UNIT 5-1

Theory of Shape Description

Chapter 4 illustrated many simple parts that required only one view to completely describe them. However, in industry, the majority of parts that have to be drawn are more complicated than the ones previously described. More than one view of the object is required to show all the construction features. Except for complex objects of irregular shape, it is seldom necessary to draw more than three views.

Pictorial (three-dimensional) drawings of objects are sometimes used, but the majority of drawings used in mechanical drafting for completely describing an object are multiview drawings as shown in Fig. 5-1-1.

Pictorial projections, such as axonometric, oblique, and perspective projection, are useful for illustrative purposes and are frequently employed in installation and maintenance drawings and design sketches.

As a result of new drawing techniques and equipment, pictorial drawings are becoming a popular form of communication, especially with people not trained to read engineering drawings. Practically all drawings of do-it-yourself projects for the general public or of assembly-line instructions for non-technical personnel are done in pictorial form.

SHAPE DESCRIPTION BY VIEWS

When looking at objects, we normally see them as three-dimensional, having width, depth, and height, or length, width, and height. The choice of terms used depends on the shape and proportions of the object.

Spherical shapes, such as a basketball, are described as having a certain diameter (one term).

Cylindrical shapes, such as a baseball bat, have diameter and length. However, a hockey puck would have diameter and thickness (two terms).

Objects which are not spherical or cylindrical require three terms to describe their overall shape. The terms used for a car would probably be length, width, and height; for a filing cabinet, width, height, and depth; for a sheet of drawing paper, length, width, and thickness. These terms are used interchangeably according to the proportions of the object being described, and the position it is in when being viewed. For example, a telephone pole lying on the ground would be described as having diameter and length, but when placed in a vertical position, its dimensions would be diameter and height.

In general, distances from left to right are referred to as width or length, distances from front to back as depth or width, and vertical distances (except when very small in proportion to the others) as height. On drawings, the multidimensional shape is represented by a
The three planes used in orthographic projection.

ISO projection symbol.

Relationship of object with viewing planes in third-angle projection.

Locating ISO projection symbol on drawing paper.

VIEWING THE OBJECT FROM ALL SIX SIDES

UNFOLDING GLASS BOX TO GIVE THIRD ANGLE LAYOUT OF VIEWS

OBJECT ENCLOSED IN GLASS BOX

Systematic arrangement of views.
view or views on the flat surface of the drawing paper.

Many mechanical parts do not have a definite "front" or "side" or "top," as do objects, such as refrigerators, desks, or houses, and their shapes vary from the simple to the complex. Decisions have to be made on how many views, and which views, will be drawn. Following are some basic guidelines.

1. Draw those views that are necessary to fully explain the shape.
2. The front view is usually the "key" view; it shows the width or length of the object and gives the most information about its shape. When the longest dimension is drawn in a horizontal position, the object will seem balanced.

3. Choose those views that will show most of the detailed features of the object as "visible," thus avoiding the extensive use of "hidden" feature lines.

Surface Terms
When describing the shape of an object, reference is often made to the types of surfaces found on the object relative to the three principal viewing planes—horizontal plane, vertical plane, profile plane. These surfaces can be identified as follows:

- **Parallel** flat surfaces that are parallel to the three principal viewing planes;
- **Hidden** surfaces that are hidden in one or more reference planes;
- **Inclined** flat surfaces that are inclined in one plane and parallel to the other two planes;
- **Oblique** flat surfaces that are inclined in all three reference planes;
- **Circular** surfaces that have diameter or radius.

PICTORIAL VIEWS
Pictorial drawings represent the shape with just one view. See Fig. 5-1-2A. However, the majority of parts manufactured in industry are too complicated in shape and detail to be described successfully by a pictorial view.

ORTHOGRAPHIC PROJECTION
The drafter must represent the part which appears as three-dimensional (width, height, depth) to the eye on the flat plane of the drawing paper. Different views of the object—front, side, and top views—are systematically arranged on the drawing paper to convey the necessary information to the reader (Figs. 5-1-2B and 5-1-3). Features are projected from one view to another. This type of drawing is called an orthographic projection. The word orthographic is derived from two Greek words: orthos, meaning straight, correct, at right angles to; and graphikos, meaning to write or describe by drawing lines.

An orthographic view is what you would see looking directly at one side or "face" of the object. See Fig. 5-1-2(C). When looking directly at the front face, you would see width and height (two dimensions) but not the third dimension, depth. Each orthographic view gives two of the three major dimensions.

Orthographic Systems
Two systems of orthographic projection, known as first- and third-angle projection, are used (Fig. 5-1-4). Third-angle projection is used in the United States, Canada, and many other countries throughout the world. First-angle projection, which will be described in detail in Unit 5-8, is used mainly in many European and Asiatic countries. As world trade has brought about the exchange of engineering drawings as well as the end products, drafters are now called upon to communicate in, as well as understand, both types of orthographic projection.
USE OF A MITER LINE

The use of a miter line provides a fast and accurate method of constructing the third view once two views are established (Fig. 5-2-2).

Using a Miter Line to Construct the Top View

1. Given the front and side views, project vertical lines up from the side view.
2. Establish how far from the front view the side view is to be drawn (distance D).
3. Construct the miter line at 45° to the horizon.
4. Where the horizontal projection lines of the top view intersect the miter line, drop vertical projection lines.
5. Project horizontal lines to the right of the front view and complete the side view.

Using a Miter Line to Construct the Right Side View

1. Given the top and front views, project lines to the right of the top view.
2. Establish how far from the front view the side view is to be drawn (distance D).
3. Construct the miter line at 45° to the horizon.
4. Where the vertical projection lines of the side view intersect the miter line, project horizontal lines to the left.

CAD

The working area on the CRT monitor must be established prior to selecting the paper size for the completed drawing.

Construction lines are menu options used in the preparation of multiview drawings on the CRT monitor (Fig. 5-2-3).

ASSIGNMENTS

See Assignments 3 through 6 for Unit 5-2 on pages 78 and 79.

UNIT 5-3

All Surfaces Parallel and All Edges and Lines Visible

To fully appreciate the shape and detail of views drawn in third-angle orthographic projection, the units for this chapter have been designed according to the types of surfaces generally found on objects. These surfaces can be divided into flat surfaces parallel to the viewing planes with and without hidden features; flat surfaces which appear inclined in one plane and parallel to the other two principal reference planes (called inclined surfaces); flat surfaces which are inclined in all three reference planes (called oblique surfaces); and surfaces which have diameters or radii. These drawings are so designed that
ISO Projection Symbol

With two types of projection being used on engineering drawings, a method of identifying the type of projection is necessary. The International Standards Organization, known as ISO, has recommended that the symbol shown in Fig. 5-1-5 be shown on all drawings and located preferably in the lower right-hand corner of the drawing, adjacent to the title block (Fig. 5-1-6).

Drawings made in the United States are understood to be shown in third-angle projection if the ISO symbol is not used.

Third-Angle Projection

In third-angle projection, the object is positioned in the third-angle quadrant, as shown in Fig. 5-1-7. The person viewing the object does so from six different positions, namely, from the top, front, right side, left side, rear, and bottom. The views or pictures seen from these positions are then recorded or drawn on the plane located between the viewer and the object. These six viewing planes are then rotated or positioned so that they lie in a single plane, as shown in Fig. 5-1-8. Rarely are all six views used. An exception would be the drawing of a die (one of a pair of dice). See Fig. 5-1-9. Only the views which are necessary to fully describe the object are drawn. Simple objects, such as a gasket, can be described sufficiently by one view alone. However, in mechanical drafting two- or three-view drawings of objects are more common, the rear, bottom, and one of the two side views being rarely used.

UNIT 5-2

Arrangement of Views

SPACING THE VIEWS

It is important for clarity and good appearance that the views be well balanced on the drawing paper, whether the drawing shows one view, two views, three views, or more. The drafter must anticipate the approximate space required. This is determined from the size of the object to be drawn, the number of views, the scale used, and the space between views. Ample space should be provided between views to permit placement of dimensions on the drawing without crowding. Space should also be allotted so that notes can be added without crowding. However, space between views should not be excessive.

Figure 5-2-1 shows how to balance the views for a three-view drawing. For a drawing with two or more views, follow these guidelines:

ASSIGNMENTS

See Assignments 1 and 2 for Unit 5-1 on page 78.
All CAD systems have the option to create different line styles. On large systems, these options are found on the aux-

Hidden Surfaces and Edges

Most objects drawn in engineering offices are more complicated than the ones shown in Fig. 5-4-1. Many features (lines, holes, etc.), cannot be seen when viewed from outside the piece. These hidden edges are shown with hidden lines and are normally required on the drawing to show the true shape of the object.

Hidden lines consist of short, evenly spaced dashes. They should be omitted when not required to preserve the clarity of the drawing. The length of dashes may vary slightly in relation to the size of the drawing.

Lines depicting hidden features and phantom details should always begin and end with a dash in contact with the line at which they start and end, except when such a dash would form a continuation of a visible detail line. Dashes should join at corners. Arcs should start with dashes at the tangent points (Fig. 5-4-2). Figure 5-4-3 shows additional examples of objects requiring hidden lines.

UNIT 5 - 4
Hidden Surfaces and Edges

ASSIGNMENTS

See Assignments 7 and 8 for Unit 5-3 on pages 79 and 80.

UNIT 5 - 4
Hidden Surfaces and Edges

Fig. 5-3-1 Illustrations of objects drawn in third-angle orthographic projection.

NOTE: ARROWS INDICATE DIRECTION OF SIGHT WHEN LOOKING AT THE FRONT VIEW.
ASSIGNMENTS
See Assignments 9 through 12 for Unit 5-4 on pages 80 and 81.

UNIT 5-5
Inclined Surfaces

If the surfaces of an object lie in either a horizontal or a vertical position, the surfaces appear in their true shapes in one of the three views, and these surfaces appear as a line in the other two views.

When a surface is inclined or sloped in only one direction, then that surface is not seen in its true shape in the top, front, or side view. It is, however, seen in two views as a distorted surface. On the third view it appears as a line.

The true length of surfaces A and B in Fig. 5-5-1 is seen in the front view only. In the top and side views, only the width of surfaces A and B appears in its true size. The length of these surfaces is foreshortened. Figure 5-5-2 shows additional examples.

Where an inclined surface has important features that must be shown clearly and without distortion, an auxiliary
or helper view must be used. This type of view will be discussed in detail in Chap. 15.

ASSIGNMENTS

See Assignments 13 through 16 for Unit 5-5 on page 83.

UNIT 5 - 6
Circular Features

Typical parts with circular features are illustrated in Fig. 5-6-1. Note that the circular feature appears circular in one view only and that no line is used to show where a curved surface joins a flat surface. Hidden circles, like hidden flat surfaces, are represented on drawings by a hidden line.

The intersection of unfinished surfaces, such as found on cast parts, that are rounded or filleted at the point of theoretical intersection, may be indicated conventionally by a line. See Unit 8-18.
Center Lines
A center line is drawn as a thin, broken line of long and short dashes, spaced alternately. Such lines may be used to locate center points, axes of cylindrical parts, and axes of symmetry, as shown in Fig. 5-6-2. Solid center lines are often used when the circular features are small. Center lines should project for a short distance beyond the outline of the part or feature to which they refer. They must be extended for use as extension lines for dimensioning purposes, but in this case the extended portion is not broken.

On views showing the circular features, the point of intersection of the two center lines is shown by the two intersecting short dashes.

ASSIGNMENTS
See Assignments 17 through 21 for Unit 5-6 on page 87 and 88.

UNIT 5-7
Oblique Surfaces
When a surface is sloped so that it is not perpendicular to any of the three viewing planes, it will appear as a surface in all three views but never in its true shape. This is referred to as an oblique surface (Fig. 5-7-1). Since the oblique surface is not perpendicular to the viewing planes, it cannot be parallel to them and consequently appears foreshortened. If a true view is required for this surface, two auxiliary views—a primary and a secondary view—need to be drawn. This is discussed in detail under Secondary Auxiliary Views in Unit 15-4. Figure 5-7-2 shows additional examples of objects having oblique surfaces.

ASSIGNMENTS
See Assignments 22 and 23 for Unit 5-7 on page 91.

UNIT 5-8
First-Angle Orthographic Projection
As mentioned previously, first-angle orthographic projection is used in many countries throughout the world. Today with global marketing and the interchange of drawings with different countries, drafters are called upon to prepare and interpret drawings in both first- and third-angle projection. In first-angle projection, all the views are projected onto the planes located behind the objects rather than onto the planes lying between the objects and the viewer, as in third-angle projection. This is shown in Fig. 5-8-2. The unfolding and positioning of the views in one plane are shown in Fig. 5-8-3. Note that the views are on opposite sides of the front view with the exception of the rear view. A comparison between the views of first- and third-angle projections is shown in Figs. 5-8-1 and 5-8-4. Remember that the views are identical in shape and detail, and only their location in reference to the front view has changed.
A comparison between third- and first-angle projection.

When viewing from the top, the image which is seen (top view) is projected beyond the object and onto the bottom horizontal plane.

When viewing from the left side, the image which is seen (left-side view) is projected beyond the object and onto the right profile plane.

When viewing from the front, the image which is seen (front view) is projected beyond the object and onto the back vertical plane.

NOTE: Front vertical and left profile planes not shown on this drawing.

Unfolding glass box to give the first angle layout of views.

A simple object shown in pictorial and orthographic.
ASSIGNMENTS
See Assignments 24 and 25 for Unit 5-8 on page 92.

UNIT 5-9
One- and Two-View Drawings

VIEW SELECTION
Views should be chosen that will best describe the object to be shown. Only the minimum number of views that will completely portray the size and shape of the part should be used. They should also be chosen to avoid hidden feature lines whenever possible, as shown in Fig. 5-9-1.

Except for complex objects of irregular shape, it is seldom necessary to draw more than three views. For representing simple parts, one- or two-view drawings will often be adequate.

ONE-VIEW DRAWINGS
In one-view drawings, the third dimension, such as thickness, may be expressed by a note or by descriptive words or abbreviations, such as DIA, Ø, or HEXAGON ACROSS FLATS. Square sections may be indicated by light crossed diagonal lines. This applies whether the face is parallel or inclined to the drawing plane. These are illustrated in Fig. 5-9-2.

When cylindrically shaped surfaces include special features such as a keyseat, a side view (often called an end view) is required.

TWO-VIEW DRAWINGS
Frequently the drafter will decide that only two views are necessary to explain fully the shape of an object (Fig. 5-9-3). For this reason, some drawings consist of two adjacent views, such as the top and front views only, or front and right side views only. Two views are usually sufficient to explain fully the shape of cylindrical objects; if three views were used, two of them would be identical, depending on the detail structure of the part.

ASSIGNMENT
See Assignment 26 for Unit 5-9 on page 93.

UNIT 5-10
Special Views

PARTIAL VIEWS
Symmetrical objects may often be adequately portrayed by half views (Fig. 5-10-1A). A center line is used to show the axis of symmetry. Two short thick lines, above and below the view of the object, are drawn at right angles to and on the center line to indicate the line of symmetry.

Partial views, which show only a limited portion of the object with remote details omitted, should be used, when necessary, to clarify the meaning of the drawing (Fig. 5-10-1B). Such views are used to avoid the necessity of drawing many hidden features.

On drawings of objects where two side views can be used to better advantage than one, each need not be complete if together they depict the shape. Show only the hidden lines of features immediately behind the view (Fig. 5-10-1C).
REAR VIEWS AND ENLARGED VIEWS

Placement of Views

When views are placed in the relative positions shown in Fig. 5-1-8, it is rarely necessary to identify them. When they are placed in other than the regular projected position, the removed view must be clearly identified.

Whenever appropriate, the orientation of the main view on a detail drawing should be the same as on the assembly drawing. To avoid the crowding of dimensions and notes, ample space must be provided between views.

Rear Views

Rear views are normally projected to the right or left. When this projection is not practical, because of the length of the part, particularly for panels and mounting plates, the rear view must not be projected up or down. Doing so would result in the part being shown upside down. Instead, the view should be drawn as if it were projected sideways but located in some other position, and it should be clearly labeled REAR VIEW REMOVED (Fig. 5-10-2).

Enlarged Views

Enlarged views are used when it is desirable to show a feature in greater detail or to eliminate the crowding of details or dimensions (Fig. 5-10-3). The enlarged view should be oriented in the same manner as the main view. However, if an enlarged view is rotated, state the direction and the amount of rotation of the detail. The scale of enlargement must be shown, and both views should be identified by one of the three methods shown.
Key Plans

A method particularly applicable to structural work is to include a small key plan using bold lines on each sheet of a drawing series that shows the relationship of the detail on that sheet to the whole work, as in Fig. 5-10-4.

Opposite-Hand Views

Where parts are symmetrically opposite, such as for right- and left-hand usage, one part is drawn in detail and the other is described by a note such as PART B SAME EXCEPT OPPOSITE HAND. It is preferable to show both part numbers on the same drawing (Fig. 5-10-5).

ASSIGNMENT

See Assignments 27 through 29 for Unit 5-10 on pages 94 and 95.
ASSIGNMENTS FOR CHAPTER 5

Assignments for Unit 5-2, Arrangement of Views

3. Make a sketch similar to Fig. 5-2-1B and C and establish the distance between Plane 1 and the left border line and between Plane 2 and the bottom border line, given the following: top, front, and right side views; scale 1:2; drawing space 8.00 x 10.50 in.; part size: W = 8.50, H = 4.90, D = 4.50; space between views (X and Y), 1.50 in.

4. Make a sketch similar to Fig. 5-2-1B and C and establish the distance between Plane 1 and the left border line and between Plane 2 and the bottom border line, given the following: top, front, and right side views; scale 1:1; drawing space 8.00 x 10.50 in.; part size: W = 4.10, H = 1.40, D = 2.10; space between views (X and Y), 1.50 in.

5. Step block, Fig. 5-2-A, sheet size A (A4), scale 1:1. Make a three-view drawing using a miter line to complete the right side view. Space between views to be 1.50 in.

6. Stop block, Fig. 5-2-B, sheet size A (A4), scale 1:1. Make a three-view drawing using a miter line to complete the top view. Space between views to be 1.50 in.

Assignments for Unit 5-1, Theory of Shape Description

1. Make a two-view sketch, at a suitable scale, of one of the following: a coffee mug, a dinner plate, a drinking glass or mug. Identify the terms that would be used to best describe the object's overall size.

2. Make a three-view sketch, at a suitable scale, of one of the following: a kitchen table, a filing cabinet, a writing desk, a car, a house, a chest of drawers. Identify the terms that would best describe the object's overall size.

Note: CAD may be substituted for manual drafting for any assignments in this chapter.

Fig. 5-2-A Step block.

Fig. 5-2-B Stop block.
Assignments for Unit 5-3, All Surfaces Parallel and All Edges and Lines Visible

7. On an A (A4) size sheet of preprinted grid paper (.25 in. or 10 mm grids) sketch three views of each of the objects shown in Figs. 5-3-A and 5-3-B. Each square shown on the objects represents one square on the grid paper. Allow one grid space between views and a minimum of two grid spaces between objects. Identify the type of projection used by placing the appropriate ISO projection symbol at the bottom of the drawing.

8. On an A (A4) size sheet draw three views of one of the parts shown in Figs. 5-3-C to 5-3-F. Allow 1 in. or 25 mm between views. Scale full or 1:1. Do not dimension.

Fig. 5-3-A Sketching assignment.

Fig. 5-3-B Sketching assignment.

Fig. 5-3-D Corner block.

Fig. 5-3-E T bracket.

Fig. 5-3-F Angle step bracket.
Assignments for Units 5-4, All Surfaces Parallel to the Viewing Plane with Some Edges and Surfaces Hidden

9. On an A (A4) size sheet of preprinted grid paper (.25 in. or 10 mm grids) sketch three views of each of the objects shown in Figs. 5-4-A and 5-4-B. Each square shown on the objects represents one square on the grid paper. Allow one grid space between views and a minimum of two spaces between objects. Identify the type of projection by placing the ISO projection symbol at the bottom of the drawing.

10. Same as Assignment 9 except sketch the objects shown in Figs. 5-4-C and 5-4-D.
11. On an A (A4) size sheet make a three-view drawing of one of the parts shown in Figs. 5-4-E to 5-4-H. Scale 1:1. Allow 1.20 in. (30 mm) between views. Do not dimension.

12. Matching test. Match the pictorial drawings to the orthographic drawings shown in Fig. 5-4-J.

Fig. 5-4-E Adapter.

Fig. 5-4-F Link.

Fig. 5-4-G Bracket.

Fig. 5-4-H Guide block.
Fig. 5-4-1 Match pictorial drawings A through M with orthographic drawings.

### Theory of Shape Description

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Assignments for Unit 5-5, Inclined Surfaces

13. On an A (A4) size sheet of preprinted grid paper (.25 in. or 10 mm grids) sketch three views of each of the objects shown in Figs. 5-5-A and 5-5-B. Each square shown on the objects represents one square on the grid paper. Allow one grid space between views and a minimum of two grid spaces between objects. The sloped (inclined) surfaces on each of the three objects are identified by a letter. Identify the sloped surfaces on each of the three views with a corresponding letter. Also identify the type of projection used by placing the appropriate ISO symbol at the bottom of the drawing.

14. On a B (A3) size sheet, make a three-view drawing of one of the parts shown in Figs. 5-5-C to 5-5-F. Allow 1.20 in. (30 mm) between views. Do not dimension. Scale 1:1.

15. Sketching assignment. Make three-view sketches of the parts shown in Figs. 5-5-G through 5-5-K.

16. Matching test. Match the pictorial drawings to the orthographic drawings shown in Fig. 5-5-L.
Fig. 5-5-G Sketching assignment.

Fig. 5-5-H Sketching assignment.
Fig. 5-5-J Sketching assignment.

Fig. 5-5-K Sketching assignment.
Fig. 5.5.L Matching test.
Assignments for Unit 5-6, Circular Features

17. On an A (A4) size sheet of preprinted grid paper (.25 in. or 10 mm grids) sketch three views of each of the objects shown in Figs. 5-6-A and 5-6-B. Each square shown on the objects represents one square on the grid paper. Allow one grid space between views and a minimum of two grid spaces between objects. Identify the type of projection used by placing the appropriate ISO projection symbol at the bottom of the drawing.

18. One an A (A3) size sheet, make a three-view drawing of one of the parts shown in Figs. 5-6-C to 5-6-F. Allow 1.20 in. (30 mm) between views. Do not dimension. Scale 1:1.

Fig. 5-6-A Sketching assignment.
Fig. 5-6-B Sketching assignment.
Fig. 5-6-C Rod support.
Fig. 5-6-D Pillow block.
Fig. 5-6-E Cradle support.
Fig. 5-6-F Rocker arm.
19. Sketching assignment. Make three-view sketches of the parts shown in Fig. 5-6-G.

20. Sketching assignment. Sketch the views needed for a multiview drawing for the parts shown in Fig. 5-6-H. Choose your own sizes and estimate proportions.

21. Completion test. See Fig. 5-6-J.

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Fig. 5-6-G Sketching assignment.

Fig. 5-6-H Sketching assignment.
Assignments for Unit 5-7, Oblique Surfaces

22. On an A (A4) size sheet of preprinted grid paper (.25 in. or 10 mm grids) sketch three views of each of the objects shown in Figs. 5-7-A to 5-7-C. Draw three objects on each sheet. Each square on the objects represents one square on the grid paper. Allow one grid space between views and a minimum of two grid spaces between objects. The oblique surfaces on the objects are identified by a letter. Identify the oblique surfaces on each of the three views with a corresponding letter. Also identify the type of projection used by placing the appropriate ISO symbol at the bottom of the drawing.

23. On a B (A3) size sheet, make a three-view drawing of one of the parts shown in Figs. 5-7-D to 5-7-G. Allow 1.20 in. (30 mm) between views. Do not dimension.

Fig. 5-7-A Sketching assignment.

Fig. 5-7-B Sketching assignment.

Fig. 5-7-C Sketching assignment.

Fig. 5-7-D Base plate.

Fig. 5-7-E Angle brace.
Assignments for Unit 5-8, First-Angle Orthographic Projection

24. On two A (A4) size sheets of preprinted grid paper (.25 in. or 10 mm grids) sketch three views in first-angle orthographic projection of each of the objects shown in Figs. 5-8-A and 5-8-B. Draw three objects on each sheet. Each square on the objects represents one square on the grid paper. Allow one grid space between views and a minimum of two grid spaces between objects. Identify the type or projection used by placing the ISO projection symbol at the bottom of the drawing.

25. On a B (A3) size sheet, make a three-view drawing in first-angle projection of one of the parts shown in Figs. 5-8-C to 5-8-F. Allow 1.20 in. (30 mm) between views. Do not dimension.
Assignments for Unit 5-9, One- and Two-View Drawings

26. On an A3 size sheet, select any four of the objects shown in Fig. 5-9-A or 5-9-B and draw only the necessary views in orthographic third-angle projection which will completely describe each part. Use symbols or abbreviations where possible. The drawings need not be to scale but should be drawn in proportion to the illustrations shown.
Assignments for Unit 5-10,
Special Views

27. On a B (A3) size sheet, select any one of the objects shown in Figs. 5-10-A to 5-10-D and draw only the necessary views (full and partial) which will completely describe each part. Add dimensions and machining symbols where required. Scale 1:1.

28. On a B (A3) size sheet, select one of the panels shown in Fig. 5-10-E or 5-10-F and make a detail drawing of the part. Enlarged views are recommended. Panels such as these, where labeling is used to identify the terminals, are used extensively in the electrical and electronics industry.
Fig. 5-10-C Flanged coupling.

Fig. 5-10-D Connector.

Fig. 5-10-E Radio cover plate.

Fig. 5-10-F Transceiver cover plate.
29. With the most truss drawings, the scale used on the overall assembly is such that intricate detail cannot be clearly shown. As a result, enlarged detail views are added. With this type of assembly, many parts are opposite-hand to their counterparts.

The primary problem in the assembly of large-span multimember space structures has been to find some simple, inexpensive, and repetitive way to connect many members into and through a typical joint. The approach shown in this assignment is to shop-fabricate as much as possible, to ship the subassemblies to the site, and finally to complete the assembly by bolting the subassemblies together. The number, size, and strength of bolts are calculated by using the loading requirements at each connection.

Benefits of shop prefabrication of large units include minimization of field erection time and less possible error in the field resulting from the greater tolerance control in the shop.

On a B-size sheet, draw the enlarged views of the gusset assemblies shown in Fig. 5-10-G to a scale of 1 in. = 1 ft.

**Shop Bolting Data.** All structural members will be bolted to the gusset plate with five .375 in. high-strength bolts. Spacing is 1.50 in. from end and 3.00 in. center to center.

**Field Bolting Data.** All connections are to be made with five .375 in. high-strength bolts. Spacing is 1.50 in. from end and 3.00 in. center to center.

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**Fig. 5-10-G** Crescent truss.