first evaluate the condition of an item, then, based on the condition, either determine if a hidden failure has occurred or determine if a failure is imminent, and then take appropriate action. Maintenance that is required to correct a hidden failure is, of course, corrective maintenance.

CORRECTIVE ACTION: A documented design, process, procedure, or materials change implemented and validated to correct the cause of failure or design deficiency.

CORRECTIVE MAINTENANCE (CM): All actions performed as a result of failure, to restore an item to a specified condition. Corrective maintenance can include any or all of the following steps: Localization, Isolation, Disassembly, Interchange, Reassembly, Alignment and Checkout.

COST: The expenditure of resources (usually expressed in monetary units) necessary to develop, acquire, or use a product over some defined period of time.

DELAY TIME: That element of downtime during which no maintenance is being accomplished on the item because of either supply or administrative delay.

DEPENDABILITY: A measure of the degree to which an item is operable and capable of performing its required function at any (random) time during a specified mission profile, given item availability at the start of the mission. (Item state during a mission includes the combined effects of the mission-related system R&M parameters but excludes non-mission time; see availability).

DETECTABLE FAILURE: Failures at the component, equipment, subsystem, or system (product) level that can be identified through periodic testing or revealed by an alarm or an indication of an anomaly.

DIAGNOSTICS: The hardware, software, or other documented means used to determine that a malfunction has occurred and to isolate the cause of the malfunction. Also refers to "the action of detecting and isolating failures or faults."

DOWNTIME: That element of time during which an item is in an operational inventory but is not in condition to perform its required function.

EFFECTIVENESS: The degree to which PM can provide a quantitative indication of an impending functional failure, reduce the frequency with which a functional failure occurs, or prevent a functional failure.

EQUIPMENT: A general term designating an item or group of items capable of performing a complete function.

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

FAILURE, CATASTROPHIC: A failure that causes loss of the item, human life, or serious collateral damage to property.

FAILURE, HIDDEN: A failure that is not evident to the operator; that is, it is not a functional failure. A hidden failure may occur in two different ways. In the first, the item that has failed is one of two or more redundant items

performing a given function. The loss of one or more of these items does not result in a loss of the function. The second way in which a hidden failure can occur is when the function performed by the item is normally inactive. Only when the function is eventually required will the failure become evident to the operator. Hidden failures must be detected by maintenance personnel.

FAILURE, INTERMITTENT: Failure for a limited period of time, followed by the item's recovery of its ability to perform within specified limits without any remedial action.

FAILURE, RANDOM: A failure, the occurrence of which cannot be predicted except in a probabilistic or statistical sense.

FAILURE ANALYSIS: Subsequent to a failure, the logical systematic examination of an item, its construction, application, and documentation to identify the failure mode and determine the failure mechanism and its basic course.

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

FAILURE MECHANISM: The physical, chemical, electrical, thermal or other process which results in failure.

FAILURE MODE: The consequence of the mechanism through which the failure occurs, i.e., short, open, fracture, and excessive wear.

FAILURE MODE AND EFFECTS ANALYSIS (FMEA): A procedure by which each potential failure mode in a product (system) is analyzed to determine the results or effects thereof on the product and to classify each potential failure mode according to its severity or risk probability number.

FMECA: Failure Modes, Effects, and Criticality Analysis. The term is used to emphasize the classifying of failure modes as to their severity (criticality).

FAILURE RATE: The total number of failures within an item population, divided by the total number of life units expended by that population, during a particular measurement period under stated conditions.

FAILURE REPORTING AND CORRECTIVE ACTION SYSTEM (FRACAS): A closed-loop system for collecting, analyzing, and documenting failures and recording any corrective action taken to eliminate or reduce the probability of future such failures.

FALSE ALARM: A fault indicated by BIT or other monitoring circuitry where no fault can be found or confirmed.

FAULT: Immediate cause of failure (e.g., maladjustment, misalignment, defect, etc.).

FAULT DETECTION (FD): A process that discovers the existence of faults.

FAULT ISOLATION (FI): The process of determining the location of a fault to the extent necessary to effect repair.

FAULT TREE ANALYSIS: An analysis approach in which each potential system failure is traced back to all faults that could cause the failure. It is a top-down approach, whereas the FMEA is a bottom-up approach.

FINITE ELEMENT ANALYSIS (FEA): A modeling technique (normally a computer simulation) used to predict the material response or behavior of the device or item being modeled. FEA can describe material stresses and temperatures throughout the modeled device by simulating thermal or dynamic loading conditions. It can be used to assess mechanical failure mechanisms such as fatigue, rupture, creep, and buckling.

FUNCTIONAL TEST: An evaluation of a product or item while it is being operated and checked under limited conditions without the aid of its associated equipment in order to determine its fitness for use.

HIDDEN FAILURE: See Failure, Hidden.

INHERENT AVAILABILITY (A_i): A measure of availability that includes only the effects of an item design and its application, and does not account for effects of the operational and support environment.

ISOLATION: Determining the location of a failure to the extent possible, by the use of accessory equipment.

LEVELS OF MAINTENANCE: The division of maintenance, based on different and requisite technical skill, which jobs are allocated to organizations in accordance with the availability of personnel, tools, supplies, and the time within the organization. Typical maintenance levels are organizational, intermediate, and depot.

LIFE CYCLE COST (LCC): The sum of acquisition, logistics support, operating, and retirement and phase-out expenses.

LIFE CYCLE PHASES: Identifiable stages in the life of a product from the development of the first concept to removing the product from service and disposing of it. Within the Department of Defense, four phases are formally defined: Concept Exploration; Program Definition and Risk Reduction; Engineering and Manufacturing Development; and Production, Deployment, and Operational Support. Although not defined as a phase, demilitarization and disposal is defined as those activities conducted at the end of a product's useful life. Within the commercial sector, various ways of dividing the life cycle into phases are used. One way of doing this is as follows: Customer Need Analysis, Design and Development, Production and Construction, Operation and Maintenance, and Retirement and Phase-out.

LINE REPLACEABLE UNIT (LRU): A unit designed to be removed upon failure from a larger entity (product or item) in the operational environment, normally at the organizational level.

LOCALIZATION: Determining the location of a failure to the extent possible, without using accessory test equipment.

LOGISTIC TIME: That portion of downtime during which repair is delayed solely to waiting for a replacement part or other subdivision of the system.

LOGISTICS SUPPORT: The materials and services required to enable the operating forces to operate, maintain, and repair the end item within the maintenance concept defined for that end item.

MAINTAINABILITY: The relative ease and economy of time and resources with which an item can be retained in, or restored to, a specified condition when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance and repair. Also, the probability that an item can be retained in, or restored to, a specified condition when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance and repair.

MAINTENANCE: All actions necessary for retaining an item in or restoring it to a specified condition.

MAINTENANCE ACTION: An element of a maintenance event. One or more tasks (i.e., fault localization, fault isolation, servicing and inspection) necessary to retain an item in or restore it to a specified condition.

MAINTENANCE CONCEPT: A description of the planned general scheme for maintenance and support of an item in the operational environment. It provides a practical basis for design, layout, and packaging of the system and its test equipment. It establishes the scope of maintenance responsibility for each level of maintenance and the personnel resources required to maintain the system.

MAINTENANCE EVENT: One or more maintenance actions required to effect corrective and preventive maintenance due to any type of failure or malfunction, false alarm or scheduled maintenance plan.

MAINTENANCE TASK: The maintenance effort necessary for retaining an item in, or changing/restoring it to a specified condition.

MAINTENANCE TIME: An element of downtime that excludes modification and delay time.

MEAN DOWNTIME (MDT): The average time a system is unavailable for use due to a failure. Time includes the actual repair time plus all delay time associated with a repair person arriving with the appropriate replacement parts.

MEAN TIME BETWEEN CRITICAL FAILURE (MTBCF): A measure of mission or functional reliability. The mean number of life units during which the item performs its mission or function within specified limits, during a particular measurement interval under stated conditions.

MEAN TIME BETWEEN FAILURE (MTBF): A basic measure of reliability for repairable items. The mean number of life units during which all parts of the item perform within their specified limits, during a particular measurement interval under stated conditions.

MEAN TIME BETWEEN MAINTENANCE (MTBM): A measure of the reliability taking into account maintenance policy. The total number of life units expended by a given time, divided by the total number of maintenance events (scheduled and unscheduled) due to that item.

MEAN TIME BETWEEN REMOVALS (MTBR): A measure of the product reliability parameter related to demand for logistic support. The total number of system life units divided by the total number of items removed from that product during a stated period of time. This term is defined to exclude removals performed to facilitate other maintenance and removals for product improvement.

MEAN TIME TO REPAIR (MTTR): A basic measure of maintainability. The sum of corrective maintenance times at any specific level of repair, divided by the total number of failures within an item repaired at that level, during a particular interval under stated conditions.

MISSION TIME: That element of up time required to perform a stated mission profile.

NON-DESTRUCTIVE EVALUATION: A collective term referring to a wide range of technologies and methods used for nondestructive inspection, evaluation, or testing.

NON-DESTRUCTIVE INSPECTION (NDI): Any method used for inspecting an item without physically, chemically, or otherwise destroying or changing the design characteristics of the item. However, it may be necessary to remove paint or other external coatings to use the NDI method. A wide range of technology and methods are usually described as nondestructive inspection, evaluation, or testing (collectively referred to as non-destructive evaluation or NDE). The core of NDE is commonly thought to contain ultrasonic, visual, radiographic, eddy current, liquid penetrant, and magnetic particle inspection methods. Other methodologies, include acoustic emission, use of laser interference, microwaves, NMR and MRI, thermal imaging, and so forth.

NON-DETECTABLE FAILURE: Failures at the component, equipment, subsystem, or system (product) level that are identifiable by analysis but cannot be identified through periodic testing or revealed by an alarm or an indication of an anomaly.

ON-CONDITION MAINTENANCE: See Condition-based PM.

OPERATING AND SUPPORT (O&S) COSTS: Those costs associated with operating and supporting (i.e., using) a product after it is purchased or fielded.

OPERATIONAL READINESS: The ability of a military unit to respond to its operation plan(s) upon receipt of an operations order. (A function of assigned strength, item availability, status, or supply, training, etc.).

PREDICTED: That which is expected at some future time, postulated on analysis of past experience and tests.

PREDICTIVE MAINTENANCE: See Condition-based PM.

PREVENTIVE MAINTENANCE (PM): All actions performed in an attempt to retain an item in specified condition by providing systematic inspection, detection, and prevention of incipient failures.

REASSEMBLY: Assembling the items that were removed during disassembly and closing the reassembled items.

REDUNDANCY: The existence of more than one means for accomplishing a given function. Each means of accomplishing the function need not necessarily be identical.

RELIABILITY: (1) The duration or probability of failure-free performance under stated conditions. (2) The probability that an item can perform its intended function for a specified interval under stated conditions. (For non-redundant items this is equivalent to definition (1). For redundant items this is equivalent to definition of mission reliability).

RELIABILITY-CENTERED MAINTENANCE (RCM): A disciplined logic or methodology used to identify preventive and corrective maintenance tasks to realize the inherent reliability of equipment at a minimum expenditure of resources, while ensuring safe operation and use.

RETEST OK (RTOK): A situation where a failure was detected on the system, either through inspection or testing, but no fault can be found in the item that was eventually removed for repair at a field or depot location. Also see Cannot Duplicate.

SCHEDULED MAINTENANCE: Periodic prescribed inspection and/or servicing of products or items accomplished on a calendar, mileage or hours of operation basis. Included in Preventive Maintenance.

SERVICING: The performance of any act needed to keep an item in operating condition, (i.e. lubricating, fueling, oiling, cleaning, etc.), but not including preventive maintenance of parts or corrective maintenance tasks.

SINGLE-POINT FAILURE: A failure of an item that causes the system to fail and for which no redundancy or alternative operational procedure exists.

SUBSYSTEM: A combination of sets, groups, etc. that performs an operational function within a product (system) and is a major subdivision of the product. (Example: Data processing subsystem, guidance subsystem).

SYSTEM ADMINISTRATIVE TIME: System (product) downtime other than active maintenance time and logistic time.

SYSTEM DOWNTIME: The time interval between the commencement of work on a system (product) malfunction and the time when the system has been repaired and/or checked by the maintenance person, and no further maintenance activity is executed.

SYSTEM: General – A composite of equipment and skills, and techniques capable of performing or supporting an operational role, or both. A complete system includes all equipment, related facilities, material, software, services, and personnel required for its operation and support to the degree that it can be considered self-sufficient in its intended operational environment.

TESTABILITY: A design characteristic that allows status (operable, inoperable, or degraded) of an item to be determined and the isolation of faults within the item to be performed in a timely manner.

TOTAL SYSTEM DOWNTIME: The time interval between the reporting of a system (product) malfunction and the time when the system has been repaired and/or checked by the maintenance person, and no further maintenance activity is executed.

UNSCHEDULED MAINTENANCE: Corrective maintenance performed in response to a suspected failure.

UPTIME: That element of **ACTIVE TIME** during which an item is in condition to perform its required functions. (Increases availability and dependability).

USEFUL LIFE: The number of life units from manufacture to when the item has an unrepairable failure or unacceptable failure rate. Also, the period of time before the failure rate increases due to wearout.

WEAROUT: The process that results in an increase of the failure rate or probability of failure as the number of life units increases.