

# **Painter (General)**

**NSQF LEVEL - 5**

**1<sup>st</sup> Year (Volume I of II)**

---

## **TRADE THEORY**

---

**SECTOR: Paint & Coating**



Directorate General of Training

**GOVERNMENT OF INDIA  
MINISTRY OF LABOUR & EMPLOYMENT  
DIRECTORATE GENERAL OF EMPLOYMENT & TRAINING**



---

**NATIONAL INSTRUCTIONAL  
MEDIA INSTITUTE, CHENNAI**

---

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

**Sector : Paint & Coating**

**Duration : 2 - Years**

**Trades : Painter (General) - 1<sup>st</sup> Year - (Volume I of II) - Trade Theory - NSQF Level - 5**

**Developed & Published by**



**National Instructional Media Institute**

Post Box No.3142

Guindy, Chennai - 600 032

INDIA

Email: chennai-nimi@nic.in

Website: www.nimi.gov.in

**Copyright @ 2021 National Instructional Media Institute, Chennai**

First Edition :

December 2021

Copies :

**Rs. /-**

## 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 Media Development Committee members of various stakeholders 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 **Painter (General) - Trade Theory - 1<sup>st</sup> Year - (Volume I of II) - in Paint & Coating Sector**. The NSQF Level - 5 Trade Practical 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 Level - 5 trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 5 the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these Instructional Media Packages 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

Director General  
Directorate General of Training  
Ministry of Skill Development & Entrepreneurship  
Government of India.

New Delhi - 110 001

## PREFACE

The National Instructional Media Institute (NIMI) was established in 1986 at Chennai by then Directorate General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under Directorate General of Training, Ministry of Skill Development and Entrepreneurship) Government of India, with technical assistance from the Govt. of Federal Republic of Germany. The prime objective of this Institute is to develop and provide instructional materials for various trades as per the prescribed syllabi under the Craftsman and Apprenticeship Training Schemes.

The instructional materials are created keeping in mind, the main objective of Vocational Training under NCVT/NAC in India, which is to help an individual to master skills to do a job. The instructional materials are generated in the form of Instructional Media Packages (IMPs). An IMP consists of Theory book, Practical book, Test and Assignment book, Instructor Guide, Audio Visual Aid (Wall charts and Transparencies) and other support materials.

The trade practical book consists of series of exercises to be completed by the trainees in the workshop. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered. The trade theory book provides related theoretical knowledge required to enable the trainee to do a job. The test and assignments will enable the instructor to give assignments for the evaluation of the performance of a trainee. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also help him to assess the trainee's understanding. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirements, day to day lessons and demonstrations.

IMPs also deals with the complex skills required to be developed for effective team work. Necessary care has also been taken to include important skill areas of allied trades as prescribed in the syllabus.

The availability of a complete Instructional Media Package in an institute helps both the trainer and management to impart effective training.

The IMPs are the outcome of collective efforts of the staff members of NIMI and the members of the Media Development Committees specially drawn from Public and Private sector industries, various training institutes under the Directorate General of Training (DGT), Government and Private ITIs.

NIMI would like to take this opportunity to convey sincere thanks to the Directors of Employment & Training of various State Governments, Training Departments of Industries both in the Public and Private sectors, Officers of DGT and DGT field institutes, proof readers, individual media developers and coordinators, but for whose active support NIMI would not have been able to bring out this materials.

Chennai - 600 032

EXECUTIVE DIRECTOR

## **ACKNOWLEDGEMENT**

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisation to bring out this IMP for the trade of **Painter (General) - 1<sup>st</sup> Year - (Volume I of II) - Trade Theory - NSQF LEVEL - 5** under the **Paint & Coating** Sector for ITIs.

### **MEDIA DEVELOPMENT COMMITTEE MEMBERS**

Shri. Ketan Patel	-	Deputy Director RDSDE, Gujarat.
Shri. A. Thangavelu	-	Asst. Training officer (Retd.) Govt. I.T.I. Guindy.
Shri. V.C. Chandaliya	-	Craft Instructor Govt. I.T.I. Kholkapur, Maharashtra.
Shri. Harish	-	Patron & past president IPCAC (Indian paints & Coating association)

### **NIMI - COORDINATORS**

Shri. Nirmalya Nath	-	Deputy Director, NIMI, Chennai - 32.
Shri. V. Gopalakrishnan	-	Assistant Manager 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 Instructional Material.

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

NIMI is grateful to all others who have directly or indirectly helped in developing this IMP.

# INTRODUCTION

## TRADE PRACTICAL

The trade practical manual is intended to be used in workshop . It consists of a series of practical exercises to be completed by the trainees during the one year course of the **Painter (General)** Trade supplemented and supported by instructions/ informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in compliance with NSQF LEVEL - 5.

The manual is divided into Six modules.

	<b>Module Name</b>	<b>Hours</b>
Module 1	- <b>Safety Workshop Practice</b>	35 Hrs
Module 2	- <b>Free Hand Sketch Lines and Strokes</b>	165 Hrs
Module 3	- <b>Colours and Colour Knowledge</b>	100 Hrs
Module 4	- <b>Drawing and Painting instruments</b>	150 Hrs
Module 5	- <b>Lettering Types</b>	50 Hrs
Module 6	- <b>Basic Carpenter and Plumbing Work</b>	100 Hrs
<b>Total</b>		<b>600 Hrs</b>

The skill training in the shop floor is planned through a series of practical exercises centred around some practical project. However, there are few instances where the individual exercise does not form a part of project.

While developing the practical manual a sincere effort was made to prepare each exercise which will be easy to understand and carry out even by below average trainee. However the development team accept that there is a scope for further improvement. NIMI, looks forward to the suggestions from the experienced training faculty for improving the manual.

## TRADE THEORY

The manual of trade theory consists of theoretical information for the Two years course of the Painter (General) Trade. The contents are sequenced according to the practical exercise contained in the manual on Trade practical. Attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This co-relation is maintained to help the trainees to develop the perceptual capabilities for performing the skills.

The Trade theory has to be taught and learnt along with the corresponding exercise contained in the manual on trade practical. The indicating about the corresponding practical exercise are given in every sheet of this manual.

It will be preferable to teach/learn the trade theory connected to each exercise atleast one class before performing the related skills in the shop floor. The trade theory is to be treated as an integrated part of each exercise.

The material is not the purpose of self learning and should be considered as supplementary to class room instruction.

## CONTENTS

<b>Lesson No.</b>	<b>Title of the Lesson</b>	<b>Learning Outcome</b>	<b>Page No.</b>
1.1.01 - 11	<b>Module 1: Safety Workshop Practice</b>		
	Organisation structure of the industrial training institute		1
	Scope of the painter (General) and knowledge about the facilities in the I.T.I		2
	Safety practice		3
	Knowledge of personal safety and general precautions observed in the shop	1	5
	Safety practice - fire extinguishers		7
	Types of fire extinguishers		9
	Elementary first-aid		10
	Electrical safety tips		11
	Safe disposal of toxic dust		13
Concept of house keeping & 5 'S' method		13	
1.2.12 - 17  1.2.18 - 20  1.2.21 - 22  1.2.23  1.2.24	<b>Module 2: Free Hand Sketch Lines and Strokes</b>		
	Lines and stroke		15
	Pencil & Their types		18
	Types of colour	1 & 2	22
	Sketching		24
	Human anatomy		28
1.3.25 - 35	<b>Module 3: Colours and Colour Knowledge</b>	3	
	Elements of arts		36
1.4.36 - 46	<b>Module 4: Drawing and Painting instruments</b>		
	Drawing and Painting instruments - Features and their uses		45
	Art tool & equipments		50
	Mount Board & Frames	4	52
	Brush and their types		54
	Drawing materials		56
1.5.47 - 52	<b>Module 5: Lettering Types</b>		
	Lettering and their types	5	62
	Hand writing		67
1.6.53 - 60	<b>Module 6: Basic Carpenter and Plumbing Work</b>		
	Carpenter work safety and carpenter tools		68
	Classification and uses of marking tools		69
	Measuring and testing tools		71
Common India timbers		75	

Lesson No.	Title of the Lesson	Learning Outcome	Page No.
1.6.61 - 67	Defects in timber Diseases in timber and decay of timber Introduction to plumping work Spanners and their Uses Wrenches Different types of pipes (G.I, C.I, D.I PVC, CPVC, PPR, AC and HDPE etc) Different types of pipe fittings for various purpose in pipelines Types of fittings for different joints in different pipes PVC and CPVC pipe General layout of water pipe connection to mains Erecting of rain water pipe system Tracing of leakage in water supply system by sound test Inspection and testing of water supply system Pressure testing of pipeline with pressure testing machine	6	77 80 82 84 87 88 91 96 102 109 110 112 113 114

## LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

S.No.	Learning Outcome	Ref. Ex.No.
1	<b>Make different types of sketching viz., free Hand sketching of different objects, designing of different shapes, size, geometrical shapes of different objects following safety precaution.</b>	1.1.01 - 1.2.20
2	<b>Able draw the free Hand sketching of Human figures, Shading, Use graph &amp; figure enlargement.</b>	1.2.21 - 1.2.24
3	<b>Identify the type of papers, colour schemes and compose different types of colour shade in 2D design.</b>	1.3.25 - 1.3.35
4	<b>Create different types of realistic objects viz., bird, animals, realistic human figure with application of colour shades.</b>	1.4.36 - 1.4.46
5	<b>Demonstrate with colour shades on different types of letters (Devanagari, roman, gothic, Text writing/ lettering.)</b>	1.5.47 - 1.5.52
6	<b>Plan &amp; organize the work to make a job as per specification and applying different types of basic operation. [Basic fitting operation – marking, Chiseling, Filing, Drilling, Pipe fitting]</b>	1.6.53 - 1.6.67

## SYLLABUS

<b>Duration</b>	<b>Reference Learning Outcome</b>	<b>Professional Skills (Trade Practical) with Indicative hours</b>	<b>Professional Knowledge (Trade Theory)</b>
Professional Skill 150Hrs; Professional Knowledge 42Hrs	Make different types of sketching viz., free Hand sketching of different objects, designing of different shapes, size, geometrical shapes of different objects following safety precaution.	<ol style="list-style-type: none"> <li>1. Introduction of trade skills and work application. (02hrs.)</li> <li>2. Safety attitude development of the trainee by educating them to use personal protective equipment (PPE) and Material safety data sheet (MSDS). (05hrs.)</li> <li>3. First-aid method and basic training. (02hrs.)</li> <li>4. Safe disposal of waste materials like- cotton waste, waste paint and waste paint material etc.(02hrs.)</li> <li>5. Hazard and non hazard identification and avoidance. (02hrs.)</li> <li>6. Use of firefighting equipment, likeextinguishers, sand bucket, water etc. (10 hrs.)</li> <li>7. Identification of safety signs, like- Danger, warning, caution and personnel safety .(01hr)</li> <li>8. Importance of trade training. (02hrs.)</li> <li>9. Understand precautions to be followed while working in the painting jobs. (02hrs.)</li> <li>10. Motivational talk by experts. (05 hrs.)</li> <li>11. 5S training. (02hrs.)</li> <li>12. Draw different sketches and hand writing practice. (15 hrs.)</li> </ol>	Introduction of the Institution; rules and management (work) Process of an Institution. Knowledge about the facilities; leaves and rules and subjects an syllabus. Introduction of vocational trade, The importance of trade in the industrial Development of the nation Care in Vocational trade. (14hrs)
		<ol style="list-style-type: none"> <li>13. Introduction and identification of tools and equipments different for cleaning and painting. (15 hrs.)</li> <li>14. Identification and there assembly and function of trade machineries. (10 hrs.)</li> </ol>	Accident and First-Aid: Cost of Accidents; Causes and effects of an accident; First-Aid in case of internal injuries; fracture; wound and electric shock. (07hrs)
		<ol style="list-style-type: none"> <li>15. Free hands sketching practice of different lines and strokes. (17hrs.)</li> <li>16. Free hands sketching practice of nature forms like- flowers, leaves, trees. (17hrs.)</li> <li>17. Free hands sketching practice of birds and animals. (16hrs.)</li> </ol>	Lines- Different types of lines; its uses and specialty. Pencil-Origin of pencil and its introduction. Different types of pencils; uses and its specialty. (14hrs)
		<ol style="list-style-type: none"> <li>18. Draw geometrical shapes and construct for design. (15 hrs.)</li> <li>19. Draw free hand geometrical forms in perspective. (5hrs.)</li> <li>20. Draw free hand different types of perspective. (5 hrs.)</li> </ol>	Colours for drawing and painting: charcoals, oil and dry pestles, water; poster; acrylic; oil colours and reducer medium. (07hrs)
Professional Skill 50Hrs;	Ability to synthesizeof free Hand sketching of Human figures,	21. Free hands sketching practice of human figures. (10hrs.)	Definition and Need of Sketching-Introduction to sketching; its benefits and

Professional Knowledge 14Hrs	Shading, Use graph & figure enlargement.	22. Black & white/ colour pencil shading of human figures (Male, female & children). (15hrs.) 23. Graph and figure enlargement with pencil shading. (10hrs.) 24. Draw with shading different tools and equipments of trade. (15hrs.)	importance in our culture and traditions as well to the trainees. Human organs and their proper place; Body structures of Male and Female. (14hrs)
Professional Skill 100 Hrs; Professional Knowledge 28 Hrs	Identify of paper, colour schemes and compose different types of colour shade Expertise in 2D design.	25. Marking & Cutting different Drawing Paper as per given size. (05hrs.) 26. Draw colour wheel with poster colour. (10 hrs.) 27. Draw & Colour Design in primary, Secondary & Tertiary colours. (10hrs.) 28. Marking & Out line Drawing 2D Design. (05 hrs.) 29. Coloring 2D design in Warm & Cool Colors. (10 hrs.) 30. Make 2D design & Colour in Contrasting colors. (10 hrs.)  Make colour shades: 31. Make gray scale in pencil shading (5hrs.) 32. Make gray scale in poster colour (5hrs.) 33. Make different colour scale in poster colour (15 hrs.)  34. Make 2D Design in different Composition paint in High key, middle key & low key by poster colour. (20 hrs.) 35. Colour mixing & matching Touch up on Damage posters & photographs. (5 hrs.)	Colours & colour knowledge: Definition of colour; colour blindness; tone, colour shade primary, secondary, tertiary. (14 hrs)  Colour wheel, colours & Different types of colour schemes & colour harmony. (07 hrs)  Brush: Different types of Brushes with shapes & sizes. Use & Care of Brushes. (07 hrs)
Professional Skill 150 Hrs; Professional Knowledge 42 Hrs	Create different types of realistic objects viz., bird, animals, realistic human figure with application of colour shades.	36. Draw & colour realistic drawing of Birds. (25 hrs.) 37. Draw & colour realistic drawing of Animals. (25 hrs.)  38. Draw & colour realistic drawing of Human figure. (20hrs.) 39. Mounting & Decorate Painted Pictures. (05hrs.)  40. Draw Landscape. (05hrs.) 41. Colouring Landscape in water/poster colour. (15 hrs.) 42. Use graph on portrait picture & Enlarge outline drawing on drawing paper. (05 hrs.) 43. Water or poster colouring on enlarged drawing (15 hrs.) 44. Draw & Colour Safety or Related Trade Poster. (10 hrs.)  45. Enlarge & Sketching Cinema Posters. (05 hrs.) 46. Colouring enlarged Cinema Poster. (20 hrs.)	Drawing instruments- Drawing board; T-square; steel and wooden scale; set square; compass; Colour dish. (14 hrs)  Brush- Different types of brushes with shapes and sizes. Uses and care of brush. (07hrs)  Drawing paper- Types of drawing papers; its uses and care. (14hrs)  Knife-Uses; different types of Putty knife; Scraper knife; hacking knife; Diamond-glazier; Gilder knife; Shave hook knife; Stencil knife; Chisel knife. (07hrs)
Professional Skill 50 Hrs;	Demonstrate with colour shades different types	47. Sketching & coloring gothic letters in English. (10 hrs.)	

Professional Knowledge 14 Hrs	Letters (Devanagari, roman, gothic, Text writing/lettering.) and apply them in appropriate place.	<p>48. Sketching &amp; coloring gothic letters in Mother Language. (10 hrs.)</p> <p>49. Sketching &amp; coloring Roman letters. (09hrs.)</p> <p>50. Do free hand boru Strokes Devnagri. (08hrs.)</p> <p>51. Sketching &amp; colouring Devnagri letters. (08hrs.)</p> <p>52. Sketching &amp; colouring Text or Italic letters. (05 hrs.)</p>	<p><b>Lettering-</b> Description; uses of devnagri, Roman, Gothic; Italic and Text writing. Spacing - Mechanic and Optical spacing. (14hrs)</p>
Professional Skill 100 Hrs; Professional Knowledge 28 Hrs	Plan and organize the work to make job as per specification applying different types of basic operation. [Basic fitting operation – marking, Chiselling, Filing, Drilling, Pipe fitting]	<p><b>CARPENTER WORK:</b></p> <p>53. Marking Practice on wood. (07hrs.)</p> <p>54. Holding &amp; Sawing Practice different size of wood. (10 hrs.)</p> <p>55. Teeth setting &amp; sharpening of different saw. (07hrs.)</p> <p>56. Tennening Half cut on wooden border. (05 hrs.)</p> <p>57. Setting of planers &amp; sharpening on plane blade. (05 hrs.)</p> <p>58. Plane on different wooden surfaces. (06hrs.)</p> <p>59. Chiselling slots on thick wood. (05 hrs.)</p> <p>60. Drilling on wood with different drilling tools (Gimlet, Hand Drill, Portable electrical drilling machine. (05 hrs.)</p> <p>61. Identify &amp; check different types of pipe. (05 hrs.)</p> <p>62. Do pipe cutting &amp; threading (10 hrs.)</p> <p>63. Apply different types of pipe joint/ fitting of different materials &amp; different diameter. (Use PVC pipe) (10 hrs.)</p> <p>64. Make a simple lap joint. (05 hrs.)</p> <p>65. Make a simple mitred half lap joint. (05 hrs.)</p> <p>66. Make a simple Dovetail joint. (05 hrs.)</p> <p>67. Joint fitting with nails, screw, glue etc. (10 hrs.)</p>	<p><b>Carpenter - safety precaution description, Use hand tools, carpenter tools, types of wood their description &amp; use common defects in timber &amp; their effects.</b></p> <p><b>Plumber:</b> Instruction to the trade safety precautions and elementary first aid. Plumber hand tools description on rain water &amp; pipe system including installation of water supply fitting. Description of different types of pipes &amp; their use such as galvanized pipes, PVC pipes.</p> <p>Pipe line leakage &amp; Maintenance. (21 hrs)</p> <p><b>Equipments for joint, Joints - Types and uses of different types of joints. (07 hrs)</b></p> <p>Selection of cloth, instruments, chemicals, cloth fitting, exposing.(14 hrs)</p>



## Organisation structure of the industrial training institute

Objectives: At the end of this lesson you shall be able to

- state the organisational structure of the I.T.I.

Organisation structure of industrial training institute (ITI):

Industrial training institute plays a vital role in economy of our country and in terms of providing skilled manpower for the global needs.

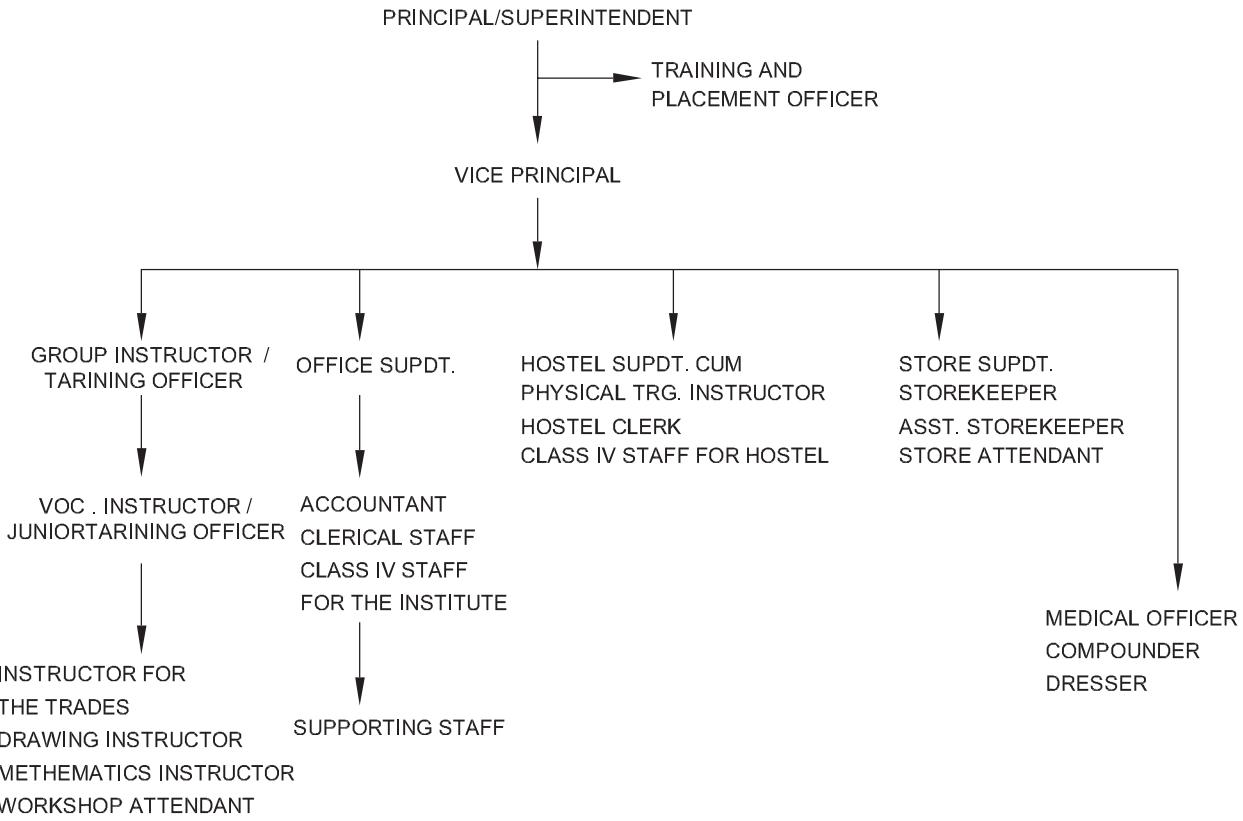
The directorate of training comes under ministry of skill development and entrepreneurship (MSME) offers a range of vocational training trades in different sectors based on economy / labour market. The vocational training programmes are delivered under the aegis of national council of vocational training. They are given

training in various trades including engineering and non engineering trades. The training duration is as 6 month, 1 year, 2 year. The minimum eligibility for admission in I.T.I 8th, 10th, 12th and above with respect to the trades and admission process will be held in every year in July.

The head of the industrial training institute is the principal under whom there is one vice principle accounts officer and other technical and non technical staffs are working in the organisation. The structure of organisation is as follows. (Fig 1)

Fig 1

ORGANISATIONAL CHART OF ITI



# **Scope of the painter (General) and knowledge about the facilities in the I.T.I**

**Objectives:** At the end of this exercise you shall be able to

- state the importance and scope of the painter general trade
- state the facilities in the I.T.I.

## **Scope of the painter (General) training**

Painter (General) trade craftsman training scheme (CTS) is one of the most popular trade delivered nation wide through the network of I.T.I. This trade duration is two years.

**Carrier of painter general trainees:** Painter (general) can join the apprenticeship training in different types of industries on completion of training DGT conduct the examination and issue the national apprenticeship certification (NAC).

Painter (general) on completion of I.T.I and NAC can joint craftman instructor training scheme (CTI) to become an instructor in I.T.I.s.

## **Job opportunities:**

- Painter can join in central and state government establishments
- Employment opportunities in overseas

## **Self employment opportunities:**

- Service centre in rural and urban areas
- General maintenance contractor
- Auto body painting shop
- Advertisement board writing and drawing
- Screen printing work
- Building wall painting work
- Paint dealership

**General discipline in the institute:** Always be polite, courteous while in institute

Do not arguments with others, on matters of related to your training or with the office while seeking clarifications.

Do not bring bad name to your precious time in gossips with your friends and on activities other than training.

Do not waste your precious time in gossips with your friends and on activities other than training.

Do not be late to the theory practical and other classes.

Do not be late to the theory practical and other classes.

Do not interfere in others activities.

Attentive and listen to the lecture carefully during the theory class and practical demonstration given by the instructor.

Give respect to your trainer and all other staffs and co-trainees in your institute.

Be interested in all the training activities.

Do not make noise and play while undergoing training.

Keep the institute premises neat and clean avoid polluting the environment.

Do not take away any material from the institute which does not belongs to you.

Always attend the institute well dressed and good physical appearance.

Be regular to attend the training without fail and avoid absent from the theory or practical classes for simple reasons.

Prepare well before writing a test/examination.

Avoid any malpractice during the test/examination.

Write your theory and practical records regularly and submit them for correction

Take care of your safety as well as others safety while doing the practicals.

## Time-table

Practical and theory class hours are scheduled in advance and working hours generally 8 hrs.

I.T.I working hours as per I.T.I administration timing schedule.

**Facilities in I.T.I:** Hostel, First aid kit, Visiting doctor canteen, sports, libraries and industrial visit, implant training and campus interview provided by the institute.

## Course content in the syllabus:

- Safety precautions
- Free hand sketching of different objects
- Designing of different shapes, sizes and different objects
- Free hand sketching of human figures, shading use graph & figure enlargement
- Compose different types of colour shade in 2D, 3D design
- Create a different types of letters and colour shading.
- Manufacture simple sheet metal and wood items
- Working with DTP, Coral draw and photo shop
- Produce sign board, Name plate, Screen printing

# Safety practice

**Objectives:** At the end of this lesson you shall be able to

- state the causes for accidents in general terms
- state the safe attitudes
- list out the four basic categories of safety signs.

**Causes for accidents:** Normally accidents do not just happen. They are caused.

Causes for accidents are many. Some of the important causes are listed below.

- Unawareness of danger
- Disregard for safety
- Negligence
- Lack of understanding of proper safety procedures
- Untidy condition of workplace
- Inadequate light and ventilation
- Improper use of tools
- Unsafe conditions

**Safe attitudes:** People's attitudes govern what they do or fail to do. In most cases where someone is working with unsafe equipment or in an unsafe situation, somebody has allowed that state of affairs to come about by something they have done or failed to do.

Most accidents don't just happen; they are caused by people who (for example) damage equipment or see it is faulty but don't report it, or leave tools and equipment lying about for other people to trip over.

**Responsibilities:** Safety doesn't just happen - it has to be organised and achieved like the work-process of which it forms a part. The law states that both an employer and his employees have a responsibility in this behalf.

**Employer's responsibilities:** The effort a firm puts into planning and organising work, into training people, into engaging skilled and competent workers, maintaining plant and equipment, and checking, inspecting and keeping records- all of this contributes to the safety in the workplace.

The employer will be responsible for equipment provided in the working conditions and the training given on nature of work to their employees.

**Employee's responsibilities:** Employer will be responsible for the equipment to use as per training and follow the general attitude to safety.

A great deal is done by employers and other people to make your working life safer; but always remember you are responsible for your own actions and the effect they have on others. You must not take that responsibility lightly.

**Rules and procedures at work:** What you must do, by law, is often included in the various rules and procedures laid down by your employer. They may be written down, but more often than not, are just the way a firm does things - you will learn these from other workers, when you

do your job. Follow the rules for issue and use of tools, protective clothing and equipment, reporting procedures, emergency drills, access to restricted areas, and many other matters. Such rules are essential for they contribute to the efficiency and safety of the job.

**Safety signs:** As you go about your work on a construction site you will see a variety of signs and notices. Some of these will be familiar to you - a 'no smoking' sign for example; others you may not have seen before. It is up to you to learn what they mean - and to take notice of them. They warn of the possible danger, and must not be ignored.

Safety signs fall into four separate categories. These can be recognised by their shape and colour. Sometimes they may be just a symbol; other signs may include letters or figures and provide extra information such as the clearance height of an obstacle or the safe working load of a crane.

The four basic categories of signs are as follows. (Fig.1)

- prohibition signs
- mandatory signs
- warning signs
- Information signs

## Prohibition signs (Fig 1)



- Shape** - Circular.  
**Colour** - Red border and cross bar.  
Black symbol on white background.  
**Meaning** - Shows it must not be done.  
**Example** - No smoking.

## Mandatory signs



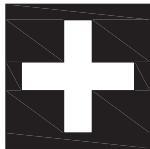
- Shape** - Circular.  
**Colour** - White symbol on blue background.  
**Meaning** - Shows what must be done.  
**Example** - Wear hand protection.

## Warning signs



- Shape** - Triangular.  
**Colour** - Yellow background with black border and symbol.  
**Meaning** - Warns of hazard or danger.  
**Example** - Caution, risk of electric shock.

## Information signs



- Shape** - Square or oblong.  
**Colour** - White symbols on green background.  
**Meaning** - Indicates or gives information of safety provision.  
**Example** - First aid point.

## Prohibition signs (Fig 2)

Fig 2



## Mandatory signs (Fig 3)

Fig 3



## Warning signs (Fig 4)

### Questions about your safety

Do you know the general safety rules that cover your place of work?

Are you familiar with the safety laws that cover your particular job?

Do you know how to do your work without causing danger to yourself, your workmates and the general public?

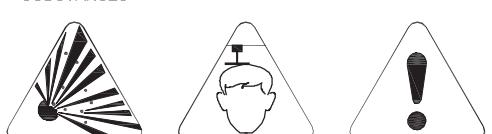
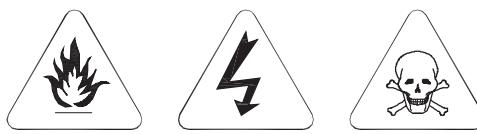
Are the plant, machinery and tools that you use really safe? Do you know how to use them safely and keep them in a safe condition?

Do you wear all the right protective clothing, and have you been issued with all the necessary safety equipment?

Have you been given all the necessary safety information about the materials used?

Have you been given training and instruction to enable you to do your job safely?

Fig 4



PGN10124

Do you know who is responsible for safety at your place of work?

Do you know who are the appointed 'Safety Representatives'?

- Stop the machine before changing the speed.
- Disengage the automatic feeds before switching off.
- Check the oil level before starting the machine.
- Before starting the machine, move the ram by hand to ensure that the ram or tool-handler does not strike the workpiece or table.
- Never start a machine unless all the safety guards are in position.
- Take measurements only after stopping the machine.
- Use wooden planks over the bed while loading and unloading heavy jobs.
- Do not stop the machine before the finish of the cutting stroke.

**Safety is a concept, understand it.**

**Safety is a habit, cultivate it.**

# **Knowledge of personal safety and general precautions observed in the shop**

**Objectives:** At the end of this lesson you shall be able to

- state the is personal protective equipment and its purpose
- name the two categories of personal protective equipment
- list the most common type of personal protective equipment.

## **Personal Protective Equipment (PPE)**

Devices, equipment, clothing are used by the employees, as a last resort, to protect against hazards in the workplace. The primary approach in any safety effort is that the hazard to the workmen should be eliminated or controlled by engineering methods rather than protecting the workmen through the use of personal protective equipment (PPE). Engineering methods could include design change, substitution, ventilation, mechanical handling, automation, etc.

The Factories Act, 1948 and several other labour legislations 1996 have provisions for effective use of appropriate types of PPE.

Ways to ensure workplace safety and use personal protective equipment (PPE) effectively.

- Workers to get up-to-date safety information from the regulatory agencies that workplace safety in their specific area.
- To use all available text resources that may be in work area and for applicable safety information on how to use PPE best.
- When it comes to the most common types of personal protective equipment, like goggles, gloves or bodysuits, these items are much less effective if they are not worn at all times, or whenever a specific danger exists in a work process. Using PPE consistent will help to avoid some common kinds of industrial accidents.
- Personal protective gear is not always enough to protect workers against workplace dangers. Knowing more about the overall context of your work activity can help to fully protect from anything that might threaten health and safety on the job.

- Inspection of gear thoroughly to make sure that it has the standard of quality and adequately protect the user should be continuously carried out.

## **Categories of PPEs**

Depending upon the nature of hazard, the PPE is broadly divided into the following two categories:

- 1 Non-respiratory: Those used for protection against injury from outside the body, i.e. for protecting the head, eye, face, hand, arm, foot, leg and other body parts
- 2 Respiratory: Those used for protection from harm due to inhalation of contaminated air.

They are to meet the applicable BIS (Bureau of Indian Standards) standards for different types of PPE.

The guidelines on 'Personal Protective Equipment' is issued to facilitate the plant management in maintaining an effective programme with respect to protection of persons against hazards, which cannot be eliminated or controlled by engineering methods listed in table1.

**Table1**

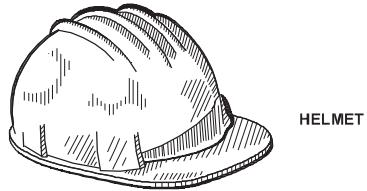
No.	Title
PPE 1	Helmet
PPE 2	Safety footwear
PPE 3	Respiratory protective equipment
PPE 4	Arms and hands protection
PPE 5	Eyes and face protection
PPE 6	Protective clothing and overall
PPE 7	Ears protection
PPE 8	Safety belt and harnesses

**Common type of personal protective equipments and their uses and hazards are as follows**

Types of protection	Hazards	PPE to be used
Head protection (Fig 1)	1. Falling objects 2. Striking against objects 3. Spatter	Helmets
Foot protection (Fig 2)	1. Hot spatter 2. Falling objects 3. Working wet area	Leather leg guards Safety shoes Gum boots
Nose (Fig 3)	1. Dust particles 2. Fumes/ gases/ vapours	Nose mask
Hand protection (Fig 4)	1. Heat burn due to direct contact 2. Blows sparks moderate heat 3. Electric shock	Hand gloves

Eye protection (Figs 5 & 6)	1. Flying dust particles 2. UV rays, IR rays heat and High amount of visible radiation	Goggles Face shield Hand shield Head shield
Face Protection (Figs 6 & 7)	1. Spark generated during Welding, grinding 2. Welding spatter striking 3. Face protection from UV rays	Face shield Head shield with or without ear muff
Ear protection	1. High noise level	Helmets with welders screen for welders  Ear plug Ear muff
Body protection (Figs 8 & 9)	1. Hot particles	Leather aprons

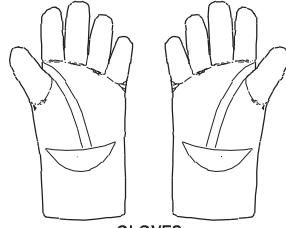
Fig 1



HELMET

PGN110131

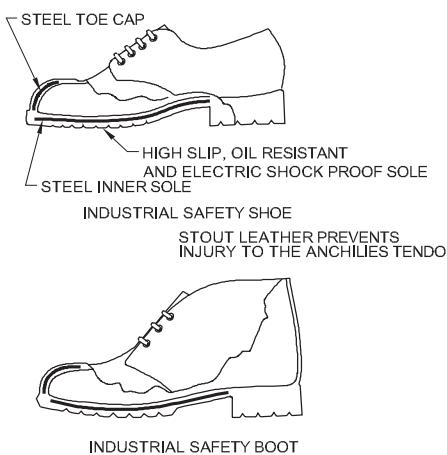
Fig 4



GLOVES

PGN110134

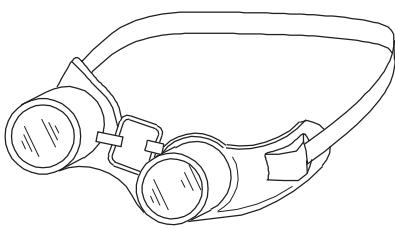
Fig 2



INDUSTRIAL SAFETY BOOT

PGN110132

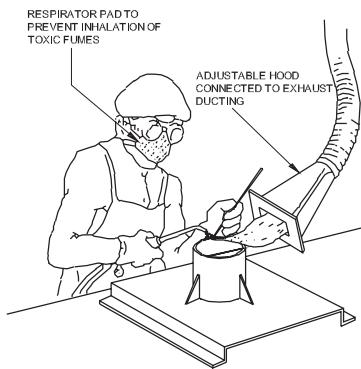
Fig 5



GOGGLES

PGN110135

Fig 3

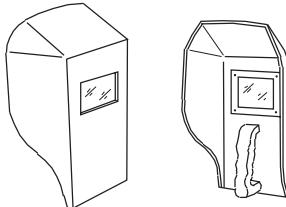


RESPIRATOR PAD TO PREVENT INHALATION OF TOXIC FUMES

ADJUSTABLE HOOD CONNECTED TO EXHAUST DUCTING

PGN110133

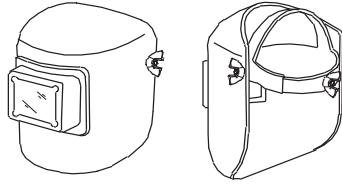
Fig 6



HAND SCREEN

PGN110136

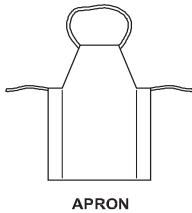
Fig 7



WELDING HELMET

PGN110137

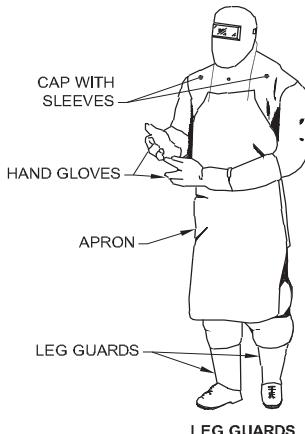
Fig 8



APRON

PGN110138

Fig 9



LEG GUARDS

PGN110139

## Safety practice - fire extinguishers

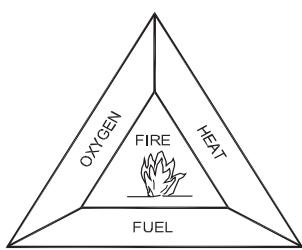
**Objectives:** At the end of this lesson you shall be able to

- state the effects of a fire break out
- state the causes for fire in a workshop
- state the conditions required for combustion relevant to fire prevention
- state the general precautionary measures to be taken for prevention of fire.

Fire is the burning of combustible material. It might injure people, and sometimes cause loss of life as well. Hence, every effort must be made to prevent fire.

The following are the three factors that must be present in combination for a fire to continue to burn. (Fig 1)

Fig 1



PGN110141

**Fuel:** Any substance, liquid, solid or gas will burn, if there is oxygen and high enough temperatures.

**Heat:** Every fuel will begin to burn at a certain temperature. It varies and depends on the fuel. Solids and liquids give off vapour when heated, and it is this vapour which ignites. Some liquids do not have to be heated as they give off vapour at normal room temperature say 15oC, eg. petrol.

**Oxygen:** Usually exists in sufficient quantity in air to keep a fire burning.

**Extinguishing of fire:** Isolating or removing any of these factors from the combination will extinguish the fire. There are three basic ways of achieving this.

- Starving the fire of fuel removes this element.
- Smothering - ie. isolate the fire from the supply of oxygen by blanketing it with foam, sand etc.
- Cooling - use water to lower the temperature.

**Removing any one of these factors will extinguish the fire.**

**Preventing fires:** The majority of fires begin with small outbreaks which burn unnoticed until they have a secure hold. Most fires could be prevented with more care and by following some simple common sense rules.

Accumulation of combustible refuse (cotton waste soaked with oil, scrap wood, paper, etc.) in odd corneres are a fire risk. Refuse should be removed to collection points.

The cause of fire in electrical equipment is misuse or neglect. Loose connections, wrongly rated fuses, over loaded circuits cause overheating which may in turn lead to a fire. Damage to insulation between conductors in cables causes fire.

Clothing and anything else which might catch fire should be kept well away from heaters. Make sure that the heater is shut off at the end of the working day.

Highly flammable liquids and petroleum mixtures (thinner, adhesive solutions, solvents, kerosene, spirit, LPG gas etc.) should be stored in the flammable material storage area.

Blowlamps and torches must not be left burning when they are not in use.

**Extinguishing fires:** Fires are classified into four types in terms of the nature of fuel. (Figs 2,3,4 & 5)

Different types of fire have to be dealt with in different ways and with different extinguishing agents.

An extinguishing agent is the material or substance used to put out the fire, and is usually (but not always) contained in a fire extinguisher with a release mechanism for spraying into the fire.

It is important to know the right type of agent for extinguishing a particular type of fire; using a wrong agent can make things worse. There is no classification

for ‘electrical fires’ as such, since these are only fires in materials where electricity is present.

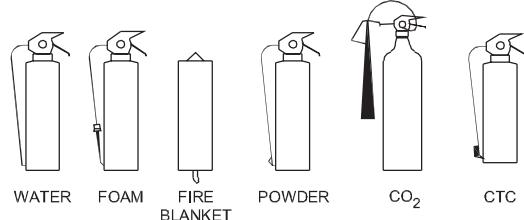
# Types of fire extinguishers

**Objectives:** At the end of this lesson you shall be able to

- distinguish different types of fire extinguishers
- determine the correct type of fire extinguisher to be used based on the class of fire
- describe the general procedure to be adopted in the event of a fire.

Many types of fire extinguishers are available with different extinguishing 'agents' to deal with different classes of fires. (Fig 1)

Fig 1

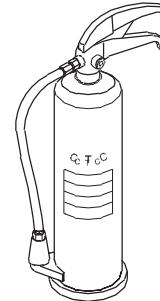


PGN110151

Must not be used on fires where electrical equipment is involved.

**Dry powder extinguishers (Fig 4):** Extinguishers fitted with dry powder may be of the gas cartridge or stored pressure type. Appearance and method of operation is the same as that of the water-filled one. The main distinguishing feature is the fork shaped nozzle. Powders have been developed to deal with class D fires.

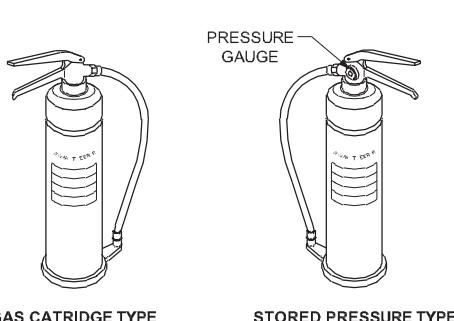
Fig 4



PGN110154

**Water-filled extinguishers:** There are two methods of operation. (Fig 2)

Fig 2



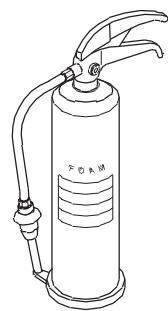
PGN110152

- Gas cartridge type
- Stored pressure type

With both methods of operation the discharge can be interrupted as required, conserving the contents and preventing unnecessary water damage.

**Foam extinguishers (Fig 3):** These may be of stored pressure or gas cartridge types. Always check the operating instructions on the extinguisher before use.

Fig 3



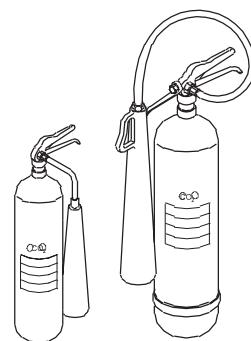
PGN110153

Most suitable for

- flammable liquid fires
- running liquid fires.

**Carbon dioxide (Co<sub>2</sub>):** This type is easily distinguished by the distinctively shaped discharge horn. (Fig 5).

Fig 5



PGN110155

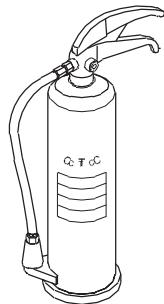
Suitable for Class B fires. Best suited where contamination by deposits must be avoided. Not generally effective in open air.

Always check the operating instructions on the container before use. Available with different gadgets of operation such as - plunger, lever, trigger etc.

**Halon extinguishers (Fig 6):** These extinguishers may be filled with carbon-tetrachloride and Bromochlorodifluoro methene (BCF). They may be either gas cartridge or stored pressure type.

They are more effective in extinguishing small fires involving pouring liquids. These extinguishers are particularly suitable and safe to use on electrical equipment as the chemicals are electrically non-conductive.

Fig 6



PGN10156

**The fumes given off by these extinguishers are dangerous, especially in confined space.**

The general procedure in the event of a fire

- Raise an alarm.
- Turn off all machinery and power (gas and electricity).
- Close the doors and windows, but do not lock or bolt them. This will limit the oxygen fed to the fire and prevent its spreading.
- Try to deal with the fire if you can do so safely. Do not risk getting trapped.
- Anybody not involved in fighting the fire should leave calmly using the emergency exits and go to the designated assembly point. Failure to do this may mean that some person being unaccounted for and others may have to put themselves to the trouble of searching for him or her at risk to themselves.

## Elementary first-aid

**Objectives:** At the end of this lesson you shall be able to

- define first aid
- list out the first aid key points
- describe the ABC of first aid.
- determine the responsiveness.

First aid is defined as the immediate care and support given to an acutely injured or ill person, primarily to save life,

First aid procedure often consists of simple and basic life saving techniques that an individual performs with proper training and knowledge.

The key aims of first aid can be summarized in three key points:

- Preserve life: If the patient was breathing, a first aider would normally place them in the recovery position, with the patient learnt over on their side, which also has the effect of clearing the tongue from the pharynx. The first aider will be taught to deal with this through a combination of 'back slaps' and 'abdominal thrusts'. Once the airway has been opened, the first aider would assess to see if the patient is breathing.
- Prevent further harm: Also sometimes called prevent the condition from worsening, or danger of further injury, this covers both external factors, such as moving a patient away from any cause of harm, and applying first aid techniques to prevent worsening of the condition, such as applying pressure to stop a bleed becoming dangerous.
- Promote recovery: First aid also involves trying to start the recovery process from the illness or injury, and in some cases might involve completing a treatment, such as in the case of applying a plaster to a small wound.

### ABC of first aid

ABC stands for airway, breathing and circulation.

- **Airway:** Attention must first be brought to the airway to ensure it is clear. Obstruction (choking) is a life-threatening emergency.

- **Breathing:** Breathing if stops, the victim may die soon. Hence means of providing support for breathing is an important next steps. There are several methods practiced in first aid.
- **Circulation:** Blood circulation is vital to keep person alive. The first aiders now trained to go straight to chest compressions through CPR methods.

When providing first aid one needs to follow some rule. There are certain basic norms in teaching and training students in the approach and administration of first aid to sick and injured.

### Important guideline for first aiders

#### Evaluate the situation

Are there things that might put the first aider at risk. When faced with accidents like fire, toxic smoke, gasses, an unstable building, live electrical wires or other dangerous scenario, the first aider should be very careful not to rush into a situation, which may prove to be fatal.

#### Avoid moving the victim

Avoid moving the victim unless they are immediate danger. Moving a victim will often make injuries worse, especially in the case of spinal cord injuries.

#### Call emergency services

Call for help or tell someone else to call for help as soon as possible. If alone at the accident scene, try to establish breathing before calling for help, and do not leave the victim alone unattended.

#### Determine responsiveness

If a person is unconscious, try to rouse them by gently shaking and speaking to them.

**If the person remains unresponsive, carefully roll them on the side (recovery position) and open his airway.**

- Keep head and neck aligned.
- Carefully roll them onto their back while holding hishead.

#### First aid

- Call EMERGENCY number.
- Check the person's airway, breathing, and pulse frequently. If necessary, begin rescue breathing and CPR.
- If the person is breathing and lying on the back and after ruling out spinal injury, carefully roll the person onto the side, preferably left side. Bend the top leg so both hip and knee are at right angles. Gently tilt the head back to keep the airway open. If breathing or pulse stops at any time, roll the person on to his back and begin CPR.

- If there is a spinal injury, the victims position may have to be carefully assessed. If the person vomits, roll the entire body at one time to the side. Support the neck and back to keep the head and body in the same position while you roll.

- Keep the person warm until medical help arrives.
- If you see a person fainting, try to prevent a fall, lay the person flat on the floor and raise the level of feet above and support.
- If fainting is likely due to low blood sugar, give the person something sweet to eat or drink when they become conscious.

#### Do not

- Do not give an unconscious person any food or drink.
- Do not leave the person alone.
- Do not place a pillow under the head of an unconscious person.
- Do not slap an unconscious person's face or splash water on the face to try to revive him.

## Electrical safety tips

**Objectives:** At the end of this lesson you shall be able to

- rescue a person who is in contact with a live wire
- treat a person for electric shock/injury.

The severity of an electric shock will depend on the level of current which passes through the body and the length of time of contact. Do not delay, act at once. Make sure that the electric current has been disconnected.

If the casualty is still in contact with the supply - break the contact either by switching off the power, removing the plug or wrenching the cable free. If not, stand on some insulating material such as dry wood, rubber or plastic, or using whatever is at hand to insulate yourself and break the contact by pushing or pulling the person free. (Figs 1 & 2)

In bare foot, do not touch the victim with your bare hands until the circuit is made dead or moved away from the equipment.

If the victim is aloft, measures must be taken to prevent him from falling or atleast make him fall safe.

Electric burns on the victim may not cover a big area but may be deep seated. All you can do is to cover the area with a clean, sterile dressing and treat for shock. Get expert help as quickly as possible.

If the victim is unconscious but is breathing, loosen the clothing about the neck, chest and waist and place the casualty in the recovery position.(Fig 3)

Keep a constant check on the breathing and pulse rate.

Keep the casualty warm and comfortable. (Fig 4)

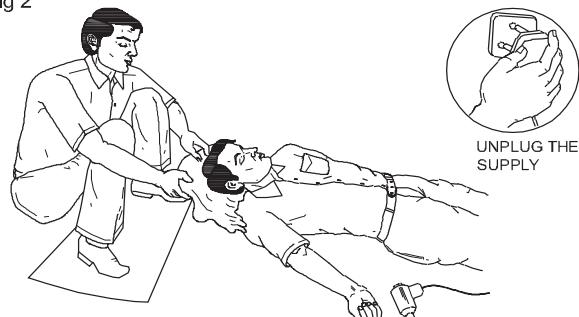
Send for help.

Fig 1



PGN110161

Fig 2

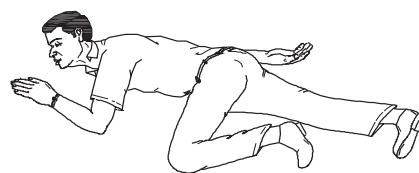


UNPLUG THE SUPPLY

INSULATE YOURSELF AND PULL THE VICTIM AWAY FROM SUPPLY

PGN110162

Fig 3



KEEP THE VICTIM AT EASE

PGN110163

Fig 4



PGN10164

**Do not give an unconscious person anything by mouth.**

**Do not leave an unconscious person unattended**

If the casualty is not breathing - Act at once - don't waste time!

Safety practice first - aid

**Electric shock:** The severity of an electric shock will depend on the level of the current which passes through the body and the length of time of the contact.

Other factors that contribute to the severity of shock are:

- Age of the person
- Not wearing insulating footware or wearing wet foot wear
- Weather condition
- Floor is wet or dry
- Mains voltage etc.

**Effects of electric shock:** The effect of current at very low levels may only be an unpleasant tingling sensation, but this in itself may be sufficient to cause one to lose his balance and fall.

At higher levels of current, the person receiving the shock may be thrown off his feet and will experience severe pain, and possibly minor burns at the point of contact.

At an excessive level of current flow, the muscles may contract and the person unable to release his grip on the conductor. He becomes conscious and the muscles of the heart may contract spasmodically (fibrillation). This may be fatal.

Electric shock can also cause burning of the skin at the point of contact.

#### Treatment of electric shock

**Prompt treatment is essential.**

If assistance is close at hand, send for medical aid, then carry on with emergency treatment.

If you are alone, proceed with treatment at once.

Switch off the current, if this can be done without undue delay. Otherwise, remove the victim from contact with the live conductor, using dry non-conducting materials such

as a wooden bar, rope, a scarf, the victim's coat-tails, any dry article of clothing, a belt, rolled-up newspaper, non-metallic hose, PVC tubing, bakelised paper, tube etc. (Fig 5)

Fig 5



PGN10165

Avoid direct contact with the victim. Wrap your hands in dry material if rubber gloves are not available.

**Electrical burns:** A person receiving an electric shock may also sustain burns when the current passes through his body. Do not waste time by applying first aid to the burns until breathing has been restored and the patient can breathe normally - unaided.

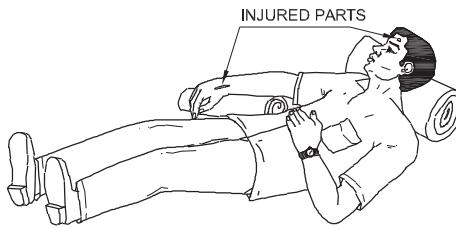
**Burns and scalds:** Burns are very painful. If a large area of the body is burnt, give no treatment, except to exclude the air, eg. by covering with water, clean paper, or a clean shirt. This relieves the pain.

**Severe bleeding:** Any wound which is bleeding profusely, especially in the wrist, hand or fingers must be considered serious and must receive professional attention. As an immediate first aid measure, pressure on the wound itself is the best means of stopping the bleeding and avoiding infection.

**Immediate action:** Always in cases of severe bleeding

- Make the patient lie down and rest
- If possible, raise the injured part above the level of the body (Fig 6)

Fig 6



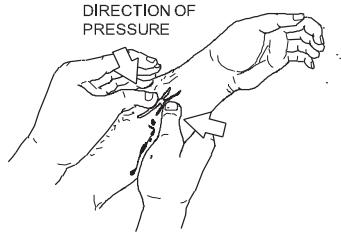
PGN10166

- Apply pressure to the wound
- Summon assistance.

**To control severe bleeding:** Squeeze together the sides of the wound. Apply pressure as long as it is necessary to stop the bleeding. When the bleeding has stopped, put a dressing over the wound, and cover it with a pad of soft material. (Fig 7)

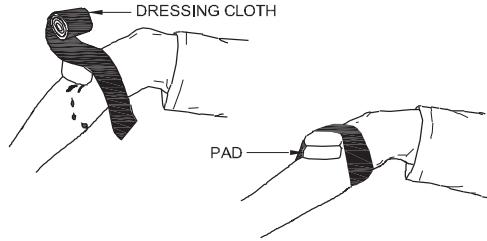
For an abdominal stab wound, such as may be caused by falling on a sharp tool, keep the patient bending over the wound to stop internal bleeding.

Fig 7



PGN110167

Fig 8



PGN110168

**Large wound:** Apply a clean pad (preferably an individual dressing) and bandage firmly in place. If bleeding is very severe apply more than one dressing. (Fig 8)

## Safe disposal of toxic dust

**Objectives:** At the end of this exercise you shall be able to

- list the waste material in paint shop
- explain the methods of disposal of waste material.

**Introduction:** The paint shop produces paint fumes containing air fog gasses which are harmful to human health. Hence a systematic and scientifically designed methods are adopted for safe disposal of such toxic dust.

Dust from paint removing and cleaning to be flown into the air since dust floating in the air for many hours may cause harm to people who breath unknowingly when used compressed air jet to clean the paint dust confirming the PPE to safety regulation & policies. This includes over-all coat, face mask, safety goggles for eyes, ear plug for ear protection, rubber gloves of barrier cream for hand and valved respirator for breathing.

Don't use compressed air to clean dust from various paint removed component of sign boards. Solvent used for cleaning can also form a toxic waste wash work cloths separately from other cloths so that toxic dust does not get transfer to other cloth paint shop waste water must be caught in a sledge pit and not into the storm water drain. Vacuum cleaner is a best device control toxic waste. Providing high speed exhaust ventilation can solve toxic diet use paint can not re-used is stored in a separate container and stored with unique identification waste cotton and paints stored in separate container, labeled on container.

## Concept of house keeping & 5 'S' method

**Objectives:** At the end of this lesson you shall be able to

- elements of house keeping and cleanliness at work place
- state the concept of 5'S' techniques.

**Concept of house keeping:** House keeping is the systematic process of making home/work place neat and clean. House keeper is responsible for systematic administration of activities that provide segregation, storage, transfer, processing treatment and disposal of solid waste (which is collected during cleaning)

**Scope of house keeping maintenance:** The scope of work hieghly depend on where the house keeping activity is performed in general, maintains cleanliness and orderliness, Furnishes the room, office, workplace, house keeping supervisor assisted by an assistant house keeper.

- Eye appeal
- Safety
- Maintenance

**Elements of housekeeping and cleanliness at workplace:** The major elements which are normally included in the housekeeping and cleanliness practices at the workplace are described below.

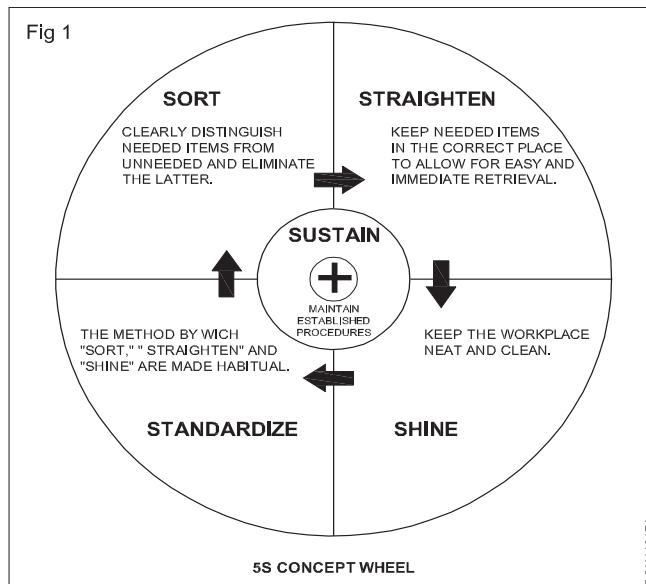
- **Dust and dirt removal:** Working in dusty and dirty area is unhygienic as well as unhealthy for the employees, regular sweeping the workplace for the removal of dust and dirt is an essential housekeeping and cleanliness practice. Further, compressed air is not to be used for removing dust or dirt off employees or equipment. Compressed air can caused dirt and dust paticles to be embedded under the skin or in the eye.
- **Employees facilities:** Adequate employees facilities such as drinking water, wash rooms, toilet blocks, and rest rooms are to be provided for the employees at the workplace so that employees can use them when there is a need. Cleanliness at the place of these facilities is an important aspect of the facilities.
- **Flooring:** Floors are to be cleaned regularly and immediately if liquids or other materials are spilled. Poor floor conditions are a leading cause of accidents in the workplace. It is also important to replace worn, ripped or damaged flooring that poses a trip hazard.

- **Lighting:** Adequate lighting reduces the potential for accidents. It is to be ensured that inoperative light fixtures are repaired and dirty light fixtures are cleaned regularly so that the light intensity levels are maintained at the workplace.
- **Aisles and stairways:** Aisles and stairways are to be kept clear and not to be used for storage. It is also important to maintain adequate lighting in stairways. Further stairways need to have railings preferably round railings for adequate grip.
- **Spill control:** The best method to control spills is to prevent them from happening. Regular cleaning and maintenance on machines and equipment is an essential practice. When cleaning a spill, it is required to use the proper cleaning agents or absorbent materials. It is also to be ensured that the waste products are disposed of properly.
- **Waste disposal:** The regular collection of the waste materials contribute to good housekeeping and cleanliness practices. Placing containers for wastes near the place where the waste is produced encourages orderly waste disposal and makes collection easier. All recyclable wastes after their collection are to be transferred to their designated places so that the waste materials can be dispatched to the point of use or sold.
- **Tools and equipment:** Tools and equipment are required to be inspected prior to their use. Damaged or worn tools are to be taken out of service immediately. Tools are to be cleaned and returned to their storage place after use.
- **Maintenance:** One of the most important elements of good housekeeping and cleanliness practices is the maintenance of the equipment and the buildings housing them. This means keeping buildings, equipment and machinery in safe and efficient working condition. When a workplace looks neglected means there are broken windows, defective plumbing, broken floor surfaces and dirty walls etc. These conditions can cause accidents and affect work practices.
- **Storage:** Proper storage of materials is essential in a good housekeeping and cleanliness practice. All storage areas need to be clearly marked. Also it is important that all containers be labeled properly. If materials are being stored correctly, then the incidents of strain injuries, chemical exposures and fires get reduced drastically.
- **Clutter control:** Cluttered workplaces typically happen because of poor housekeeping practices. This type of workplace can lead to a number of issues which include ergonomic as well as injuries. It is important to develop practices where items like tools, chemicals, cords, and containers are returned to their appropriate storage location when not in use.
- **Individual workspace:** Individual workspace need to be kept neat, cleared of everything not needed for

work. It is necessary to make a checklist which is to be used by the employees to evaluate their workspace.

It can be said that a clean work area demonstrate the pride employees have with the job and the culture of safety at the workplace.

### 5 Steps (5s) - Concept (Fig 1)



5s is a people-oriented and practice-oriented approach. 5s expects every one to participate in it. It becomes a basic for continuous improvement in the organisation.

The terms (5s) 5 steps are

**Step 1: SEIRI (Sorting out)**

**Step 2: SEITON (Systematic arrangement)**

**Step 3: SEISO (Shine cleanliness)**

**Step 4: SEIKTSU (Standardization)**

**Step 5: SHITSURE (Self discipline)**

Fig 1 shows the 5s concept wheel.

The list describes how to organize a work space for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items and sustaining the new order.

### Benefits of 5s

- Work place becomes clear and better organised.
- Working in workplace becomes easier.
- Reduction in cost.
- People tend to be more disciplined.
- Delay is avoided.
- Less absenteeism.
- Better use of floor space.
- Less accidents.
- High productivity with quality etc.

## Lines and stroke

**Objectives:** At the end of this lesson you shall be able to

- state the about various types of lines
- state the different kinds of lines
- state the lines and its symbolic meanings
- make a list of the lines
- describe the various types of strokes.

**Lines:** Line is the most important and basic part of painting line is defined as when many number of points meet and form an object. These lines represent the two dimensional and three dimensional objects, sculpture and architecture and these lines find an important place to form and definite object.

The lines can be drawn by using pencil, brush and have a form, beauty and each lines creates a different meaning or emotion during the primeval period the people created language using the lines and in their caves made pictures of human beings, animals and explained their thought through line of art and we can see them in Ajanta caves which are arched and rhythmical.

When we of paintings of the ajunta, rushal and rajput style we understand the importance of lines in Indian painting and creativity of artist language in line.

Lines are different types horizontal lines, emission lines, angular lines, flame phate lines, dual type lines, periodic lines, dashed lines, terminal lines, spot lines, chart lines, circular lines etc.

A line connects two points. It is also made by moving point. Lines can be thick or thin. They can be long or short. They can be vertical, horizontal, or diagonal. They can be solid or dotted or dashed. Lines can be curved or straight or combinations of both lines can be literal or implied. Draw a series of 3,4,5 points.

Each line represented and gives it unique characteristics. Thick lines convey a different meaning than thin lines. A curved lines send a different message than a sharp straight line.

### Elements of lines

**Length:** Before you start drawing and objects, you have to determine the length of the lines, depending on the one objects you want to draw and the message you wish to convey. For instance, a long line is used to represent strong, or distant object while a short line depicts small, cute and close.

**Width:** The width of lines determines the type of message convey with painting. Normally, the two main types of width: thin and thick. A thin line indicates a delicate, slim, and light weight object, thick line represents the strength, weight, and power of the object.

**Weight:** In art, the weight of a line means the continuous change of width. When an object is in front of another.

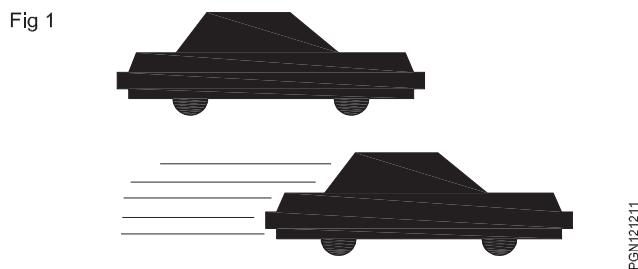
**Texture:** The texture of a line is meant to define its smoothness or roughness. To vary the texture of your lines simply change your working medium. For instance, if you are using a marker, replace it with charcoal, also vary a line's texture by changing your digital brushes.

**Style:** The most common styles of lines in the art include continuous, dashed, dotted, and implied lines. Colour and implied lines help to direct the eyes of the viewer to what you want them to see in the painting dotted and dashed lines are good for patterns, calling for attention and energy.

**Types of lines:** There are several types of lines defined by their use.

- **Contour lines** are used to define edges. They create boundaries around or inside an object. Most lines you encounter are contour lines. In web design these could be the borders you add around an object or group of objects.
- **Dividing lines** can also define edges, but what distinguishes them from contour lines is they divide space. The lines between columns of text are dividing lines as are the lines separating menu items.
- **Decoration lines** are used to embellish an object. Cross-hatching is an example of using decoration lines to add shading and form to an object. The line beneath liked text is a decorative lines as are the lines used to create a floral background image.
- **Gesture lines** are quick and rough continuous lines used to capture form and movement. They are generally used when studying the shape and motion of the human form. You likely won't use gesture lines (based on the technical definition) in a web design, but you could certainly create patterns of lines to signify motion or build up a form. (Fig 1)

Fig 1



**The meaning of different kinds of lines:** As mentioned above there are a lot of different ways describe a given line and each gives a line unique characteristics.

**Thin lines** are fragile. They appear easy to break or knock over. They suggest frailty and convey an elegant quality. They are delicate and give off an ephemeral air.

**Thick lines** on the other hand appear difficult to break. They suggest strength and give emphasis to nearby elements. Thick lines are bold and make a statement.

**Horizontal lines** are parallel to the horizon (hence the name). They look like they're lying down at rest, asleep. They suggest calm and quiet, a relaxed comfort.

Horizontal lines can't fall over. They accentuate width. They're stable and secure. The convey an absence of conflict, a restful peace. Horizontal lines by their connection to the horizon are associated with earth bound things and idea. (Fig 2)

**Vertical lines** are perpendicular to the horizon. They are filled with potential energy that could be released if they were to fall over. Vertical lines are strong and rigid. They can suggest stability, especially when thicker. Vertical lines accentuate height and convey a lack of movement, which is usually seen as horizontal. (Fig 2)

They stretch from the earth to the heavens and are often connected with religious feelings. Their tallness and formality may give the impression of dignity.

**Diagonal lines** are unbalanced. They are filled with restless and uncontrolled energy. They can appear to be either rising or falling and convey action and motion. Their kinetic energy and apparent movement create tension and excitement. Diagonal lines are more dramatic than either horizontal or vertical lines. (Fig 2)

**Diagonal lines** can also appear solid and unmoving if they are holding something up or at rest against a vertical line or plane. (Fig 2)

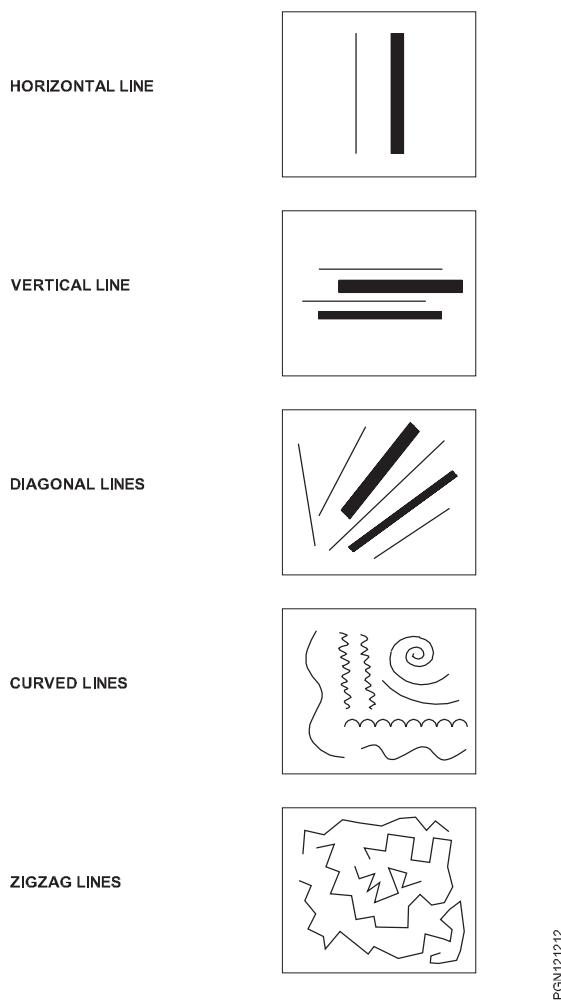
**Curved lines** are softer than straight lines. They sweep and turn gracefully between end points. They are less definite and predictable than straight lines. They bend, they change direction. Curved lines express fluid movement. They can be dynamic depending on how much they curve. The less active the curve the calmer the feeling. (Fig 2)

**Zigzag lines** are a combination of diagonal lines that connect at points. They take on the dynamic and high energy characteristics of diagonal lines. They create excitement and intense movement. They convey confusion and nervousness as they change direction quickly and frequently. They can imply danger and destruction as they break down. (Fig 2)

### Types of line (Fig 3)

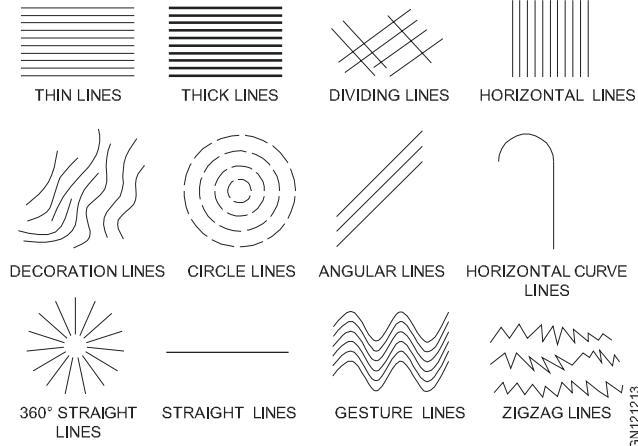
**Line of Art:** Sketching line diagram is drawn by pencil or by different coloured lines. It is normally done by single colour.

Fig 2



PGN121212

Fig 3



PGN121213

**Contours:** Shade and texture are included in it. Apart from lines colouring materials and dots are used in line art realistic.

Before the invention of photography and halftones, line art was the only format available to illustrate in print publications. This type of illustration used black ink on white paper. It also included stippling hatching, and at times shades of gray could be replicated. Even today, a line is one the most funda elements of art.

A line has many functions in art but the most important one is the indication of the edges of 2 -dimensional

shape or 3-dimensional form. A 2-dimensional shape is normally shown by way of an outline while dimensional is shown through contour lines.

But although this type of art is usually monochromatic, nothing stops you from having lines of different colours. Line art focuses on form and drawings of several constant widths (technical illustrations), cartograph, cartoon, and ideograph.

As an artist, it is important to know how to use different lines in your work because everything begins with a dot and then develops into different lines.

**Line variation:** The artist used the free hand and geometrical lines to express different emotions like, sadness, happiness, anger, fierceness, tenderness, nobility, speed, struggle, explode, peace, fear, war, youth, enthusiasm etc.

Each line has got its importance admiration in art developing a visual grammar use of different types of lines in art and when to use them

Length in lines can be long (far) or short (small, cute, close)

Width in lines goes from thin (delicate, slim, lightweight) to thick (strength, weight, power).

Weight in lines means the continuous change of width. By varying the weight one can capture energy, movement and even suggest when one object is in front of the other.

Texture in lines defines how smooth or rough it is varying it can simply mean changing your working medium (for example, going from marker to charcoal or changing your digital brush).

Style of lines refers to continuous, dotted, dashed or implied lines. Continuous or implied lines are great for leading the eye of the viewer in the direction you want them to go. Dashed or dotted lines are great for patterns, energy and calling for attention.

**Painting strokes:** The configuration given to paint by contact with the bristles of brush also the paint left on the surface by a single application of a brush or palette knife often used figuratively to describe the quality especially of a narrative or description a story told in broad brush strokes. There are five strokes in art.

- Gradient blending, wet into wet, optical mixing, stumbling and smudging.

#### **Paint strokes:**

- |                        |                    |
|------------------------|--------------------|
| - Glazing strokes      | - Smooth strokes   |
| - Flowing strokes      | - Parallel strokes |
| - Scumbling strokes    | - Vertical strokes |
| - Semicircular strokes |                    |

**Brush strokes:** The basic brush strokes used by writers.

- 1 The appositive
- 2 The participle,

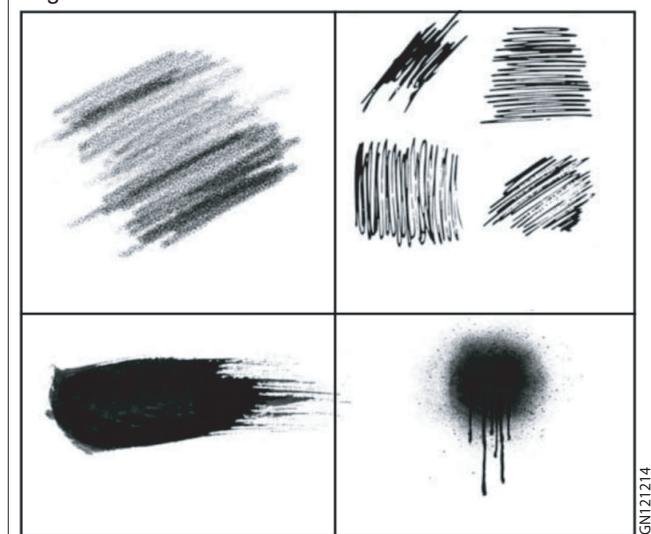
- 3 The absolute
- 4 Adjective shifted out of order
- 5 Action verbs
- 1 Horizontal line - mode, peace, calmness
- 2 Vertical line - steady, piagnity
- 3 Slant line - stir, speed, composition, enthosisim
- 4 Rhythmic line - enthusiasm, lazy
- 5 Rhythemic curved line - happiness, mouth, pentiness
- 6 Intersecting lines- enthusiasm, toxic
- 7 Penetrating line - war, struggle reject
- 8 Thin lines - tenderness, wear
- 9 Thick lines - energy, equilibrium
- 10 Circle lines - improve, enthusiasm
- 11 Emission lines - solidarity, scope
- 12 Anaulem line - learnness, importance, wrong, devout etc.
- 13 Flame type lines - ambition
- 14 Dual type line - grow, impulsiveness, idealists
- 15 Terminal line - ansity
- 16 Dotted lines - incomplete, functions
- 17 Straw lines - cohabitation
- 18 Circular line - Wonderful, beautiful lines and its names

#### **Following are the types of strokes (Fig 4)**

- |                      |                     |
|----------------------|---------------------|
| <b>Pencil stroke</b> | <b>Pen stroke</b>   |
| <b>Brush stroke</b>  | <b>Spary stroke</b> |

**Stroke:** The action of rapidly applying colour on a paper or any surface in painting by using pencil, pen, brush, chalk or brush is known as stroke. A good stroke can be made with practice. There is a sense of movement in the original painting. A pencil stroke brings life to an inanimate picture.

Fig 4



# Pencil & Their types

**Objectives:** At the end of this lesson you shall be able to

- state the history of the pencil
- make a list the types of pencil
- explaining the importance of pencil in the painting field
- state the parts of a pencil
- describe the function of a pencil.

**History of the pencil:** The addition of a woodeen casing surrounding the graphite stick was first developed by an italian couple, lyndiana and simonio bernacotti, as early as the 1560s. Their design featured a hollowed out juniper stick into which the graphite would be placed to produce a flat carpenter's pencil. The oldest example of a carpenter's pencil is dated from the 17th century and was found in the roof of a german house, built during this peroid. (Fig 1)

In time, the manufacturing process evolved to use a wooden casing, sawn into two halves and then carved out for the graphite stick. The two halves would then be glued together. This technique proved so successful that it has changed little in the last four centuries. Each pencil capable of 35 miles of earthing , which equals to approximately 45,000 words. The uniqueness of the pencil as a writing instruments cannot be under estimated.

Fig 1



Pencils are used for writing and draw a drawing, in this narrow pigment is fitted inside a cylndered wooden piece. It is used for writing on a piece of paper and make sketches or drawing. This is a simple device by which you can make sketches drawn quickly and it is also used to drawing and painting and also to make different inventions and textures. For making various types of lines like sharp, thin, thick and other lines, separate pencils are used. By giving lines and more pressures pencils are being used. By giving lines and more pressures on pencils different stroke variations can be given.

**Different types of pencils:** All the drawing and writing mediums, needs different types of pencils for a complete drawing set. (Fig 2)

Initially, graphite sticks were properly wrapped in strings, and later, these graphite sticks were presented in wood-cases, giving birth to the very first wood-cased pencil. Basically, the graphite was inserted in wooden

sticks that were hollowed out. So it looked like sticks of graphite were being enclosed within similar-shaped wood cases or coverings, enough, companies like faber-castell and steadtler came into existence, forming an active global pencil industry that continued to develop century industrial revolution.

The following 14 main categories of pencils that are still being used

## Table of contents

### B Pencils (Bold pencils) H Pencils (Hard pencils)

1 8B	10 2H
2 7B	11 3H
3 6B	12 4H
4 5B	13 5H
5 4B	14 6H
6 3B	
7 2B	
8 HB	
9 F	

## Types of pencils chart

**B Pencils:** May use them for note-taking purpose, they are excellent for doodling and sketching, purpose.

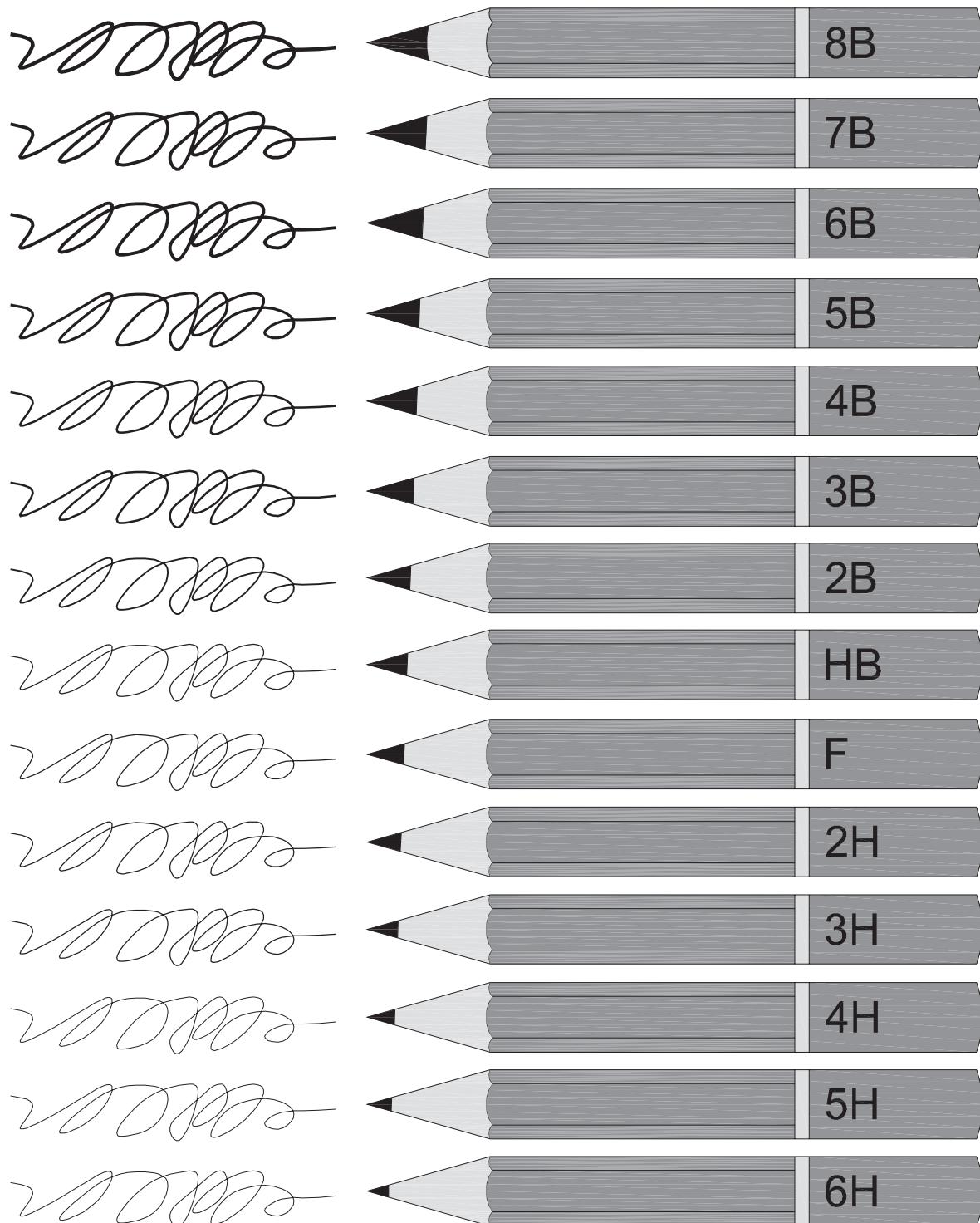
**8B pencil:** This type of pencil is extremely dark and comes out as the darkest of grays on paper. It is best used for drawing and sketching purposes since it takes very dark and prominent marks that end up sticking out on the paper (Fig 3)

**7B pencil:** Almost similar to 8B, this type of pencil is also great for art-related purposes. It gives off a very dark gray shade that sticks to the paper and makes drawings look great on paper. (Fig 4)

**6B Pencils:** This pencil is best for those who like to draw, and it is particularly meant for adding dark values to your drawing pieces. This is also a great option for creating portraits where you would want to achieve realistic textures like skin, fur or fabric. (Fig 5)

**5B Pencils:** This pencil produces a darker mark than the ones after it and is quite softer than a 2B pencil for example. This is because the higher number of B that a pencil is, the softer the pencil will be. (Fig 6)

Fig 2



PGN121223

Fig 3



PGN121223

Fig 5



PGN121223

Fig 4



PGN121224

Fig 6



PGN121226

**4B Pencils:** The 4B pencil is slightly lighter than the ones before it and is also an excellent choice for sketching and drawing purposes. Anyone with an aptitude for art and drawing will definitely enjoy using this pencil. (Fig 7)

Fig 7



ease and convenience so one can easily use these pencils to design products or write things on paper.

This pencil type is great for any technical work that involves making lines that are easily erasable. This is particularly because 2H contains a very light amount of lead. It is also a great option for those who just begun to draw and wish to add very light shades to their drawing. (Fig 12)

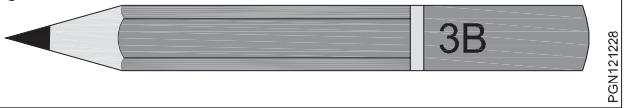
Fig 12



PGN12122C

**3B Pencils:** This pencil is more like a mix of dark and light but is more towards a lighter gray. It is an ideal option for those who like their drawings to contain light values with slight shades of dark gray. (Fig 8)

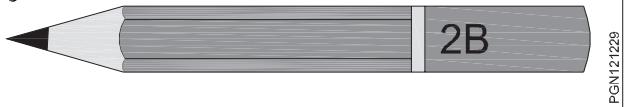
Fig 8



PGN12122B

**2B Pencils:** This 2B pencil is best for medium to dark shading and provides a good range of tone or value from light to a dark shade. It is commonly used shading and sketching. (Fig 9)

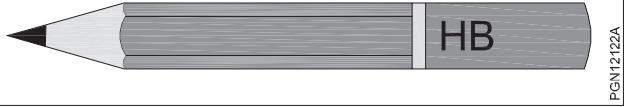
Fig 9



PGN121229

This pencil falls in the exact middle of the pencil lead scale. HB is a significantly hard pencil, making it a reasonably hard pencil even for drawing purposes. (Fig 10)

Fig 10

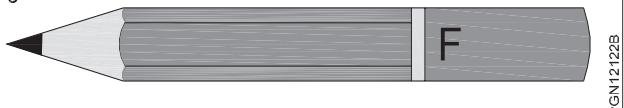


PGN12122A

The ‘H’ refers to the hardness of the pencil, and the letter ‘B’ is used to denote the blackness of the particular pencil’s mark.

**F:** ‘F’ stands for fine point. This pencil, compared to the others is slightly harder. While it is certainly easier than a few to keep sharp, it is way too dark for general and everyday drawing. (Fig 11)

Fig 11



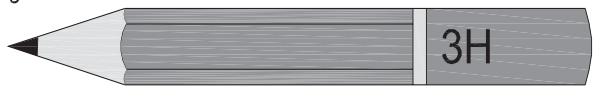
PGN121225

**H Pencils:** In this case, ‘H’ refers to the hardness of the pencil. This is to say that the higher the value of H a pencil has, the harder its lead will be. And the harder the lead is, the lightest the pencil will be.

The ‘H’ pencils are generally very hard, and they are able to hold a tip in place, ensuring extreme precision. They also make light lines that can be erased with great

**3H Pencil:** 3H is an extremely light shade of gray that leaves a very light imprint on paper. It can be a great choice for sketches where you need to add light shades or slightly fill in the empty spaces with a pencil. (Fig 13)

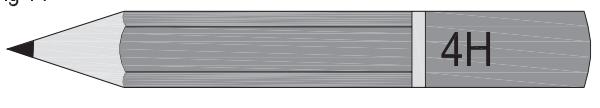
Fig 13



PGN12122D

**4H Pencil:** This is an excellent choice of pencil for light, fine and even shading. It is more towards the gray side and less shiny because of the amount of clay it contains. It is also easier to keep sharp so can be easily used for shading and sketching. (Fig 14)

Fig 14



PGN12122E

**5H Pencil:** This type of pencil helps create the darkest and the thinnest of lines, given its hardness levels. This happens because it falls towards the end of the ‘H’ or hardness scale, hence, giving a hard touch. It is a great option particularly for those who are into drawing and sketching and wish to draw dark and thinnest lines. (Fig 15)

Fig 15



PGN12122F

**6H Pencil:** This is a top-quality graphite pencil that is primarily designed for the purpose of sketching, writing, and drawing. It is an ideal pencil for artistic and technical applications. (Fig 16)

Fig 16



PGN12122G

Keeping in mind the hardness rule, it gives maximum hardness with the darkest and thinnest look on paper.

By pencil shading on the paper surface triangular effect can be given, various textures like stant, straight, crones lines which crones each others at a print can be made by pencil shading. These sketches are permanent erases have to be water erase the lines.

### Parts of a pencil: (Fig 17)

- 1 Hard pigments
- 2 Wooded part
- 3 Coloured part
- 4 Ferrule
- 5 Eraser



**Graphite pencil:** Ordinary pencils are made from graphite powder and clay blinder paste. These are grey and blanch in colour and also called lead pencils. These are ordinary pencils used for art, Engineering and writing and called drawing pencils.

In mark the graphite drawing pencils are available from HB, H to 9H and B to 9B. HB is ordinary pencils. Other H for stands hard, B for Black.

H-2H, 4H, 6H, 9H pencils are there popularity 2H pencils are hard and faded. 9H is more hard and faded in engineering drawing all types of H pencils.

The light lines made from charcoal after shading come out easily and the paper does not get applied. That's why it is a good medium, to practice sketching. That's why after sketching complete, so as to stitch on the paper a fixative spray is sprayed on it. Charcoal is applied light and slowly with the help of brush. For sketching large pictures it is a suitable medium and its success depends on control on our hands while drawing the sketches and lines.

**Colour pencil:** This is the medium of drawing. These are called crayons which are made by a coloured paste on cylindrical wood. This is different from graphite and charcoal pencil. Wax and oil are the basic components of a colour pencil and these are manufactured with the help of the pollution of pigment. Binder and additive and wed for shading paper. These colour are available in various shades, bonds and sizes by which many types for pencil shading paper. These colour are available in various shades, bonds and sizes by which many types of pencil shading can be do.

**Glass marking pencil:** Wax based coloured pigment is used in this pencil you can write on smooth glass like surface with this pencil and can also be written not only on glass and pipe, but also on metal plastic, pottery, china clay vessel, leather stove, painted articles, bright and smooth surface. It can be engraved on paper by also which is written on the smooth surface can be removed by wiping. These surfaces cannot be marked by ordinary pencils, but only by this pencil for cutting. Because of its oily character the with this it can be used for marking on glass. It is more useful for industrialist, cooker carpenter and also available in scattered colours.

**Water colour pencil:** Water colour pencil is a beautiful medium art count creation cannot be done through any other medium, because its base is pencil. After sketching with water colour on paper, then with the help of water brush painting is done. The sketch done by pencil lines with the water and appears as water colour on the paper.

## Types of colour

**Objectives:** At the end of this lesson you shall be able to

- state the names of different colours
- describe the methods of painting
- state the importance of colour.

**Types of colours:** There are many types of colors are used in art and painting work. Colour types are as follows.

- Water Colour
- Poster Colour
- Acrylic Colour
- Oil Colour

**Water Colour:** Water colours are recognized for their transparency, gentle wash and ability to develop complete colours by creating varying levels of colour. To make a plain wash, small particles of colours spread evenly on the paper, which the colour of the lower surface is visible in every particle. Its medium is water and these colours are transparent and bright. Its medium is water.

In India this colour is being used to make picture in landscape in handmade paper for brightness the top of the white paper portion is left and light transparent colour of bright to deep textures is applied and white and colour is not being used by the transparency of the water colour, beautiful art work is done, to use this you should have enough knowledge about water colour applications. The painter should have in depth knowledge of shadow, light colour dyes.

Where this water colour is applied it becomes permanent, that's why, while applying it should be applied confidently and thoughtfully because there is no scope for improvement the picture should be complete in a small time that's why there should be control on the paint brush and water colour while painting.

The characteristics of this method are brightness, freshness, flow and encouragement and the strokes allied by brush with self confidence, density brings the picture becomes attractive and alive.

In market we can get water colors in tube and cake form use a short brush to apply water colour brush is made of sable hair on soft round synthetic bristles with this style and daily practice you can master over it.

In central asia this painting is known as brush painting or stroke painting.

**Poster colour:** Poster paint is a distemper paint that usually uses starch, cornstarch, cellulose, gum water, or another glue size as its binder. It either comes in large bottles or jars or in powdered form. It is normally a cheap paint used in for practice in art classes.

Poster colour is a water soluble paint, this paint consisting of a colour mixed with a binder such as glue or gum to

give it a dull finish. Many poster colours are available, it is one of the most eye catching media. This poster colour is used to create colour signs and banner. It is perfect for lettering and creates much thicker lines than a typical marker.

For advertisement, poster 2D design, resolution picture, nature picture, portrait painting, greetings, design etc. Poster colour is being used. There colour oscillate, but when some of them are mixed up it becomes clay coloured or cloudy. This colour is used on drawing paper, mount board, paper and on walls surface. This colour is temporary gets dissolved in water. It is available in various shading in tubes and bottles and are ablated by brushed and spray method.

**Acrylic colour:** Quick drying paint made from suspended dyes in acrylic polymer emulsion is called acrylic colour. These are soluble in water.

By using water you can make this acrylic colour paint into a liquid form. but when it gets dried up it becomes water resistant. After painting with acrylic colour it looks like water colour, poster colour and oil painting. It doesn't depend on any harmful solvent and it can be applied on a large surface and with the help of a brush, roller, and corner box brush it can be painted on canvas, paper, plywood, wall etc. After drying it becomes permanent and the surface becomes strong.

**Working with acrylics:** Most paints are made by mixing dry paint pigment together with a wet binder. The difference between the type of paints you see in the art store, for example, oil paint, acrylic paint or watercolour, is simply due to the different type of binder used.

Acrylic paints use an acrylic polymer emulsion binder, which means they are water-soluble when wet but become water-resistant when dry.

This allows you to build a painting in layers, without disturbing the layer underneath (also perfect for hiding any mistakes)

Acrylics dry by evaporation and tend to dry quite quickly.

Artists refer to this as having a short 'working time', however, this can vary depending on several different factors, the main ones are:

How thick or thin you apply or layout the paint (on the palette and canvas)

Absorbency of the surface your working on

What you dilute the paint with, either water or a specialist medium

The heat and humidity of the environment you are painting in evaporation can be controlled by

Using a stay-wet palette that has been designed specifically to keep acrylic paints wet and workable for longer. It will stop the air getting to your paints, the longer they are out in the atmosphere the quicker they dry off. The staywet palette will keep the paints wet for a good few days, in comparison to if they were just left out in the open air where small mixes can dry off in a few minutes

There are specialist acrylic polymer mediums you can add into your paint mixes to dilute and keep them wetter for longer or extend their 'working time'. They can change the consistency of acrylic paint and allow you more flexibility and creative freedom than any other type of paint. The trick is to use the right ones for the right situation

Using OPEN or Interactive Acrylics specially designed to stay wet or open for longer (Fig 1)

Fig 1



Misting the paints with water.

Opaque colours cover other paints easily and are great for making solid, flat areas of colour and covering up any mistakes you've made.

Transparent colours are used for luminous glazing and subtle tinting usually at the later stages of a painting.

They are often labelled on a paint tube to guide you, for example, Winsor & Newton use the following abbreviations: (Fig 2)

Fig 2



- T for transparent colours
- ST for semi-transparent colours
- SO semi-opaque colours
- O opaque colours

**Oil colours:** It is most durable colour and preferred in canvas paints landscape, skill picture, abstract image and portrait are portrait are beautifully painted with oil paint. It is applied with hog hair and shaper hair brush and in painting field oil paint is considered as the long last paint.

Oil painting, painting in oil colours, a medium consisting of pigments suspended in drying oils. The outstanding facility with which fusion of tones or colour is achieved makes it unique among fluid painting mediums; at the same time, satisfactory linear treatment and crisp effects are easily obtained. Opaque, transparent, and translucent, and translucent painting all lie within its range, and it is unsurpassed for textural variation.

Artists' oil colours are made by mixing dry powder pigments with selected refined linseed oil to a stiff paste consistency and grinding it by strong friction in steel roller mills. The consistency of the colour is important. The standard is a smooth, buttery paste, not stringy or long or tracky. When a more flowing or mobile quality is required by the artist, a liquid painting medium such as pure gum turpentine must be mixed with it. In order to accelerate drying, a siccative, or liquid drier, is sometimes used.

A coat of picture varnish is usually given to a finished oil painting to protect it from atmospheric attacks minor abrasions, and an injurious accumulation of dirt. This varnish film can be removed safely by experts using isopropyl alcohol and other common solvents. Varnishing also brings the surface to a uniform lustre and brings the tonal depth and colour intensity virtually to the levels originally created by the artist in wet paint. Some contemporary painters, especially those who do not favour deep, intense colouring, prefer a matte, or lustreless, finish in oil paintings.

**Water proof ink: (Fig 3)**

Fig 3



This is a special black and colourful ink. Which is used in a large extent in the printing and writing field. Now a days it is prudently used in painting and outline. Since it is a water proof ink it dries up quickly and water has no effect on it. In an art and lettering black ink is used and for comics book, printing, glass painting coloured ink is used. Water proof drawing ink black is suitable for all papers, cards and drawing papers, free flowing, safe for use in bow pens and croquills.

**Printing Ink:** In the liquid and paste form ink is called pigment. It is being used for drawing images, writing and marking design on the painting surface. This ink is used for paint with the help of pen, brush to write or draw sketch. In letter press, screen printing and lithograph printing. this dark ink is widely used in paste form.

Printing ink used turpentine or kerosene is used for liquid form.

It is a complete medium consisting of solvents, pigments, dyes, resins, greases, non-dissolving, particulate matter, fluorescent and other material.

**Fluorescent colour:** Fluorescent colour emit more light than the traditional ones and reflective. These colours are bright and attractive. These colours are in the form of paste and powder.

With the help of brush and spray medium is used for applied on the surface. It is widely used in designing and lettering purposes. These colours are prepared by mixing fevicol water and fluorescent powder.

Lettering on the wall is drawing in old days while painting the cinema posters, bright allows were made by mixing oil paint with in acid oil and fluorescent powder with the help of this cinema posters printed in a large scale, fluorescent colour ink was used for screen and off set printing. In various styles of painting and particulaary in thermocol design fluorescent colour was applied with the help of them.

**Reducer medium:** A reducer is a pure function that takes an action and the previous state of the application and returns the new state the action describes what happened and it is the reducer's job to return the new state based on that action it may seem simple but it does have to be a pure function with no side effects.

A reducer is a function that determines changes to an application's state it uses the action it receives to determine this change. Use tools like reduce, that help manage an applications state changes in a single store so that they behave consistently.

**Charcoal:** Artists charcoal is a form of a dry art medium made of finely ground organic materials that are held together by a gum or wax binders by eliminating the oxygen inside the material during the production process.

**Purpose:** Suitable for drawing sketching or smudging a charcoal pencil offers a familiar feel and provides you with a lot of control over your marks. Even in this more structured form it can be manipulated to create an array of rich and dark tones as well as thin lines and bold ones.

Charcoal is traditionally made from thin peeled willow twigs which are heated without the presence of oxygen. This produces black crumbly sticks which leave microscopic particles in the paper or textile fibres producing a luster that is dense at the pressure point, but more diffuse or powdery at the edges.

Charcoal pencils are much more difficult to erase than a stick or bottom. When too much pressure is applied the charcoal pencil can create an indentation may completely ruin a drawing.

**Dry pastel:** Pastel dry drawing medium executed with fragile, finger-size sticks. These drawing crayons called pastels are made of powdered pigments combined with a minimum of non greasy binder usually gum tragacanth or from the mid 20th century, methyl cellulose.

**Oil pastels:** Oil pastels are similar to oil paints dry out or harden completely.

## Sketching

---

**Objectives:** At the end of this lesson you shall be able to

- state the importance of sketching
- make a list of sketching medium
- state the benefits and importance of sketching.

**Sketching:** A sketch is rapidly free hand drawing, that is not usually intended as a finished work. A sketch may serve a number of purpose of painting. It might record something that the artist might record or develop an idea for later use on any surface or media.

In painting through any medium sketching can be done. The term is most often applied to graphic work educated in a dry manner such as pencil, charcoal or pastel is used to a long extent and apart from that good sketches drawn or drawing executed by ink pen, ball pen, nasher pen, water colour oil paint. Sketching usually refers to students of painting. Many things are studied clearly for a

large design. Sketching is also a type of doodling in which ambition is taken into account. If there is any problem regarding design then the ideas related to its solution is well clarified through sketching. Also to draw complex design in tree style is difficult then sketching plays an important role in the development of design process.

Sketching is also a form of sketching and in the beginning of design house this was used to represent it. Due to these sketches intelligence, concentration and ability to concentrate develops. It has life and career this skill may from alliterate. While drawing no artist can draw in minute detail, but he concentrates only on its important part and points.

Bonds, babies and animals are not at one place, so these subjects are good for sketching. The sketch concept is very unique and personal. The artist is familiar with inner identity.

Mainly there are three types of sketches

- 1 Simple sketch (Fig 1)
- 2 Rough/Rapid sketch (Fig 2)
- 3 Finish sketch (Fig 3)

Fig 1



PGN121821

Fig 2



PGN121822

Pencil is used to show the detail or fineness of the picture. 2A-4A pencil is used to show the texture and shading. The lead of the black pencil soft white 9A lead is very dash and used for dark shading. For sketching 2A pencil and for shading 4A pencil is being used widely.

#### A guide to pencil sketching techniques

Pencil sketching has long been a popular art form and its no wonder why sketching with a pencil is versatile, portable and requires only a few basic supplies with just few tools can create an incredibly detailed and beautiful work of art. Sketching techniques can take pencil drawing to a whole new level, bringing greater depth and refinement to the artwork you create. There are different types of sketching techniques.

Fig 3



PGN121823

- 1 Hatching or cross hatching
- 2 Stippling
- 3 Scribing
- 4 Circling
- 5 Smooth shading or blending
- 6 Creating highlights
- 7 Rendering

#### Benefits of sketching

- 1 Sketching and drawing is a great way to improve your creative skills and start thinking in a different way. Art shows you that there is normally more than one way to solve a problem. Art encourages open minded thinking and creativity. These can be really helpful for personal development and solving problems. Skills you learn through sketching can be applied in a number of different areas.
- 2 Sketching help develop a number of different areas of human brain. Develop the ability to focus and pay attention, a skill that can be very useful throughout life and career. It also develops hand-eye coordination so that everyday tasks can become easier. But it also develops strategic thinking, a concept that can be useful to everyone.
- 3 Sketching can even improve holistic health. Build self esteem and confidence through art and sketches as become better. To get a sense of achievement and start feeling proud of your art which you will carry that confidence. Having confidence in work.
- 4 Sketching can also help to improve communication skills. Because there are no words in a drawing, well most of the time, the artist finds other ways to communicate with the practice. This can help to improve other communication skills by better understand of feelings and emotions and without the need for words to be spoken.

Sketching is great for a number of different reasons and they don't just apply to pencil and paper sketching. All of these advantages simply come from the act of drawing and taking time to sketch. The lifestyle benefits of this hobby are incredible and can really help improve the skills in a number of different areas of life, not just sketching.

## **Importance of sketching**

There are six reasons for

- Sketching is fun
- Sketching brings out the best idea
- Clients love sketches
- Sketching in your inspiration
- Sketching is a time saver
- Sketching is for everyone

## **10 Great Health Benefits Of Painting And Drawing**

**1 Improved creativity:** Painting and drawing would obviously make use of one's imagination. They would create vivid images of houses, people, and places. People can even choose to portray their emotions and produce abstract art. As these would entail the creation of personal works, one would have to use his artistic skills. These activities would then play a beneficial role in the development of one's brain.

For right-brained or artistic people, painting and drawing would be healthy ways of enhancing the creative skills that they already manifest. On the other hand, left-brained or analytical people can also stimulate their creativity and improve it.

Knowing these factors, drawing and painting is highly recommended for children. In fact, many children who are at the developing ages are encouraged to engage in painting and drawing. By promoting the development of their brains, they would be more prepared for academic work. Furthermore, they would have an easier time conveying their ideas to their peers.

**2 Improved memory:** On the other hand, the health benefits of painting and drawing are also enjoyed by those who experience illnesses such as Alzheimer's disease. Although they may have problems with their memory, enabling them to engage in painting and drawing can help boost their recalling skills. As they sharpen their minds through imagination and thinking, they may experience less complicated conditions of their illnesses. Thus, they may still enjoy a lot of activities in their lives in spite of their condition.

**3 Improved communication skills:** Another point in the long list of health benefits of painting and drawing would involve the opportunity to improve one's communication with other people.

As art involves expressing one's inner thoughts and feelings, he may project all these indescribable emotions through paintings and drawings. In using art to break free from personal limitations, individuals can surpass their weaknesses. These can include shyness, autism, and other disabilities.

Furthermore, as painting and drawing are continuous processes, these individuals would improve their flow of thought as they create such artworks. These can be very useful for their future endeavors.

**4 Improved problem solving skills:** Aside from these benefits, people may actually be surprised that painting and drawing can also instigate the development of critical thinking and problem solving. In fact, painting and drawing enables an individual to realize that there can be more than one solution to a single problem. As they discover the artworks they can produce from a blank sketch pad, they develop the technique of thinking outside the box.

Painting and drawing would widen their perspectives on various situations. In effect, they would be able to address various tasks in a creative and very effective way.

## **Emotional Restoration**

**5 Stress relief:** Perhaps the major health benefits of painting and drawing involve the emotional aspects of individuals. For one, many people use art to release stress.

As the pressures of life can be very tiring, individuals have tried painting and drawing to relax from the demanding requirements of life. They are able to free themselves from the stress that has accumulated by releasing these in the form of color and drawing. As they temporarily exit the world of fears and worries, they enter the world of fun and excitement.

Releasing one's stress can be very beneficial to reduce their risk of other physiological illnesses.

**6 More positive emotions:** Additionally, creating these paintings and drawings would obviously lessen the negative emotions within an individual. This would be replaced by the positive thoughts and feelings as color and drawings would be exemplified. Of course, as one develops his skills in painting and drawing, these would produce very good results. Hence, this may make an individual feel good about his capabilities. These activities would boost his self-esteem and would inspire him to believe in what he can do.

Through these health benefits of painting and drawing, an individual may also develop optimism and feel happier through painting and drawing. With the body and mind becoming more relaxed, one can function better.

**7 Release of hidden emotions:** Furthermore, as one pours out his emotions through art, he concentrates on releasing all these hidden emotions. In fact, physical pain may even disappear as one is deeply involved in his paintings and drawings. Research has called this state the "Alpha"; this signifies that part of one's brain is consciously performing activities while the unconscious part is also expressed. Such a state can also be obtained from other activities such as prayer, music, and meditation. This state would release energy and would revitalize an individual. He would gain strength in this special form of recovery. In effect, the healing process can be faster and more effective.

Knowing these benefits, it isn't surprising to know that painting and drawing are highly recommended for an individual's recuperation from painful events such as war and abuse (e.g. rape). In fact, many therapists

include these activities in the schedules of their patients. They would encourage their patients to release their feelings.

As an individual is able to find a safe environment to convey his emotions, the health benefits of painting and drawing can be maximized to aid the recovery of this said individual. He would be immersed in a world of cleansing from all the bitter events that may have happened to him. His stress level and emotional anxiety would be soothed, thus enabling him to function better and return back to his regular work.

Through painting and drawing, many therapies have become successful. With the added support of family and loved ones, patients are able to achieve inner peace and find closure from their previous experiences.

**8 Increase of emotional intelligence:** Given these various health benefits of painting and drawing, it is clear that these activities can cause an increase in an individual's emotional intelligence. In enabling one's emotions to flow through art, one can create a better grasp of his varying feelings. One can experiment on feelings of joy, peace, love, and happiness while performing these tasks.

Through the improvements in one's personality and emotional stability, painting and drawing do not benefit a single individual but even the people around him. As the individual would be able to respond to the emotions felt by others, these people would also share the positive effects of art.

The individual who engages in doing such art can brighten other people's days and help them cope with whatever difficulties they may experience. As he has more control of his emotions, he would be an excellent companion for the people with whom he interacts.

**Improving the Senses:** As the health benefits of painting and drawing are evident in one's mental activities, these activities can also promote the improvement of the senses. Knowing the role of the brain in delivering messages to instruct the actions to be performed by one's body, stimulating this integral organ is vital to improve the organs it controls. Thus, an individual who has engaged in painting and drawing would experience many positive changes in how he would respond to and perceive the world.

**9 Better mobility:** Art can enable a person to have better mobility. As the individual would need to use a brush or pencil to create artworks, develop more efficient hand movements. Through the improvement of one's brain activities, signals can be effectively sent from the brain to the motor neurons that would deliver the specific action that must be performed. As a result, fine motor skills would arise.

**10 Observant of the details:** To add to the list of health benefits of painting and drawing, these activities would enable one to become more observant of the details of his surroundings. As one is more exposed to light, darkness, color, shading, and many other properties of painting and drawing, he would be able to pay closer attention to finer details. Human eyes would be trained to look for intricate designs and forms that may have been ignored in the past. Thus, as the brain would let one's concentration improve, an individual may see and appreciate even the most minuscule details that can be viewed.

Given the various health benefits of painting and drawing, it is clear these activities can be very useful in promoting the welfare of an individual. Aside from improving mental and emotional capabilities, an individual may enjoy improved sensory and motor skills through constant painting and drawing.

Knowing the difficulties that are offered by life, it would be nice to occasionally take some time off, lift a paintbrush or pencil, and start painting or drawing.

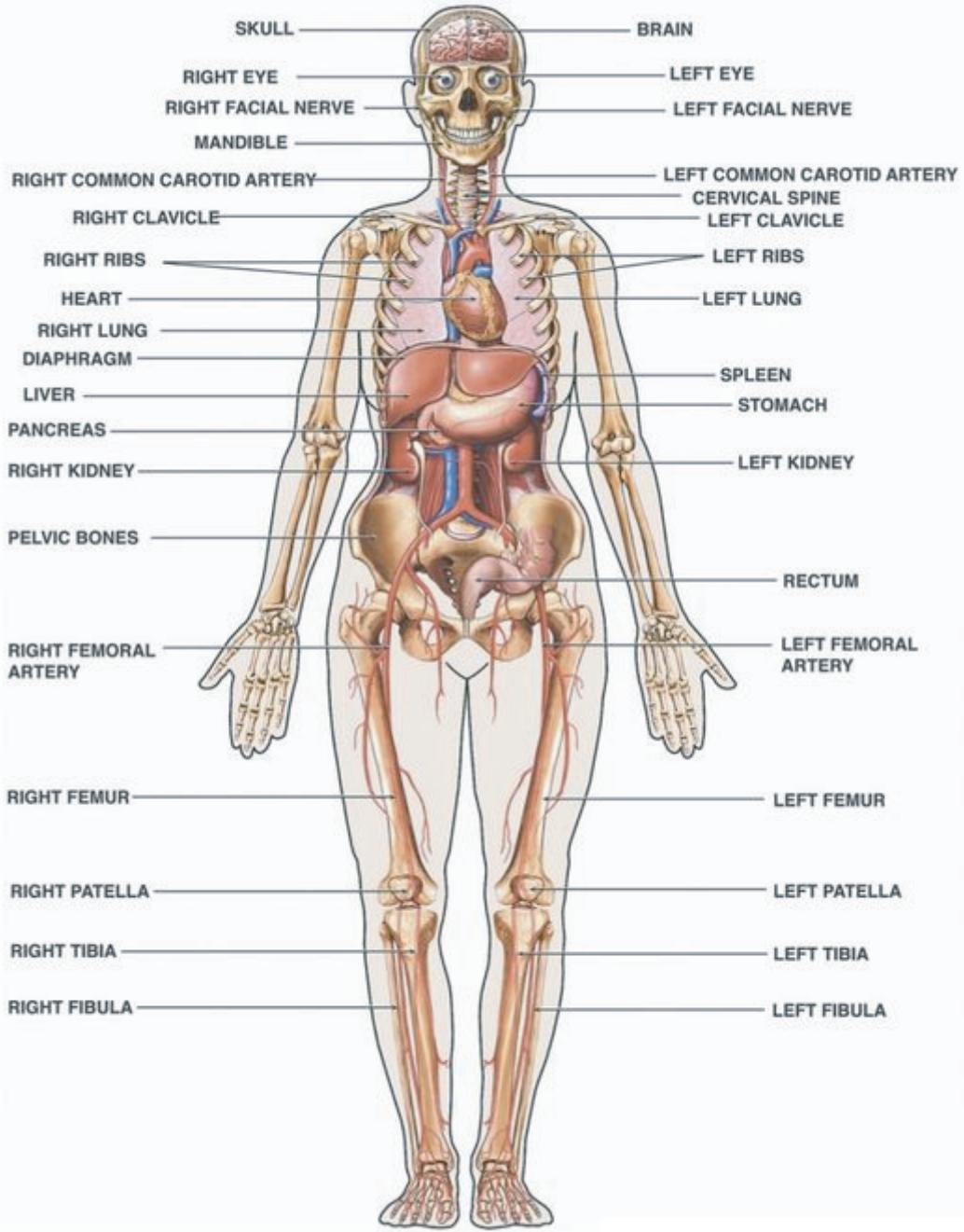
## Human anatomy

**Objective:** At the end of this lesson you shall be able to

- describe the size of the human anatomy.

### Human organs and their places (Fig 1)

Fig 1



PGN122111

### Anatomy:

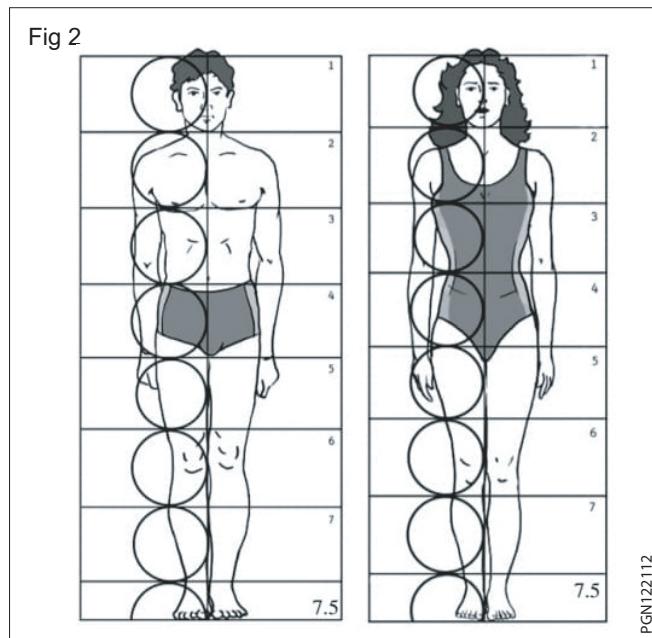
Study of anatomy is very important for painting art work. It is necessary to study the skeleton, muscles, skin symmetry and composition of the human body.

Despite having more than one standard and its measurements the layout of the functions of the parameters remains troubled. In the anatomy of the human body this height is drivelines of his face. There will be a change in the height because in human beings it will for a very tall

person it will be eight times of his face, for a short person it will be six and a half or seven times.

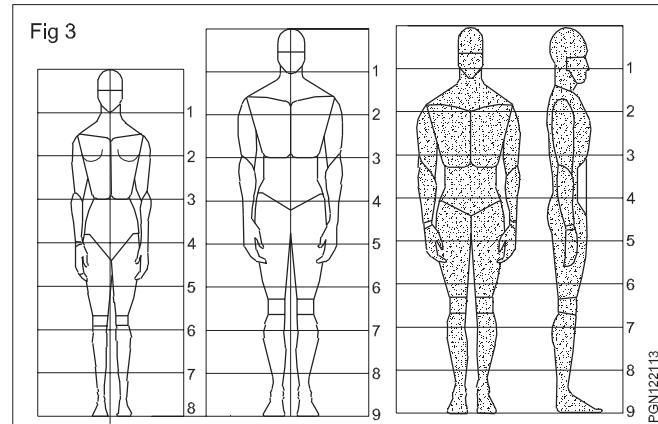
For normal man or woman the shoulder width is 2 times of his height of the head while for children the length of the body will be 5 to 6 times of its face. Their will be suitable changes according to the age. His palm measurement will be his face's measurement. The basic results of the human body, the composition of the bones and the muscles of the body must be consistent and realistic. Also it is necessary for the painter to be able to draw the figure. (Fig 1)

### Body structures of male and female (Fig 2)



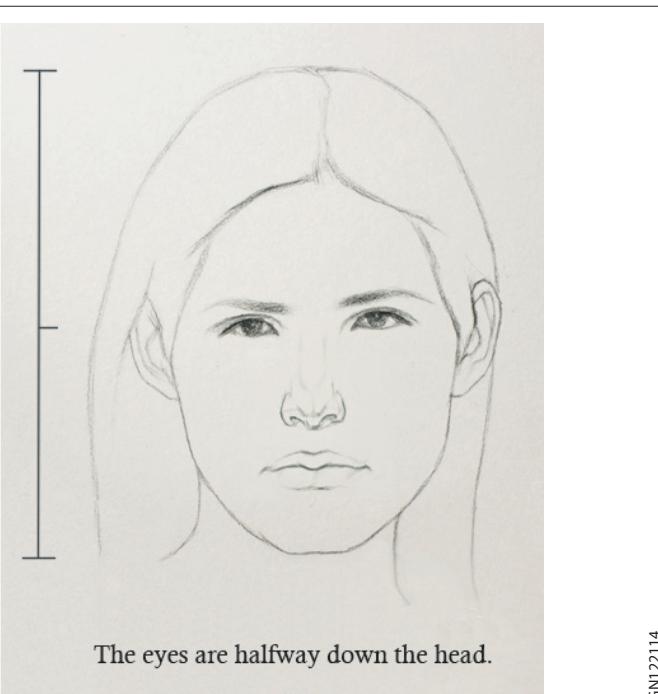
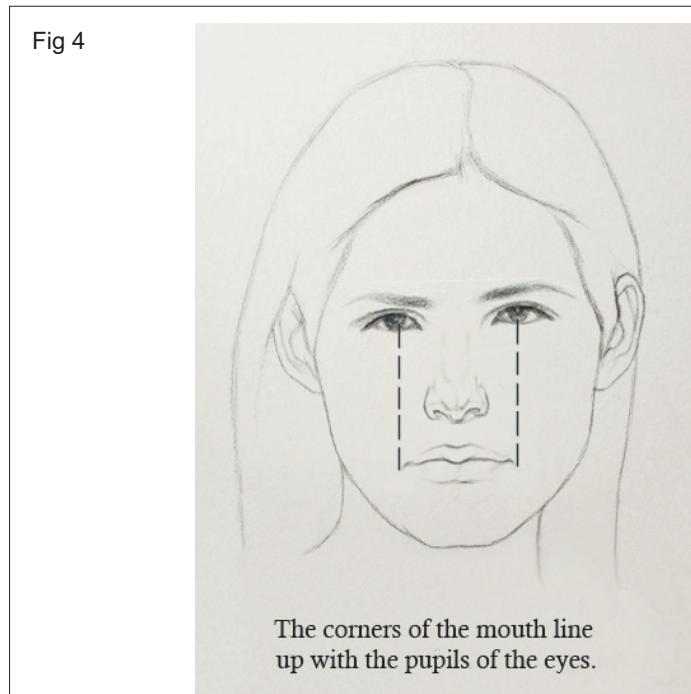
Measurement of seven and a half to head is a method by which heads form and length is used to measure the figures height and width. It is decided in this method of measuring head of a person usually for height it is seven and half and width to heads. This method is beneficial for the youth and those who have problems with shaping the phase in the proper result, human shape results must be graphically consistent realistic, artistic is why to know the basic moulds and is necessary to know about the confection of the bones, when we want to measure the human anatomy, it is dependent on basic human consequences and this is taken for training needs.

Ladies and mens outcomes differs in new born, young child outcomes. (Fig 3)



Different ages person heights will be vary and measuring the height based on head will be vary.

Men/women – from head seven and half to eight times (Fig 4)

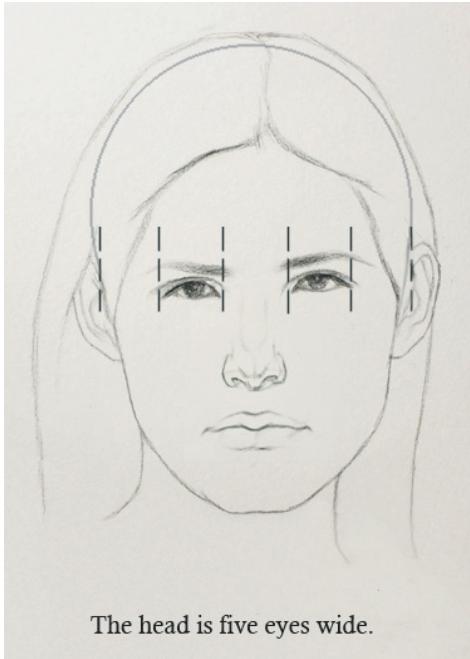


PGN122114

Teen – from head six to seven times

Boy – from head five and half to six times (Fig 5)

Fig 5



The head is five eyes wide.



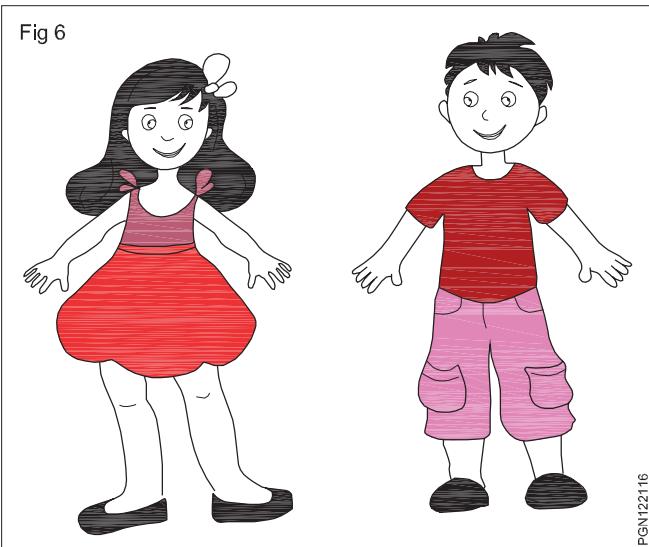
The space between the eyes is about the same width as an eye.

PGN122115

Child – from head to nose to five and a half times

Head is always measured from top to bottom. (Fig 6)

Fig 6



## Graphic & Its perspective

**Objectives:** At the end of this lesson you shall be able to

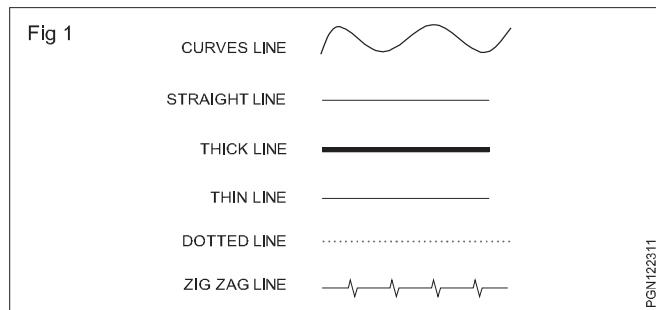
- state the importance of graphic design
- state the uses of LOGO Design
- state the perspective in painting
- describe the types of perspective.

### Graphic design

Visual communication and problem solving is achieved through the use of topography, photography and illustration through graphic design. Graphic designer assembles ions, images and material to bring the ideas and images into visual representation. To create visual designs they employ to topography. Visual art, page layout technique. Graphic design consists of corporate design (LOGO and branding), editorial design (Monthly, paper & Books), environmental design, advertisement, web design, communication design, product – packaging, singing board.

Visual design is the basic units in parts of arts. One who create the design and concepts the visual message. Line graphic design is the most basic part.

Curved line, straight line, thick line, thin line etc are two and three dimensional are used in graphic. (Fig 1)



### 2 LOGO Designer (LOGO – Language of Graphics Orientation)

Logo of any company, trademark. Appreciation is representing is the graphic form. LOGO is made a visual sign to give the information about company product and services.

Before designing a company letter head, business card and choosing its colours, first they should have their LOGO. (Fig 2)



**Perspective:** Linear or part projection approach is two types one of graphical projection approach to the graphic arts second one is equal projection to the graphic arts.

Graphical approach means approximate representation of an idea.

Usually the plain surface line being with (line parts) Linear approach characteristic is that when the viewer view the object from distance increases it appears smaller.

That is the result of the visible line in a line are less visible by crossing the visible lines. All objects move from the side of the horizontal line, but above and below the horizontal line depending on the point of view used. Perspective is a technique of describing three dimensional sections spatial relationships in three dimension, in two dimensions from the point of view of the holder.

### Human faces result from the front

**Result 1:** The eyes will be at a half way a of below the head. Fig 3A

**Result 2:** In the vertical line of the tear duct on the side of the nose. Fig 3C

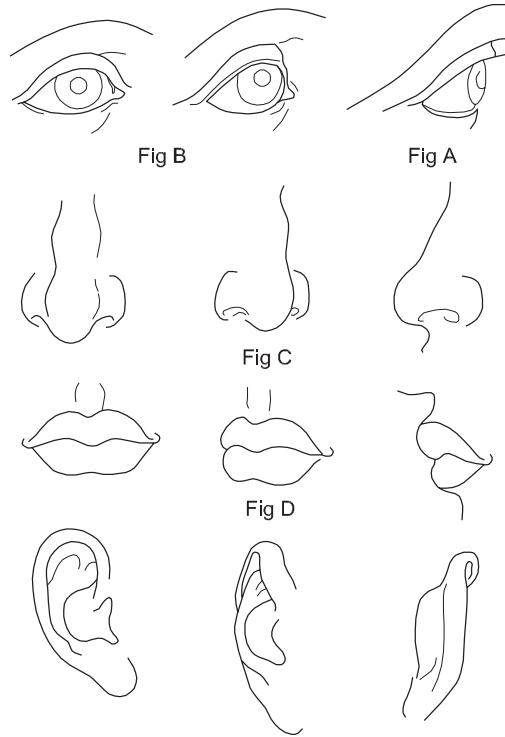
**Result 3:** The distance between the two eyes is width of one eye. Fig 3B

**Result 4:** The head is about the width of five eye width Fig 3b

**Result 5:** The corners of the mouth are in the perpendicular lines of the pupils of the eyes. Fig 3D

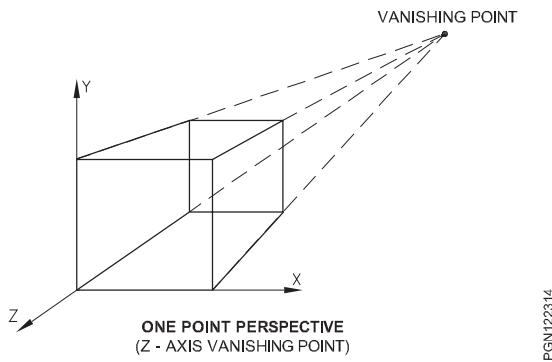
To make a portrait out of memory and thoughts a lines knowledge is necessary.

Fig 3



**One point perspective:** Sketch means there is only one invisible point in the line. Even if there is no requirement, then also when the viewer is seeing the object in straight line, even though it is in reverse direction, it is on horizontal line. In the writers method, a point approach is that whenever any visual object moves away it looks smaller and when it is situated in the horizontal line it moves towards the invisible line on the plain surface of a paper this is the only way to show an objection three dimensional and real. (Fig 4)

Fig 4



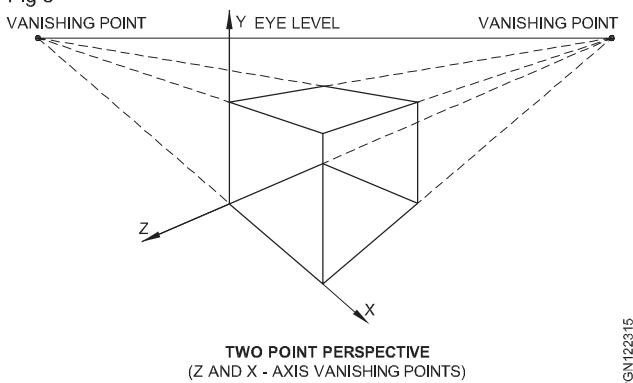
**Two – point perspective:** Line approach is that in which the parallel line passes through the breadth and depth of the object which is shown as a back at two different points measured up to 90° difference of the horizontal by measure at the common mid-point of the projection.

When we are from our view point two invisible points are called two point perspective. This perspective is used in architecture drawing and also it is used for both exterior and interior objects.

Approach on a flat surface creates an implosion of depth and difference. In approach there are three basic types. Single point, two points and three points. When the impression of depth and place is created, the invisible points numbers are one, two, three,

When we are drawing a 2 dimensional plane is being used and when we try to bring reality into our drawings and to achieve, in this place feel of three dimensional is created. (Fig 5)

Fig 5



Ex: Men's sketching start 5 from top to 7.5 to 8 heads but when sketching about children it starts from top by 5 to 6 heads.

Men's results (Basic results) (Fig 6)

The male result is primarily used on the basis of many human forms.

Fig 6



PGN122316

Women's result: (Fig 7)

The result of a women and the result of a man are the same. But for the womans there was a separate characteristic. While creating woman certain factors were to be includes. Her neck should be narrow and long, shoulders wide, hands should be narrow and legs should be more ringe.

Fig 7



PGN122317

## Pencil shading

**Objectives:** At the end of this lesson you shall be able to

- state the importance of pencil shading in painting
- describe about the various types of pencil shading
- state the characteristics of pencil shading
- describe the tools of shading
- state the shading techniques.

**Pencil shading:** Pencil shading is real art flags an important role. It is known as the art suitable for making a object drawing appear darker lines or lighter. Pencil shading is an art by which an object which in darker region to appear more darker, lines dense for light parts light shade.

It is used to bring on the paper the impression of the depth of the light and shadow areas.

Shading means form, space and in the most important sketching it will bring the impression. It will increase the picture's value and is a very important powers. When shading is employed it makes a realistic picture and it is look like a three dimensional picture.

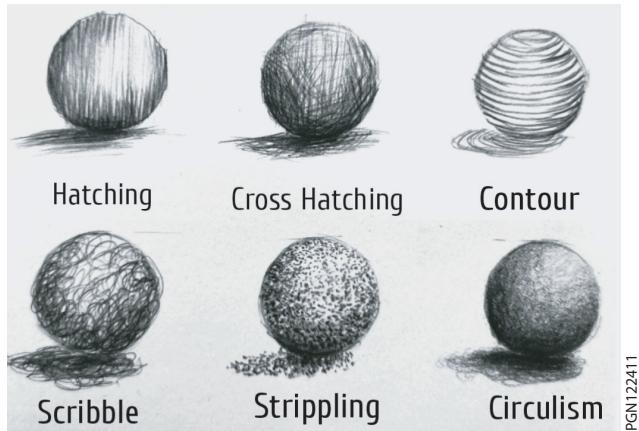
Shading in painting has a very important place and bring reality in it. It also creates the impression of the intensity of shading and also 3D.

To inhibit art it is a suitable medium and it is a technique for lines and sketching

Different types of pencil shading techniques (Fig 1)

- 1 Hatching
- 2 Cross hatching
- 3 Contour scrabble hatching
- 4 Sleeping
- 5 Circulism / Blending

Fig 1



The creative shading will take your art to a higher level. Shading art makes all the difference between an amateur drawing and a piece of art, simply because shadows add depth to your subject. Shading is the part that makes a

drawing go from a flat contour drawing to a 3 dimensional illusion.

**There are many types for shading and each type will change the style of your drawing.**

**Cross hatching (Fig 2):** Cross hatching is where you overlap lines at various angles. It's great for drawing fabrics like burlap, textured (wrinkly) skin and whatever else you can think of that displays such a pattern. To shade light areas, lighten you lines and space them further apart. In shadowed areas, darken them and bring them.

Fig 2



PGN122412

If you like to start by the lightest area and then add layers of cross hatching until reach the darkest area of the drawing.

**Hatching (with parallel lines) (Figs 3a & 3b):** Hatching with parallel lines is the same as cross hatching, except you are making all the lines go in the same direction. It is a bit more time consuming than cross hatching but can lead to interesting results.

**Contour shading (Fig 4):** Contour shading is similar to hatching and cross hatching. The difference is that the lines are curved to follow the contours of the subject. So these lines can be drawn horizontally, vertically and even diagonally. (Fig 4)

**Scribbles:** A doodle is a drawing made while a person's attention is otherwise occupied. Doodles are simple drawings that can have concrete representational meaning or may just be composed of randomm and abstract lines, generally without ever lifting the drawing device from the paper, in which case it is usually called a "scribble".

Scribbling or scumbling is a fun way to shade a drawing and it goes fast. Scumbling or scribble drawing shading works particularly well for portraits and still life.

Fig 3

Fig a

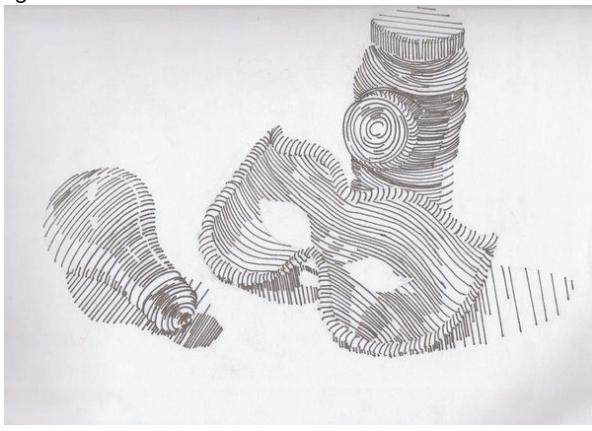


Fig b



PGN122413

Fig 4



PGN122414

**Powder shading (Fig 5):** This is the modern form of pencil shading. In this style, stumping powder and paper stumps are used to draw pictures. The stumping powder is smooth and does not have any shiny particle. The paper is to be used should have small grains so that the powder remains on the paper.

After finishing the drawing a fixative spray is applied so that the powder stick on too the paper. Powder shading

on pictures or painting should be covered with a butter trace paper or should be photo framed.

Fig 5



PGN122415

In the shading shadow light plays an important role. Due to this type of effect only in this type fast or drawing reality, dimension and 3D effect can be shown and the shadow light to be used at different levels and varying shades have to be shown. The interrelationship of shadow light is called shadow discrimination.

Charcoal powder and graphite powders are used for drawing shading purpose.

**Blending stump:** A blending stump is a cylindrical drawing tool, tapered at the end and usually made of rolled paper, used by artists to smudge or blend marks made with charcoal, connate crayon, pencil on other drawing stencils. Painter makes use these for charcoal or powder shading.

With the help of this paper stumps to remove colour strokes from graphite and coloured powder shading on picture. With the use of cotton duds, cotton cloth and fingers you can do powder shading on paper. When the blending tip stump gets spoiled it is sharpened by sand paper or sharpener. To make dark, medium and light shade in portrait different stumps are used.

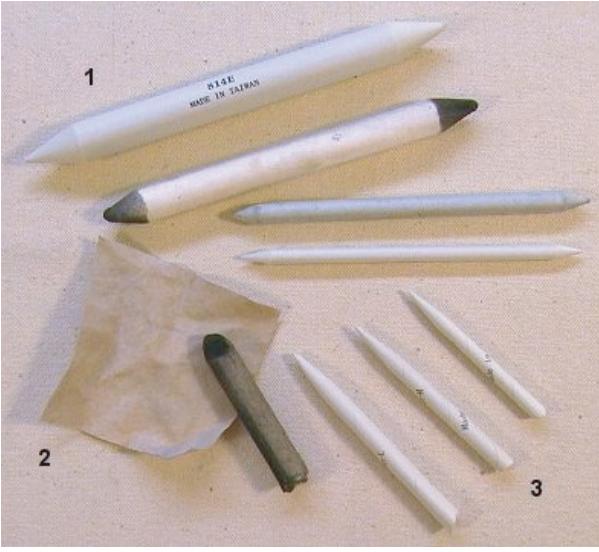
**Croonwell/Dippen:** Adippen usually consist of a metal nib with capillary channels like those of a fountain pen nibs, mounted in a holder or handle, done metal and plastic. Generally dip pens have no ink reservoir must recharge the ink from an ink bowl or bottle to continue drawing on writing. Recharging can be done by dipped ink an ink well, with an eye dropper a spring or brush. (Fig 6)

#### Tools for drawing and shading (Fig 6)

##### Shading technique

- 1 Hold the pencil at approximately a 45° angle shading is done with the side of the pencil tip.
- 2 Move the pencil with your shoulder or wrist. Each produces different types of marks.
- 3 The harder you press during shading the darker the mark produced and the darker the shade.
- 4 Spark with a light pressure and increase pressure of application as you proceed in overlapping pencil strokes.

Fig 6



- Charcoal sticks artists pencils and care sticks
- Image by one light studio via shutter stick
- Graphite sticks.
- Inks, dip brushes, dip pens and pens
- Craft knife, erasers stumps and sharpeners
- Papers

Fig 7



PGN122417

- 5 Apply strokes in various overlapping of several different angles and directions the resulting shade will be more even with greater luminosity.

#### Tool for drawing and shading (Fig 7)

Arts more drawing pencil set – 12 piece sketching pencils, graphite pencils shading pencils for sketching art pencils for drawing and shading sketch pencils for drawing pencils for artists.

- Graphite pencils
- Colored and pastel pencils

## Elements of arts

**Objectives:** At the end of this exercise you shall be able to

- name the elements of arts
- describe the importance and function of the elements of arts.

### Elements of colour

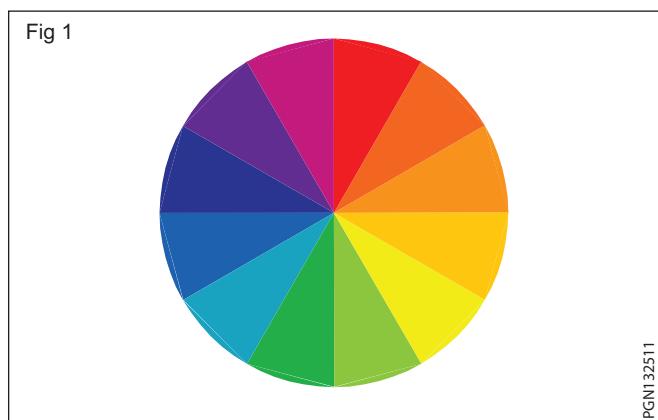
The intensity of colour depends on the amount of energy contained within the wavelength, colour has three virtues.

1 Hue      2 Chroma      3 Value

**Hue:** The actual colour - (The color it self)

Hue is simply the colour position around the colour wheel and the brightest, purest version of each colour. Hue is determined by the wavelength because each wavelength produces a definite colour on retina of the eye. The largest wavelength creating the red colour and the shortest wavelength creating violet colour. In the same way the intermediate wavelengths in between these two colours represent other colours. (Fig 1)

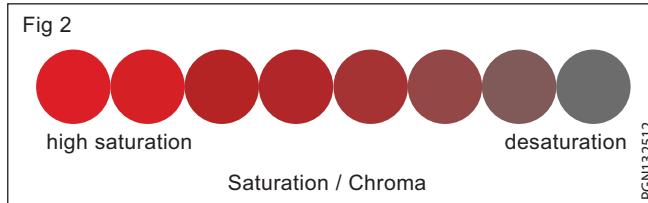
**Saturation / Chroma** - The brightness or dullness of a colour



Saturation or Chroma is also known as intensity. This tells how vibrant (lively) a colour is. A desaturated colour is greyed out and dull, while a saturated colour is vibrant and strong. If colour has more intensity it means the colour has more saturation. (Fig 2)

**Chroma:** Chroma is that one in which brilliance may be less or more. That brilliance depends on gray colour. Adding gray to any basic colour reduces the brightness of the original colour, changes its color. The brightness of the black, white and gray colours can be reduced by making full use of right on bright colour it becomes attractive and it harms the fixture.

**Saturation:** The colorfulness of an object as compared to the light levels. For example, in a dark image a color may be saturated if it stands out as somewhat bright. In a bright image, a color has to appear brighter than the rest to be considered saturated.



**Gray scale:** Three dimensionality can be seen in a two dimensional picture with the help of a gray scale. If the place of high key, middle key or low key is changed in an image gives different results. By these changes are brought in space, intensity and depth. Due to the shadow key the form of full image is changed for this it becomes necessary to study the rotating scale of eleven parts. Top portion of the scale is white and bottom portion is black colour. The middle nine parts are divided by three shades of each.

1 High key    2 Middle key    3 Low key

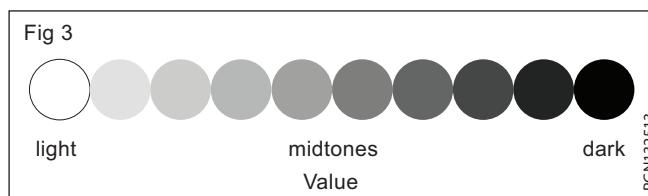
**High key:** The part which is below the white colour on the grey scale is called high key.

**Middle key:** In gray scale middle key is in 5 to 7 nos portion. The measure of white and black colour is almost equal. These three parts are high middle, middle and lower middle.

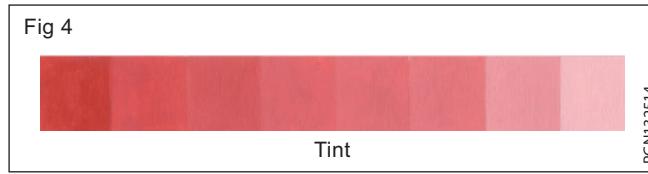
**Low key:** The part which goes is above the three parts of the black colour is called low key. It is called as high deep, middle deep and lower deep keys.

### Value The lightness or darkness of a colour.

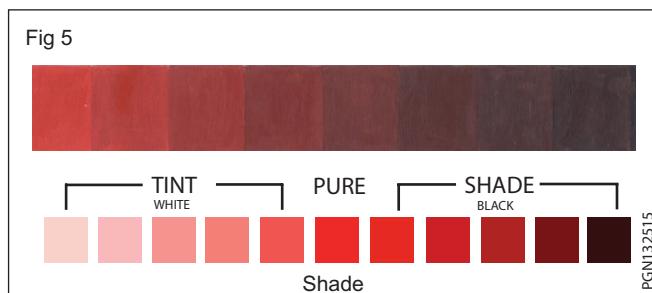
Value tells us how dark or light a colour is. When dealing with pure colour (hue) value can be affected by adding white or black to a colour. (Fig 3)



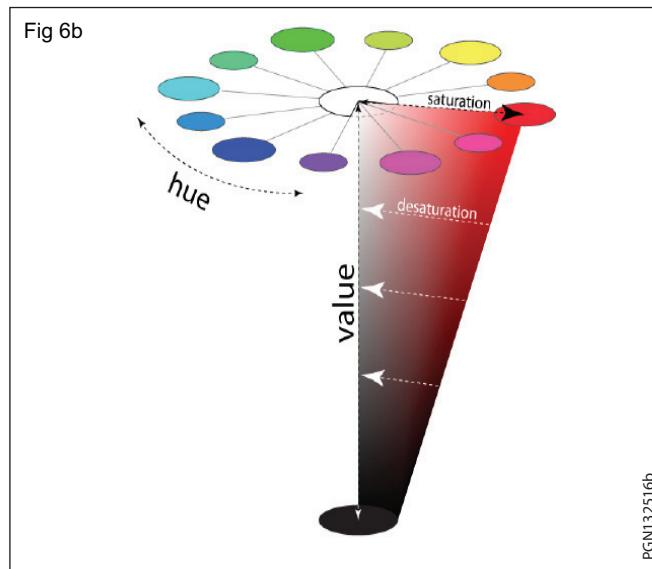
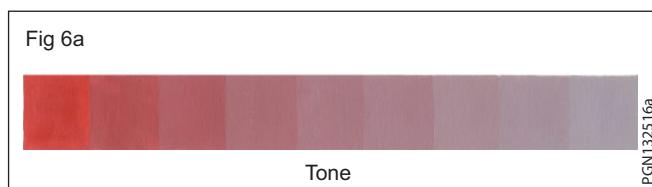
i **Tint:** A tint is created when you add white to a color and lighten it. It is also sometimes called a pastel color. (Fig 4)



**ii Shade:** A shade is created when you add black to a color and darken it. Just as with tints, you can add black to any of the twelve hues of the color wheel or to any combination of hues of the color wheel to create shades of that hue by adding various amounts of black. (Fig 5)



**iii Tone:** A tone is created when you add both white and black (which is grey), to a color and tone it down. (Fig 6a & 6b)

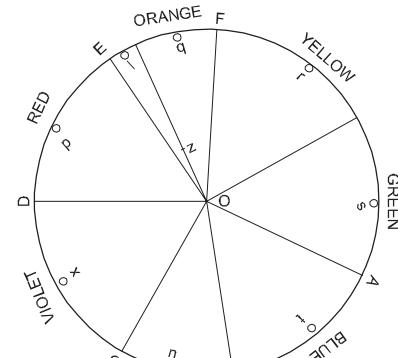


**Colour Wheel:** The color wheel or color circle is the basic tool for combining colors. It gives good understanding of colours. It consists of the colours of the rainbow arranged in circular fashion. This colour wheel can be used to explain the main relationships of colours. An understanding of these relationship is useful for choosing furnishings, coverings, paints and other colour materials.

A color wheel or color circle is an abstract illustrative organisation of color hues around circle, which shows the relationships between primary colors and tertiary colors etc. Most color wheels are based on three primary & secondary colors and fix international formed by mixing with secondary known as tertiary colors, for a total of 12 main divisions, some add more intermediates for 24 named colors. They make us of the trichromatic model of color. The different types of color wheels.

Newton's asymmetric color wheel based on musical intervals. Mixing "rays" in amounts given by the circles yields color "z" (1704) (Fig 7)

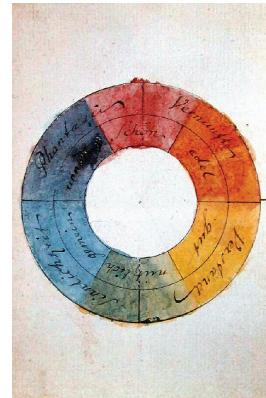
Fig 7



PGN132517

Goethe's symmetric color wheel with 'reciprocally evoked colours' (1810) (Fig 8)

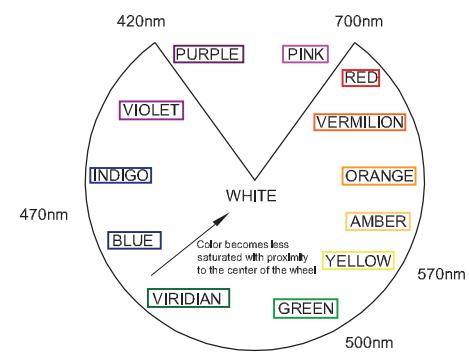
Fig 8



PGN132518

A color circle based on additive combinations of the light spectrum, after schiffman (1990) (Fig 9)

Fig 9



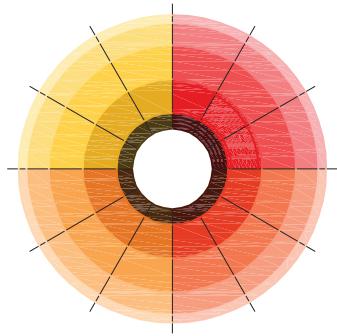
PGN132519

Human color wheel based on the hue and light detected on human skins, after Harbisson (2004-2009) (Fig 10)

RGB color wheel (Fig 11)

RYB color wheel (Fig 12)

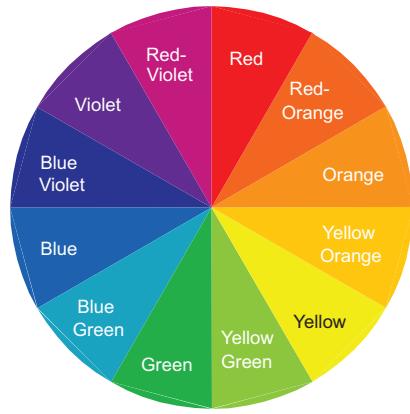
Fig 10



THE HUMAN COLOR WHEEL

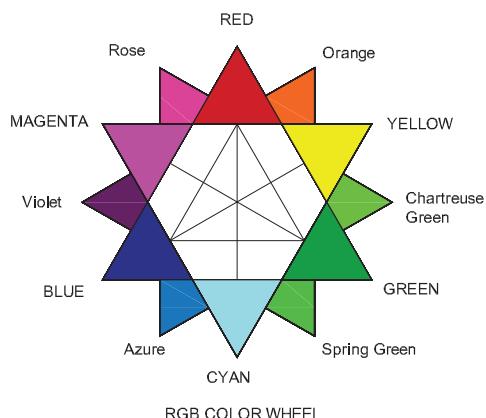
PGN13251A

Fig 13



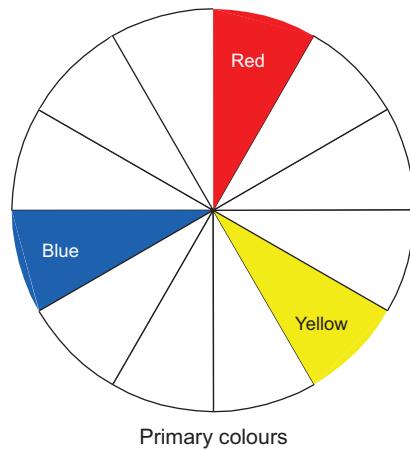
PGN13251D

Fig 11



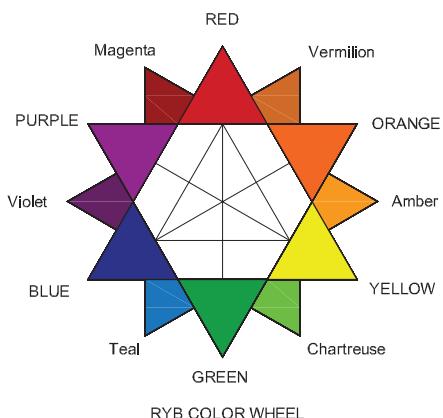
PGN13251B

Fig 14



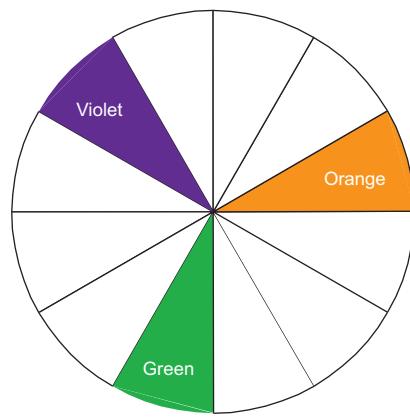
PGN13251E

Fig 12



PGN13251C

Fig 15



PGN13251F

The first colour wheel was presented by Sir Isaac Newton in the 17th century when he first discovered the visible spectrum of light. Around this time, colour was thought to be a product of the mixing of light and dark, with red being the “most light”, and blue the “most dark”. (Fig 13)

**Primary Colours:** Red, blue and yellow are known as primary colours because they cannot be obtained by mixing any other colours. (Fig 14)

**Secondary Colours:** Secondary colours are obtained by mixing two primary colour. They are orange (red + yellow), green (yellow + blue), and violet (blue + red). (Fig 15)

One Primary Colour + Another Primary Colour =  
1 Secondary Colour

Example: Red + Yellow = Orange (Fig 16)

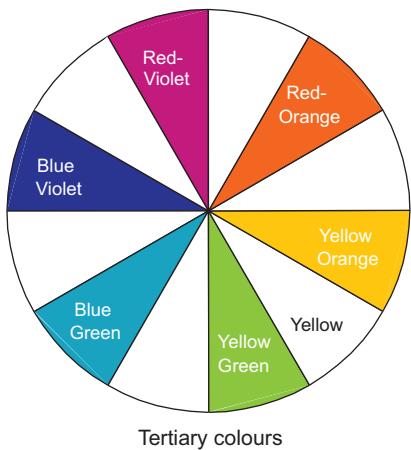
Fig 16



PGN13251G

**Tertiary colours:** Tertiary colours are created by mixing equal parts of a primary colour and a secondary colour together. There are six tertiary colours - red - violet, red - orange, blue - green, yellow - green, blue - violet and yellow - orange. The proper way to refer tertiary colours is by listing the primary colour first and secondary colour, second. (Fig 17)

Fig 17



PGN13251H

Red violet (magenta)

Red orange (vermillion)

Blue green (aqua)

Yellow green (lime green)

Blue violet (purple)

Yellow orange (marigold)

One Primary + One Secondary = One Tertiary colour

Example: Red + Orange = redorange (Fig 18)

Fig 18



PGN13251I

**Quaternary colours:** The colours formed after mixing the tertiary colour is called quaternary colours. This colour is very fuzzy, swinly, clay-like and black

- Raddish grey + yellowish grey = Orange grey
- Yellowish grey + bluish grey = greenish grey (sage)
- bluish grey + reddish grey = Purplish grey (plum)

### Intermediate colours

The colour formed after the mixing of primary colour and secondary colour is intermediate colour:

- 1 Yellow + orange = Yellow orange
- 2 Red + orange = Red orange
- 3 Red + purple = Red purple
- 4 Blue + Purple = Blue purple

5 Blue + green = Blue green

6 Yellow + green = Yellow green

The colours formed by suitable colour mix is called intermediate colour.

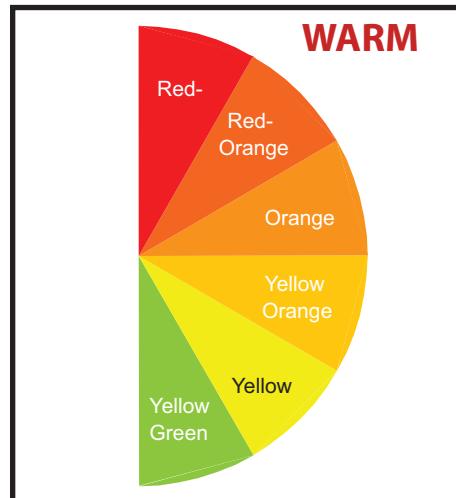
### Classification based on characteristics of colours

Colours can also be classified into various groups based on their characteristics.

**1 Colour temperature:** Colour temperature refers to the warmth or coolness of a color. A color's temperature affects the color of everything we see. The colour wheel can be split into two main groups warm colours and cool colours. But, individual colours can also change in temperature as we move around our colour wheel. For example, A warm red includes more yellow and a cool red includes more blue.

**i Warm colours:** Warm colours are those colours which are bright, aggressive, attract attention and excite emotions. It also makes a colour schemes cheerful and rich. The hue from red to yellow colour including orange, pink and brown are on the maximum side warm colours. (Fig 19)

Fig 19

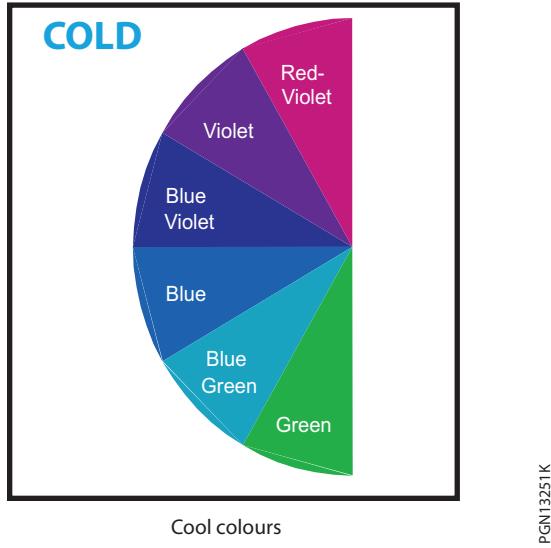


PGN13251J

**ii Cool colours:** Cool colours have opposite effects of warm colours. It cools down the metabolism of the body. Sometimes it appears gloomy and oppressive but cool shades of blue and green look clean and inviting for a nice change. The hues from green to violet including blue and all shades of grey are known as cool colours. (Fig 20)

**2 Light colours:** Light colours is the mixture of basic hues and white colour which reduces the intensity of colour. Light colour looks sof and sublimed and is preferred in interior decoration. Light colour scheme may look effective in its quiet way depending on environmental surroundings.

Fig 20



**3 Dark colours:** Dark colours are the mixture of basic hues with black or warm colours with their actual hues which may or may not be mixed with black colour. These colours look heavy, dense, strong and solid and generally combined with lighter colours. Dark red, purple, green and blue are associated with royalty and dignity.

**4 Dull colours:** Dull colours are the mixture of basic colours and grey or in other words we can say diffusion of basic colour in grey. It creates a blurry impression but at the same it helps to reduce tension.

**Brightness:** Brightness is the degree to which a color appears to be radiating light. For example, changing the brightness of a flat screen display can have a significant influence on the perceived lightness and darkness of colors. This is one reason why items may look different in digital photographs than they do in person based on the screen you are using and its current brightness settings.

**Spectral vs Non-Spectral:** A spectral color is a pure wavelength of light. These are typically listed as red, orange, yellow, green, blue, indigo and violet. A non-spectral color is a color that results from mixing different wavelengths of light such as white, brown, grey and pink. It should be noted that most colors perceived as red, orange, yellow, green, blue and violet are mixes of non-spectral color. For example, RGB display technologies have no ability to display the spectral color violet but simulate this with combinations of blue and red.

**Colour scheme:** Color schemes are logical combinations of colors on the color wheel. The purpose of a color scheme is to create an aesthetic feeling of style and appeal.

#### Uses of colour scheme

##### Colour is responsible for so many factors

- i It makes the interior pleasing.
- ii The dimensions of an interior can be made to look smaller or bigger with the help of colours.

iii It camouflages undersized elements in an interior

iv It creates a certain mood in an interior - mood of relaxation or mood of activity etc.

#### Types of colour scheme

**1 Monochromatic color schemes:** "Mono" means "one", "chroma" means "colour". A monochromatic colour scheme consists of using one colour in varying intensities. (Monochromatic color schemes are derived from a single base hue and extended using its shades, tones and tints. Tints are achieved by adding white and shades and tones are achieved by adding a darker color, grey or black).

This colour scheme helps to give a spacious feeling to an interior and provides unity for a composition and a quiet background for objects and people within it. (Fig 21)

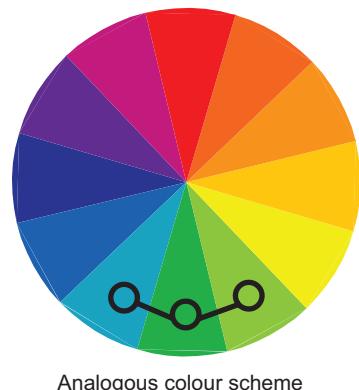
Fig 21



**2 Analogous color scheme:** Analogous color schemes use colors that are next to each other on the color wheel. They usually match well and create serene and comfortable designs. Analogous color schemes are often found in nature and are harmonious and pleasing to the eye.

This colours scheme is one of the simplest and most appealing colour harmonies and works best if you choose one dominant colour and use the other colours as accents. (Fig 22)

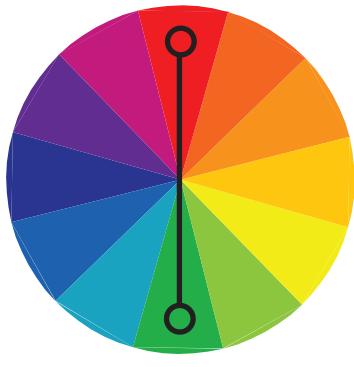
Fig 22



**3 Complementary colour schemes:** Complementary colours are directly opposite to each other on the colour wheel. These colours need not be used in their pure form. They can be used in many values or intensities. The high contrast of complementary colours creates a vibrant look especially when used at full saturation.

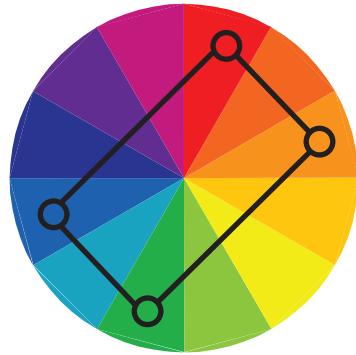
This type of colour scheme is great for creating strong contrast in your image. (Fig 23)

Fig 23



Complementary color scheme

Fig 26



Rectangle colour scheme

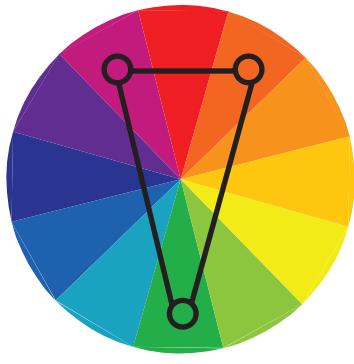
PGN13251P

PGN13251Q

**4 Split-Complementary color scheme:** The split-complementary color scheme is a variation of the complementary color scheme. In addition to the base color, it uses the two colors adjacent to its complement.

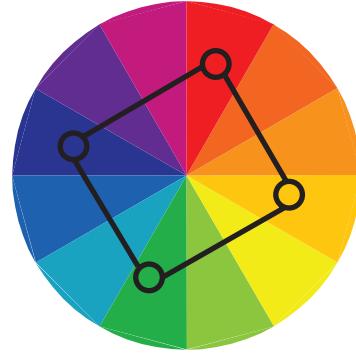
This color scheme has the same strong visual contrast as the complementary color scheme, but has less tension. (Fig 24)

Fig 24



Split Complementary color scheme

Fig 26



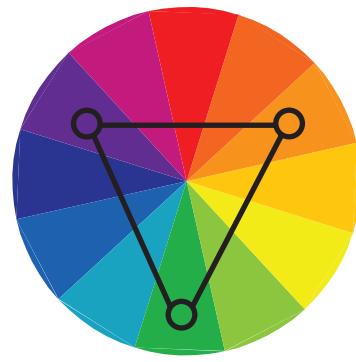
Square colour scheme

PGN13251Q

**7 Triadic colour scheme:** A triadic color scheme uses colors that are evenly spaced around the color wheel. Triadic color schemes tend to be quite vibrant, even if you use pale or unsaturated versions of your hues.

This colour scheme works best when you use one colour as dominant colour, and the other two in lesser quantity. These colour combinations are often bolder and more vibrant. (Fig 27)

Fig 27



PGN13251R

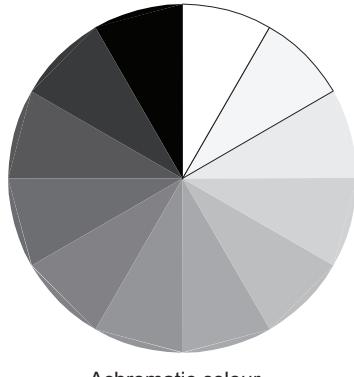
**5 Rectangle (tetradic) color scheme:** The rectangle or tetradic color scheme uses four colors arranged into two complementary pairs. This rich color scheme offers plenty of possibilities for variation.

This colour scheme works best when you focus on one main colour and use the other colours as contrasting accents (subtle way). (Fig 25)

**6 Square colour scheme:** The square color scheme is similar to the rectangle, but with all four colors spaced evenly around the color circle. Square color schemes work best if you let one color be dominant. (Fig 26)

**8 Achromatic colour:** An achromatic color scheme is simply colorless scheme possessing no hue, using only black, white and grey. It has (White, grey and black) lightness but no hue or saturation. They can be created by mixing complementary colours together." (Fig 28)

Fig 28



PGN13251S

- 9 The following are associations with the color purple include royalty, imagination, power, luxury, wealth, extravagance, ambition, wisdom.
- 10 Some associations of the color blue include the sea, the sky, trust, honesty, loyalty, sincerity, peace, tranquility, intelligence.
- 11 Some associations of the colour green include spring, growth, renewal of rebirth, balance, nature, grass of gardens stability, possessiveness, jealousy, envy, fertility, safety, money, recycling
- 12 Some associations of the colour yellow include creativity, sunshine, happiness, energy, cowardice, deceit, warnings, instability, clarity, activity
- 13 Orange color association of the color include risk taking, citrus, healthy food, halloween, target market and audience enthusiasm happiness, autumn harvest, creativity, spontaneity orange color can be used to people talking or thinking.
- 14 Red color associations include the following energy, positivity, action, war, danger, strength, courage and all things intense and passionate, love, sex, passion and desire.

**Natural colours (Fig 29):** [Colours which are not included in colour wheel are known as neutral colours eg: white, black, grey, brown and tans]

Fig 29



PGN13251T

#### Guidelines for good colour schemes

- a In all colour schemes one colour should dominate. This basic colour occupies 60 to 70 percent of the whole colour.
- b Definite colour schemes like harmonious, complementary or triad are recommended.
- c A safe colour scheme consists of tints and shades of one colour
- d A colour scheme should be definitely dark or light.
- e Either warm or cool colours should dominate.

f Every colour scheme must have a dominating colour and secondary colour.

g A neutralised colour (grey) is best for large areas.

h Rely on colours to brighten dark areas.

#### Psychological impact of colours

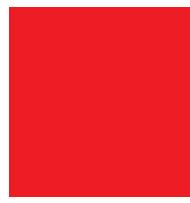
##### Introduction

Color psychology is the study of colors in relation to human behavior. Colors and emotions are always closely linked together. A Warm colour can evoke different emotion than a cool colour and a bright colour can create different feeling than a muted colour. It all depends on how the psychological effects of color are being used.

##### Colour psychology in interior design

Colour psychology is a powerful interior design tool that impacts the mood of a room more than any other factor. Different shades evoke certain emotions so, when choosing colours, it's important to consider the kind of atmosphere you wish to create and which colours will help you achieve this. It is important to note that each colour impacts on different people differently. Many factors can influence these including one's age, race, culture as well as life experiences. However, people will always respond to colour no matter what. In general, following colors create following psychological effects in interiors.

**1 Red colour:** Red colours is the bright colour in the whole spectrum. It has a dynamic character and denotes courage and aggressiveness. It affects the atmosphere and makes it hot and non tolerable. But it is a definite positive colour. It should be used in a room where the sun rays do not reach. The most intense colour, red raises a room's energy level and pumps the adrenaline. In the living or dining room, red draws people together and stimulates conversation. In an entrance hall, it creates a strong first impression.



Red colour

**2 Blue colour:** Blue is one of the strongest hues of the colour psychology spectrum, It is believed to bring down blood pressure and slow respiration and heart rate. It is a cool static colour which has the property on increasing the distance from which it is being reflected to the observer. It makes atmosphere calm and soothing. It promotes relaxation after a day of hard work, but at the same time too much of blue can be depressing. This colour is often recommended for bedrooms and bathrooms where you want to create a relaxing environment.



Blue colour

- 3 Yellow colour:** Yellow is the colour of intellectual nature. It captures the warmth of sunlight and evokes positivity. It's a great choice for kitchens, dining rooms and bathrooms, where it is energising and welcoming.



Yellow colour

- 4 Green colour:** Green is psychologically the most soothing colour and it is largely found in nature. It is a combination of blue and yellow. It cools the environment and is a natural healing agent. It is a soothing and safe colour, even its excess use does not harm. Being a cool friendly color it mixes well with many other colors. It looks great with white and is suitable for almost any room in the house. It stimulates thoughts of balance, growth and restoration in colour psychology.



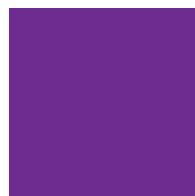
Green colour

- 5 Orange colour:** Orange hues are bright, fun and energize. It is a combination of yellow and red. It brings brightness, cheer and happiness in the atmosphere. It gives the feeling of well being. It is suitable for lobby and children room.



Orange colour

- 6 Purple colour:** Purple has long been the colour of royalty, and can inspire creativity and spirituality. It's a popular choice for kid's rooms. It is great in areas for study room, but should not be used in a busy or active room. Lavender can become grey looking in rooms that do not have much natural light. Using this colour in a dressing room creates the maximum effect, and you can also use it in your hallway to give a good impressive look.



Purple colour

- 7 Black colour:** Black is always associated with sophistication, elegance and luxury. It's most often used as an accent in the home, as all - black interiors can become dreary and overwhelming very quickly. (It is always used in small amounts with contrasting, complementary colors. When used right, it can add depth and timeless elegance to a room. Avoid using black in large quantities as it can seem oppressive).



Black colour

- 8 White colour:** White is the colour of purity and cleanliness, and often is regarded as blank palette. White can help smaller spaces appear large. It can also make rooms look livelier, fresher and crisper, but can also be very cold and barren without the proper accent pieces. Excess use of this colour can lead to feeling of emptiness.



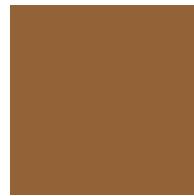
White colour

**9 Grey colour:** Grey is a combination of white and black and therefore a mixture of qualities of both. The grey interior gives a formality that is subtle elegance without being too conservative. Its effect depends very much on the color shade that you will use. For example, if grey has a yellow tint it may be depressed, especially if you have things in the room in various shades of brown. But a beautiful shade of grey, in combination with not very bright white color, can create a clean and refreshing appearance. If you have too many grey areas will become predominant and create a boring environment.



Grey colour

**10 Brown colour:** Brown is a mixture of red, yellow and black. It represents tradition and conservation taste. It stimulates growth and achievement. It is said to be a rich colour as we get qualities of red, yellow and black. Brown is the best for furniture upholstery and wardrobes. Brown shades are truly versatile, and go with any design style and mood.



Brown colour

**11 Beige colour:** Beige is a mixture of light yellow and grey. It can be matched with all colours. It merges with surroundings. If you are not sure which colour is suitable for a room, try beige.



Beige colour

## Drawing and painting instruments - Features and their uses

**Objectives:** At the end of this lesson you shall be able to

- name the contents of an instrument box
- state the features and uses of large compass and large divider
- state the features and uses of bow instruments, beam compass
- state the use of lengthening bar, screw driver, lead case and ruling pen
- state the grades of the pencils
- state the scales, drawing board, set square, eraser, protractor, pencil and sharpener
- state the templates.

The quality of a good drawing not only depends on the talent of the painter but also on the quality of instruments he uses.

Drawing and painting instruments are generally sold in sets in boxes, but they are also available separately. The main parts of high grade instruments are generally made of Nickel or Brass. They must be rust proof. Tool steel is used for making the blades of the inking pen, bow instruments.

An instrument box contains the following: (Fig 1a to h)

- Large compass (with attachment facility) (a)
- large divider (b)
- Bow compasses, bow divider (c)
- Lengthening bar (d)
- Pen point for attachment (e)
- Screw driver (f)
- Lead case (g)
- Liner (h)

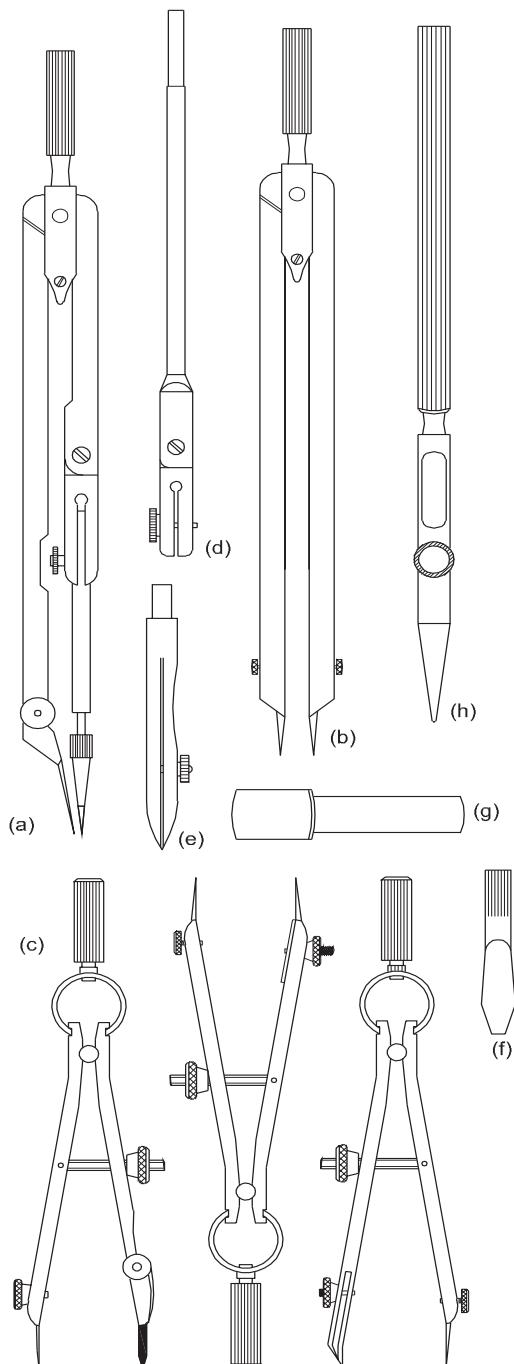
**Large compass (Fig 2):** It has a knee joint in one leg that permits the insertion of pen or pencil point or attaching lengthening bar with pen or pencil point attached to it. It is used for drawing large circles / arcs also for taking large measurements. The pin on the other leg can be swiveled to vertical position when drawing large circles, while drawing the circles of arcs it should be held in such a way that the needle point leg and pencil point leg should be bent so as to make perpendicular to the paper.

**As a rule while drawing concentric circles, small circles should be drawn first before the centre point gets worn.**

**Large divider:** It is used to transfer dimensions and dividing lines into a number of equal parts. Divider with adjustable joints is preferable rather than plain legs. (Fig 3)

**Bow instruments:** Bow pencil and bow pen compass are used for drawing circles of approximately 25 mm radius. Bow divider is used for marking or dividing smaller spaces. There are two types (i) Integral legs with spring action (4e) (ii) two legs held with a curved spring on top with handle on it.

Fig 1



DRAWING INSTRUMENTS

Fig 2

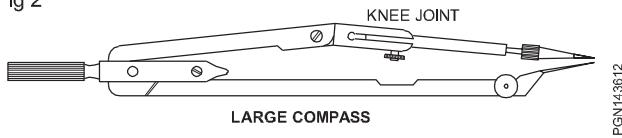
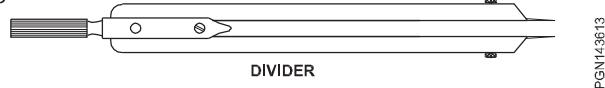


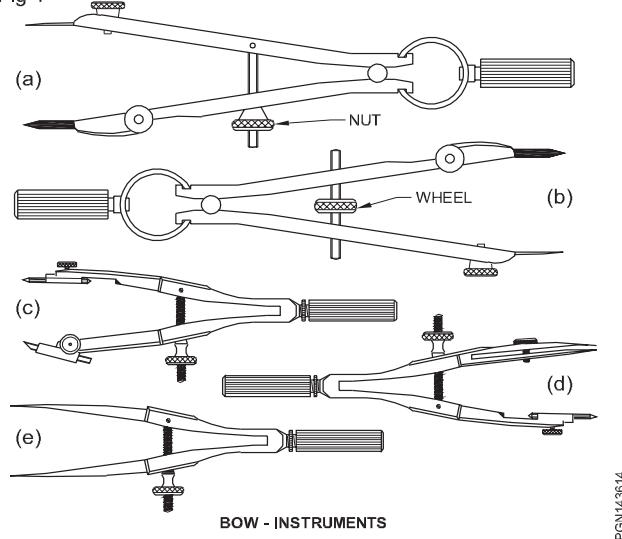
Fig 3



Bow instruments may have adjusting wheel and nut. To draw circles, it is better to mark the required distance separately and set the instruments and check. Then only the circles or arcs should be drawn on the drawing.

Fig 4 shows different types of bow instruments. Adjustment should be made with the thumb and middle finger. The instrument is manipulated by twisting the knurled head between the thumb and finger.

Fig 4



**Drop spring bow pencil and pen (Fig 5):** Drop spring bow pencil and pen are designed for drawing multiple identical small circles. example rivet holes drilled / reamed holes.

The central pin is made to move freely up and down through the tube attached to the pen or pencil unit. It is used by holding the knurled head of the tube between thumb and middle finger while the index finger is placed on the top of the pin. The pin point is placed on the centre point of the circle to be drawn (Fig 5) and pencil or pen is lowered until it touches paper. The instrument is turned clockwise and the circle is drawn.

**Beam compass (Fig 6):** It consists of a beam made of steel rod or wood . The steel point is used as centre, and by adjusting the compass point (Pencil / Pen), very big circles and arcs are drawn. The divider point and the pencil point are replaceable to the adjustable holders. These pens have provision for varying the thickness of lines.

**Inking pen or liner or ruling pen (Fig 7):** It is used to ink the straight lines drawn with the instruments but never for free hand lines or lettering.

Fig 5

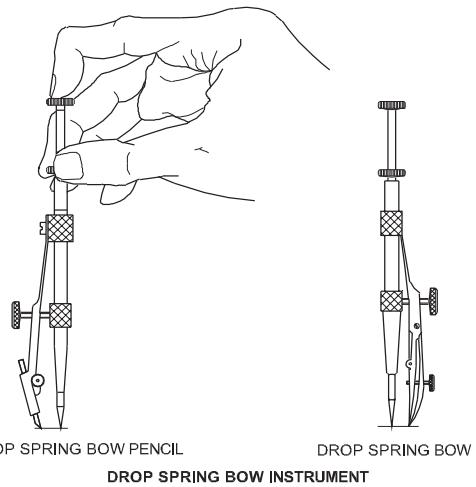


Fig 6

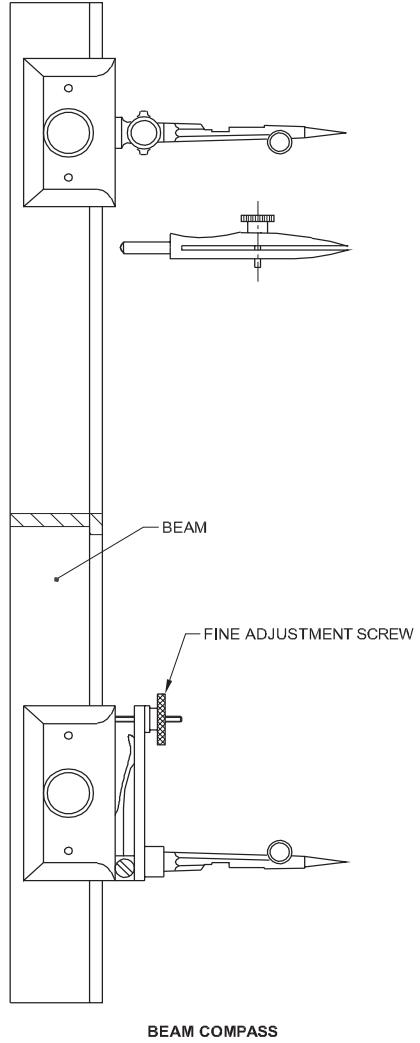
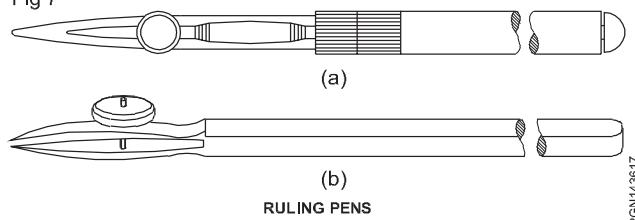


Fig 7



**Lengthening bar (Fig 8):** To draw larger circles, it is fitted to the compass. The pencil point or pen point is inserted to its end.

Pencil, pen and needle points are replaceable spares attachable to compass.

Fig 8

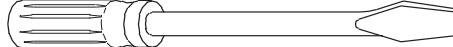


LENGTHENING BAR

PGN143618

**Screw driver (Fig 9):** Used for adjusting the screws of the instruments.

Fig 9



SCREW DRIVER

PGN143619

**Lead case (Fig 10):** Lead case is the box for holding the pencil leads.

Fig 10

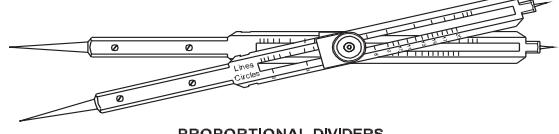


LEAD CASE

PGN14361A

**Proportional divider:** For enlarging or reducing drawing, dividing a line into a number of equal parts, proportional divider is used. It is best suitable for percentage reduction with the help of graduation marked on the instrument. (Fig 11)

Fig 11



PROPORTIONAL DIVIDERS

PGN14361B

**Pencils (Fig 12):** Soft lead pencils are used to draw a perfect outline of picture. This will allow to fill the paint in correctly, within the borders of drawing.

Use coloured pencils to create interesting textures and add details to drawings. In drawing office, standard pencils (lead encased in wood) and semi-automatic pencils are made for use. Pencil leads are made of graphite with kaoline (clay) of varying proportion to get the desired grades. More kaoline higher the hardness of pencil leads.

**Grades of pencils:** Pencils are graded according to the hardness or softness of the lead.

**Hardest pencil is 9H grade and softest pencil is 7B grade.** Selection of grade of pencils depends on the type of line work required and paper on which it is used.

Softer lead pencils are used to produce thicker and darker line work, but they wearout quickly. Medium grade of H, 2H are used for general line work as well as for lettering. HB pencil ia an ordinary pencil. It means hard and B.bold or black.

Harder grade leads produce lighter and thinner lines. Most construction line work is done with 4H, 5H and 6H pencil leads, producing thin but also sufficiently dark by

Fig 12

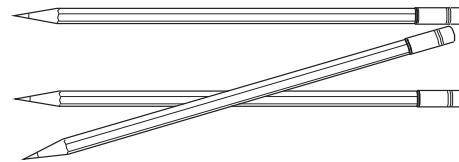


Fig B

SHARP CONICAL POINT (FOR GENERAL LINE WORK AND LETTERING)  
GRADE MARK. DO NOT SHARPEN THIS END

(a) DRAWING PENCIL

DRAFTING PENCIL LEADS AVAILABLE IN ALL GRADES  
(b) MECHANICAL PENCIL

0.5 mm  
FINE LEADS, REQUIRE NO SHARPENING  
(c) FINE-LEAD MECHANICAL PENCIL

DRAWING PENCILS

PGN14361C

exerting pressure. Depending upon the individuals touch and the style of writing, right pencil may be selected.

For any drawing on drawing paper or tracing paper, lines should be black, particularly drawings which are to be reproduced. For this purpose, the pencil chosen must be soft enough to produce jet black lines as well hard enough not to smudge easily. The point should not crumble under normal working pressure.

The pencils should not be hard and cut grooves on the paper while drawing with normal pressure, Pencils H, 2H or 3H depending upon the paper (quality) and weather conditions are selected.

In summer the pencil leads become softer due to rise in temperature, so slightly harder pencils can be made use of softer grade pencils are used on smooth surfaces for lettering and arrow head.

During rainy season or when humidity is more, the drawing paper expands and wrinkles form, pencil leads become harder. So softer pencils are to be used. Whatever may be grade of pencil you use, always prefer quality pencils/ leads viz., Venus, Kohinoor, Apsara etc.

For better line work, i.e., dense black lines, prefer paper which is not having too much teeth (roughness).

**Selection of pencils:** Pencil grades vary from one brand to another brand. Select the grades of the pencil depending upon the type of line work. For construction lines, you can choose 2H or 3H, for lettering and object lines grade H pencils. In general H, HB and 2H are used.

H medium hard

HB medium soft

2H hard

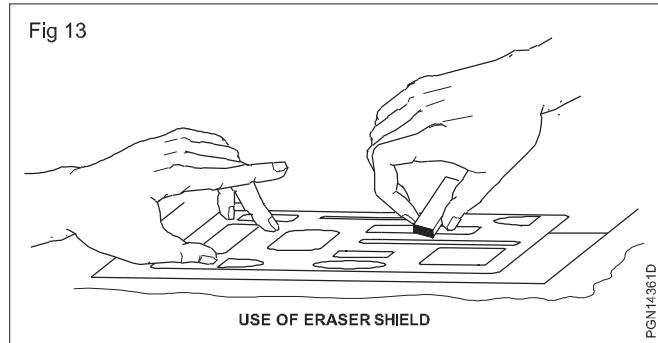
Pencils used for drawing are always hexagonal in cross sections as they do not roll easily even when they are placed on slope surfaces. Its cross section helps in rotating the pencil, while drawing lines, to give uniform line thickness.

Now-a-days automatic (Mechanical) pencils or clutch pencils are available in different sizes (lead dia 0.3, 0.5, 0.7 or 0.9 mm). They are easy to handle as there is no

reduction of holding length pencil leads can be replaced, as per required grade of hardness. They produce lines of uniform width without sharpening.

**Erasing shield:** When, on a drawing, if a part of a line or some lines among many other lines need to be erased or modified, in normal way of erasing will damage the other nearby lines. In such a situation an erasing shield is effectively useful. It is a thin metallic sheet having small openings of different sizes and shapes. A suitable opening is aligned to the line to be erased and the line is removed by the eraser. (Fig 13)

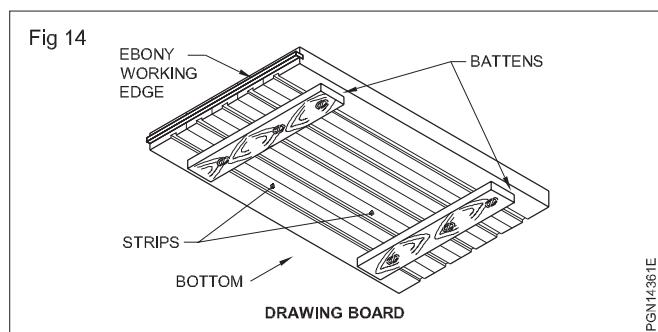
Fig 13



USE OF ERASER SHIELD

**Drawing board (Fig 14):** Drawing board is one of the main equipment painting artists. It is used for supporting the drawing paper/tracing paper for making drawings. It is made of well seasoned wood strips of about 25 mm thick or masonite, free from knots and warping. It should be softer enough to allow insertion and removal of drawing pins. Two battens are fastened to the board by screws, in slotted joints. They prevent warping and at the same time permit expansion and contraction of the strips due to the change of moisture in the atmosphere.

Fig 14



One of the shorter edges of the drawing board, is provided with an “ebony edge” (hard wood) fitted perfectly straight.

Standard drawing boards are designated as follows as per IS:1444-1989.

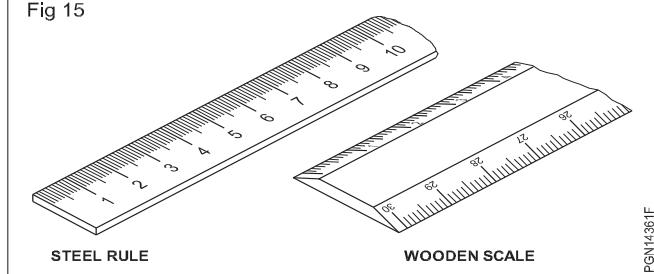
Sl. No.	Designation	Size (mm)
1	$D_0$	1500 x 1000 x 25
2	$D_1$	1000 x 700 x 25
3	$D_2$	700 x 500 x 15
4	$D_3$	500 x 350 x 15

The working edge (ebony) must be straight.

Now-a-days the drawing boards are available with laminated surfaces. The flatness can be checked by placing a straight edge on its surface. If no light passes between them, the surface is perfectly flat.

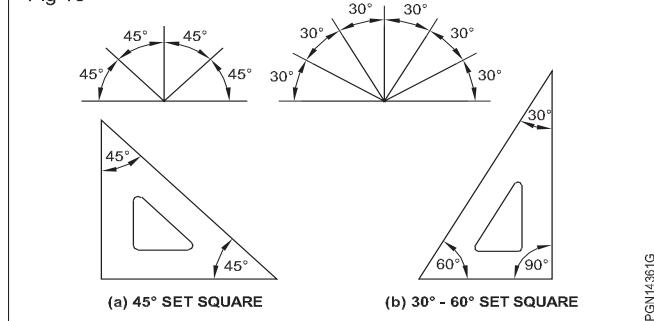
**Scales:** Scales are used to transfer and/or to measure the dimensions. They are made of wood, steel, ivory, celluloid or plastic, stainless steel scales are more durable. Different types of scales are used. They are either flat, bevel edged or triangular cross-section. Scales of 15 cm long, 2 cm wide or 30 cm long 3.5 cm wide flat scales are in general use. Thin section or bevel edged scales are preferred over thick flat scales. Parallax error will be nil or least while using thin / tapered edge scales. (Fig 15)

Fig 15



**Set square (IS:1361-1988):** Transparent celluloid/Plastic setsquares are preferred and are commonly used rather than ebonite ones. They are two in number, each having one corner with  $90^\circ$ . The setsquare with  $60^\circ$ - $30^\circ$  of 250 mm long and  $45^\circ$  of 200 mm long is convenient for use. Setsquares sometimes lose their accuracy due to internal strains. So they should be tested periodically. (Fig 16)

Fig 16



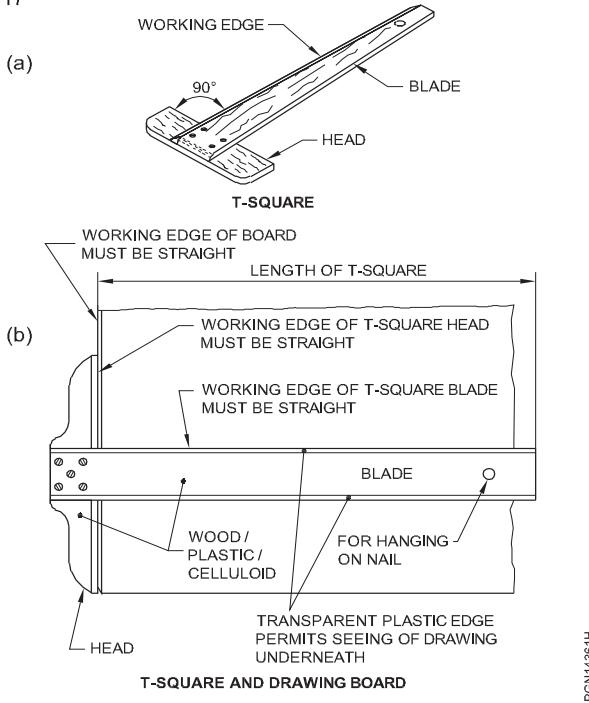
Sometimes set squares have French curves. Setsquares are used to draw all straight lines except horizontal lines. It is convenient to draw horizontal lines using Mini drafter.

With the help of Mini drafter and manipulating the  $45^\circ$ ,  $30^\circ$ - $60^\circ$  setsquares, angular lines in the multiples of  $15^\circ$ ; Parallel lines to a given inclined line and perpendicular to can be drawn.

Set squares with graduated, bevel edge and French curve openings are preferable. They are also used to draw smooth curves. Setsquare should never be used as guide for trimming papers.

**T Square (Fig 17):** T square is an technical drawing instrument and it is used as a guide to draw the horizon line on draftsman drafting table. It guides the set square

Fig 17



to draw a vertical line. Its name is obtained from the English letter 'T'. Its length is 18', 24', 30', 36' & 42 inches. Its measurements depend on the length of the drawing

board. It is used to draw vertical and parallel lines. It is used to support the set square.

**Protractor (Fig 18):** A protractor is a measuring instrument, typically made of transparent plastic or glass, for measuring angles. Its dia is 100mm and it has an angle measurement upto 1degree most protractor measure angles in degrees, while radium scale protractors measure angle in radians. Most protractors are divided into 180 equal parts. Its figures or readings can be read either in clockwise or anticlockwise direction.

**Eraser / Rubber (Fig 19):** It is a piece of rubber or other material and it is used to erase the written material by a pencil. It is available in different colours and shapes.

The modern eraser is usually a mixture of an abrasive such as synthetic rubber and other ingredient.

**Pencil sharpener (Fig 20):** A pencil sharpener also referred to as pencil pointer. It is a tool for sharpening a pencil's writing point by shaving a way its worn surface. The block shaped sharpener consists of a combined point-shaping cone that is aligned to the cylindrical pencil alignment guide hole, into which the pencil is inserted. A sharp blade is mounted on the top so that its sharp edge just enters the shading cone tangentially with the use of the pencil become sharp to write.

Fig 18

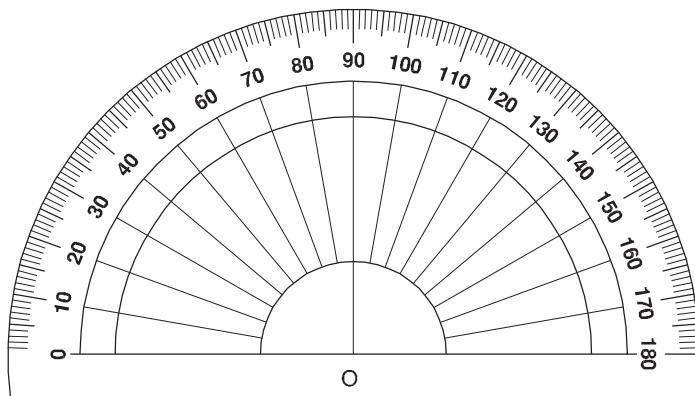


Fig 19

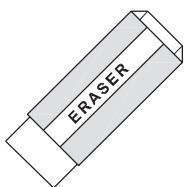
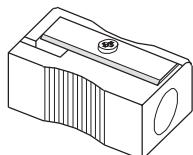
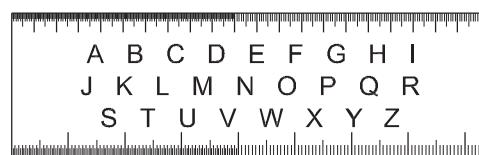


Fig 20



Template (Fig 21)

Fig 21



Stencils cut on flat plastic with different shapes, designs or letters are called drafting templates. It is used to repeat the outline of a shape, design or letter with a pencil or pen. Many graphing templates have different architecture scales, which are used for different tasks of painting works.

# Art tool & equipments

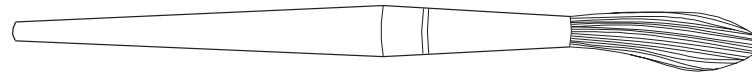
**Objectives:** At the end of this lesson you shall be able to

- state the paint brush, painting palette, painting knife, eraser.

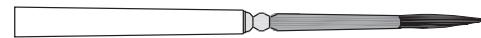
**1 Paint brush (Fig 1):** A paint brush is also used for applying colour and sometimes ink. A paint brush is usually made by clamping the bristles to a handle with ferrule. They are available in various sizes, shapes and materials. To apply paint on a large surface. Thick brush is used to apply paint finely or with precision the thin brush is used for painting and decoration. Different

brushes give different types of results depending on their characteristics. The paint brush is a magic tool for creating works of art. There are a wide selection of paint brushes of varying shapes and sizes that produce different results. Below the detailed information of brushes are given.

Fig 1



TYPES OF BRUSHES



ROUND BRUSH NO 2



ROUND BRUSH NO 4



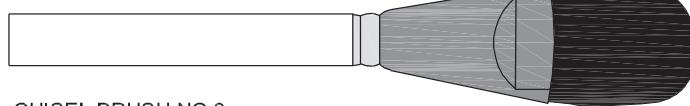
ROUND BRUSH NO 6



FLAT BRUSH NO 2



FLAT BRUSH NO 4



CHISEL BRUSH NO 6

PGN43621

The round brush No.2 will give you fine detailed strokes.

The round brush No.4 will give you moderate strokes.

The round brush No.6 will allow you to fill larger areas with contour.

The flat brush No.2 will help you to fill small flat spaces.

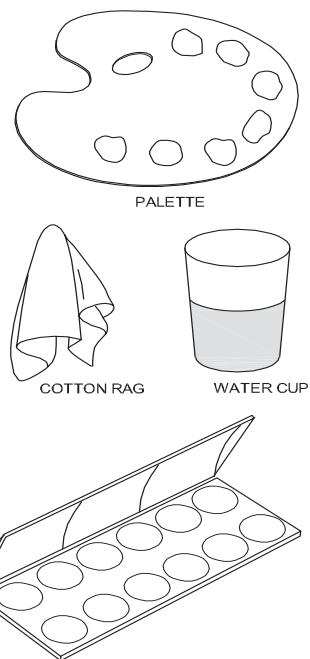
The flat brush No.4 will allow you to fill larger spaces.

Chisel brush No.6 will help you to produce slant strokes.

**2 Painting Palette:** The most commonly known type of painter's palette is made of a thin wood board designed to be held in the artist's hand and rest on the artist's while painting, the paint or colour is taken on the

palette and it is mixed as needed and applied on the canvas, varnish and netting solution is applied to the palette so that the colour does not absorb, painting palettes are available in the market in different shapes and materials. (Fig 2)

Fig 2



PALETTE



COTTON RAG



WATER CUP

**5 Dipper (Container):** Dipper is made from thick plate of steel or high plastic. An oil dipper is used to hold a supply of turpentine oil, or painting medium. Fastened to the painters palette. Dipper is used to hold the palette from either side while doing sign board painting or portrait artist painting. If there is a clip on either side of dipper then the palette can be fixed on any side. It is very light and small bowls are provided in it to keep turpentine and linseed oil. (Fig 5)

Fig 5



Dipper

PGN143625

Palette made from wood, plastic, acrylic, metal used for oil colour the palette made from wood or acrylic material is used for water and poster colour palette made from plastic and china clay is used for common purpose while painting you should always keep a cup of water near you to keep washing a painting brush and also keep a cotton rag clean and wipe your art material.

**3 Palette knife:** This knife is made from stainless steel and the blade length is 3 to 6 inches and it is flexible. It is used to remove paint from the palette and for mixing different paints or colours. It is used in fine art painting. (Fig 3)

Fig 3



Palette knife

PGN143622

**4 Painting knife:** This knife is made from high quality stainless steel. It is similar to palette knife and its blade is shorter. It is used to paint on canvas / paper by taking oil and acrylic colour from palette. Painting done through this knife is called knife painting. (Fig 4)

Fig 4



Painting knife

PGN143624

Fig 6



Painting easel

PGN143626

**7 Wooden scale:** Wooden scales are used to draw lines on paper, wall and boards. Measurements can be taken upto a limited range. It is used to maintain the balance of the hand while doing signboard painting.

In it millimeters, centimeter and inch graduations are there wooden scales lengths are 12', 18' and 24 inches and its one end is tapered.

## Mount Board & Frames

**Objectives:** At the end of this lesson you shall be able to  
• state the mount boards and frames.

**Mount boards:** Mount board is also called foam core. It is made by pressing light foam piece in between two paper. It is a solid board. It has a thickness of upto 1.4mm, 1.25mm & 1.65mm mount board serves to protect a framed photography or piece of artwork by providing a rigid, sturdy backing to keep photographs and art work from moving or warping in the frame. The thick cartoon cutting fame placed inside to hold the frame firmly is called mounting.

The following are the measurement standards of full mount board in modern India.

Plain mount board – 20" x 28" and its thickness range from 1.50mm to 2.50mm. The mount board adds depth to the picture and the artwork looks beautiful. It is mostly used to make posters related to different topics from poster colour. It is also used in the architectural field to make house or building model with different colours of mount board. Mount boards are available in different colours texture and sizes. It is very important to frame the mounting under the glass of an artwork with water colour, sketching, charcoal and pastel. Mounting has to be done keeping in mind some basic elements regarding double mounting. In double mounting fame it brings a dash shade to the picture. Golden coloured wooden slip with painting inside the frame makes the frame work strong and beautiful.

**Frame:** Frame around an artwork is called framing which is the last stop of its beauty. After framing only painting gets its fullness. By this artwork looks attractive and it is safe also. The frames are made of different materials. For this plaster, wood, fiber, paper, glass and metal are used. Normally wooden frames are used widely. Teak wooden frames appear beautiful and is long lasting. The importance of photo on artwork increases by framing and we get more attracted towards artwork. Frames are mainly two types, plain and moulding. The different types of frames is as given below.

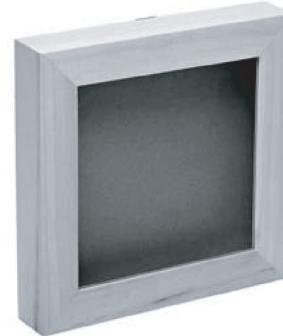
- 1 Box frame
- 2 Standard frame
- 3 Floating frame
- 4 Deep edge frame
- 5 Plaster frame

### Different types of frames

**1 Box frame:** The depth of this frame is more than that of other frames and photograph attractive artwork can be easily displayed. Which type of artwork we want

to inhibit, it depends on the selection of the frame for it. These frames can be done for uplifting artifacts like sports memory, handicraft, uplifting craft while framing in the box frame there should be a nominal gap between the glass and the artwork otherwise the glass will break. This frame is being used to show the depth of artwork. (Fig 1)

Fig 1



Box frame

PGN143631

**2 Standard frame:** Standard frames are used in house and offices. It is usually normal and permanent in colour. This frame keeps the eyes fixed on the picture. These frames are available in different shapes. These frames are available in black, brown and bright colour. (Fig 2)

Fig 2



Standards frame

PGN143632

**3 Floating frame:** In this type of frame wooden, fiber and any other metallic door frames are not being used. To make it visible on the wall on any surface, two inch pushpins are fixed on the four corner of the glass and the walls with the help of the screws. It creates an impression that glass is hanging before the wall. This is called floating frame. Photo or picture is left in between thick glass pictures and this creates an impression that photo is inside a frame. (Fig 3)

Fig 3



Floating frame

PGN1433633

- 4 Deep edge frame:** The deep edge frame is a wooden frames side width it will be one inch or more on this structure canvas is used on the front and side width. The painting is done on the front side of the canvas the same painting is extended to its width of one inch or more on its side. We see a portion of the painting due to the above reason and no framing is required. (Fig 4)

Fig 4



Deep edge frame

PGN1433634

- 5 Plaster frame:** This frames are being widely used for old pictures, the frame is made by carving the wall around the picture in a certain mould and applying sticky clay or cement plaster to it. In the olden times plaster frames were very strong but now a days there decorative frames are made from plaster of parts and fiber and bright colours are applied to it. Golden colour is widely used. At present its prevail once has decreased to a great extent. (Fig 5)

Fig 5



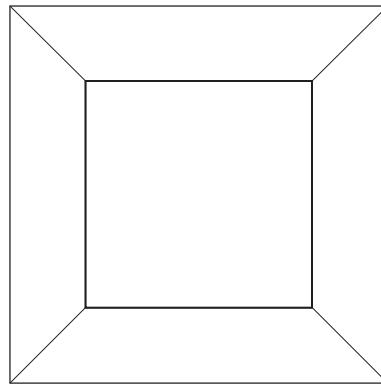
Plaster frame

PGN1433635

## Different shapes of frames

- 1 Square/Square size frame:** When the picture is not normal then choose square size picture frame. The square frame around which focuses the eye of the beholder in the picture. (Fig 6)

Fig 6

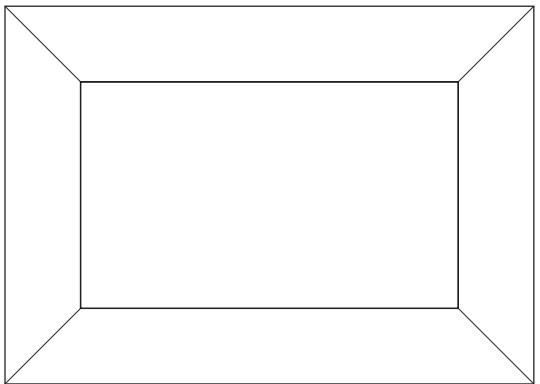


SQUARE FRAME

PGN1433636

- 2 Rectangular frame: (Rectangle):** This frame is commonly used for picture framing. This frame can be easily flitted and to fit the picture need not be cut. That size being common for photography and painting, frames of this size can be easily found in different places. (Fig 7)

Fig 7

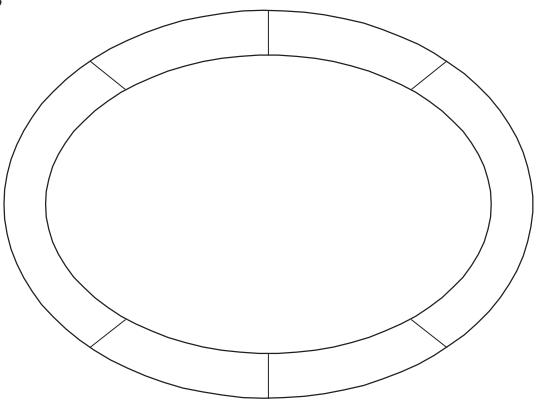


RECTANGLE FRAME

PGN1433637

- 3 Oval/Round frame:** This type of frame is rare use in artwork the high-end frame draws attention. In comparison to other frames these are fancy framer. (Figs 8 & 9)

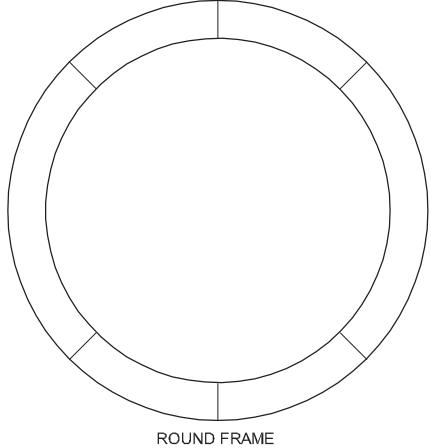
Fig 8



OVAL FRAME

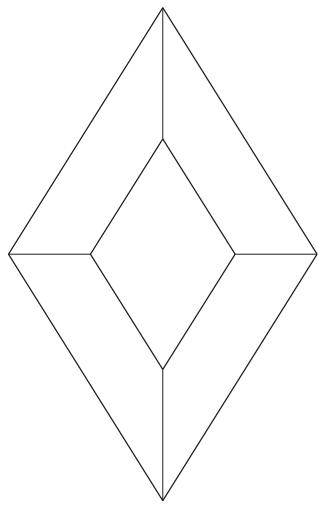
PGN1433638

Fig 9



PGN143639

Fig 10



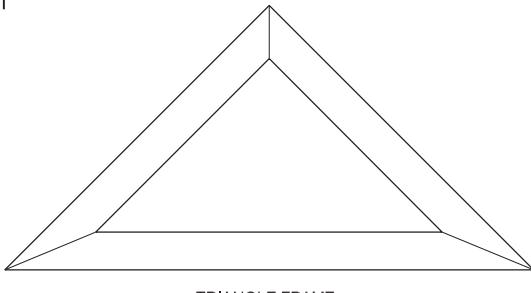
DIAMOND FRAME

PGN14363A

### 3 Diamond & triangle shield frame (Figs 10, 11 & 12)

This type of frame is comparison rarely used to ask frame work

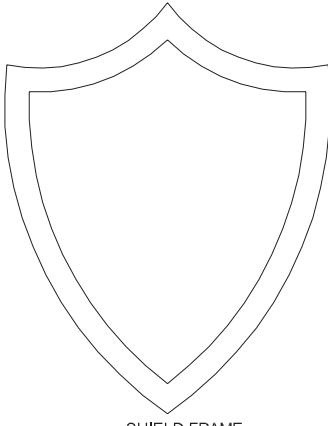
Fig 11



TRIANGLE FRAME

PGN14363B

Fig 12



SHIELD FRAME

PGN14363C

## Brush and their types

**Objectives:** At the end of this lesson you shall be able to

- state the different types of brushes .

**Brushes:** Brushes are made from animal hairs. It is made from pig, goat, bear, bull, sable animals tail, feather of squirrel and other animals birds hair. (Fig 1)

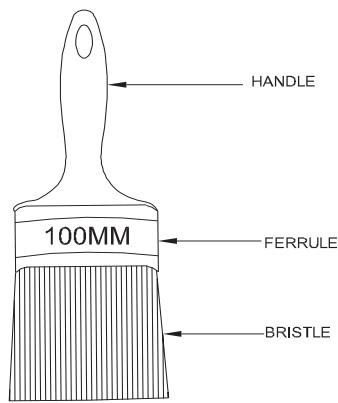
It is medium various shapes. It is used for different colour painting work. Brush has three part

- Bristles
- Ferrule
- Handle

The animals hair are bundled and by applying special cement it is fitted into a metal ferrule. Resin is the cement used to make distemper and varnishing brush. Vulcanized rubber is used for varnish brush distention made from glue or thread is not be used for varnish & oil paint.

Due to this material being flexible, there is as possibility of sticking out of the bristles on back side of the brush. In the industrial field this brush is used to remove the dust, trash, iron chips from the machines. After dipping in water the brush becomes soft and the brush gets spoiled.

Fig 1

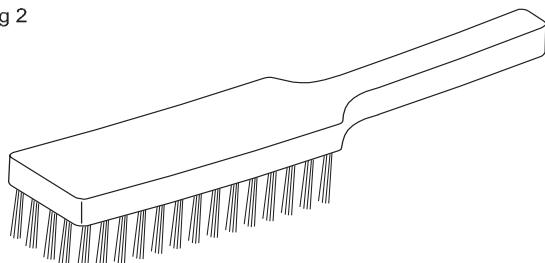


PGN143641

For different types of works different types of brushes are being used. For small and decorative works small brush with soft bristles are used. For big works, 25mm to 100mm brushes with hard bristles are used. There are different types of brushes according to the work.

**Dusting brush:** It is used to clean dust, trash from the surfaces. Some brushes are wrapped with wire and then a specific type of wire has been used by dipping it in gum. Its width is 34' and length 44' and thickness 112'. The bristles are black and brown in colour and it has a short life. (Fig 2)

Fig 2

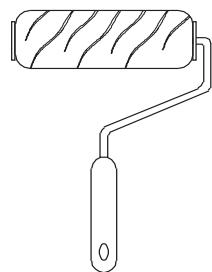


PGN143642

PGN143645

**Roller brush/Round brush:** It is used to painting a large surfaces. It's bristles length is four to five inches. Before dipping it in the paint the bristles have to be tied with good quality of thread. Some brushes are made from rich rubber or vulcanized rubber. The brushes made by this method has long life and its shape is oval and round. These brushes are used for large colors wash. It has to be held at 60° angle and then painted to get good results. It is convenient to do painting by varnish and enamel paint by this brush. (Fig 3)

Fig 3

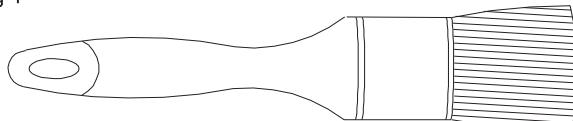


PGN143643

PGN143646

**Sash tool brush:** These brushes are round and sharp. The brush number is determined as per the bristles length. When these brushes are manufactured. Resin cement is applied on it, while some brushes bristles are tied by a thread. (Fig 4)

Fig 4

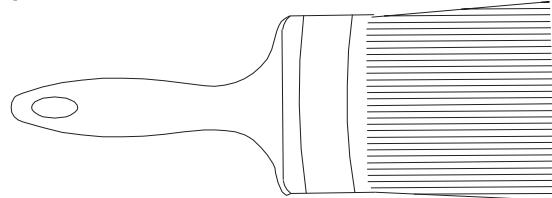


PGN143644

The bristles of these brushes are soft and black in colour and also they are flat and round. As the brush handle is long, with this grill painting is carried out. These brushes are used for rubber setting work.

**Wall brush:** It is called as ground brush. It is used for wall surface painting. This brush bristable width is 100 mm. (Fig 5)

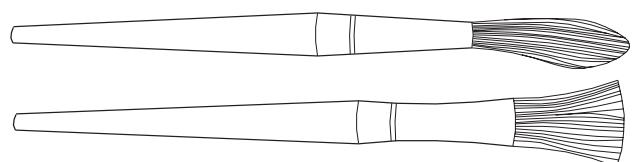
Fig 5



PGN143645

**Flat brush:** These brushes are made with various shapes of handles. Generally these brushes bristles width are 1' to 4 inches only. The hair of this brush is dipped in the chemical of good quality and tied with rubber or thread and applied in a good quality ferrule. By this, the brush becomes stronger for distemper and oil paint. Flat brush is being used this brush is available in three types. (Fig 6)

Fig 6



PGN143646

- a Thick
- b Doodle thick
- c Extra thick

As thick brushes have less hair or bristles the ability to spread colours is less. Extra thick brushes are suitable for this and in large painting works flat brushes are being used. Ex: Building, painting, handling

#### Decorating brush

Decorating brushes are as follows

- a Sample hair brush / synthetic brush
- b Hog hair brush
- c Stencil brush
- d Fan brush
- e Filbert brush

**a Sample hair brush (Fig 7):** This brush is used to do decorative works in the painting work. This brush is made from the hairs of sable animal, squirrel. It is available in two shapes flat and round and it is mainly used for water colour, poster colour and also for signboard painting. In market it is available of from 0 to 18 numbers. If the usage of these two types of hair brush is restricted then nylon or synthetic brushes usage.

Fig 7



PGN143647

**b Hog hair brushes:** Hog bristle brushes are an excellent option for both oil and acrylic painting. The thick coarse nature of hog hair is best suited for medium to thick bodies paints and therefore will not be effective for water colour applications. Hog bristles come in a wide variety of quality.

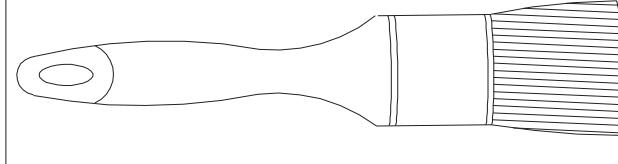
Hog hair brushes have long been used for paint brushes and art brushes because such animal fibres are flexible and resilient and display an excellent capacity for holding paint brushes No. as 2, 4, 6, 8, 10, 12.....etc.,

**c Stencil brush:** Its hairs on bristles are thick and round in stencil brush because of it less bristles a hair good stenciling was can be carried out easily hog hair must is used many times for stencil brush.

**d Fun brush:** It is a thin brush with the spread out in a semi-circle, like a hand-held paper fan. The metal ferrule holds the hairs in this shape. Even when wet, the hairs stay spread out, won't come together to form a point. Its hairs are a bit rough. This brush is used for oil painting in canvas and also used for finishing work.

**e Filbert brush:** The filbert paint brush is used in artwork. It has a thick ferrule and hairs that are on average, medium to long hairs in the shape of an oval filberts are particularly effective in portrait, landscape realism painting and blending work. (Fig 8)

Fig 8



PGN143648

### Maintenance of a brush

- 1 When this brush is dipped in an acid solution the hair falls off, so don't use the acid to clean the brush.
- 2 The paintbrush used for oil painting has to be cleaned with kerosene, thinner and turpentine.
- 3 Do not mix the paint in paint box with a brush.
- 4 Do not leave the brush dipped in varnish open for a long time.
- 5 Don't apply the paint rear portion of the brush.
- 6 After washing the brush should be kept in a right to fit.

## Drawing materials

**Objectives:** At the end of this lesson you shall be able to

- identify man-made and machine-made papers
- state the relationship between the sides of standard size sheets
- designate and state the length and breadth of standard drawing sheet sizes
- interpret the sizes of elongated series in the table
- state the method used in arriving at the standard sizes
- state the sizes elongated series of sheet sizes.

**Drawing paper:** These are two types

- Hand-made paper
- Mill-made paper

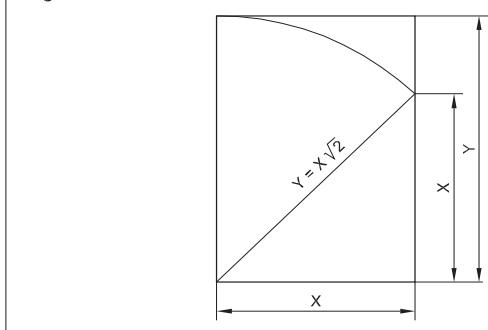
Hand-made papers have rough surfaces, pale in colour and not used for regular work, but meant for charts.

Mill-made papers are most commonly used for regular work, and are available in different sizes and rolls. They are specified by their weight in kg per ream or density in grams per square meter.(GSM)

**Size of drawing sheets (in mm):** While working or handling, the papers are liable to tear on the edges. So slightly large size (untrimmed) sheets are preferred. They are trimmed afterwards. IS:10811:1983 lays down such as designation of preferred trimmed and untrimmed sizes.

The basic principle involved in arriving at the sizes of the drawing paper is as under. The area of the biggest size ( $A_n$ ) is  $1m^2$  and its length and breadth are in the ratio  $1:\sqrt{2}$ . Let  $x$  and  $y$  are the sides of the paper. The surface area of  $A_0$  is  $1m^2$ , then the sides are  $x = 0.841$  m and  $y = 1.189$  m. (Fig 1)

Fig 1



PGN143651

Two series of successive sizes are obtained by either halving or doubling along the length. The area of the successive sizes are in the ratio of 1:2.

**Designation of sheets:** The drawing sheets are designated by symbols such as  $A_0, A_1, A_2, A_3, A_4$  and  $A_5$ .  $A_0$  being the largest. Table 1 below gives the length and breadth of the above sizes of sheets. (Trimmed and untrimmed)

The relationship between two sides is same as that of a side of a square and its diagonal.

**TABLE 1**

Designation	Trimmed size	Untrimmed size
A <sub>0</sub>	841 x 1189	880 x 1230
A <sub>1</sub>	594 x 841	625 x 880
A <sub>2</sub>	420 x 594	450 x 625
A <sub>3</sub>	297 x 420	330 x 450
A <sub>4</sub>	210 x 297	240 x 330
A <sub>5</sub>	148 x 210	165 x 240

For drawings which cannot be accommodated in above sheets, elongated series are used. Elongated series are designated by symbols A<sub>1</sub> x 3; A<sub>2</sub> x 4 etc.

Special elongated series increasing its widths, double, treble etc. are designated as follows A<sub>3</sub> x 3, A<sub>3</sub> x 4, A<sub>4</sub> x 3, A<sub>4</sub> x 4, A<sub>4</sub> x 5. Please refer Table 2

**TABLE 2****Special elongated series**

Designation	Size
A <sub>3</sub> x 3	420 x 891
A <sub>3</sub> x 4	420 x 1189
A <sub>4</sub> x 3	297 x 630
A <sub>4</sub> x 4	297 x 841
A <sub>4</sub> x 5	297 x 1051

**Exceptional elongated series**

Designation	Size
A <sub>0</sub> x 2	1189 x 1682
A <sub>0</sub> x 3	1189 x 2523
A <sub>1</sub> x 3	841 x 1783
A <sub>1</sub> x 4	841 x 2378
A <sub>2</sub> x 3	594 x 1261
A <sub>2</sub> x 4	594 x 1682
A <sub>2</sub> x 5	594 x 2102
A <sub>3</sub> x 5	420 x 1486
A <sub>3</sub> x 6	420 x 1783
A <sub>3</sub> x 7	420 x 2080
A <sub>4</sub> x 6	297 x 1261
A <sub>4</sub> x 7	297 x 1471
A <sub>4</sub> x 8	297 x 1682
A <sub>4</sub> x 9	297 x 1892

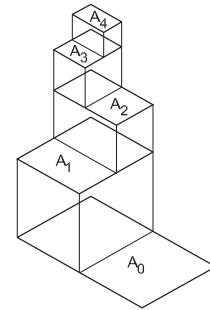
A<sub>4</sub> x 3 means the length of A<sub>4</sub> size is retained and the other side is 3 times the width of A<sub>4</sub>.

$$A_4 \times 3 = 297 \times 630 \quad (210 \times 3)$$

Figs 2 & 3 shows how the sheet sizes are formed by halving/doubling and similarity of format.

White drawing papers which do not become yellow on exposure to atmosphere are used for finished drawings, maps, charts and drawings for photographic reproductions.

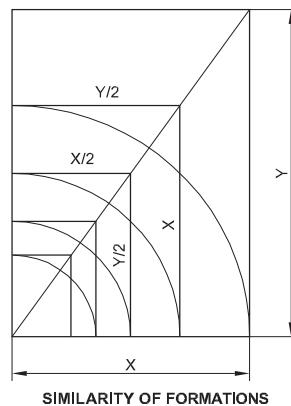
Fig 2



HALVING AND DOUBLING

PGN143652

Fig 3



SIMILARITY OF FORMATIONS

PGN143653

For pencil layouts and working drawings, cream colour papers are best suited.

**Quality drawing paper:** The drawing papers should have sufficient teeth or grain to take the pencil lines and withstand repeated erasing.

A backing paper is to be placed on the drawing board before fixing drawing / tracing paper, to get uniform lines. Before starting the drawing, the layout should be drawn. (Ref: IS:10711)

**Drawing paper types and its uses**

In art work for drawing and painting separate type of papers are used. They are as following types

- 1 Norway drawing paper
- 2 Snow white paper
- 3 Handmade paper
- 4 Mount board
- 5 Tinted paper
- 6 Oil paper
- 7 Art paper
- 8 Crepe paper
- 9 Acid free paper
- 10 Acrylic paper
- 11 Bristol paper
- 12 Canvas paper
- 13 Cellulose fiber paper
- 14 Charcoal paper

- 15 Cotton fiber paper
- 16 Drawing paper
- 17 Hot press paper
- 18 Layout bond paper
- 19 marker paper
- 20 Mixed media paper
- 21 News print paper
- 22 Oil painting paper
- 23 Palette paper
- 24 Pastel paper
- 25 Print making paper
- 26 Sand paper
- 27 Sketching paper
- 28 Tracing paper
- 29 Toned paper
- 30 Unfinished paper
- 31 Vellum paper
- 32 Water color paper

Drawing paper is normally painted with pencil, charcoal. Paster, water colour and poster colour. These paper are available in different size.

Sizes from 224 x 284 to 304 are available. When drawing with pencil on a drawing paper, it is be erased by an eraser.

Commercial painting, advertisement, poster designs are done through different colours on paper. Sometimes pastels, cryons, carbon pencils, paper used for powder shading. The powder shading used except an oil paper.

**Paper and its uses:** Different papers are being used for painting according to the importance of paper it is being used.

**Norway paper:** This paper is not fully white, but it is bale yellow and rough also. Pencil shading is done well on this paper. By envoy the written material by pencil, its top layer gets spoiled and minimize the usage of rubber.

**Snow white paper:** This paper is fully white and smooth. This is used for pencil shading and poster colour pictures. This is mostly used for drawing engineering drawings.

### **Handmade paper**

These are of two types

- 1 Rough handmade
- 2 Matte handmade

Rough handmade paper is rough and on matte handmade paper just like canvas it has got small pares. Hand made paper is prominently used for water colour, portrait and landscape painting before painting on drawing this paper is

made full wet – by dipping it in water and then panoramic it on the board by gum. Even on dry hand made paper water colour painting can be done.

**Mount boards:** Mount board is also called foam core. It is made by pressing light foam piece in between two papers. It is a solid board. It has a thickness range up to 1.4 mm, 1.25 mm & 1.65 mm, 1.65 mm board is believed type of museum quality mount board services to protect a framed photograph on piece of artwork by providing a rigid, sturdy backing to keep photography and artwork form moving or washing in the frame. The thick cartoon cutting frame placed inside to hold the frame firmly is called mounting Mount board – 20 x 28 and its thickness range from 1.5 mm to 3.0 mm. It is mostly used to make posters related to different topics from poster colour. As the paper is thick then it is used to mount the four sides of the drawing or painting with water colour painting is done on the mount board.

**Tinted paper:** This paper is available in different colours in the market. This paper is used to make poster colours, water colour and pastel illustrator keeping the base colour of the tinted paper as it is and using shade & light draw the drawing or painting.

**Oil paper:** To draw drawing with oil colour on oil paint this paper is being used. Due to the specific coating on the paper, the oil cannot absorb the paint, and it retains its shine.

**Art paper:** Art paper is a special coating and hence the need for precise sketching. Art drawing paper is a heavier and better sketching and finished work. The ideal mediums used with drawing paper are graphic, charcoal, dry monochroms soft pastel, oil pastel markers pen and ink. This paper is relatively new surface in the world of paper. Art paper with stand many media techniques commonly used by artists today.

**Newspoint:** Uses this paper for rough sketching on pen work in kalakshetra. This is the most cheaper paper than all others. It is thin and thick white.

**Tracing:** Make any picture, or design as same line that you have to use trace paper. This paper is transparent and the same design repeats it self. It is mostly and widely used in draftsman trade.

**Craft paper:** In the field of painting trace paper is used in handicrafts and jewellery field. This paper is very thin, ensued texture and available in many colour.

**Acid free paper:** Acid free paper may have been trated to make it acid free. Acid free paper does not have acid in it. It is the opposite of acid paper. The treatment includes buffing with calcium carbonate to neutralize the acid in the paper. This acid is absorbed through the age or as the paper ages. Eventually this treatment will wear off and the paper will begin to deteriorate. When the paper is not acid free, it will become yellow.

**Acrylic paper:** Acrylic paper is both delicate line and textured paper that is an ideal size for use with acrylic graphite pencil and acrylic are ideal mediums for this paper.

**Bristol paper:** Bristol paper is a cotton fiber type of paper. It is usually multiply but can be found in one plug and three plug. One plug is ideal for tracing. Bristol is versatile and durable. It is a high standard for drawing paper.

**Canvas textured paper:** Canvas textured paper is ideal for oil and acrylic because it is sized so that oil does not step to the sides of the paper. This paper is ideal for practicing techniques for using paint. This type of paper is often used in school to help while teaching techniques. Coloured pencils, oils, acrylic graphite and painting mediums are ideal for this paper.

**Cellulose fiber paper:** Cellulose fiber paper is made from wood pulp and the most common paper you will find. This paper is acidic but can handle different writing implements and erasing.

**Charcoal paper:** Charcoal paper is 100 percent cotton with a finish that is unique. Charcoal paper is considered a laid paper. It gives you precise control over your medium for shading purposes. The best mediums include monochromes, pastel, graphite, charcoal, and drawing chalks.

There are artists who have used light washes of ink, watercolor, and gouache. It would be best if you kept in mind that this paper is lightweight and cannot accept much water

**Cold press paper:** Cold press paper has been smoothly a little from a cold finish, cold press paper does not have much texture and has weaker tooth than paper that is considered rough paper. However many artists consider the texture of this paper to be just right for them.

**Cotton fiber paper:** Cotton fiber paper is the most durable paper. It is highest quality and handle the most erasing.

**Hot press paper:** Hot press paper undergoes a process that is similar to ironing clothes to smooth the paper. The hot press allows to have the most details on art paper. This type of paper is ideal for drafting ,etching, printmaking, or polished sketching.

**Mixed media paper:** Mixed media paper is a newer type of paper in the art world. This paper was intended to do exactly as its name suggests, which is to withstand many different types of media.

Many feel this paper has qualities of water color, but the drawing surface is like vellum. The best mediums for this

paper are just about anyone from acrylic to watercolor to gel pens and anymore.

**Pastel paper:** Pastel paper is unique because it is smooth in one side and rougher on the otherside. Pastel paper is best for pastels. You can use the charcoal and drawing chart.

**Print making paper:** Print making paper is a versatile and heavy weight paper. It is the perfect size for a large number of printing inks it is used for many drawing styles such as woodblock, lithography, fine drawing and aquatint. It is ideal medicines for print making papers are water color, drawing chalks, graphite.

**Sand paper:** Sand paper can be used for drawing. This light sand paper. This light sand paper is intended for heavy application of media while remaining rough. When you use sandpaper for a drawing, it has a smoky look to it because the paper is often visible in areas. The best medium for sandpaper is a pastel pencil or a coloured pencil.

**Sketch paper:** Sketch paper is most often used for practice, experimenting with new media, and a quick mark up of what will be completed on a heavier paper. Sketch paper is lighter than drawing paper. Many artists have a sketch book with this type of paper when they keep items to use for reference later. Colored pencils, graphite, monochrome chalk, oil pencils, and charcoal drawing chalk are the best medium for this paper.

**Toned paper:** Toned paper comes in shades : blue, gray, and tan. The tone of this paper gives the ability to sketch and draw on mid - range colored paper to give it a different look. In addition, it allows you to use light and dark values to make it easier for highlights and shadows.

**Vellum paper:** Vellum is a paper that is translucent and has a variety of uses, especially for arts and crafts. It is used as tracing paper but also can cover art or be used as decoration. Graphite markers, chalk, pastels, markers, and coloured pencil are the perfect medium.

**Water color paper:** Water color paper is the largest category of paper. It comes in a wide variety of weights and textures. Typical weights include 90lb,140lb, and 300lb. The higher the weight means, the stiffer the paper is. Often, artists will stretch 90 and 140lb paper to prevent it from moving while painting.

## Painting knives

**Objective:** At the end of this lesson you shall be able to  
• state the different types of Knives.

**Painting knife:** The terms painting knife and palette knife are often used interchangeably when describing the technique of applying paint to a surface with the blade of an artist's knife. Both tools are made of either plastic or of wood and metal. Both are available in a variety of blade shapes and sizes. A palette knife handle is generally

straight, having at most a slight bend. The purpose of the palette knife is to mix colours or clean the surface of the palette. On the other hand, a painting knife has a deep bend in the handle that keeps the artists knuckles out of the paint. As its name indicates, a painting knife is used for actual painting.

Apply paint with knife is to achieve the desired thickness and swirls of paint. The knife as a conductor would hold a bar on and change the angle of the knife to the board to achieve the desired effects. A clean palette knife is essential for changing the art colors. To remove paint from the blade, simply wipe it with a clean cloth or paper towel. Carefully inspect the painting knife after each stroke once paint has begin to accumulate on the board.

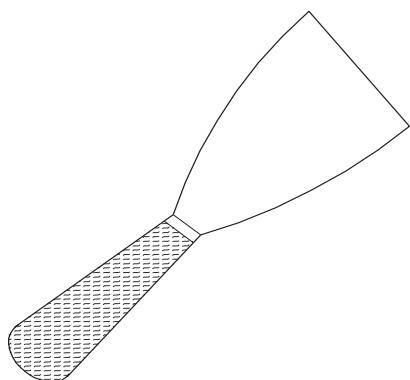
**Choosing the painting knife size:** Smooth relatively flat areas can be painted with a large blade, So the larger painting knife is used for laying in large areas of paint. water or sky.

**Knives:** Knife has got an importance in the painting field. The following works are carried out by knife paper cutting, stenciling, removing old putty scraping of colours, putting fill up and glass cutting work.

#### Functions of knife

**Scraper knife:** It is made of high quality steel and flat and whose front is sharp and taper. It is made up of wood, plastic on metal and its handle is riveted to the scraper. It is used to remove the old paint by scraping and removing the heat – softened wall paper. (Fig 1)

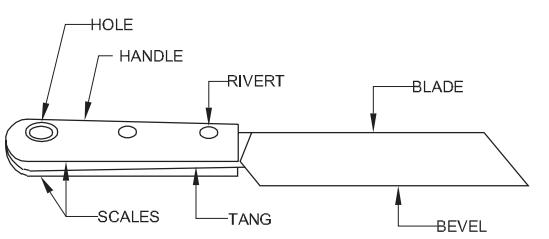
Fig 1



PGN143661

**Hacking knife:** With this knives sharp can scrape the old putty and remove it. Its handle is made of wood and fitted by rivet. Its blade is of high quality steel and tapered. It is used to scrape the dried putty from windows for glass pane from the windows frame the hardened putty can be removed with a hammer by its thick blade. (Fig 2)

Fig 2



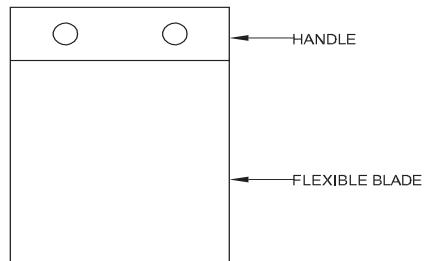
PGN143662

**Putty knife:** In spray painting and building painting used to fill the putty on the surface holes and to remove the excess putty on the painting surface sharpen and its blade are made of thin spring steel. For removing spray painting from 1 to 4 mm With 2 to 8 mm putty knife on walls and large surfaces the putty can be applied putty for painting. As per the given shape putty knife are of two types.

A Rectangular thin piece of spring steel sheet.

The knife should be cleaned after the putty is filled. If the old putty gets stitched to knife then this putty cannot be filled again with this knife. (Fig 3)

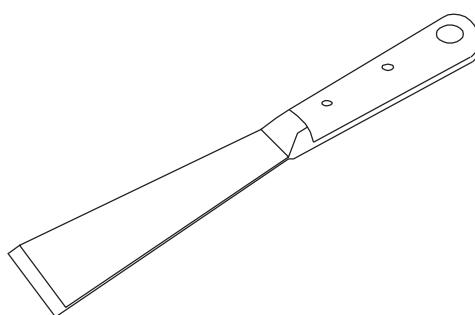
Fig 3



PGN143663

**Palette knife:** A palette knife is a blunt tool used for mixing & applying paint, with a flexible steel blade. Its length is three to six inches and the blade sits in the handle. Its handle is made of wood or plastic. It is used to remove paint or to mix oil colour in a palette. (Fig 4)

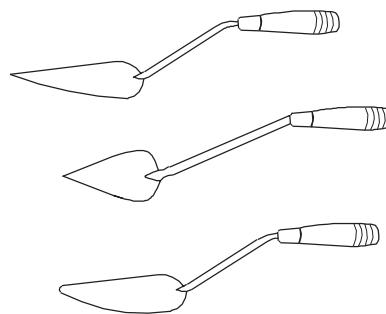
Fig 4



PGN143664

**Painting knife:** It is made of stainless steel. It is similar to palette knife and its blade is small and that is why it is not flexible painting knife is used to take oil colour or acrylic colour from palette and carry on the painting. The painting done by this knife is called painting knife. (Fig 5)

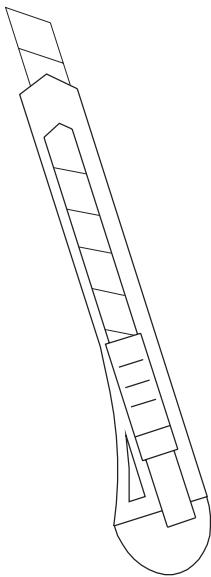
Fig 5



PGN143665

**Stencil knife:** This is made from good quality steel. Its blades are sharp. It is to be used carefully with this knife stencils can be cut or sharply with this you can cut stencils on to drawing paper, oil paper and cartoon while stenciling you have to keep glass underneath the paper. (Fig 6)

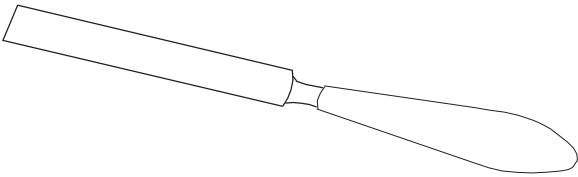
Fig 6



PGN143666

**Glazier putty knife:** It is made of good steel and metal. In this wooden handle is there and is fitted by riveting. On the steel frame of windows glass pane putty can be filled by fingers and then with glazier knife it is made plain. As the knifes sides are sharp the struck putty on the window pane can be removed easily. (Fig 7)

Fig 7



PGN143667

### Diamond glazier knife (Fig 8)

This knife is divided into three parts

- a Head
- b BGDT
- c Handle

Fig 8

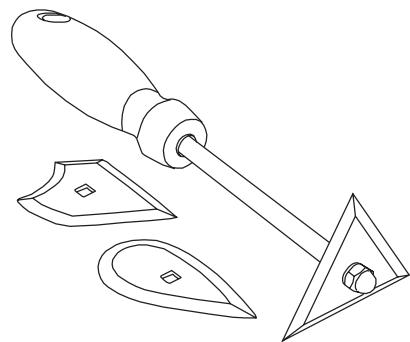


PGN143668

Diamond is fit end on the tip of its head, which is being used to cut the glass. It is also called as glass cutter. In this knife there are holes according to the thicknesses of glass and the glass is separated by drawing a line and holding it in the hole. If the glass is not cut properly and it has to be done in 90° triangle line, then with the help of cutting, an attempt is made to cut the glass little by little. Glazier knife is made of thick and fine steel.

**Shave – hoot knife:** Shave hoot knife tighten the blade to the front of the rod six to eight inches and the rod is fitted into the wooden handle. To clean the moulding this tool is being used. Its blades are sharp, square and triangular in shape. It is used to cut the wall cracks. It have three types of blades and it can be easily remove and refit it on the handle. (Fig 9)

Fig 9



PGN143669

## Painter (General) - Lettering Types

## Lettering and their types

**Objectives :** At the end of this lesson you shall be to

- recognise different lettering types
- decide standard proportion for height, width and spacing of letters
- devanagari letters history
- hand lettering tools and instruments
- lettering calligraphy tools & design.

Apart from graphical elements (lines, arcs, circles etc) technical drawings and art will also contain written informations.

These written informations are referred as "lettering".

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

Fig 1

<b>ABCDEF GH</b>	GOTHIC ALL LETTERS HAVING THE ELEMENTARY STROKES OF EVEN WIDTH ARE CLASSIFIED AS GOTHIC
<b>abcdefgh</b>	
<b>ABCDEF GH</b>	ROMAN ALL LETTERS HAVING THE ELEMENTARY STROKES "ACCENTED" OR CONSISTING OF HEAVY AND LIGHT LINES ARE CLASSIFIED AS ROMAN
<b>abcdef gh</b>	
<b>ABCDEF GH</b>	ITALIC ALL SLANTING LETTERS ARE CLASSIFIED AS ITALIC. THESE MAY BE FURTHER DESIGNATED AS ROMAN-ITALICS, GOTHIC-ITALICS, TEXT-ITALICS
<b>abcdef gh</b>	
<b>ABCDEF GH</b>	TEXT THIS TERM INCLUDES ALL STYLES OF OLD ENGLISH, GERMAN TEXT, BRAELEY TEXT OF OTHERS OF VARIOUS TRADE NAMES. TEXT STYLES ARE TOO ILLEGIBLE FOR COMMERCIAL PURPOSES
	PGN154711

**Lettering:** Letter writing is a type of art. In which each letter of the sentence serves as an illustration. Every letter is made with the utmost care and it plays an important role in that creation. Syllables usually root doesn't get translated into letters because that particular word is made with that in mind.

Lettering includes comic book (story book), decoration, sign board painting and graphics design. Eg., Posters, letter heads, logos, advertisements etc.,

There are five types of lettering.

- 1 Block lettering
- 2 Roman lettering
- 3 Italic lettering
- 4 Ornamental text lettering
- 5 Devanagari (Balbodh) lettering

**1 Block lettering:** The letters which are composed of the same thick components on all sides are called Block lettering. (Fig 2)

- 1 Mechanical spacing) (Fig 2a)
- 2 Optical spacing (Fig 2b)

Fig 2



PGN154712

**2 Roam lettering:** The English letters which are arranged in the composition of thin and thick components of the same size are called Roman lettering. (Fig 3)

Fig 3



PGN154713

**3 Italic lettering:** Letters of any type drawn diagonally are called Italic lettering. (Fig 4)

Fig 4



PGN154714

**4 Ornamental text lettering:** The letters which are made in beautiful, ornament form are called text, ornamental or modern lettering. (Figs 5 & 6)

Fig 5



PGN154715

Fig 6



PGN154716

**5 Devanagari (Balbodh) lettering:** The letters which are placed at a specific place in the composition of thin and thick components are called Devanagari/Balbodh lettering. Devanagari lettering is used in all regional languages in India, hence it is considered as popular lettering. (Fig 7)

Fig 7



PGN154717

**6 Correct lettering spacing:** ‘Correct letter spacing’ means the correct spacing between two letters. Instead of taking out beautiful letters, one should try to keep the spacing between the letters uniform, this is very important. Because new students find it troublesome how to keep the spacing. This means it is very important to know how to keep spacing in them instead of extracting beautiful characters. While learning the composition of letters, considering its composition, one should be uniform and beautiful, just as the pages of the book are in a similar tone. There appears to be incompleteness in some of the proofs. That is, keeping the correct spacing of letters with the help of eye sight is called ‘optical equalized spacing’. This is called correct spacing. Keeping this simple thing in mind from the beginning soon makes sense. There are two type of letter spacing.

1 Different letters under the composition and the space they take cannot be used in the same proof.

- 2 Spacing instead of using letters, the letters can be read by keeping the spacing slightly less than half its spacing.
- 3 For convenience three divisions of letters are made.
  - a Regular E F H N U
  - b Irregular AIJKLMNOPQRS
  - c Circular-BCDGOPQRS
- 4 While writing the circular letter, fill in the remaining letters in the space against the evidence against it.
- 5 If the spelling is reduced in these regular and circular shaped letters those letters can be read.

It is essential to practice writing alphabets in Roman script, in Devanagari script or other scripts Writing letters correctly and well is a part of painting. Whose lettering is good, that painter needs beautiful letter writing for sign boards, function boards for exhibition, wall pictures, advertisements, book covers, greeting cards. Roman script is used for English and Devanagari script is used for all languages. The basic composition of this script is decided according to the rules. In the method of writing letters with Boru, the upper line is shorter and the lower line becomes thick, in this way Boru is caught. In the Devanagari script, the right end of the thickness of the boru is held up and the left end of the boru is held down in this way.

- 1 It is also necessary to think about the letters for which it is going to be used, if the letters are to be made for the poster, then they should be clearly visible even from a distance. Delight and good consistency are essential in the lettering of the greeting card. The main purpose of the letter is to make the subject effective for which letters are being used.
- 2 The letters should be big enough that the board or paper on which they are written looks attractive. Must be of proper size and in the right place.
- 3 All letters must be the same. If all the letters are diagonal, they will look the same. It works even if the shape changes, but the artistry should not be harmed in any way.
- 4 Use bright colours to paint the letter so that it looks attractive on the colour of the background.
- 5 Always keep the surface clean while doing lettering work. Take care that the surface is not damaged. Give importance to the outline of the lettering rather than painting the letter.

**Painting (Fig 8):** There are two main type of letters in English.

1 Upper case or Capital letters

2 Lower case or Small letters

When capital and small letters are arranged together, the letters are divided vertically into four parts.

Top line              Middle line

Base line              Drop line

Fig 8

# Painting

PGN154718

**Calligraphy:** It is a visual art related to writing. Making ornate compositions of letters with the help of writing instruments such as boru, pen, brush, cut nib, marker is called calligraphy. At present calligraphy has become a part of inscription art work in fine art. Pen and brush are the main tools of calligraphy. The pen of calligraphy is flat, circular or pointed. According to the decoration. Cut nib, Mult nib are used. Apart from this, calligraphy work can also be done excellently with felt-tip and ball point pen. The calligraphy pen should be held vertically at the top of the page for straight downward strokes. If you want to apply curved strokes, then the pen should be held in 45 degrees as shown in the Fig 9.

Fig 9



PGN154719

**Boru (Bamboo pen) (Fig 10):** Boru is made from thin bamboo. The front part of the bamboo is chamfered. Due to this, after immersing in the Boru ink, the ink remains in its hollow part and that ink comes out while writing by pressing on the paper. Every time Boru has to dip in ink. Devanagari and English calligraphy characters can be written well by Boru. While writing with Boru, a thin line is formed where the letters are twisted, while a thick line is formed in the horizontal and vertical place. With the practice of Boru, it becomes easier to make letters with a brush. This allows the hand to gain momentum and practice writing Devanagari and cursive calligraphy letters. It also practices letter strokes.

Fig 10



PGN15471A

**Cut nib (Fig 11):** Cut nib & dip pen, is a type of fountain pen, which is written using ink. Nibs are made from a variety of materials and in different sizes and types. The tip of a cut nib is cut, so it is called a cut nib. Thick letters can be made from this nib due to the excessive amount of ink coming out. Due to the flattening of the nib, where the letter or design is bent (curve), a thin line is formed while the straight and vertical lines become thick. Devanagari alphabets, English Roman and cursive calligraphy can

be made exquisitely with cut nibs. The cut nib is used for writing greeting or certificate.

Fig 11



PGN15471B

The pen should be held in 45 degrees while writing with cut nib.

**Marker pen:** The marker pen is filled with ink. It has a tip to release the ink. The types of markers are decided according to its size. These are as follows

- a Round marker
- b Flat marker (also called chisel marker pen)

**a Round marker:** Since the tip of the round marker is round, it is used to write letters of equal thickness. (Fig 12)

Fig 12



PGN15471C

**b Flat marker:** Its tip is flat and slanted from one side, hence it is called Flat marker or Chisel type marker. This marker is used to write Devanagari or Roman letters. Markers are used more for calligraphy works. Both the above mentioned markers are available in the market in different tip sizes. There are two types of marker ink. (Fig 13)

Fig 13



PGN15471D

- a Regular ink marker
- b Permanent ink marker

Regular ink is written on paper with a marker. Its ink is wiped off when writing on other things. Permanent markers can be written on paper, cloth, glass, aluminium or plastic and cannot be erased. Its ink is made from toluene and xylene in solvents, both of which are harmful and have a strong colour.

**Flat lettering brush:** Devanagari, Roman letters and calligraphy can be done in the best way with Boru. Cut Nib or chisel marker pen. But with these means one or one and a half inches high or smaller lettering or calligraphy can be done. For lettering larger than this, a flat brush is used. Since this brush is flat, it can be used to do direct Devanagari or Roman lettering instead of sketching. The thickness of the brush. Small letters can be written with a small brush and capital letters with a big brush. When this brush is flat, when lettering on the surface, the curved side (curved part) is written thin and the horizontal or vertical side is thick. Flat lettering brush hairs are slightly longer and soft fitted into fine ferrules. These days synthetic flat lettering brushes are available in the market. (Fig 14)

Fig 14



PGN15471E

Even more suitable lettering works can be done. The colour comes in the brush made from animal hair and these brushed become hard after being in water or colour. Lettering can be done better with a sable brush than with a synthetic or nylon brush. To do lettering with a flat brush, it is very important to have control over the hands and this is possible only with constant practice. Lettering and engraving can be done well with this brush. This brush is used for sign boards.

### Hand lettering tools and instruments

Tombow dual brush pen marker (set of 10)

Tombow hard-tip brush pen marker (set of 10)

staedtler lead holder

Tombow for ink of pencil mono sand eraser

Rhodia graph black note pad

Strathmore 9"x12" Tracing pad

Bristol 9"x12" pad

Staedtler mars technico

Felt pens

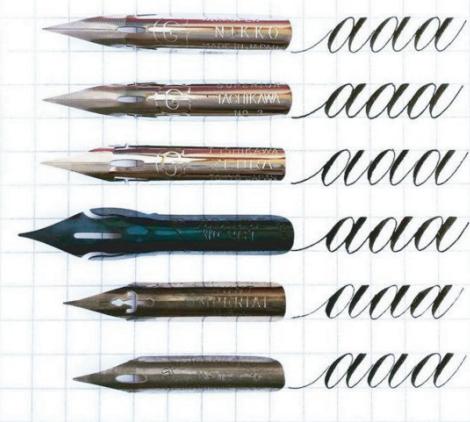
Brush pens

Nib pen - The tool of the calligrapher

Flat pen

### Lettering and calligrapher tools (Fig 15)

Fig 15



PGN15471F

- Light table
- Tracing paper
- Tombow mono zero eraser
- Kneaded eraser
- Rolling ruler
- Composition ruler
- Microphone stand
- Video light
- Scanner
- Art supplies storage box
- Eye dropper
- Flat brushes
- Gouache

Calligraphy is a visual art associated with writing art of Calligraphy script reference chart is given below will help you to draw fine art. (Fig 16)

Fig 16

Script Reference Chart

	A	B	C	D	E	F	G	H	I	K	L	M	N	O
ROMAN & LATE ROMAN SCRPTS	λ	β	γ	δ	ε	ϝ	Ϛ	Ϛ	Ϛ	Ϛ	Ϛ	Ϛ	Ϛ	Ϛ
	ѧ	ܾ	ܷ	ܸ	ܹ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ
	ܶ	ܷ	ܸ	ܹ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ
INSULAR & NATIONAL SCRPTS	ܶ	ܷ	ܸ	ܹ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ
	ܶ	ܷ	ܸ	ܹ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ
CAROLINE & EARLY GOTHEIC SCRPTS	ܶ	ܷ	ܸ	ܹ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ
	ܶ	ܷ	ܸ	ܹ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ
GOTHIC SCRPTS	ܶ	ܷ	ܸ	ܹ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ
	ܶ	ܷ	ܸ	ܹ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ
ITALIAN & HUMANIST SCRPTS	ܶ	ܷ	ܸ	ܹ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ
	ܶ	ܷ	ܸ	ܹ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ
POST-RUNESIAN SCRPTS	ܶ	ܷ	ܸ	ܹ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ
	ܶ	ܷ	ܸ	ܹ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ	ܻ

PGN15471G

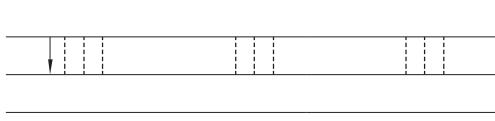
**Method of draw letters line:** Various methods of line drawing used for writing alphabets. They are as follows (Fig 17)

- 1 Standing lines
- 2 Slanting lines (Right)
- 3 Sleeping line
- 4 Slanting line (left)
- 5 Zig Zag line
- 6 Curves
- 7 Bumps
- 8 Circle

**Script reference chart (Fig 17)**

Fig 17

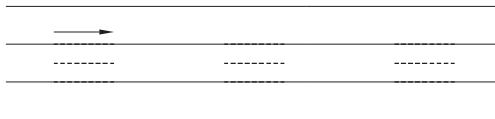
STANDING LINES



SLANTING LINES (R)



SLEEPING LINES



SLANTING LINES (L)



ZIGZAG LINES



CURVES



BUMPS



CIRCLE



## Hand writing

**Objectives:** At the end of this exercise you shall be able to

- identify the different type of letters
- state the method of draw a different sketches.

**Introduction on hand writing:** In our country people's are used to communicate their message from one person to another person by oral language, body language and written language.

Every language have their own style of letters to write and communicate their message by writing.

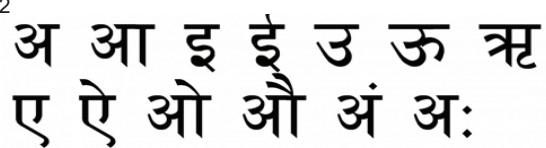
Letters are draw by art of lines as follows. Tamil letters design (Fig 1)

Fig 1



Hindi letter design (Fig 2)

Fig 2



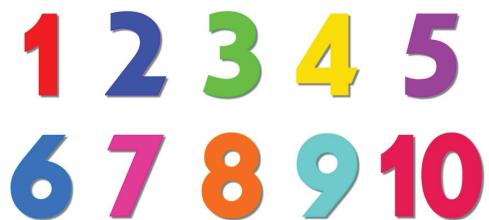
Example of English writing text letter (Fig 3)

Fig 3



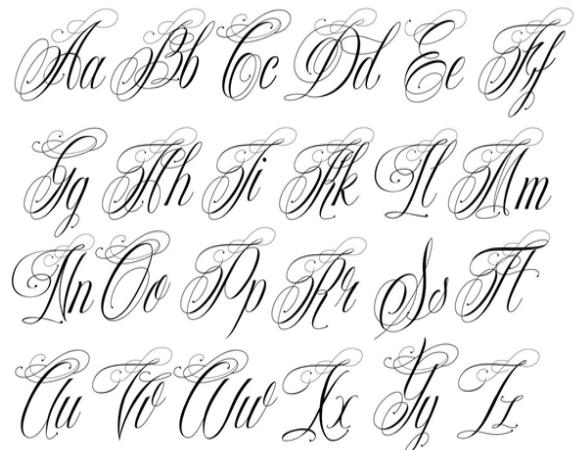
Numerical letters graphic design sample (Fig 4)

Fig 4



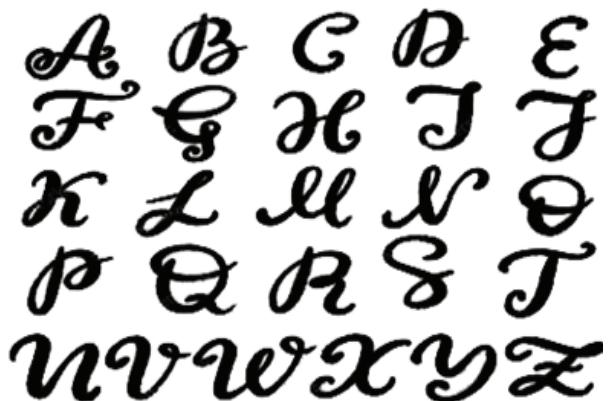
Example of English writting style (Fig 5)

Fig 5



English letters graphic design sample (Fig 6)

Fig 6



## Carpenter work safety and carpenter tools

**Objectives:** At the end of this lesson you shall be able to

- state the safety precaution on carpenter work
- state the use of carpenter hand tools
- state the types of wood and common defects in timber.

### Introduction of carpenter work

Carpentry is working of wood cutting, shaping polishing, assembling and installing of assembled materials on their location marked to fix the assembled part.

Carpenter makes, assemblies alters and repairs wooden structures and articles. Study the wooden structure sample structures and articles. Study the wooden structure sample drawing before start the wood work and select the timber to suit the requirements. Repair the damaged wooden parts.

Safety precaution on carpenter work:

Safety precaution is most important to wood work craftsman for protect him/her self from any accident happen during work. The following safety precautions to be follow while on wood work.

- Select the proper tools and avoid wear loose clothing.
- Ensure the tool condition is in good condition
- Select the suitable wood for structure or articles in similar manner.
- Marks them to size by using square scriber and other tools
- Saws chisels and planes wooden pieces to required sizes.

### Introduction of carpentry hand tools

**Objective:** At the end of this lesson you shall be able to

- introduction of carpentry hand tools.

Carpentry hand tools are listed as per the following:

- 1 Marking and testing tools  
(e.g) scriber, spirit level, try squares, marking gauge etc.,
- 2 Holding and supporting tools  
(e.g) mitre box, work table, clamps etc.,
- 3 Measuring tools  
(e.g) Foot rule, tape rule, caliper etc.,
- 4 Cutting tools  
(e.g) saws, chisels etc.,
- 5 Planing tools  
(e.g) Planes, spoke shave etc.

- Check parts frequently with square, foot rule measuring tape and ensure corrections.]
- Assembling the parts and secures them in position by screwing, nailing or drawing.
- Ensure the assembled structure is match with drawing or sample.
- Glue the parts together
- Smoothen and finish the surface with sand paper and article made by you.
- Sharpen the tools as required condition.
- When you finish work with a tool, clean and keep it in shape place.

**Note:** Accidents donot happen they are caused, most accidents are avoidable. A good craftsman should be having a knowledge of various safety precautions.

The shop floor should always be kept clean and free from debris, otherwise it may cause us to slip over and fall on it.

- 6 Boring tools  
(e.g) Hand drill, auger, bits, twist bit, etc.,
- 7 Striking tools  
(e.g), Hammers, mallet etc.,
- 8 Driving tools  
(e.g), Screw driver, spanner's etc.,
- 9 Miscellaneous tools  
(e.g) Punches, Pincer etc.,
- 10 Abrasion tools  
(e.g), File, oil stone etc.,

# Classification and uses of marking tools

**Objectives:** At the end of this lesson you shall be able to

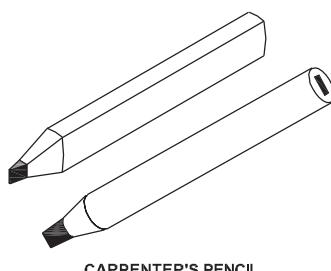
- state the different type of marking tools
- explain the use of marking tools
- brief constructional features of marking tools.

Marking off or layout is carried out to indicate the location of operation to be done and provide guidance during sequence of operations.

- Marking out is done with pencil or scribe etc.,

## Carpenter's pencil (Fig 1)

Fig 1

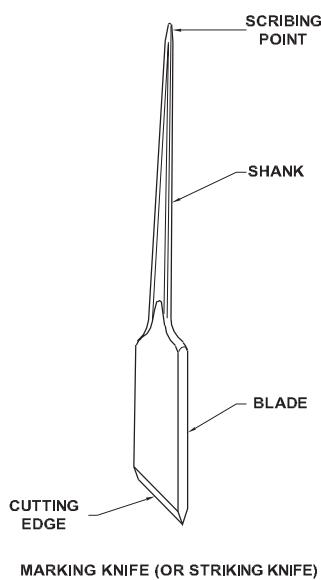


PGN165311

- Carpenter's pencil usually is an oval cross-section.
- It is sharpened with a chisel.
- The pencil is not used for an accurate work.
- Suitable pencil hardness for marking out on 'HB', 'H' and 'F'

## Marking knife (Fig 2)

Fig 2



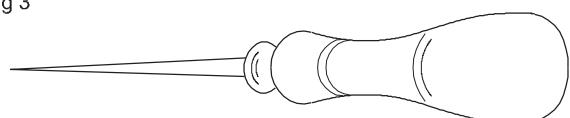
PGN165312

It is made of steel fashioned to a point at one end and a sharp blade at the other end to form a cutting edge. The blade or knife is used for marking cut lines where a vertical shoulder is to be cut with a saw or chisel. The point is used for marking distances and scribing lines.

## Steel scribe (Fig 3)

A steel scribe should be sharp at its point. It is used for scribing lines on which a chisel cut or a saw cut is made.

Fig 3

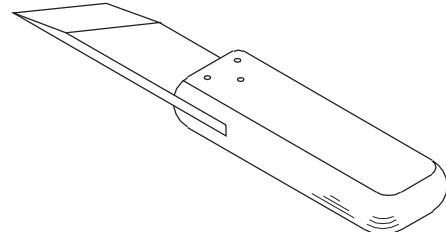


PGN165313

The scribe should not be used as an awl. Do not strike the handle with a hammer.

Marking knife is also used for marking and scribing .It is a steel blade fixed in a wooden handle. it serves the same purpose as that of scribe. (Fig 4)

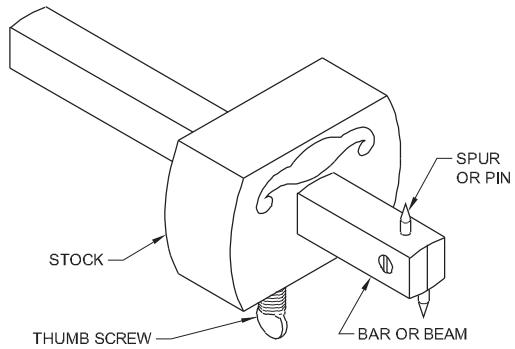
Fig 4



PGN165314

## Marking gauge (Fig 5)

Fig 5



PGN165315

Marking gauge is used for marking lines parallel to a face and edge (e.g) gauging width and thickness.

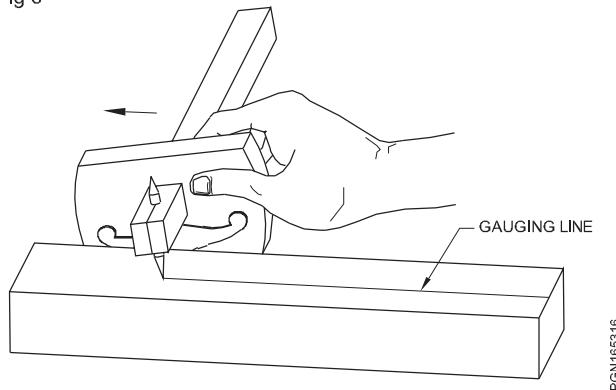
The marking gauge can be made of wood or steel. The gauge consists of square, wooden bar or beam on which wooden block or stock is sliding. This block can be fastened at any required measurement by use of a thumb screw.

In better form of gauges the stock is protected from wear by a piece of brass set flush with surface. The bar is graduated in millimeter and provided with a spur or steel point at the end. It is always advisable to measure the distance from the spur to the face of the block, with an 'ordinary rule'.

The gauge is set by loosing the screw and the stock is shifted to the distance required from the spur. Measurement are taken from a rule.

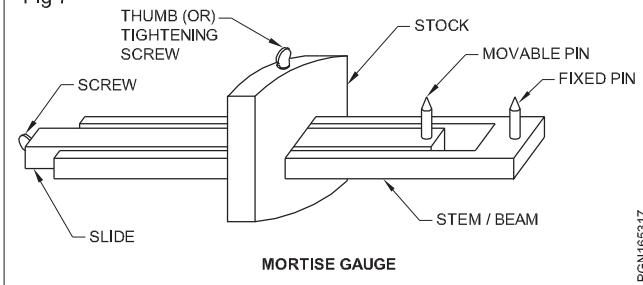
After setting the screw is tightened while gauging the stock is firmly held against the wood and pushed in forward direction. (Fig 6)

Fig 6



### Mortise gauge (Fig 7)

Fig 7



A mortise gauge is a marking gauge with two spurs. The two spurs can be spaced at different distances and mark two parallel lines at a time.

This is made of hard wood and has an adjusting screw in the end of the beam.

The screw moves one of the spurs up and down as desired. The other side of the beam is fitted with a single point as no the ordinary marking gauge.

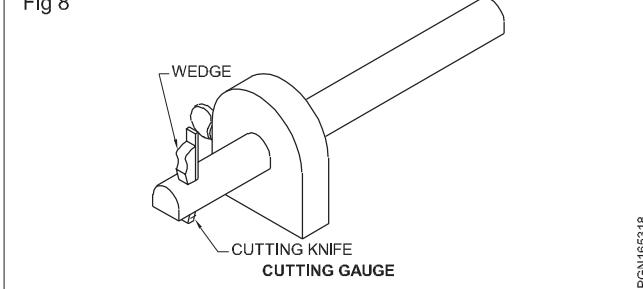
The gauge is used for marking mortises and tendons, and similar joints using parallel lines.

Stem/beam and stock made of beech wood. Thumb screw made of box wood. Pin or spur made of steel.

### Cutting gauge (Fig 8)

This is just the construction of a marking gauge.

Fig 8

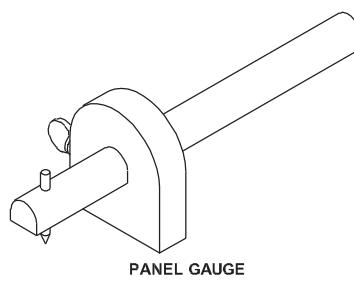


At the end of the stem scribing knife is fixed with aid of one wedge. By loosening the wedge, the length of knife may be increased or decreased. In broad planks scribing marks can be marked with this gauge.

Deep marks can be scribed with this cutting gauge for making grooves, rebates and dovetails. It is possible to cut thin strips of timber and plywood upto 3mm thick.

### Panel gauge (Fig 9)

Fig 9



This is just like single marking gauge but the stem and stock are long. The length of stem is 450mm. In planks longer than 150mm scribing marks are made with the panel gauge.

### Trammel points (Fig 10 & 11)

Fig 10

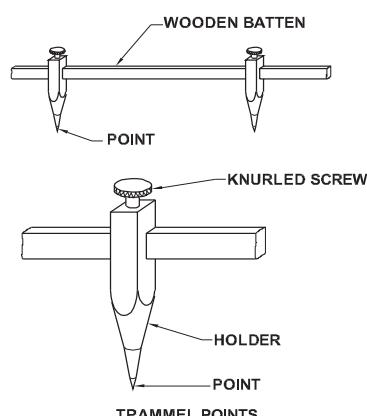
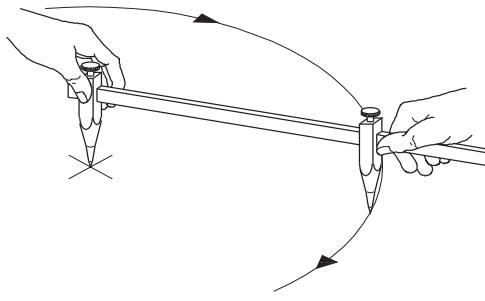


Fig 11



Trammel points are used for laying out larger circles and arcs.

Two sliding points are fastened to a wooden batten or a steel rod at any distance required from each other by turning the knurled screw. The point is fastened to the batten or steel rod.

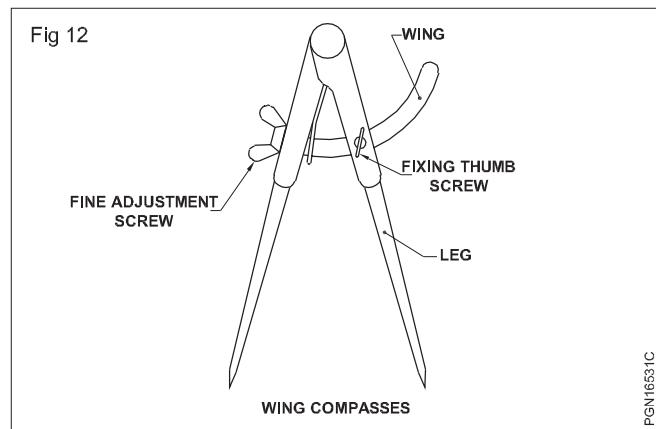
**Wing compass;** If consists of a pair of dividers (legs) made of steel.

The legs are sharpened to points and at the top they are riveted or screwed.

They are fixed at the required radius by means of a set screw. (Fig 12)

### Uses

- 1 For setting out arcs of circles.
- 2 To transfer the measurement from the steel rule to the job.
- 3 To mark curves.



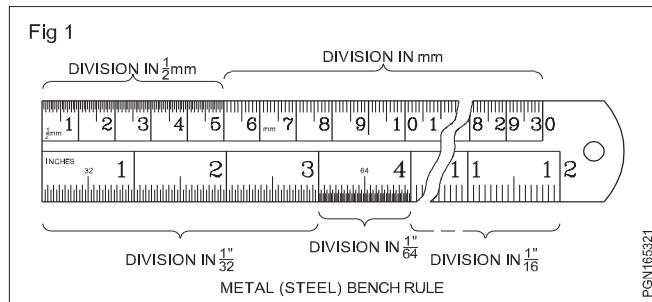
PGN16531C

## Measuring and testing tools

**Objectives:** At the end of this lesson you shall be able to

- state the different types of measuring and testing tools
- explain the use of measuring and testing tools
- brief the constructional and features of measuring and testing tools.

### The Rule (Steel) (Fig 1)

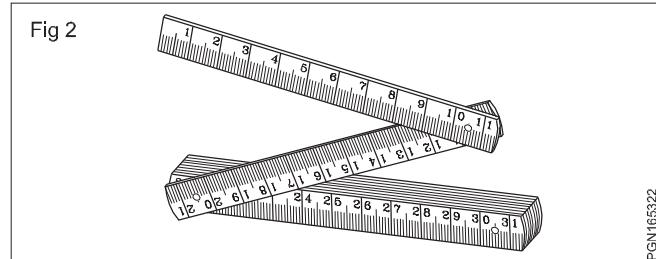


- In the workshop wooden or steel rules are used
- The division in cm is 30cm long and sub divided in mm (2) and half mm (3).
- The division in inches is 12 inches (12") long twelve inches equals one English foot 12" = 1'
- The Sub division is accurate in 1/16" (4) in 1/32" (5) and In 1/64" (6).
- For the conversion of parts of an Inch in to the metric system (with units: m, cm, mm) a conversion table might be useful.

1/16"	=	1.6 mm
2/16"	=	1/8" = 3.2 mm
3/16"	=	4.8 mm
4/16"	=	1/4" = 6.35mm
5/16"	=	8.0mm
6/16"	=	3/8" = 9.5mm
7/16"	=	11.1mm
8/16"	=	1/2" = 12.7mm
9/16"	=	14.3mm
10/16"	=	5/8" = 15.9mm

11/16"	=	=	17.5mm
12/16"	=	3/4"	= 19.05mm
13/16"	=	=	20.6mm
14/16"	=	7/8"	= 22.2mm
15/16"	=	=	23.8mm
16/16"	=	1"	= 25.4mm

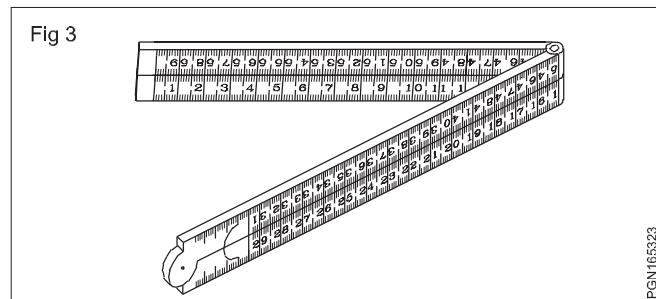
### Collapsible Carpenter's rule (Zig-Zag) (Fig 2)



It is also called Zig-Zag rule. It consists of 10 pieces each loosely riveted to one another. Each piece is 10cm long and total length is 1 metre.

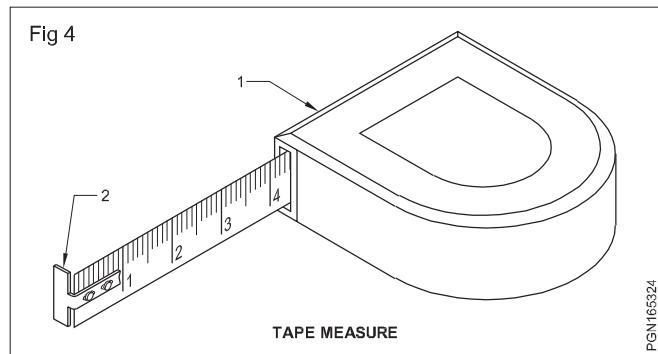
Longer distances can be measured with this rule. Sometimes it contains British system measurements on the other side.

### Folding Rule (Foot rule) (Fig 3)



It is also called foot rule. It has four folds each of which is 6 inches or 150mm long. It is joined in a plastic a metallic hinge. After taking measurement, keep the scale folded and free from dust. It is easily carried in packets. Metal clip is provide at the end of this rule to avoid wear and tear.

### Tape measurement Rule (Fig 4)



Tape measures are used for longer measurements. The tape is made of steel and is durable and accurate. When not in use, the tape should be kept in the box. Division are made in centimeters or in inches.

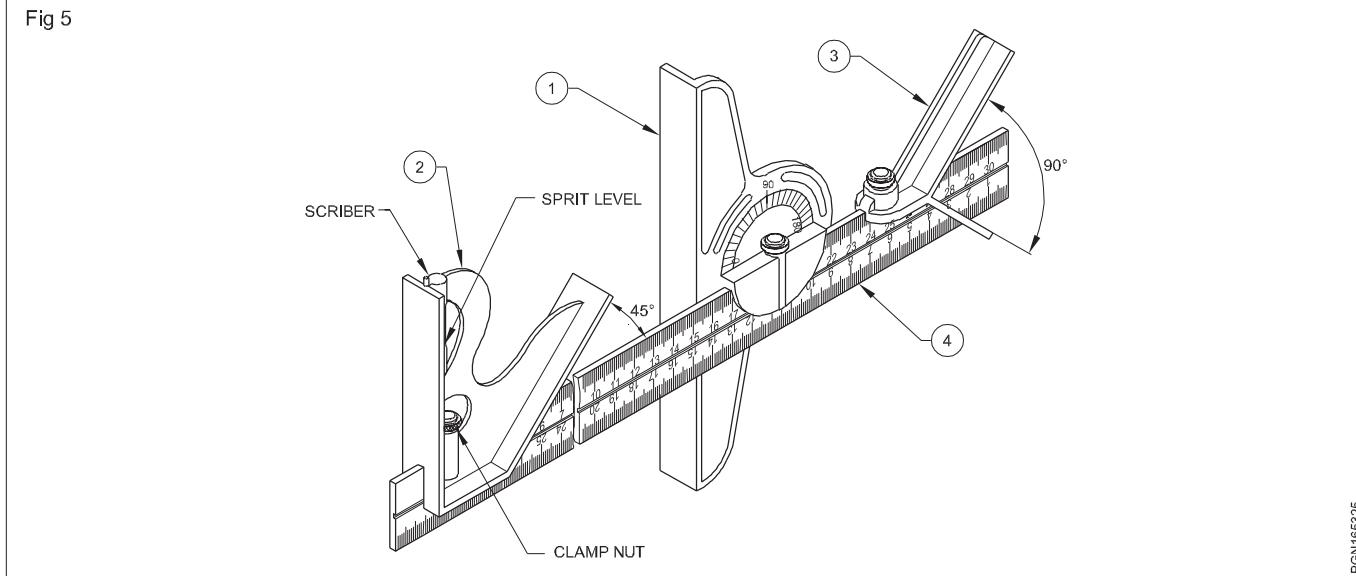
Tape measure has a sliding end piece for inside and outside measurement.

### Combination set

Combination sets can be used for different types of work, like layout work, measurement and checking of angles.

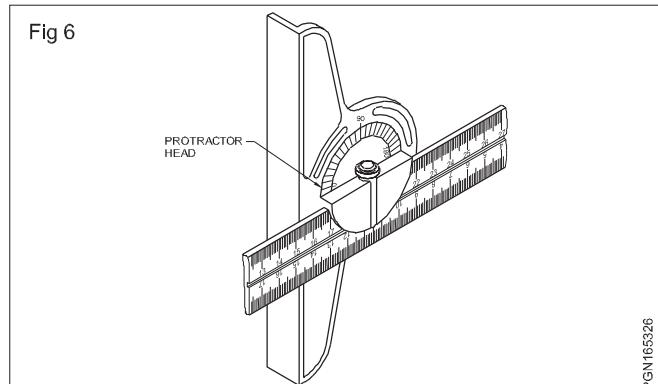
### The combination set has a (Fig 5)

- Protractor head (1)
- Square head (2)
- Centre head (3)
- Rule (4)



**Protractor Head:** The protractor head can be rotated and set to any required angle.

The protractor head is used for marking and measuring angles within an accuracy of 1°. The spirit level attached to this is useful for setting jobs in a horizontal plane. (Fig 6)



**Square head:** The square head has one measuring face at 90° and another at 45° to the rule.

It is used to mark and check 90° and 45° angles. It can also be used to set workpieces on the machines and measure the depth of slots. (Figs 7a,b & c).

**Centre Head:** This along with the rule is used for locating the centre of cylindrical jobs. (Fig 7d)

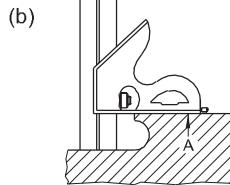
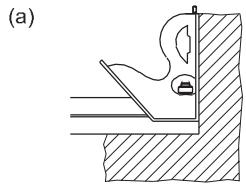
For ensuring accurate results, the combination set should be cleaned well after use and should not be mixed with cutting tools, either while using or storing.

**Calipers:** Calipers are simple measuring instruments used to transfer measurements from a steel rule to objects, and vice versa.

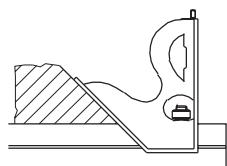
Calipers are of different types depending on the type of the joint and the shape of the leg.

**Types of Joints:** The commonly used calipers are firm joint calipers and spring joint calipers.

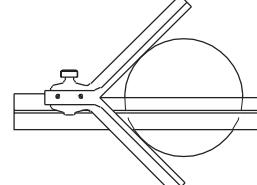
Fig 7



(c)



(d)



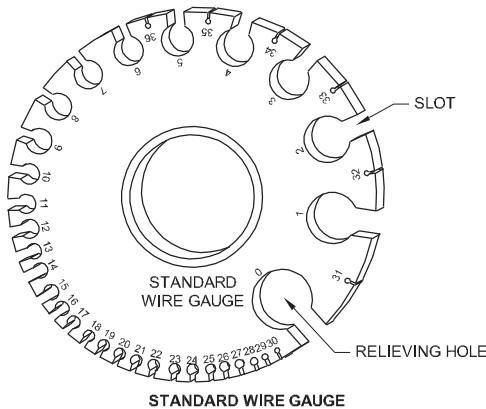
PGN165327

### Standard wire gauge (Fig 8)

The job drawing indicate only gauge or thickness of the sheet to be used. Before starting the work identify the correct thickness of the sheet. The thickness of the sheet is measured with the help of the standard wire gauge.

The gauge consist of a disc shape smoothened steel metal piece with numerous slots around the outside edge. These slots are of various width and correspond to certain gauge number.

Fig 8



PGN165328

Gauge number is stamped on one side of each slot and on the other side, the decimal part of an inch is stamped to show the thickness of the sheet and diameter of the wire.

Thickness of the sheet is checked by inserting the edge of sheet in the appropriate slot of the standard wire gauge.

Wire diameter is checked by inserting the wire only in the slot, and not in the circle.

Higher the SWG gauge number, lesser the thickness of the sheet.

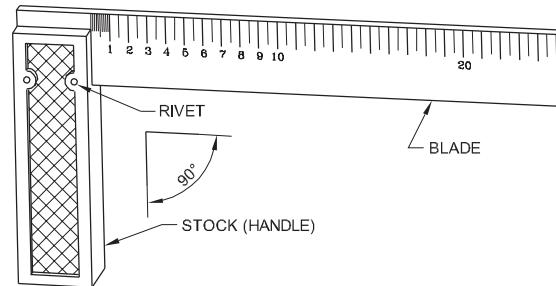
### Try square

The try square is a precision instrument.

- Which is used to check squareness of a surface.

- The accuracy of measurements by a try square about 0.002mm per 100mm length.
- Which is accurate enough for most work shop purposes.
- The blade is fixed to the stock at 90°. (Fig 9)

Fig 9



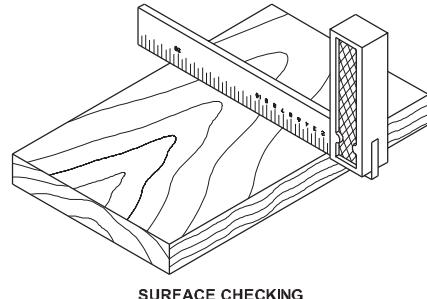
PGN165329

### Uses

#### The try square is used

- To check the flatness of the surface.(Fig 10)

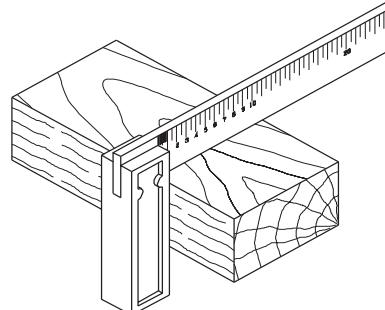
Fig 10



PGN16532A

- To check the squareness of edge. (Fig 11)

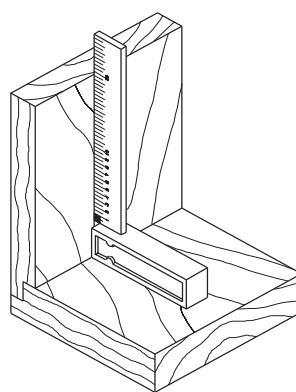
Fig 11



PGN16532B

- To check the inside squareness. (Fig 12)

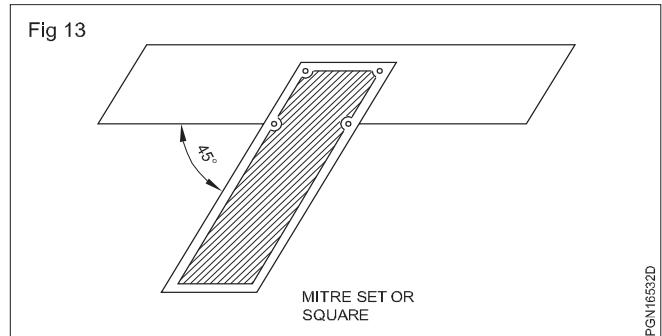
Fig 12



PGN16532C

- The blade of try squares are made of hardened steel.
- The stock is made of seasoned hard wood or cast iron, mild steel and aluminum.
- If it is made of wood it must be well seasoned timber.
- To prevent the wooden stock from wearing a brass plate is fixed to the inside edge.
- The try squares are specified according to their blade lengths.
- Try square blade lengths are available in 100,150,200,250mm and 300mm.

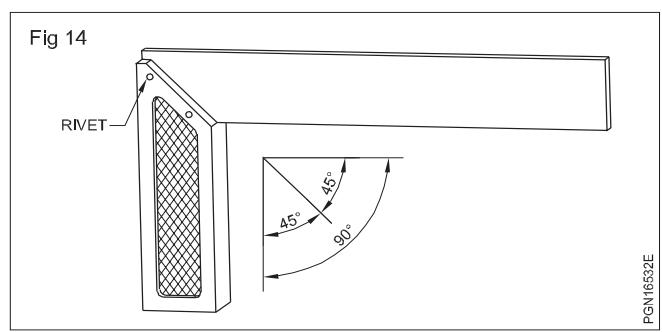
### Mitre square (Fig 13)



- To mark 45° and to test 45° by mitre square are used at the end of its stock and at the cutting of the blade.
- It is fixed permanently by rivets, the length of its blade is 200mm to 350mm. There are graduations on its blade.
- The only difference between try square and mitre square is that the blade and stock are fixed at 90° in the try square and 45° in the mitre square.

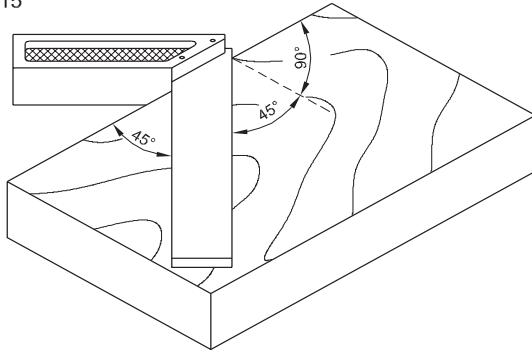
### Try and Mitre square

- The try square and mitre square is also useful for angle 45°, 90° and 135°. (Fig 14)



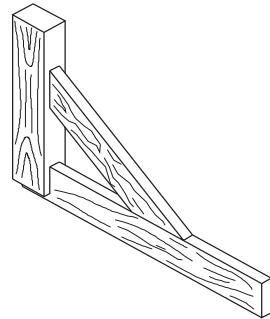
- The try and mitre square is useful for setting out mitres at 45 testing chamfers and other work 45° or 135°. (Fig 15)
- The blade is permanently fixed so the stock is at an angle of 90° to the blade which is 200mm to 350mm.

Fig 15



Wooden try square (Fig 16)

Fig 16



The try square is fully made of wood. Its handle is slightly heavier than blade. The length of blade is 600mm (24") and width is 50mm (2"). The length of the handle is 400mm some times up to the length of 450mm.

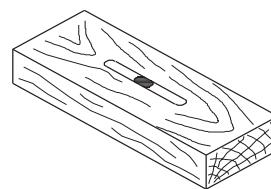
Without changing the angle 90° the handle and the blade are diagonally attached, by a brace. angle of wooden try square is 90°.

### Uses

This is used for carpentry works and for building construction works. Large and wide planks are used to scribe the works.

### Spirit level (Fig 17)

Fig 17



A spirit level is used principally by the carpenter. It consists of a piece of wood (common wood for spirit level is Teak wood) or aluminum into which a spirit level glass is fastened horizontally and vertically. As the glass tube is not filled, a bubble always remains, when the bubble is in the centre of glass indicated by lines marked on it, the structure on which the level rests is absolutely horizontal or vertical.

In some spirit level there will be two glass tubes perpendicular to the horizontal glass tube. This will be called as plumb glass and is used to test the perpendicularity of walls and windows. (Fig 18)

Fig 18

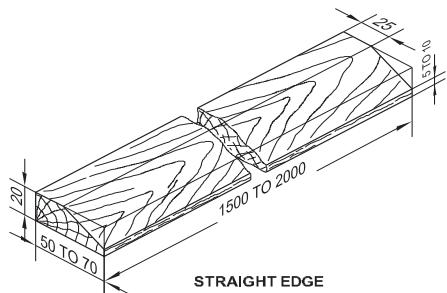


CARPENTER LEVEL

PGN16532I

### Straight edge (Fig 19)

Fig 19



PGN16532J

Straight edge made of steel or wood with perfectly straight parallel edges, although sometimes has only one straight edge.

**Uses:** For testing the straightness of surface and edges.

Its length is 1500mm to 2000mm breadth 50mm to 70mm and thickness 20mm.

'T' bevel or bevel square

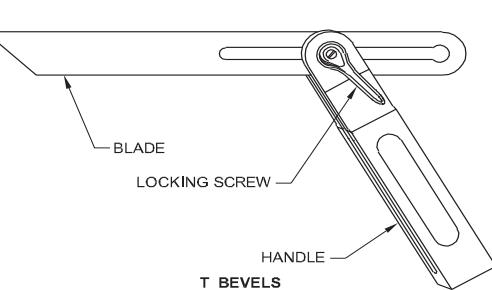
The T-bevel is used to test and transfer angles other than right angles. The bevel is called sliding bevel because it has an adjustable sliding blade. The blade may be locked by a wing nut or set screw.

The required angle is set from a straight edge and the degrees are measured against a protractor.

#### Uses

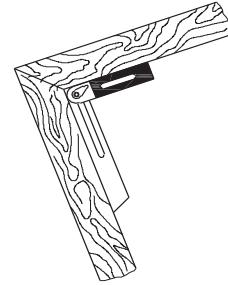
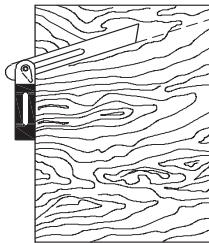
The sliding bevel is used for laying out dovetails, side rails for chairs, chamfers, bevels and for transferring angles from the drawing to the work piece. The parts of the bevel square. (Figs 20 & 21)

Fig 20



PGN16532K

Fig 21



PGN16532L

**Handle:** Handle is made of hard wood, cast iron and aluminum. The top edge is half rounded and there is a slot to fix the bevel square.

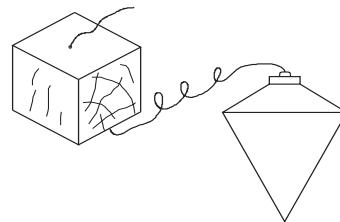
**Blade:** One edge of the blade is half rounded and their other edge is cut at 45°. There is a longitudinal slot. The handle is fitted with the wing nut in the slot or with a machine screw. The slotted blade passes through a slot in the stock.

On loosening the wing nut the blade can be shifted to any angle. And also the blade can be extended for further length if necessary.

**Locking nut:** This may be a wing nut or a set screw used for loosening or tightening the blade.

### Plumb bob (Fig 22)

Fig 22



PGN16532M

This tool consists of a solid brass or metal cylinder with a pointed end which is attached to a suspending line so that its tip always points vertically down. Its upper part is a small wooden block with a hole drilled in its centre so that the line with the cylinder on it can be pulled up or lowered down through the hole.

The diameter of the wooden block is slightly greater than the diameter of cylinder so that the cylinder can move freely up and down without touching the work piece.

The main use of the plumb bob is a more accurate replacement for the vertical spirit level and also to transfer points down vertically in marking.

## Common India timbers

**Objectives:** At the end of this lesson you shall be able to

- state the types of common India timbers
- explain the properties of India timbers
- brief the uses of India timbers
- list the advantages of India timbers.

#### Teak

It is very valuable timber. It is a large tree with light coloured leaves.

The wood is straight grained and of rich brown yellow color.

Sap wood is pale yellowish and heart wood is golden brown. In India it is found in Madhya pradesh, Maharashtra, Andhra pradesh, Kerala and Gujarat, maximum of teak out put is from Madhya pradesh. It is hard and heavy and weighting about 650 kg/m<sup>3</sup> at 12% moisture content suitable for any work, ship building furniture and cabinet making etc.,

**Deodar:** It has straight tall trunk having short branches and pointed leaves. It is found in altitudes of 1200 to 3000m. The tree has lofty straight trunk with small branches. It is found in Arunachal Pradesh, Punjab, Himalayas, Kashmir and U.P.

The sap wood is white and heart wood is light yellowish brown. The wood is hard and heavy with average weight 545 kg/m<sup>3</sup> at 12% moisture content. It has a medium fine and even texture deoder is a non-porous wood.

**Uses:** Construction purposes, furniture, packing cases, railways sleepers, carriages etc.,

**Chir:** It is similar to deoder but is inferior in quality. The sap wood is white and heart wood is light yellowish brown.

It is hard and heavy with an average weight of 575 kg/m<sup>3</sup>. It is medium and uneven textured with straight to spiral or twisted grain.

#### Uses

Construction purposes, furniture, height packing and cabinet making.

**Kail:** It is an ever-green tree.

Kail is similar structure to chir. It is found in foot hills of Himalayas Kashmir, Punjab, and Uttarpradesh. The sap wood is white and heart wood is light and pinkish red.

It is closely grained hard and durable.

It has resinous colour when freshly cut.

It is soft and light with average weight 515 kg/m<sup>3</sup>

**Uses:** Cabinet making, furniture, packing cases, drawing boards and railways sleepers etc.,

**Shisham (sissoo):** It is a tree having short trunk and large branches.

It is found in Assam, Orissa, U.P. Punjab, Himachal Pradesh, Bihar etc.,

Sap of sissoo is pale yellowish and heart wood is golden or dark brown. It generally grows along the road side.

It is hard and heavy with an average width of 780 kg/m<sup>3</sup>

It has medium coarse texture with fairly straight inter locked grains.

**Sal:** It is a straight growing up right tree.

It is found in Assam UP, Orissa, Maharashtra, Andhra pradesh, Tripura, Madhya Pradesh etc.,

The sap wood is pale yellowish and heart wood is brown or reddish brown.

The wood is hard and heavy with an average of 855 kg/m<sup>3</sup>

It is coarse textured with inter locked grains.

#### Uses

It is a valuable timber and recommended for all.

Construction purposes and railways sleepers.

**Babul:** It has small leaves and the not available in large shapes.

It is available in abundance all over India. The wood is closed grained and tough colour of wood is pale red and weighing about 785 kg/m<sup>3</sup>. It is not available in large sizes.

#### Uses

Tool handles, wheels and bodies of carts, ploughs and other structural works.

**Mango:** Mango is found all over India. The wood is of inferior quality, coarse and open grained and weighting about 690 kg/m<sup>3</sup> colour of wood is yellowish gray. It contains large amount of moisture and sap.

#### Uses

Inferior quality doors and windows, packing case etc.,

**Bamboo:** This tree is found practically all the parts of India. It is a flexible and strong material.

Bamboo grows naturally on soils which are neither too acidic nor too alkaline. The greater concentration of Bamboo is however found in Assam Region.

It is used for making the poor man's hut all over the country.

#### Uses

Walls, portions, flooring, ceiling, roofing ladder, basket making mats, walking sticks, umbrella handle, toys and paper pulp.

#### Advantages of timber

- 1 It can be easily converted to any size and shape.
- 2 It has a high resale and salvage value.
- 3 Timber construction is light in weight.
- 4 Timber has better insulating properties.
- 5 Timber can be used for loading and loading elements.
- 6 Timber connections are easy to make.
- 7 In terms of specific strength timber is better to many other building materials.
- 8 Durability of timbers is very high, if properly seasoned and pressed.

# Defects in timber

**Objectives:** At the end of this lesson you shall be able to

- identify the defects in timber
- explain the knots, shakes and grains
- state the causes for defects in timber.

## Defects in timber

Natural defects occurs in all kind of timber depending upon the soil upon which they grow and climatic conditions to which they are subjected while growing.

A defect in any irregularities occurring in or on the timber

Defects reduces strength durability or utility value of the timber.

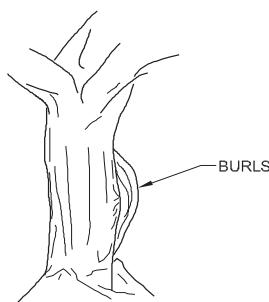
**Causes:** Lighting, strong winds, fires, diseases, parasite (insects, fungi etc),

Carelessness while felling, seasoning, Conversion, fungi and insects.

### Common defects

**Burls:** Burl are abnormal growths on the side of the tree caused by some injury or irritation of the trunk. (Fig 1)

Fig 1



PGN165331

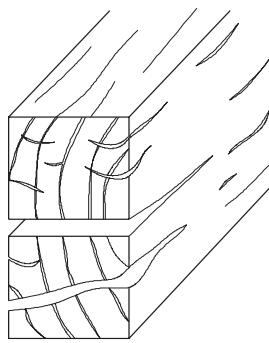
**Case hardening:** Is a condition of the outer layer of timber is abnormally hard.

Caused by incomplete seasoning and this outer layers are dried too quickly.

**Check:** Check is the separation of the wood extending for a few (inches) centimeter along the grain and formed while drying.

**End check:** Occurring on the end of the piece of timber. (Fig 2)

Fig 2



PGN165332

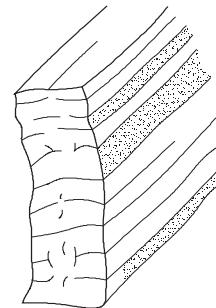
**Internal check:** Occurring in the interior of the piece

**Surface check:** Occurring on the surface of the piece.

**Through check:** On which extends through the piece from one surface to the other.

**Collapse:** A flattening of the cells may be due to excessive or uneven drying. (Fig 3)

Fig 3



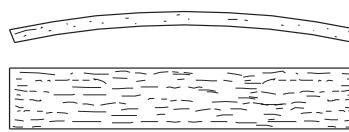
COLLAPSED BOARD

PGN165333

This may be prevented if drying in low temperature.

**Bowing:** A curvature from plane along the wide surface of the board. Caused by uneven shrinkage and uneven drying during seasoning. (Fig 4)

Fig 4



BOWING

PGN165334

Board not being out parallel to the growth rings.

**Cupping:** A simple curvature across the width of board due to greater shrinkage on the concave side. (Fig 5)

Fig 5



CUPPING

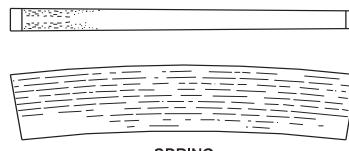
PGN165335

It is more pronounced in back sawn boards.

The curvature is usually away from the heart

**Spring:** A curvature along the edge of the board. (Fig 6)

Fig 6



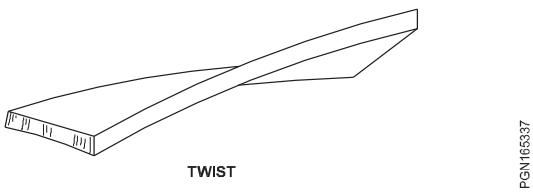
SPRING

PGN165336

Not affecting the face, the face remaining flat caused by uneven shrinkage and poor drying of the timber.

### Twisted fibres (Fig 7)

Fig 7



This defect is due to the tree being twisted constantly in one direction by the force of prevalent wood.

A spiral distortion along the length of the piece of timber.

This may be caused by uneven shrinkage due to uneven drying.

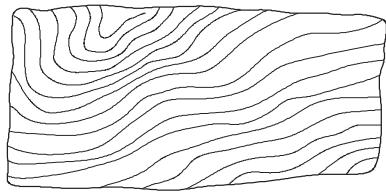
### Warp

Any variation from a true flat surface (not perfectly flat).

### Upsets

This is the fracture of the fibre across the grain and may be the result of injury in felling. (Fig 8)

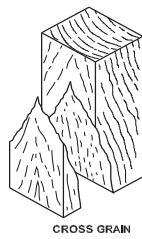
Fig 8



### Grain

Refers to the direction of the cells and vessels of the wood. (Fig 9)

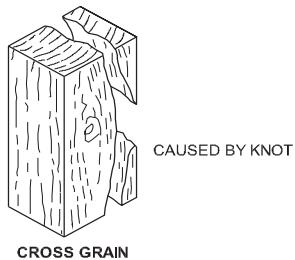
Fig 9



### Cross grain

When have a varying inclinations to the axis of the piece due to cutting from timber in which the straightness of the grain is imperfect. (Fig 10)

Fig 10

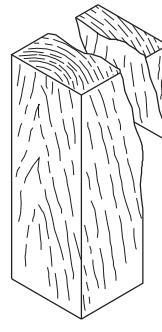


### Diagonal grain

When the fibers do not run parallel to the axis of the piece, although cut from straight grained timber.

This is caused by cutting parallel to the axis of the log instead of parallel to the bark. (Fig 11)

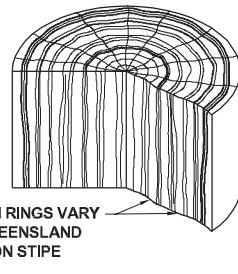
Fig 11



### Inter lock grain

Caused by the fibers of adjacent layers of wood being spirally inclined in opposite directions. This grained surface is difficult to plane. (Fig 12)

Fig 12

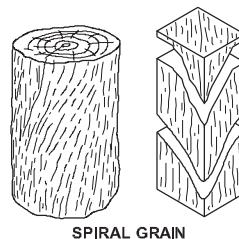


### Spiral grain

Occurs when the fibers have taken a spiral course in the tree trunk as if the tree have been twisted.

The cause is not definitely known. (Fig 13)

Fig 13



### Wavy grain

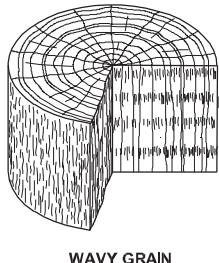
A wavy arrangement of the fibers, also known as curly or fiddle back grain.

This grained surface is difficult to plane and work. (Fig 14)

### Waney edge

This defect lies in the sap wood which accompanies wane due to economical conversion of logs.

Fig 14



WAVY GRAIN

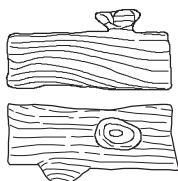
PGN16533E

### Rind galls

These peculiar curved swelling found on living or dead tree.

Generally caused by the growing of the layer over the "Wounds" left after the branches have been imperfectly cut off or removed. (Fig 15)

Fig 15



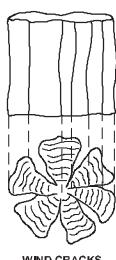
RIND-GALLS

PGN16533F

### Wind cracks

These are shakes or splits on the sides of a bark of timber due to the shrinkage of the exterior surface exposed at atmospheric agencies like sun and wind etc. (Fig 16)

Fig 16



WIND CRACKS

PGN16533G

### Knots

Caused by a branch or limb being cut through during the process of sawing up the log.

They may live or dead but break the continuity of fibres.

Generally these are distinct defect either in appearance or weakening the wood. (Fig 17)

#### Loose or dead knot

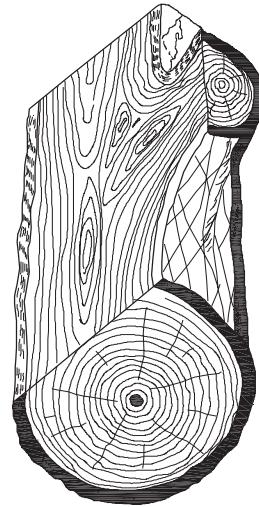
Left by branches that have been cut off or broken before felling.

It is loose in position on the surface of the piece.

It cannot be relied on to remain in position in the piece.

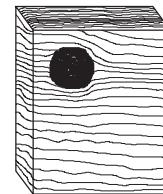
(Fig 18)

Fig 17



PGN16533H

Fig 18



DEAD KNOT

PGN16533I

#### Live or sound knot

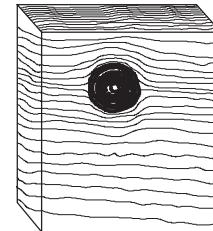
It is left by a branch when the tree is felled.

It is solid across its face and hard as the timber surrounding it.

#### It is free from decay

Knots are considered to add beauty and effect in the final appearance. (Fig 19)

Fig 19



LIVE KNOT

PGN16533J

### Shakes

Is the partial or complete separation between adjoining layers of wood.

Due to the relief of growth stresses present in the stem at the time of felling.

To impact of the tree with the ground.

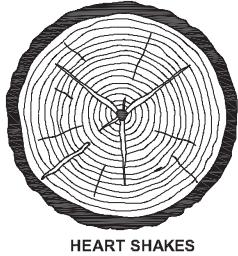
#### Heart shake

These are the cracks or splits in the centre.

Starting from the pith and extending in the direction of the medullary rays in one or opposite directions towards sap wood.

Such defects are found in over matured trees, but sometimes they may be caused by quick drying of central part of the tree. (Fig 20)

Fig 20



HEART SHAKES

PGN16533K

If a tree nearing maturity is felled and left unbreakable for a long time.

This defect is caused due to shrink of heart wood.

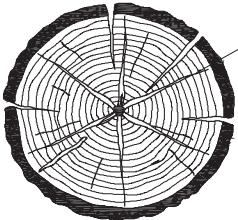
#### Star shake

These are crack or split which extend from bark towards sap wood.

This defect is caused when the tree is subjected to serve heat or frost during its growth.

The width of these cracks or shake is more at the outer ends and reduces when they extend towards centre. (Fig 21)

Fig 21



STAR SHAKE

PGN16533L

#### Cup shake or ring shake

These are formed by the rupture of tissue in a circular direction across the cross section of a log.

It forms usually along the annual rings. (Fig 22)

### Diseases in timber and decay of timber

**Objectives:** At the end of this lesson you shall be able to

- state the decay that occur in timber
- explain the effects caused by the diseases in timber.

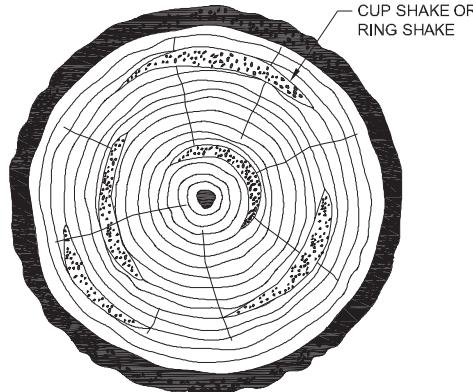
#### Decay

When timber is confined to a place where it is liable to be subjected to alternate dry and wet conditions or when used in dark unventilated position it gives birth to two common diseases.

1 Dry rot

2 Wet rot

Fig 22



PGN16533M

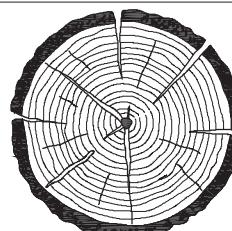
#### Radial shake

These are similar to star shake, but it occurs due to exposure to sun when felled timber is placed for seasoning.

These cracks are fine, irregular and numerous.

Many cracks or splits run for a short distance from bark towards centre than follow the course of an annual ring and lastly go towards the centre radially. (Fig 23)

Fig 23



RADIAL SHAKES

PGN16533N

When the rupture extends only a part round, it is called cup shake.

When the whole way round or almost so it is called ring shake.

This defect is caused either due to unequal growth or due to sudden contraction for timber under atmospheric changes assisted by twisting action due to wind.

#### Dry rot

The disease in timber is caused due to lack of ventilation. Due to improper ventilation there is growth of fungus which eats away the fibres of timber and reduces them to powder. The growth of fungus accelerates the process of dry rot, but the origin of the disease is due to the decomposition of sap in the timber. This

decomposition supplies food for the growth of fungi. The disease is highly infectious and causes tremendous destruction of the timber. This disease may develop in seasoned timber, timber or uns seasoned timber treated with preservatives. This disease is common in warm cellars, unventilated wooden floors basements ends of timbers built into walls.

This disease can be detected by tapping at one end of timber post or log and hearing the sound on the other end. If distinct sound is heard then it indicates a sound timber and if a dull sound is heard then it is a sign of decayed or diseased timber.

The following method can be adopted to prevent or eradicate this disease.

- 1 By allowing free circulation of free air.
- 2 Portion of wood attacked by dry rot should be cut off and the remaining portion painted with copper sulphate.
- 3 By exposing the infected portion to sunlight and sweeping of fungus.

#### **Wet rot**

This disease is the result of decomposition of timber caused by damp and moisture. This disease is further induced by alternate wet and dry conditions. The portion of the timber attacked by wet reduces to greyish brown powder. In this disease the timber is just decomposed while wet and then it scales off when it dries.

This disease can develop in a timber whether dead or alive. All types of timber used in uncovered situations is likely to be exposed to rain and hence subjected to wet rot.

This wet rot disease can be avoided by removing sap from timber through seasoning first and then treating it with preservatives.

#### **Diseases**

Timber is said to be decayed when it is deteriorated to the extent it loses its value as an engineering material. Timber deteriorates in strength when it is subjected to excessive defects, diseases or attacked by insects. These insects damage the appearance and reduce their strength. Following insects generally attack the timber.

##### **a Pinhole borers**

They attack the standing tree or recently felled timber.

##### **b Powder post beetles**

They attack timber while it is stacked for seasoning sale or awaiting use for years.

##### **Termite or white ants**

They attack timber used for structural purposes in buildings bridges, poles, sleepers fence posts etc. The following are various causes of decay.

- 1 Alternate dry and wet conditions .
- 2 Improper stacking storage of timber.
- 3 Improper seasoning or unseasoned timber.
- 4 Use of unseasoned timber treated with preservatives.
- 5 Use of seasoned timber without treating with preservatives.
- 6 Presence of moisture sap and different types of insects.
- 7 Development of defects during growth conversion improper use etc.
- 8 Improper position of structural member of timber.
- 9 Development of timber disease.
- 10 Effect of natural agencies.

## Introduction to plumping work

Objectives: At the end of this lesson you shall be able to

- state the safety precaution of plumping work
- state the use of plumping hand tool
- description on rain water and pipe system installation method
- state the pipe line leakage and maintenance.

### Safety precaution of plumping work:

- Study the nature of plumping work and estimate the cost of work.
- Select the materials for particular job
- Select the tools for the job
- Study the job drawing carefully
- Wear the proper dress while working
- Fix the pipes properly without any leakage
- Use the sealing compound for pipe fitting
- Use the solutions to fix the PVC and UPVC pipes
- Use the proper tools for plumping work
- Use the hack saw blade to cut the pipes
- Use the first aid kit while unexpected accidents happened during plumping work.

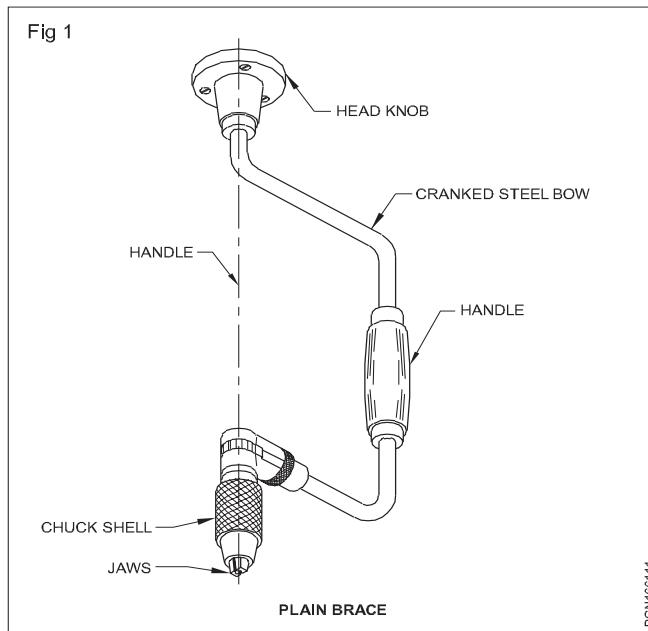
**Plumber hand tools:** Different types plumber hand tools are used to measure, cut, fix, threading the metal and PVC pipes. The hand tools are as follows

- Plain brace
- Ratchet brace
- Die stock and dies
- Single end spanner
- Double end spanner
- Adjustable spanner
- Ratchet type die set
- Pipe wrenches
- Chain pipe wrenches
- Open end spanner
- Ring spanner
- Combined spanner
- Tubular spanner
- Socket spanner
- Offset spanner

### The brace (plain & Ratchet)

Circular holes are drilled or bored in wood by means of drill. To penetrate into the wooden piece it is necessary to use the drill to cut a hole.

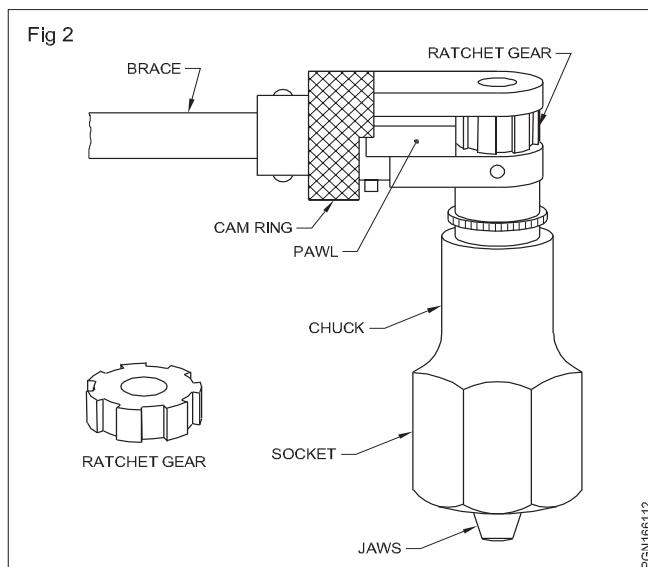
The brace is a cranked tool for holding a bit while boring a hole. The brace is used to give a rotating movement. The head, knob and the handle can rotate freely. (Fig 1)



PGN166111

The chuck consists of a metal screwed chuck shell in which the jaws are enclosed. When the shell is loosened the jaws will be open to receive the bit.

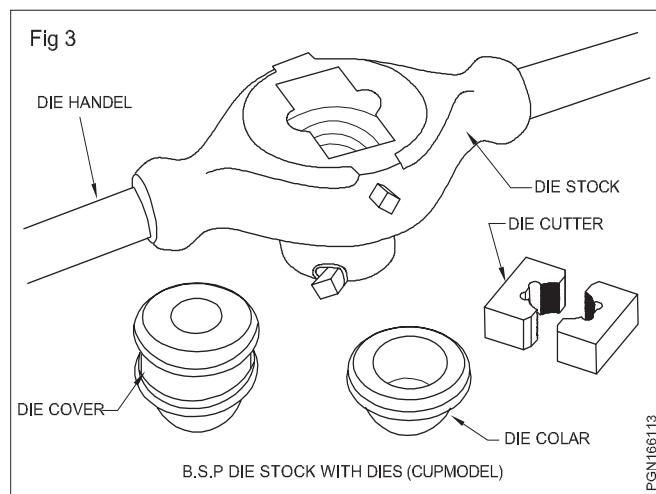
### The ratchet brace (Fig 2)



PGN166112

The ratchet brace is provided with a ratchet mechanism. The ratchet permits the brace to be rotated to and fro while the chuck rotates in only one direction. The cam ring can be set in positions for clock - wise and anti - clockwise rotation.

### Die stock and dies (Fig 3)



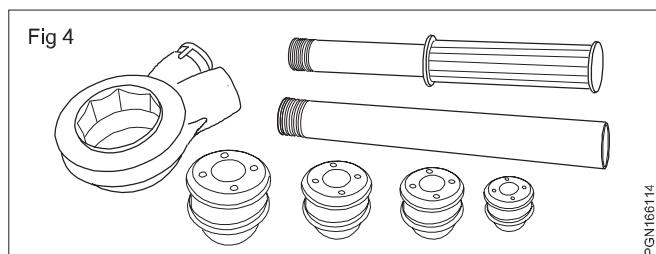
This B.S.P die set is used for making external threads on pipes used for plumbing work 1/2" (15mm) 3/4" (20mm) 1" (25mm) cutters and collars are changed and can be used to cut the threads using same die - stock and die - cover cutter are split into two pieces. One end of the cutters are chamfered which makes easy to assemble before threading.

### Parts

Die - stock	Die - Cover	Die - Collar
Die - Cutter	Die - Handle	Adjustable screw

Use lubrication oil frequently as this will make threading easy and prevent the damage of teeth in the die cutter.

### Ratchet type dieset (Fig 4)



This type die set are now a days used to cut threads up to 32 mm f G.I pipes another type is from 1/2" (15mm) to 2" (50mm)

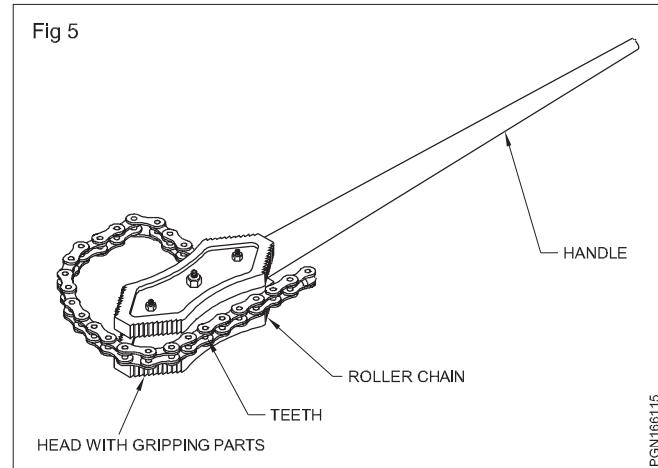
If the pipe is loose it must be hold securely in either a pipe stand or pipe vice or a bench mounted vice.

To fit the die head to the ratchet head select the size die according to the size of the pipe push it into the left side of the ratchet head.

Die stock with the die located over the pipe place a small quantity of cutting oil.

Avoid long cut as this will increase the heat and teeth is in the dies will be damaged.

### Chain pipe wrench (Fig 5)

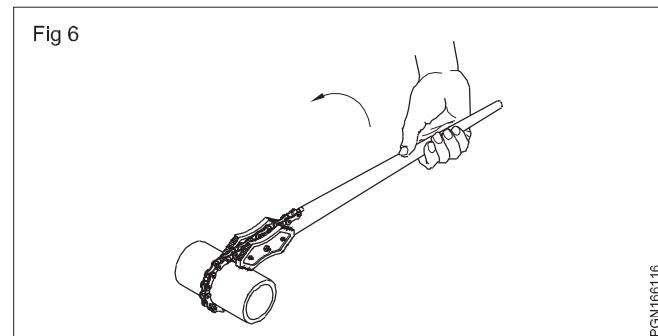


Chain pipe wrenches are used for pipes with diameters of 50mm to 150mm. They may be used for gripping cylindrical or irregular objects.

### Application of chain pipe wrench

To use a chain pipe wrench, the head is placed on the pipe and the chain pulled round the circumference of the pipe. The chain is then engaged with the large teeth in the centre of the head.

The movement of the lever in the direction indicated by the arrow in the figure caused the serrated edges of the head to wedge firmly against the pipe giving a firm grip. (Fig 6)



The chain pipe wrench is a heavy gripping tool and should not be used for pipes with less than 50mm diameter.

# Spanners and their Uses

**Objectives:** At the end of this lesson you shall be able to

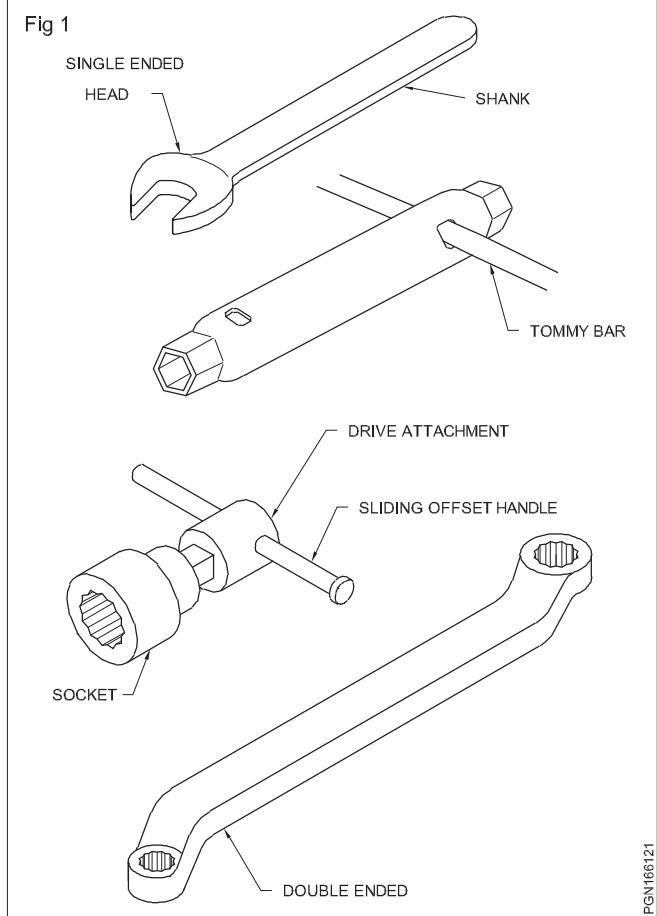
- state the necessity of spanners
- identify the different types of spanners
- specify the spanners
- list out the parts of adjustable spanners
- state the features of 'C' spanners and their uses.

**Necessity of Spanners:** are used for operating threaded fasteners, bolts and nuts. They are made with jaws or opening that fit square on hexagonal nuts and bolts and screw heads. They are made of high tensile or alloy steel. They are drop-forged and heat-treated for strength. Finally they are given a smooth surface finish for ease of gripping.

Spanners vary considerably in shape to provide ease of operation under different conditions.

The basic types of spanners are: (Fig 1)

Fig 1



- Open end spanners (1)

- Tube or tubular box spanners (2)

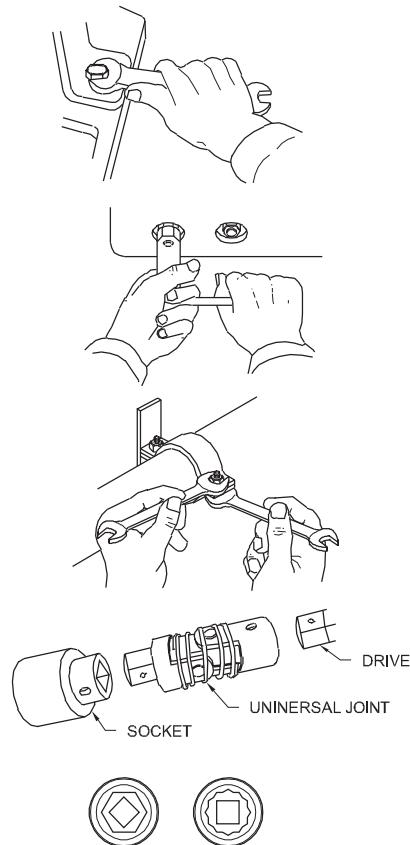
- Socket spanners (3)

- Ring spanners (4)

The correct spanner to use is the one that fits exactly and allows room for use. They should also permit the job to be done in a shorter time.

The following are the points to be noted for using spanners in a safe way. (Fig 2)

Fig 2



PGN166122

Use open end and ring spanners by pulling on the shank. It is safest to pull as there is less chance of hitting your knuckles if the spanner or nut slips suddenly. If you are forced to push the spanner, use the base of your hand and keep your hand open.

Use both hands for large spanners.

Keep yourself balanced and firm to avoid slipping yourself, if the spanner slips suddenly. Hold on to some support, if there is any chance of falling.

Use both hands as shown in the figure, when using tubular box spanners. (Fig 2)

Use two spanners as shown in the figure to stop the head of the bolt rotating as the nut is operated. (Fig 2)

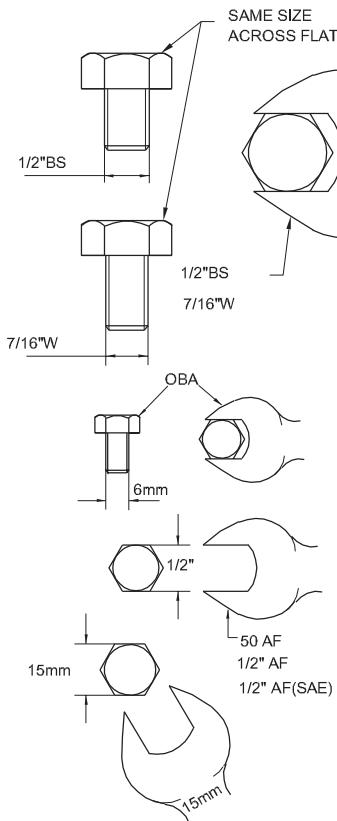
Socket spanners may be turned by accessories which have square driving ends. (Fig 2)

Size and identification of spanners

The size of a spanner is determined by the nut or bolt it fits. The distance across the flats of a nut or bolt varies both with the size and the thread system.

In the British system the nominal size of the bolt is used to identify the spanner. (Fig 3)

Fig 3



PGN166123

In the unified standard system (Fig 3), the spanners are marked with a number based on the decimal equivalent of the nominal fractional size across the flats of the hexagon, following the sign A/F or with the fractional size across the flats following the sign A/F. In the metric system, spanners are marked with the size across the jaw opening followed by the abbreviation 'mm'.

To fit exactly, a spanner must be :

- of the correct size
- placed correctly on the nut
- in good condition.

Spanners have their jaws slightly wider than the width of the nut so that they can be placed into position easily. Any excess more than a few hundredths of a millimeter clearance could cause the spanner to slip under pressure.

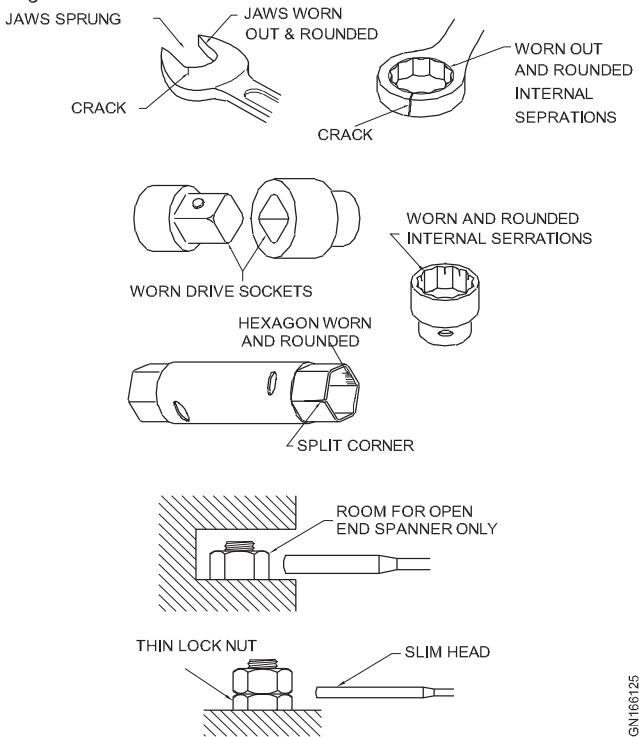
**Place the spanner so that its jaws bear fully on the flats of the nut. (Figs 4 & 5)**

Fig 4



PGN166124

Fig 5



PGN166125

Incorrect use damages the spanners & the nuts too.

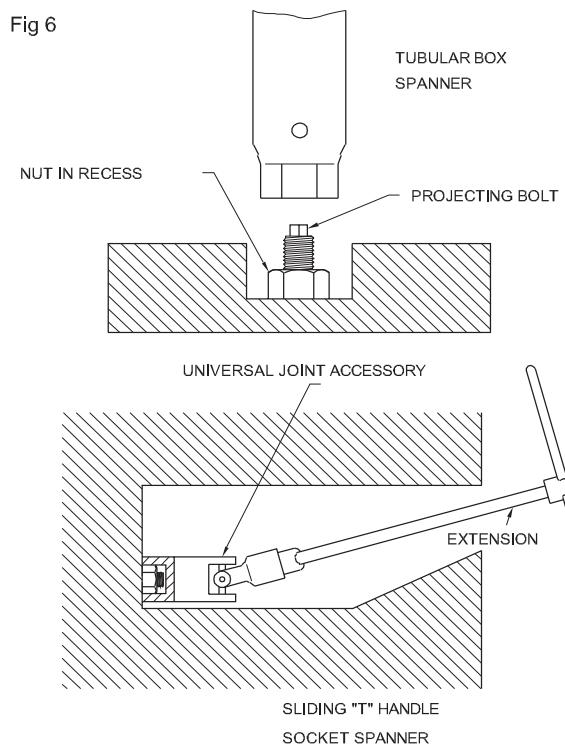
Discard any defective spanners. The spanners illustrated here are dangerous for use.

Choose spanners that allow room for use.

Nuts in inaccessible positions may be reached with socket spanners, with special drawing accessories.

#### Length of spanners (Fig 6)

Fig 6



PGN166126

Normally spanners have a length that is about ten times the width of the jaw opening.

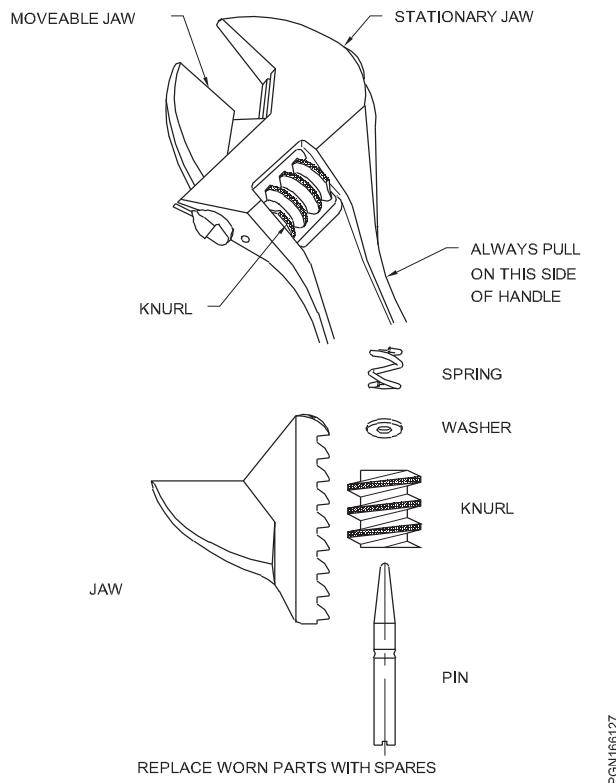
Never exert excessive pull on a spanner, particularly by using a pipe to extend the length of a spanner.

Excess turning effect of the spanner could result in:

- Stripping the thread
- Shearing the bolt
- straining the jaws of the spanner
- making the spanner slip and cause an accident.

### Adjustable spanners (Figs 7 & 8)

Fig 7

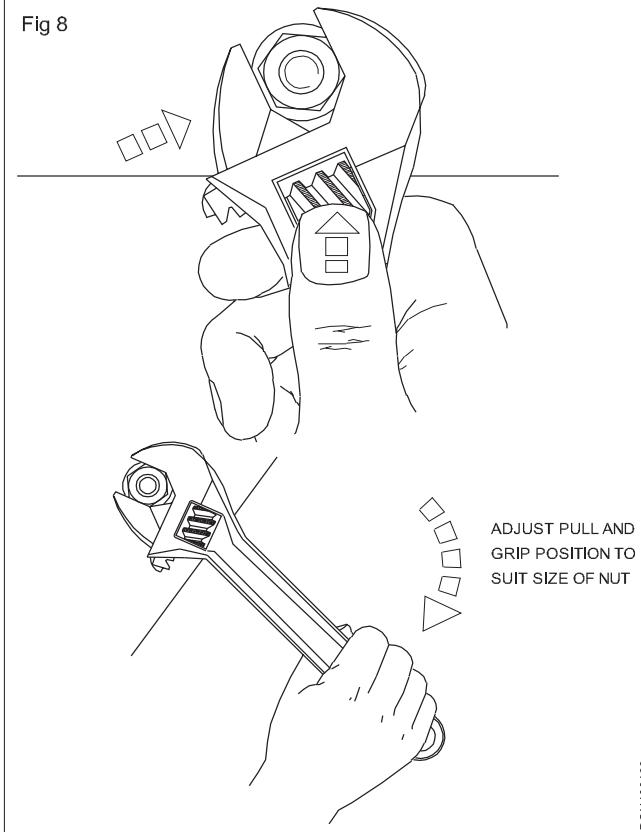


Most common types of adjustable spanners are similar to open end spanners, but they have one movable jaw. The opening between the jaws of a typical 250 mm spanner can be adjusted from zero to 28.5 mm. Adjustable spanners may range in length from 100 mm to 760 mm. The type illustrated has its jaws set at an angle of 22 1/2° to the handle. Adjustable spanners are convenient for use where a full kit of spanners cannot be carried about. They are not intended to replace fixed spanners which are more suitable for heavy service. If the movable jaw or knurled screw is cracked or worn out, replace them with spare ones.

When using the adjustable spanner follow the steps given below.

Place it on the nut so that the jaw opening points in the same general direction the handle is to be pulled. In this position the spanners are less liable to slip and the required turning force can be exerted without damage to the moving jaw and knurl.

Fig 8



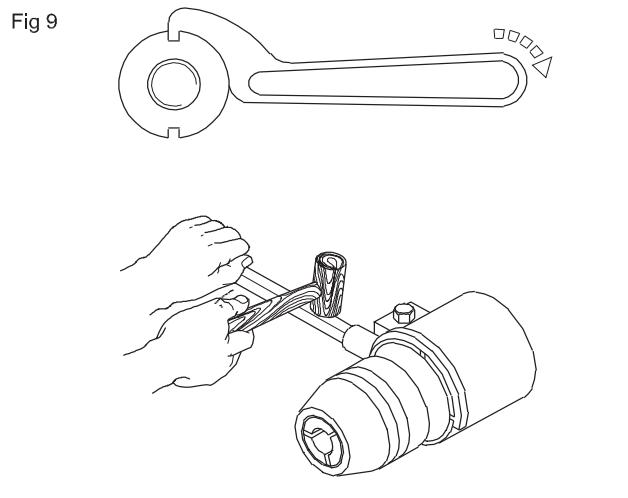
Push the jaws into full contact with the nut.

Use the thumb to tighten the adjusting knurl so that the jaws fit the nut strongly.

Pull continuously. The length of the handle is designed to suit the maximum opening of the jaws. With small nuts, a very small pull on the handle will produce the required torque.

### 'C' spanners (Hook spanners) (Fig 9)

Fig 9

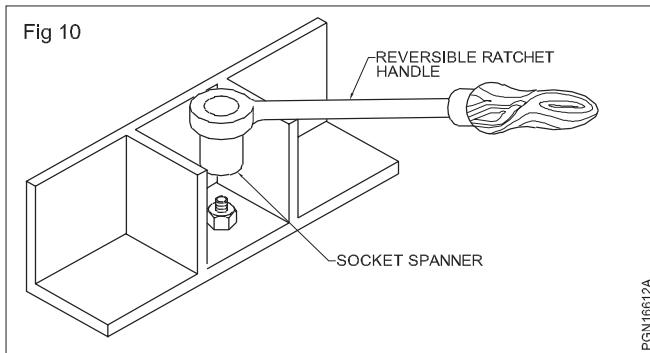


It has a lug that fits in a notch, cut in the outer edge of a round nut. The 'C' section is placed around the nut in the direction in which it is to be turned. In adjustable hook wrenches, part of the 'C' section pivots to fit nuts with a range of diameters. A set of three spanners is needed to cover diameters from 19 mm to 120 mm.

The applications of 'C' spanners are shown in the figure.

C' Spanners are also used for zero - selfing of micrometer.

With socket spanners (Fig 10), use the reversible ratchet handle for doing fast work, where turning space is restricted.



## Wrenches

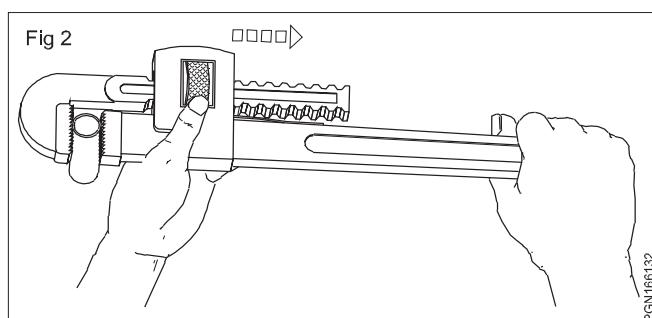
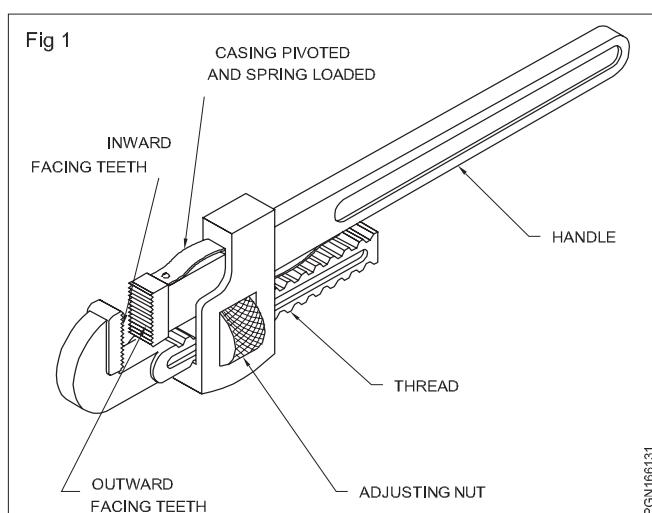
**Objectives:** At the end of this lesson you shall be able to

- state the different types of wrenches
- state the features of each type of wrenches.

### Types of wrenches

- Still son pipe wrench
- Footprint pipe wrench
- Tension wrench
- Hexagon socket wrench

### Stillson pipe wrenches (Figs 1 & 2)



These are used for gripping and turning pipes of a wide range of diameters.

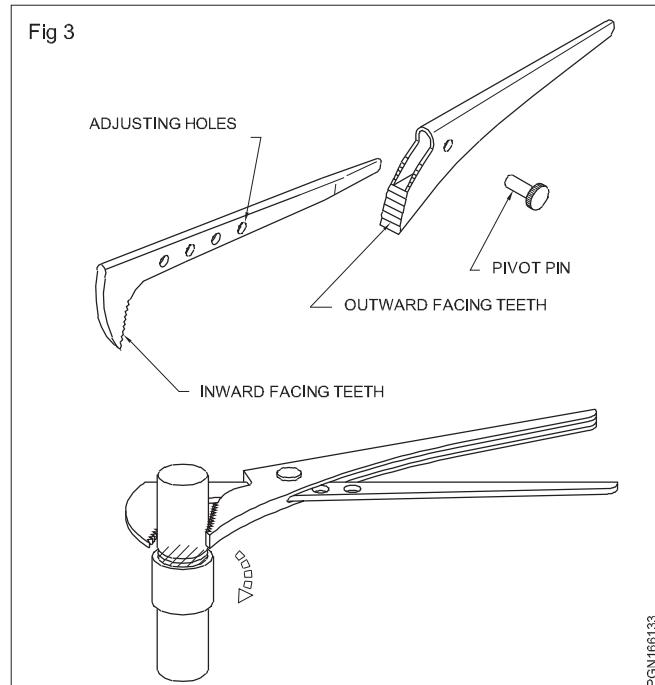
The parts and their names are shown in the figure.

A jaw is fixed to the handle with outward facing teeth. Attached to the handle by a pivot pin is a spring-loaded casing that carries a knurled adjusting nut. This engages with a thread on the adjustable arm of a jaw with inward facing teeth.

Once the jaws are adjusted, the spring loading keeps them in contact with the work, and the toggle action causes the hardened serrations to bite into the work.

The jaws will mark the work. File off any burrs. Never use them on polished or plated surfaces. Never grip hardened materials with this type of wrench as this will damage the serrations.

### Footprint pipe wrenches (Fig 3)

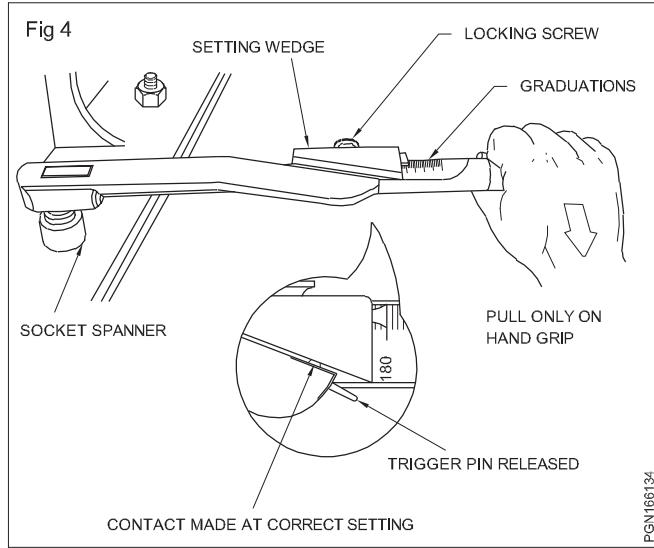


These are used for gripping and turning pipes and round stock, particularly in confined spaces.

Adjust the size by fitting the removable pin in the hole that allows the pipe to be gripped, with the handles a comfortable distance apart. Thrust the jaws fully on to the pipe. Squeeze the handles firmly. Pull on the folded steel handle to turn the pipe. Stop squeezing and slide the jaws back round the pipe, squeeze and pull again.

File off any burrs raised by the jaws on the pipe.

## Tension wrenches (Fig 4)



A tension wrench acts as a torque limiting device for turning (rotating) nuts to a predetermined degree of tightness. This avoids breaking the fasteners. It is also essential to avoid warping or springing components held by multiple fasteners that could be unevenly or excessively tightened, cylinder heads of engines, for example.

Some tension wrenches have direct reading indicators that you must watch as you pull the handle to the desired extent. With others, you preset to the desired graduation and pull until you detect a signal which may be an audible click, the release of a trigger pin or an automatic release within the wrench mechanism.

To apply the correct torque with a tension wrench :

- check that the threads of the nut and the bolt are clean and well formed.
- pull slowly with evenly increasing effort on the hand grip of the handle.

## Different type of pipes (G.I, C.I, D.I PVC, CPVC, PPR, AC and HDPE etc)

**Objectives:** At the end of this lesson you shall be able to

- state various type of pipes used for various purposes
- state the advantages and disadvantages of A C pipe
- state the various uses of cast iron pipe
- state the uses of P.V.C C.P.V.C and P.P.R
- state the uses of HDPE pipes.

### Pipes and pipe fittings

Various types of pipes and tubes are used for the following purposes.

- Domestic hot and cold water supplies.
- Waste water outlets.
- High pressure steam supplies.
- Hydraulic oil supplies.
- Lubricating oil supplies.
- Special fluid and gases for industrial processes.
- Pneumatic systems.
- Refrigeration systems.
- Fuel oil supplies.

The common types of pipes classified according to material are:

- Galvanized iron pipes
- Mild steel pipes
- Cast iron pipes
- C.I. soil pipes
- Copper pipes
- Aluminium pipes
- Brass pipes
- Lead pipes
- P.V.C. pipes

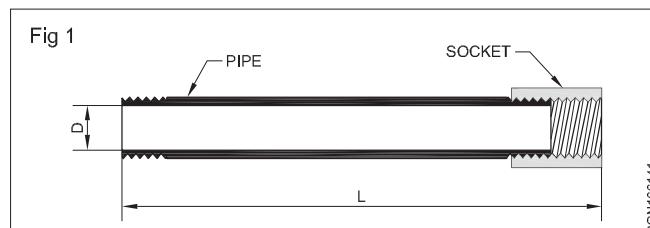
- Rubber pipes
- Plastic pipes
- Stoneware pipes

**Standard pipe fitting:** 'Pipe fittings' are those fittings that may be attached to pipes in order to:

- Change the direction of the pipe
- Connect a branch with a main water supply pipe
- Connect two or more pipes of different sizes

Close the pipe ends.

**G.I.pipe:** The hollow long open ended object of circular cross section is a pipe. (Fig 1)



Mild steel pipe after galvanisation are called galvanised iron pipes. It may be of hot finished seam less, electric resistance welded, high frequency induction welded, hot finished welded or cold finished seam less.

All screwed pipes and sockets shall have threads as per I.S.554. Dimensions and nominal mass of G.I. medium pipes are as per Table 2/I.S1239.

Tolerance on thickness and mass of G.I.pipes shall be as per P2/I.S.1239.

G.I.pipes available in market are of 6m lengths. Measurements are taken including one socket. It will have threads on both ends. One end will have socket and another end has PVC bush to protect thread. Pipes used for water distribution are of 50 to 150mmf. Pipes used in house connection are of 15 to 32mmf.

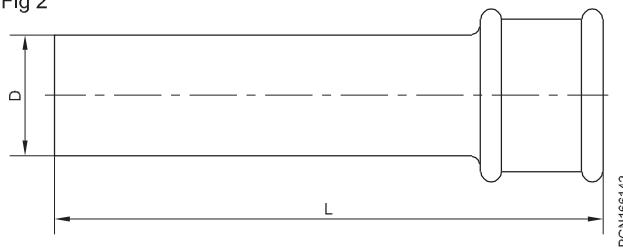
**Grades:** There are 3 grades of G.I. pipe i.e. high, medium and low. They are marked with paint band of red, blue and yellow respectively. Medium grade pipes are used for water supply.

The diameter of pipe is specified by its nominal bore. The socket are designated by the respective nominal bore of pipe for which they are intended.

### AC pipes:

**General:** AC pipes are manufactured from pure asbestos fibre, portland cement and silica under high pressure in machines and are available from 5cm to 100cm in diameter and 2m to 3m in length. The pipes have socket at one end of the pipe for joining. AC pipes are used for carrying waste water or rain water. (Fig 2)

Fig 2



**C.I.pipe:** C.I.pipes are manufactured using good quality grey cast iron. These pipes are manufactured in two different methods. i.e. sand casting or centrifugal casting (Fig 3).

Sand cast pipes are manufactured by pouring moulded pig iron in the sand moulds. The centrifugal cast pipes (spun pipes) are manufactured by using metal moulds and rotating mould by means of machine. Due to the centrifugal force the molten metal spreads uniformly. These pipes are generally free from Blister, sand holes, or air blocks.

Inside and outside are coated with Bitumenous solution.

- Cast iron pipes shall have the following qualities.
  - It should be able to cut, drill, chipping and fitting.
  - There should not be any crack.
  - There should be no visible blister, air block, sand holes.
  - There should be bell sound on hammering with a small hammer.
- C.I.pipes are classified into 5 types based on its use and physical properties.
- C.I water supply pipes

- C.I drain and sewer pipes
- C.I soil pipes
- C.I waste pipes
- C.I rain water pipes

Spun iron pipes used in water supply shall conform to IS1536. These are available from 80mm to 750mm. There are three class of pipes like Class LA, Class A and Class B. The specials used in these pipe shall conform to IS 1538- specials used in these pipe shall conform to IS 1538- specials like bends, collar, offset, reducer, tee, Y junction etc. are available. These pipes are joined with use of pig lead or lead wool.

Sand cast CI pipes used for soil pipes shall conform to IS. 1729. Spun iron CI pipes used for soil pipes shall conform to IS. 3989

### Types of PVC pipes

#### Polyvinyl Chloride (PVC)

- Polyvinyl chloride (PVC) is manufacture from ethylene or acetylene.
- It is essentially consists of polymerisation of vinyl chloride.
- PVC has to be mixed besides plasticizers, with release agents, stabilizers etc. to make it easily processable.

#### Uses

- Non plasticized grades are widely used for the manufacture of pipes and conduits.
- It is used as cable coating because of its high Electrical Resistance.
- Blow moulded components are used for replacement of glass for its high transparency.
- Non-toxic products are used for packing foods.
- Manufacture of Toys, dolls, paper coating, lampshade, etc.
- PVC is used for temperature below about 1400F.

#### Poly propylene Random Co-polymer (PPR)

- Latest and advanced Technology using raw material PP co-polymer.
- It is used for cold and hot water system, water purifying, chemical flow, etc.
- Three key parameters for polyfusion welding are
  - i Temperature
  - ii Pressure
  - iii Time
  - i Temperature
- Temperature around  $2600 \pm 50^{\circ}\text{C}$  to ensure proper plastification of the joint.

## ii Pressure

- Weld components need to be inserted into the weld at even pressure and length.

## iii Time

i Warming up time

ii Adoption time

iii Connection time

### i Warming up time

Warming up time starts when both components are simultaneously pressed.

## ii Adoption time

Adoption time starts when components are removed from welder.

## iii Connection time

Connection time is the components being pushed with each other with lateral pressure.

## iv Weld hardening time

Hardening time is the joint to get cooled and free from physical stresses.

**Table for PPR Welding**

Diameter mm	Melting length mm				
		T1	T2	T3	T4 (Seconds)
20	12	5	3	5	2
40	16	12	6	12	4
75	26	30	8	30	6
125	41	60	10	60	8

### Co-polymer vinyl chloride (CPVC)

- CPC and CPVC are made of the same basic elements.
- CPVC is altered by a free radical chlorination reaction that effectively increases the chlorine content of the material
- CPVC to be used temperatures upto 1900F.
- CPVC pipe is an off-white or yellowish colour.
- CPVC pipe is more suitable for hot water and potable water system

### HDPE pipe (Fig 3)

#### HDPE pipes and fittings

HDPE pipe was established in 2002. HDPE pipes and fittings ranges from 300 to 400 mm so far tests have shown that the pressure pipes made of HDPE have a life time of over 100 years.

Ensures a trouble free service of the pipe and of course the compete piping system. Pipes made of polyethylene (PE) and polypropylene (PP) are thermoplastics with excellent properties for the application of water and sewer. These are resistant to many chemicals and very suitable for conveying and storing various liquids.

It can be welded, can be reused continuously. The whole pipe line is a homogenous systems and absolutely safe. This has good chemical resistance. The smooth round surface of plastic pipes does not give the teeth of rodents sufficient hold to cause damage.

No damage to PE pipe lines by termites has ever been occurred. PE and PP are not a nutrient medium for bacteria fungi and spores. Resistant to all forms of microbial attack as well as to both sulphurous acid and sulphates. The standard lengths of 6m reduced the amount of joints branches can be manufactured and delivered in every type and form triangle can be adapted individually from 30° to 90°.

Fig 3



# Different types of pipe fittings for various purpose in pipelines

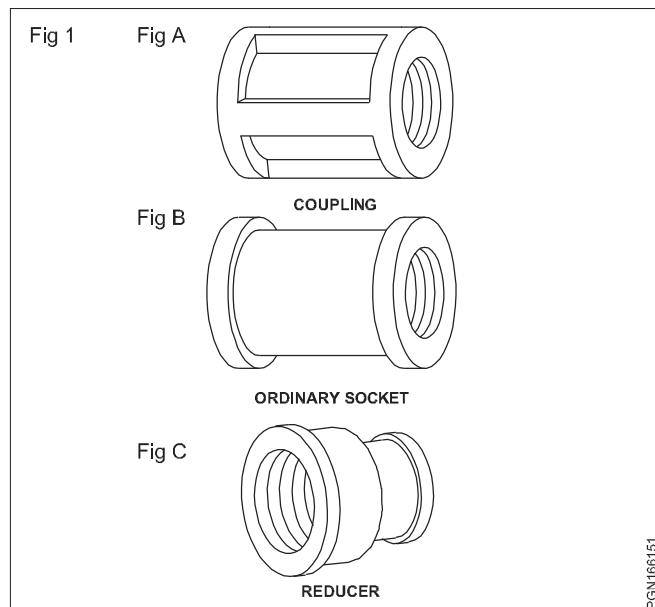
**Objectives:** At the end of this lesson you shall be able to

- state the standard pipe fittings of various types and sizes
- state the types of elbows, unions, plugs and special fittings
- state the materials from which they are made
- state the symbols used for the pipe
- state the uses of HDPE pipes.

## Standard pipe fittings

**Coupling:** An ordinary coupling shown in (Fig 1a), usually comes with the pipe, one coupling to each length. The couplings are made of cast iron metal or of brass. They are regularly threaded with right hand thread R and L coupling have projecting bars or rings to distinguish them from standard coupling. Another form of coupling called an extension piece is shown in (Fig 1b) It differs from the standard coupling in that it has a male thread at one end there are numerous other type is known as reducers.

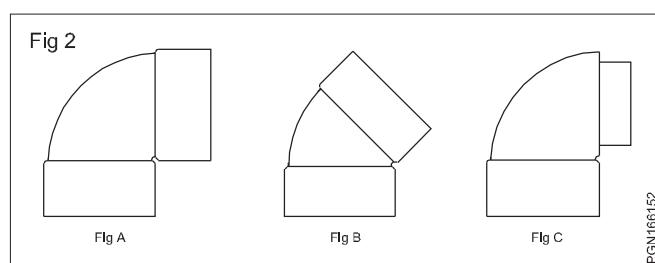
**Reducer (Fig 1c):** A reducer coupling is used to connect two pipes with different diameters.



**Elbows (Fig 2a):** Elbows and bends provide deviations of 90° and 45° in pipe work systems.

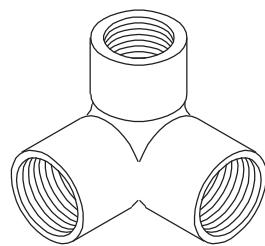
The 45° elbows allow pipe deviation of 450 (Fig 2b).

**Reducer elbow (Fig 2C):** The reducer elbow is used to connect two different dia pipes in deviation of 90° in pipe line work systems.



**Three way elbow:** Three way elbow is used to connect three pipes at deviations of 90°. (Fig 3)

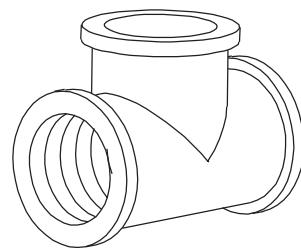
Fig 3



PGN166154

**Tee (or) Three way:** A tee is used to take a branch line at deviation of 90°. (Fig 4)

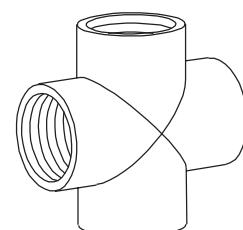
Fig 4



PGN166154

**Four way:** A fourway is used to connect four bits from straight line two opposite 90° are joined. (Fig 5)

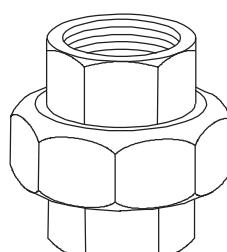
Fig 5



PGN166155

**Union:** A device used to connect pipes when unions are used in pipe lines it is easy to dismantle and repair. (Fig 6)

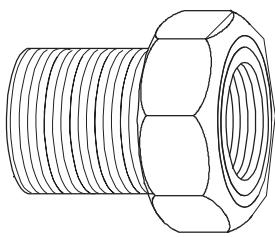
Fig 6



PGN166156

(Fig 7) This is special fittings used to connect two different diameter pipes one side is internal threaded used for joining small diameter pipe other type is external threaded used for joining bigger diameter pipe.

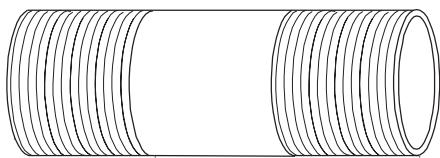
Fig 7



PGN166157

**Pipe nipples (Fig 8):** A nipple is a piece of pipe less than 30 CM length thread on both end.

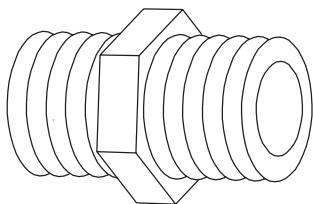
Fig 8



PGN166158

**Hexagonal nipple (Fig 9):** This nipple is used where fittings or valve are to be very close to each other. Both sides are external threaded and a hexagonal steps at the middle for gripping. (Fig 9)

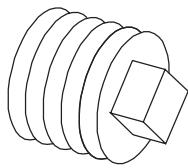
Fig 9



PGN166159

**Plug (Fig 10):** A plug is used for closing the end of a pipe or a fitting having a female thread square head is provided at the top to grip. Plugs are made on sizes ranging from 6 mm to 300 mm. It is made of castiron, malleable iron and brass.

Fig 10

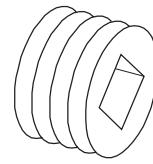


PGN16615A

**CAP (Fig 11):** A cap is female threaded and is used for closing the end of a pipe or fitting having a male thread cap are made of castiron malleable iron and brass They are regularly made in sizes from 6mm to 150mm.

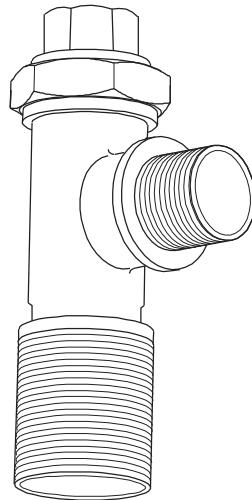
**Ferrule (Fig 12):** This ferrule is made of gun metal and is used to take service connection from water supply main line. It is fitted in the C.I pipes and P.V.C supply main line. It is fitted in the C.I pipes and P.V.C saddle.

Fig 11



PGN16615B

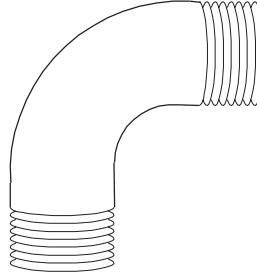
Fig 12



PGN16615C

**BEND (Fig 13):** This bend is made of G.I pipe having external thread on both end It is used to join with the male threaded pipes using couplings or flanges join directly to the female threaded fittings.

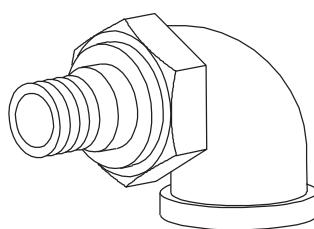
Fig 13



PGN16615D

**Union elbow (Fig 14):** A pipe fitting with a male union at one end.

Fig 14



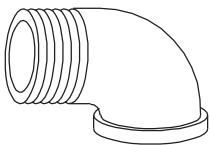
PGN16615E

**Elbow M+F:** A pipe fitting as above only one internal threads and other one external thread. (Fig 15)

**Bend (M+F):** A fitting as before but with an external thread and internal thread.(Fig 16)

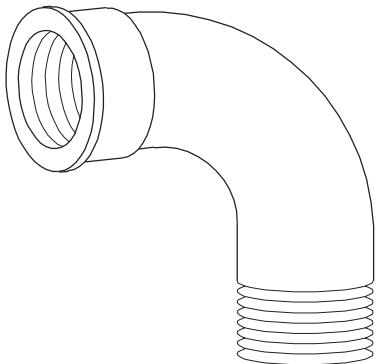
**Bend 45° (F+F):** A fitting as before. Both ends have internal threads. (Fig 17)

Fig 15



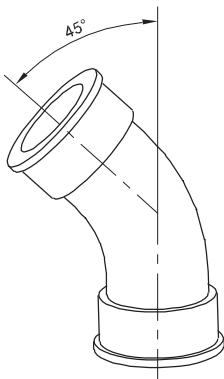
PGN16615F

Fig 16



PGN16615G

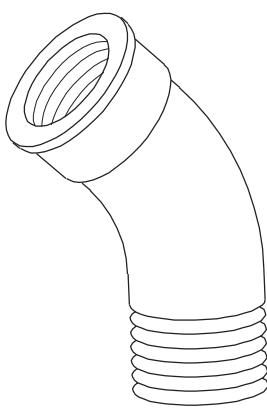
Fig 17



PGN16615H

**Bend 45° (M+F):** A pipe fitting as before only one end has an external (Male) thread and the other end has internal (female) thread. (Fig 18).

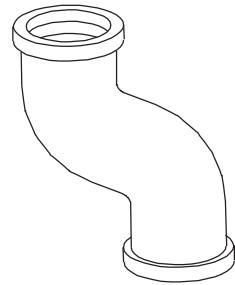
Fig 18



PGN16615I

**Offsets:** In piping, part of the pipe line must sometimes be in a position, parallel to but not in alignment with the balance of the pipe. An experienced pipe fitter can offset the line by bending the pipe, but ordinarily when the offset or distance between the axes of the two pipes is of standard dimension, a fitting called an offset, can be used more conveniently. (Fig 19)

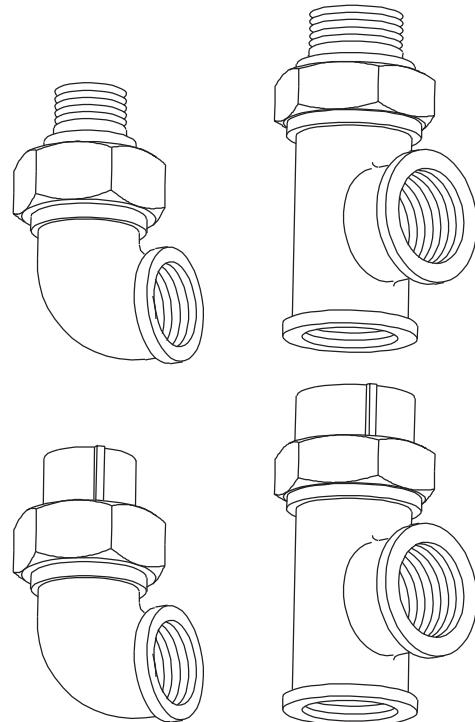
Fig 19



PGN16615J

**Special union elbow and tee:** The frequent use of union in pipe lines is desirable for convenience in case of repair. When the union is combined with a fitting, the advantage of a union is obtained with only one threaded joint instead of two as in the case of a separate union. A disadvantage of union fittings is that they are not usually as easily obtainable as ordinary fitting as shown in (Fig 20). Various union elbows and union tees of the female and of the male and female types.

Fig 20



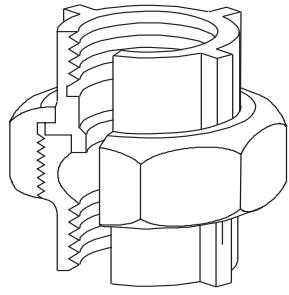
VARIOUS UNION ELBOWS AND UNION TEES

PGN16615K

**Unions:** There are various kinds of unions available in the market. The two pipes are to be joined by the union must be in approximate alignment to secure a tight joint because of the flat surfaces which must press against the gasket. Various union having spherical seat and ground joints have been devised. These consist of a composition ring bearing against iron or with both contact surface of composition. (Figs 21,22 & 23) shows the construction of a ground joint unions. Unions are also made entirely of brass with ground joints.

On working drawings or sketches plumbing pipe fittings are shown by symbols.

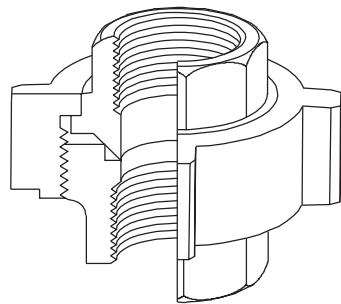
Fig 21



GASKET TYPE UNION

PGN16615L

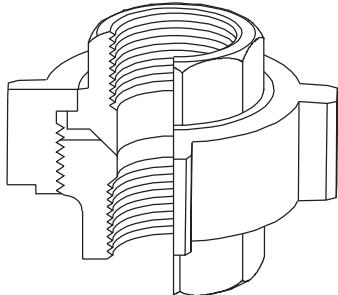
Fig 23



GROUND JOINT TYPE UNION

PGN16615N

Fig 22



PGN16615M

Piping symbols are used by architects and plumbing engineers on blueprints or working drawings. They represent the various plumbing fixtures and piping systems as well as the pipe fittings and valves used to construct these systems.

Plumbers must recognize these symbols in order to locate water supply systems on drawings or sketches.

### Standard symbols for plumbing, piping and valves

#### Plumbing

Corner Bathtub		Standard kitchen sink		Water closet (Flush valve, floor outlet).	
Recessed Bathtub		Kitchen sink, R & L Drain Board		Water closet (Flush valve, wall-Hung).	
Sitz Bath		Kitchen sink, LH Drain Board		Urinal (Wall-Hung)	
Bidet		Combination sink & Dishwasher		Urinal (Seal)	
Shower stal		Combination sink & Laundry Tray		Urinal (Trough-Type)	
Shower head	PLAN ELEV	Service sink		Drinking Fountain (Recessed)	
Overhead gang shower	PLAN ELEV	Wash sink (Wall-Type)		Drinking Fountain (Semi-Recessed)	
Pedestal lavatory		Wash sink			
Wall Lavatory		Laundry Tray (single)			
Corner lavatory		Laundry Tray (Double)			
Handicapped lavatory		Water closet (Tank Type)			
Dental lavatory	DENTAL LAV	Water closet (Integral Tank)			

Plumbing (continued)		Drinking water	Return	Lateral	
Drinking Fountain (Projecting type)		Vacuum cleaning	V V	Expansion joint	
Hot water Tank	HW T	Compressed air	A		
Water heater	WH				
Meter	M				
Hose Rack	HR				
Hose Bibb	HB				
Gas outlet	G				
Vacuum outlet	V				
Drain	D				
Grease separator	G				
Oil separator	O				
Cleanout	C O				
Garage drain					
Floor drain with backwater valve					
Roof sump					
Piping		Pipe fittings			
		Fitting	Screwed	Solidward	
Soil and waste, above grade		Joint	+	○	Gate valve
Soil and waste, Below grade		Elbow-90°	f +	○ ○	Globe valve
Vent		Elbow-45°	f	○	Angle globe valve
Cold water		Elbow-Turned up	○ +	○ ○	angle gate valve
Hot water		Elbow-Turned down	○ +	○ ○	Check valve
Hot water return					Angle check valve
Fire line	F F				Stop cock
Gas line	G G				Safety valve
Acid waste	ACID				Quick-opening valve
Drinking water supply					Float valve
					Motor - Operated Gate valve
		Pipe fittings (continued)			
		Fitting	Screwed	Solidward	
Soil and waste, above grade		Elbow-long radius	f +		
Soil and waste, Below grade		Side outlet elbow-outlet down	○ +		
Vent		Side outlet elbow-outlet up	○ +		
Cold water		Base elbow	f +		
Hot water		Double branch elbow	+ +		
Hot water return		Single sweep tee	+ +		
Fire line	F F	Double sweep tee	+ +		
Gas line	G G	Reducing elbow	f +	○ ○	
Acid waste	ACID	Tee	+ +	○ ○	
Drinking water supply		Tee-outlet up	+ ○ +	○ ○ ○	
		Tee-outlet down	+ ○ +	○ ○ ○	
		Side outlet tee-outlet up	+ ○ +		
		Side outlet tee-outlet down	+ ○ +		
		Cross	+ ○ +	○ ○ ○	
		Concentric reducer	-○-	○ ○ ○	
		Eccentric reducer	-○-	○ ○ ○	

# Types of fittings for different joints in different pipes

**Objectives:** At the end of this lesson you shall be able to

- state the different fittings used for different pipe joints and their uses
- state the method adopted for flange joint, socket joint with lead
- state the method of datachable joint stone ware socket and spigot cement murtar joint
- state the method of ductile iron pipe joint.

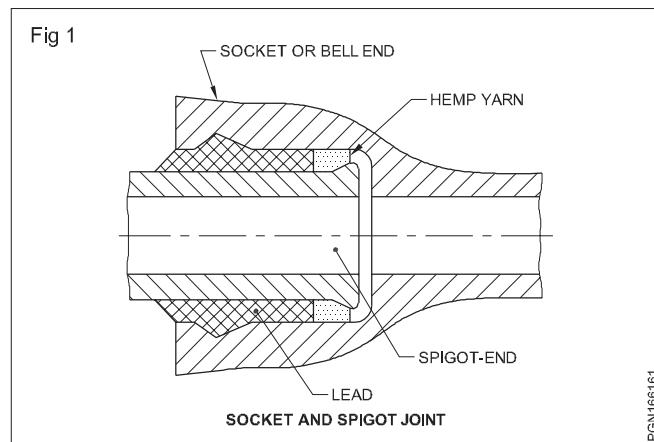
Rain water is a source for the soil and stored in a tank pipes are used for handling & transporting the water in position.

Pipes are manufacturing in small length of 2 to 6 meters. These small pieces of pipes are then joined together after placing in position, to make a continuous length of pipe line.

The pipe joints are classified as follows

- 1 Spigot and socket joint
- 2 Expansion joint
- 3 Flanged joint
- 4 Screwed joint
- 5 Collar joint
- 6 A.C pipe joint
- 7 Solvent cement joint

## 1 Socket and spigot joint (Fig 1)

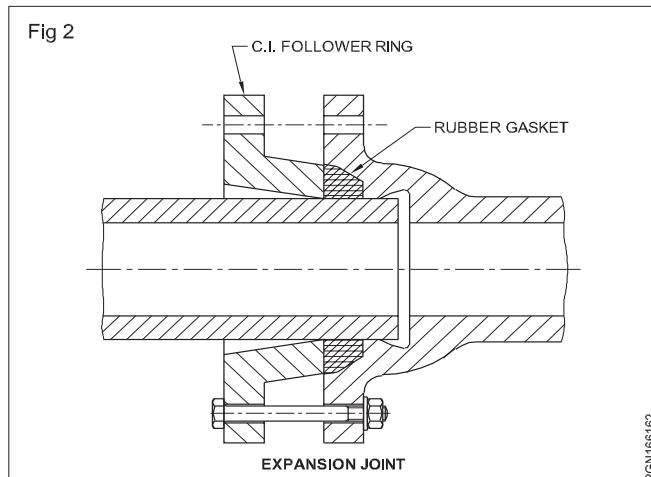


This type of joints are mostly used for cast iron pipes. Sometimes wet clay is used to make light contact between the runner and pipe so that hot lead may not run out of the joints space. The molten lead is then poured into the "V" shaped opening left in the top by the clamped joint runner. The space between the hemp yarn and the clamp runner is filled with molten lead. When the lead has hardened, the runner is removed the lead which shrinks while cooling is again tightened by means of caulking tool and hammer.

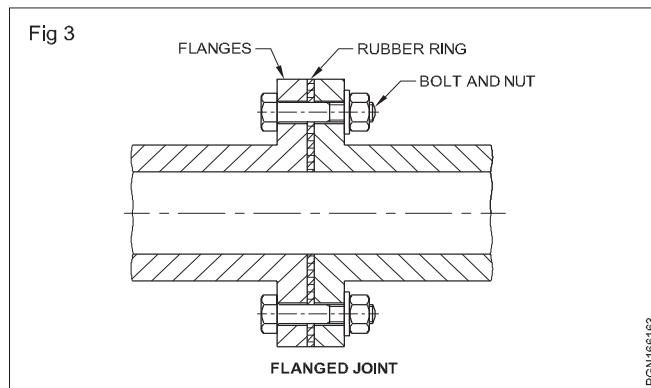
## 2 Expansion joint (Fig 2)

This joint is used at such places where pipes contract due to change in atmospheric temperature and thus checks the setting of thermal stresses in the pipe. In this joint the socket end is flanged with cast iron follower ring, which can freely slide on the spigot end or plane and of other pipe. An elastic rubber gasket is tightly

pressed between the annular space of socket and spigot by means of bolts as shown in the (Fig 2).



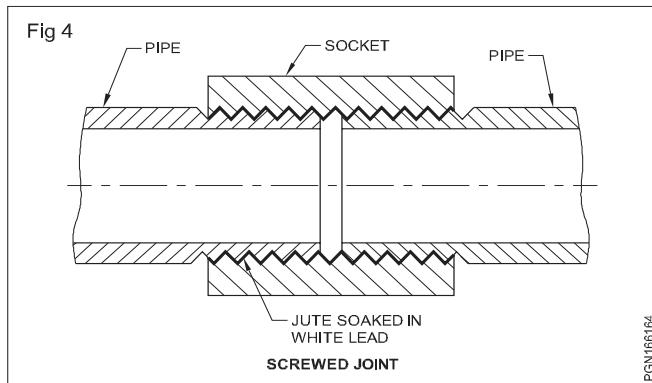
## 3 Flanged joint (Fig 3)



This joint is mostly used for temporary pipe lines, because the pipe line can be dismantled and again assembled at other place. The pipe in this case has flanges on its both end welded or screwed with pipe. The two end of the pipes which are to be joined together are brought in perfect level near one another and after placing one hard rubber washer between flanges are bolted. Placing of washer or gasket of rubber, canvas, copper or lead between the two ends of flanges is very necessary for securing a perfect water tight joint. This joint cannot be used at such places where it has to bear vibration or deflection of pipes. (Fig 3)

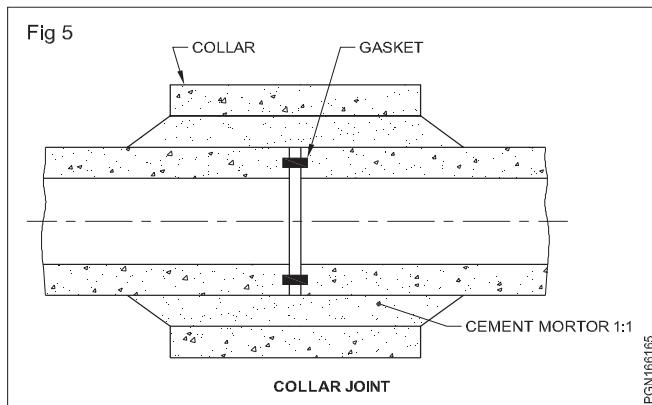
These joints are commonly used for joining pumping station, filter plants, hydraulic laboratory boiler, house etc. where it may be necessary occasionally to dismantle and reassemble the pipe line. If the steel pipes are to be jointed by these joints, it is better to screw the separately cast flanges on the pipe and then they are joined.

#### 4 Screwed joint (Fig 4)



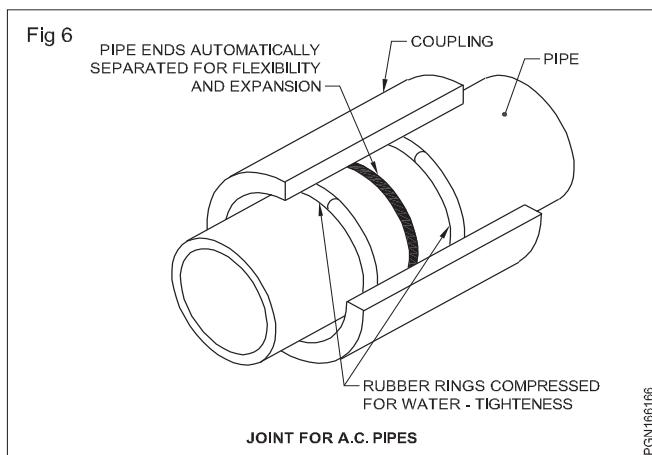
This joint is mostly used for connecting small dia. cast iron, wrought iron and galvanised pipes. The ends of the pipe have threads on outside while socket or coupling has threads on the inner side. The same socket is screwed on both the end of the pipe to join them, for making water tight joint zinc paint or hemp yarn should be placed in the threads of the pipe before screwing socket over it. (Fig 4)

#### 5 Collar joint (Fig 5)



This type of joints are mostly used for joining big diameter concrete and asbestos cement pipes. The end of the pipes are brought in one level before each other. The rubber gasket between steel rings and jute-rope soaked in cement is kept on the groove and the collar is placed at the joint so that it should have the same lap on both the pipes. Now 1:1 cement mortar is filled in the space between the pipes and the collar as shown in (Fig 5).

#### 6 AC pipe Joint (Fig 6)

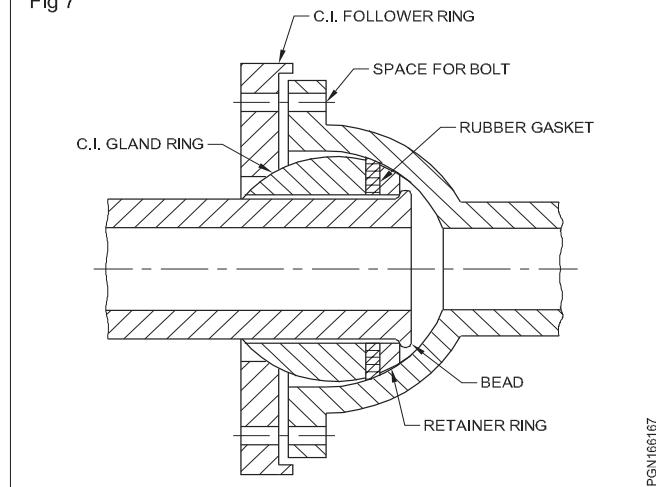


For joining small diameter AC pipe the two ends of pipes are butted against each other then two rubber ring will be slipped over the pipes and the coupling will be pushed over the rings as shown in (Fig 6).

#### 7 Flexible joint

Sometimes the joint is also called bolt and socket or universal joint. This joint is used at such places where settlement is likely to occur after the laying of the pipe. This joints can also be used for laying pipe on curves, because at the joints, the pipe can be laid at angle. This is a special type of joint. (Fig 7)

Fig 7



#### 8 Solvent cement joint

Clean the contacting surface of joint with a clean cloth- Abrace these area with emery paper and again clean it. Apply an even coat of solvent adhesive with a clean dry brush having sufficient width for quick application. Immediately after applying solvent cement, insert the pipe in the socket to its full depth and turn it through 90° angle. Leave joint undisturbed till the joint sets.

For small breakage of pipe i.e. less than 300mm  $\varnothing$  a piece of pipe bigger than damaged portion can be cut vertically into unequal half. After applying thin coat of PVC solvent cement around the damaged portion and inside the bigger half cut pipe piece, stick it over the damaged portion.

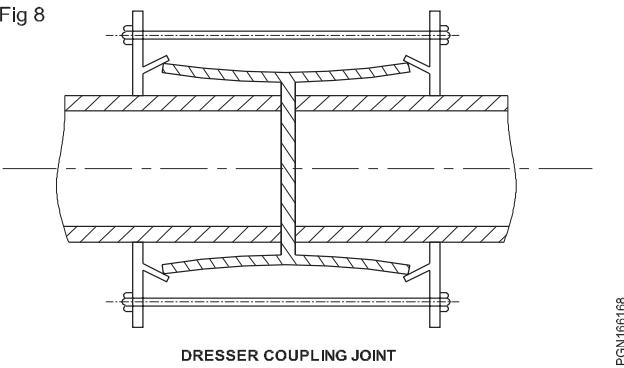
#### 9 Mechanical Joints

This type of joint is used for jointing cast iron, steel or wrought iron pipes, when both the ends of the pipes are plain or spigot. There are two types of mechanical joints.

**a Dresser-coupling:** It essentially consists of one middle ring, two follower rings and two rubber gaskets. The two follower rings are connected together by bolts, and when they are tightened they press both the gaskets tightly below the ends of the middle ring. In this way the joint remains watertight.

These joints are very strong and rigid, and can withstand vibration and shocks upto certain limit. These joints are most suitable for carrying water lines over bridges, where it has to bear vibrations. (Fig 8)

Fig 8

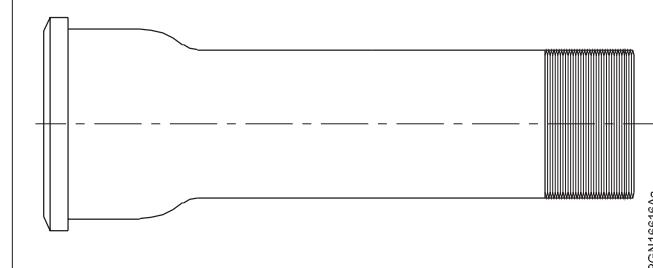


- Alkali resistance test

- Crushing strength test

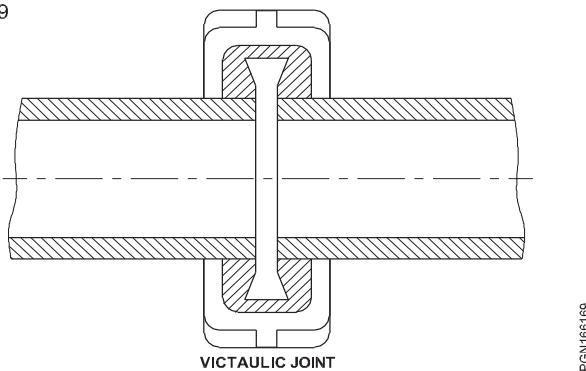
Details refer IS 651 (Fig 10a)

Fig 10a



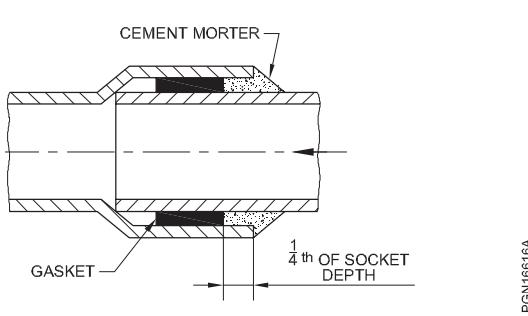
- b) **Victaulic-Joint:** In this type of joint a gasket or leak proof ring is slipped over both the ends of the pipes as shown in the Fig 9. This gasket is pressed from all sides on both the pipes by means of half iron coupling by bolts. The ends of pipes are kept sufficient apart to allow for free expansion, contraction and deflection. This joints can bear shocks, vibrations etc. and is used for cast-iron, steel or wrought iron pipes line in expose places. (Fig 9)

Fig 9



### Stone ware pipe joint (Fig 10)

Fig 10



This type of joint is called socket and spigot joint. For this joint spigot end is inserted to the socket end and hempyam (or) gasket soaked in thick cement slurry is placed in the gaps. This hempyarn is caulked tightly by the spun yarn caulking chisel.

Cement mortar of ratio 1:1 is filled in the socket for the  $45^\circ$  angle this is mostly used for under ground drainage.

Tests to be conducted on SW pipe are

- Hydraulic test
- Acid resistance test

Permissible tolerance on internal diameter of pipe are as under.

0	Permissible tolerance
100	3 mm
150	5 mm
200 - 230	6 mm
250 - 350	8 mm
400 - 450	10 mm
500 - 600	12 mm-

Plumber should check the following

- Pipes are straight
- Pipes are circular throughout
- Pipes has got required glazing.
- Pipes sounds riging on knocking.
- There are no obstructions inside pipe.

**Ductile iron pipe (D.I pipe):** Ductile iron pipe is sized according to a dimensionless term known as the pipe size or nominal diameter.

Individual lengths of ductile iron pipe are joined either by flanges, coupling

**Flanged joints:** Flanges are flat rings around the end of pipes which mate with an equivalent flange from another pipe the two being held together by bolts usually passed through holes drilled through the flanges.

A deformable gasket, usually elastomeric, placed between raised faces on the mating flanges provides the seal.

Flanges are designed to a large number of specifications that differ because of dimensional variations in pipes sizes and pressure requirements and because of independent standards development.

A flanged joint is rigid and can bear both tension and compression as well as a limited degree of shear and bending.

It also can be dismantled after assembly. Due to the rigid nature of the joint and the risk of excessive bending moment being imposed it is advised that flanged pipe work is not buried.

**Spigot and socket joint:** Spigot and sockets involve a normal pipe end the spigot being inserted into the socket or bell of another pipe or fitting with a seal being made between the two with in the socket.

A large number of different socket and seals exist. The most modern is the push joint (or) slip joint

Where by the socket and rubber seal is designed to allow the pipe spigot to be after lubrication, simply pushed into the socket. Push joints remain proprietary designs.

Also available are locking gasket systems these locking gasket systems allow the pipe to be pushed together but do not allow the joint to come apart without using a special tool or torch on the gasket

In the late 1950's ductile iron pipe was introduced to the market place featuring higher strength and similar corrosion resistance compare to cast iron.

An expected life span of 100 years, using evolved laying practices had an estimated life up to 110 years. Like most ferrous materials ductile iron is susceptible to corrosion can occur in two ways in ductile iron pipes.

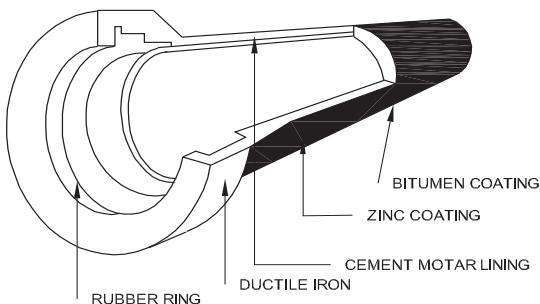
Graphitization and corrosion pitting unprotected pipes in highly corrosive soil tend to have shorter life spans.

Use of polyethylene sleeking can reduce corrosion by controlling the effect of corrosive soil on piping.

Ductile iron pipe is some what resistant to internal corrosion in potable water cement mortar lining is by for the most common port land cement is used the cement mortar in the ratio 1:2 and 1:3:5 There are two types of jointing method.

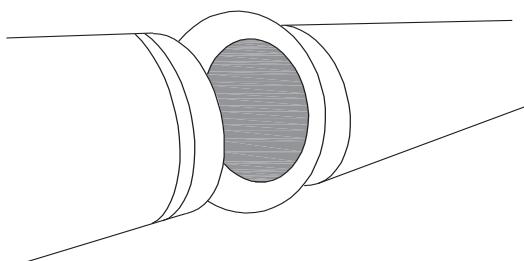
#### Ductile iron (DI) Pipe Joints (Figs 11,12,13 &14)

Fig 11



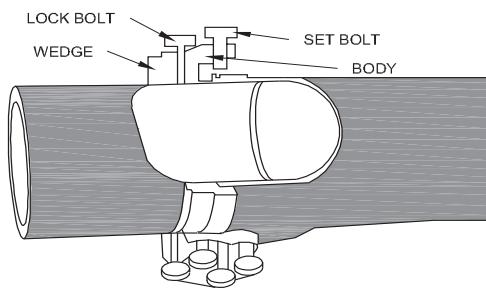
PGN166168

Fig 12



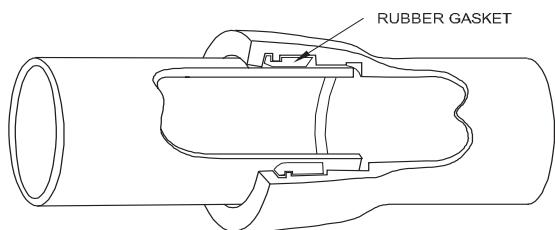
PGN166168

Fig 13



PGN16616D

Fig 14



PGN16616E

**Sand cast iron pipes:** Sand cast iron spigot as socket soil and waste and ventilating pipes, fittings and accessories should confirm is 1729. Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes fittings and accessories should confirm IS3989. These pipes can be recognised by looking at the socket shape. The fittings shall confirm to the respective I.S. Specifications to which the pipe itself confirm to which they are connected. There should not be any visible cracks, taps and pinholes and it should ring clearly when struck with light hand hammer. These pipes are available at 1.5, 1.75, 2, 2.5 and 3m lengths. (Figs 15, 16, 17 & 18).

The pipes and fittings should be without ears. The pipes and fittings are coated internally and externally with same material at factory.

The access door fittings should be designed so as to avoid dead spaces in which filth may accumulate. Door are provided with 3mm rubber insertion packing and when closed and bolted, the joints should be water tight.

The standard weight and the accuracy of pipes and their tolerance should be as under.

#### Sand cast iron pipes

Nominal dia of bore mm	Thickness mm	Overall weight of pipe in Kg excluding ear for effective length		
		1.5m	1.8m	2.00m
50	5	9.56	11.41	12.65
75	5	13.83	16.52	18.37
100	5	18.14	21.67	24.15
150	5	26.70	31.92	35.66

Fig 15

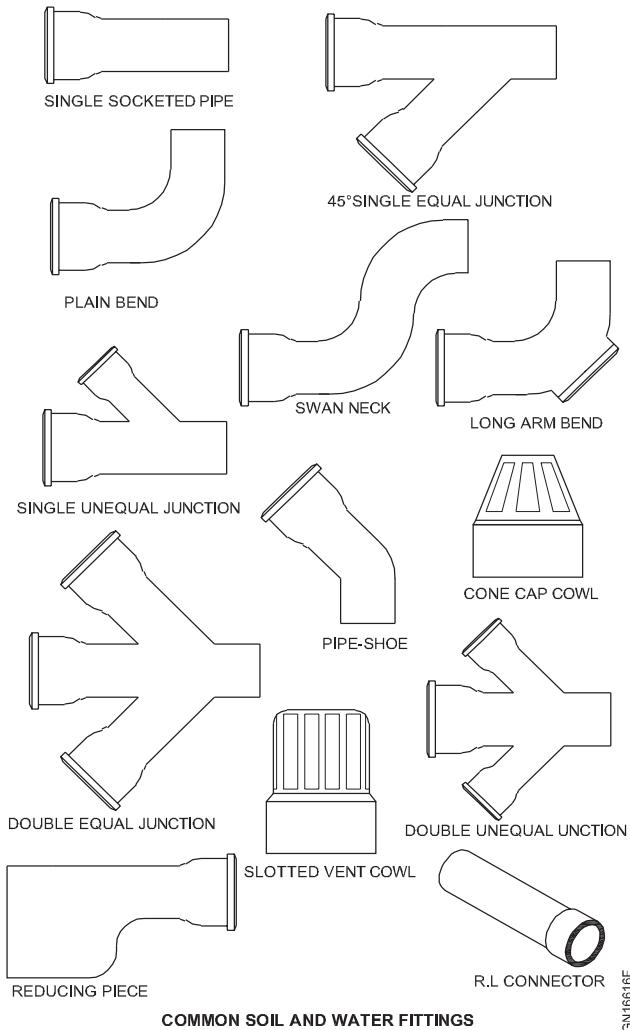
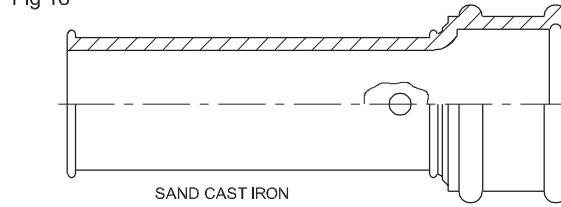


Fig 18



PGN16616I

**Cast iron (Spun pipes)**

Nominal ∅	Thick ness	Overall weight in kg for effective length in meter for				
		3m	2.5m	2m	1.8m	1.5m
50	3.5	13.4	11.3	9.2	8.4	7.1
75	3.5	20.0	16.8	13.8	12.5	10.6
100	4.0	30.0	25.2	21.0	18.8	16.0
150	5.0	56.0	47.0	38.5	34.9	29.5

**Table 1**

Dimension in mm	Nominal ∅ in mm	Tolerance mm
External ∅ of barrel	50,75	± 3
	100	± 3.5
	150	± 4.0
Internal ∅ socket	All diameter	± 3.00
Depth of socket	All diameter	± 10.00

- Inspection opening

**Pipe fittings**

Very extensive range of cast iron fittings is available. Refer manufacturer's catalogues). Care must be taken specifying and selecting the fittings. Always check the following points. (Fig 19)

Fig 19

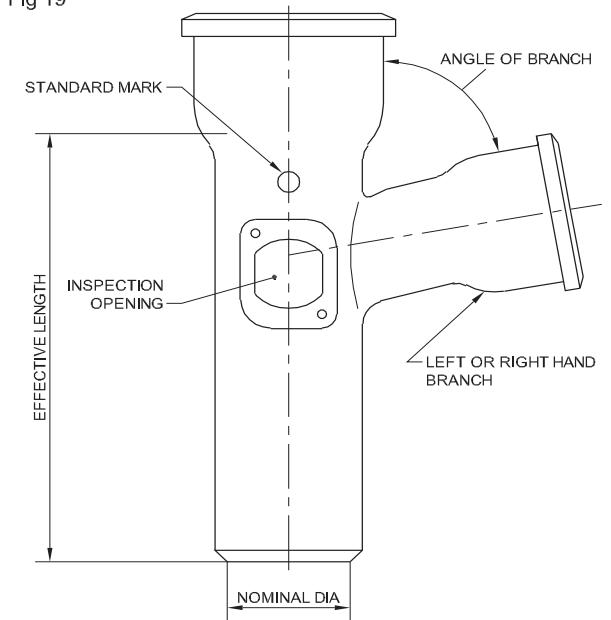
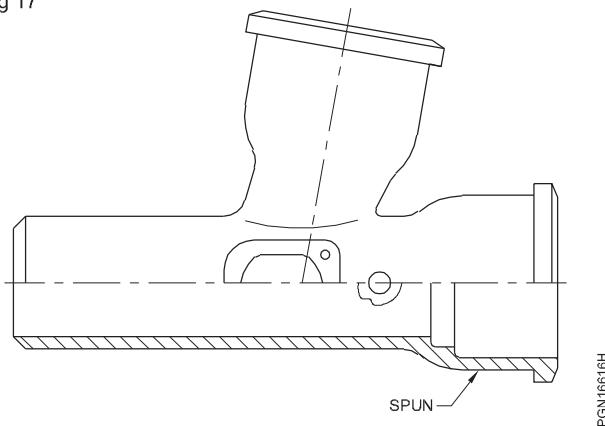


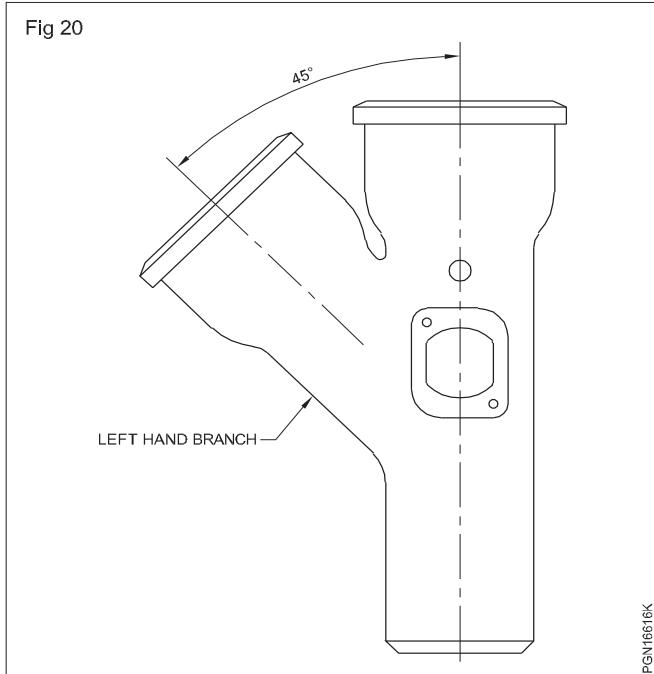
Fig 17



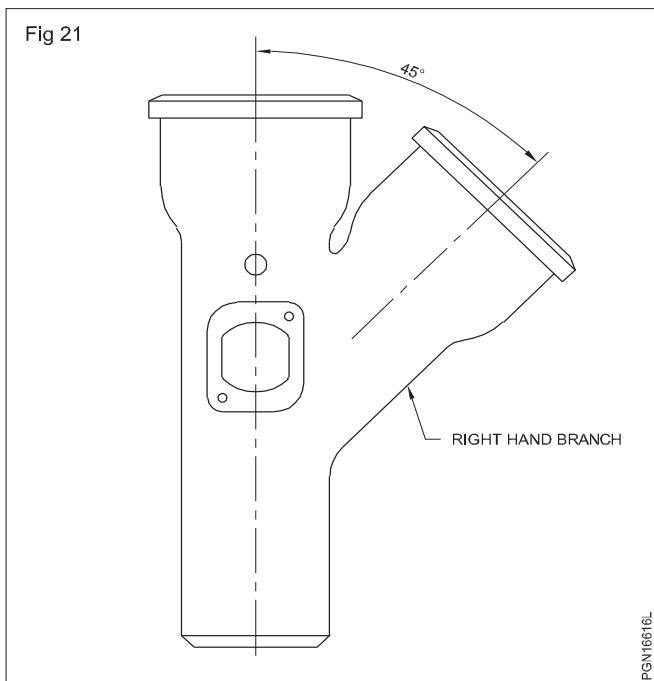
- Nominal diameter
- Standard mark
- Inspection opening
- Left or right hand branch
- Angle of branch
- Effective length

Specification branches can be handed either left or right. A branch can be used in either position. The hand of the branch is determined by its position when the branch is from the front.

- Shows a left hand branch. (Fig 20)



- Shows a right hand branch (Fig 21).



Some countries, a "branch" may be called a "junction".

Anches can be of equal or unequal diameters and are to receive the discharge from a waste pipe or for a connection to an anti - syphon vent pipe.

The angles of branches in common use are

- 45°
- 70°
- 80°

Branches may be equal and unequal.

E.g equal x 50mm

Unequal 75 x 50 mm

Double branches of equal and unequal f with 45°, 70° and 87°, "Y" branches, (Fig 21) invert branches, long arm sanitary branches, bends both large and short radius are used to change the direction of flow. They are available as plain fittings or with inspection openings. The angle of the bend vary from 15°, 30°, 45°, 60°, 70°, 80°, and 87°. By using a combination of bends as 2 x 45° bends a large radius 90° bend can be obtained and it will help for easy flow rather than using 87° bend. (Fig 22) offsets, reducers and tapering pieces are available. C. I traps are fitted in an installation to prevent foul air passing into the building. Three common types of traps are P trap, S trap and Q trap. (Figs 23, 24 & 25)

Floor outlets are fitted areas such as kitchen, bathrooms and corridors. Surface cleaning water is discharged into outlet through a trap as shown in (Fig 26).

Fig 22

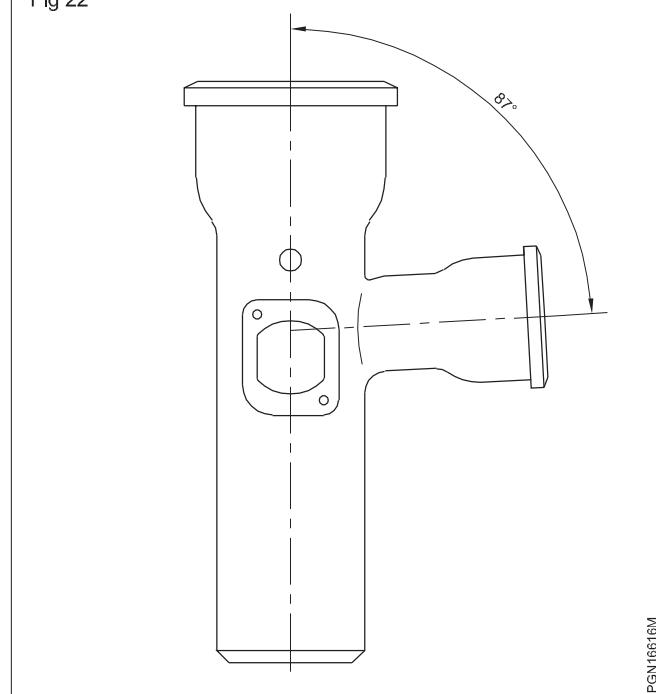
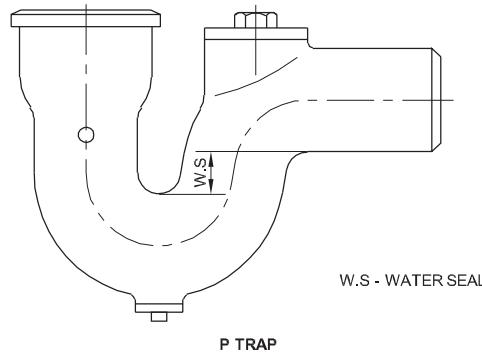
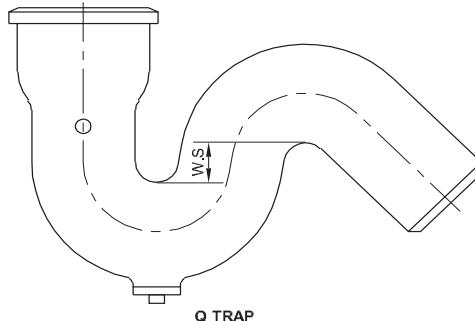


Fig 23



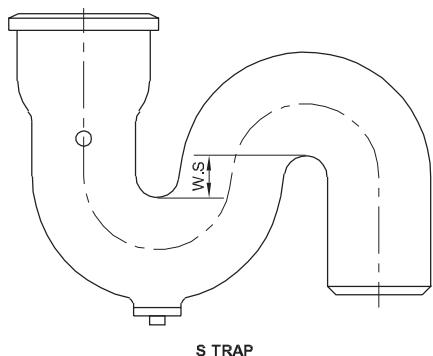
PGN16616N

Fig 25



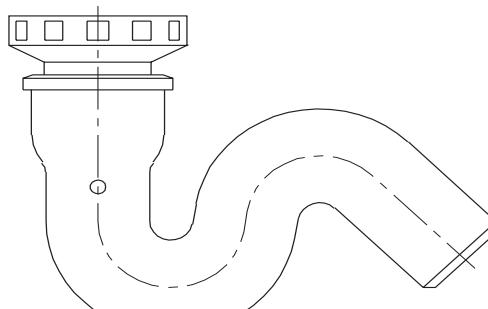
PGN16616P

Fig 24



PGN16616O

Fig 26



PGN16616Q

## PVC and CPVC pipe

**Objectives:** At the end of this lesson you shall be able to

- state the different type of PVC fittings used for different purposes
- state the different type of CPVC pipe and HDPE fittings.

### PVC pipes

**General:** PVC pipes are manufactured using poly vinyl chloride and additives. PVC pipes are available in 6 metres length and the pipe is specified by the outer diameter of the pipe. PVC pipes are available with bell or socket end. (Fig 1)

Fig 1



PGN166171

### Disadvantages

- PVC pipes could not be used for carrying hot water.

### Types of PVC pipes

- Low density polyethylene pipes.
- High density polyethylene pipes.
- Polyethylene pipes are normally available in black colour.
- Rigid (unplasticized).

**Uses:** PVC pipes are used for carrying drinking, waste and rain water.

### PVC pipe fitting

**Unplasticized polyvinyl chloride (UPVC) pipe:** There are two types of pipes as detailed under

Type A is used in ventilation pipe work and rain water application.

Type B: is used in soil and waste discharge system. these pipes should conform IS13592. The material from which the pipes are produced consists of Polyvinyl Chloride, additives and stabilizer.

Pipes are available in length of 2,3,4 & 6M either plain or with sliding/grooved sockets. A tolerance of +10mm on specified lengths are permitted. The pipes are

### Advantages

- PVC pipes are light weight.
- They are corrosion free.
- Cost of PVC pipe is cheaper than G.I/C.I/A.C pipes.

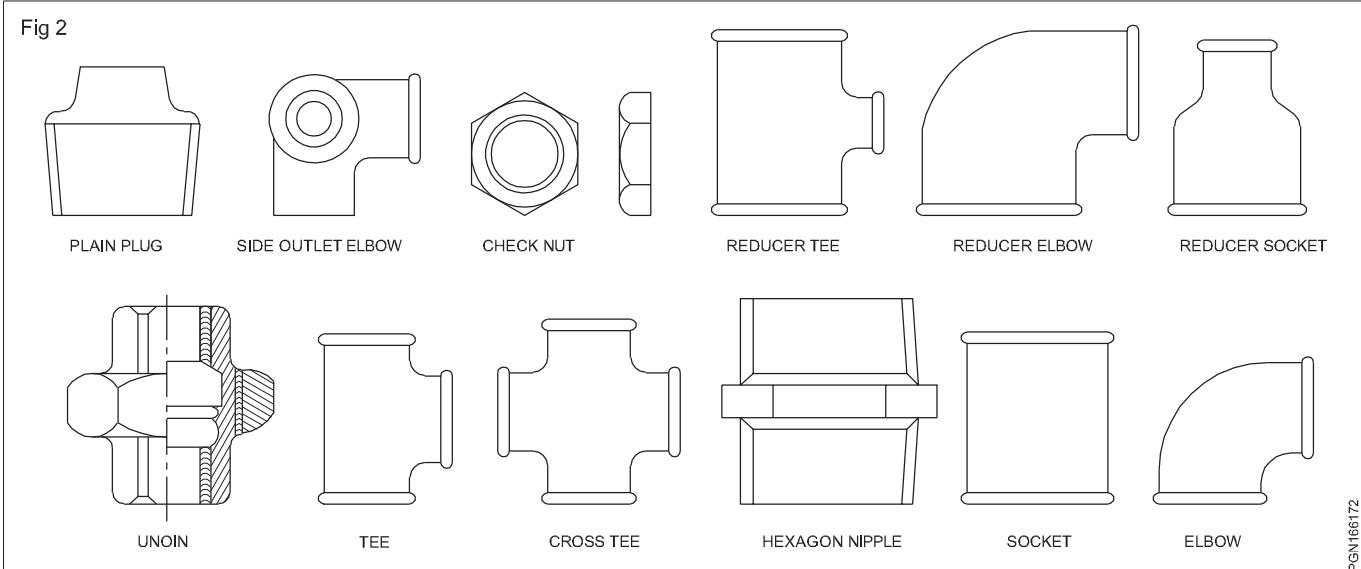
designated by its outside diameter. The mean outside f, outside f at any point wall thickness for Type A and B are at Table1.

Size of pipe mm	Support distance in meter	
	Vertical	Horizontal
40	1.2	0.5
50	1.2	0.7
75	1.8	0.9
110	1.8	0.9
160	1.8	1.0

Fittings used should confirm to IS14735 and rubber ring to IS5382. The pipes and fittings are provided with square groove and special shaped rubber rings. The single socketted pipes cover with plain end duly chafed at the end. When required lengths are cut from pipe the plain end to be chamfered. The plain end of all fittings are chamfered at the end. The pipes should be supported on the walls with PVC pipe clip and it should be fixed below the socket of pipe or fitting (not on the socket). Maximum spacing of clips shall be as under.

### Types of PVC joints and their uses

#### Union (Fig 2)



It is a fitting used to connect two pipes.

It is used

At the beginning of a pipe system inside a room.

For all appliances

Mid way between long pipe line.

Union enables repairs/replacement of the pipe line system, without disturbing the other parts of the system.

#### Socket

These fittings are used to connect one length to another, for continuation of the pipe line.

#### Elbow

It connects two pipes at 90° has a short curvature

#### Bend

Bend connects two pipes at any required angle.

It cannot be used in walls because of a layer curvature.

#### Tee

Tee is a fitting with a side outlet at 90° to the run of the pipe.

#### Cross Tee

Cross Tee is a fitting with four branches arranged in pairs each at right angles to the other.

#### Reducer

This fitting is larger at one end than the other.

It is used to connect pipes of two different diameters by

- Reducer Tee
- Reducer elbow
- Reducer bend
- Reducer socket

#### Barrel nipple

It is a piece of pipe threaded at both ends and can be used for short extension of the plumbing line.

#### Double nipple

It is used to connect two fittings within a short distance. It has threads on both sides of the central piece.

#### Plug

Plug has an exterior pipe thread end and a projecting head for fitting in the socket.

#### HDPE pipe fittings (Fig 3)

#### PVC pipe fittings (Fig 4)

#### UPVC pipe fittings (Fig 5)

#### CPVC pipe fittings (Fig 6)

#### PPR pipe fittings (Fig 7)

Fig 3



Fig 7



Fig 4



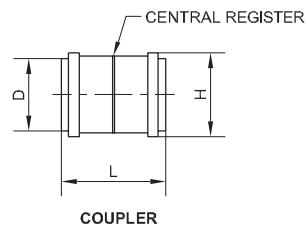
Fig 5



P.V.C Sanitary Fitting for Soil waste and Rain water pipes

#### Coupler (Fig 8)

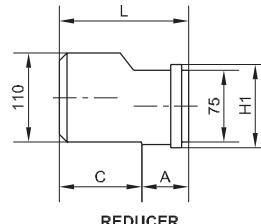
Fig 8



PGN166178

#### Reducer (Fig 9)

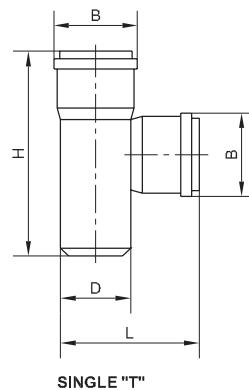
Fig 9



PGN166179

#### Single "T" (Fig 10)

Fig 10



PGN16617A

Fig 6



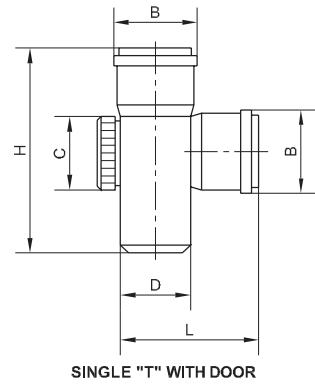
#### Single "T" with door (Fig 11)

#### Reducing "T" (Fig 12)

#### Cross "T" (Fig 13)

#### Cross "T" with door (Fig 14)

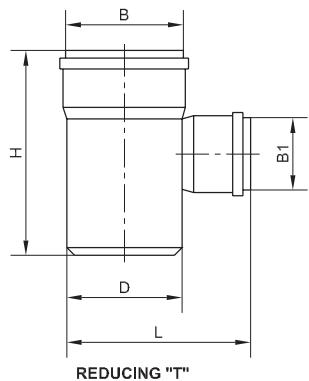
Fig 11



SINGLE "T" WITH DOOR

PGN16617B

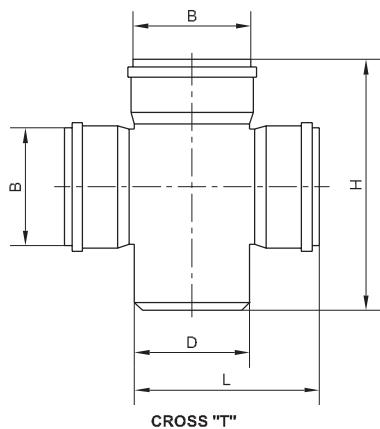
Fig 12



REDUCING "T"

PGN16617C

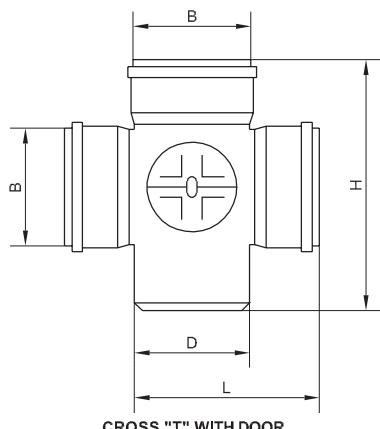
Fig 13



CROSS "T"

PGN16617D

Fig 14



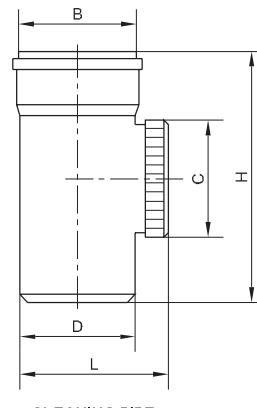
CROSS "T" WITH DOOR

PGN16617E

**Cleaning pipe (Fig 15)**

**Bend 45° (Fig 16)**

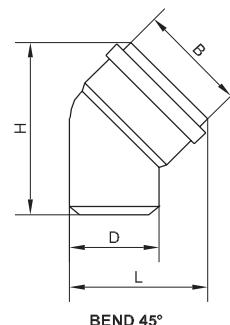
Fig 15



CLEANING PIPE

PGN16617F

Fig 16

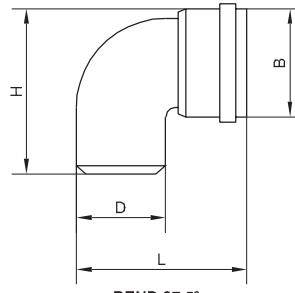


BEND 45°

PGN16617G

**Bend 87.5° (Fig 17)**

Fig 17

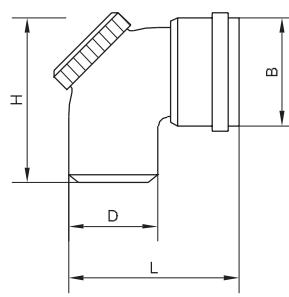


BEND 87.5°

PGN16617H

**Door bend (Fig 18)**

Fig 18



DOOR BEND

PGN16617I

**Door bend RS/LS (Fig 19)**

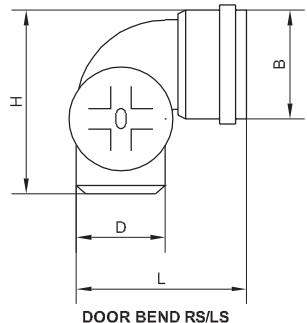
**Single "Y" (Fig 20)**

**Single "Y" with door (Fig 21)**

**Reducing "Y" (Fig 22)**

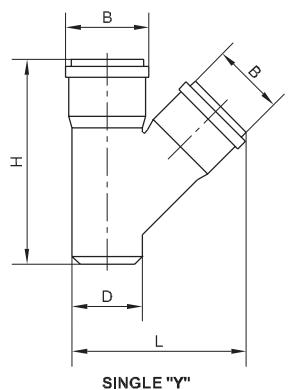
**Double "Y" (Fig 23)**

Fig 19



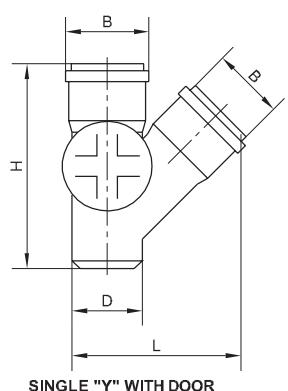
PGN16617J

Fig 20



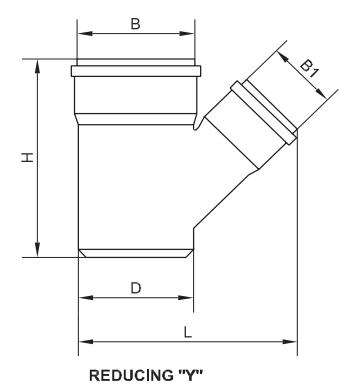
PGN16617K

Fig 21



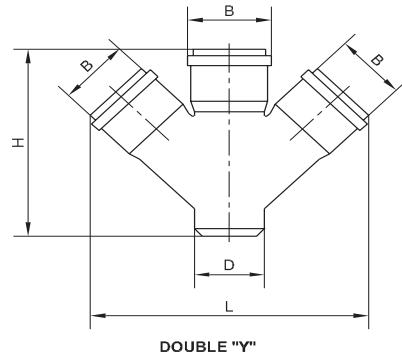
PGN16617L

Fig 22



PGN16617M

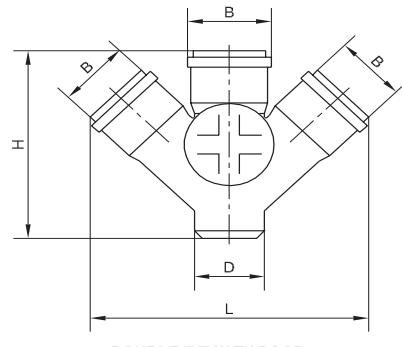
Fig 23



PGN16617N

### Double "Y" with door (Fig 24)

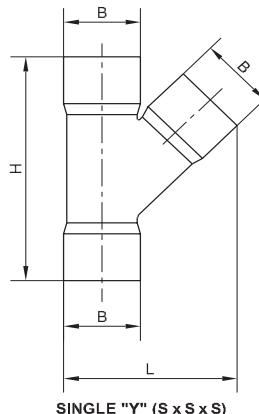
Fig 24



PGN16617O

### Single "Y" (S x S x S) (Fig 25)

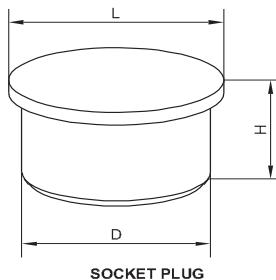
Fig 25



PGN16617P

### Socket plug (Fig 26)

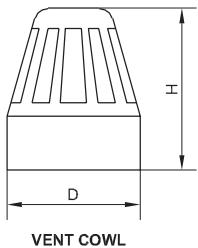
Fig 26



PGN16617Q

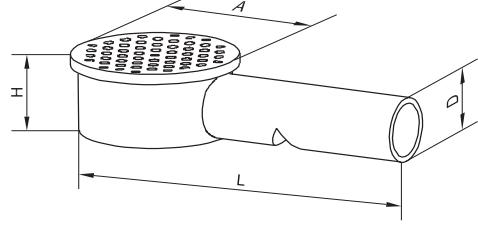
### Vent cowl (Fig 27)

Fig 27



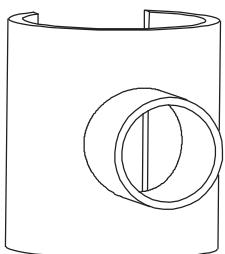
### Nahan trap (Fig 31)

Fig 31



### Branch saddle (Fig 28)

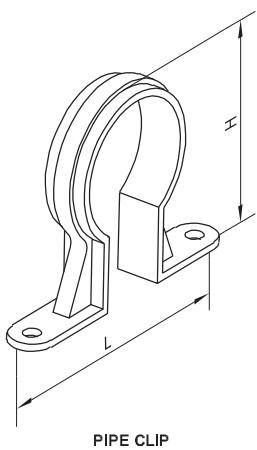
Fig 28



PGN16617R

### Pipe clip (Fig 29)

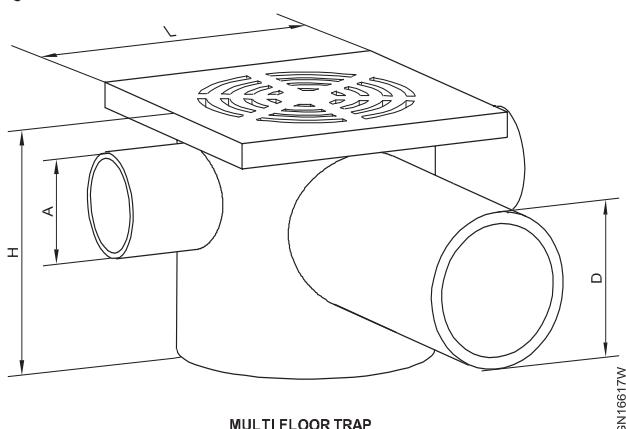
Fig 29



PGN16617S

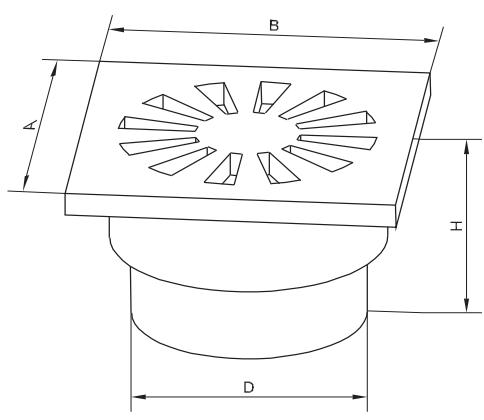
### Multi floor trap (Fig 32)

Fig 32



### Floor drain (Fig 30)

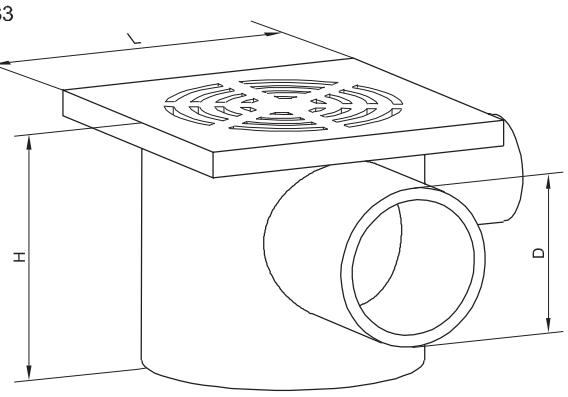
Fig 30



PGN16617T

### Plain floor trap (Fig 33)

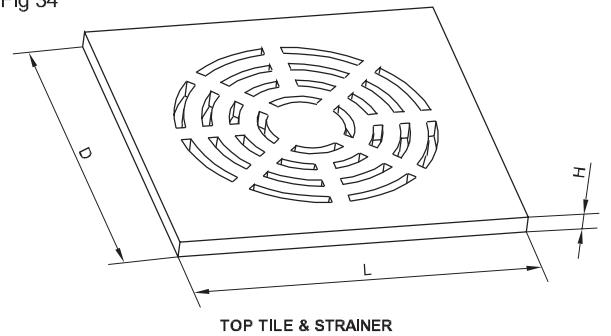
Fig 33



PGN16617U

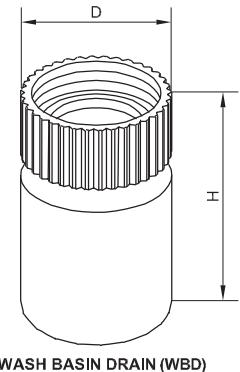
### Top tile & strainer (Fig 34)

Fig 34



### Wash basin drain (WBD) (Fig 35)

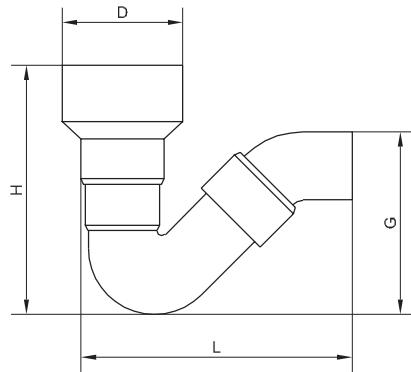
Fig 35



WASH BASIN DRAIN (WBD)

### Gully trap (Fig 39)

Fig 39

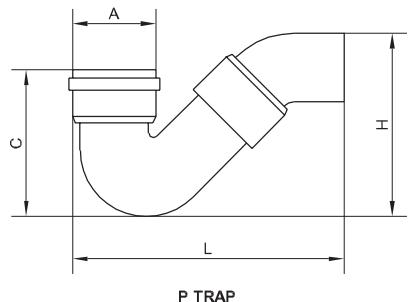


GULLY TRAP

PGN16617Z1

### P trap (Fig 36)

Fig 36

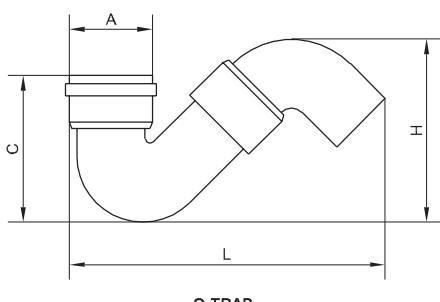


P TRAP

PGN16617Z1

### Q trap (Fig 37)

Fig 37

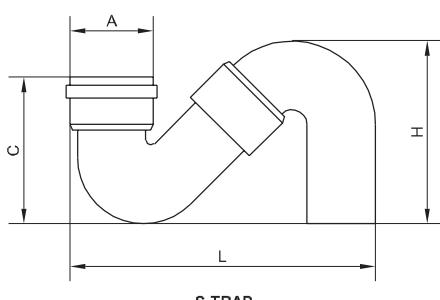


Q TRAP

PGN16617Z1

### S trap (Fig 38)

Fig 38

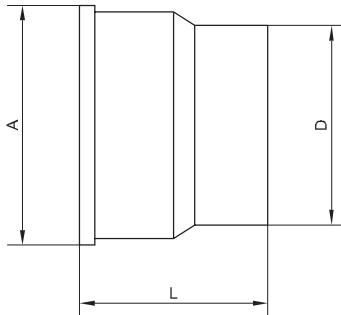


S TRAP

PGN16617Z3

### W.C. Connector straight (Reducer type) (Fig 40)

Fig 40

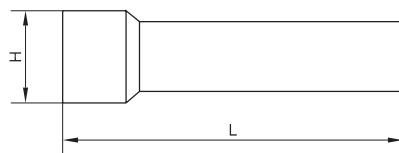


W.C. CONNECTOR STRAIGHT (REDUCER TYPE)

PGN16617Z5

### W.C. Connector (Straight) (Fig 41)

Fig 41

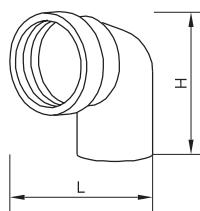


W.C. CONNECTOR (STRAIGHT)

PGN16617Z6

### W.C. Connector (Bend) (Fig 42)

Fig 42



W.C. CONNECTOR (BENT)

PGN16617Z7

# General layout of water pipe connection to mains

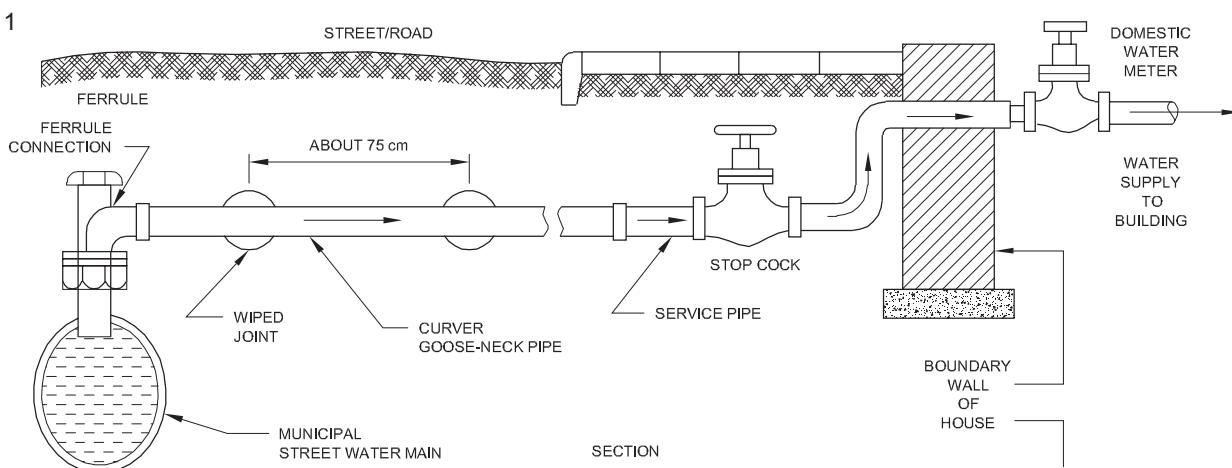
**Objectives:** At the end of the lesson you shall be able to

- state house water connection.
- state goose neck, service pipe, stop cock
- state water meter and stop cocks.

## The house water connection

An installing a 'water supply plumping system' in a building is, to obtain a 'water connection' from the municipal water main, because the water supply to a house or a building can start only from this point. A typical water connection, connecting the service pipe with the municipal water main, is shown in Fig 1. As is evident, the water connection consists of : (i) a ferrule; (ii) a goose neck; (iii) a service pipe; (iv) a stop cock; and (v) a water meter, as described below:

Fig 1



THE WATER CONNECTION

PGN166181

## Goose neck

Goose neck is small sized curved pipe made of a flexible material (usually lead) and is about 75cm in length forming a flexible connection between the water service pipe.

## Service pipe

Service pipe is galvanized iron pipe of size less than 50 mm dia. It should be laid underground in a trench in which no sewer or drainage pipe is laid. The service pipe which supplies water to the building through the municipal main is thus connected to the main through the goose neck and ferrule.

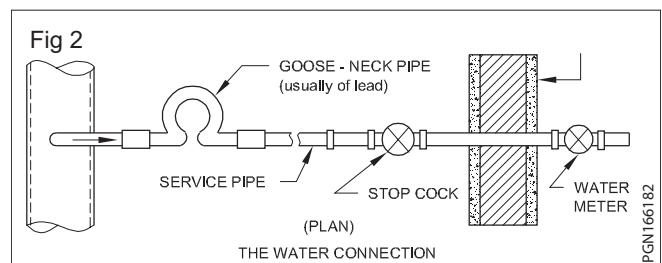
## Stop cock

The stop cock is provided before the water enters the water meter in the house. It is housed in a suitable masonry chamber with a removable cover, and is fixed in the street close to the boundary wall in an accessible position. Sometimes, it is provided just before the water meter inside the house, keeping both of them in one chamber. The details of stop cocks are given in the next article.

## Ferrule

A ferrule is a right angled sleeve made of brass or gun metal, and it is joined to a hole drilled in the water main, and it is screwed down with a plug. Its size usually varies between 10 to 50 mm dia. For all other connections of more than 50 mm dia, a tee branch connection, off the water main, is used.

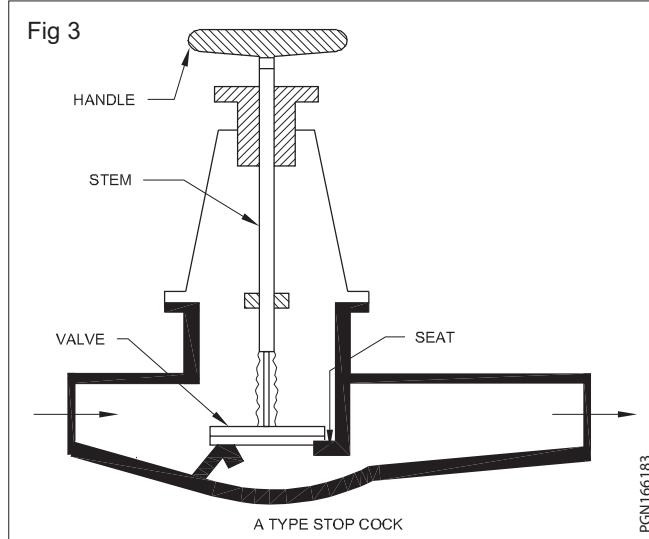
## Water meter (Fig 2)



Water meter measures and records the quantity of water consumed in the house. The domestic type water meter generally employed for houses is fitted into the service pipe with unions, which enables the meter to be changed where necessary. The water meter is generally fixed in an iron box fitted in an opening or cavity made in the boundary wall of the house, and is covered with a movable iron cover.

### Stop cocks (Fig 3)

A stop cock is a screw down type of sluice valve which is used in smaller sized pipes in service connections for stopping or opening the supply. They are generally provided at the water entrance of each building and also within the building. When provided just prior to the water meter in each house connection, they should be enclosed in a proper cast iron box having a hinged cover.



## Erecting of rain water pipe system

**Objectives:** At the end of the lesson you shall be able to

- state the installation of rain water pipe from roof to ground
- fix the rain water gutter with rain water pipe.

### Installation of rain water pipe from roof to ground:

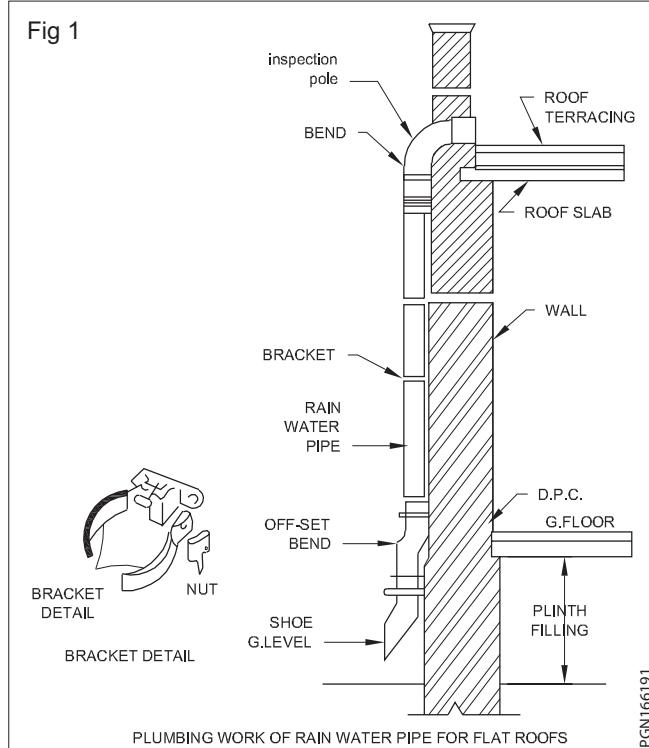
The pipe laid to collect the rain water from the roofs is known as rain water pipe. The water from the flat as well as sloppy roofs is to be connected and brought on the ground level, from where it is allowed to flow in open drains.

Rain water pipes for drainage of roofs (Fig 1). The roofs of a building shall be constructed or framed as to permit effectual drainage of the rain water there from by means of a sufficient number of rain water pipes of adequate size so arranged, jointed and fixed as to ensure that the rain water is carried away from the building without causing dampness in any part of the walls or foundations of the building or those of an adjacent building.

The rain water pipes shall be fixed to the outside of the external walls of the building or in recesses or chase cut or framed in such external walls or in such other manner as may be approved by the administrative authority.

(A rain water pipe conveying rain water shall discharge directly or by means of a channel into or over an inlet to a surface drain or shall discharge freely in a compound, drained to surface drain or shall discharge freely in a compound, drained to surface drain but in no case shall it discharge directly into any closed drain.

Whenever it is not possible to discharge a rain water pipe into or over an inlet to a surface drain or in a compound, drain to surface drain or in a street drain within 30m from the boundary of the premises, such rain water pipe shall discharge into a gully trap which shall be connected with the street drain. Such a gully trap shall have a screen and a silt catcher incorporated in its design.



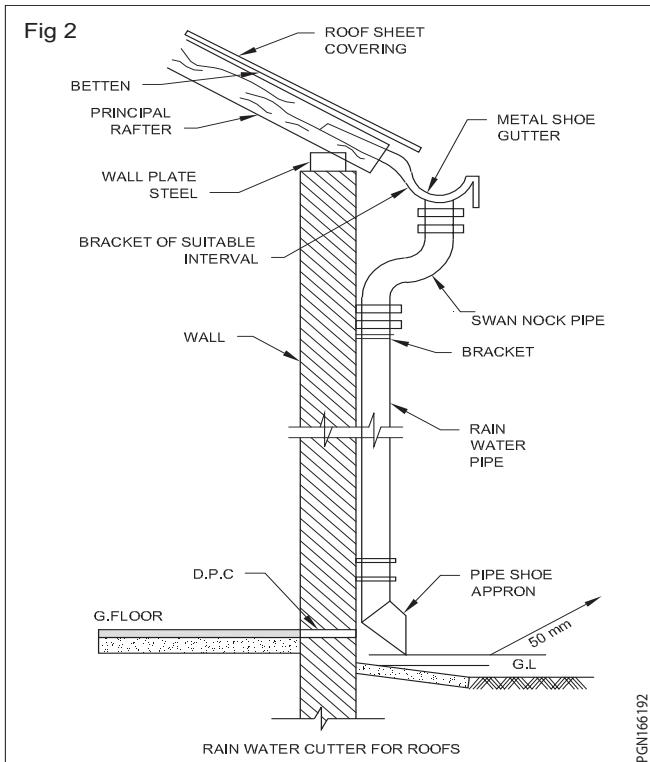
Rain water pipes shall be constructed of cast iron, asbestos cement, galvanized sheet or other equally suitable material and shall be securely fixed. The latest practice, however it is not to use the pipes made from galvanized sheets for rain water services. Cast iron rain water pipes and fittings shall conform to IS: 1230 -1979. Asbestos cement building pipes and gutters and fittings (Fig 2) (spigot and socket type) shall conform to IS: 1626 (Part 1) 1980, IS 1626 (Part 2) 1980 and IS: 1626 (Part 3) 1981. Sizing of rain water pipes for roof drainage: Rain water pipes shall be normally sized on the basis of roof

areas according to Table as under. A bell mouth inlet at the roof surface is found to give better drainage effect, provided proper slopes are given to the roof surface.

The spacing of pipes depends on the position of the windows and arc openings but 6m apart is a convenient distance. The strainer fixed to the bell mouth inlet shall have an area 1½ to 2 times the area of pipe which it connects.

### Laying of rainwater pipe

- 1 Correct threading, the same which is on the specials should be done on the pipes.
- 2 All the joints should be made water-tight by wrapping jute thread and white lead paint in the threads, while screwing.
- 3 Over-screwing should not be done in any case, otherwise it may split or crack the parts of the fittings, socket, elbow, tee or cross etc.
- 4 While measuring the length of pipes for cutting, due to allowance for the space of fittings should be made, otherwise the length of the pipes may be more or less.



PGN166192

Sl. No.	Dia. of pipe mm	Average rate of rainfall in mm					
		50	75	100	125	150	200
Roof area in square metres							
1	50	13.4	8.9	6.6	5.3	4.4	3.3
2	65	24.4	16.0	12.0	9.6	8.0	6.0
3	75	40.8	27.0	20.4	16.3	13.6	10.2
4	100	85.4	57.0	42.7	34.2	28.5	21.3
5	125			80.5	64.3	53.5	40.0
6	150					83.6	62.7

- 5 All the pegs should be fixed with their border end inside the wall and smaller size in face of the wall.
- 6 Only the required size whole should be made in the wall for fixing of pegs, brackets etc. de-shape the pipe and make it oval in section.
- 7 While bending the pipes on the bending machines, care should be taken otherwise it may also press the pipe and give more bend than desired.
- 8 The cutting of the pipes should be done properly, it should be at right angle to the axis of the pipe.
- 9 The pipes should be fixed with pipe-hooks at proper place. These hooks should be driven in the masonry joints.
- 10 In case of accidents first-aid facilities should be available.

# Tracing of leakage in water supply system by sound test

**Objectives:** At the end of this lesson you shall be able to

- state the losses from water supply system
- explain benefits of leak detection and repair
- state the types of leakages
- explain the leak detection and repair strategies.

## Losses from Water Supply System

Detecting and repairing leaks is one of the main components of water conservation. This guidance document will address the strategies to reduce water loss due to leaks, and acknowledges the concepts developed by organizations such as the International Water Association

Old or poorly constructed pipelines, inadequate corrosion protection, poorly maintained valves and mechanical damage are some of the factors contributing to leakage. Leak detection has historically assumed that all, if not most, leaks rise to the surface and are visible. In fact, many leaks continue below the surface for long periods of time and remain undetected.

With an aggressive leak detection program, water systems can search for and reduce previously undetected leaks. Water lost after treatment and pressurization, but before delivered for the intended use, is water, money and energy wasted. Accurate location and repair of leaking water pipes in a supply system greatly reduces these losses. Once a leak is detected, the water utility must take corrective action to minimize water losses in the water distribution system.

## Benefits of Leak Detection and Repair

Minimizing leakage in water systems has many benefits for water customers (and their suppliers). These benefits include:

- Improved operational efficiency.
- Lowered water system operational costs.
- Reduced potential for contamination.
- Extended life of facilities.
- Reduced potential property damage and water system liability.
- Reduced water outage events.
- Improved public relations.

Some added benefits of leak detection and repair that are difficult to quantify include:

- Increased knowledge about the distribution system, which can be used to respond more quickly to emergencies and set priorities for replacement or rehabilitation programs;
- More efficient use of existing supplies and delayed capacity expansion;
- Increased firefighting capability.

Leak detection and repair programs can lead other important water system activities, such as:

- Inspecting hydrants and valves in a distribution system;
- Updating distribution system maps;

- Using remote sensor and telemetry technologies for ongoing monitoring and analysis of source, transmission, and distribution facilities. Remote sensors and monitoring software can alert operators to leaks, fluctuations in pressure, problems with equipment integrity, and other concerns; and
- Inspecting pipes, cleaning, lining, and other maintenance efforts to improve the distribution system and prevent leaks and ruptures from occurring. Systems might also consider methods for minimizing water used in routine water system maintenance.

## Types of Leaks

There are different types of leaks, including service line leaks, and valve leaks, but in most cases, the largest portion of unaccounted-for water is lost through leaks in supply lines. There are many possible causes of leaks, and often a combination of factors leads to their occurrence. The material, composition, age, and joining methods of the distribution system components can influence leak occurrence.

Another related factor is the quality of the initial installation of distribution system components. Water conditions are also a factor, including temperature, velocity, and pressure. External conditions, such as stray electric current; contact with other structures; and stress from traffic vibrations, frost loads, and freezing soil around a pipe can also contribute to leaks.

## Underground Leaks

The underground piping on either side of a water meter should be maintained. Leaks in underground plumbing can be caused by many different factors, including rusting through from age or from stray electric currents from other underground utilities that can prematurely rust metallic piping, driving over piping with heavy trucks or equipment, poor initial installation, freezing and thawing of a pipeline, leaking joints or valves, or transient high pressure events such as opening and closing valves or starting and stopping pumps quickly.

Signs of underground leaks include:

- Unusually wet spots in landscaped areas and/or water pooling on the ground surface.
- An area that is green, moldy, soft, or mossy surrounded by drier conditions.
- A notable drop in water pressure/flow volume.
- A sudden problem with rusty water or dirt or air in the water supply (there are other causes for this besides a leak).
- A portion of an irrigated area is suddenly brown/dead/dying when it used to be thriving (water pressure is too low to enable distant heads to pop up properly).

- Heaving or cracking of paved areas. Sink holes or potholes.
- Uneven floor grade or leaning of a structure.
- Unexplained sudden increase in water use, consistently high water use, or water use that has been climbing at a fairly steady rate for several billing cycles.

### Leak Detection and Repair Strategies

There are various methods for detecting water distribution system leaks. These methods usually involve using sonic leak-detection equipment, which identifies the sound of water escaping a pipe. These devices can include pinpoint listening devices that make contact with valves and hydrants, and geophones that listen directly on the ground. In addition, correlator devices can listen at two points simultaneously to pinpoint the exact location of a leak.

Large leaks do not necessarily constitute the greatest volume of lost water, particularly if water reaches the surface where they are usually found quickly, isolated,

and repaired. However, undetected leaks, even small ones, can lead to large quantities of lost water since these leaks might exist for a long time. Ironically, many small leaks are easier to detect because they are noisier and easier to hear using hydrophones. The most difficult leaks to detect and repair are usually those under stream crossings. Leak detection efforts should focus on that portion of the distribution system.

### Checking for Leaks

Identifying leaks can be difficult; however, at minimum the following should be performed:

- Inspect irrigation systems for obvious above ground leaks. Extremely wet areas above an underground pipe can be an indication of a broken pipe or joint.
- Examine equipment routinely and look at exposed pipes to see if you can visually see any leaking water.

If you suspect a leak at your facility, take steps to get the leak fixed.

## Inspection and testing of water supply system

**Objective:** At the end of the lesson you shall be able to  
 • state the soundness of the pipe line system.

### Testing of the pipe lines

After a pipe line has been laid, fitted with all appurtenances and accessories, painted both from inside as well as outside by means of protective paints, etc., the pipe line will be tested for the soundness in its construction. The soundness of the construction is examined by performing the pressure test on the pipe line. The set by step procedure adopted for performing this test is described below:

The pipe line is tested from section to section. Thus, at a time, only one particular section lying between two sluice valves is taken up for testing.

The downstream sluice valve is closed, and water is admitted into the pipe through the upstream sluice valve. The air valves will be properly operated during filling up of the pipe.

The upstream valve, through which water was admitted, is closed, so as to completely isolate the pipe section from the rest of the pipe.

Pressure gauges are then fitted along the length of the pipe section at suitable intervals (say 1 km or so) on the crown, through holes left for this purpose.

The pressure in the pipe line is low raised by means of a small hand force pump or a hydraulic pressure pump, till the test pressure (to be measured on the pressure gauge fixed on the pipe) is nearly 25-50% above the highest working pressure.

The pipe and the joints are then visualized for water tightness. The applied test pressure should also maintain itself without any appreciable loss during the observation period, which may be at least 4 hours.

When the field test pressure is less than the works test pressure, then the observation period should be increased to at least 24 hours.

The pipe is finally evaluated through drain valves, and them observed defects (in the test) are rectified, so as to make the line fit for use. The pipe is again tested by repeating the and ensure proper rectification of defects is carried out.

After the satisfactory completion of the pressure test, a leakage test at a pressure to be specified by the authority for a duration of 2 hours may also be performed. Leakage is defined as the quantity of water that is required to be supplied for maintaining the specified leakage test pressure after the pipe has been filled with water and the air is expelled.

In a newly laid pipe line, there should generally be no leakage. Moreover, the allowable leakage during the maintenance stage of pipes carefully laid and well tested during construction, should also not exceed the value given by equation below:

$$q_L = N \cdot D \sqrt{P}$$

115

where

$q_L$  = Allow leakage in cm /hr

N = Number of joints in the length of the pipe line

D = Diameter of pipe in mm

P = The average test pressure during the leakage test in kg/cm<sup>2</sup> (i.e. 10 m of water head)

# Pressure testing of pipeline with pressure testing machine

**Objectives:** At the end of the lesson you shall be able to

- state the application of pressure testing machine
- explain the pressure test conducting.

## Application

- Boilers, Pressure Vessels, C.I. Mains, Casting parts
- Gas Cylinder, Pipes & Tubes parts
- Subject to Hydro Test Pressure

## Special Features

- Portable hand operated system can be easily handled by one man
- Pump unit is mounted on fabricated M.S. water tank which stores liquid for testing

- Pump does not require any foundation

- Provides self base for testing

## Standard Accessories

- Pressure release cock made from brass metal.
- Discharge pressure hose with attachment of 1/2 : BSP Length 2 Mtrs.
- Stainless Steel Glycerin filled pressure gauge with 4" inch dial
- Suction & discharge valve (NRV) made from Stainless Steel material

**Performance table**

Discharge size BSP MM	Max. Pressure Kg/cm <sup>2</sup> P.S.I	Output CC/Stroke	Plunger Size in mm	Water Tank Size in ltrs
1/2" 12.5	35 500	15.70	19	9

## Conducting the Pressure Test

To conduct a pressure test of building services piping systems in all Station buildings, complete the following steps:

1. Identify the maximum test pressure to be used, as determined by the Project Engineer or Field Engineer.
2. Identify the type of pipe system to be tested. The maximum aggregate length of pipe to be tested at one time is 40 feet.
3. Examine all connections prior to the test to ensure proper tightness
4. Determine the pressure rating for all connected fittings and devices to ensure they are rated for the maximum test pressure.
5. Isolate any equipment that may be damaged by the test and indicate this isolation on the test form.
6. Secure a blind flange or cap suitable for the system's rated pressure on all openings that are not closed off by valves.
7. Plug all test, drain, and vent ports that are not required for the test.
8. If the section of pipe being tested is isolated from other sections by in-line valves, ensure the portion not being tested is open to the atmosphere.

For Pneumatic Testing follow steps 9 through 15:

- 9 Apply a preliminary test pressure of 25 psi.

**This pressure should be held for a minimum of 10 minutes to allow for the location of any major leaks. If leaks are detected during this step, or at any time during the test, relieve the pressure and take appropriate action to correct the leak. If necessary, consult the Project Engineer for instruction.**

- 10 Apply the test pressure in increments of 25 psi, until the maximum test pressure is reached. Hold pressure for 5 minutes at each 25 psi increment and inspect for leaks before adding more pressure.

- 11 Hold this pressure for 25 hours.

- 12 Obtain confirmation of successful by the operator after the 24 hour time period.

- 13 Remove the pressure with caution to avoid escaping air stream, debris and high decibel noise level.

After completing these steps, pressure testing is completed once the test is successfully completed, then piping system is ready for service.