S-606

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COMPILED BY	TITLE: DRAWING SPECIFICATION ON DIMENSIONS	JOB
APPROVED		

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1. GENERAL:

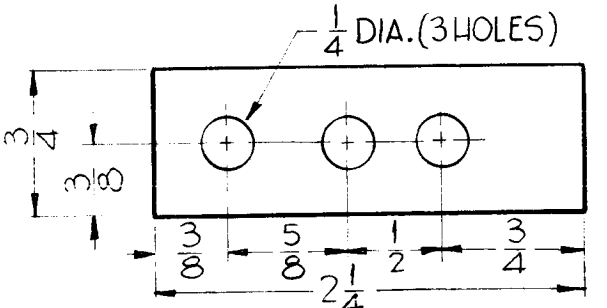
After the shape of an object has been described by orthographic views, the value of the drawing for the construction of the object depends upon dimensions and notes that describe pertinent details. Before dimensioning the drawing, study the object and understand its functional requirements; then put yourself in the place of the Die Maker, Machinist, etc., and mentally construct the object to discover which dimensions would best give the information.

DIMENSIONS

2. SUPERFLUOUS DIMENSIONS:

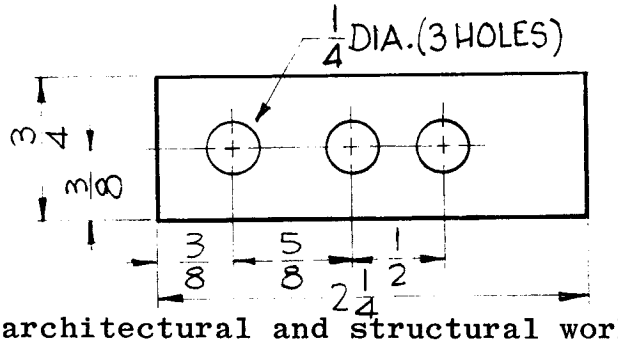
Duplicate or unnecessary dimensions are to be avoided because they may cause confusion and delay. When a drawing is changed or revised, a duplicate dimension may not be noticed and changed along with its counterpart; hence a distance will have two different values, one incorrect. An unnecessary dimension is any dimension, other than a duplicate, that is not essential in making the piece. Because of the allowable variation permitted the manufacturer on each dimension, difficulties will be encountered if unnecessary dimensions occur when parts are to be interchangeable. Actually, if the proper dimensions have been selected, it will be possible to establish a point on the object in any given direction with only one dimension.

Unnecessary dimensions always occur when all the individual dimensions are given, in addition to the over-all dimension (Fig. A).



(FIG A)

One dimension of the series must be omitted if the over-all dimension is used, thus allowing only one possible positioning from each dimension (Fig. B).

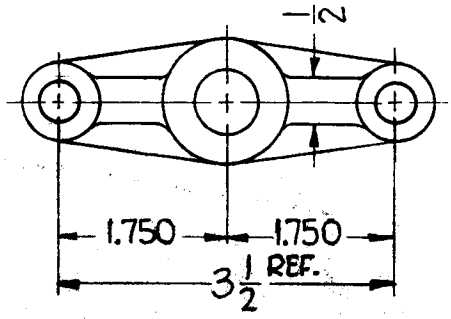


(FIG B)

In architectural and structural work, where the interchangeability of parts is usually irrelevant, unnecessary dimensions cause no difficulty and all dimensions are given.

Although it is important not to "over-dimension" a part, it is equally important to give all the dimensions that are needed to locate every point, line, or surface of the object. Every dimension that the workman will require in making the part must be given.

Dimensions for similar features, such as the thickn ss of several ribs obviously of the same size, need not be repeated (Fig. C).



(FIG C)

Also, such details as the size of fillets and round can be provided for with a general note. *Any superfluous or omitted dimensions can be easily discovered by mentally going through the manufacture, or even the drawing, of the part, checking each dimension as it is needed.

3. REFERENCE DIMENSIONS:

Occasionally it is useful, for reference and checking purposes, to give all dimensions in a series as well as the over-all dimension. In such cases one dimension is marked with the abbreviation "REF" as shown in Fig. C. According to ASA definition, a reference dimension is "a dimension without tolerence, used for information purposes only, and do s not gov rn machining or insp c-tion op rations".

*Ref: Specification on notes (Sheet 25)

4. FEET AND INCHES:

Where feet and inches are used, the ASA recommends that dimensions up to and including 72 inches be given in inches and greater lengths in feet and inches. If no foot or inch marks appear on a drawing, the dimension values indicate inches unless a different unit of measurement is indicated by a general note.

5. PLACEMENT OF DIMENSIONS:

5.01 GENERAL RULES:

After the distances have been selected, it is possible to decide (1) the view on which the distance will be indicated, (2) the particular place on that view, and (3) the form of the dimension itself. Numerous principles, some with the force of a rule, can be given, but in all cases the important consideration is clarity.

PRINCIPLES:

1. Dimensions outside the view are preferred, unless added clearness, simplicity, and ease of reading will result from placing some of them inside. For good appearance, dimensions should be kept off the cut surfaces of sections. When it is not possible to do this, the section lining is omitted around the numbers,
2. Dimensions between the views are preferred unless there is some reason for placing them elsewhere.

3. Dimensions should be applied to one view only; that is, with dimensions between views, the extension lines should be drawn from one view, not from both views.

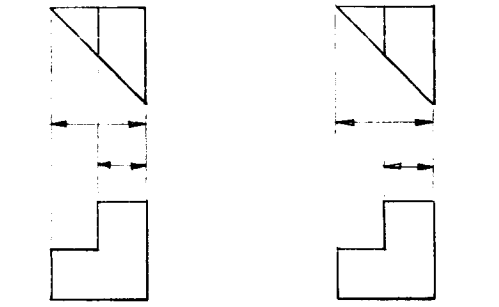


FIG: 11:32

4. Dimensions should be placed on the view that shows the distance in its true length.

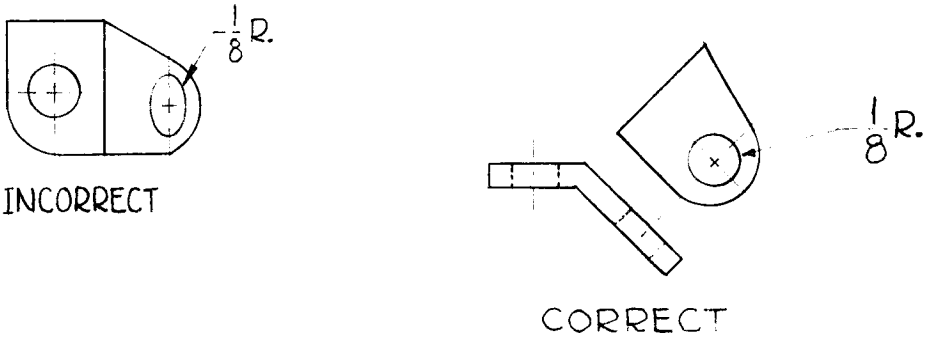


FIG: 11:33

5. Dimension lines should be spaced, in general, $\frac{1}{2}$ in. away from the outlines of the view. This applies to a single dimension or to the first dimension of several in a series.

6. Parallel dimension lines should be spaced uniformly with at least 3/8 in. between lines.

7. Values should be midway between the arrowheads, except when a center line interferes (Fig. 11.34) or when the values of several parallel dimensions are staggered (Fig. 11.35).

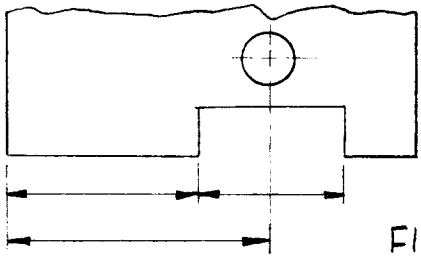


FIG. 11·34

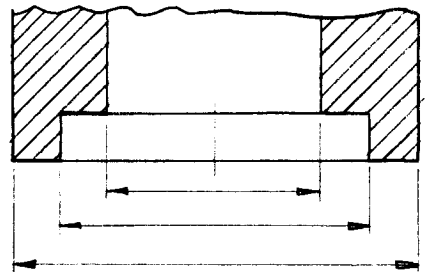
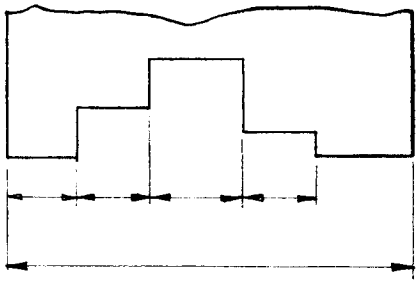


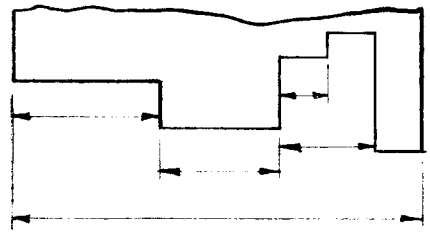
FIG. 11·35

8. Continuous or staggered dimension lines may be used, depending upon convenience and readability. Continuous dimension lines are preferred where possible (Fig. 11.36 and 11.37).



CONTINUOUS FORM

FIG 11·36



STAGGERED FORM

FIG 11.37

9. Always place a longer dimension line outside a shorter one to avoid crossing dimension lines with the extension lines of other dimensions. Thus an overall dimension (maximum size of piece in a given direction) will be outside all other dimensions.

10. Dimensions should never be crowded. If the space is small, follow one of the methods given in paragraph 5.04 (Dimensioning in limited space) sheet 12.

11. Center lines are used to indicate the symmetry of shapes, and frequently eliminate the need for a positioning dimension. They should be considered as part of the dimensioning and drawn in finished form at the time of dimensioning. They should extend about 1/8 in. beyond the shape for which they indicate symmetry, unless they are carried further to serve as extension lines. Center lines should not be continued between views.

12. All notes must read horizontally (from the bottom of the drawing).

CAUTION

1. Never use a center line, a line of a view, or an extension line as a dimension line.

2. Never place a dimension line on a center line or place a dimension line where a center line should properly be.

3. Never allow a line of any kind to pass through a dimension figure.

4. Never allow the crossing of two dimension lines or an extension line and a dimension line.

5. Avoid dimensioning to dashed lines if possible.

5.02 CONTOUR PRINCIPLE:

One of the views of an object will usually describe the shape of some detailed feature better than another view or views, and the feature is then said to be"characteristic" in that particular view. In reading a drawing, it is natural to look for the dimensions of a given feature wherever that feature appears most characteristic, and an advantage in clarity and in ease of reading will certainly result if the dimensions is placed there. In Fig.11.29 the rounded corner, the drilled hole, and the lower notched corner are all characteristic in, and dimensioned on, the front view. The projecting shape on the front of the object is more characteristic in the top view and is dimensioned there.

Dimensions for prisms should be placed so that two of the three dimensions are on the view showing the contour shape and the third on one of the other views (Fig. 11.18 and 11.29).

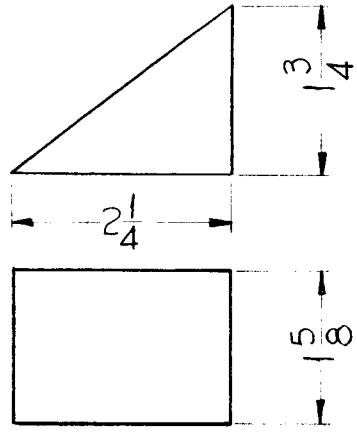


FIG. 11.18 PRISM

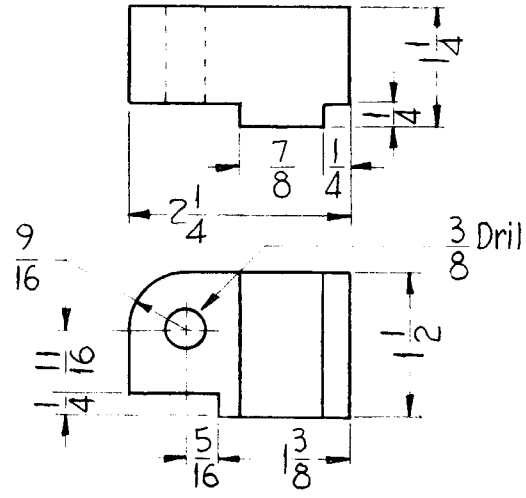


FIG. 11.29 THE CONTOUR PRINCIPAL

5.03 CYLINDERS

Dimensions for cylinders, the diameter and length, are usually best placed on the noncircular view (Fig. 11.30A). This practice keeps the dimensions on one view, a convenience for the workman. Occasionally a cylindrical hole is dimensioned with the diameter at an angle on the circular view, as indicated at (B). This practice should never be used unless there is a clear space for the dimension value. In some cases, however, the value can be carried outside the view, as at (C). When a round hole is specified by a note as at (D), the leader should point to the circular view if possible. The note has an advantage in that the diameter, operation, and depth can all be given together. Giving the diameter on the circular view as at (B), (C) and (D) may make for ease of reading, as the dimensions of position will probably be given there also, as indicated at (D). When it is not ovbious from the drawing, a dimension may be indicated as a diameter by following the value with the letter D, as shown in Fig. 11.31.

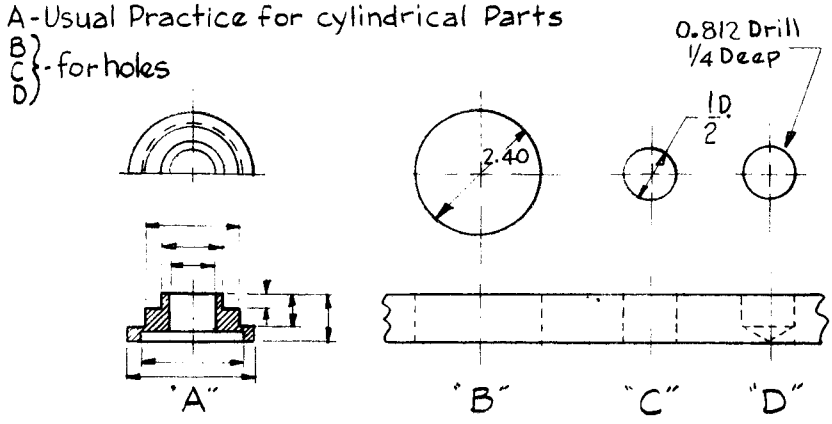


FIG. 11.30 DIMENSIONS FOR CYLINDERS

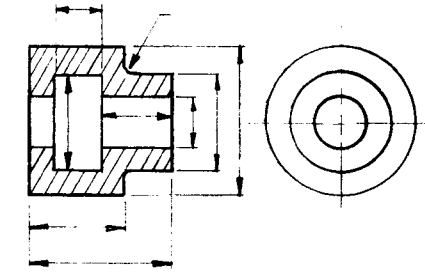
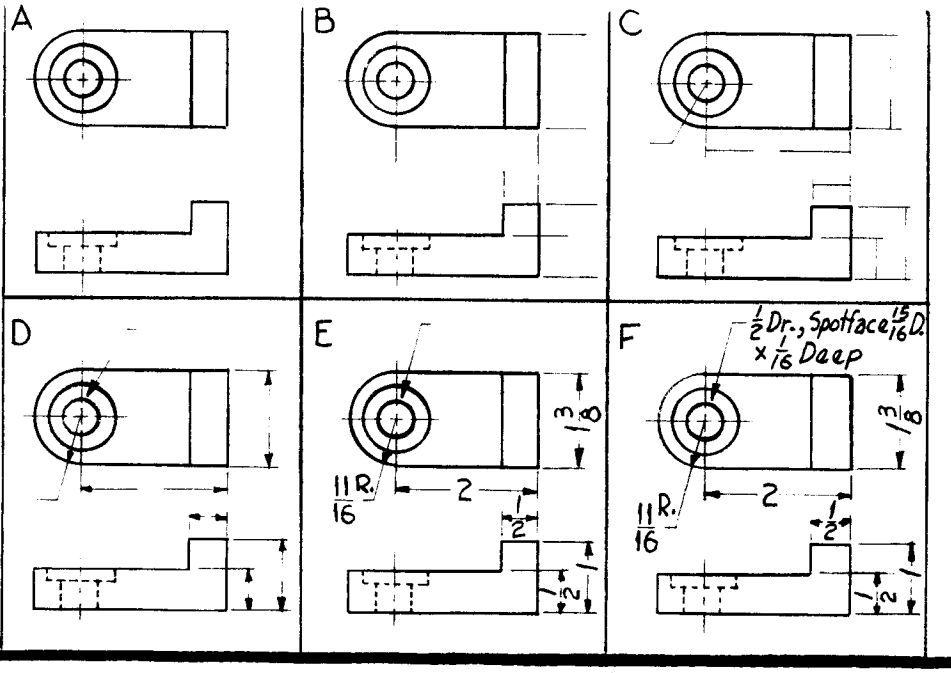


FIG. 11.31
DIMENSIONS INSIDE THE VIEW

5.05 ORDER OF DIMENSIONING:

A systematic order of dimensioning is a great help. Fig. 11.40 illustrates the procedure. First complete the shape description (A). Then place the extension lines and extend the center lines where necessary (B), thus planning for the location of both size and position dimensions; study the placement of each dimension and make alterations if desirable or necessary. Add the dimension lines (C). Draw arrowheads and leaders for notes (D). Then add values and letter notes (E and F). It is desirable to add the notes after the dimensions have been placed. If the notes are placed first, they may occupy a space needed for a dimension. Because of the freedom allowed in the use of leaders, notes may be given in almost any available space.

Fig. 1140--ORDER OF DIMENSIONING



5.04 DIMENSIONING IN LIMITED SPACE:

Dimensions should never be crowded into a space too small to contain them. One of the methods in Fig.11.38 can be used where space is limited. Sometimes a note is appropriate. If the space is small and crowded, an enlarged removed section or part view can be used (Fig. 11.39).

Fig. 11.38--DIMENSIONS IN LIMITED SPACE

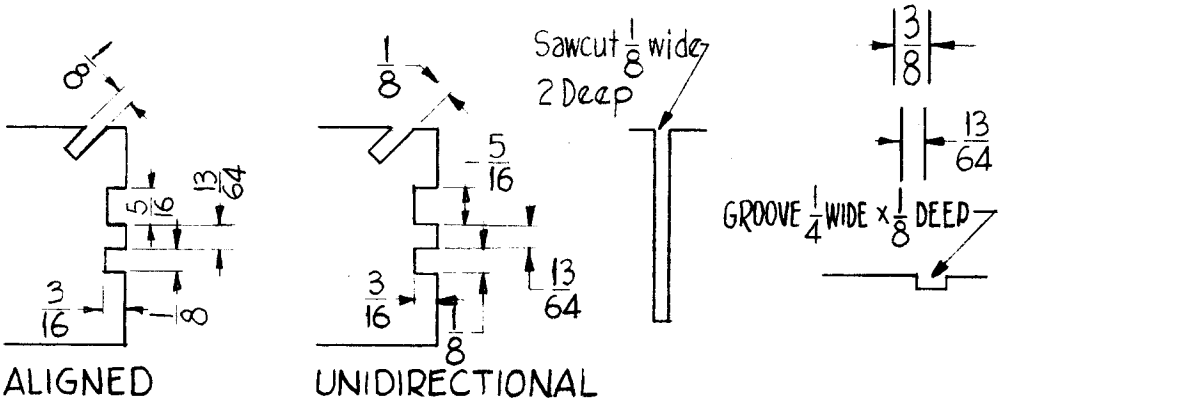
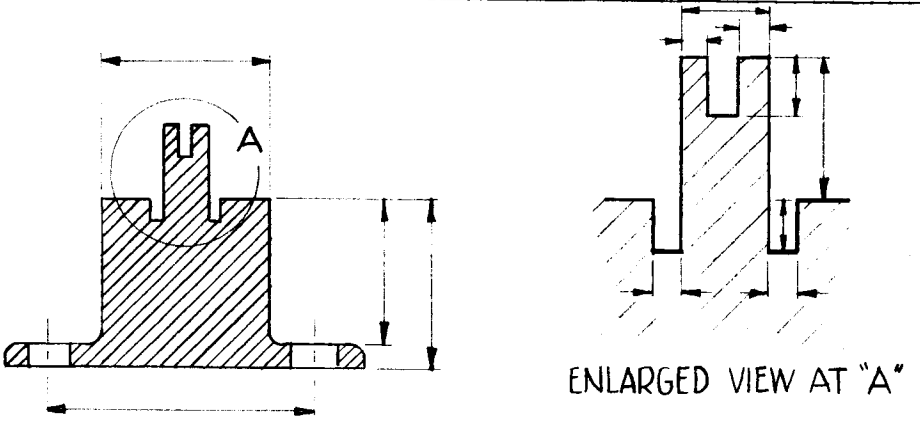


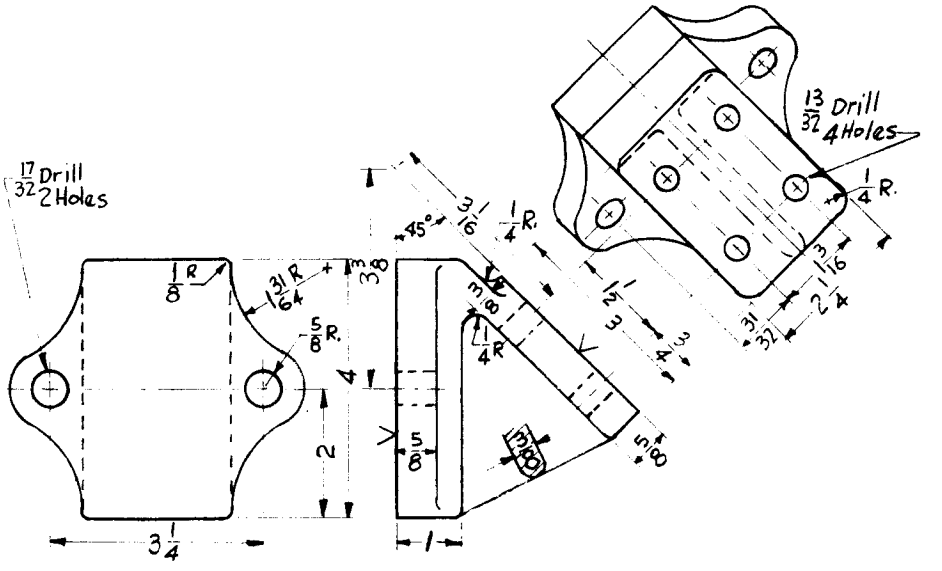
Fig. 11.39--USE OF ENLARGED DETAIL TO CLARIFY DIMENSIONS



5.06 DIMENSIONING OF AUXILIARY VIEWS:

In placing dimensions on an auxiliary view, the same principles of dimensioning apply as for any other drawing, but special attention should be paid to the contour principle given in paragraph 11.31. An auxiliary view is made for the purpose of showing a view normally projected of some inclined or skewed face; for this reason the dimensioning of the face should be placed where it is easiest to read, which will be on the normally projected or auxiliary view. Note in Fig. 11.41 that the spacing and size of holes as well as the size of the inclined face are dimensioned on the auxiliary view. Note further that the orientational dimensions of the inclined face to the rest of the object could not be placed on the auxiliary view.

Fig. 11.41 DIMENSIONING ON AN AUXILIARY (NORMAL) VIEW



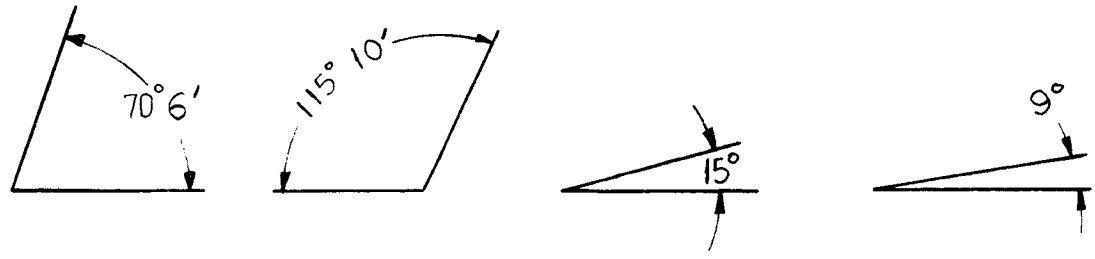
5.07 DIMENSIONING OF SECTIONAL VIEWS

Dimensions that must be placed on sectional views are usually placed outside the view so as not to be crowded within cross-hatched areas. However, sometimes a dimension must be placed across a cross-hatched area. Then this is the case, the cross-hatching is left out around the dimension figures, as illustrated in Fig. 11.31.

5.08 DIMENSIONING OF ANGLES

The dimension line for an angle is a circle arc with its center at the intersection of the sides of the angle (Fig. 11.44). The value is placed to read horizontally, with the exception that in the aligned system large arcs have the value aligned with the dimension arc. Angular values should be written in the form $35^{o}7'$ with no dash between the degrees and the minutes.

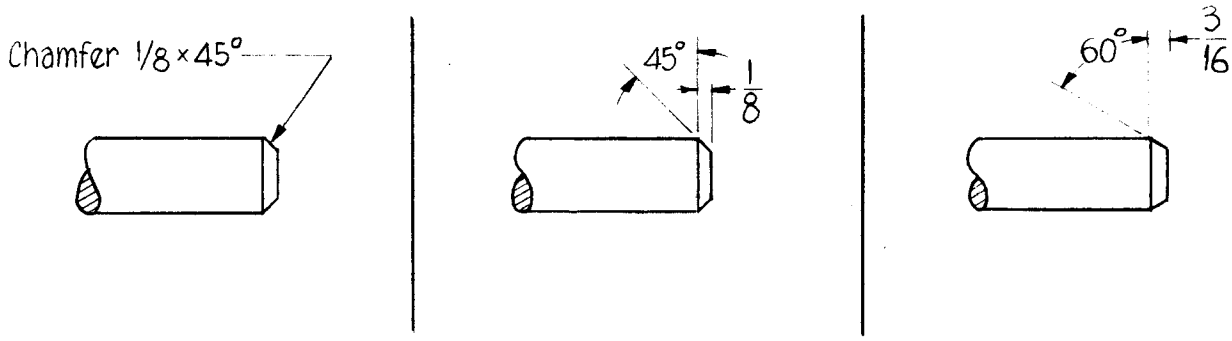
Fig. 11.44--DIMENSIONS FOR ANGLES



5.09 DIMENSIONING OF CHAMFERS:

Chamfers may be dimensioned by note, as in Fig. 11.45A, if the angle is 45°. The linear size is understood to be short side of the chamfer triangle; the dimensioning without a note shown at (B) is in conformity with this. If the chamfer angle is other than 45°, it is dimensioned as at (C).

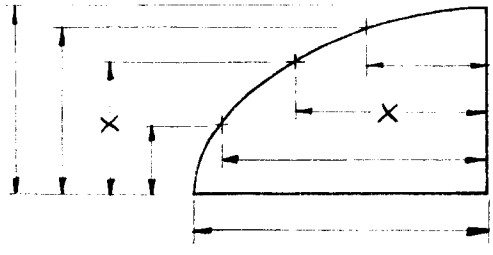
Fig. 11.45--CHAMFER DIMENSIONING



5.10 DIMENSIONING OF CURVES:

Curves for which greater accuracy is not required are dimensioned by offsets, as in Fig. 11.51. For greater accuracy, dimensions from datum features, as in Fig. 11.52, are recommended. Note in Fig. 11.52 that any pair of dimensions (indicated at X) could be given to greater accuracy than the others, in order to position a point for which greater accuracy is required.

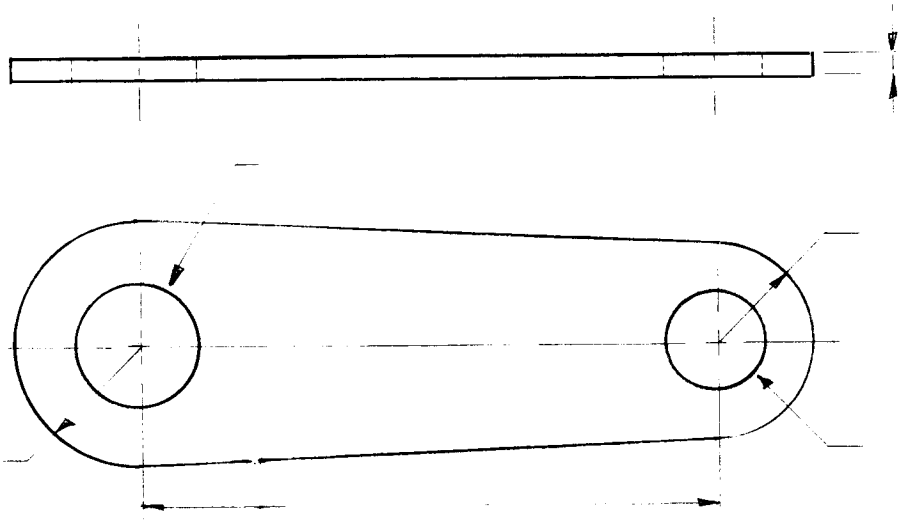
Fig. 11.52--CURVE DIMENSIONED FROM DATUM EDGES



5.11 DIMENSIONING OF SHAPES WITH ROUND ENDS

These should be dimensioned according to their method of manufacture. Fig. 11.53 shows several similar contours and the typical dimensioning for each. The link (A), to be cut from thin material, has the radius of the ends and the center distance given as it would be laid out. At (B) is shown a cast pad dimensioned as at (A), with the dimensions most usable for the pattern maker. The drawing at (C) shows a slot machined from solid stock with an endmilling cutter. The dimensions give the diameter of the cutter and the travel of the milling-machine table. The slot at (D) is similar to that at (C) but is dimensioned for quantity production, where, instead of the table travel, the overall length is wanted for gaging purposes. Pratt and Whitney keys and key seats are dimensioned by the method shown at (D).

Fig. 11.53--DIMENSIONING OF ROUND END SHAPES



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TITLE:

JOB

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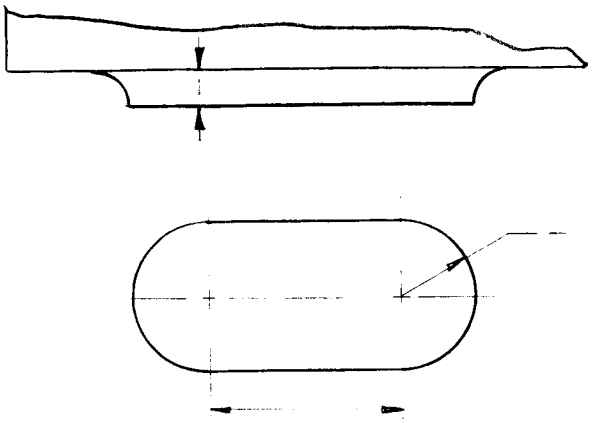
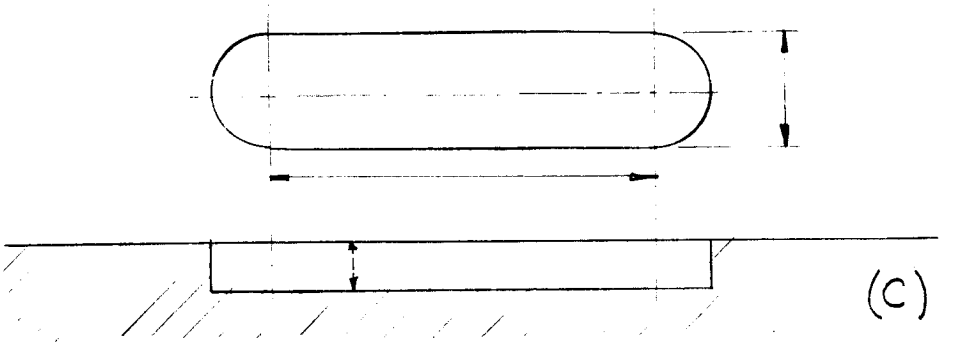
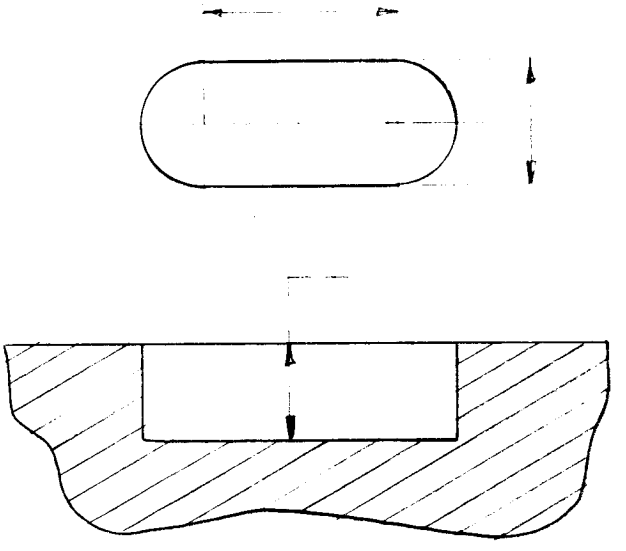


(B)



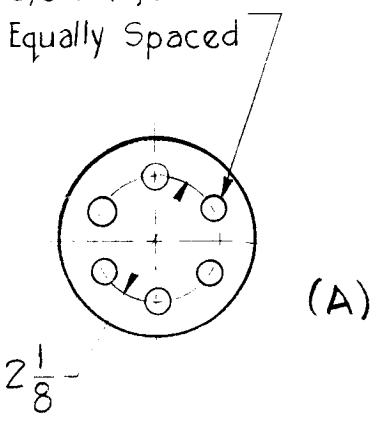
(C)



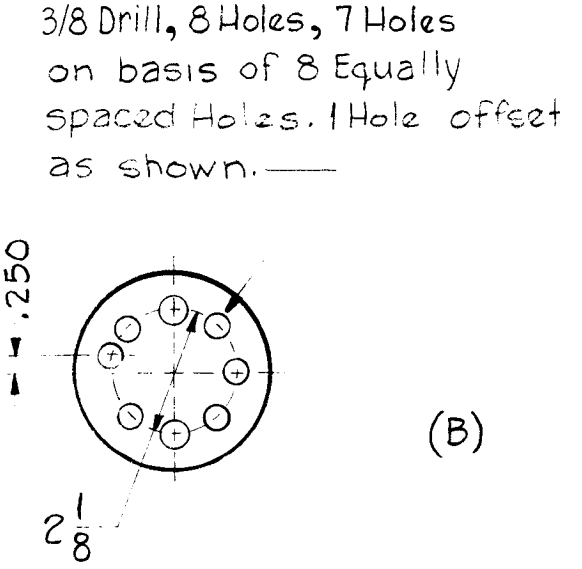
(D)

5.12 POSITIONING OF HOLES:

Hole circles are circular center lines, on which the centers of a number of holes are located. One practice is to give the diameter of the hole circle and a note specifying the size of the holes, the number required and the spacing, as in Fig. (A). If one or more holes are not in the regular equally spaced position, their locations may be given by an offset dimension as shown in Fig. (B).



(A)

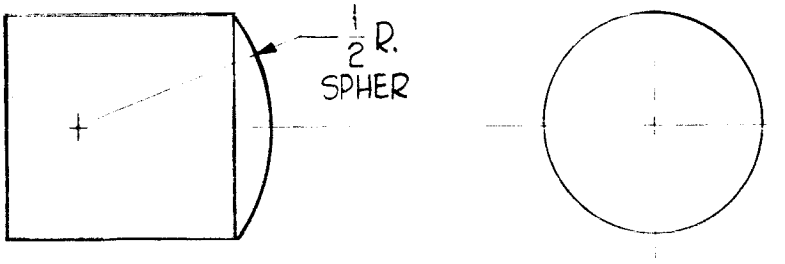


(B)

5.13 DIMENSIONING OF SPHERICAL SURFACES:

Spherical surfaces should be dimensioned as in Fig. 11.64, that is, by placing the abreviation "SPHER" after the dimension value.

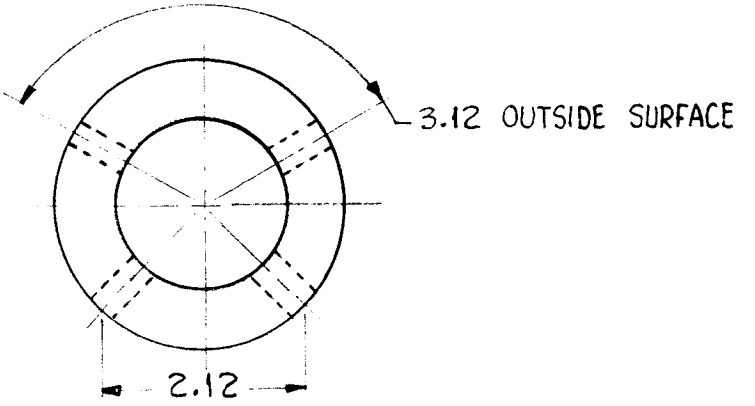
Fig. 11.64--DIMENSIONING A SPHERICAL SURFACE



5.14 DIMENSIONING OF CURVED SURFACES:

A position on a curved part may be misconstrued unless there is a specification showing the surface of the part to which the dimension applies as in Fig. 11.65.

Fig. 11.65--DIMENSIONING A POSITION ON A CURVED SURFACE



5.15 DIMENSIONING OF ARCS:

Arcs should be dimensioned by giving the radius on the view that shows the true shape of the curve. The dimension line for a radius should always be drawn as a radial line at an angle (Fig. 11.48), never horizontal or vertical; and only one arrowhead is used. There is no arrowhead at the arc center. The numerical value should be followed by the letter R. Depending upon the size of the radius and the available space for the value, the dimension line and value are both inside the arc, or the line is inside and the value outside, or, for small arcs, both are outside, as shown in the illustration. When the center of an arc lies outside the limits of the drawing, the center is moved closer along a center line of the arc and dimension line is jogged to meet the new center (Fig. 11.49). The portion of the dimension line adjacent to the arc is a radial line of the true center. A curved line made up of circle arcs is dimensioned by radii with the centers located, as in Fig. 11.50.

Fig. 11.48--DIMENSIONING OF RADII

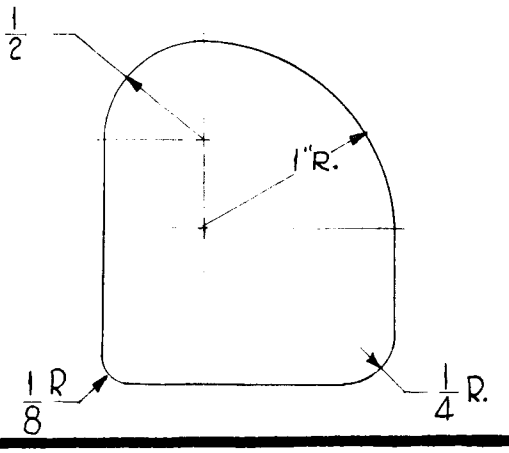


Fig. 11.49--DIMENSIONING OF RADII HAVING INACCESSIBLE CENTERS

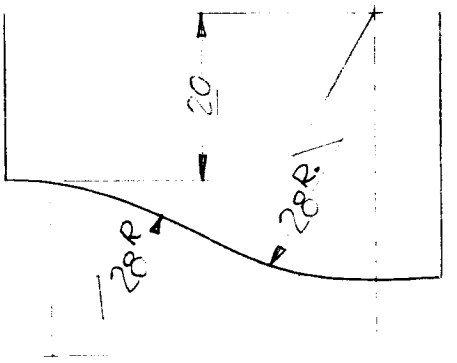
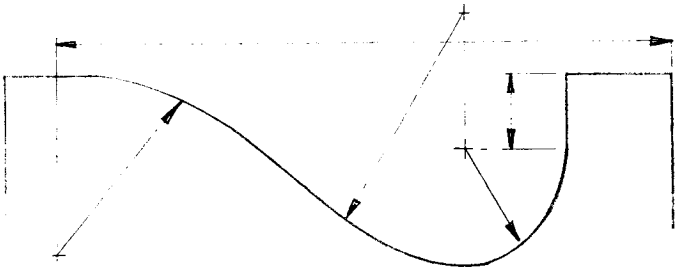


Fig. 11.50--DIMENSIONING A CURVE MADE UP OF A RADII

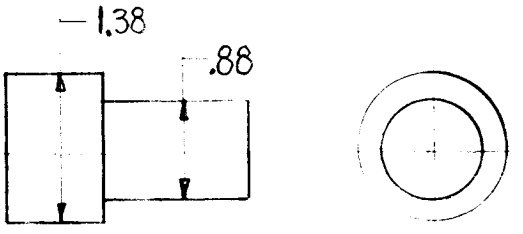
POSITION OF CENTERS MUST BE GIVEN

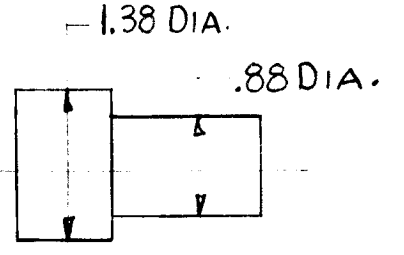


5.16 DIMENSIONING OF CYLINDRICAL SURFACES

Cylindrical surfaces on a drawing having an end view may be dimensioned as in Fig. 11.63A; if there is no end view, "DIA" should be placed after each value as in Fig. 11.63B.

Fig. 11.63--(CYLINDER DIMENSIONING A-END VIEW SHOWN
B-NO END VIEW)





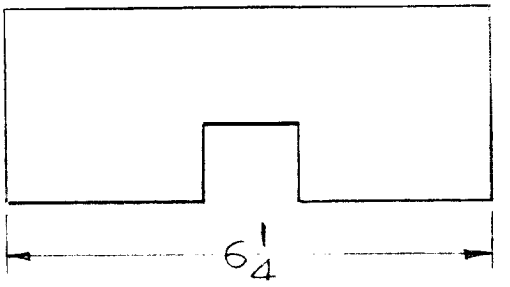
5.17 DIMENSIONING OF LINES AND SYMBOLS:

Dimension lines, extension lines, and leaders are made with fine full lines the same width as center lines so as to contrast with the heavier outlines of the views. See the alphabet of lines.

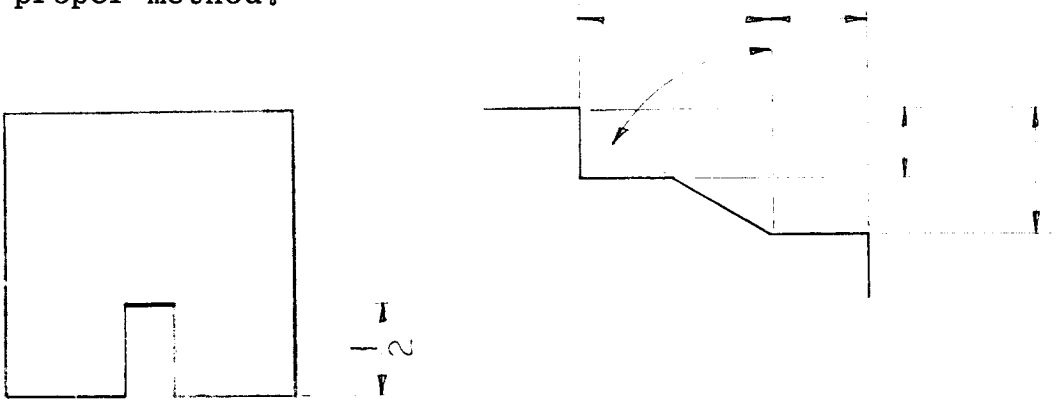
EXTENSION LINES

These extend from the view to a dimension placed outside the view. They should not touch the outline of the view but should start about 1/16" from it and extend about 1/8" beyond the last dimension line.

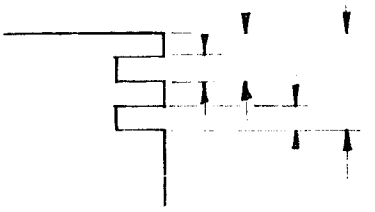
EXAMPLE



Extension lines should not be broken where they cross each other or an outline of a view, see detail for proper method.



However, when space is restricted and the extension lines come close to arrowheads, the extension lines may be broken for clarity, as in detail below:



DATE	TMC SPECIFICATION NO. S-606	
SH. 25 OF		
COMPILED BY	TITLE: DRAWING SPECIFICATION ON NOTES	JOB
APPROVED		

NOTES:

These are statements giving information that cannot be given by views and dimensions. They almost always specify some standard shape, operation or material and are classified as general or specific.

A general note applies to the entire part; a specific note applies to an individual feature. Occasionally a note will save an additional view; or even an entire drawing; for example by indicating RIGHT-AND-LEFT-HAND PARTS.

General notes do not require the use of a leader and should be grouped together above the title block.

Examples are as follows:

UNLESS OTHERWISE SPECIFIED

MOUNT INSERTS AFTER FINISHING

FINISH ALL OVER

REMOVE ALL BURRS

FILLETS $\frac{1}{4}$ R

DIMENSIONS APPLY BEFORE PLATING

DIMENSIONS APPLY AFTER PLATING

USE MATERIAL THICKNESS ON ALL BENDS FOR MAX. RADIUS UNLESS OTHERWISE SPECIFIED

Specific notes almost always require a leader and should therefore be placed fairly close to the feature to which they apply. Most common are notes giving an operation w/o size, as $\frac{1}{2}$ DRILL, 4 HOLES.