International Standard 1122/1

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Glossary of gear terms — Part 1 : Geometrical definitions

Vocabulaire des engrenages — Partie 1 : Définitions géométriques

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Contents

* At present under study; the glossary for worm gear pairs will be published later on in the form of an addendum to this part of ISO 1122.

Glossary of gear terms — Part 1 : Geometrical definitions

0.1 Introduction

The drawing up of a vocabulary of gears may be conceived in many different ways, depending on the aim : in its most simplified form, the vocabulary may have the sole aim of fixing the terminology, which sometimes varies from one workshop to another, that is to say, it may consist of a simple list of recommended terms, possibly completed by corresponding terms in other languages, but without definitions, on the assumption that these are already familiar to the people dealing with gears. On the other hand, the glossary may be a proper document of instruction, containing both the definition of each term and all useful comments to make it readily intelligible to young people and to enable them to understand better the various mathematical and practical consequences which may result from it in connection with the range of other definitions.

Since we are here dealing with international standardization, it seems essential to enable men who deal with gears to understand one another, without error or ambiguity, by placing at their disposal the standard terms in each language which have exactly the same significance between one country and another.

This part of ISO 1122 must not therefore be regarded as aiming directly at teaching, which would necessitate longer explanations, nor as intended specifically for workshop technicians who would doubtless prefer shortened and perhaps less rigorous definitions which could easily be assimilated in the light of their long experience. This part of ISO 1122 has been drawn up for general use in the sense of a dictionary which may confidently be consulted in case of doubt or disagreement.

For this reason, this part of ISO 1122 gives as rigorous a geometrical definition as possible for each term, since this is an indispensable factor in eliminating uncertainty in the interpretation of difficult passages, especially as regards dealings between countries where different languages are used.

If certain definitions are found to be somewhat abstract in character, it is nevertheless true that the work was carried out taking account solely of practical necessities, deliberately leaving aside all purely theoretical and historical considerations. (Thus it is, for example, that only ordinary gears with constant ratio are considered, to the exclusion of elliptical or other types of gears, and that no reference is made to working hyperboloids, which have their place in kinematic theories but are not actually used in the study, cutting or use of gear wheels).

For the same reason, in the case of two equivalent definitions which would be equally possible for the same term, but one of which is a consequence of the other, only the more general definition has been retained as a basic definition even if, in some cases, it would have been more convenient to use the other. (For example, the module may be defined in terms of the pitch or the diameter and the number of teeth; here, the first definition, which is more general and is applicable even in the case of the rack, must be considered to be the basic definition).

Comparison of the proposal drawn up in this way with the standards and proposals which were taken as a starting point shows great similarity as regards subject matter; this similarity is clearly imposed by gear engineering itself, which is the same in all countries.

As regards form, the following should be noted :

— on the one hand, the addition of certain terms which did not exist in older standards (e.g. constant chord);

— on the other hand, the elimination of some other terms, which have either secondary or no interest in practice and which actually belong, not to a vocabulary of gears, but to a vocabulary of geometrical or kinematic sciences, and which have already been adequately defined in this respect;

— lastly, certain French terms did not have corresponding terms in English; in the English version, these terms appear as translations of the French terms and have been put between square brackets.

0.2 Scope and field of application

This part of ISO 1122 contains the part of the international glossary of gears which is devoted solely to geometrical definitions.

It gives, for each of the geometrical terms relative to gears, a standard definition which will be valid internationally, the corresponding term being chosen as far as possible in each language in such a way as to be a direct reflection of the meaning of the definition.

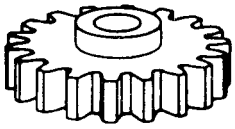
Since the latter condition can only be partially fulfilled in any particular language, as a result of the necessity of respecting certain established conventions, it is advisable, as far as translation into other languages is concerned, to refer always to the meaning of the definition itself, rather than to a simple transposition of the original term.

1 General definitions

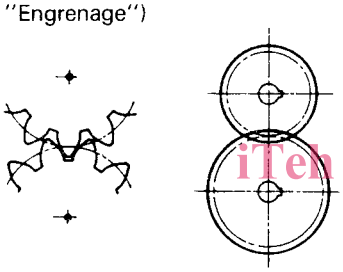
1.1 Kinematic definitions

1.1.1 Relative position of axes

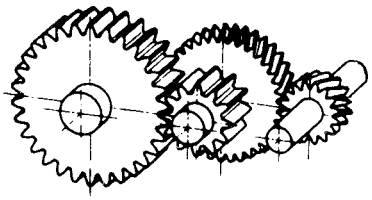
1.1.1.1 toothed gear : Any toothed member designed to transmit motion to another one, or receive motion from it, by means of successively engaging teeth.



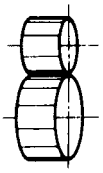
1.1.1.2 [gear pair] *: An elementary mechanism consisting of two gears mobile around axes of invariable relative position, and one of which turns the other by the action of teeth successively in contact.
(French term : "Engrenage")



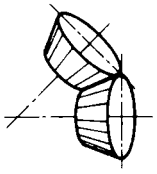
1.1.1.3 train of gears : Any combination of gear pairs.



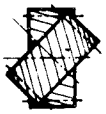
1.1.1.4 [gear pair with parallel axes]* : A gear pair whose axes are parallel.
(French term : "Engrenage parallèle")



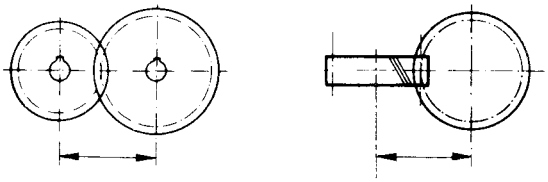
1.1.1.5 [gear pair with intersecting axes]* : A gear pair whose axes intersect.
(French term : "Engrenage concourant")



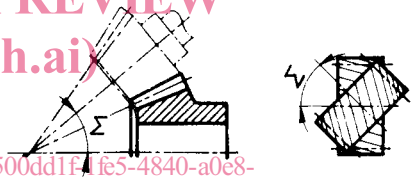
1.1.1.6 [gear pair with non-parallel, non-intersecting axes]* : A gear pair whose axes are non-parallel, non-intersecting axes.
(French term : "Engrenage gauche")



1.1.1.7 centre distance : The shortest distance between the axes of a gear pair with parallel axes or with non-parallel, non-intersecting axes.

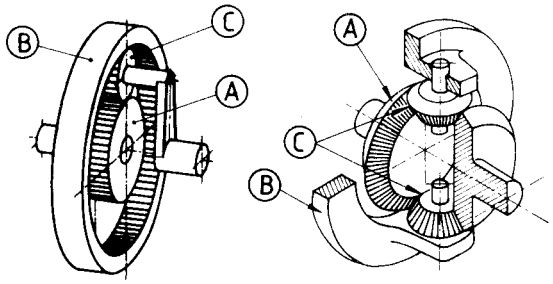


1.1.1.8 shaft angle : The smallest angle through which one of the axes must be rotated in order to bring the axes into coincidence (gear pair with intersecting axes) or must be swivelled in order to bring the axes parallel (gear pair with non-parallel, non-intersecting axes) so as to cause their direction of rotation to be opposite.



1.1.1.9 planetary or epicyclic gear train

(1) [single planetary gear train]* : A gear train comprising three co-axial elements, two of which are extreme gears with fixed axes, the third being a carrier which may or may not turn around the common axes of the two gears and which supports one or more intermediate gears.
(French term : "Train planétaire simple")



A : Sun gear
B : Ring gear
C : Planet gear

(2) [compound planetary gear train]* : A planetary gear train consisting of several coupled single planetary gear trains.
(French term : "Train planétaire composé")

* Between brackets is a translation of the French term for which there is no corresponding special term in English.

1.1.2 Mating gears

1.1.2.1 mating gear : Either one of the two gears of a pair, considered in relation to the other.

1.1.2.2 pinion : That one of the two gears of a pair which has the smaller number of teeth.

1.1.2.3 wheel or gear : That one of the two gears of a pair which has the larger number of teeth.

1.1.2.4 driving gear : That gear, of a pair, which turns the other.

1.1.2.5 driven gear : That gear, of a pair, which is turned by the other.

1.1.2.6 sun gear : In a planetary gear train, the extreme gear with external teeth.

1.1.2.7 ring gear : In a planetary gear train, the extreme gear with internal teeth.

1.1.2.8 planet gear : In a planetary gear train, the (or one of the) intermediate gear(s).

1.1.3 Relative speeds

1.1.3.1 gear ratio : The quotient of the number of teeth of the wheel to that of the pinion.

1.1.3.2 transmission ratio : The quotient of the angular speed of the first driving gear of a train of gears to that of the last driven gear.

NOTE — When it is necessary, it is agreed to give to the transmission ratio the sign + when these angular speeds are of the same direction and the sign − when they are of opposite direction.

1.1.3.3 speed reducing gear pair (or train) : A gear pair or a train of gears of which the angular speed of the last driven gear is less than that of the first driving gear.

1.1.3.4 speed increasing gear pair (or train) : A gear pair or a train of gears of which the angular speed of the last driven gear is greater than that of the first driving gear.

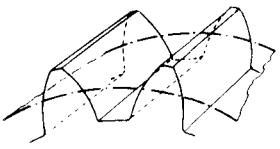
1.1.3.5 speed reducing ratio : The transmission ratio of a speed reducing gear pair or train of gears.

1.1.3.6 speed increasing ratio : The inverse of the transmission ratio of a speed increasing gear pair or train of gears.

1.1.4 Pitch and reference surfaces

1.1.4.1 pitch surface : The geometrical surface described by the instantaneous axis of the movement of the mating gear in relation to the gear under consideration in a given gear pair.

1.1.4.2 reference surface : An imaginary conventional surface with reference to which the tooth dimensions of a gear, considered alone, are defined. It is the pitch surface of engagement with the basic rack.



1.1.4.3 reference ..... * : A qualification applicable to every term defined from the reference surface of a gear.

1.1.4.4 working ..... * : A qualification applicable to every term defined from the pitch surface of a gear in a gear pair.

1.2 Teeth characteristics

1.2.1 General terms

1.2.1.1 gear tooth : Each of the projecting parts of a gear which are intended to ensure, by contact with the teeth of another gear, that one of the gears turns the other.

NOTE — In French, the teeth of a gear are collectively named "denture".

1.2.1.2 tooth space : The space between two adjacent teeth of a gear.

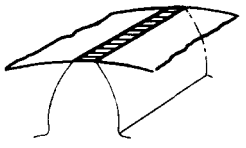
1.2.1.3 dimensions : For teeth dimensions (tooth depth, addendum, dedendum, pitch, thickness, spacewidth, chord, addendum modification) see following clauses.

1.2.1.4 module and diametral pitch : See following clauses.

1.2.1.5 reduced value of a dimension : The quotient of the dimension under consideration, expressed in millimetres, by the module; or the product of the dimension under consideration, expressed in inches, by the diametral pitch. When the dimension under consideration is the addendum modification or the shaft angle modification, the reduced value is called "coefficient".

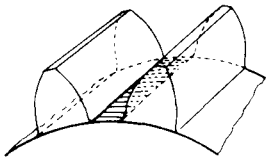
1.2.2 Tip and root surfaces

1.2.2.1 tip surface : Surface, coaxial with the gear, containing the crests of the teeth.

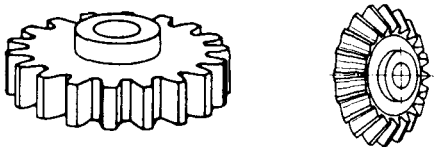


* By convention, the qualification "reference" may always be omitted, as understood, except when in express opposition to the qualification "working". Write the word "tooth" before "reference" when there is a risk of confusion with specially machined datum surface, also termed reference surface.

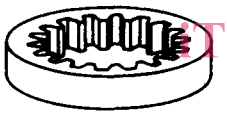
1.2.2.2 root surface : Surface, coaxial with the gear, tangential to the bottom of the tooth spaces.



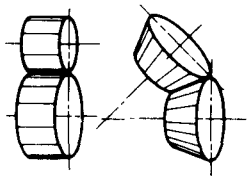
1.2.2.3 external gear : A gear whose tip surface is external to the root surface.*



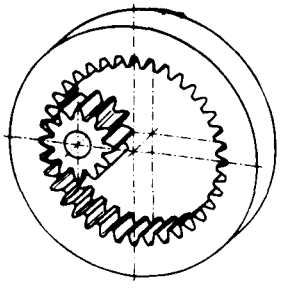
1.2.2.4 internal gear : A gear whose tip surface is internal to the root surface.*



1.2.2.5 external gear pair : A gear pair of which both gears are external gears.

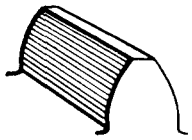


1.2.2.6 internal gear pair : A gear pair of which one gear is an internal gear.

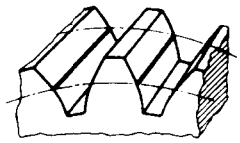


1.2.3 Flanks and profiles

1.2.3.1 tooth flank : That portion of the surface of a tooth lying between the tip surface and the root surface.

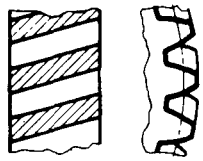


1.2.3.2 tooth trace** : The line of intersection of a tooth flank with the reference surface.

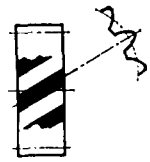


1.2.3.3 tooth profile** : The line of intersection of a tooth flank with any defined surface cutting the reference surface.

1.2.3.4 transverse profile** : The line of intersection of a tooth flank by a surface perpendicular to the straight generators of the reference surface.



1.2.3.5 normal profile : The line of intersection of a tooth flank by a surface orthogonal to the tooth traces.



1.2.3.6 axial profile : The line of intersection of a tooth flank by a plane containing the axis of the gear.

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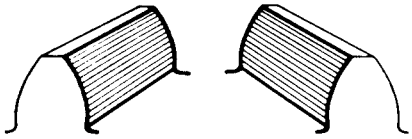
* In order to avoid any ambiguity, especially in the case of bevel gears, consider the section of both surfaces by a plane perpendicular to the axis of the gear.

** Term defined with respect to the reference surface (qualification "reference" understood). Add the qualification "working" for the corresponding term defined with respect to the pitch surface.

1.2.4 Flanks — qualifications

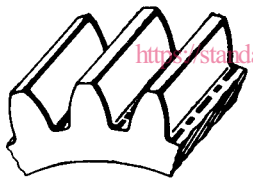
1.2.4.1 mating flank : In a gear pair, either one of the two flanks in contact considered in relation to the other.

1.2.4.2 right (or left) flank : For an observer looking from that side of the gear conventionally chosen as reference side : that one of the two flanks of a tooth which is on the right (or the left) of the tooth, when seen with its tip upwards.

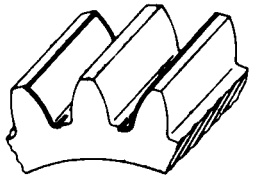


Right flank Left flank

1.2.4.3 corresponding flanks : Of the teeth of a gear, flanks which are all right flanks, or all left flanks.



1.2.4.4 opposite flanks : Of the teeth of a gear, one or more right flanks in relation to one or more left flanks.

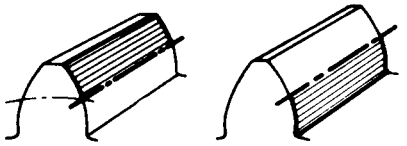


1.2.4.5 working flank : That flank of a tooth by which motion is transmitted to, or received from, a mating gear.

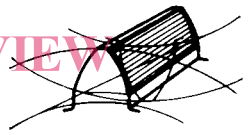
1.2.4.6 non-working flank : The opposite flank to the working flank of a tooth.

1.2.5 Parts of flanks

1.2.5.1 addendum (or dedendum) flank* : That portion of the flank lying between the tip (or root) surface and the reference surface.

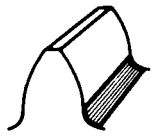


1.2.5.2 active flank: That portion of a tooth flank of a gear which contacts the tooth flanks of a mating gear.



1.2.5.3 usable flank : The largest portion of the tooth flank of an individual gear which may be used as active flank.

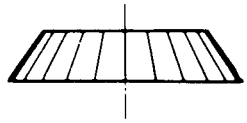
1.2.5.4 fillet : That portion of the flank between the usable flank and the bottom of the tooth spaces.



1.2.6 Definitions in terms of tooth traces

1.2.6.1 spur gear : A cylindrical gear whose tooth traces are straight line generators of the reference cylinder.

1.2.6.2 straight bevel gear : A bevel gear whose tooth traces are straight line generators of the reference cone.



* Term defined with respect to the reference surface (qualification "reference" understood). Add the qualification "working" for the corresponding term defined with respect to the pitch surface.

1.2.6.3 helical gear : A cylindrical gear whose tooth traces are helices.

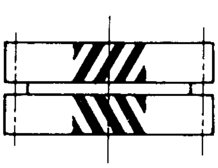
1.2.6.4 right-hand teeth : Teeth whose successive transverse profiles show clockwise displacement with increasing distance from an observer looking along the straight line generators of the reference surface.

NOTE — It must be noted that a rack is regarded as an external gear of infinitely large diameter (see 2.1.7.1).

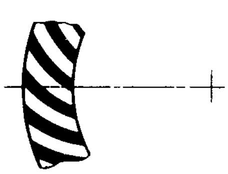
1.2.6.5 left-hand teeth : Teeth whose successive transverse profiles show anticlockwise displacement with increasing distance from an observer looking along the straight line generators of the reference surface.

NOTE — It must be noted that a rack is regarded as an external gear of infinitely large diameter (see 2.1.7.1).

1.2.6.6 double helical gear (or gear pair) : A cylindrical gear (or gear pair) in which a part of the facewidth is right-hand and the other left-hand, with or without a gap between them.



1.2.6.7 spiral bevel gear : A bevel gear whose tooth traces are curved lines other than helices.



1.3 Tooth generation

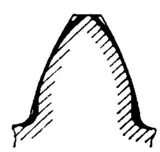
1.3.1 Generating gear, interference and modification of the flank shape

1.3.1.1 generating gear of a gear : A gear, either real or imaginary, used for defining the gear under consideration. The usable flanks of the gear are the envelope of those of its generating gear, under the conditions of relative position and motion specified.

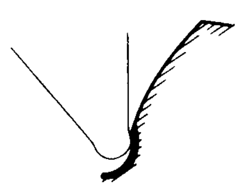
1.3.1.2 meshing interference : The theoretical penetration of a flank in its mating flank when their meshing occurs outside certain limits.

1.3.1.3 cutter interference : The penetration of the cutting tool in the flank of the tooth with result of removal of material causing a systematic variation between the cut flank and the theoretical profile of the tooth.

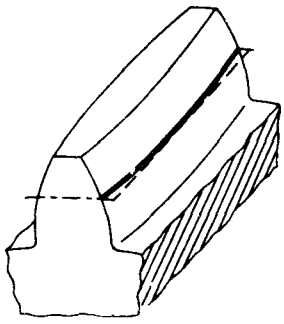
1.3.1.4 tip (or root) relief : The intentional modification of the form of the tooth profile implying a removal of material at the tip (or at the root) in order to smooth the contact of a flank with its mating flank.



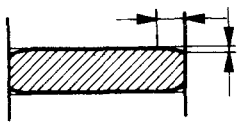
1.3.1.5 undercut : The intentional modification of the fillet implying a removal of material obtained, for instance, by means of a cutting tool with protuberance, in order to facilitate the eventual working following the cutting.



1.3.1.6 crowning : Progressive reduction of the tooth thickness from the middle part towards each end face, in order to ensure the transmittance of the stresses of a flank to its mating flank under the best conditions.



1.3.1.7 end relief : Progressive reduction of tooth thickness over a small part of the facewidth terminating at the end faces of the teeth in order to cut out the edges.

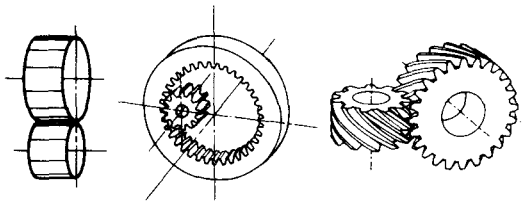


1.3.2 Definitions in terms of tooth generation

1.3.2.1 cylindrical gear : A gear whose reference surface is a cylinder.

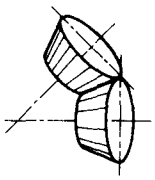
1.3.2.2 bevel gear : A gear whose reference surface is a cone.

1.3.2.3 cylindrical gear pair : A pair of mating cylindrical gears.



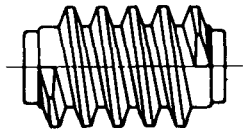
NOTE — This gear pair may be qualified as "spur" when it is made up of spur gears, or as "helical" when it is made up of helical gears.

1.3.2.4 bevel gear pair : A pair of mating bevel gears, with intersecting axes.

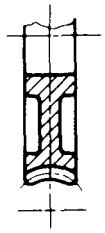


NOTE — This gear pair may be qualified as "straight" when it is made up of straight gears, or as "helical" when it is made up of helical gears, or as "spiral" when it is made up of spiral gears.

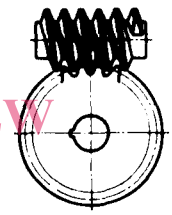
1.3.2.5 worm : A gear of cylindrical or torical form that meshes with a worm wheel (see 1.3.2.6).



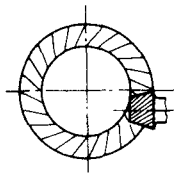
1.3.2.6 worm wheel : A gear whose flanks are capable of line contact with the flanks of a worm meshing with it on non-parallel, non-intersecting axes.



1.3.2.7 worm gear pair : A worm and its mating worm wheel.



1.3.2.8 hypoid gear pair : A pair of gears of conical or approximately conical form, having non-parallel, non-intersecting axes.



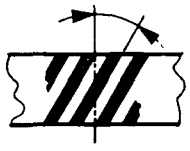
1.3.2.9 hypoid gear : Either one of the two gears of a hypoid gear pair.

1.4 Geometrical and kinematical notions used in gears

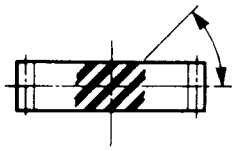
1.4.1 Geometrical lines

1.4.1.1 helix : On a cylinder of revolution, a curve whose tangents are inclined at a constant angle to the axis of the cylinder.

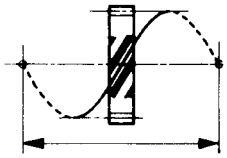
1.4.1.2 helix angle : The acute angle between the tangent to a helix and the straight generator of the cylinder on which it lies.



1.4.1.3 lead angle : The acute angle between the tangent to a helix and a plane perpendicular to the axis of the cylinder on which it lies.



1.4.1.4 lead : The distance between two consecutive intersections of a helix by a straight generator of the cylinder on which it lies.

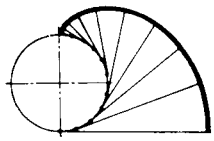


1.4.1.5 cycloid : A plane curve described by a point on a circle (the "generating circle") which rolls without slip on a fixed straight line (the "base line").

1.4.1.6 epicycloid : A plane curve described by a point on a circle (the "generating circle") which rolls without slip on the outside of a fixed circle (the "base circle").

1.4.1.7 hypocycloid : A plane curve described by a point on a circle (the "generating circle") which rolls without slip on the inside of a fixed circle (the "base circle").

1.4.1.8 involute to a circle : A plane curve described by a point on a straight line (the "generating line") which rolls without slip on a fixed circle (the "base circle").



1.4.1.9 spherical involute : On the surface of a sphere, the curve described by a point on a great circle (the "generating circle") which moves over the sphere by rolling without slip on a fixed small circle of the sphere (the "base circle").

1.4.2 Geometrical surfaces

1.4.2.1 involute helicoid : The surface generated by a straight line inclined at a constant angle to the axis of a cylinder of revolution ("base cylinder") and rolling without slip on the surface of that cylinder (i.e. constantly tangent to a helix of the cylinder).

A section by a plane perpendicular to the axis of the cylinder is an involute to a circle.

1.4.2.2 spherical involute helicoid : The surface generated by a straight line inclined at a constant angle to the axis of a cone of revolution ("base cone") and rolling without slip on the surface of that cone.

A section by a sphere having its centre at the apex of the cone is a spherical involute.

1.4.3 instantaneous axis : In a gear pair with parallel or non-parallel axes, the imaginary line around which occurs the relative instantaneous rotation of a gear in relation to its mating gear. In a gear pair with non-parallel, non-intersecting axes, the imaginary line around which occurs the relative instantaneous helical movement of a gear in relation to its mating gear.

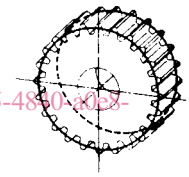
2 Cylindrical gears and gear pairs

2.1 Cylindrical gears

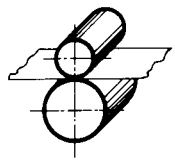
NOTE — The following definitions refer also to the rack considered as a gear of infinitely great diameter.

2.1.1 Cylinders

2.1.1.1 reference cylinder* : The reference surface of a cylindrical gear.



2.1.1.2 pitch cylinder : The pitch surface of a cylindrical gear, in a gear pair with parallel axes.

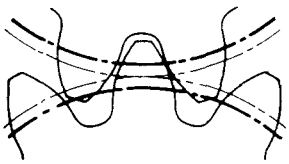


2.1.1.3 tip (or root) cylinder : The tip (or root) surface of a cylindrical gear.

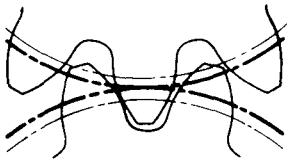
* By convention, the qualification "reference" may always be omitted, as understood, except when in express opposition to the qualification "working". Write the word "tooth" before "reference" when there is a risk of confusion with specially machined datum surface, also termed reference surface.

2.1.1.4 transverse profile : (see 1.2.3.4).

2.1.1.5 reference (or pitch) circle* : The line of intersection of the reference (or pitch) cylinder by a plane perpendicular to the axis of the gear.



Reference circles



Pitch circles

2.1.1.6 reference (or pitch) diameter* : The diameter of the reference (or pitch) circle.

2.1.1.7 tip (or root) circle : The line of intersection of the tip (or root) cylinder by a plane perpendicular to the axis of the gear.

2.1.1.8 tip (or root) diameter : The diameter of the tip (or root) circle.

2.1.1.9 facewidth : The width over the toothed part of a gear, measured along a straight line generator of the reference cylinder.

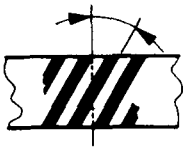
2.1.2 Helices of helical gears

2.1.2.1 reference helix : The tooth trace of a helical gear.

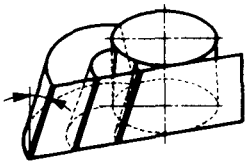
2.1.2.2 pitch helix : The intersection of a tooth flank with the pitch cylinder of a helical gear.

2.1.2.3 base helix : In an involute helical gear (see 2.1.7.4), the line of intersection of the involute helicoid of a flank with the base cylinder.

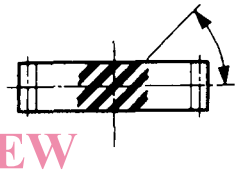
2.1.2.4 helix angle** : The helix angle of the reference helix of a helical gear.



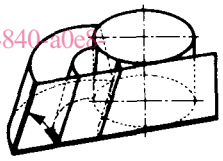
2.1.2.5 base helix angle : The helix angle of the base helix of an involute helical gear.



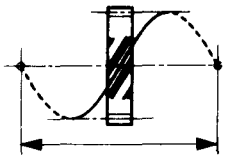
2.1.2.6 lead angle** : The lead angle of the reference helix of a helical gear.



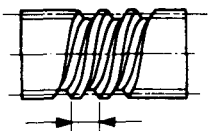
2.1.2.7 base lead angle : The lead angle of the base helix of an involute helical gear.



2.1.2.8 lead : (see 1.4.1.4).



2.1.2.9 axial pitch : The distance between the points of intersection of any line parallel to the axis of a helical gear with two consecutive corresponding flanks.



* By convention, the qualification "reference" may always be omitted, as understood, except when in express opposition to the qualification "working". Write the word "tooth" before "reference" when there is a risk of confusion with specially machined datum surface, also termed reference surface.

** Term defined with respect to the reference surface (qualification "reference" understood). Add the qualification "working" for the corresponding term defined with respect to the pitch surface.