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GLOSSARY OF RELIABILITY TERMINOLOGY ASSOCIATED WITH AUTOMOTIVE ELECTRONICS

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

This glossary has been compiled to assist, by serving as a reference, in the communication between the automotive electronics engineer and the reliability engineer.

1. Scope—This compilation of terms, acronyms and symbols was drawn from usage which should be familiar to those working in automotive electronics reliability. Terms are included which are used to describe how items, materials and systems are evaluated for reliability, how they fail, how failures are modeled and how failures are prevented. Terms are also included from the disciplines of designing for reliability, testing and failure analysis as well as the general disciplines of Quality and Reliability Engineering. This glossary is intended to augment SAE J1213, Glossary of Automotive Electronic Terms.

2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1213—Glossary of Automotive Electronic Terms

SAE AE-9 1987—Automotive Electronics Reliability Handbook

2.2 Related Publications—A listing of applicable military and other organizational reference documents, from which many of these terms and definitions were drawn, is provided as a source of alternate or related definitions.

Military

MIL-STD-105D—Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-202E—Test Methods for Electronic and Electrical Component Parts

MIL-HDBK-217D—Reliability Prediction of Electronic Equipment

MIL-STD-280A—Definitions of Item Levels, Item Exchangeability, Models, and Related Terms

MIL-STD-414—Sampling Procedures and Tables for Inspection by Variables for Percent Defective

MIL-STD-756B—Reliability Models and Prediction

MIL-STD-781C—Reliability Design Qualification and Production Acceptance Tests — Experimental

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MIL-STD-790B—Reliability Assurance Program for Electronic Parts Specification
 MIL-STD-810C—Environmental Test Methods
 MIL-STD-883B—Test Methods and Procedures for Microelectronics
 MIL-STD-1313—Microelectronics Terms and Definitions
 MIL-Q-9858A—Quality Program Requirements
 AR-92—Quality Program Requirements
 MIL-S-195001—Semiconductor Devices, General Specification for
 MIC M38510D—Microcircuits, General Specifications for
 MIL-STD-470—Maintainability Program Requirements for Systems and Equipments
 MIL-STD-471A—Maintainability Verification/Demonstration/Evaluation
 MIL-HDBK-472—Maintainability Prediction
 MIL-STD-891—Contractor Parts Control and Standardization Program
 MIL-STD-701—Preferred and Guidance List of Semiconductor Devices
 MIL-STD-198A—Selection and Use of Capacitors
 MIL-STD-199B—Selection and Use of Resistors
 MIL-STD-1562—List of Standard Microcircuits
 MIL-STD-976—Certification Requirements for JAN Microcircuits

EIA

Reliability Bulletin No. 1—A General Guide for Technical Reporting of Electronic Reliability Measurement
 Reliability Bulletin No. 4A—Reliability Qualifications
 Reliability Bulletin No. 5—Equipment Reliability Specification Guideline
 Reliability Bulletin No. 10—Selection and Validation of Low Population and/or State of the Art Parts
 Reliability Bulletin No. 9—Failure Mode and Effects Analyses
 Reliability Bulletin No. 8—Equipment Burn-In
 Engineering Bulletin No. 17—User Guidelines for Quality and Reliability Assurance of LSI Components
 Engineering Bulletin No. 11—User Guidelines for Microelectronic Reliability Estimation
 JEDEC Standard No. 22—Test Methods and Procedures for Solid State Devices Used in Transportation/
 Automotive Applications

Other

ASQC 1973—Glossary and Tables for Statistical Quality Control
 ASQC Procurement Quality Control - 2nd Edition
 ANSI/ASQC A3-1978—Quality Systems Terminology
 ANSI/ASQC A2-1978—Terms, Symbols and Definitions for Acceptance Sampling
 ANSI/ASQC A1-1978—Definitions, Symbols, Formulas and Tables for Control Charts
 How to Speak Fluent Quality- National Semiconductor Co.
 RDH 376—Reliability Design Handbook - Reliability Analysis Center
 WPS-1—Analysis Techniques for Mechanical Reliability - Reliability Analysis Center
 1987 Desk Manual- Microelectronic Manufacturing and Testing
 The American Heritage Dictionary- 2nd College Edn. 1982 Houghton Mifflin Co.

3. Definitions

3.1 Accelerated Life Test—A life test under test conditions that are more severe than usual operating conditions. It is necessary that a relationship between test severity and the probability distribution of life be ascertainable.

3.2 Acceleration Factor

- a. The factor by which the failure rate can be increased by an increased environmental stress.
- b. The ratio between the times necessary to obtain the same portion of failure in two equal samples under two different sets of stress conditions, involving the same failure modes and mechanisms.

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- 3.3 Accept/reject Test**—A test, the result of which will be the action to accept or reject something, for example, an hypothesis or a batch of incoming material.
- 3.4 Acceptable Quality Level (AQL)**—The maximum percent defective which can be considered satisfactory as a process average, or the percent defect whose probability of rejection is designated by α .
- 3.5 Acceptance Number**—The largest number of defects that can occur in an acceptance sampling plan and still have the lot accepted.
- 3.6 Acceptance Sampling Plan**—An accept/reject test whose purpose is to accept or reject a lot of items or material.
- 3.7 Accessibility**—A measure of the relative ease of admission to the various areas of an item.
- 3.8 Achieved Reliability**—The reliability demonstrated at a given point in time under specified conditions of use and environment.
- 3.9 Activation Energy**
- a. The energy level at which a specific microelectronic failure mechanism becomes active (in electron volts).
 - b. The slope of the time temperature regression line in the Arrhenius equation (in electron volts).
- 3.10 Active Element**—A part that converts or controls energy, for example, transistor, diode, electron tube, relay.
- 3.11 Active Element Group**—An active element and its associated supporting (passive) parts, for example, an amplifier circuit, a relay circuit, a pump and its plumbing and fittings.
- 3.12 Aging**—The effect whereby the probability density function of strength is changed (strength is reduced) with time.
- 3.13 Allocation**—The process of assigning reliability requirements to individual units to attain the desired system reliability.
- 3.14 Alpha Particle Induced Soft Errors**—Integrated circuit memory transient errors due to emission of alpha particles during radioactive decay of uranium or thorium contamination in the IC packaging material.
- 3.15 Ambient**—Used to denote surrounding, encompassing, or local conditions. Usually applied to environments, for example, ambient temperature, ambient pressure.
- 3.16 Apportionment**—Synonym of Allocation.
- 3.17 Arithmetic Mean**—The arithmetic mean of n numbers is the sum of the n numbers, divided n .
- 3.18 Arrhenius Model**—A mathematical representation of the dependence of failure rate on absolute temperature and activation energy. The model assumes that degradation of a performance parameter is linear with time with the failure rate a function of temperature stress. The temperature dependence is taken to be the exponential function:

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$$\theta_1 = \theta_2 \exp [(E/k)(1/T_2 - 1/T_1)] \quad (\text{Eq. 1})$$

where:

θ_1 = mean time to failure at T_1

θ_2 = mean time to failure at T_2

T = junction temperature in K

E = activation energy in eV

k = Boltzman's constant ($8.617 \cdot 10^5$ eV/K)

3.19 Arrhenius Acceleration Factor—The acceleration factor F is the factor by which the time to fail can be reduced by increased temperature.

$$F = \theta_1/\theta_2 = \exp (E/k)(1/T_2 - 1/T_1) \quad (\text{Eq. 2})$$

3.20 Assessment

- a. A critical appraisal, including qualitative judgments about an item, such as importance of analysis results, design criticality and failure effect.
- b. The use of test data and/or operational service data to form estimates of population parameters and to evaluate the precision of these estimates.

3.21 Attribute—A term used to designate a method of measurement whereby units are examined by noting the presence (or absence) of some characteristic or attribute in each of the units in the group under consideration and by counting how many units do (or do not) possess it. Inspection by attributes can be of two kinds – either the unit of product is classified simply as defective or nondefective, or the number of defects in the unit of product is counted, with respect to a given requirement or set of requirements.

3.22 Attribute Testing—Testing to evaluate whether or not an item possesses a specified attribute.

3.23 Automatic Test Equipment (ATE)—Test equipment that contains provisions for automatically performing a series of pre programmed tests.

3.24 Availability (Operational Readiness)—The probability that at any point in time the system is either operating satisfactorily or ready to be placed in operation on demand when used under stated conditions.

3.25 Average—A general term. It often means arithmetic mean, but can refer to s-expected value, median, mode, or some other measure of the general location of the data values.

3.26 Average Outgoing Quality (AOQ)—The average quality of outgoing product after 100% inspection of rejected lots, with replacement by good units of all defective units found in inspection.

3.27 Average Outgoing Quality Limit (AOQL)—The maximum average outgoing quality (AOQ) for a sampling plan.

3.28 Bake-out—To subject an unsealed item to an elevated temperature to drive out moisture and unwanted gases prior to other process or sealing.

3.29 Bathtub Curve—A plot of failure rate of an item (whether repairable or not) vs. time. The failure rate initially decreases, then stays reasonably constant, then begins to rise rather rapidly. It has the shape of a bathtub. Not all items have this behavior.

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3.30 Bias

- a. The difference between the s-expected value of an estimator and the value of the true parameter.
- b. Applied voltage.

3.31 Binomial Distribution—The probability of r , or fewer successes in n independent trials, given a probability of success p in a single trial, is given by the cumulative binomial distribution:

$$\Pr(x \leq r) = F(r; p, n) = \sum_{x=0}^r \binom{n}{x} p^x (1-p)^{n-x} \quad (\text{Eq. 3})$$

3.32 Binomial Function—The probability of exactly x successes in n independent trials, given a probability of success p in a single trial, is given by the binomial probability function:

$$\binom{n}{x} p^x (1-p)^{n-x}, x = 0, 1, 2, \dots, n \quad (\text{Eq. 4})$$

$$0 \leq p \leq 1$$

3.33 Bond

- a. An interconnection which performs a permanent electrical and/or mechanical function.
- b. To join with adhesives.

3.34 Bond Lift Off—The failure mode whereby the bonded lead separates the surface to which it was attached.

3.35 Bond Strength—In wire bonding, the pull force at rupture of the bond interface.

3.36 Breadboard Model—A preliminary assembly of parts to test the feasibility of an item or principle without regard to eventual design or form. Usually refers to a small collection of electronic parts.

3.37 Burn-in—The initial operation of an item to stabilize its characteristics, and to minimize infant mortality in the field.

3.38 Capability

- a. A measure of the ability of an item to achieve mission objectives given the conditions during the mission.
- b. The spread of performance of a process in a state of statistical control; the amount of variation from common causes identified after all special causes of variation have been eliminated.

3.39 C Chart—Control chart for number of nonconformities observed in some specified inspection. The units should be alike in size and in the apparent likelihood of the existence of the nonconformity, in order that the area of opportunity for nonconformity be constant from unit to unit.

3.40 Central Line—The line on a control chart that represents the average or median value of the items being plotted. It is shown as a solid line.

3.41 Checkout—Tests or observations on an item to determine its condition or status.

3.42 Coefficient Of Variation—The standard deviation divided by the mean, multiplied by 100 and expressed as a percentage.

3.43 Complexity Level—A measure of the number of active elements required to perform a specific system function.

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3.44 Component—A self-contained combination of parts, subassemblies, or assemblies which perform a distinctive function in the overall operation of an equipment. Often used interchangeably with (electronic) part.

3.45 Confidence—A specialized statistical term referring to the reliance to be placed in an assertion about the value of a parameter of a probability distribution.

3.46 Confidence Coefficient

- a. A measure of assurance that a statement based upon statistical data is correct.
- b. The probability that an unknown parameter lies within a stated interval or is greater or less than some stated value.

3.47 Confidence Interval—The interval within which it is asserted that the parameter of a probability distribution lies.

3.48 Confidence Level

$$\text{Equals } 1 - \alpha \quad (\text{Eq. 5})$$

where:

a = the risk (%)

3.49 Confidence Limit—A bound of a confidence interval.

3.50 Consistency—A statistical term relating to the behavior of an estimator as the sample size becomes very large. An estimator is consistent if it converges to the population value as the sample size becomes large.

3.51 Constant Failure Rate

- a. A term characterizing the instantaneous failure rate in the middle, or "useful life" period of the Bathtub Curve model of item life.
- b. A term characterizing the hazard rate, $h(t)$, of an item having an exponential reliability function.

3.52 Contamination—A general term used to describe an unwanted material that adversely affects the physical or electrical characteristics of an item.

3.53 Continuous Sampling Plan—In acceptance sampling, a plan intended for application to a continuous flow of individual units of product that involves acceptance or rejection on a unit-by-unit inspection and sampling. Continuous sampling plans are usually characterized by requiring that each period of 100% inspection be continued until a specified number of consecutively inspected units are found clear of defects.

3.54 Corrective Action—A documented design, material or process change to correct the true cause of a failure. Part replacement with a like item does not constitute appropriate corrective action. Rather, the action should make it impossible for that failure to happen again.

3.55 Correlation—A form statistical dependence between two variables. Unless stated otherwise, linear correlation is implied.

3.56 Correlation Coefficient—A number between -1 and $+1$, which indicates the degree of linear relationship between two sets of numbers. Coefficients of -1 and $+1$ represent perfect linear agreement between two variables, while a coefficient of zero implies none.

3.57 Corrode—To dissolve or wear away gradually, especially by chemical action

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- 3.58 Corrosion**—The deterioration of a substance (usually a metal) because of a reaction with its environment, or with a corroding agent.
- 3.59 Cosmetic Defect**—A variation from the conventional appearance of an item such as a slight change in its color, not necessarily detrimental to service performance.
- 3.60 Cost-Effectiveness**—A measure of the value received for the resources expended.
- 3.61 Crack**—Evidence of a full or partial break without separation of parts.
- 3.62 Craze**—A network of fine cracks in the surface.
- 3.63 Creep**
- a. Elongation or fracture resulting from loads sustained over relatively long time at high temperatures.
 - b. The dimensional change with time of a material under load.
- 3.64 Criticality**—A relative measure of the consequences of a failure.
- 3.65 Criticality Analysis**—A procedure by which each potential failure mode is evaluated and ranked according to the combined influences of severity and probability of occurrence.
- 3.66 Cumulative Distribution Function (CDF)**—The probability that the random variable takes on any value less than or equal to a value x , that is,
- $$\text{Cdf}(x) = \text{Pr}(X \leq x) \quad (\text{Eq. 6})$$
- The unreliability function with regard to failure
- $$F(t) = \text{Pr}(T \leq t) \quad (\text{Eq. 7})$$
- 3.67 Cut Set**—In a Fault Tree, any basic event or combination of basic events whose occurrence will cause the top event to occur.
- 3.68 Debugging**—The period of "shakedown operation" of a finished equipment performed prior to placing it in use. During this period, defective parts and workmanship errors are corrected under test conditions that closely simulate field operation.
- 3.69 Decap**—To de-encapsulate. To remove the cover or plastic encapsulant on an item.
- 3.70 Decreasing Failure Rate**
- a. A term characterizing the instantaneous failure rate in the first or "infant mortality" period of the Bathtub Curve model or product life.
 - b. A term characterizing the hazard rate $h(t)$ of an item having a Weibull reliability function with slope $B < 1$.
- 3.71 Defect**—A deviation of an item from some ideal state. The ideal state is usually given in a formal specification.
- 3.72 Defect, Critical**—A defect that could result in hazardous or unsafe conditions for individuals using, maintaining or depending on the item.
- 3.73 Defective**—A unit of product which contains one or more defects.
- 3.74 Degradation**—A gradual deterioration in performance as a function of time.

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- 3.75 Delta Limits**—The difference between initial and final readings usually associated with the difference between the zero time readings on a life test and the final readings. Determine how much parameters shift during the test.
- 3.76 Demonstrated**—That which has been proven by the use of concrete evidence gathered under specified conditions.
- 3.77 Dependability**—A measure of the item operating condition at one or more points during the mission, including the effects of Reliability, Maintainability and Survivability, given the item condition(s) at the start of the mission. It may be stated as the probability that an item will (1) enter or occupy any one of its required operational modes during a specified mission and (2) perform the functions associated with those operational modes.
- 3.78 Derating**—The intentional reduction of stress/strength ratio in the application of an item, usually for the purpose of reducing the occurrence of stress related failures.
- 3.79 Design Adequacy**—The probability that the system will satisfy effectiveness requirements, given that the system design satisfied the design specification.
- 3.80 Device**—Any subdivision of a system; synonym for ITEM.
- 3.81 Discrimination Ratio**—A measure of the distance between two specific points of the operating characteristic curve which are used to define the acceptance sampling plan.
- 3.82 Dissociation**—The breakdown of a substance into two or more constituents.
- 3.83 Distribution**—Generally short for Cumulative Distribution Function.
- 3.84 Downtime**—The total time during which the system is not in condition to perform its intended function.
- 3.85 Durability**—The probability that an item will operate as specified under stated conditions without a wearout failure; a special case of reliability.
- 3.86 Duty Cycle**—The ratio of the time "on" of a device or system divided by the total cycle time. For a device that normally runs intermittently rather than continuously, the amount of time a device operates as opposed to its idle time.
- 3.87 Early Failure Period**—That period of life, after assembly, in which failures occur at an initially high rate because of the presence of defective parts and workmanship defects.
- 3.88 EDX Spectrometer**—Generally used with a scanning electron microscope (SEM) to provide elemental analysis of X-rays generated on the region being hit by the electron beam.
- 3.89 Effectiveness**—The capability of the system or device to perform its function.
- 3.90 Efficiency**—A statistical term relating to the dispersion in values of an ESTIMATOR. It is between zero and one.
- 3.91 Electromagnetic Compatibility (EMC)**—"The"capability of electronic equipment to function in the intended electromagnetic environment at designed levels of efficiency.
- 3.92 Electromigration**—Dendritic or filamentary growth of a metal (for example, silver) in an electric field.
- 3.93 Emission Spectrograph**—An instrument which identifies the presence of elements by burning the sample in an air plasma and analyzing the resultant optical spectrum.

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- 3.94 Engineering, Human**—The science of studying the man-machine relation in order to minimize the effects of human error and fatigue and thereby provide a more reliable operating system.
- 3.95 Engineering, Reliability**—The science of including those factors in the basic design which will assure the required degree of reliability.
- 3.96 Environment**—The aggregate of all external conditions and influences affecting the life and development of the product.
- 3.97 Electrical Overstress (EOS)**—The electrical stressing of electronic components beyond specifications.
- 3.98 Electrostatic Discharge (ESD)**—The transfer of electric charge between bodies at different electrostatic potentials caused by direct contact or by an electrostatic field.
- 3.99 Estimator**—A statistic, which is derived from a sample, used to infer a value of a parameter of an assumed distribution model.
- 3.100 Expected Value**—The mean or average, defined as: If x is a random variable and $F(x)$ is its CDF

$$E(x) = \int x df(x) \quad (\text{Eq. 8})$$

where the integration is over all x .

For continuous variables with a pdf, this reduces to

$$E(x) = \int x \text{ pdf}(x) dx \quad (\text{Eq. 9})$$

For discrete random variables with a pmf, this reduces to

$$E(x) = \sum x_n p(x_n) \quad (\text{Eq. 10})$$

where the sum is over all n .

- 3.101 Exponential Distribution**—The probability density function

$$f(t) = \lambda \exp(-\lambda t) \quad (\text{Eq. 11})$$

where λ , the failure rate is constant

- 3.102 Exponential Model**—In reliability engineering, a model based on the assumption that times t between successive failures are described by the exponential distribution.
- 3.103 Evaluation**—A broad term used to encompass prediction, measurement and demonstration.
- 3.104 Extreme Value Distribution**—The asymptotic distribution of the smallest extreme from a statistical distribution; used to model capacitor breakdown voltage, time to failure of corrosion, etc. The pdf is:

$$p(x) = \exp(x) \exp[-\exp(x)] \quad (\text{Eq. 12})$$

- 3.105 Eyring Model**—An accelerated life test model in which failure rate is related to temperature. Given by:

$$\lambda = T \exp(A - B/T) \quad (\text{Eq. 13})$$

- 3.106 Failure**—The termination of the ability of an item to perform its required function.

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- 3.107 Failure Analysis**—The identification of the failure mode, the failure mechanism and the cause. Often includes physical dissection.
- 3.108 Failure, Catastrophic**—A sudden change in the operating characteristics of an item resulting in a complete loss of useful performance.
- 3.109 Failure Degradation**—A failure occurs as a result of a gradual or partial change in the operating characteristics of an item.
- 3.110 Failure Effect**—The consequences a failure mode has on the operation, function or status of an item.
- 3.111 Failure, Incipient**—A degradation failure which is just beginning to exist.
- 3.112 Failure, Induced**—A failure caused by a physical condition external to the failed item.
- 3.113 Failure, Infant**—A failure that occurs during the early life of an item.
- 3.114 Failure, Inherent**—A failure basically caused by a physical condition or phenomenon internal to the failed item.
- 3.115 Failure, Initial**—The first failure to occur in use.
- 3.116 Failure, Latent**—A malfunction that occurs as a result of a previous exposure to a condition that did not result in an immediately detectable failure.
- 3.117 Failure Mechanism**—The mechanical, chemical or other process that results in a failure.
- 3.118 Failure Mode**—The effect or manner by which a failure is observed. Generally describes the way the failure occurs.
- 3.119 Failure Modes And Effects Analysis (FMEA)**—A systematic, organized procedure for evaluating potential failures in an operating system.
- 3.120 Failure Modes, Effects And Criticality Analysis (FMECA)**—An analysis of possible modes of failure, their causes, effects, their criticalities and expected frequencies of occurrence.
- 3.121 Failure, Nonrelevant**—A failure not applicable to the computation or reliability.
- 3.122 Failure, Primary**—A failure whose occurrence is not caused by other failures.
- 3.123 Failure, Random**—A failure whose occurrence is not predictable in an absolute sense but is predictable in a probabilistic sense.
- 3.124 Failure Rate**
- a. The conditional probability that an item will fail just after time t , given the item has not failed up to time t .
 - b. The number of failures of an item per unit measure of life (cycles, time, miles, events, etc.) as applicable for the item.
- 3.125 Failure, Relevant**—A failure attributable to a deficiency of design, manufacture or materials of the failed device, applicable to the computation of reliability.
- 3.126 Failure, Secondary**—A failure caused directly or indirectly by the failure of another item.

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- 3.127 Failure, Wearout**—A failure whose time of occurrence is governed by rapidly increasing failure rate.
- 3.128 Fatigue**—Cracking or fracture from cyclic loads.
- 3.129 Fault**—An attribute which adversely affects the reliability of a device.
- 3.130 Fault Tree Analysis (FTA)**—A method of reliability analysis in which a logical block diagram is used to indicate contributing lower level events.
- 3.131 Fit**—A contraction of Failure unIT, having a value of failures per 10^9 component-hours.
- 3.132 Forced Defect**—A failure induced by stress testing.
- 3.133 Foreign Material**—The presence of an object or material which comes from some source external to the part or system.
- 3.134 Freedom, Degree of**—The number of observations that are free to vary at random, regardless of the restrictions imposed by the mathematics describing the statistic.
- 3.135 Functional Failure**—A failure whereby a device does not perform its intended function when the inputs or controls are correct.
- 3.136 Gamma Distribution**—An important distribution in statistical queuing theory. Given by:

$$\text{pdf}(x) = \frac{\lambda(\lambda t)^{k-1} e^{-\lambda t}}{\Gamma(k)} \quad (\text{Eq. 14})$$

where:

$$\Gamma(k) = \int_0^{\infty} u^{k-1} e^{-u} du$$

$\lambda, \beta, t > 0$

- 3.137 Gaussian Distribution (See Normal Distribution)**—A 2-parameter distribution with

$$\text{pdf}(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{x-u}{\sigma}\right)^2\right] \quad (\text{Eq. 15})$$

- 3.138 Geometric Mean**—The geometric mean of n numbers is the n th root of their product.
- 3.139 Glass Transition Temperature**—The temperature at which an amorphous polymer changes from a hard and relatively brittle condition to a viscous or rubbery condition.
- 3.140 Go, No-Go**—The result of a test of an attribute. It is either good or bad.
- 3.141 Goodness Of Fit**—A statistical term that quantifies how likely a sample was to have come from a given probability distribution.
- 3.142 Hazard Rate $h(t)$**
- At a particular time, the rate of change of the number of items that have failed divided by the number of items surviving.
 - Represents the probability that an item still functioning at time t will fail in the interval $(t, t+\Delta t)$, where Δt is an infinitesimal time increment. Hazard rate is synonymous with conditional failure rate or instantaneous failure rate.

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$$h(t) = \lim_{t \rightarrow 0} \frac{R(t) - R(t + \Delta t)}{t R(t)} \quad (\text{Eq. 16})$$

$$h(t) = f(t)/R(t) \quad (\text{Eq. 17})$$

- 3.143 Hermeticity**—The effectiveness of the seal of microelectronic and semiconductor devices with designed internal cavities.
- 3.144 Homogeneous**—Of the same or similar nature. Uniform in structure or composition.
- 3.145 Human Factors**—A body of scientific facts about human characteristics. The term covers all biomedical and psychosocial considerations. It includes but is not limited to principles and applications in the areas of human engineering, personnel selection, training, life support, job performance aids and performance evaluation.
- 3.146 Hypothesis, Null**—An hypothesis that there is no difference between some characteristics of the parent populations of several different samples, that is, that the samples come from similar populations. A conjecture about the true state of nature, that if true, will only rarely be rejected as the outcome of an experiment or measurement.
- 3.147 Increasing Failure Rate**
- A term characterizing the instantaneous failure rate in the third or "wearout" period of the Bathtub Curve model of product life.
 - A term characterizing the hazard rate $h(t)$ of an item having a Normal reliability function, for instance.
- 3.148 Infant Mortality**—Premature catastrophic failures occurring at a much greater rate than during the useful life period prior to the onset of substantial wearout.
- 3.149 Inspection**—The examination and testing of supplies and services (including, when appropriate, raw materials, components and intermediate assemblies) to determine whether they conform to specified requirements.
- 3.150 Inspection By Attributes**—Inspection whereby either the unit of product or characteristic thereof is classified simply as defective or nondefective, or the number of defects in the unit or product is counted with respect to a given requirement.
- 3.151 Inspection By Variables**—Inspection wherein certain quality characteristics of a sample are evaluated with respect to a continuous numerical scale and expressed as precise points along this scale. Variable inspections record the degree of conformance of the unit with specified requirements for the quality characteristics involved.
- 3.152 Inspection Level**—An indication of the relative size of the sample to the size of the lot.
- 3.153 Inspection Lot**—A collection of units of product bearing identification and treated as a unique entity from which a sample is to be taken and inspected to determine conformance with the acceptability criteria.
- 3.154 Item**—An all-inclusive term, to include assemblies, subassemblies accessories, parts, equipment and services, applied to what is being discussed.
- 3.155 Life Test**—A test, usually of several items, made for the purpose of estimating some characteristic(s) of the probability distribution of life.

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- 3.156 Log Normal Distribution**—The model of a random variable whose logarithm follows the Normal function with parameters μ and σ . It is a life model for a process whose value results from the multiplication of many small errors. Its pdf-

$$f(x;\mu,\sigma) = 1/(\sigma x \sqrt{2\pi}) \exp [-1/2\sigma^2(\ln x - \mu)^2] \quad (\text{Eq. 18})$$

$$x > 0$$

$$\sigma > 0$$

$$-\infty < \mu < \infty$$

- 3.157 Longevity**—Length of useful life of a product to its ultimate wearout requiring complete rehabilitation. This is a term generally applied in the definition of a safe, useful life for an equipment or system under the conditions of storage and use to which it will be exposed during its lifetime.
- 3.158 Lot**—A group of units from a particular device type submitted each time for inspection and/or testing is called a lot.
- 3.159 Lot Quality**—The true fraction defective in a lot.
- 3.160 Lot Reject Rate (LRR)**—The lot reject rate is the percentage of lots rejected from the lots evaluated.
- 3.161 Lot Tolerance Percent Defective (LTPD)**—The percent defective which is to be accepted a minimum or arbitrary fraction of the time, or that percent defective whose probability of rejection is designated by β .
- 3.162 Maintainability**—A characteristic of design and installation which is expressed as the probability that an item will be retained in or restored to a specified condition within a given period of time, when the maintenance is performed in accordance with prescribed procedures and resources.
- 3.163 Maintenance, Preventive**—The maintenance performed in an attempt to retain an item in a specified condition by providing systematic inspection, detection and prevention of incipient failure.
- 3.164 Margin Testing**—Testing in which item environments such as line voltage or temperature are changed to reversibly worsen the performance. Its purpose is to find how much margin is left in the item for its degradation.
- 3.165 Mean**
- The expected value of a random variable.
 - The first moment of a probability distribution about its origin. As specifically defined and modified, for example, the arithmetic mean (sums), the geometric mean (products), the harmonic mean (reciprocals), logarithmic mean, etc.

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3.166 Mean Life (θ)—The arithmetic average of lifetimes of all items considered.

$$\theta = \int_0^T R(t) dt = \int_0^T t p df(t) dt \quad (\text{Eq. 19})$$

where:

$R(t)$ = the s-reliability of the item

T = the interval over which the mean life is desired, usually the useful life

3.167 Mean-Life-Between-Failures—This concept is the same as Mean Life except that it is for repaired items and is the mean up-time of the item. The formula is the same as for Mean Life except that $R(t)$ is interpreted as the distribution of up-times.

3.168 Mean Time Between Failures (MTBF)—For a particular interval, the total functioning life of a population of an item divided by the total number of failures within the population during the measurement interval. The definition holds for time, cycles, miles, events or other measure of life units. A basic measure of reliability of repairable items.

3.169 Mean-Time-Between-Maintenance(MTBM)—The mean of the distribution of the time intervals between maintenance actions (either preventive, corrective or both).

3.170 Mean-Time-To-Failure(MTTF)—For nonrepaired items, the mean life.

3.171 Mean-Time-To-Repair(MTTR)—The total corrective maintenance time divided by the total number of corrective maintenance actions during a given period of time.

$$\text{MTTR} = \int_0^T G(t) dt \quad (\text{Eq. 20})$$

where:

$G(t)$ = Cdf of repair time

T = Maximum allowed repair time

3.172 Median—The median of a distribution of one random variable X of the discrete or continuous type is a value of x such that $\Pr(X \leq x) = 1/2$ and $\Pr(X \geq x) = 1/2$, the middle value.

3.173 Mission—The objective or task, together with the purpose, which clearly indicates the action to be taken.

3.174 Mission Reliability—The probability of success of an item to perform its required function for the duration of its intended mission.

3.175 Mission Profile—The mission profile describes the events and conditions, including times and time spans, associated with a specific operational usage of an item. It is one segment of the operational cycle.

3.176 Mode—The mode of a distribution of one random variable X of discrete or continuous type is a value of x that maximizes the pdf $f(x)$.

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3.177 Model—A mathematical representation of a process. In Reliability there are two primary modeling concepts.

- a. A statistical function describing a life characteristic.
- b. A description of the reliability connectivity of the parts of a system.

3.178 Model, Parallel—A representation of the connection of the parts in a system such that the failure of all parts so connected is required for failure of that section of the system.

3.179 Model, Series—A representation of the connection of parts of a system such that failure of any part so connected will cause failure of that section of the system.

3.180 Module—An item which is packaged and is part of the next higher level of assembly.

3.181 Normal Distribution (See Gaussian)—The most prominent continuous distribution in statistics, frequently referred to as the Gaussian or bell-shaped distribution. Its density function is

$$f(x; \mu, \sigma) = \frac{1}{\sigma \sqrt{2\pi}} \exp -\frac{(x - \mu)^2}{2\sigma^2}, -\infty < x < \infty, -\infty < \mu < \infty, \sigma > 0 \quad (\text{Eq. 21})$$

with mean μ and variance σ . The theoretical justification for the normal distribution lies in the central-limit theorem, which shows that under very broad conditions the distribution of the average of n independent observations from any distribution approaches a normal distribution as n becomes large.

3.182 Normal Variable—A random variable that is normally distributed. In situations where the random variable represents the total effect of many "small" independent causes, each with mutually independent errors, the central limit theorem leads to the prospect the variable will be normally distributed.

3.183 Operating Characteristic (OC Curve)—A curve showing the relation between the probability of acceptance and either lot quality or process quality, whichever is applicable.

3.184 Operational Readiness—The probability that, at any point in time, the system is either operating satisfactorily or ready to be placed in operation on demand when used under stated conditions, including stated allowable warning time. Thus, total calendar time is the basis for computation of operational readiness.

3.185 Overcoat—A thin film of insulating material over micro-circuit elements to provide mechanical protection or prevention of contamination.

3.186 Overstress—A condition wherein the severity level of operation are more than usual or more than the specification.

3.187 Part

- a. An item that will not be disassembled for maintenance.
- b. The least subdivision of a system.
- c. An item which cannot ordinarily be disassembled without being destroyed.

3.188 Parts Per Million (PPM)—Describing fractional defective, PPM is obtained by multiplying percent defective by 10 000; for example, 0.01% = 100 ppm.

3.189 Passive Element—An element that is not active, that is, does not control energy; for example, a resistor, capacitor or an inductor.

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3.190 Percentage Defective—That proportion of a lot which is defective. This is the figure of merit in the population domain which characterizes quality control measurements and differentiates it from reliability.

3.191 Physiochemical Instability—Change from an initial material bulk property, such as strength resiliency, volume, composition, etc., as a result of age, pressure, temperature, etc.

3.192 Pin Hole—A microscopic hole through an insulating (glass) layer. A defect.

3.193 Population—The totality of the set of items, units, measurements, etc., real or conceptual, that is under consideration.

3.194 Probability

- a. Classical—If an event can occur in N equally likely and different ways, and if n of these ways have an attribute A , then the probability of the occurrence of A , denoted $\Pr(A)$ is defined as n/N .
- b. Frequency—If an experiment is conducted N times, and outcome A occurs n times, then the limit of n/N as N becomes large, is defined as the probability of A , denoted as $\Pr(A)$.
- c. Subjective—The probability $\Pr(A)$ is a measure of the degree of belief one holds in a specified proposition A .

3.195 Probability Density Function—A continuous $f(x)$ is a pdf if $f(x) \geq 0$, $-\infty < x < \infty$

$$\int_{-\infty}^{\infty} f(x) dx = 1 \quad (\text{Eq. 22})$$

3.196 Probability Mass Function—A discrete $f(x)$ is a pmf if $f(x) = 0$ for all x , except for a finite countable set of values of x for which $f(x) > 0$, and

$$\sum_x f(x) = 1, \text{ for all } x \text{ such that } f(x) > 0 \quad (\text{Eq. 23})$$

3.197 Probability Function—The probability function is defined in terms of its pdf or pmf. If there is a pdf, $F(x)$ is continuous and is defined by

$$F(x) = \int_{-\infty}^x f(x) dx \quad (\text{Eq. 24})$$

If there is a pmf, $F(x)$ is discrete and is defined by

$$F(x) = \sum_x f(x) \quad (\text{Eq. 25})$$

3.198 Probability Distribution—A mathematical function with specific properties which describes the probability that a random variable will take on a value or a set of values. If the random variable is continuous and well behaved enough, there will be a pdf. If the random variable is discrete, there will be a pmf.

3.199 Probability Paper—Graph paper constructed so that cumulative distribution curves plot as straight lines. Paper is available for normal, log-normal, Weibull, and several other distributions.

3.200 Process Average (PA)—The total number of units rejected over an extended period of time divided by the total number of units produced over the same period of time.

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- 3.201 Pull Test**—A test to determine the bond strength of a lead to an interconnecting surface, usually perpendicular to the surface, by pulling to failure
- 3.202 Purple Plague**—One of several gold-aluminum compounds formed when bonding gold to aluminum and activated by exposure to moisture and high temperature, resulting in brittle, time based bond failure.
- 3.203 Qualification**—The entire process by which products are obtained from manufacturers or distributors, examined and tested, and then identified on a Qualified Products List.
- 3.204 Quality**
- a. The composite of all characteristics or attributes, including performance, of an item.
 - b. A measure of the degree to which an item conforms to applicable specification and workmanship standards.
 - c. A property which refers to the tendency of an item to be made to specific specifications or the customer's express needs, or both. See current publications by Juran, Deming, Crosby, et al.
- 3.205 Quality Assurance**—A system of activities whose purpose it is to provide assurance that the overall quality control job is, in fact, being done effectively.
- 3.206 Quality Characteristics**—Those properties of an item or process which can be measured, reviewed or observed and which are identified in the drawings, specifications or constructural requirements. Reliability becomes a quality characteristic when so defined.
- 3.207 Quality Control (QC)**—The overall system of activities whose purpose is to provide a quality of product or service which meets the needs of users; also, the use of such a system.
- 3.208 Randomness**—The occurrence of an event in accordance with the laws of chance.
- 3.209 Random Event**—The occurrence of an event affected by chance alone. For example, heads or tails on a flipped coin occurs at random.
- 3.210 Random Sample**—As commonly used in acceptance sampling theory, the process of selecting sample units in such a manner that all units under consideration have the same probability of being selected.
- 3.211 Random Variable (r.v.)**—A function defined on a sample space, or a transformation which associates a real number with each point in a sample space.
- 3.212 Redundancy**—The existence of more than one means for accomplishing a given function.
- 3.213 Redundancy, Active**—A type of redundancy where all items in the group are operating simultaneously.
- 3.214 Redundancy, Standby**—A type of redundancy where the alternative means of performing the function is inoperative until needed and is switched on upon failure of the primary means of performing the function.
- 3.215 Regression Analysis**—A mathematical means to fit an assumed model to data containing errors by minimizing the sum of squared deviations from the fit.
- 3.216 Reliability**—The probability that a device will function without failure over a specified time period or amount of usage at stated conditions.
- 3.217 Reliability Growth**—The increase in reliability as a result of the effort, the resource commitment to improve design, purchasing, production, and inspection procedures.

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- 3.218 Reliability, Inherent**—The potential reliability of an item present in its design.
- 3.219 Reliability, Intrinsic**—The probability that a device will perform its specified function determined on the basis of a statistical analysis of the failure rates and other characteristics of the parts and components which comprise the device.
- 3.220 Reliability, Predicted**—The process of quantitatively assessing whether a proposed or actual equipment design will meet a specified reliability requirement.
- 3.221 Reliability With Repair**—The reliability that can be achieved when preventive maintenance is allowed.
- 3.222 Repairability**—The probability that a failed system will be restored to operable condition in a specified active repair time.
- 3.223 Risk**—The probability of rendering a wrong decision based on inadequate data or analysis. The probability of an undesired outcome.
- 3.224 Risk, Consumer's (b)**—For a given sampling plan, the probability of acceptance for a designated numerical value of relatively poor submitted quality.
- 3.225 Risk, Producer's (a)**—For a given sampling plan, the probability of rejection for a designated numerical value of relatively good submitted quality.
- 3.226 Risk Priority Number**—In an FMEA, the product of the Occurrence Ranking, the Severity Ranking and the Detection Ranking
- 3.227 Safety**—The conservation of human life and its effectiveness, and the prevention of damage to items, consistent with mission requirements.
- 3.228 Sample**—A random selection of units from a lot, usually made for the purpose of evaluating the characteristics of the lot.
- 3.229 Scanning Electron Microscope (SEM)**—An instrument which provides a visual image of the surface of an item. It scans an electron beam over the surface of a sample held in a vacuum and measures any of several resultant particle counts or energies. Provides depth of field and resolution significantly exceeding light counts microscopy and may be used at magnifications exceeding 50 000 times.
- 3.230 Screening**—The process of performing 100% inspection, or exposure to stress, on product lots and removing the defective units from the lots.
- 3.231 Screening Test**—A test or combination of tests intended to remove unsatisfactory items or those likely to exhibit early failures.
- 3.232 Serviceability**—A measure of the degree to which servicing of an item will be accomplished within a given time under specified conditions.
- 3.233 Servicing**—The replenishment of consumables needed to keep an item in operating condition, but not including any other preventive maintenance or any corrective maintenance.
- 3.234 Severity Level**—A general term implying the degree to which an environment will cause damage or shorten life, or both.
- 3.235 Shear Test**—Test of the shear strength of various attachments, for example, die attach, wire bond, wire weld, contact weld, etc. by application of force in the plane.

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- 3.236 Short Circuit**—An abnormal connection of relatively low impedance, whether made intentionally or accidentally between two points of different electric potential.
- 3.237 Significance**—Results that show deviations between an hypothesis and the observations used as a test of the hypothesis greater than can be explained by random variation or chance alone, are called statistically significant.
- 3.238 Significance Level**—The probability of rejecting the null hypothesis when it is actually true.
- 3.239 Sneak Circuit**—An unexpected path or logic flow within a system which, under certain conditions, can initiate an undesired function or inhibit a desired function.
- 3.240 Soft Error**—Temporary memory content error due to intrusion of an alpha particle, for instance.
- 3.241 Standard Deviation**—The square root of the variance.
- 3.242 Statistic**—A value calculated from a sample which is used to estimate some characteristic of a population.
- 3.243 Statistical Control**—Control of a process by statistical methods. A process is said to be in a state of statistical control if the variations among the sampling results from it can be attributed to a stable pattern of chance causes.
- 3.244 Statistical Model**—A probability distribution as a representation of time to failure.
- 3.245 Step Stress Test**—A test consisting of several stress levels applied sequentially for periods of equal duration to a sample. During each period, a stated stress level is applied, and the stress level is increased from one step to the next.
- 3.246 Storage Life (Shelf Life)**—The length of time an item can be stored under specified conditions and still meet specified requirements.
- 3.247 Stress**—A general and ambiguous term used as an extension of its meaning in mechanics as that which could cause failure. It does not distinguish between those things which cause permanent damage (deterioration) and those things which do not.
- 3.248 Stress Relief**—A design means to minimize the effects of stress, for example, a cable clamp or a conformal coat.
- 3.249 Stress, Component**—The stresses on component parts during testing, assembly or use which affect the failure rate and hence the reliability of the parts. Voltage, power temperature and thermal environmental stress are included.
- 3.250 Subassembly**—A replaceable combination of parts which is an element of an assembly.
- 3.251 Subsystem**—A major subdivision of a system which performs a specified function in the overall operation of a system.
- 3.252 Survivability**—The measure of the degree to which an item will withstand hostile man-made environment and not suffer abortive impairment of its ability to accomplish its designated mission.
- 3.253 Survivor Function $S_f(t)$** —The Reliability distribution function. The probability that an item will survive to time t .

$$S_f(t) = \Pr(T > t) \quad t > 0, T \text{ a r.v.} \quad (\text{Eq. 26})$$

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- 3.254 Suspended Item**—An item removed from test prior to failure.
- 3.255 System**—A combination of complete operation equipments, assemblies, components, parts or accessories interconnected to perform a specific operational function.
- 3.256 System Effectiveness**—A measure of the degree to which an item can be expected to achieve a set of specific mission requirements and which may be expressed as a function of availability, dependability and capability.
- 3.257 Temperature Cycle**—A stress test where the temperature of the medium (usually air) surrounding the test items is varied in a predetermined manner over the temperature range in such a way that the internal item temperature is kept at a fixed minimal increment from the medium temperature.
- 3.258 Test To Failure**—The practice of inducing increased electrical and mechanical stresses in order to determine the maximum capability of a device so that conservative use in subsequent applications will, thereby, increase its life through the derating determined by these tests.
- 3.259 Thermal Endurance**—The time at a selected temperature for a material or system of materials to deteriorate to some predetermined level of electrical, mechanical or chemical performance under prescribed conditions of test.
- 3.260 Thermal Fatigue**—The failure of materials subjected to alternating heating and cooling.
- 3.261 Thermal Shock**—A stress test in which the temperature of the medium surrounding the test items is varied as rapidly as possible in order to create large, cyclic temperature gradients in the test items.
- 3.262 Time, Active**—That time during which an item is operational.
- 3.263 Time Down**—That element of time during which the item is not in condition to perform its intended function.
- 3.264 Time Mission**—That element of uptime during which the item is performing its designated mission.
- 3.265 Time, Up**—That element of active time during which an item is either alert, reacting or performing a mission.
- 3.266 Variable**—In testing, the characteristic under examination which can have many values.
- 3.267 Variance**—The average of the squares of the deviations of individual values from their average. It is a measure of dispersion of a random variable. The second moment about the mean of a pdf given by
- $$\text{var} = \int_{-\infty}^{\infty} (x - \mu)^2 f(x) dx \quad (\text{Eq. 27})$$
- 3.268 Warranty**—A written guarantee of the performance of a product in which the maker for a specific period of time or other variable will be responsible for the repair or replacement of defective items.
- 3.269 Wear**—The mechanical removal of surface material by adhesion or abrasion.
- 3.270 Wearout**—The process of attrition which results in an increase of hazard rate with increasing age (cycles, miles, events or time) as applicable for the item.

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3.271 Weibull Distribution—A general distribution, which is suitable for describing the life characteristic of a large group of problems. The general expression for the Weibull cumulative distribution function is defined, for $F(t=0)=0$ as

$$F(t) = 1 - e^{-\left(\frac{t}{\theta}\right)^\beta} \quad (\text{Eq. 28})$$

β = Weibull Slope—The shape parameter of the distribution and equal to the slope of the line drawn through the failure data plotted on Weibull probability paper.

θ = Characteristic Life—The scale parameter of the distribution and always equal to the life at 63.2% cumulative failure.

3.272 X Chart—Control chart for averages \bar{X} of values in a subgroup.

3.273 X-Ray Spectrometer—Spectrographic analysis to characterize elements which are present.

3.274 Yield—Elongation or fracture resulting from a single application of load in a relatively short period of time.

4. Acronyms. Abbreviations And Symbols

AGREE	Advisory Group on Reliability of Electronic Equipment
AOQ	Average Outgoing Quality
AOQL	Average Outgoing Quality Limit
AQL	Acceptance Quality Level
ATE	Automatic Test Equipment
BITE	Built-In Test Equipment
Cdf	Cumulative Distribution Function
CFR	Constant Failure Rate
COO	Cost of Ownership
C_p	Process Potential Index
C_{pk}	Process Performance for Two-Sided Spec Limits
DECAP	De-encapsulation
DFR	Declining Failure Rate
EDX	Energy Dispersive X-Ray
EDS	Energy Dispersive Spectrometer
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EOM	Ease of Maintenance
EOS	Electrical Overstress
ESD	Electrostatic Discharge
ESS	Environmental Stress Screening
FAR	Failure Analysis Request/Report
FIT	Failure Unit
FMA	Failure Modes Analysis
FMEA	Failure Modes and Effects Analysis
FMECA	Failure Modes and Effects Criticality Analysis
FRACAS	Failure Reporting, Analysis and Corrective Action System
FTA	Fault Tree Analysis
HAST	Highly Accelerated Stress Test
$h(t)$	Hazard Function
IFR	Increasing Failure
JAN	Joint Army
LCC	Life Cycle Cost

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LSC	Logistic Support Cost
LTPD	Lot Tolerance Percent Defective
MRB	Material Review Board
MTBF	Mean Time Between Failure
MTBM	Mean Time Between Maintenance
MTTF	Mean Time to Failure
MTTR	Mean Time to Repair
NPF	No Problem Found
NTF	No Trouble Found
OC	Operating Characteristic (Curve)
ORLA	Optimum Repair Level Analysis
PA	Product Assurance / Process Average
PDA	Process Defect Average
pdf	Probability Density Function
pmf	Probability Mass Function
PPL	Preferred arts
PPM	Parts Per Million
PRST	Probability Ratio Sequential Test
QA	Quality Assurance
QC	Quality Control
QPL	Qualified Products List
R	Reliability
RAC	Reliability Analysis Center
RPM	Reliability Planning and Management
r.v.	Random Variable
s	Sample Standard Deviation
s-	Statistical (Prefix)
SCA	Sneak Circuit Analysis
SEM	Scanning Electron Microscope
Sf(t)	Survivor Function
SPC	Statistical Process Control
TNI	Trouble Not Identified
z(t)	Hazard Function
α	Producer's Risk
β	Weibull Slope, Consumer's Risk
λ	Failure Rate
μ	Mean
θ	Mean Life
σ	Standard Deviation

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Rationale—Not applicable.

Relationship of SAE Standard to ISO Standard—Not applicable.

Application—This compilation of terms, acronyms and symbols was drawn from usage which should be familiar to those working in automotive electronics reliability. Terms are included which are used to describe how items, materials and systems are evaluated for reliability, how they fail, how failures are modeled and how failures are prevented. Terms are also included from the disciplines of designing for reliability, testing and failure analysis as well as the general disciplines of Quality and Reliability Engineering. This glossary is intended to augment SAE J1213, Glossary of Automotive Electronic Terms.

Reference Section

SAE J1213—Glossary of Automotive Electronic Terms

Military

MIL-STD-105D—Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-202E—Test Methods for Electronic and Electrical Component Parts

MIL-HDBK-217D—Reliability Prediction of Electronic Equipment

MIL-STD-280A—Definitions of Item Levels, Item Exchangeability, Models, and Related Terms

MIL-STD-414—Sampling Procedures and Tables for Inspection by Variables for Percent Defective

MIL-STD-756B—Reliability Models and Prediction

MIL-STD-781C—Reliability Design Qualification and Production Acceptance Tests — Experimental

MIL-STD-790B—Reliability Assurance Program for Electronic Parts Specification

MIL-STD-810C—Environmental Test Methods

MIL-STD-883B—Test Methods and Procedures for Microelectronics

MIL-STD-1313—Microelectronics Terms and Definitions

MIL-Q-9858A—Quality Program Requirements

AR-92—Quality Program Requirements

MIL-S-195001—Semiconductor Devices, General Specification for

MIC M38510D—Microcircuits, General Specifications for

MIL-STD-470—Maintainability Program Requirements for Systems and Equipments

MIL-STD-471A—Maintainability Verification/Demonstration/Evaluation

MIL-HDBK-472—Maintainability Prediction

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MIL-STD-891—Contractor Parts Control and Standardization Program

MIL-STD-701—Preferred and Guidance List of Semiconductor Devices

MIL-STD-198A—Selection and Use of Capacitors

MIL-STD-199B—Selection and Use of Resistors

MIL-STD-1562—List of Standard Microcircuits

MIL-STD-976—Certification Requirements for JAN Microcircuits

EIA

Reliability Bulletin No. 1—A General Guide for Technical Reporting of Electronic Reliability Measurement

Reliability Bulletin No. 4A—Reliability Qualifications

Reliability Bulletin No. 5—Equipment Reliability Specification Guideline

Reliability Bulletin No. 10—Selection and Validation of Low Population and/or State of the Art Parts

Reliability Bulletin No. 9—Failure Mode and Effects Analyses

Reliability Bulletin No. 8—Equipment Burn-In

Engineering Bulletin No. 17—User Guidelines for Quality and Reliability Assurance of LSI Components

Engineering Bulletin No. 11—User Guidelines for Microelectronic Reliability Estimation

JEDEC Standard No. 22—Test Methods and Procedures for Solid State Devices Used in Transportation/Automotive Applications

Other

ASQC 1973—Glossary and Tables for Statistical Quality Control

ASQC Procurement Quality Control - 2nd Edition

ANSI/ASQC A3-1978—Quality Systems Terminology

ANSI/ASQC A2-1978—Terms, Symbols and Definitions for Acceptance Sampling

ANSI/ASQC A1-1978—Definitions, Symbols, Formulas and Tables for Control Charts

How to Speak Fluent Quality- National Semiconductor Co.

RDH 376—Reliability Design Handbook - Reliability Analysis Center

WPS-1—Analysis Techniques for Mechanical Reliability - Reliability Analysis Center

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1987 Desk Manual- Microelectronic Manufacturing and Testing

SAE AE-9 1987—Automotive Electronics Reliability Handbook

The American Heritage Dictionary- 2nd College Edn. 1982 Houghton Mifflin Co.

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