

MECHANICAL DRAWING WORKING DRAWING CONVENTIONS

General

Mechanical drafting principles are based on time tested practices based on standards set forth by **The American Standards Institute (ANSI)**. Mechanical drawing techniques refers to a style or quality of a drawing imparted by the individual drafter to the work. It is characterized by crisp black line work, lettering, consistency, and uniformity. Mechanical drawings should reflect the rigid line control of a mechanically produced drawing. The development of good detail drawings is a real engineering accomplishment and art. Students should develop a stylized drawing technique that conforms to the rigid conventions of line drafting with added variations of artistic techniques to produce a very individualized finished drawing.

Working drawings or production drawings are a complete set of drawings used to bring the designed project to its finished state of manufacture. Working drawings usually consist of detail drawings and assembly drawings. Through the detail drawings the draftsman must convey in a technical language all information required to bring about the manufacture of each individual part. Assembly drawings show how all the parts go together in the complete product. Assembly drawings can be made by tracing the necessary elements from the detail drawings.

To be able to accurately prepare the required drawings the draftsman must have a thorough knowledge of the latest engineering specifications, be familiar with the latest manufacturing techniques, and be knowledgeable and skilled in the techniques of Mechanical drafting. Therefore it is imperative that the mechanical drafter develop good drawing techniques.

Lettering

Lettering heights will be in accordance with the recommendations of the ANSI Standards. General lettering and dimensioning use 3/32" to 1/8" high lettering with 1/8" being preferred. The recommended minimum letter heights can be found in **Table 16.1**.

Drawing Numbers

All drawings will be numbered. There are many different numbering systems used throughout industry so that there is no one standard system used. Numbering will depend on the company standards and drafting practice. Drawing numbers are very important and therefore are lettered with large letters. The heights range from 3/8" to 5/16" high.

Drawing Scales

The standard unit of mechanical measurement is either **Inches** or **Millimeters**. The scale is always noted as and INCHES such as 1" = 1" or 1/2" = 1", or as MILLIMETERS such as 1mm = 1mm. The word SCALE is always written to identify what is being read for example SCALE: 1" = 1".

When a drawing sheet contains details drawn using different scales the notation **SCALE: AS NOTED** is used in the title block. When a detail or drawing is not made to any scale the notation N.T.S. is used to indicate that the drawing is **NOT TO SCALE**.

Selection of Views

A drawing should only contain those views needed for a clear and complete shape description of the object. Views are selected that show best the essential contours or shapes and contain the least number of hidden lines. Detail drawings and assembly drawings can utilize any number of necessary views including section views, auxiliary views, and partial views. The purpose of an assembly drawing is to show how the parts fit together and to suggest function. Therefore the views selected to show an assembly should convey the relationships of parts not show detailed shapes.

Section views:

Sectioning is used extensively in assembly drawings to eliminate the need to draw hidden parts. Any kind section view such as full sections, half sections, aligned sections, offset sections may be used. To distinguish between adjacent parts in a section view section lines are drawn in opposing directions. Section lining may also vary in spacing to distinguish between adjacent parts. For general use, the cast-iron general-purpose sectioning lining is used. Thin parts in assembly drawings should be solid black instead of using section lining. Rounded parts such as bolts, shafts, pins, keys, nuts, etc. are not crosshatched even though the cutting plane passes through them. It is customary to show these parts unsectioned or "in the round."

Hidden lines:

Views should be chosen that show as many features with visible lines as possible. Hidden lines should be used wherever necessary to make the drawing clear. Where they are not needed for clearness they should be omitted.

Dimensions:

Dimensions are included on all detail drawings. All of the rules and techniques of dimensioning as specified by ANSI apply. Dimensioning can be either unidirectional or aligned but not both in the same set of drawings.

Dimensions are not generally given on assembly drawings. If dimensions are included, they are limited to some function of the object as a whole. These would include showing a minimum or a maximum dimension, a dimension that is needed when machining is required in the assembly process, or general notes applied to the overall assembly.

Center Lines:

Center lines are used to indicate an axis of symmetry, show paths of motion, or used as extension lines in dimensioning. Center lines are used mainly in dimensioning and should be omitted from unimportant shapes. Center lines should be used in assembly drawings to show symmetry between mating parts, alignment of parts, and paths of motion to suggest function.

Title Blocks

Title blocks are a very important part of the overall drawing. They contain information not given directly on the drawing with dimensions or notes. Title blocks for structural drawings are prepared according to the specifications set forth by the company. The following information is generally provided in the title block:

- Title of the project/name of the drawing
- Name and address of the client.
- Name and address of the manufacturing company.
- Date of the completion of the drawing package.
- Scale of the drawing.
- Drawing Number.

Lettering should be simple and conform to the overall lettering style of the drawing. Lettering can be produced with templates, stencils, appliqué, lettering instruments, or simply freehand with guidelines.

The heights of the lettering should follow in accordance with their relative importance. The drawing number should receive the greatest emphasis and have a height greater than 5/16". The

drawing name, title of the project, clients name, and the name of the company should follow with a letter height of 1/4". The addresses, the date, and the scale should have a letter height of 1/8". Incidental words like **DATE** and **SCALE** should receive the least emphasis and have a letter height of 1/16".

The lettering in the title block should be either centered or have a flush margin. Variations in the lettering heights adds an overall pleasing affect to the drawing and breaks up the monotony of a line drawing and the margins tie in with overall style of the drawing adding continuity and consistency to the drawing.

Revision Blocks

Revisions blocks always appear on a drawing to record any changes that are made after the drawing has been approved. Changes to the drawing are necessitated by changes in design, changes made by the customer, or changes due to errors in design. Changes are made by erasures directly on the original drawing. Additions are made by drawing directly onto the original. The revisions to the drawing are highlighted and marked and referenced to the revision block.

Bill of Materials

The bill of materials is a listing of all of the component parts of the assembly. The bill of materials includes part number, part name, number required, material of part, and sometimes other descriptive text. The bill of materials is included on all detail drawings and assembly drawings or can be on a separate sheet. Generally the bill of materials is shown with the assembly drawings and includes only those parts shown on the assembly drawing sheet.

General Notes

Notes are classified as general notes and as local notes. Notes are lettered horizontally on a sheet with guidelines and arranged in a systematic manner. Abbreviations in general notes should be avoided as much as possible. Proper grammar, sentence structure and punctuation are used in constructing a note.

Note columns are titled to make them distinguishable from other parts of the drawing. The lettering heights are larger than the lettering height use for general lettering and should be the same height as other titles on the sheet.

Each note is referenced with a number. Margins are used to align the note numbers and the notes. Use a minimum space of 1/2 inch between the number and the note. The spacing between lines in a note should be one-half of the actual letter height. Spacing between notes should be such that each note is distinguished from the other notes. This space should be at least equal to one letter height.

Remember, uniformity and consistency play an important role in the construction of the note column.

GENERAL NOTES

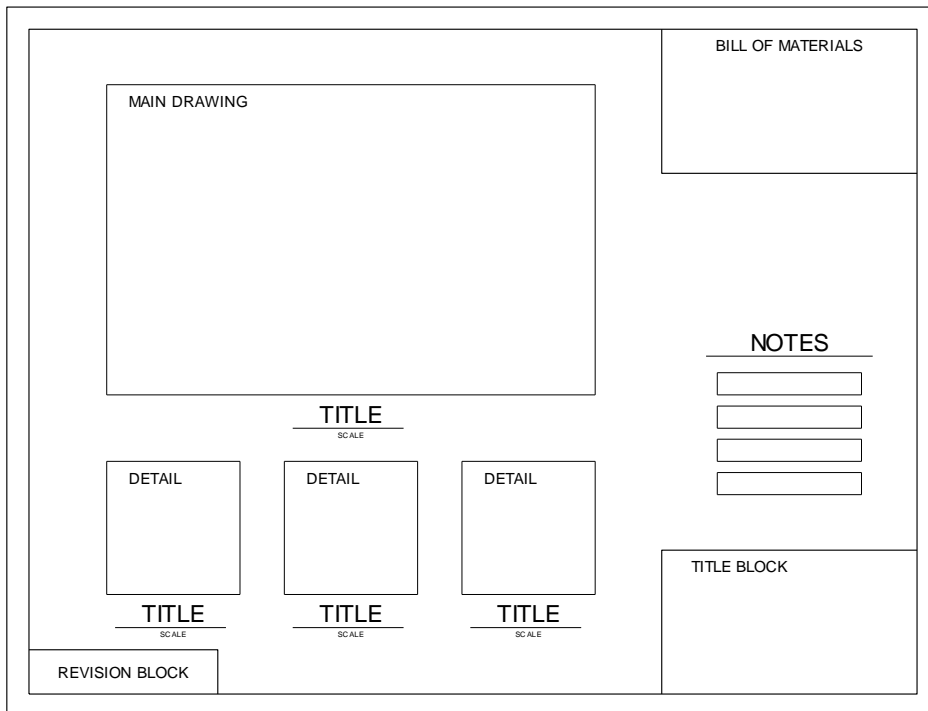
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Sheet Layout

The drawing paper need to be framed with a border line. A 1/2 inch border line is drawn around the paper. This line is a very thick line. The border line can be a single line or a double line and should conform to the overall style of the drawing. Title blocks are added and placed along the bottom and/or the right side of the drawing paper.

In general, all of the drawing area should be filled. The main drawing should be the dominate picture on the sheet with detail drawings and general notes related to the main drawing placed around it. Assembly views and detail drawings can be combined on one sheet or details shown together and assemblies shown on separate sheets. The drafter should determine the necessary views for each assembly and detail and block in all views lightly before beginning to draw. Ample space should be allowed for all dimensioning and notes. Views from one detail should not overlap views from another.

All drawings, details, and notes should be titled. Titles are placed beneath the picture.



Titles and Part Identification

Circles containing part numbers are used to identify parts on detail and assembly drawings. Identification circles are 7/16" to 1/2" diameter. Identification circles on assembly drawings are placed adjacent to the parts with leaders terminated by arrowheads touching the parts. Leader lines can vary in style such as leaders with shoulders, without shoulders, straight line leaders or leaders that are curved. Curved leader lines are drawn with an irregular curve. Leader terminators can be either arrowheads touching the part or dots extended to the inside of the part.

All entities on a drawing must have a title whether it is an assembly, section view, detail, note column, symbols legend, etc. Titles are lettered large enough catch the viewers eye. Generally the lettering is between 1/4" and 3/4" high. To accent the titles even more they can underlined. Underlining can consist of a single line, a double line, or a combination of thick and thin lines. The underlining can be centered with the lettering, be flush, or be broken as shown when using circle call-outs. A few examples of titles and underlining are shown below.