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BRITISH STANDARD 2517 : 1954

DEFINITIONS FOR USE IN MECHANICAL ENGINEERING

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BRITISH STANDARD

DEFINITIONS FOR USE IN MECHANICAL ENGINEERING

DEFINITIONS RELATING TO
CONSTRUCTION, DRAWING PRACTICE, SIZE AND
TOLERANCE, LIMITS AND FITS
SCREW THREADS, SURFACE TEXTURE
AND GAUGES

B.S. 2517 : 1954

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THIS BRITISH STANDARD, having been approved by the Mechanical Engineering Industry Standards Committee and endorsed by the chairman of the Engineering Divisional Council, was published under the authority of the General Council on 12 November, 1954.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 2500, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook, price 12s. 6d.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following B.S.I. references relate to the work on this standard:—
Committee reference MEE/1. Draft for comment CK(MEE)6372.

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CO-OPERATING ORGANIZATIONS

The Mechanical Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:—

Admiralty
Air Ministry
Associated Offices' Technical Committee
Association of Consulting Engineers (Incorporated)
British Chemical Plant Manufacturers' Association
British Compressed Air Society
British Electrical and Allied Manufacturers' Association
British Electricity Authority and Area Board
British Engineers' Association
British Internal Combustion Engine Manufacturers' Association
British Iron and Steel Federation
British Railways, British Transport Commission
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Engineering Equipment Users' Association
Gas Council
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Institution of Civil Engineers
Institution of Gas Engineers
Institution of Heating and Ventilating Engineers
Institution of Mechanical Engineers
Institution of Mechanical Engineers (Automobile Division)
Institution of Production Engineers
Locomotive Manufacturers' Association
Machine Tool Trades' Association
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Radio Industry Council
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BRITISH STANDARD

DEFINITIONS FOR USE IN MECHANICAL ENGINEERING

DEFINITIONS RELATING TO CONSTRUCTION, DRAWING PRACTICE, SIZE AND TOLERANCE, LIMITS AND FITS, SCREW THREADS, SURFACE TEXTURE AND GAUGES

FOREWORD

The definitions in this standard relate to terms which are of general application in the engineering industry, and more particularly in mechanical engineering. They do not include definitions of any terms specially applicable to individual industries.

There are in current use a number of terms which are not well-defined, and usages which are not even mutually consistent. The attempt has been made here to provide a logical code which is free from ambiguity. In some cases it has been necessary to modify existing definitions slightly, or to restrict the use of certain terms to specialized applications. Generally, however, there is no serious departure from current meanings which are well established.

In preparing this standard consideration was given to definitions which have been adopted in America and to those included in the manual 'Dimensional Analysis of Engineering Design, Part I,' prepared by the British Inter-Services Committee, and in most cases a substantial measure of common agreement has been attained.

Related British Standards are:

B.S. 21. Pipe threads
B.S. 84. Screw threads of Whitworth form
B.S. 308. Engineering drawing practice
B.S. 919. Screw gauge limits and tolerances
B.S. 969. Plain limit gauges, limits and tolerances
B.S. 1134. The assessment of surface texture
B.S. 1580. Unified screw threads
B.S. 1916. Limits and fits for engineering.

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SECTION 1. CONSTRUCTION

No.	Term	Definition
0101	**Assembly**	A combination of parts assembled together to make up a composite article.
0102	**Sub-assembly**	A composite part of a larger assembly; it is treated for convenience as a separate small assembly.
0103	**Component**	A part which, together with other parts, serves to make up an assembly. NOTE. A component may be either a sub-assembly or a single detail.
0104	**Detail**	A part consisting of a single piece; that is, one which cannot be further subdivided. NOTE. A 'fabricated' part, i.e. a single part consisting of two or more pieces permanently joined together by welding, brazing, or similar means, may properly be described as a detail in relation to the assembly to which it belongs. The individual pieces from which it is made are details in relation to the part.
0105	**Interchangeable part**	A part constructed in such a manner and to such limits of size, that it can be satisfactorily substituted for any corresponding part in any assembly of the kind for which it is intended, and function correctly. NOTE. An interchangeable part may be either a single detail or a unit assembly.
0106	**Interchangeable assembly**	An assembly consisting wholly of interchangeable parts. NOTE. The parts of an interchangeable assembly may include interchangeable units or sub-assemblies of which the internal details are not themselves interchangeable.
0107	**Unit assembly**	A sub-assembly which is normally treated as a single item for purposes of replacement or repair. NOTE 1. Subject to satisfactory general workmanship and performance a unit assembly is not required, in principle, to be made up of interchangeable parts, though for convenience of manufacture it may be so made. Certain specified parts, together with their mating parts, may, however, be required to be interchangeable for purposes of replacement. A typical example would be the electric starter motor on a car, of which the brushes and brush-holders alone need to be interchangeable, so far as its internal construction is concerned. NOTE 2. Apart from the actual means of attachment, the general dimensions of an interchangeable unit must be such that it can be accommodated in the space available for it in the larger assembly. This latter, however, is not usually a stringent condition.

No.	Term	Definition
0108	**Selective assembly**	A procedure in which parts of any one type are classified into several groups according to size. The parts which are intended to be mated with these are also classified according to size in the same number of groups. Corresponding groups are then expected to assemble and to function properly. NOTE 1. In modern industry, this system is generally used only where accurate fits must be maintained and where the cost of machining parts universally interchangeable for such fits is prohibitive. NOTE 2. The term selective assembly is sometimes incorrectly applied to instances where components are fitted by trial and error.

SECTION 2. DRAWINGS AND SCHEDULES

0201	**General arrangement drawing**	A drawing of a complete finished product which shows the components arranged together to make up the final assembly with means whereby these can be identified on the sub-assembly or detail drawings. NOTE. The general arrangement drawing should not exhibit constructional requirements for individual parts.
0202	**Assembly or sub-assembly drawing**	Similar in character to a general arrangement drawing but it is limited to the individual assembly to which it relates. NOTE. No general arrangement drawing will be required in many instances for small articles, the assembly drawing being sufficient.
0203	**Detail drawing**	A drawing which gives manufacturing requirements for a specific detail or details. NOTE. For small articles, the assembly and detail drawings are often included in a single sheet.
0204	**Operation drawing** OPERATION SCHEDULE	A document which shows, for the guidance of the operator, the procedure to be adopted in carrying out the particular series of operations by which a part is to be made. NOTE 1. The operation drawing does not necessarily reproduce the full requirements for the finished parts which are shown on the detail drawing. Its purpose is to give instructions to the operator which will ensure that these requirements are met. For example, the detail drawing may specify tolerances on the diameters and geometrical positions of a series of holes. The operation drawing may include instructions such as 'Use drill No. . . . with jig No. . . .'. NOTE 2. Since the process of production in any particular factory depends on the plant available, each individual factory or organization should be responsible for the preparation of its own operation drawings.
0205	**Item**	A term used to describe an article listed in a schedule. NOTE. An item may be an independent article such as a pump or a spanner, or a component of an assembly such as a relief valve, or a gauge glass for a boiler.

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SECTION 3. GEOMETRY OF PARTS

No.	Term	Definition
0301	**Dimension**	A geometrical element in a design, such as a length, diameter or angle, of which the size is specified. NOTE 1. The definition relates to the fundamental conception of a dimension. In its broadest sense it is not limited solely to geometric elements in the design, but may also include, for example, weights or capacities. NOTE 2. In ordinary usage the word 'dimension' is often employed to denote the specified size, thus reference is made to the 'dimensioning' of a drawing, when the meaning is to enter upon it the specified values of the dimensions.
0302	**Auxiliary dimension**	A dimension of which the size is given solely for information or convenience of reference. NOTE. Auxiliary dimensions are *additional* to those which define the design requirements, from which they are derived by calculation. Their sizes are given for guidance only, to assist production, and carry no tolerances. If necessary the basis of calculation should be indicated on the drawing.
0303	**Constructional dimension**	A dimension of which the size is specified solely for the purpose of defining a positional or angular relationship between two or more features, or the form of a surface or profile in a design. NOTE. Tolerances are never assigned directly to constructional dimensions. They are assigned only to the resulting positional lay-out, or geometrical form, which the constructional dimensions serve to define.
0304	**Datum dimension**	A dimension of which the size is given for the purpose of fixing the position of a datum plane, line or point. (See definition 0308.) NOTE. The sizes of datum dimensions are exact, carrying no tolerance.
0305	**Feature**	An individual characteristic of a part, such as a cylindrical surface, shoulder, screw thread, slot, flat surface, profile or the like.
0306	**Positional feature** CONCENTRIC FEATURE	One of a group of features which is required to conform to a specified positional/concentric relationship with others in the group. NOTE 1. Concentric features are, in fact, only special cases of positional features for which the implied centre distance is zero. NOTE 2. Symmetrical features can also, in some instances, be treated as positional features. But for symmetrical features in general, equality of disposition on either side of a mean line or plane is often more important than specific positional relationships. In such cases relatively liberal tolerances may be allowed for position, and symmetry must be checked independently by direct measurement.

No.	Term	Definition
0307	**Datum feature**	One of a group of positional features which serves as a reference for the location of other features in the group. NOTE 1. In order to provide satisfactory registration of corresponding groups of features on mating components, tolerances on datum features must be kept small in relation to those on the remaining features of the group. NOTE 2. A flat surface is frequently used as a datum feature for both linear and angular relationships. When so used it should preferably be described as a 'datum surface' to distinguish it from a datum plane. (See definition 0308.)
0308	**Datum plane, line or point**	A plane, line or point, occupying a defined position in relation to a feature, with reference to which some associated dimension(s) is/are required to be within specified limits of size. NOTE 1. A datum plane, line or point establishes an exact geometrical reference as distinct from the physical reference provided by a datum feature. NOTE 2. The associated dimension(s) may refer either to the same feature or to the location of other features relative to the datum plane, line or point.
0309	**Geometrical reference frame**	The diagram composed of the constructional dimensions which serve to establish the true geometrical relationships between the positional features in any one group.
0310	**Basic form**	The theoretical form of a surface or profile on which the design form(s) for that surface or profile (or pair of mating profiles) is/are based. (See also definition 0611.) NOTE. Basic forms may serve a variety of purposes—for example, the basic profile of a Whitworth screw thread, the basic rack for a family of gears, the curve of lift for a cam, or the like. The relationship of the design form to the basic form depends on the circumstances of each individual case. (See also definition 0311.)
0311	**Design form**	The form of a surface or profile which, in association with the limits of tolerance. serves to define the design requirements for that surface or profile. (See also definitions 0410 and 0612.) NOTE 1. The design form is the form shown on the drawing when, as is usually the case, the permissible limits of variation for the form are expressed as limits of tolerance. NOTE 2. The design form may differ materially from the basic form. For example, in the design of a cam the basic form may be the desired curve of lift, while the design form must take account of the nature and size of the follower. In the case of screw threads the design forms for the screw and nut may provide for clearances at the major and/or minor diameters, while the basic form is common to both. NOTE 3. Basic and design forms may, or may not, be associated with specific sizes. Thus, the basic and design forms for a screw *thread*, e.g. Whitworth or Unified forms, are purely geometrical *shapes*, not associated with any particular size. But when related to a physical object, such as a *bolt* or *nut*, the conception of size becomes an essential factor in the

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No.	Term	Definition
		specification of the design form. This is usually the case with all design forms shown on drawings. NOTE 4. The general form of the actual surface or profile is allowed to vary from the design form to the extent determined by the associated limits of tolerance. Irregularities in the general form of the surface or profile may be further controlled by the specification of surface texture requirements.

SECTION 4. SIZE AND TOLERANCE

0401	**Size**	A generic term denoting magnitude of any kind. NOTE. In its general sense the term 'size' is not confined to geometrical magnitudes, but may relate, for example, to weights, capacities, horse-powers or ratings of any kind. Except to the extent indicated in the Notes to definitions 0301 and 0404 however, the definitions which follow are concerned only with the sizes of geometrical dimensions. (See also definition 0301.)
0402	**Basic size**	The theoretical size of a dimension on which the limits of size, and the design sizes, for that dimension are based. See Figs. 5 and 6. (See also definition 0403.) NOTE 1. The term 'basic' connotes a theoretical conception which establishes a point of departure from which some dependent conception is derived. NOTE 2. The basic size is the same for corresponding dimensions on both members of a mating pair. NOTE 3. The limits of size are derived from the basic size by the application of the allowance, if any, between mating parts, and of the tolerance(s) on the part(s). Alternatively, the same design requirements may be expressed by equivalent associations of design size(s) and limits of tolerance.
0403	**Design size**	The size which, in association with the limits of tolerance, serves to define the design requirements for the dimension to which it relates. See Figs. 1, 5 and 6. (See also definition 0410.) NOTE 1. The design size is the size shown on the drawing when the permissible limits of variation in size are expressed as limits of tolerance. NOTE 2. The design size for one member of a mating pair is usually the same as the basic size. That for the other member varies with the grade of fit. NOTE 3. Since the same design requirements (limits of size) can be expressed by design sizes associated with either unilateral or bilateral limits of tolerance, it follows that the design size for a particular requirement depends on the method of tolerancing employed on the drawing. With unilateral tolerancing the design sizes are the maximum metal limits, and those for a pair of mating parts differ by the amount of the allowance. NOTE 4. When the design requirement is expressed by quoting two limits of size there is usually no necessity to consider specific design sizes or limits of tolerance. These can only be derived by making some assumption as to an implied method of tolerancing. If necessary, in the absence of any indication to the contrary, unilateral tolerancing is normally to be assumed.

No.	Term	Definition
0404	**Nominal size**	The size by which an object, or part, is designated as a matter of convenience. NOTE 1. The nominal size is often, but not necessarily always, the same as the basic size. Thus, for example, a 1 in. B.S. pipe thread is described by reference to the nominal bore of the pipe but has a basic major diameter of 1·309 in. NOTE 2. The use of the term nominal size is not confined to geometrical sizes; it applies, for example, to such expressions as a 12 h.p. motor, a 1000-gallon tank, a 100-watt lamp or a 7-lb weight.
0405	**Actual size**	The measured size of a dimension on an individual part. NOTE. By international agreement, industrial measurements, unless otherwise stated, are assumed to be correct at 68°F. (20°C.); gauges and measuring tools should be adjusted at this temperature.
0406	**Basic angle (or taper)**	The theoretical size of an angle or taper, on which the design size for that angle or taper is based. (See note to definition 0407.) NOTE. Basic angles or tapers are not toleranced. If the size of an angle or taper is shown on the drawing as 'basic' the limits of tolerance for that angle or taper are governed by the tolerances on the associated linear dimensions.
0407	**Design angle (or taper)**	The size of an angle or taper which, in association with the limits of tolerance, serves to define the design requirements for that angle or taper. (See also definition 0410.) NOTE. The design size of an angle or taper is normally identical with the basic angle or taper. It is associated with limits of tolerance also expressed in terms of angle or taper.
0408	**Tolerance**	The total amount of variation permitted for the size of a dimension, a positional relationship, or the form of a profile, or other design requirement. NOTE. Tolerances for linear or angular sizes, form, position, etc., may be expressed in a variety of ways on a drawing. They are not necessarily shown directly; reference may be made instead to standard specifications (e.g. for screw threads). In every case, however, the effect is to define a zone of tolerance within which the size or shape of the part is allowed to vary, unless some further restriction (e.g. on roundness or straightness) is specifically stated.
0409	**Limits of size**	The maximum and minimum sizes permitted for a dimension. See Fig. 1. NOTE 1. The difference between the limits of size is equal to the tolerance. NOTE 2. Unless otherwise stated, variations of form are permitted within the zone of tolerance defined by the limits of size. (See also Note 3 to definition 0410.)
0410	**Limits of tolerance**	The maximum amounts, positive or negative, by which the actual size of a dimension, or the form of a profile or surface, is permitted to depart from the design size or form. See Fig. 1. NOTE 1. The limits of tolerance are equal to the algebraic differences between the limits of size and the design size.

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