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DEFINITIONS FOR USE IN MECHANICAL ENGINEERING

BUREAU OF CEYLON STANDARDS

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Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This Standard does not purport to include all the necessary provisions of a contract.

SRI LANKA STANDARD

DEFINITIONS FOR USE IN MECHANICAL ENGINEERING

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

FOREWORD

This Sri Lanka standard definitions for use in mechanical engineering has been prepared by the drafting committee on glossary of terms in mechanical engineering. It was approved by the mechanical engineering divisional committee of the Bureau of Ceylon Standards and was authorised for adoption and publication by the Council of the Bureau on 1973-09-10.

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 consistent. The attempt has been made here to provide a logical code which is free from ambiguity. Generally however, there is no serious departure from current meanings which are well established.

British Standards were consulted in the preparation of this standard and the assistance gained therefrom is acknowledged.

SECTION 1 CONSTRUCTION

No.	Term	Definition
01.01	assembly	A combination of parts assembled together to make up a composite article.
01.02	sub-assembly	A composite part of a larger assembly; it is treated for convenience as a separate small assembly.
01.03	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.*
01.04	detail	A part consisting of a single piece; that is, one which cannot be further subdivided. *NOTE - A 'fabricated' part, for example: 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.*

01.05	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.*
01.06	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.*
01.07	unit assembly	A sub-assembly which is normally treated as a single item for purposes of replacement or repair.

No.	Term	Definition
		NOTES *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.* *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.*

01.08	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.

NOTES

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.

2 The term selective assembly is sometimes incorrectly applied to instances where components are fitted by trial and error.

SECTION 2 DRAWINGS AND SCHEDULES

02.01	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.

No.	Term	Definition
		NOTE - The general arrangement drawing should not exhibit constructional requirements for individual parts.
02.02	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.*
02.03	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.*
02.04	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.

NOTES

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....'

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.

02.05 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.

No.	Term	Definition
03.01	dimensions	A geometrical element in a design, such as a length, diameter or angle, of which the size is specified. *NOTES* *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, masses or volumes.* *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.*

03.02	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.*
03.03	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.*

No.	Term	Definition
03.04	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 **03.08**).
		NOTE - The sizes of datum dimensions are exact carrying no tolerance.
03.05	feature	An individual characteristic of a part, such as a cylindrical surface, shoulder, screw thread, slot, flat surface, profile or the like.
03.06	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.

NOTES

1 Concentric features are, in fact, only special cases of positional features for which the implied centre distance is zero.

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 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.

03.07 **datum feature**

One of a group of positional features which serves as a reference for the location of other features in the group.

No.	Term	Definition
		NOTES *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.* *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 03.08).*
03.08	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.

NOTES

1 A datum plane, line or point establishes an exact geometrical reference as distinct from the physical reference provided by a datum feature.

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.

03.09 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.

No.	Term	Definition
03.10	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 **06.11**). *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* **03.11***).*
03.11	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 **04.10** and **06.12**).

NOTES

1 The design form is the form shown on the drawing when, as is usually the case permissible limits of variation for the form are expressed as limits of tolerance.

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.

3 Basic and design forms may, or may not, be associated with specific sizes. Thus, the basic and design forms for a screw thread, for example 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

No.	Term	Definition
		specification of the design form. This is usually the case with all design forms shown on drawings.
		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

No.	Term	Definition
04.01	size	Number expressing in a particular unit the numerical value of a length. *NOTE - In its general sense the term 'size' is not confined to geometrical magnitudes, but may relate, for example, to weights capacities, horse-power or ratings of any kind. The above definition is valid for the terms which follow*

except to the extent indicated in the Notes to definitions **03·01** *and* **04·04** *(See also definition* **03.01**).

04.02 **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** and also definition **04·03**).

NOTES

1 The term 'basic' connotes a theoretical conception which establishes a point of departure from which some dependent conception is derived.

2 The basic size is the same for corresponding dimensions on both members of a mating pair.

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

No.	Term	Definition
		associations of design size (s) and limits of tolerance.
04.03	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 04.10). *NOTES* *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.* *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.* *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.

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.

04.04 nominal size

The size by which an object, or part is designated as a matter of convenience.

No.	Term	Definition
		NOTES *1 The nominal size is often, but not necessarily always, the same as the basic size. Thus for example, a 1 in (25.4 mm) pipe thread is described by reference to the nominal bore of the pipe but has a basic major diameter of 1.309 in (33.249 mm).* *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/litre tank, a 100-watt lamp or a 7-lb/kg mass.*
04.05	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 20 °C (68 °F, 293.2 °K); gauges and measuring tools should be adjusted at this temperature.*

04.06	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 04.01). *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.*
04.07	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 04.10). *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.*

No.	Term	Definition
04.08	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 (for example 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 (for example on roundness or straightness) is specifically stated.*
04.09	limits of size	The maximum and minimum sizes permitted for a dimension. See Fig. 1. *NOTES* *1 The difference between the limits of size is equal to the tolerance.*

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 04.10).

04.10 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.

NOTES

1 The limits of tolerance are equal to the algebraic differences between the limits of size and the design size.

2 The algebraic difference between the limits of tolerance is equal to the tolerance.

No.	Term	Definition
		3 Limits of tolerance and limits of size are often referred to, without distinction, simply as 'limits'. This is not likely to cause confusion since the circumstances are usually well understood in each case. For precise statement, however, it is necessary to distinguish clearly between these alternative methods of expressing limits.
04.11	unilateral tolerance	A tolerance in which variation is permitted only in one direction from the design size (or form). See Fig. 1. *NOTE - Unilateral tolerances are normally used in relation to the dimensions of mating features. The tolerances lie wholly above the design size for the hole (or internal feature) and wholly below the design size for the shaft (or external feature) respectively.*
04.12	bilateral tolerance	A tolerance in which variation is permitted in both directions from the design size (or form). See Fig. 1.

NOTE - Bilateral tolerances are normally used for general limits relating to the dimensions of non-mating features and disposed equally on either side of the design size (or form).

04.13 **positional tolerance**

The total amount of variation permitted for the location of a positional feature in the group of which it is a member.

NOTES

1 Positional tolerances include tolerances on distances between centres, and concentricity as a special case.

2 From the nature of the case, positional tolerances are normally distributed either bilaterally or in all directions round a centre. The positional tolerance is thus equal to twice the maximum permitted departure from true geometrical position.

No	Term	Definition
04.14	form tolerances	The total amount of variation permitted for the form of a feature. *NOTES* *1 Form tolerances include tolerances on simple geometrical characteristics such as straightness, roundness, flatness etc., together with tolerances on more complicated profiles.* *2 If no form tolerance is specified, variations in form are permitted within the zone of tolerance defined by the limits of size, where these apply.*
04.15	feature tolerance	The tolerance on the size of a feature, such as the diameter of a pin or hole, or the width of a slot, as distinct from the geometrical tolerance, if any, on the position of the feature in relation to other features.

04.16 **metal tolerance**

The form tolerance on a profile, expressed as the total dimensional variation, measured in a direction normal to the profile, in the amount of metal (or other material) permitted to be present at the surface of that profile.

NOTES

1 Metal tolerances are normally indicated by limits of tolerance defining the maximum permitted positive and/or negative departures from the design form of the profile.

2 It is not usual to speak of metal tolerances in relation to cylindrical or similar simple forms. It may be noted, however, that the metal tolerance on a cylinder would be half the diametrical tolerance.

No.	Term	Definition
04.17	maximum metal limit	A term denoting the condition in which the greatest permissible amount of metal (or other material) is present at the surface of a feature (See Fig. 1). *NOTE - The low limit of size for a hole, and the high limit for a shaft, are 'maximum metal' limits.*
04.18	minimum metal limit	A term denoting the condition in which the least permissible amount of metal (or other material) is present at the surface of a feature. *NOTE - The high limit of size for a hole, and the low limit of size for a shaft, are 'minimum metal' limits.*

SECTION 5 LIMITS AND FITS

No.	Term	Definition
05.01	clearance	The difference between the size of a hole (or internal feature) and that of the mating shaft (or external feature) when the latter is the smaller. See Fig 2.

NOTE - The particular instance in which two mating parts are identical in size may be regarded as a limiting case of either clearance or interference (See also definition 05.02).

05.02	interference	The difference between the size of a hole (or internal feature) and that of the mating shaft (or external feature) when the latter is the larger. See Fig. 3. See Note to definition 05.01.
05.03	allowance	The prescribed (algebraic) difference between the low limit of size for the hole (or internal feature) and the high limit of size for the mating shaft (or external feature).

NOTES

1 A positive (+) allowance, results always in a clearance fit. See Fig. 4A.

No.	Term	Definition
		2 A negative (-) allowance, if its magnitude exceeds the sum of the tolerances on the two mating parts, results always in an interference fit. See Fig. 4C.
		3 A negative (-) allowance, if its magnitude is less than the sum of the tolerances on the two mating parts, results in a transition fit. See Fig. 4B.
05.04	fit	The relationship existing between two mating parts with respect to the amount of clearance or interference which is present when they are assembled.
		NOTE - The word 'fit' is also used, in a wider sense, to signify the whole range of varying fits which may result from a particular combination of allowances and tolerances (See also definitions 05.05 05.06, 05.07 and 05.15).

05.05 **classes of fit**

Indicate the general character of the fit that may occur between pairs of mating parts made within prescribed limits. See Fig. 4.

There are three classes of fit, namely:

a) Clearance fit, in which the limits for the mating parts are so disposed that clearance always occurs when any pair made within the prescribed limits is assembled. See Fig. 4A.

b) Interference fit, in which the limits for the mating parts are so disposed that interference always occurs when any pair made within the prescribed limits is assembled. See Fig. 4C.

c) Transition fit, in which the limits for the mating parts are so disposed that either clearance or interference may occur when pairs made within the prescribed limits are assembled. See Fig. 4B.

No.	Term	Definition
		NOTES *1 The class of fit depends solely on the relationship between the allowance and the tolerances on the mating parts.* *2 The terms 'clearance fit' and 'interference fit' are also frequently used to describe the actual condition of fit between an individual pair of mating parts. No confusion is likely to arise from this in practice. The use of the term 'transition fit' is necessarily confined to describing a class of fit.*
05.06	types of fit	Indicate the suitability of a fit for some specific functioning requirement, for example, free fit, running fit, sliding fit, push fit, force fit, drive fit and the like.

		NOTE - The type of a fit is determined primarily by the relationship of the allowance and of the tolerances to the basic size, though it may be affected by other factors also, for example, surface finish.
05.07	**limit system**	A system of standard allowances and tolerances, in graded amounts associated with specified ranges of basic sizes, from which, by selection, suitable limits of size may be assigned to mating parts so as to provide for any desired type of fit.
05.08	**hole basis limit system**	A limit system in which the design size for the hole (or internal feature) is the basic size, and variations in the grade of fit, for any particular grade of hole, are obtained by varying the allowance and the tolerance on the shaft (or external feature). See Fig. 5.

No.	Term	Definition
		NOTE - In a unilateral hole basis system the low limit of size for the hole (or internal member) is equal to the basic size.
05.09	shaft basis limit system	A limit system in which the design size for the shaft (or external feature) is the basic size, and variations in the grade of fit, for any particular grade of shaft, are obtained by varying the allowance and the tolerance on the hole (or internal feature). See Fig. 6
		NOTE - In a unilateral shaft basis system the high limit of size for the shaft (or external member) is equal to the basic size.
05.10	basic member	That one of a pair of mating parts of which the design size is equal to the basic size.

05.11 **deviations**

The algebraic amounts by which the limits of size are greater (+) or less (-) than the basic size.

NOTES

1 The deviations for the basic member of a mating pair are identical with the limits of tolerance for that member.

2 The difference between the deviations for each member is equal to the tolerance for that member.

05.12 unilateral limit system

A limit system in which the tolerance assigned to the basic member is unilateral (See also definition **04.11**).

NOTE - In a unilateral limit system the design size of the basic member represents the maximum metal condition of that member.

05.13 bilateral limit system

A limit system in which the tolerance assigned to the basic member is bilateral (See also definition **04.12**).

No.	Term	Definition
05.14	grade of a feature	That characteristic of a feature which is determined by the relationship between the tolerance, and the allowance, if any, on the feature and its basic size. *NOTES* *1 The grade of a feature is not related solely to accuracy of workmanship but to the kind of fit which is to be expected when that feature is mated with a corresponding feature, also of specified grade.* *2 It is uncommon to refer to the grade of a part, rather than to the grade of a feature. Since a part may, usually does, present a number of separate features, the use of this expression involves an implied assumption as to the particular feature on which the grading is based. In the case of shaft or journal the cylindrical surface is the feature concerned in grading, though other features may be present on the parts.*

05.15 **grade of a fit**

That characteristic of a fit which is determined by the associated grades of the features constituting a mating pair.

NOTES

1 In general, a particular grade of fit may be expected to give effectively the same type of fit throughout several neighbouring ranges of size, but may not necessarily give the same type of fit for widely differing size ranges.

2 The complete specification of the grade of a fit involves statements of the grades of the tolerances on the two mating features, and of the associated allowance, if any.

A. General

No.	Term	Definition
06.01	screw thread	The ridge produced by forming, on the surface of a cylinder or cone, a continuous helical or spiral groove of uniform section such that the distance measured parallel to the axis between two corresponding points on its contour is propotional of their relative angular displacement about the axis. *NOTE - This definition describes a perfect screw thread.*
06.02	external (male) screw thread	A thread formed on the external surface of a cylinder or cone. See Figs. 8 and 10A. *NOTE - The thread on a bolt is a typical example of an external screw thread.*

06.03	internal (female) screw thread	A thread formed on the internal surface of a hollow cylinder or cone. See Figs. 9 and 10B. *NOTE - The threads in nuts, tapped holes, or screwed sockets are typical examples of internal screw threads.*
06.04	right-hand screw thread	A thread which, if assembled with a stationary mating thread, recedes from the observer when rotated in a clockwise direction. See Fig. 7A.
06.05	left-hand screw thread	A thread which, if assembled with a stationary mating thread, recedes from the observer when rotated in an anti-clockwise direction. See Fig. 7B.
06.06	parallel screw thread	A thread formed on the surface of a cylinder. See Figs. 8 and 9.
06.07	taper screw thread	A thread formed on the surface of a cone. See Figs. 10A and 10B.

No.	Term	Definition
06.08	single-start screw thread	A thread formed by a single continuous helical groove. See Figs. **7A** and **7B**.
06.09	multi-start screw thread	A thread formed by a combination of two or more helical grooves equally spaced along the axis. See Fig. **7C**.

B. Geometry of screw threads

No.	Term	Definition
06.10	form	The shape of one complete profile of the thread between corresponding points, at the bottom of adjacent grooves, as shown in an axial plane section.
06.11	basic form	The theoretical form on which the design forms for both the external and internal threads are based. See Figs. **11**, **12A**, **12B** and **17A**.
06.12	design forms	The forms of the external and internal threads in relation to which the limits of tolerance are assigned. See Fig. **11**.

NOTES

1 The two design forms normally represent the maximum metal forms for the respective threads.

2 Screw threads may have different design forms, derived from the same basic form, for the internal and external members respectively.

3 The design forms for screw threads are not necessarily shown in detail on the drawing; both they and the associated limits of tolerance may be defined by an appropriate reference to a standard specification.

4 The general form of the screw thread is allowed to vary from the design form within the zone defined by the associated limits of tolerance.

No.	Term	Definition
06.13	flanks	Those parts of the surface, on either side of the thread, the inter-sections of which an axial plane are theoretically straight lines. See Fig. 12A.
06.14	crest	That part of the surface of a thread which connects adjacent flanks at the top of the ridge. See Figs. 8 and 9.
06.15	root	That part of the surface of a thread which connects adjacent flanks at the bottom of the groove. See Figs. 8 and 9.
06.16	included angle angle of thread	The angle between the flanks of the thread, measured in an axial plane section. See Figs. 12A and 12B.
06.17	flank angles	The angles between the individual flanks and the perpendicular to the axis of the thread measured in an axial plane section. See Figs. 12A and 12B.

06.18	fundamental triangle	A triangle of which two sides represent the form of a theoretical thread with sharp crest and roots, having the same pitch and flank angles as the basic thread form and whose third side, or base, is parallel to a generator of the cylinder or cone on which the thread is formed. See Figs. **12A** and **12B**. *NOTE - The fundamental triangle provides the framework on which the basic and design forms of the thread are set out.*
06.19	apex	The sharp corner of the fundamental triangle opposite to its base. See Figs. **12A** and **12B**.
06.20	height (or depth) of the fundamental triangle	The distance, measured perpendicular to the axis from its apex to its base. See Fig. **12A**.

No.	Term	Definition
06.21	basic truncation	The distance, measured perpendicular to the axis, between the basic major or minor cylinder or cone and the adjacent apex of the fundamental triangle. See Fig. 12A. *NOTES* *1 The terms 'basic major truncation' and 'basic minor truncation' may also be used, and are self explanatory; the basic major and minor truncations are not necessarily equal.* *2 For definitions of major and minor cylinders see definitions* 06.31 *and* 06.32.

C. Pitch of screw threads

No.	Term	Definition
06.22	axis	The axis of the pitch cylinder or cone of a screw thread. See Figs. 8,9,10A,10B and 16 (See also definitions 06.26 and 06.27).

NOTE - References to the 'axis' of a screw thread are usually in general terms. This definition is, however, required for precision of statement.

06.23	pitch	The distance, measured parallel to the axis, between corresponding points on adjacent thread forms in the same axial plane section and on the same side of the axis. See Figs. **7A**, **7B**, **7C**, **10A**, **10B**, **17B** and **17C**. *NOTE - The pitch (in inch/millimetre) is the reciprocal of the number of threads per inch/millimetre.*
06.24	lead	The distance, measured parallel to the axis, between corresponding points on consecutive contours of the same thread helix in the same axial plane section and on the same side of the helix. See Fig. **7C**. *NOTES* *1 The lead is the distance the thread advances axially in one revolution.*

No.	Term	Definition
		2 For a single-start thread the lead is identical with the pitch. The use of the term lead is normally confined to multi-start threads.
		3 The lead (in inches) is the reciprocal of the number of turns per inch.
06.25	cumulative pitch	The distance, measured parallel to the axis of the thread, between corresponding points on any two thread forms, whether in the same axial plane or not.
06.26	pitch cylinder	An imaginary cylinder, co-axial with the thread, which intersects the surface of a parallel thread in such a manner that the intercept on a generator of the cylinder between the points where it meets the opposite flanks of the thread groove is equal to half the basic pitch of the thread. See Figs. **8** and **9**.

06.27	pitch cone	An imaginary cone, co-axial with the thread, which intersects the surface of a taper thread in such a manner that the axial distance between the points where a generator of the cone meets the opposite flanks of the thread groove is equal to half the basic pitch of the thread. See Figs. 10A and 10B.
06.28	pitch line	The generator of the pitch cylinder or cone. See Figs. 8, 9, 10A, 10B 17B and 17C.
06.29	pitch point	The point where the pitch line intersects the flank of the thread. See Figs. 8, 9, 10A and 10B.
06.30	lead angle	On a parallel thread the angle made by the helix of the thread at the pitch point with a plane perpendicular to the axis. On a taper thread the angle made at a given axial position by the conical spiral of the thread at the pitch point with a plane perpendicular to the axis.

No.	Term	Definition
D.	**Diameter of screw threads**	
06.31	major cylinder (or cone)	An imaginary cylindrical (or conical) surface which just touches the crests of an external thread or the roots of an internal thread. See Figs. 8,9, 10A and 10B.
06.32	minor cylinder (or cone)	An imaginary cylindrical (or conical) surface which just touches the roots of an external thread or the crests of an internal thread. See Figs. 8, 9, 10A and 10B.
06.33	major diameter	The diameter of the major cylinder of a parallel thread or of the major cone of a taper thread, in a specified plane normal to the axis (See Figs. 8, 9, 10A and 10B).

06.34	**minor diameter**	The diameter of the minor cylinder of a parallel thread or of the minor cone of taper thread, in a specified plane normal to the axis. See Figs. **8**, **9**, **10A** and **10B**.
06.35	**effective (or pitch) diameter**	The diameter of the pitch cylinder of a parallel thread or of the pitch cone of a taper thread, in a specified plane normal to the axis. See Figs. **8**, **9**, **10A** and **10B**.
		NOTE - It is necessary to draw a distinction between the 'simple' effective diameter, as defined here, and the 'virtual' effective diameter (See definition 06.36*).*
06.36	**virtual effective diameter** effective size	The effective diameter of an imaginary thread of perfect pitch and angle, having the full depth of flanks, but clear at the crests and roots, which would just assemble with the actual thread over the prescribed length of engagement.

No.	Term	Definition
		NOTE - The 'virtual' effective diameter exceeds the simple effective diameter in the case of an external thread, but is less than the simple effective diameter in the case of an internal thread, by an amount corresponding to the combined diametral effects due to any errors in the pitch and/or the flank angles of the thread.
E.	**Taper screw threads**	
06.37	gauge diameter	The basic major diameter of the thread, whether external or internal. See Fig.13. *NOTE - The basic major diameter of a parallel threaded coupling is equal to the gauge diameter of the corresponding pipe end.*

06.38	gauge plane	The plane perpendicular to the axis at which the major cone has the gauge diameter, See Fig. 13. *NOTE - The gauge plane is theoretically located at the surface of the internal screw (coupling) or at a distance equal to the basic gauge length from the small end of the external screw (pipe end).*
06.39	gauge length	On an external screw, (pipe end). The distance, parallel to the axis, from the gauge plane to the small end of the screw. See Fig. 13.
06.40	complete thread	That part of the thread which is fully formed at both crest and root. See Fig. 13. *NOTE - When there is a chamfer at the start of the thread, not exceeding one pitch in length, it is included within the length of complete thread.*

No.	Term	Definition
06.41	incomplete thread	That part of the thread which is fully formed at the root but truncated at the crest by its intersection with the cylindrical surface of the work. See Fig. 13.
06.42	washout thread VANISH THREAD	That part of the thread which is not fully formed at the root. See Fig. 13. *NOTE - The washout thread is produced by the bevel at the starting of the threading tool.*
06.43	vanish cone	An imaginary cone the surface of which would pass through the roots of the washout thread.
06.44	useful thread effective thread	This comprises both the complete thread and the incomplete thread but excludes the washout thread (See Fig. 13).
06.45	total thread	This comprises the complete thread, the incomplete thread, and the washout thread. See Fig. 13.

06.46 **wrenching allowance**

The length of useful thread which is provided to accommodate the relative movement between the pipe end and the coupling required for wrenching beyond the position of hand engagement. See Fig. 13.

06.47 **fitting allowance**

The total length of useful thread beyond the gauge plane on the pipe end, required to provide for assembly with the maximum permitted over-size coupling. See Fig. 13.

NOTE - A corresponding margin is required at the inner end of the thread in the coupling unless this is either chambered or screwed right through.

No.	Term	Definition
F. Assembly of screw threads		
06.48	length to the end of full thread (length of full thread)	The distance from the plane defining the end of the thread to the parallel plane, normal to the axis, which passes through the point on the root diameter helix at which the thread ceases to be fully formed at the root. See Figs.14A and 14B *NOTES* *1 The term 'full thread' applies only to parallel threads, and should not be confused with 'complete thread' which applies only to taper threads.* *2 The full thread excludes that part of the thread over which, owing to the form and mode of operation of the threading tool, the root ceases to be fully formed. It includes the length of any permissible chamfer at the free end of the thread.*

3 The root diameter is the minor diameter of an external thread, or the major diameter of an internal thread.

06.49	depth of engagement	The radial distance by which the thread forms of two mating threads overlap each other. The radial distance between the basic major cylinder of the external thread and the minimum minor cylinder of the internal thread represents 100 per cent depth of engagement. See Fig. 15.
06.50	length of engagement	The axial distance over which two mating threads are designed to make contact. See Fig. 16.
06.51	leading flank	The flank which, when the thread is about to be assembled with a mating thread, faces the mating thread. See Fig. 16.

No.	Term	Definition
06.52	following flank	The flank of a thread which is opposite to the leading flank. See Fig. 16
06.53	pressure flank	The flank that takes the thrust or load in an assembly. See Fig. 16.
		NOTE - The terms 'pressure' and 'clearing' flanks are used particularly in relation to Buttress and similar threads.
06.54	clearing flank	The flank that does not take the thrust or load in an assembly. See Fig. 16 (see Note under definition 06.53).
06.55	grade (or class) of a thread	The characteristic of a thread which is determined by the relationship between the tolerance, and the associated allowance, if any, on the thread, and its basic size.

NOTE - The grade of a thread is not related solely to the accuracy of workmanship, but also to the fit which is to be expected when mating threads are assembled.

06.56	grade of fit of a threaded pair	That characteristic of a fit which is determined by the associated grades of the two mating threads.
06.57	blunt start	The condition resulting from the removal of the partial thread at the entering end.

NOTE - Blunt start is commonly provided on threaded parts which are repeatedly assembled by hand, such as loose couplings and thread gauges, to facilitate the entry of the threads without damage and to prevent cutting of the hands.

No.	Term	Definition
06.58	major crest truncation	The distance, if any, measured perpendicular to the axis, between the generators of the major cylinders or cones for the basic and design forms of the external thread, assuming no allowance. See Fig. 17B. *NOTE - The major crest truncation is additional to the basic truncation.*
06.59	minor crest truncation	The distance, if any, measured perpendicular to the axis, between the generators of the minor cylinders or cones for the basic and design forms of the internal thread. See Fig. 17C. *Note - The minor crest truncation is additional to the basic truncation.*
06.60	major clearance	The distance, measured perpendicular to the axis, between the design forms at the root of the internal thread and the crest of the external thread. See Fig. 15.

06.61	minor clearance	The distance, measured perpendicular to the axis, between the design forms at the crest of the internal thread and the root of the external thread. See Fig. 15.
06.62	addendum	The radial distance between the major and pitch cylinders (or cones) of an external thread; the radial distance between the pitch and minor cylinders (or cones) of an internal thread. See Figs. 17B and 17C.
06.63	dedendum	The radial distance between the pitch and minor cylinders (or cones) of an external thread; the radial distance between the major and pitch cylinders (or cones) of an internal thread. See Figs. 17B and 17C.
06.64	depth of thread	The radial distance between its major and minor cylinders or cones. See Figs. 17B and 17C.

No.	Term	Definition
		NOTE - The depth of thread is equal to the sum of the addendum and the dedendum.
06.65	thickness of thread	The distance between the flanks of a thread measured parallel to the axis at the design pitch line. See Figs. 17B and 17C.
		NOTE - This definition applies only to parallel threads.
SECTION 7 SURFACE TEXTURE		
07.01	surface	The boundary of an object which separates that object from another substance - usually the surrounding air.
07.02	design form	The form of a surface or profile which, in association with the limits of tolerance, serves to define the design requirements of that surface or profile (See also definitions 03.11, 04.10 and 06.12).

07.03	**surface texture** **surface roughness**	The characteristic quality of an actual surface due to small departures from its general geometrical form, which, occuring at regular or irregular intervals, tend to form a texture or pattern on the surface. See Fig. **18**. *NOTES* *1 The expression 'general geometrical form' relates to the dominant shape of the surface which constitutes an approximation to the design form that it is intended to reproduce.* *2 It is possible for two or more kinds of irregularity to be combined in the complete texture of a surface in such a way that they are not readily distinguishable individually by eye or touch.*
07.04	profile	The shape of a specified normal section through the surface.

No.	Term	Definition
07.05	wave-form	The average shape of each recurring outline in the profile, when similar outlines are repeated at regular intervals. See Fig. 19.
07.06	wave-length	The distance from crest to crest in the wave form. See Fig. 19. *NOTE - When the wave-form is resolved into its individual sinusoidal components the term wave-length is applicable to any one of the latter.*
07.07	spacing	The average distance between the more prominent irregularities on a profile. See Fig. 19. *NOTE - The application of this definition to texture of non-repeating type is necessarily somewhat general in character; when the irregularities are repeated at regular intervals the spacing is the dominant wave-length of the profile.*

07.08	modified profile	The profile that results from the exclusion from the actual profile of all components of the texture having a wave-length (or spacing) exceeding a certain specified maximum.
07.09	wave-length cut-off	In an electrical measuring instrument the maximum or minimum wave-length which the instrument is adopted to register. *NOTE - The term wave-length cut-off, when used alone, is taken to refer to the maximum wave-length limit. When distinction between the two limits is required the terms 'upper wave-length cut-off' and 'lower wave-length cut-off' are used.*
07.10	sampling length	The length of profile selected for the purpose of making an individual measurement of surface texture.

No.	Term	Definition
		NOTES *1 Index numbers are narmally assessed as mean results obtained from the measurement of several sampling lengths, taken consecutively along the surface.* *2 The wave-length cut-offs of electrical measuring instrument are made to be equal to the desired sampling length or lengths. The indications of index numbers given by electrical integrating instruments refer automatically to mean results from several consecutive sampling lengths.*
07.11	traversing length	The length of the surface examined in the course of making one complete determination of surface texture. *NOTE - The traversing length may include one or more sampling lengths and usually includes several sampling lengths.*

07.12	centre line	A line conforming to the prescribed geometrical form of the profile and parallel to the general direction of latter throughout the sampling length, such that the sums of the areas contained between it and those parts of the profile which lie on either side of it are equal. See Fig. 20.
07.13	mean line	A line conforming to the prescribed geometrical form of the profile and so placed that the sum of the squares of the ordinates between it and the profile is a minimum.
		NOTE - The definition of the mean line is mathematically more precise, but is more restricted in application, and less convenient for general use than that of the centre line. Its advantage lies in its application to the theory underlying the construction and performance of electrical measuring instruments. Under ordinary conditions the mean line and the centre line are effectively identical.

No.	Term	Definition
07.14	surface texture index numbers roughness index number	Numerical assessments of the average height and/or depth of the irregularities constituting surface texture. *NOTE - Index numbers for surface texture, measurements are assessed in terms of centreline-average (C.L.A) values, expressed in micro-inches/microns.* *1 micro-inch = 0.000 001 in.* = 10^{-6} *in.* *1 micrometre or micron = 0.000 001m* = 10^{-6} *m*
07.15	centre-line average height	The average value of the departure of the profile from its centre-line throughout the prescribed sampling length, including the portions which lie both above and below the centre-line without regard to sign. See Fig. 20.
07.16	lay	The dominant direction of the tool marks or scratches in a surface texture having directional quality(See Fig. 21).

07.17	primary texture	That component of the surface texture which results from the normal action of the tool in the production process. (See Fig. 18 (See also Note under definition 07.18).
07.18	secondary texture - waviness	Those components of the surface texture which result from imperfections in the performance of the machine; for example vibration, untruth of a rotary cutter, errors in gear wheels, or the like. See Fig. 19. *NOTE - It should be observed that the terms 'primary' and 'secondary' relate solely to the intrinsic nature of the components of texture to which they refer, and have no bearing on their relative magnitudes or importance.*

NOTE - ***By international agreement all gauges, unless otherwise stated are assumed to be adjusted for size at the temperature of 20°C (68°F, 293.2°K)***

No.	Term	Definition
08.01	standard gauge	A gauge of simple type, such as an end bar, or plain cylindrical plug, the size of which has been determined as precisely as possible in relation to the ultimate standard of length.
08.02	master gauge	A gauge used as the ultimate reference in the control of all products of the kind to which it relates. *NOTES* *1 Master gauges, once they have been verified and accepted, take the place of the drawing as the ultimate authority for the verification of the reference and other gauges used in the control of the work.*

2 Master gauges must be held only by the authority ultimately responsible for the accuracy of all other gauges directly derived therefrom.

08.03 reference gauge

A gauge used for reference in the control of other gauges, or of the product.

NOTE - A reference gauge may be either:

a) similar to a standard gauge, but held in a work inspection room for reference purposes;

b) similar, or supplementary, to the workshop or inspection gauges, but made as closely as possible to the appropriate limit for the work, and used as a more exact check on the product in cases of doubt or dispute; or

c) a gauge designed to check directly the overall performance of workshop or inspection gauges. Reference gauges of this kind are opposite in type to the gauges they are used

No.	Term	Definition
		to control, for example, a plug reference gauge is used to control a ring gauge, and vice versa.
08.04	limit gauge	A fixed gauge used to determine whether the size of a part is within the limits assigned for it. *NOTES* *1 Limit gauges are either GO gauges or NOT GO gauges, of which the former must, and the latter must not, assemble, with the part to be examined. In simple cases the GO and NOT GO gauges may be associated in a single gauge, as in a double-ended plug.* *2 The word 'fixed' used in connection with gauges implies that the sizes of the gauging features which control the work are not adjustable during the process of gauging. For example, a micrometer as normally used is not a*

fixed gauge, but an adjustable calliper when pre-set and locked functions as a fixed gauge.

08.05 GO gauge

A gauge used to control the maximum metal limits of the work.

NOTES

1 Go limit gauges should combine in a single size gauge the GO limit sizes for all the dimensions which they are intended to control, for example, a GO screw gauge must be made to the maximum metal limit for the complete thread.

2 If it becomes necessary to make allowance on the dimensions of a compound GO gauge to provide for permitted errors of concentricity, position or the like, then it may be necessary also to provide separate Go gauges for the individual dimensions of the work.

No.	Term	Definition
08.06	NOT GO gauge	A gauge used to control the minimum metal limits of the work. *NOTE - It is essential that separate NOT GO gauges should be provided for each independent dimension on the work which it is required to control; for example, separate NOT GO gauges are necessary to control the minimum metal limits for the major, minor and effective diameters of screw threads.*
08.07	workshop gauge	A gauge used during the actual production of the work.
08.08	inspection gauge	A gauge used in the final inspection of a part, after completion. *NOTE - Final inspection may be that carried out either by the manufacturer, or by the purchaser.*

08.09	general gauge	A gauge designed to serve, under appropriate conditions, either as a workship or as an inspection gauge. *NOTE - The 'general gauge' takes the place of the earlier types of workshop and inspection gauges having tolerance zones respectively inside and outside the limits for the work. The gauge limits are so disposed that a general GO gauge near its maximum metal limit can be used as a workshop gauge, while one near its minimum metal limit or slightly worn, can be used as an inspection gauge; a general NOT GO gauge near its maximum metal limit can be used as an inspection gauge, while one near its minimum metal limit, or slightly worn, can be used as a workshop gauge.*

No.	Term	Definition
08.10	position gauge	A gauge used to determine whether a number of features on a component are in correct geometrical relationship with each other within the assigned tolerances. *NOTE - Position gauges are often complicated in construction, the simplest type is a two-pin gauge for determining the spacing of a pair of holes or a two-hole gauge for determining the spacing of a pair of pins.*
08.11	receiver gauge	A gauge designed to check simultaneously all relevant features on a component.
08.12	check gauge	A gauge used for checking the accuracy of other gauges. *NOTE - Check gauges are commonly used for the verification of individual dimensions on the gauges to which they relate. A gauge used to check*

the overall performance of another gauge is sometimes described as a reference gauge.

08.13 **setting gauge**
setting piece

A gauge used as a control in the setting of an adjustable workshop or inspection gauge, or of a comparator for measuring the work.

NOTE – A setting gauge should be of appropriate (known) size, and of a geometrical form corresponding to that of the work which is ultimately to be gauged or measured.

INDEX

A

Actual size 04.05
Addendum 06.02
Allowance 05.03
  Fitting 06.47
  Wrenching 06.46
Angle,
  basic 04·06
  design 04·07
  included 06·16
  lead 06·30
Angle of thread 06·16
Angles, flank 06·17
Apex 06·19
Assembly 01·01
  interchangeable 01·06
  selective 01·08
  sub 01·02
  unit 01·07

Clearance 05·01
  fit 05·05
  major 06·60
  minor 06·61
Clearing flank 06·54
Complete thread 06·40
Component 01·03
Concentric feature 03·06
Constructional dimension 03·03
Crest 06·14
Cumulative pitch 06·25

D

Datum,
  dimension 03·04
  feature 03·07
  line 03·08
  plane 03·08
  point 03·08

Assembly drawing 02.02
Auxiliary dimension 03.02
Axis 06.22

B

Basic,
  angle 04.06
  form 03.10
  form of screw thread 06.11
  member 05.10
  size 04.02
  taper 04.06
  truncation 06.21
Bilateral system 05.13
Bilateral tolerance 04.12
Blunt start 06.57

C

Centre line 07.12
Centre line average height 07.15
Check gauge 08.12
Classes of fit 05.05

Dedendum 06.63
Depth of engagement 06.49
Depth (height) of fundamental
  triangle 06.20
Depth of thread 06.64
Design,
  angle 04.07
  four 03.11
  form of screw thread 06.12
  form of a surface or
  profile 07.02
  size 04.03
  taper 04.07
Detail 01.04
Detail drawing 02.03
Deviations 05.11
Diameter,
  effective 06.35
  gauge 06.37
  major 06.33
  minor 06.34
  pitch 06.35
  virtual effective 06.36

Dimension 03.01
auxiliary 03.02
constructional 03.03
datum 03.04
Drawing,
assembly 02.02
detail 02.03
general arrangement 02.01
operation 02.04
sub-assembly 02.02

E

Effective, diameter 06.35
Engagement,
depth of 06.49
length of 06.50
External screw thread 06.02

F

Feature 03.05
Concentric 03.06
datum 03.07
grade of 05.14
Fundamental triangle 06.18
height (depth) of 06.20

G

Gauge,
check 08.12
general 08.09
GO 08.05
inspection 08.08
limit 08.04
master 08.02
NOT GO 08.06
position 08.10
receiver 08.11
reference 08.03
setting 08.13
standard 08.01
workshop 08.07
Gauge diameter 06.37
Gauge length 03.69
Gauge plane 06.38
General arrangement drawing 02.61
General gauge 08.09
Geometrical reference frame 03.09
Go gauge 08.05

  positional 03.06
Feature tolerance 04.15
Female screw thread 06.03
Fit 05.04
  classes of 05.05
  grade of 05.15
  grade of a threaded pair 06.56
  types of 05.06
Fitting allowance 06.47
Flank,
  clearing 06.54
  following 06.52
  leading 06.51
  pressure 06.53
Flank angles 06.17
Flanks 06.13
Following flank 06.52
Form 06.10
  basic 03.10
  basic(screw thread) 06.11
  design 03.11
  design(screw thread) 06.12
  design(surface finish) 07.02
  tolerances 04.14

Grade,
  of a feature 05.14
  of a fit 05.15
  of fit of a threaded pair 06.56
  (or class) of a thread 06.55

H

Height (depth) of fundamental triangle 06.20
Hole basis limit system 05.08

I

Included angle 06.16
Incomplete thread 06.41
Inspection gauge 08.08
Interchangeable,
  assembly 01.06
  part 01.05
Interference 05.02
  fit 05.05
Internal screw thread 06.03
Item 02.05

L

Lay 07.16
Lead 06.24
Lead angle 06.30
Leading flank 06.51
Left-hand screw thread 06.05
Length of engagement 06.50
Length to the end of full
  thread(length of full
  thread) 06.48
Limit,
  maximum metal 04.17
  minimum metal 04.18
Limit gauge 08.04
Limit system 05.07
  bilateral 05.13
  hole basis 05.08
  shaft basis 05.09
  unilateral 05.12
Limits of size 04.09
Limits of tolerance 04.10

O

Operation drawing 02.04
Operation schedule 02.04

P

Parallel screw thread 06.06
Part, interchangeable 01.05
Pitch, 06.23
  cumulative 06.25
Pitch cone 06.27
Pitch cylinder 06.26
Pitch diameter 06.35
Pitch line 06.28
Pitch point 06.29
Position gauge 08.10
Positional feature 03.06
Positional tolerance 04.13
Pressure flank 06.53
Primary texture 07.17
Profile 07.04
  modified 07.08

M

Major clearance 06.60
Major cone 06.31
Major crest truncation 06.58
Major cylinder 06.31
Major diameter 06.33
Male screw thread 06.02
Master gauge 08.02
Maximum metal limit 04.17
Mean line 07.13
Metal tolerance 04.16
Minimum metal limit 04.18
Minor clearance 06.61
Minor cone 06.32
Minor crest truncation 06.59
Minor cylinder 06.32
Minor diameter 06.34
Modified profile 07.08
Multi-start screw thread 06.09

N

Nominal size 04.04
NOT GO gauge 08.06

R

Receiver gauge 08.11
Reference gauge 08.03
Right hand screw thread 06.04
Root 06.15
Roughness index number 07.14
Roughness, surface 07.03

S

Sampling length 07.10
Schedule, operation 02.04
Screw thread 06.01
  external 06.02
  female 06.03
  internal 06.03
  left hand 06.05
  male 06.02
  multi start 06.09
  parallel 06.06
  right hand 06.04
  single start 06.08
  taper 06.07
Secondary texture 07.18

Selective assembly 01.08
Setting gauge 08.13
Shaft basis limit system 05.09
Single start screw thread 06.08
Size 04.01
actual 04.05
basic 04.02
design 04.03
limits of 04.09
nominal 04.04
Spacing 07.07
Standard gauge 08.01
Sub-assembly 01.02
Sub-assembly drawing 02.02
Surface 07.01
Surface roughness 07.03
Surface texture 07.03
Surface texture index Nos. 07.14

T

Taper
basic 04.06
design 04.07
Taper screw thread 06.07
Total thread 06.45
transition fit 05.05
Traversing length 07.11
Truncation,
basic 06.21
major crest 06.58
minor crest 06.59
Types of fit 05.06

U

Unilateral system 05.12
Unilateral tolerance 04.11
Useful thread 06.44
Unit assembly 01.07

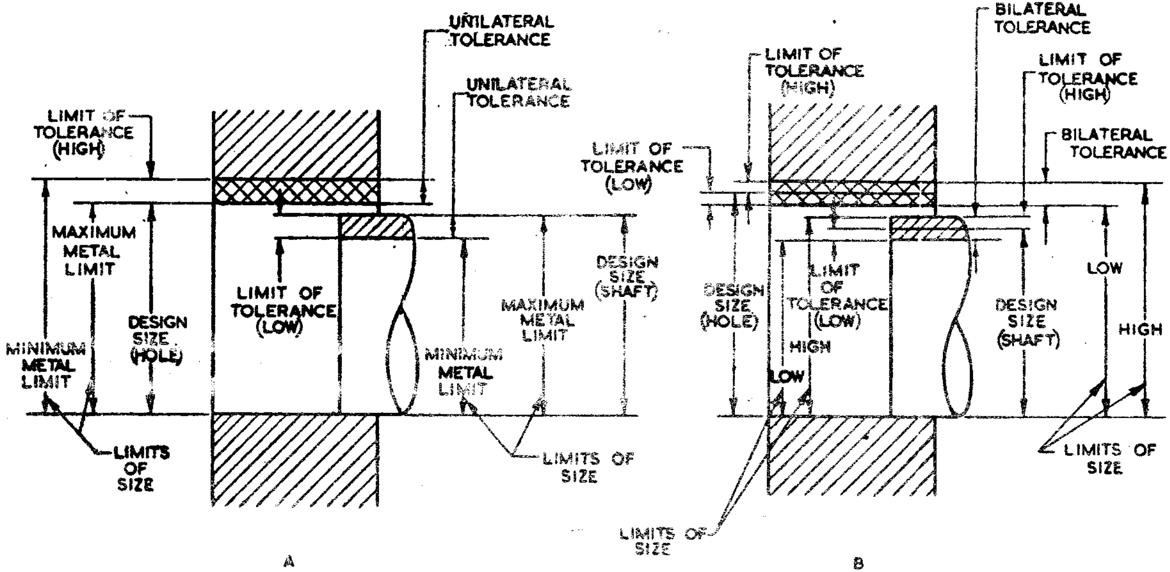
V

Vanish cone 06.43
Vanish thread 06.42
Virtual effective diameter 06.36

W

Washout thread 06.42

Texture,
  primary 07.17
  secondary 07.18
  surface 07.03
Thickness of thread 06.65
Thread(see also Screw Thread)
  basic form 06.11
  complete 06.40
  depth 06.64
  design forms 06.12
  form 06.10
  grade (or class) 06.55
  incomplete 06.41
  thickness 06.65
  total 06.45
  useful 06.44
  washout 06.42
Tolerance 04.08
  bilateral 04.12
  feature 04.15
  form 04.14
  limits of 04.10
  metal 04.16
  positional 04.13
  unilateral 04.11
Wave form 07.05
Wave length 07.06
Wave length cut off 07.09
Waviness 07.18
Workshop gauge 08.07
Wrenching allowance 06.46


UNILATERAL TOLERANCE
UNILATERAL TOLERANCE
LIMIT OF TOLERANCE (HIGH)
MAXIMUM METAL LIMIT
DESIGN SIZE (HOLE)
MINIMUM METAL LIMIT
LIMITS OF SIZE
LIMIT OF TOLERANCE (LOW)
MINIMUM METAL LIMIT
MAXIMUM METAL LIMIT
DESIGN SIZE (SHAFT)
LIMITS OF SIZE
A
BILATERAL TOLERANCE
LIMIT OF TOLERANCE (HIGH)
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BILATERAL TOLERANCE
LIMIT OF TOLERANCE (LOW)
DESIGN SIZE (HOLE)
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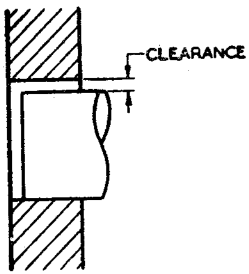
DESIGN SIZE (SHAFT)
LOW
HIGH
LIMITS OF SIZE
LIMITS OF SIZE
B

FIGURE 1



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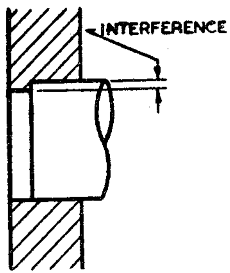

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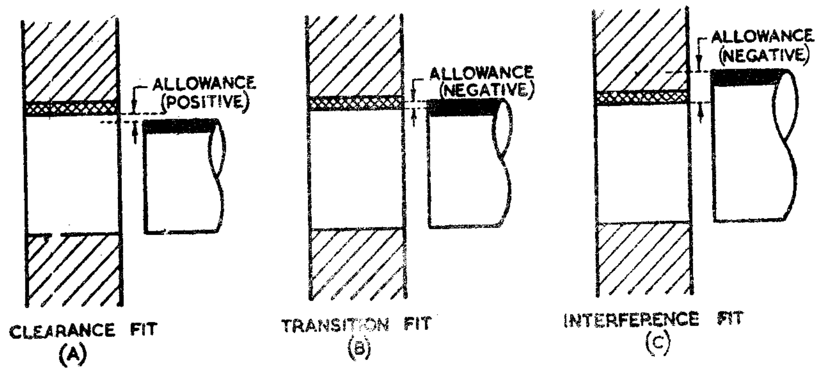
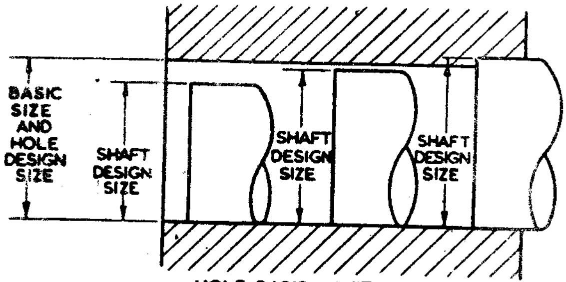


CLASSES OF FIT

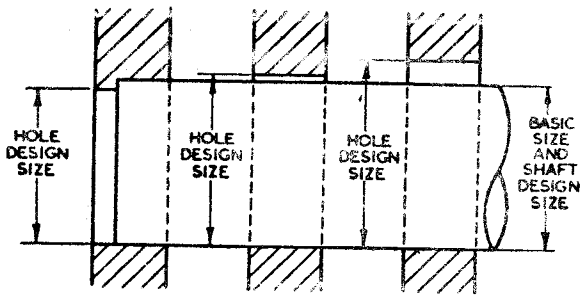
INDICATES TOLERANCE ZONES

FIGURE 4



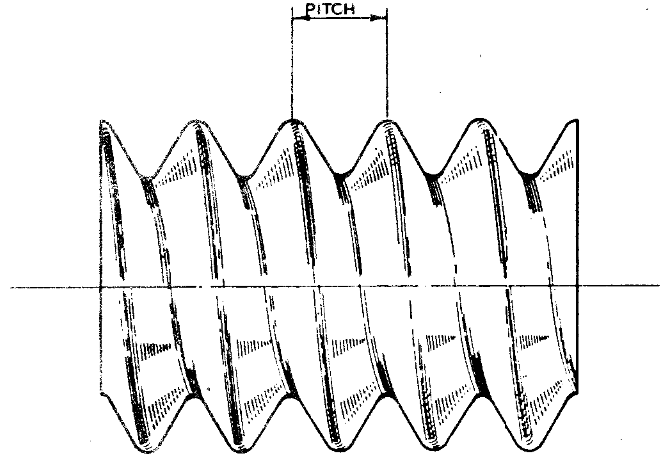
HOLE BASIS LIMIT SYSTEM

FIGURE 5



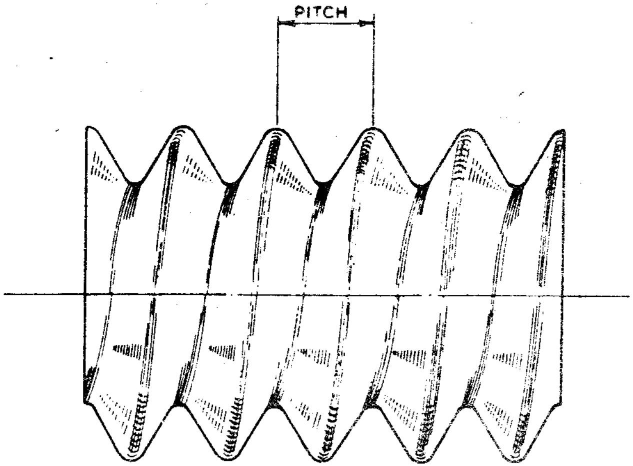
SHAFT BASIS LIMIT SYSTEM

FIGURE 6



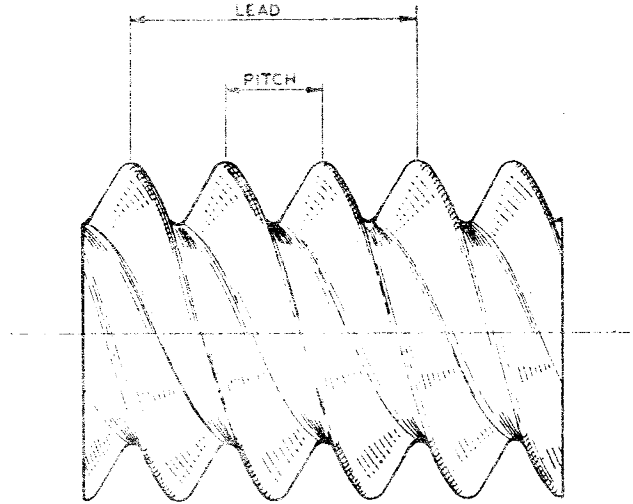
SINGLE-START SCREW THREAD (RIGHT HAND)

FIGURE 7a



SINGLE-START SCREW THREAD (LEFT HAND)

FIGURE 7b



MULTI-START SCREW THREAD (TRIPLE-START RIGHT-HAND)

FIGURE 7c

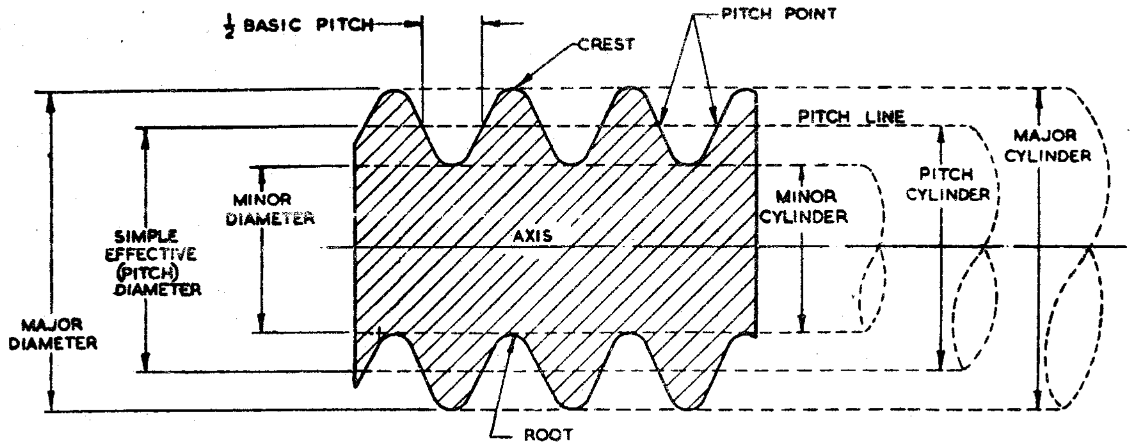


FIGURE 8 - External parallel screw thread

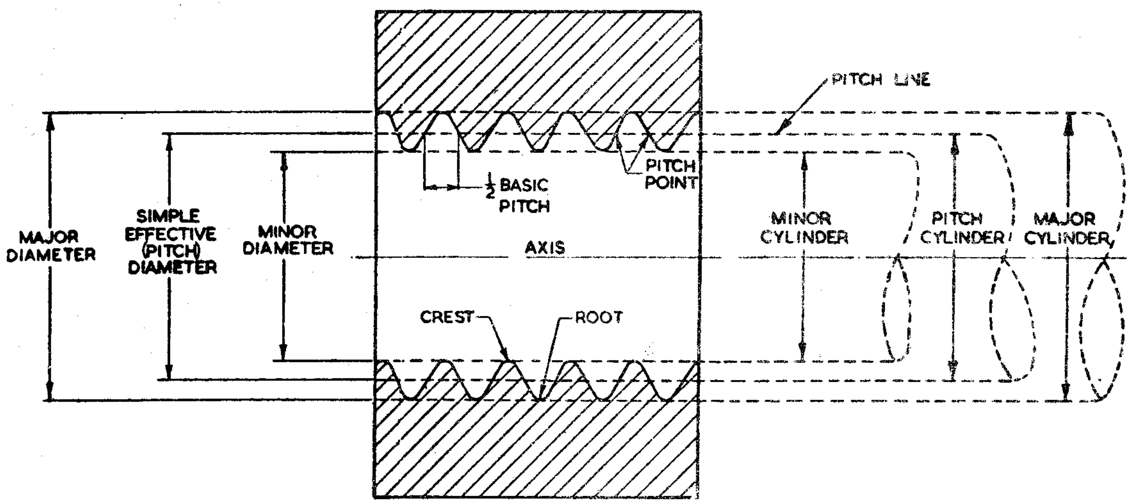


FIGURE 9 - Internal parallel screw thread

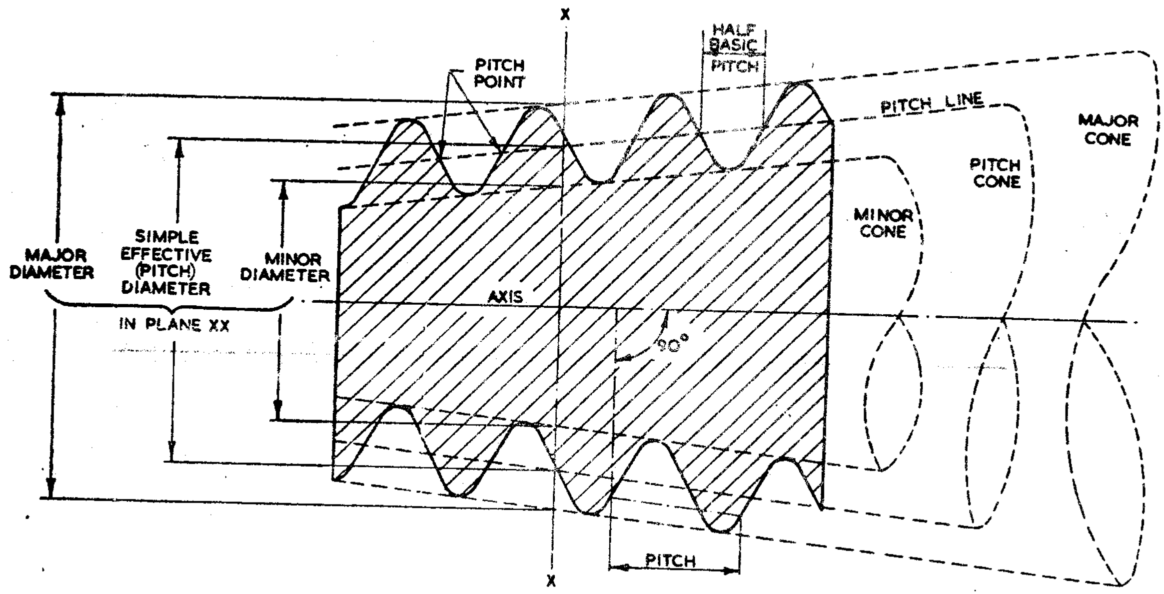


FIGURE 10a - External taper screw thread

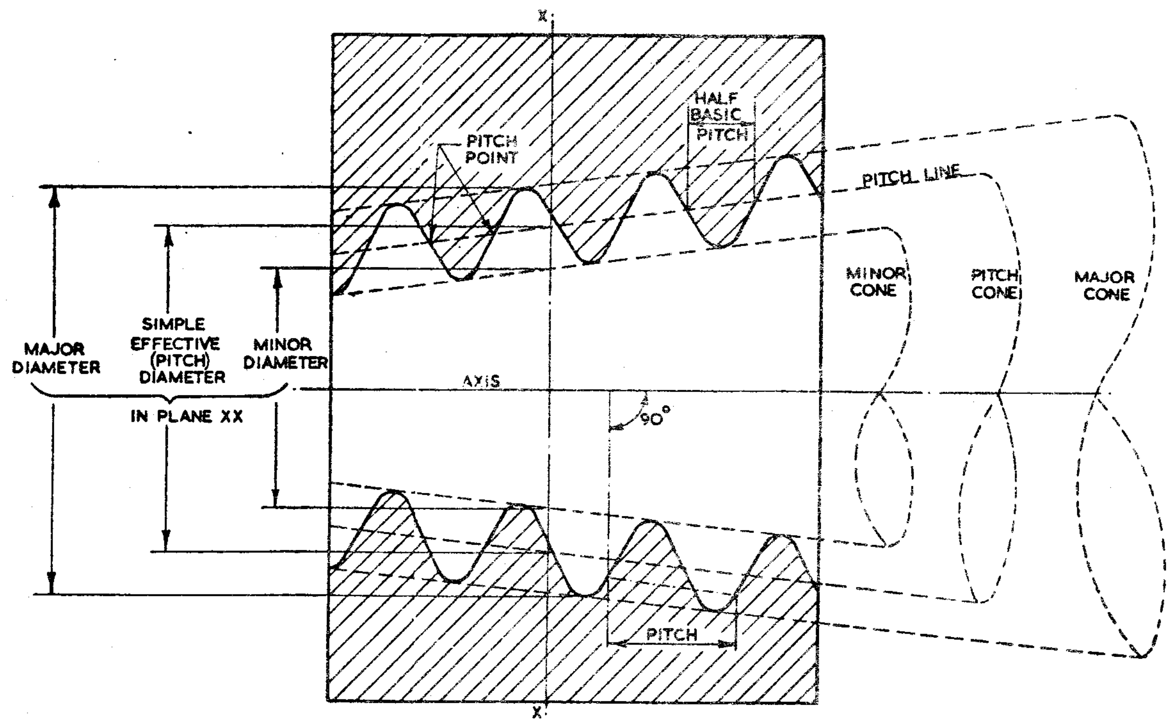


FIGURE 10b - Internal taper screw thread

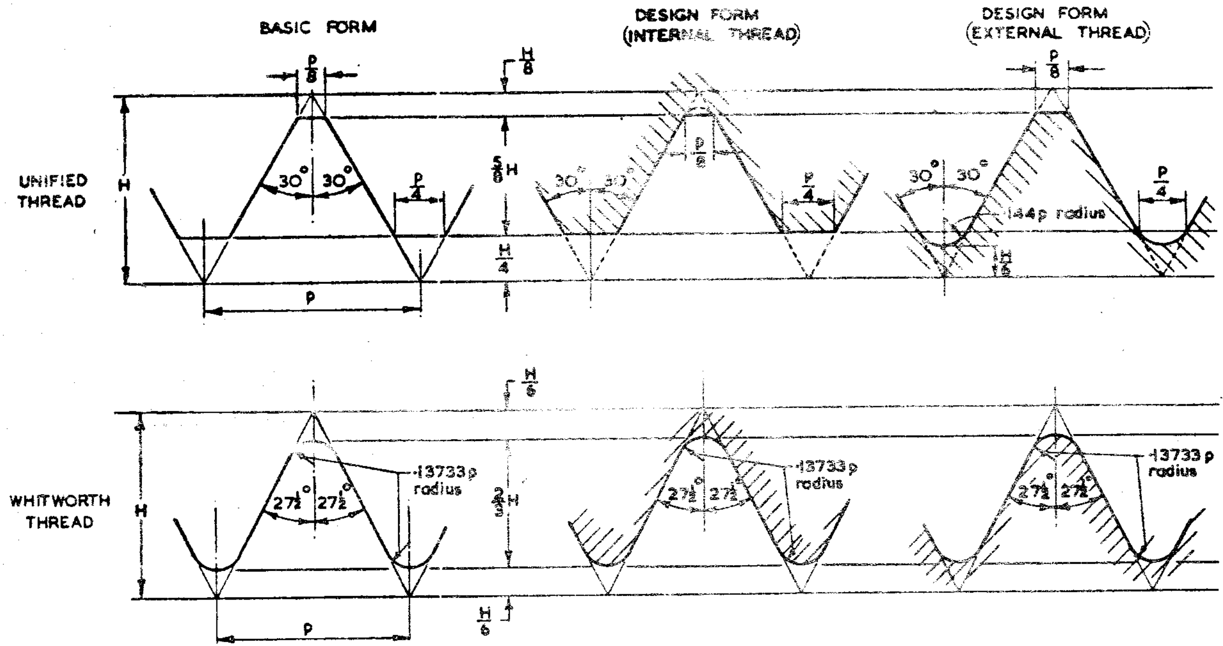
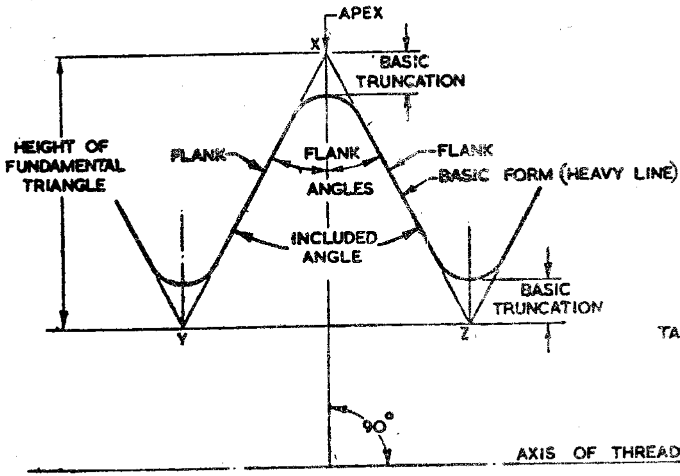
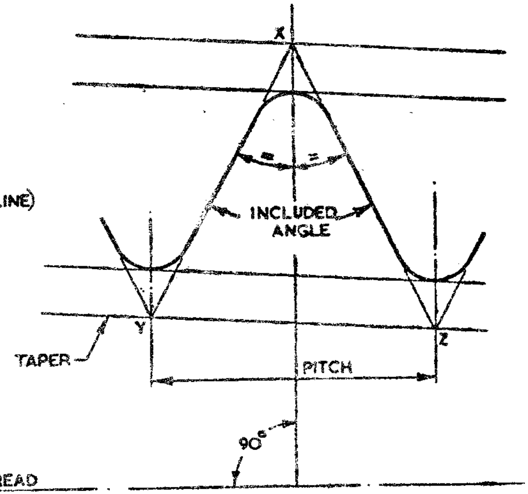


FIGURE 11 - Basic and design forms of threads



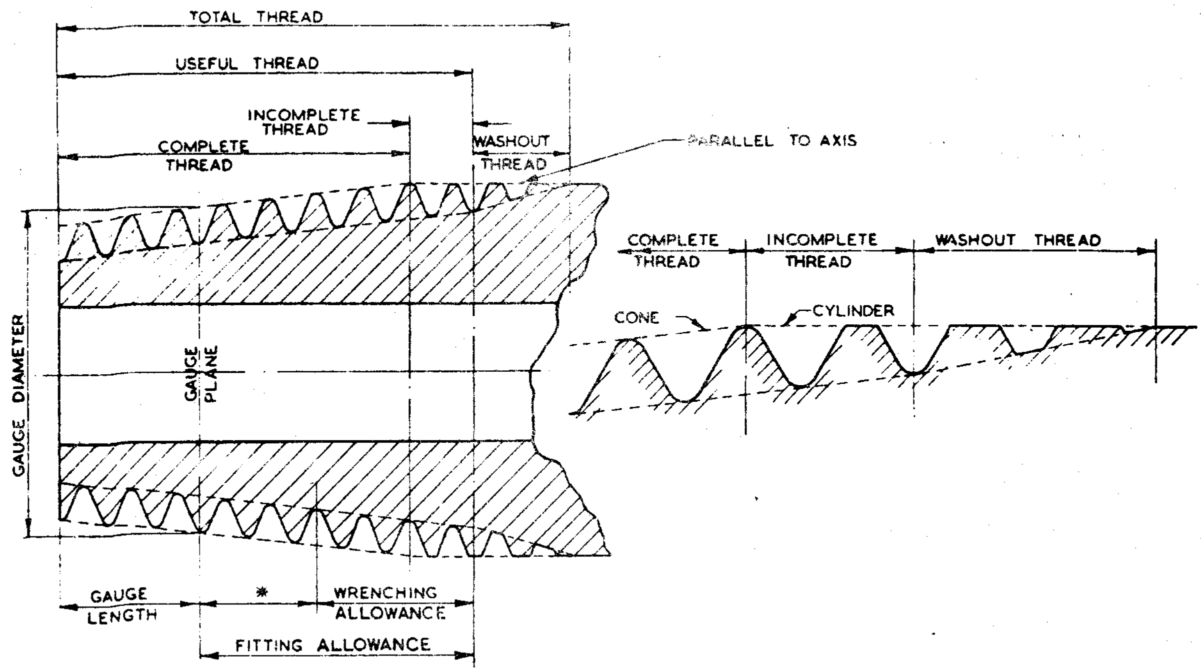
PARALLEL SCREW THREAD
THE FUNDAMENTAL
TRIANGLE IS XYZ.

FIGURE 12a



TAPER SCREW THREAD
THE FUNDAMENTAL
TRIANGLE IS XYZ.

FIGURE 12b



* NOTE - THIS LENGTH IS EQUIVALENT TO THE POSITIVE TOLERANCE ON THE COUPLING

FIGURE 13

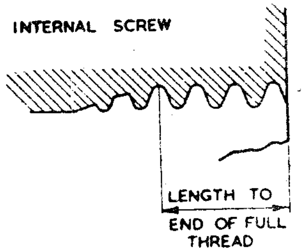


FIGURE 14a

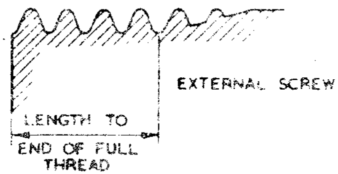


FIGURE 14b

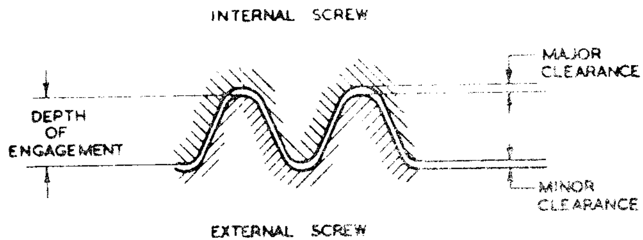


FIGURE 15

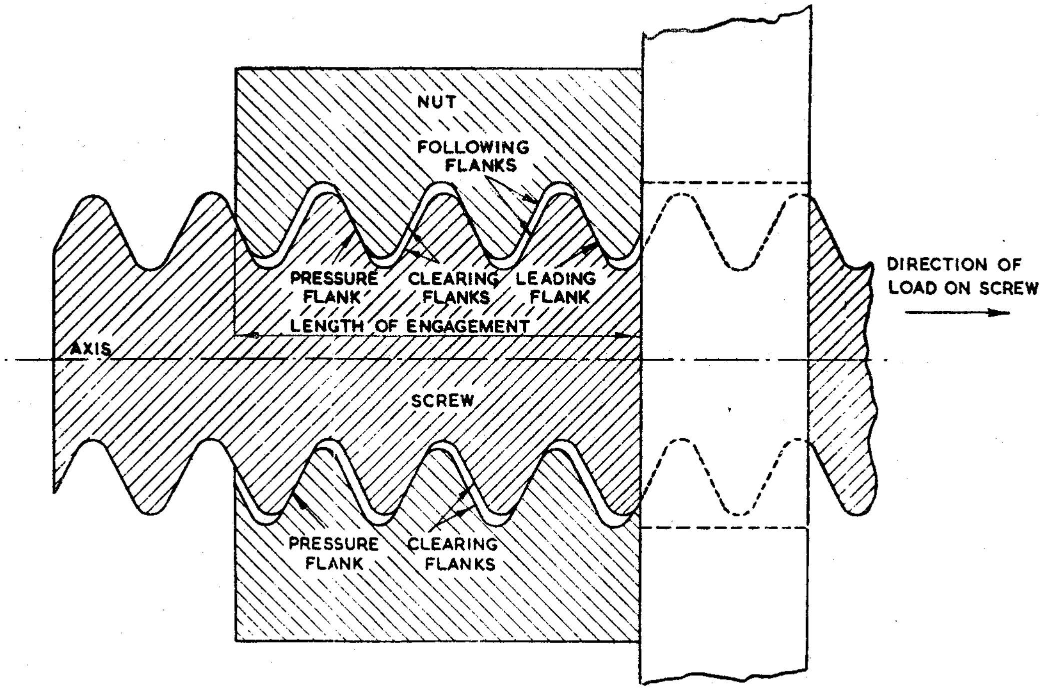
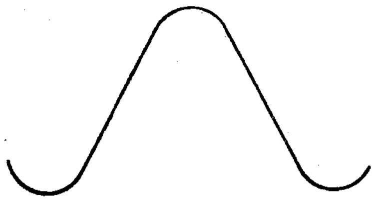
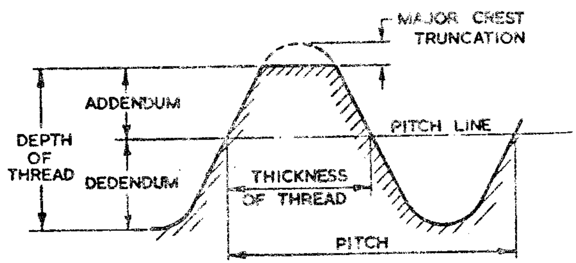

NUT
FOLLOWING FLANKS
PRESSURE FLANK
CLEARING FLANKS
LEADING FLANK
LENGTH OF ENGAGEMENT
AXIS
SCREW
PRESSURE FLANK
CLEARING FLANKS
DIRECTION OF LOAD ON SCREW

FIGURE 16



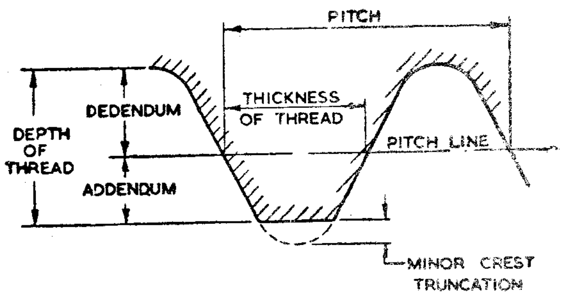
BASIC FORM

FIGURE 17a



DESIGN FORM (EXTERNAL THREAD)

FIGURE 17b



DESIGN FORM (INTERNAL THREAD)

FIGURE 17c

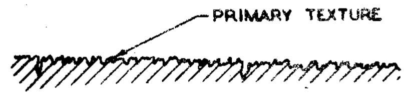
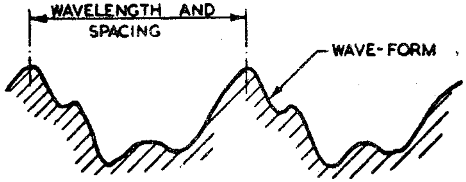
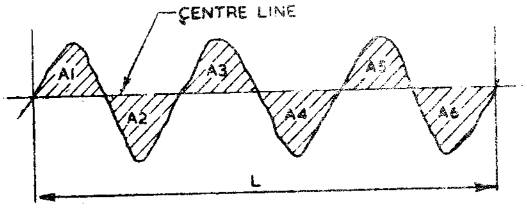


FIGURE 18



SECONDARY TEXTURE OR WAVINESS

FIGURE 19



AREA (A1 + A3 + A5) = AREA (A2 + A4 + A6)

CENTRE LINE AVERAGE HEIGHT OVER LENGTH L = $\frac{(A1 + A2 + A3 + A4 + A5 + A6)}{L}$

FIGURE 20

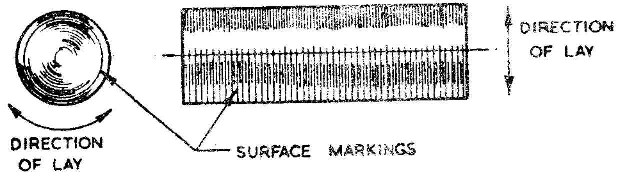


FIGURE 21

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