PEARSON NEW INTERNATIONAL EDITION

Technical Drawing with Engineering Graphics

Giesecke et al.

Fourteenth Edition

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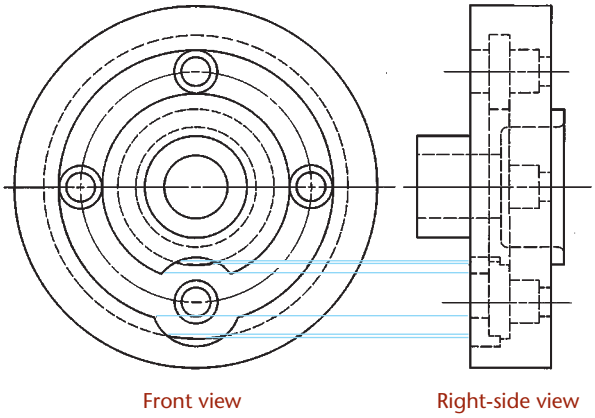
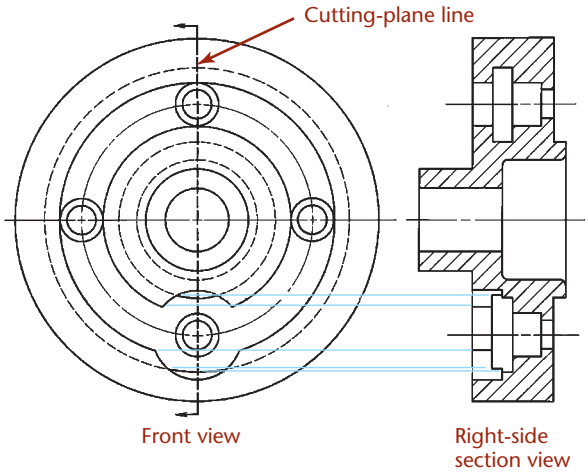
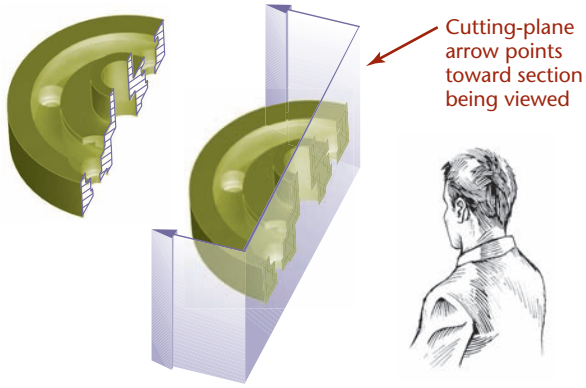


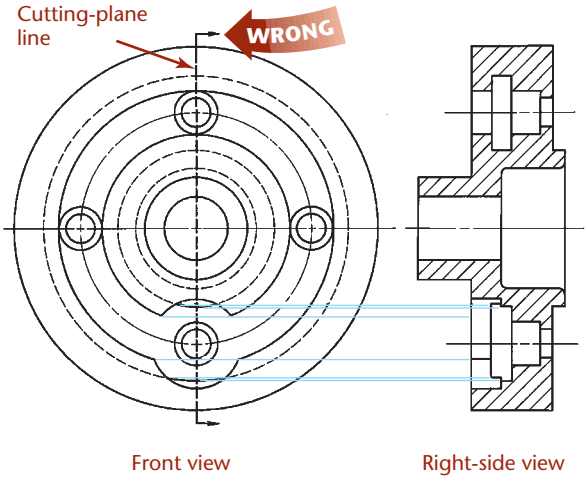
3 Front and Right-Side Views. *Parts with a lot of interior detail may have so many hidden lines that their views are confusing.*



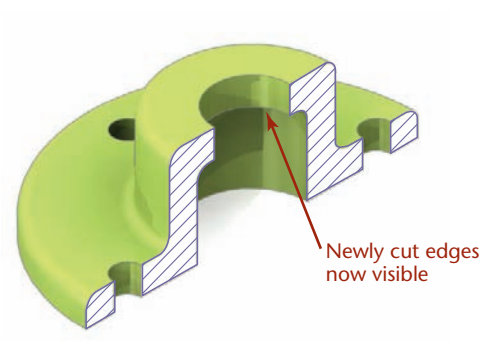
4 Front and Right-Side View in Full Section. *Using a section view makes it easier to see interior details.*

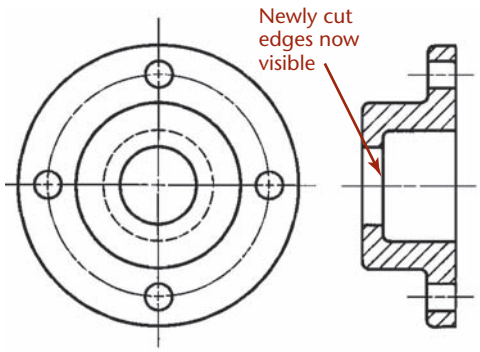


5 Cutting-plane line indicates direction of sight.



6 Arrows should not point to removed portion.





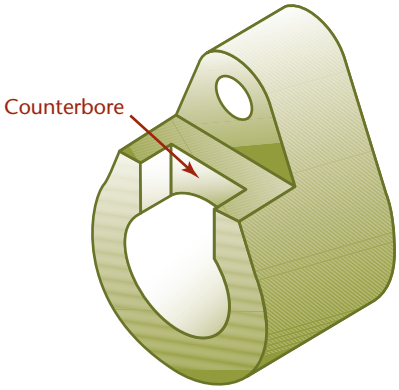
7 Newly visible edges cut by cutting plane are crosshatched with section lining.

STEP by STEP

VISUALIZING A FULL SECTION

Choose a Cutting Plane

1 This illustration shows a collar to be sectioned. It has a drilled and counterbored hole. To produce a clear section showing both the counterbored hole and the smaller hole near the top of the object, choose a cutting plane that will pass through the vertical centerline in the front view, and imagine the right half of the object removed.



Identify the Surfaces

2 Below is a pictorial drawing of the remaining half. The first step in projecting the section view is making sure that you interpret the object correctly. Identifying the surfaces on the object can help.

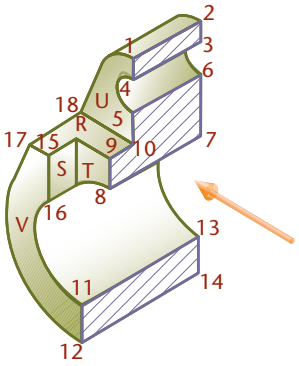
Surfaces R, S, T, U, and V have been labeled on the given views and the pictorial view.

Which surface is R in the front view?

Which surface is U in the top view?

Are they normal, inclined, or oblique surfaces?

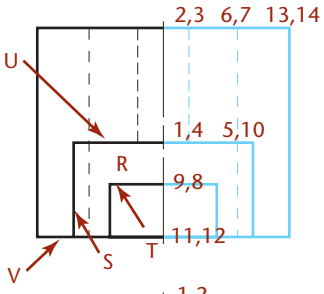
Can you identify the counterbore in each view?



Draw the Section View

3 To draw the section view, omit the portion of the object in front of the cutting plane. You will be drawing only the portion that remains.

Determine which are solid parts of the object the cutting plane will pass through. *Hint: The outside of an object can never be a hole; it must be solid, unless the cutting plane passes through a slot to the exterior.*

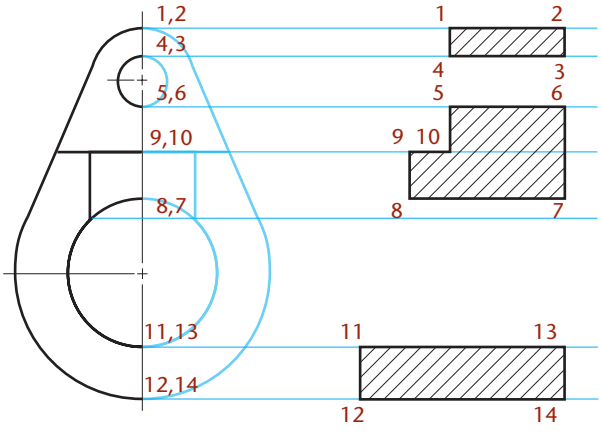


The points that will be projected to create the section view have been identified for you in the example shown.

The three surfaces produced by the cutting plane are bounded by points 1-2-3-4 and 5-6-7-8-9-10 and 13-14-12-11. These are shown hatched.

Each sectioned area is completely enclosed by a boundary of visible lines. In addition to the cut surfaces, the section view shows all visible parts behind the cutting plane.

No hidden lines are shown. However, the corresponding section shown in this step is incomplete, because visible lines are missing.



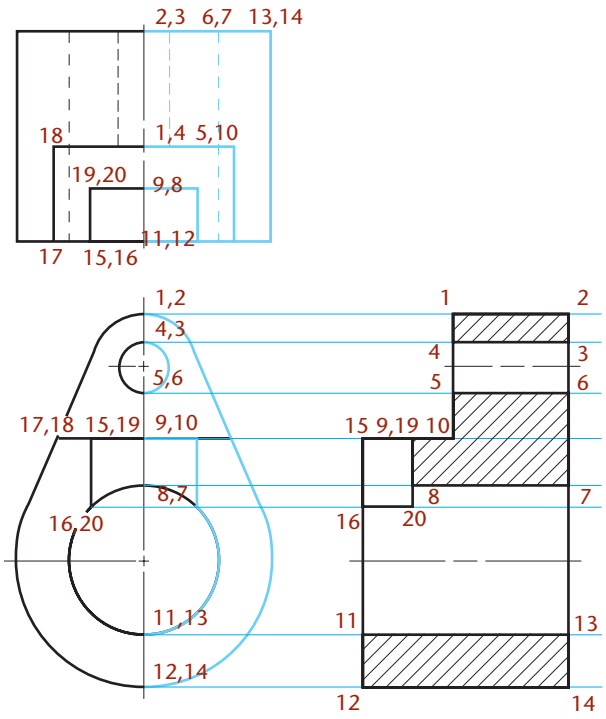
Project the Visible Lines

4 From the direction the section is viewed, the top surface (V) of the object appears in the section as a visible line (12-11-16-15-17).

The bottom surface of the object appears similarly as 14-13-7-6-3-2. The bottom surface of the counterbore appears in the section as line 19-20.

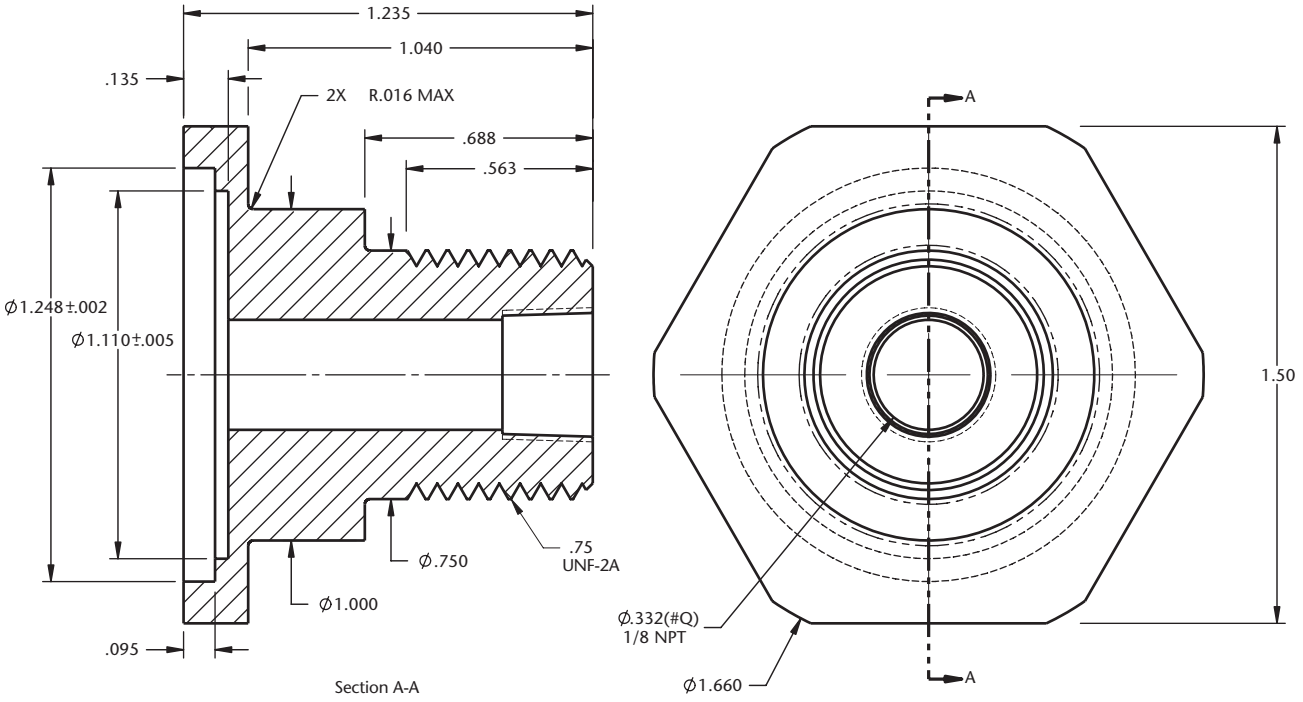
Also, the back half of the counterbore and the drilled hole appear as rectangles in the section at 19-20-15-16 and 3-4-5-6. These points must also be projected. The finished view is shown at right.

Notice that since all cut surfaces are part of the same object, the hatching must all run in the same direction.

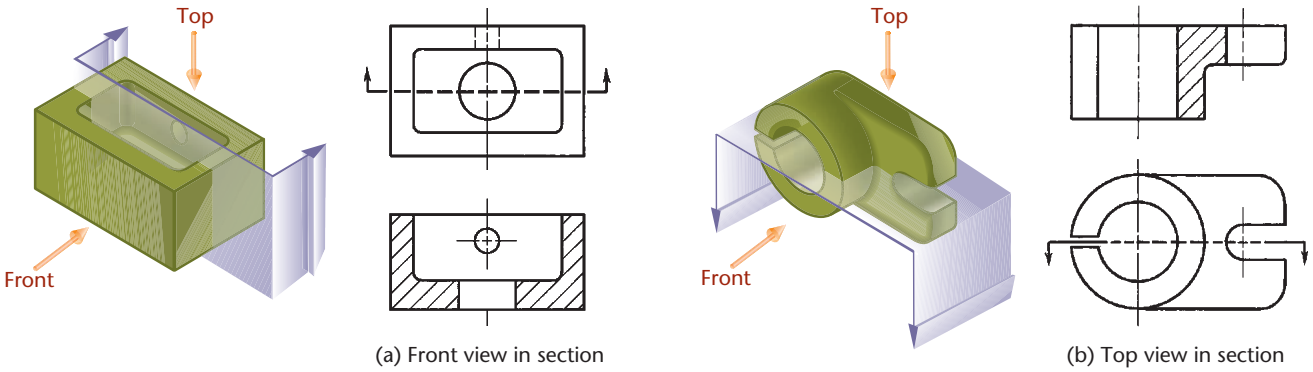


1 PLACEMENT OF SECTION VIEWS

Section views can replace the normal top, front, side, or other standard orthographic views in the standard view arrangement. Figure 8 shows an example. In this drawing, the front view of the object is shown in section. Only two views are necessary. The front view is shown as a section view, and the cutting-plane line is shown in the right-side view.



8 Section views can replace standard orthographic views. (Courtesy of Wood's Power-Grip. Co. Inc.)



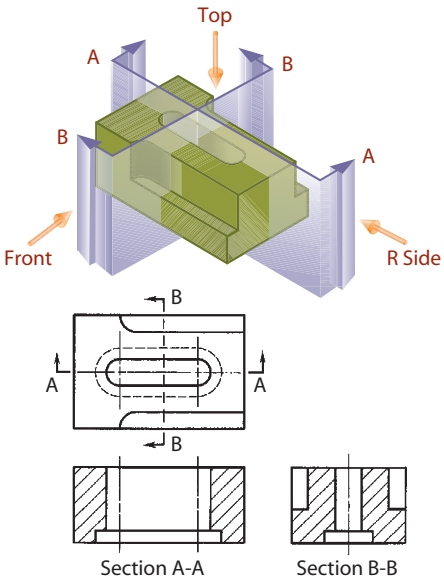
(a) Front view in section (b) Top view in section

9 Front and Top Views in Section

In Figure 9a, the object is cut through with a plane parallel to the front view. The front half of the object is imagined removed. The resulting full section may be referred to as the "front view in section" because it occupies the front view position.

In Figure 9b, the cutting plane is a horizontal plane (which would appear as a line in the front view). The upper half of the object is imagined removed. The resulting full section is shown in place of the top view.

When adding a section view to your drawing keep in mind that your purpose is to document and convey information about your design and show the information in the way that best achieves this objective.



10 Front and Side Views in Section

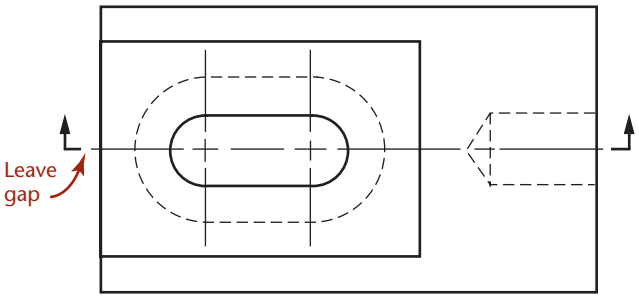
2 LABELING CUTTING PLANES

In Figure 10, two cutting planes are shown, one a plane parallel to the front view and the other a plane parallel to the side view, both of which appear edgewise in the top view. Each section is completely independent of the other and drawn as if the other were not present.

For section A–A, the front half of the object is imagined removed. The back half is then viewed in the direction of the arrows for a front view, and the resulting section is a front view in section.

For section B–B, the right half of the object is imagined removed. The left half is then viewed in the direction of the arrows for a right-side view, and the resulting section is a right-side view in section. The cutting-plane lines are preferably drawn through an exterior view (in this case the top view, as shown) instead of a section view.

The cutting-plane lines in Figure 10 are shown for purposes of illustration only. They are generally omitted in cases where the location of the cutting plane is obvious.



11 The cutting-plane line takes precedence over the centerline.

3 LINE PRECEDENCE

When a cutting-plane line coincides with a centerline, the cutting-plane line takes precedence. When the cutting-plane line would obscure important details in the view, just the ends of the line outside the view and the arrows can be shown as in Figure 11. When you do this, be sure to leave a small but visible gap between the lines of the view and the small portion of the cutting-plane line.

4 RULES FOR LINES IN SECTION VIEWS

When creating section views follow these general rules:

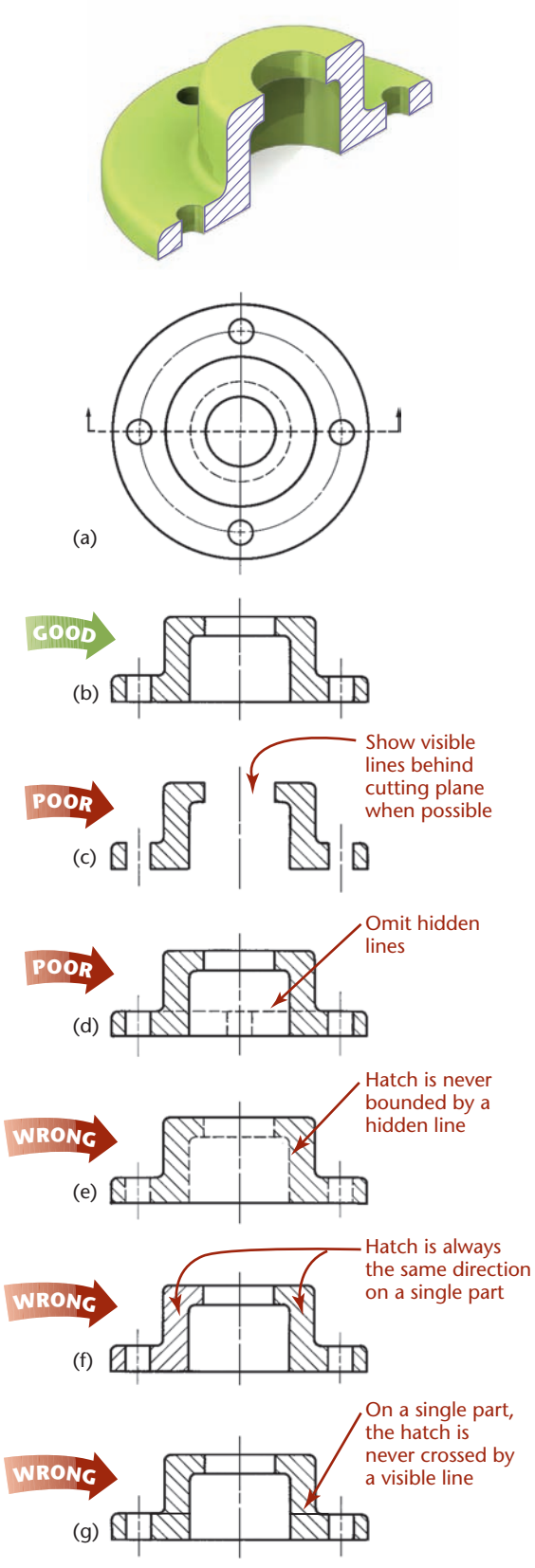
- Show *edges and contours that are now visible behind the cutting plane*; otherwise a section will appear to be made up of disconnected and unrelated parts. (Occasionally, visible lines behind the cutting plane may be omitted, particularly from those generated from 3D models.)
- Omit *hidden lines in section views*. Section views are used to show interior detail without a confusion of hidden lines, so add them only if necessary to understand the part.
- Sometimes hidden lines are necessary for clarity and should be used in such cases, especially if their use will make it possible to omit a view (Figure 12d).
- A sectioned area is always completely bounded by a visible outline—never by a hidden line, because in every case the cut surfaces will be the closest surface in the section view and therefore their boundary lines will be visible (Figure 12e).
- In a section view of an object, the section lines in all hatched areas for that object must be parallel, not as shown in Figure 12f. The use of section lining in opposite directions is an indication of different parts, as when two or more parts are adjacent in an assembly drawing.
- A visible line can never cross a sectioned area in a view of a single part. This would be impossible on the full section of a single part because the section lines are all in the same plane. A line across it would indicate a change of plane (Figure 12g). In an assembly section, this would be possible. You will learn about assemblies later in the chapter.

TIP

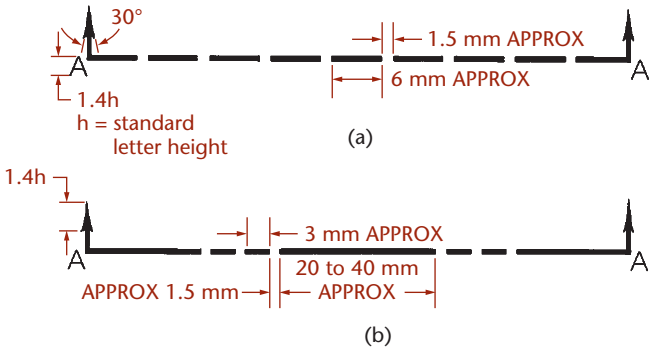
Learning the rules for section lining saves time. Extra hidden lines and hatching that is denser than necessary take longer to draw and make drawings slower to print. They also make drawings harder to read.

TIP

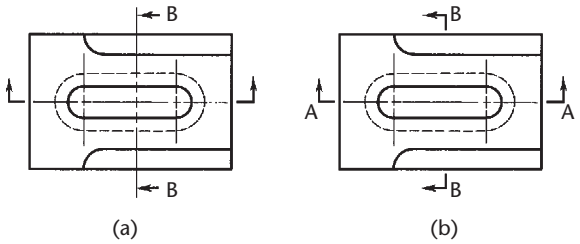
In CAD, when views can be placed by projection from a 3D model, saving time by omitting a view is not a big concern, but saving space on the drawing sheet by leaving out a view often may be.



12 Right and Wrong Lines in Section Views



13 Cutting-Plane Lines (Full Size)



14 Alternative Methods for Showing a Cutting Plane

5 CUTTING-PLANE LINE STYLE

Figure 13a shows the preferred style of line to use for the cutting-plane line. It is made up of equal dashes, each about 6 mm (1/4") long ending in arrowheads. This form works especially well for drawings. The alternative style, shown in Figure 13b, uses alternating long dashes and pairs of short dashes and ends with arrowheads. This style has been in general use for a long time, so you may still see it on drawings. Both lines are drawn the same thickness as visible lines. The arrowheads at the ends of the cutting-plane line indicate the direction in which the cutaway object is viewed (as was shown in Figure 5).

Use capital letters at the ends of the cutting-plane line when necessary to help the drawing's reader match each cutting-plane line to its section view. Figure 10 showed an example where the cutting plane is labeled and the resulting section view is labeled to match. This most often occurs in the case of multiple sections or removed sections, which are discussed later in the chapter.

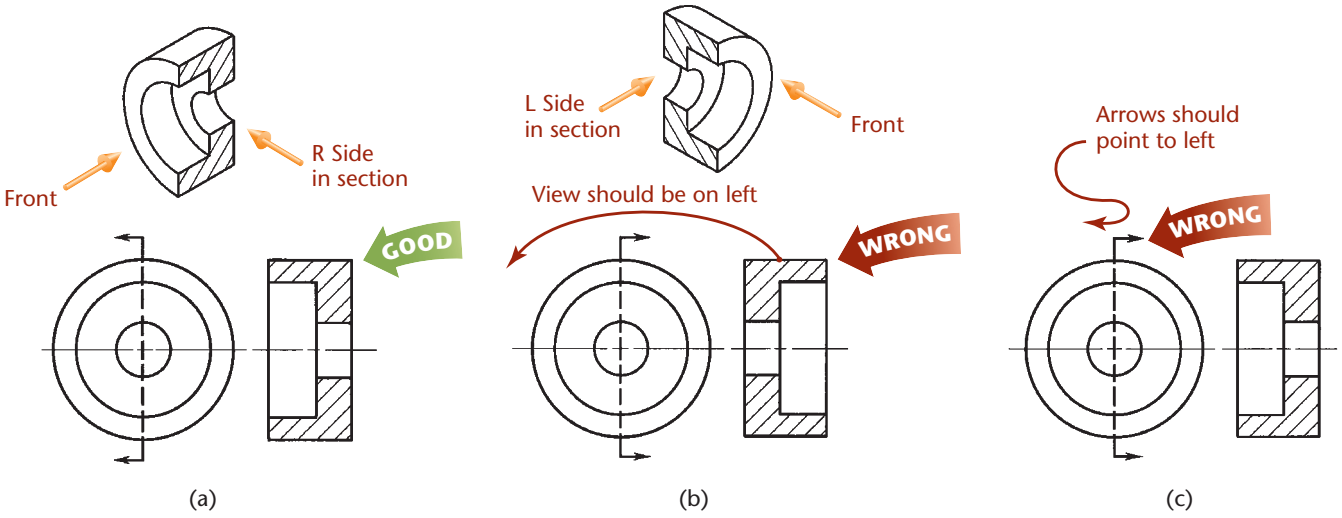
An alternative method for showing the cutting plane is to draw the cutting-line pattern and then draw reference arrows pointing to it in the direction of sight (Figure 14a).

Especially on architectural drawings, the center of the cutting-plane line is often left out and stylized arrows are used to identify the cutting plane (Figure 14b).

The arrows on the cutting-plane lines are made larger than the dimension arrowheads to call attention to the location of sections and removed views. Make the arrows 1.4 times the drawing letter height. Make the view label text 1.4 times the drawing letter height also. For example, an 8.5" × 11" drawing uses text that is .125" (1/8") tall as a minimum, so for this sheet size, use arrows on the cutting plane .175" (about 3/16", or about 4.5 mm) tall (Figure 13).

Visualizing Cutting-Plane Direction

Correct and incorrect relations between cutting-plane lines and corresponding sectional views are shown in Figure 15.



15 Correct and Incorrect Cutting-Plane Line Placement