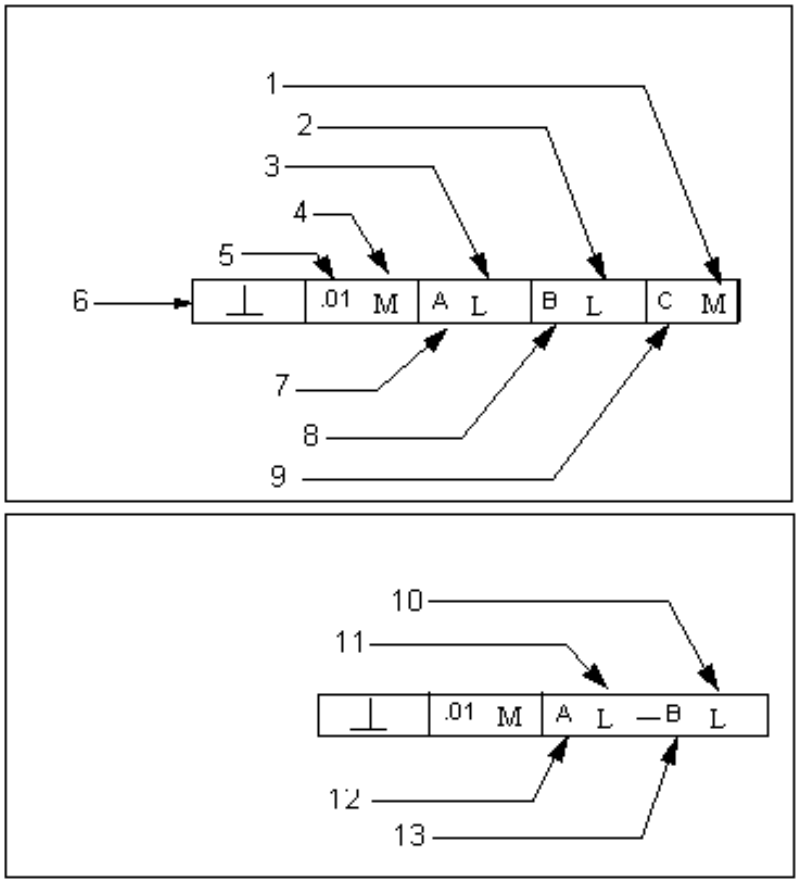
Example: Geometric Tolerance Layout

Pro/ENGINEER specifies a GTOL for an individual feature by means of a feature control frame (a rectangle) divided into compartments containing the GTOL symbol followed by the tolerance value. Where applicable, it also follows the tolerance with a material condition symbol.

If a GTOL is related to a datum, it places the reference datum name in a compartment following the tolerance value. Where applicable, it follows the datum reference letter with a material condition symbol.



1 Matl Cond, Tertiary
2 Matl Cond, Secondary
3 Matl Cond, Primary
4 Matl Cond, Tolerance
5 Value
6 Type
7 Datum Ref, Primary
8 Datum Ref, Secondary
9 Datum Ref, Tertiary
10 Matl Cond, Primary, Compound
11 Matl Cond, Primary, Basic
12 Datum Ref, Primary, Basic
13 Datum Ref, Primary, Compound

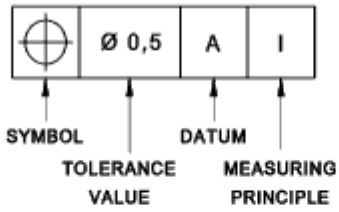
Geometric tolerances specify the maximum variation that is allowed in form or position from true geometry. The geometric tolerance is, in essence, the width or diameter of tolerance zone within which a surface or axis of hole or cylinder can lie which results in resulting feature being acceptable for proper function and interchangeability.

If a tolerance of form is not specified on a drawing for a feature, then the feature as made will be acceptable regardless of form variation. The tolerances of form control straightness, flatness, parallelism, angular displacement etc. etc.

The tolerance zone will be one of the following:

- The area within a circle
- The area between two circles
- The area between two equidistant lines or between two parallel straight lines
- The space within a cylinder
- The space between two coaxial cylinders
- The space between two equidistant surfaces or two parallel planes
- The space within a bent pipe

Tolerance Frame with Symbol identifications




STRAIGHTNESS


FLATNESS


CIRCULARITY


CYLINDRICITY


PROFILE OF LINE


PROFILE OF SURFACE


COAXILITY


POSITION


SYMMETRY


PARALLELISM

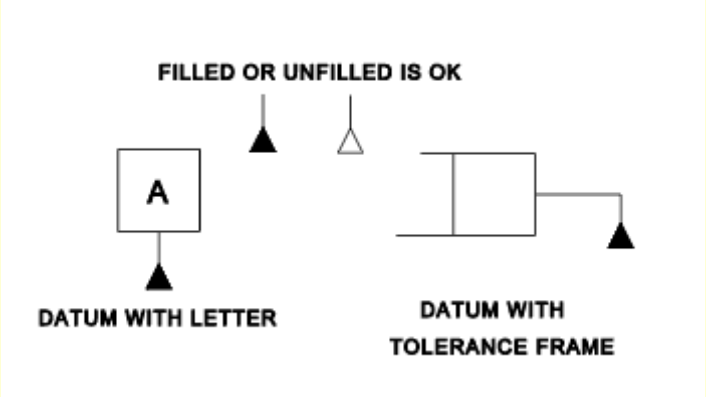

PERPENDICITY


ANGULARITY

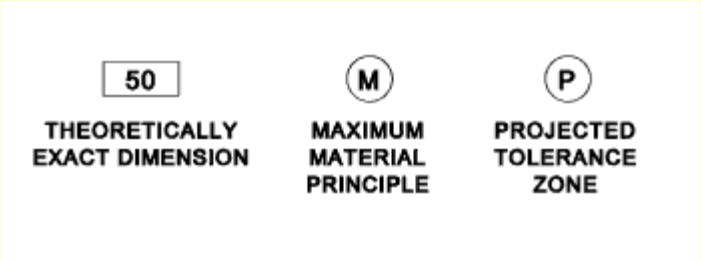

RUN-OUT


TOTAL RUN-OUT

Indication of datum



Supplimentary Symbols



Tolerance Frame Variations

The tolerance frame can be divided into two or more compartments.
These compartments include from left to right

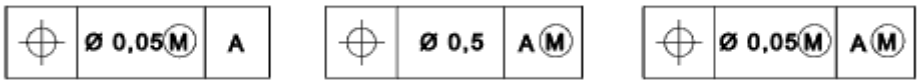
- The symbol for the feature to be toleranced
- The tolerance value..If the tolerance zone is circular or cylinderical it is preceded with a Ø
- Letters for datums when the toleranced feature is specified in relation to one, or more datums.

If more than one datum is specified then additional partitions are provided

Maximum Material Indication in Tolerance Frame

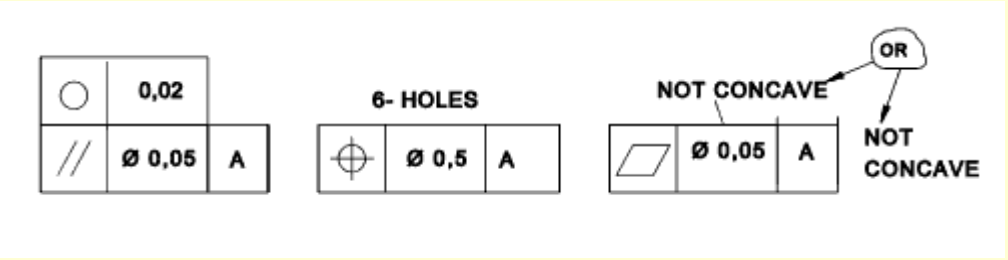
The maximum material condition, when used, is indicated by a symbol placed after the tolerance value, after the datum letter, or both.

See the figures below:



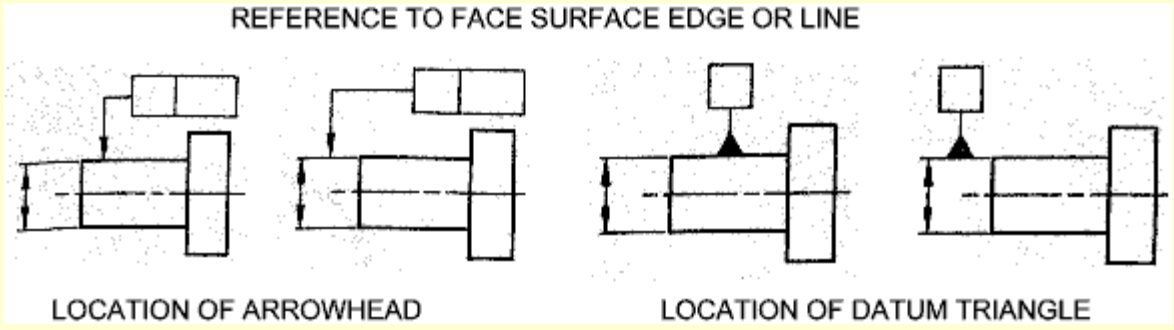
Additional Frames- Notes

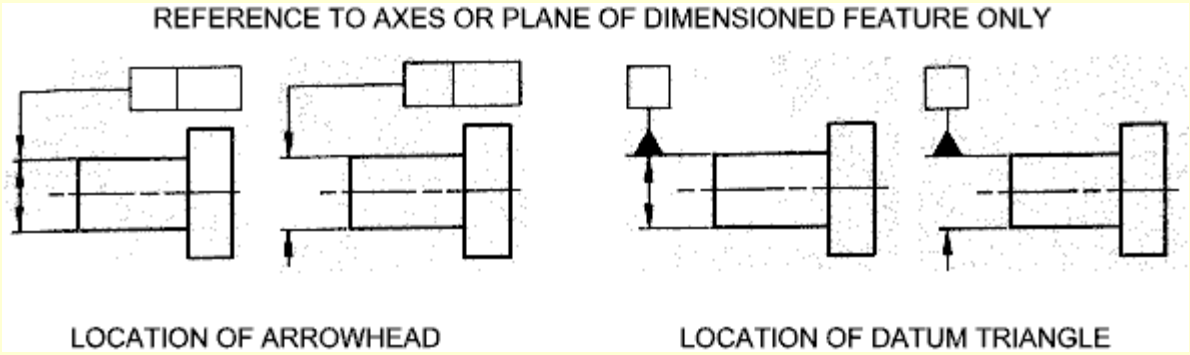
If a single frame cannot convey sufficient information it is acceptable to stack additional frames and/or provide additional notes..

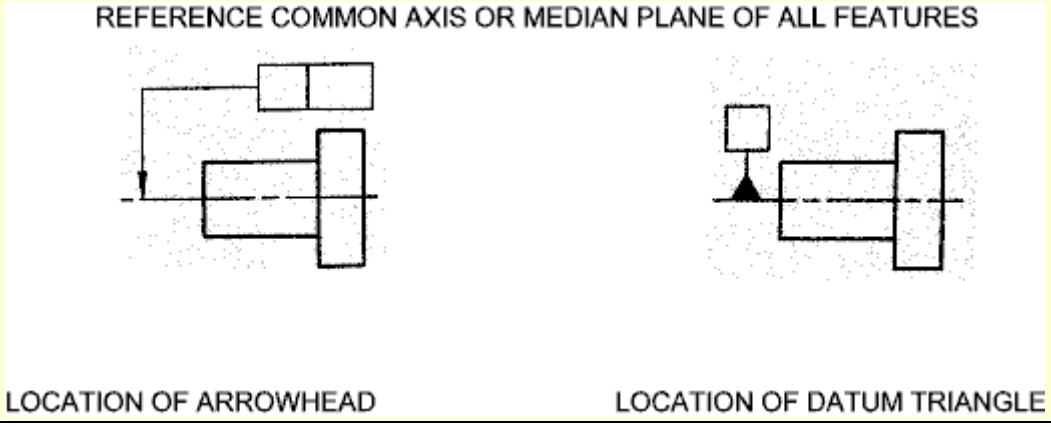


Positioning of Frames /Datum triangles

The features selected for the tolerancing frame or datums triangles are identified as shown below

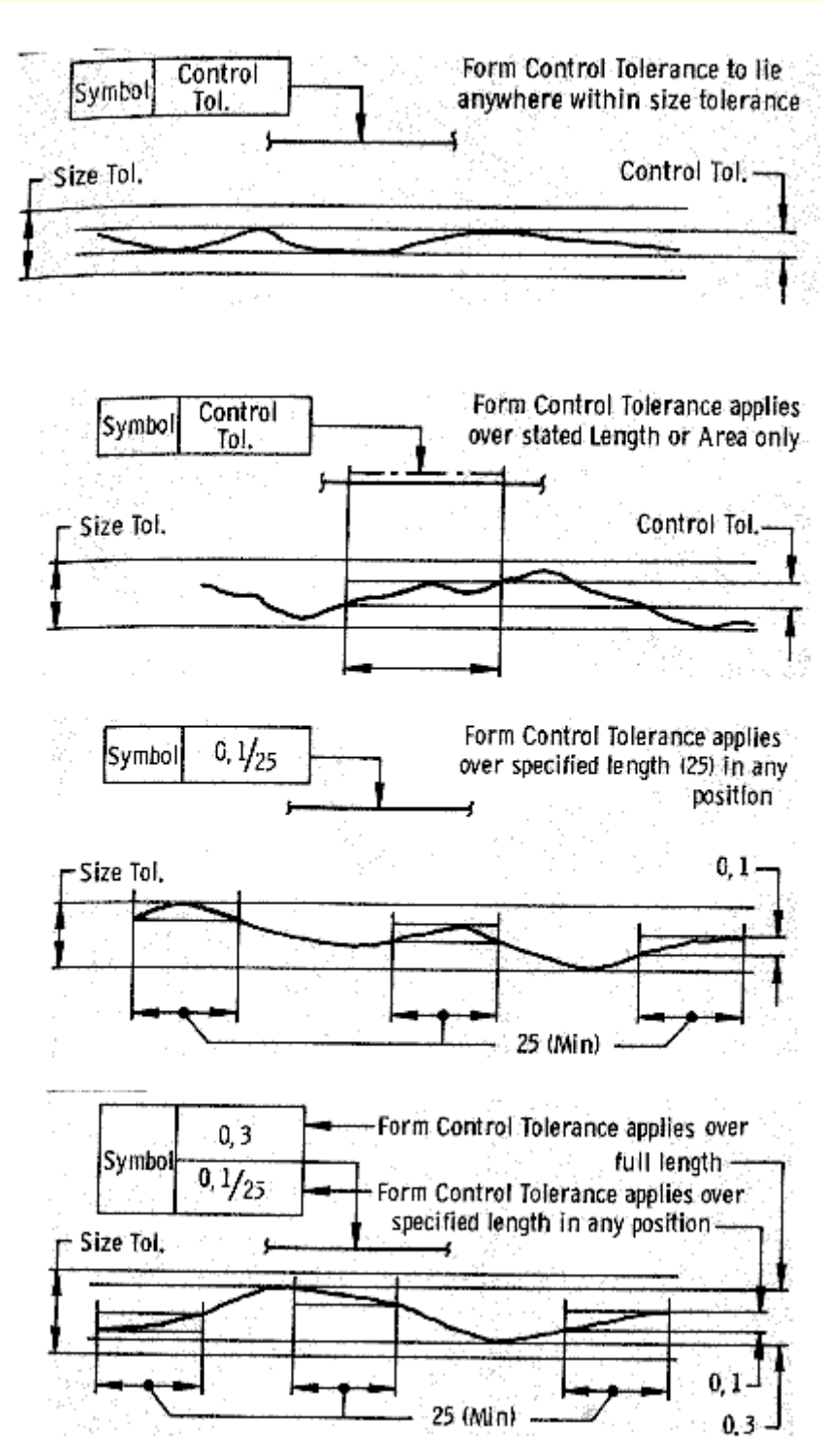




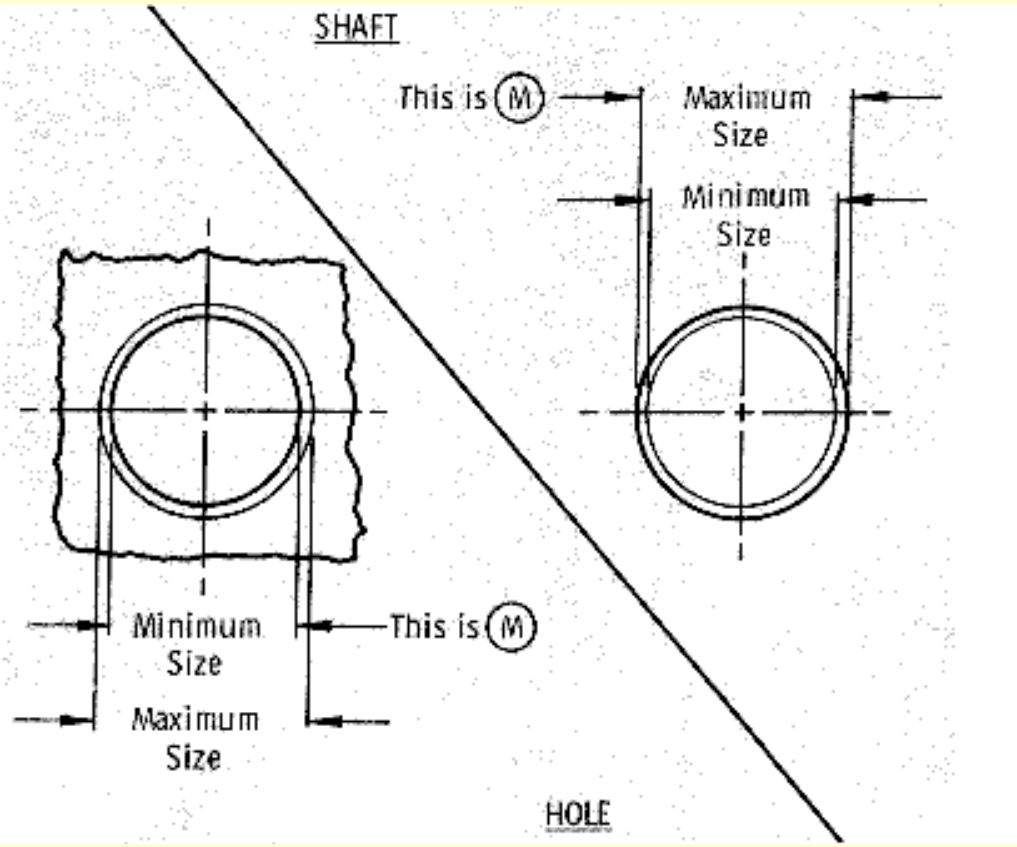


Geometrical Tolerancing Examples

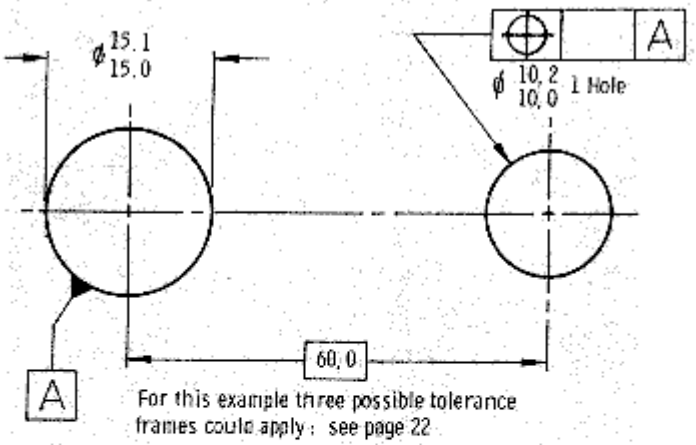
Examples of Form Control



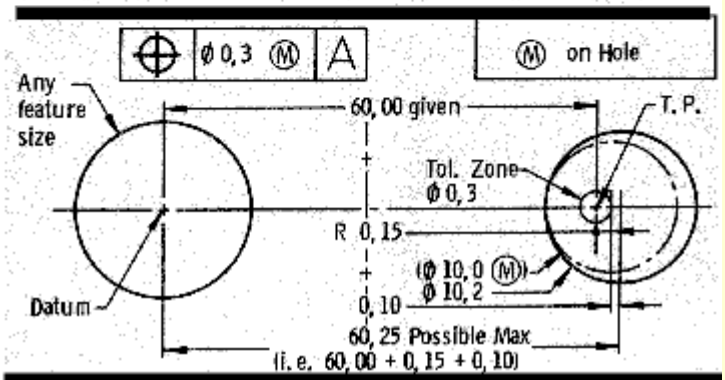
Examples of Maximum Material Condition

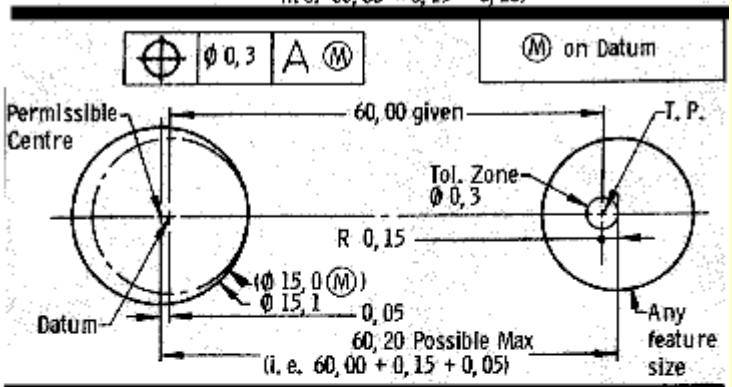


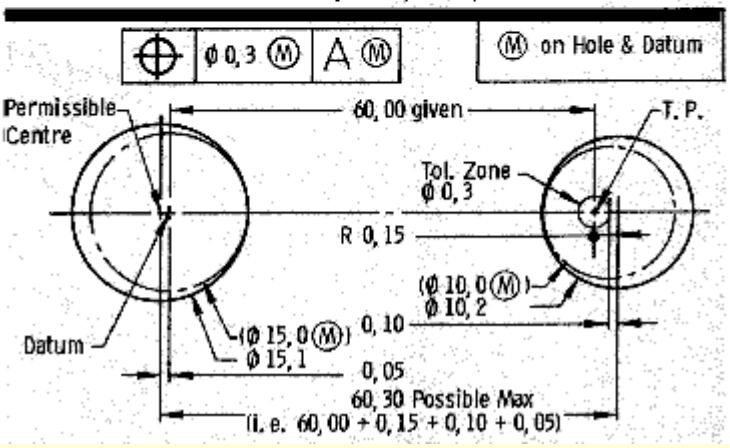
EXAMPLE - CENTRE DISTANCE OF TWO HOLES



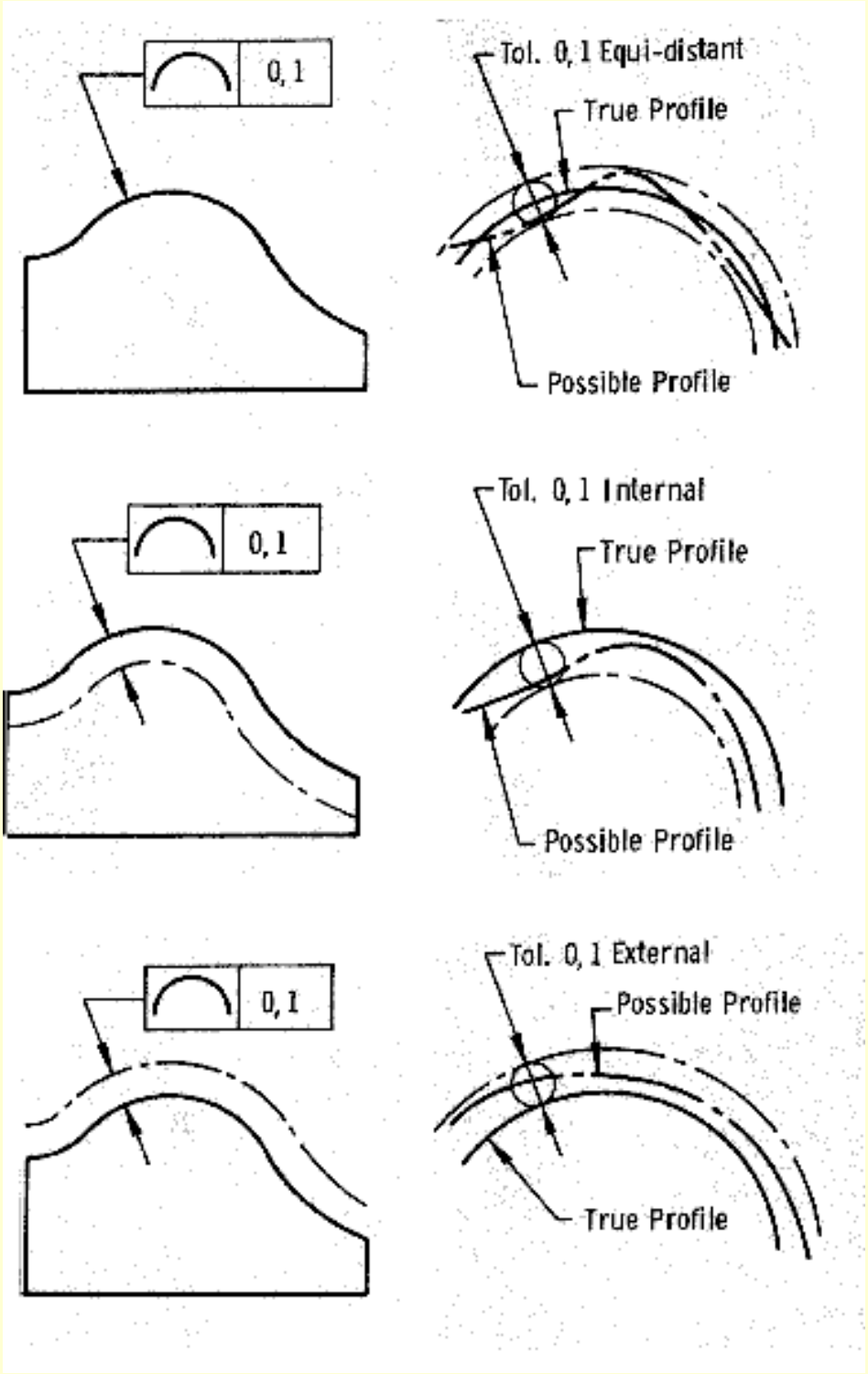
For this example three possible tolerance frames could apply : see page 22



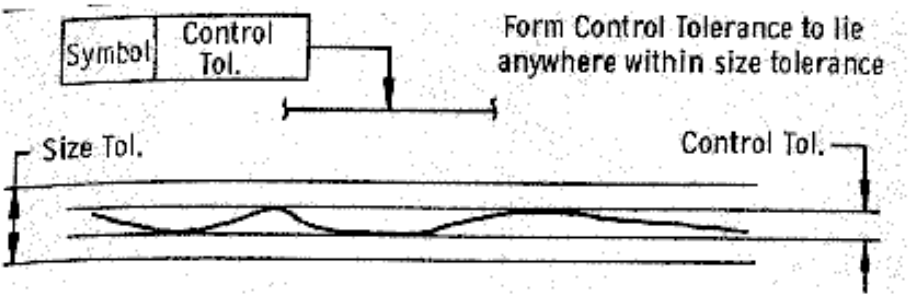


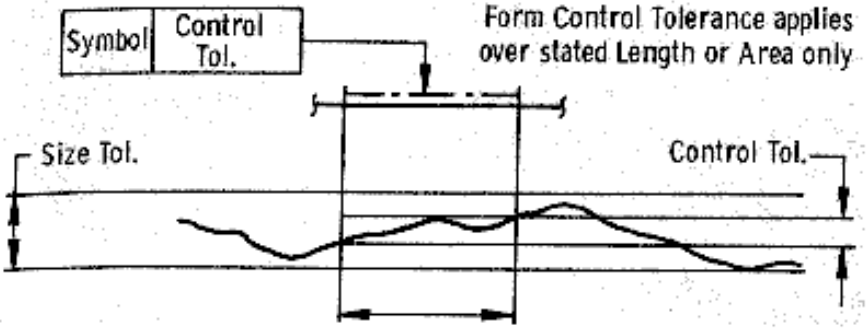


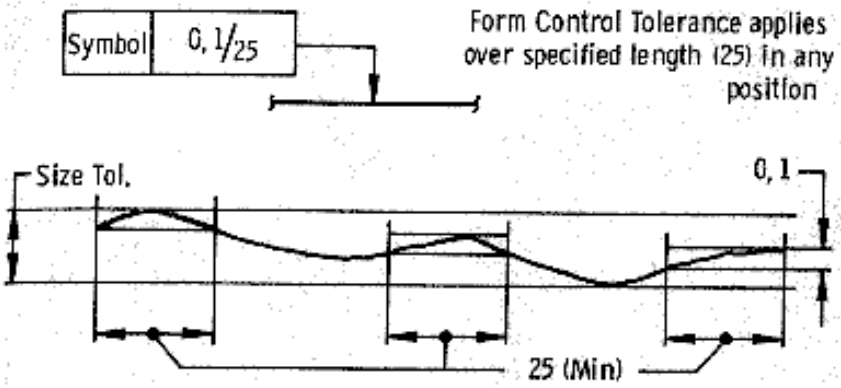
Examples of Profile Tolerancing

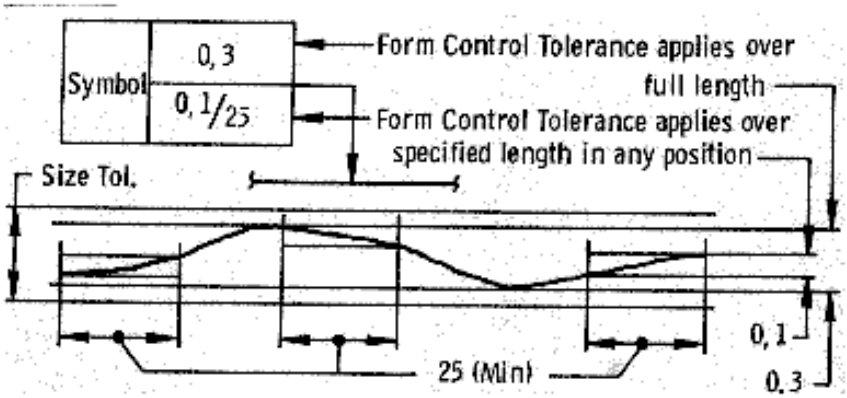


Examples of Form Control

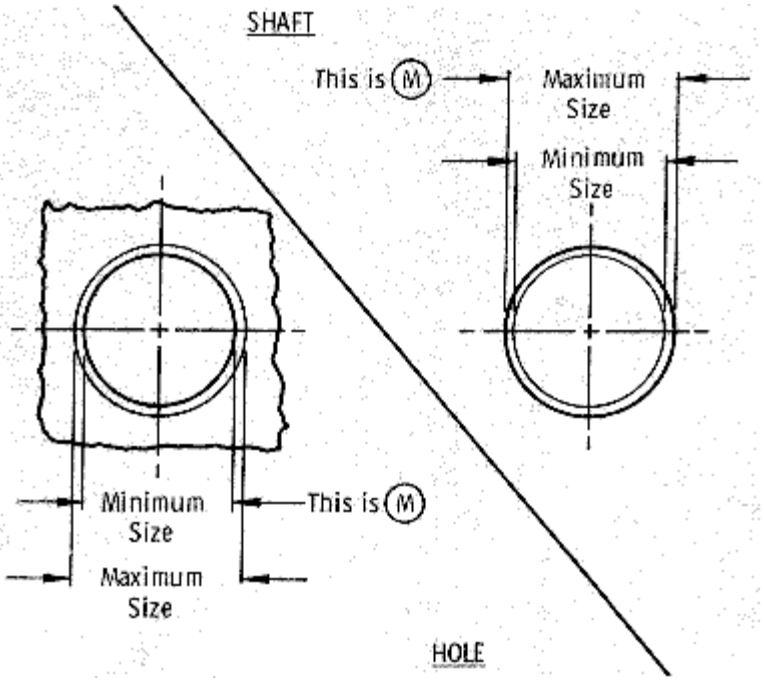




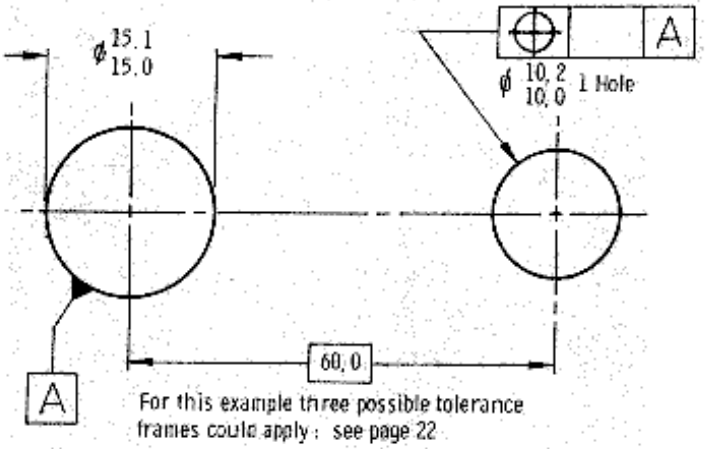




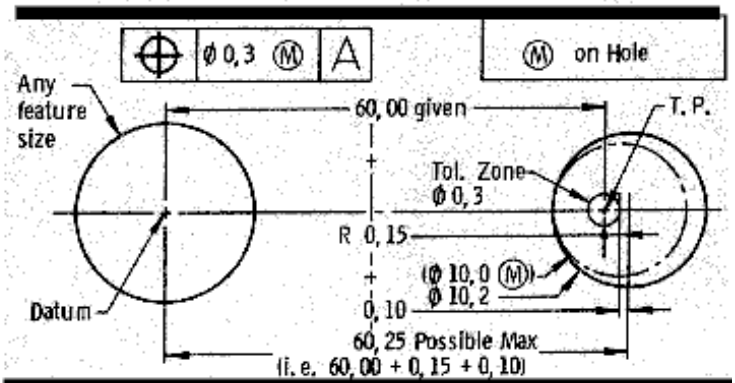
Examples of Maximum Material Condition

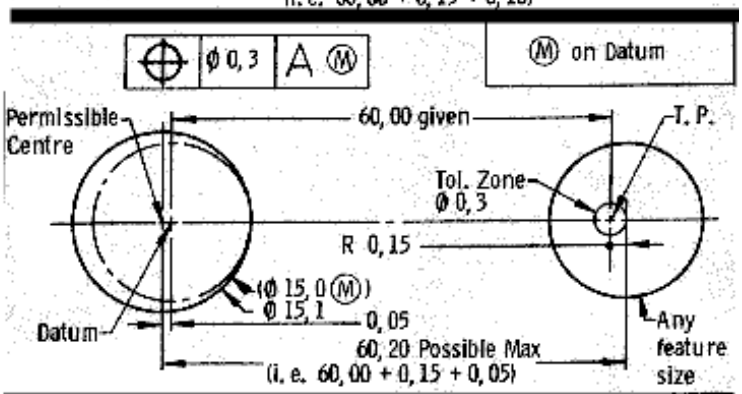


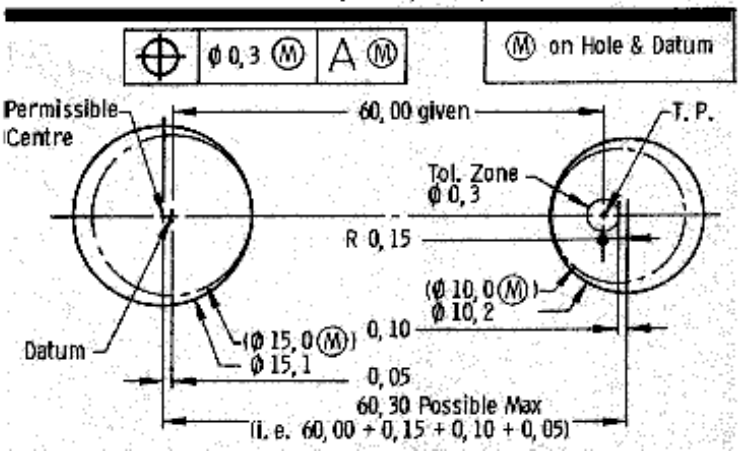
EXAMPLE - CENTRE DISTANCE OF TWO HOLES



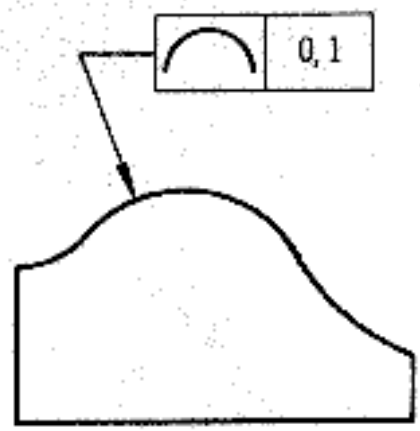
For this example three possible tolerance frames could apply : see page 22

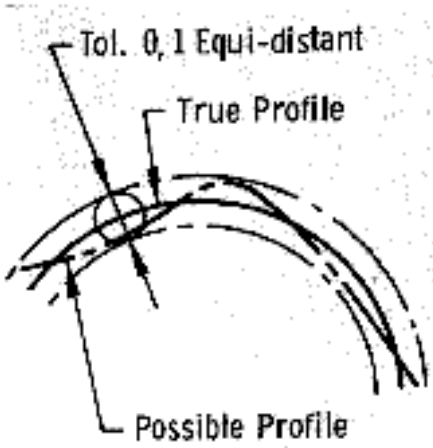


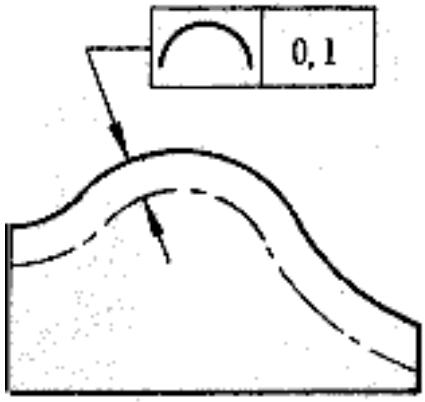


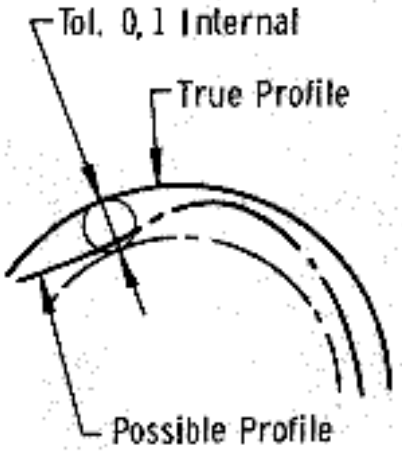


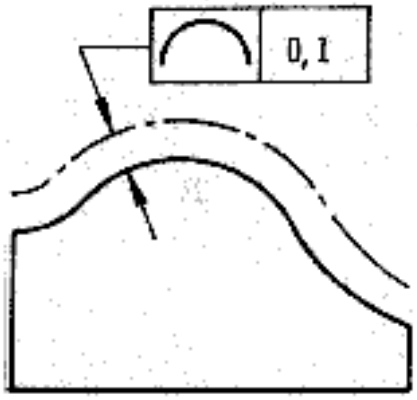
Examples of Profile Tolerancing

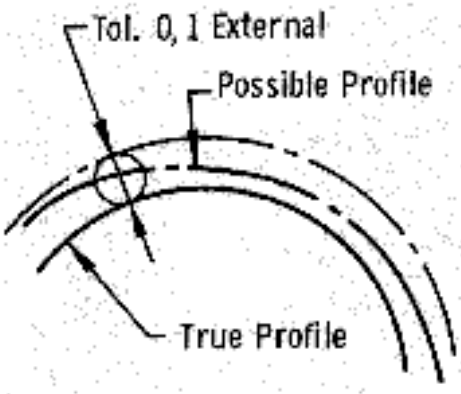




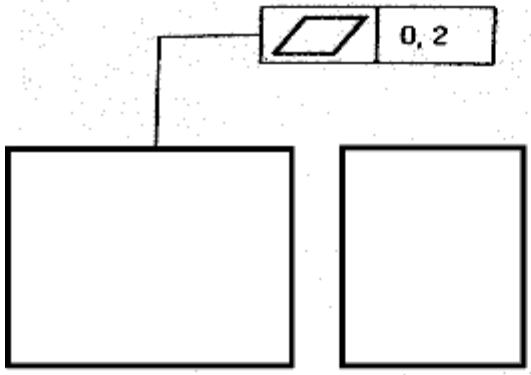


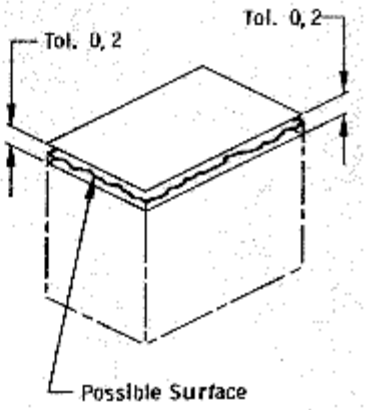


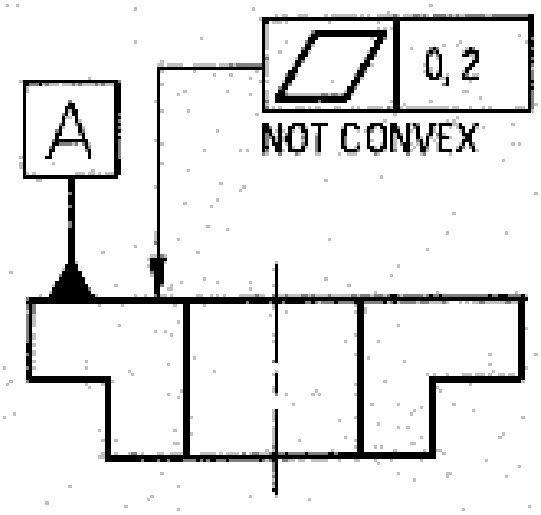


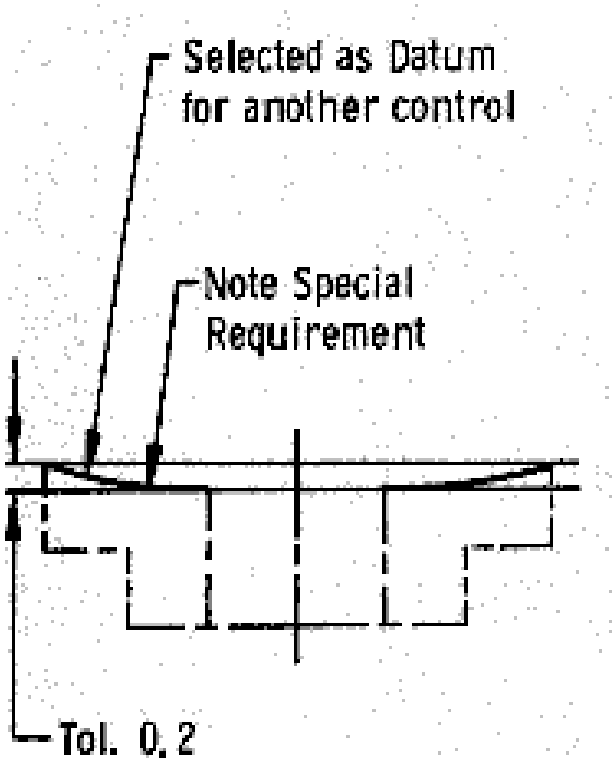


Flatness

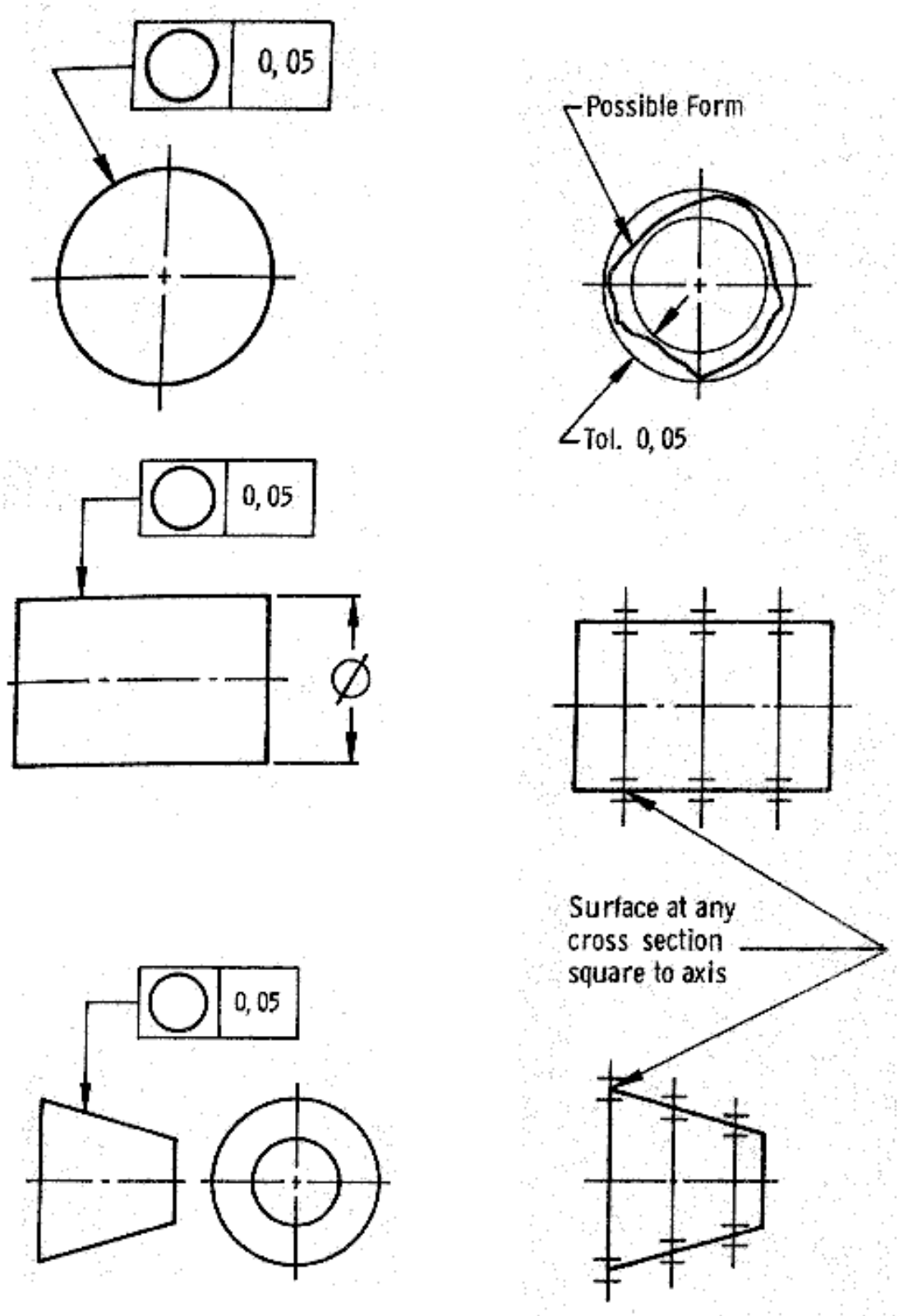

0, 2


Tol. 0, 2
Tol. 0, 2
Possible Surface

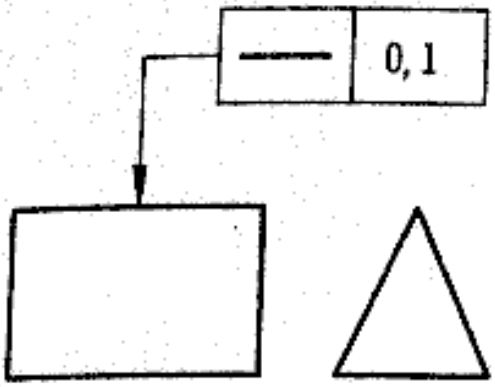

A
0, 2
NOT CONVEX

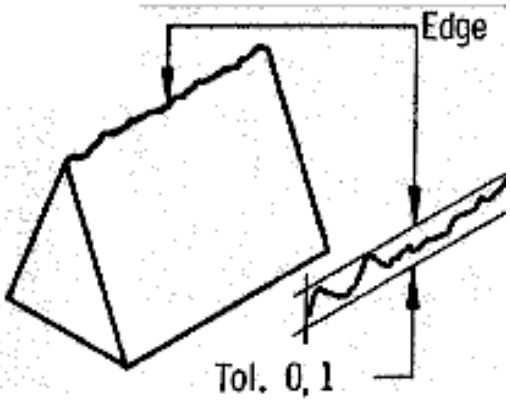

Selected as Datum
for another control
Note Special
Requirement
Tol. 0, 2

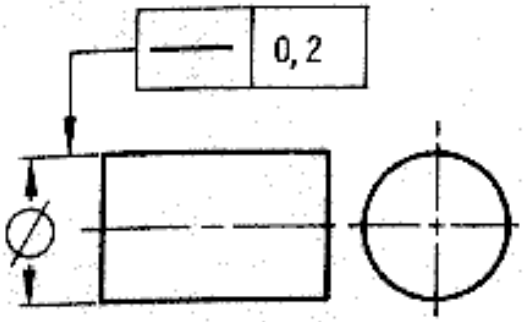
Roundness

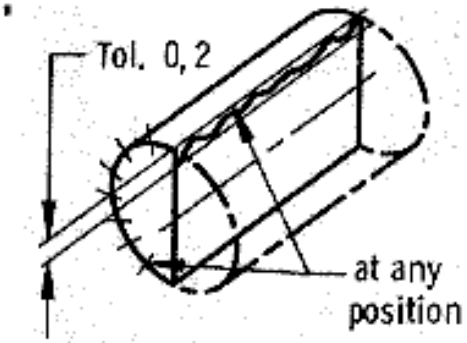

0, 05
Possible Form
Tol. 0, 05
0, 05
∅
0, 05
Surface at any
cross section
square to axis

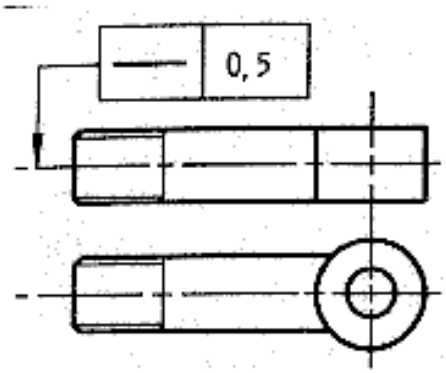
Straightness

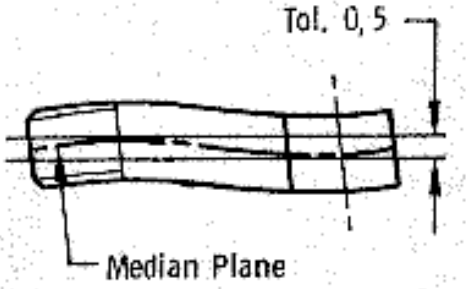


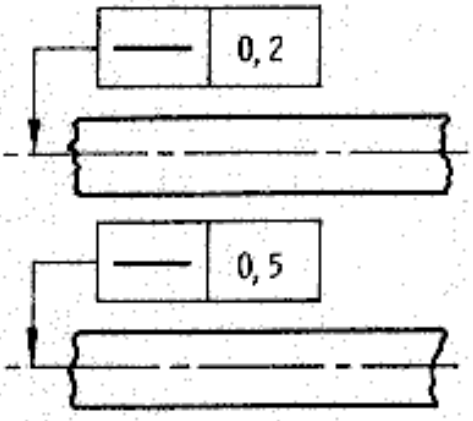


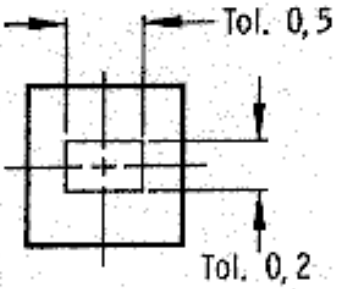


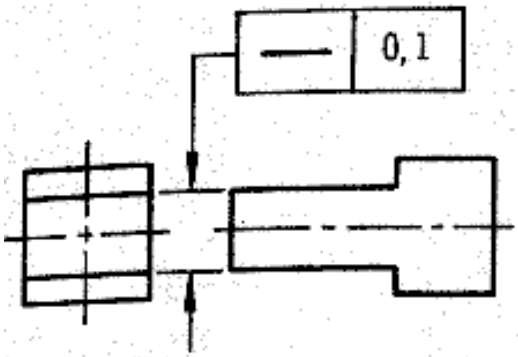


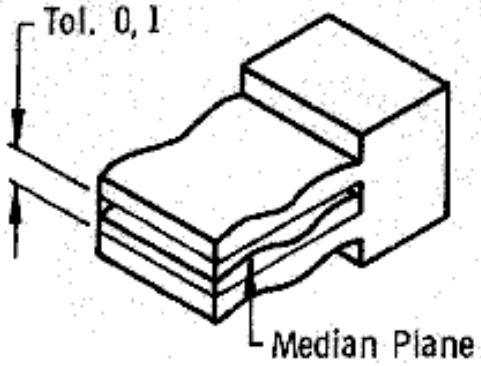


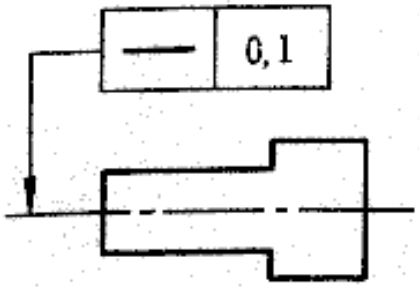


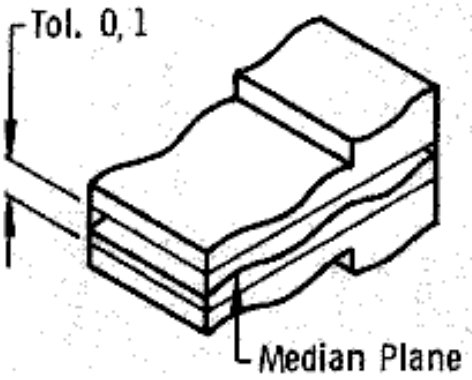


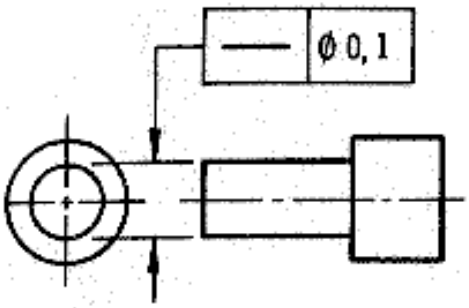


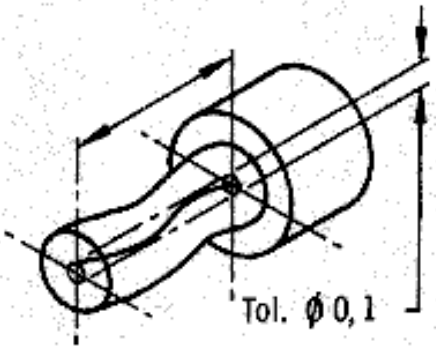

0, 1

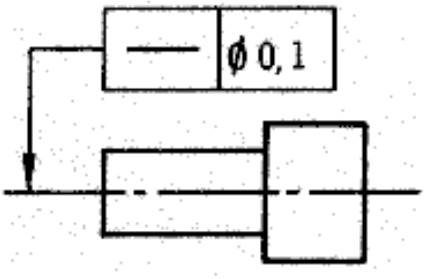

Tol. 0, 1
Median Plane

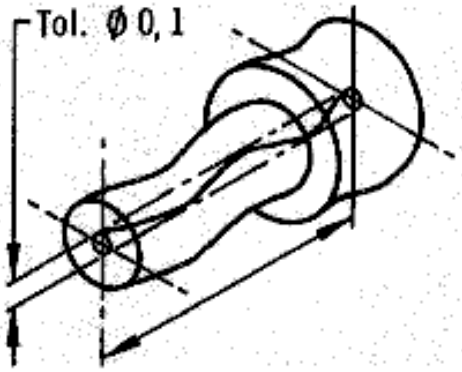

0, 1


Tol. 0, 1
Median Plane

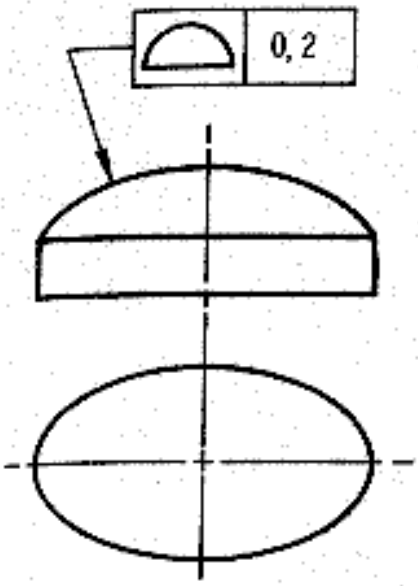

ϕ 0, 1

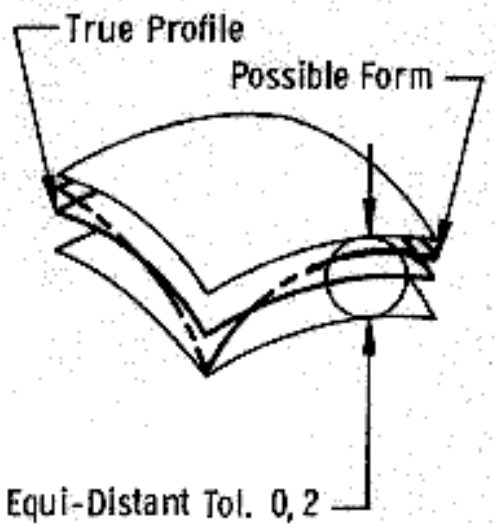

Tol. ϕ 0, 1

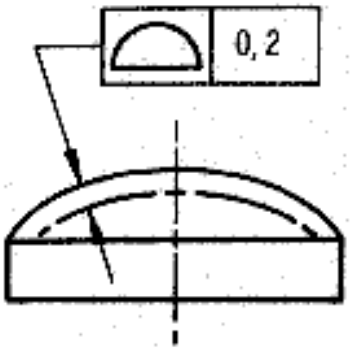

ϕ 0, 1

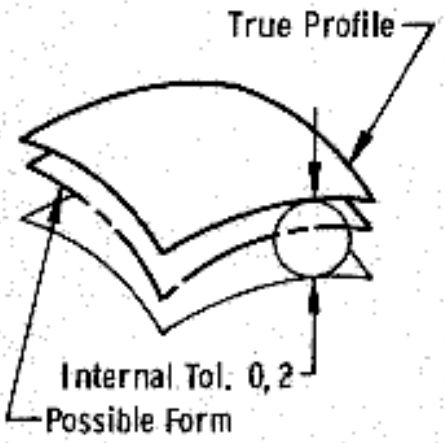

Tol. ϕ 0, 1

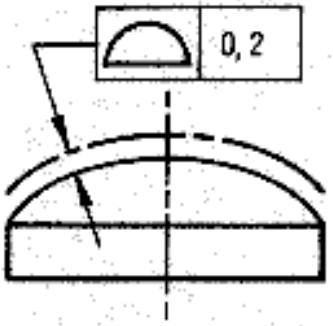
Form

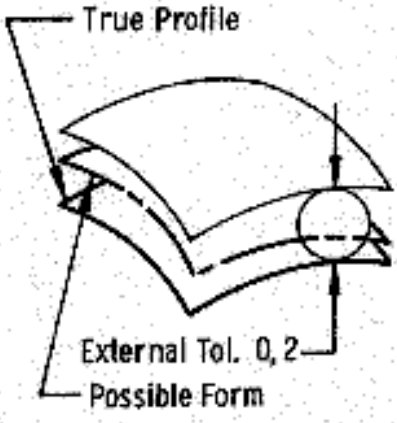

0, 2


True Profile
Possible Form
Equi-Distant Tol. 0, 2

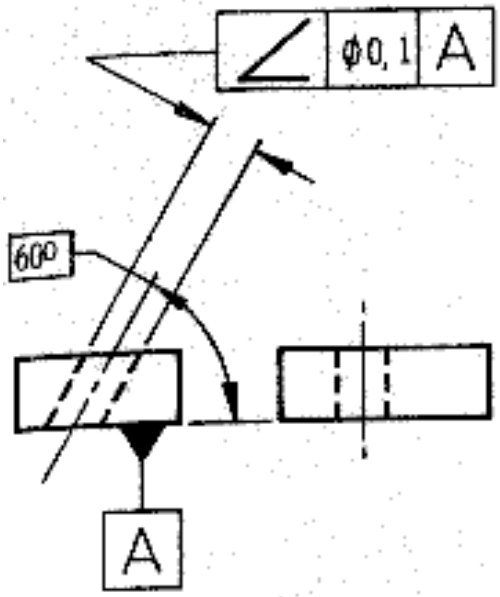

0, 2

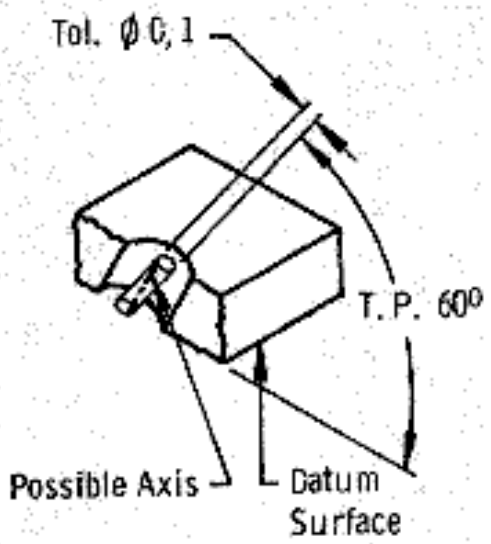

True Profile
Internal Tol. 0, 2
Possible Form

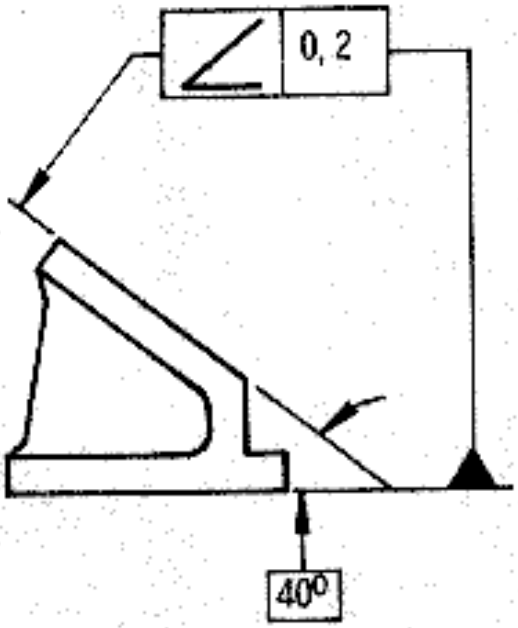

0, 2

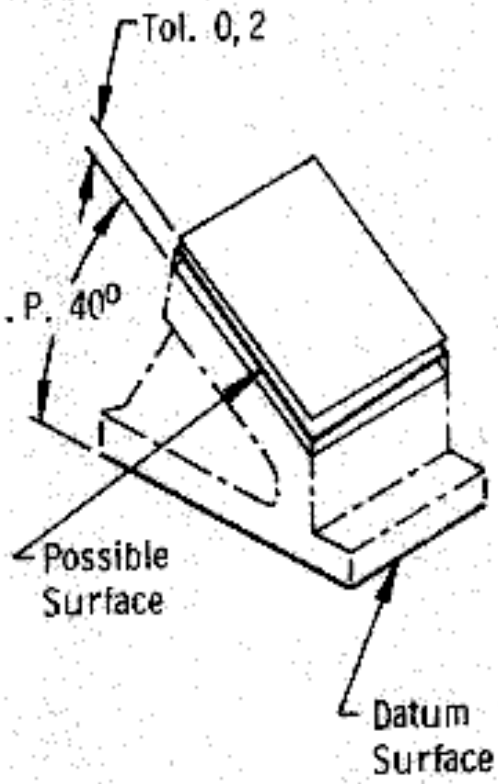

True Profile
External Tol. 0, 2
Possible Form

Angularity

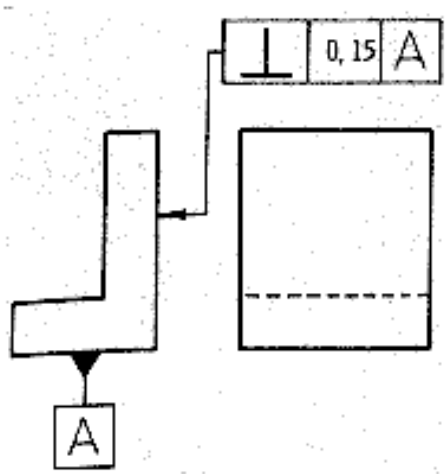

⌀0,1
A
60°
A

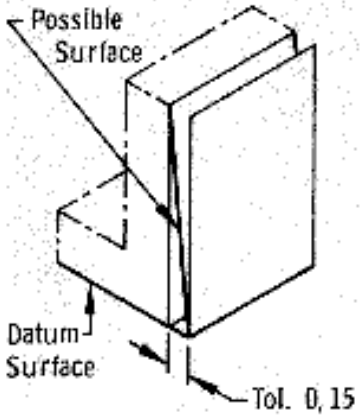

Tol. ⌀0,1
T.P. 60°
Possible Axis
Datum Surface

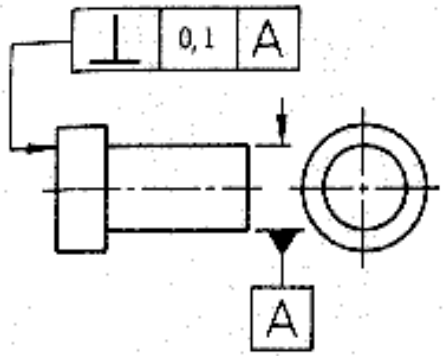

0,2
40°

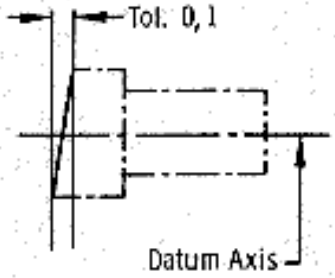

Tol. 0,2
T.P. 40°
Possible Surface
Datum Surface

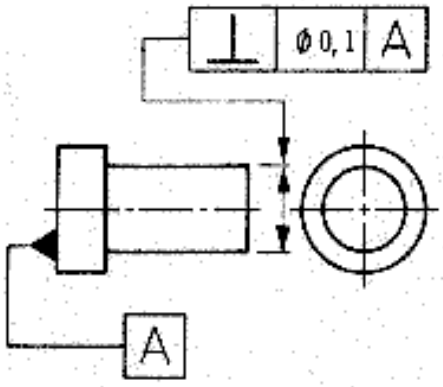
Squareness

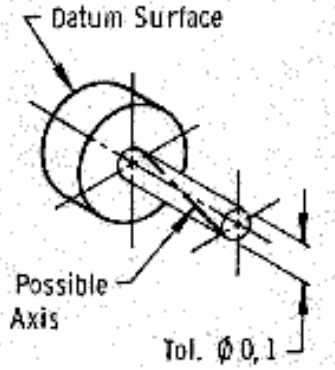

0, 15 A
A

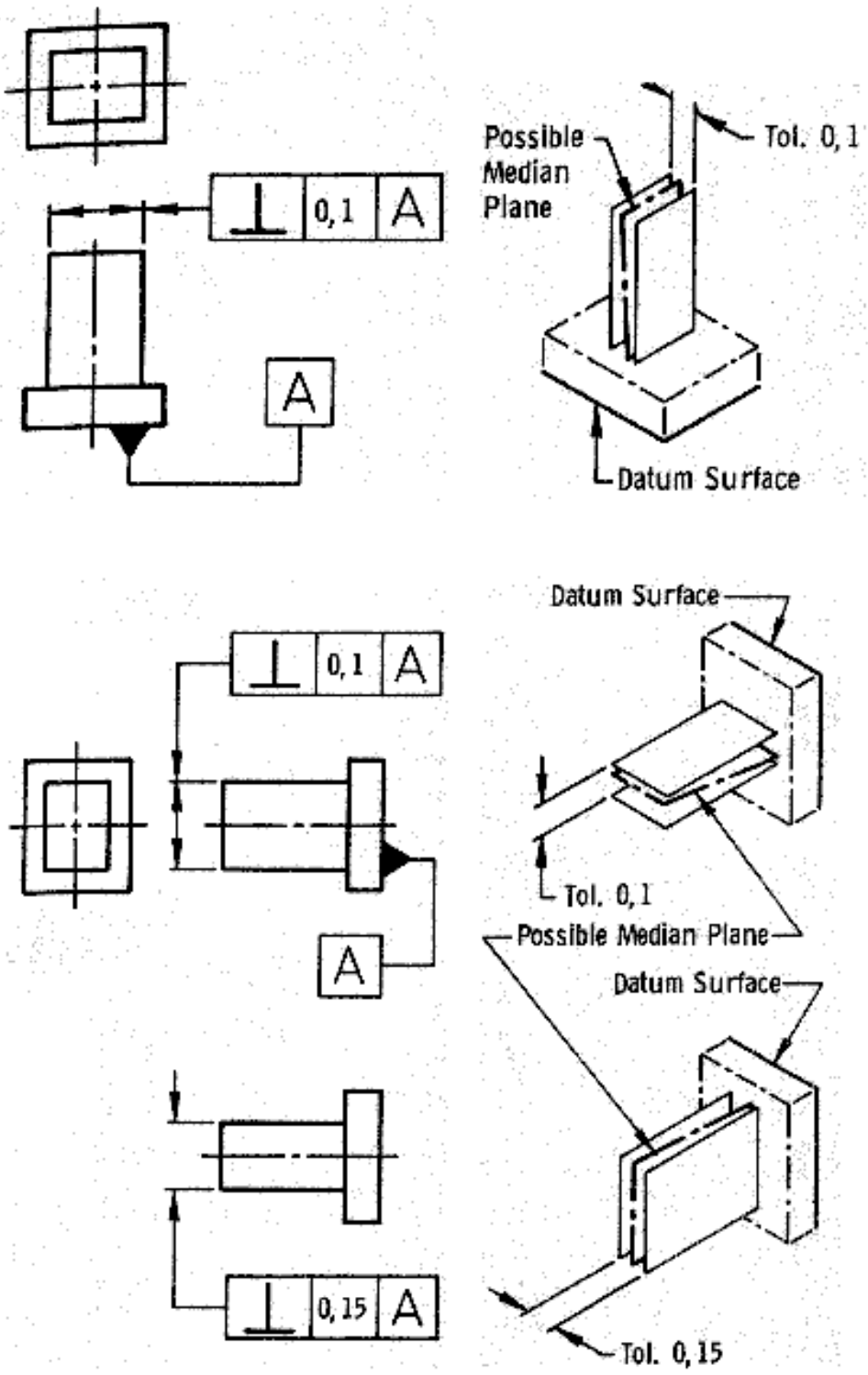

Possible Surface
Datum Surface
Tol. 0, 15


0, 1 A
A

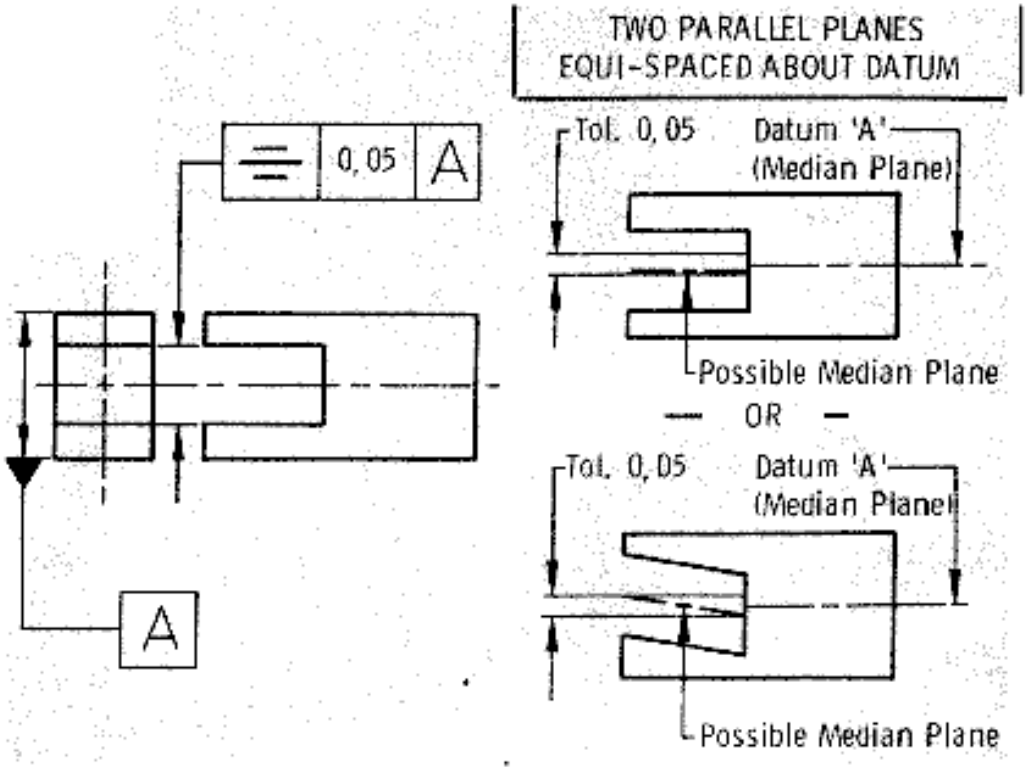

Tol. 0, 1
Datum Axis

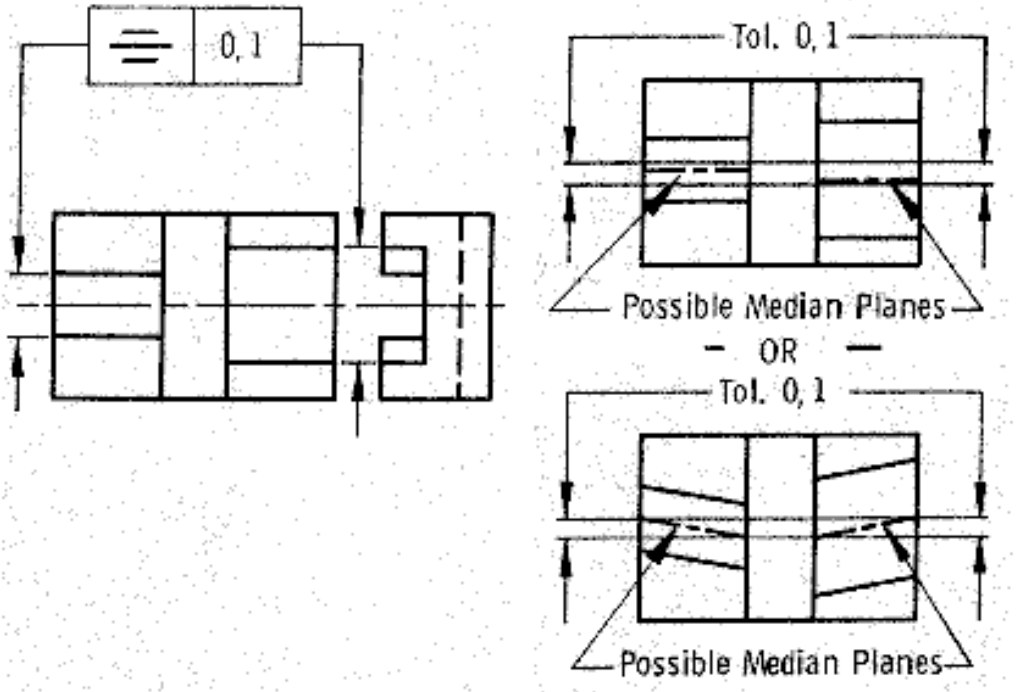

Ø 0, 1 A
A


Datum Surface
Possible Axis
Tol. Ø 0, 1

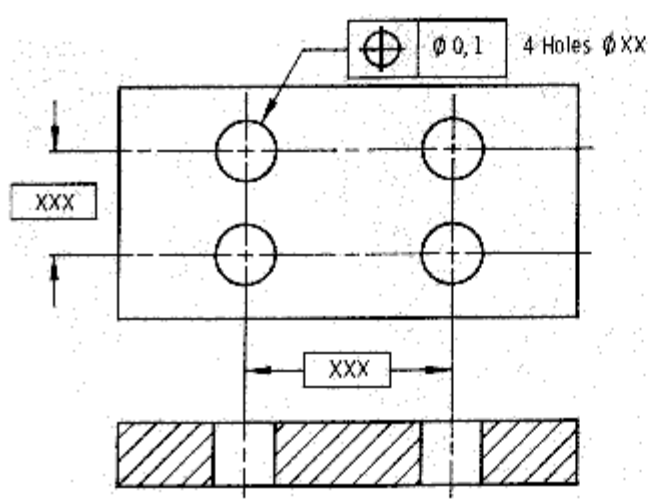

⊥ 0,1 A
A
Possible Median Plane
Tol. 0,1
Datum Surface
⊥ 0,1 A
A
Datum Surface
Tol. 0,1
Possible Median Plane
Datum Surface
⊥ 0,15 A
Tol. 0,15

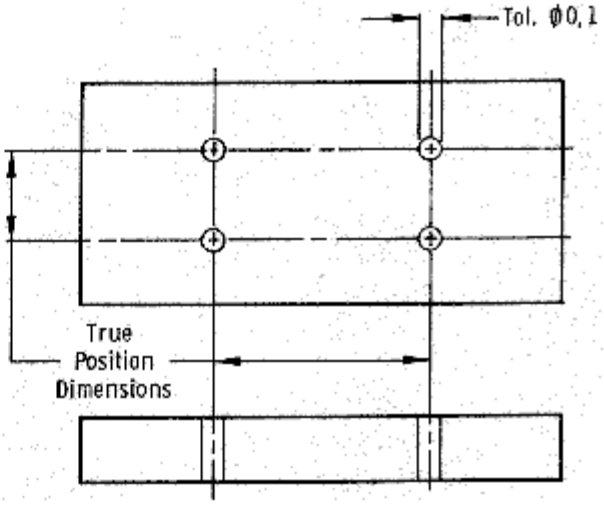
Symmetry

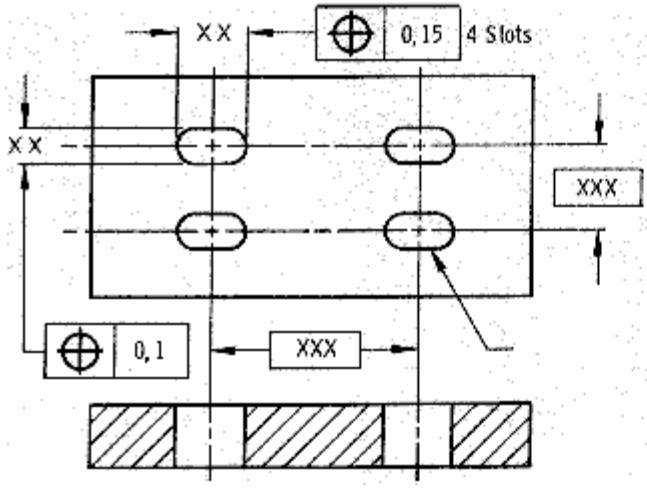

TWO PARALLEL PLANES
EQUI-SPACED ABOUT DATUM
0, 05
A
A
Tol. 0, 05
Datum 'A'
(Median Plane)
Possible Median Plane
— OR —
Tol. 0, 05
Datum 'A'
(Median Plane)
Possible Median Plane

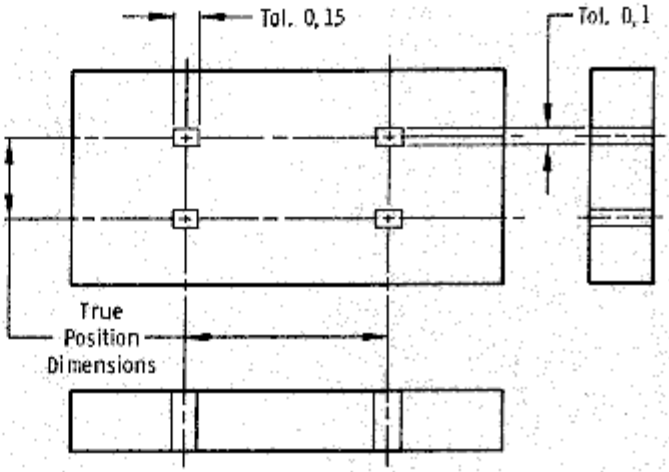

0, 1
Tol. 0, 1
Possible Median Planes
— OR —
Tol. 0, 1
Possible Median Planes

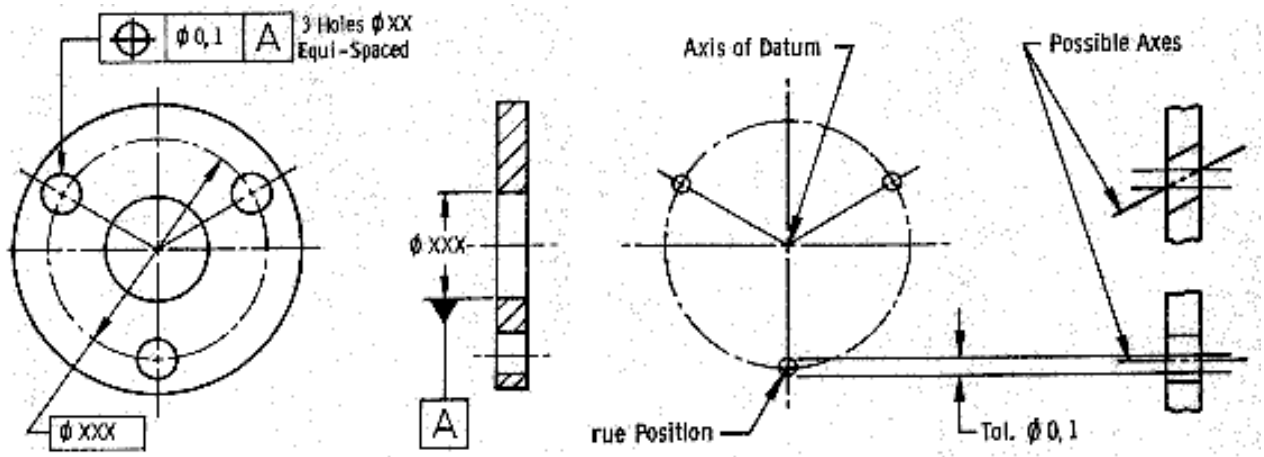
Examples of position

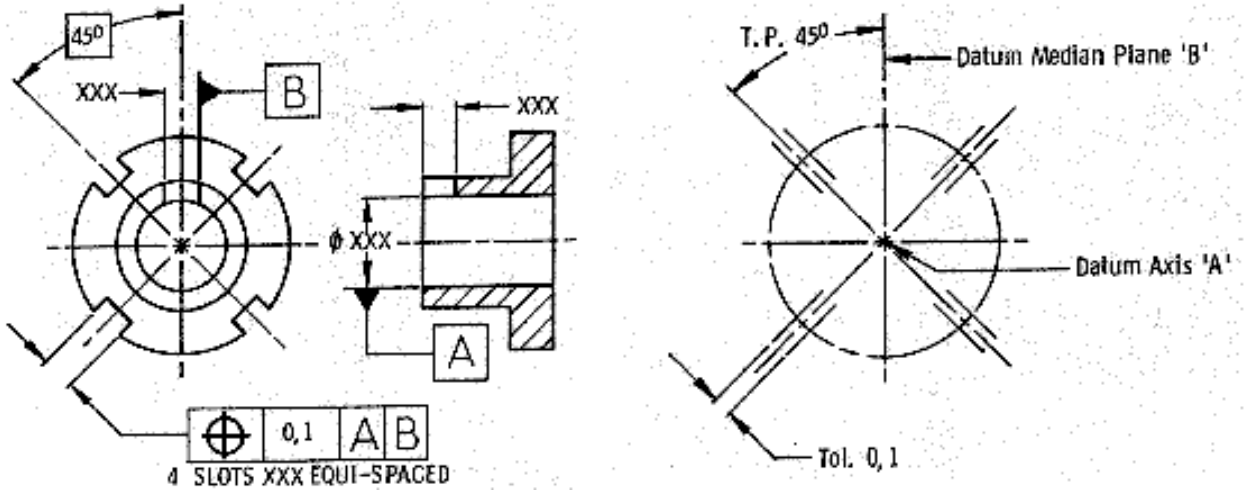




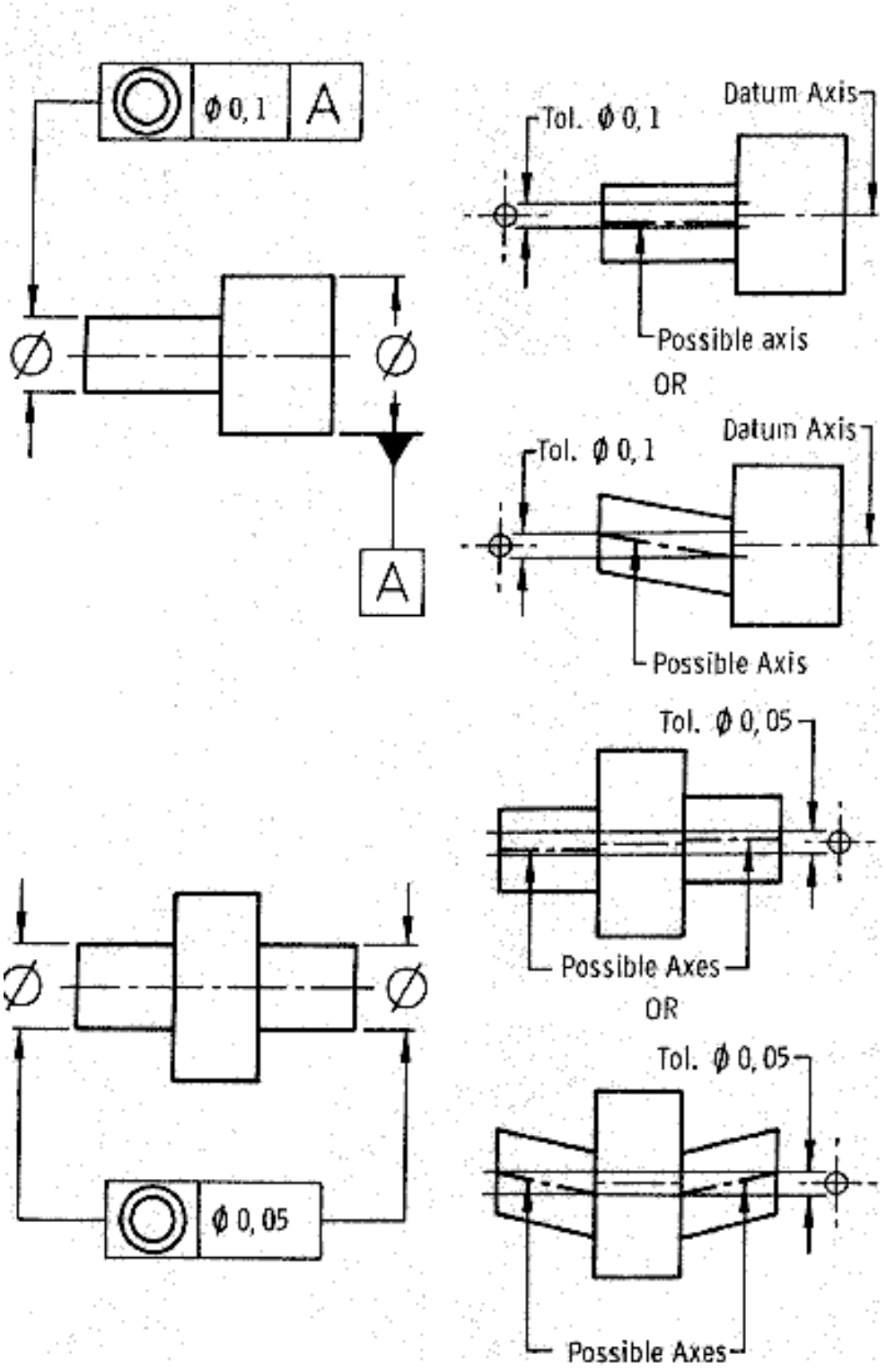


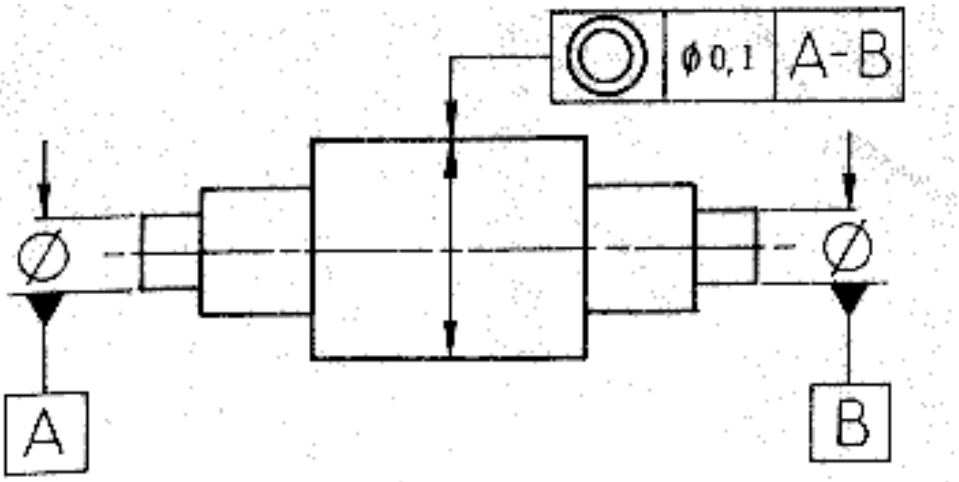



⌖ ϕ 0,1 A
3 Holes ϕ XX
Equi-Spaced
ϕ XXX
ϕ XXX
A
Axis of Datum
Possible Axes
rue Position
Tol. ϕ 0,1


45°
XXX
B
XXX
ϕ XXX
A
⌖ 0,1 A B
4 SLOTS XXX EQUI-SPACED
T.P. 45°
Datum Median Plane 'B'
Datum Axis 'A'
Tol. 0,1

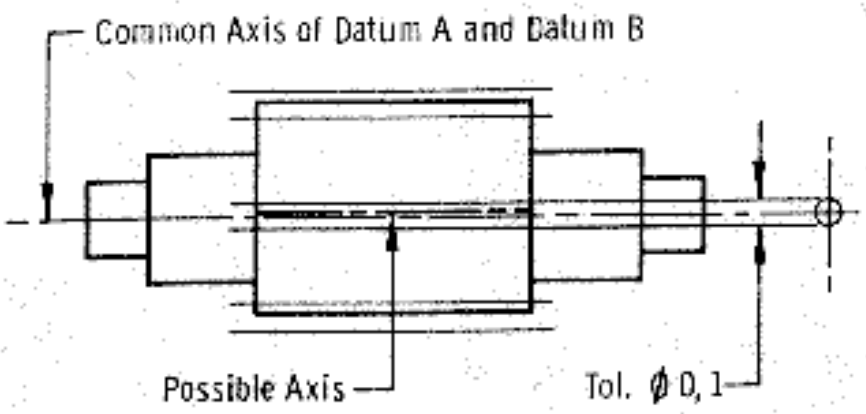
Examples of Concentricity



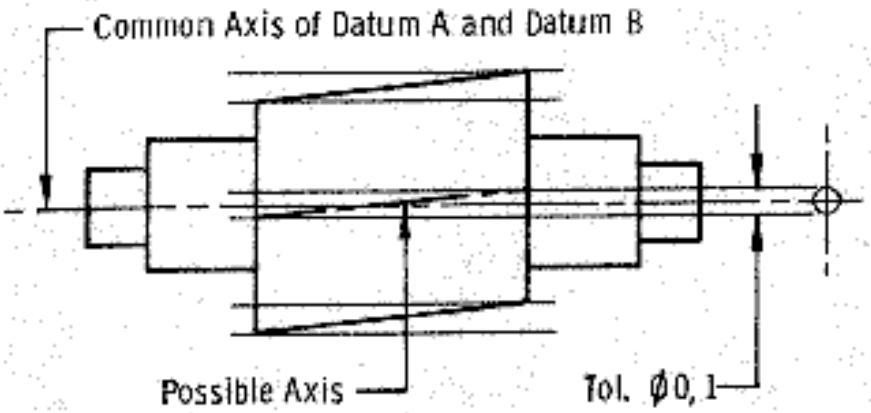


INTERPRETATION

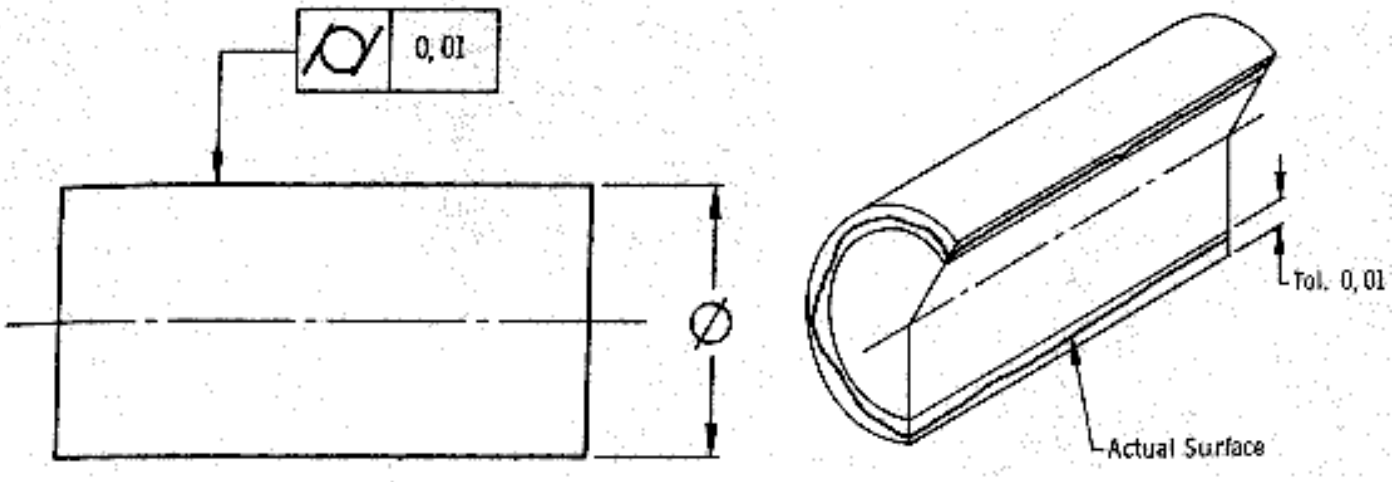
CYLINDER ON DATUM AXIS



OR



Examples of Cylindricity



Examples of Runout