

DATUMS (PLANAR)

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DATUMS (PLANAR)

Sections:

1. Datums
2. Implied Datums
3. Planar Datums
4. Datum Targets

DATUMS

A **datum** is a theoretically exact plane, point, or axis from which a dimensional measurement is made. A **datum feature** is a part feature that contacts a datum. A **planar datum** is the true geometric counterpart of a planar datum feature. A **true geometric counterpart** is the theoretical perfect boundary or best fit tangent plane of a specified datum feature.

Depending upon the type of datum feature, a true geometric counterpart may be:

1. A tangent plane contacting the high points of a surface.
2. A maximum material condition boundary.
3. A least material condition boundary.
4. A virtual condition boundary.
5. An actual mating envelope.
6. A mathematically defined contour.
7. A worst-case boundary.

DATUMS

Since a **true geometric counterpart is theoretical**, the datum is **assumed** to exist in, and be simulated by, the associated inspection (or processing) equipment. The inspection equipment (or gage surfaces) used to establish a datum is called the datum feature simulator. For example, surface plates and gage surfaces – though not perfect planes – are of such quality that they are assumed to be perfect and are used as simulated datums. A simulated datum is the plane (or axis) established by the datum feature simulator. For practical purposes in industry, a simulated datum is used as the datum

DATUMS

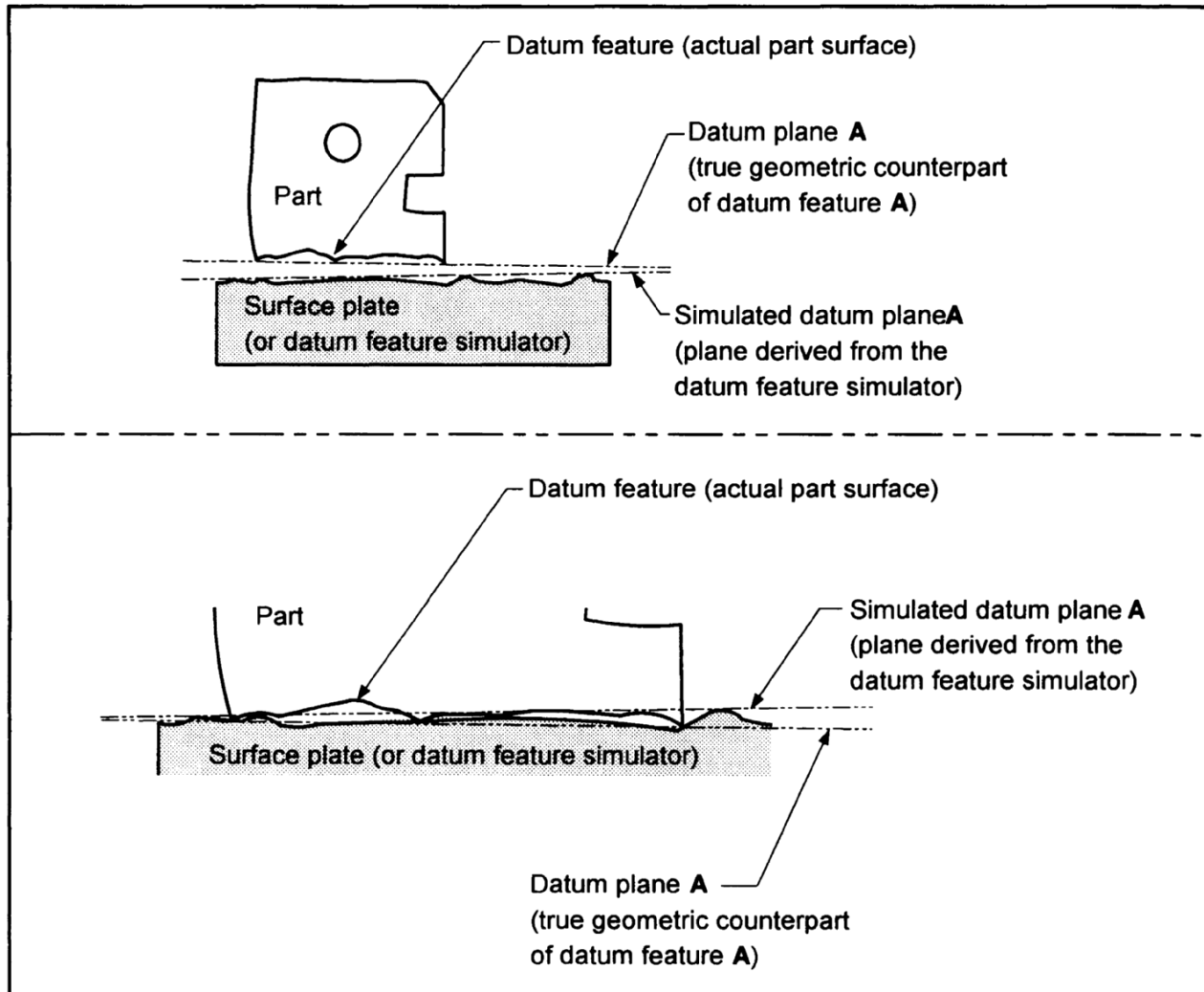


FIGURE 5-2 Planar Datums

IMPLIED DATUMS

An implied datum is an assumed plane, axis, or point from which a dimensional measurement is made. Implied datums are an old concept from coordinate tolerancing. In the figure below, the bottom and left sides of the block are considered implied datums.

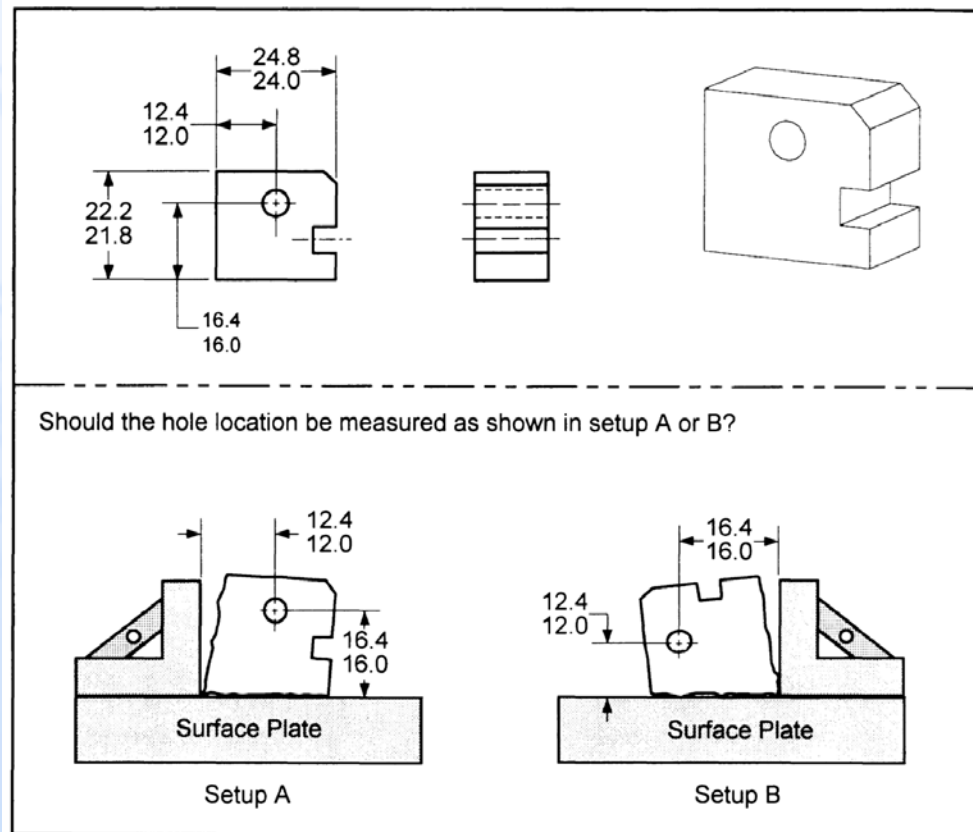


FIGURE 5-1 Implied Datums

IMPLIED DATUMS

Shortcomings of Implied Datums

Implied datums have two major shortcomings. *First*, they **do not clearly communicate** to the drawing user **which surfaces should contact the inspection equipment**. When the drawing does not clearly specify which surfaces are to contact the inspection equipment, the inspector must make an assumption. *Second*, implied datums **do not communicate** to the drawing user **in which sequence the part should be brought into contact with the inspection equipment**. If the order is not clearly specified, each inspector could assume a different sequence. Each sequence would then produce different results for the part measurements.

IMPLIED DATUMS

Consequences of Implied Datums

The use of implied datums requires the inspector to **assume** which part surfaces should contact the inspection equipment and in **what sequence**. A part that is to specification when measured properly may be rejected when measured from the wrong surfaces or when using the wrong sequence. Also, a part that would be out of specification when measured properly, may pass inspection when measured from the wrong surfaces or using the wrong sequence.

The use of implied datums results in two **consequences**:

1. Good parts are rejected.
2. Bad parts are accepted.

PLANAR DATUMS

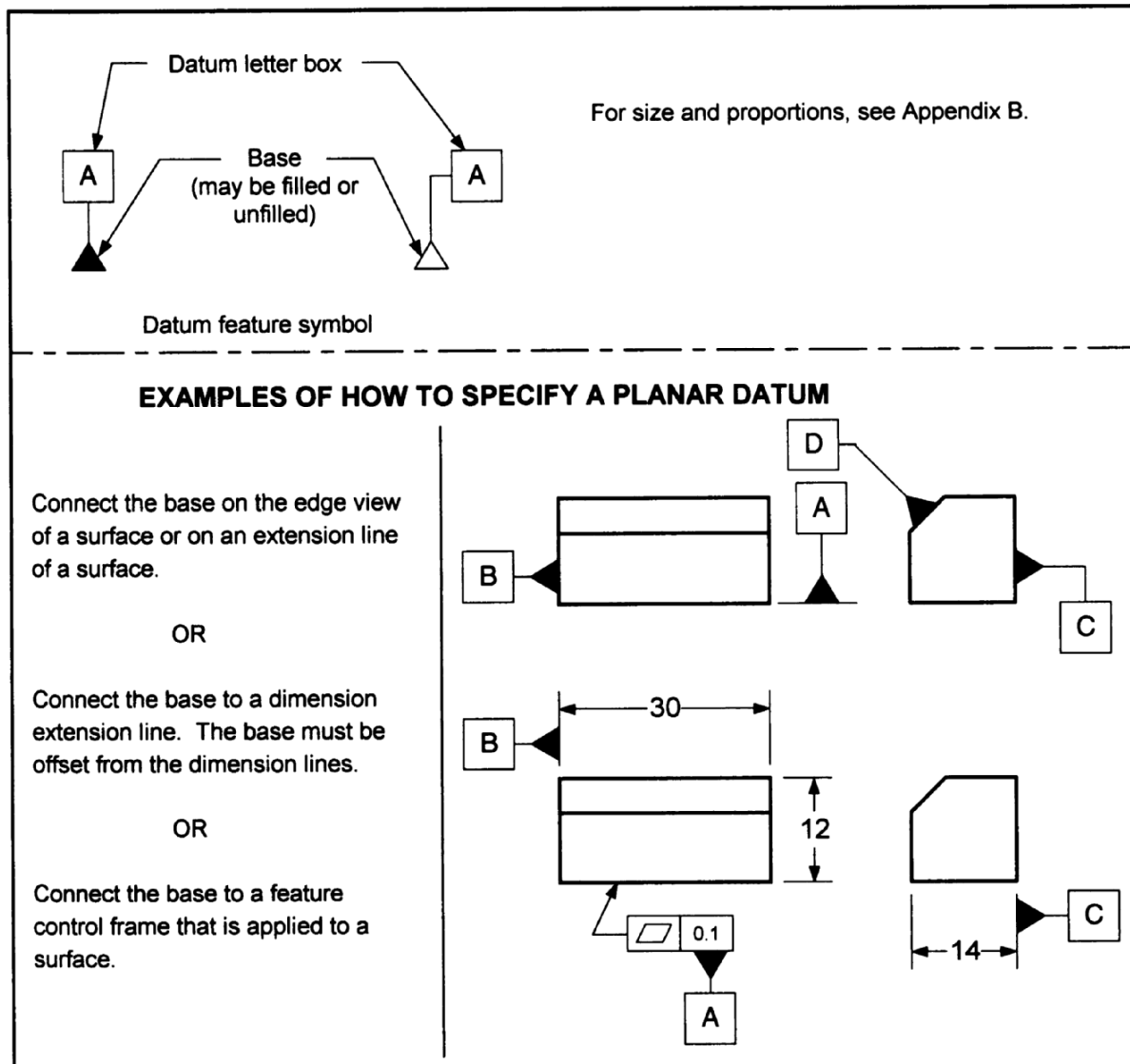


FIGURE 5-3 Datum Feature Symbol

PLANAR DATUMS

Datum Selection

Datum features are **selected** on the basis of **part function** and **assembly requirements**. The datum features are often the features that orient (stabilize) and locate the part in its assembly. For example, the part below mounts on surface A and is located by diameter B. For assembly, the holes need to be located relative to the features that mount and locate the part to the mating part. Therefore, surface A and diameter B are designated as datum features.

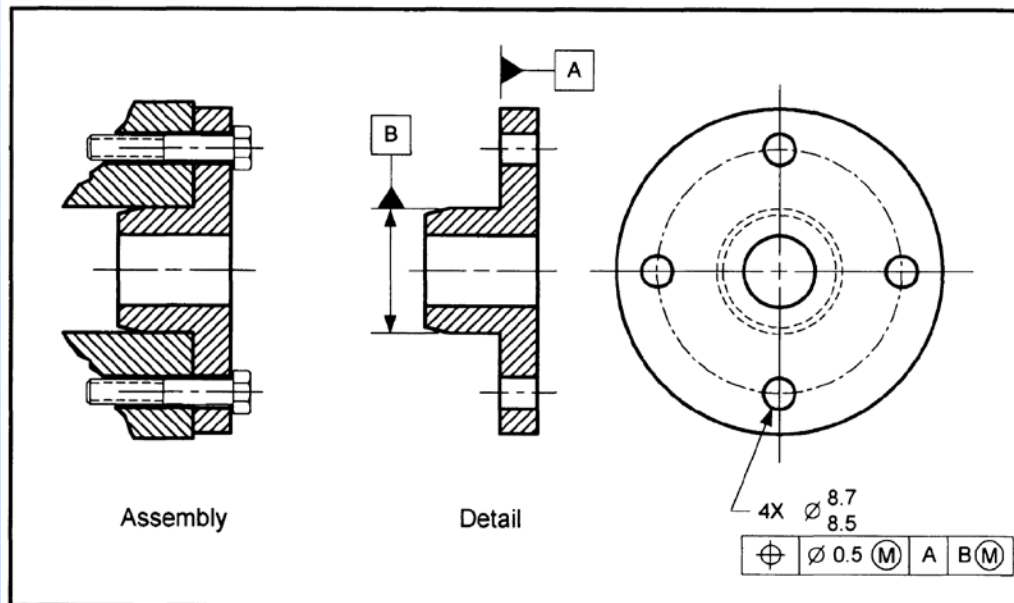


FIGURE 5-4 Datum Selection

PLANAR DATUMS

Referencing Datums in Feature Control Frames

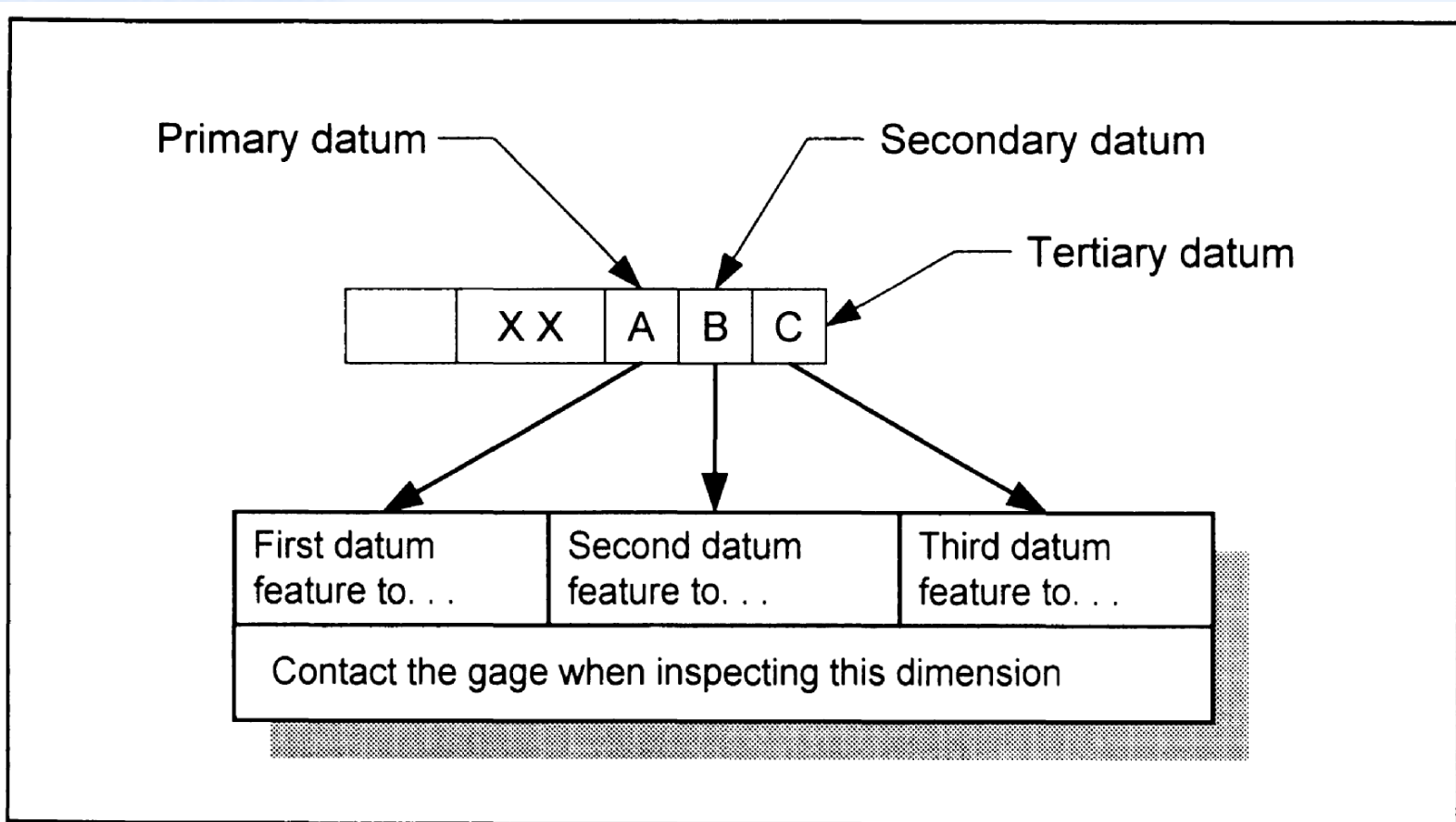


FIGURE 5-5 Referencing Datums in Feature Control Frames

PLANAR DATUMS

Datum Reference Frame

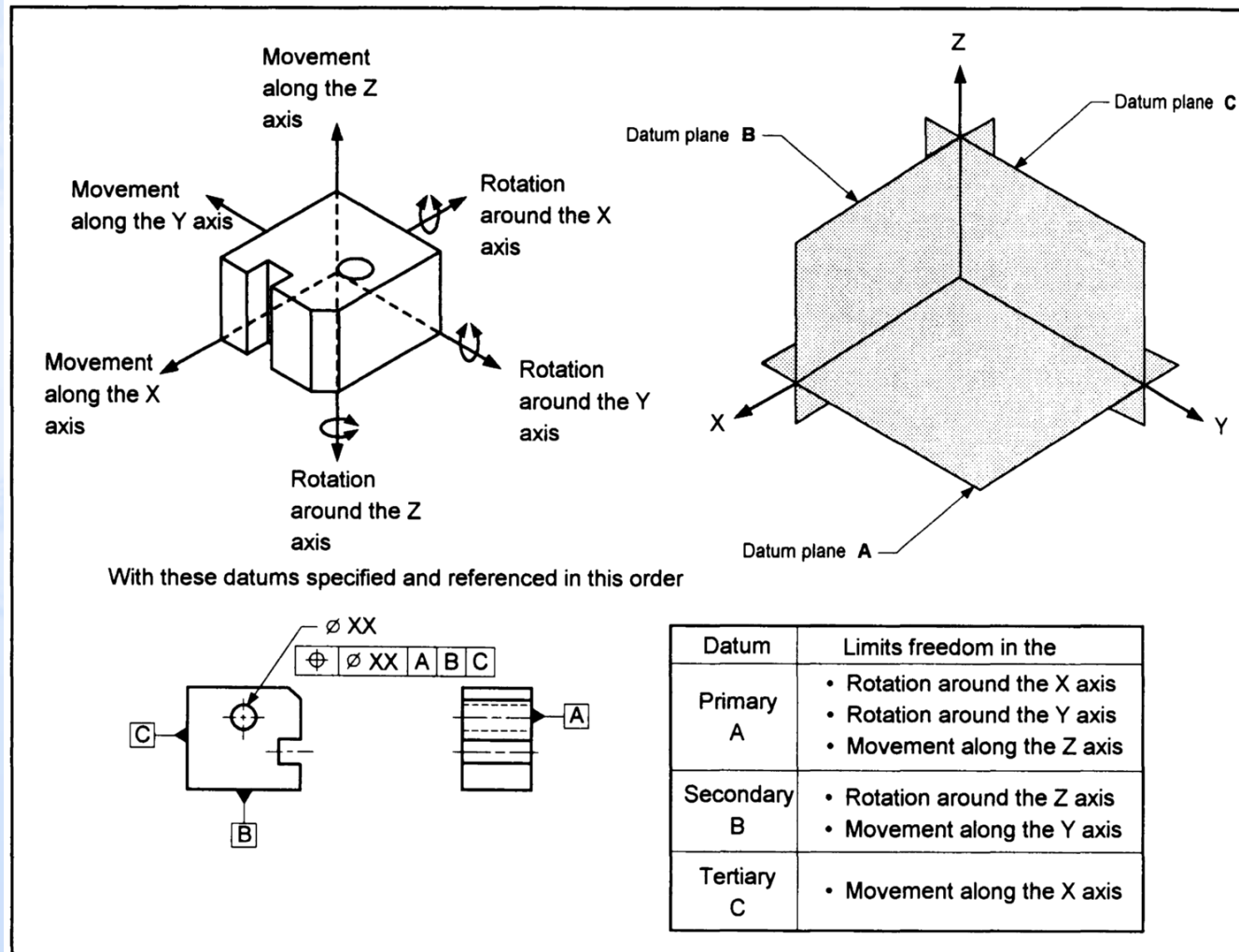


FIGURE 5-6 Datum Reference Frame

PLANAR DATUMS

Datum Reference Frame

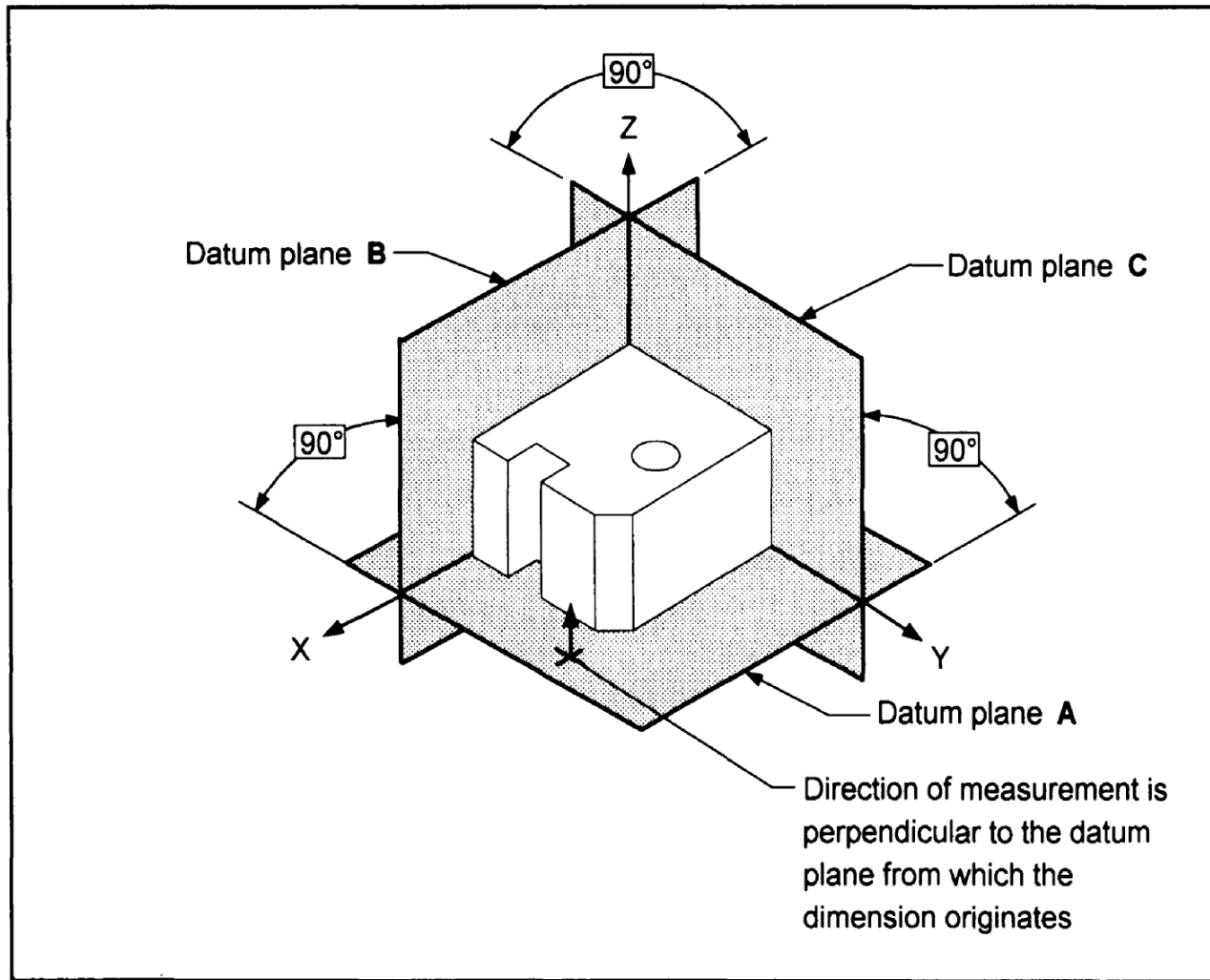


FIGURE 5-7 Datum Reference Frame

PLANAR DATUMS

Datum Reference Frame

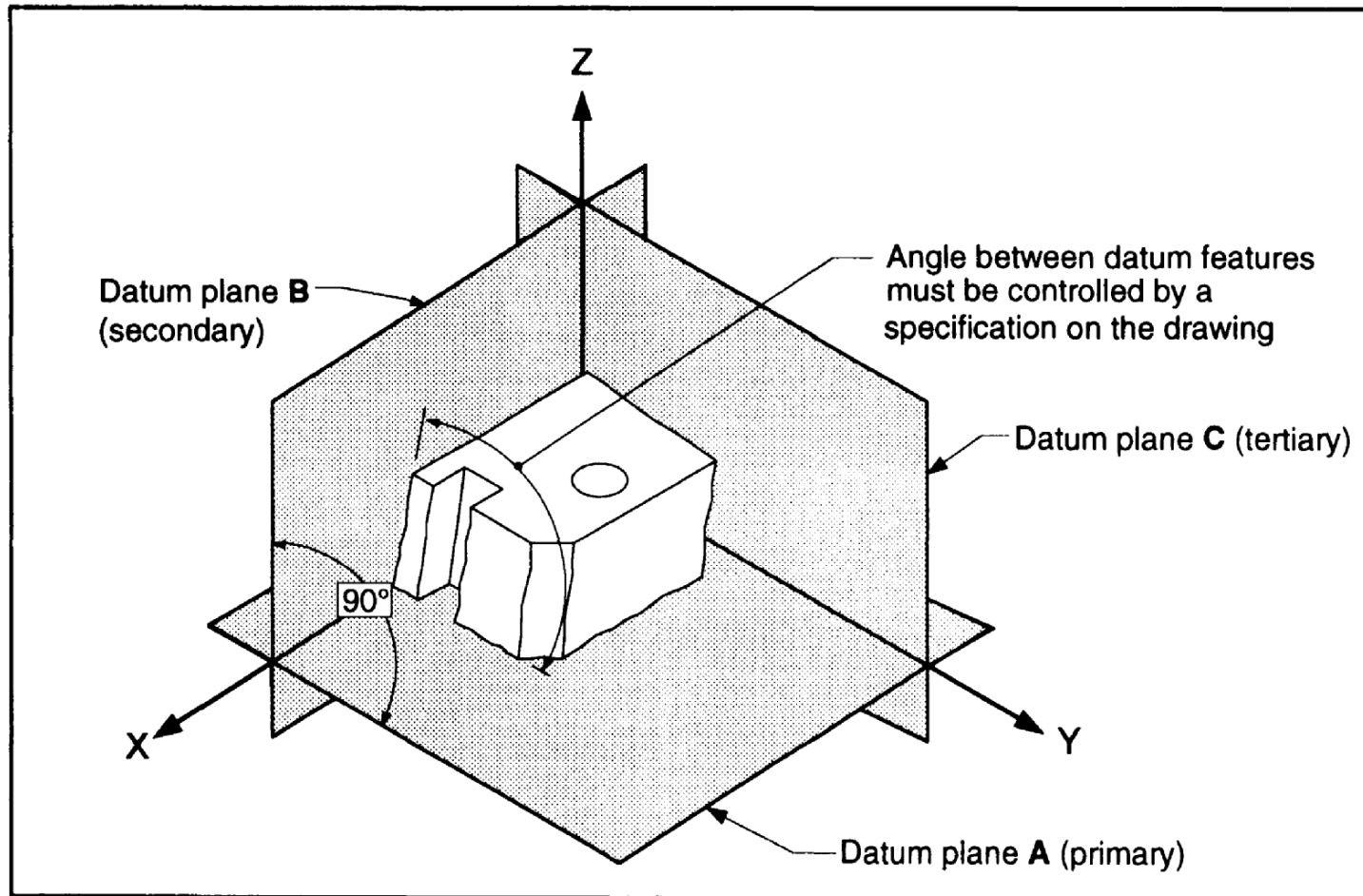


FIGURE 5-8 Datum Features

PLANAR DATUMS

The 3-2-1 Rule

The 3-2-1 Rule defines the **minimum number of points of contact required** for a part datum feature with its primary, secondary, and tertiary datum planes. The 3-2-1 Rule only applies on a part with all planar datums. The **primary datum** feature has **at least three points** of contact with its datum plane. The **secondary datum** feature has **at least two points** of contact with its datum plane. The **tertiary datum** feature has **at least one point** of contact with its datum plane. The 3-2-1 Rule applies to planar datum features only.

PLANAR DATUMS

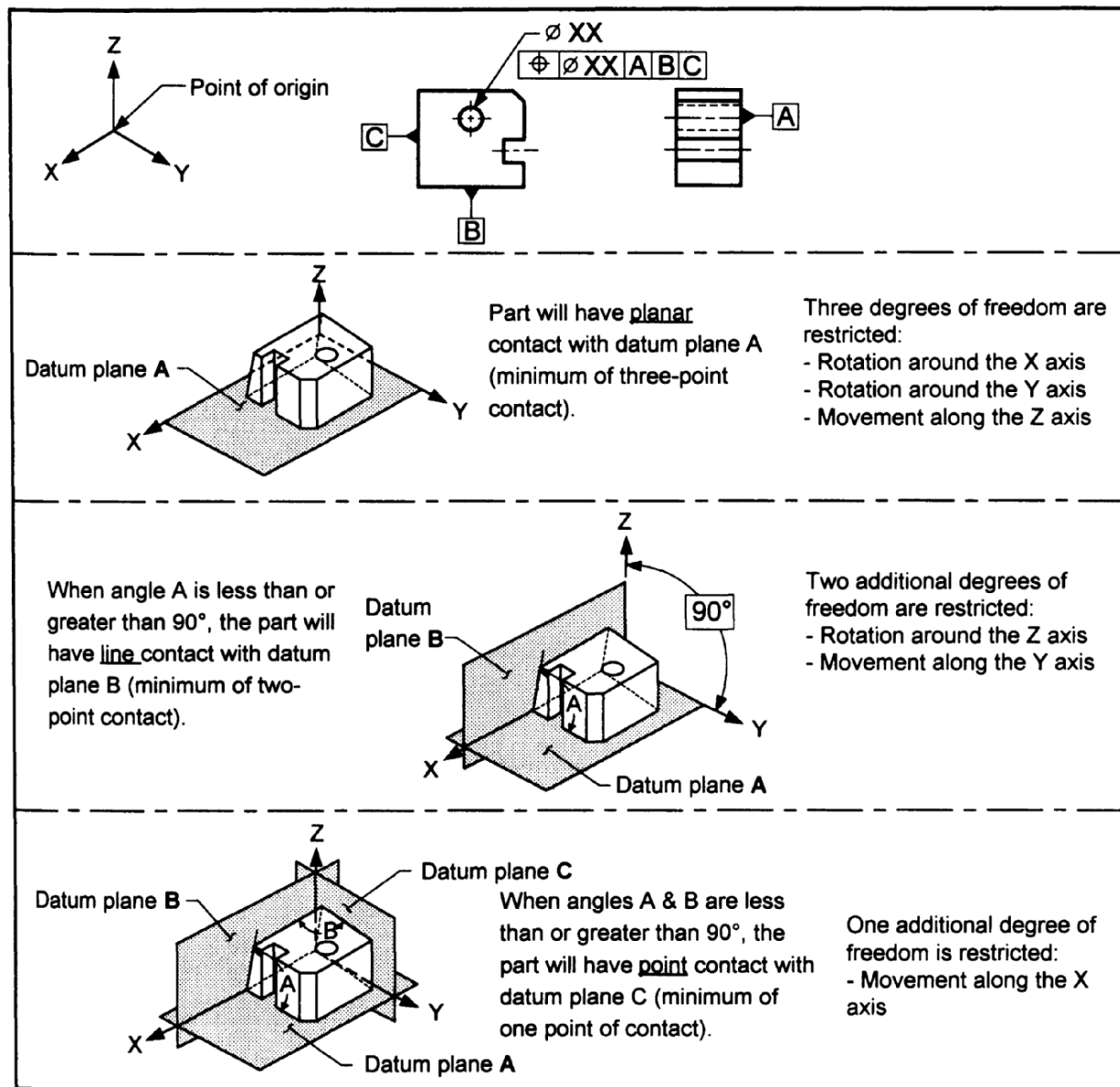


FIGURE 5-9 Primary, Secondary, and Tertiary Datums

PLANAR DATUMS

Datum-Related Versus FOS Dimensions

Only dimensions that are related to a datum reference frame through geometric tolerances should be measured in a datum reference frame. If a dimension is not associated to a datum reference frame with a geometric tolerance, then there is no specification on how to locate the part in the datum reference frame.

PLANAR DATUMS

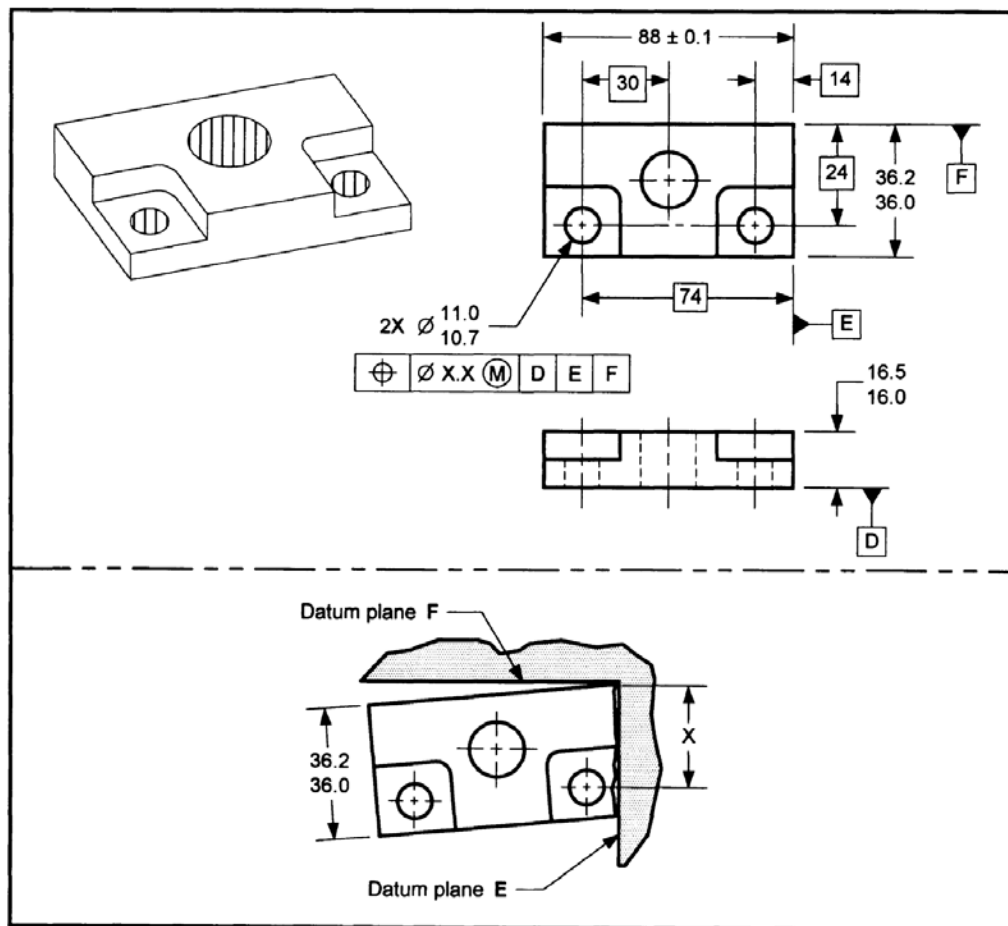


FIGURE 5-10 Datum-Related Versus Feature of Size Dimensions

In this figure, the hole locations are related to the datum reference frame, D primary, E secondary, and F tertiary. During inspection of the hole location dimensions, the part should be mounted in datum reference frame D-E-F, but the overall dimensions are not related to the datum reference frame. The overall dimensions are FOS dimensions. During inspection of the overall dimensions, the part should not be mounted in the datum reference frame.

PLANAR DATUMS

Inclined Datum Features

An inclined datum feature is a datum feature that is at an angle other than 90°, relative to the other datum features. On parts with datum features (surfaces) at angles other than 90°, the datum reference frame will contain planes at the basic angle of the part surface.

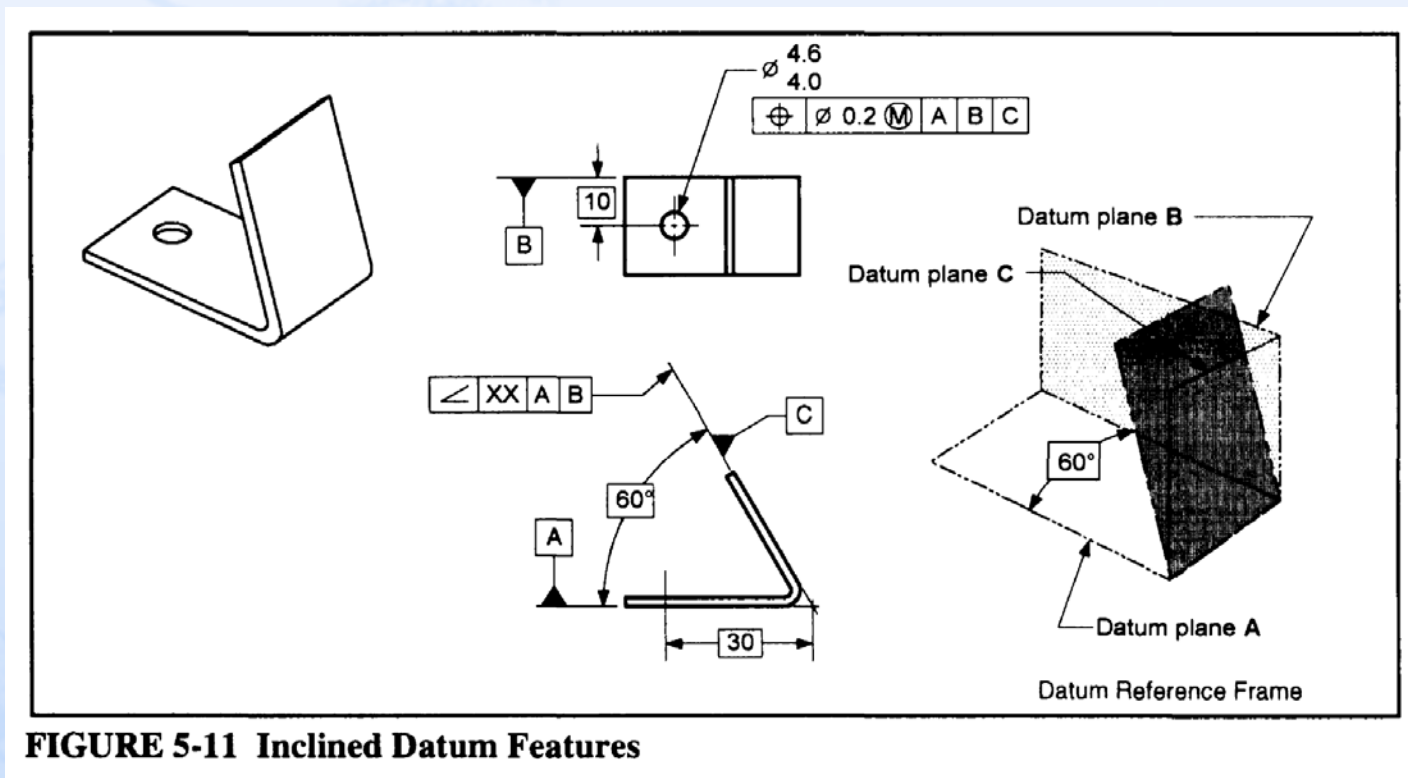


FIGURE 5-11 Inclined Datum Features

PLANAR DATUMS

Coplanar Datum Features

Coplanar surfaces are **two or more surfaces that are on the same plane**.

Coplanar datum features are two or more datum features that are on the same plane. A single datum plane can be established from multiple surfaces. In this case, a datum feature symbol is attached to a profile control. The profile control limits the flatness and coplanarity of the surfaces. The note following this profile control – “two surfaces” – also denotes that datum feature A is comprised of two surfaces.

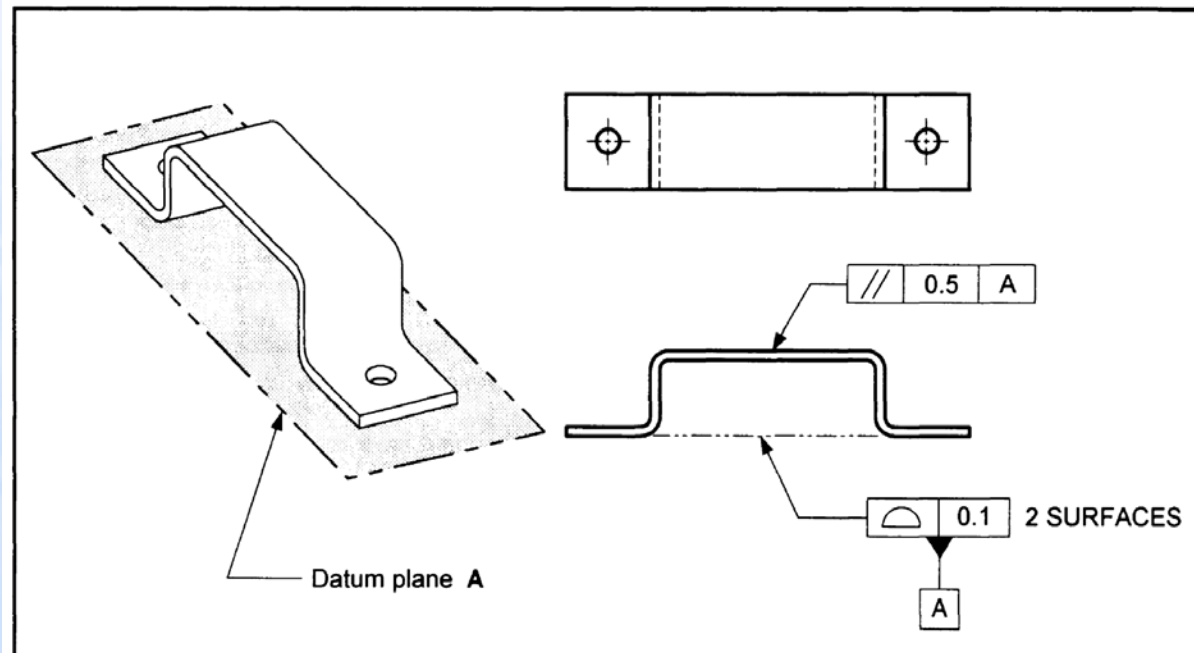


FIGURE 5-13 Coplanar Datum Features

DATUM TARGETS

Datum targets are **symbols that describe the shape, size, and location of gage elements that are used to establish datum planes or axes.**

Datum targets are shown on the part surfaces on a drawing, but they actually **do not exist on a part.** Datum targets describe gage elements. The gage elements only contact a portion of the part surface. Datum targets can be specified to simulate a point, line or area contact on a part. **The use of datum targets allows a stable and repeatable relationship for a part with its gage.**

Datum targets should be specified on parts where it is not practical (or possible) to use an entire surface as a datum feature. A few examples are castings, forgings, irregularly shaped parts, plastic parts, and weldments. These types of parts often do not have a planar datum feature, or the datum feature is likely to be warped or bowed; this results in an unsuitable contact with a full datum plane. Often the part will rock, wobble, or not rest in the same position on a full datum plane.

DATUM TARGETS

Datum Target Symbols

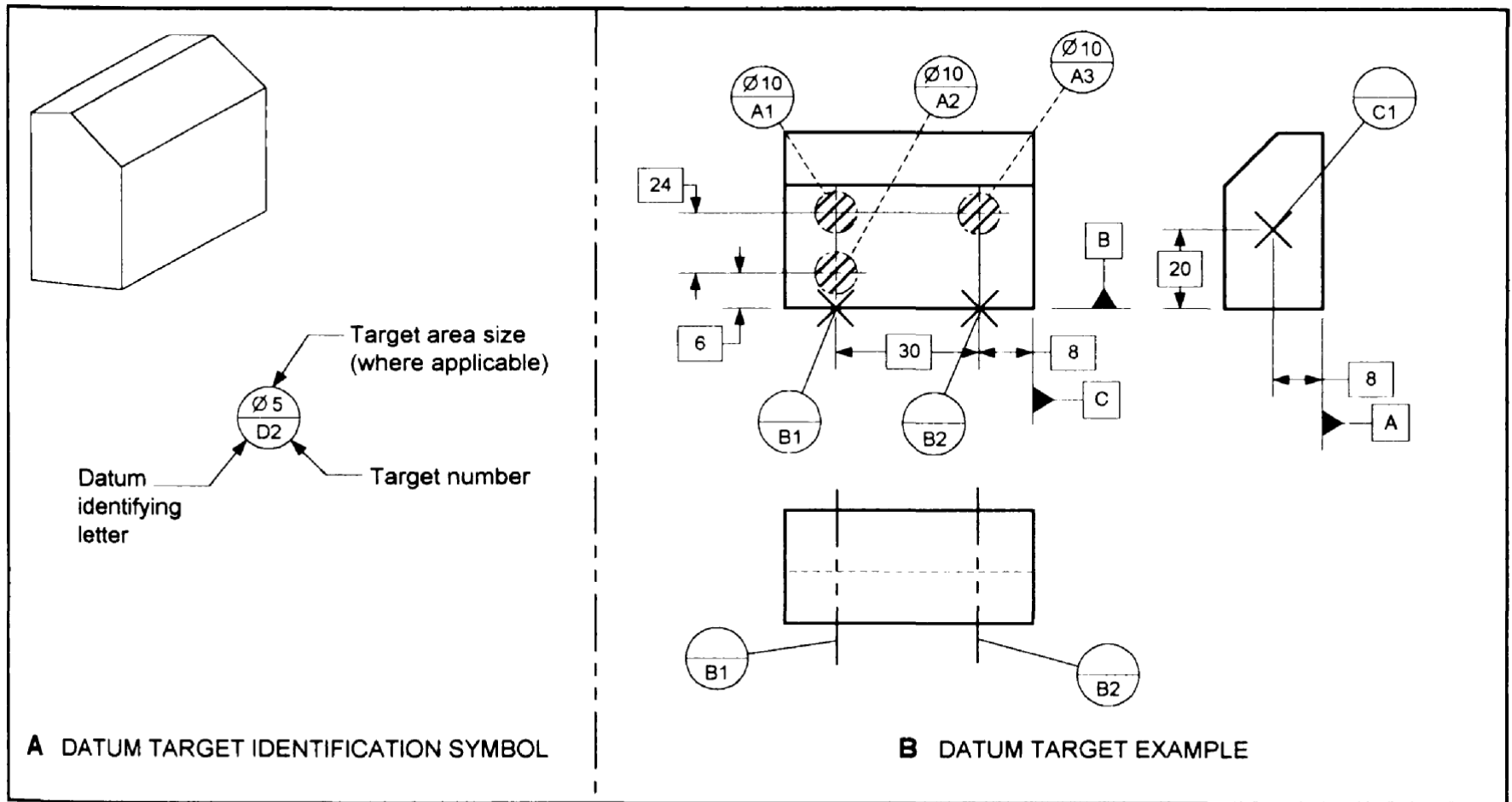


FIGURE 5-14 Datum Target Symbols

DATUM TARGETS

When to Use Datum Targets

Datum targets should be used whenever...

1. It is not practical to use the entire surface as a datum plane.
2. The designer suspects the part may rock or wobble when the datum feature contacts the datum plane.
3. Only a portion of the feature is used in the function of the part.

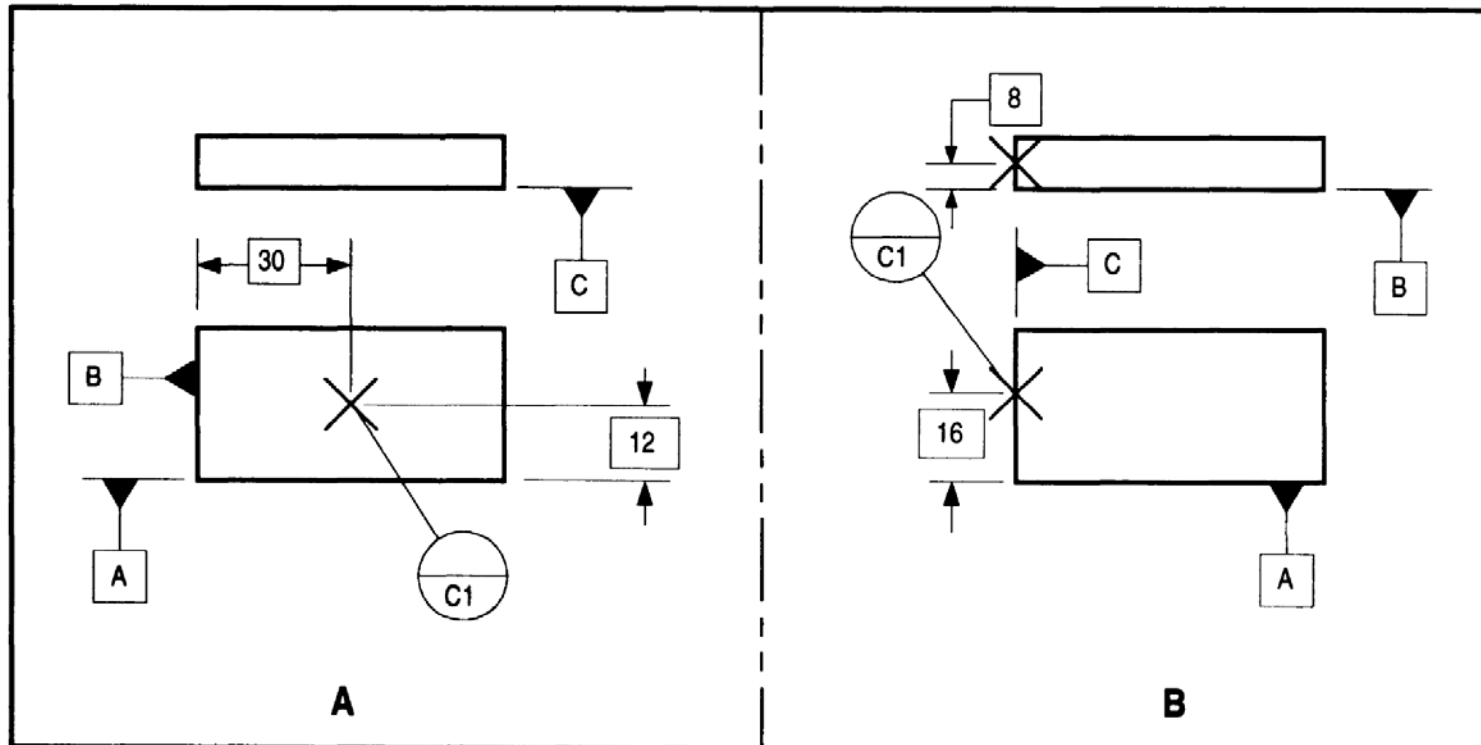


FIGURE 5-15 Datum Target Points

DATUM TARGETS

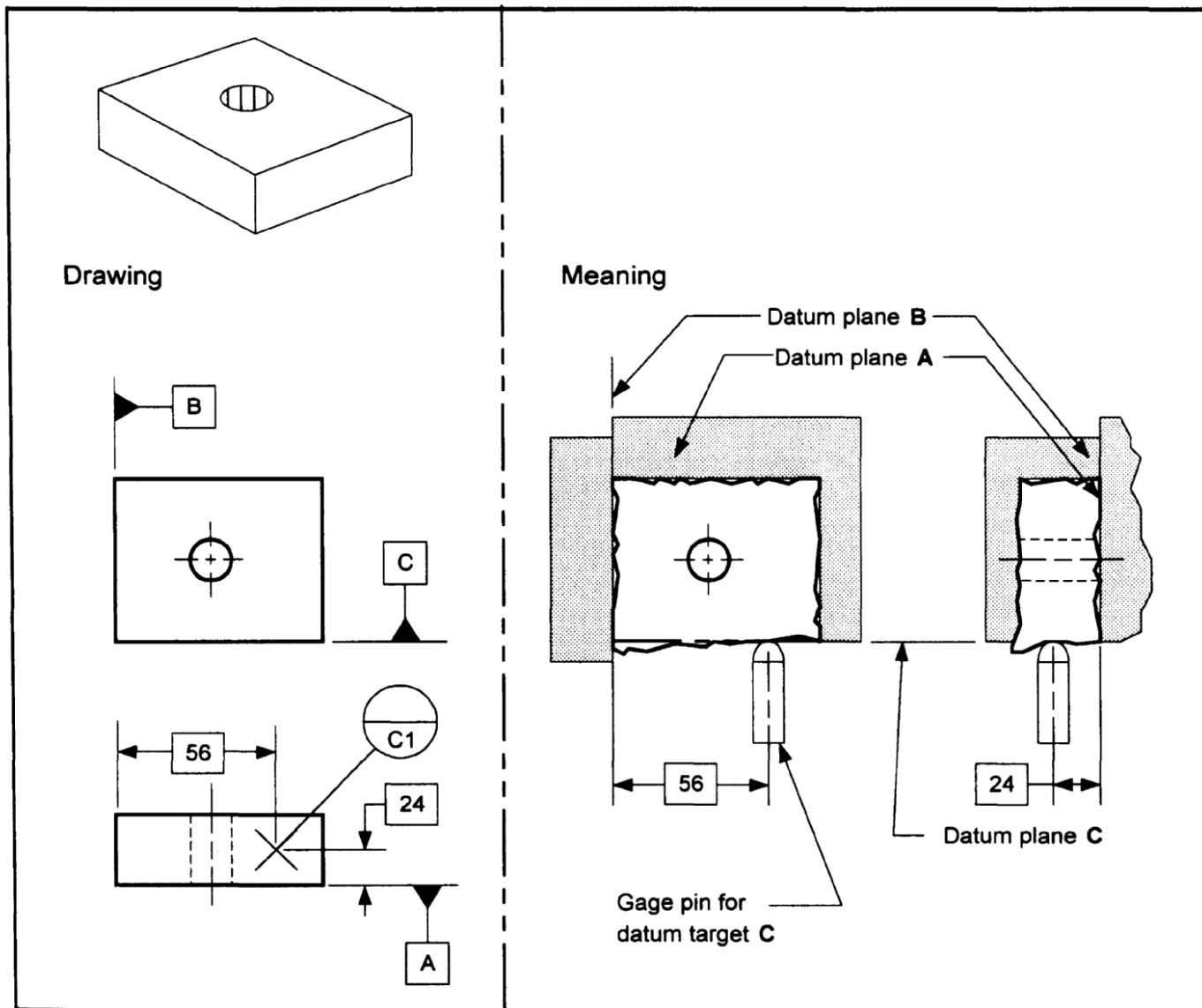


FIGURE 5-16 Datum Target Points

DATUM TARGETS

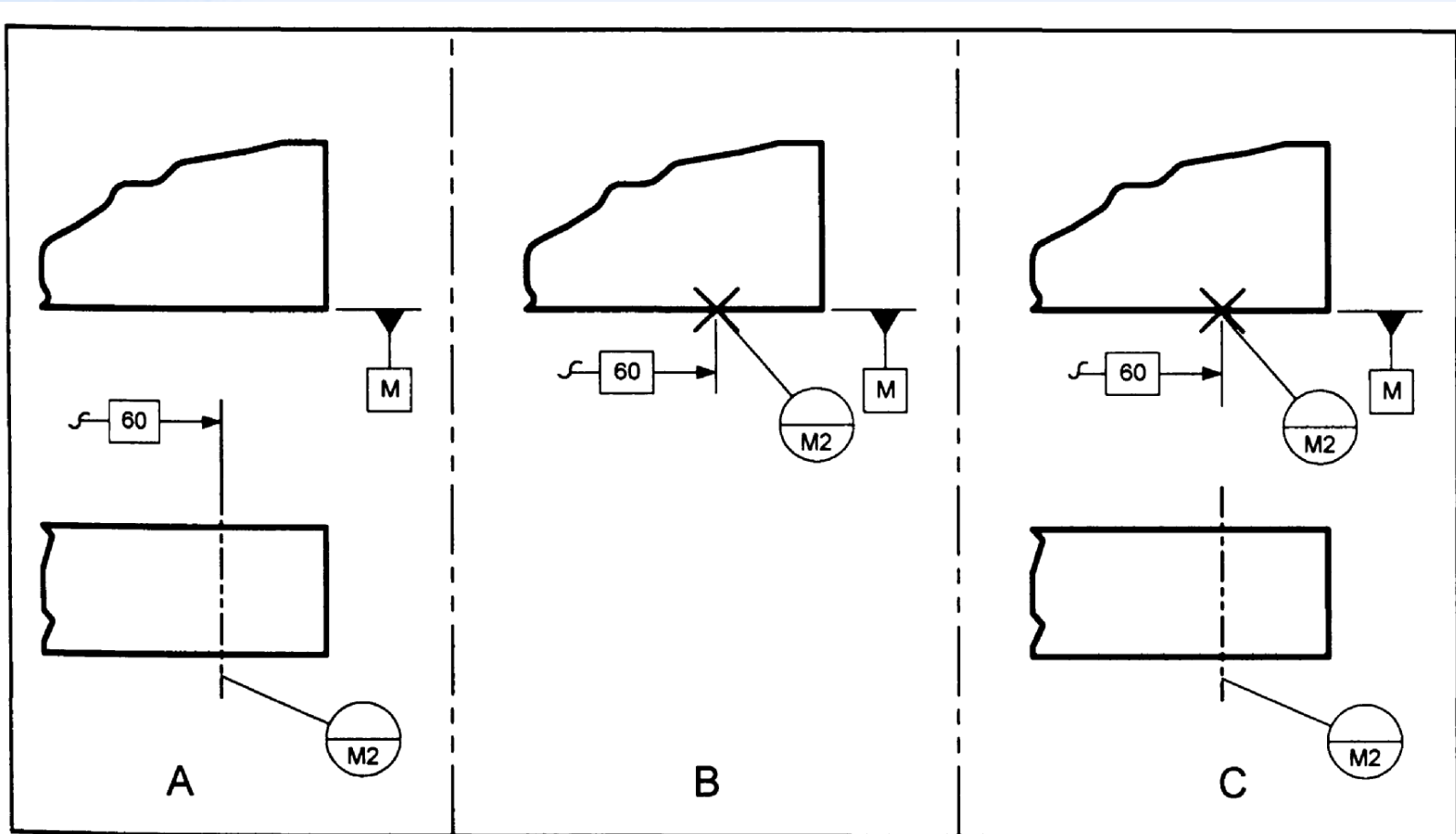


FIGURE 5-17 Symbols for Datum Target Lines

DATUM TARGETS

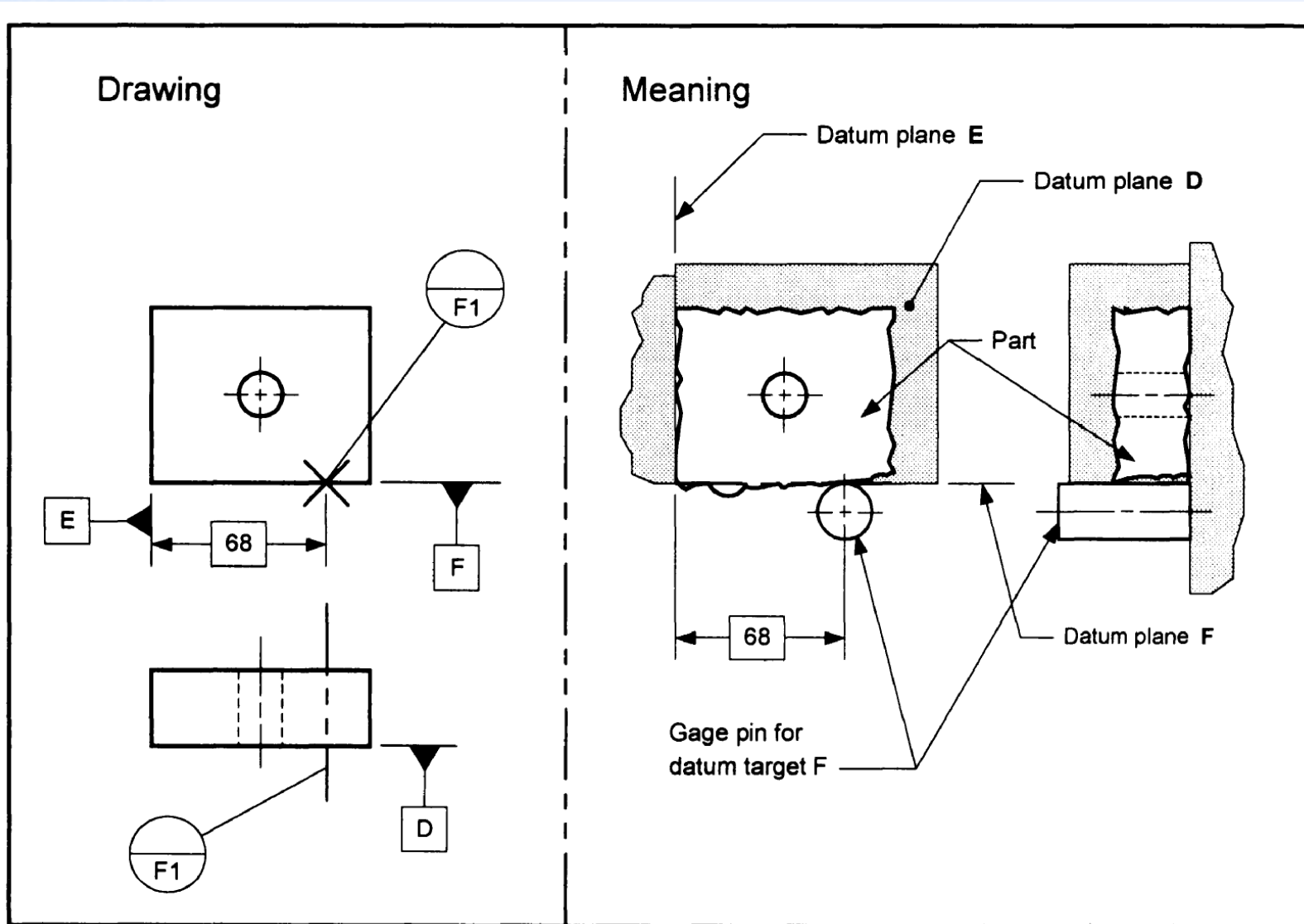


FIGURE 5-18 Datum Target Lines

DATUM TARGETS

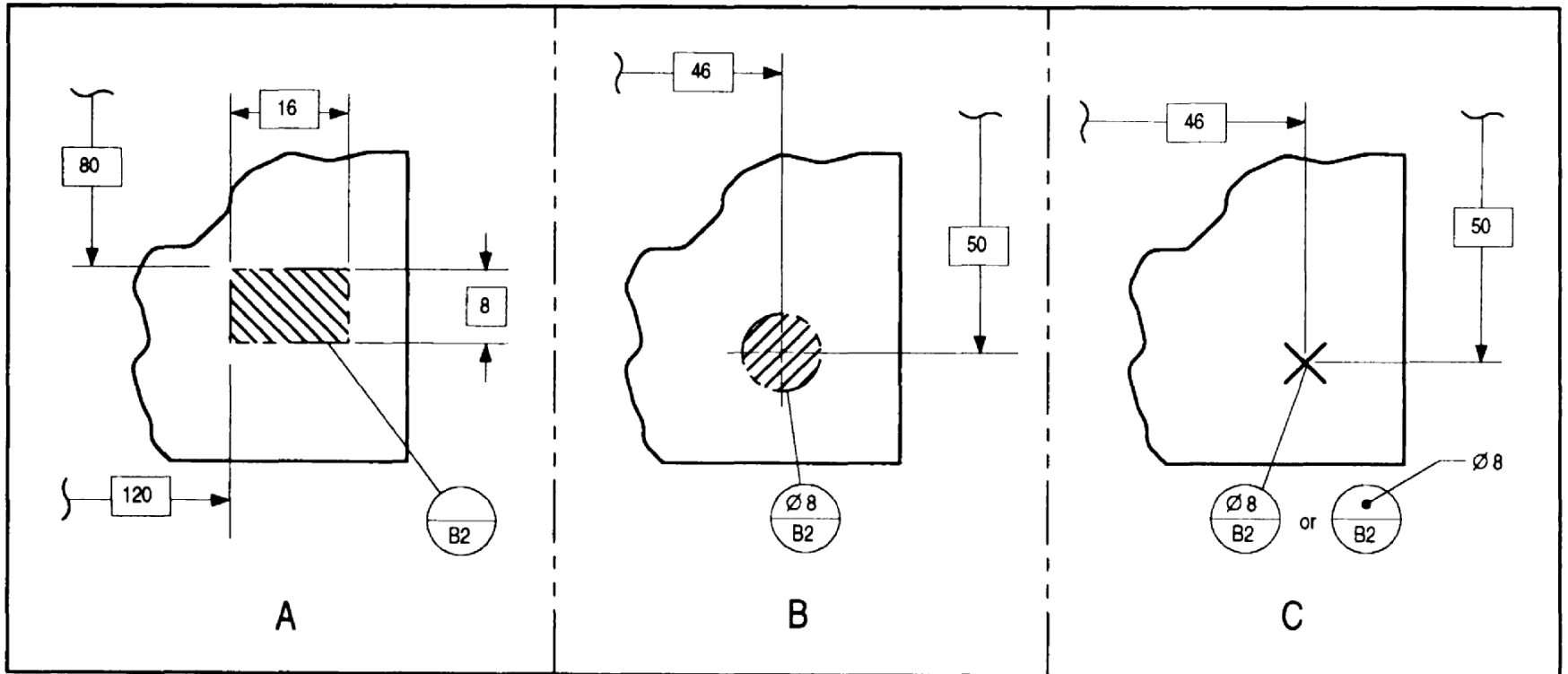


FIGURE 5-19 Datum Target Areas

DATUM TARGETS

Datum Target Applications

Although there are only three datum target symbols, they can be used in a variety of ways and on a number of different types of parts. This section illustrates and explains three different datum target applications:

1. Creating a partial reference frame from partial surfaces
2. Creating a partial datum reference frame from offset surfaces
3. Creating a complete datum reference frame from irregular surfaces

When using datum targets to establish a complete datum reference frame, three requirements should be met:

1. Basic dimensions should be used to define and locate the datum targets.
2. The datum reference frame must restrain the part in all six degrees of freedom.
3. The part dimensioning must ensure that the part will rest in the gage in only one orientation and location.

DATUM TARGETS

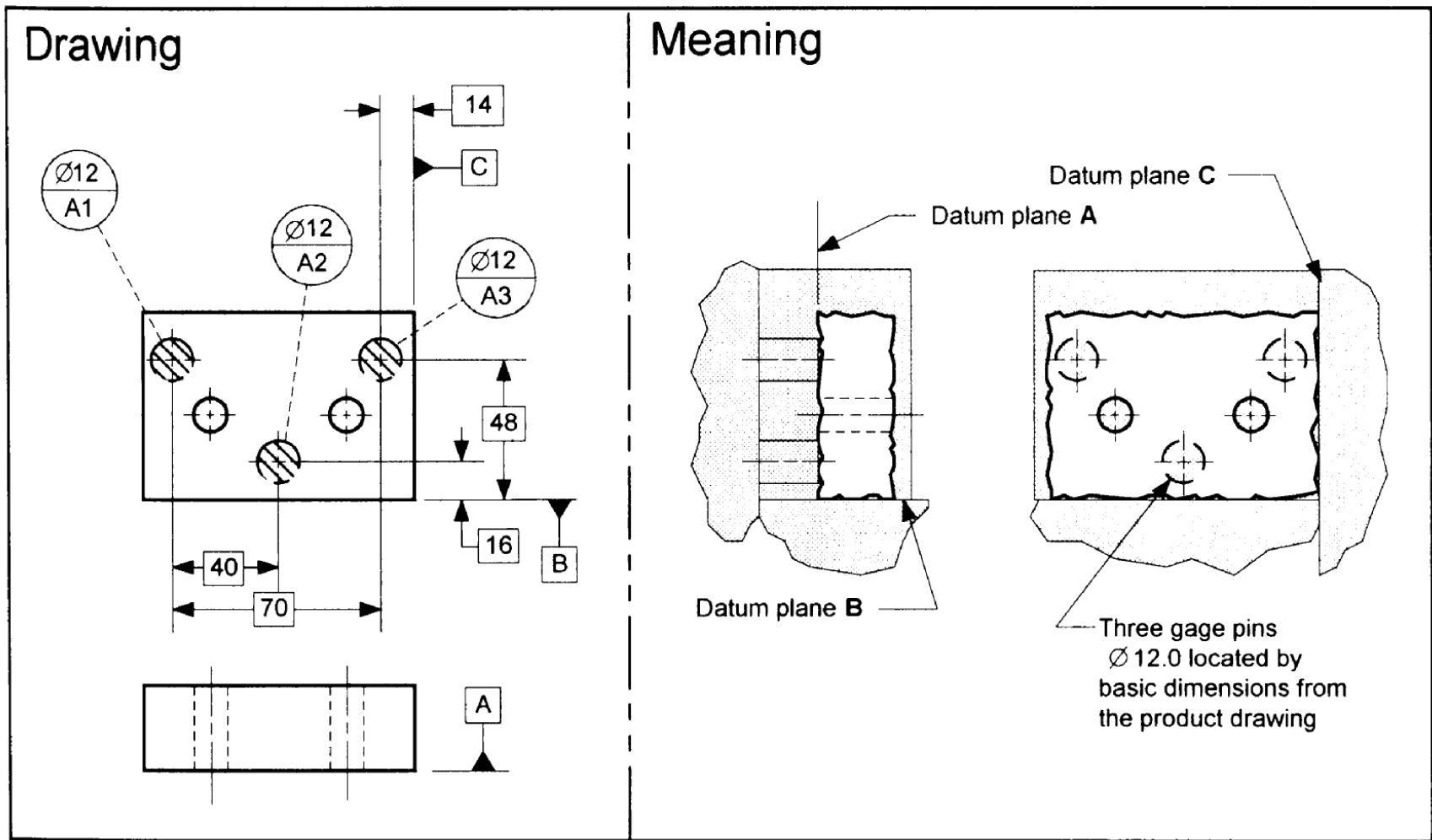


FIGURE 5-20 Datum Target Applications

DATUM TARGETS

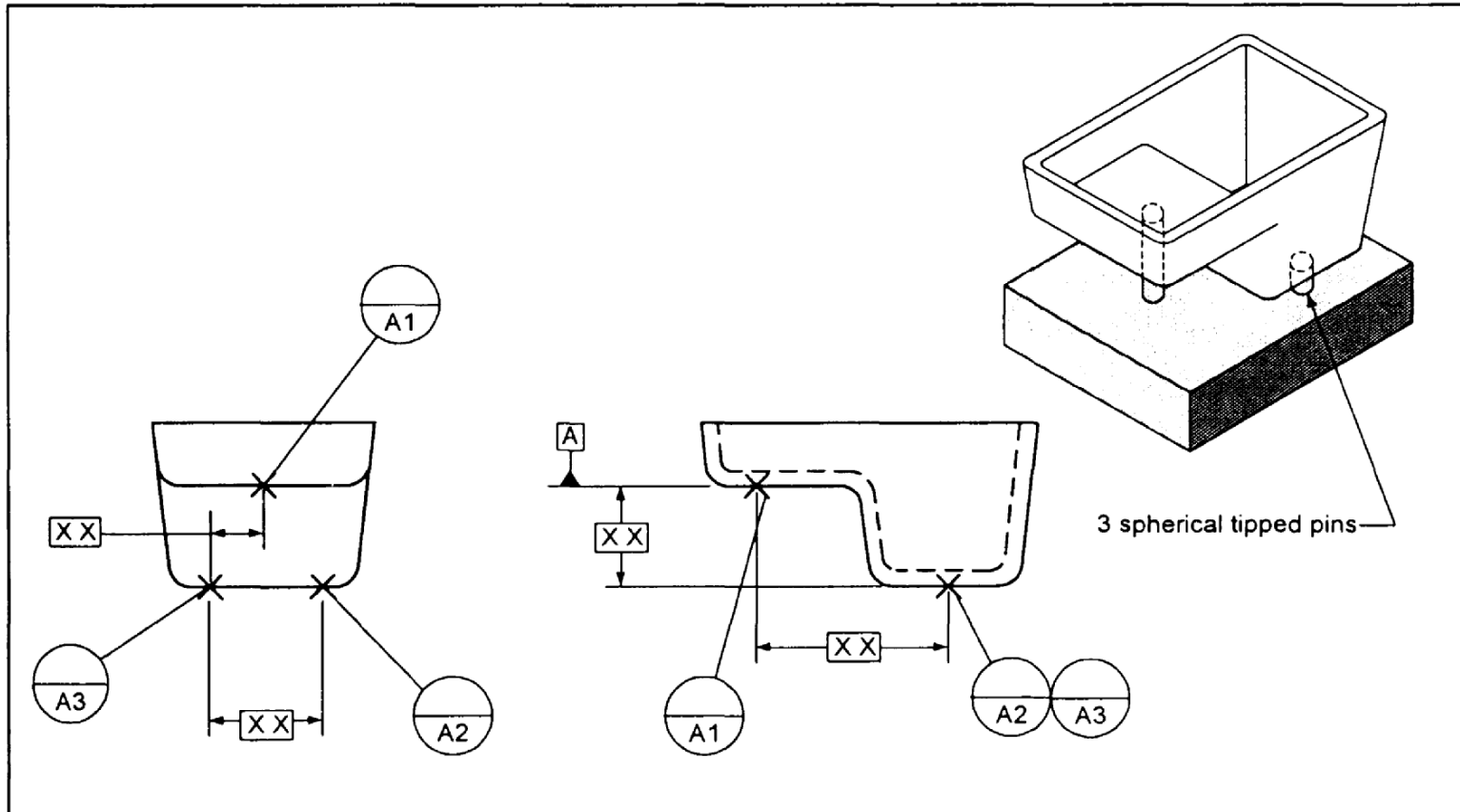


FIGURE 5-22 Datum Target Point Application

DATUM TARGETS

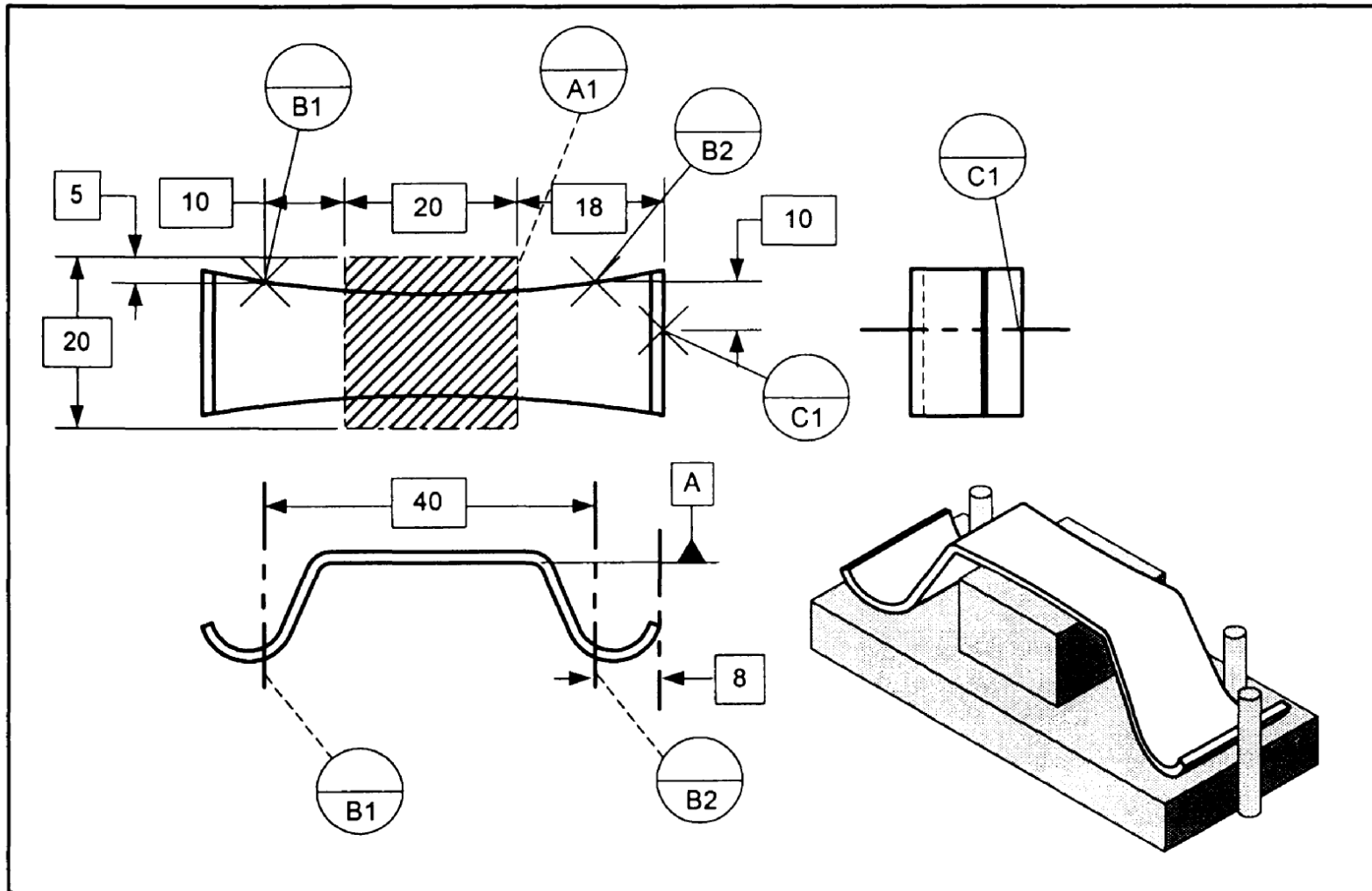


FIGURE 5-23 Datum Target Application

REFERENCES

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<http://www.tec-ease.com/tips/september-98.htm>