DWG 001
Blueprint Reading
Line Standards
Drawing Symbols
Instructor Guide
Introduction

Module Purpose
The purpose of the Blueprint Reading modules is to introduce students to production drawings and blueprint reading.

Module Objectives
By the end of all Blueprint Reading modules, students should be able to:

- Describe the Picture Sheet and locate information contained in the three major Picture Sheet areas.
- Locate the Title Block on a drawing and identify the name, purpose of a drawing, and other fields depicted.
- Use the Drawing Numbering System, prefixes, and part numbers.
- Identify and explain the purpose of the un-dimensioned picture sheet as a template.
- Use orthographic projection to complete the third view when given two views.
- Demonstrate conventional line standards and identify callouts, including conventional symbols and fastener symbols.
- Identify the types of views, including Standard views, Detail views, Sectional views, Auxiliary views, and be able to demonstrate the use of cut views and directional arrows.
- Identify types of dimensioning, including Linear, Angular, Arc, Circle and Cylinder, Coordinate, and be able to explain the purpose of tolerancing.

Topics Covered
In this module topics covered include:

Line standards, Extra Views, and Drawing Symbols
- Interpreting standard line practices
- Detail views
- Identifying parts callout
- Fastener and hole symbols
Line Standards, Extra Views, and Drawing Symbols

Introduction

The picture area is Engineering’s answer to a design problem. They put this answer on a drawing using lines and symbols common to the industry. This makes the drawing, which becomes a blueprint, a means of communication between the engineer and the user.

This section will explain how to read and interpret lines, part callouts, and symbols that are shown on a picture sheet. Engineering groups use standard lines, symbols, and drafting procedures to describe information contained on picture sheets.

Many of the conventions used are contained in The American Society of Mechanical Engineers Drawing and Related Documentation Practices such as ASME Y14.5M.

This program provides a fundamental knowledge of blueprint reading. Explanations on more advanced concepts can be found in the applicable documents.

Objectives for this section

At the end of this section, you should be able to:

• Demonstrate how to read and use conventional line standards.
• Identify callouts, including conventional symbols and permanent fastener symbols.

Interpreting Standard Line Practices

Some people believe that it is necessary to be a drafter or engineer to understand a blueprint completely. If this were true, it would be impossible to read a blueprint unless all the steps executed by the drafter were understood. It is obvious that one can read a book without being an author. Similarly, it is possible to read a blueprint without being a drafter.

One characteristic of reading blueprints is reading line standards. Line standards are used to describe all characteristics of detail, assembly, and installation drawings – including all shapes and dimensions.

Remember that the picture sheet of a drawing is made up of only three basic lines – straight, curved, and broken. How they are used and the form they show are the keys to what they tell us.

On the following pages, you will see many of the line symbols common to picture sheets.
Line Standards, Extra Views, and Drawing Symbols (continued)

Line Standards

<table>
<thead>
<tr>
<th>Name</th>
<th>Convention</th>
<th>Description and Application</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visible Lines or Outline</td>
<td></td>
<td>Heavy, unbroken lines. Used to indicate visible edges of an object. Sometimes called object lines.</td>
<td><img src="image1.png" alt="Example" /></td>
</tr>
<tr>
<td>Hidden Lines or Invisible Lines</td>
<td></td>
<td>Medium lines with short, evenly-spaced dashes. Used to indicate concealed edges. The dashes may vary depending on the size of the drawing.</td>
<td><img src="image2.png" alt="Example" /></td>
</tr>
<tr>
<td>Centerlines</td>
<td></td>
<td>Thin lines made up of long and short dashes alternately spaced and consistent in length. Used to indicate symmetry about an axis, and location of centers. Used to indicate travel of a center in motion.</td>
<td><img src="image3.png" alt="Example" /></td>
</tr>
<tr>
<td>Dimension Lines</td>
<td>▲</td>
<td>Thin lines terminated with arrowheads at each end. Used to indicate distance measured. Numerals may appear in the center of the line or at one end.</td>
<td><img src="image4.png" alt="Example" /></td>
</tr>
<tr>
<td>Extension Lines</td>
<td></td>
<td>Thin, unbroken lines. Used to indicate extent of dimensions.</td>
<td><img src="image5.png" alt="Example" /></td>
</tr>
<tr>
<td>Leader</td>
<td>▼</td>
<td>Thin lines terminated with an arrowhead or dot at one end. Used to indicate a part, dimension, or other reference.</td>
<td><img src="image6.png" alt="Example" /></td>
</tr>
</tbody>
</table>
### Line Standards, Extra Views, and Drawing Symbols (continued)

#### Line Standards

<table>
<thead>
<tr>
<th>Name</th>
<th>Convention</th>
<th>Description and Application</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phantom Line</td>
<td></td>
<td>Medium series of one long dash and two short dashes, evenly spaced, ending with a long dash. Used to indicate alternative position of parts, repeated detail, or to show reference parts. Also used to show adjacent parts and variable contours of lines in motion.</td>
<td>[Image]</td>
</tr>
<tr>
<td>Stitch Line</td>
<td></td>
<td>Medium line of short dashes, evenly spaced, and labeled. Used to indicate stitching or sawing.</td>
<td>[Image]</td>
</tr>
<tr>
<td>Break (long)</td>
<td></td>
<td>Thin, solid, ruled lines with freehand zig-zags. Used only if breaks are fairly long. Used to reduce size of drawing required, to delineate object, and to reduce detail.</td>
<td>[Image]</td>
</tr>
<tr>
<td>Break (short)</td>
<td></td>
<td>Thick solid freehand lines. Used to indicate a short break. Shows that an object may be shortened for clarity.</td>
<td>[Image]</td>
</tr>
<tr>
<td>Cutting or viewing plane or view indicator line</td>
<td></td>
<td>Thick solid lines with arrowheads. Heavy broken lines 0.38 to 2.00 inches long, depending on the size of the drawing. Used to indicate direction in which selection of plane is viewed or taken. Shows sectional cuts or auxiliary views.</td>
<td>[Image]</td>
</tr>
</tbody>
</table>
Line Standards, Extra Views, and Drawing Symbols (continued)

Practice Review
Line Standards, Extra Views, and Drawing Symbols

Practice Review (continued)

Write the name of each of the lettered Leader Lines depicted in the drawing.

A. _____ phantom line _____  F. _____ short break _____
B. _____ visible line or outline _____  G. _____ view plane line _____
C. _____ dimension line _____  H. _____ hidden line _____
D. _____ centerline _____  I. _____ long break _____
E. _____ centerline _____  J. _____ extension line _____
Extra Views

Normally, three or even fewer views are adequate to describe an object. However, oblique surfaces and hidden lines can be so difficult to visualize that the drafter may incorporate extra views to aid the mechanic in the visualization of a part, assembly, or installation.

Isometric Views

Many picture sheets show a three-dimensional view, called an isometric view, to provide the blueprint reader a three dimensional context for the parts represented by the orthogonal projections. Isometric views show the three sides of the part. To do this the part is rotated or tilted, so that the viewer can see three sides.

Because tilting causes the lines to shorten, isometric views do not represent a consistent scale throughout the drawing.

Not all parts can be easily described by the three orthogonal views, however. Therefore, the drafter often prepares extra views to depict hidden parts of the drawing, or parts that are oblique to the orthogonal projection.

Consider the following illustration. In the isometric drawing, one part of the item is oblique to all other views. To adequately describe the oblique surface of the item, the drafter will project an extra view on a plane parallel to the oblique surface.

Oblique plane in an isometric drawing
**Viewing Plane Lines**

To properly convey the orientation of an extra view for the blueprint reader, drafters use viewing and cutting plane lines.

Viewing plane lines are used to indicate that an extra view is available in another portion of the picture sheet to help describe the item as seen from another direction.

The arrows on the view indicator point toward the affected surface.

The figure below shows an example of a viewing plane line:

![Viewing Plane Line Example](image)

*Extra view*

Looking in the direction of the arrows

**Cutting Lines**

Cutting lines are similar to viewing lines in that they show the item from another direction. However, cutting lines indicate that an imaginary plane is passed through the item. The extra view is typically a cross-section of the item.

The following depicts examples of cutting lines.
Sectional view

Looking in the direction of the arrows.
Line Standards, Extra Views, and Drawing Symbols (continued)

Practice Review

**Overview**

Ask students to work in pairs for this practice review.

Indicate which view corresponds to the view lines depicted in each drawing below.

1. A

   
   ![View A](image1)

   (a) ![View (a)](image2)

   (b) ![View (b)](image3)

   (c) ![View (c)](image4)

   (d) ![View (d)](image5)

2. C

   
   ![View C](image6)

   (a) ![View (a)](image7)

   (b) ![View (b)](image8)

   (c) ![View (c)](image9)

   (d) ![View (d)](image10)

3. A

   
   ![View A](image11)

   (a) ![View (a)](image12)

   (b) ![View (b)](image13)

   (c) ![View (c)](image14)

   (d) ![View (d)](image15)

4. B

   
   ![View B](image16)

   (a) ![View (a)](image17)

   (b) ![View (b)](image18)

   (c) ![View (c)](image19)

   (d) ![View (d)](image20)

5. A or C

   
   ![View A or C](image21)

   (a) ![View (a)](image22)

   (b) ![View (b)](image23)

   (c) ![View (c)](image24)

   (d) ![View (d)](image25)

6. A

   
   ![View A](image26)

   (a) ![View (a)](image27)

   (b) ![View (b)](image28)

   (c) ![View (c)](image29)

   (d) ![View (d)](image30)

7. A

   
   ![View A](image31)

   (a) ![View (a)](image32)

   (b) ![View (b)](image33)

   (c) ![View (c)](image34)

   (d) ![View (d)](image35)
**Line Standards, Extra Views and Drawing Symbols (continued)**

**Detail Views**

A detail view shows an object or an area of an object in greater detail to clarify that area. The detail view is in the same plane as the principle view. Details are usually drawn in a large scale. The view is identified by a leader type indicator. A heavy dashed circle around the area is an acceptable alternative.

![Detail view](image)

**Detail View Rotation**

Sometimes detail views are rotated to clarify the drawing. They may be rotated in either of two directions – clockwise (CW) or counter-clockwise (CCW).

The amount, in degrees, and the direction of rotation is normally shown with the view identification.

**Auxiliary and Sectional Views**

The views just described are often referred to as auxiliary and sectional views. Auxiliary views are view callouts by view plane lines or detail views. Sectional views are views produced by cutting lines and show cross-sections of components.
Labeling Small Drawings

Some extra views are labeled by placing a letter (or letters) next to each view or cutting line arrow. The letters are then repeated immediately below the extra view. In some cases, the referenced picture sheet is also identified. This type of view labeling is common in unzoned drawings, but is not well-suited to large drawings:

<table>
<thead>
<tr>
<th>View Indicators</th>
<th>View Titles</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A-A</td>
</tr>
<tr>
<td>B</td>
<td>B-B</td>
</tr>
<tr>
<td>IV</td>
<td>IV</td>
</tr>
<tr>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>A-SH 2</td>
<td>A-A SH 2</td>
</tr>
<tr>
<td>III SH 2</td>
<td>III SH 2</td>
</tr>
</tbody>
</table>

Examples of labeling
Labeling Large Drawings

In large drawings where the locations are identified by zones on the picture sheet, the cutting and view lines are more complicated.

To label cutting and view lines on zoned picture sheets, numbers and letters are used to indicate the respective zones in which the view arrows are contained.

In cases where two or more views are taken from one zone, a number is added in front of the zone callout. For example, if there were two views taken from zone B3, one would be 1B3 and the other 2B3. In addition, a zone code is added (as a subscript) to show the location of the view.

If a view is taken from one picture sheet and shown on another, a dash and the number of the picture sheet follow the zone callout. For example, in view 1C5-2A7-6 the “2” is the picture where the view is from, in this case sheet 2. The A7-6 is the zone and picture sheet where it will be displayed, in this case sheet 6.

Below are examples of view labels for zoned picture sheets.

<table>
<thead>
<tr>
<th>View Indicators</th>
<th>View Titles</th>
<th>View Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1B3_C4</td>
<td>1B3</td>
<td>C4, Same Sheet</td>
</tr>
<tr>
<td>2B3-2_C4-6</td>
<td>2B3-2</td>
<td>C4, Sheet 6</td>
</tr>
<tr>
<td>1D5_B5</td>
<td>1D5</td>
<td>B5, Same Sheet</td>
</tr>
<tr>
<td>See 1D5_B5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1A4_A9</td>
<td>1A4</td>
<td>A9, Same Sheet</td>
</tr>
<tr>
<td>1D5-2_B3-4</td>
<td>1D5-2</td>
<td>B3, Sheet 4</td>
</tr>
</tbody>
</table>

View labels for zoned picture sheets
Line Standards, Extra Views, and Drawing Symbols (continued)

Practice Review

Note: This drawing is rotated 90°.

1. The arrows of a cutting line on a sectional view are telling you the direction you are to look.

![Diagram]

2. In what zone is the sectional view depicted for the view arrow labeled 2C4? C2
3. In the view labeled 1C3, what does C3 indicate? 
   **The zone from which the sectional view is taken.**

4. View arrow 1B5 has A4-2 next to it. What does this label mean?
   **The auxiliary view is at zone A4 on sheet 2.**

5. What view label is at A4? **1A6**
Identifying Parts Callouts

On the picture sheet, parts are identified by their part number.

The end product of the drawing — sometimes known as the end item — is identified with its dash number only. The dash number will be located below the principal view. It may also include the abbreviation ASSY (for assembly) or INSTL (for installation).

When complete part numbers (drawing number plus the dash number) are shown in the picture sheet, the blueprint reader will need to refer to the respective drawing number to view the detailed part.

All parts, except the view label, are called out with the use of leader lines that point to the edge of the part they are associated with.

With the exception of common shop items such as fasteners, all part numbers shown on the picture sheet will be called out in the parts list.
Find Numbers and Reference Callouts

A find number is a method for cross-referencing an item from the picture area of the drawing to the parts list. It is a substitute for a part number as a callout on the picture sheet. It is referenced in an enclosed circle.

When items are identified with phantom lines for reference purposes, the drawing number is shown without a dash number, and the letters REF are shown after the number.

Using find numbers
Many fasteners are common shop items; they are commonly used items purchased in bulk quantities, such as nuts, bolts, rivets, shims, etc.

Shop distribution standards are shown on the picture sheet, but are not always listed in the parts list. When a bolt, screw, or nut is depicted on a drawing, the part number is printed on the head or connected to it by a leader line such as in the example below.

The callout sometimes includes, besides the bolt or screw number, the number of the washer and the nut that goes with it.

![Example of fastener callouts](image)

A complete picture of the fastener is not necessary. Instead, a blank cross can be used to identify the location and type of fastener.

![Example of fastener, washer, and nut callouts](image)
The fastener symbol may include a two- or three-letter code for the type of fastener. The diameter of the fastener will be depicted in 32nds of an inch.

**Box around fastener code indicates fluid tight installation.**

**Typical fastener codes**


- **XZJ 6N**: 6/32-inch diameter lockbolt, pull type, pan head material, 3/4-inch nominal grip BACB30GWBA12, install with NAS108E5 collar. Protruding head far side. (Lockbolts require hole sizes to be shown on drawing.)
**Picture Sheet Fastener Notes**

When fastener symbols are shown on the picture sheet, the drawing includes a fastener symbol code block that cross-references the fastener code with the part number of the fastener. The fastener symbol code block is in the upper-right corner next to the revision block. It may also be accompanied by special fastener notes.

---

**Fastener notes on the picture sheet**
Fastener Holes

Hole sizes for hi-shear rivets, lock bolts, screws, bolts, and special fastening devices will be called out on the blueprint.

There is a distinct difference between fastener callouts and hole size callouts. A fastener callout, for other than common rivets, does not give the authority for drilling or reaming a hole. The mere fact that a ¼-inch bolt is required in a certain location does not authorize the shop mechanic to drill a ¼-inch hole. In some cases, the forces acting on the structure make it mandatory that a very close fit exists between bolt and hole. In other cases it is desirable that a loose fit be maintained. The shop mechanic, not knowing what type of load will be exerted on the bolt, cannot determine what type fit should exist. In other words, the mechanic must rely entirely on the blueprint and the BAC specification for that information.

Fastener hole sizes may be stated in either of two ways: by drill size (#11, F, etc.) or by decimal size (.191, .257, etc.). Decimal size callouts usually include a desired or nominal size, a minimum size, and a maximum size.

Illustrating nominal, minimum, and maximum dimensions
Multiple Patterns

Fastener callouts may appear as below. The callout appears in only one location and bears the notation (number of) PLACES.

\[
\text{BACB30LU3–6} \\
\text{NAS1149D0332J 3 REQD} \\
\text{BACN10JC3} \\
\text{INSTALL 2 WASHERS} \\
\text{UNDER BOLT HEAD} \\
\text{2 PLACES}
\]

Using multiple patterns

A complete symbol doesn’t need to be drawn in each place when all fasteners are identical. Instead, a blank cross is used for all duplicate fasteners.

Fastener diameters are measured in 32nds of an inch and grip lengths are measured in 16ths of an inch.

Depicting fastener types
Countersinking and Dimples

In addition to fasteners and hole callouts, you will encounter other special representations such as countersinking, dimpling, tool holes and coordination holes.

Countersinking and dimpling instructions for rivets, high-shear rivets, and lockbolts are given by the symbols used to identify these fasteners. On some drawings, countersinking instructions contain a dimension for countersink diameter. This is to ensure against high fastener heads after installation.

Countersinking and Dimples (continued)

Depicting countersinking and dimpling
Tool Hole Symbols

Tool holes are necessary in all parts made by routing. They are used to clamp the part to the router table during the routing operation, and are used in subsequent stages of fabrication to locate the parts on forming dies and assembly jigs. Standard tool hole size is .247 to .260. However, a few drawings call for size .091 to .104.

Coordinating Hole Callouts

Coordinating holes, or K holes, are used for assembling two or more parts without the use of jigs, or for accurately locating parts in assembly jigs. K holes are located and indicated on the drawing at the request of the Tooling Section. K holes may be any size requested by Tooling.
Nut Plates

A great many nut plates of various sizes and types are required on an airplane. The symbols used in drawings look very much like actual nut plates, except that they are schematics, not pictures. For example, the holes are often shown as simple centerlines.

Abbreviated symbols, as shown below, may be used where several nut plates are required in one area on the drawing. The part number will usually appear near one of the symbols, with the notation (number of) PLACES.

```
+       +       +
+       +       +
+       +       +
AN366F1032
(3 PLACES)
```

The symbols are usually altered to make it easier to tell one nut plate from another if several different sizes or types are required in one area. Rivets used to attach a nut plate are specified by means of rivet symbols; they are not part of the nut plate symbol.
# Common Symbols

<table>
<thead>
<tr>
<th>Name</th>
<th>Convention</th>
<th>Description and Application</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centerline</td>
<td>![CL]</td>
<td>Designates the center plane of an object when used in conjunction with a centerline.</td>
<td><img src="image" alt="Example" /></td>
</tr>
<tr>
<td>Flag Indicator</td>
<td><img src="image" alt="Flag" /></td>
<td>Numbers, letters, or symbols are drawn inside the flag to indicate a cross-reference. Notes: Letters or symbols are only for special applications.</td>
<td><img src="image" alt="Example" /></td>
</tr>
<tr>
<td>Directional Indicator</td>
<td><img src="image" alt="Directional" /></td>
<td>Shows the relationship of a view to airplane coordinates and the perspective of an object.</td>
<td><img src="image" alt="Example" /></td>
</tr>
<tr>
<td>Fastener Location</td>
<td><img src="image" alt="Fastener Location" /></td>
<td>The number in the fastener hole location symbol designates the fastener diameter in 32nds of an inch.</td>
<td><img src="image" alt="Example" /></td>
</tr>
<tr>
<td>5/32 dia Fastener Location</td>
<td><img src="image" alt="5/32" /></td>
<td>5</td>
<td><img src="image" alt="Example" /></td>
</tr>
<tr>
<td>Fastener Callout</td>
<td><img src="image" alt="XD" /></td>
<td>5</td>
<td><img src="image" alt="Example" /></td>
</tr>
<tr>
<td>K, 6/ Coordinating Hole</td>
<td><img src="image" alt="K" /></td>
<td>These holes are production facilities used to coordinate tools for example, to install parts, assemblies, or installations.</td>
<td><img src="image" alt="Example" /></td>
</tr>
</tbody>
</table>

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**Common Symbols (continued)**

<table>
<thead>
<tr>
<th>Name</th>
<th>Convention</th>
<th>Description and Application</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Tooling Coordinated Surface</td>
<td>$</td>
<td>Used for agreed-upon critical engineering and tooling reference surfaces.</td>
<td></td>
</tr>
<tr>
<td>Tooling Holes</td>
<td>T</td>
<td>Holes used in the fabrication of detail parts. They hold parts in place during manufacturing operations.</td>
<td>OML</td>
</tr>
<tr>
<td>Station Indicator</td>
<td>STA 360</td>
<td>Used to designate stations (STA), waterlines (WL), and buttock lines (BL).</td>
<td></td>
</tr>
<tr>
<td>Limited Release Indicator</td>
<td>00</td>
<td>Limited, see assembly breakdown list for release.</td>
<td>NAS 1801-3-B NAS 1800-3-FI</td>
</tr>
</tbody>
</table>
### Overview
Memorizing these symbols will help students improve their ability to read blueprints. Match 1 – 19 by placing the letter next to the symbol it corresponds with.

Match 1-8 with the items in the right column.

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1. D |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | A. Hidden Line
| 2. C |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | B. Dimension Line
| 3. E |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | C. Visible Line
| 5. G |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | E. Centerline
| 6. B |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | F. Break
| 7. A |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | G. Sectional Views (Cut View)
| 8. F |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | H. Leader Line
### Line Standards, Extra Views, and Drawing Symbols

**Practice Review (continued)**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9. <strong>E</strong></td>
<td><img src="image" alt="FT 6" /></td>
<td>A. Limited Release</td>
</tr>
<tr>
<td>10. <strong>H</strong></td>
<td>![Cross]</td>
<td>B. Tooling Hole</td>
</tr>
<tr>
<td>11. <strong>G</strong></td>
<td><img src="image" alt="Flagnotes" /></td>
<td>C. Flagnotes</td>
</tr>
<tr>
<td>12. <strong>C</strong></td>
<td><img src="image" alt="Centerline" /></td>
<td>D. Centerline</td>
</tr>
<tr>
<td>13. <strong>A</strong></td>
<td><img src="image" alt="00" /></td>
<td>E. Fastener Callout</td>
</tr>
<tr>
<td>14. <strong>F</strong></td>
<td><img src="image" alt="Station Indicator" /></td>
<td>F. Station Indicator</td>
</tr>
<tr>
<td>15. <strong>D</strong></td>
<td><img src="image" alt="5/32 Fastener hole location" /></td>
<td>G. 5/32 Fastener hole location</td>
</tr>
<tr>
<td>16. <strong>I</strong></td>
<td><img src="image" alt="Fastener Location" /></td>
<td>H. Fastener Location</td>
</tr>
<tr>
<td>17. <strong>B</strong></td>
<td><img src="image" alt="Directional Indicator" /></td>
<td>I. Directional Indicator</td>
</tr>
</tbody>
</table>

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Line Standards, Extra Views, and Drawing Symbols

Practice Review (continued)

18. **K**

<table>
<thead>
<tr>
<th>BAC63CNF3-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN303D1CL</td>
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<td>BACN10J3</td>
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J. K or Coordinating Hole

19. **J**

K. Fastener Callout (Removable Fastener)

Turn to Drawing 254T1201, sheet 2 and answer the following questions:

1. In the fastener symbol block shown on this drawing, what fastener does XPH refer to? **BACR15DR( )-()**

2. According to the fastener symbols shown, which of the fasteners is a 5/32 fastener? **YTV (BACB30VT + BACC30B2 ()**

3. Look at the fastener location H38, shown in zone B8. What does the fastener symbol depicted indicate? **Fastener BACR15DR( )-() at two places with .0970 -.1010 diameter hole, 3/32 diameter fastener with head on far side.**

4. What fastener is required for the three identical places shown at A7? **YTV (BACB30VT + BACC30B2 ()**

5. What fasteners are needed for the holes indicated in auxiliary view 1D8? **Two ZCB (BACR15BA ( ) AD ( ) C**

6. What are the maximum and minimum dimensions for the hole designated H25 at zone A6? **.1320 -.1290**
Summary

This section introduced students to various features found on picture sheets; including line standards, callouts, and some of the symbols that they will frequently encounter.

Line standards are used to describe the shape and dimensions of items contained in engineering drawings. Line standards are numerous but are necessary to depict objects. Many times the usual views of an item are not sufficient to describe the item clearly. Extra views are incorporated into drawings to provide blueprint readers additional clarification of the item as seen from a different direction.

The isometric view is a three-dimensional representation of the item. In an isometric view you can see three sides of an object simultaneously. Because isometric views are not orthogonal views, their representations do not accurately reflect the dimensions of the object.

Extra views are depicted with the use of viewing plane lines and cutting lines. Viewing plane lines offer the blueprint reader another orthogonal projection in the direction being viewed.

Cutting plane lines offer the blueprint reader a cross-section of the item to look as if the item was sliced into two pieces.

Occasionally, blueprints will display a detail view. This isn’t to be confused with detail picture sheets. Detail views enlarge part areas or show complex dimensions in greater detail.

In drafting, view plane lines and detail views are called auxiliary views. Cutting lines depict sectional views.

Numerous labeling conventions direct the blueprint reader to extra views. These labeling conventions indicate the title and location of the view on picture sheets. In addition they may identify part callouts and components such as fasteners and holes.