



IEC/TC OR SC: <b>56</b>	SECRETARIAT: <b>GB</b>	DATE: <b>2020-12-18</b>
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### A. TITLE AND SCOPE OF TC 56

#### Title

The current title of TC56 is "Dependability".

#### Scope

The purpose of TC 56 is to prepare international standards in the field of dependability, in all appropriate technological areas, including those not normally dealt with by IEC Technical Committees. Dependability is the ability to perform as and when required and is time dependent in application. Dependability can be expressed in terms of core attributes of availability, reliability, maintainability and supportability that are tailored to application-specific functional and service attributes.

TC 56 standards are related to products, processes and management activities. The standards provide systematic methods and tools for dependability assessment, technical risk assessment and management of services and systems throughout their life cycles.

Dependability is a technical discipline that is important in quality management, asset management, risk management and financial decision making. It is managed through life cycle processes involving availability and its core performance attributes of reliability, maintainability and supportability, as well as application specific performance attributes such as recoverability, survivability, integrity and security for products and service dependability evaluation.

#### Background

Initial meetings were held starting in 1965 following a German proposal. TC 56 was formally approved by IEC in late 1966 as Technical Committee 56 "Reliability of electronic components and equipment" with the first meeting held in 1967. The title was later changed to "Reliability and maintainability". This title was then changed to "Dependability" in 1989 to better reflect the technological evolution and business needs on a broader scope of applications based on the concept of dependability. In 1990, following consultations with ISO, it was agreed that the scope of TC 56's work should no longer be limited to the electrotechnical field, but should address generic dependability issues across all disciplines.

In the beginning, the committee was oriented primarily towards testing of electronics and statistical methods associated with testing, for example, test plans. Soon standards in availability and maintainability were added and later management aspects of dependability were included. In 1988, the standards of TC 56 were restructured on the so-called "toolbox principle". The idea was that a number of standards, called "application guides" should give guidance to non-expert users and point to a number of "tool" standards. An expert user would be able to go directly to the "tool" standards. Due to the slow process of revising existing standards, the "toolbox" structure was not fully implemented until year 2000. With emphasis by the Standardisation Management Board on self-contained standards, TC 56 is continuing to restructure standards to be more self contained, so the user does not have to buy several standards in order to perform a task.

When the US MIL standards ceased to be mandatory, a new situation developed, since TC 56 offers international standards in similar areas. These standards are reviewed and updated at least every 5 years, while few of the MIL standards are maintained any more.

Technical development expanded the activities of TC 56 to cover maintenance support as well as technological risk. Therefore the title "Reliability and maintainability" no longer covered the scope

of the committee. The term "dependability" was therefore introduced as an "umbrella term" which like the term "quality" covers a lot of aspects, some of which are quantifiable and some are not. The term dependability now covers reliability, availability, maintainability, maintenance, maintenance support and technological risk.

The activities of TC 56 were expanded to cover more than electronics. Non-electronic equipment and systems were included as well as software and human aspects. Today TC 56 covers areas from components to complex systems, networks and open systems and from management aspects to manufacturing. From being mainly focused on Test Analysis and Fix (TAAF), TC 56 is now also working with standards covering dependability aspects of product development, design integration, maintenance, risk assessment and obsolescence.

### **Emerging trends**

Dependability concepts are critical for modern trends in an increasingly integrated world that is more and more dependent on interconnected technologies such as open systems and the Internet of Things. Dependability promotes clean energy technology applications which encourage energy conservation, include information technology, embrace design principles to reduce, recycle and reuse, advocate the interoperability of system components to achieve simplicity in designs, adopt reusability and utilize applicable commercial-off-the-shelf (COTS) products. In addition to proven dependability tools and techniques, TC 56 is now challenged to provide new or improved methods to deal with the high dependability demands that society now expects.

## **B. MANAGEMENT STRUCTURE OF THE TC**

### **Management structure**

TC 56 has the following Working Groups which act as maintenance teams for existing standards and support the work on new standards by providing experts who have experience in dependability applications and standard development. Several Advisory Groups assist with the management of the Committee.

*WG1 Dependability terminology:*

- produces new and maintains existing terms and definitions related to dependability for inclusion in the IEV;
- advises Project Leaders on terminology for writing clear and unambiguous standards and promoting clear communications, for example in contract situations;
- ensures that the terms defined clarify any linkages to terms used in other fields, for example, quality;
- liaises with other TCs on IEC terms and definitions, as appropriate.

*WG2 Dependability techniques* develops and maintains standards on:

- reliability tools and techniques;
- test and analysis methods;
- statistical procedures associated with these techniques and methods (applied statistics).

*WG3 Management and systems* develops and maintains standards on:

- management of dependability;
- maintainability, supportability and maintenance;
- technological risk assessment;
- systems engineering and human aspects.

*WG4 Information systems* develops and maintains standards on:

- dependability of information systems including open systems, Internet of Things (IoT), Systems of Systems (SoS).
- dependability of IT security.

TC 56 has the following Advisory Groups that assist the Committee with specific aspects.

The Strategic Advisory Group (SAG):

- advises the Chair of TC 56 on industry requirements and dependability standards needed to serve those needs;
- coordinates the work of the Working Groups. Convenors and deputy convenors (secretaries) of the Working Groups, as well as invited experts from the member bodies, participate in the meetings;
- provides on-going guidance on strategic issues and long range planning.

The Legal Advisory Group (LAG):

- advises the Chair, convenors and project leaders on the legal implications of TC 56 standards;
- responds to inquiries and reviews working drafts of documents as to legal implications to provide input to the Working Groups before documents are circulated;
- provides expertise in relation to the laws, regulations and important court decisions pertinent to the work of TC 56.

The Communication Advisory Group (CAG):

- advises on managing communication of TC56 dependability activities and application through the website;
- advises on facilitating communication with liaison partners;
- organizes seminars to promote the value of dependability to stakeholders.

#### **Liaison activities**

TC 56 maintains liaison activities with a number of ISO and IEC TCs and SCs and some external organizations:

IEC/TC 1 Terminology

IEC/TC 9 Electrical equipment and systems for railways

IEC/TC 13 Electrical energy measurement and control

IEC/TC 44 Safety of machinery – Electrotechnical aspects

IEC/SC 45A Instrumentation and control of nuclear facilities

IEC/TC 47 Semiconductor devices

IEC/SC 65A Industrial-process measurement and control – System aspects

IEC/TC 104 Environmental conditions, classification and methods of test

IEC/TC 107 Process management for avionics

ISO/TC 67 Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries

ISO/TC 69/SC 1 Applications of statistical methods – Terminology and symbols

ISO/TC 108/SC 5 Mechanical vibration and shock – Condition monitoring and diagnostics of machines

ISO/TC 159/SC 4 Ergonomics of human-system interaction

ISO/TC 176/SC 1 Quality management and quality assurance – Concepts and terminology

ISO/TC 176/SC 2 Quality management and quality assurance – Quality systems

ISO/TC 199 Safety of machinery

ISO/TC 251 Asset management

ISO/TC 262 Risk management

ISO/IEC JTC 1/SC 7 Information technology – Software and systems engineering

ISO/IEC JTC 1/SC 41 Internet of things and related technologies

CEN/TC 319 Maintenance

IEC ACOS

International Institute of Obsolescence Management (IIOM)

## C. BUSINESS ENVIRONMENT

### Market relevance

The dependability of a product or system implies that it is trustworthy and capable of performing the desired service upon demand to meet business objectives and user needs. Dependability is an engineering discipline to assure integrity, achieve performance, ensure availability and sustain interoperability of diverse products and services selected for system integration. Dependability attributes affect cost-effectiveness in business operations and influence successful outcomes of the system life cycle to achieve optimal performance. System dependability deals with error avoidance, fault tolerance and failure prevention techniques. It provides industry best practices to enhance the applications of dependability characteristics which are critical to system design and implementation. Dependability characteristics are well sought by business enterprises for global standardization to facilitate international trade.

Dependability is becoming increasingly important in a modern society, since all of society depends on technology and services for survival, comfort, security and entertainment. Without dependable products and services, electricity would be frequently unavailable, transportation not meeting service levels and information missing or obsolete. Without dependability, there would be numerous car, train, aeroplane and ship accidents and numerous medical maltreatments every day. There is an increased focus on physical asset management practices where TC 56 standards provide a significant component of how it is implemented.

### Sales of standards through IEC

Sales figures for TC56 standards only cover a minor part of total sales as they list only standards sold by IEC in Geneva. Most National Standardisation Bodies also sell TC 56 standards, in some cases in translation, and all TC 56 standards are confirmed as European Standards (EN) through the process of parallel voting. Many standards are now being sold through subscription services. The sales figures in Table 1 for 2015-2018 and 2019 year-to-date until July can therefore only be used to compare as a rough indication of the interest for the different standards and should not be taken as the actual sales volume. The table below shows the top standards that have been sold in the past few years with the total of all standards sold for this time period amounting to 1164 standards.

TC 56 Standard	2015	2016	2017	2018	2019-07 ytd	Total
IEC 60812 FMEA	57	53	71	84	42	307
IEC 61709 Electronic components - Reliability - Reference conditions	12	6	30	45	21	114
IEC 61882 HAZOP studies	10	20	21	21	12	84
IEC 61025 Fault tree analysis	13	12	20	17	12	74
IEC 62402 Obsolescence management	12	16	11	9	18	66
IEC TR 62380 Reliability data handbook (superseded by 61709)	15	19	8	1	3	46
IEC 31010 Risk assessment techniques	7	5	11	7	7	37
IEC 60300-1 Dependability management	7	5	6	8	6	32
IEC 60300-3-11 Reliability centred maintenance	6	4	7	7	7	31
IEC 62506 Methods for product accelerated testing	9	6	4	8	5	32
IEC 60300-3-3 Life cycle costing	3	4	8	8	6	29
IEC 61078 Reliability block diagrams	5	6	12	0	4	27
IEC 62740 Root cause analysis	3	4	6	6	3	22
IEC 60300-3-5 Reliability test conditions and statistical test principles	3	2	3	2	4	14
IEC 61160 Design reviews	5	1	5		3	14
IEC 60300-3-2 Collection of dependability data	3	4	3	4	1	15
IEC 60300-3-1 Dependability analysis techniques	4	2	3	3	2	14
IEC 60300-3-10 Maintainability	3	2	3	1	1	10
<b>TOTAL FOR IEC SALES</b>	<b>177</b>	<b>171</b>	<b>232</b>	<b>231</b>	<b>157</b>	<b>968</b>

### Regulatory compliance

Dependability standards are not directly intended for use in regulations but they may be referenced as best practice for complying with regulations.

#### D. MARKET DEMAND

Market demand of dependability standards covers a broad range of industry sectors, such as computers and electronics, communication networks, process controls, transportation and distribution, energy, safety and security, educational and academic institutions and government agencies. These stakeholders all have vested interests in assuring stability, trustworthiness and safety in their systems, products and services. Dependability is knowledge driven and instigates technology research and development for practical implementation to meet user needs. Global competition fuels the market demands for incorporation of dependability characteristics into systems, products and services. Dependability has emerged from its traditional quality roots as an enabling mechanism for system design assurance, provides fault tolerant design options, and advocates risk mitigation processes to reduce failure occurrences and impact consequences. Dependability has become an important criterion for business strategies to guide new acquisitions. Dependability is also essential when building or acquiring an asset to help determine the cost-effectiveness and return-on-investment relating to the asset.

TC 56 will produce and maintain standards on dependability with a wide application, but not product specific standards. This delimits TC 56 from component design, test and manufacturing standards as well as standards on safety and product standards for software.

#### E. TRENDS IN TECHNOLOGY AND IN THE MARKET

##### **Trends in technology**

Technology trends over the past decade have indicated a rapid growth and application of Information Technology (IT) in most technology-based industries, which demand the need for dependability engineering and methodology standardization. This is evident in the merging of the telecommunications, computers, and entertainment industries due to technology convergence and industry collaboration, to deliver value-added systems, products and services. The increase in broadband access and high speed computing capabilities has resulted in the dominance of internet services and web development. Technology diffusion and innovative software architectures have enabled the use of third-party software functionality over the internet to permit cross-platform, cross-provider and cross-domain applications. The software engine has become the driving mechanism to realize complex system operations. However, systems containing software are prone to virus attacks and security intrusion. Technology utilizing dependability techniques is an important component in virus prevention and security protection to assure sustainable system operation. Dependability plays a critical role in robust hardware and software designs to reduce system risk exposures and minimize network vulnerability. Dependability facilitates the achievement of viable e-businesses for seamless integration and enterprise process management. This paradigm shift has put the global business communities in a situation of relying heavily on software intensive systems to sustain business operations. System dependability influences the success of system performance and guarantees data integrity.

Components today are highly integrated and very complex like "systems on a chip" and nano-technology. The reliability requirements of components are extremely high and increasing. TC 56 realises that the technology is so complex and fast changing that TC56 will not be able to standardize qualification tests for components or publish and update failure rate data. TC 56 therefore concentrates on guidance standards as well as technical guidelines on how to collect relevant data and how to use modern components in a design process.

##### **Trends in the market**

Market trends reflect rapid technology evolution and user adaptation, hence fostering industry awareness and the need for dependability guidelines and methodology applications. The new generation of dependability standards has to fill the technical gaps to provide a generic framework and technical guidance for establishing dependability design standards and application criteria. They are critical for most technology-based systems, products and services. Dependability principles have expanded beyond classical reliability theory for realization in engineering applications and implementation of technical practices. The standardization focus is on development of relevant dependability methods and techniques suitable for system and network applications. Emphasis is placed on software intensive systems and their software elements as the target driving force for dependability performance achievements in new product introduction and sustainable service provision.

Today's society is so dependent on technological systems that the demand for dependability is very high and increasing. High dependability requirements and quick time to market make it very difficult to verify dependability targets by testing. Therefore analysis methods, design methodology and management aspects are increasing in importance.

Even though the dependability requirements are very high, life cycle costs, especially warranty costs, which are mainly associated with dependability issues, are increasing, making dependability activities highly profitable. Standards produced by TC 56 help companies reduce warranty costs through analysis, testing and maintenance. Appraisal costs are reduced by standards on testing and prevention costs are minimized by standards on analysis and management of dependability. For software, costs of testing can be estimated as 26% and prevention to 8% of the development costs. In addition, there are life cycle costs not covered by warranty, as for example maintenance costs and costs for maintenance support.

TC 56 standards can be used by all companies from large companies to medium size and even small companies. The number of such companies worldwide is very large. Outsourcing increases the demand for clear and unambiguous standards as a basis for contracts and cooperation. This ensures healthy competition ("a level playing field") and reduces transaction costs (the costs to set up, monitor and if needed enforce a contract).

#### **F. SYSTEM APPROACH ASPECTS (REFERENCE - AC/33/2013)**

The system approach for dependability engages the fundamental principles of systems engineering and application of life cycle processes for activity identification and resource allocation, evaluates the internal and external environments to assess associated impacts, establishes the customer and supplier relationships and coordinates the transition activities of the supply-chain. It integrates the technology knowledge-base and experience-data sharing for collaboration. The system approach advocates the planning, design and implementation of relevant processes to engineer dependability into systems, assesses and measures the performance results to assure dependability achievement. It incorporates the appropriate enabling mechanisms to optimize the desirable system objective outcomes subject to technical constraints and resource limitations.

The system approach includes dependability management systems under the total life cycle process as well as dependability for items, complex systems, stand alone systems, equipment, components and devices. For dependability, a system includes hardware, software and human aspects.

#### **G. CONFORMITY ASSESSMENT**

TC 56 standards are generally intended to provide guidance and not generate requirements related to conformity assessment. Compliance with requirements in a TC 56 standard is voluntary, unless the standard is called out in a contract, in the quality management system of the company/organisation. A TC56 standard may be used by the manufacturer for compliance such as with the CE Marking or UL process. TC 56 does provide a number of standards that could be used for reliability testing and screening.

Standards can be used for certification e.g. ISO 9001 and ISO 55001, if a standardisation body offers such certification. If a company/organisation chooses to be certified, compliance with the standard that the certification is based on is of course required. But more standards may be used to comply with specific clauses in the certification standard. For example, for the life time of a product (ISO 9001 Clause 8.5.5), IEC 61649 Weibull analysis may be used. For determining if an asset is improving or deteriorating over time (ISO 55001 requirement) IEC 61710 Power law may be used. TC56 therefore supplies tools that may be utilized to comply with specific requirements (clauses) of certification standards such as, for example, ISO 9001 and ISO 55001. However, it must be emphasised that companies/organisations are free to use other methods that they choose themselves, if in that way they can show sufficient compliance with certification requirements.