International Standard

ISO 5459

Technical drawings — Geometrical tolerancing — Datums and datum-systems for geometrical tolerances

Dessins techniques — Tolérancement géométrique — Références spécifiées et systèmes de références spécifiées pour tolérances géométriques

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 5459 was developed by Technical Committee ISO/TC 10, *Technical drawings*, and was circulated to the member bodies in February 1978.

It has been approved by the member bodies of the following countries :

Australia	India	Spain
Austria	Italy	Sweden
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The member body of the following country expressed disapproval of the document on technical grounds :

France

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Technical drawings — Geometrical tolerancing — Datums and datum-systems for geometrical tolerances

0 Introduction

For uniformity all figures in this International Standard are in first angle projection.

It should be understood that the third angle projection could equally well have been used without prejudice to the principles established.

For the definitive presentation (proportions and dimensions) of symbols for geometrical tolerancing, see ISO 7083.

1 Scope and field of application

This International Standard describes datum and datum-systems for geometrical tolerancing, their definitions, practical embodiments and their indications on technical drawings in the field of mechanical engineering.

2 References

ISO 128, *Technical drawings — General principles of presentation.* [1]

ISO 129, *Engineering drawings — Dimensioning.* [2]

ISO 1101, *Technical drawings — Geometrical tolerancing — Tolerances of form, orientation, location and run-out — Generalities, definitions, symbols, indications on drawings.* [3]

ISO 2692, *Technical drawings — Geometrical tolerancing — Maximum material principle.* [4]

ISO 7083, *Techical drawings — Symbols for geometical tolerancing — Proportions and dimensions.* [5]

3 Definitions

3.1 datum : A theoretically exact geometric reference (such as axes, planes, straight lines, etc.) to which toleranced features are related. Datums may be based on one or more datum features of a part.

3.2 datum-system : A group of two or more separate datums used as a combined reference for a toleranced feature.

3.3 datum feature : A real feature of a part (such as an edge, a surface, or a hole, etc.), which is used to establish the location of a datum.

NOTE — As datum features are subject to manufacturing errors and variations, it may be necessary where appropriate to specify tolerances of form to them.

3.4 datum target : A point, line or limited area on the workpiece to be used for contact with the manufacturing and inspection equipment, to define the required datums in order to satisfy the functional requirements.

3.5 simulated datum feature : A real surface of adequately precise form (such as a surface plate, a bearing, or a mandrel, etc.) contacting the datum feature(s) and used to establish the datum(s).

NOTE — Simulated datum features are used as the practical embodiment of the datums during manufacture and inspection.

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1) At present at the stage of draft. (Revision of ISO/R 128-1959.)

2) At present at the stage of draft. (Revision of ISO/R 129-1959.)

3) At present at the stage of draft. (Revision of ISO/R 1101/1-1969.)

4) At present at the stage of draft. (Revision of ISO/R 1101/2-1974.)

5) At present at the stage of draft.

4 Establishing datums

Features indicated as datums have inherent inaccuracies resulting from the production process. These may take the form of convex, concave or conical deviations. The following methods are examples for establishing datums.

4.1 Datum being a straight line or a plane

The datum feature shall be arranged in such a way that the maximum distance between it and the simulated datum feature has the least possible value. Should the datum feature not be stable with the contacting surface, suitable supports should be placed between them at a practical distance apart. For lines, use two supports (see figure 1) and for flat surfaces, use three supports.
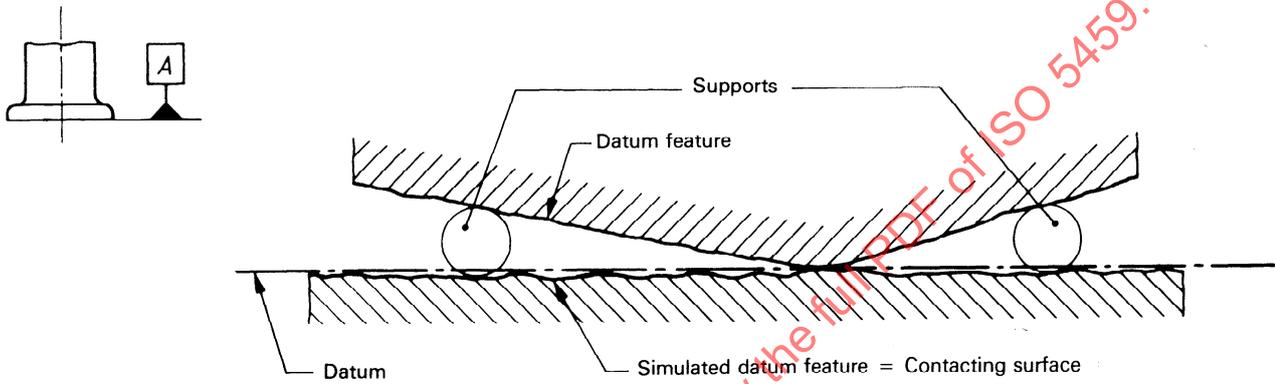
Figure 1

4.2 Datum being the axis of a cylinder

The datum is the axis of the largest inscribed cylinder of a hole or the smallest circumscribed cylinder of a shaft, so located that any possible movement of the cylinder in any direction is equalised (see figure 2).
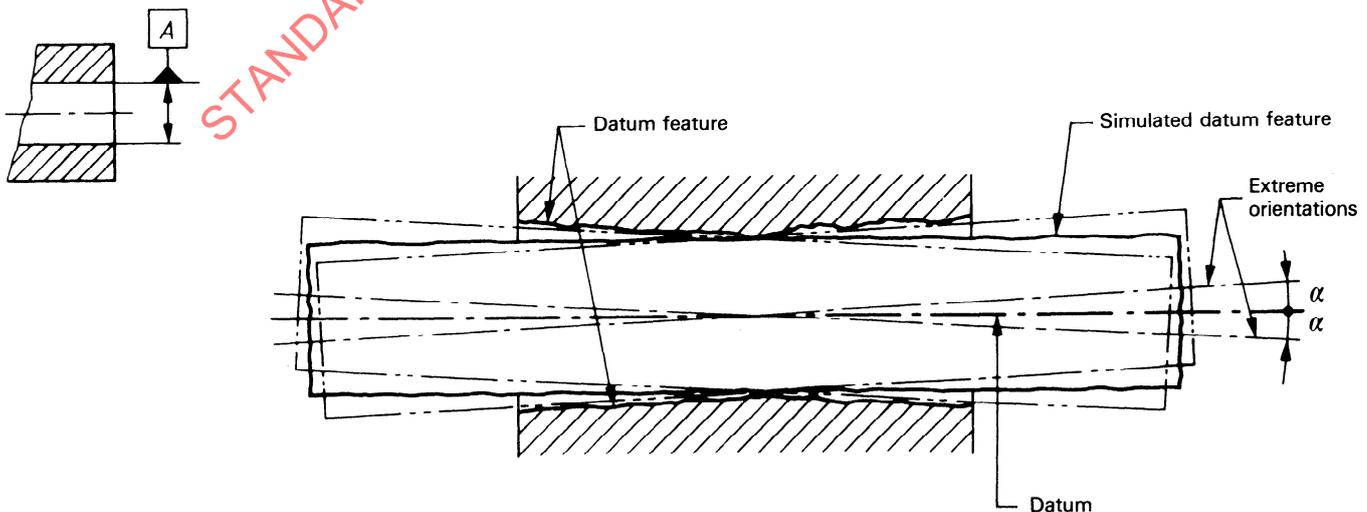
Figure 2

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4.3 Datum being the common axis or common median plane

In the example shown in figure 3, the datum is the common axis formed by the two smallest circumscribed coaxial cylinders.

Datum feature

Datum

Simulated datum feature = Contacting surface
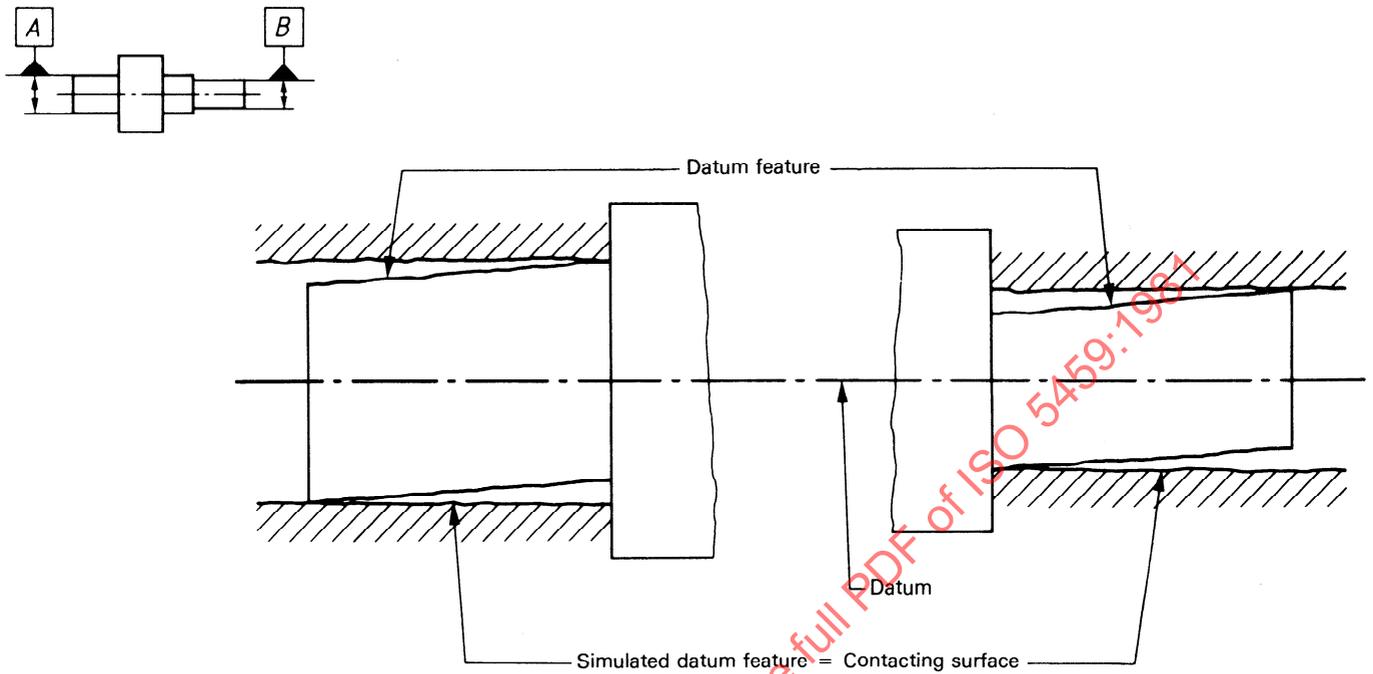
Figure 3

4.4 Datums being the axis of a cylinder and perpendicular to a plane

The datum "A" is the plane represented by the contacting flat surface.

The datum "B" is the axis of the largest inscribed cylinder, perpendicular to the datum "A".

Datum B

Datum feature B

Datum feature A

90°

Datum A

Simulated datum features = Contacting surfaces
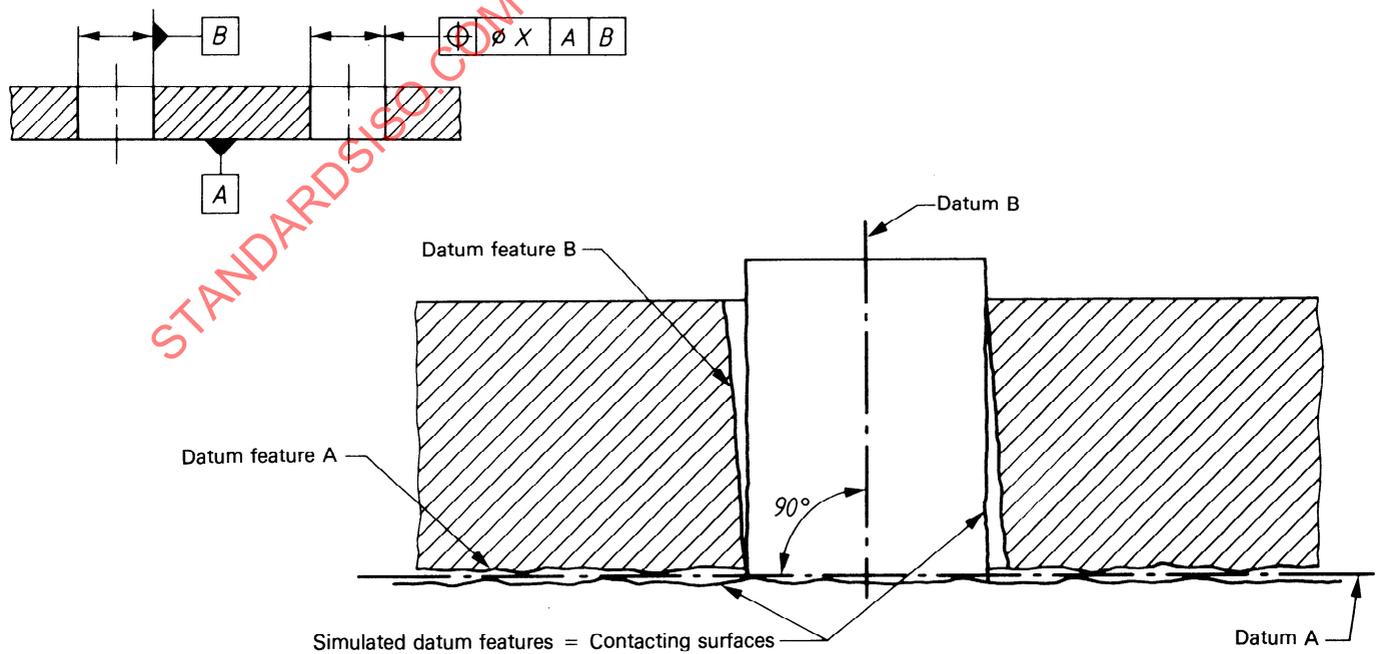
Figure 4

NOTE — In the above example the datum "A" is considered to be primary and the datum "B", secondary (see 6.2.3).

5 Application of datums

Datums and datum-systems are used as the base for establishing the geometric relationship of related features. The quality of relevant datum features and simulated datum features must be adequate for functional requirements.

The following table shows :

— the indication of datums on technical drawings;

— the datum features;

— how datums are established by means of simulated datum features.

Table — Examples

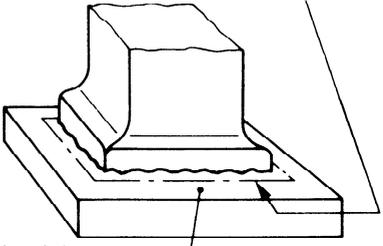| Datums	Datum features	Establishment of datums
Datum - centre-point Centre-point of a sphere Sphere ϕ **Figure 5**	Real surface **Figure 6**	Simulated datum feature = Four contacting points (representing the smallest circumscribed sphere) on the vee-block Datum = Centre-point of the smallest circumscribed sphere **Figure 7**
Centre-point of a circle **Figure 8**	Real profile of circle **Figure 9**	Simulated datum feature = Largest inscribed circle Datum = Centre of the largest inscribed circle **Figure 10**
Centre-point of a circle **Figure 11**	Real profile of circle **Figure 12**	Simulated datum feature = Smallest circumscribed circle Datum = Centre of the smallest circumscribed circle **Figure 13**
Datum-line Axis of a hole **Figure 14**	Real surface **Figure 15**	Simulated datum feature = Largest inscribed cylinder Datum = Axis of the largest inscribed cylinder **Figure 16**
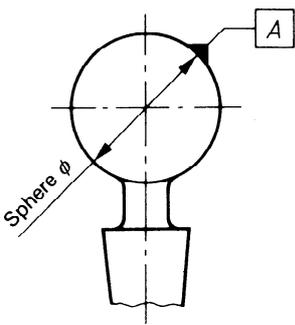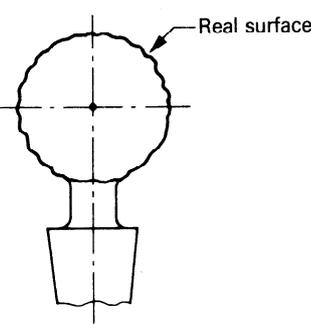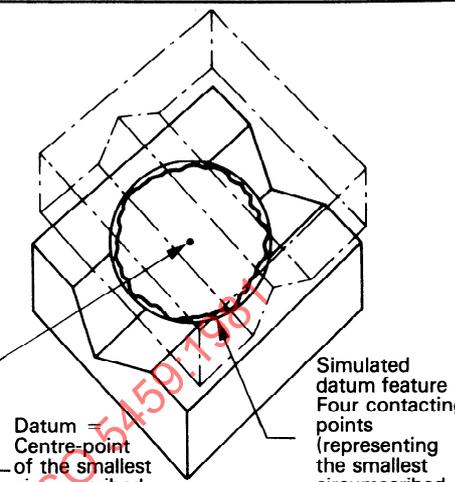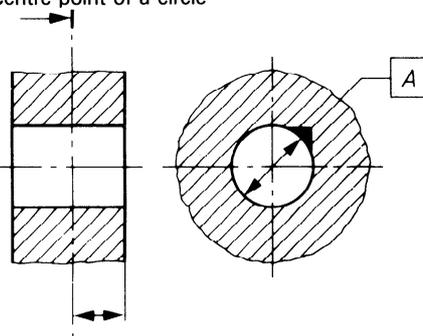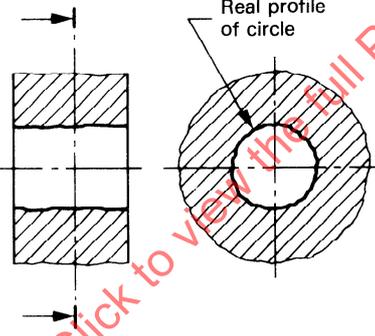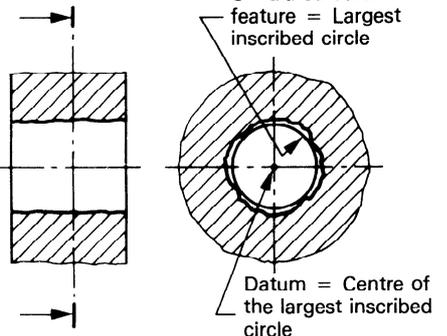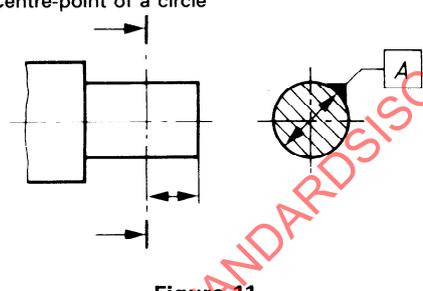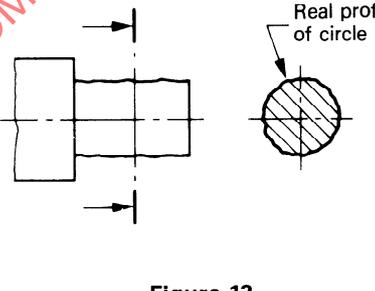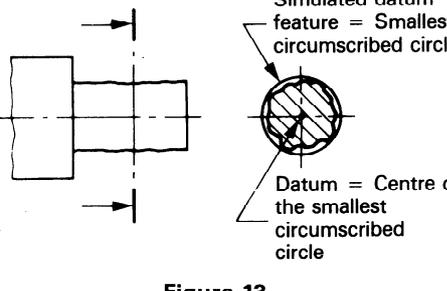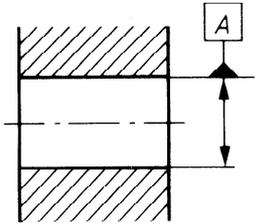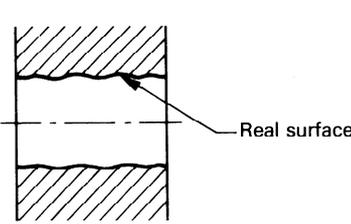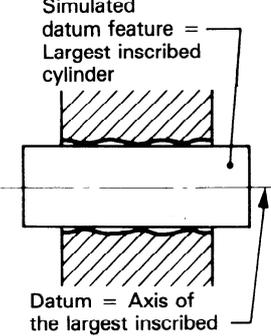
5

Table — Examples (*concluded*)

Datums	Datum features	Establishment of datums
Axis of a shaft	Real surface	Simulated datum feature = Smallest circumscribed cylinder Datum = Axis of the smallest circumscribed cylinder
Figure 17	**Figure 18**	**Figure 19**
Datum-plane Surface of a part	Real surface	Datum = Plane established by the surface plate Simulated datum feature = Surface of the surface plate
Figure 20	**Figure 21**	**Figure 22**
Median plane Median plane of the two surfaces of a part	Real surfaces	Simulated datum feature = Contacting flat surfaces Datum = Median plane established by the two contacting flat surfaces
Figure 23	**Figure 24**	**Figure 25**
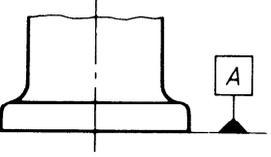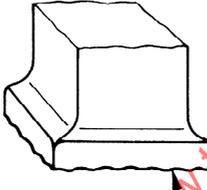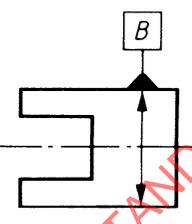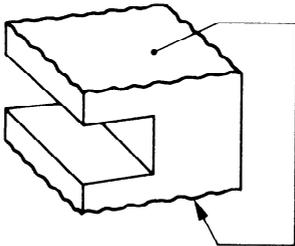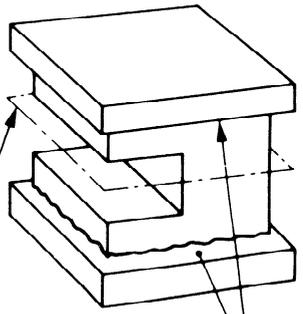
6 Indication of datums and datum-systems

6.1 Datum symbols

6.1.1 Datum triangle

The datums are indicated by a leader line terminating in a filled or an open triangle (see figure 26).

6.1.2 Datum letter

To identify a datum for reference purposes, a capital letter is enclosed in a frame connected to the datum triangle (see figure 27).

If the tolerance frame can be connected in a clear and simple manner with the datum by a leader line, the datum letter may be omitted (see ISO 1101).

Figure 26

Figure 27

6.2 Datum and datum-systems specified in the tolerance frame

A datum may be established by one or more features. The following procedures should be used as appropriate.

6.2.1 Datum established by a single feature

Where the datum is established by a single feature, the datum is indicated by a single letter in the third compartment of the tolerance frame.
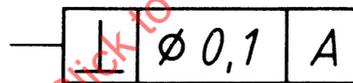
Figure 28

6.2.2 Common datum established by two features

Where the common datum is established by two features, the datum is indicated in the third compartment of the tolerance frame by two letters separated by a hyphen.
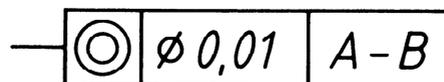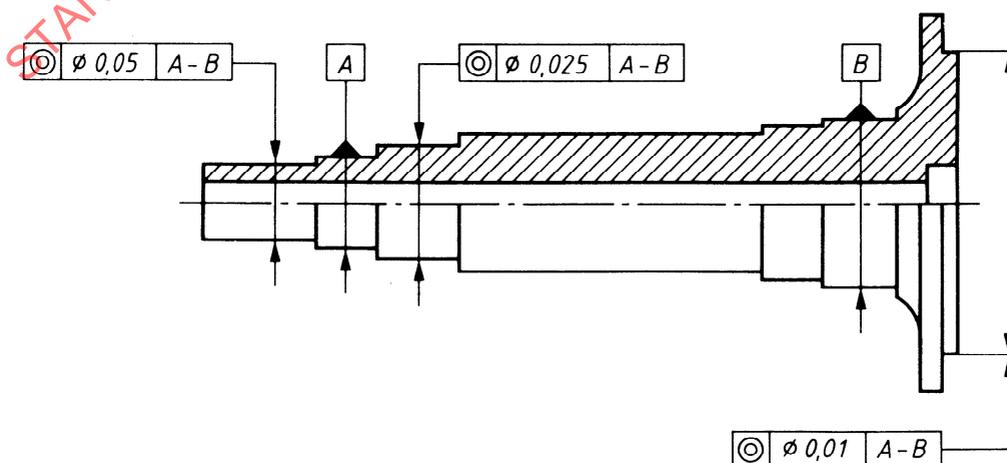
Figure 29

Figure 30

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6.2.3 Datum-system established by two or more features

Where a datum system is established by two or more features, i.e. multiple datums, their datum letters are indicated in the third and subsequent compartments of the tolerance frame, in accordance with the sequence of the datums.
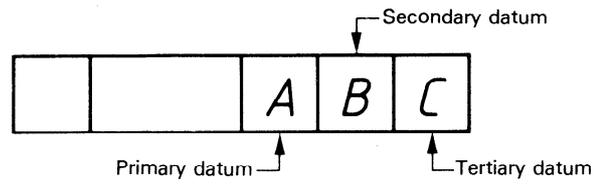

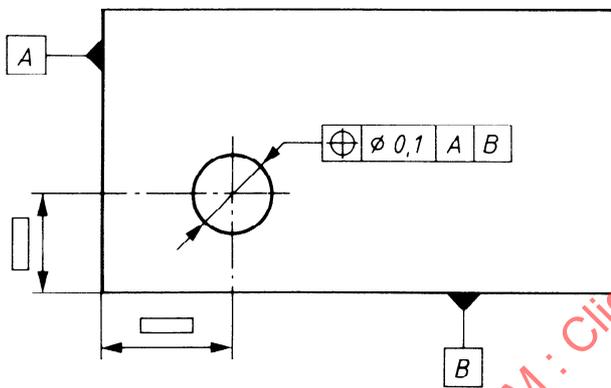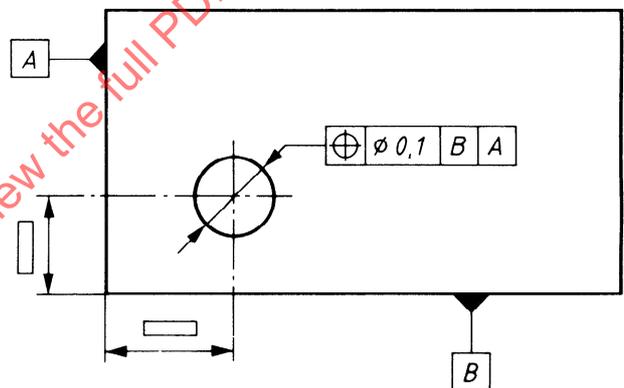
Figure 31

Indication on the drawing

Figure 32

Figure 33

The sequence of the datums is of considerable influence to the result obtained.
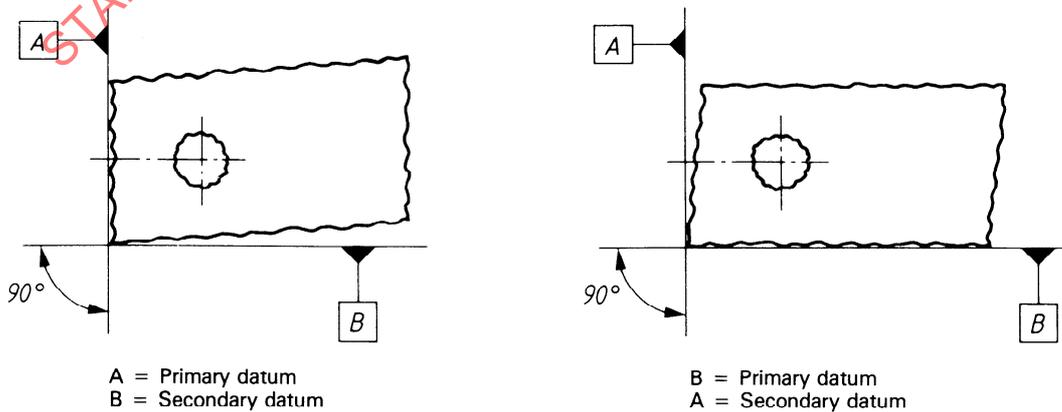
Results

A = Primary datum
B = Secondary datum

B = Primary datum
A = Secondary datum

Figure 34

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Example
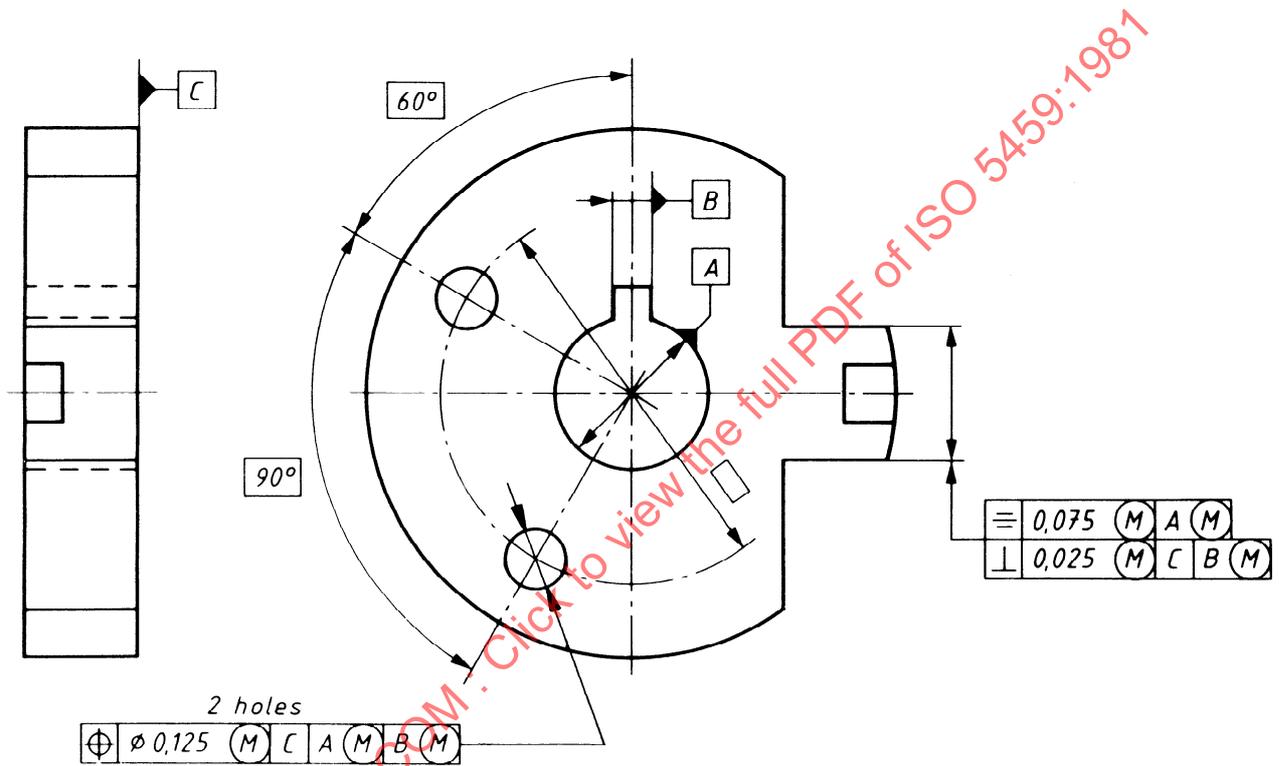
Figure 35

7 Datum targets

In the case of a surface, the datum feature may vary significantly from its ideal form. Thus, specification of a total surface as a datum feature may introduce variations or lack of repeatability in measurements taken from it (see figures 36 and 37).
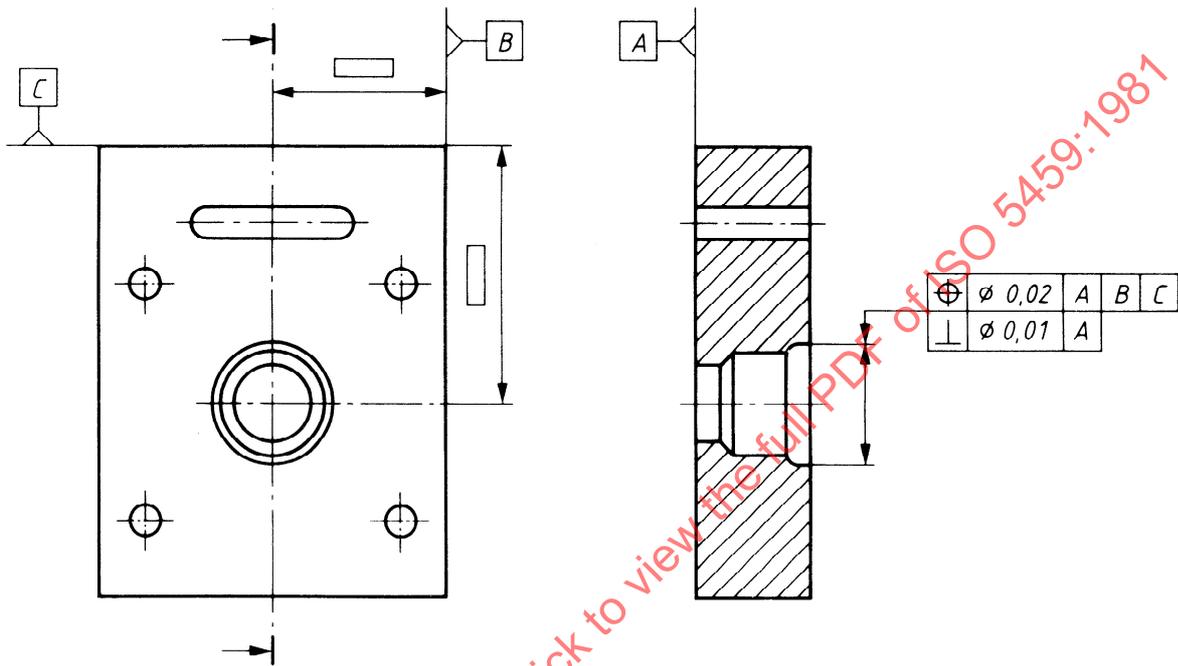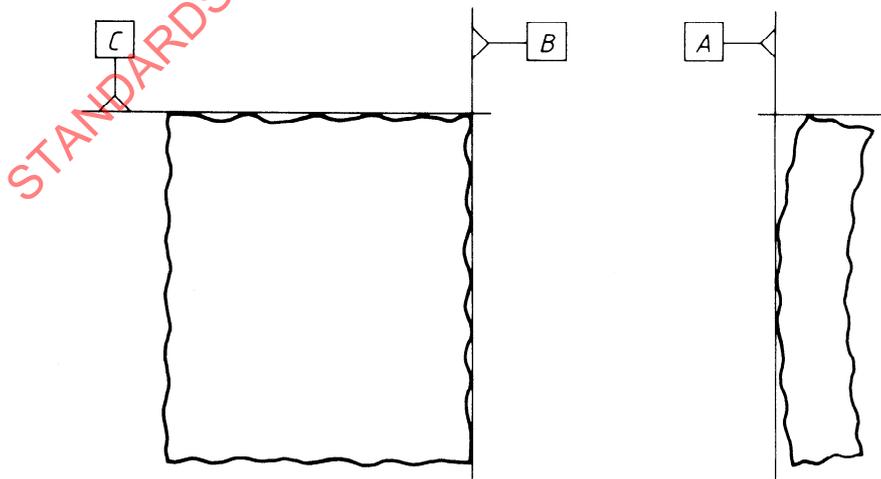

Figure 36

Figure 37

It may therefore be necessary to introduce datum targets.

Before specifying the datum targets, it is necessary to consider whether the functioning of the part may be endangered by specifying the datum to consist only of datum targets instead of the whole surface. In this respect the influence of the deviations from the ideal geometrical form and positions, which may occur, shall be considered.

7.1 Symbols for datum targets

To indicate the datum targets on a drawing, the following symbols shall be used.

7.1.1 Datum target frame

The datum targets are indicated by a circular frame divided in two compartments by a horizontal line. The lower compartment is reserved for a letter and a digit. The letter represents the datum feature and the digit the datum target number.

The upper compartment is reserved for additional information, such as dimensions of the target area. If there is not sufficient space within the compartment, the information may be placed outside and connected to the appropriate compartment by a leader line.

Figure 38

The datum target frame is connected to the datum target symbol by a leader line, terminated by an arrow.

7.1.2 Datum targets

If the datum target is

— a point : it is indicated by a cross,

— a line : it is indicated by two crosses,
connected by a thin continuous line

— an area : it is indicated by a hatched area surrounded
by a thin double dashed chain line

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The symbols shall be placed on that view of the drawing which most clearly shows the relevant surface (see figure 42). The locations of the datum targets may be dimensioned on that view which is most convenient, preferably in a full view.

Examples

Figure 39

Figure 40

Figure 41