# ENGINEERING DRAWING

## (NSQF)

## 1st YEAR

## (For 2 Year Trades)

## (As per Revised Syllabus July 2022)

## Group 26

# Painter (General)



Directorate General of Training

DIRECTORATE GENERAL OF TRAINING
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
GOVERNMENTOF INDIA

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

Post Box No. 3142, CTI Campus, Guindy, Chennai - 600 032

**Engineering Drawing (NSQF) 1st Year (For 2 Year Trades)**

**Group 26 Engineering Trades**

**As per Revised syllabus July 2022 under CTS**

## Developed & Published by

**National Instructional Media Institute**
Post Box No.3142
Guindy, Chennai - 600032
INDIA
Email: chennai-nimi@nic.in
Website: www.nimi.gov.in



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# FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, by 2020 to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of comprising various stakeholder's viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Engineering Drawing 1st Year (For 2 Year Trades)** NSQF **Group 26 Engineering Trades (Revised 2022)** under CTS will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

The Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind



**SHRI. ATUL KUMAR TIWARI., I.A.S.,**
Secretary
Ministry of Skill Development & Entrepreneurship,
Government of India.

New Delhi - 110 001

# PREFACE

The National Instructional Media Institute(NIMI) was set up at Chennai, by the Directorate General of Training, Ministry of skill Development and Entrepreneurship, Government of India, with the technical assistance from the Govt of the Federal Republic of Germany with the prime objective of developing and disseminating instructional Material for various trades as per prescribed syllabus and Craftsman Training Programme(CTS) under NSQF levels.

The Instructional materials are developed and produced in the form of Instructional Media Packages (IMPs), consisting of Trade Theory, Trade Practical, Test and Assignment Book, Instructor Guide, Wall charts, Transparencies and other supportive materials. The above material will enable to achieve overall improvement in the standard of training in ITIs.

A national multi-skill programme called SKILL INDIA, was launched by the Government of India, through a Gazette Notification from the Ministry of Finance (Dept of Economic Affairs), Govt of India, dated 27th December 2013, with a view to create opportunities, space and scope for the development of talents of Indian Youth, and to develop those sectors under Skill Development.

The emphasis is to skill the Youth in such a manner to enable them to get employment and also improve Entrepreneurship by providing training, support and guidance for all occupation that were of traditional types. The training programme would be in the lines of International level, so that youths of our Country can get employed within the Country or Overseas employment. The **National Skill Qualification Framework (NSQF)**, anchored at the National Skill Development Agency(NSDA), is a Nationally Integrated Education and competency-based framework, to organize all qualifications according to a series of **levels of Knowledge, Skill and Aptitude.** Under NSQF the learner can acquire the Certification for Competency needed at any level through formal, non-formal or informal learning.

The **Engineering Drawing** 1st Year (For 2 Year Trades) NSQF Group 26 - Engineering Trades (Revised 2022) under CTS is one of the book developed by the core group members as per the NSQF syllabus.

The **Engineering Drawing** 1st Year (For 2 Year Trades) NSQF Group 26 - Engineering Trades (Revised 2022) under CTS as per NSQF is the outcome of the collective efforts of experts from Field Institutes of DGT, Champion ITI's for each of the Sectors, and also Media Development Committee **(MDC)** members and Staff of **NIMI.** NIMI wishes that the above material will fulfill to satisfy the long needs of the trainees and instructors and shall help the trainees for their Employability in Vocational Training.

NIMI would like to take this opportunity to convey sincere thanks to all the Members and Media Development Committee (MDC) members.

**Chennai - 600 032** **EXECUTIVE DIRECTOR**

# ACKNOWLEDGEMENT

The National Instructional Media Institute (NIMI) sincerely acknowledge with thanks the co-operation and contribution of the following Media Developers to bring this IMP for the course **Engineering Drawing 1st Year (For 2 Year Trades) Group 26 - Engineering Trades** as per NSQF Revised 2022.

**MEDIA DEVELOPMENT COMMITTEE MEMBERS**

| | | |
|---|---|---|
| Shri. M. Sangara pandian | - | Training Officer (Retd.)<br>CTI, Govt. of India, Guindy, Chennai - 32. |
| Shri. G. Sathiamoorthy | - | Jr. Training Officer - SG (Retd.)<br>Govt I.T.I, Trichy, DET - Tamilnadu. |
| Shri. S. Loganathan | - | Assistant Training Officer,<br>Govt I.T.I, Ambattur. |
| Shri. C.C. Subramanian | - | Training Officer (Retd.)<br>Balamandir PHMITI, Chennai - 17. |

**NIMI CO-ORDINATORS**

| | | |
|---|---|---|
| Shri. Nirmalya Nath | - | Deputy General Manager,<br>NIMI, Chennai - 32. |
| Shri. G. Michael Johny | - | Manager,<br>NIMI, Chennai - 32. |

NIMI records its appreciation of the **Data Entry, CAD, DTP Operators** for their excellent and devoted services in the process of development of this IMP.

NIMI also acknowledges with thanks, the efforts rendered by all other staff who have contributed for the development of this book.

# INTRODUCTION

Theory and procedure along with the related exercises for further practice

This book on theory and procedure along with related exercises contains theoretical information on **1st Year Engineering drawing** NSQF (For 2 Year Revised syllabus July 2022 Group 26 - Engineering Trades) and procedure of drawing/ sketching different exercise for further practice are also available. Wherever required, BIS specification has been used.

Exercise for further practice

The practice exercise is given with Theory and procedure for 1st Year book made obsolete as it was felt that, it is very difficult to work in workbook using drawing instruments. It is well known fact that, any drawing is prepared on suitable standard size of drawing sheets only.

The instructor is herewith advised to go through the instructions given below and to follow them in view of imparting much drawing skill in the trainees.

Acquiring the above said ability and doing small drawings is not a simple task. These books will provide a good platform for achieving the said skills.

**Time allotment:**

**Duration of 1st Year : 38 Hrs**

| Sl. No. | Topic | Exercise No. | Time Allotment |
|---|---|---|---|
| 1 | Free hand drawing | 1.1.01 - 1.1.03 | 8 |
| 2 | Drawing of Geometrical Figures | 1.2.04 - 1.2.07 | 12 |
| 3 | Dimensioning | 1.3.08 | 10 |
| 4 | Symbolic Representation | 1.4.09 | 8 |
| | | | **38 Hrs** |

**Instructions to the Instructors**

It is suggested to get the drawing prepared on A4/A3 sheets preferably on only one side. If separate table and chair facility is available for every trainee then it is preferred to use A3 sheets and if the drawing hall is provided with desks then A4 sheets may be used. However while preparing bigger drawings on A4 sheets suitable reduction scale to be used or multiple sheets may be used for detailed and assembly drawings.

First the border and the title block to be drawn only for the first sheet of the chapter. Eg. for conical sections only first sheet will have the title block whereas the rest of the sheets of that chapter will have only borders.

Serial number of sheet and total no. of sheets to be mentioned on each sheet.

The completed sheet to be punched and filled in a box file/ suitable files and preserved by the trainees carefully after the approval of instructor, VP and Principal of the Institute.

The file may be referred by the authority before granting the internal marks at the end of the Year.

## CONTENTS





## LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

- **Read and apply engineering drawing for different application in the field of work.**

# SYLLABUS

**1st Year** **Group 26 - Revised syllabus July 2022** **Duration: 1 Year**
**2 Year Engineering trades under CTS**

**CTS Trades Covered:** Painter (General)

| S.no. | Syllabus | Time in Hrs |
|---|---|---|
| 1 | Free hand drawing of -<br>• Geometrical figures and blocks with dimension<br>• Transferring measurement from the given object to the free hand sketches.<br>• Free hand drawing of hand tools and measuring tools. | 8 |
| 2 | Drawing of Geometrical figures:<br>• Angle, Triangle, Circle, Rectangle, Square, Parallelogram.<br>• Lettering & Numbering - Single Stroke, Double Stroke, Inclined | 12 |
| 3 | Dimensioning<br>• Types of arrowheads | 10 |
| 4 | Symbolic representation -<br>• Different symbols used in the Painter (General) trades. | 8 |
| | **Total** | **38** |

# Free hand drawing of - Geometrical figures and blocks with dimension

## Introduction to engineering drawing and drawing instruments

### Communication

There are many different ways of communicating ideas, information, instructions, requests, etc. They can be transmitted by signs or gestures, by word of mouth, in writing, or graphically. In an industrial context the graphical method is commonly used with communication is achieved by means of engineering drawings.

If oral and written communication only were used when dealing with technical matters, misunderstandings could arise, particularly in relation to shape and size. The lack of a universal spoken language makes communication and understanding even more difficult because of the necessity to translate both words and meaning from one language to another.

However, the universally accepted methods used in graphical communication through engineering drawings eliminate many of these difficulties and make it possible for drawing prepared by a British designer to be correctly interpreted or "read" by, for example, his German, French or Dutch counterparts.

Equally important, the components shown on the drawings could be made by suitably skilled craftsmen of any nationality provided they can "read" an engineering drawing.

Conventionally prepared engineering drawings provide the main means of communication between the "ideas" men (the designers and draughtsman) and the craftsmen (machinists, fitters, assemblers, etc.). For the communication to be effective, everyone concerned must interpret the drawing in the same way. Only then will the finished product be exactly as the designer envisages it.

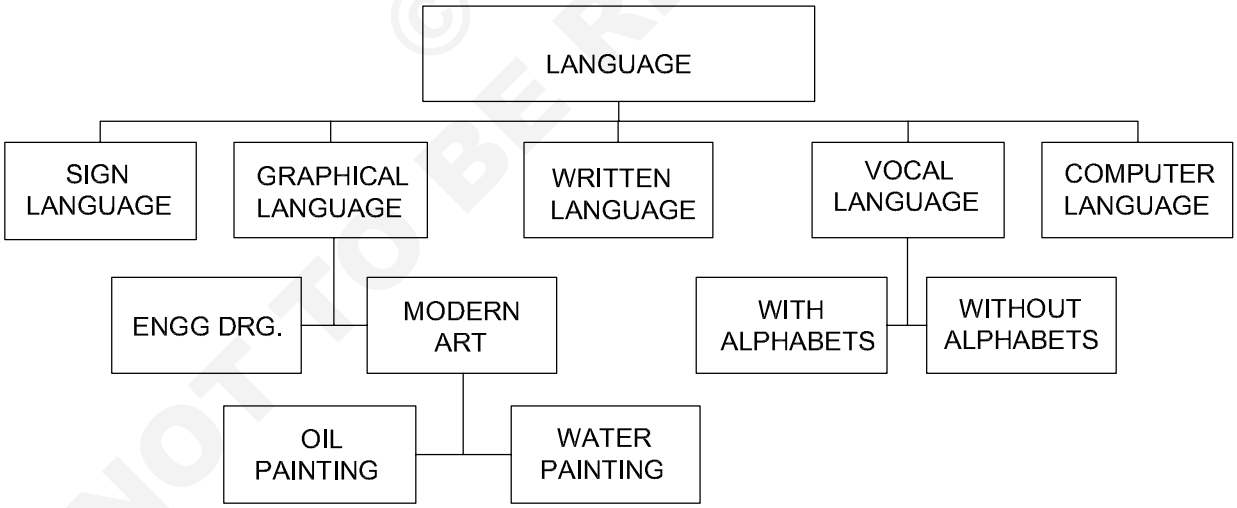
To ensure uniformity of interpretation, the British Standards Institution has prepared a booklet entitled BS 308:1972, Engineering Drawing Practice. Now in three parts, this publication recommends the methods which should be adopted for the preparation of drawing used in the engineering industry.

The standards and conventions in most common use and hence those required for a basic understanding of engineering drawing are illustrated and explained in this book.

### Language

1 It is the media of communication (Fig 1)

Fig 1



**Conclusion**

Effective communication is possible when graphical language is supported by written language/vocal language and vice versa.

Engineering drawing is a language that uses both graphical language and written language for effective communication.

**Engineering drawing is a graphical language that also uses written language for effective communication.**

**The importance of Engineering Drawing**

The economic success of any country is mainly dependent on its industrial development. Due to globalization, any industry in our country is expected to be of a global market standard. For the above-mentioned reasons, our Indian products require very high quality for their size, dimension, fit, tolerance, and finish etc.

To produce the best standard product, all the technical personnel (Engineers to Craftsman) in an industry must have a sound knowledge of engineering drawing because engineering drawing is the language of engineers. Engineering drawing is a universal language. Different types of lines make up their alphabets. Technical personnel in any industry, including craftsman, are expected to communicate anything concerning a part or a component by means of drawings involving lines, symbols, conventions, abbreviations etc.

With our spoken languages, it is impossible to express the details of a job or a product. Engineering drawing knowledge and practise are a must for designing or producing a component or part. Even a small mistake in the drawing may reflect very badly on the product. Therefore, reading and doing engineering drawings are very essential for craftsmen and engineers.

A drawing is a graphical representation of an object, or part of it, and is the result of creative thought by an engineer or technician. When one person sketches a rough map in giving direction to another, this is graphic communication. Graphic communication involves using visual materials to relate ideas. Drawings, photographs, slides, transparencies, and sketches are all forms of graphic communication. Any medium that uses a graphic image to aid in conveying a message, instructions, or an idea is involved in graphic communication.

One of the most widely used forms of graphic communication is the drawing. Technically, it can be defined as **"a graphic representation of an idea, a concept or an entity which actually or potentially exists in life"**

Drawing is one of the oldest forms of communicating, dating back even farther than verbal communication. The drawing itself is a method of communicating necessary information about an abstract, such as an idea or concept or a graphic representation of some real entity, such as a machine part, house or tools. There are two basic types of drawings: Artistic and Technical drawings.

**Technical drawings**

Technical drawings 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.

The technical drawing, on the other hand is not subtle, or abstract. It does not require an understanding of its creator, only on understanding of technical drawings. A technical drawing is a means of clearly and concisely communicating all of the information necessary to transform an idea or a concept in to reality. Therefore, a technical drawing often contains more than just a graphic representation of its subject. It also contains dimensions, notes and specifications.

**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**

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

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

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

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

**Main types of Engineering drawing**

Regardless of branch of engineering the engineering drawing is used. However based on the major engineering branches, engineering drawing can be classified as follows: (Fig 2)

**Mechanical Engineering drawings**

Some examples of mechanical engineering drawings are part and assembly drawings, riveted joints, welded joints, fabrication drawings, pneumatics and hydraulics drawings, pipeline diagrams, keys coupling drawings etc. (Fig 3&4)

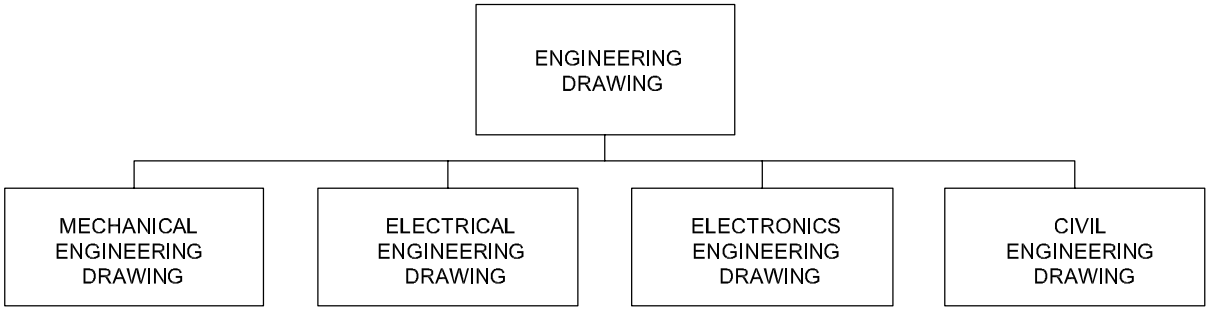
**Electrical engineering drawing**

Wiring diagrams of home and industries, circuit diagrams, electrical installation drawings etc.

**Example**

The voltage supply to a filament lamp is 10.8V. The voltage should be 12V. (Fig 5)

Fig 2




## Mechanical Engineering Drawings (Fig 3&4)

Fig 3

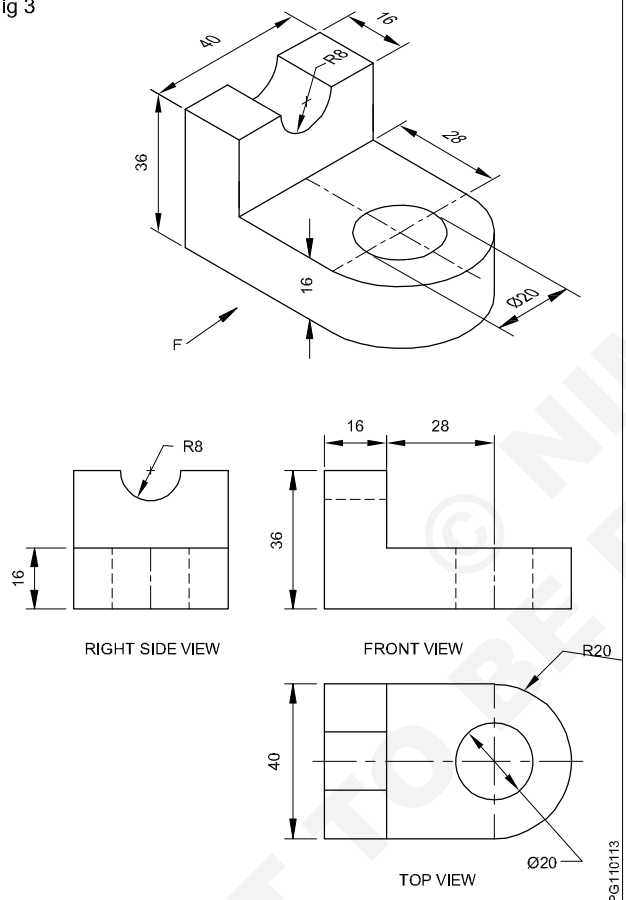
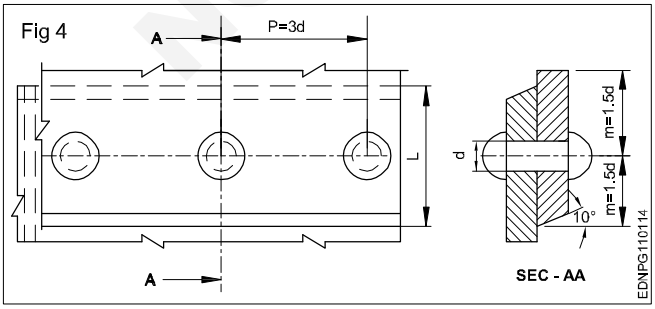
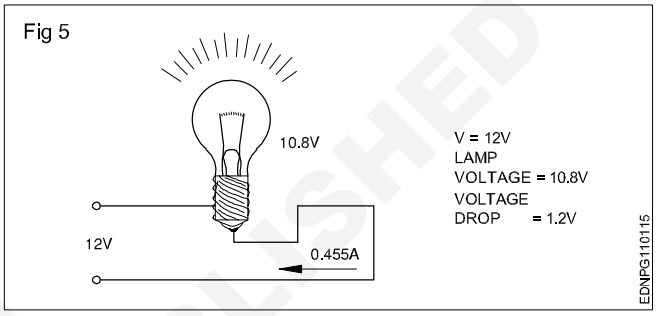



Fig 4




## Electrical Engineering Drawing (Fig 5)

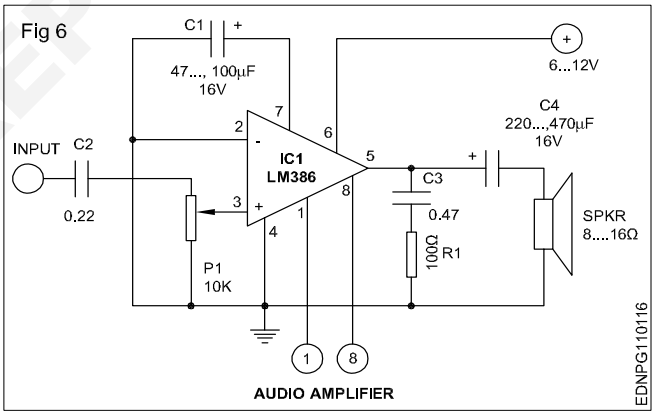
Fig 5




## Electronics Engineering Drawing

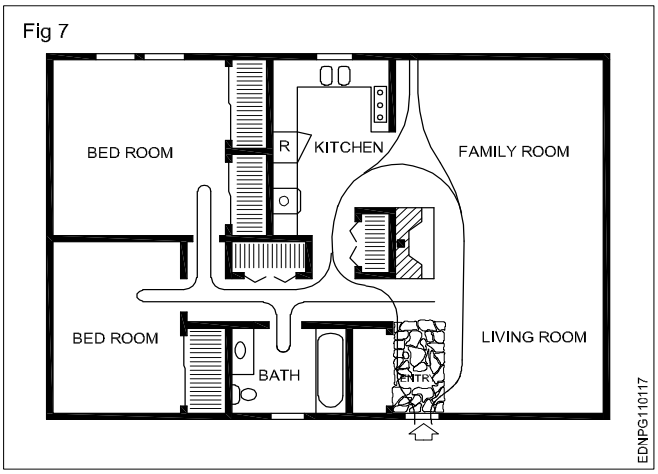
## Audio amplifier (Fig 6)

Fig 6




## Civil Engineering Drawing (Fig 7)

Fig 7



## Lines - Types and applications in drawing

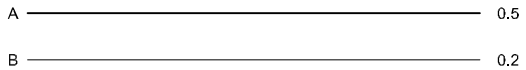
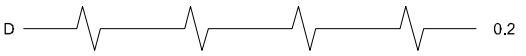
Drawings are made up of different types of lines. Just a language with alphabet and grammar.

Lines of different thicknesses and features are used for specific use.

Technical drawings are drawn with different types of lines. By proper choice and application of lines, product features can be correctly defined in a drawing. Different types of lines recommended for specific applications are given in Table 1.

Table 1

**Types of lines and their application**

| Lines | Description | General applications<br>See figure and other relevant figure |
|---|---|---|
|  | Continuous thick | A1 Visible outlines<br>A2 Visible edges |
|  | Continuous thin (straight) | B1 Imaginary lines of intersection<br>B2 Dimension lines<br>B3 projection lines or extension line<br>B4 Leader lines<br>B5 Hatching<br>B6 Outlines of revolved sections in place<br>B7 Short centre lines<br>B8 Thread line<br>B9 Diagonal line |
|  | Continuous thin free hand | C1 Limits of partial or interrupted views & sections, if the limit is not a chain thin |
|  | Continuous thin (Straight) with zig-zags | D1 Line (See figures) |
|  | Dashed thick | E1 Hidden outlines<br>E2 Hidden edges |
|  | Dashed thin | F1 Hidden outlines<br>F2 Hidden edges |
|  | Chain thin | G1 Centre lines<br>G2 Lines of symmetry<br>G3 Trajectories |
|  | Chain thin, thick at ends & changes of direction | H1 Cutting planes |
|  | Chain thick | J1 Indication of lines or surfaces to which a special requirement applies |
|  | Chain thin double-dashed | K1 Outlines of adjacent parts<br>K2 Alternative and extreme positions of movable parts<br>K3 Centroidal lines<br>K4 Initial outlines prior to forming<br>K5 Parts situated in front of the cutting plane |

1 This type of line is suited for production of drawings by machines.
2 Although two alternatives are available, it is recommended that on any one drawing, only one type of line be used.

In the above range, for craftsmen, 0.5 is preferred. This Table shows the 0.5 line range and other lines under this range.

The numbers on the right side of the lines refer to the line thickness in mm.

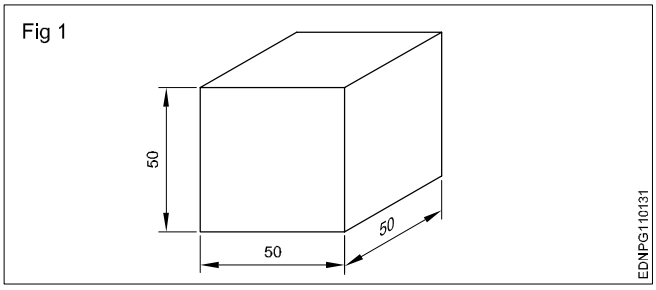
## Geometrical figures and blocks with dimension

**Freehand sketching:** Apart from making drawing using instruments, often craftsmen will be required to make drawings with their free hand.

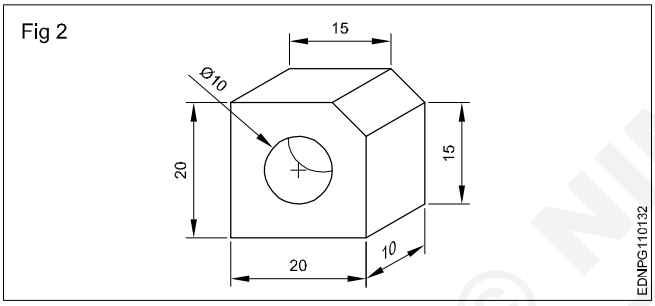
Freehand sketching is the easiest method to express the shape of a piece part or a component by an engineer or craftsman.

Freehand sketches are not usually made to scale. However, they should be as nearly to the proportions as possible.

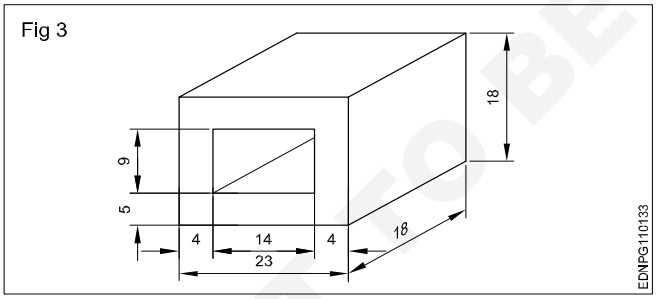
**Cube (Fig 1)**



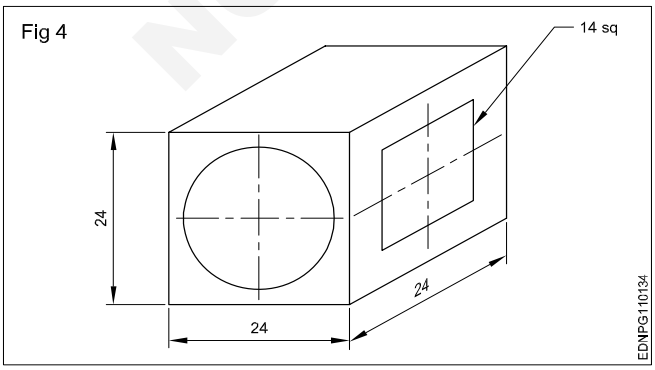

**Square block (Fig 2)**



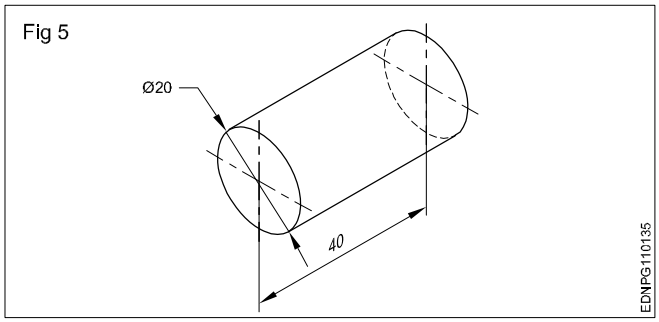

**Rectangular block (Fig 3)**



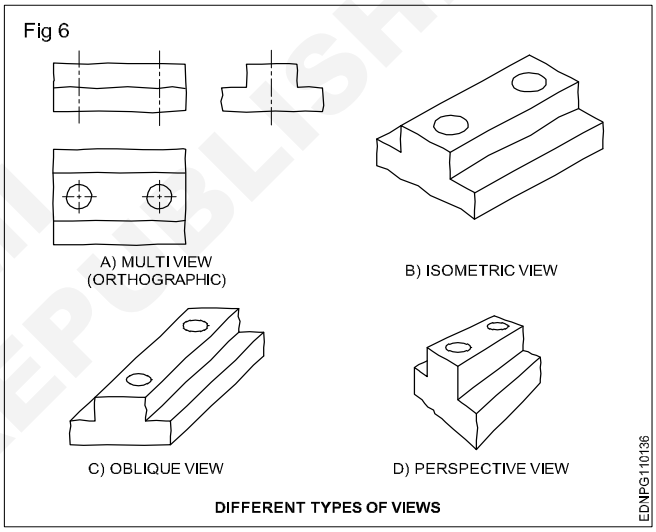

**Cube block (Fig 4)**




**Cylinder (Fig 5)**



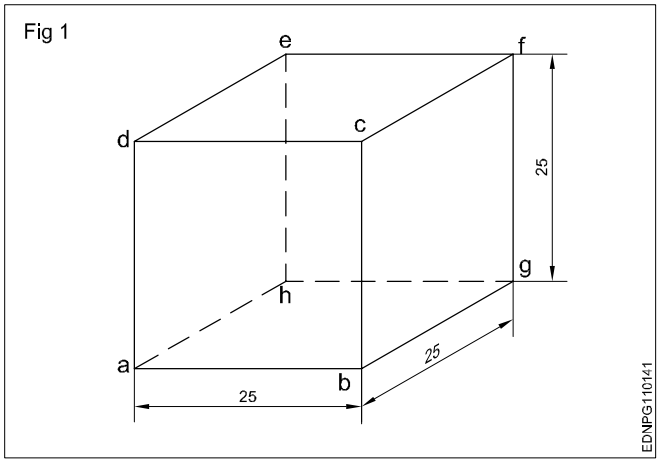

**Materials for free hand sketching:** A4 size sheet (preferably a pad instead of loose papers) pencils of soft grade. Example H, HB, and a good quality eraser are the only materials required. For drawing different darkness, the pencil points should be sharpened to a conical shape. Fig 6 shows some free hand sketches of different types of views.




## Procedure

Freehand drawing of solid figures, cubes, cuboids, cone, prism, pyramid, frustum of a cone with dimensions

**Cube (Fig 1)**

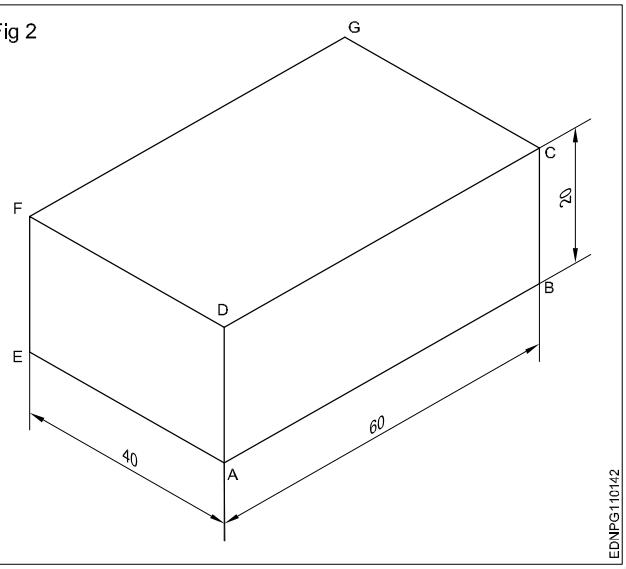


- Draw squares of a, b, c and d.
- Draw 30° from points b, c and d for the length of 25mm.
- Mark point g from b, f from c and e from d as shown in the figure.
- Joint all points.

**Cuboid (Fig 2)**

Draw the isometric drawing of a cuboid of base 60 mm x 40 mm and the height of 20 mm. (Fig 2)

Fig 2

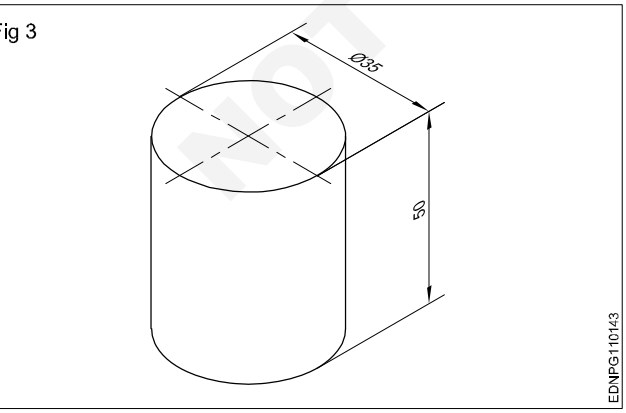



Draw the three isometric axes through the point 'A'.

- Mark AB = 60mm, AE = 40mm and AD= 20mm representing the three sides of cuboid.
- Draw two vertical lines EF and BC parallel to AD from points E and B respectively.
- Similarly, draw two more lines parallel to AB and AE to mark G's interesting point from F and C.
- Draw lines parallel to DC and FG Draw lines parallel to DF and GC.
- Join all the points.

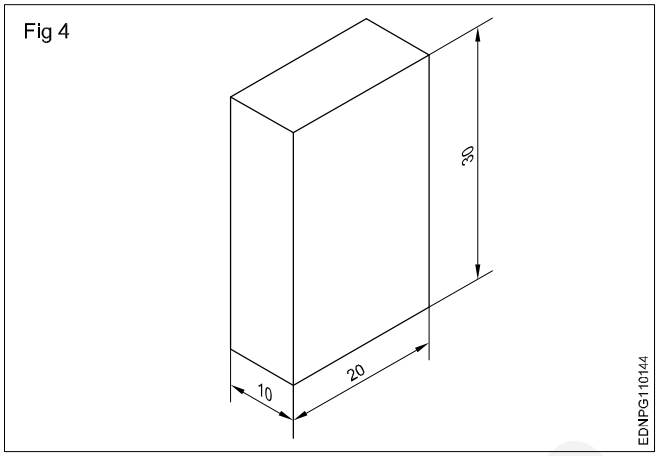
**Cylinder (Fig 3)**

Fig 3



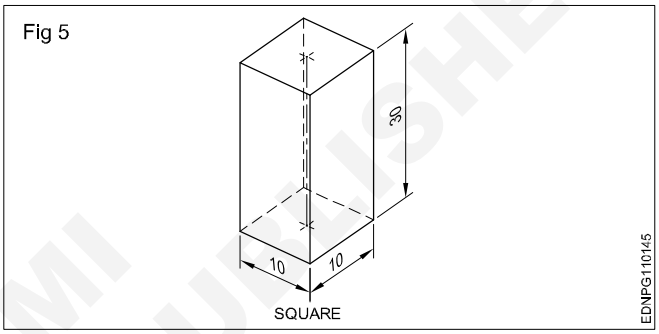

**Rectangular prism (Fig 4)**

Fig 4



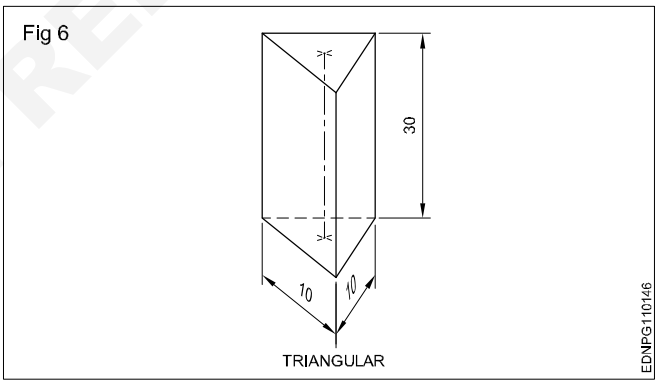

**Square Prism (Fig 5)**

Fig 5



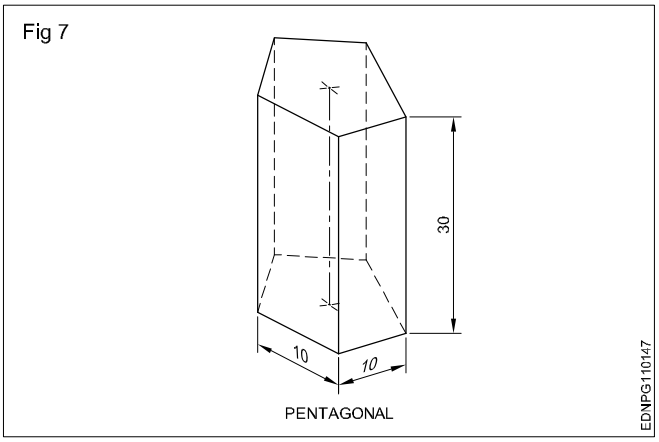

**Triangular Prism (Fig 6)**

Fig 6



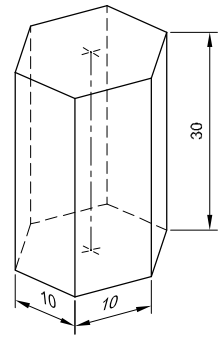

**Pentagonal prism (Fig 7)**

Fig 7



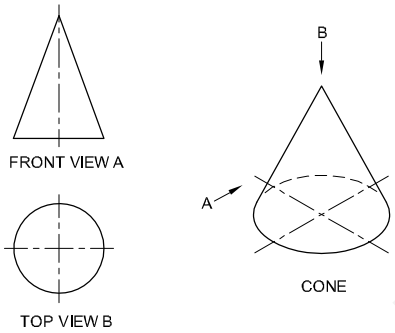
**Hexagonal prism (Fig 8)**

Fig 8




**Cone:** When a right-angled triangle revolves about one of its sides forming the right angle, a cone is generated. Cone forming has a circular face and a slant curved surface. (Fig 9)

Fig 9




**Pyramids:** Pyramids are polyhedron solids having a base surface whose shape may be triangular, square or polygon and as many slant triangular faces as there are sides in the base. All the slant triangular faces join at a common point called APEX.

Similar to prisms, pyramids also are known by the shape of their base viz triangular, square, rectangular, pentagonal, hexagonal etc. The imaginary line joining the centre of the base to the apex is called the AXIS.

Fig 10 shows some pyramids and their views.

When a semi-circle revolves about its diameter a sphere is generated. A sphere has no flat surface. (Fig 11D)

**Frustums:** Pyramid/cone is cut parallel to the base and the top portion is removed. The remaining bottom portion is called the frustum of a pyramid/cone.

If the cutting plane is at an angle to the axis/base, the pyramids or cones are called "Truncated pyramids or cones".

Fig 10

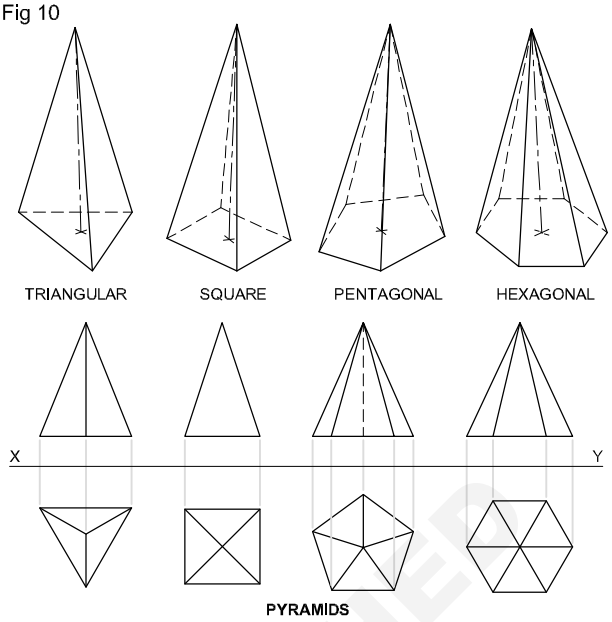



Fig 11

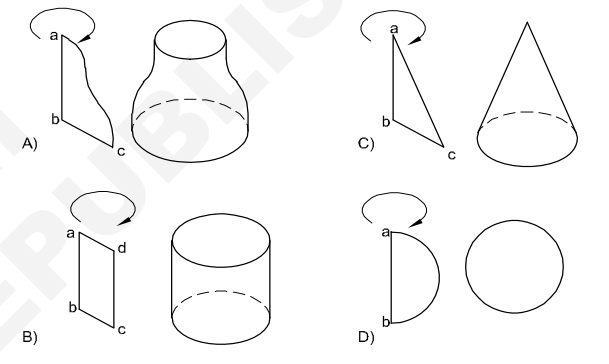
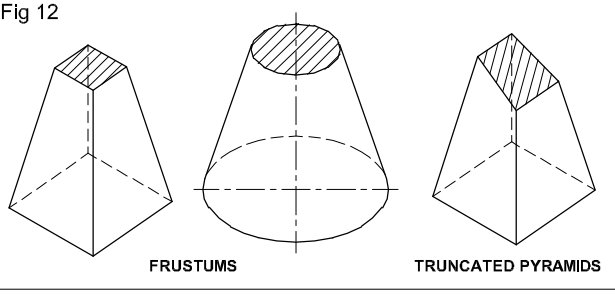



Fig 12 shows frustums and truncated pyramids.

All items we use are solids. Their shapes may confirm individual geometrical solids like prisms, cones or other combinations.

Fig 12



## Free hand drawing of - Transferring measurement from the given object to the free hand sketches

Fig 1

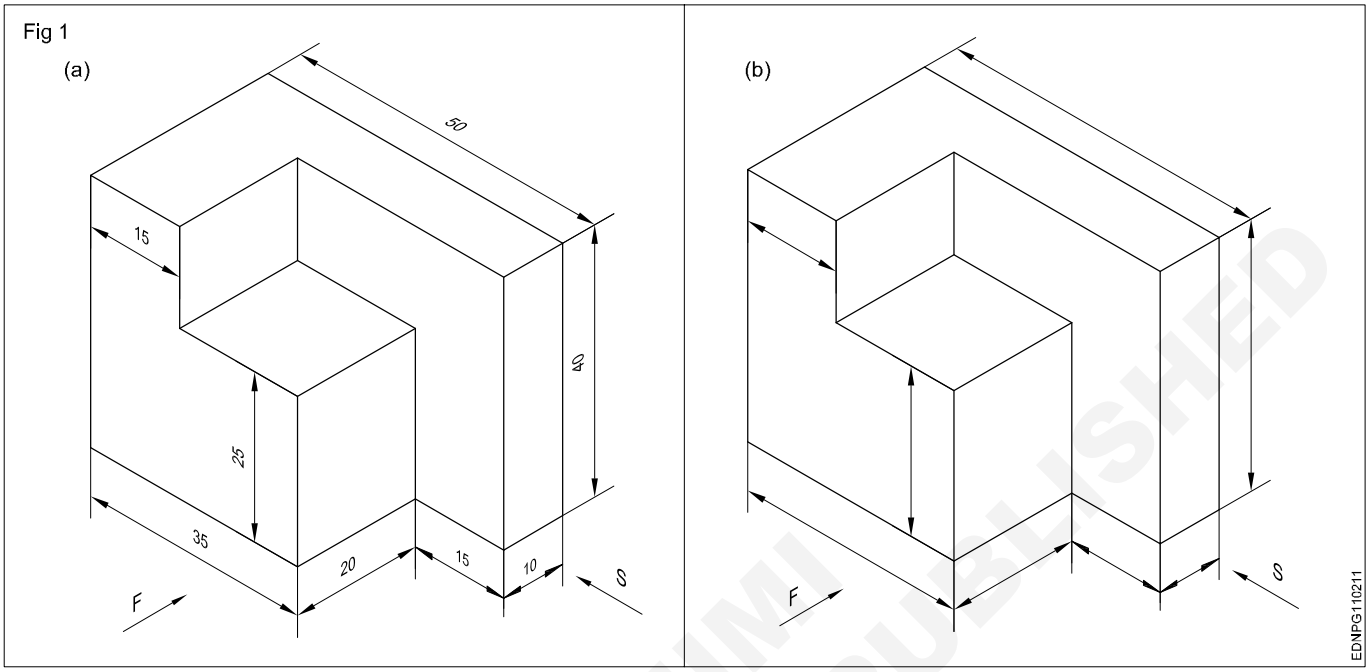



Fig 2

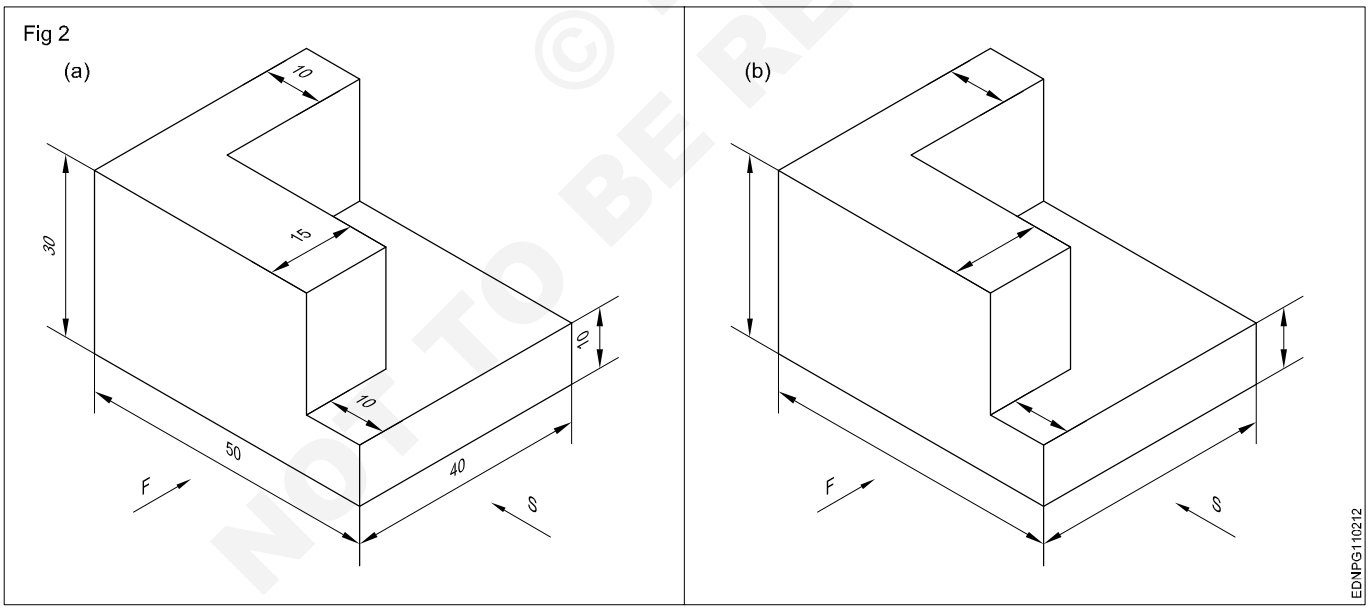
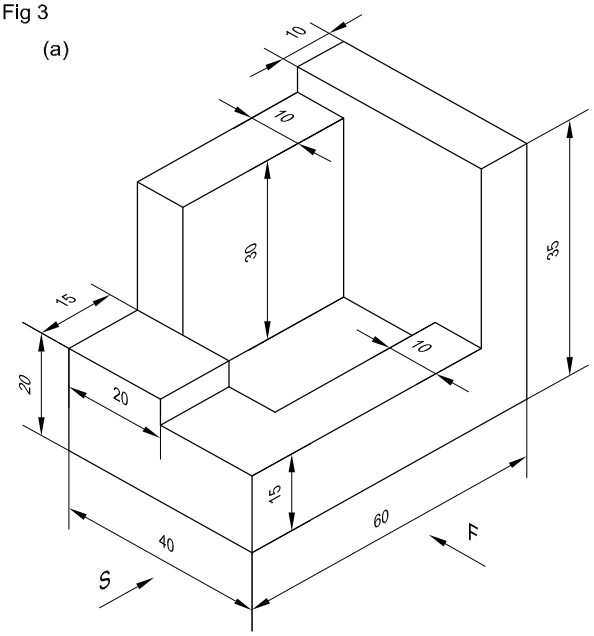
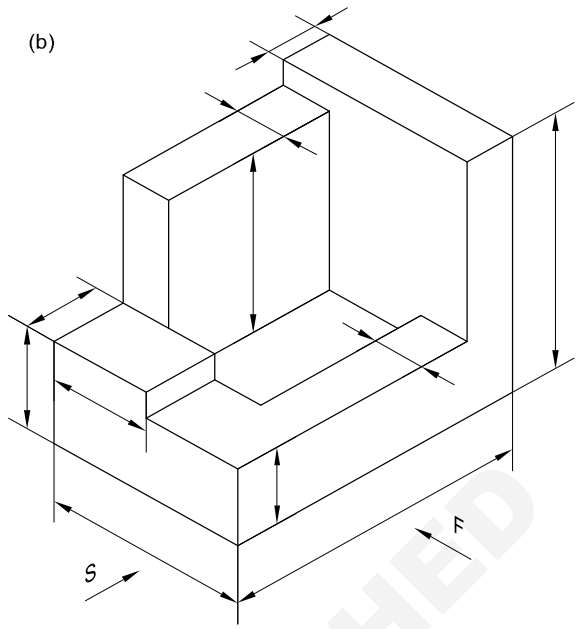


Fig 3

(a)



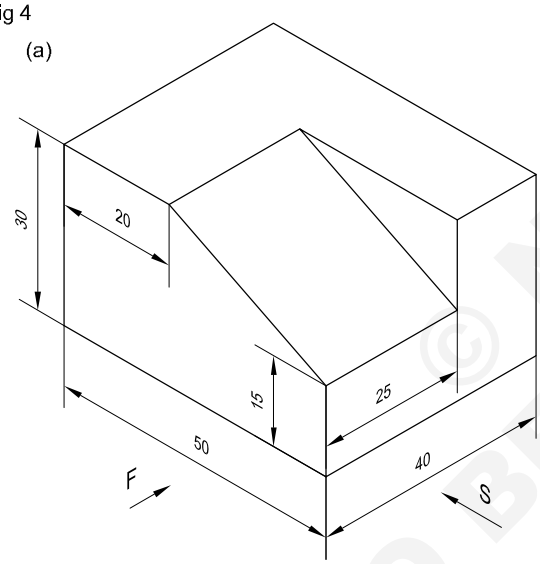

(b)



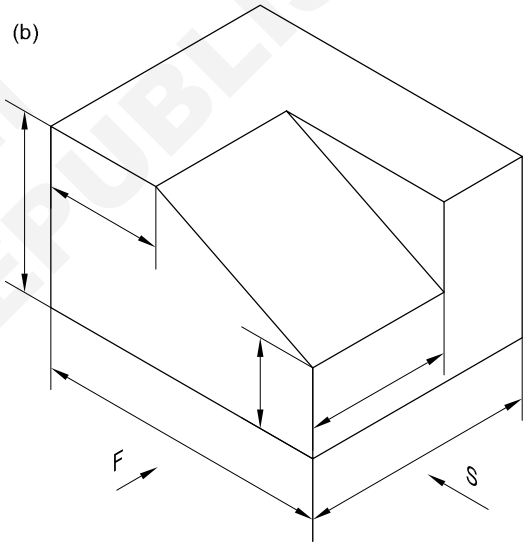

EDNPG110213

Fig 4

(a)



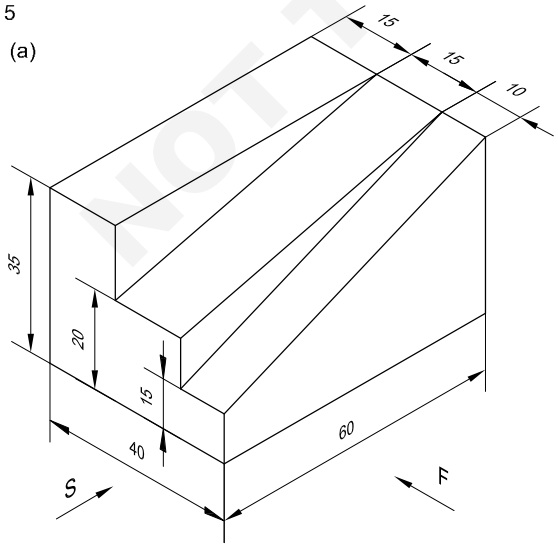

(b)



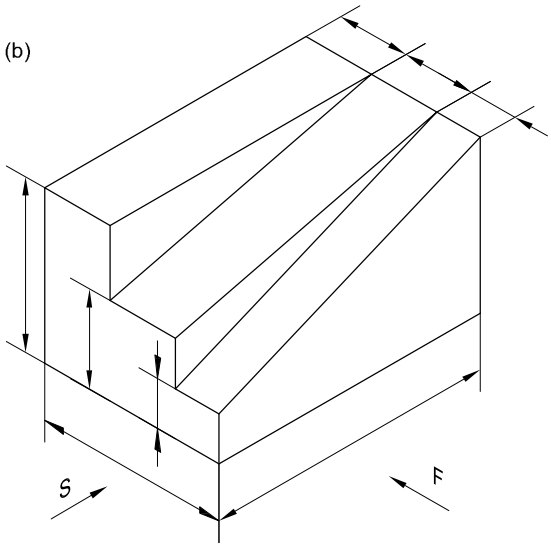

EDNPG110214

Fig 5

(a)



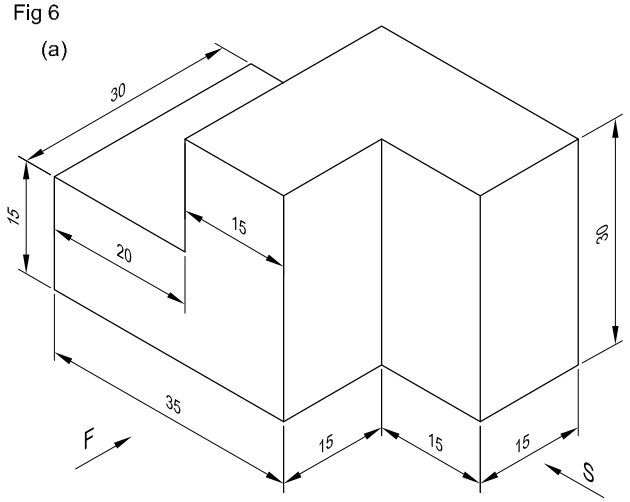

(b)



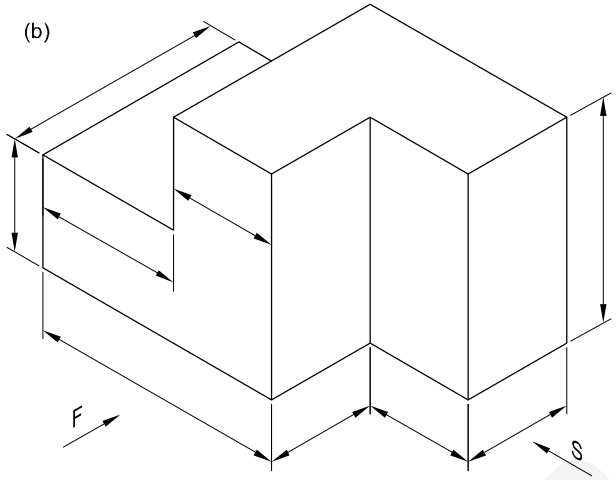

EDNPG110215

Fig 6

(a)



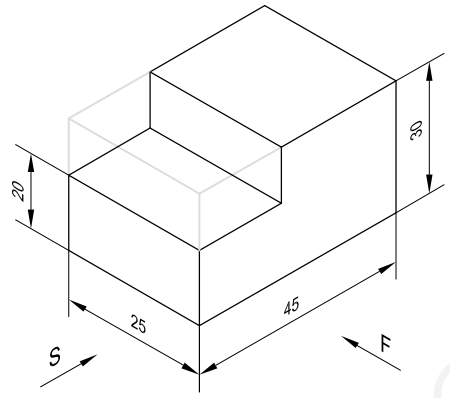

(b)



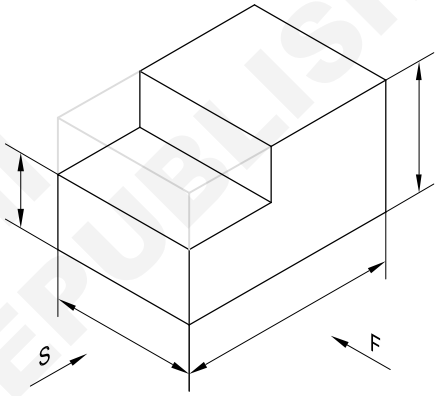

EDNPG110216

Fig 7

(a)



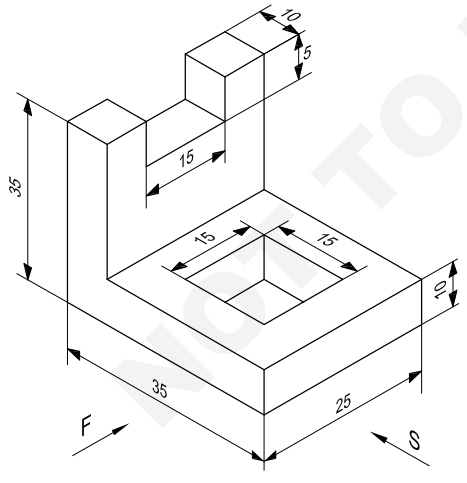

(b)



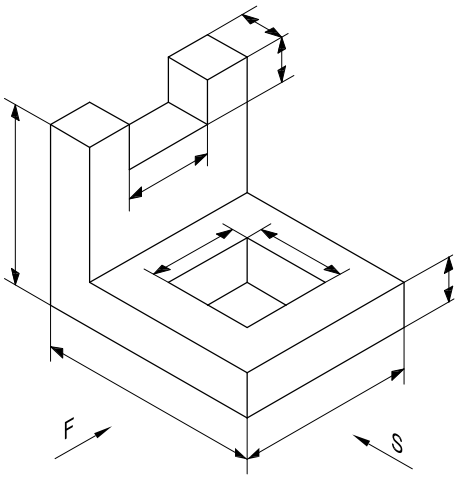

EDNPG110217

Fig 8

(a)



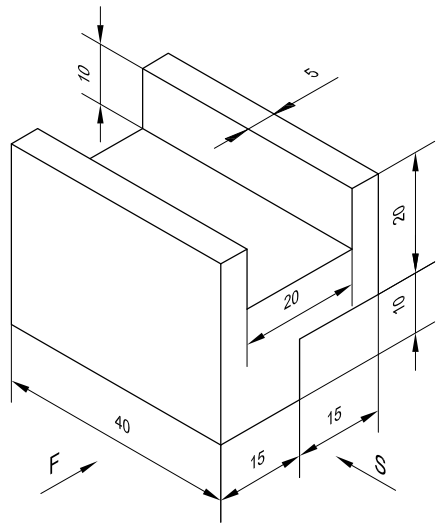

(b)



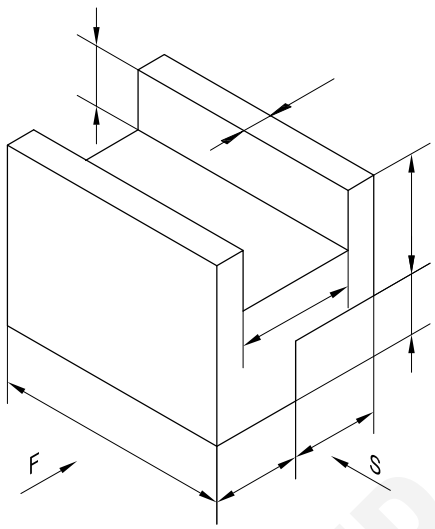

EDNPG110218

Fig 9

(a)



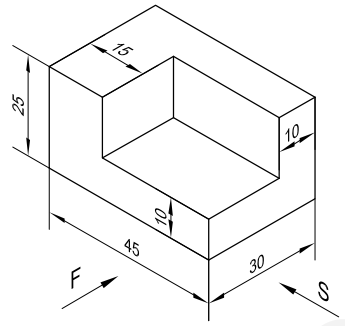

(b)



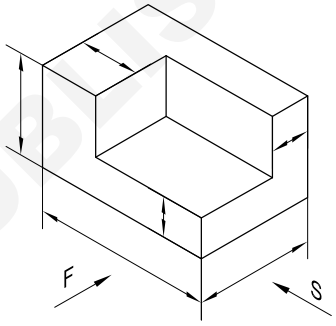

EDNPG110219

Fig 10

(a)




(b)

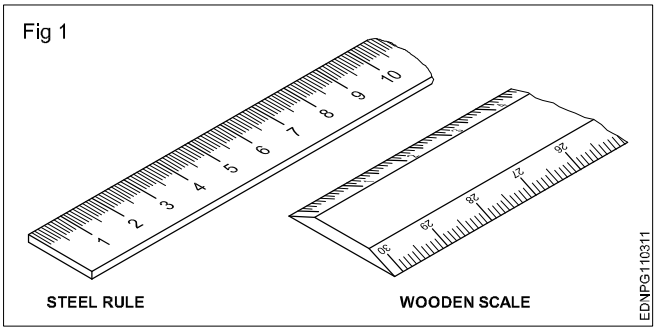



EDNPG110210A

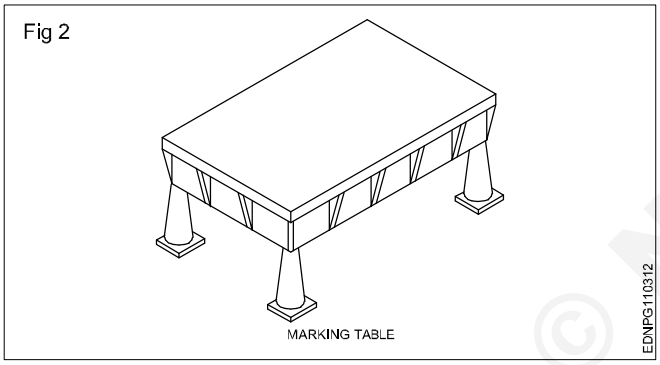
# Free hand drawing of hand tools and measuring tools

### Hand Tools

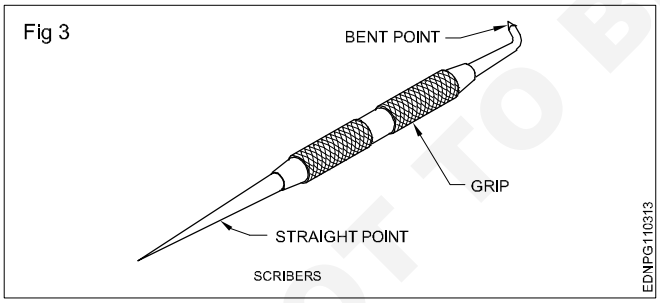
Steel rule and Wooden Scale (Fig 1)



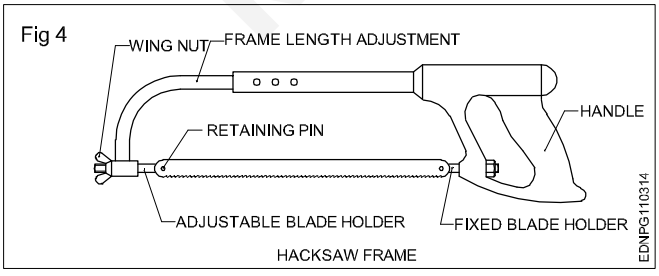

Marking table (Fig 2)



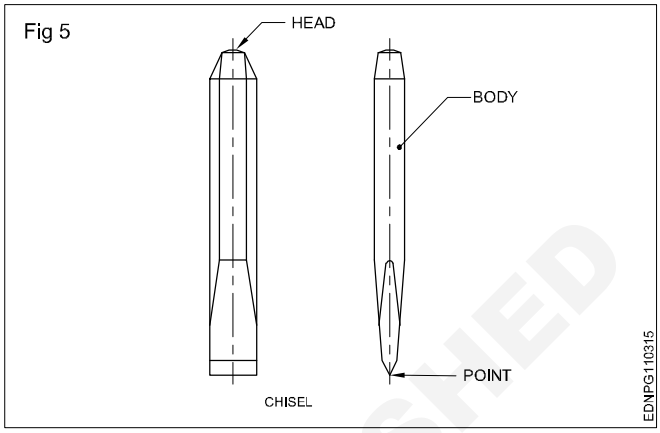

Scribers (Fig 3)



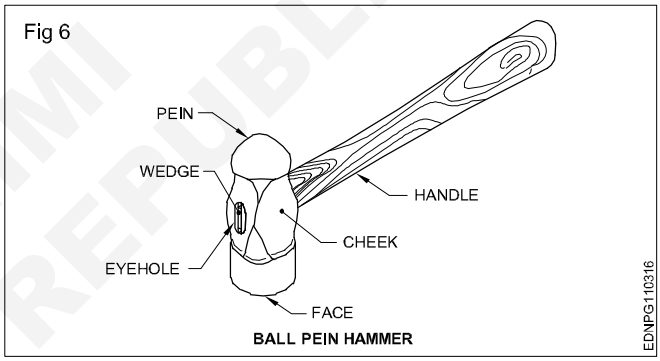

Hacksaw frame (Fig 4)



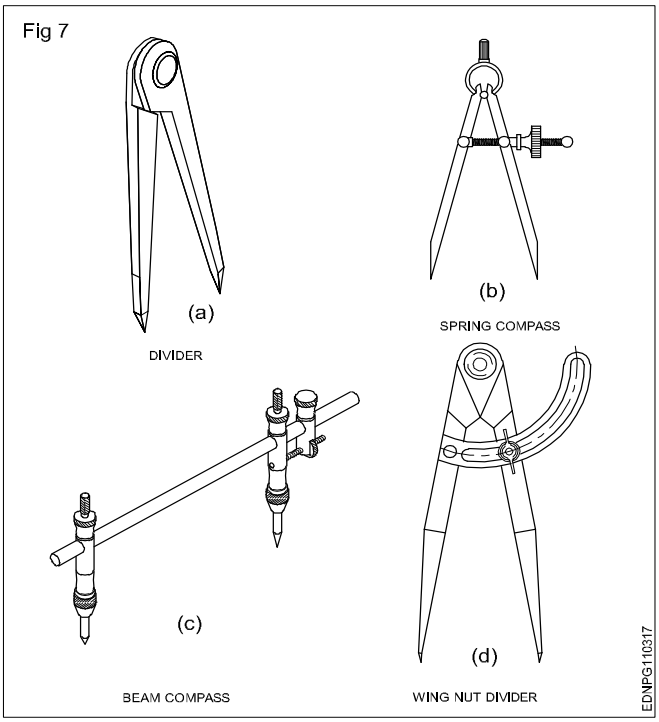

Chisel (Fig 5)




Ball pein hammer (Fig 6)

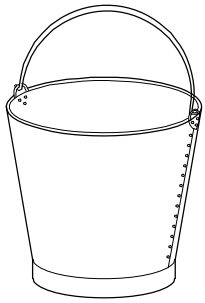



Compass and divider (Fig 7)



Bucket (Fig 8)

Fig 8

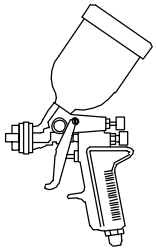


BUCKET

EDNPG110318

Gravity feed spary gun (Fig 9)

Fig 9

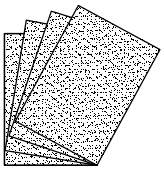


PAINT SPRAY GUN

EDNPG110319

Sand paper (Fig 10)

Fig 10



SAND PAPER

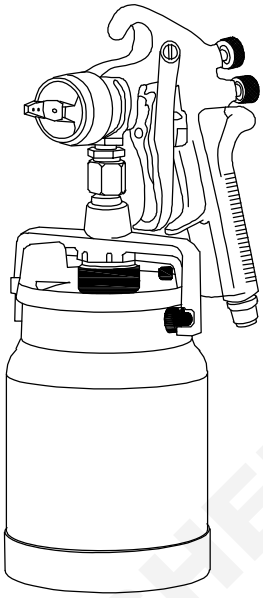
EDNPG11031A

Types of painting brushes (Fig 11)

Fig 11

Suction feed spray gun (Fig 12)

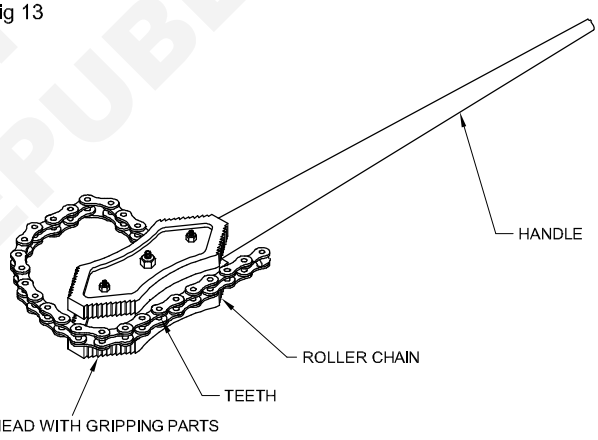
Fig 12



EDNPG11031C

Chain pipe wrench (Fig 13)

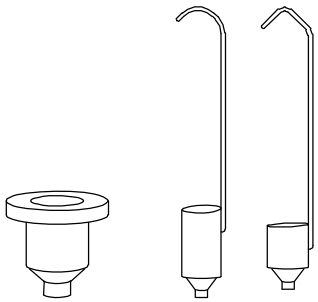
Fig 13




EDNPG11031D

Viscosity cup (Fig 14)

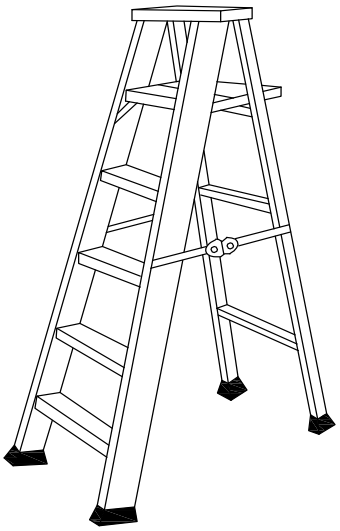
Fig 14



EDNPG11031E

Step ladder (Fig 15)

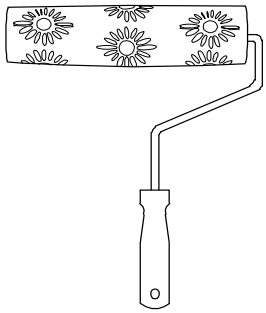
Fig 15



EDNPG11031F

Paint dip feed roller (Fig 16)

Fig 16



PAINT DIP FEED ROLLER

EDNPG11031G

Toothbrush (Fig 17)

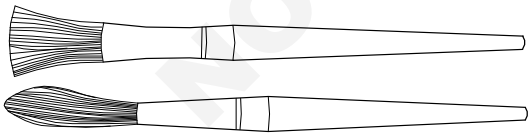
Fig 17

TOOTHBRUSH

EDNPG11031H

Artist brushes (Fig 18)

Fig 18



BRUSHES

EDNPG11031I

Sketch pen (Fig 19)

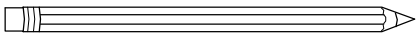
Fig 19

SKETCH PEN

EDNPG11031J

Pencil (Fig 20)

Fig 20

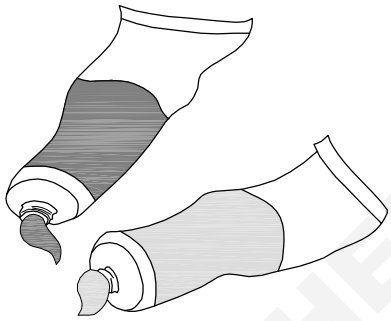


PENCIL

EDNPG11031K

Tube colours (Fig 21)

Fig 21

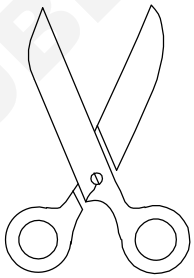


TUBE COLOURS

EDNPG11031L

Scissors (Fig 22)

Fig 22

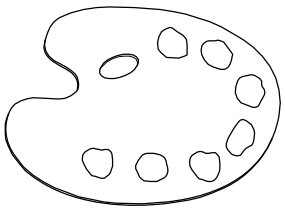


SCISSORS

EDNPG11031M

Palette (Fig 23)

Fig 23

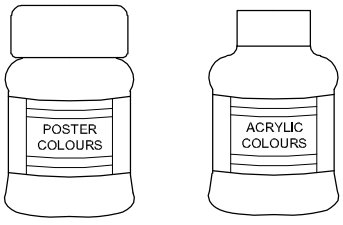


PALETTE

EDNPG11031N

Colours (Fig 24)

Fig 24

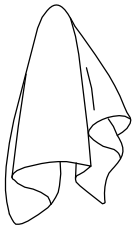



POSTER COLOURS ACRYLIC COLOURS

EDNPG11031O

Cotton rag (Fig 25)

Fig 25

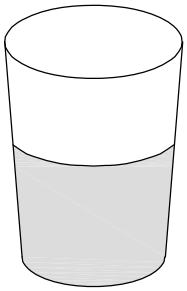


COTTON RAG

EDNPG11031P

Water cup (Fig 26)

Fig 26

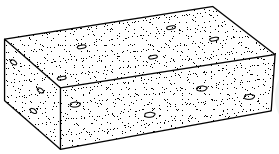


WATER CUP

EDNPG11031Q

Sponge (Fig 27)

Fig 27



SPONGE

EDNPG11031R

Glue (Fig 28)

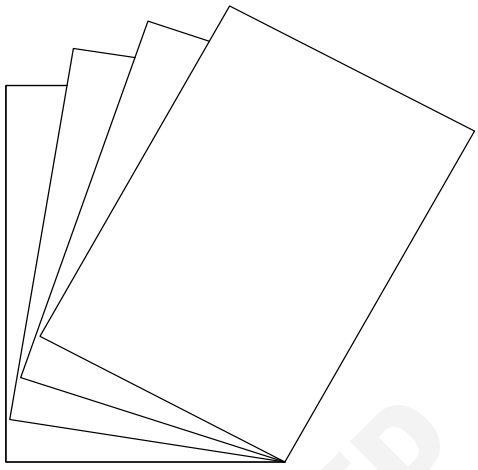
Fig 28


GLUE

EDNPG11031S

Papers (Fig 29)

Fig 29

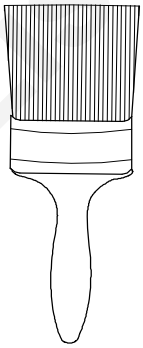


PAPERS

EDNPG11031T

Wall brush (Fig 30)

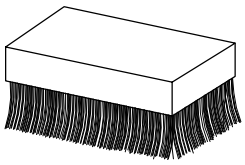
Fig 30



EDNPG11031U

Wire brush (Fig 31)

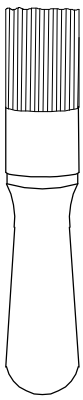
Fig 31



EDNPG11031V

Stenciline brush (Fig 32)

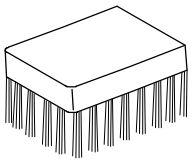
Fig 32



EDNPG11031W

Stippler brush (Fig 33)

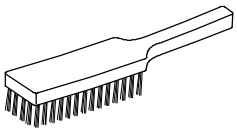
Fig 33



EDNPG11031X

Dust brush (Fig 34)

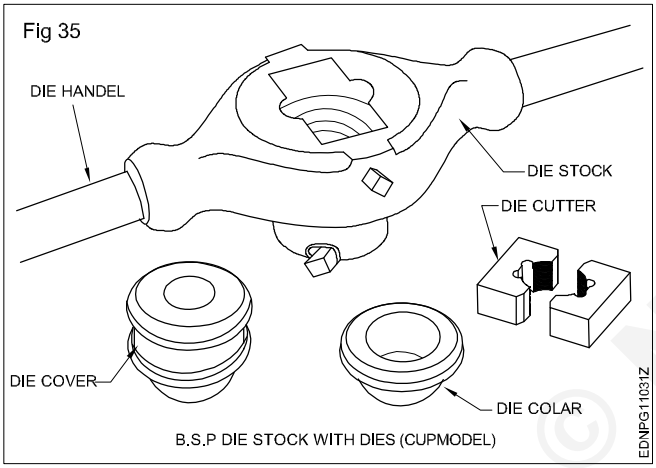
Fig 34



EDNPG11031Y

Die stock and dies (Fig 35)

Fig 35

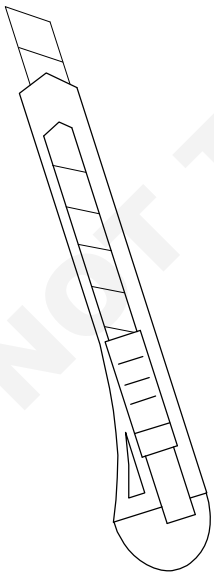



B.S.P DIE STOCK WITH DIES (CUPMODEL)

EDNPG11031Z

Stencil knife (Fig 36)

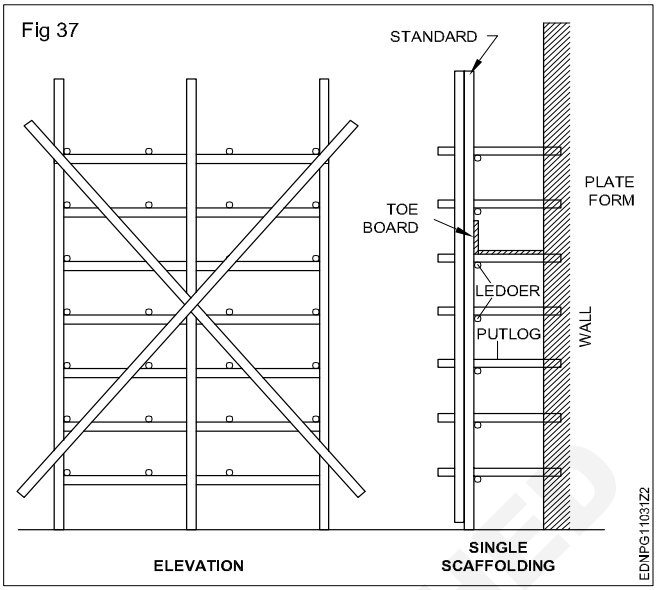
Fig 36



EDNPG11031Z1

Single scaffolding (Fig 37)

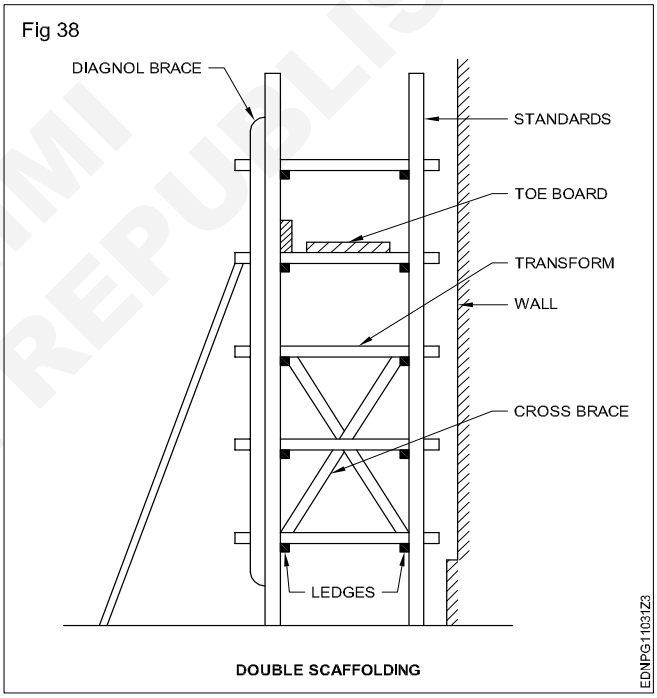
Fig 37




EDNPG11031Z2

Double scaffolding (Fig 38)

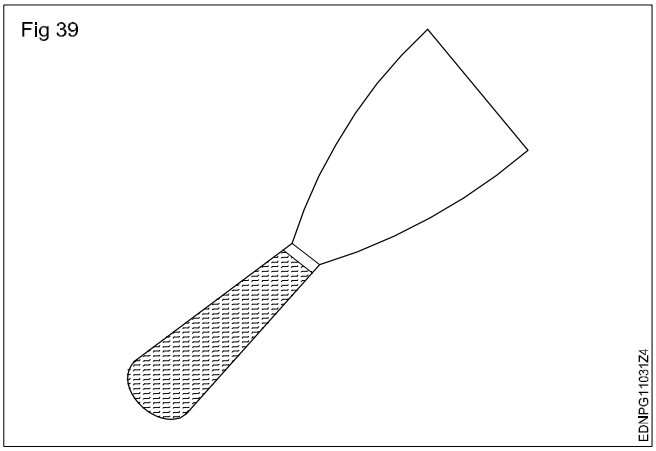
Fig 38




EDNPG11031Z3

Scraper knife (Fig 39)

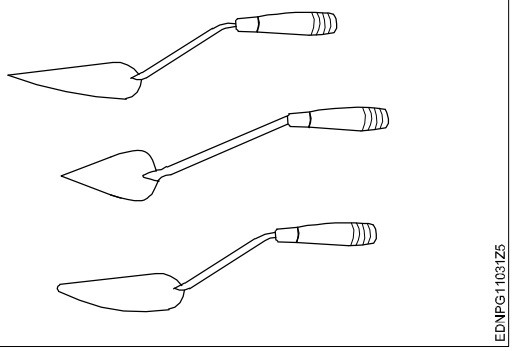
Fig 39



EDNPG11031Z4

Painting knife (Fig 40)

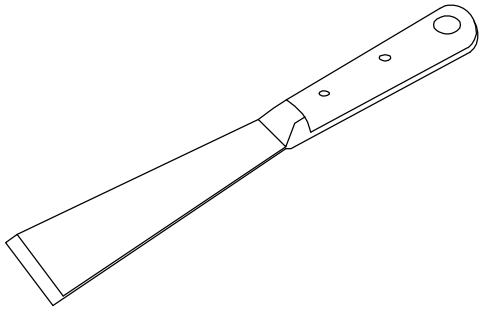
Fig 40



EDNPG1103125

Palette knife (Fig 41)

Fig 41



EDNPG1103126

Shading stick (Fig 42)

Fig 42

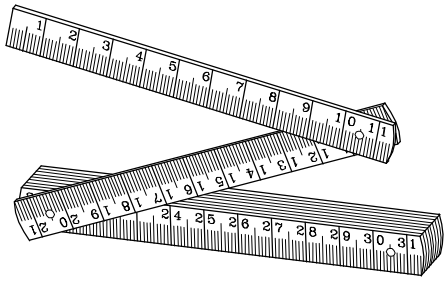
Eraser stick (Fig 43)

Fig 42

**Carpenter Trade Tools**

Collapsible carpenter rule (Fig 44)

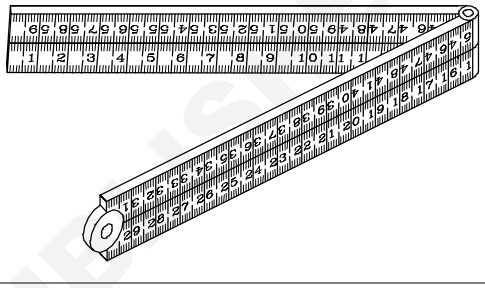
Fig 44



EDNPG1103129

Folding rule (Fig 45)

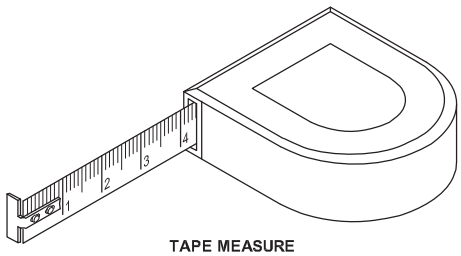
Fig 45



EDNPG1103127A

Tape Measure (Fig 46)

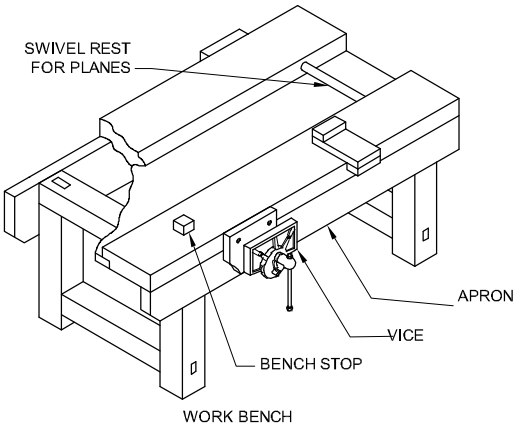
Fig 46




EDNPG1103128

Carpenter's work bench (Fig 47)

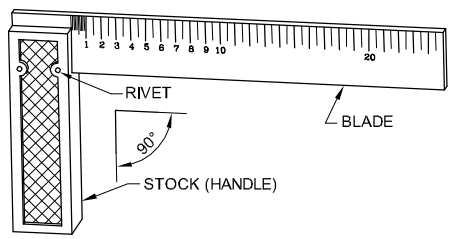
Fig 47




EDNPG1103127C

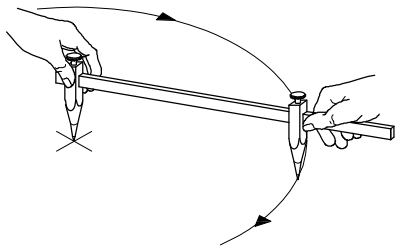
Try square (Fig 48)

Fig 48



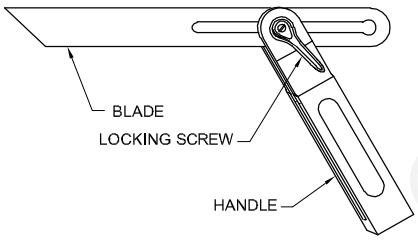

Marking knife or striking knife (Fig 49)

Fig 49



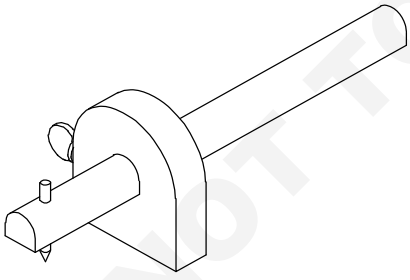

'T' - Bevels (or) bevel square (Fig 50)

Fig 50



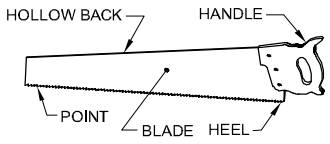

Panel gauge (Fig 51)

Fig 51



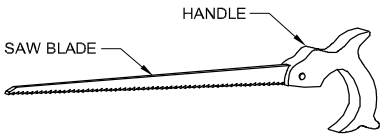

Cross cut saw (Fig 52)

Fig 52



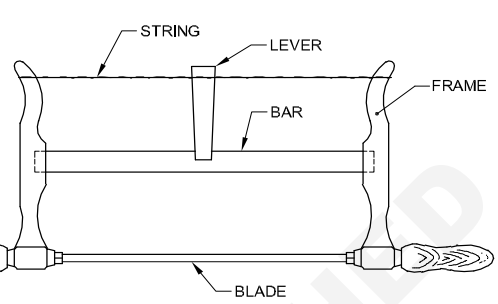

Compass saw (Fig 53)

Fig 53



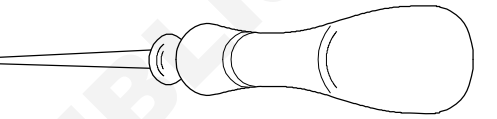

Bow saw (Fig 54)

Fig 54



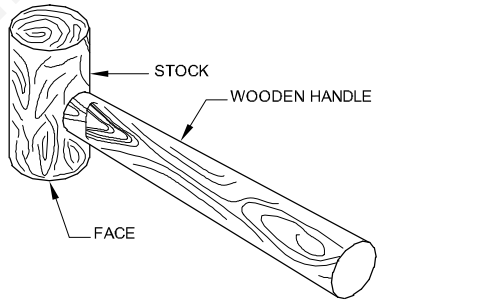

Steel scriber (Fig 55)

Fig 55



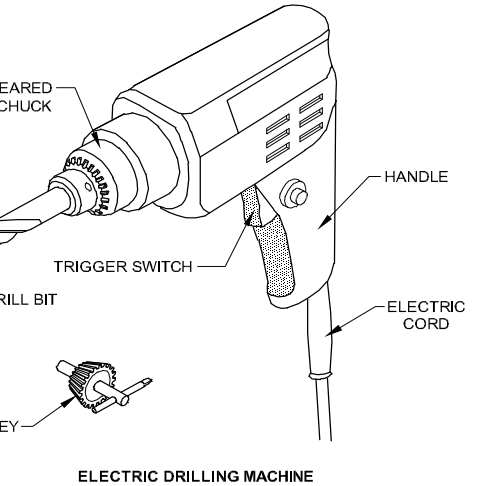

Mallet (Fig 56)

Fig 56



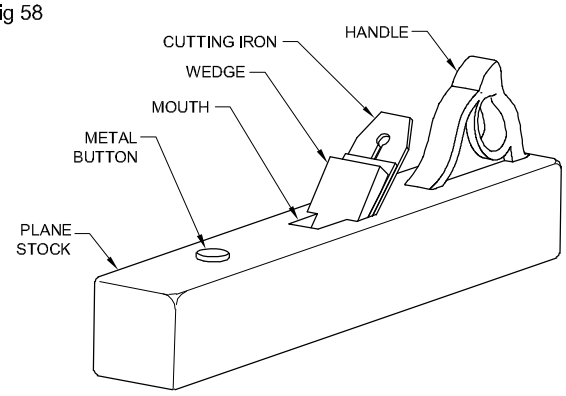

Electric drilling machine (Fig 57)

Fig 57



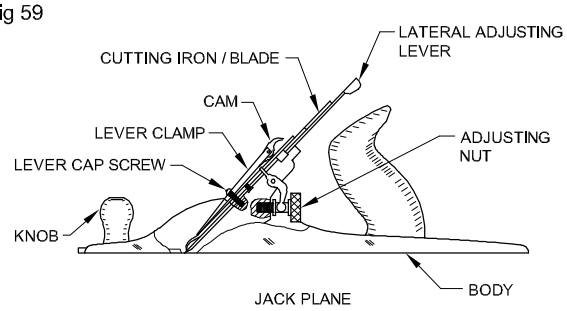
Trying plane (Fig 58)

Fig 58



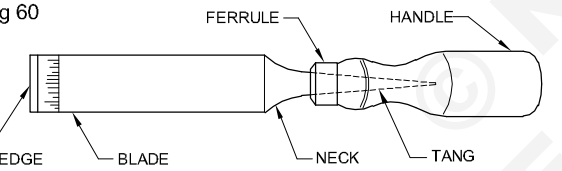

Adjustable metal jack plane (Fig 59)

Fig 59




Bench firmer chisel (Fig 60)

Fig 60

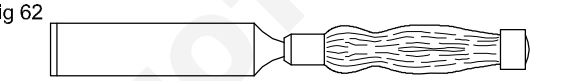



Bevel edge firmer chisel (Fig 61)

Fig 61

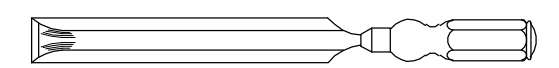

Registered firmer chisel (Fig 62)

Fig 62




Paring chisel (Fig 63)

Fig 63

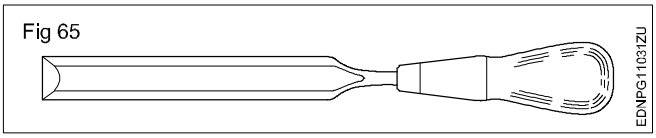



Socket firmer or socket mortise (Fig 64)

Fig 64

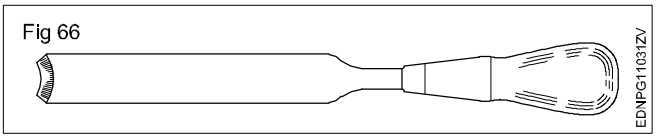

Inside bevelled gouge (Fig 65)

Fig 65



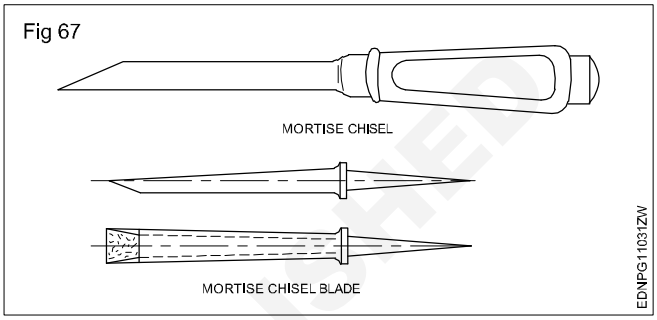

Outside bevelled gouge (Fig 66)

Fig 66



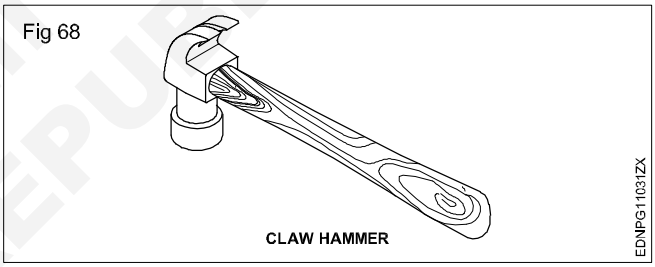

Mortise chisel (Fig 67)

Fig 67



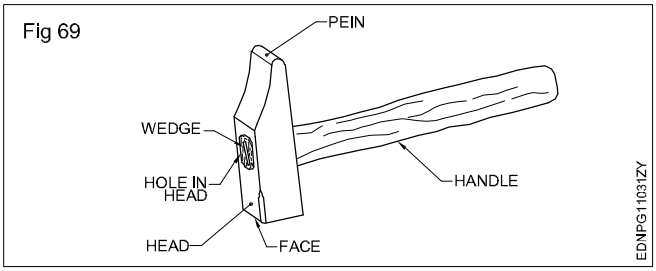

Claw hammer (Fig 68)

Fig 68




Carpenters' hammer (Fig 69)

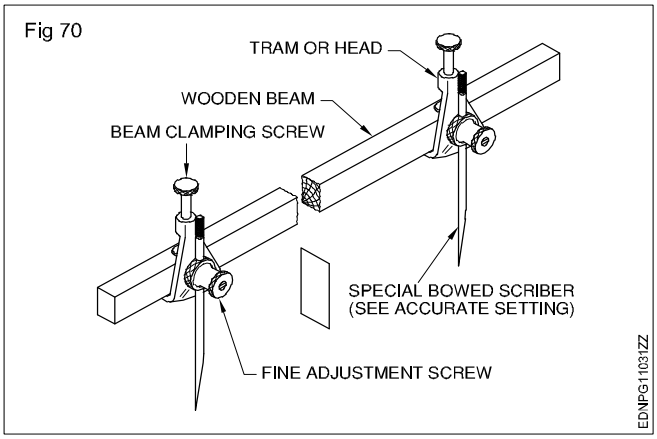
Fig 69




**Sheet Metal Trade Tools**

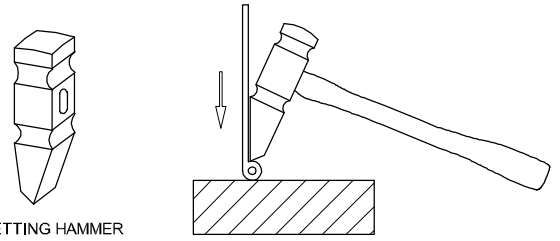
Special bowed scriber (Fig 70)

Fig 70



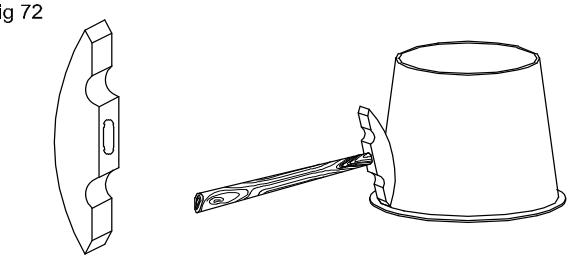
Setting hammer (Fig 71)

Fig 71



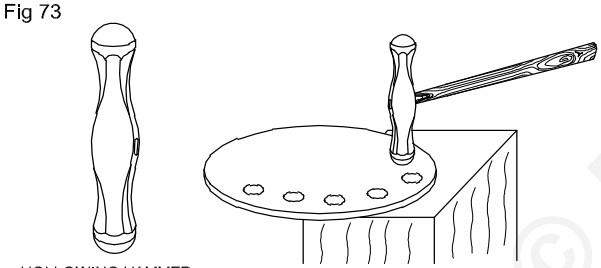

Creasing hammer (Fig 72)

Fig 72



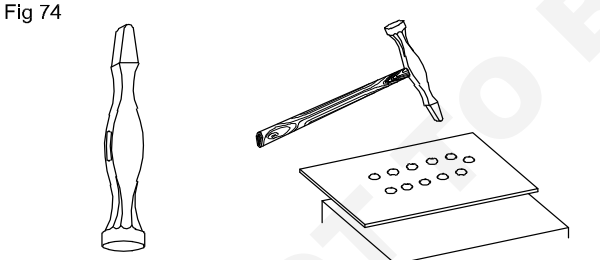

Hollowing hammer (Fig 73)

Fig 73



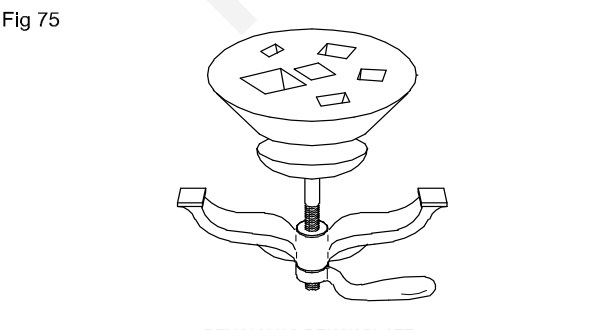

Peening hammer (Fig 74)

Fig 74




Revolving bench plate (Fig 75)

Fig 75

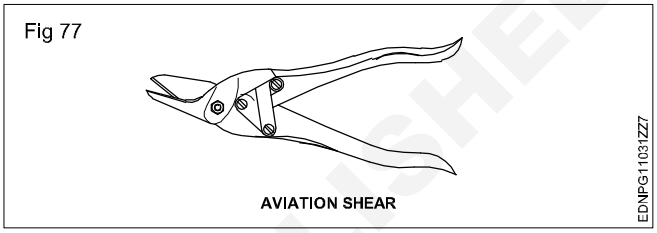



Dry Film Thickness (DFT) gauge (Fig 76)

Fig 76

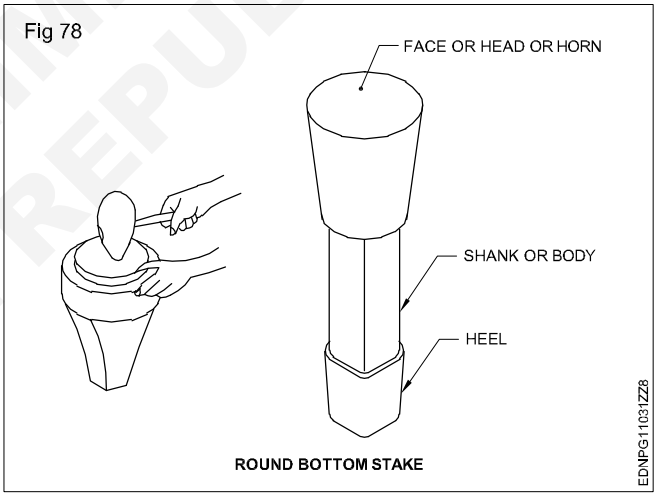

Aviation shear (Fig 77)

Fig 77



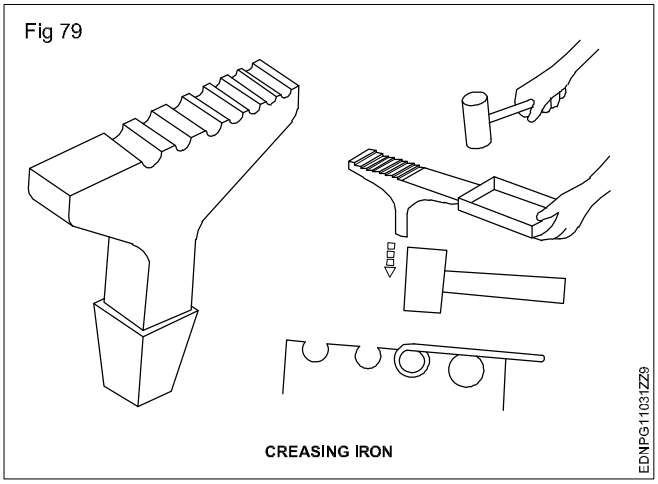

Round bottom stake (Fig 78)

Fig 78



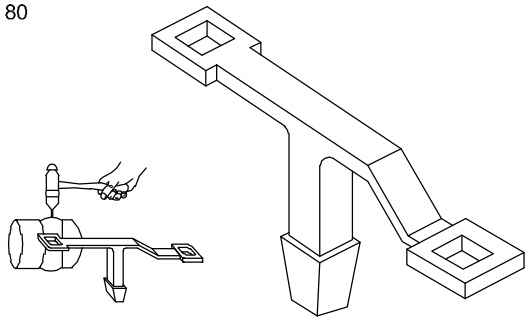

Creasing iron (Fig 79)

Fig 79



Tinman’s horse (Fig 80)

Fig 80

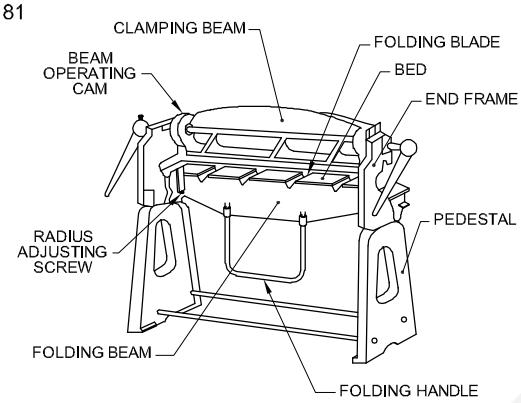


TINMAN'S HORSE

EDNPG11031ZZA

Bar folder (Fig 81)

Fig 81

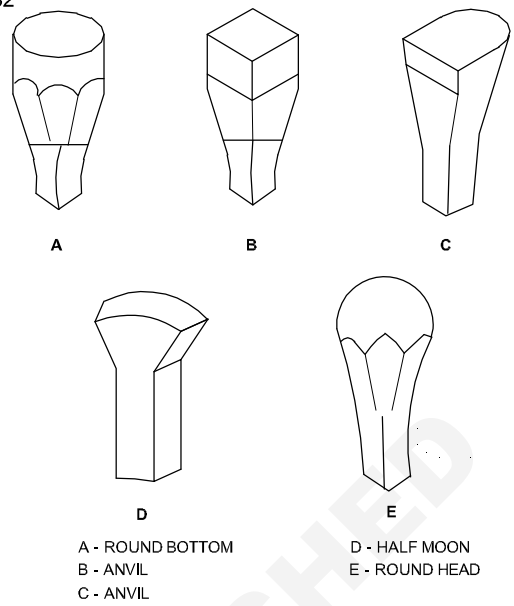



BAR FOLDER

EDNPG11031ZZB

Heads (Fig 82)

Fig 82




HEADS

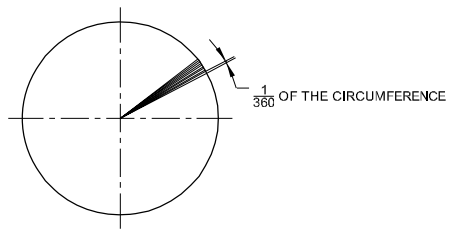
EDNPG11031ZZC

## Drawing of geometrical figures - Angle & triangle

**Angles:** Angle is the inclination between two straight lines meeting at a point or meeting when extended. AB and BC are two straight lines meeting at B. The inclination between them is called an angle. The angle is expressed in degrees or radians.

**Concept of a degree:** When the circumference of a circle is divided into 360 equal parts and radial lines are drawn through these points, the inclination between the two adjacent radial lines is defined as one degree. Thus a circle is said to contain 360°. (Fig 1)

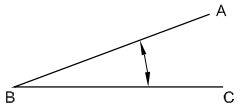
Fig 1




EDNPG120411

**Acute angle:** An angle that is less than 90° is called an acute angle. (Fig 2)

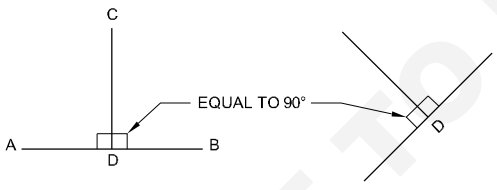
Fig 2




EDNPG120412

**Right angle:** The angle between a reference line and a perpendicular line is called a right angle. (Fig 3)

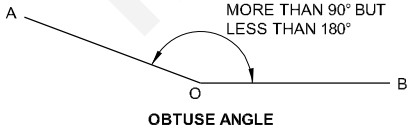
Fig 3




EDNPG120413

**Obtuse angle:** This refers to an angle between 90° and 180°. (Fig 4)

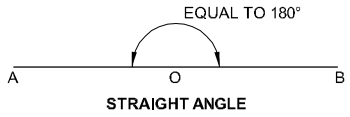
Fig 4




EDNPG120414

**Straight angle:** This refers to an angle of 180°. This is also called the angle of a straight line. (Fig 5)

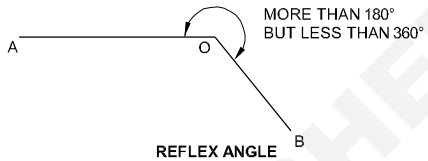
Fig 5




EDNPG120415

**Reflex angle:** It is the angle that is more than 180°, but less than 360°. (Fig 6)

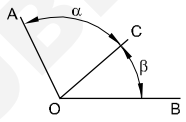
Fig 6




EDNPG120416

**Adjacent angles:** These are the angles lying on either side of a line. (Fig 7)

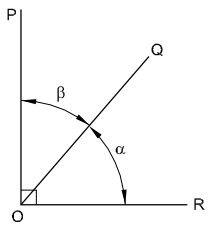
Fig 7




EDNPG120417

**Complementary angles:** When the sum of the two angles is equal to 90°, angle POQ + angle QOR = 90° angle POQ and angle QOR are complementary angles to each other. (Fig 8)

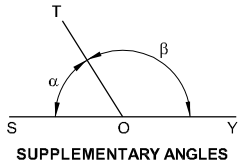
Fig 8




EDNPG120418

**Supplementary angle:** When the sum of the two adjacent angles is equal to 180°, for example, angle SOT + angle TOY = 180°, angle SOT and angle TOY are supplementary angles to each other. (Fig 9)

Fig 9




EDNPG120419

## Triangle - different types

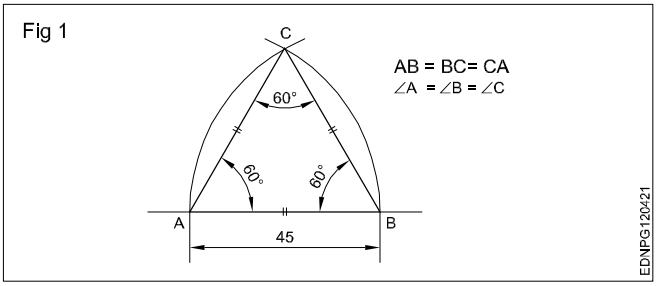
Triangle is a closed plane figure having three sides and three angles. The sum of the three angles always equals to 180°.

To define a triangle, we need to have a minimum of three measurements as follows:

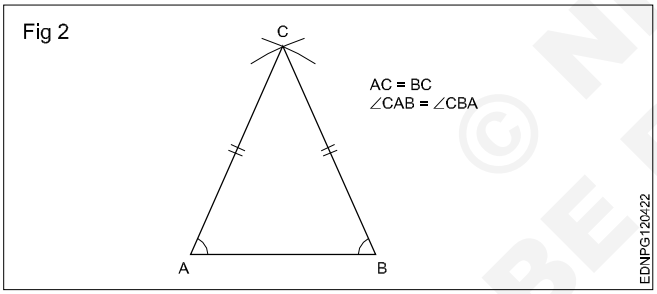
- 3 sides or
- 2 sides and one angle or
- 2 angles and one side

### Types of triangles

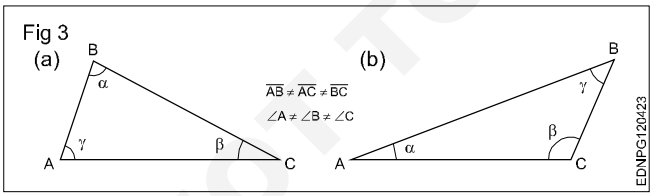
1 **Equilateral triangle** is a triangle having all the three sides equal. Also all the three angles are equal (60°). (Fig 1)




2 **Isosceles triangle** has two of its sides equal. The angles opposite the two equal sides are also equal. (Fig 2)




3 **Scalene triangle** has all three sides unequal in length. All three angles are also unequal. (Fig 3)



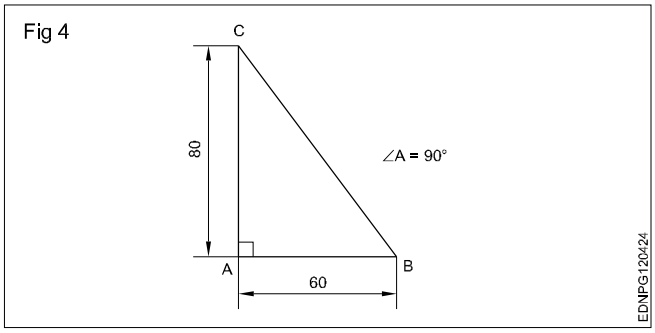

4 **A right-angled triangle** is one in which one of the angles is equal to 90° (Right angle). The side opposite the right angle is called the hypotenuse. (Fig 4)

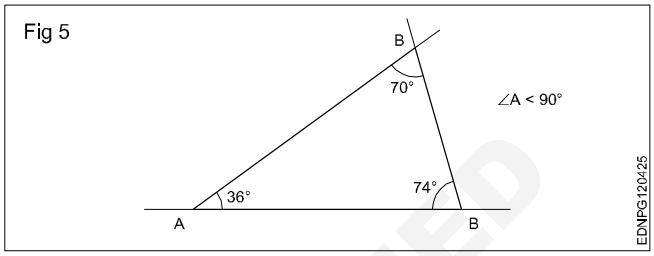
5 **An Acute angled triangle** is one in which all the three angles are less than 90°. (Fig 5)

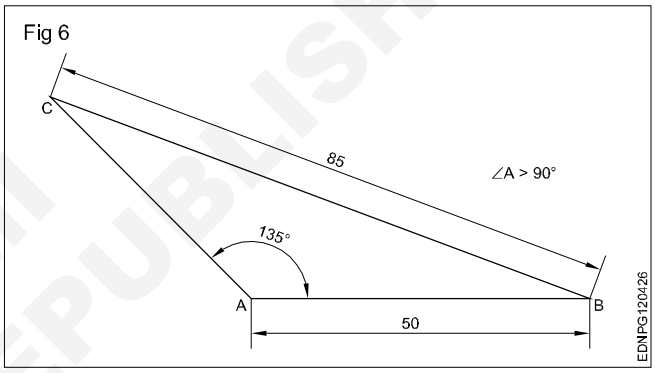
6 **Obtuse angled triangle** has one of the angles more than 90°. (Fig 6)

**The sum of the three angles in any triangle is equal to 180°.**

**The sum of any two sides is more than the third side.**



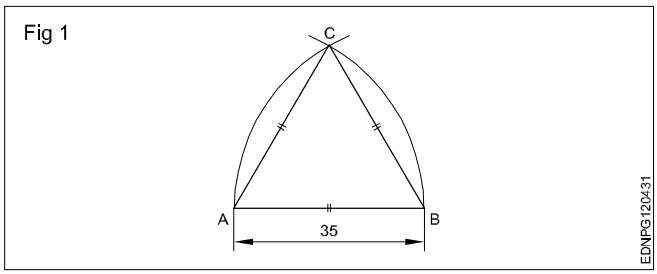




## Procedure to draw the triangle

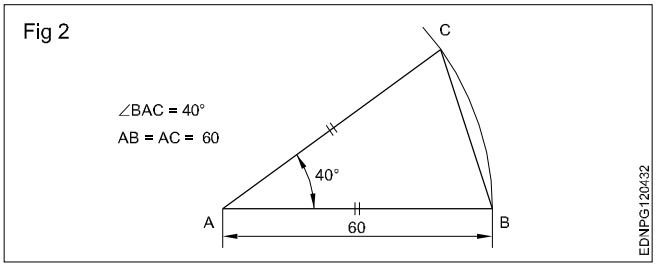
**1 Equilateral triangle (Fig 1) AB = BC = CA = 35 mm.**

- Draw a line and mark AB 35 mm side of the triangle.
- Draw radius from centre A and B, arcs cutting mark at C (Fig 1).
- Join CA and CB.
- ABC is a required triangle.



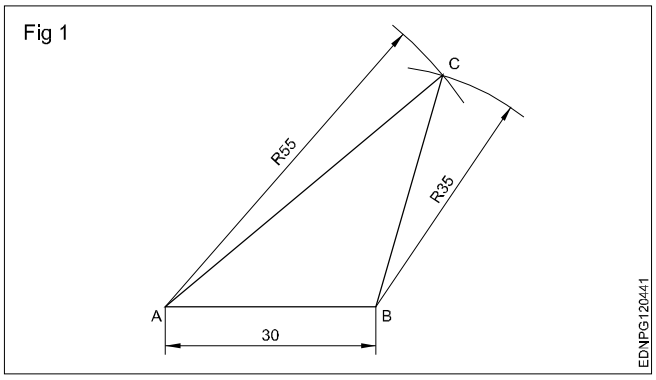

**2 Isosceles triangle : AB = AC = 60 mm & $\angle BAC = 40°$ .**

- Draw the side AB equal to 60 mm. `A' as the centre, draw an arc of radius AB.
- Draw a line AC at 40° to AB.
- Join BC to form the triangle ABC. (Fig 2)



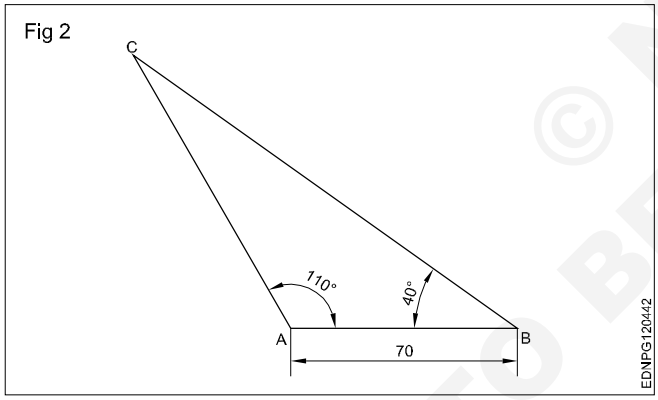

## Exercise

1 **Scalene triangle: AB = 30 mm, AC = 55 mm & BC= 35 mm. (Fig 1)**

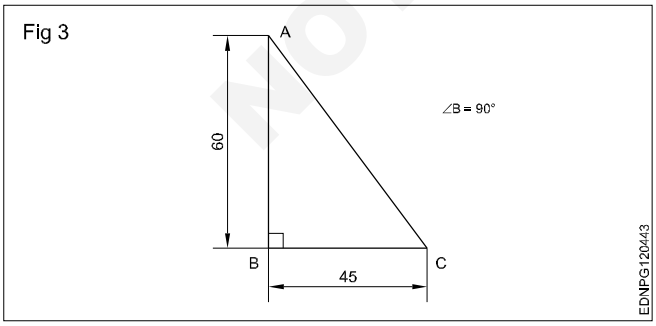



2 **Scalene triangle: AB = 70 mm. (Fig 2)**

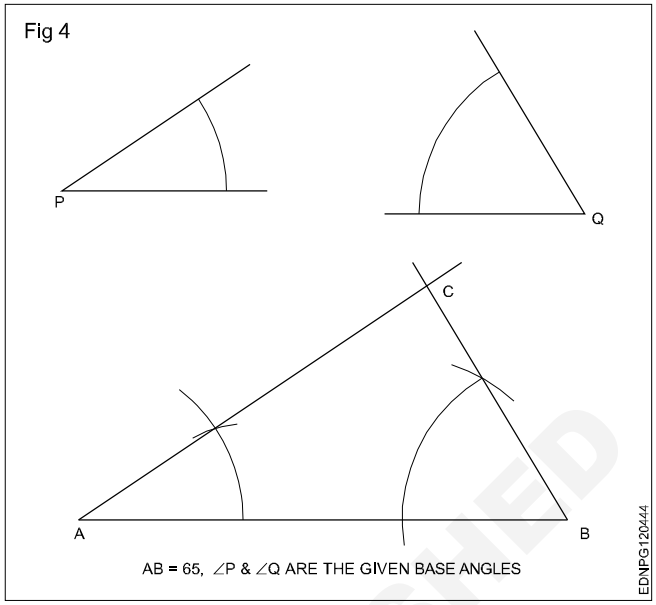
$\angle ABC = 40°$ & $\angle BAC = 110°$



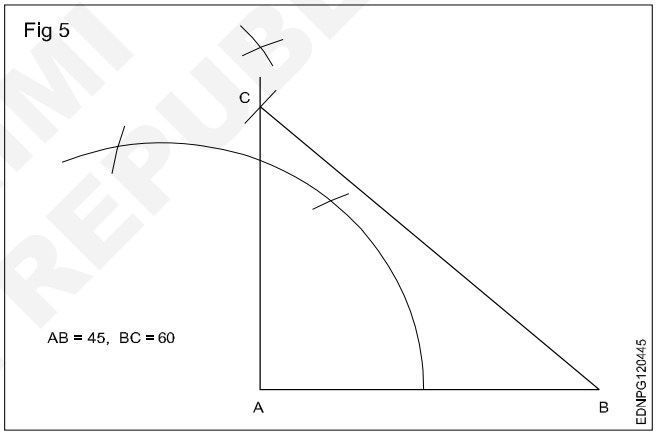

3 **Right angled triangle: AB = 60 mm, BC = 45 mm. (Fig 3)**



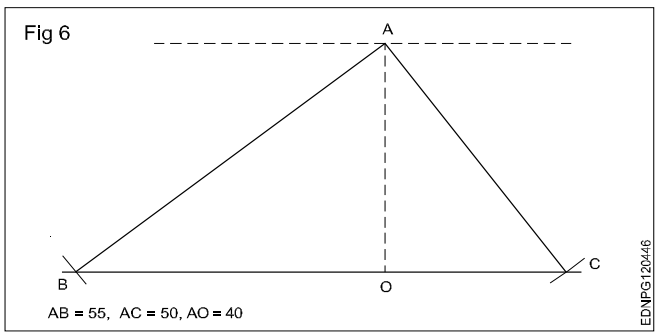

4 Draw a triangle when one side and 2 angles being given in Fig 4.




5 Draw a right angled triangle when the base and hypotenuse being given in Fig 5.




6 Draw a triangle with the altitude and two sides being given in Fig 6.



# Drawing of geometrical figures - Circle

**Circle:** Circle is a plane figure bounded by a curve, formed by the locus of a point which moves so that it is always at a fixed distance from a stationary point the "Centre".

**Radius:** The distance from the centre to any point on the circle is called the "Radius".

**Diameter:** The length of a straight line between two points on the curve, passing through the centre is called the "Diameter". (D: Dia or d) It is twice the radius.

**Circumference:** It is the linear length of the entire curve, equal to $\pi D$ .

**Arc:** A part of the circle between any two points on the circumference or periphery is called an 'Arc'.

**Chord:** A straight line joining the ends of an arc is called the chord. (Longest chord of the circle is the diameter)

**Segment:** A part of the circle or area bound by the arc and chord is the segment of the circle.

**Sector:** It is the part of a circle bounded by two radii (plural of radius) meeting at an angle and an arc.

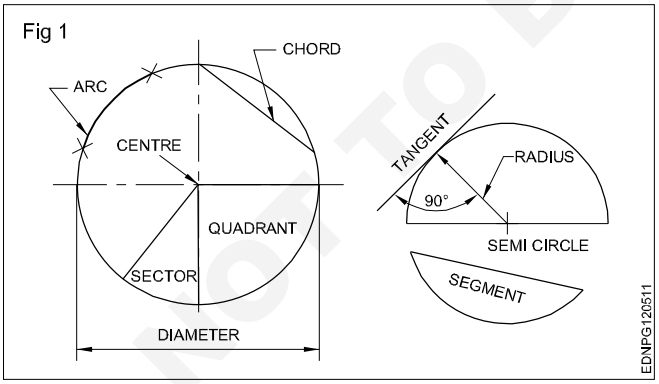
**Quadrant:** Part of a circle with radii making 90° with each other is a quadrant (one-fourth of the circle).

Half of the circle is called a semi-circle.

**Tangent:** The tangent of a circle is a straight line just touching the circle at a point. It does not cut or pass through the circle when extended.

Fig 1 shows all the above elements.

Fig 1




**Concentric circles:** When two or more circles (drawn) have a common centre, they are called concentric circles. Ball-bearing is the best example of concentric circles. (Fig 2)

**Eccentric circles:** Circles within a circle but with different centres are called eccentric circles. (Fig 3)

Fig 2

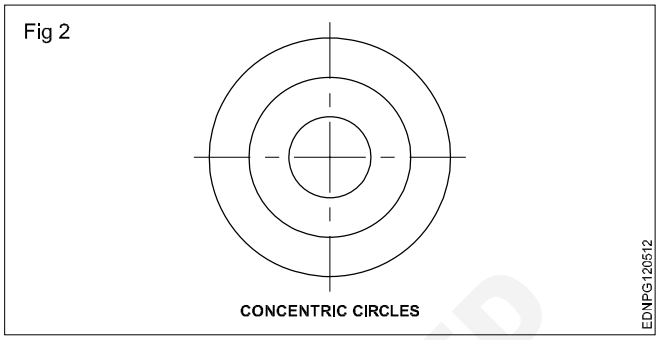
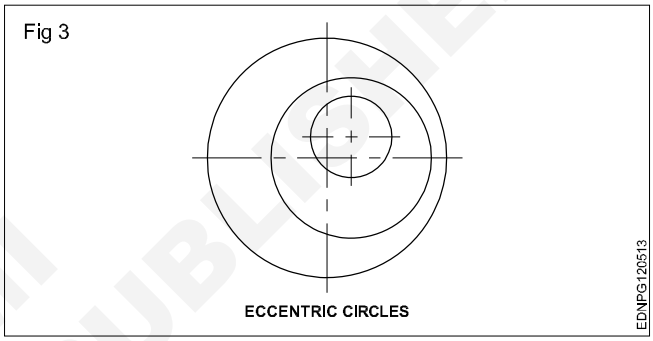



Fig 3

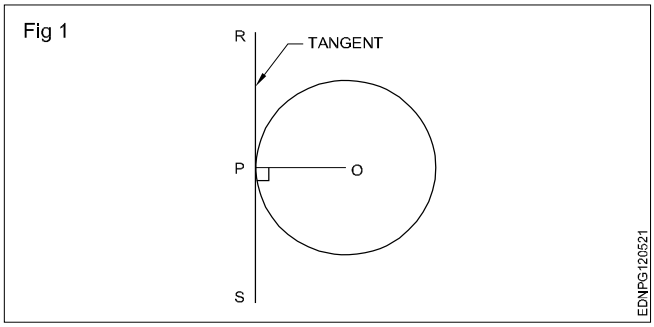



## Circle and Arcs

### Exercise

**1 Draw a tangent to a given circle of ϕ 50 mm at any point `P' on it. (Fig 1)**

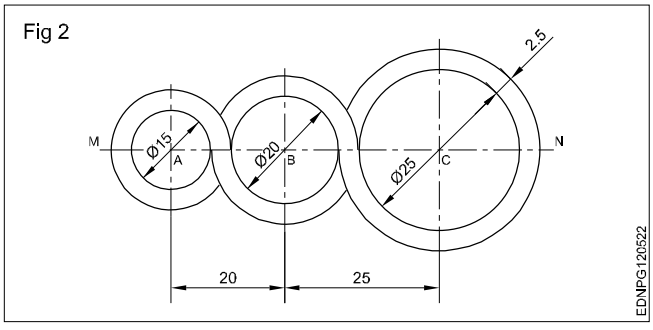
Fig 1



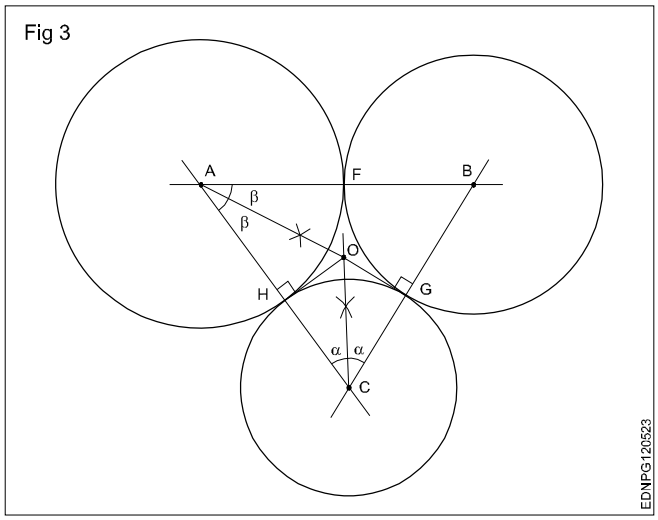

**2 Draw a loop of 3 circles pattern. (Fig 2)**

Draw any line MN and mark points A,B and C. So that AB = 20 mm and BC = 25 mm.

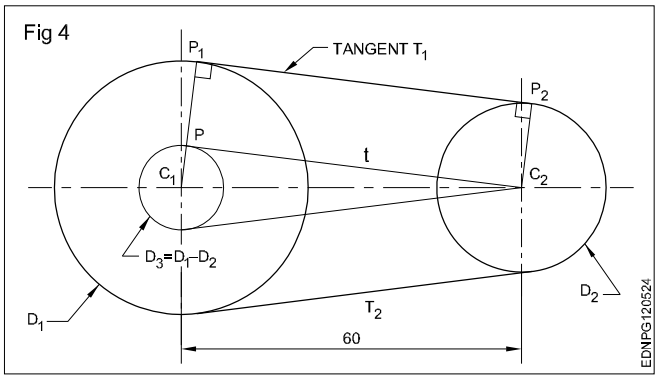
Fig 2



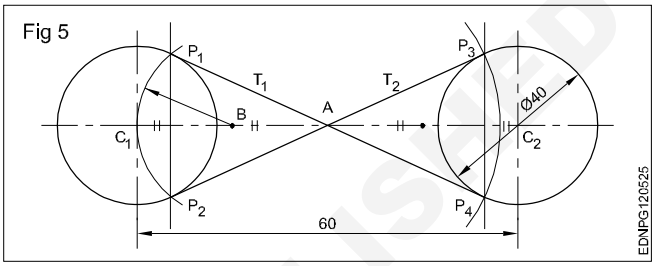
**3 3 Draw three circles tangential to each other if centres A, B & C are given. (Fig 3)**




**4 Draw external tangents to circles of dia 40 and 30 and centre distance 60 mm. (Fig 4)**

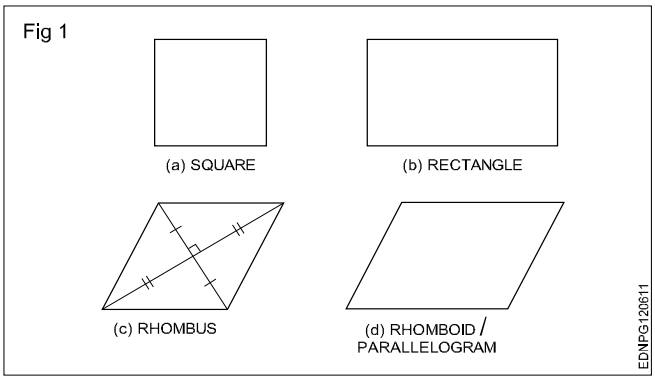



**5 Draw internal tangents to circles of the same diameter 40 each and a centre distance of 60 mm. (Fig 5)**



# Drawing of geometrical figures - Square, rectangle and parallelogram

A quadrilateral is a plane figure bounded by four sides and four angles. The sum of the four angles in a quadrilateral is (interior angles) equal to 360°. The side joining opposite corners is called diagonal. To construct a quadrilateral out of four sides, four angles and two diagonals a minimum of five dimensions are required of which two must besides. Quadrilaterals are also referred as Trapezium. (Fig 1)



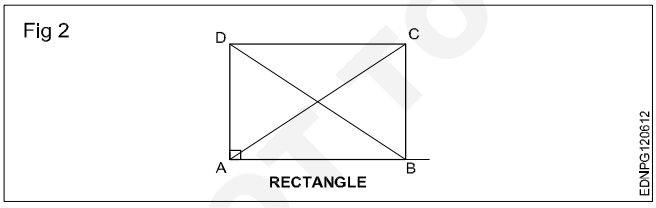

**Types of quadrilaterals** (Fig 1)

- Square
- Rectangle
- Rhomboid / Parallelogram

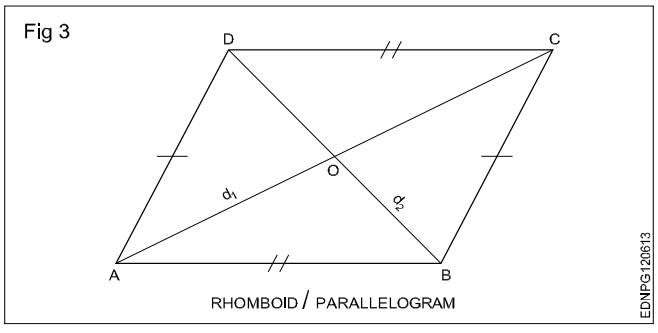
**Square:** In a square all the four sides are equal and its four angles are at right angles. The two diagonals are equal and perpendicular to each other.

**Rectangle** (Fig 2): In a rectangle, opposite sides are equal and parallel and all four angles are right angles.

Fig 2 shows a rectangle ABCD, Sides AB = DC and BC = AD. Diagonals AC and BD are equal. Diagonals are not bisected at right angles.




**Rhomboid/Parallelogram** (Fig 3): In a parallelogram, opposite sides are equal and parallel. Opposite angles are also equal. Diagonals are not equal but bisect each other.

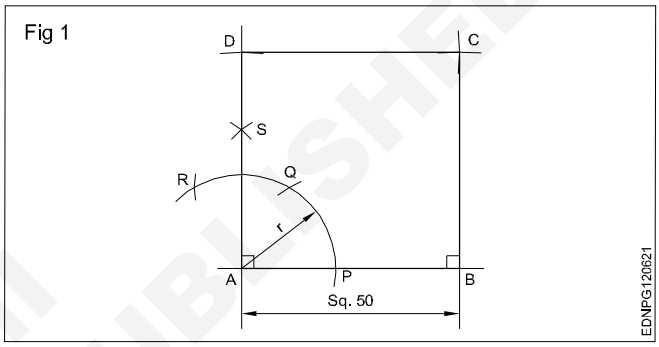



## Procedure to draw the square, rectangle and parallelogram

### Square

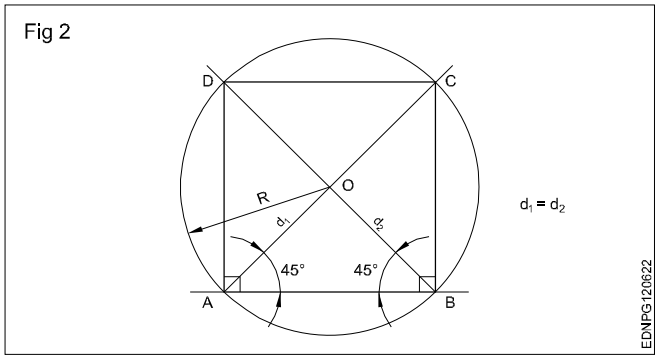
1 **1st method** (Fig 1)**:** A square of side 50 mm by erecting perpendicular using compass and 45° set square.

Draw a line 50mm, 'A' as centre draw an arc of convenient radius. Same arc cut and mark as PQR. Draw a line perpendicular, mark 50mm and make a square as shown in figure.

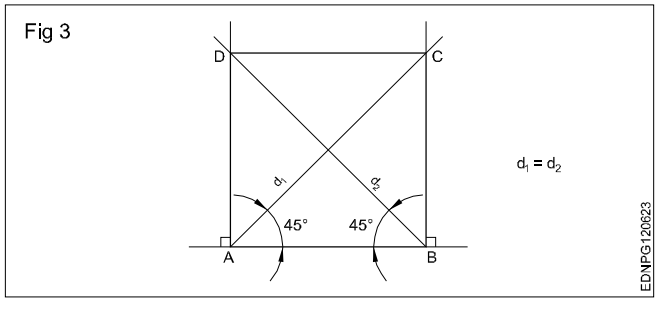



2 **2nd method (Fig 2):** A square of side 60 mm using 45° setsquare and compass.

Draw a horizontal AB = 60 mm from point 'A' & 'B' using 45° setsquare draw diagonal and circle of radius OA with centre 'O'. Join points AD, DC & CB complete the required square.

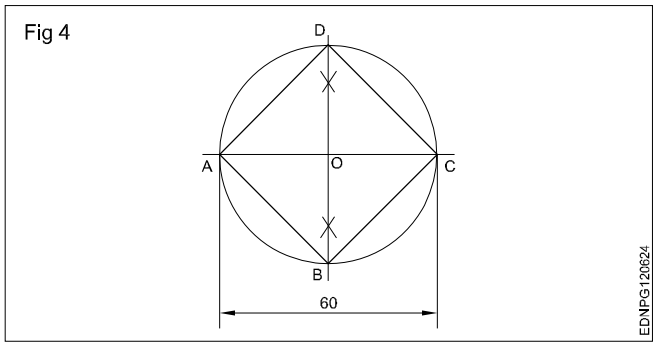



3 **3rd method (Fig 3):** A square of side 60 mm long by erecting perpendicular and also using 45° setsquare. Mark AD, BC join ABCD is required square.



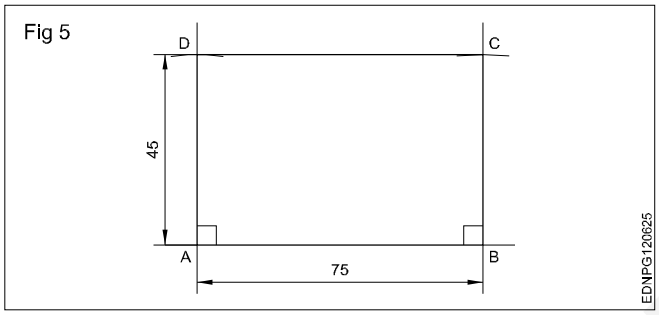
**4 Square having diagonal 60 mm** (Fig 4)

Draw horizontal and vertical centre lines intersecting and make circle join all points ABC&D.




**5 Rectangle** (Fig 5)

Side AB = 75 mm, side AD = 45 mm using setsquare and compass. Join AD, BC is required rectangle.

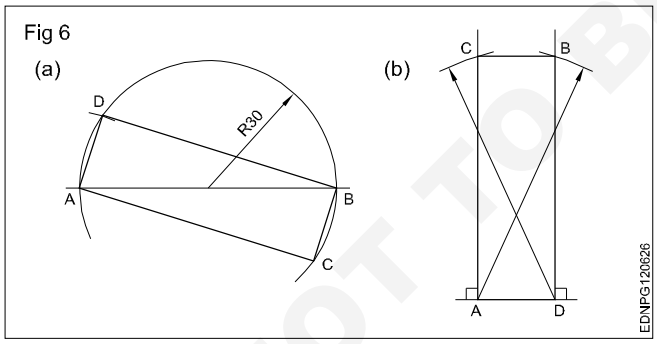



**6 Rectangle - Diagonal - 60 mm and one side 20 mm**

**1st method** (Fig 6a)

**2nd method** (Fig 6b)

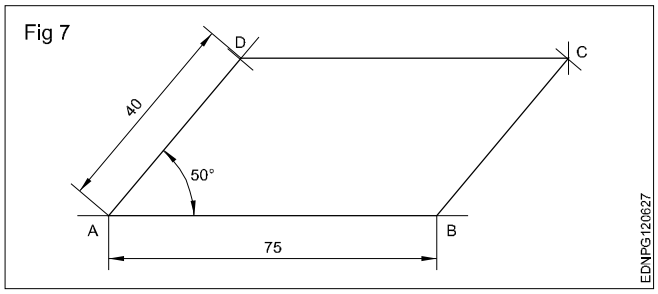
ADBC is the required rectangle of side 20 mm and diagonal 60 mm by using set sqaure and compass.




**7 Parallelogram** (Fig 7)

Sides = 75 mm and 40 mm, angle 50°

- Draw line AD equal to 40 mm and 50° angle to AB.
- ‘D’ as centre, draw an arc of radius equal to AB.
- 'B' as centre, draw an arc of radius equal at AD, upwards such that they meet at a point 'C'. Join ABCD is required parallelogram.



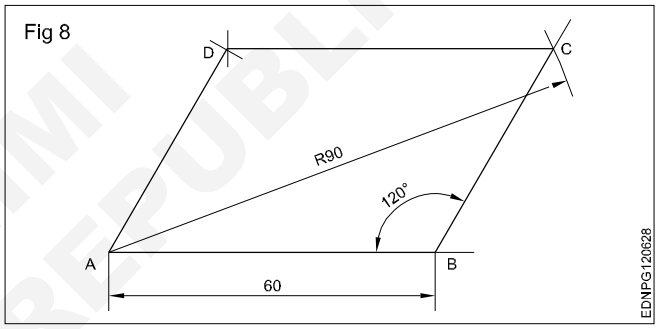

**8 Parallelogram** (Fig 8)

Parallelogram - Side AB = 60 mm

Diagonal AC = 90 mm ∠ABC = 120°

- Draw a line AB = 60 mm, angle 120° at B to AB.
- 'A' as centre with radius 90 mm, draw an arc cutting 120° line from ‘B’ at ‘C’.
- ‘C’ as centre, radius = AB, draw an arc.
- ‘A’ as centre and BC as radius, draw another arc, both arcs meet at ‘D’. Join AD and DC.

  ABCD is the required parallelogram.

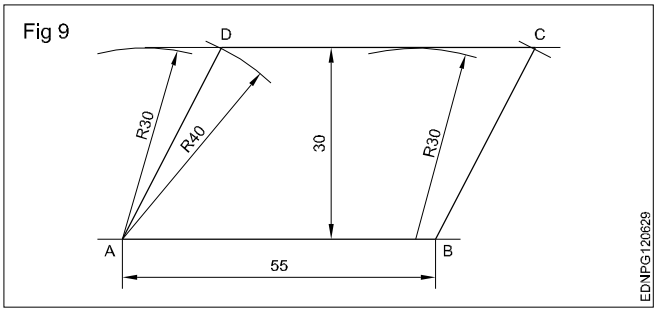



**9 Parallelogram** (Fig 9)

Sides AB = 55 mm, BC = 40 mm and vertical height = 30 mm.

- Draw the line AB 55 mm long.
- ‘A’ and ‘B’ as centres and radius (R) 30 mm, draw arcs above the line.
- Draw a parallel tangetial line to AB touching the arcs.
- ‘A’ and ‘B’ as centres, draw an arc of 40 mm radius cutting the line at ‘D’ and ‘C’.

  ABCD is required parallelogram.



## Lettering & numbering – Single stroke, double stroke & inclined

**Styles of lettering:** Many styles of lettering are in use today. However, a few styles which are commonly used are shown in Fig 1.

Fig 1


**Standard heights/Width:** The standard heights recommended by BIS SP: 46-2003 are in the progressive ratio of "square root 2". They are namely 2.5 - 3.5 - 5 - 7 - 10 - 14 and 20 mm. The height of lower case letter (without tail or stem) are 2.5, 3.5, 5, 7, 10 and 14 mm.

There are two standard ratios for the line thickness "d". They are A & B. In A = line thickness (d) is h/14 and in B=line thickness (d) is h/10.

**Lowercase** means small letters, as opposed to capital **letters**. The word yes, is for example, is in **lowercase**, while the word YES is in **upper case**. For many programmes, this distinction is very important. Programmes that distinguish between **uppercase** and **lowercase** are said to be case sensitive

The width of different letters in terms of "d" is as follows:

**Lettering A**

| Width (W) | Capital letters | Width |
|---|---|---|
| 1 | I | 1d |
| 5 | J,L | 5d |
| 6 | C,E,F | 6d |
| 7 | B,D,G,H,K,N,O,P,R,S,T,U & Z | 7d |
| 8 | A,Q,V,X,Y | 8d |
| 9 | M | 9d |
| 12 | W | 12d |

**Lower case letters and numerals**

| Width (W) | Letters/Numerals | Width |
|---|---|---|
| 1 | i | 1d |
| 3 | j,l | 3d |
| 4 | f,t,l | 4d |
| 5 | c,r | 5d |
| 6 | a,b,d,e,g,h,k,n,o,p,q,s,u,v;3;5 | 6d |
| 7 | a,0 (zero), 2,4,6,7,0,8,9 | 7d |
| 9 | m | 9d |
| 10 | w | 10d |

The width of different letters in terms of stroke (line) is as follows:

**Uppercase Lettering BIS SP: 46-2003**

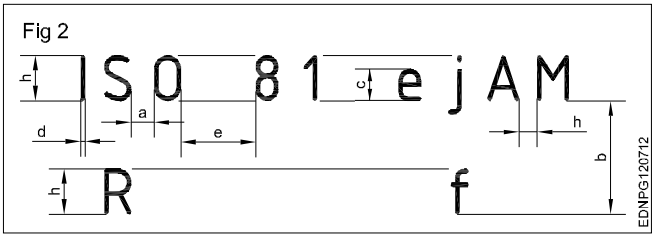
| Width (W) | Capital letters |
|---|---|
| 1 | I |
| 4 | J |
| 5 | C,E,F,L |
| 6 | B,D,G,H,K,N,O,P,R,S,T,U & Z |
| 7 | A,M,Q,V,X,Y |
| 9 | W |

**Lower case letters and numerals**

| Width (W) | Letters/Numerals |
|---|---|
| 1 | i |
| 2 | l |
| 3 | j,l |
| 4 | c,f,r,t |
| 5 | a,b,d,e,g,h,k,n,o,,q,s,u,v,x,y,x |
| | 0,2,3,5 to 9 |
| | 0,2,3,5 to 9 |
| 6 | a,4 |

**Spacing of letters:** Recommended spacing between characters, a minimum spacing of baselines and minimum spacing between words as per BIS SP: 46-2003 are given below in Fig 2.

Fig 2

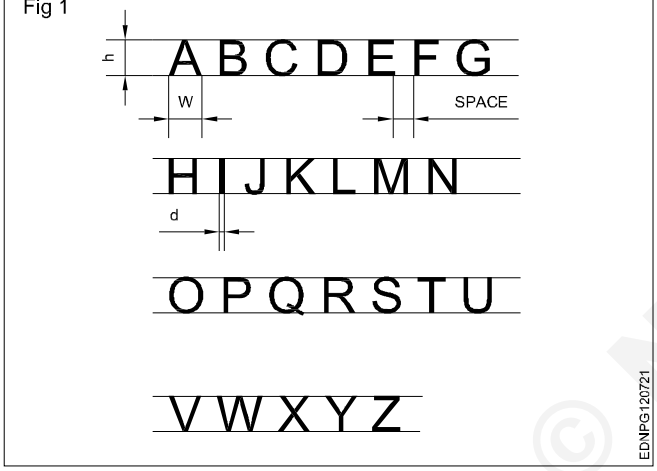



## Lettering

### Procedure

1 Print 10 mm single stroke capital letters and numerals in vertical style using either scale or set-square and by freehand. (Fig 1)

Fig 1




- Draw horizontal parallel lines (thin lines) of 10 mm distance.

**10 mm distances denote the height of the letter.**

- Mark the width of the letters recommended by BIS (IS:9609-1983)

**The width of different letters in terms of `d' is as follows: `d' indicates stroke thickness i.e d: h/ 10.**

| Width (W) | Capital letters |
|---|---|
| 1 | I |
| 4 | J |
| 5 | C,E,F,L |
| 6 | B,D,G,H,K,N,O,P,R,S,T,U & Z |
| 7 | A,M,Q,V,X,Y |
| 9 | W |

**For curved letters use a smooth freehand curve.**

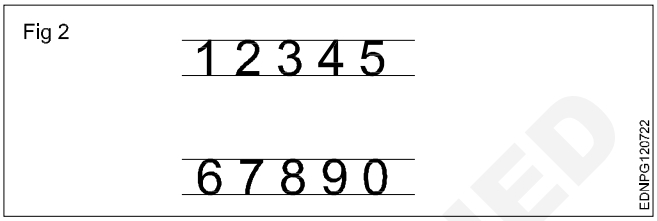
**Print straight line letters using either scale or set-squares.**

**To maintain the uniform thickness of the line, use a conical point soft grade pencil and avoid too much sharpness.**

**Guidelines of both top and bottom should always be drawn with a sharp pencil.**

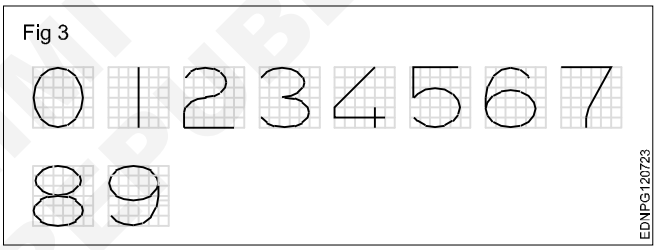
Numerals 2.1 (Fig 2)

Fig 2




- Follow the same procedure of letters.
- `h' is height of numerals and `d' is the stroke thickness.
- Width of numerals in terms of `d' is as follows shown in square grid (Fig 3).

Fig 3




2 Print 10 mm single stroke capital letters and numerals in inclined style (Fig 4).

Fig 4

Practice the following lettering exercises in A3/A4 paper as per the given ratio

1 Single stroke inclined letters of ratio 7:6, 7:5, 7:4, 7:3, 7:1 (Fig 5)

Fig 5

2 Single stroke vertical letters of ratio 7:6, 7:5, 7.4, 7:3, 7:1 (Fig 6)

Fig 6


SINGLE STROKE VERTICAL LETTERS

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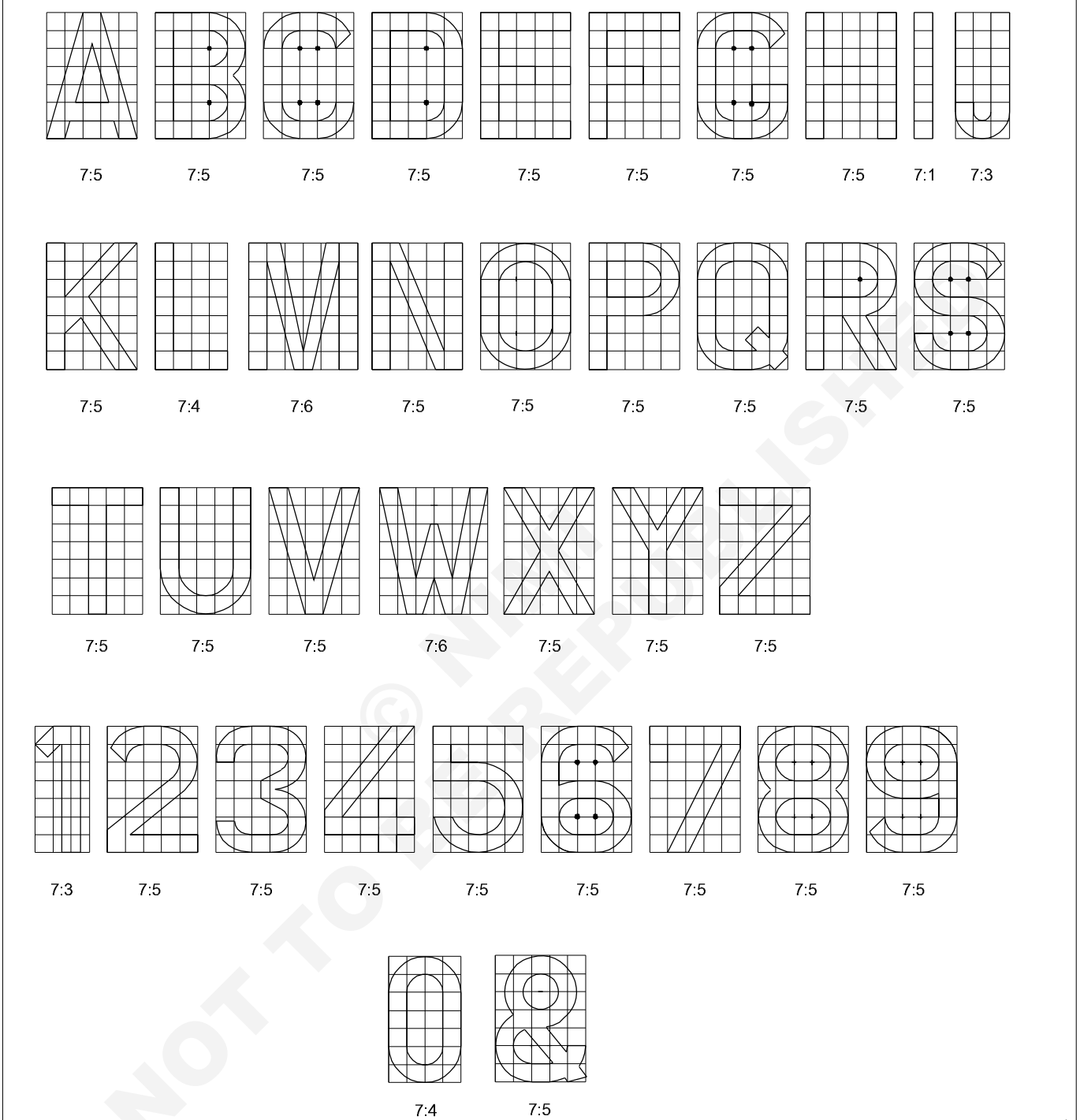
3 Double stroke vertical letters of ratio 7:6, 7:5, 7.4, 7:3, 7:1 (Fig 7)

Fig 7




DOUBLE STROKE VERTICAL LETTERS

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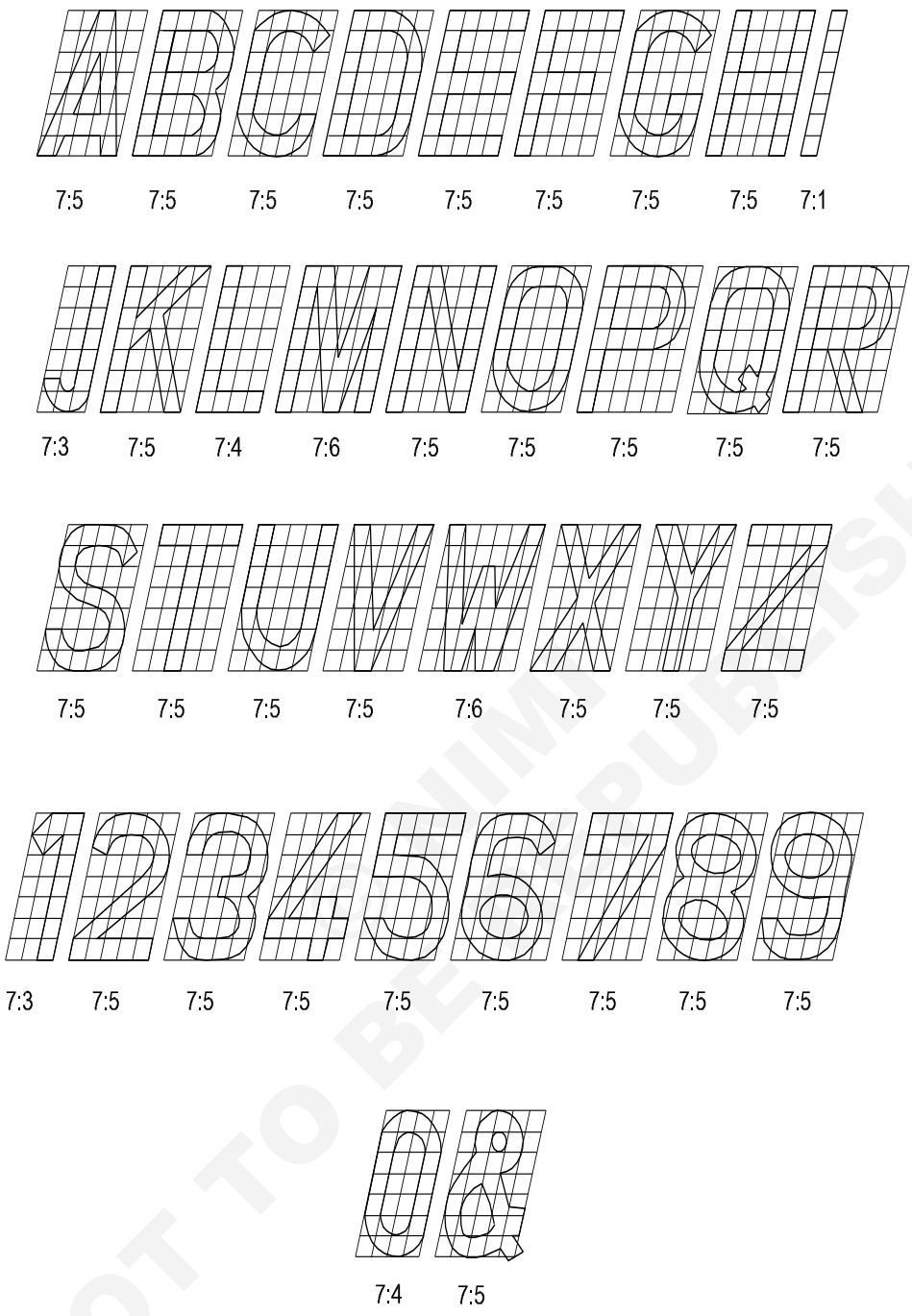
4 Double stroke inclined letters of ratio 7:6, 7:5, 7.4, 7:3, 7:1 (Fig 8)

Fig 8




DOUBLE STROKE INCLINED LETTERS

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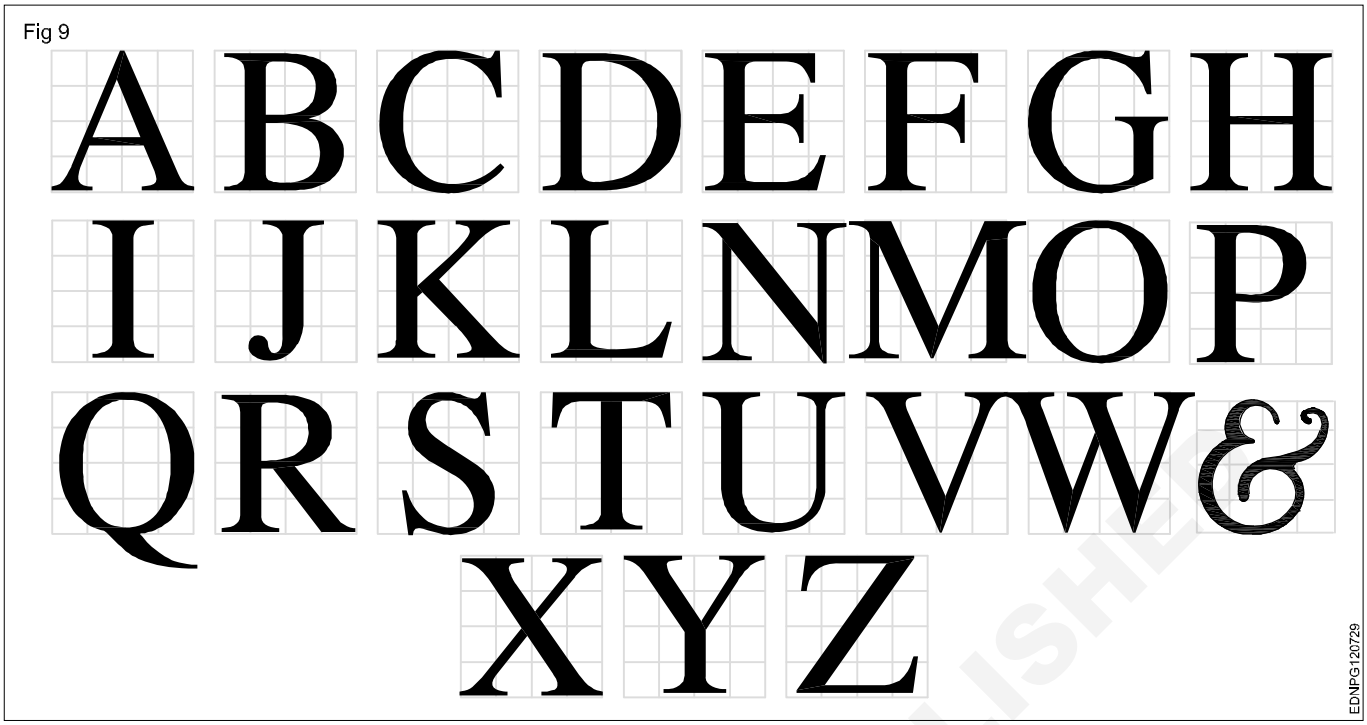
5 Sketching the Roman letters. (Fig 9)

Fig 9




6 Sketching the letters in double stroke italic free hand capital lettering and numerical. (Fig 10)

Fig 10

7 Draw and sketch the italic of small letters. (Fig 11)

Fig 11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8 Sketching the Texy in Old English letters, German text. (Fig 12)

Fig 12


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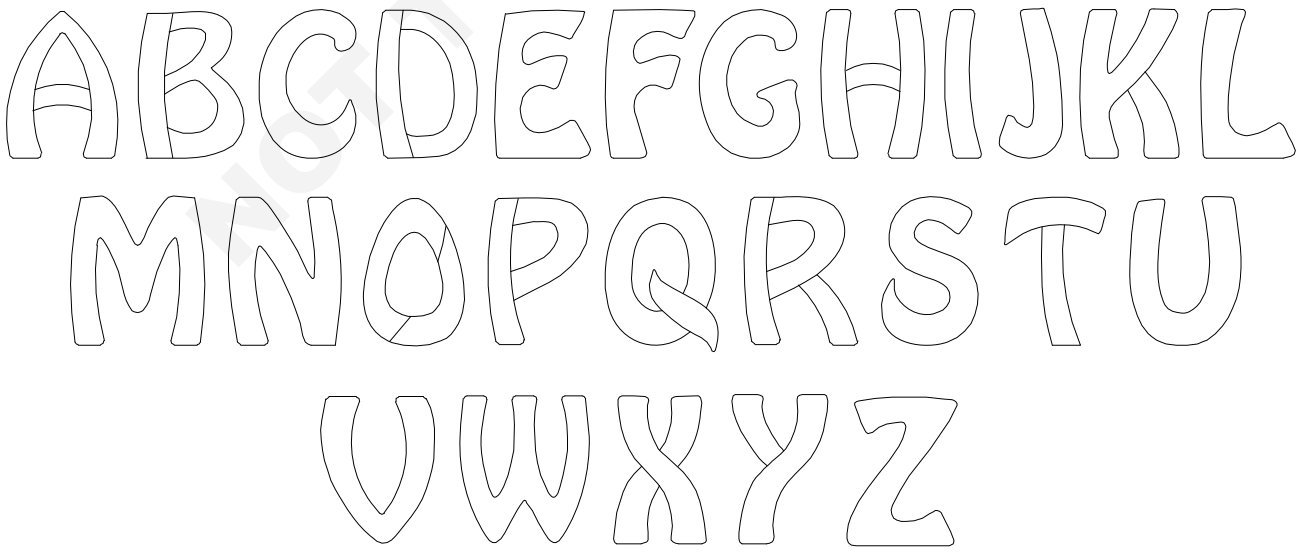
9 Sketching the text letters. (Fig 13)

Fig 13

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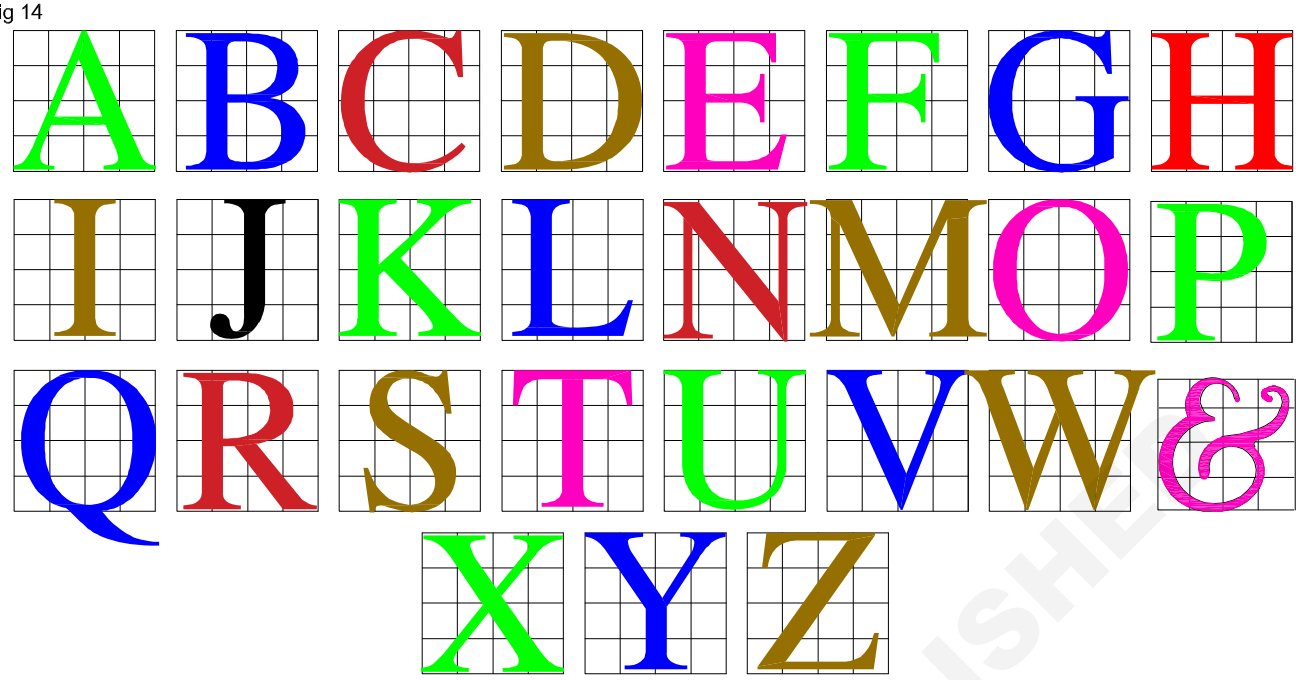
10 Colouring the Roman letters. (Fig 14)

Fig 14




11 Practice to draw and colouring numericals and italic letters. (Fig 15)

Fig 15

12 Colour on the lettering sketch. (Fig 16)

Fig 16

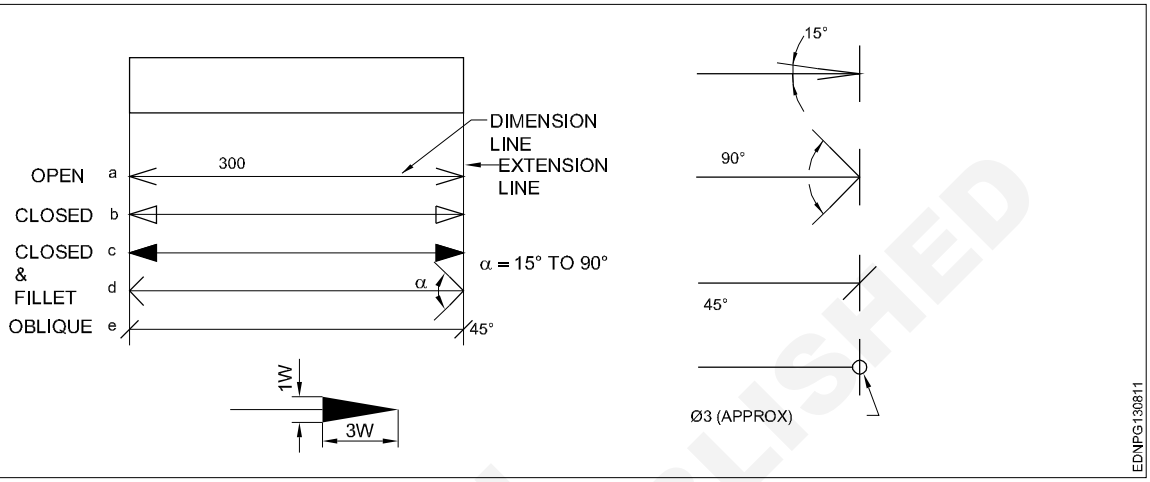

13 Use the poster colour on the text letters. (Fig 17)

Fig 17

## Dimensioning - Types of arrow heads

**Dimension line:** These are thin continuous lines, terminated at ends by arrowheads, dots or oblique lines touching the extension line. (Fig 1)

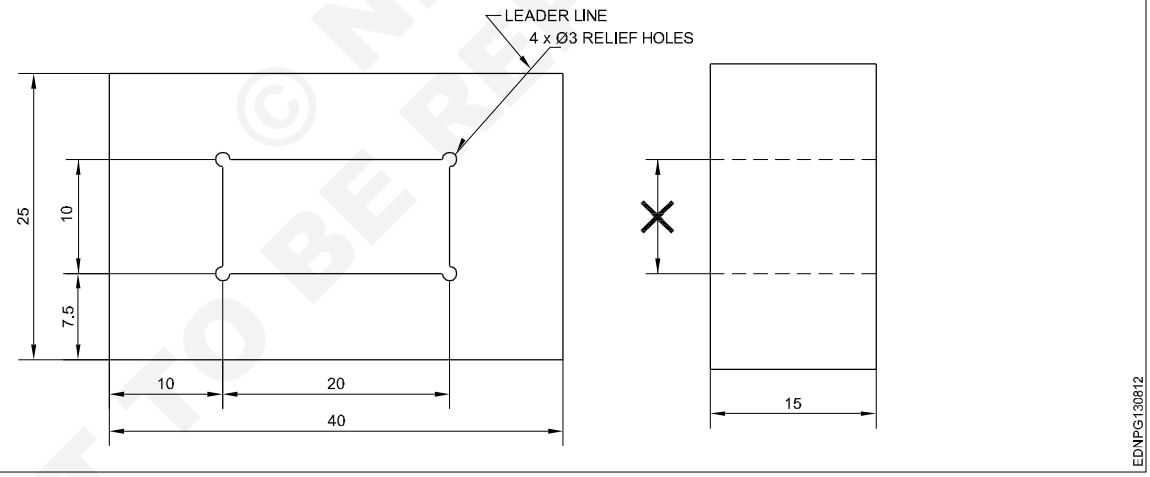
Fig 1




A dimension line may cut or cross another dimension line where there is no other way.

Dimension to the hidden lines be avoided. (Fig 2)

Fig 2




Arrowheads may be placed outside where space is insufficient.

**Leader line:** It is a thin continuous line. It connects a note or dimension with the features to which it applies. (Fig 2)

**Termination and Origin indication:** The size of the terminations (arrowheads/oblique strokes) shall be proportional to the size of the drawing. Only one style of arrowhead shall be used on a single drawing. However, where the space is too small for the arrowheads, it may be substituted by a dot or by an oblique line. Arrowheads are drawn as short lines forming barbs at any convenient included angle between 15° and 90°. They may be open, closed or closed and filled in. Oblique strokes are drawn as short lines inclined at 45°. (Fig 1)

**Indicating dimensional values on drawings:** All dimensional values shall be shown on drawings in characters of sufficient size to ensure complete legibility on the original drawings as well as on reproductions made from micro-filming.

They shall be placed in such a way that they are not crossed or separated by any other line on the drawing.

## Symbolic representation - Different symbols used in the painter (general) trades

**Practice to draw the following free hand sketching line**

| S.No. | Description | Symbol |
|---|---|---|
| 1 | Thick | |
| 2 | Thin | |
| 3 | Tapeven | |
| 4 | Uneven | |
| 5 | Short | |
| 6 | Long | |
| 7 | Continuous | |
| 8 | Broken | |
| 9 | Horizontal | |
| 10 | Vertical | |
| 11 | Diagonally oblique | |
| 12 | Curve | |

| S.No. | Description | Symbol |
|---|---|---|
| 13 | Perpendicular | |
| 14 | Parallel | |
| 15 | Radius | |
| 16 | Sharp | |
| 17 | Blurry | |
| 18 | Irregular | |
| 19 | Painty | |
| 20 | Zig-zag | |
| 21 | Jagged | |
| 22 | Graceful | |
| 23 | Smooth | |

| S.No. | Description | Symbol |
|---|---|---|
| 24 | Brush |  |
| 25 | Painting wall |  |
| 26 | Painting palette |  |
| 27 | Painter canvas linear |  |
| 28 | Paint home sign |  |
| 29 | Painter transparent |  |
| 30 | Paint roller sign |  |
| 31 | Fine art line |  |

| S.No. | Description | Symbol |
|---|---|---|
| 32 | Car painting |  |
| 33 | Cave painting |  |
| 34 | Art board |  |
| 35 | Spray paint |  |
| 36 | Stencil cutting |  |

**Pixel perfect symbol**