Phase 1 Fabrication

Carousel 1

Engineering Drawing

Practice and Standards

Part 1 – Technical Drawing Standards

ENGINEERING DRAWING – Part 1

BASIC ASPECTS OF ENGINEERING DRAWING

CONTENTS **PAGE NO**

Importance of Engineering Drawing

Technical drawing allows efficient communication among engineers and can be kept as a record of the planning process.
Since a picture is worth a thousand words, a technical drawing is a much more effective tool for engineers than a written plan.

Fields of Use:

Technical drawing is the preferred method of drafting in all engineering fields, including, but not limited to, civil engineering, electrical engineering, mechanical engineering and architecture.

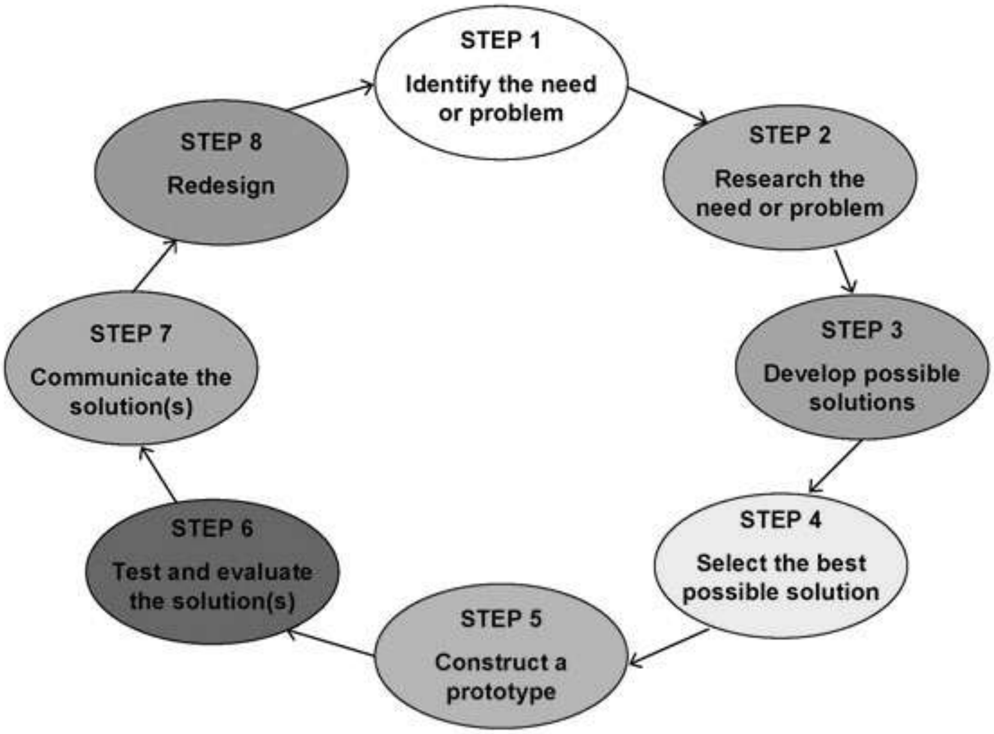
Purpose of studying Engineering Drawing

To develop the ability to produce simple engineering drawing and sketches based on current practice.

To develop the skills to read manufacturing and construction drawings used in industry.

To develop a working knowledge of the layout of plant and equipment.

To develop skills in abstracting information from calculation sheets and schematic diagrams to produce working drawings for manufacturers, installers and fabricators.



INTRODUCTION TO ENGINEERING DRAWING

Engineering technicians and craftsmen must be able to communicate ideas and facts clearly and without ambiguity. For them, verbal communication is very important, but often hopelessly inadequate. Often it requires reinforcing or simplifying so that the subject of the communication does not become a very long round of instruction, questions, answers, further queries and explanations.

Similarly, written communications can be very different. A simple item may require pages and pages of description to enable someone else to gain an impression of its shape and size. Even then there is the danger of the description being ambiguous or boring, so that the reader has great difficulty in forming an accurate mental or physical impression of an item.

To overcome these difficulties a very efficient form of graphical communication had been developed. This graphical communication is what has become known as engineering drawing. It is effective, so effective that often it can be understood by technicians and craftsmen who may never understand a word of the written language on the drawing.

All technicians and craftsmen rely on their own ability to interpret and construct sketches and drawings. Without the skill to read drawings a technician or craftsman may have great difficulty in finding employment. The added skill of being able to make reliable engineering sketches and drawings can often increase employment opportunities.

The Draughting Team

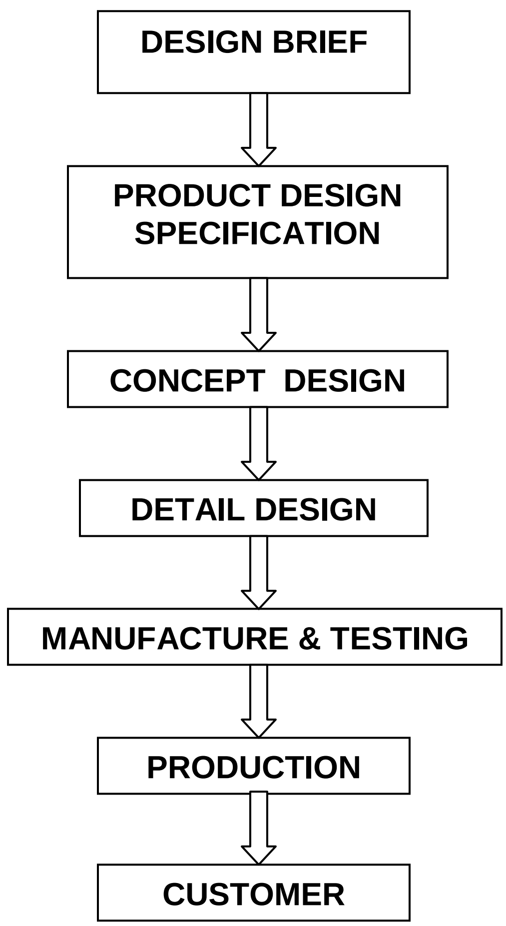
While it is recognised that all technicians must be proficient graphical communicators, there are those in industry who are trained to make sketches and drawings professionally. They are called designers and draughtspersons.

The Designer

This is where a new component or part starts. The designer is given a requirement and instructed to design a solution. He starts by sketching and he may pass some of his sketches on to other technicians to research and develop his solution. Having arrived at a satisfactory solution, the designer may modify his original sketches or produce more accurate drawings known as design layouts. These are then passed over to a draughts person to draw out in great detail.

The Draughtsperson

The draughtsperson is the key communicator. It is his/her responsibility to work from the designer's sketches or layouts and make detailed working drawings; drawings from which items can be manufactured, assembled, constructed, tested and maintained.

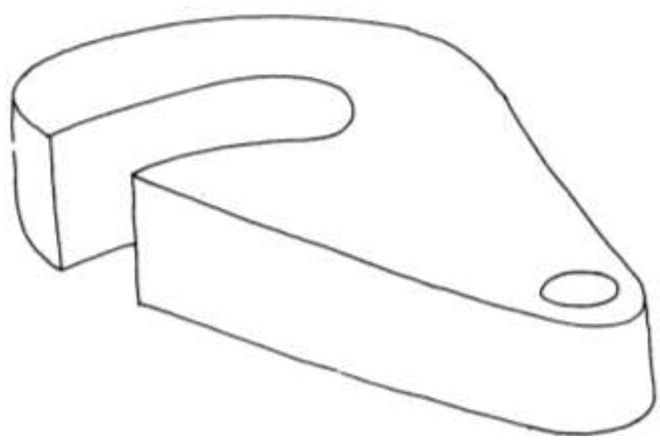


2 DIFFERENT TYPES OF ENGINEERING DRAWINGS

There are many types of engineering drawings in use. The following are some of the most common.

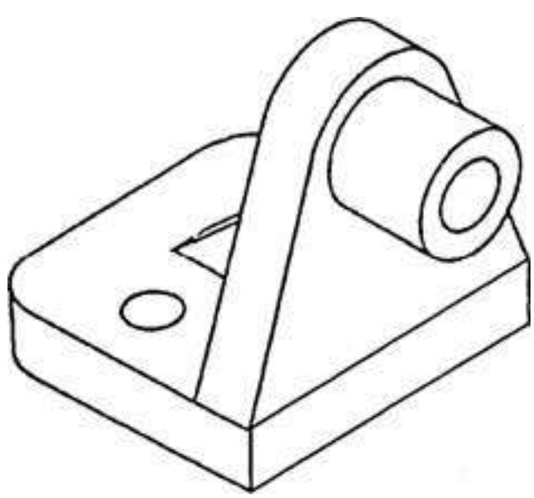
2.1 Freehand Pictorial Sketches

These are three-dimensional sketches favoured by the designer, technicians and craftsmen as a means of expressing ideas and communicating informally. No drawing instruments are required to make this type of drawing, but a good sense of proportion and special ability is useful. Clear linear diagrams are preferred to artistic impressions.



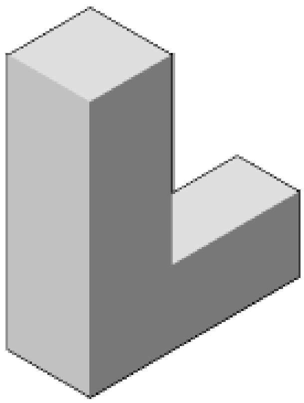
2.2 Pictorial Sketches

These are three-dimensional sketches constructed with drawing instruments. They are not drawn to any particular dimension but proportion and visual balance is carefully maintained to communicate an accurate impression.

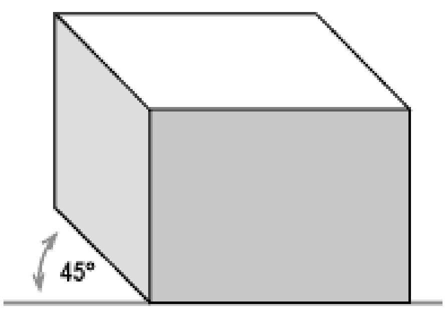


2.3 Pictorial Drawings

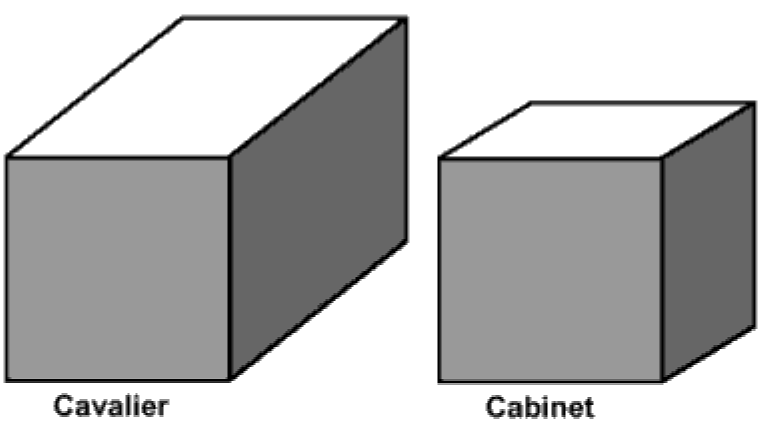
These are three-dimensional drawings constructed to exact sizes using drawing instruments. Several different types of pictorial drawings exist, each type being identified by the angular attitude of both horizontal axes. The following types illustrated are the most common in general use: Isometric, Oblique, Oblique Cabinet and Perspective.



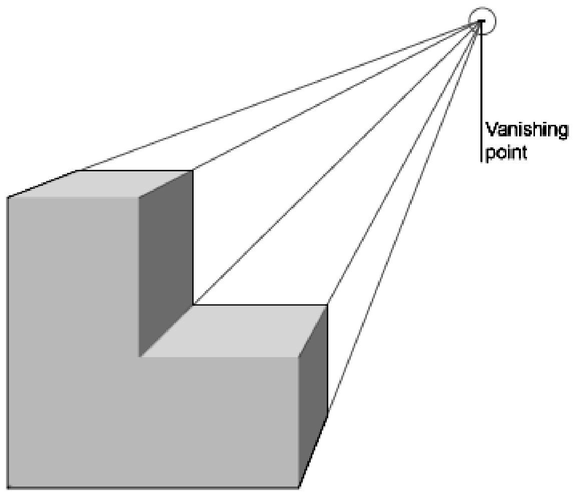
ISOMETRIC VIEW



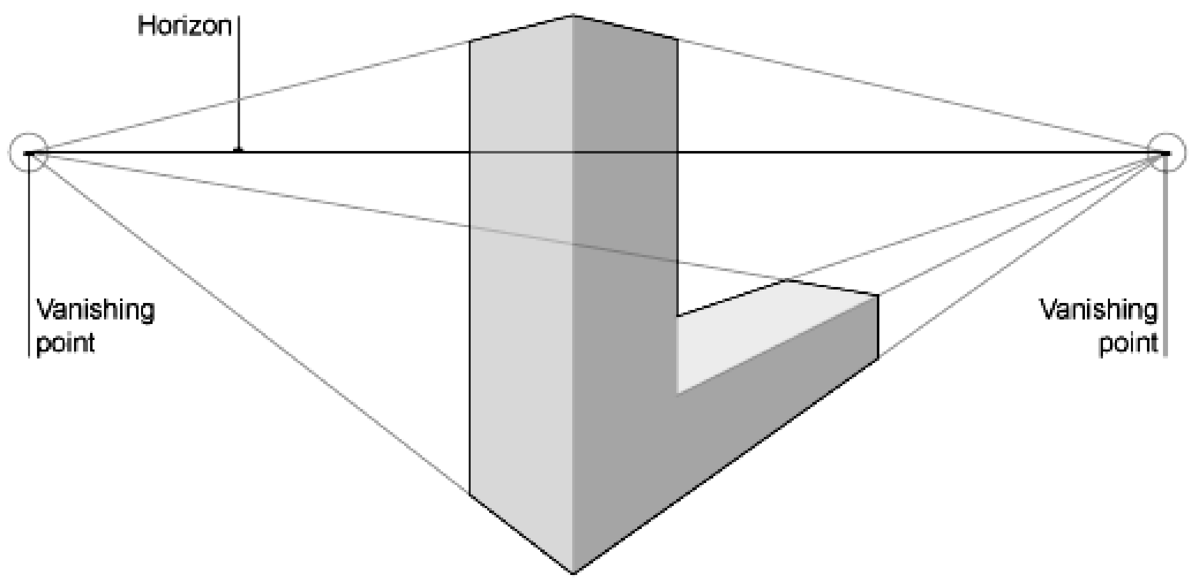
OBLIQUE VIEW



OBLIQUE CAVALIER & CABINET VIEWS



SINGLE POINT PERSPECTIVE VIEW



TWO POINT PERSPECTIVE VIEW

6 OBLIQUE PROJECTION

Pictorial drawing in which the front face and all the faces parallel to the front face are presented as a true shape, while the depth is distorted and projected along an oblique axis, is called oblique projections.

For a three-dimensional object, two of the three dimensions correspond with the horizontal and vertical axis, while the third is drawn obliquely from the other two.

The object angle can by any convenient angle between 0˚ and 180˚ (but not 0˚, 90˚, or 180˚). For convenience it is usually 30˚ or 45˚.

There are two principle types of oblique presentation, oblique cavalier and oblique cabinet.

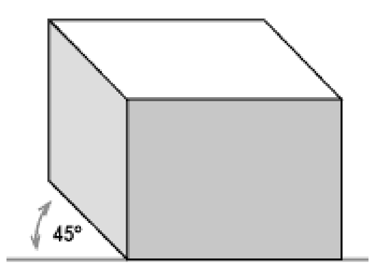
<u>Oblique Cavalier</u>

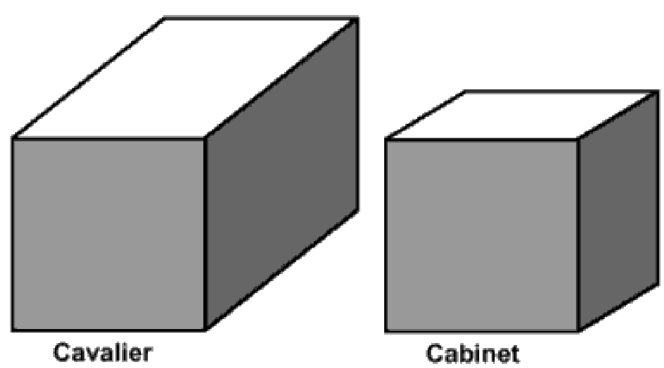
True lengths are marked off along the horizontal, vertical and oblique axes.

The oblique axis tends to exaggerate the depth, often causing visual distortion, as in the case of the cube in the figure shown.

<u>Oblique Cabinet</u>

True lengths are marked off along the horizontal and vertical axis, but along the receding axis the length is foreshortened to effect a visual correction. The amount of foreshortening is usually one-half of the true length, however, it can be varied where necessary.

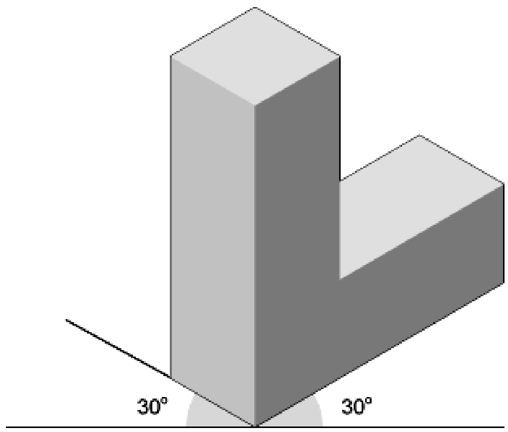


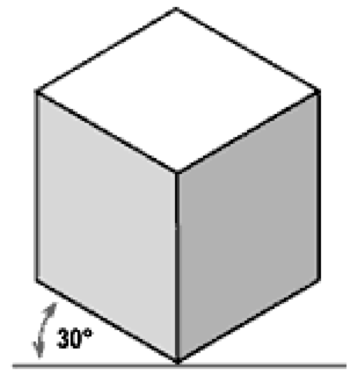


7 ISOMETRIC PROJECTION

This is a system of pictorial drawing based upon three axis set 120˚ apart.

True lengths are measured along any axis, but dimensions and features not parallel to the three axes have to be constructed from co-ordinates.





The procedure followed when constructing an isometric rectangle is as follows:

i) Draw faintly the isometric axis.

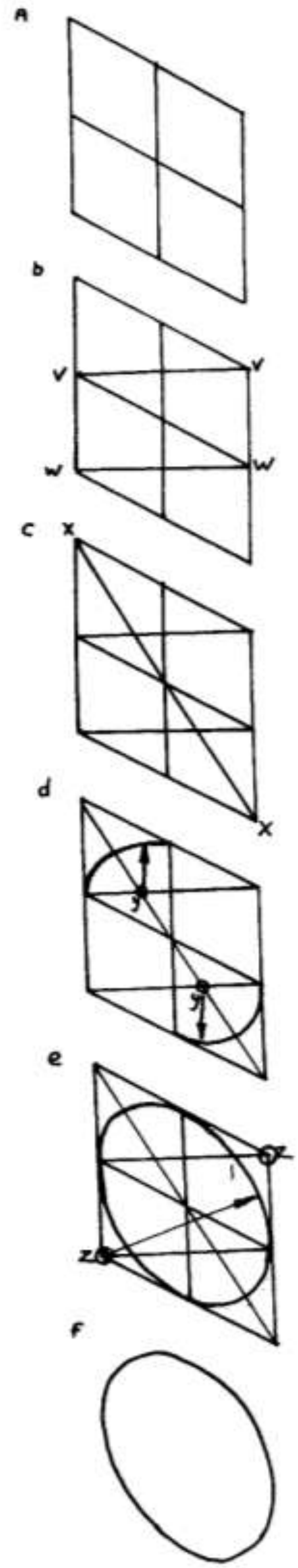
ii) Measure the true lengths along one receding axis.

iii) Measure the true widths along the receding axis.

iv) Along the vertical axis measure the true height.

v) With a straight edge and a set square complete the figure.

Isometric Circles



Their shape appears elliptical in isometric presentation. Where they are parallel to an axis, an approximate method of construction is adequate for most purposes.

The procedure followed to construct an isometric circle is
as follows:

a) Construct a rhombus to coincide with the attitude of the isometric circle along the axis. Mark the centre lines on the side of the rhombus.

b) Draw faintly, horizontal lines VV and WW.

c) Draw faintly the oblique line XX.

d) With centres Y and Y draw areas of small radius.

e) With centres Z and Z complete the isometric circle by drawing ones of larger radius.

Any dimensional object can be shown by isometric presentation by combining the various individual construction techniques using the following procedure.

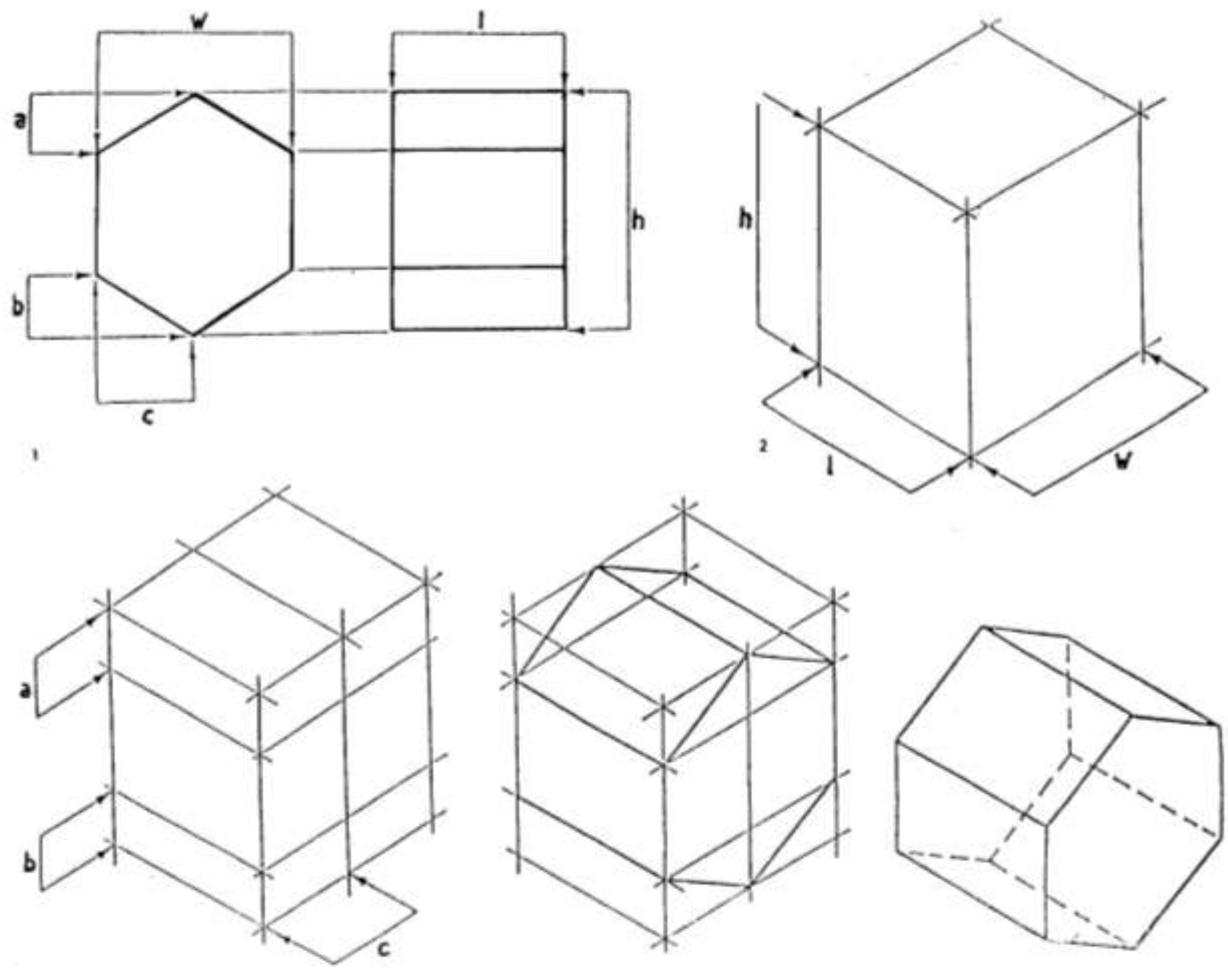
i) To enable to isometric view to be constructed accurately, at least two-dimensional views may be necessary.

ii) A ‘box’ construction is made along the isometric axis.

iii) The isometric view is drawn using the box construction; then, by careful erasing, the construction lines are removed.

Care must be taken to plan the attitude of presentation of a component to make sure that the maximum detail is revealed.

EXAMPLE: ISOMETRIC PRISM



How do you represent a 3D object as a 2D object drawing?

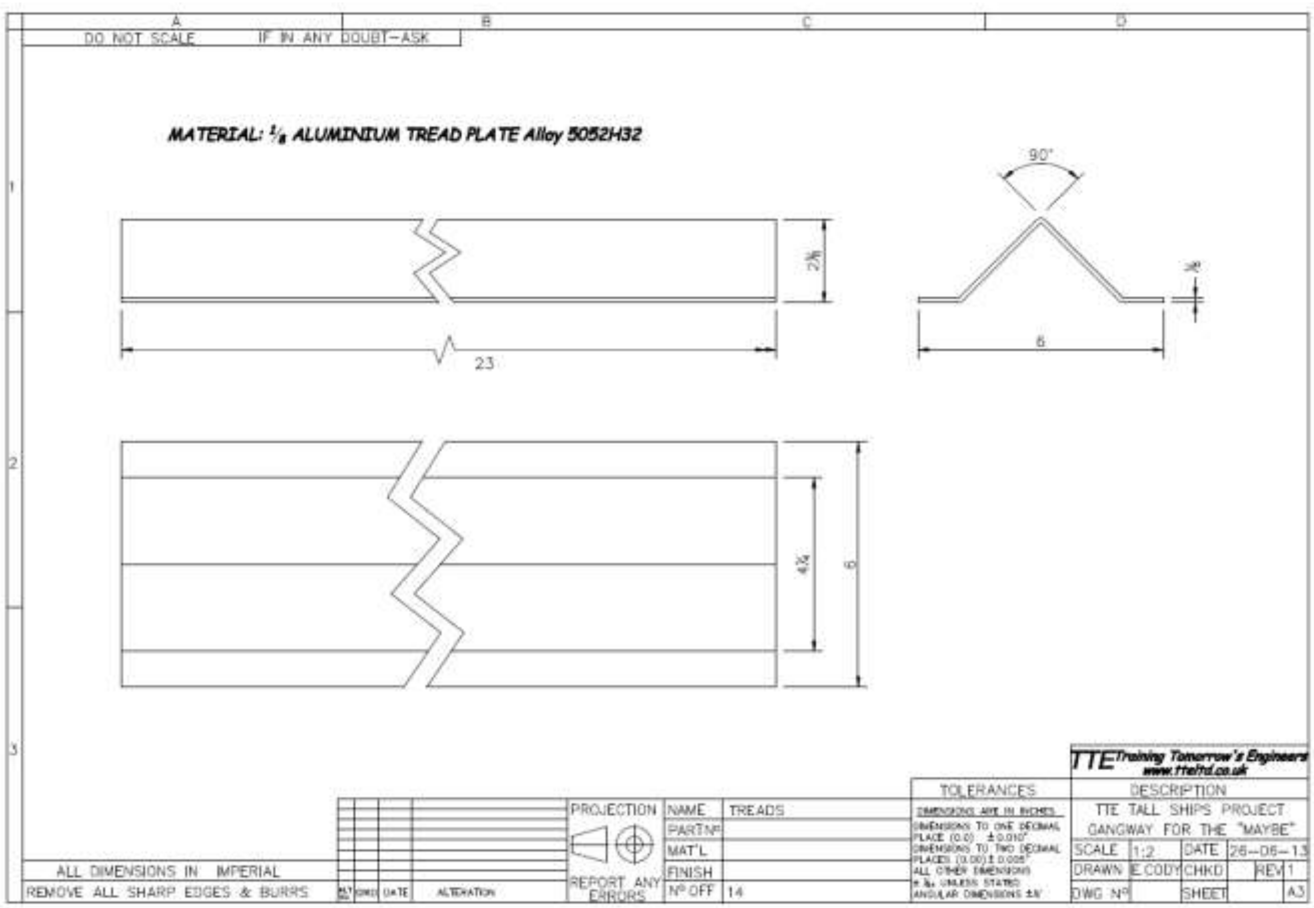
In engineering, a technique called **orthographic projection** is used to show a three dimensional object as a two dimensional drawing.

Isometric drawings give 3D views but don't give enough information about an object's true look because you can't see the exact shape and size of each feature.

Orthographic projection allows all possible views of a three dimensional object to be shown in a two dimensional drawing. It uses multiple views of the object, taken from points of view rotated about the object's center through increments of 90°.

2.4 Single Part or Detail Drawings

These are usually two-dimensional drawings showing one or several views of a single item. They are constructed using drawing instruments and are drawn to very formal rules known as drawing standards. This type of drawing communicates all the information necessary to manufacture an item.



3 DRAUGHTING STANDARDS

The primary purpose of making an engineering drawing is to communicate information effectively and efficiently. To ensure that these drawings are clear and readable and also to make them comprehendible to a wide scope of people, certain rules and practices have been laid down by certain bodies to standardise drawing practice.

The main Britain system is that compiled by the British Standards Institution. They publish "BS EN 8888: Engineering Drawing Practice". This is the basic guide to engineering drawing practice in the United Kingdom and the EU.

"BS EN 8888, makes clear recommendations for engineering drawings relating to general principles, dimensioning and tolerancing practice. It is understood that the British Standards Institution only "recommends" certain practices, but these commendations have been employed for a long time and are proven as being effective and these days they are sometimes looked upon as rules rather than recommendations.

It must be understood that the British Standards are not the only standards employed. There is also the International Standards Organisation (ISO) which produces its recommendations. There are also National Standards produced by other countries in a similar manner to our British Standards.

Abbreviations and Symbols

It is common practice to shorten words or replace them with symbols. Wherever this practice is adopted, it is important to use only the recognised standard abbreviation or symbol, otherwise communication may be impaired.

4 DRAWING SCALES

For convenience, it is sometimes necessary to draw a component proportionally smaller or larger than its natural size. This occurs when:

i) The component is too large for a particular sheet of drawing paper. It then has to be 'scaled-down' (drawn proportionally smaller).

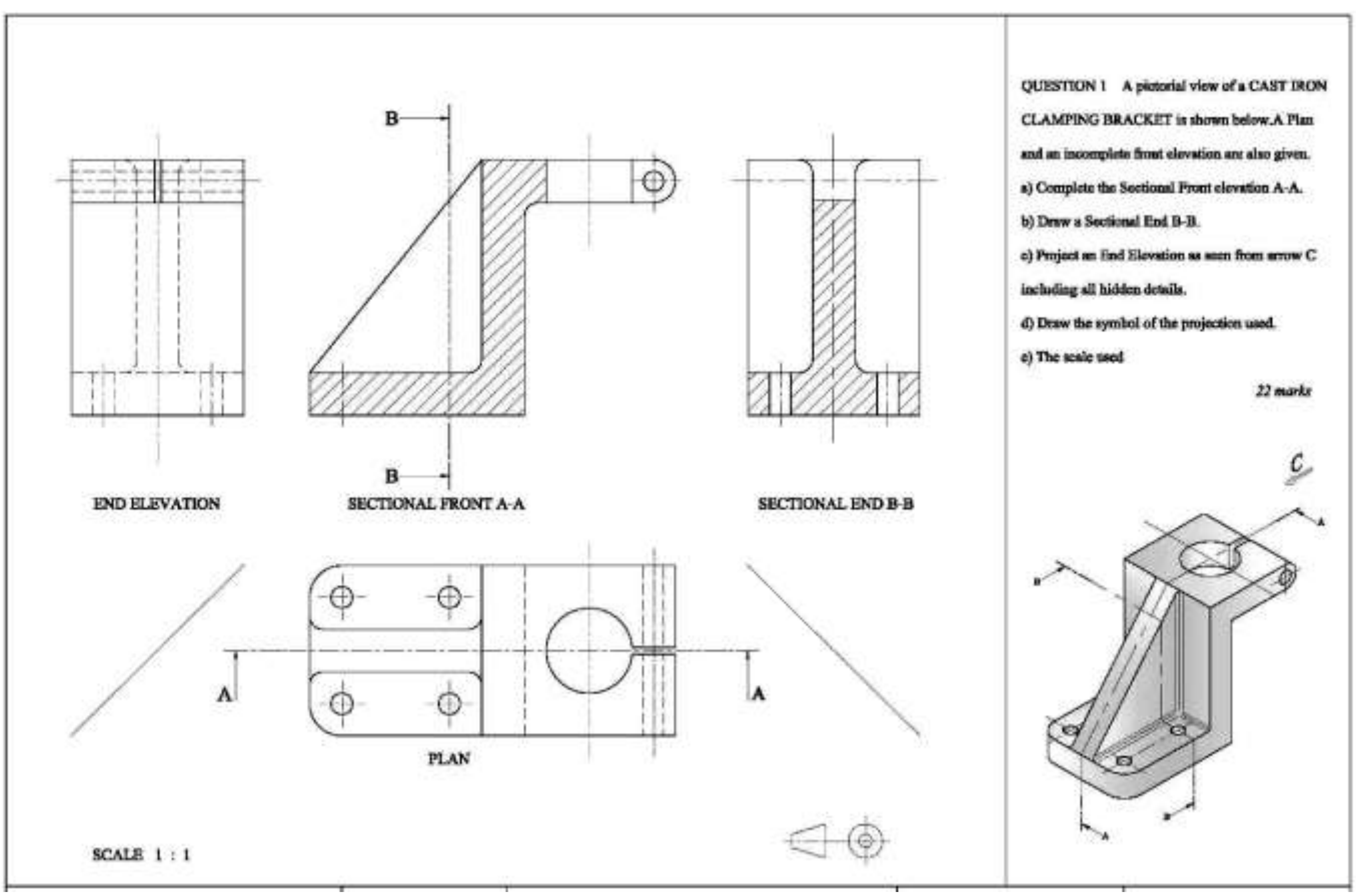
ii) The component is so small that it cannot be drawn or dimensioned clearly. It then has to be 'scaled-up' (drawn proportionally larger). When this occurs, it is usual to add an outline view of the natural size of the component to give a correct impression of size.

Drawing scales can be varied to suit a particular drawing, and scale rules are made in arrangement of standard scales.

DRAWING SCALE RATIO'S

Less than Natural size	Natural Size	Greater than Natural Size
1:1000	1.1	2.1
1:500	1.1	5.1
1:100	1.1	10.1
1:50	1.1	50:1
1:10	1.1	100:1
1:5	1.1	500:1
1.2	1.1	1000:1

5 ORTHOGRAPHIC PROJECTION

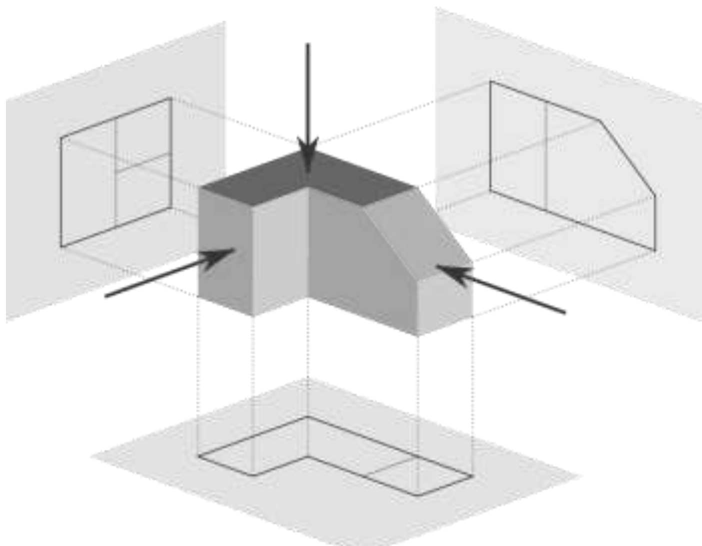


This is a method of drawing three views of a component in separate projections to give a three-dimensional view of the component in one drawing. There are two systems of presentation used for this practice:

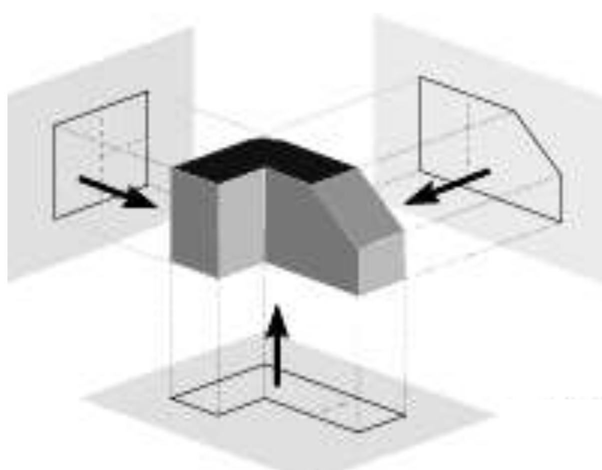
i) First Angle Projection: In this system, each view is a two-dimensional representation of the far side of an adjacent view.

ii) Third Angle Projection: In this system, each view is a two-dimension representation of the near side of an adjacent view.

First angle

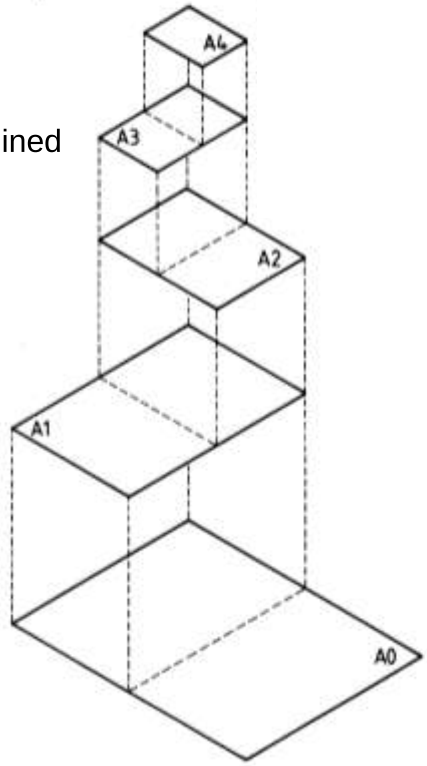


Third angle



DRAWING SIZES

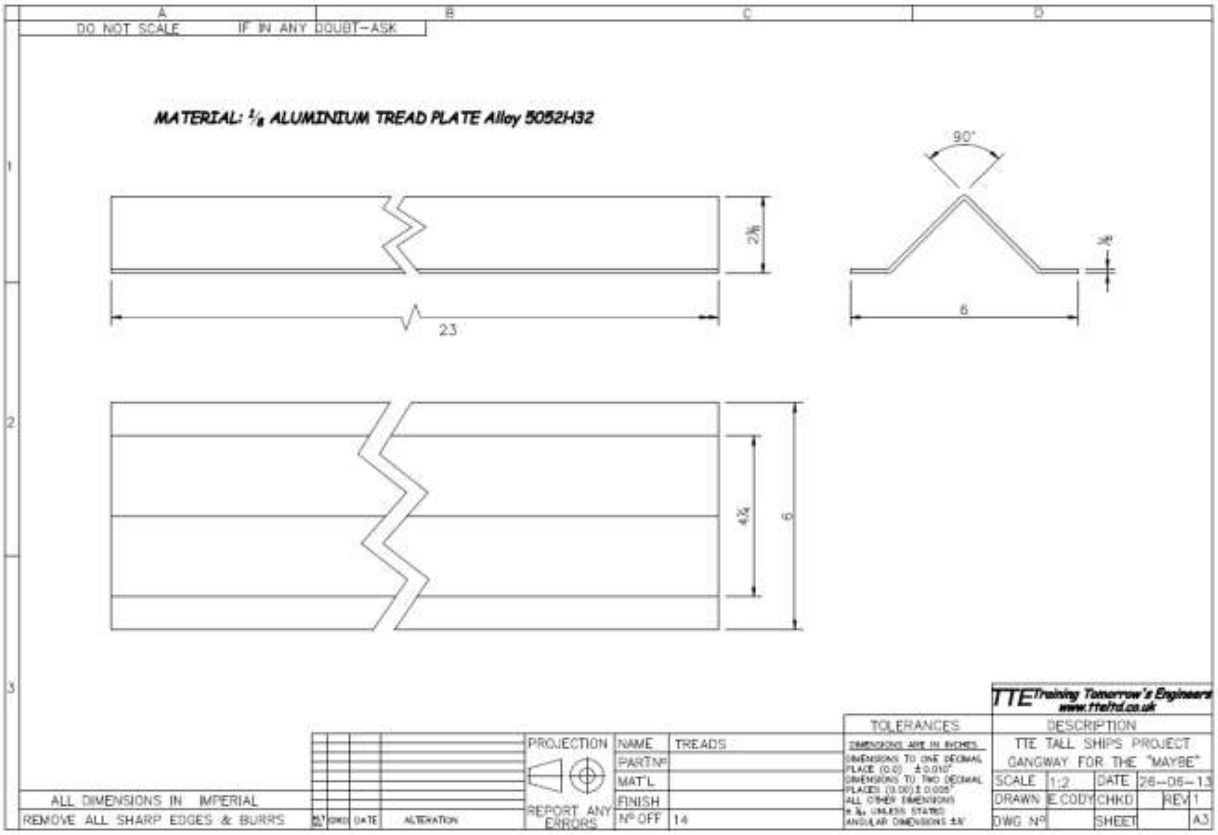
The size of drawing paper used may be determined by the type of drawing required . the amount of information and complexity of the project



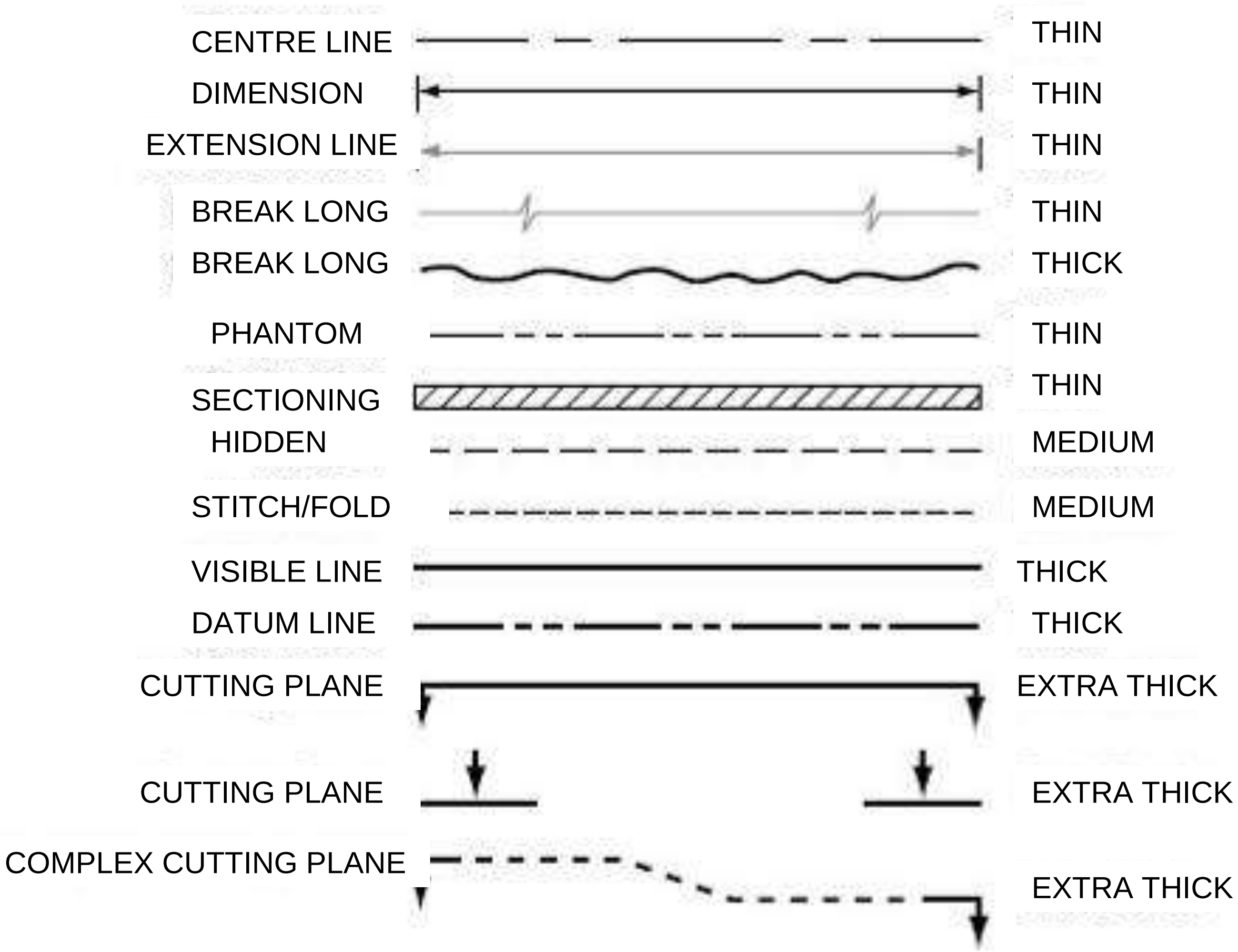
A4 = 210 mm × 297 mm
A3 = 297 mm × 420 mm
A2 = 420 mm × 594 mm
A1 = 594 mm × 841 mm
A0 = 841 mm × 1189 mm
The sides of all sheets are in the ratio 1 : √2

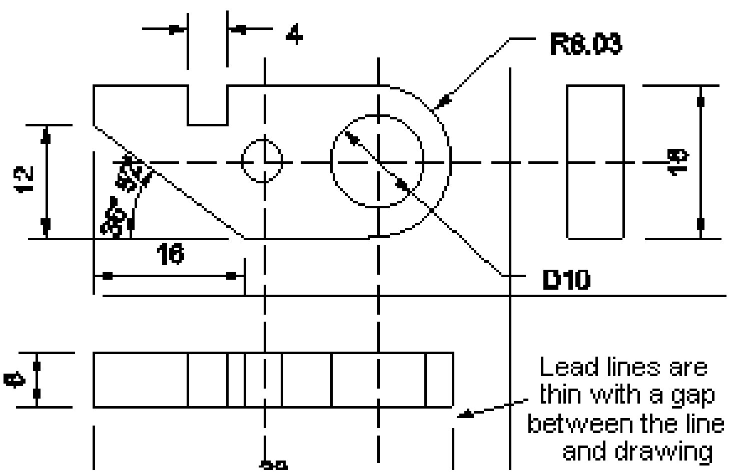
A0 is nominally one square metre in area and forms the basis of the series

DRAWING LAYOUT


DO NOT SCALE
IF IN ANY DOUBT—ASK
MATERIAL: 1/8 ALUMINIUM TREAD PLATE Alloy 5052H32
90°
23
6
TOLERANCES
DESCRIPTION
TTE TALL SHIPS PROJECT
GANGWAY FOR THE "MAYBE"
PROJECTION
NAME
TREADS
MAT'L
FINISH
Nº OFF
14
REPORT ANY ERRORS
ALL DIMENSIONS IN IMPERIAL
REMOVE ALL SHARP EDGES & BURRS
SCALE
1:2
DATE
26-06-13
DRAWN
E.CODY
CHKD
REV
1
DWG Nº
SHEET
A3

LINE TYPES





Projection Lines are thin with a 3mm gap between the line and the drawing.

Dimension lines are thin and end in arrows 3mm in length.

Dimensions are placed above dimension lines and are read from left to right

Abbreviations D (or Dia) and R (or Rad) are used to indicate Diameters and Radii.

8 SECTIONAL OR CUT THROUGH VIEWS

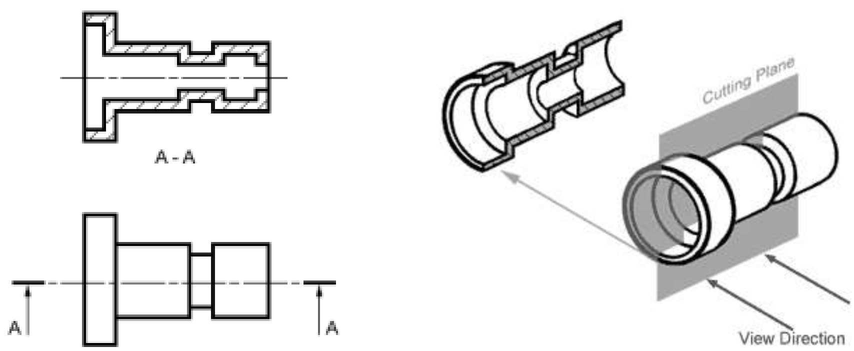
A component that has hidden internal details that are difficult to show can be drawn as a sectional component, i.e. one that has been cut open to reveal the internal details. Any component that is represented in this cut form must have the cut faces 'hatched' to make the sectioning clear.

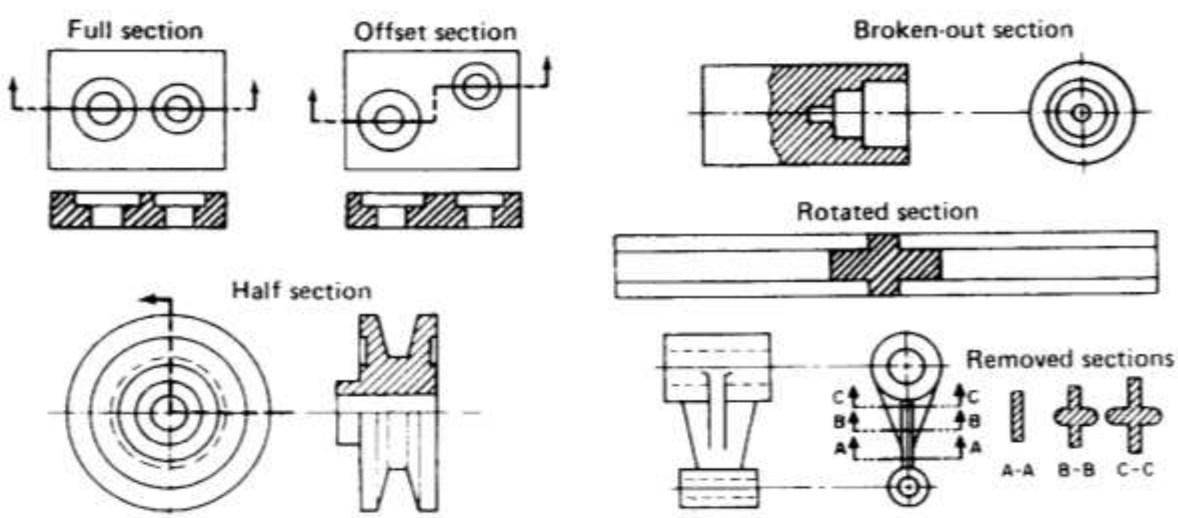
Hatching lines are parallel lines that are drawn no more than 4 mm apart at an angle of 45˚ to a chosen axis.

Sectional views should be clearly defined by cutting planes which are centre lines with thicker ends and arrow indicating the direction of view. Reference letters are needed it more than one sectional view is to be shown.

Any parts with long symmetrical axis such as webs, rivets, keys, pins, spindles, shafts, dowels, nuts, bolts and washers should not be drawn as sectioned features along their length and are not hatched.

Types of sections





9 DIMENSIONS

For drawing purposes, a dimension is a numeral, or numerals, representing a measurable size for a feature. On a drawing, the unit of the dimension should be stated clearly with the dimensions, or as a general note.

Choice of dimensions and their layout on the drawing sheet, is very important. A badly dimensioned drawing can be difficult to read and mistakes can occur. The following rules, provide a basis for good dimensioning practice:

i) All dimensions should be given one only.

ii) No dimensions should have to be measured off the drawing.

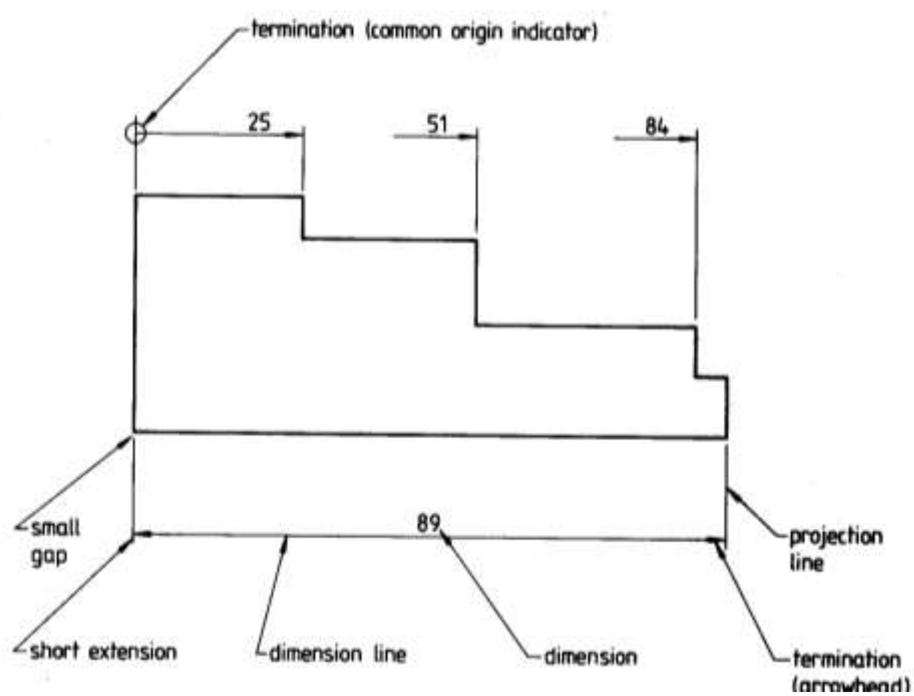
iii) No calculations should be necessary by a person working to a drawing.

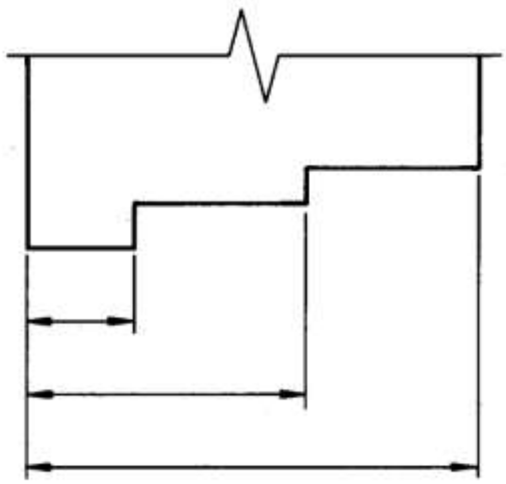
Dimension Lines

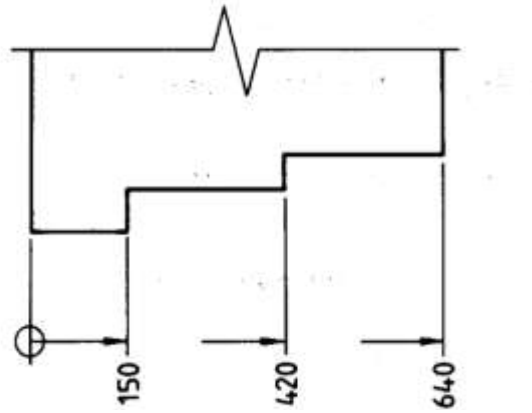
The positioning of dimension lines should be carefully planned so that they are clearly readable and to ensure that they do not confuse any further details shown on the drawing.

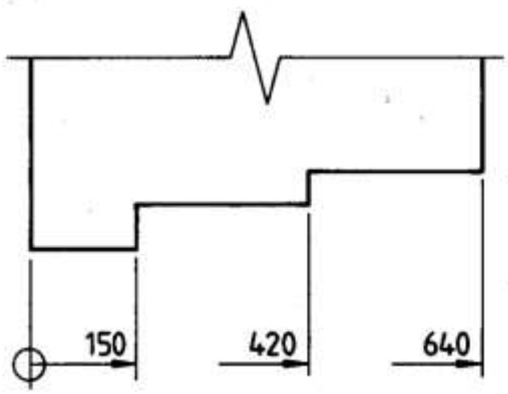
They are usually drawn as an unbroken line that terminates at each end with a neat sharp arrow head that touches the relative Projection lines. (These are lines that extend from the outline of the feature to facilitate dimensioning).

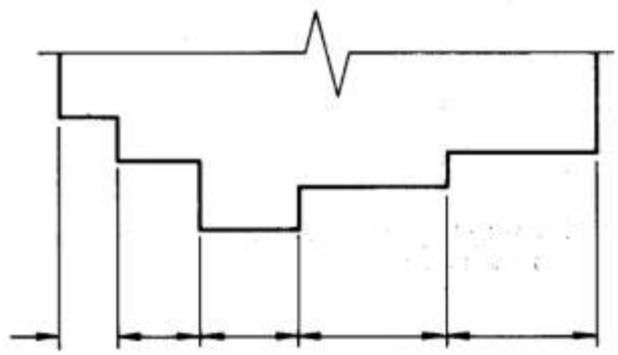
The dimensions should be centrally placed, above the dimension line, and dimension lines should only be positioned so that they can be read from the bottom of the drawing sheet or from the right hand side.

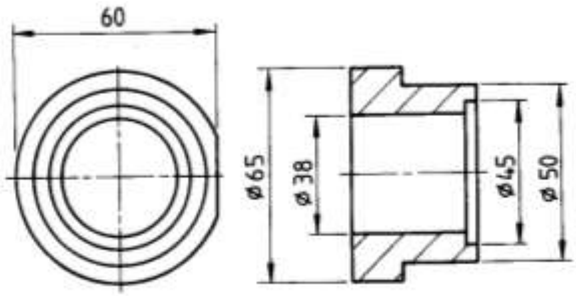


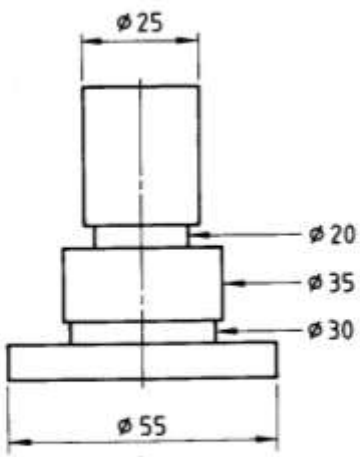


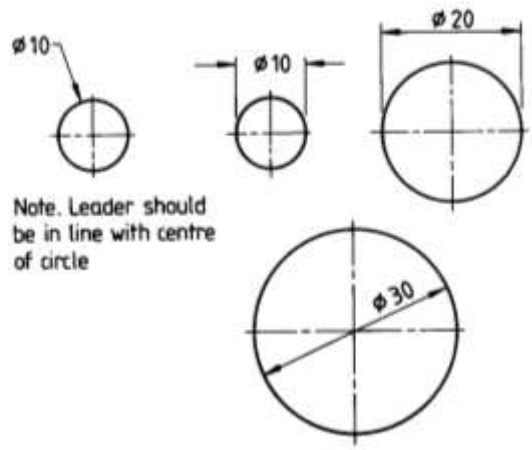

150
420
640


150
420
640







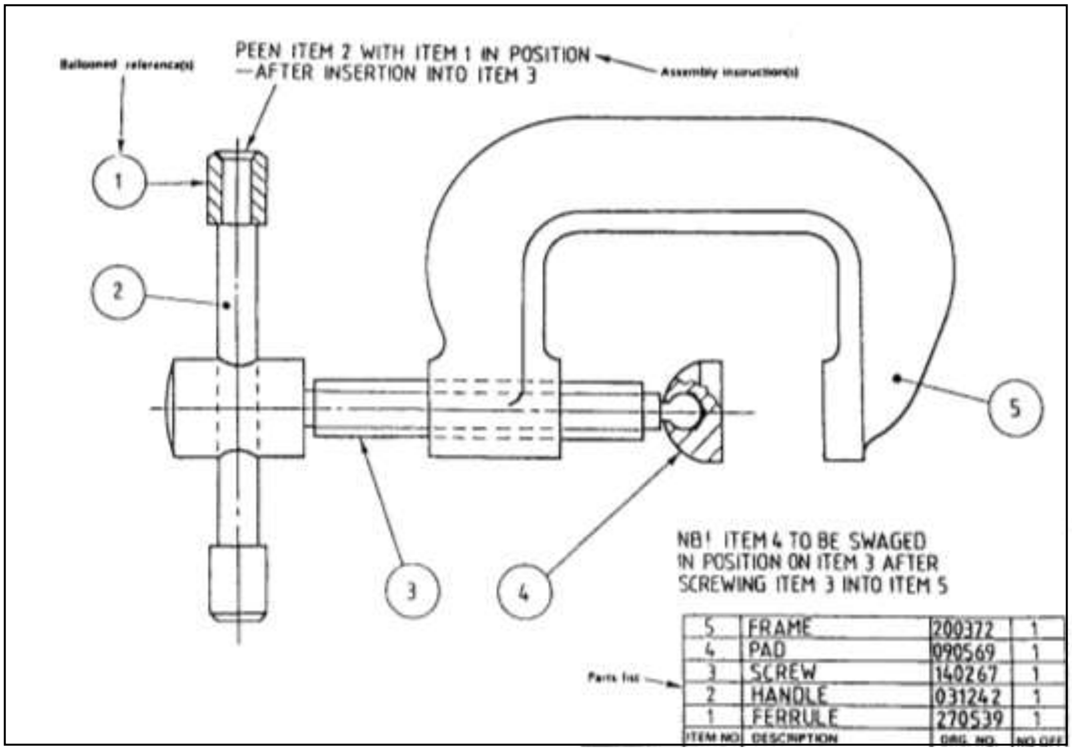


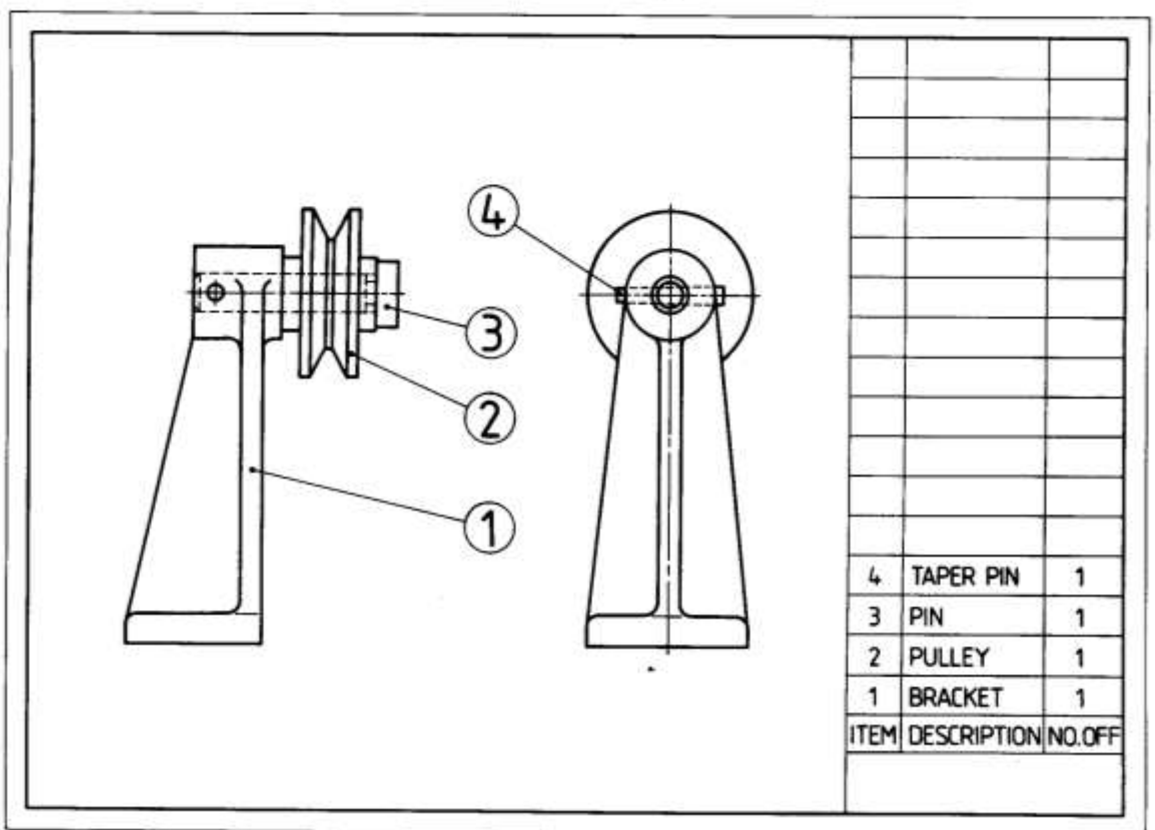
10 BALLOON REFERENCING

If all parts of a component were labelled or all details of components were given on the actual component representation, the amount of written information would possibly obscure the graphical information given. To overcome this problem a system called Balloon Referencing is used.

This system consists of a table of information or a parts list given on the drawing away from the main representation which has each piece of information referenced by either a letter or a number. The drawing then has a line coming away from each part or section of the component which terminates at the outer end in a circle. In this circle can be given the reference letter or number of the relevant information, thus enabling a cross reference process to be carried out to obtain the information. The opposite end of the line can terminate in either a spot or an arrow head.

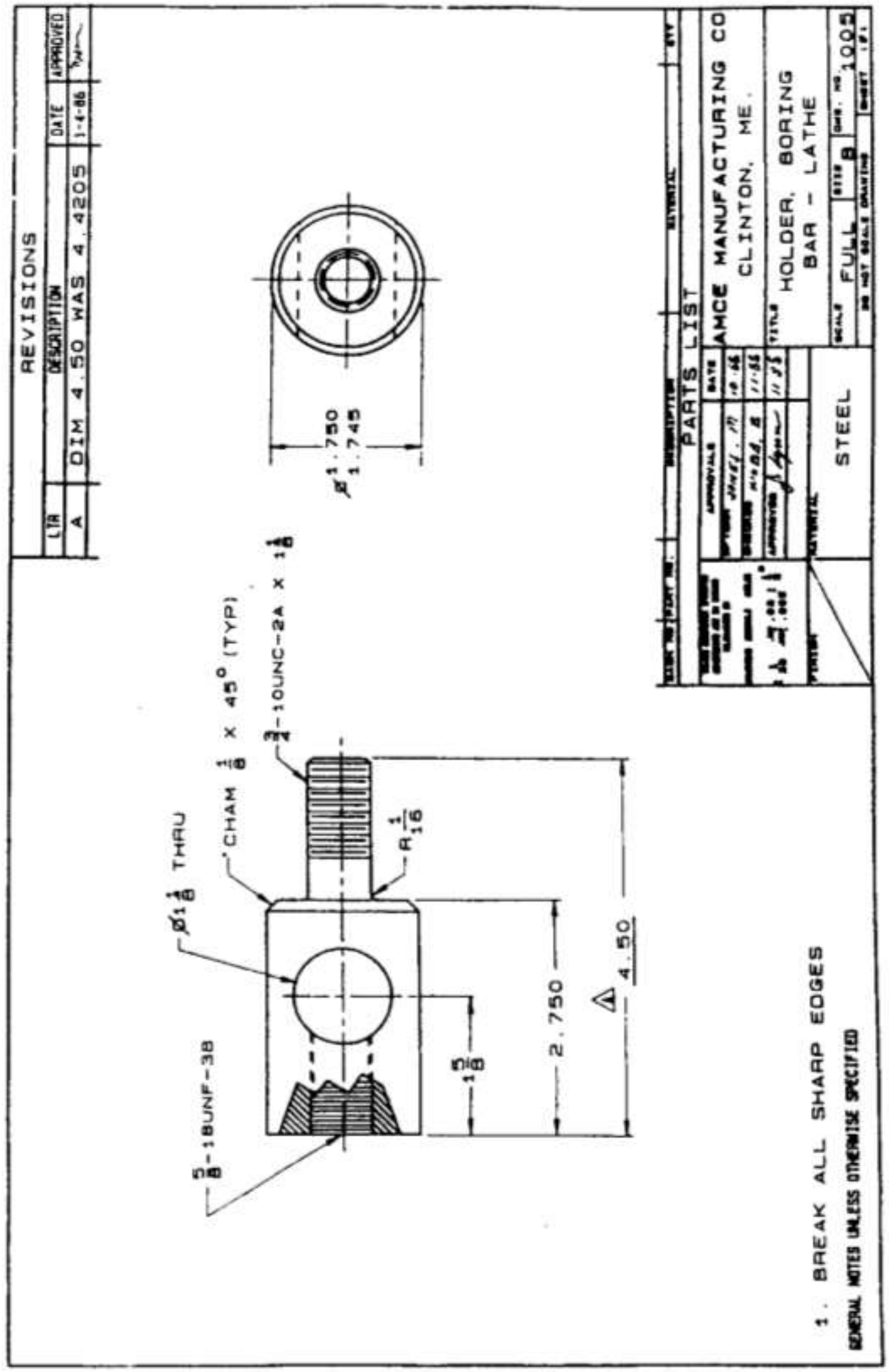
This process enables the drawing to maintain its clarity whilst still giving all the required information.



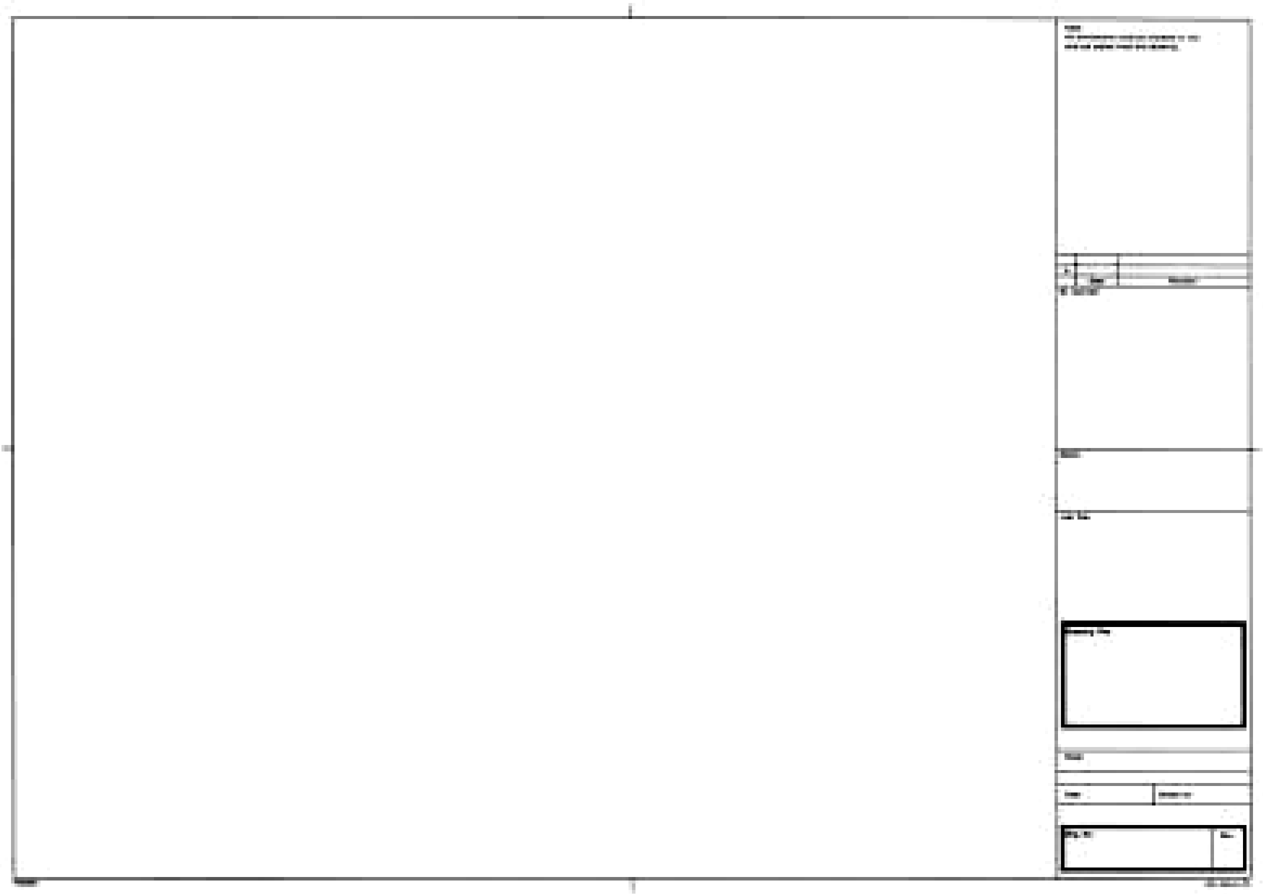


(d) Assembly drawing

Detail drawing

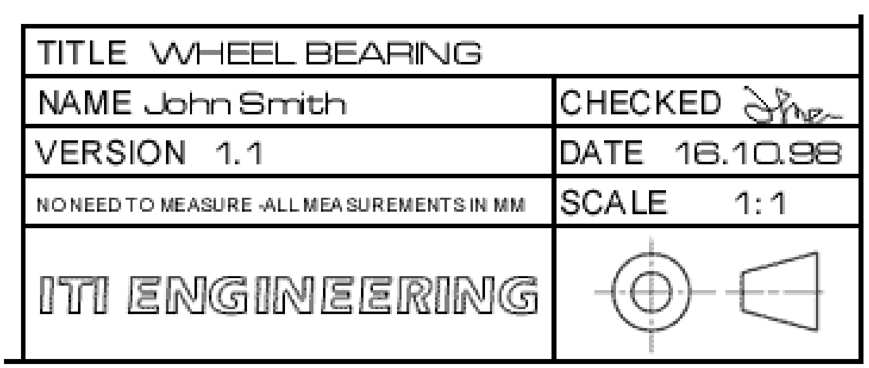


Blank drafting sheet



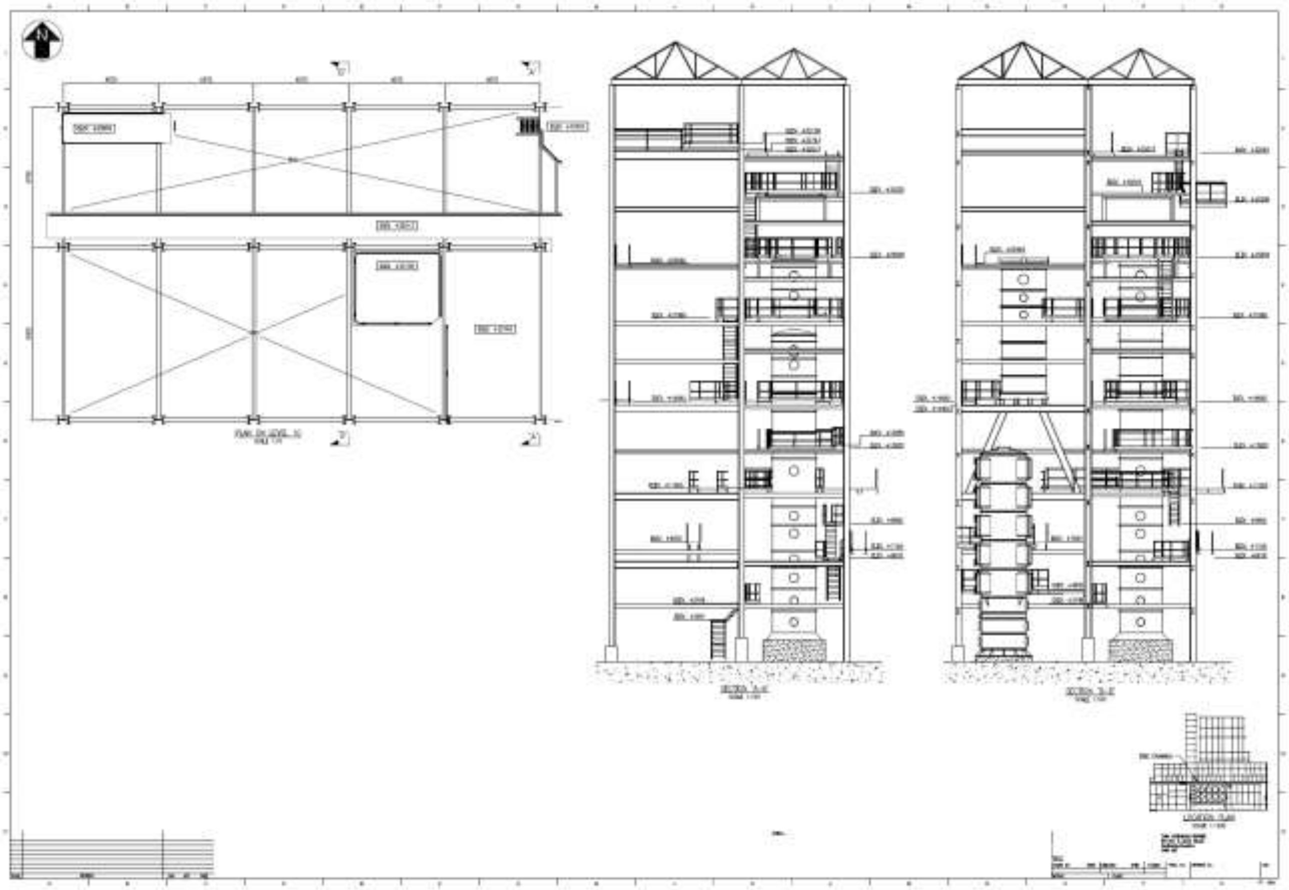
The layout of an engineering drawing

It is important that you follow some simple rules when producing an engineering drawing which although may not be useful now, will be useful when working in industry.
All engineering drawings should feature an information box. An example is shown below.

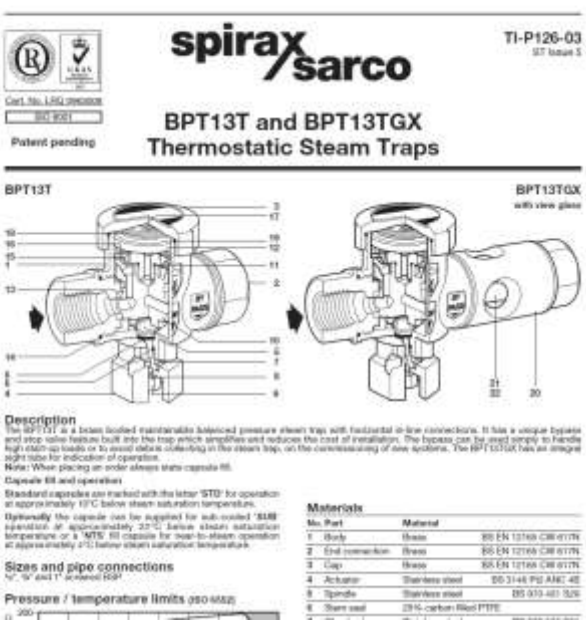


Types of drawings used on site.

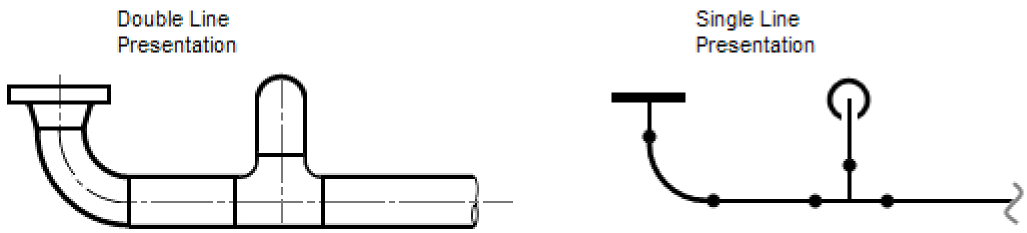
Site Plan



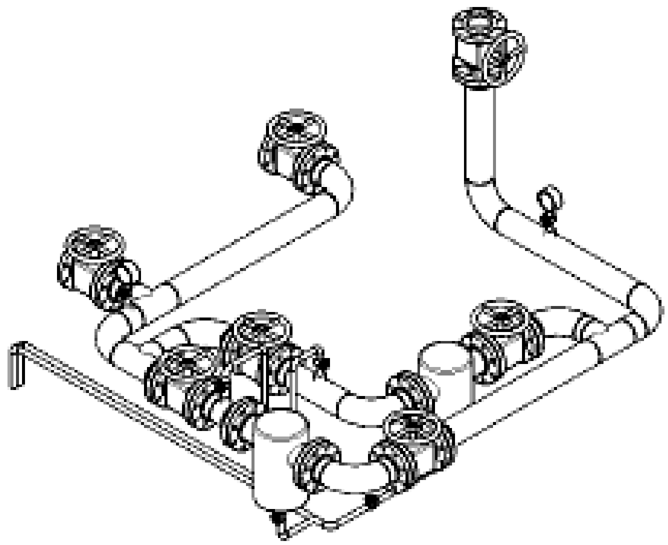
Presentation drawing



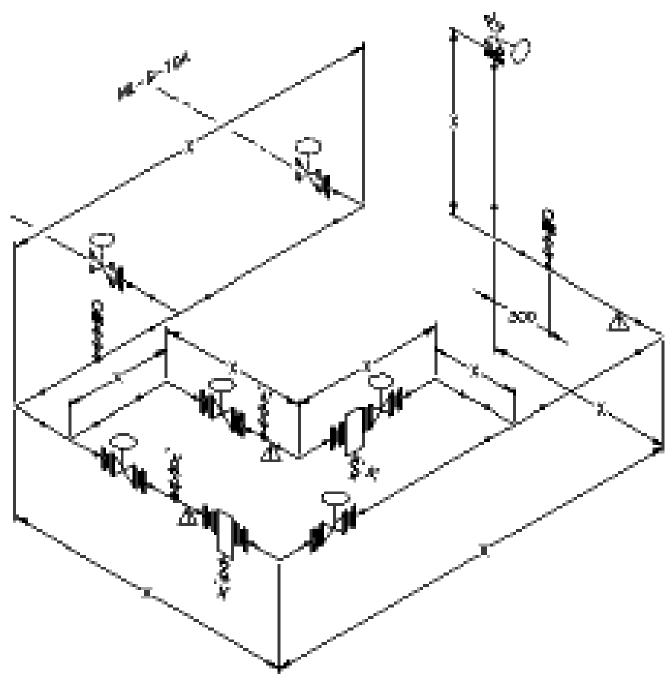
PIPING DRAWINGS



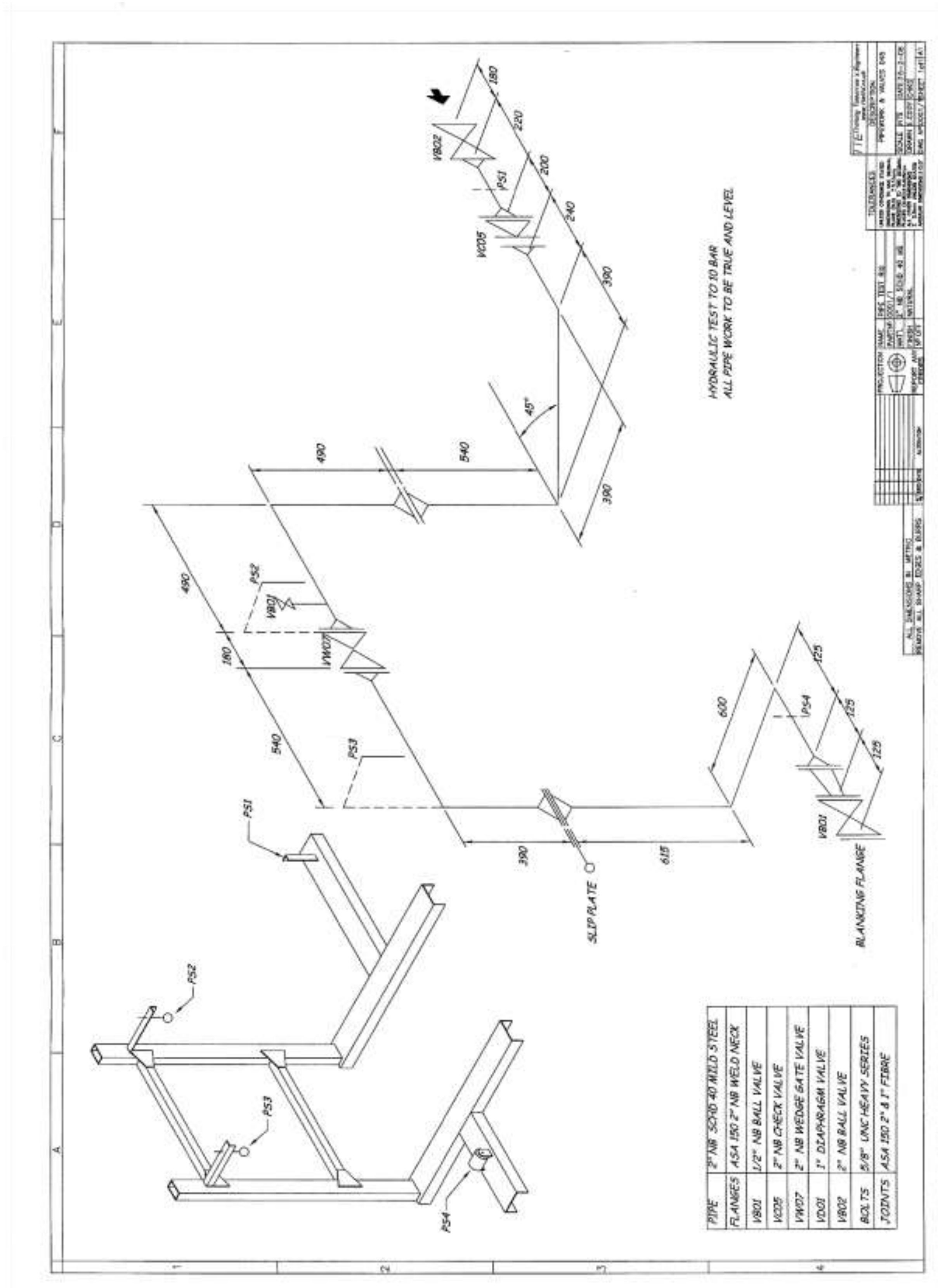
DOUBLE LINE ISOMETRIC PIPING DRAWING

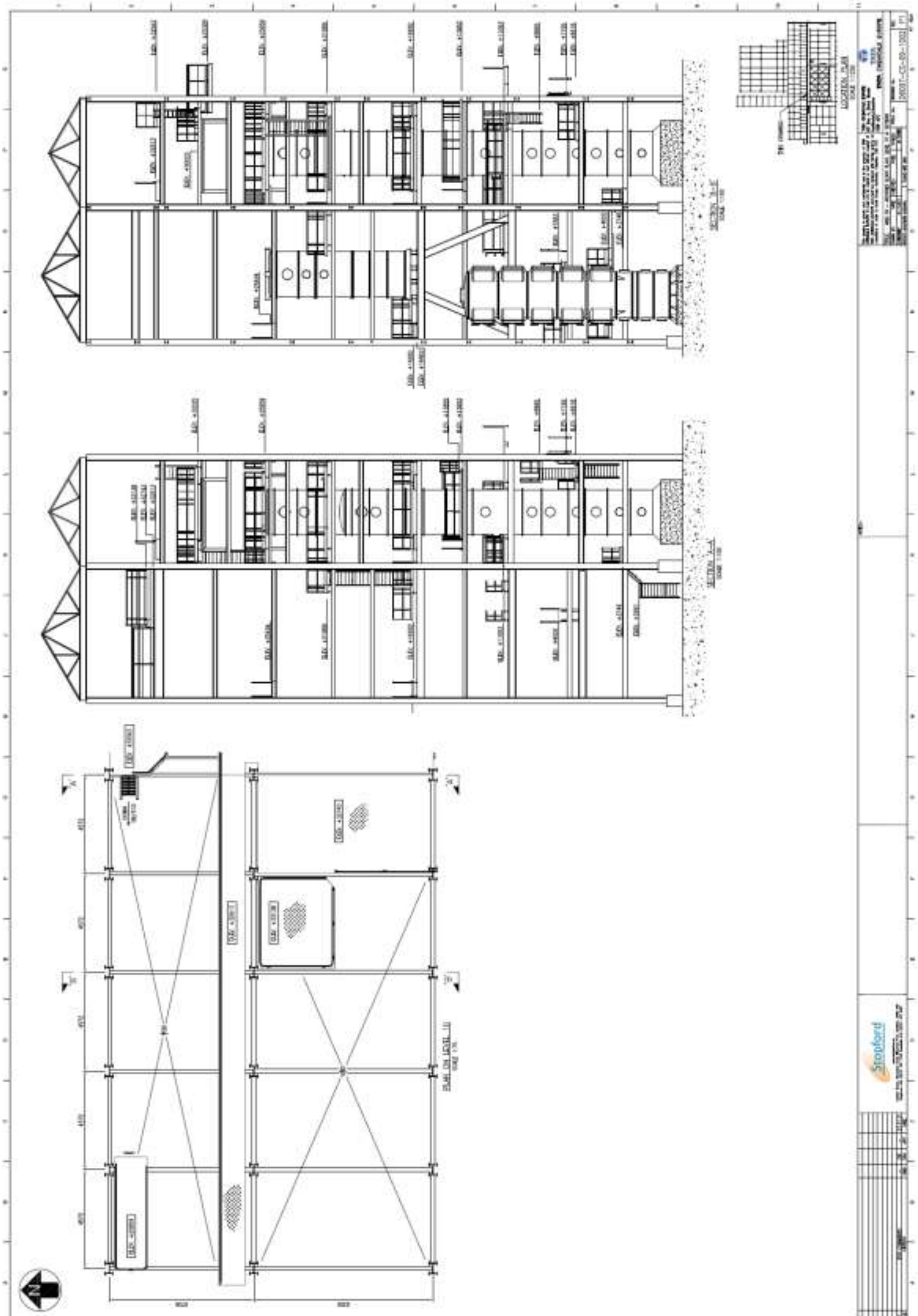


SINGLE LINE ISOMETRIC PIPING DRAWING



SINGLE LINE ISOMETRIC PIPING DRAWING


HYDRAULIC TEST TO 10 BAR
ALL PIPE WORK TO BE TRUE AND LEVEL
SLIP PLATE
BLANKING FLANGE
PIPE 2" NB SCHD 40 MILD STEEL
FLANGES ASA 150 2" NB WELD NECK
VB01 1/2" NB BALL VALVE
VC05 2" NB CHECK VALVE
VW07 2" NB WEDGE GATE VALVE
VD01 1" DIAPHRAGM VALVE
VB02 2" NB BALL VALVE
BOLTS 5/8" UNC HEAVY SERIES
JOINTS ASA 150 2" & 1" FIBRE



BUILDING LAYOUT DRAWING