UNIT E: Working Drawings

Competency: D505.00

Demonstrate working drawing principles and techniques.

Objective: D505.01

Explain the concepts and principles underlying the creation of detailed drawings.

Introduction: The purpose of this unit is to show that working drawings give all the information needed to manufacture or build a single part or a complete machine or structure. Working drawings must be complete and clear, and they must conform to drafting standards. Knowledge of the design requirements, manufacturing processes, and drafting practices on the part of the design and drafting team is critical. Working drawings normally include detail and assembly drawings.

Trade and industry conforms to the drafting standards set by ASME and ISO; however, it is important to note that some companies have created their own software and additional standards for personal drawing needs. While it is impossible to explain all formats that companies use, it is imperative for the drafter to recognize the differences.

(BTD 335-350, TD 411-423)

Explain the following:

A. Detailed drawings are production drawings that show necessary views, dimensions, and notes required to make a part without the use of additional information.

B. Number of details per sheet.

1. All details can be placed on individual sheets.
2. When large or complicated mechanisms are represented, the details may be drawn on several sheets with several details to a sheet.
3. If the structure is small or composed of few parts, all details can be drawn on one sheet.

C. Drawing standards for details

1. Attention should first be given to spacing.
2. The same scale should be used for all details.
3. Each detail should be represented by the regular views, sections, or auxiliaries needed to describe the part clearly.
4. Must have all dimensions and notes.
5. All parts must be identified or drawn with the exception of standard parts.

D. Identifying parts.

1. The old method is to letter a title note under each detail, which would then be circled or underlined.

2. The new method is to give a parts list or bill of materials.
3. A bill of materials or parts list consists of an itemized list of the several parts of a structure shown on the drawing. When numerous parts are used, the list can be given on a separate sheet.
    a. Lists part number, title, material, and quantity required.
    b. May include pattern numbers, stock sizes, and weights.
4. The parts list is located above the title block reading upward or in the upper right corner reading downward.
5. Parts should be listed in general order of size or importance of details.
6. Standard parts should be listed even when they are not drawn.

C. Every drawing should have a title strip or title block to show in an organized way all necessary information not shown on the drawing itself. The title strip should contain but is not limited to the following:

1. Name of the object represented.
2. Name and address of the manufacturer.
3. Name and address of the purchasing company, if any.
4. Signature of the drafter that made the drawing and the date of completion.
5. Signature of the checker and date of completion.
6. Signature of the chief drafter, chief engineer, or other official, and the date of approval.
7. Scale of the drawing.
8. Number of the drawing.

D. Drawing numbers.

1. Every drawing should be numbered.
2. It is advisable to use simple serial numbers, but varies from industry to industry.
3. It is advisable to avoid using drawing numbers to convey other information; however some companies place a prefix such as A, B, C, or D in front of the number to denote the sheet size.
4. The drawing number is usually the number of the part itself.
5. The drawing number is bold, ¼" high, and located in the lower right and upper left corner of the sheet.

E. When a drawing is completed it is turned over to the checker. It is checked for soundness of design, correct views, complete dimensioning, legibility, clearances, materials, standard parts, and title block information.

F. Change records.

1. A change strip or revision strip is included at some convenient place on the drawing.
2. In the change strip, the change is briefly described, initialed, and dated.
3. The change is labeled on the drawing usually by an encircled letter.

UNIT E: Working Drawings

Competency: D505.00

Demonstrate working drawing principles and techniques.

Objective: D505.02

Explain the concepts and principles underlying the creation of assembly drawings.

Explain the following:

A. Assembly drawings guide workers in assembling parts properly and for general reference throughout the shops.

B. Assembly drawings show the assembled machine or structure, with all detail parts in their functional positions.

C. In selecting views for an assembly drawing, the drafter must keep in mind the purpose of the drawing, which is to show how the parts fit together and to suggest the function of the entire unit.

1. The assembly should not describe the shapes of individual parts.
2. The views selected should be the minimum views or partial views that will show how the parts fit together.

D. A subassembly is used with large or complicated machines when it is not possible to show all parts in one assembly and a separate drawing is needed.

E. Title strips are the same for an assembly drawing as a detail drawing except for the addition of the word assembly in the title.

F. A parts list may be placed on a separate sheet or in any convenient open corner on the drawing. It is preferred to be read up from the title block or down from the upper right corner.

1. The parts list includes the part number, name, material, and number of pieces required.
2. Each part is identified on the drawing by lettering the part numbers in .438 or .500 diameter circles near the assembly, and drawing leaders to each part where it is clearly shown.
3. The circles should be arranged in groups and in vertical or horizontal rows.

G. Assembly sections.

1. In an assembly drawing where several adjacent parts are sectioned, it is necessary to draw the section lines in different directions to distinguish the pieces clearly.
    a. The first large area is section-lined at 45°.

b. The next large area is then section-lined at 45° in the opposite direction.
c. Additional areas are section-lined at 30° or 60° with horizontal.
d. If necessary, to make any area contrast with the others, any other angle may be used.

2. Section lines do not meet at the visible lines separating the areas.
3. For small areas the lines are drawn closer together.
4. In sectioning very thin parts, when there is not enough space for section lining, the sectioned parts may be shown solid.
5. It is customary not to section parts that would make the drawing less clear, such as bolts, nuts, shafts, keys, ribs, gear teeth, spokes, screws, nails, ball and roller bearings, and pins.

H. Design assemblies or layouts.
1. One of the initial drawings created by the designer, usually drawn to full scale to enable the designer to visualize the part more clearly.
2. Includes the views necessary to show the size and shape of each part of the mechanism, but dimensions are omitted.

I. Outline assembly or installation assembly
1. The purpose is to give general information regarding the character and size of the unit and how it fits in its environment.
2. In an outline assembly there is little or no section lining.
3. Only the principal overall and center-to-center distances needed to clarify questions of installation are given.
4. Outline assemblies are sometimes referred to as exploded assemblies.

J. Working drawing assembly
1. A working drawing assembly combines detail and assembly drawings giving complete dimensions and notes for all parts.
2. Used in place of separate detail and assembly drawings for simple parts.

K. General assembly
1. Shows how the part fits together and how the assembly functions.
2. Chief use is in the assembly shop where all finished parts are received and put together.
3. Views shown may be regular, sections, auxiliary, and partial.
4. No dimensions are usually given on a general assembly.

UNIT E: Working Drawings

Competency: D505.00

Demonstrate working drawing principles and techniques.

Objective: D505.03

Interpret information on a working drawing.

Explain the following:

A. Approaching the print.

1. Analyze the title block.

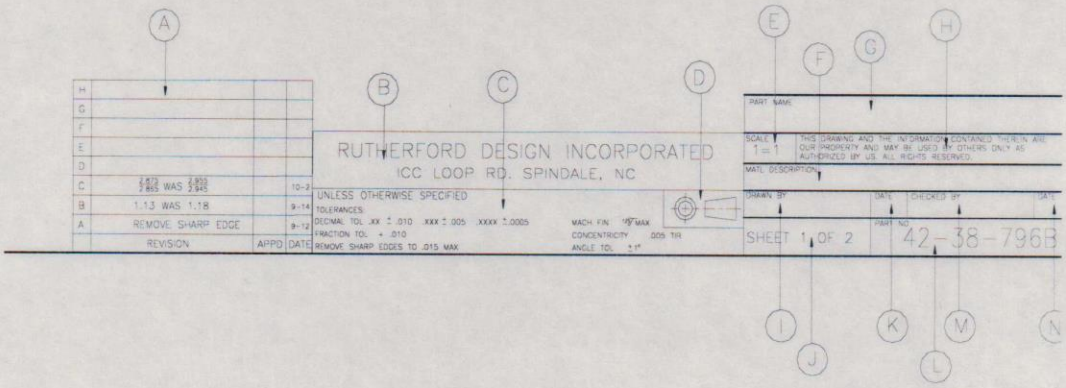
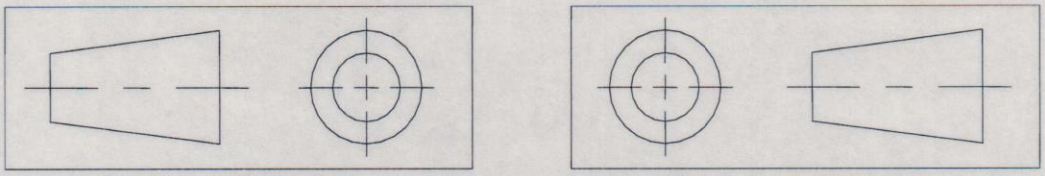


Figure D505.03.01 Example of a title block

A-Revision strip, B-name and address of the manufacturer, C-Notes and tolerances not specified on the drawing, D- Drawing standard, E- Scale of the drawing, F- Material description of the part, G- Part name, H- Personal privacy statement, I- Name of drafter, J Number of sheet, K- Date drafter completed drawing, L- Part number, M- Name of checker, N- Date drawing was checked

2. Determine the language of the print, and whether it is drawn in first-angle projection or third-angle projection. The standard can be written in the title block or shown as a symbol.



First-Angle Projection Third-Angle Projection

Figure D505.03.02 Symbols for projection

3. Clarify which views are seen on the drawing.
    a. Determine placement of the regular views.
    b. Determine cutting plane lines and corresponding section views.
    c. Determine detail size and descriptions.
        1. Details should be labeled by a phantom line circle on the drawing where they occur.
        2. Details can be placed in any convenient space on the drawing. Under the separated detail should be the name and scale of the detail.

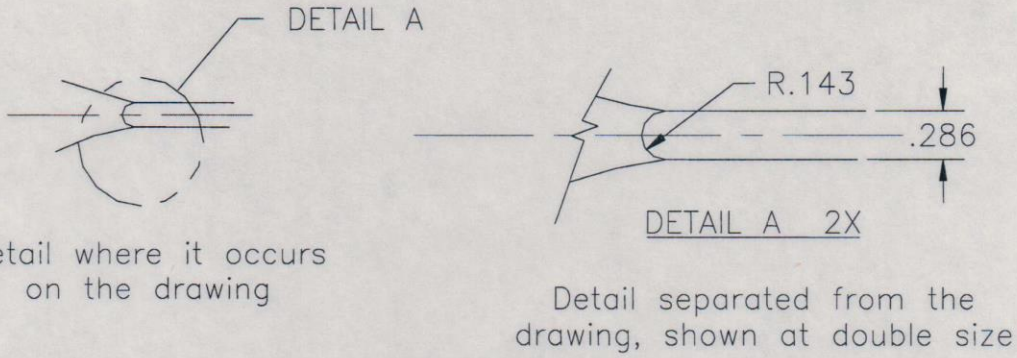


Figure D505.03.03 Examples of details on a drawing

4. Examine all notes within the title block and on the drawing.
    a. General notes may be given in any convenient open space on the drawing.
    b. Local notes can be indicated through use of a leader or a bubble.

Figure D505.03.04 Examples of notes on a drawing

5. Locate datums and reference dimensions.
6. Decipher line types, dimensions, symbols, and abbreviations.
    a. A complete list of abbreviations used on engineering drawings can be found in ANSI Y 1.1

Table 00X.03.01	**Commonly Used Abbreviations**
ALLOW-Allowance	**CH**-Case Harden
ALUM-Aluminum	**CHAM**-Chamfer
ALY-Alloy	**CI**-Cast Iron
ANL-Anneal	**CL**-Clearance
APPD-Approved	**CONC**-Concentric
APPROX-Approximate	**COND**-Condition
ASSY-Assembly	**COP**-Copper
AUX-Auxiliary	**CRS**-Cold Rolled Steel
B/M-Bill of Materials	**CSTG**-Casting
BEV-Bevel	**CYL**-Cylinder
BRG-Bearing	**DAT**-Datum
BRKT-Bracket	**DCN**-Drawing Change Notice
BRS-Brass	**DIA**-Diameter
BRZ-Bronze	**DWG**-Drawing
BUSH-Bushing	**EA**-Each
C TO C-Center to Center	**ECO**-Engineering Change Order
C'BORE-Counterbore	**ECR**-Engineering Change Revision
C'SINK-Countersink	**EQ**-Equal
CDS-Cold Drawn Steel	**ES**-Engineering Specifications

EST-Estimate
FAB-Fabricate
FAO-Finish All Over
FIL-Fillet
FIN-Finish
FORG-Forging
FST-Forged Steel
GA-Gage
GALV-Galvanized
GRD-Grind
GSKT-Gasket
HCS-High Carbon Steel
HEX-Hexagon
HOR-Horizontal
HT TR-Heat Treat
ID-Inside Diameter
INSTL-Installation
KWY-Keyway
LH-Left Hand
MACH-Machine
MAG-Magnesium
MATL-Material
MAX-Maximum
MI-Malleable Iron
MIN-Minimum
MISC-Miscellaneous
MOD-Modification
NO.-Number
NOM-Nominal
NTS-Not To Scale
OD-Outside Diameter
P-Pitch
PROC-Process
QTY-Quantity
QUAL-Quality
R-Radius
REF-Reference
REQD-Required
REV-Revision
RH-Right Hand
RIV-Rivet
SCH-Schedule
SCR-Screw
SECT-Section
SF-Spotface
SH-Sheet
SPEC-Specification
SPL-Special
SQ-Square
SST-Stainless Steel
STD-Standard
STL-Steel
SYM-Symmetrical
TEM-Temper
THD-Thread
TOL-Tolerance
TYP-Typical
VAR-Variable
VERT-Vertical
W-Width
WI-Wrought Iron
WT-Weight