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Terminology of reliability for automotive electrical and electronics

汽车电气电子可靠性术语

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Terminology of reliability for automotive electrical and electronics

1 Scope

This standard defines reliability terms and definitions related to the automotive electrical and electronics.

This standard applies to all kinds of technical data, which is related to the automotive electrical and electronics.

2 Terms and definitions

2.1 Basic terminology

2.1.1 Basic concepts

2.1.1.1

Item

Object of consideration.

Note: An item can be a single part, component, device, functional unit, equipment, subsystem or system.

[GB/T 2900.99-2016, definition 192-01-01]

2.1.1.2

Part

A single inseparable part in a machine, which is the basic component of the machine AND the basic unit in the machine manufacturing process.

2.1.1.3

Component

The constituent parts of a device, which cannot be divided into smaller parts, without losing their specific function.

[GB/T 2900.1-2008, definition 3.3.19]

2.1.1.4

Passive element

Electronic components, that can achieve their own functions, without an external energy source, such as capacitors, resistors, etc.

2.1.1.5

Active element

Electronic components, that require an external energy source to achieve their own functions, such as transistors, diodes, tubes, relays, etc.

2.1.1.6

Device

A physical element or combination of such elements, to achieve a desired function.

Note: A device can be part of a larger device.

[GB/T 2900.1-2008, definition 3.3.18]

2.1.1.7

Installation

An appliance or a group of interrelated devices and/or appliances, which is installed in a given location, for a specific purpose, including all appliances that make them work well.

[GB/T 2900.1-2008, definition 3.3.24]

2.1.1.8

Subsystem

Within a system, a group of parts, components or combination of devices, that perform a certain function of use, such as power sub-system, body control sub-system, power sub-system, etc.

2.1.1.9

System

A collection of all interrelated elements, which are considered in the defined sense

ideal conditions of use and warranty.

2.1.2.7

Operational reliability

The reliability of the product, when it is used in the actual environment, which reflects the comprehensive influence of product design, manufacture, use, maintenance, environment and other factors.

2.1.2.8

Reliability with repair

The reliability, that a product can achieve, with preventive maintenance.

2.1.2.9

Maintainability

The probability, that the product under the given conditions of use can complete the given actual maintenance work, within the stated time interval, when the maintenance is carried out, under the stated conditions AND according to the stated procedures and resources.

2.1.2.10

Serviceability

The degree, to which product maintenance is accomplished, within specified conditions and within a specified time period.

2.1.2.11

Preventive maintenance

All activities, which are carried out to maintain a product in a specified state, by systematically checking, detection, eliminating symptoms of failure. It includes pre-maintenance, scheduled maintenance, conditional maintenance, fault inspection, etc.

2.1.2.12

Repairability

The probability, that a failed system will return to normal working condition, within the specified effective maintenance time.

2.1.2.13

Availability

The ability to be in a state of performing as required.

[GB/T 2900.99-2016, definition 192-01-23]

2.1.2.14

Durability

The ability of a product to perform the required function, under given conditions of use and maintenance, until the end of its useful life.

[GB/T 2900.99-2016, definition 192-01-21]

2.1.2.15

Survivability

The ability of a product, to withstand man-made environmental disturbances and perform specified tasks, without destructive damage.

2.1.2.16

Operational readiness

The probability that, at any point in time, the system is in good working order OR capable of replacing the old system under specified conditions (including the allowable lead time).

2.1.2.17

Cost-effectiveness

A basic indicator, for measuring the effectiveness of cost usage.

2.1.2.18

System effectiveness

The degree, to which a system meets the requirements of a specific set of tasks, under specified conditions and within a specified period of time. It is related to availability, mission success and inherent capability.

2.1.3 Defects and failures

2.1.3.1

Defect

2.1.3.9

Aging

The phenomenon, in which the properties of materials exposed to natural or artificial environmental conditions deteriorate, over time.

2.1.3.10

Degradation

The process, by which a product gradually loses its function or ability to perform.

2.1.3.11

Wear

Mechanical removal of surface material, due to adhesion or peeling of the surface.

2.1.3.12

Wear out

The process of increase in fault rate OR the process by which the probability of fault increases with the number of life units.

2.1.3.13

Fatigue

Damage, which is caused by cyclic loading.

2.1.3.14

Contamination

A substance, that affects the physical or electrical properties of a part.

2.1.3.15

Foreign material

Substances, which come from outside the part or system.

2.1.3.16

Pin hole

Tiny holes, which pass through the insulating layer (glass layer).

2.1.3.17

Crazing

Defects, that appear as web-like cracks on the surface.

[GB/T 15757-2002, definition 4.4.5]

2.1.3.18

Crack

Parts are broken in whole or in part BUT show no signs of overall separation.

2.1.3.19

Dissociation

The breakdown of a substance into two or more substances.

2.1.3.20

Thermal fatigue

A failure mode, in which a material eventually cracks or causes damage, under the repeated action of alternating thermal stress.

2.1.3.21

Purple plague

A brittle compound, which is formed at the interface, when gold and aluminum are in close contact and exposed to high temperature and high humidity. It breaks the bond between gold and aluminum.

2.1.3.22

Creep

Under the action of high temperature and stress below the yield strength, the plastic deformation of the material increases with time.

2.1.3.23

Yield

In the process of stretching or compressing the material, when the stress exceeds the elastic limit, the deformation increases rapidly, AND the material loses the ability to resist continuous deformation. When the stress reaches a certain value, although the

2.1.3.30

Sneak circuit

Unexpected paths or logic circuits, that excite unintended functions or inhibit intended functions, under specific circumstances.

2.1.3.31

Failure

Loss of the ability to perform a requirement.

[GB/T 2900.99-2016, definition 192-03-01]

2.1.3.32

Fault

Loss of ability to perform as required, due to internal conditions.

[GB/T 2900.99-2016, definition 192-04-01]

2.1.3.33

Failure rate

A basic parameter of product reliability. Its measurement method is the ratio -- of the total number of product failures TO the total number of product life units, -- under specified conditions and within a specified period.

2.1.3.34

Hazard rate

h(t)

At a specific time, the rate of change -- of the number of products that have failed, as divided by the number of products that have not failed, -- that is, the probability that a product, that is still working at time t, will fail at interval Δt, as shown in formula (1) and formula (2).

$$h(t)=\lim_{t\to 0}\frac{R(t)-R(t+\Delta t)}{tR(t)} \qquad \cdots\cdots(1)$$

$$h(t)=f(t)/R(t) \qquad \cdots\cdots(2)$$

Where:

R(t) - Product reliability;

f(t) - Product failure rate.

2.1.3.35

Fit

The unit of failure rate, 1 fit represents 1 component failure in 1 hour in 1 billion components.

2.1.3.36

Initial failure

Failure that occurs for the first time, during product use.

2.1.3.37

Early life failure

The failure of a product, in the early stage of its life, due to defects in design, manufacture, assembly. The failure rate decreases with the increase in the number of life units.

2.1.3.38

Bathtub curve

During the life cycle of the product, the bathtub-shaped curve where the typical failure rate changes over time.

2.1.3.39

Decreasing failure rate

The instantaneous failure rate, which expresses the product bathtub curve model OR the initial or "early failure" stage of the product life cycle.

2.1.3.40

Constant failure rate; CFR

The instantaneous failure rate, which expresses the middle of the bathtub curve model of the part life, OR the "effective life" period in the bathtub curve model.

2.1.3.41

Increasing failure rate

The instantaneous failure rate, which expresses the third or "wear" stage of the

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