NONRESIDENT TRAINING COURSE

September 2015

Blueprint Reading and Sketching

NAVEDTRA 14040A

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SYM	DESCRIPTION	BY	DATE	APPD
A	REVISED BM LINE ITEM NO. 2	CDN	11/90	

REVISIONS

FUNCTIONAL COMPONENTS DEPARTMENT			
	ARCH CIVIL	ELEC	MECH
DSGN			
DRAFT	CDN		
DSGN CK			
MTD			
PROJECT MGR	A. Sominsky		
ENGR DIR			
SYSTEM MGR	R.K. Nukushina		
CONST DIR			
SATISFACTORY TO			
TITLE		DATE	
APPROVED		DATE	
J. Fung, P. E. FOR COMMANDER NAVFAC		6/02/87	

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

CIVIL ENGINEER SUPPORT OFFICE ← Name of Local Activity

NAVAL CONSTRUCTION BATTALION CENTER — PORT HUENEME, CALIFORNIA

NAVAL CONTROL OF SHIPPING OFFICE

SIZE	CODE IDENT NO	NAVFAC DRAWING NO	
	80091	6271415 ← Number Assigned by NAVFACENGCOM Western Division	
		ABFC SYS NO	14013
SCALE	3/8"=1"-0"		SHEET 1 OF 1

Figure 1-1 — Title block.

Revision Block

If a revision has been made, the revision block will be in the upper right corner of the blueprint, as shown in *Figure 1-2*. All revisions in this block are identified by a letter and a brief description of the revision. A revised drawing is shown by the addition of a letter to the original number, as in *Figure 1-2*. When the print is revised, the letter A in the revision block is replaced by the letter B, and so forth.

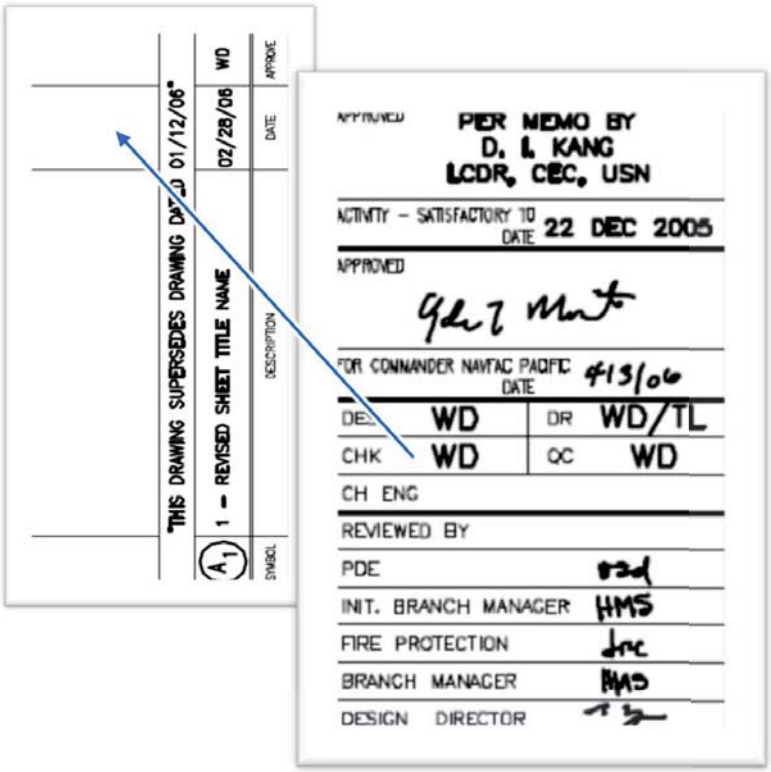


Figure 1-2 — Revision block.

Drawing Number

Each blueprint has a drawing number (*Figure 1-1*), which appears in a block in the lower right corner of the title block. The drawing number can be shown in other places, for example, near the top border line in the upper corner or on the reverse side at the other end so it will be visible when the drawing is rolled. On blueprints with more than one sheet, the information in the number block shows the sheet number and the number of sheets in the series. For example, the title blocks have SHEET 1 of 1 (*Figure 1-1*).

Reference Number

Reference numbers that appear in the title block refer to numbers of other blueprints. A dash and a number show that more than one detail is shown on a drawing. When two parts are shown in one detail drawing, the print will have the drawing number plus a dash and an individual number. An example of a reference number would be 6271415-1 in the lower right corner of the title block.

In addition to appearing in the title block, the dash and number may appear on the face of the drawings near the parts they identify. Some commercial prints use a leader line to show the drawing

and dash number of the part. Others use a circle 3/8 inch in diameter around the dash number, and carry a leader line to the part.

A dash and number identify changed or improved parts and right- and left-hand parts. Many aircraft parts on the left-hand (LH) side of an aircraft are mirror images of the corresponding parts on the right-hand (RH) side. The LH part is usually shown in the drawing.

Some parts are on the LH side, and some are on the RH side. On some prints you may see a notation above the title block, such as 159674 LH shown or 159674-1 RH opposite. Both parts carry the same number. Some companies use odd numbers for RH parts and even numbers for LH parts.

Zone Number

Zone numbers serve the same purpose as the numbers and letters printed on borders of maps to help you locate a particular point or part. To find a point or part, you should mentally draw horizontal and vertical lines from these letters and numerals. These lines will intersect at the point or part you are looking for.

You will use practically the same system to help you locate parts, sections, and views on large blueprinted objects (for example, assembly drawings of aircraft). To find parts numbered in the title, look up the numbers in squares along the lower border. Read zone numbers from right to left.

Scale Block

The scale block (*Figure 1-1*) in the title block of the blueprint shows the size of the drawing compared with the actual size of the part. The scale may be shown as 1″= 2″, 1″= 12″, 1/2″= 1′, and so forth. For example, the drawing may be shown as full size, one-half size, or one-fourth size.

If the scale is shown as 1″= 2″, each line on the print is shown one-half its actual length. If a scale is shown as 3″= 1″, each line on the print is three times its actual length.

The scale is chosen to fit the object being drawn and the space available on a sheet of drawing paper.

Never measure a drawing; use dimensions. The print may have been reduced in size from the original drawing, or you might not take the scale of the drawing into consideration. Paper stretches and shrinks as the humidity changes. Read the dimensions on the drawing; they always remain the same.

Graphical scales on maps and plot plans show the number of feet or miles represented by an inch. A fraction such as 1/500 means that 1 unit on the map is equal to 500 like units on the ground. A large-scale map has a scale of 1″= 10′; a map with a scale of 1″= 1,000′ is a small-scale map. The following chapters of this manual have more information on the different types of scales used in technical drawings.

Station Number

A station on an aircraft may be described as a rib. Aircraft drawings use various systems of station markings. For example, the center line of the aircraft on one drawing may be taken as the zero station. Objects to the right or left of center along the wings or stabilizers are found by giving the number of inches between them and the center line zero station. On other drawings, the zero station may be at the nose of the fuselage, at a firewall, or at some other location, depending on the purpose of the drawing. Station numbers for a typical aircraft are illustrated in *Figure 1-3*.

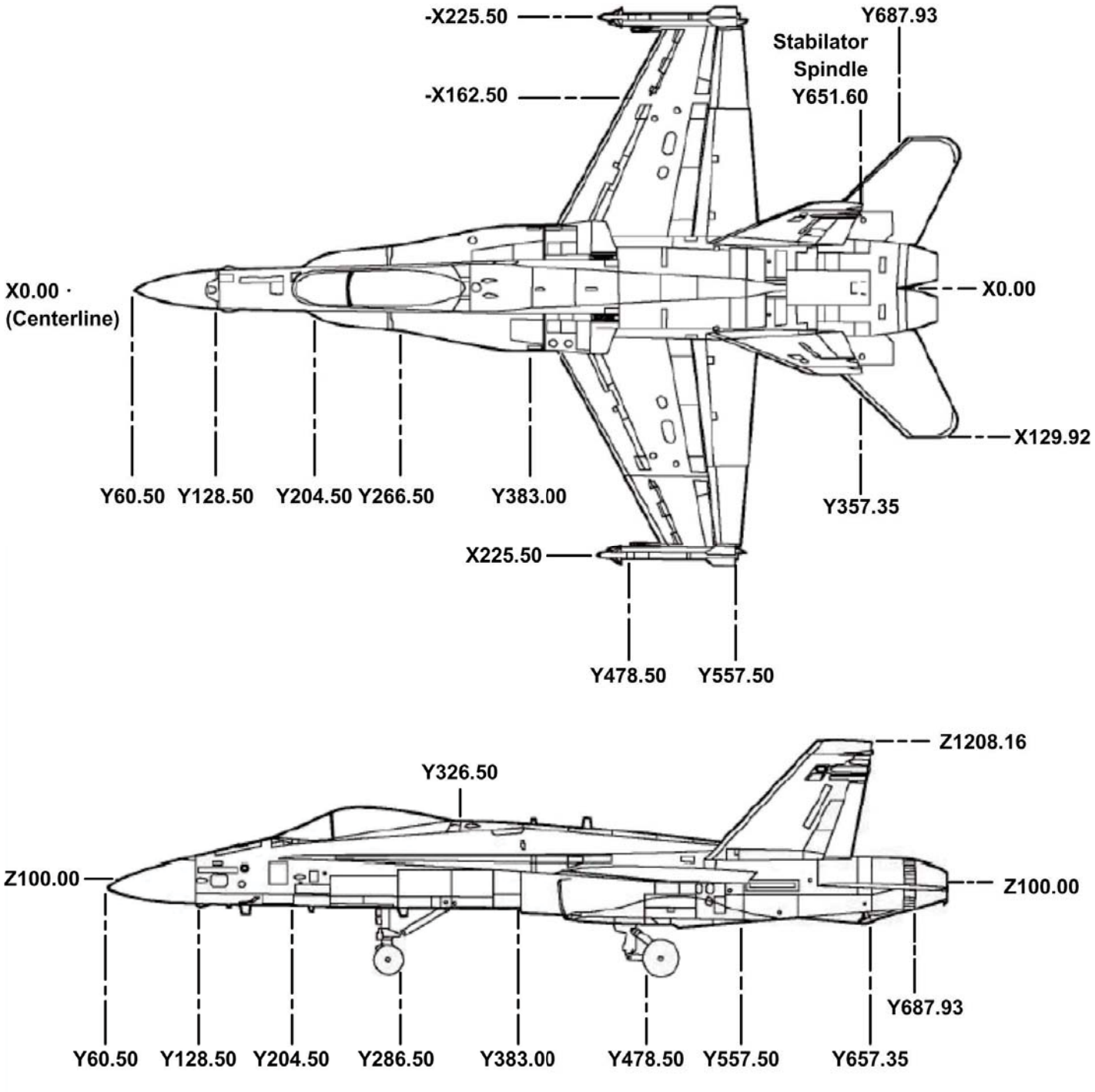


Figure 1-3 — Aircraft stations and frames.

Bill of Material

The bill of material block contains a list of the parts and/or material needed for the project. The block identifies parts and materials by stock number or another appropriate number, and lists the quantities requited.

The bill of material often contains a list of standard parts, known as a parts list or schedule. A bill of material for an electrical plan is illustrated in *Table 1-2*.

Table 1-2 — Sample of Bill of Material

BILL OF MATERIAL					
ITEM	DESCRIPTION	UNIT	ASSEMBLY OR FSN NO.	QUANTITIES	
				TROP	NORTH
3-1	LIGHTING CIRCUIT – NAVFAC DWG. NO. 203414	FT	3016	3	16
3-2	POWER BUS, 100A – NAV DWG. NO. 30413 1	FT	3047	1	20
3-3	RECEPTICAL CKT – NAV DWG. NO. 303660	EA	3019	2	1
3-4	BOX, RECEPTACLE W/CLAMP FO NONMETALLIC SHEATH WIRE	EA	5325-102-604	3	1
3-5	LAMP, ELECTRIC, MED BASE, INSTIDE FROSTED, 200 W, 120 V	EA	6240-180-314	60	6
3-6	PLUG: ATTACHMENT, 3 WIRE, 15 AMP, 125 V	HD	5936-102-309	10	1
3-7	PLATE: BRASS, DUPLEX RECEPTACLE	EA	5325-100-101	5	6
3-8	RECEPTACLE, DUPLEX, 3 WIRE, 15 AMP, 125 V	EA	5325-100-102	5	1
3-9	RCO, GROUND, 3/4″ X 10′ 0″	EA	3325-800-101	12	1
3-10	WIRE NO 2 1/C STRANDED, HARD DRAWN, BARE	EA	6143-134-200	52	1
3-11	SWITCH, SAFETY 2 P, ST 30 AMP, 250 V PLUS FUSE	EA	5930-142-401	2	1
3-12	CLAMP, GROUND ROD	EA	5009-100-101	13	13
3-13	SWITCH, SAFETY, 200 AMP, 250 V, 3 P	EA	6930-201-903	1	1
3-14	FUSE, RENEWABLE 200 AMP, 250 V	EA	6920-100-000	6	6
3-15	LINK FUSE, 200 AMP, 250 V	EA	6920-100-001	6	6
3-16	FUSE PLUG, 30 AMP, 125 V	EA	6920-100-102	12	12

Application Block

The application block on a blueprint of a part or assembly (*Table 1-3*) identifies directly or by reference the larger unit that contains the part or assembly on the drawing. The next assembly (NEXT ASS'Y) column will contain the drawing number or model number of the next larger assembly of which the smaller unit or assembly is a part. The USED ON column shows the model number or equivalent designation of the assembled unit's part.

Table 1-3 — Application Block

2A	1AB
NEXT ASS'Y	**USED ON**
APPLICATION	

Finish Marks

Finish marks (P) (*Figure 1-4*) used on machine drawings show surfaces to be finished by machining. Machining provides a better surface appearance and a better fit with closely mated parts. Machined finishes are NOT the same as finishes of paint, enamel, grease, chromium plating, or similar coatings.

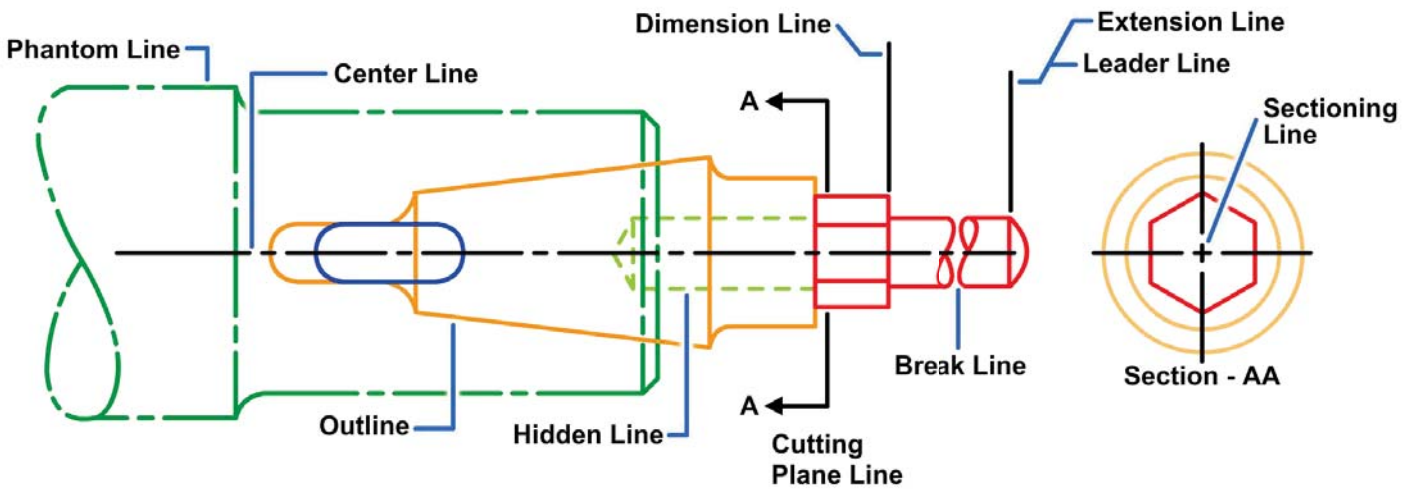


Figure 1-4 — Finish marks.

Notes and Specifications

Blueprints show all of the information about an object or part graphically. However, supervisors, contractors, manufacturers, and craftsmen need more information, and not all information is adaptable to the graphic form of presentation. Such information is shown on the drawings as notes or as a set of specifications attached to the drawings.

Notes

Notes (*Figure 1-5*) are placed on drawings to give additional information to clarify the object on the blueprint. Leader lines show the precise part notated.

Specifications

A specification (*Figure 1-6*) is a statement or document containing a description, such as the terms of a contract or details of an object or objects not shown on a blueprint or drawing. Specifications describe items so they can be manufactured, assembled, and maintained

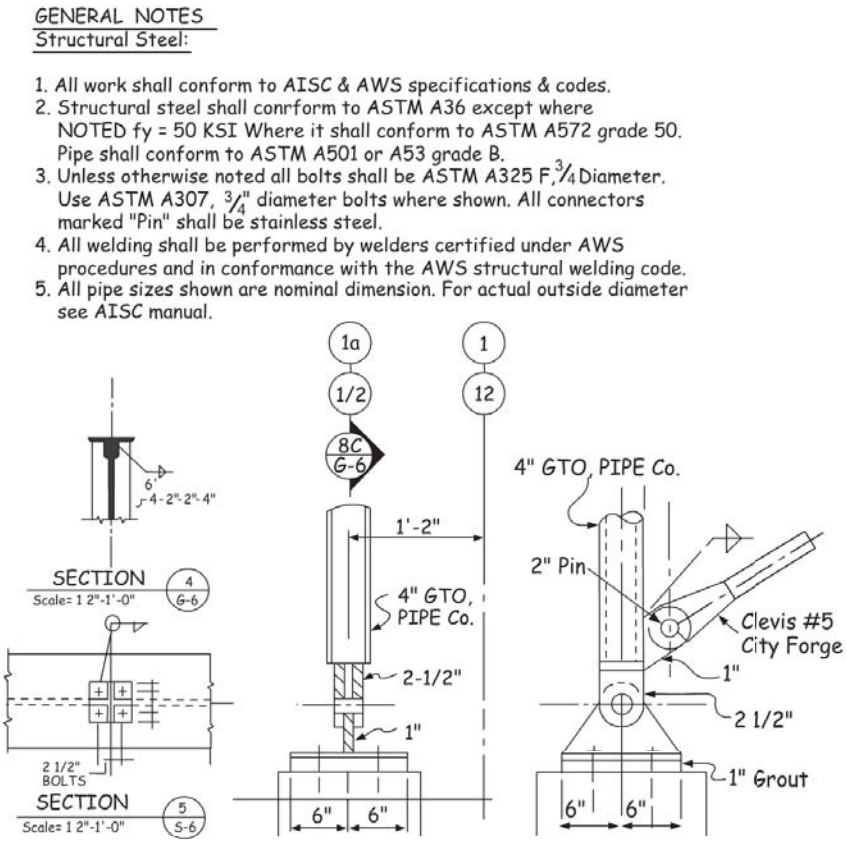


Figure 1-5 — Example of blueprint notes.

according to their performance requirements. They furnish enough information to show that the item conforms to the description and that it can be made without the need for research, development, design engineering, or other help from the preparing organization.

Federal specifications cover the characteristics of material and supplies used jointly by the Navy and other Government departments.

Legends and Symbols

A legend, if used, is placed in the upper right corner of a blueprint below the revision block. The legend explains or defines a symbol or special mark placed on the blueprint. An example of a blueprint legend is shown in *Figure 1-7*.

SPECNOTES	
00 00 01.A2	DUMPSTER (NIC)
05 52 13.A2	DUAL 1 1/2" O.D. PIPE HANDRAILS AT 2'-4" AND 3'-0" ELEVATIONS; MOUNT TO GUARDRAIL OR WALL WITH MINIMUM 2 1/4" CLEARANCE; SEE 2+6/A514
05 52 13.A4	TYPICAL 42" GUARDRAIL; SEE 3+5/A514
10 73 13.A1	PREFINISHED ALUMINUM CANOPY SUPPORT FRAME
10 73 16.A1	DOCK BUMPERS ATTACHED TO VERTICAL WALL
22 00 60.C1	GREASE TRAP; SEE PLUMBING
23 00 50.A1	HVAC EQUIPMENT; SEE MECHANICAL
32 13 19.A1	SLIDING ALUMINUM GATE
33 00 00.A1	GAS METER (NIC)

Figure 1-6 — Example of blueprint specifications.

LEGEND	
TB#	TACKBOARD; SEE A443
MB#	MARKERBOARD; SEE A443
TS	TACK STRIP; SEE A443
SB	SMART BOARD; SEE TELECOM
AWP	ACOUSTIC WALL PANELING
C#	CASEWORK ELEVATION; SEE A441 - A443
℄	CENTERLINE
B_o	BOLLARD; SEE 7/A513
DS	DOWNSPOUT
IJ	ISOLATION JOINT
RD	ROOF DRAIN
OS	OVERFLOW SCUPPER; SEE PLUMBING
EJ	EXPANSION JOINT; SEE VARIOUS DETAILS SHEET A516
GR	GUARDRAIL; SEE 3+5/A514
LV1	LOUVER; SEE WINDOW TYPES
M.O.	MASONRY OPENING
FEC	SEMI-RECESSED FIRE EXTINGUISHER CABINET
FE	WALL BRACKET MOUNTED FIRE EXTINGUISHER
A1	WINDOW TAG; SEE WINDOW TYPES
157-A	DOOR TAG; SEE DOOR SCHEDULE
A1	WALL TAG; SEE A321 AND A322
CC	COT CURTAIN

Figure 1-7 — Blueprint legend.

THE MEANING OF LINES

To read blueprints, you must understand the use of lines. The alphabet of lines is the common language of the technician and the engineer. In drawing an object, the different views are arranged in a certain way, and then different types of lines convey the information. The use of standard lines in a simple drawing is shown in *Figure 1-4*. Line characteristics, such as width, breaks in the line, and zigzags, have meaning, as shown in *Figure 1-8*.

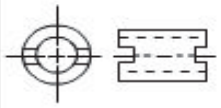
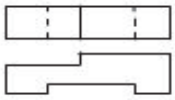
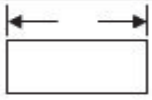
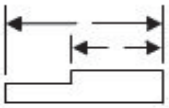
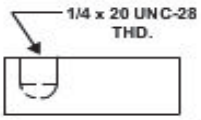
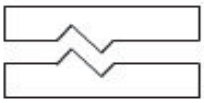
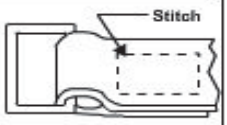
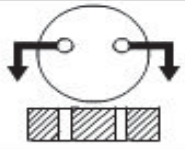
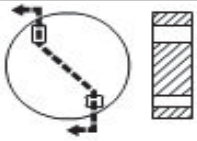
LINE STANDARDS			
Name	**Convention**	**Description and Application**	**Example**
Center Lines		Thin lines made up of long and short dashes alternately spaced and consistent in length. Used to indicate symmetry about an axis and location of centers.	
Visible Lines		Heavy unbroken lines Used to indicate visible edges of an object	
Hidden Lines		Medium lines with short evenly spaced dashes Used to indicate concealed edges	
Extension Lines		Thin unbroken lines Used to indicate extent of dimensions	
Dimension Lines		Thin lines terminated with arrow heads at each end Used to indicate distance measured	
Leader		Thin line terminated with arrowhead or dot at one end Used to indicate a part, dimension or other reference	
Break (Long)		Thin, solid ruled lines with freehand zigzags Used to reduce size of drawing required to delineate object and reduce detail	
Break (Short)		Thick, solid free hand lines Used to indicate a short break	
Phantom or Datum Line		Medium series of one long dash and two short dases evenly spaced ending with long dash Used to indicate alternate position of parts, repeated detail or to indicate a datum plane	
Stitch Line		Medium line of short dases evenly spaced and labeled Used to indicate stitching or sewing	
Cutting or Viewing Plane Viewing Plane Optional		Thick solid lines with arrowhead to indicate direction in which section or plane is viewed or taken	
Cutting Plane for Complex or Offset Views		Thick short dashes Used to show offset with arrowheads to show direction viewed	

Figure 1-8 — Line characteristics and conventions for MIL-STD drawings.

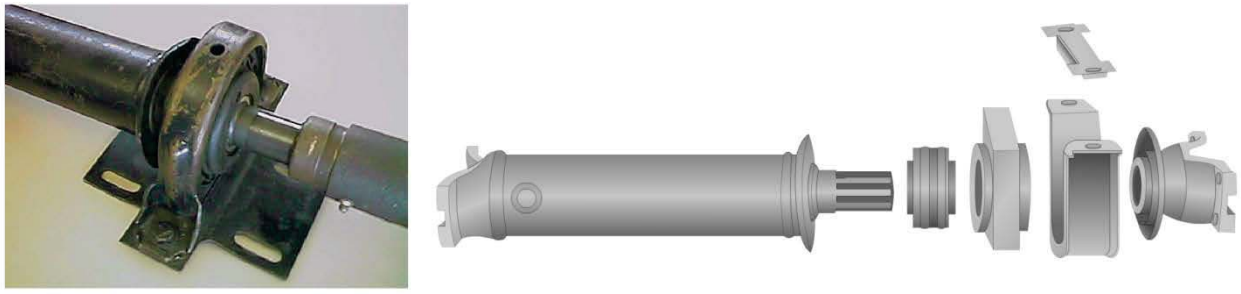


Figure 3-37 — Exploded view.

Detail Drawings

A detail drawing (*Figure 3-38*) is a print that shows a single component or part. It includes a complete and exact description of the part's shape and dimensions, and how it is made. A complete detail drawing will show in a direct and simple manner the shape, exact size, type of material, finish for each part, tolerance, necessary shop operations, number of parts required, and so forth. A detail drawing is not the same as a detail view. A detail view shows part of a drawing in the same plane and in the same arrangement, but in greater detail and to a larger scale than in the principal view.

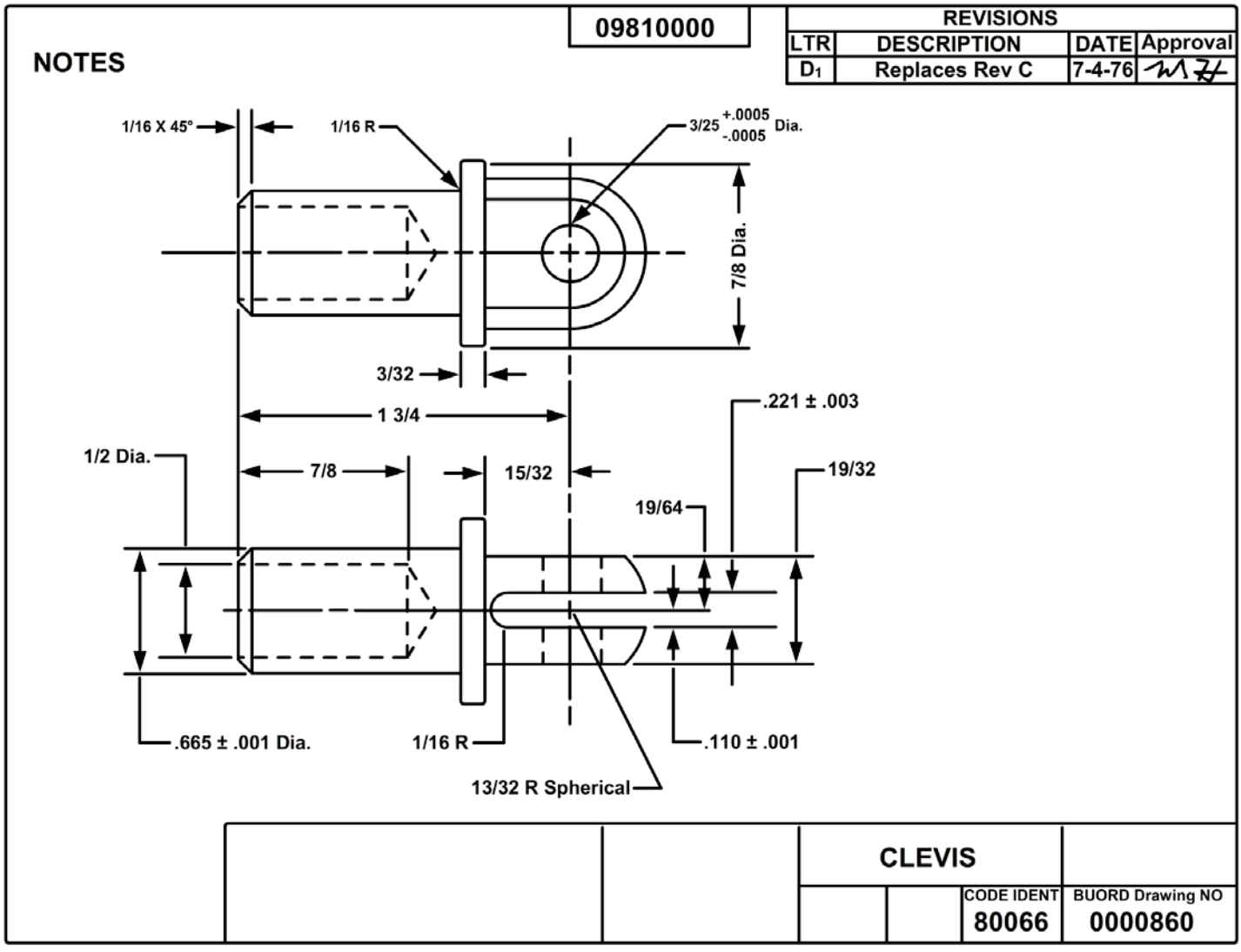


Figure 3-38 — Detail drawing of a clevis.

Study *Figure 3-38* closely and apply the principles for reading two-view orthographic drawings. The dimensions on the detail drawing in *Figure 3-38* are conventional, except for the four tolerance dimensions given. In the top view, on the right end of the part, is a hole requiring a diameter of 0.3125 +0.0005, but no minus (–). This indication means that the diameter of the hole can be no less than 0.3125, but as large as 0.3130. In the bottom view, on the left end of the part, there is a diameter of 0.665 ±0.001. This plus and minus dimension means the diameter can be a minimum of 0.664, and a maximum of 0.666. The other two tolerance dimensions given are at the left of the bottom view. An isometric view of the clevis is shown in *Figure 3-39*.

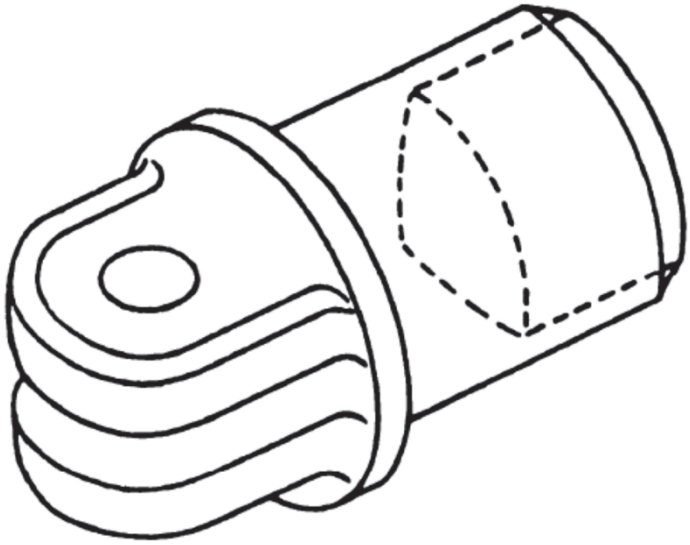


Figure 3-39 — Isometric drawing of a clevis.

An isometric drawing of the base pivot is shown in *Figure 3-40*. The base pivot is shown orthographically in *Figure 3-41*. You may think the drawing is complicated, but it really is not. It does, however, have more symbols and abbreviations than this training manual has shown you so far.

Various views and section drawings are often necessary in machine drawings because of complicated parts or components. It is almost impossible to read the multiple hidden lines necessary to show the object in a regular orthographic print. For this reason machine drawings have one more view that shows the interior of the object by cutting away a portion of the part. You can see this procedure in the upper portion of the view on the left of *Figure 3-41*.

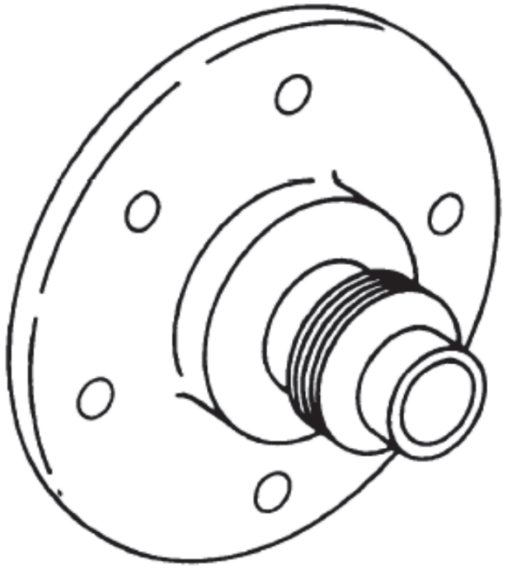


Figure 3-40 — Isometric drawing of a base pivot.

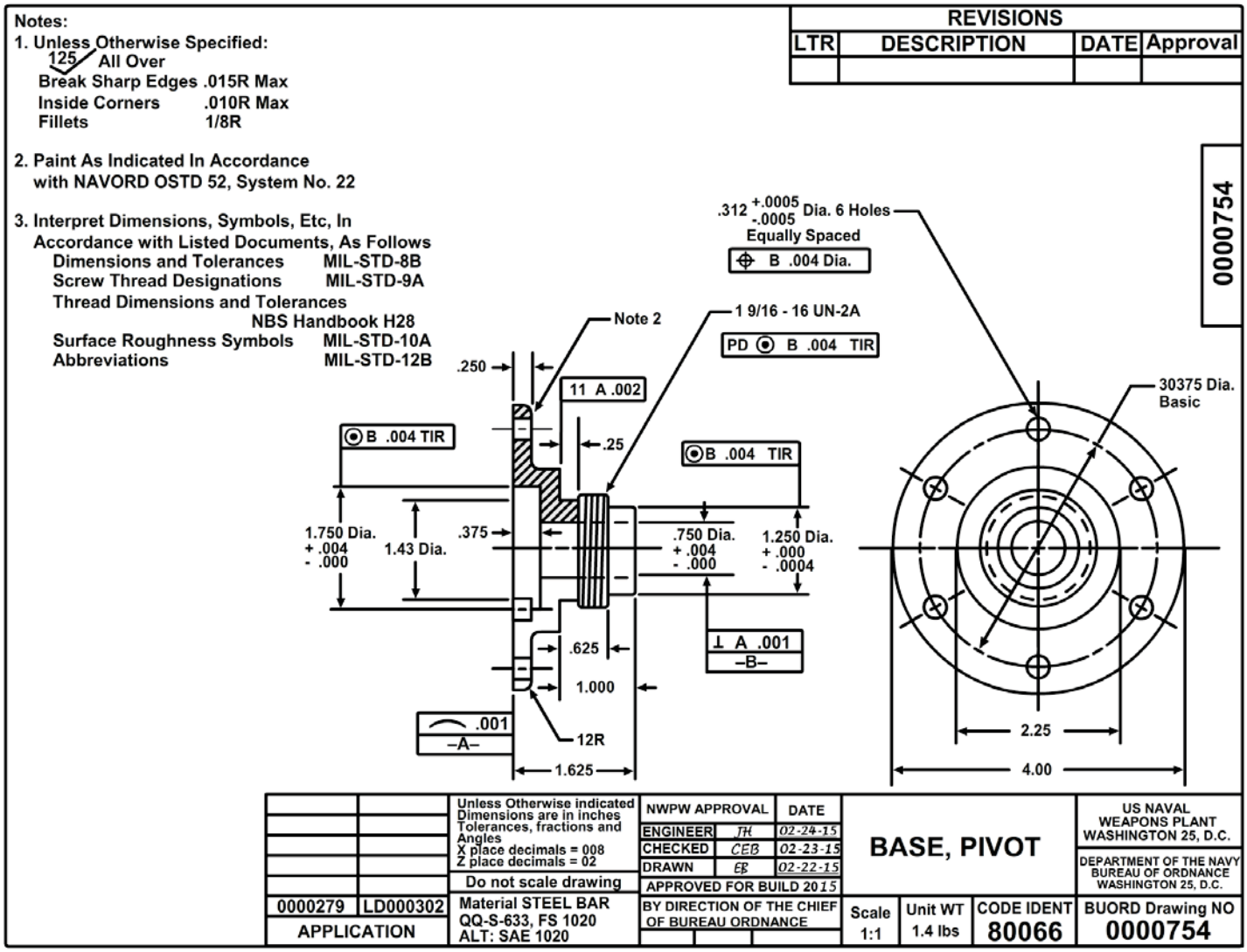


Figure 3-41 — Detail drawing of a base pivot.