UDC 744.43 : 621.753 – 408.6 : 003.62

Ref. No. : ISO/R 1101-1969 (E)

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 1101

TOLERANCES OF FORM AND OF POSITION

PART I

GENERALITIES, SYMBOLS, INDICATIONS ON DRAWINGS

1st EDITION

July 1969

For each individual country the only valid standard is the national standard of that country.

Printed in Switzerland

Also issued in French and Russian. Copies to be obtained through the national standards organizations.

BRIEF HISTORY

The ISO Recommendation R 1101, *Tolerances of form and of position – Part I : Generalities, symbols, indications on drawings*, was drawn up by Technical Committee ISO/TC 10, *Drawings (General principles)*, the Secretariat of which is held by the Association Suisse de Normalisation (SNV).

Work on this question led to the adoption of a Draft ISO Recommendation.

In August 1966, this Draft ISO Recommendation (No. 1016) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Argentina	Iran	Spain
Austria	Ireland	Sweden
Belgium	Israel	Switzerland
Canada	Italy	Turkey
Chile	Japan	U.A.R.
Denmark	Korea, Rep. of	United Kingdom
Finland	Netherlands	U.S.A.
France	Norway	U.S.S.R.
Germany	Portugal	Yugoslavia
Greece	Romania	
India	South Africa, Rep. of	

One Member Body opposed the approval of the Draft :

Australia

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in July 1969, to accept it as an ISO RECOMMENDATION.

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ISO Recommendation | R 1101 | July 1969

TOLERANCES OF FORM AND OF POSITION

PART I

GENERALITIES, SYMBOLS, INDICATIONS ON DRAWINGS

INTRODUCTORY NOTE

For uniformity all the linear dimensions given in this ISO Recommendation are in metric units only and the figures are in projection method E (called European or first angle projection). It should be understood that inch units and/or projection method A (called American or third angle projection) could equally well have been used without prejudice to the principles established.

1. SCOPE

1.1 This ISO Recommendation gives the principles of the symbolization and of the indication on technical drawings of tolerances of form and of position (form, orientation, position and run-out) and establishes the appropriate geometrical definitions. The primary object of this method of tolerancing is to ensure satisfactory functioning and interchangeability.

1.2 These tolerances of form and position should be specified only where they are essential to ensure the fitness of the part for its purpose.

1.3 When only a tolerance of size is specified, this tolerance also limits certain errors of form and of position (e.g. flatness and parallelism – see the table in section 3). The actual surfaces of the manufactured part may then deviate from the specified geometrical form on condition that they remain within the tolerances of size. If the errors of form must remain within other limits, a tolerance of form must be specified.

1.4 A tolerance of form or of position may be specified even if no tolerance of size is given.

1.5 The system of indicating tolerances of form and of position does not necessarily imply the use of any particular method of production, measurement or gauging.

2. DEFINITIONS

2.1 A tolerance of form or of position of a geometrical feature (point, line, surface or median plane) defines the zone within which this feature is to be contained. (See Note 1 below).

2.2 According to the characteristic which is to be toleranced and the manner in which it is dimensioned, the tolerance zone is one of the following :

- the area within a circle;
- the area between two concentric circles;
- the area between two parallel lines or two parallel straight lines;
- the space within a sphere;
- the space within a cylinder or between two coaxial cylinders;
- the space between two parallel surfaces or two parallel planes;
- the space within a parallelepiped.

2.3 The feature may be of any form or orientation within this tolerance zone, unless a more restrictive indication is given by an explanatory note.

2.4 Unless otherwise specified in accordance with clauses 4.5 to 4.7, the tolerance applies to the whole length or surface of the considered feature.

2.5 The datum feature is the feature to which tolerances of orientation, position and run-out are related.

2.6 The form of a datum feature should be sufficiently accurate for its purpose and it may therefore be necessary, in some cases, to specify tolerances of form for the datum features. (See Note 2 below).

NOTES

1. The form of a single feature is deemed to be correct when the distance of its individual points from a superimposed surface of ideal geometrical form is equal to or less than the value of the specified tolerance. The orientation of the ideal surface should be chosen so that the maximum distance between it and the actual surface of the feature concerned is the least possible value.

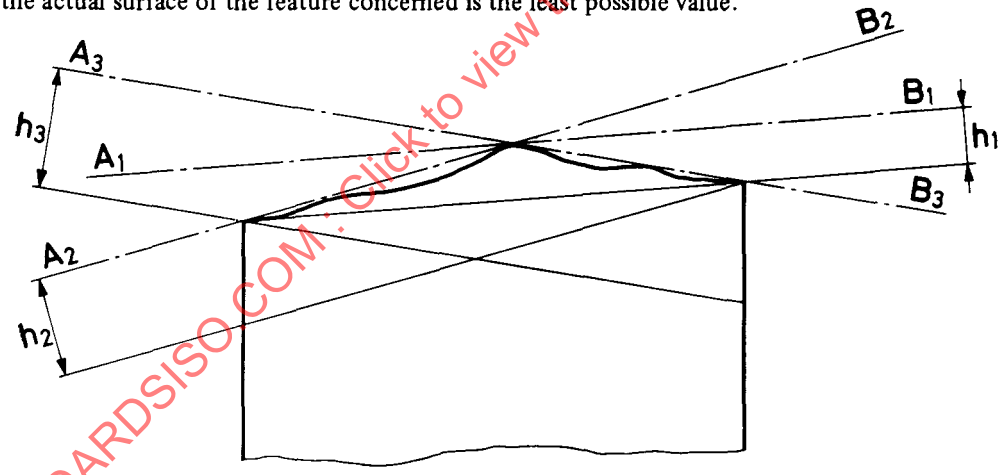


FIG. 1

Possible orientations of the ideal surface :	A_1-B_1		A_2-B_2		A_3-B_3
Corresponding maximum distances :	h_1		h_2		h_3
In the case of Figure 1 :	h_1	$<$	h_2	$<$	h_3

Therefore the orientation of the ideal surface is A_1-B_1, and h_1 is to be equal to or less than the specified tolerance.

2. In some cases it may be desirable to indicate the position of certain points which will possibly form a temporary datum feature for the purposes of both manufacture and inspection of components.

3. SYMBOLS

The following symbols represent the types of characteristics to be controlled by the tolerance.

Characteristics to be toleranced		Symbols
Form of single features	Straightness	
	Flatness	
	Circularity (Roundness)	
	Cylindricity	
	Profile of any line	
	Profile of any surface	
Orientation of related features	Parallelism	
	Perpendicularity (Squareness)	
	Angularity	
Position of related features	Position	
	Concentricity and coaxiality	
	Symmetry	
Run-out		

4. INDICATIONS ON THE DRAWINGS

4.1 The necessary indications are written in a rectangular frame which is divided into two, sometimes three, compartments. These compartments are filled in, from left to right, in the following order (see Fig. 2 and 3) :

- the symbol for the characteristic to be toleranced, as in section 3;
- tolerance value (total value) in the unit used for linear dimensions. This value is preceded by the sign ϕ if the tolerance zone is circular or cylindrical, or by the indication "sphere ϕ" if the tolerance zone is spherical;
- if appropriate, the letter or letters identifying the datum feature or features.

FIG. 2

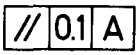


FIG. 3

4.2 The tolerance frame is connected to the toleranced feature by a leader line terminating with an arrow in the following way :

- on the outline of the feature or an extension of the outline (but not at a dimension line), when the tolerance refers to the line or surface itself (see Fig. 4);
- on the projection line at the dimension line when the tolerance refers to the axis or median plane of the part so dimensioned (see Fig. 5 and 7) or on the axis when the tolerance refers to the axis or median plane of all features common to that axis or median plane (see Fig. 6, 8 and 9).

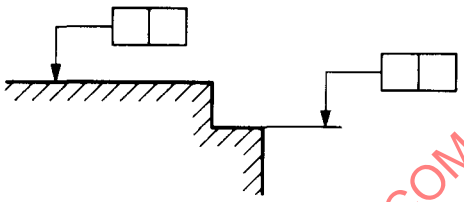


FIG. 4

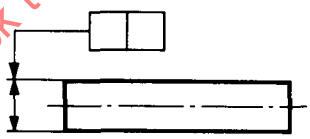


FIG. 5

FIG. 6

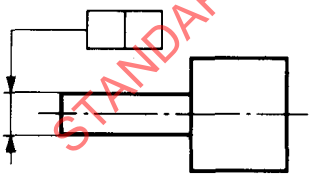


FIG. 7

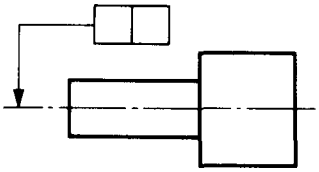


FIG. 8

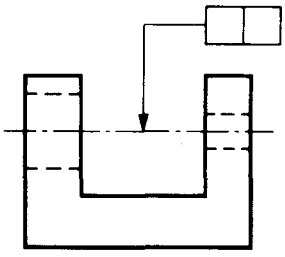


FIG. 9

If the tolerance zone is not circular, cylindrical or spherical, its width is in the direction of the arrow terminating the line joining the symbol frame to the feature which is toleranced.

4.3 The datum feature or datum features are indicated by a leader line terminating in a solid triangle, the base of which lies

- on the outline of the feature or an extension of the outline (but not at a dimension line), when the datum feature is the line or surface itself (see Fig. 10);
- on the projection line at the dimension line when the datum feature is the axis or median plane of the part so dimensioned (see Fig. 11, 13 and 16) or on the axis or median plane of all features common to that axis or median plane (see Fig. 12, 14 and 15) if such an axis can be determined with sufficient accuracy.

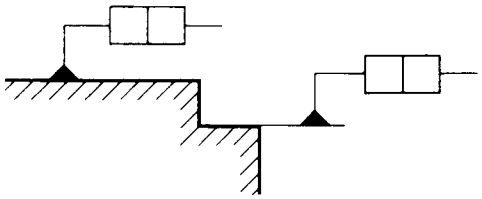


FIG. 10

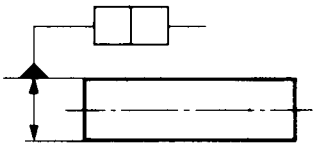


FIG. 11

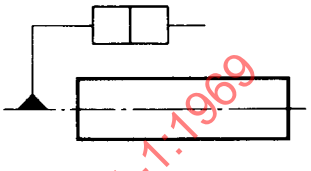


FIG. 12

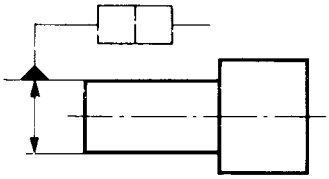


FIG. 13

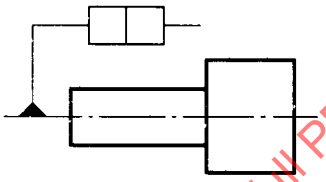


FIG. 14

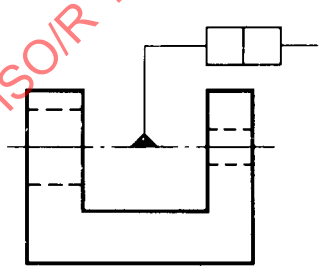


FIG. 15

If there is insufficient space for two arrows, one of them may be replaced by this triangle (see Fig. 16).

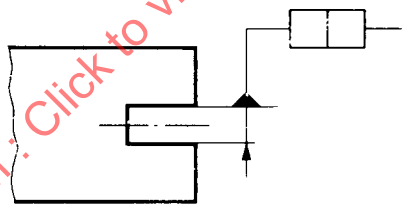


FIG. 16

If the tolerance frame cannot be connected in a clear and simple manner with the datum feature, a capital letter (different for every datum feature) is used (see Fig. 17 and 18).

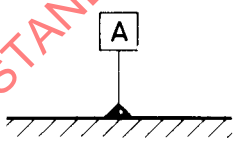


FIG. 17

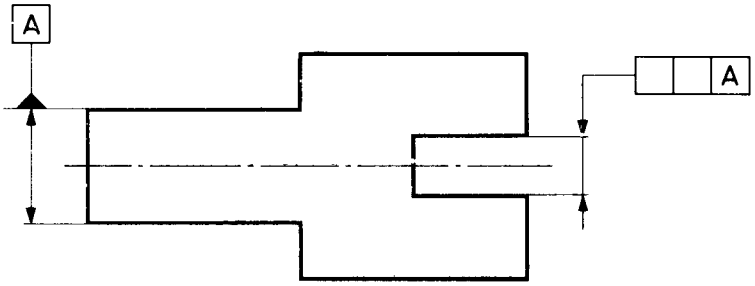


FIG. 18

This capital letter is enclosed in a frame connected to the datum feature as described in the first part of this clause.

4.4 If two associated features are identical, or there is no reason to choose one as a datum feature, the tolerance is indicated as in Figure 19.

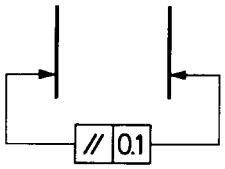


FIG. 19

4.5 If the tolerance is applied to a specified length, lying anywhere, the value of this length should be added after the tolerance value and separated from it by an oblique stroke.

In the case of a surface, the same indication is used. This means that the tolerance applies to all lines of the specified length in any position and any direction (see Fig. 20).

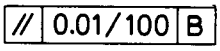


FIG. 20

4.6 If, to the tolerance on the whole feature, another tolerance of the same type but smaller and restricted on a limited length is added, the latter tolerance should be indicated below the former (see Fig. 21).

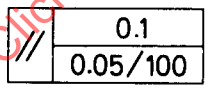


FIG. 21

4.7 If the tolerance is applied to a restricted part of the feature only, this should be dimensioned as shown in Figure 22 (in accordance with ISO Recommendation R 129, *Engineering drawing – Dimensioning*, clause 2.5).

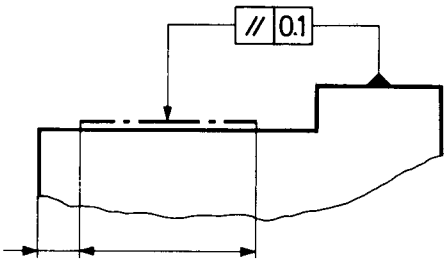


FIG. 22

4.8 The indication of "maximum material principle" (see ISO Recommendation R . . . *, *The maximum material principle*) is shown by the symbol Ⓜ placed after

- the tolerance value (see Fig. 23),
- the datum letter (see Fig. 24),
- or both (see Fig. 25),

according to whether the maximum material condition is to be applied to the toleranced feature, the datum feature, or both.

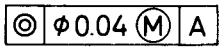


FIG. 23

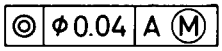


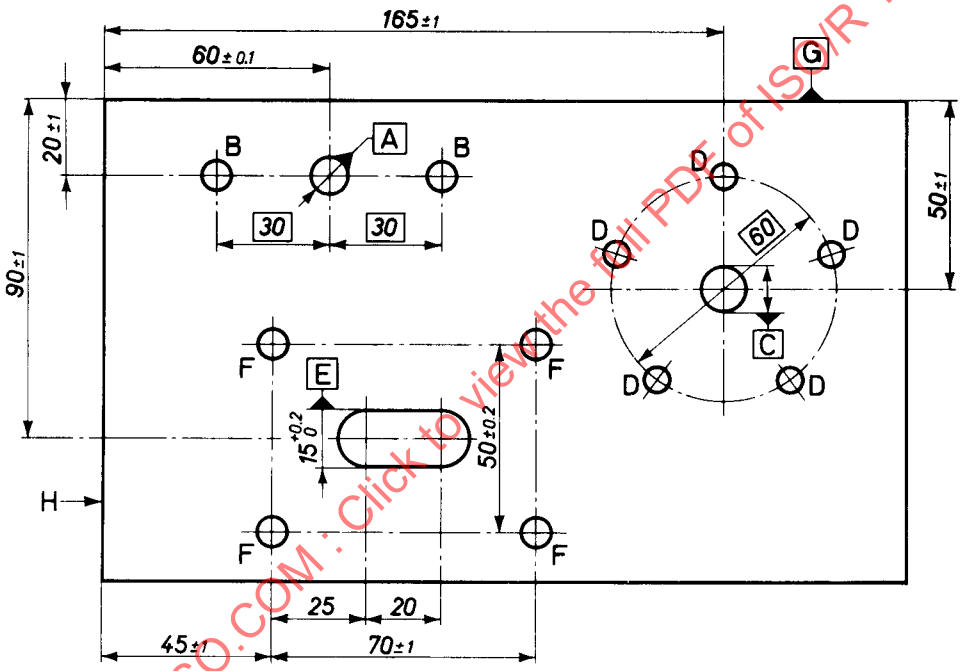
FIG. 24

FIG. 25

4.9 If tolerances of position or of profile are prescribed for a feature, the dimensions determining the true position or the profile must not be toleranced. If tolerances of angularity are prescribed for a feature, the dimensions determining the angle must not be toleranced.

These dimensions are enclosed thus : [30]. The corresponding actual dimensions of the part are subject only to the specified position tolerance, profile tolerance or angularity tolerance.

4.10 As an alternative to showing the tolerances individually on a drawing, they may be grouped in a table (see Fig. 26).



Group	Letter	Holes		Tolerances	
		Dimension	Number		
1	A	ϕ 10 $^{+0.1}_{0}$	1	Datum Ⓜ	
	B	ϕ 8 $^{+0.5}_{0}$	2	Tol. ϕ 0.8 Ⓜ	
2	C	ϕ 12 $^{+0.2}_{0}$	1	Datum Ⓜ	
	D	ϕ 7 $^{+0.5}_{0}$	5	Tol. ϕ 0.6 Ⓜ	
3	E	–	–	Datum Ⓜ	
	F	ϕ 8 $^{+0.5}_{0}$	4	Tol. 0.1 Ⓜ	
4	G	–	–	Datum	
	H	–	–	Tol. 0.05	

FIG. 26

NOTE. – The dimensions which are not enclosed in a frame or individually toleranced are subject to the general tolerance.

* In course of preparation.

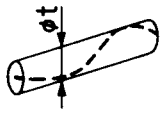
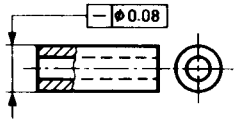
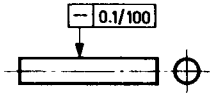
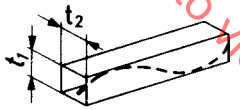
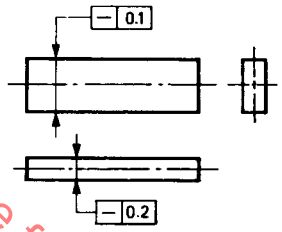
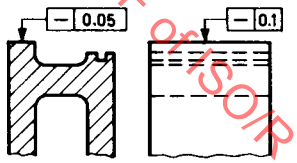
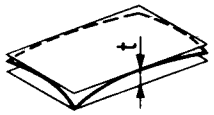
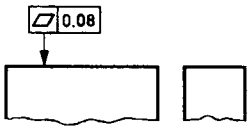
5. DETAILED DEFINITIONS OF TOLERANCES

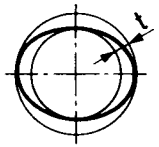
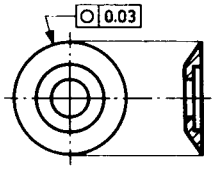
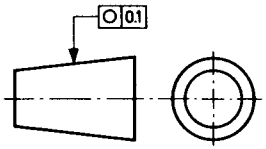
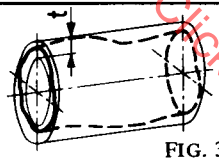
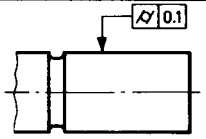
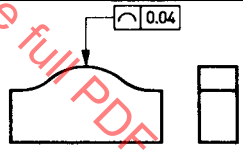
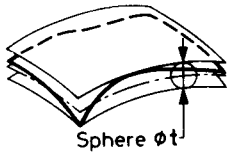
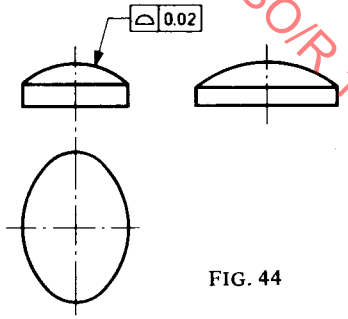
The various tolerances are defined as indicated in the following pages. For simplicity in all these definitions it is assumed that the feature considered has no other errors than those with which the definition deals.

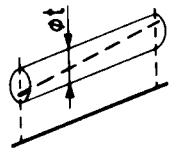
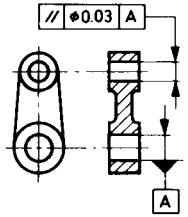
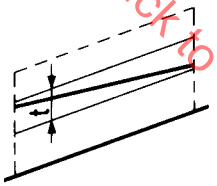
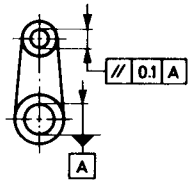
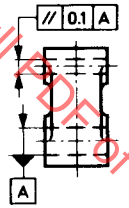
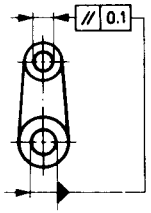
Where required for functional reasons, one or more characteristics will be toleranced to define the geometrical accuracy of a feature. When the geometrical accuracy of a feature is defined by certain types of tolerance, other errors of this feature in some cases will be controlled by this tolerance (e.g. straightness is controlled by size or parallelism). Thus it would rarely be necessary to symbolize all of these characteristics, since the other errors are included in the zone of tolerance defined by the symbol specified.

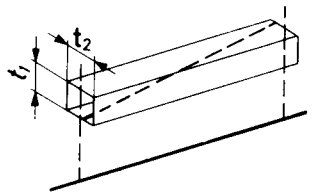
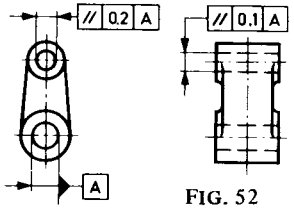
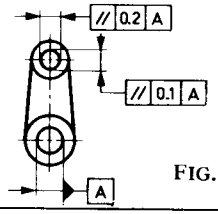
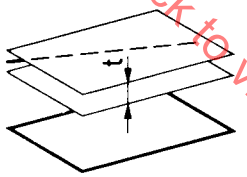
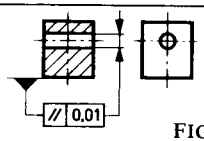
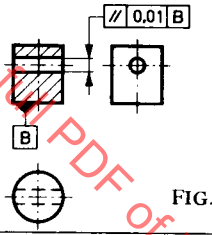
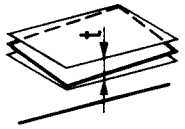
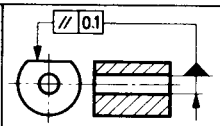
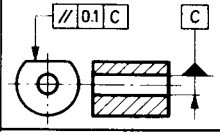
On the contrary, certain other types of tolerances do not control other errors (e.g. straightness does not control parallelism).

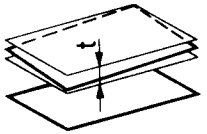
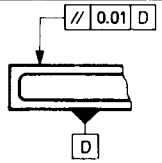
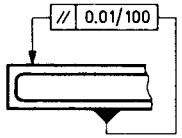
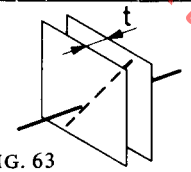
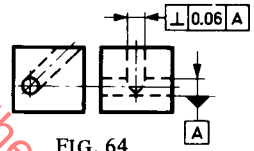
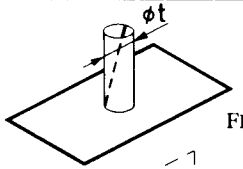
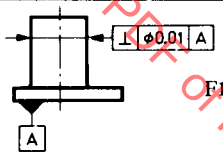
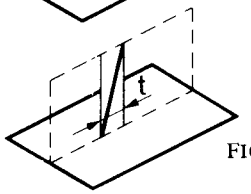
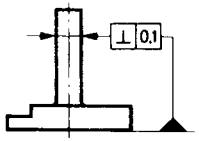
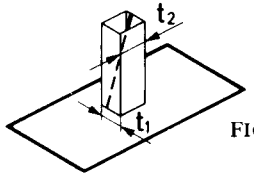
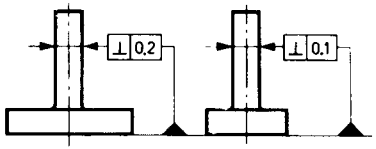
In the figures within the left-hand column of the following pages, the tolerance zones are often shown on only one side of the datum feature (e.g. in Fig. 71 and 72), but it is self-evident that the tolerance zones must always correspond to the whole extension of the toleranced feature.

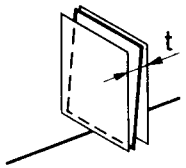
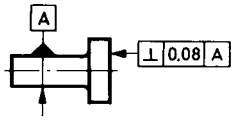
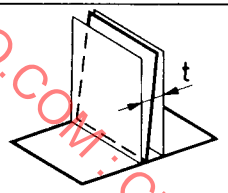
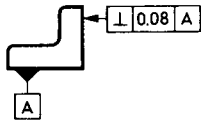
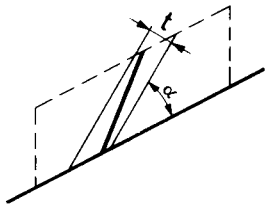
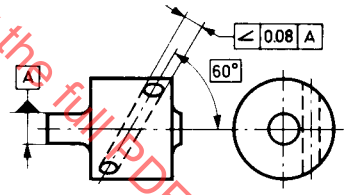
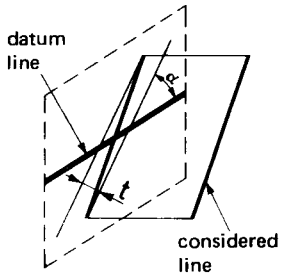
DEFINITION OF THE TOLERANCE ZONE	INDICATION AND INTERPRETATION
5.1 Straightness tolerance	
5.1.1 *Straightness tolerance of a line*	
The tolerance zone is limited by a cylinder of diameter t if the tolerance value is preceded by the sign ϕ.  FIG. 27	 FIG. 28 The *axis* of the cylinder to the dimension of which the tolerance frame is connected should be contained in a cylindrical zone of diameter 0.08.
The tolerance zone is limited by two parallel straight lines, a distance t apart, if the tolerance is only specified in one plane.  FIG. 29	 FIG. 30 *Any portion of length 100 of any generator* of the cylindrical surface indicated by the arrow should be contained between two parallel straight lines 0.1 apart.
The tolerance zone is limited by a parallelepiped of section $t_1 \times t_2$ if the tolerance is specified in two planes perpendicular to each other.  FIG. 31	 FIG. 32 The *axis* of the bar should be contained within a parallelepipedic zone of width 0.1 in the vertical and 0.2 in the horizontal direction.
5.1.2 *Straightness tolerance of a surface in two directions*	
	 FIG. 33 If *two different straightness* tolerances are applied to two directions on the same surface (see Fig. 33), the straightness tolerance zone of this surface is 0.05 in that direction shown on the left-hand view and 0.1 in that direction shown on the right-hand view.
5.2 Flatness tolerance	
The tolerance zone is limited by two parallel planes a distance t apart.  FIG. 34	 FIG. 35 The *surface* should be contained between two parallel planes 0.08 apart.

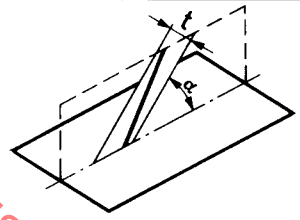
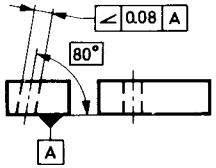
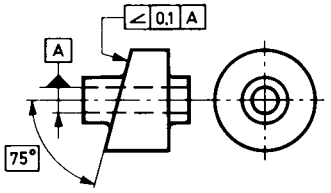
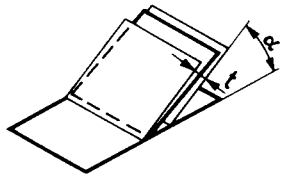
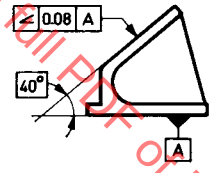
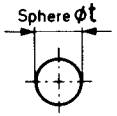
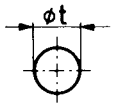
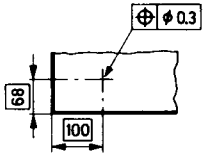
DEFINITION OF THE TOLERANCE ZONE (*continued*)	INDICATION AND INTERPRETATION (*continued*)
5.3 Circularity tolerance	
The tolerance zone in the considered plane is limited by two concentric circles a distance t apart.  FIG. 36	 FIG. 37 The *circumference* of the disk should be contained between two co-planar concentric circles 0.03 apart.  FIG. 38 The *circumference* of each cross-section should be contained between two co-planar concentric circles 0.1 apart.
5.4 Cylindricity tolerance	
The tolerance zone is limited by two coaxial cylinders a distance t apart.  FIG. 39	 FIG. 40 The *considered surface* should be contained between two coaxial cylinders the radii of which differ by 0.1.
5.5 Profile tolerance of any line	
The tolerance zone is limited by two enveloping lines of circles of diameter t the centres of which are situated on a line having the correct geometrical form.  FIG. 41	 FIG. 42 In each section parallel to the plane of projection the *considered profile* should be contained between two lines enveloping circles of diameter 0.04 the centres of which are situated on a line having the correct geometrical profile.
5.6 Profile tolerance of any surface	
The tolerance zone is limited by two enveloping surfaces of spheres of diameter t the centres of which are situated on a surface having the correct geometrical form.  FIG. 43	 FIG. 44 The *considered surface* should be contained between two surfaces enveloping spheres of diameter 0.02 the centres of which are situated on a surface having the correct geometrical form.

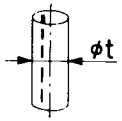
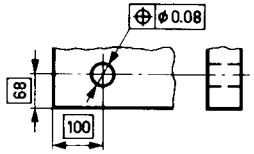
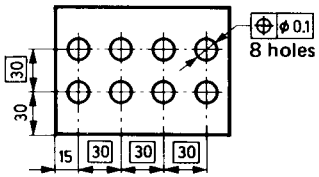
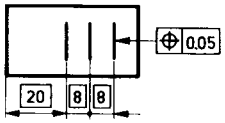
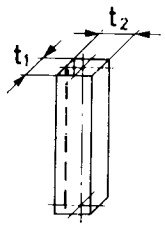
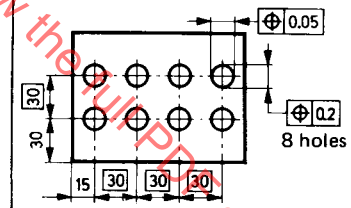
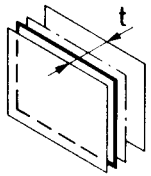
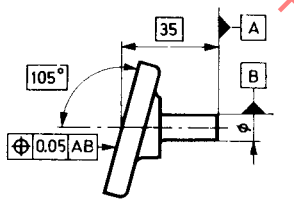
DEFINITION OF THE TOLERANCE ZONE (*continued*)	INDICATION AND INTERPRETATION (*continued*)
5.7 Parallelism tolerance	
5.7.1 *Parallelism tolerance of a line with reference to a datum line*	
The tolerance zone is limited by a cylinder of diameter t parallel to the datum line if the tolerance value is preceded by the sign ϕ.  FIG. 45	 FIG. 46 The *upper axis* should be contained in a cylindrical zone of diameter 0.03 parallel to the lower axis A (datum line).
The tolerance zone is limited by two parallel straight lines a distance t apart and parallel to the datum line if the tolerance is only specified in one plane.  FIG. 47	 FIG. 48  FIG. 49 The *upper axis* should be contained between two straight lines 0.1 apart, which are parallel to the lower axis A and lie in the vertical plane. (See Fig. 48 or 49)
	 FIG. 50 The *upper axis* should be contained between two straight lines 0.1 apart, which are parallel to the lower axis and lie in the horizontal plane.

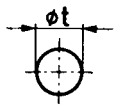
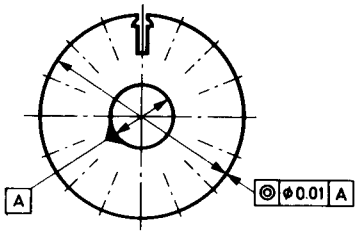
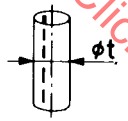
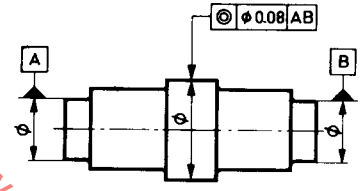
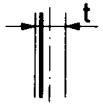
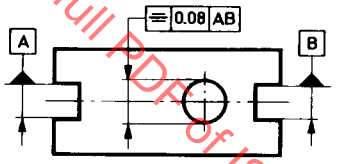
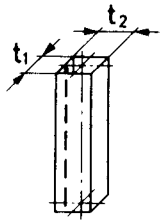
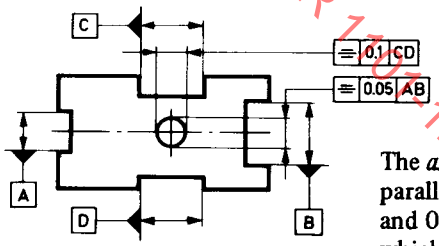
DEFINITION OF THE TOLERANCE ZONE (*continued*)	INDICATION AND INTERPRETATION (*continued*)
The tolerance zone is limited by a parallelepiped of section $t_1 \times t_2$ and parallel to the datum line if the tolerance is specified in two planes perpendicular to each other.  FIG. 51	 FIG. 52  FIG. 53 The *upper axis* should be contained in a parallelepipedic tolerance zone having a width of 0.2 in the horizontal and 0.1 in the vertical direction and which is parallel to the datum axis A. (See Fig. 52 or 53).
5.7.2 *Parallelism tolerance of a line with reference to a datum plane*	
The tolerance zone is limited by two parallel planes a distance t apart and parallel to the datum plane.  FIG. 54	 FIG. 55  FIG. 56 The *axis of the hole* should be contained between two planes 0.01 apart and parallel to the datum surface. (See Fig. 55 or 56)
5.7.3 *Parallelism tolerance of a surface with reference to a datum line*	
The tolerance zone is limited by two parallel planes a distance t apart and parallel to the datum line.  FIG. 57	 FIG. 58  FIG. 59 The *upper surface* should be contained between two planes 0.1 apart and parallel to the axis of the hole (datum line). (See Fig. 58 or 59)

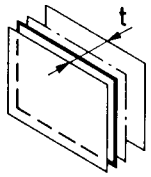
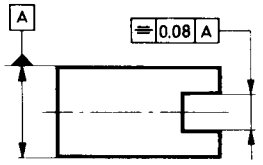
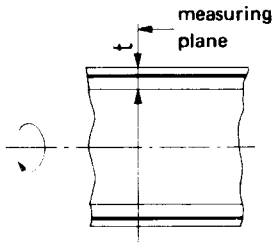
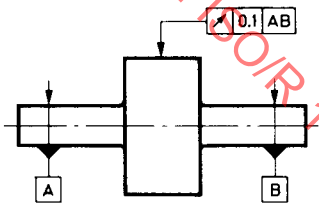
DEFINITION OF THE TOLERANCE ZONE (*continued*)	INDICATION AND INTERPRETATION (*continued*)
5.7.4 *Parallelism tolerance of a surface with reference to a datum plane*	
The tolerance zone is limited by two parallel planes a distance t apart and parallel to the datum plane.  FIG. 60	 FIG. 61 The *upper surface* should be contained between two parallel planes 0.01 apart and parallel to the lower surface D (datum plane).  FIG. 62 All the points on the *upper surface* in a length of 100, placed anywhere on this surface, should be contained between two parallel planes 0.01 apart and parallel to the lower surface (datum plane).
5.8 Perpendicularity tolerance	
5.8.1 *Perpendicularity tolerance of a line supposed to be straight with reference to a datum line*	
The tolerance zone is limited by two parallel planes a distance t apart and perpendicular to the datum line.  FIG. 63	 FIG. 64 The *axis of the inclined hole* should be contained between two parallel planes 0.06 apart and perpendicular to the axis of the horizontal hole A (datum line).
5.8.2 *Perpendicularity tolerance of a line with reference to a datum plane*	
The tolerance zone is limited by a cylinder of diameter t perpendicular to the datum plane if the tolerance value is preceded by the sign ϕ.  FIG. 65	 FIG. 66 The *axis of the cylinder* to the dimension of which the tolerance frame is connected should be contained in a cylindrical zone of diameter 0.01 perpendicular to the surface A (datum plane).
The tolerance zone is limited by two parallel straight lines a distance t apart and perpendicular to the datum plane if the tolerance is specified only in one plane.  FIG. 67	 FIG. 68 The *axis of the cylinder* to the dimension of which the tolerance frame is connected should be contained between two parallel straight lines 0.1 apart, perpendicular to the datum plane and lying in the plane shown on the drawing.
The tolerance zone is limited by a parallelepiped of section $t_1 \times t_2$ and perpendicular to the datum plane if the tolerance is specified in two planes perpendicular to each other.  FIG. 69	 FIG. 70 The *axis of the cylinder* should be contained in a parallelepipedic tolerance zone of 0.1 × 0.2 which is perpendicular to the datum plane.

DEFINITION OF THE TOLERANCE ZONE (*continued*)	INDICATION AND INTERPRETATION (*continued*)
5.8.3 *Perpendicularity tolerance of a surface with reference to a datum line*	
The tolerance zone is limited by two parallel planes a distance *t* apart and perpendicular to the datum line.  FIG. 71	 FIG. 72 The *right-hand face* of the piece should be contained between two parallel planes 0.08 apart and perpendicular to the axis A (datum line).
5.8.4 *Perpendicularity tolerance of a surface with reference to a datum plane*	
The tolerance zone is limited by two parallel planes a distance *t* apart and perpendicular to the datum plane.  FIG. 73	 FIG. 74 The *vertical surface* should be contained between two parallel planes 0.08 apart and perpendicular to the horizontal surface A (datum plane).
5.9 Angularity tolerance	
5.9.1 *Angularity tolerance of a line with reference to a datum line*	
The tolerance zone is limited by two parallel straight lines a distance *t* apart and inclined at the specified angle to the datum line.  FIG. 75	 FIG. 76 The *axis of the hole* should be contained between two parallel straight lines 0.08 apart which are inclined at 60° to the horizontal axis A (datum line).
If the considered line and the datum line are not in the same plane the tolerance zone is applied to the projection of the considered line on a plane containing the datum line and parallel to the considered line.  FIG. 77	

DEFINITION OF THE TOLERANCE ZONE (*continued*)	INDICATION AND INTERPRETATION (*continued*)
5.9.2 *Angularity tolerance of a line with reference to a datum plane*	
The tolerance zone is limited by two parallel straight lines a distance t apart and inclined at the specified angle to the datum plane.  FIG. 78	 FIG. 79 The *axis of the hole* should be contained between two parallel straight lines 0.08 apart which are inclined at 80° to the plane A (datum plane).
5.9.3 *Angularity tolerance of a surface with reference to a datum line*	
The tolerance zone is limited by two parallel planes a distance t apart and inclined at the specified angle to the datum line.  FIG. 80	 FIG. 81 The *inclined surface* should be contained between two parallel planes 0.1 apart which are inclined at 75° to the axis A (datum line).
5.9.4 *Angularity tolerance of a surface with reference to a datum plane*	
The tolerance zone is limited by two parallel planes a distance t apart and inclined at the specified angle to the datum plane.  FIG. 82	 FIG. 83 The *inclined surface* should be contained between two parallel planes 0.08 apart which are inclined at 40° to the plane A (datum plane).
5.10 Positional tolerance	
5.10.1 *Positional tolerance of a point*	
The tolerance zone is limited by a sphere or a circle of diameter t the centre of which is in the true specified position of the considered point.  FIG. 84  FIG. 85	 FIG. 86 The actual *point of intersection* should lie inside a circle of 0.3 diameter, the centre of which coincides with the true specified position of the considered point of intersection.

DEFINITION OF THE TOLERANCE ZONE (*continued*)	INDICATION AND INTERPRETATION (*continued*)
5.10.2 *Positional tolerance of a line*	
The tolerance zone is limited by a cylinder of diameter t the axis of which is in the true specified position of the considered line if the tolerance value is preceded by the sign ϕ.  FIG. 87	 FIG. 88 The *axis of the hole* should be contained within a cylindrical zone of diameter 0.08 the axis of which is in the true specified position of the line.
	 FIG. 89 Each of the *axes of the eight holes* should be contained within a cylindrical zone of diameter 0.1 the axes of which are in the true specified position.
The tolerance zone is limited by two parallel straight lines a distance t apart and disposed symmetrically with respect to the true specified position of the considered line if the tolerance is only specified in one plane.  FIG. 90	 FIG. 91 Each of the *lines* should be contained between two parallel straight lines 0.05 apart which are symmetrically disposed about the true specified position of the lines.
The tolerance zone is limited by a parallelepiped of section $t_1 \times t_2$ the axis of which is in the true specified position of the considered line if the tolerance is specified in two planes perpendicular to each other.  FIG. 92	 FIG. 93 Each of the *axes of the eight holes* should be contained within a parallelepipedic zone of width 0.05 in the horizontal and 0.2 in the vertical plane, and the axis of which is in the true specified position of the considered hole.
5.10.3 *Positional tolerance of a flat surface or a median plane*	
The tolerance zone is limited by two parallel planes a distance t apart and disposed symmetrically with respect to the true specified position of the considered surface.  FIG. 94	 FIG. 95 The *inclined surface* should be contained between two parallel planes which are 0.05 apart and which are symmetrically disposed with respect to the true position of the considered plane with reference to datum plane A and axis of datum cylinder B.

DEFINITION OF THE TOLERANCE ZONE *(continued)*	INDICATION AND INTERPRETATION *(continued)*
5.11 Concentricity, coaxiality and symmetry tolerance	
5.11.1 *Concentricity tolerance of a point*	
The tolerance zone is limited by a circle of diameter t the centre of which coincides with the datum point.  FIG. 96	 FIG. 97 The *centre of the circle,* to the dimension of which the tolerance frame is connected, should be contained in a circle of diameter 0.01 concentric with the centre of the datum circle A.
5.11.2 *Coaxiality and symmetry tolerance of a line or an axis*	
(Coaxiality) The toerance zone is limited by a cylinder of diameter t the axis of which coincides with the datum axis if the tolerance value is preceded by the sign ϕ.  FIG. 98	 FIG. 99 The *axis of the cylinder*, to the dimension of which the tolerance frame is connected, should be contained in a cylindrical zone of diameter 0.08 coaxial with the datum axis AB.
(Symmetry) The tolerance zone is limited by two parallel straight lines or two parallel planes a distance t apart and disposed symmetrically with respect to the datum axis (or datum plane) if the tolerance is only specified in one plane.  FIG. 100	 FIG. 101 The *axis of the hole* should be contained between two parallel planes which are 0.08 apart and symmetrically disposed with respect to the actual common medium plane of the datum slots A and B.
The tolerance zone is limited by a parallelepiped of section $t_1 \times t_2$ the axis of which coincides with the datum axis if the tolerance is specified in two planes perpendicular to each other.  FIG. 102	 FIG. 103 The *axis of the hole* should be contained in a parallelepipedic zone of width 0.1 in the horizontal and 0.05 in the vertical direction and the axis of which coincides with the datum axes AB and CD.

DEFINITION OF THE TOLERANCE ZONE (*continued*)	INDICATION AND INTERPRETATION (*continued*)
5.11.3 *Symmetry tolerance of a median plane*	
The tolerance zone is limited by two parallel planes a distance *t* apart and disposed symmetrically with respect to the datum axis or datum plane.  FIG. 104	 FIG. 105 The *median plane* of the slot should be contained between two parallel planes, which are 0.08 apart and symmetrically disposed about the median plane of the datum feature A.
5.12 Run-out tolerance	
The run-out tolerance represents the maximum permissible variation *t* of position of the considered feature with respect to a fixed point during one complete revolution about the datum axis (without relative axial displacement of the part and the measuring instrument). The run-out tolerance applies separately to every measuring position. Except when otherwise stated, this variation is measured in the direction indicated by the arrow at the end of the leader line which points to the toleranced feature. The run-out tolerance may include defects of circularity, coaxiality, perpendicularity or flatness, provided the sum of these defects does not exceed the specified run-out tolerance. The run-out tolerance consequently specifies neither the straightness and the angle of the generating line to the datum axis (see Fig. 106 and 108) nor the flatness of the surface (see Fig. 110).	
5.12.1 The tolerance zone is limited within any plane perpendicular to the axis by two concentric circles a distance *t* apart.  FIG. 106	 FIG. 107 The *radial run-out* must not be greater than 0.1 in any measuring plane during one complete revolution about the common axis of the surfaces A and B.