BSI

BS 4778 : 1979

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Glossary of terms used in

Quality assurance (including reliability and maintainability terms)

Vocabulaire du contrôle de la qualité (y compris les termes relatifs à la fidelité et à la maintenabilité)

Wörterverzeichnis der Qualitätssicherung (einschließlich Begriffe der Zuverlässigkeit und Einhaltbarkeit)

British Standards Institution

Contents

BS 4778 *(continued)*

Foreword

The first edition of BS 4778, which was published in 1971, contained 41 terms and definitions arranged in alphabetical order plus an appendix containing dictionary definitions of words commonly used in the quality assurance field. As was stated in the foreword it covered only a selection of general terms and thus avoided more specialized technical terminology.

The intervening years have seen a considerable growth of interest with regard to the quality of both products and services in response to market demand, consumer protection and product liability considerations. Consequently the need has been recognized for the development of a quality assurance glossary to cover in a more comprehensive manner terminology in areas such as quality management, costing and control, reliability, maintainability, decision taking, risk management, etc.

In this revised version of BS 4778, the opportunity has been taken, in the interest of European and international standardization, to adopt terms and definitions from EOQC, ISO and IEC publications where these are in general accord with established usage of the term in the United Kingdom. However, there are a number of terms for which the existing English definitions have been retained, or where definitions from a source other than EOQC, ISO and IEC have been adopted. This has been done either because they more accurately reflect the established United Kingdom usage, or because a more colloquially worded English version of a European or international definition is preferred; in some cases it is because there are no existing European or international definitions for the terms.

In compiling this glossary the committee has sought the views and comments of as broad a spectrum of opinion as possible in industry, commerce and government bodies and organizations, with the aim of producing a standard which would gain acceptance in as wide a field as possible. Total agreement will rarely, if ever, be achieved in compiling a document of this nature.

It did not prove possible to include at this stage proposals for a more extensive document. However, appendix A lists some terms related to quality assurance that can be found in other publications.

British Standard Glossary of terms used in

Quality assurance (including reliability and maintainability terms)

Section one. General

0. Introduction

Although it is generally acknowledged that the principles of quality assurance cross all industrial boundaries and professional disciplines, in a similar manner to financial control, there is often resistance to their general application. This may be the result of ignorance or a wish to maintain an established departmental demarcation. Much time and effort is wasted both within and between industry, commerce, government and professional and academic institutions when ambiguities arise as a result of the inability to differentiate adequately between such terms as 'grade' and 'quality level'; 'precision' and 'accuracy'; defects (in manufacturing) and 'failure(s)' (which might be the result of misuse rather than poor manufacturing or design) and similar terms which form an interface between various sectors in society. Moreover, the professional or technical use of these terms is often at variance with the meanings attributed to them by lay people. Recent or pending legislation within both the USA and the EEC relating to quality, reliability, maintainability, product liability and safety has emphasized the important interface between quality assurance, standards and the law, and the need for a more precise professional approach in the future by all the various disciplines concerned.

In accordance with the principles established in BS 4891, the prime definition of 'quality assurance' emphasizes that 'quality is everybody's business' and is not just the concern of a specialist department, if one happens to exist. In the larger organizations where specialist quality departments perform co-ordinating functions, it is important to identify the responsibilities and terms of reference of the other departments with regard to achieving the quality objectives of the organization.

NOTE. In order to make this glossary more generally applicable, proposals to include specialized 'compound terms' were not accepted. However, since quality assurance (QA) is implied within many of the definitions given (although not specifically mentioned) it is hoped that particular sectors will be able to utilize the definitions in BS 4778 as a basis for their own terminology.

1. Scope

This document presents, in an illustrated and structured form, concepts, terms and definitions designed to aid communication in quality assurance and related disciplines such as reliability and maintainability.

NOTE. It is recommended that the terms and definitions given in this standard be used in preference to product-orientated terminology currently in use in certain industrial sectors.

2. Arrangement

The glossary of terms has been arranged in conceptual form instead of alphabetically: also many of the principal interface terms are preceded by an explanation of the concept on which the definition is based.

NOTE 1. Many of the terms used in quality assurance are ordinary words which are used in a special or restricted way and therefore the dictionary definition may not be appropriate.

NOTE 2. No significance is attached to the change in type face of definitions or their sequence of numbering.

3. References

The titles of the standards publications referred to in this standard are listed on the inside back cover.

The following documents extend or amplify some of the aspects of quality assurance covered by this document.

BS 600	Application of statistical methods to industrial standardization and quality control
BS 1313	Fraction-defective charts for quality control
BS 2564	Control chart technique when manufacturing to a specification, with special reference to articles machined to dimensional tolerances
BS 2846	Guide to statistical interpretation of data Part 1 Routine analysis of quantitative data Part 2 Estimation of the mean-confidence interval Part 3 Determination of a statistical tolerance interval Part 4 Techniques of estimation and tests relating to means and variances Part 5 Power of tests relating to means and variances Part 6 Comparison of two means in the case of paired observations
BS 4891	A guide to quality assurance
BS 5179	Guide to the operation and evaluation of quality assurance systems Part 1 Final inspection system Part 2 Comprehensive inspection system Part 3 Comprehensive quality control system
BS 5532	Statistics – Vocabulary and symbols
BS 5703*	Guide to Cusum techniques
BS 5750*	Specification for quality systems
BS 6000	Guide to the use of BS 6001. Sampling procedures and tables for inspection by attributes
BS 6001	Sampling procedures and tables for inspection by attributes
BS 6002	Specification for sampling procedures and charts for inspection by variables for percent defective
BS 5781*	Specification for calibration systems
PD 6112	Guide to the preparation of specifications
DD 10	Guide to the reliability of engineering equipment and parts. Introduction
DD 11	Guide on the reliability programme for engineering equipment and parts
DD 12	Guide on the reliability of engineering equipment and parts
DD 13	Guide on the assessment of reliability of engineering equipment and parts
DD 14	Guide on the specification of reliability of engineering equipment and parts
DD 15	Guide on the production, flow, analysis and interpretation of reliability data for engineering equipment and parts
DD 16	Guide on the reliability of engineering equipment and parts. Practical examples of DD 10 to DD 15

*In course of preparation.

Section two. Basic terms

4. Quality

4.1 Concept of quality. The word quality is often used for several distinct purposes:

(a) *'comparative sense'* or *'degree of excellence'*, whereby products may be ranked on a relative basis, sometimes referred to as 'grade' (see **15.1**).

(b) *'quantitative sense'* as used in manufacturing, product release and for technical evaluations, sometimes referred to as 'quality level' (see **23.4**).

(c) *'fitness for purpose sense'* which relates the evaluation of a product or service to its ability to satisfy a given need.

Within the context of this standard and in accordance with established usage in the quality assurance field the word 'quality' is used in the 'fitness for purpose' sense as defined in **4.1.1**.

In order to improve communication and differentiate precisely between these three principal uses, it is strongly recommended that the concept of 'grade' (see **15.1**) and 'quality level' (see **23.4**) be utilized as appropriate to avoid confusion, ambiguity and misunderstanding.

4.1.1 *quality.* The totality of features and characteristics of a product or service that bear on its ability to satisfy a given need.

NOTE. In order to be able to assure, control or improve quality, it is necessary to be able to evaluate it. This definition calls for the identification of those characteristics and features bearing upon the 'fitness for purpose' of a product or service. The 'ability to satisfy a given need' includes economics as well as availability, maintainability, reliability, design and all other characteristics that the need for a product or service involves.

5. Quality assurance

5.1 Concept of quality assurance. For the purposes of this standard 'quality assurance' is defined as embracing all activities and functions concerned with the attainment of quality, rather than in the narrower sense only of the provision of proof associated with the word 'assurance'. Thus quality assurance includes the determination and assessment of quality.

If 'quality assurance' is used as the title of a department, its authority and activities should not supplant or reduce the responsibility of other departments concerning their contribution to quality. (For further guidance on organizational aspects see appendix C of BS 4891 : 1972.)

5.1.1 *quality assurance.* All activities and functions concerned with the attainment of quality.

6. Specification

6.1 Concept of specification. The concept and definition of quality cover all aspects of a product, and it follows that the general specification of a product should cover all of its features and characteristics. In practice there is considerable diversity in the contents and details given in the specification of products and services, and it cannot be assumed that the specification of all products in the same general category will always contain the same elements from the quality viewpoint.

In order to clarify the position, this document proposes the recognition of twelve types of specification corresponding to the different ways in which the quality of a product or service may be approached. The definitions of these twelve types of specification are given under the following headings:

Target specification
Functional specification
Product specification
Materials specification
Process specification
Inspection specification
Test specification
Acceptance specification
Installation specification
Use specification
Maintenance specification
Disposal specification

In practice the information given under these headings may be collated and treated as a single comprehensive specification, but in the initial drafting it is recommended that they are treated separately so that each is given its full specialized attention.

This subject is of paramount importance in the achievement of quality: in many cases poor products or services are the result of inadequate, ambiguous or imprecise specifications.

6.1.1 *specification.* The document that prescribes in detail the requirements with which the product or service has to comply.

NOTE 1. Specification may refer to drawings, patterns or other relevant documents, and it may also indicate the means and the criteria whereby compliance can be checked.

NOTE 2. For particular types of specification see the entries under the headings Target, Functional, Product, Materials, Process, Inspection, Test, Acceptance, Installation, Use, Maintenance and Disposal specification.

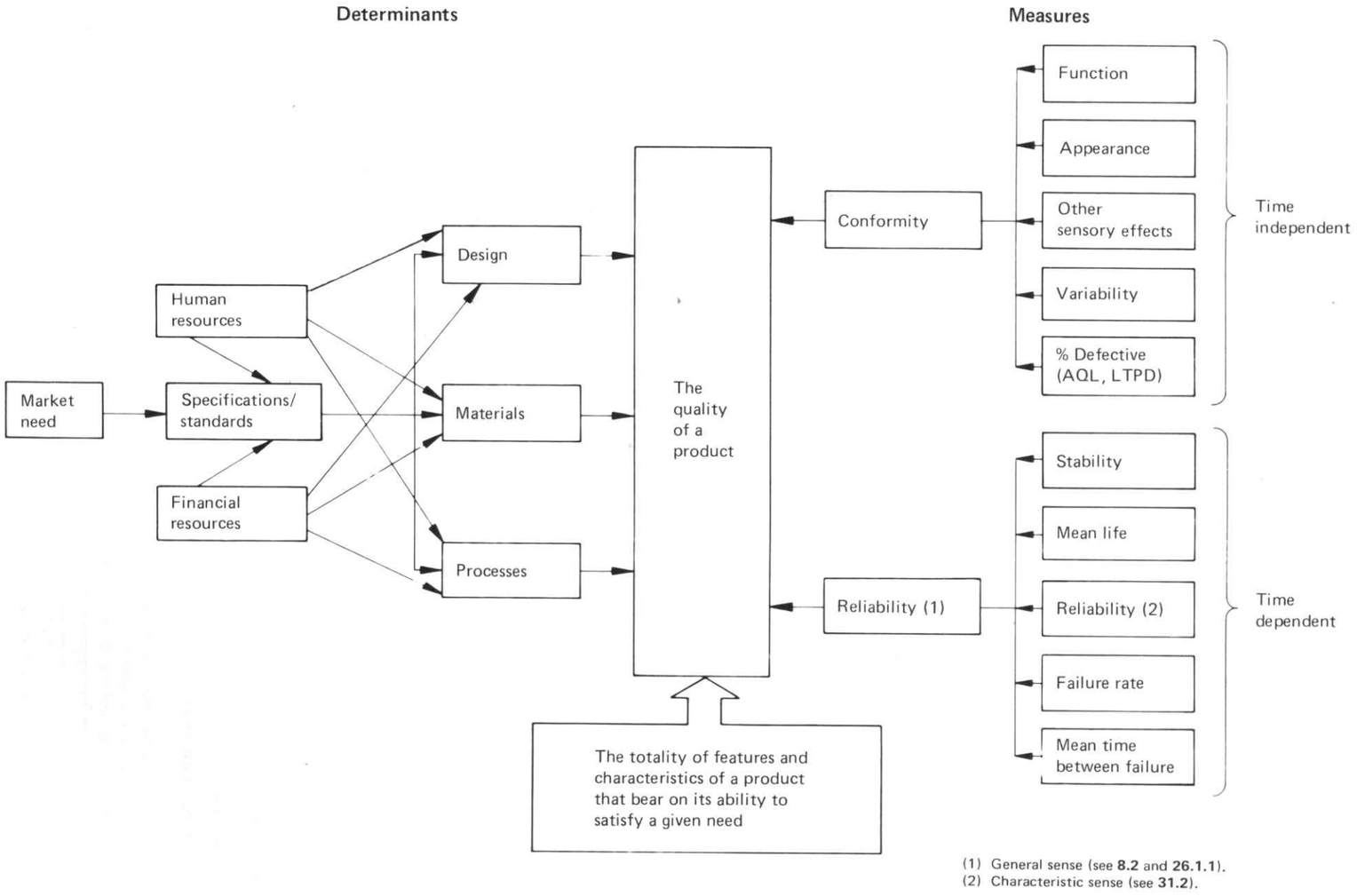
NOTE 3. For some services the requirement is given verbally rather than by means of a written specification.

7. Product and service quality determinants

NOTE. See figures 1 and 2 for the conceptual relationships of product and service quality determinants and measures.

7.1 design. The process of task recognition and problem-solving with the object of fulfilling needs by the creation of products and services.

* In course of preparation.



(1) General sense (see **8.2** and **26.1.1**).
(2) Characteristic sense (see **31.2**).

Figure 1. Some of the determinants and measures of the quality of a product

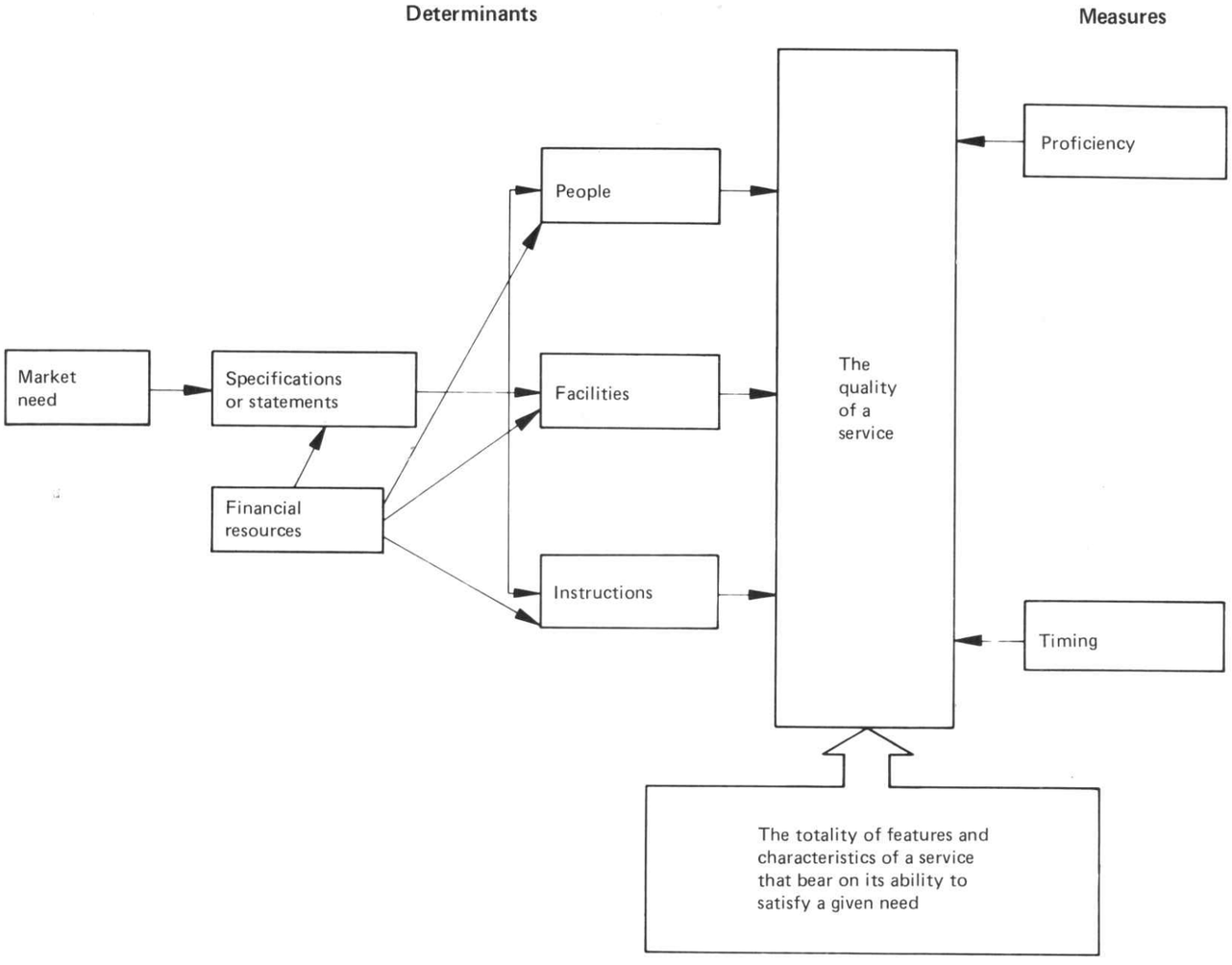


Figure 2. Some of the determinants and measures of the quality of a service

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7.2 process. The method of operation in any particular stage of manufacture of the material part, component or assembly involved.

7.3 facilities. The tools, materials, supplies, instruments, equipment and other resources available for creating the product or performing the service.

7.4 instruction. The written and/or spoken direction given with regard to what is to be done, including the information given in training.

8. Product and service quality measures

NOTE. See figures 1 and 2 for the conceptual relationships of product and service quality determinants and measures.

8.1 conformity. The fulfilment of a specified requirement by a quality characteristic of an item or service, the assessment of which does not depend essentially on the passage of time.

8.2 reliability. The ability of an item to perform a required function under stated conditions for a stated period of time.

NOTE. The term 'reliability' is also used as a reliability characteristic denoting a probability of success, or a success ratio.

8.3 accuracy. The closeness of an observed quantity to the defined or true value.

NOTE. Accuracy is usually expressed in terms of error or uncertainty.

8.4 precision. The closeness of agreement between the results obtained by applying defined procedure several times under prescribed conditions.

NOTE 1. Precision can relate to 'precision of statement' (e.g. 0.040 is more precise than 0.04) or 'precision of results'.

NOTE 2. Repeatability and reproducibility are measures of precision (for further information see BS 5497).

NOTE 3. The relationship between the process variability and the specification tolerance is usually termed 'relative precision' (for further information see BS 2564).

8.5 proficiency. As a measure of service quality, the degree of skill with which a performed service is carried out.

8.6 timing. The period of time, or the point in time when the service is required to be performed.

9. Quality achievement of products, services and organizations

9.1 compliance. An indication or judgement that the product or service meets the requirements of the relevant specification or regulation; also the state of meeting the requirements.

10. General terms: material objects

10.1 Concept of the term 'item'. The term 'item' is used to denote any part, sub-equipment or system that can be individually considered and separately examined or tested. In this standard to avoid repetition, 'item' includes population of items, samples, etc. where the context justifies its use.

10.1.1 *item.* The term is defined as follows:

(a) a part, equipment, sub-system or system that can be individually considered and separately examined or tested;

(b) an actual or conventional object on which a set of observations may be made;

(c) defined quantity of material on which a set of observations may be made;

(d) an observed value, either qualitative (attributes) or quantitative (measured).

10.2 population (universe). The totality of items under consideration.

10.3 characteristic. A property that helps to distinguish between items of a given population.

10.4 parameter. A quantity that serves to describe or to characterize the distribution of a population.

10.5 lot/batch. A definite quantity of some commodity manufactured or produced under conditions which are presumed uniform.

NOTE. In some industries 'lot' and 'batch' are not regarded as being synonymous. Where they have distinctly different meanings, these should be defined. Where it is unnecessary to retain the distinction, the word 'lot' is preferred.

10.6 sample. A group of items or individuals, taken from a larger collection or population, that provides information needed for assessing a characteristic (or characteristics) of the population, or which serves as a basis for action on the population or the process that produced it.

NOTE 1. The term may also be used to describe a portion of material taken for the same purpose from a larger bulk of material or a sample of observations.

NOTE 2. Many statistical techniques require that the sample shall be drawn at random.

10.7 specimen. A representative single item or a measured quantity of material.

NOTE. The term is often used in the formation of a sample.

10.8 materiel. Equipment, stores, supplies and spares that form the subject of a contract.

NOTE. This generic term is often used for large scale procurement purposes and avoids the necessity of repeating items covered in this definition (see BS 5750).

10.9 consignment. Goods or products issued or received as one delivery and covered by one set of documents. A consignment may consist of one or more lots/batches.

10.10 quarantine store. A secure place in which all supplies therein await proof of compliance with specified requirements.

10.11 bonded store. A secure place in which only those supplies that have been accepted as satisfactory by the inspection staff should be held.

Section three. Management

11. Quality management

11.1 quality manual. A document setting out the general quality policies, procedures, and practices of an organization.

11.2 quality system. The organization structure, responsibilities, activities, resources and events that together provide organized procedures and methods of implementation to ensure the capability of the organization to meet quality requirements (see BS 5750).

11.3 quality programme. A documented set of activities, resources and events serving to implement the quality system of an organization.

11.4 quality plan. A document derived from the quality programme (extended if necessary) setting out the specific quality practices, resources and activities relevant to a particular contract or project.

11.5 quality audit. The independent examination of quality to provide information.

NOTE. This is a general term. In practice more specific terms should be used, such as those listed in **11.6** to **11.8** and shown in figure 3.

11.6 product quality audit. The independent examination of product quality to provide information.

NOTE. For further information see figure 3.

11.7 process quality audit. The independent examination of process quality to provide information.

NOTE. For further information see figure 3.

11.8 quality system audit. The independent examination of an organization's quality assurance system carried out by an auditing team of the organization.

NOTE. An alternative term is 'quality system review'. For further information see figure 3.

11.9 quality verification. The provision of evidence or proof that requirements for quality have been met.

NOTE 1. Quality assessment and quality validation are considered to be synonymous with quality verification.

NOTE 2. For further information see figure 3.

11.10 quality engineering. The application of appropriate techniques and skills to achieve the required quality.

11.11 vendor appraisal. Assessment of a potential supplier's capability of controlling quality, carried out before placing orders.

NOTE. For further information see figure 3.

11.12 supplier evaluation. Assessment of a supplier's control of quality, carried out after placing orders.

NOTE. For further information see figure 3 and BS 5179.

11.13 supplier rating. An index of the actual performance of a supplier.

11.14 design review. A formal, documented and systematic critical study of a design proposal by specialists as required and not necessarily engaged in the design.

NOTE. For further guidance see appendix B of BS 4891 : 1972.

11.15 calibration. All the operations for the purpose of determining the values of the errors of a measuring instrument (and, if necessary, to determine other metrological properties).

NOTE 1. The metrological usage of the term 'calibration' is often extended to include operations such as adjustment, gauging, scale graduation, etc.

NOTE 2. This definition is the same as that given in BS 5233.

12. Economics

12.1 cost(s). The expenditure (actual or notional) incurred on, or attributable to, a given thing.

NOTE. The word 'cost' can rarely stand on its own, and should be qualified as to its nature or limitations (e.g. historical, variable, etc.) and related to a particular thing or 'object of thought' (e.g. a given quantity or unit of goods made or services performed).

12.2 cost function. An expression of the way cost varies with a given parameter.

12.3 quality related costs. The expenditure incurred in defect prevention and appraisal activities plus the losses due to internal and external failure.

12.4 prevention costs. The cost of any action taken to investigate, prevent or reduce defects and failures.

NOTE. Prevention costs can include the cost of planning, setting up and maintaining the quality control system.

12.5 appraisal costs. The cost of assessing the quality achieved.

NOTE. Appraisal costs can include the cost of inspecting, testing, etc. carried out during and on completion of manufacture.

12.6 failure costs, internal. The costs arising within the manufacturing organization of the failure to achieve quality specified.

NOTE. The term can include the cost of scrap, rework and re-inspection, and also consequential losses within the organization.

12.7 failure costs, external. The costs arising outside the manufacturing organization of the failure to achieve quality specified.

NOTE. The term can include the costs of claims against warranty, replacement and consequential losses of custom and good will.

12.8 economic quality. The economic level of quality at which the cost of securing higher quality would exceed the benefits of the improved quality.

13. Safety

13.1 Concept of the term 'safety'. The system approach is being applied to safety in response to the need for a process for optimizing the allocation of limited resources in complex situations. Ideally system safety provides such a process for safety enhancement by taking into account all the hazards and related factors in the life cycle of a product or system that can affect safety in operation. It assesses at various stages of a life cycle the risks this operation may entail, employing at each stage analytical procedures that are consistent with the available information, and consequent uncertainties about the product or systems operation. On the basis of such assessment it supports the rational allocation of available resources so as to attain the minimum cumulative risks. Many variations and even inconsistencies appear in the specific interpretation of the concept.

13.1.1 *safety.* The freedom from unacceptable risks of personal harm.

NOTE. Safety is defined in context of risk of personal harm. It is traceable quantitatively in decision-making on acceptable risks.

13.2 safety management. The application of organizational and management principles in order to assure with high confidence the timely realization of the goal of optimum safety.

NOTE. Safety management encompasses planning, organizing and controlling those development and operational activities directed towards this goal, including the co-ordinating of all interfaces (internal and external) among them, and evaluating the overall integrated safety programme to assess its capabilities for the attainment of the goal.

13.3 Concept of hazard and risk. The idea of a hazard is limited to a set of existing conditions with the potential for leading to one or more accidents with harmful consequences. For this potential to be realized, an activating change has to occur. Hazard can be classified as, e.g.:

(a) catastrophic;

(b) critical;

(c) controlled or marginal;

(d) negligible.

Risk can be defined in terms of the probability of occurrence of a hazard, or the consequence. Such a consequence could occur as a result of compounding several different hazards.

The assessment of risk incorporates risk quantification and risk evaluation. This separation can be beneficial in avoiding confusion between the objective process of risk quantifica-

Concept of quality audit. Quality auditing is a non-executive function, as distinct from operations such as inspection and surveillance (performed for the sole purpose of product acceptance or process control) which involve making decisions for action, although it can involve the review of such functions.

Quality auditing can relate to the quality of a product, process or system. Quality auditing is usually carried out on a periodic basis and involves the independent and systematic examination of actions that influence quality. The object is to ascertain compliance with the implementation of the quality system, programme, plan, specification or contract requirements and, where necessary, their suitability.

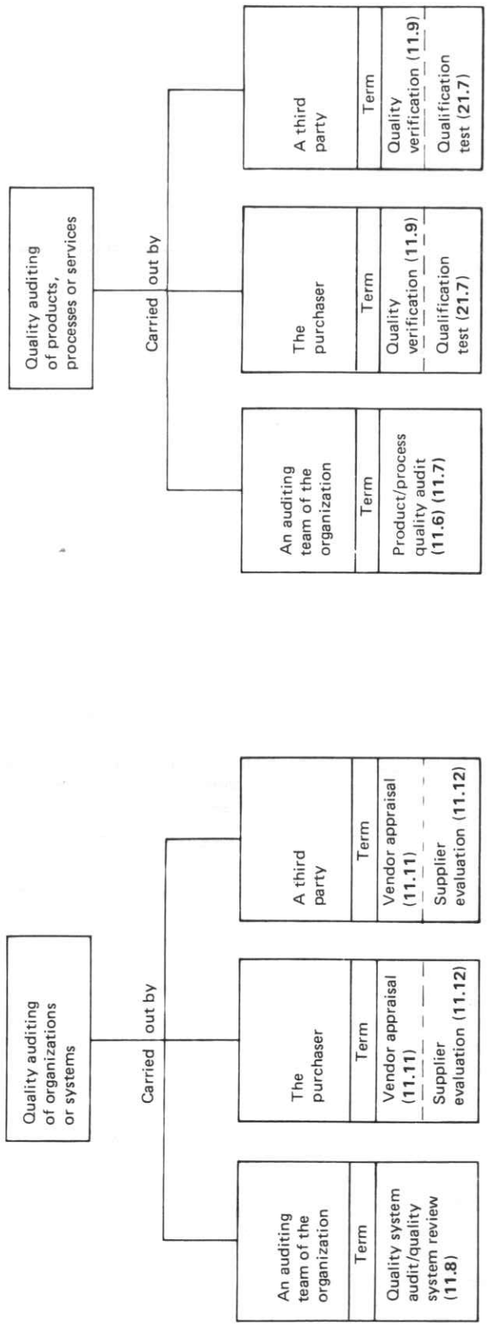


Figure 3. Concepts of quality auditing and their descriptive names

tion and the essentially subjective interpretation of the significance of estimated risks.

Risk quantification cannot measure risk acceptability, which is the concern of the relevant decision makers who have to judge the benefits, alternative uses of resources and other factors unrelated to the process of risk quantification. Moreover, the uncertainties in the quantification do not become entangled quantitatively in the process of judgement. They are simply determinants of the potential range (and perhaps distribution) or variation of the value of the quantified risk. This range can be assessed for acceptability.

13.3.1 *hazard.* A set of conditions in the operation of a product or system with the potential for initiating an accident sequence.

NOTE. This term has a different meaning when used in connection with reliability.

13.3.2 *risk.* The combined effect of the probability of occurrence of an undesirable event, and the magnitude of the event.

13.4 hazard analysis. The identification of hazards, the determination of the probabilities of their occurrence and the consequences of the credible accident sequences of each hazard.

13.5 risk assessment. The integrated analysis of the risks inherent in a product, system or facility and their significance in an appropriate context.

13.6 risk quantification. The estimation of a given risk by a statistical and/or analytical modelling process.

NOTE. This may be done by such logic tree modelling methods as are employed in hazard analysis, or by statistical inferences from historical accident data deriving from past circumstances 'similar' to those of the product or system or planned operation of facilities, e.g. by developing probabilities of future accidents from files of historical reports of such accidents.

13.7 risk evaluation. The appraisal of the significance of a given quantitative (or, when acceptable, qualitative) measure of risk.

13.8 risk management. The process whereby decisions are made to accept a known risk or hazard or to eliminate or mitigate it.

NOTE. A compromise is made considering increased cost, schedule requirements and effectiveness of redesign or retraining, installation of warning and safety devices and procedural changes. Risk management is also concerned with the mitigation of those risks deriving from unavoidable hazards through the optimum specification of warning and safety devices and risk control procedures such as contingency plans and emergency actions.

13.9 product liability. The onus on a producer or distributor for the condition of a product that causes an event by which someone suffers loss or harm.

14. Probability

14.1 probability. A real number in a scale 0 to 1 attached to a random event. It can be related to a long run relative frequency of occurrence or degree of belief that an event will occur.

NOTE. The scale 0 to 1 can be expressed as a percentage. 100 % is certainty.

14.2 confidence interval (two-sided). When it is possible to define two functions T_1 and T_2 of the observed value such that, θ being a population parameter to be estimated, the probability $Pr\,(T_1 \leqslant \theta \leqslant T_2)$ is equal to $1 - \alpha$ (where $1 - \alpha$ is a fixed number, positive and less than 1), the interval between T_1 and T_2 is a two-sided confidence interval for θ.

The limits T_1 and T_2 of the confidence interval are random variables and, as such, they will generally assume different values in every sample.

In a long series of samples the relative frequency of occurrence where the interval includes θ would be approximately equal to $1 - \alpha$.

NOTE. For further guidance on confidence intervals and limits see BS 2846 : Parts 1 to 6.

14.3 confidence limits. End points of the confidence interval that is believed to include the population parameter with a specified degree of confidence.

14.4 confidence level. The value $1 - \alpha$ of the probability associated with a confidence interval or a statistical tolerance interval.

14.5 consumer's risk. The probability of accepting a lot whose proportion defective has a value stated by the given sampling plan as rejectable.

14.6 producer's risk. The probability of rejecting a lot whose proportion defective has a value stated by the given sampling plan as acceptable.

Section four. Design

15. Quality at the product specification or design stage

15.1 Concept of grade. In some industries differences in finish, performance, size, degree of excellence, degree of refinement, etc. of a product or service, or the extent of the attention given by a service, are identified in terms of different qualities or levels of qualities. This approach is not supported in this standard, but instead the term 'grade' is used to identify such differences. Thus it is possible within a particular grade of product or service to have different levels of quality in the 'fitness for purpose' sense; consequently a high grade article can be of low quality if it does not meet its specification. Similarly, a low grade article (that is an article whose concept is of an elementary or 'utility' kind) may be of high quality.

The same concept applies to service industries, for example, in the services provided by an hotel. In this case an hotel with few public rooms, no bars, no lift, etc., could be low on a grade scale, but its quality could be high if the limited services which it did provide were exemplary.

15.1.1 *grade.* When applied to a material or product, an indication of the degree of refinement; when applied to a service, the diversity of functions or facilities provided.

NOTE 1. Where grade is denoted numerically, it is common for the highest grade to be 1, and the lower grades 2, 3 and 4.

NOTE 2. Where grade is denoted by a point score, for example by a number of stars, the lowest grade has the fewest points, or stars.

15.2 operational requirements. All the functional and performance requirements of a product.

15.3 configuration. The complete technical description required to make, test, accept, install, operate, maintain and logistically support an item.

15.4 target specification. The document that describes the primary purpose of an item and gives the essential guidance concerning such matters as its style, grade, performance, appearance, conditions of use (including health and safety considerations), characteristics, packaging, conformity, reliability, maintenance, etc.

NOTE. The target specification is often the result of a feasibility study and forms the basis of the design. It is sometimes known as the 'design brief' or the 'primary specification'.

16. Design for manufacture and construction

16.1 production requirements. A statement of the nature of the manufacturing methods and facilities available; in particular the ease of manufacture, assembly and installation of an item, including access to its parts, tooling requirements and realistic tolerances.

17. Design for reliability

17.1 functional specification. The document that describes in detail the characteristics of the product with regard to its intended capability.

NOTE. As far as possible this specification should be written in quantitative terms.

17.2 redundancy. In an item, the existence of more than one means for performing a given function.

17.3 active redundancy. That redundancy wherein all means for performing a given function are operating simultaneously.

17.4 standby redundancy. That redundancy wherein the alternative means for performing a given function are inoperative until needed.

17.5 storage life. The specified length of time prior to use for which items which are inherently subject to deterioration are deemed to remain fit for use under prescribed conditions.

NOTE. This is sometimes known as 'shelf life'.

17.6 fail safe. A designed property of an item that prevents its failures being critical failures.

17.7 failure mode and effect analysis (FMEA). The study of the potential failures that might occur in any part of a system to determine the probable effect of each on all other parts of the system and on probable operational success.

17.8 failure mode effect and criticality analysis (FMECA). The study of the potential failures that might occur in any part of a system to determine the probable effect of each on all other parts of the system and on probable operational success, the results of which are ranked in order of seriousness.

17.9 incident sequence analysis (failure tree analysis) (FTA). The study of the possible sequence of events constituting the failure of a system using the diagrammatic method of algorithms.

NOTE. The term 'fault free analysis' is also used.

17.10 concept of the term 'stress'. The term 'stress' is used to denote the intensity of the applied loading in the broadest sense. The item may be loaded by internal or external forces, electrical or mechanical effects, metallurgical, chemical or biological agents, temperatures, or other effects in any combination. A stress need not have a detrimental effect upon reliability.

17.10.1 *stress.* All influences or a part thereof to which an item is exposed at a certain instant.

17.11 functional stress. The stress to which an item is exposed solely due to the performance of its function.

17.12 environmental stress. The stress to which an item is exposed solely due to its presence in an environment.

17.13 tolerated stress. The stress under which the reliability characteristics of an item reaches the set limit.

17.14 stress analysis. The study of the effects of stresses on an item and their distribution, taking into account the operational requirements of the item.

17.15 environmental condition. State of the characteristics of the environment of an item.

NOTE 1. This comprises temperature, humidity, pressure, dust, vibration, acceleration, etc.

NOTE 2. A state of equilibrium should prevail before any statements on the item under these conditions can be made.

17.16 derating. Reduction of the intensity of a stress for the purpose of gaining an advantage at another point, e.g. improvement of reliability.

17.17 derating factor. Complement-to-1 of the quotient of actual stress to maximum limited stress.

18. Design for use and maintenance

NOTE. Further maintenance terms can be found in section twelve.

18.1 installation specification. The document that describes in detail the procedure for installing the product including, if necessary, the procedure for unpacking and preparation prior to installation.

18.2 use specification. The document that describes in detail the method of bringing into use, operating, controlling and adjusting the product.

NOTE. This document may be in the form of an instruction manual.

18.3 maintenance requirements. A statement of the nature of the maintenance method, in particular the skill of the personnel involved, their facilities and the duration and frequency of maintenance action.

18.4 disposal specification. The document that describes in detail the method and precautions to be observed in discarding or otherwise disposing of the product when it has failed or is no longer required for any reason.

NOTE. The essential features of this document are usually given in the form of a warning notice displayed on the product.

Section five. Manufacture and construction

19. Quality control in manufacture and construction

19.1 Concept of quality control. That aspect of quality assurance that concerns the practical means of securing product or service quality as set out in the specification for a product or a process. The term may be applied to the system of control or to the product or service being controlled.

19.1.1 *quality control.* The operational techniques and activities that sustain the product or service quality to specified requirements. It is also the use of such techniques and activities.

19.2 quality control surveillance. The overseeing of a supplier's quality control organization and methods by the customer, his representative or an independent organization.

19.3 process quality control. That part of quality control that is concerned with maintaining process variability within the required limits.

19.4 process capability. The limits of inherent variability within which a machine tool or other process operates as governed by the prevailing circumstances.

NOTE. The relationship between the process variability and the specification tolerance is termed 'relative precision'. (For further information see BS 2564).

19.5 product specification. The document that describes, for manufacturing purposes, the item concerned.

19.6 material specification. The document that describes in detail the materials, components, or supplies used in manufacturing the item.

19.7 process specification.

(a) *for discrete items.* The document that describes in detail the method of assembling or producing the item.

(b) *for bulk commodities.* The document that describes in detail the procedures and operations to be carried out on the materials used.

(c) *for plant.* The document that describes the control of facilities used in a treatment or sequence of treatments of the item or commodity.

19.8 concession. The authorization to use or release a limited quantity of material, components or stores already manufactured but not complying with the specified requirements.

19.9 statistical quality control. That part of quality control in which statistical techniques are used.

NOTE. These techniques include the use of frequency distributions, measures of central tendency and dispersion, control charts, acceptance sampling, regression analysis, tests of significance, etc.

19.10 control chart. A chart with upper and/or lower control limits on which are plotted values of some statistical measures for a series of samples or subgroups. The chart frequently shows a central line to assist detection of a trend of plotted values towards either control limits (see BS 1313 and BS 2564).

19.11 control limits. Limits on a control chart that are used as criteria for action, or for judging whether a set of data does or does not indicate lack of control.

19.12 process average (estimated). The average percentage defective or average number of defects per 100 items, whichever is applicable, submitted for original inspection.

20. Tolerances

20.1 Concept of tolerance. There is often confusion over the terms 'tolerance zone' and 'statistical tolerance interval'. Although closely linked they are *not* synonymous.

The first term relates generally to limiting (physical) requirements specified for, or imposed on, a particular characteristic (e.g. a dimension of an item may be specified as 50 ± 2 mm, giving a tolerance zone of 48 mm to 52 mm).

On the other hand, a 'statistical tolerance interval' relates to a statistical concept and is a function of inherent variability, the limits of which are often referred to as 'natural limits of a process'. As such it relates directly to 'process capability'.

In formal terms a 'tolerance zone' is the zone of values in which a measurable characteristic is in conformity with its specification. A 'statistical tolerance interval' is an interval for which it can be stated with a given level of confidence that it contains at least a specified proportion of the population or totality of items (for further information see BS 2846 : Part 3).

20.1.1 *specification tolerance.* The permitted variation in a process or a characteristic of an item.

NOTE. The relationship between the process variability and the specification tolerance is termed 'relative precision'. (For further information see BS 2564.)

Section six. Inspection and test

21. Inspection and test

21.1 inspection. The process of measuring, examining, testing, gauging, or otherwise comparing the item with the applicable requirements.

21.2 inspection specification. The document that describes in detail the methods of inspection including, if necessary, the basis for consequent action.

21.3 test. A critical trial (often involving stress, see **17.10**) or examination of one or more properties or characteristics of a material, product, or set of observations.

21.4 test specification. The document that describes in detail the methods of conducting tests including, if necessary, the criteria for assessing the result.

NOTE. A test specification may contain clauses for conformity and reliability assessment.

21.5 type test. A test or series of tests directed towards approval of a design, conducted to determine whether an item is capable of meeting the requirements of the product specification.

21.6 type approval. The status given to a design that has been shown by type tests to meet all the requirements of the product specification and which is suitable for a specific application.

21.7 qualification test. A test or series of tests directed towards establishing the competence of the manufacturer to produce the item.

NOTE. For further information see figure 3.

21.8 qualification approval. The status given to a manufacturer's production unit, whose product has been shown to meet all the requirements of the product specification and quality plan.

21.9 capability approval. Approval granted to a supplier for a range of items or services for which it has been demonstrated that his declared design rules, manufacturing processes and quality control are capable of producing items or services, the quality of which meets the specified requirements.

NOTE. This definition is the same as that given in BS 9000.

21.10 in-process inspection. Product inspection carried out at various discrete stages in manufacture.

21.11 patrol inspection. Inspection carried out during routine or random visits to several production stages.

21.12 acceptance inspection. The inspection of items to decide whether the lot/batch offered is acceptable.

21.13 acceptance specification. The document that describes in detail the criteria for acceptance of the product.

21.14 inspection level. A code reference that serves as a means of entering certain sampling tables and governs the relative amount of inspection for a batch or lot size.

21.15 inspection lot. A definite quantity of items submitted for inspection.

NOTE. An inspection lot is normally manufactured by one supplier under conditions that are presumed uniform.

21.16 normal inspection. The inspection that is used when there is no reason to think that the quality of the product differs from that specified.

21.17 tightened inspection. The inspection, more severe than the normal inspection, that is used when the results of normal inspection of a number of lots/batches indicate that the quality of the product is worse than that specified.

21.18 reduced inspection. The inspection, less severe than the normal inspection, that is used when the results of normal inspection of a number of lots/batches indicate that the quality of the product is better than that specified.

21.19 original inspection. The first inspection of an item or lot/batch as distinct from an inspection resulting from a prior rejection.

21.20 100 % inspection. Inspection of all the items or of the whole material in a lot/batch for all the characteristics under consideration.

21.21 screening inspection. 100 % inspection carried out for the purpose of removing defective items from a lot that has been rejected.

21.22 receiving inspection. Inspection by the recipient of material or manufactured products.

21.23 attribute. A characteristic that is appraised in terms of whether it meets or does not meet a given requirement (e.g. go or not go).

21.24 variable. A characteristic that is appraised in terms of values on a continuous scale.

21.25 inspection by attributes. Inspection whereby certain characteristics of an item are assessed without measurement and classified as conforming or not conforming to specified requirements.

NOTE. When used in sampling schemes the number of non-conforming items is counted and this information can then be used as the basis for sentencing a lot/batch. The count can be of defects or defective items (see BS 6001).

21.26 inspection by variables. Inspection wherein certain characteristics of an item are evaluated against a numerical scale and are expressed as points along this scale.

NOTE. The distribution of these points is mathematically related to specified requirements to determine the degree of conformance of these characteristics (see BS 6002).

21.27 final inspection. The last inspection before delivery or acceptance.

Section seven. Sampling and decisions

22. Sampling

22.1 sampling scheme. An overall system containing a range of sampling plans and procedures, based on the mathematical theory of probability and statistics whereby the results of inspecting one or more samples is used to determine the acceptance or rejection of a lot/batch, or to assess its quality.

22.2 sampling plan. A statement of the sample sizes and decision criteria (e.g. acceptance or rejection numbers for inspection by attributes) applicable to a particular lot/batch in accordance with a particular sampling scheme.

22.3 sample size. The number of specimens in the sample.

NOTE. In a multi-stage sample the size is the total number of specimens at the conclusion of the final stage of sampling.

22.4 sampling procedure. Operational requirements and/or instructions relating to the use of particular sampling schemes and/or sampling plans.

22.5 sampling inspection. The inspection of a limited number of items or of a limited quantity of material, taken at random from the lot or batch according to a prescribed sampling plan.

22.6 sampling verification. The establishment by a systematic sampling scheme that the producer's sampling procedures accord with his declared sampling scheme and fairly ascertain the quality of the goods under assessment.

22.7 acceptance sampling. Sampling inspection in which decisions are made to accept or reject the product.

NOTE 1. As defined above, the alternative to acceptance is rejection, although in practice the alternative may take some form other than outright rejection.

NOTE 2. In lot-by-lot sampling, acceptance and rejection relate to individual lots. In continuous sampling, acceptance and rejection relate to individual units or to blocks of consecutive items, depending on the stated procedure.

22.8 continuous sampling plan. A sampling plan formulated for the particular circumstances of continuous production.

22.9 single sampling. A type of sampling that consists of taking only one sample from a lot/batch.

22.10 double sampling. A type of sampling that may require the taking of a second sample according to the information given by the first.

22.11 multiple sampling. A type of sampling that may require the taking of up to k successive samples, the decision on taking the ith sample ($i \leqslant k$) being dependent on the information given by the (i - 1) previous samples.

22.12 sequential sampling. A type of sampling that requires the taking of successive items, or sometimes successive groups of items, but without fixing their number in advance, the decision to accept or reject the lot/batch being taken as soon as the results permit, according to the sampling plan.

22.13 stratified sampling. A type of sampling in which the population is divided into different sub-populations (called 'strata') and sampling is then carried out so that specified proportions of the sample are drawn from the different strata.

23. Decisions in sampling inspection

23.1 Concept of acceptable quality level (AQL). When a consumer designates some specific value of AQL for a certain characteristic or group of characteristics, he indicates to the supplier that his (the consumer's) acceptance sampling plan will accept the great majority of the lots that the supplier submits, provided that the process average level of per cent defective in these lots is no greater than the designated value of AQL. Thus the AQL is a designated value of per cent defective (or defects per 100 units) that the consumer indicates will be accepted for most of the time by the acceptance sampling procedure to be used.

The AQL alone does not describe the protection to the consumer for individual lots, but more directly relates to what might be expected from a series of lots, provided that the steps called for in the reference AQL system of procedure are taken. It is necessary to refer to the operating characteristic curve of the sampling plan that the consumer will use, or to the AOQL of the plan, to determine what protection the consumer will have (see BS 6000).

23.1.1 *acceptable quality level (AQL).* The maximum per cent defective (or the maximum number of defects per 100 units) that, for purposes of acceptance sampling, can be considered satisfactory as a process average.

23.2 average outgoing quality (AOQ). The fraction defective or the number of defects per 100 items of the product obtained after inspection, including not only lots accepted by the sampling plan, but also lots, rejected by the plan, that have been given 100 % inspection, and in which all defective items have been replaced by non-defective items.

23.3 average outgoing quality limit (AOQL). For a given sampling plan, the maximum value of the average outgoing quality (AOQ) for all possible incoming fractions defective.

23.4 quality level. A general indication of the extent of departure from the ideal: usually a numerical value indicating either the degree of conformity or the degree of non-conformity, especially in sampling inspection.

NOTE. Quality level is a term used in a comparative sense. Where possible a more precise term should be used, e.g. 'proportion effective', 'fraction effective', 'fraction defective', 'acceptable quality level', 'limiting quality', 'average outgoing quality limit'.

23.5 limiting quality. In a sampling plan, the fraction defective that corresponds to a specified and relatively low probability of acceptance.

NOTE. When expressed as per cent defective, it may be referred to as 'lot tolerance per cent defective' ('LTPD').

23.6 lot tolerance per cent defective (LTPD). See preceding note.

23.7 acceptance. Agreement to take a lot as offered.

23.8 acceptance number (Ac). In sampling inspection by attributes, the highest number of defects or defective items found in the sample that permits the acceptance of the lot.

23.9 acceptability constant (k). A constant dependent on the specified value of the acceptable quality level and the sample size.

NOTE. Acceptability constant is used as decision criterion in sampling by variables (for further information see BS 6002).

23.10 rejection/reject. Refusal to accept an item or lot as offered.

23.11 rejection number (Re). In sampling inspection by attributes, the lowest number of defects or defective items found in the sample that requires the rejection of the lot.

23.12 fraction defective. The number of defective items divided by the total number of items inspected. Multiplied by 100, the fraction defective gives the 'per cent defective'.

NOTE 1. Fraction defective is sometimes termed 'proportion defective'. Fraction effective and proportion effective are complementary to the above.

NOTE 2. Fraction defective can apply to a sample or a lot.

Section eight. Certification

24. Certification

24.1 Concept of certification. Certification is an area in which quality assurance impinges on regulations, approvals and requirements for manufacturers to satisfy legal obligations. It is a means by which a producer can demonstrate compliance with these constraints (see **24.1.1**).

NOTE. For further information see ISO Guide 2.

24.1.1 *certification.* The authoritative act of documenting compliance with requirements.

NOTE. The requirements can relate to personnel, processes, products, organizations and services.

24.2 certification body. An impartial body, governmental or non-governmental, possessing the necessary competence and reliability to operate a certification system, and in which the interests of all parties concerned with the functioning of the system are represented.

24.3 certification system. A system having its own rules of procedure and management for carrying out conformity certification.

24.4 certificate of conformity. A document signed by a qualified party affirming that, at the time of assessment, the product or service met the stated requirements.

NOTE. 'Release certificate', 'release note', 'certificate of compliance' and 'certificate of conformance', are considered to be synonymous with 'certificate of conformity'.

Section nine. Quality deficiencies

25. Quality deficiencies in manufacture and construction

25.1 Concept of defect and its relationship with failure. Defects or defectives relate to items not complying with the requirements of specifications, where the non-compliance is the responsibility of a manufacturer or supplier.

The concept of failure relates to reliability which, in general, concerns performance in service, normally under the control of a purchaser rather than a supplier or a manufacturer. Consequently the classification of failure is of particular importance not only for determining causes, but also for the allocation of responsibility for corrective action or compensation.

Some failures are caused by defects introduced during manufacture, but this may not be apparent at the time when the failure occurs. It is recommended, therefore, that in the reliability field the term 'defect' should not be used when first reporting an incident (a failure), but that it should be reserved for use as the explanation of the incident when this has been positively identified as being the responsibility of the manufacturer, supplier or installer.

A classification of defect is the distinguishing of possible defects of the item classified according to their seriousness. Defects will normally be grouped into one or more of the following classes; however, defects may be grouped into other classes (e.g. A, B, C) or into subclasses within these classes.

In this standard no change has been made to the definition of defect from that given in the first edition of BS 4778, but a note has been added indicating the restricted use of the term.

25.1.1 *defect.* Any non-conformance of an item to specified requirements.

NOTE 1. Defect is restricted to the requirements of manufacturing, assembly, installation and final test.

NOTE 2. This term may require a different definition when used in connection with product liability.

25.2 critical defect. A defect that analysis, judgement and experience indicates is likely to result in hazardous or unsafe conditions for individuals using, maintaining or depending upon the product or that is likely to prevent performance of the function of a major end item.

25.3 major defect. A defect, other than a critical defect, that is likely to result in a failure, or to reduce materially the ability to use the item for its intended purpose.

25.4 minor defect. A defect that is not likely to reduce materially the ability to use the item for its intended purpose, or that is a departure from established specifications having little bearing on the effective use or operation of the product.

25.5 defective item. An item containing one or more defects.

NOTE. This term may require a different definition when used in connection with product liability.

25.6 critically defective item. An item that contains one or more critical defects; it may also contain major or minor defects.

25.7 major defective item. An item that contains one or more major defects; it may also contain minor defects but no critical defects.

25.8 minor defective item. An item that contains one or more minor defects but no critical or major defects.

25.9 assignable cause. A factor (usually systematic) that can be detected and identified as contributing to a change in a quality characteristic.

25.10 random effects. Unavoidable changes in a quality characteristic inherent in a process.

NOTE. The causes of these changes are not identifiable.

Section ten. Reliability

NOTE. In **26.1** to **38.2** (definitions relating to reliability) the word 'time' may be replaced by 'distance', 'cycles', or other quantities or units as may be appropriate.

26. Reliability : general

26.1 Concept of reliability. Reliability as a concept is a special development of the engineering industries, in particular the electronics and aerospace industries. In the practice of these industries reliability is used as the collective name for those measures of quality that reflect the effect of time in storage or use of a product, as distinct from those measures that show the state of the product at the time of delivery. Other industries are equally concerned with the time aspect of the quality of their products, but the reliability concept is expressed in other terms. For example, in food products, storage life is an important reliability characteristic but the subject is seldom referred to under the name of reliability (for further guidance see BS 5760).

26.1.1 *reliability* (general sense). The ability of an item to perform a required function under stated conditions for a stated period of time.

NOTE. The term 'reliability' is also used as a reliability characteristic denoting a probability of success or success ratio.

26.2 Importance of reliability. Purchasers are tending to demand more comprehensive specifications of goods and services they wish to purchase, so that not only do they require to be informed of how a product should be used and/or maintained: they also require some indication of how long they can expect it to remain serviceable and the rate at which chance failures may occur (primarily because of the financial implications involved, i.e. its cost effectiveness).

Reliability (one of the measures of quality, see figure 1) exists as an objective or a requirement of a product from its inception to the end of its working life. The creation of reliability lies essentially in the sphere of design. On products in which reliability is of prime importance, quantitative requirements should be included in the functional specification. Traditionally, satisfactory reliability has been achieved by the evolution of design procedures, codes of practice or methods of working that have been shown by experience to give good results. Consequently, the vast majority of products in use today are usually referred to as 'reliable' or 'unreliable' in the qualitative sense.

26.3 general statement on the probabilistic nature of reliability. Reliability is concerned with the probability of future events based on past observations. Any reliability characteristic term may thus be used in respect of what has been observed and what may happen, the latter use being defined in terms of a probability.

26.4 durability. The ability of an item to perform its required function under stated conditions of use and under stated conditions of preventive or corrective maintenance until a limiting state is reached.

NOTE. In some cases the stated conditions of use may include a stated succession or combination of stresses.

27. Failure

27.1 Concept of failure. The word 'failure' is the basic term denoting the termination of a required function. It is applied to parts and equipment in all circumstances. (See also 'concept of defect' **25.1.**)

27.1.1 *failure.* The termination of the ability of an item to perform a required function.

27.2 failure cause. The circumstances during design, manufacture, assembly, installation, or use that have led to failure.

27.3 failure mode. The effect by which a failure is observed.

27.4 failure mechanism. The physical, chemical or other process that results in failure.

27.5 failure criteria. Limited conditions relating to the admissibility of the deviation from the characteristic value due to changes after the beginning of stress. These conditions refer to the gravity and, in the case of temporary changes, also to the duration.

27.6 change

(a) *General.* Disagreement of the observed state of a characteristic at a certain time with the observed state of this characteristic at a previous time.

(b) *For measurable characteristics.* Differences between the observed value of a characteristic at a certain time and the observed value of this characteristic at a previous time.

27.7 restorable change. Change that can be reversed by a special measure (restoration stress).

27.8 reversible change. Change in which a characteristic value is unambiguously correlated with an influencing quantity.

28. Failure classification

28.1 Concept of failure classification. In practice some kinds of failure are more important than others and it is necessary to distinguish between them. This is done in this document by adding an adjective to the word 'failure'. For example a complete failure is the complete lack of the required function. A partial failure is an event which results in one or more deviations in characteristics, but not such as to cause complete lack of the required function. A failure term applies only to the item under consideration, but if the failure is judged by its effect on another item, a different term may be involved. Thus a complete failure of a particular part may cause only a partial failure of the equipment of which it is a part.

When dealing with failure data on equipment in the field it is important to distinguish between parts that fail as a result of misuse and those that fail due to a weakness in the part itself. Unless this distinction is made, action to reduce an unacceptably high proportion of failures may be misdirected. It is therefore recommended that failure statements should indicate which kind of failure is being considered or whether, as often happens, it will have to be presumed that both weakness and misuse failures are involved and that they cannot readily be distinguished.

28.2 Classification of failure as to cause

28.2.1 *misuse failure.* Failure attributable to the application of stresses beyond the stated capabilities of the item.

28.2.2 *inherent weakness failure.* Failure attributable to weakness inherent in the item itself when subjected to stresses within the stated capabilities of the item.

NOTE. Such a failure may be due to the design, in which case all specimens would be expected to fail from this cause, or it may be due to an abnormality in the materials or process of manufacture, in which case only specimens containing such an abnormality would be expected to fail.

28.2.3 *wear-out failure.* Failure whose probability of occurrence increases with the passage of time and which occurs as a result of failure mechanisms that are characteristic of the population.

28.3 Classification of failure as to degree

28.3.1 *partial failure.* Failure resulting from deviations in characteristic(s) beyond specified limits, but not such as to cause complete lack of the required function.

NOTE. The limits referred to in this category are special limits specified for this purpose.

28.3.2 *complete failure.* Failure resulting from deviations in characteristic(s) beyond specified limits such as to cause complete lack of the required function.

NOTE. The limits referred to in this category are special limits specified for this purpose.

28.4 Classification of failure as to suddenness

28.4.1 *sudden failure.* Failure that could not be anticipated by prior examination or monitoring.

28.4.2 *gradual failure.* Failure that could be anticipated by prior examination or monitoring.

28.4.3 *intermittent failure.* Failure of an item for a limited period of time, following which the item recovers its required function without being subjected to any external corrective action.

NOTE. Such a failure is often recurrent.

28.5 Classification of failure as to relevance

28.5.1 *relevant failure.* Failure that is to be included in interpreting test results or in calculating the value of a reliability characteristic.

NOTE. The criteria for the inclusion should be stated.

28.5.2 *non-relevant failure.* Failure that is to be excluded in interpreting test results or in calculating the value of a reliability characteristic.

NOTE. The criteria for the exclusion should be stated.

28.6 Classification of failure as to consequence

28.6.1 *critical failure.* Failure of an item that is likely to cause injury to persons or significant damage to material.

28.6.2 *major failure.* Failure of an item, other than a critical failure, that is likely to reduce the ability of a more complex item to perform its required function.

28.6.3 *minor failure.* Failure of an item, other than a critical failure, that does not reduce the ability of a more complex item to perform its required function.

28.7 Classification of failure as to dependence

28.7.1 *primary failure.* Failure of an item not caused either directly or indirectly by the failure of another item.

28.7.2 *secondary failure.* Failure of an item caused either directly or indirectly by the failure of another item.

29. Occurrence of failure

29.1 early failure period. That possible early period, beginning at a stated time and during which the failure rate decreases rapidly in comparison with that of a subsequent period.

NOTE 1. Figure 4 shows the failure rate pattern when the terms of **29.1**, **29.2** and **29.3** all apply to the item.

NOTE 2. In any particular case it is necessary to explain what is meant by 'decreases rapidly'.

29.2 'constant' failure rate period. That possible period during which the failures occur at an approximately uniform rate.

NOTE 1. Figure 4 shows the failure rate pattern when the terms of **29.1**, **29.2** and **29.3** all apply to the item.

NOTE 2. In any particular case it is necessary to explain what is meant by approximately uniform rate.

29.3 wear-out failure period. That possible period during which the failure rate increases rapidly in comparison with the preceding period.

NOTE 1. Figure 4 shows the failure rate pattern when the terms of **29.1**, **29.2** and **29.3** all apply to the item.

NOTE 2. In any particular case it is necessary to explain what is meant by 'increases rapidly'.

29.4 useful life. The period from a stated time, during which, under stated conditions, an item has an acceptable failure rate, or until an unrepairable failure occurs.

NOTE. The useful life of an item may also be determined for other reasons.

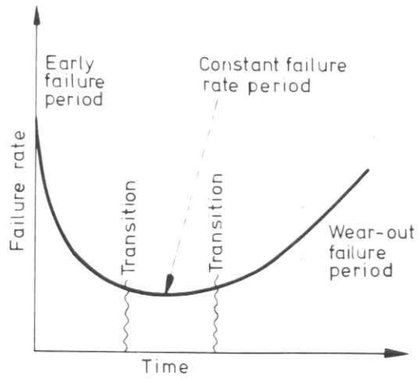


Figure 4. Example of failure/time pattern

30. Reliability tests

30.1 endurance test. An experiment carried out over a period of time to investigate how the properties of an item are affected by the application of stated stresses.

30.2 environment. All external physical conditions that may influence the performance of an item.

30.3 environmental test. Product testing under specified conditions of environment that are likely to affect performance.

30.4 step stress test. A test consisting of several stress levels applied sequentially for periods of equal duration to one sample. During each period a stated stress level is applied and the stress level is increased from one period to the next.

30.5 accelerated test. A test in which the applied stress level is chosen to exceed that stated in the reference conditions in order to shorten the time required to observe the stress response of the item, or magnify the responses in a given time. To be valid, an accelerated test shall not alter the basic modes and mechanisms of failure, or their relative prevalence.

30.6 acceleration factor. The ratio between the times necessary to obtain the same stated proportion of failures in two equal samples under two different sets of stress conditions involving the same failure modes and mechanisms.

30.7 reliability compliance test. An experiment carried out to show whether or not the value of a reliability characteristic of an item complies with its stated reliability requirements.

30.8 reliability determination test. An experiment carried out to determine the value of a reliability characteristic of an item.

NOTE. Analysis of available data may also be used for reliability determination.

30.9 laboratory reliability test. A reliability compliance or determination test made under prescribed and controlled operating and environmental conditions that may or may not simulate field conditions.

30.10 field reliability test. A reliability compliance or determination test made in the field where operating, environmental, maintenance and measurement conditions are recorded.

30.11 failure rate acceleration factor. The ratio of the accelerated testing failure rate to the failure rate under stated reference test conditions. Both failure rates refer to the same time period in the life of the tested items.

31. Reliability characteristics

31.1 Concept of reliability characteristics. Reliability characteristics are quantities used to express reliability in numerical terms.

The significance of reliability characteristic terms, for example failure rate, depends on the statistical treatment or technical assumptions made in particular circumstances. In order to clarify which variation is being used, each is given a different name. For example, the term 'observed failure rate' relates to the failure rate observed under a given set of circumstances, and the definition requires that the number of specimens, duration, failure definition, etc. will all have to be stated. If appropriate statistical treatment is given to an observed failure rate, the results are the limiting values of a confidence interval within which the true failure rate lies. This is called the 'assessed failure rate'. The extension of this approach to other variations of the reliability characteristic terms is shown in figure 5.

When the adjective 'assessed' is used, this is to be understood in the statistical sense.

Where 'observed' values of characteristics are used they are estimates of the true values, but not necessarily the best estimates.

Six characteristics of reliability are:

1. Reliability
2. Mean life
3. Failure rate
4. Mean time to failure
5. Mean time between failure
6. Q-percentile life

NOTE. The four variations (observed, assessed, extrapolated and predicted) of a reliability characteristic may be used in respect of what has been achieved and of what is required. Thus a statement of the requirement may be made as a target for the observed, assessed, etc. failure rate.

31.2 Reliability (characteristic sense)

31.2.1 *observed reliability of non-repaired items.* For a stated period of time, the ratio of the number of items that performed their functions satisfactorily at the end of the period to the total number of items in the sample at the beginning of the period.

31.2.2 *observed reliability of repaired item or items.* The ratio of the number of occasions on which an item or items performed their functions satisfactorily for a stated period of time to the total number of occasions the item or items were required to perform for the same period.

NOTE. The criteria for what constitutes a satisfactory function have to be stated.

31.2.3 *assessed reliability.* The reliability of an item determined by a limiting value or values of the confidence interval associated with a stated confidence level, based on the same data as the observed reliability of nominally identical items.

NOTE 1. The source of the data has to be stated.

NOTE 2. Results can be accumulated (combined) only when all conditions are similar.

NOTE 3. The assumed underlying distribution of failures against time has to be stated.

NOTE 4. It should be stated whether a one-sided or a two-sided interval is being used.

NOTE 5. Where one limiting value is given this is usually the lower limit.

31.2.4 *extrapolated reliability.* Extension by a defined extrapolation or interpolation of the observed or assessed reliability for duration and/or conditions different from those applying to the observed or assessed reliability.

NOTE. The validity of the extrapolation has to be justified.

31.2.5 *predicted reliability.* For the stated conditions of use, and taking into account the design of an item, the reliability computed from the observed, assessed, or extrapolated reliabilities of its parts.

NOTE. Engineering and statistical assumptions have to be stated, as well as the bases used for the computation (observed or assessed).

31.3 Mean life (for non-repaired items)

31.3.1 *observed mean life.* The mean value of the lengths of observed times of failure of all items in a sample under stated conditions.

NOTE. The criteria for what constitutes a failure have to be stated.

31.3.2 *assessed mean life.* The mean life of an item determined by a limiting value or values of the confidence interval associated with a stated confidence level, based on

the same data as the observed mean life of nominally identical items.

NOTE 1. The source of the data has to be stated.

NOTE 2. Results can be accumulated (combined) only when all conditions are similar.

NOTE 3. The assumed underlying distribution of failure against time has to be stated.

NOTE 4. It should be stated whether a one-sided or a two-sided interval is being used.

NOTE 5. Where one limiting value is given this is usually the lower limit.

31.3.3 *extrapolated mean life.* Extension by a defined extrapolation or interpolation of the observed or assessed mean life for stress conditions different from those applying in the observed or assessed mean life.

NOTE. The validity of the extrapolation has to be justified.

31.3.4 *predicted mean life.* For the stated conditions of use, and taking into account the design of an item, the mean life computed from the observed, assessed or extrapolated mean life of its parts.

NOTE. Engineering and statistical assumptions have to be stated, as well as the bases used for the computation (observed or assessed).

31.4 Failure rate

31.4.1 *observed failure rate.* For a stated period in the life of an item, the ratio of the total number of failures in a sample to the cumulative observed time on that sample. The observed failure rate is to be associated with particular and stated time intervals (or summation of intervals) in the life of the item, and with stated conditions.

NOTE 1. The criteria for what constitutes a failure has to be stated.

NOTE 2. 'Cumulative time' is the sum of the times during which each individual item has been performing its required function under stated conditions.

31.4.2 *assessed failure rate.* The failure rate of an item determined by a limiting value or values of the confidence interval associated with a stated confidence level, based on the same data as the observed failure rate of nominally identical items.

NOTE 1. The sources of the data have to be stated.

NOTE 2. Results can be accumulated (combined) only when all conditions are similar.

NOTE 3. The assumed underlying distribution of failures against time has to be stated.

NOTE 4. It should be stated whether a one-sided or a two-sided interval is being used.

NOTE 5. Where one limiting value is given this is usually the upper limit.

31.4.3 *extrapolated failure rate.* Extension by a defined extrapolation or interpolation of the observed or assessed failure rate for duration and/or conditions different from those applying to the observed or assessed failure rate.

NOTE. The validity of the extrapolation has to be justified.

31.4.4 *predicted failure rate.* For the stated conditions of use, and taking into account the design of an item, the failure rate computed from the observed, assessed or extrapolated failure rates of its parts.

NOTE. Engineering and statistical assumptions have to be stated, as well as the bases for the computation (observed or assessed).

31.4.5 *failure rate level.* For the assessed failure rate, a value chosen from a specific series of failure rate values and used for stating requirements for the presentation of test results.

NOTE. In a requirement, failure rate level denotes the highest permissible assessed failure rate.

31.5 Mean time to failure (for truncated tests of non-repaired items) (MTTF)

31.5.1 *observed mean time to failure.* For a stated period in the life of an item, the ratio of the cumulative time for a sample to the total number of failures in the sample during the period under stated conditions.

NOTE 1. The criteria for what constitutes a failure have to be stated.

NOTE 2. 'Cumulative time' is the sum of the times during which each individual item has been performing its required function under stated conditions.

NOTE 3. Observed mean time to failure is the reciprocal of the observed failure rate during the period.

31.5.2 *assessed mean time to failure.* The mean time to failure of an item determined by a limiting value or values of the confidence interval associated with a stated confidence level based on the same data as the observed mean time to failure of nominally identical items.

NOTE 1. The source of the data has to be stated.

NOTE 2. Results can be accumulated (combined) only when all conditions are similar.

NOTE 3. The assumed underlying distribution of failures against time has to be stated.

NOTE 4. It should be stated whether a one-sided or a two-sided interval is being used.

NOTE 5. Where one limiting value is given this is usually the lower limit.

31.5.3 *extrapolated mean time to failure.* Extension by a defined extrapolation or interpolation of the observed or assessed mean time to failure for durations and/or conditions different from those applying to the observed or assessed mean time to failure.

NOTE. The validity of the extrapolation has to be justified.

31.5.4 *predicted mean time to failure.* For the stated conditions of use, and taking into account the design of an item, the mean time to failure computed from the observed, assessed or extrapolated mean times to failure of its parts.

NOTE. Engineering and statistical assumptions have to be stated, as well as the bases used for the computation (observed or assessed).

31.6 Mean time between failures (for repaired items) (MTBF)

31.6.1 *observed mean time between failures.* For a stated period in the life of an item, the mean value of the length of time between consecutive failures computed as the ratio of the cumulative observed time to the number of failures under stated conditions.

NOTE 1. The criteria for what constitutes a failure have to be stated.

NOTE 2. Cumulative time is the sum of the times during which each individual item has been performing its required function under stated conditions.

NOTE 3. This is the reciprocal of the observed failure rate during the period.

31.6.2 *assessed mean time between failures.* The mean time between failures of an item determined by a limiting value or values of the confidence interval associated with a stated confidence level based on the same data as the observed mean time between failures of nominally identical items.

NOTE 1. The source of the data has to be stated.

NOTE 2. Results can be accumulated (combined) only when all conditions are similar.

NOTE 3. The assumed underlying distribution of failures against time have to be stated.

NOTE 4. It should be stated whether a one-sided or a two-sided interval is being used.

NOTE 5. Where one limiting value is given this is usually the lower limit.

31.6.3 *extrapolated mean time between failures.* Extension by a defined extrapolation or interpolation of the observed or assessed mean time between failures for duration and/or conditions different from those applying to the observed or assessed mean time between failures.

NOTE. The validity of the extrapolation has to be justified.

31.6.4 *predicted mean time between failures.* For the stated conditions of use, and taking into account the design of an item, the mean time between failures computed from the observed, assessed, or extrapolated failure rates of its parts.

NOTE. Engineering and statistical assumptions have to be stated, as well as the bases used for the computation (observed or assessed).

31.7 *Q*-percentile life (for non-repaired items)

31.7.1 *observed Q-percentile life.* The length of observed time at which a stated proportion (*Q* %) of a sample of items has failed.

NOTE 1. The criteria for what constitutes a failure have to be stated.

NOTE 2. The *Q*-percentile life is also that life at which (100−*Q*) % reliability is observed.

31.7.2 *assessed Q-percentile life.* The *Q*-percentile life determined as a limiting value or values of the confidence interval with a stated confidence level based on the same data as the observed *Q*-percentile life of nominally identical items.

NOTE 1. The source of the data has to be stated.

NOTE 2. Results can be accumulated (combined) only when all conditions are similar.

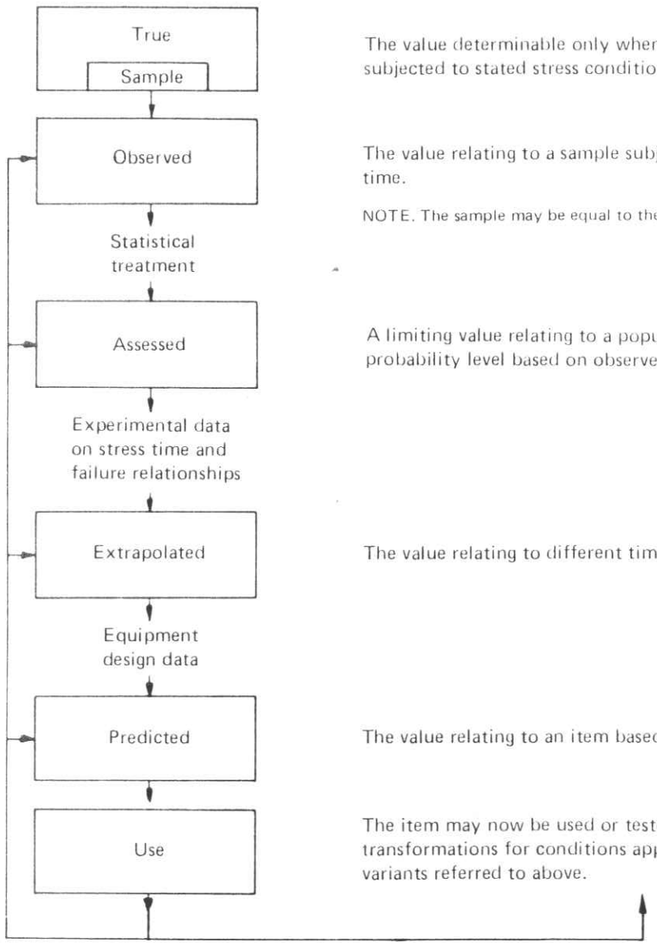
NOTE 3. The assumed underlying distribution of failures against time has to be stated.

NOTE 4. It should be stated whether a one-sided or two-sided interval is being used.

NOTE 5. Where one limiting value is given this is usually the lower point.

31.7.3 *extrapolated Q-percentile life.* Extension by a defined extrapolation or interpolation of the observed or assessed *Q*-percentile life for stress conditions different from those applying to the assessed *Q*-percentile life and for different percentages.

NOTE. The validity of the extrapolation has to be justified.



The diagram shows the general relationship among variants of reliability characteristics, for example, the possible variants of failure rate, mean time between failures, mean time to failure and mean life.

Figure 5. General relationship among kinds of reliability characteristic terms

31.7.4 *predicted Q-percentile life.* For the stated conditions of use, and taking into account the design of an item, the computed *Q*-percentile life based on the observed, assessed or extrapolated *Q*-percentile lives of its parts.

NOTE. Engineering and statistical assumptions have to be stated, as well as the bases used for the computation (observed or assessed).

32. Reliability data

32.1 Concept of reliability data. Reliability data are quantitative data used for the purpose of analysing an existing reliability situation or for making a prediction of a reliability characteristic. Depending on the precision required, the data may be limited by the use of any of the failure classification terms given in clause **28**.

32.1.1 *reliability data.* Data on characteristics permitting quantitative evaluation of reliability.

NOTE. The term includes data on conditions given together with the operational task of an item, such as stress, duration, maintenance organization and the related quantities of the reliability data.

32.2 test data. Data from observations during tests.

NOTE. All conditions should be stated in detail, for example, time/stress conditions and failure or success criteria.

32.3 field data. Data from observations during field use.

NOTE. The time, stress conditions, and failure or success criteria should be stated in detail.

32.4 initials. Number of items at the start of observation.

NOTE. The start of observation will generally coincide with the beginning of stress.

32.5 survivals. Number of items of the initials that have not failed at an instant of time.

32.6 relative survivals. Quotient of survivals to initials.

32.7 survival function. Connection between relative survivals and time.

32.8 failure frequency. Absolute value of the difference of the relative survivals at the beginning and the end of a period of time.

32.9 failure density. Quotient of failure frequency to same period of time.

32.10 failure frequency distribution. Connection between failure frequency and time.

NOTE. This term is sometimes shortened to 'failure distribution'.

32.11 cumulative failure frequency. Sum of failure frequencies up to a given time.

32.12 distribution of cumulative failure. Connection between sum of failure frequency and time.

32.13 temporary failure frequency. Complement-to-1 of the quotient of survivals at the end to survivals at the beginning of a period of time.

32.14 failure quota. Quotient of a temporary failure frequency to a period of time.

Section eleven. Maintainability

33. Maintainability

33.1 Concept of maintainability and maintenance. Many items are designed to receive attention during their life with the object of compensating for the effects of wear, or for the replacement of consumable supplies. The ease with which work of this kind can be done is called 'maintainability', and the operational function of the work is called 'maintenance'.

33.1.1 *maintainability.* The ability of an item, under stated conditions of use, to be retained in, or restored to, a state in which it can perform its required functions, when maintenance is performed under stated conditions and using prescribed procedures and resources.

NOTE 1. Maintainability can, depending on the particular analysis situation, be stated by one of several maintainability characteristics, such as discrete probability distribution, mean active maintenance time, etc.

NOTE 2. The value of the maintainability characteristics may differ for different maintenance situations.

NOTE 3. When the term 'maintainability' is used as a maintainability characteristic it refers to the fact that the maintenance actions may or may not be carried out within a given period of time.

NOTE 4. The required function may be defined as a stated condition.

33.2 maintainability requirements. A statement of the principal means and frequency of preventing an item from failing or of restoring its function when it has failed.

33.3 observed maintainability. The ratio of the number of maintenance actions which were performed in an active maintenance time less than the stated maintainability requirement to the total number of maintenance actions performed under stated conditions and in the period of observation.

33.4 predicted maintainability. The maintainability of an item calculated by taking into account the observed, assessed or extrapolated reliability and the observed or predicted maintainability of its parts and other relevant factors according to the stated conditions.

Section twelve. Maintenance

34. Maintenance

34.1 maintenance. The combinations of all technical and corresponding administrative actions intended to retain an item in, or restore it to, a state in which it can perform its required function.

NOTE. The required function may be defined as a stated condition.

34.2 maintenance specification. The document that describes in detail the procedure and circumstances for carrying out maintenance.

NOTE. This document may be in the form of a manual.

34.3 preventive maintenance. The maintenance carried out at predetermined intervals or corresponding to prescribed criteria and intended to reduce the probability of failure or the performance degradation of an item.

34.4 corrective maintenance. The maintenance carried out after a failure has occurred and intended to restore an item to a state in which it can perform its required function.

35. Maintenance time periods

NOTE. Figure 6 shows the relationship between the various phases in the total time of a maintained item and some of the elements that make up these phases.

35.1 up time. The period of time during which an item is in a condition to perform its required function.

35.2 down time. The period of time during which an item is not in a condition to perform its required function.

NOTE 1. The down time of an item will be made up of active maintenance time and delays due to awaiting labour, spares, facilities, movement, etc.

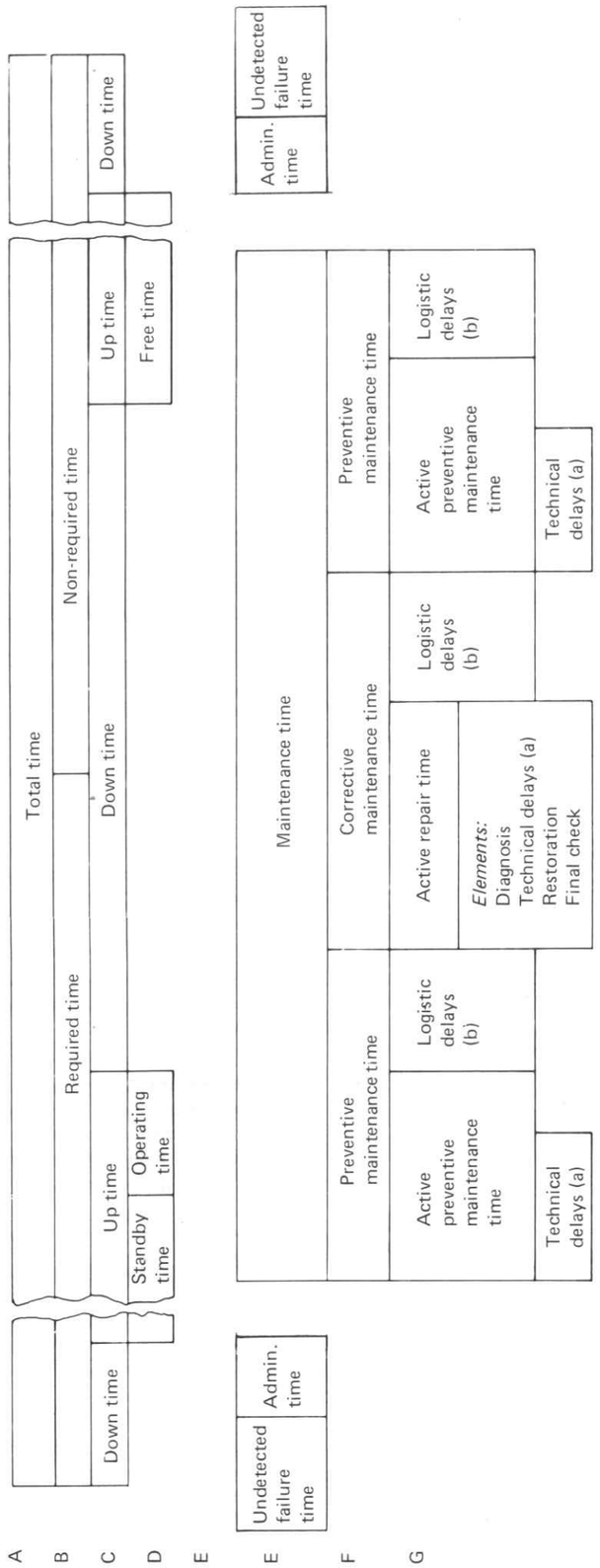
NOTE 2. Unless otherwise stated, down time of an item, due to failure, is considered to commence at the instant the item is determined to have failed.

Concept of time in connection with maintenance. The diagram represents the case of a typical piece of equipment in order to show the general relationship. In specific cases of equipment and conditions the drawing of a more complex or a more simplified diagram may be appropriate or necessary. This may also be needed when times are to be shown in strict time order.

Attention is drawn to the fact that some times related to activities in a maintenance action are not yet defined, neither the activities themselves nor the times. This is also valid for indicated times related to delays.

No significance is to be attributed to the lengths of the boxes containing the phase names, the lengths being determined by the space needed. The diagram incorporates the facility to show overlapping times.

The diagram should be read from the top line, A, downwards. The upper lines, A, B and C, may be considered to extend outwards to left and right, and to embrace an indefinite series of cycles of required/non-required times and up/down times, if necessary.



(a) Typical technical delays include setting time, cooling, interpretation and application of information, the interpretation of displays, read-outs, etc.
(b) Typical logistic delays include awaiting spares, equipment, information or environmental conditions.

Figure 6. Time periods in connection with maintenance

NOTE 3. Unless otherwise stated, down time will include any additional time necessary to reach the same state in the working programme of the item as at the time of failure.

35.3 operating time. The period of time during which an item performs its intended function.

35.4 full operating time. Operating time in which an item performs all its functions provided in their respective mode of application.

35.5 partial operating time. Operating time in which an item fulfils only a part of its functions provided for the actual case of application.

35.6 required time. The period of time during which the user requires the item to be in a condition to perform its required function.

35.7 non-required time. The period of time during which the user does not require the item to be in a condition to perform its required function.

35.8 free-time. That part of the non-required time during which an item is in a condition to perform its required function.

35.9 standby time. The period of time during which an item is needed to be in a condition to perform its required function but is not operated.

35.10 administrative time. The period of time during which an item has failed and during which corrective maintenance actions are pending or prepared but have not yet been initiated.

35.11 undetected failure time. The period of time between the instant of failure and its recognition.

35.12 beginning of stress. Point of time in which a specified stress is applied to an item for the first time.

35.13 stress cycle. A repeatable sequence of stresses.

35.14 operational cycle. A repeatable sequence of functional stresses.

35.15 instant of failure. The point of time at which the item fails.

35.16 maintenance time. The period of time during which maintenance actions, including delays inherent in the maintenance operations, are performed on an item either manually or automatically.

NOTE 1. The inherent delays include those attributable to design or to prescribed maintenance procedures.

NOTE 2. Maintenance may be carried out while the item is performing its intended function.

35.17 preventive maintenance time. That part of the maintenance time during which preventive maintenance is performed on an item, including the time attributable to logistic delays inherent in the preventive maintenance operations.

NOTE 1. The inherent delays include delays attributable to design or to prescribed maintenance procedures.

NOTE 2. Preventive maintenance time does not include any time taken to maintain an item which has been replaced.

35.18 corrective maintenance time. That part of the maintenance time, including that due to logistic delays, during which corrective maintenance is performed on an item.

35.19 active preventive maintenance time. That part of the preventive maintenance time, including technical delays inherent in the actions, during which preventive maintenance actions are performed on an item either manually or automatically.

35.20 active repair time. That part of the maintenance time in which corrective maintenance actions are performed on an item, including the time due to delays inherent in the repair operation.

NOTE 1. The inherent delays could, for example, include those attributable to design or to prescribed maintenance procedures.

NOTE 2. Active repair time does not include any time taken to repair an item that has been replaced as part of the corrective maintenance action under consideration.

NOTE 3. That part of corrective maintenance which involves test procedure may be performed either manually or automatically.

NOTE 4. Active repair time does not include any administrative, access to the item, or waiting times. The latter time categories are normally outside the control of the item supplier. Active repair time is generally stated in terms of a mean value and a maximum repair time associated with a specified percentile.

36. Maintenance characteristics

36.1 Concept of maintenance characteristics. The characteristics of maintenance operations are partly specific to the item concerned, and partly to the time element. The former do not belong to this document, but the time element consists of several phases that are common to many items which are defined in the following clauses.

36.2 observed mean maintenance time. The ratio of the sum of the active maintenance times to the total number of maintenance actions.

NOTE. The maintenance conditions applied have to be stated.

36.3 assessed mean maintenance time. The maintenance time determined as the limit or limits of the confidence interval associated with a stated confidence level and based on the same data as the observed mean maintenance time of nominally identical items.

NOTE 1. The source of the data has to be stated.

NOTE 2. Results can be accumulated (combined) only when all conditions are similar.

NOTE 3. It should be stated whether a one-sided or two-sided interval is being used.

NOTE 4. The assumed underlying distribution of maintenance times has to be stated with the reason for the assumption.

NOTE 5. When one value is given this is usually the upper limit.

NOTE 6. The maintenance conditions applied have to be stated.

36.4 predicted mean maintenance time. The mean maintenance time of an item calculated by taking into account the reliability characteristics and the mean maintenance time of all of its parts and other relevant factors according to the stated conditions.

NOTE 1. Maintenance policy, statistical assumptions and calculation methods have to be stated.

NOTE 2. The source of the data has to be stated.

NOTE 3. It is necessary to state whether the observed, assessed, extrapolated or predicted values of the mean maintenance time have been used.

Section thirteen. Availability

37. Availability

37.1 Concept of availability. The recognition of the fact that some items can be repaired when they fail, or their probability of failure can be reduced. The securing of the required function of an item is a combination of its reliability and its maintainability. The combination of these two elements is called 'availability'. The use of this term in this sense is to be distinguished from its use in connection with human resources, stores or stock considerations.

37.1.1 *availability.* The ability of an item (under combined aspects of its reliability, maintainability and maintenance support) to perform its required function at a stated instant of time or over a stated period of time.

NOTE 1. The term 'availability' is also used as an availability characteristic denoting either the probability of performing at a stated instant of time or the probability related to an interval of time.

NOTE 2. When availability is used as a characteristic it has to be associated with a modifier.

NOTE 3. The availability of an item does not necessarily imply that it is performing, but that it is in a state to perform.

38. Availability characteristics

38.1 observed mean availability. The ratio of the cumulative time for which an item has been in a condition to perform a required function to the cumulative time under observation, or at instants of time (chosen by a sampling technique), the mean of the proportion of a number of nominally identical items that have performed or have been in a condition to perform their required function.

NOTE 1. When one limiting value is given, unless otherwise stated this is usually the lower limit.

NOTE 2. The observed mean availability is to be associated with a stated period of time and with stated conditions of use and maintenance.

38.2 observed instantaneous availability. At a stated instant of time the proportion of occasions when an item has performed or has been in a condition to perform a required function.

NOTE 1. Occasions can refer to either a number of items at a single instant of time, or to one or more items at a series of instants.

NOTE 2. The run-up time is counted in down time when the equipment is brought into use for the first time.

NOTE 3. The observed instantaneous availability has to be associated with a period of time and with stated conditions of use and maintenance.

Appendix A

Some terms relating to quality assurance that can be found in other standards publications

A.1 BS 3138 : 1979 Glossary of terms used in work study organization and methods

ergonomics
interface
job evaluation
machine capacity
machine down time
method study
operator performance
organization study
standard time
system
value analysis
work balancing
work content
work measurement
work performance control
work specification
work study organization and methods

A.2 BS 3811 : 1974 Glossary of maintenance terms in terotechnology

emergency maintenance
examination
feedback
history card
overhaul
repair
servicing

A.3 BS 4335 : 1972 Glossary of terms used in project network techniques

activity
budget
budgetary control
cash flow
critical path analysis (CPA)
decision event
direct cost
event
indirect cost
network
project
resource
resource allocation
scheduling

A.4 BS 5191 : 1975 Glossary of production planning and control terms

advice note
assembly
design change
design change note
development cost
economic manufacturing quantity
final assembly
manufacturing time
method change note
modification
operation
Pareto analysis
product
production control
production planning
raw material
rectify, to
rework, to
reject note
resource
scheduling
scrap
stock control
subassembly

A.5 BS 5233 : 1975 Glossary of terms used in metrology

accuracy class
analogue (measuring) instrument
calibration
certified reference material
constant (or a measuring instrument); instrument constant
digital (measuring) instrument
direct method (of measurement)
indicated value (of a quantity); uncorrected result (of a measurement)
International System of units (SI)
legal metrology
measuring apparatus
methology
parallax error
quantity to be measured; measured quantity
reference material
reference standard
reference value
scatter (of indications or responses); dispersion (of indications or responses)
sensitivity (of a measuring instrument)
spread (range of dispersion) of indications (responses)
traceability
unit of measurement
working standard

A.6 BS 5532 : 1977 Statistics — Vocabulary and symbols

cumulative sum chart; cusum chart
histogram
normal distribution;
operating characteristic curve for a sampling plan (OC curve)
Poisson distribution
probability of acceptance
range
repeatability
reproducibility
standard deviation
standard error
statistical tolerance limits
Weibull distribution (type III extreme value distribution)

A.7 ISO Guide 2 General terms and their definitions concerning standardization and certification

consensus
standard
standardization
code of practice
regulation
technical regulation
harmonized standards
mandatory standard
reference to standards
reference to standards by exact definition
reference to standards by undated identification
general reference to standards

national standards body
international standards organization
regional standards organization
standardizing body
international standardizing body
regional standardizing body
national standard
international standard
regional standards
conformity to standards or technical specifications
administrative procedure for determining conformity

mark of conformity
conformity certification
national certification system
international certification system
regional certification system
third party certification system
self-certification
code
designation
marking
interchangeability
compatability
tolerance
variety control

Index

In this index references are to clause numbers and the method of alphabetization used is word-by-word.

Standards publications referred to
(See also clause 2)

BS 1313	Fraction-defective charts for quality control
BS 2564	Control chart technique when manufacturing to a specification, with special reference to articles machined to dimensional tolerances
BS 2846	Guide to statistical interpretation of data
BS 3138	Glossary of terms used in work study and organization and methods (O&M)
BS 3811	Glossary of maintenance terms in terotechnology
BS 4335	Glossary of terms used in project network techniques
BS 4891	A guide to quality assurance
BS 5179	Guide to the operation and evaluation of quality assurance systems
BS 5191	Glossary of production planning and control terms
BS 5233	Glossary of terms used in metrology
BS 5497	Precision of test methods and Part Guide to determination of repeatability and reproducibility for a standard test method
BS 5532	Statistics - Vocabulary and symbols
BS 6001	Sampling procedures and tables for inspection by attributes
BS 6002	Specification for sampling procedures and charts for inspection by variables for percent defective
BS 9000	General requirements for electronic components of assessed quality
BS 5760*	Guides on reliability of systems, equipments and components
BS 5750*	Specification for quality systems
ISO Guide 2	General terms and their definitions concerning standardization and certification

*In course of preparation

BSI

Amendment No. 1
published and effective from 29 May 1987
to BS 4778 : 1979

Glossary of terms used in quality assurance
(including reliability and maintainability terms)

Revised text and deletions

AMD 5641
May 1987

British Standard number BS 4778

On every page, including the covers, delete the existing number and substitute:

'BS 4778 : Part 2 : 1979'

AMD 5641
May 1987

British Standard title

On the front cover and page 2, delete the existing title and substitute:

'British Standard
Quality vocabulary
Part 2. National terms'

AMD 5641
May 1987

Foreword

At the end of the existing foreword insert the following:

'This Part contains all of the terms that were in the 1979 edition of BS 4778, but the definitions of those terms that are now in BS 4778 : Part 1 (identical with ISO 8402) have been deleted.

In the longer term it is proposed that BS 4778 will comprise three Parts as follows:

Part 1 International terms
Part 2 National terms
Part 3 Reliability and maintainability terms

Work is in hand at present to prepare drafts for the complete series.

Compliance with a British Standard does not of itself confer immunity from legal obligations.'

AMD 5641
May 1987

Clause 4.1.1 quality

Delete the existing subclause in its entirety and substitute the following:

'**4.1.1** *quality*

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 5.1.1 quality assurance

Delete the existing subclause in its entirety and substitute the following:

'5.1.1 *quality assurance*

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 6.1.1 specification

Delete the existing subclause in its entirety and substitute the following:

'**6.1.1** *specification*

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 8.2 reliability

Delete the existing subclause in its entirety and substitute the following:

'**8.2 reliability**

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 11.2 quality system

Delete the existing subclause in its entirety and substitute the following:

'**11.2 quality system**

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 11.4 quality plan

Delete the existing subclause in its entirety and substitute the following:

'**11.4 quality plan**

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 11.5 quality audit

Delete the existing subclause in its entirety and substitute the following:

'**11.5 quality audit**

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 11.8 quality system audit

Delete the existing subclause in its entirety and substitute the following:

'**11.8 quality system audit**

NOTE. This term is qualified by a note to quality audit in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 11.14 design review

Delete the existing subclause in its entirety and substitute the following:

'**11.14 design review**

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 13.9 product liability

Delete the existing subclause in its entirety and substitute the following:

'**13.9 product liability**

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 15.1.1 grade

Delete the existing subclause in its entirety and substitute the following:

'**15.1.1** *grade*

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 19.1.1 quality control

Delete the existing subclause in its entirety and substitute the following:

'**19.1.1** *quality control*

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 19.8 concession

Delete the existing subclause in its entirety and substitute the following:

'**19.8 concession**

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 21.1 inspection

Delete the existing subclause in its entirety and substitute the following:

'**21.1 inspection**

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 25.1.1 defect

Delete the existing subclause in its entirety and substitute the following:

'**25.1.1** *defect*

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

Clause 26.1.1 reliability

Delete the existing subclause in its entirety and substitute the following:

'**26.1.1** *reliability*

NOTE. This term is defined in BS 4778 : Part 1.'

AMD 5641
May 1987

New clauses 36.5, 36.6 and 36.7

Insert the following three terms and definitions at the end of Section twelve and before Section thirteen:

'**36.5 observed mean active maintenance time.** The ratio of the sum of the observed active maintenance times to the total number of maintenance actions.

36.6 assessed mean active maintenance time. The mean active maintenance time determined by a limiting value or values of the confidence interval associated with a stated confidence level based on the same data as the observed mean active maintenance time of nominally identical items.

NOTE 1. The source of the data has to be stated.

NOTE 2. Results can be accumulated (combined) only when all conditions are similar.

NOTE 3. It should be stated whether a one-sided or two-sided interval is being used.

NOTE 4. The assumed underlying distribution of mean active maintenance times have to be stated.

NOTE 5. When one limiting value is given this is usually the upper limit.

36.7 predicted mean active maintenance time (of a complex item). The mean active maintenance time of an item computed from the predicted mean active maintenance times of its parts.'