



GLOSSARY of Reliability Terms

Accelerated Life Testing – Testing to verify design reliability of machinery/equipment much sooner than if operating typically. This is intended especially for new technology, design changes, and ongoing development.

Acceptance Test (Qualification Test) – A test to determine machinery/equipment conformance to the qualification requirements in its equipment specification.

Accessibility – The amount of working space available around a component sufficient to diagnose, troubleshoot and complete maintenance activities safely and effectively. Provision must be made for movement of necessary tools and equipment with consideration for human ergonomic.

Acquisition Cost – Includes price, shipping, installation and the original cost of spares.

Actual Machine Cycle Time (Process Cycle Time) – Actual time to process a part of complete an operation. Specifically the shortest period of time at the end of which a series of events in an operation is repeated.

Allocation – The process by which a top-level quantitative requirement is assigned to lower hardware items, subsystems in relation to system-level reliability and maintainability goals.

Amortization period, yield loss/part and labour rates – are obtained by asking your finance representatives.

Availability – A measure of the degree to which machinery/equipment is in an operable and committable state at any point in time. Specifically, the percent of time that machinery/equipment will be operable when needed.

Or

The probability that a system or piece of equipment will, when used under specified conditions, operate satisfactorily and effectively. Also, the percentage of time or number of occurrences for which a product will operate properly when called upon.

Built-in-Test (BIT) – The self-test hardware and software that is internal to a unit to test te unit.

Built-in-Test Equipment (BITE) – A unit which is part of a system and is used for the express purpose of testing the system. BITE is an identifiable unit of a system.

Concept – Basic idea or generalization

Confidence limit: – An indication of the degree of confidence which one can place in an estimate based on statistical data. Confidence limits are set by confidence coefficients. A confidence coefficient



of 0.95, for instance, means that a given statement derived from statistical data will be right 95% of the time on the average.

Configuration: – The arrangement and contour of the physical and functional characteristics of systems, equipment and related items of hardware or software; the shape of a thing at a given time. The specific parts used to construct a machine.

Corrective [Unscheduled, Unplanned, Repair, Breakdown] Maintenance: – All actions performed as a result of failure, to restore a machine to a specified condition. Corrective maintenance can include any or all of the following steps : localization, isolation, disassembly, interchange, reassembly, change of spares, adjustments, alignment, balancing and checkouts.

Cost-effectiveness: – A measure of system effectiveness versus life-cycle-cost.

Critical: – Describes items especially important to product performance and more vital to operation than non-critical items.

Delay Study: – A continuous study over an extended period of time (say 2 weeks) where every incidence of downtime is recorded along with the apparent cause.

Design Machine Cycle Time [Process Cycle Time] – Specified time to process a part or complete an operation. Specifically the shortest period of time at the end of which a series of events in an operation is repeated.

Discounted cash flow analysis: – A method of making investment decisions using the time value of money.

Distribution: – See probability distribution.

Downtime: – That portion of the calendar time during which an item or piece of equipment is not able to perform its intended function fully.

Durability Life [Expected Life] – A measure of useful life, defining the number of operating hours (or cycles) until overall is expected or required.

Emergency maintenance – Corrective unscheduled repairs.

Engineering – The profession in which knowledge of the mathematical and natural sciences is applied with judgement to develop ways to utilize economically the materials and forces of nature for the benefit of mankind.



Failure – An event when machinery/equipment is not available to produce parts at specified conditions when scheduled or is not capable of producing parts or perform scheduled operations to specification. For every failure, an action is required.

Failure Analysis (FA) – The logical systematic examination of a failed item, its construction, application and documentation to verify the reported failure, identify the failure mode and determine the failure mechanism and its basic failure cause. To be adequate, the procedure must determine whether corrective action is warranted and if so, provide information to initiate corrective action.

Failure Effect – The consequence of the failure.

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

Failure Rate – Number of failure per unit of gross operating period in terms of time, events, miles, cycle, or number of parts.

Failure Mode Analysis (FMA) – For each critical parameter of a system, determining what malfunction symptom appear just before, or immediately after, failure.

Failure Mode and Effect Analysis (FMEA) – A technique to identify each potential failure mode and its effect on machinery performance.

Failure Mode Effect and Critically Analysis (FMECA) – A technique to identify each potential failure mode and its effect on performance with a measure of critically with respect to certain parameters.

Fault Tree Analysis (FTA) – A top-down approach to failure analysis starting with an undesirable event and determining all the ways it can happen.

Gross Operating Time – Total time that the machine is powered and producing parts. Gross operating time = Net operating time + Scrap time.

Infant Mortality – Early failure that exists until debugging eliminated faulty components, improper assemblies and other user and manufacturer learning problems and until the failure rate lowers.

Life Cycle – The sequence of phases through which machinery/equipment passes from conception through decommission.

Maintainability – A characteristic of design, installation and operation usually expressed at the probability that a machine can be restored to specified operable condition (returned to a serviceable state) within a specified interval of time when maintenance action is performed in accordance with prescribed procedures and resources.



Maintenance – Work performed to maintain machinery and equipment in its original operating condition to the extent possible; includes scheduled and unscheduled maintenance but does not include minor construction or change work.

Mean Cycle Between Failures (MCBF) – The average cycles between failure occurrences. The sum of operating cycles of machine divided by the total number of failures.

Mean Cycle To Repair (MCTR) -- The average cycles to restore machinery or equipment to specified conditions.

Mean Time Between Assists (MTBA) – A measure of reliability denoting the average time between assists to restore machinery/equipment to specified condition.

Mean Time Between Failures (MTBF) – The average time between failure occurrences. The sum of operating time of a machine divided by the total number of failures.

Mean Time To Repair (MTTR) – The average time to restore machinery or equipment to specified condition.

Net Operating Time – Total time that machine is producing parts, as a first pass, to specifications.

Non-operating Time – Total time that the machinery/equipment is up but not running due to blocking, starvation and/or administrative time.

Overall Equipment Effectiveness (OEE) – The product of three measurements : Percentage of time the machinery is available (**Availability**)* how fast the machinery or equipment is running relative to its design cycle (**Performance efficiency**)* percentage of the resulting product within quality specifications (**Yield**).

The overall machine effectiveness for the machinery or equipment is calculated by :

$$OEE = \text{Availability} \times \text{Performance efficiency} \times \text{Yield.}$$

Overhaul – A comprehensive inspection and restoration of machinery/equipment or one of its major parts, to an acceptable condition at a durability time or usage limit.

Predictive & Preventive [Scheduled, Planned] Maintenance – All actions performed in an attempt to retain a machine in specified condition by providing systematic inspection, detection and prevention of incipient failures.

Quality Function Deployment (QFD) – A discipline for product planning and development or redesigning an existing product in which key customer wants and needs are deployed throughout an organization. QFD provides a structure for ensuring that customers' wants and needs are carefully heard, then directly translated into a company's internal technical requirements form design through final assembly.



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

Refurbish – Clean & replace worn parts on a selective basis to make the product usable to a customer. Less involved than rebuild.

Reliability (R) – Quantitatively :The probability that machinery/equipment can perform its intended function continuously, without failure, for a specified interval of time when operating under stated or specified conditions.

Quantitatively: Freedom from operational failure in service or use on a comparative scale.

In this guide the broader meaning of reliability includes availability, maintainability, performance and safety and their interdependence.

Reliability Acceptance Testing – Experimentation conducted on production items or samples thereof to provide assurance that the reliability achieved in demonstration testing is being maintained during production.

Reliability Demonstration Testing -- Experimentation conducted on production items to show, with an agreed degree of confidence, that the required level of reliability has been attained.

Reliability Development Testing -- Experimentation conducted under simulated operational environments to improve the reliability of a design or progressively identify failure modes in order to eliminate them by design action.

Reliability Growth – Machine reliability improvement as a result of identifying and eliminating machinery or equipment failure causes during machine testing and operation.

Reliability Specification – The document that describes in detail the reliability requirement with which the product or service has to comply.

Repair – The restoration or replacement of components of facilities or equipment as necessitated by wear, tear, damage or failure. To return the facility or equipment to efficient operating condition.

Repair parts – Individual parts or assemblies required for the maintenance or repair of equipment, systems or spares. Such repair parts may be repairable or non-repairable assemblies or one piece items. Consumable supplies used in maintenance such as wiping rags, solvent and lubricants are considered repair parts.

Repairable item – Durable item determined by the application of engineering, economic and other factors to be restorable to serviceable condition through regular repair procedures.



Replaceable item : Hardware that is functionally interchangeable with another item but differs physically from the original part to the extent that installation of the replacement requires such operations as drilling, reaming, filing or shimming in addition to normal attachment or installation operation.

Safety: Elimination of hazardous conditions that could cause injury. Protection against failure, breakage and accident

Scheduled [Planned] Downtime – The elapsed time that the machine is down for scheduled maintenance or turned off for other reasons.

Scheduled Maintenance: Preplanned actions performed to keep an item in specified operating condition by means of systematic inspection, detection and prevention of incipient failure. Sometimes called as preventive maintenance (PM) but actually is a subset of PM.

Skill: Anything done with effortless ease.

Spares: Component, assemblies and equipment that are completely interchangeable with like items and can be used to replace items removed during maintenance.

Specifications : Documents that clearly and accurately describe the essential technical requirements for materials, items, equipment, systems, services; including the procedures by which it will be determined that the requirements have been met. Such document may include performance support, preservation, packaging, packing and marking requirements.

Standards : Established or accepted rules, models or criteria by which the degree of user satisfaction of a product or act is determined or against which comparisons are made.

Standard Deviation : A measure of average dispersion or departure from the mean of numbers, computed as the square root of the average of the square of differences between the numbers and their arithmetic mean. It is also a measure of uncertainty when applied to probability density distribution.

Standard item : An item for common use described accurately by a standard document or drawing.

Storage Specification : The document that describes in detail the principal conditions under which a product should be kept while waiting transport or use.

Stress Screening : Testing, by means of any production or manufacturing process that applies physical climatic stresses or forces (or combination thereof) to a product, to establish whether that product attains or fail to attain predetermined limits and to eliminate faulty, abnormal or marginal parts and manufacturing faults.



Surveillability : A qualitative factor influencing reliability. It contains such considerations as accessibility for surveillance and monitoring of a machine or its function (s), etc.

System : Assembly of correlated hardware, software, methods, procedures and people or any combination of these, all arranged or ordered toward a common objective.

Testability – A design characteristic allowing the following to be determined with a given confidence and in specified time : location of any faults, whether an item is inoperable, operable but degraded and/or operable.

Time to Repair (TTR) – Total clock time from the occurrence of failure of a component or system to the time when the component or system is restored to service (i.e. capable of producing good parts or performing operations within acceptable limits). Typical elements of repair time are : diagnostic time, replacement/fixing of broken parts, testing time and restoring.

Training : The pragmatic approach to supplementing education with particular knowledge and assistance in developing special skills. Helping people to learn to practice an art, science, trade, profession or related activity. Basically, more specialised than education and involves learning what to do rather than why it is done.

Transport/Transport Specification : The document that describes in detail the conditions to be observed in moving or conveying the product.

Total Downtime: – The elapsed time during which a machine is not capable of operating to specifications.

Total Downtime = Scheduled Downtime + Unscheduled Downtime

Troubleshooting: – Locating or isolating and identifying discrepancies or malfunctions of equipment and determining the corrective action required.

Unscheduled [Unplanned] Downtime: – The elapsed time that the machine is incapable of operating to specifications because of unanticipated breakdowns.

Unscheduled Maintenance: (UM) – Emergency Maintenance (EM) or Corrective Maintenance (CM) or Breakdown Maintenance (BM) or On-failure Maintenance (OFM) : -- to restore a failed item to usable condition

Uptime: – Total time that a machine is on-line (powered up) and capable of producing parts.
Uptime = Gross operating time + Non-operating time.

Warranty: – Guarantee that an item will perform as specified for at least a specified time.

Yield: – The fraction of products meeting quality standards produced by the machinery or equipment.



Terms Clusters

The term clusters helps users locate different expressions that correspond to a main term. The previous pages of this Glossary contain the definition of each term as it pertains to this guideline.

FAILURE

- Failure
- Failure Analysis
- Failure Mode
- Failure Mode Analysis
- Failure Mode & Effect Analysis
- Failure Mode Effect Criticality Analysis
- Fault Tree Analysis
- Infant Mortality

LIFE

- Durability Life [Expected Life]
- Gross Operating Time

MAINTENANCE

- Corrective [Unscheduled, Unplanned, Repair] Maintenance
- Maintainability
- Maintenance
- Predictive & Preventive [Scheduled, Planned] Maintenance

MISCELLENEOUS

- Accessibility
- Allocation
- Delay Study
- Life Cycle
- Overall Equipment Effectiveness (OEE)
- Overall
- Yield

RELIABILITY

- Availability
- Redundancy
- Reliability



Reliability Growth
Accelerated Life Test
Acceptance Test [Qualification Test]
Built in Test (BIT)
Built in Test Equipment (BITE)
Testability

TIME

Actual Machine Cycle Time (Process Cycle Time)
Design Machine Cycle Time (Process Cycle Time)
Mean Cycle Between Failures (MCBF)
Mean Time Between Assists (MTBA)
Mean Time Between Failures (MTBF)
Mean Time To Repair (MTTR)
Net Operating Time
Non-operating Time
Scheduled [Planned] Downtime
Time to Repair
Total Downtime
Unscheduled [Unplanned] Downtime
Uptime