PLUMBER

1st Semester

TRADE PRACTICAL

SECTOR : Construction, Construction Material & Real Estate

Directorate General of Training

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

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FOREWORD

The National Instructional Media Institute (NIMI) is an autonomous body under the Directorate General of Employment and Training (DGE&T) Ministry of Labour and Employment has been developing, producing and disseminating Instructional Media Packages (IMPs are extensively used in the Industrial Training Institutes/Training centres in Industries to impart practical training and develop work-skills for the trainees and the trainers

The Ministry of Labour & Employment constituted Mentor Councils (MCs) to revampcourses run / to be run under National Council of Vocational Training (NCVT) in 25 sectors. The MCs have representatives from thought leaders among various stakeholders viz. one of the top ten industries in the sector innovative entrepreneurs who have proved to be game-changers, academic/professional institutions (IITs etc.), experts from field institutes of DGE &T, champion ITIs for each of the sectors and experts in delivering education and training through modern methods like through use of IT, distance education etc. The technical support to the MCs is provided by Central Staff Training and Research Institute (CSTARI), Kolkata and National Instructional Media Institute (NIMI), Chennai. Some of the MCs are also supported by sector-wise Core Groups which were created internally in the Ministry (in 11 sectors).

A Steering Committee to provide overall coordination and guidance to Mentor Councils has also been constituted and has representation from the MCs, Chair positions to be endowed by the Ministry, trade unions, and experts on distance education and training. The MCs are mandated to work towards revamping/suggesting new courses, improving assessment systems, overall learning etc. for subjects under the purview of the NCVT.

Accordingly NIMI with the support and assistance of MC has developed **Plumber Trade Practical 1st Semester** in **Construction, Construction Material & Real Estate sector** to enhance the employability of ITI trainees across the country and also to meet the industry requirement.

I have no doubt that the trainees and trainers of ITIs & Training centres in industries will derive maximum benefit from these books and that NIMI's effort will go a long way in improvement of Vocational Training.

I complement Director, Mentor Council members, Media Development Committee (MDC) members and staff of NIMI for their dedicated and invaluable contribution in bringing out this publication.

ALOK KUMAR, I.A.S.,
Director General of Employment &
Training/ Joint Secretary
Ministry of Labour and Employment
Government of India

New Delhi - 110 001

PREFACE

This National Instructional Media Institute (NIMI) was set up at Chennai by the Directorate General of Employment and Training (DGE&T) Ministry of Labour and Employment, Government of India with technical assistance from the Govt. of the Federal Republic of Germany. The prime objective of this institute is to develop and disseminate instructional materials for various trades as per the prescribed syllabi under the Craftsmen and Apprenticeship Training Schemes.

The instructional materials are developed and produced in the form of Instructional Media Packages (IMPs). An IMP consists of Trade Theory book, Trade Practical book, Test and Assignment book, Instructor guide, Wall Charts and Transparencies.

Hon'ble Union Minister of Finance during the budget speech 2014-2015 mentioned about developing **Skill India** and made the following announcement

"A national multi-skill programme called Skill India is proposed to be launched. It would skill the youth with an emphasis on employability and entrepreneur skills. It will also provide training and support for traditional professions like welders, carpenters, cobblers, masons, blacksmiths, weavers etc. Convergence of various schemes to attain this objective is also proposed."

The Ministry of Labour & Employment constituted Mentor Councils (MCs) to revamp courses run / to be run under National Council of Vocational Training (NCVT) in 25 sectors which will give a sustained skill based employability to the ITI trainees as the main objective of Vocational training. The ultimate approach of NIMI is to prepare the validated IMPs based on the exercises to be done during the course of study. As the skill development is progressive the theoretical content on a particular topic is limited to the requirement in every stage. Hence the reader will find a topic spread over a number of units. The test and assignment will enable the instructor to give assignments and evaluate the performance of a trainee. If a trainee possesses the same it helps the trainee to do assignment on his own and also to evaluate himself. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also helps the trainees to grasp the technical topic quickly. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirement ,

Thus the availability of a complete Instructional Media Package in an institute helps the trainer and management to impart an effective training. Hence it is strongly recommended that the Training Institutes/Establishments should provide at least **one IMP** per unit. This will be small, one time investment but the benefits will be long lasting.

The **Plumber Trade Practical 1st Semester in Construction, Construction Material & Real Estate Sector** is one of the book develop by the core group members of the Mentor Councils (MCs). The 1st semester book includes **Module 1 - Fitter, Module 2 - Carpender , Module 3 - Gas Welding, Module 4 - Mason, Module 5 - Basic Plumbing Practice.**

The **Plumber Trade Practical 1st Semester** is the outcome of the collective efforts of Members of Mentor Council which includes academic/professional institutions (IITs etc.), experts from field institutes of DGE&T, champion ITIs for each of the sectors, and also Media Development Committee (MDC) members and staff of NIMI.

NIMI wishes that the above material (Trade Practical & Trade Theory) will fulfil to satisfy the long needs of the Trainees and Instructor and helps the trainees for their employability in vocational training.

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

A. MAHENDIRAN
Director, NIMI.

Chennai - 600 032

ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledge with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisation to bring out this IMP **(Trade Practical)** for the trade of **Plumber** under the **Construction, Construction Material & Real Estate** Sector for Craftsman Training Scheme. This Book is prepared as per Revised Syllabus.

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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 intented to be used in workshop . It consists of a series of practical exercies to be completed by the trainees during the First Semester course of the plumber trade supplemented and supported by instructions/ informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered.

The manual is divided into five modules. The distribution of Exercises for the practical in the five modules are given below.

Module 1	Fitter	11 Exercises
Module 2	Carpenter	07 Exercises
Module 3	Gas Welding	05 Exercises
Module 4	Mason	11 Exercises
Module 5	Basic Plumbing Practice	22 Exercises
	Total	56 Exercises

The skill training in the shop floor is planned through a series of practical exercises centred around some practical project. However, there are few instance 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 traninee. 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 First Semester course of the plumber Trade. The contents are sequenced according to the practical exercise contained in the manual on Trade practical. Attempt has been made to relate the theortical aspects with the skill covered in each exercise to the extent possible. This co-relation is maintained to help the trainees to develope the perceptional 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.

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Nimi

Filing practice

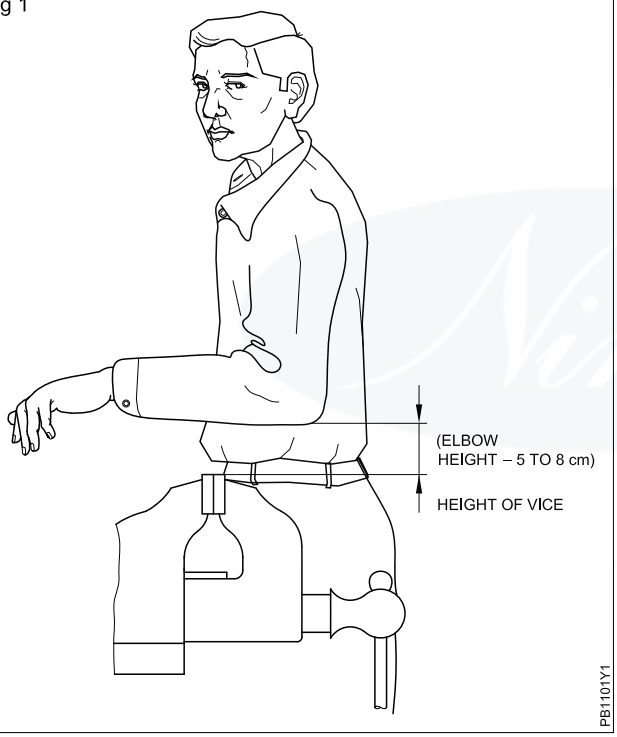
Objectives : At the end of this exercise you shall be able to

- **select a suitable height of vice**
- **clamp the job in position**
- **hold large files for filing**
- **position of feet and body during filing**
- **deburr the job**
- **check the surface with a straight edge.**

Job Sequence

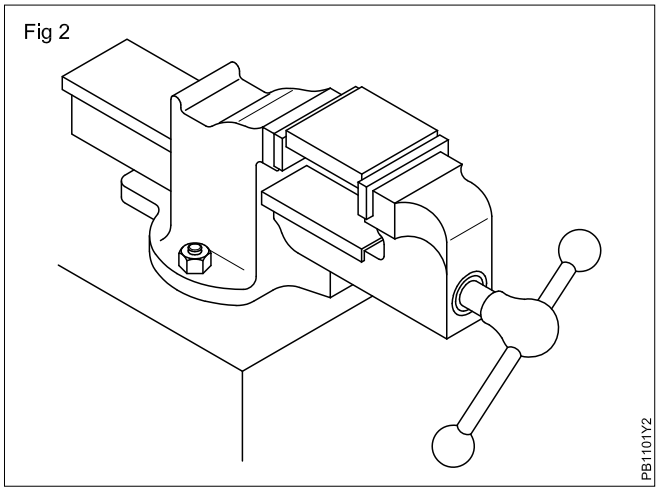
1 Select a suitable height of vice for correct body positioning for working. (Fig 1)

Fig 1



2 Clamp the workpiece centrally across the base firmly in position. (Fig 2)

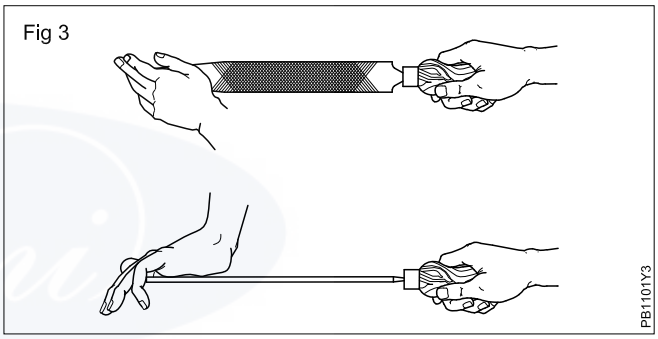
Fig 2



3 For holding large files fit right hand grips to the handle so that the end of the handle presses against the ball of the thumb.

4 The left hand should press on the file face with the palm. (Fig 3)

Fig 3



5 A safe stance during filing is to position the left leg approximately at a 30^0 angle from the vice and the righleg approximately at an angle of 75^0 from the centre of the vice.

6 Apply pressure on the file during the forward stroke.

7 The right hand pushes and presses, while the left hand only presses.

8 There should be no pressure on the return stroke.

9 Various positionsof the body movement are shown in Fig 4.

Use the full length of the file.

10 Regular Forward stroke motion on both sides pro duces even removal of fillings. (Fig 5)

11 Compensate for varying heights of both flanges by reclamping a number of times.

12 Do-burr the filed edge in the longitudinal direction (do not file the chamfer). (Fig 6)

13 Check the surface first visually (comparing with the marking line).

14 Check the flatness with the straight edge. (Fig 7)

Fig 4

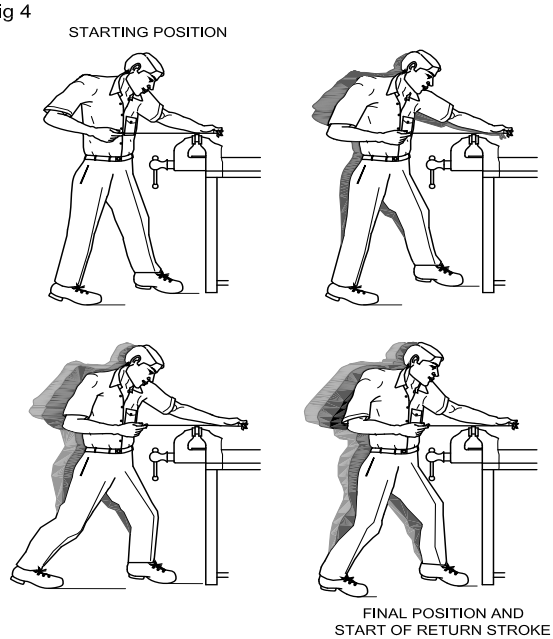


Fig 5

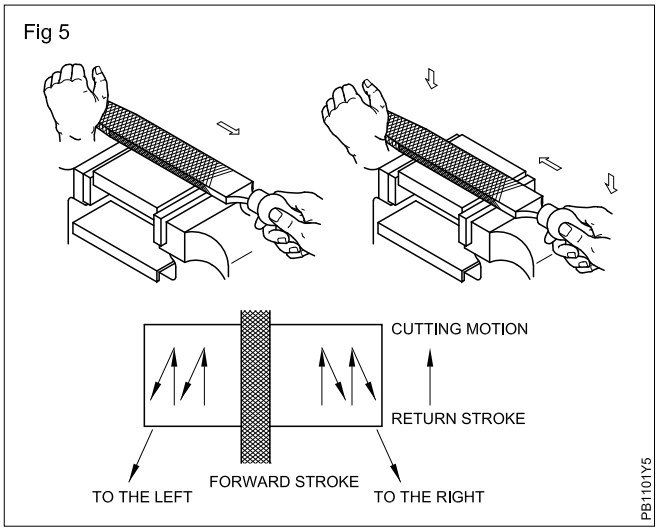


Fig 6

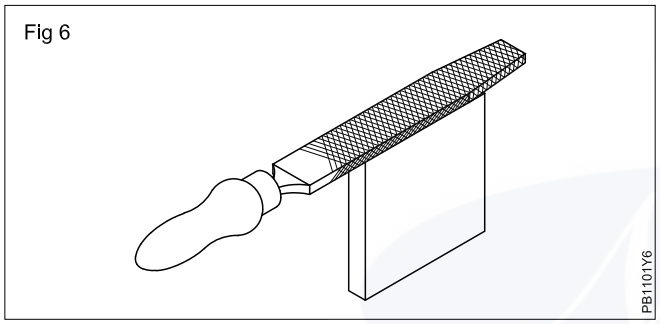
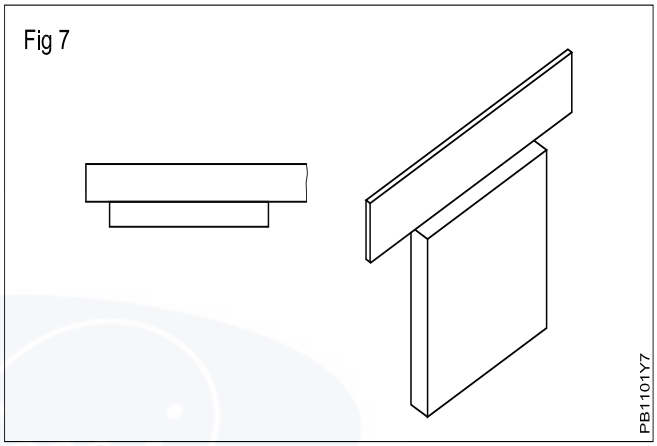


Fig 7



Cutting practice

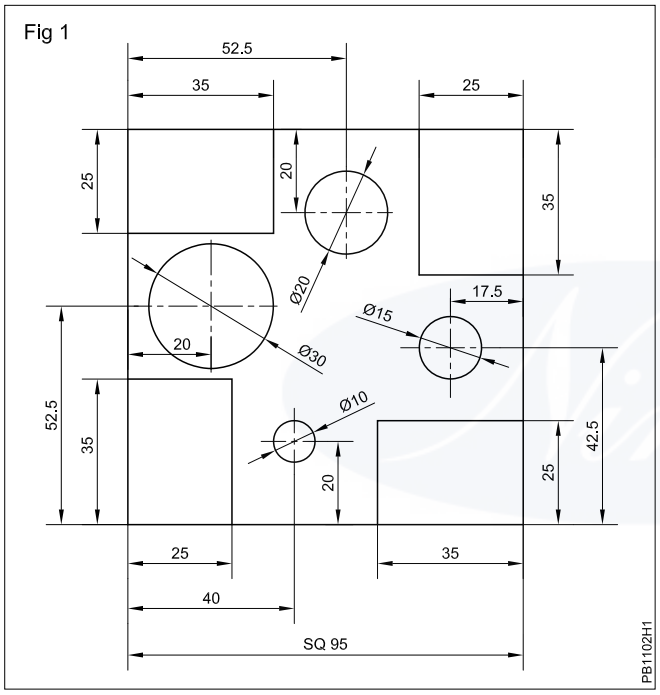
Objectives : At the end of this exercise you shall be able to

- **file surface flat and parallel with in ± 0.25mm**
- **file angle to 90^0 to a try square accuracy**
- **saw mild steel flat along a straight line**
- **mark of parallel line using a try square**
- **measure the thickness with caliper**
- **carryout day to day maintainence of marking tool and equipments.**

Job Sequence

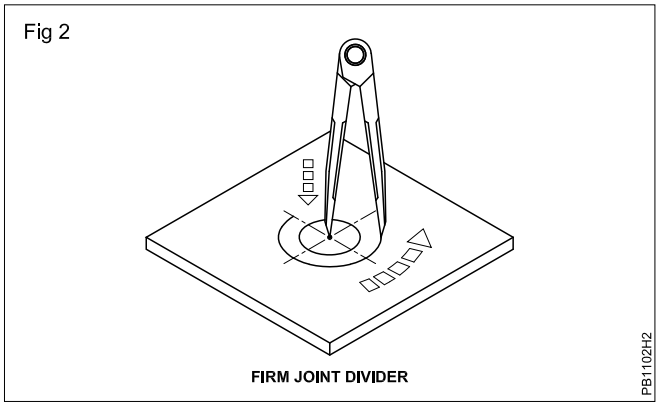
1 Check the material size as per Fig.1

Fig 1



2 Remove the punching mark from the materials on both sides and maintain a thickness of 6mm. Check thickness with caliper (Fig 2)

Fig 2



FIRM JOINT DIVIDER

3 Check the right angle with a try square.

4 Apply copper sulphate solution and allow it to dry.

5 Lay outlines as per drawing using a scriber block.

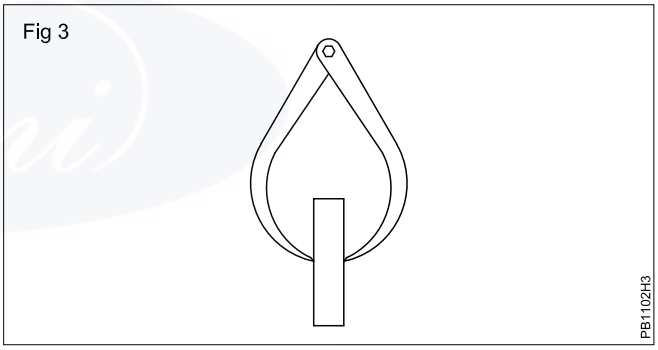
6 Punch for prominance.

7 Hacksaw along the lines.

8 Remove barr if any.

9 Mark the circle by divider. Fig 3.

Fig 3



Caution:

Select the correct pitch blade.

Use the full length of the blade while cutting.

Do not cut too fast.

Cut very slowly while cutting through.

Skill Sequence

Cleaning files

Objective : **This shall help you to**
- **clean files.**

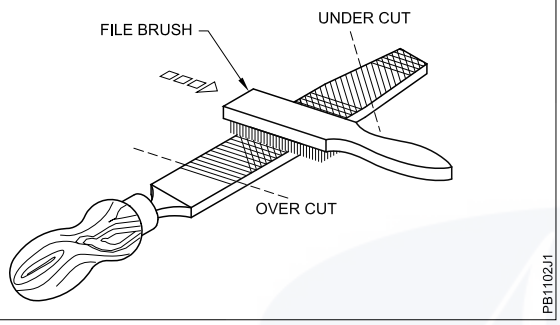
During filing, the metal chips (filing) will clog between the teeth of the files. This is known as 'pinning' of the files. Files which are pinned will produce scratches on the surface being files, and also will not bite well.

Method of removing pinning

1 Pinning of the files is removed by using a file brush (file card).

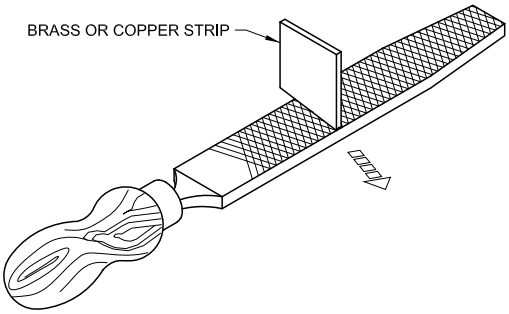
2 Pull the file brush along the direction of the overcut. (Fig 1)

Fig 1



3 Filings which do not come out easily by the file card should be taken out with a brass or copper strip. (Fig 2)

Fig 2



4 For new files, use only soft metal strips (brass or copper) for cleaning. The sharp cutting edges of the files will wear out quickly if a steel file card is used.

5 When filing a workpiece to a smooth finish more 'pinning' will take place because the pitch and depth of the teeth are less.

6 Application of chalk on the face of the file will help reduce the penetration of the teeth and 'pinning'.

7 Clean the file frequently in order to remove the filings embedded in the chalk powder.

Hacksawing (Holding-pitch selection)

Objectives : This shall help you to
- **select blades for different metal sections**
- **hold different sections of workpieces for hacksawing.**

Holding the workpiece

1 Position the metal to be cut according to the cross section for hacksawing.

2 As far as possible the job is held so as to be cut on the flat side rather than the edge or the corner. This reduces the blade breakages. (Figs 1 and 2).

3 The selection of the blade depends on the shape and hardness of the material to be cut.

Fig 1

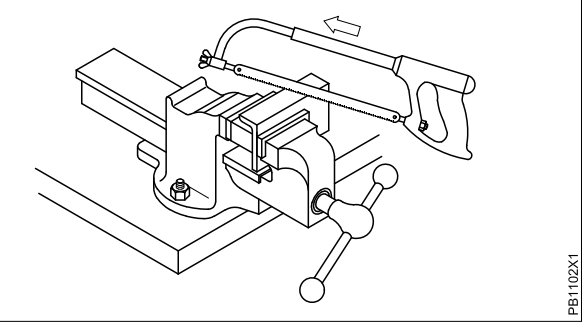
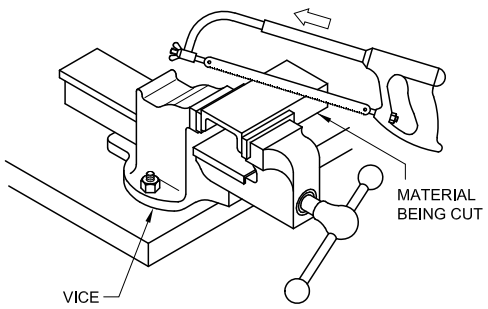


Fig 2



Pitch selection

4 For soft materials such as bronze, brass, soft steel, cast iron, heavy angles etc. use a 1.8 mm pitch blade. (Fig 3)

5 For tool steel, high carbon, high speed steel etc. use a 1.4mm pitch. For angle iron, brass tubing, copper,iron, pipe etc. use a 1mm pitch blade. (Fig 4).

6 For conduit and other thin tubing, sheet metal work etc. use a 0.8mm pitch. (Fig 5)

Fig 3

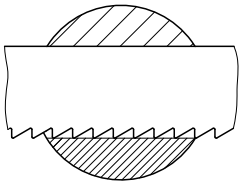


Fig 4

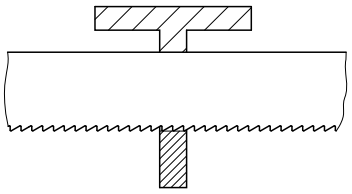
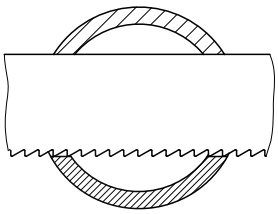


Fig 5



Hacksawing

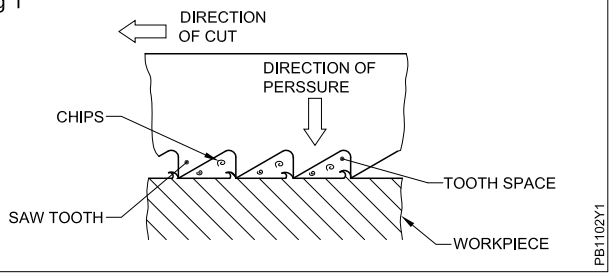
Objectives : This shall help you to

- **fix hacksaw blades maintaining correct tension and direction**
- **cut metal pieces with a hacksaw.**

Fixing of hacksaw blades

1 The teeth of the hacksaw blade should point in the direction of the cut and away from the handle. (Fig 1)

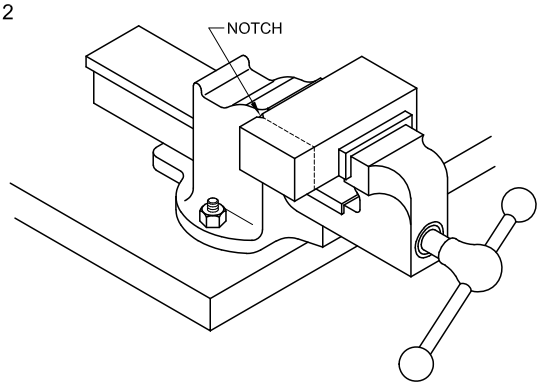
Fig 1



2 The blade should be held straight, and correctly tensioned before starting.

3 While starting the cut make a small notch. (Fig 2)

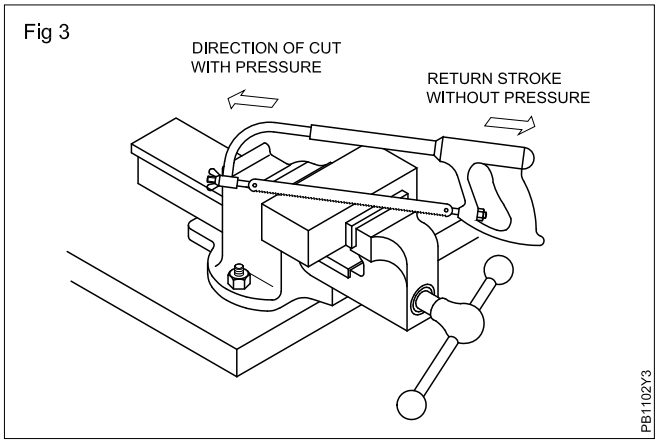
Fig 2



4 The cutting movement should be steady and the full length of the blade should be used.

5 Apply pressure only during the forward stroke. (Fig 3)

Fig 3



6 Atleast two to three teeth should be in contact with the work while cutting. Select a fine pitch blade for thin work.

7 Normally, a coolant is not necessary while hacksawing.

Do not move the blade too fast. While finishing a cut, slow down to avoid breakage of theblade and injury to yourself and others.

Chipping practice

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

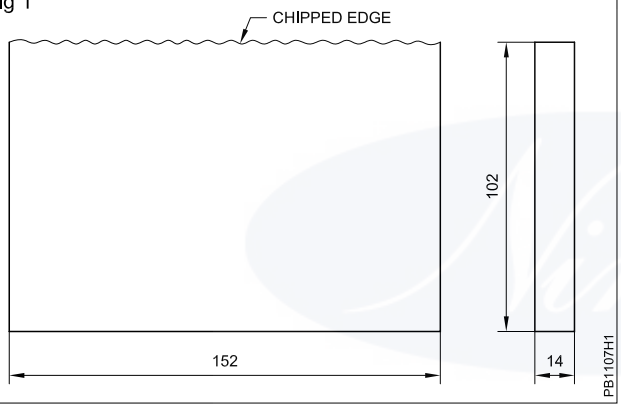
- **fix surfaces flat and parallel within an accuracy of 0.06mm**
- **mark dimension with surface gauge**
- **chip metal observing safe practice**
- **position of feet and body during filing**
- **grind a flat chisel**
- **work safely with an off hand grinder.**

Job Sequence

1 Check the raw material size.

2 File one flat surface and two adjacent sides at right angle to each other. Fig.1

Fig 1

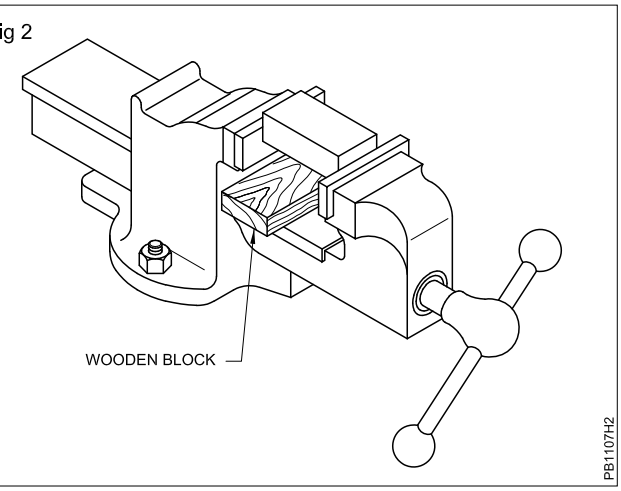


3 Mark the dimension as per drawing.

4 Punch for prominence.

5 Fix the job in the vice securely (if necessary support the work on wooden block). Fig.2.

Fig 2



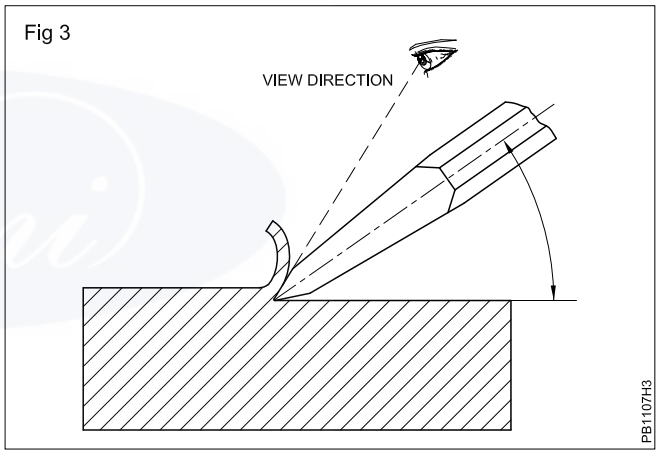
6 Chamfer the edge of the job with a flat file to get a better start for the chisel.

7 Check the vertical position of job with a try square.

8 While chipping look at the cutting edge of the chisel and not at the head of the chisel. Fig.3

9 Position the chisel in such a way cut the metal in uniform thickness.

Fig 3

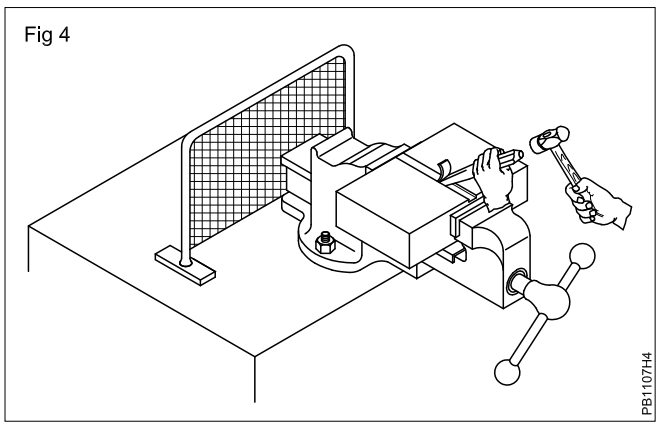


10 Stop chipping before the end of the surface other wise the edge of the job will break.

11 To prevent this, chip the end of the job from the opposite direction.

12 Hold the hammer at the end of handle for maxi m u m leverage. Fig.4.

Fig 4



Hints on chipping

- Chip metals observing safe practice.
- Before commening the chipping operation we must ensure the following.
- The hammer head must be properly secured wipe off oil substances, if any from the face of the hammer wear safely googles.
- Remove wrist watch. Install a chip guard against chip flying off.
- The work must be properly gripped in the vice, if necessary support the work on a wooden block while chipping look at the cutting edge of the chisel and not at the head of the chisel. Stop chipping before the end of the surface otherwise the edge of the job will break off.
- To prevent this, chip the end of the job from the opposite direction.

Sharpening of chisels

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

- **operate a grinder safely.**

Job Sequence

1 Chisels will become blunt due to use. For efficiency in chipping, the chisels are to be resharpended regularly. Chisels are sharpended on grinding machine. (Fig.1) After regrinding many times cutting edges become too thick. Such chisels are unsuitable for resharpening they should be forged and brought to shape before grinding. (Fig 2) Before commencing grinding the following procedure should be observed.

Fig 1

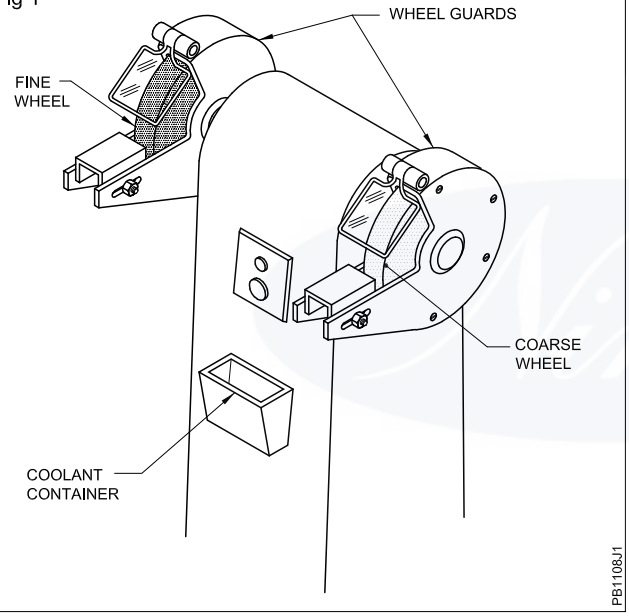


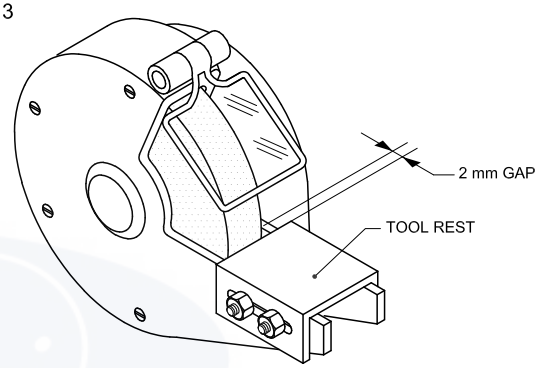
Fig 2

2 Ensure the wheel guards are in places and are securely fastened.

3 Inspect the condition of the grinding wheel for break and cracks.

4 Wear safety goggles when switching on the grinding machine stand aside until the wheel reaches the operating speed in respect the tool rest. If there is too much of gap between the tool rest and the wheel adjust it and position it as close to the wheel as possible (Fig.3) ensure that there is sufficient coolant in the container.

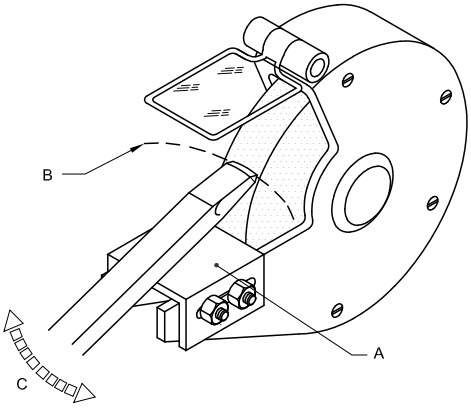
Fig 3



5 While grinding rest the body of the chisel on the tool rest (A) and allow the point to touch the wheel.(Fig.4)

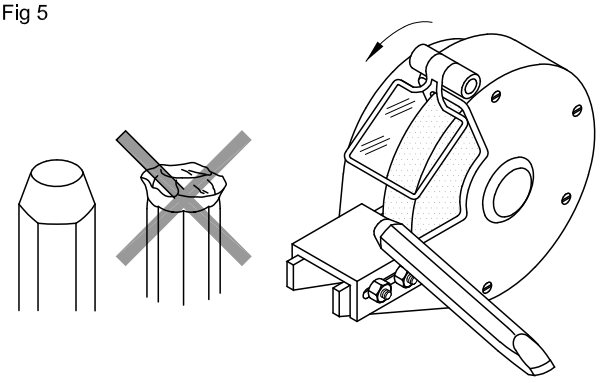
6 Rack the point slightly on both side in an area (B) to provide a slight-convexity at the cutting edge. This will help to avoid digging in of the sides while chipping. (Fig.4)

Fig 4



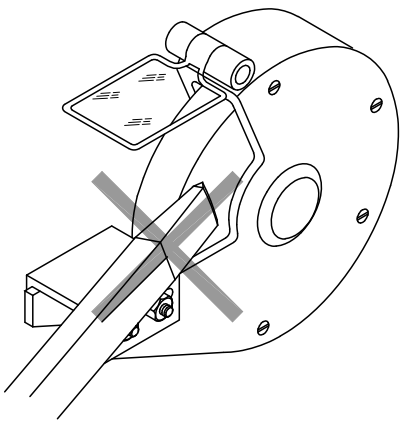
7 Keep moving the chisel across the face(C) to prevent formation of curves and gooves at the cutting edge. Dip the chisel frequently in the coolant to avoid over heating. Over heating will drop the temper of the chisel. If the chisel-head is mushroome. It should be cleaned by grinding(Fig.5). Use only the front of the grinding wheel do not grind on the side Fig.6

Fig 5



PB1108J5

Fig 6



WRONG METHOD

PB1108J6

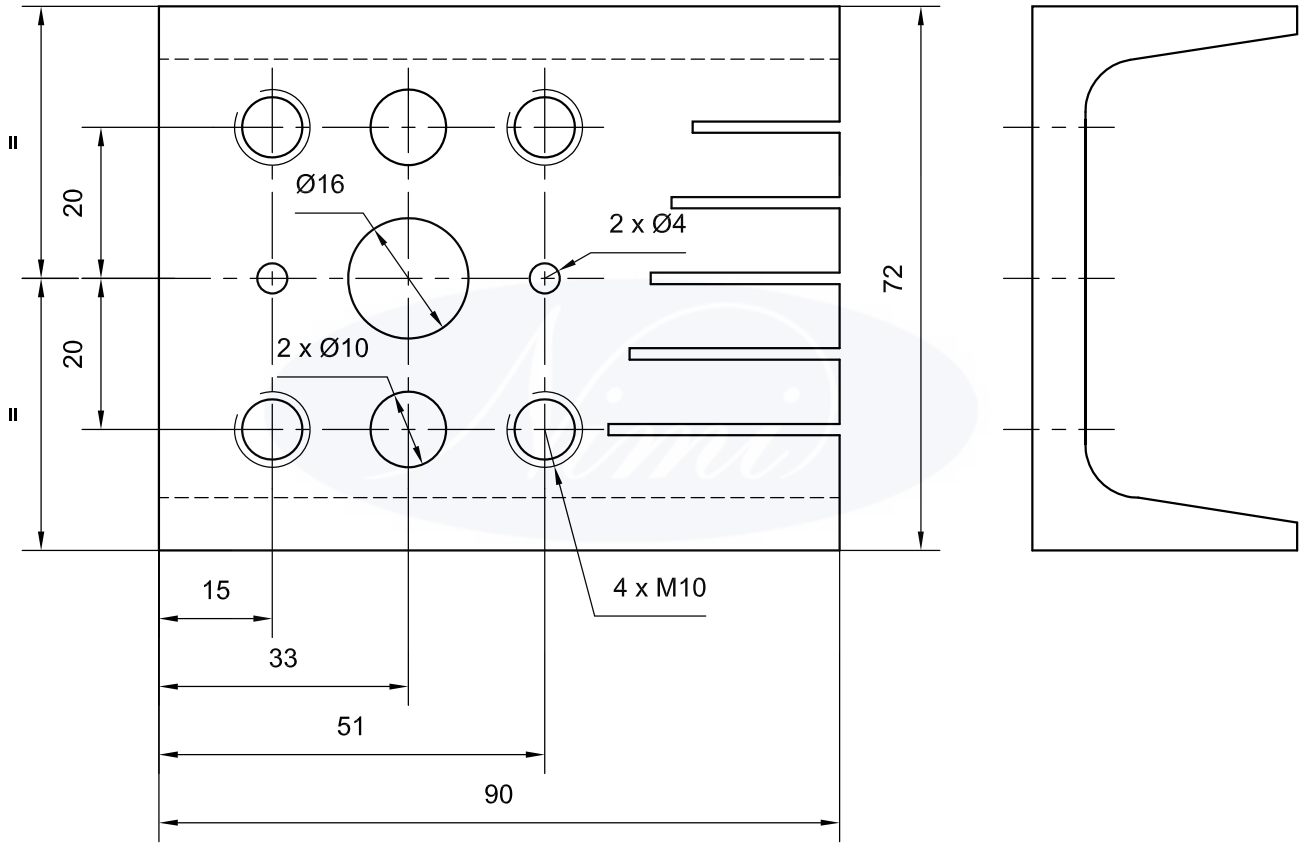
Safety: Use googles while using a grinder.

Any damage to the grinding wheel if noticed should be reported to the instructor. Do not use cotton waste or other materials to hold the chisel while grinding.

Drilling through holes and tapping

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

- **drill through holes using pedestal/bench drilling machine**
- **operate safely the pedestal/bench drilling machine**
- **cut internal threads using a set of hand taps.**



1	-	FP-1-05 ←	Fe310-O	-	-	13
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	DRILLING THROUGH HOLES & TAPPING				DEVIATIONS AS PER IS : 2102 (m)	TIME 10h
					CODE NO. MM1113E1	

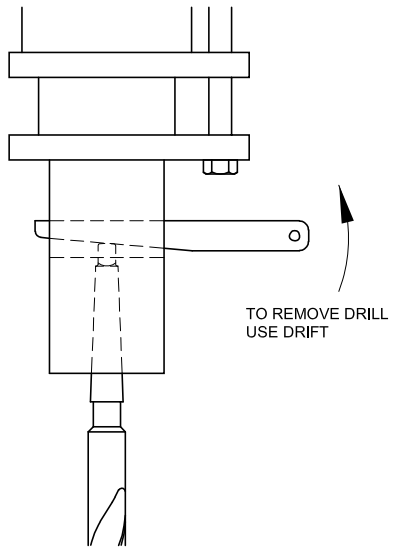
Job Sequence

- Check the raw material
- Apply marking media.
- Mark as per the drawing dimensions and punch the centre of hole with centre punch.
- Periphery of the big holes should be punched with prick punch.
- Fix the job on the machine vice.
- Set the spindle speed for 4mm drill.
- 4mm drill can be used as a pilot for all the holes.
- Use coolant while drilling.
- Drill and finish all the holes as per the drawing.
- Chamfer both sides of the holes to be tapped with 16mm dia drill to a depth of 1mm.

Caution : Use chuck key for tightening the drill in the drill chuck.

- Use drift to remove thedrill chuck and taper shank drill from drilling m/c spindle. (Fig 1)
- Do not hammer it out.

Fig 1



- Adjust the rpm of the spindle to suit the diameter of the drill. Ask your instructor.

Skill Sequence

Drilling through holes

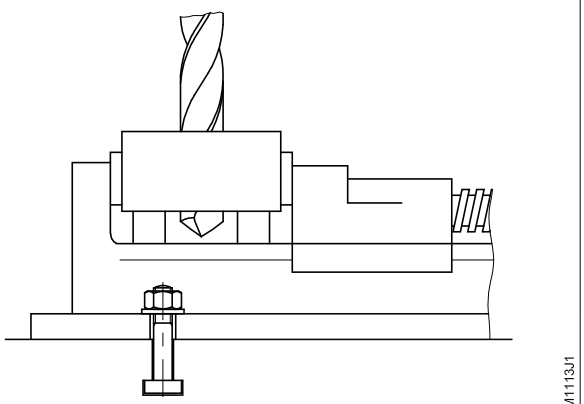
Objective : This shall help you to

- **drill holes of different diameter in a drilling machine.**

Punch the centre of the hole to be drilled by a centre punch.

Set the job in the machinevice securely by using two parallel bars to clear the drill (Fig 1)

Fig 1



Fix the drill chuck into the spindle of the drilling machine.

Fix the 4mm dia drill in the drill chuck for pilot hole.

Select the spindle speed by shifting the belt in the appropriate cone pulleys.

Drill all the holes first by 4mm drill. This will serve as a pilot hole for 8.5mm, 10mm and 16mm dia drills.

Drill 8.5mm for M10 tap.

Drill 10mm hole.

Remove the drill and drill chuck.

Fixa 16mm taper shank drill in the drilling machine spindle.

Change the spindle speed to suit 16 and drill the hole.

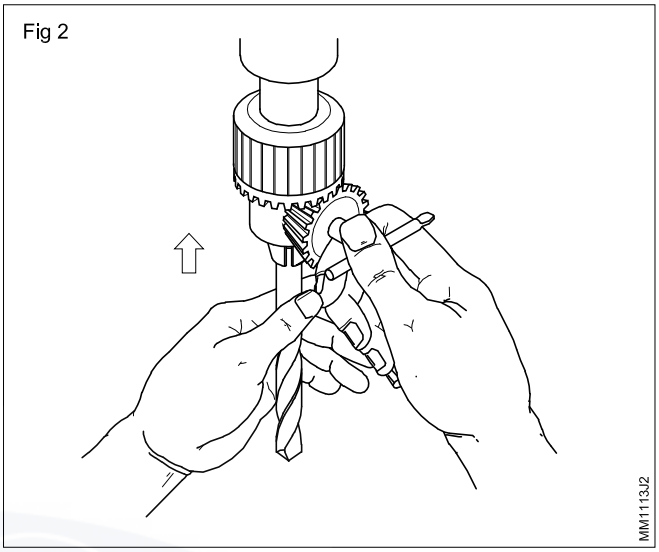
Caution: Do not remove chips with your bare hands - use brush.

Do not try to change the belt while the machine is running.

Ensure that the drill do not penetrate into the vice.

Fix securely the drill deep into the drill chuck. (Fig 2)

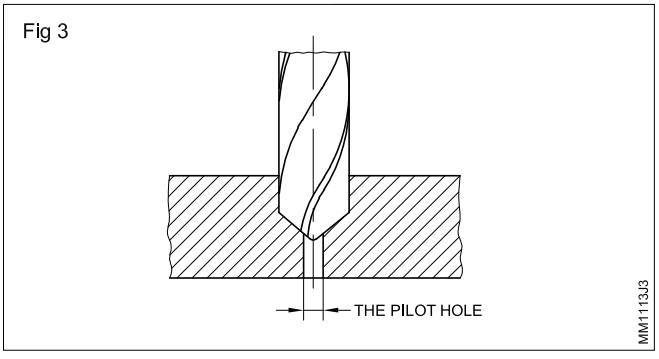
Fig 2



Since the web of large diameter drills are thicker, the dead centres of those drills do not sit in the centre punch marks. This can result in the shifting of the hole location. Thick dead centres cannot penetrate into the material easily and will impose severe strain on the drill.

These problems can be overcome by drilling pilot holes initially. (Fig 3)

Fig 3



Tapping through holes

Objective : This shall help you to

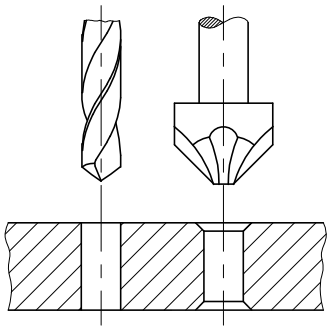
- **cut internal threads using hand taps.**

Determine the tap drill size either using the formula or the table.

Drill the hole to the required tap drill size. (An undersized hole will lead to breakage of the tap).

Chamfer the end of the drilled hole for essay aligning and starting of the tap. (Fig 1)

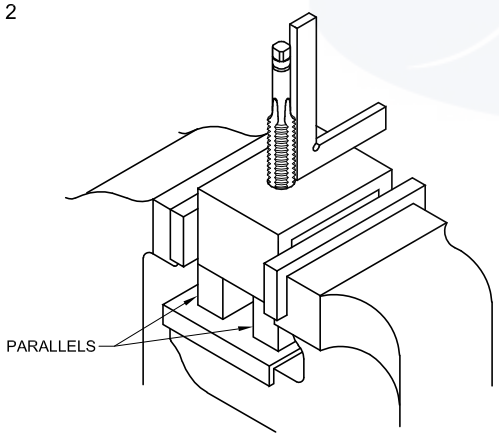
Fig 1



MM1113X1

Hold thework firmly and horizontally in the vice. The top surface of the job should be slightly above the level of the vice jaws. This will help in using a try square without any obstruction while aligning the tap. (Fig 2)

Fig 2



MM1113X2

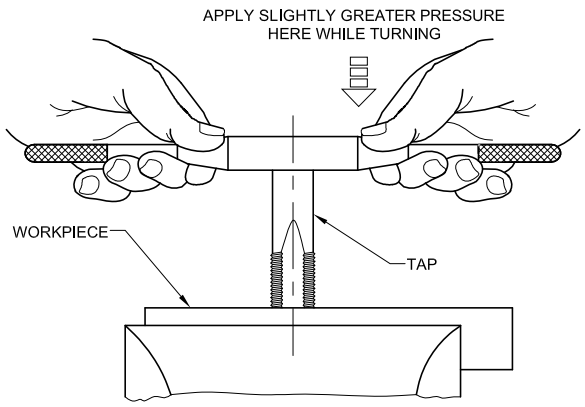
Fix the first tap (taper tap) in the correct size tap wrench. Too small a wrench will need a greater force to turn the tap. Very large and heavy wrenches will not give the 'feel' required to turn the tap as it cuts and may lead to breakage of the tap.

Position the tap in the chamfered hole vertically by ensuring the wrench is in a horizontal plane.

Exerty steady downward pressure and turn the tap wrench slowly in the clockwise direction to start the thread. Hold the tap wrench close to the centre. (Fig 3)

Remove the wrench from the tap when you are sure of starting the thread without disturbing the setting.

Fig 3

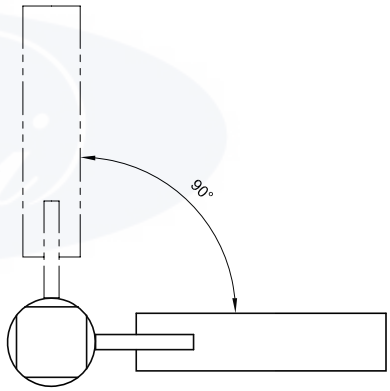


MM1113X3

SQUARING UP THE TAP

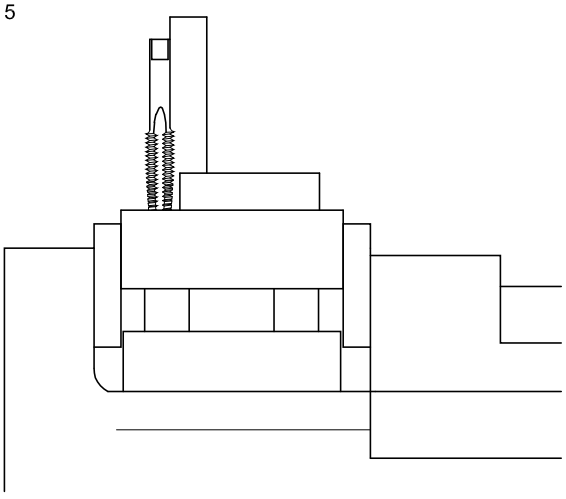
Check and make sure that the tap is vertically by using a try square in two positions at 900 to each other. (Figs 4 & 5)

Fig 4



MM1113X4

Fig 5



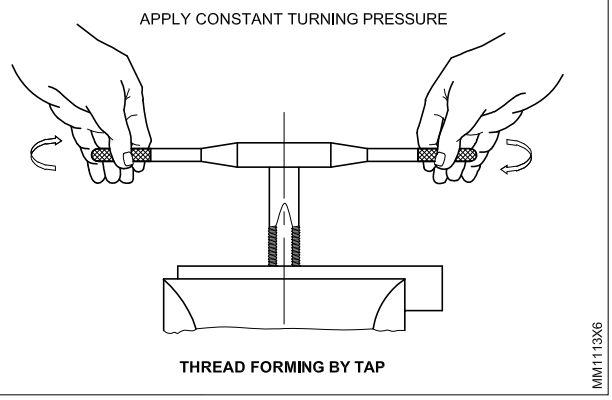
MM1113X5

Make correction if necessary by exerting slightly more pressure on the opposite side of the tap inclination.

Check the tap alignment again. The tap alignment should corrected within the first few turns. If it is tried afterwards there is a chance of breaking of the tap.

Turn the wrench lightly by holding at the ends without inserting any downward pressure after the tap is positioned vertically. The wrench pressure exerted by the ends should be well balanced. Any extra pressure on one side will spoil the tap alignment and can also cause leakage of the tap. (Fig 6)

Fig 6

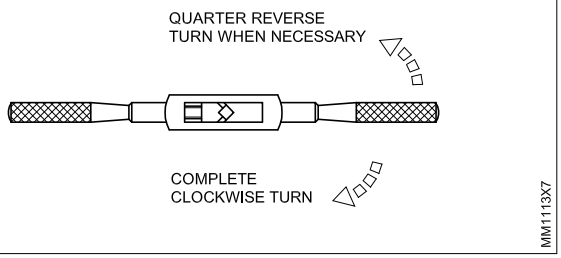


THREAD FORMING BY TAP

Continue cutting the thread. Turn backwards frequently about quarter turn, to break the chips. (Fig 7)

Stop and turn backwards when any obstruction to the movement is felt.

Fig 7



Use a cutting fluid while cutting the thread to minimise friction and heat.

Cut the thread until the hole is totally threaded.

Finish and clean up using the intermediate and plug tap..The intermediate and plug tap will not cut any thread if the first tap has entered the hole fully.

Remove the chips from the work and clean the tap with a brush.

Make sure that the dia of the hole to be tapped is correct for the given size of the tap.

Turn backwards to break the chip after every quarter turn.

Select the length of wrench suitable to the size of the tap. OVerlength of wrench may cause the breakage of tap.

Locking devices

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

- **fixing of locking devices.**

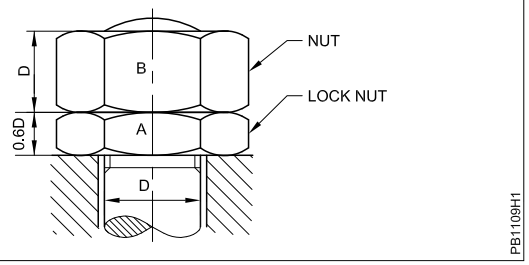
Job Sequence

Lock nut (Fig.1)

1 Fit locking nut to bolt.

2 Fit nut to the bolt.

Fig 1



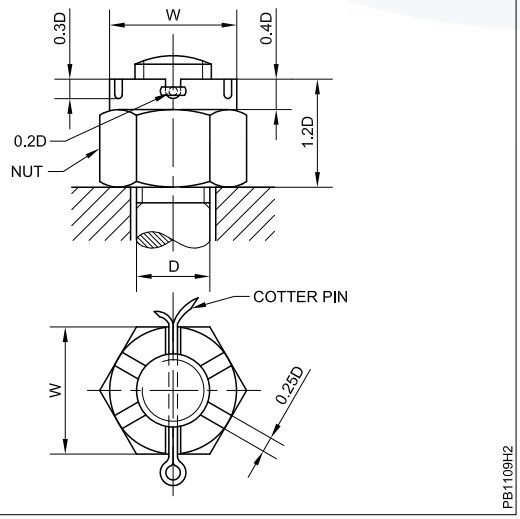
Castle nut (Fig.2)

3 Fit the nut to bolt.

4 Cut slot in cylindrical collar on top of the nut.

5 Insert collar pin in the solt of collar.

Fig 2



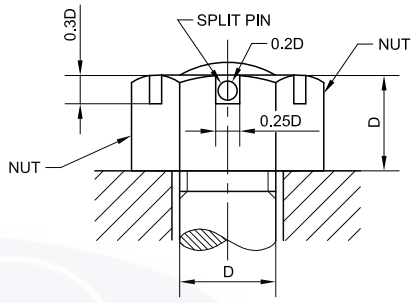
Slotted nut (Fig.3)

6 Cut slot in upper end of bolt.

7 Cut slot in cylindrical collar on nut.

8 Insert a split pin through the slot of nut and bolt.

Fig 3



Riveted joint

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

- **file thin strips flat and parallel to an accuracy of ±0.06mm**
- **drill holes and countersink on steel strips**
- **join metals using countersunk head rivets.**
- **join metals using snap head rivets**
- **name the different types of solid rivets**
- **state the uses of different types of solid rivets**
- **specify rivet sizes**
- **determine rivet diameters according to the thickness of the plates.**
- **determine hole diameters for cold working and hot working of rivets.**
- **calculate the rivet length for riveting.**

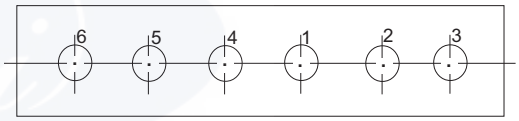
Job Sequence

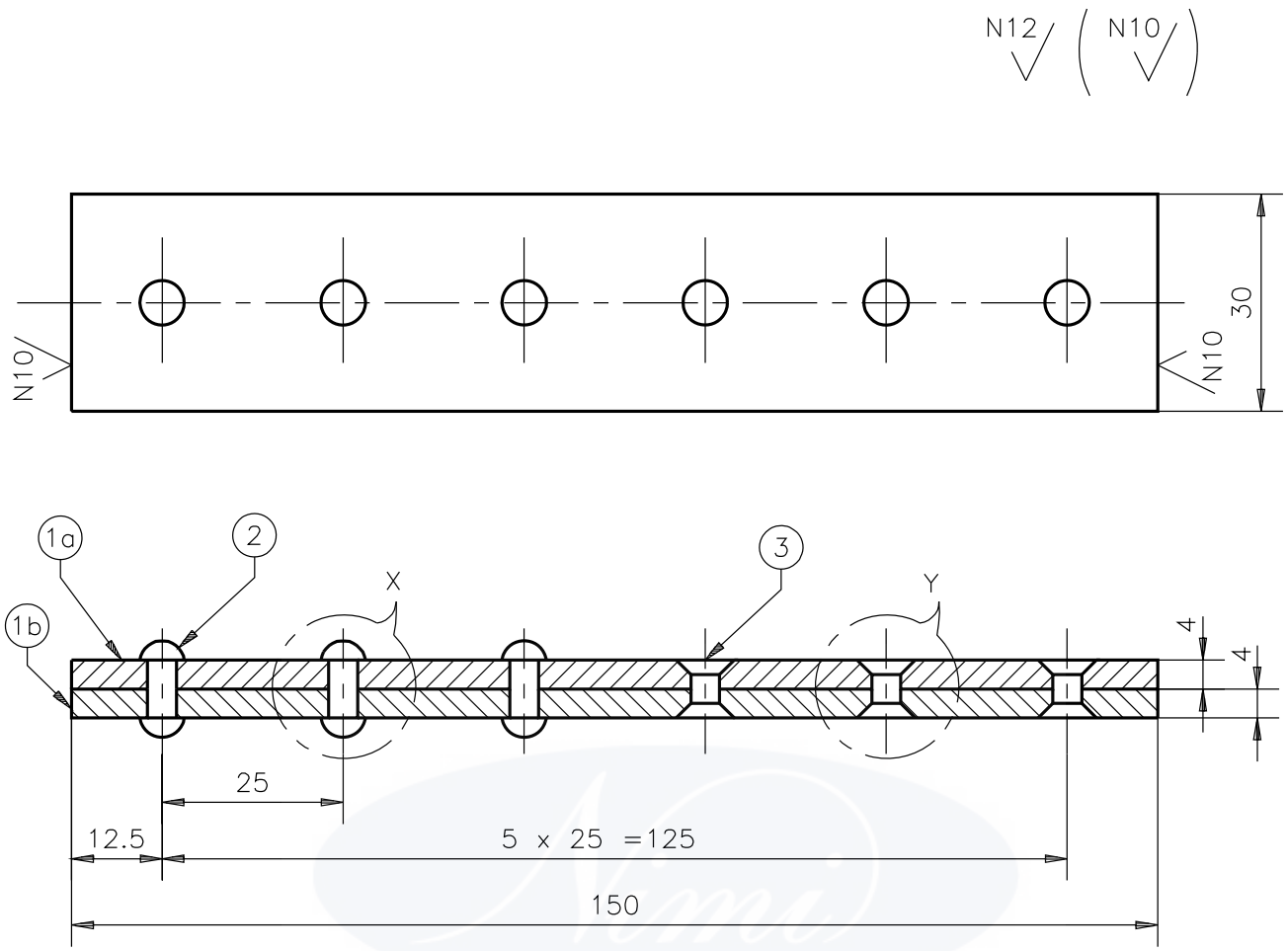
- Check the raw material size/
- File both strips to size as per drawing.
- Mark for rivet holes on steel stripes.
- Clamp sheets together and drill the holes on extreme ends.
- Remove burrs and hold both strips together using screws.
- Drill the remaining holes and separate the sheets.

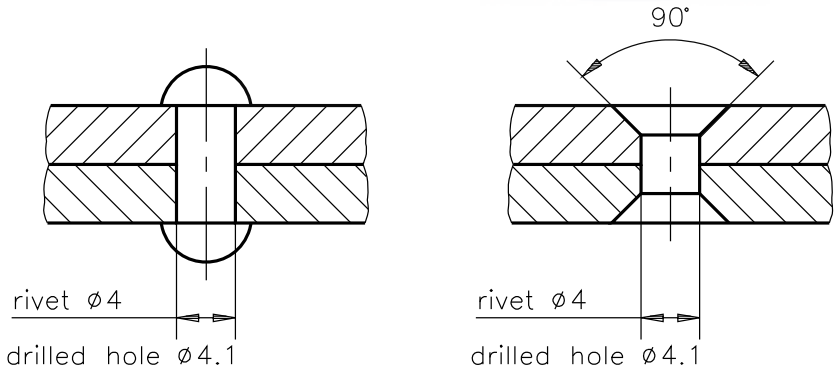
Ensure that burrs are removed.

- Countersink the holes as per drawing.
- Assemble the plates together with countersunk head rivets.
- Rivet snap heads as per drawing.

Follow the sequence of riveting as numbered in the figure.







DETAIL–X

DETAIL–Y

Method of Riveting (Snap Head Rivets)

Objectives : This shall help you to

- **select a suitable height of vice**
- **clamp the job in position**
- **hold large files for filing**
- **position of feet and body during filing**
- **deburr the job**
- **check the surface with a straight edge.**

Ensure the burrs are removed from the holes and the sheets to be riveted are straight.

Fix the dolly on the vice. Hold the dolly rigidly so that is is not shifted while riveting.

Insert the rivet in the hole and place the rivet head on the dolly to prevent deformation while hammering. (Figs 1 and 2)

Fig 1

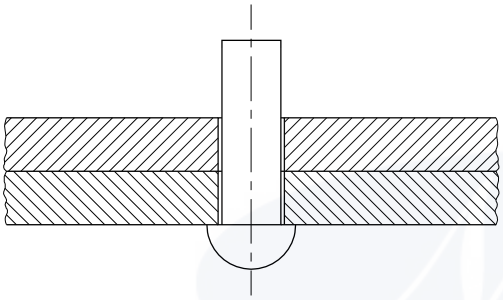
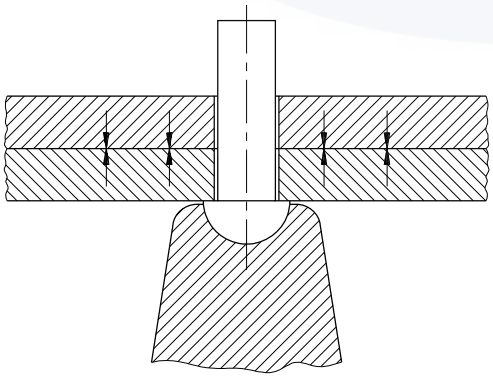


Fig 2



Be sure the holes are drilled to the correct size providing necessary clearances and are free from burrs. The length of the rivet should be according to the thickness of the plate.

See calculation for shank length.

Set the joint firmly using a rivet set. This helps to bring the sheets closer for riveting. (Fig 3)

Form rivet head roughly by hammering it down (Fig 4) initially and then round the head using a ball peen hammer. (Fig 5)

Fig 4

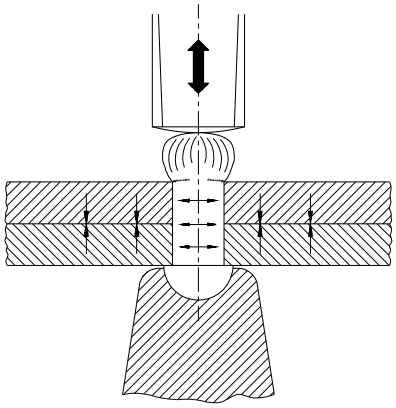
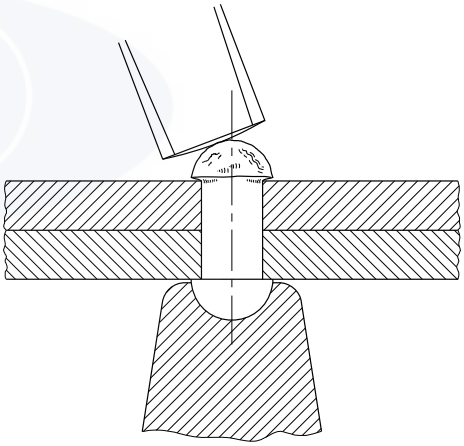
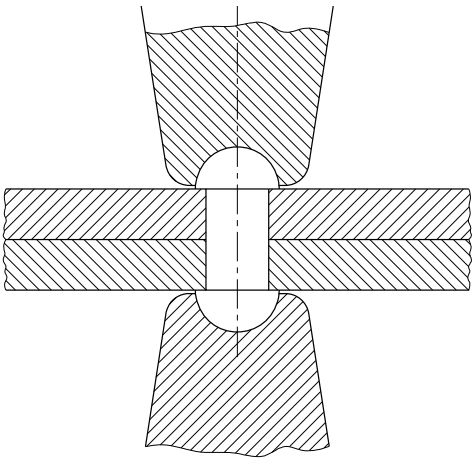


Fig 5



Form and finish the rivet head using a rivet snap. While doing this the rivet snap should be kept vertical and a few heavy blows should be given. (Fig 6)

Fig 6



Internal threading of through holes using hand tools

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

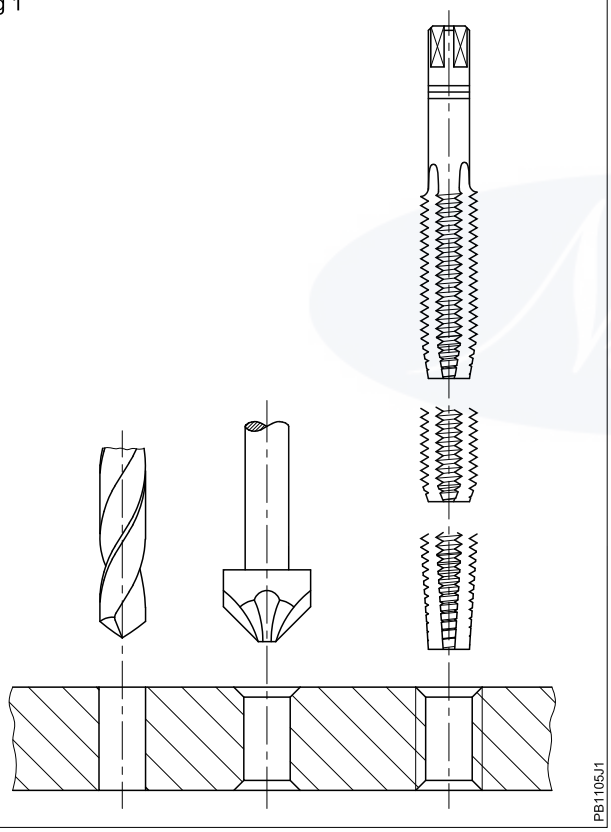
- **determine the tap drill sizes for internal threading**
- **cut internal threads using hand taps.**

Job Sequence

Determine the tap drill size: For cutting internal threads it is necessary to determine the size of the hole (tap drill size). It can be calculated using the formulae or can be chosen from the table of the drill sizes.

1 Drill the hole to the required tap drill size (Fig. 1) using drilling machine.

Fig 1

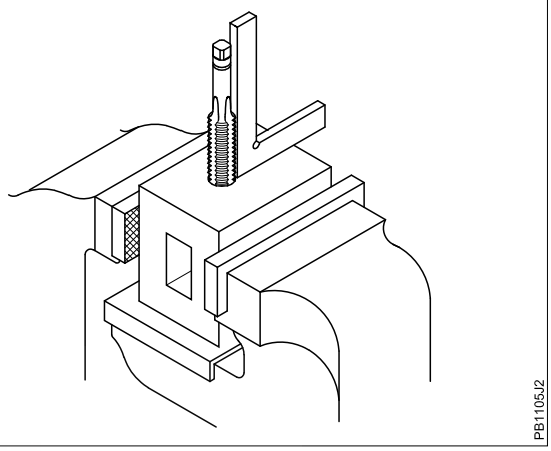


2 Hold the job firml and horizontally in the vice. The top surface should be slightly above the level of the vice jaw. This will help in using a try-square without any obstruction while aligning the tap. Use soft jaws while holding the finished surface on the vice. Fig.2

3 Fix the first tap(taper tap) in the wrench (choose correct size wrench)

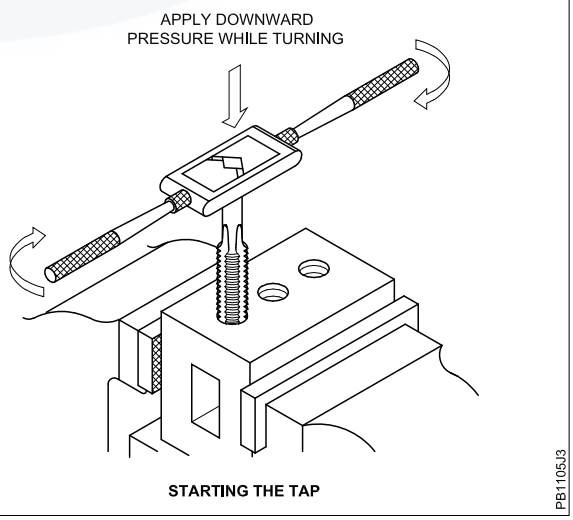
4 Too small a wrench will need a greater force to turn the tap. Very large and heavy tap wrench will not give the force required to turn the tap slowly as its cuts.

Fig 2



5 Position the tap in the chamferred hole vertically by ensuring the wrench in a horizontal plane. Exact steady downward pressure and turn the tap wrench slowly in the clockwise direction to start the thread hole the tap wrench close to the centre. Fig.3.

Fig 3



STARTING THE TAP

6 Ensure of starting of the thread, remove tap wrench without disturbing the tap alignment.

7 Check and make sure the tap is vertically use a small square for help.

8 Turn the wrench-continue the cutting of the thread until the tap is fully inside the hole being threaded.

9 Remove the chips from the work with a brush.

10 Check the thread hole with a matching screw.

11 Clean the tap with brsh and place it back on the stand.

External threading

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

- **select the correct hand die for a given thread**
- **hold the die in the stock**
- **cut external thread using a hand dies**
- **grind chamfer on the ends of studs on a bench grinder**
- **check the external thread fit (in the hole drilled in Exercise 4) by matching with internal threads.**

Job Sequence

1 Check the diameter of the bar. Fig.1

2 Cut the bright bar of 12mm and 20mm to the length of 60cm each as per drawing.

3 Square up the ends of the bar by filing.

4 Chamfer the ends using a pedestal grinder.

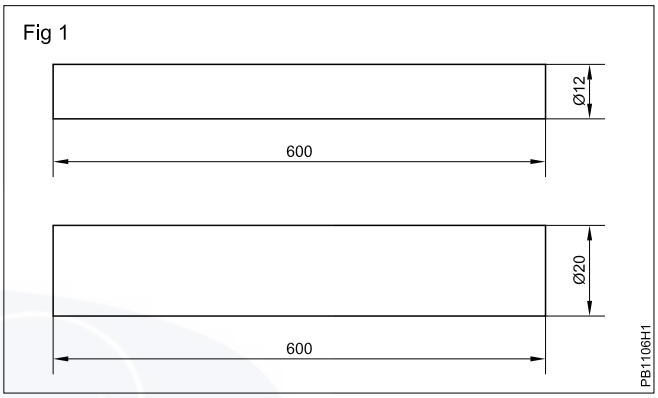
5 File and furnish both portions to size.

6 Hold the job in the bench vice.

7 Cut the thread with a die set a on one side of each rod.

8 Check the thread with the hole made in Exercise 4.

Fig 1



Skill Sequence

Objectives : This shall help you to

- **cut external threads using dies.**

1 Select a correct size and circular rod as blank and chamfer the ends

2 Blank size = Thread size - 0.1% pitch of the thread.

3 Grip the blank in the vice using a false jaw, projecting the blank above the vice jaws 5mm more than the required length of thread.

4 Fix the die in the diestock. The leading side of the die must be opposite to the stp of the die stock. (Figs. 1 & 2).

5 Open the die fully by tightening the centre screw of the die stock. (Fig.3)

6 Place the leading side of the die on the chamfer of the job.

Fig 1

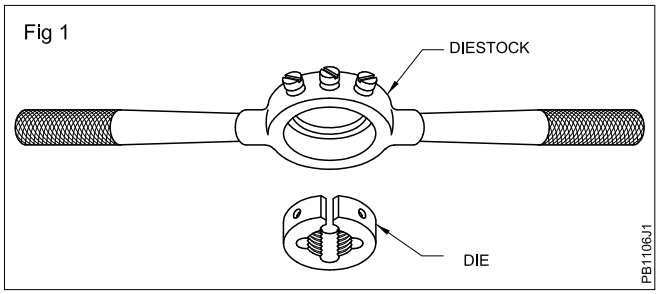


Fig 2

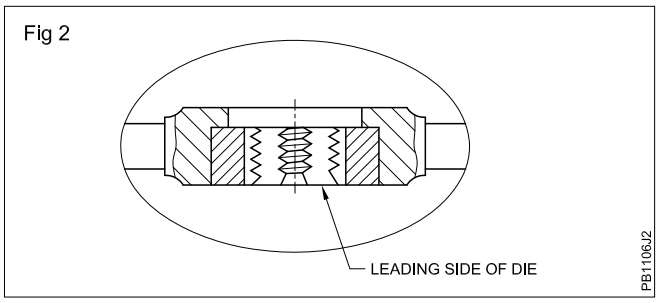
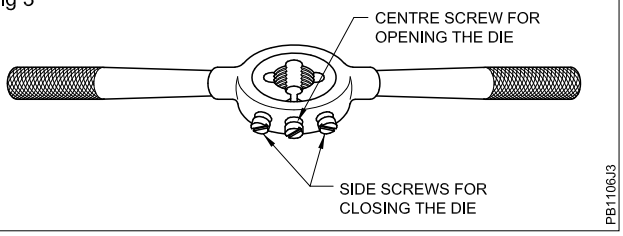


Fig 3



Start the die, square to the bolt centre line. (Figs 4 & 5)

Fig 4

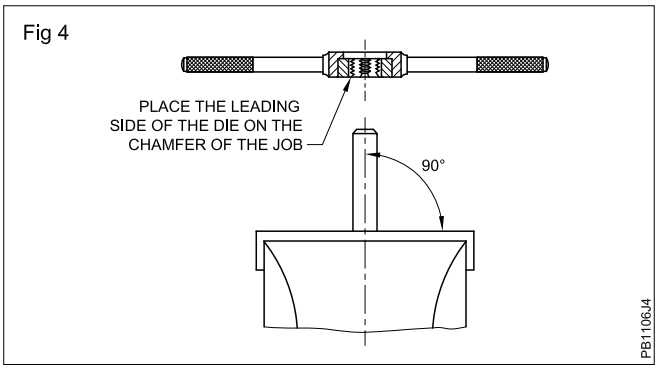
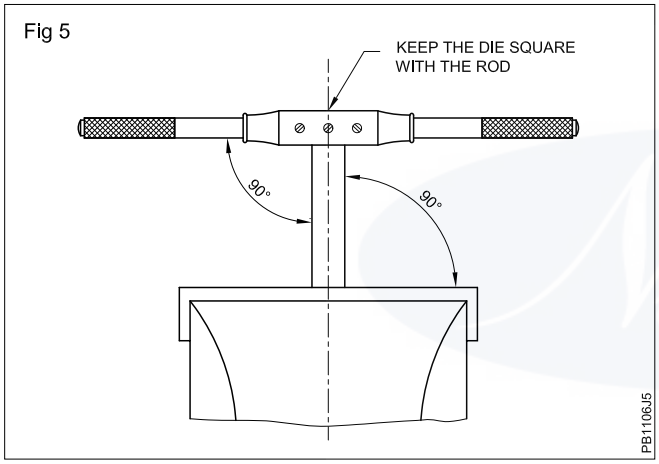


Fig 5



8 Turn in the clockwise direction to advance the die on the blank with even pressure on both ends of the die stock.

9 Cut thread slowly and reverse the die for a short distance in order to break the chips.

Use a cutting tubricant

10 Clean the die frequently with a brush to prevent the chips from clogging and also from spoiling the thread.

11 Reverse and remove the die after the full height is reached.

12 Increase the depth of the cut gradually by loosening the centre screw and tightening the side screws.

13 Too much depth of cut at one time will spoil the thread. It can also spoil the die.

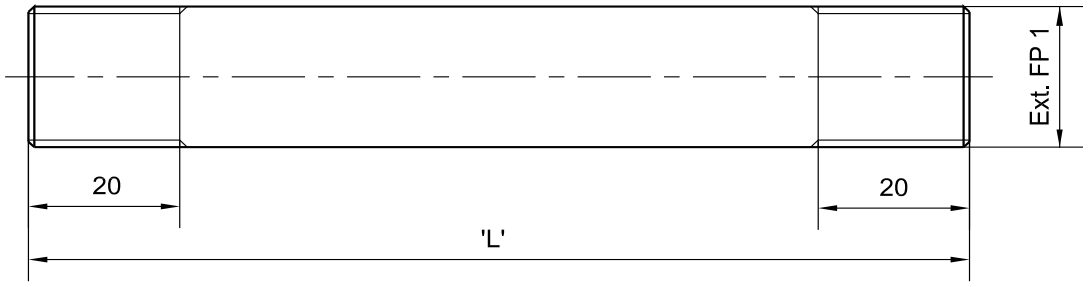
14 Check the fit of threads with a matching nut.

15 Tighten the side screws by hand and repeat cutting until the standard nut matches with the external and without undue play between the threads.

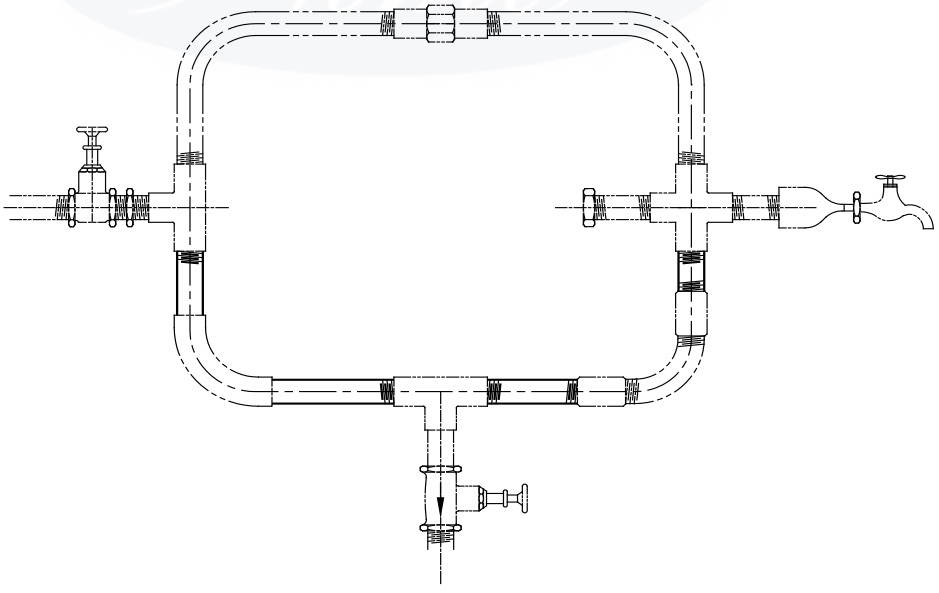
Threading G.I pipes using die stocks

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

- **cut threads on G.I pipe using die stock**



NOTE: 'L' -REFER EX.NO:-3



1	–	BMP-3-03 ←	–	–	–	6
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**PIPE THREADING (USING DIE STOCKS)**				DEVIATIONS ±0.5	TIME 5h
					CODE NO. MM1306E1	

Skill Sequence

Threading G.I pipes using die

Objective : This shall help you to

- **cut threads on G.I pipe using die stock.**

Select a set of dies, and ratchet-type die stock. (Fig 1&2)

Fig 1

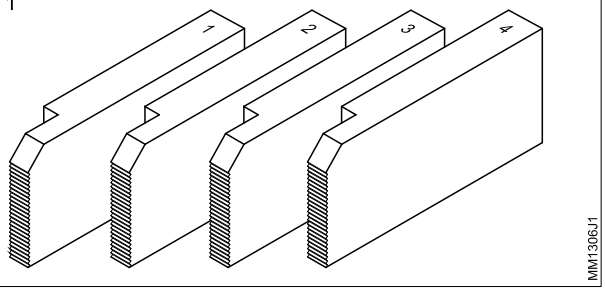
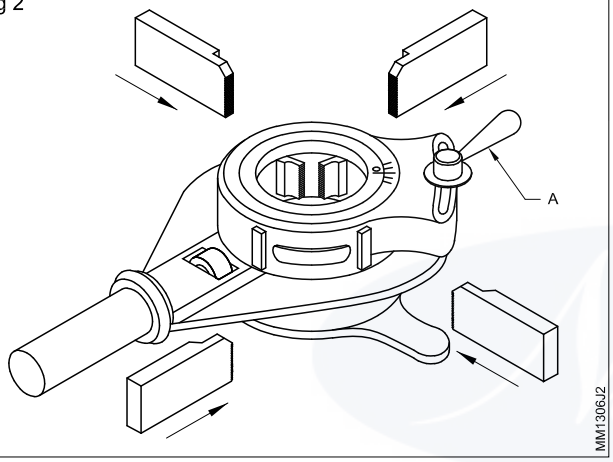


Fig 2



Open the adjustment lever. (A)

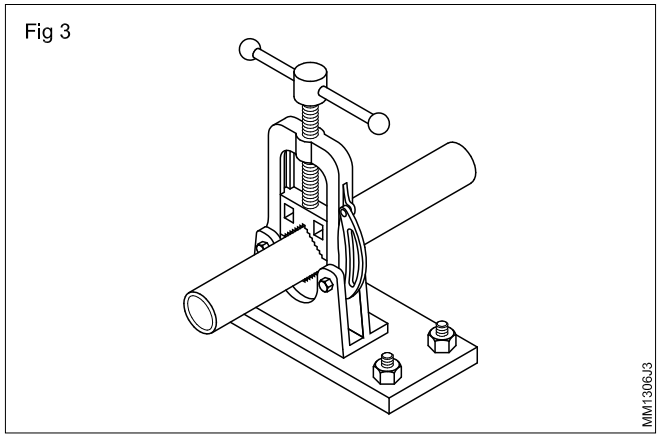
Coincide the zero setting mark '0' die stock and then insert the four dies acording to the number on the dies and die stock respectively.

Ensure that the dies sit in the correct position.

Be sure that the number on the top edge of the die correcsponds with the number of the slot into which it is to be place.

Fix the pipe in a pipe vice and tighten to prevent it from rotating. (Fig. 3)

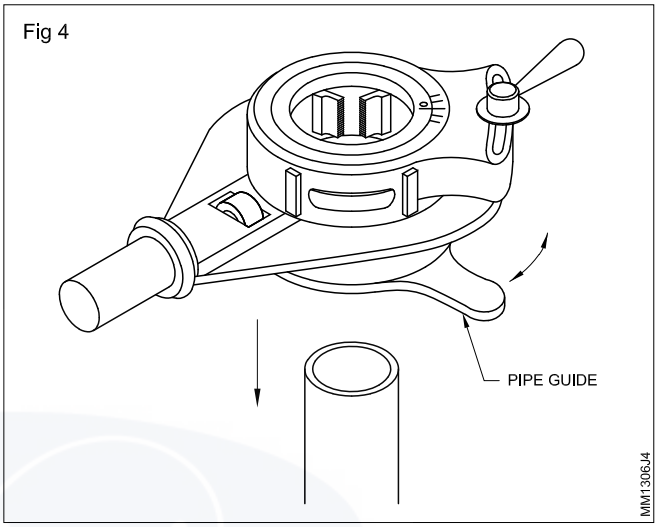
Fig 3



Ensure that the projection of the pipe is within 150-250 mm from the vice.Open the self-centering pipe guide and slide the stock over the end of the pipe.

Adjust the pipe guide for correct sliding, fit and lock into position. (Fig. 4)

Fig 4



Apply a cuting lubricant to the part which is to be threaded.

Use lard oil, or mineral - lard oil when threading G.I. pipes.

Appl a little pressure to the stock and keep the handle at rigt angle to the pipe axis.

When the dies bite into the pipe, stop pushing and continue the rotation by moving the handle up and down.

Apply the lubricant to the pipe after the first thread has been cut.

Keep rotating the handles clockwise and check the length of the pipe thread.

Ensuret that the length of the thread is sufficient to fit half way into the socket or coupling.

If the die stock and the die stick, turn the stock anticlockwise to break the chips.

Reverse the ratchet knob, ease the handle and turn the stock anticlockwise till the stock and dies come out of the pipe.

Clean the thread with a wire brush.

Form thread until the pipe extends about one or two threads beyond the end of the stock.

Remove the stock and dies by operating the quick release lever and clean off the thread with a wire brush.

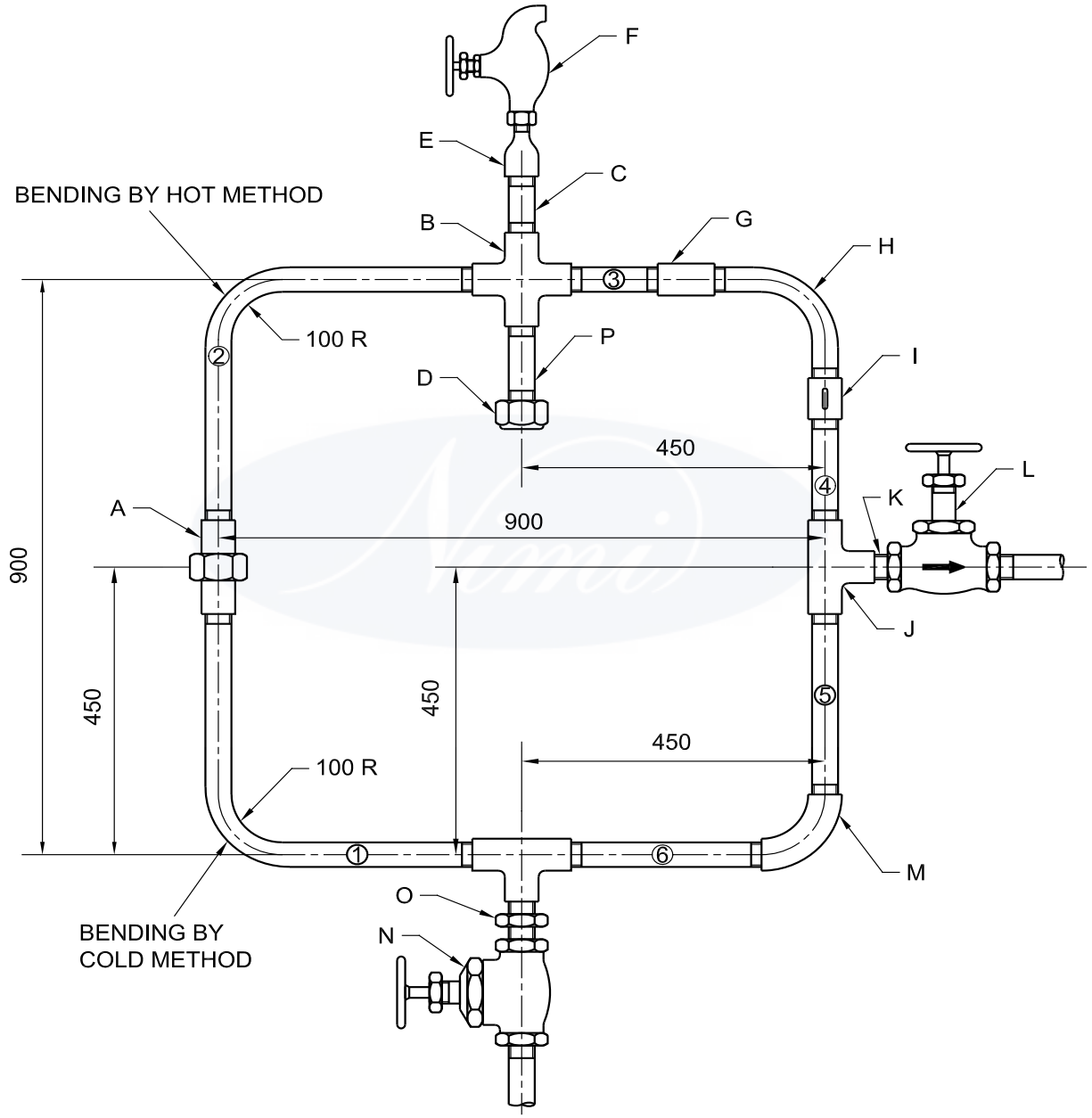
Check the formation of thread with a standard fitting.

Repeat the operation if the thread is too tight, by adjusting the dies.

Assembly of standard pipe fitting

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

- **fit the elbow with G.I. pipe**
- **fit the union with G.I. pipe**
- **fit valves with G.I. pipe**
- **assemble pipe with standard fittings.**



–	–	–	–	–	–	7
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	ASSEMBLY OF G.I. PIPES WITH STANDARD PIPE FITTING	DEVIATIONS	TIME 10h
		CODE NO. MM1307E1	

Job Sequence

Join pipe No. 2 with the 4-way cross. (B)

Fit pipe No.3 wih the ‘cross’.

Join plain coupling (G) to the other end of the pipe No. 3.

Assemble G.I.bend (H) to the plain coupling.

Fit the ribbed coupling (I) to the other end of the bend.

Join pipe No. 5 to the opposite end of ‘T’.

Assemble elbow (M) with pipe No. 5,

Fit pipe No. 6 with the other end of the elbow.

Join ‘T’ with pipe No. 6.

Fit pipe No. 1 with the opposite end of ‘T’.

Join pipe Nos. 1 & 2 with union. (A)

Fit 150mm barrel nipple (P) to the left side of the ‘cross’ and put cap (A) for it.

Put another 100mm barrel nipple (C) to the right side of the cross.

Join the reducer (E) to the barrel nipple.

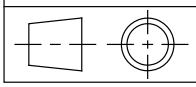
Assemble the bib-cock (F) to the other end of the reducer.

Put the hexagonal nipple (0) to the left side ‘T’.

Assemble the gate-valve to the nipple.

Test the joints for leakage.

1	25 x 150 mm	BRASS NIPPLE	G.I.	P	P	
1	25 x 25 mm	HEXAGONAL NIPPLE	G.I.	O	O	
1	25 mm	GATE VALVE	COPPER ALLOY	N	N	
1	25 mm	ELBOW	G.I.	M	M	
1	25 mm	GLOBE VALVE	COPPER ALLOY	L	L	
1	25 x 100 mm	BARREL NIPPLE	G.I.	K	K	
2	25 mm	TEE	G.I.	J	J	
1	25 mm	RIBBED COUPLING	G.I.	I	I	
1	25 mm	BEND 90°	G.I.	H	H	
1	25 mm	PLAIN COUPLING	G.I.	G	G	
1	1/2 INCH	BIB COCK	BRASS	F	F	
1	25 x 15 mm	REDUCER	G.I.	E	E	
1	25 mm	CAP	G.I.	D	D	
1	25 x 100 mm	BARREL NIPPLE	G.I.	C	C	
1	25 mm	CROSS	G.I.	B	B	
1	25 mm	UNION (WITH WASHER)	G.I.	A	A	
1	Ø25 x 4.05 - 405	PIPE (CLASS B)	G.I.	6	6	
1	Ø25 x 4.05 - 410	PIPE (CLASS B)	G.I.	5	5	
1	Ø25 x 4.05 - 290	PIPE (CLASS B)	G.I.	4	4	
1	Ø25 x 4.05 - 300	PIPE (CLASS B)	G.I.	3	3	
2	Ø25 x 4.5 - 820	PIPE (CLASS B)	G.I.	1 & 2	1 & 2	7
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**ASSEMBLY OF G.I. PIPES WITH STANDARD PIPE FITTING**	DEVIATIONS	TIME
		CODE NO. MM1307E2	

Skill Sequence

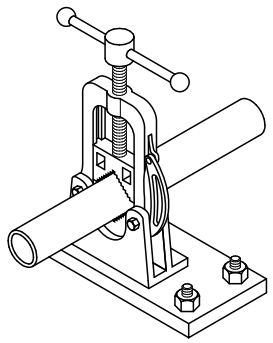
Assemble G.I. pipes with standard fittings

Objective : This shall help you to

- **assemble pipe and pipe fittings.**

Hold the pipe No.2 in a pipe vice. (Fig. 1)

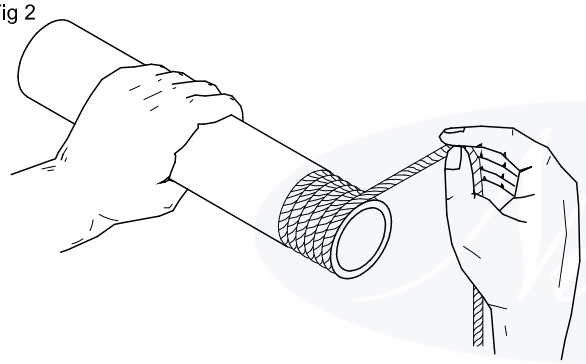
Fig 1



MM1307J1

Wind the hemp packing/cotton thread material on the external threads of the pipe. (Fig. 2)

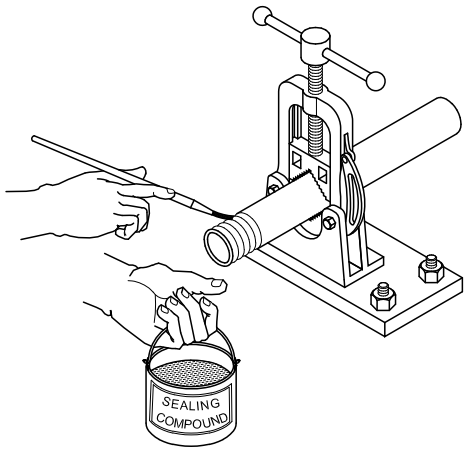
Fig 2



MM1307J2

Apply sealing compound over the pipe threads. (Fig. 3).

Fig 3



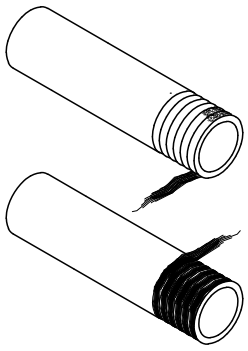
MM1307J3

Fit the 4 way cross to pipe No.2 and tighten it using a pipe wrench.

Wind the hemp packing to external threads of all the pipes and standard fittings and apply sealing compound over the threads before joining with the other one. (Fig. 4).

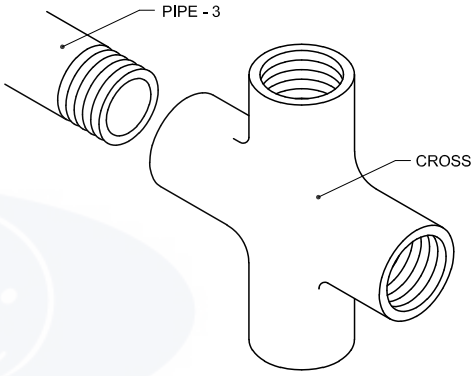
Fit pipe No. 3 with the cross. (Fig 5)

Fig 4



MM1307J4

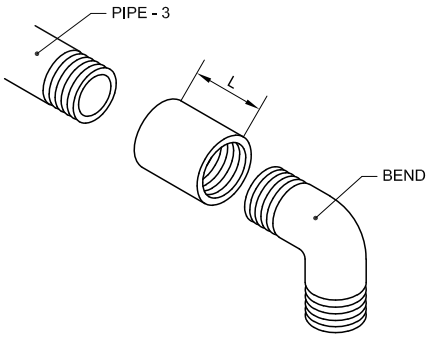
Fig 5



MM1307J5

Join the plain coupling to the other end of the pipe No. 3 (Fig. 6)

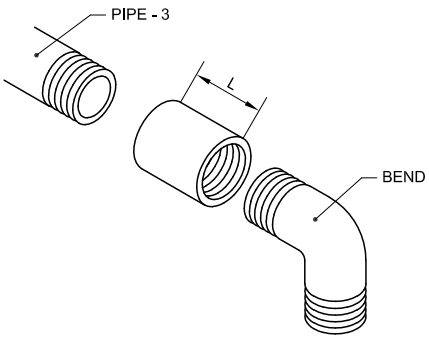
Fig 7



MM1307J7

Fit the G.I bend to the plain coupling. (Fig. 7)

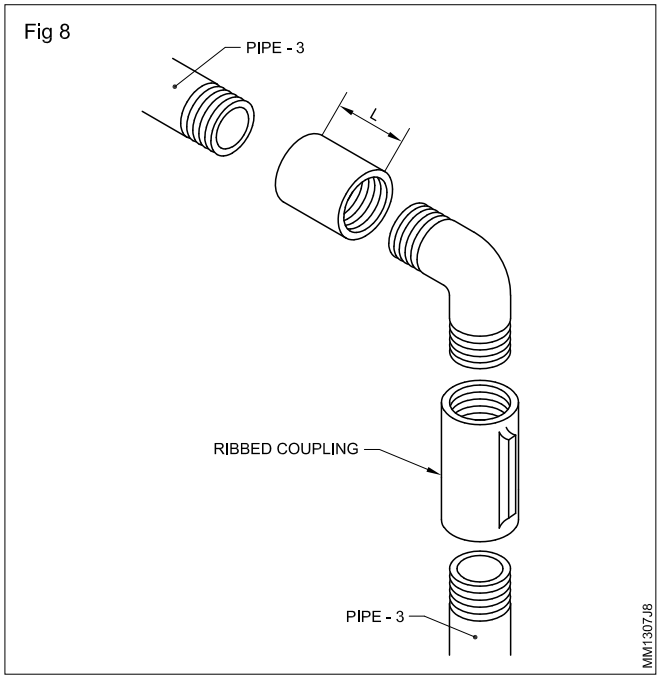
Fig 7



MM1307J7

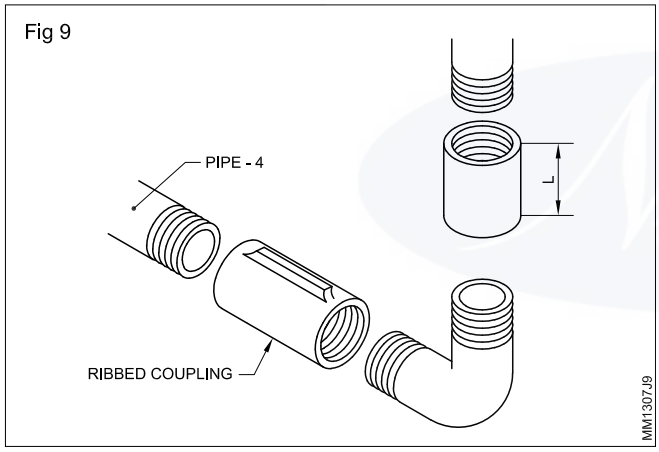
Assemble the ribbed coupling to the other end of the G.I.bend. (Fig. 8)

Fig 8



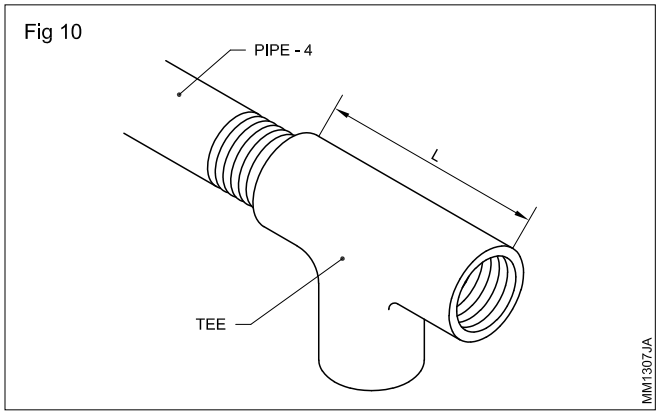
Connect pipe No. 4 to the nibbed coupling. (Fig. 9)

Fig 9



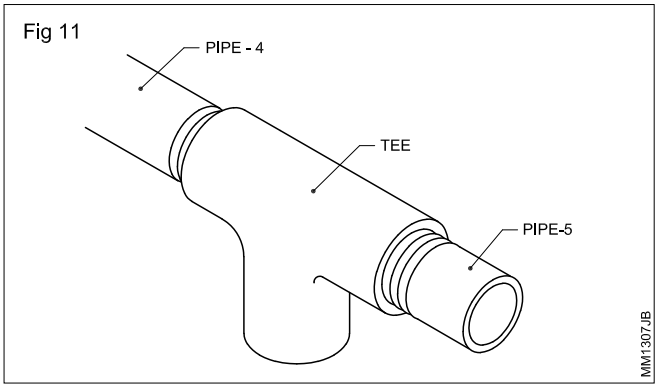
Fit 'T' with pipe No. 4. (Fig. 10)

Fig 10



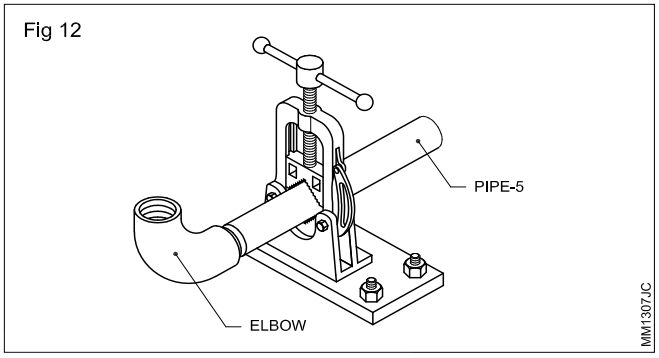
Connect pipe No. 5 to the opposite end of 'T'. (Fig.11) Clean the machine thoroughly.

Fig 11



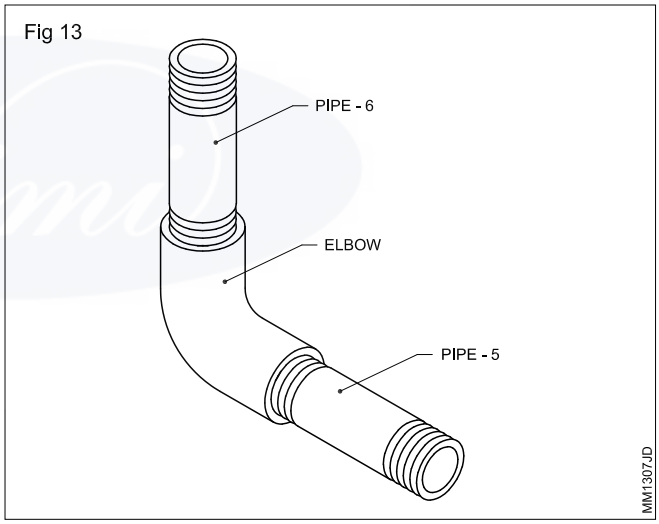
Assemble the elbow with pipe No. 5. (Fig.12)

Fig 12



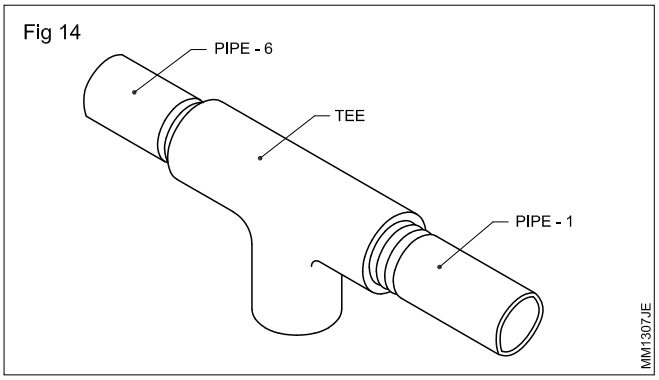
Fit pipe No. 6 with the other end of the elow. (Fig. 13)

Fig 13



Conect 'T' with pipe No. 6 (Fig. 14)

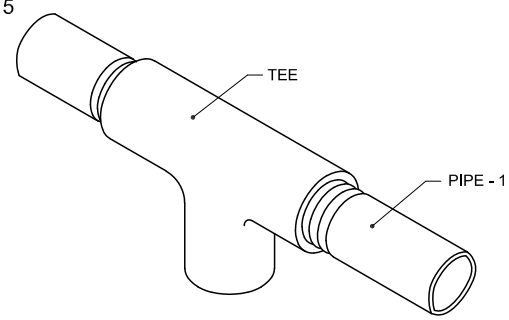
Fig 14



Fit pipe No. 1 with the opposite end of 'T'. (Fig. 15)

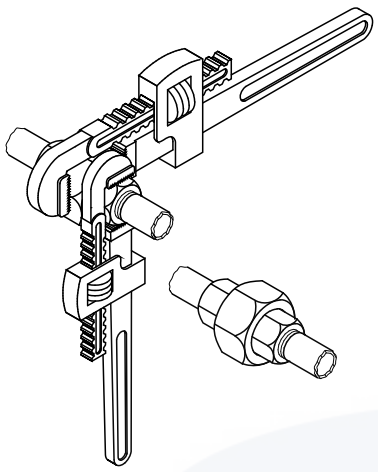
Fit the rubber washer into the union.Set pipe Nos. 1&2 with the union.

Fig 15



Hold one side of the union in pipe wrench and the ring of union in the other. (Fig. 16)

Fig 16

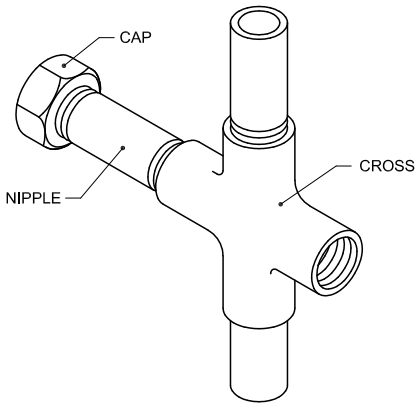


Turn the two pipe wrenches gently in opposite directions and assemble.

Use grease or vaseline onthe union joint for easy disconnection.

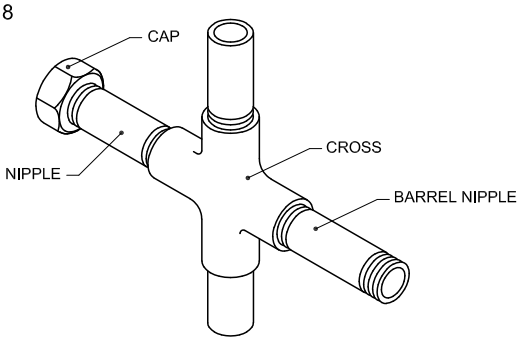
Fit a 150mm barrel nipple to the left side of the cross and put a cap for it. (Fig. 17)

Fig 17



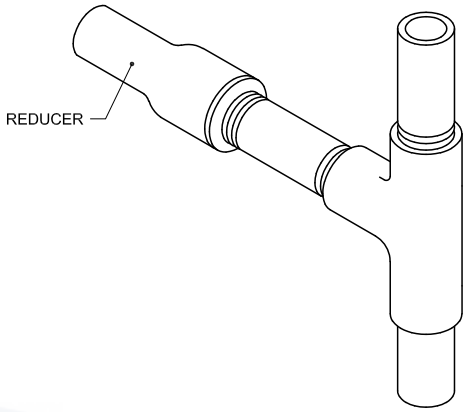
Join another 150mm barrel nipple to the right side of the cross. (Fig. 18)

Fig 18



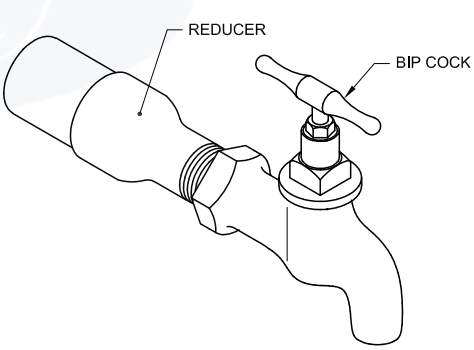
Connect the reducer to the barrel nipple. (Fig. 19)

Fig 19



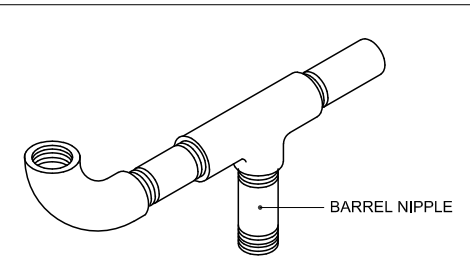
Assemble a bib-cock to the other end of the reducer. (Fig. 20)

Fig 20



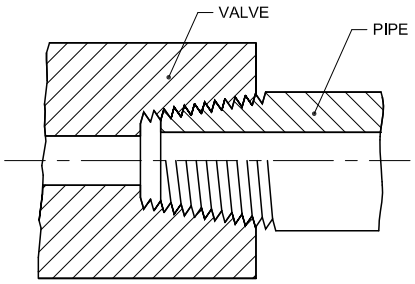
Fit a 100mm barrel nipple to the bottom side of ‘T’. (Fig. 21)

Fig 21



Assemble the gate-valve to the 100mm barrel nipple. Allow a clearance between the valve and pipe as shown in (Fig. 22).

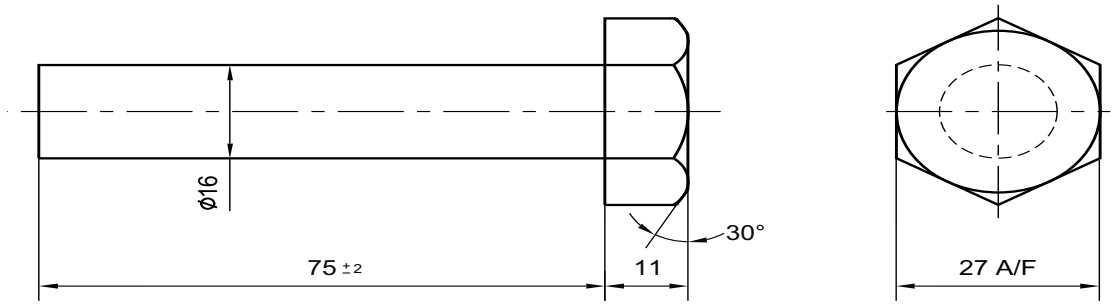
Fig 22



Forging bolt head

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

- **upset tje end of a steel bar**
- **form shapes using a bolster**
- **finish forged surfaces using swages and flatters**
- **form shapes using a bolster.**



Job Sequence

- Check the raw material for its size.
- Heat one end of the metal of 60mm length to the foging temperature.
- Upset the heated part 25mm thick.
- Spread the round head to 32mm Ø using a heading tool.
- Form a hexagonal head to size.

  Re- heat, if necessary.
- Check the width and thickness of the hexagonal head and the diameter of the shank.
- Cut the extra metal with the hot set.
- Chamfer on the hexagonal head with a hammer.
- Finish the bolt by means of swages and flatters.

Alignment of the centre and the straightness of the shank of the bolt should be maintained.

1	Ø16-110		Fe310-O			6
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**FORGING BOLT HEAD**				DEVIATIONS ± 1	TIME 10h
					CODE NO.	

Forge a Hexagonal Head Bolt

Objectives : This shall help you to

- **upset at the end of a hot stock**
- **form a hexagonal head using a bolster.**

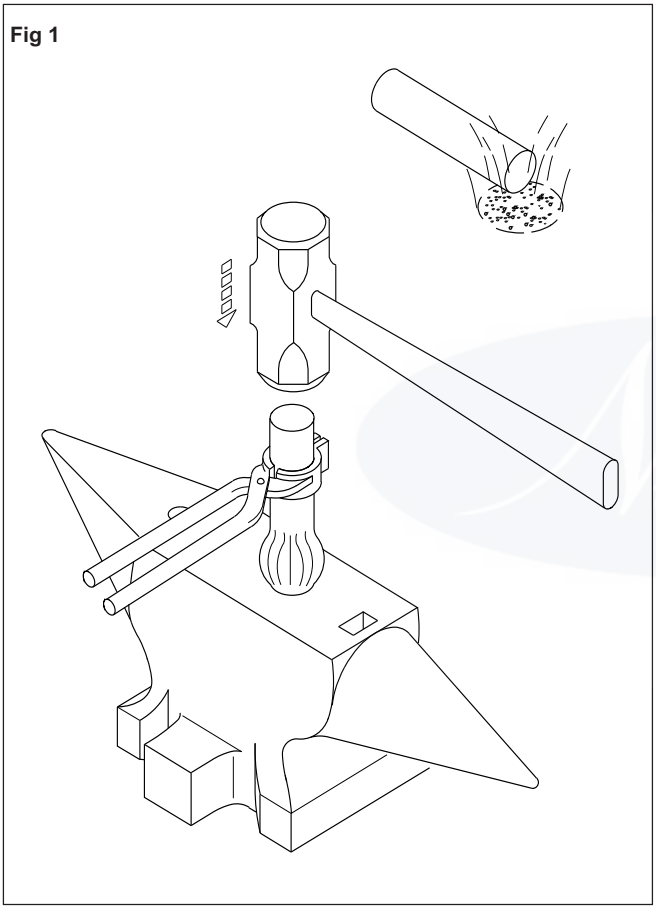
PROCEDURE

Heat one end of the stock approximately 40 mm to a yellowish colour.

After heating, if the length of the heated portion is found to be more than the required length, cool the excess length in water.

Keep the stock vertically as shown in (Fig 1). Strike on the top portion. The hot bottom will start bulging(upsetting).

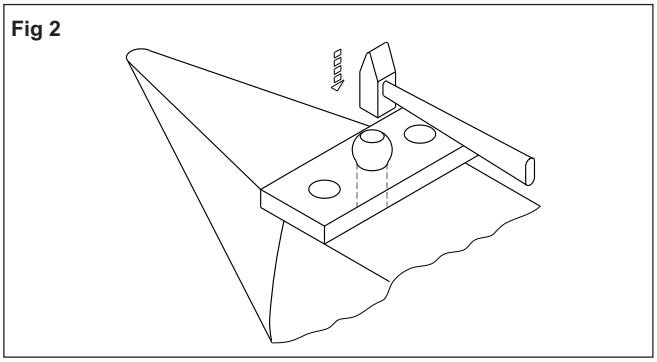
Fig 1



Repeat the operation until you get the required thickness.

Insert the upset portion on a bolster and strike on the top as shown in the (Fig 2)

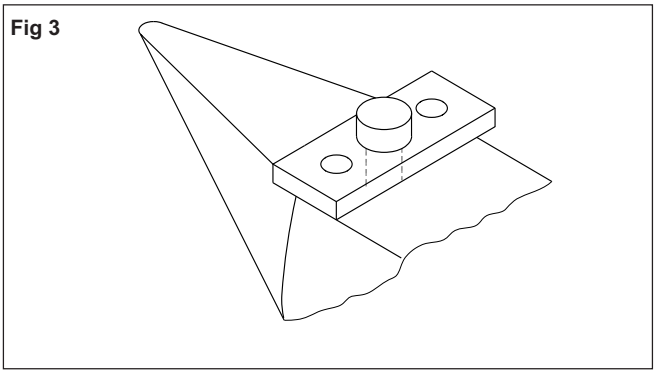
Fig 2



Repeat the operation till you get a round head.

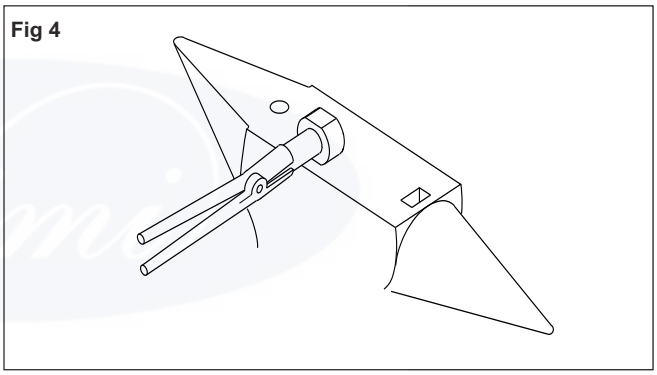
Form the round head first. (Fig 3)

Fig 3



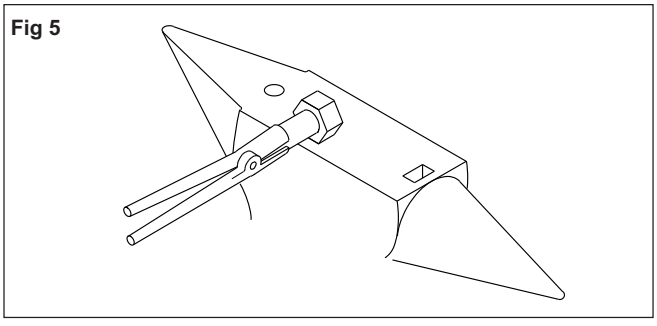
Form the head portion to a hexagonal shape. (Fig 4)

Fig 4



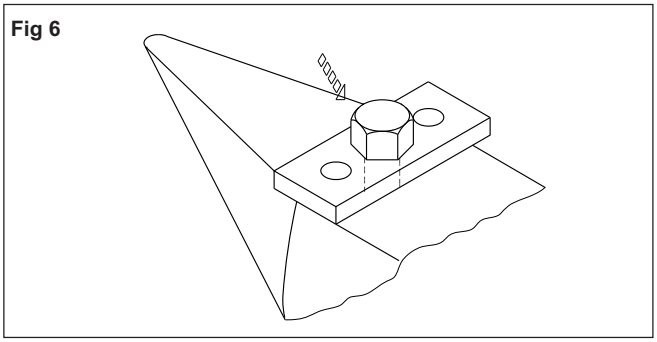
Finish the hexagonal head. (Fig 5)

Fig 5



Chamfer the corners. (Fig 6)

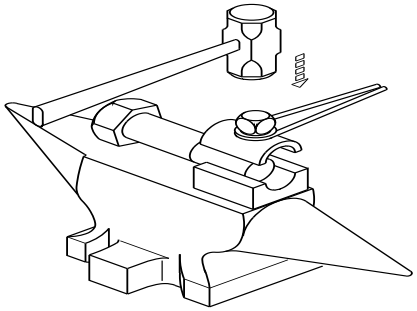
Fig 6



Finish the flat surfaces using a flatter.

Finish the bolt shank using the top and bottom swages. (Fig 7)

Fig 7



Wood cutting by chiseling

Objectives : At the end of this exercise you shall be able to
- **mark the piece for chiseling**
- **grind the sharpen chisel blade**
- **chisel the wooden pieces**

Requirements

Tools/Instruments

- Pencil
- Scriber
- Jack plane
- Try square
- Hammer
- Mallet
- Marking gauge
- Two feet four fold wooden rule
- Firmer chisel 35mm; 25mm
- Tenon saw

Equipments

- Work bench
- Carpenders vice
- Grinding stone m/c
- Oil stone
- Bench hook

Material

- Hard wood 160 x 50 x 25mm = 1 No. (Koungu wood)

JOB SEQUENCE

1 Grind and sharpen the firmer chisel.

2 Plane the job to the required size 160 x 50 x 20 mm in all sides.

3 Hold the job on the vice and check it with try square for its flatness.

4 With scriber and try square mark out lines at ad i s - tance 50mm and 100mm from left side.

5 Hold the tenon saw on the line marked and saw it to a depth of 10mm.

6 Repeat the procedure for the otherside saw it to a depth of 10mm.

7 Hold the firmer chisel in your right hand on the handle and guide the blade with left hand.

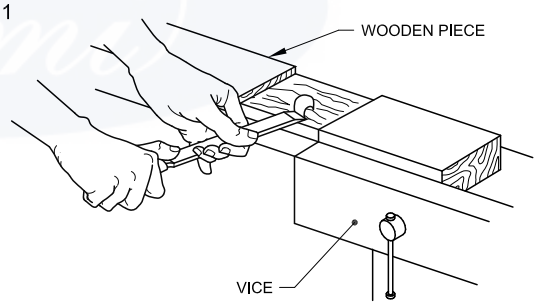
8 Control the movement of the chisel with thumb and fore finger.

9 Push it on the space to be cut.

10 Start chiselling away from you the bevel of the chisel turned upwards.

11 Chisel in an inclined direction up to middle of the portion Fig 1.

Fig 1



Safety precaution

Never hold your hand or finger before the cutting edge.

Never use a chisel without a proper handle.

12 Now reverse the work piece so that the back side comes to front and hold int the vice.

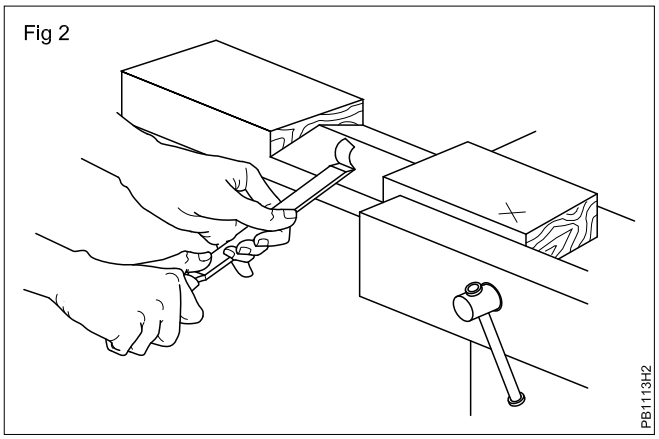
13 Chisel away from you up to middle portion.

14 Repeat the chiselling as shown in Fig 2.

15 Start chiselling slowly to cut flat portion.

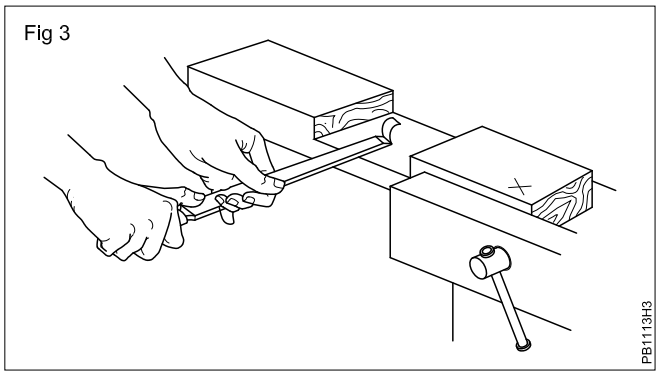
16 Repeat the procedure for the other side saw it to a depth of 10mm.

Fig 2



17 Smoothen the bottom and side walls with firmer chisels Fig 3.

Fig 3



Skill Sequence

Marking job for chiseling

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

- **mark the job for chiselling across the grain.**

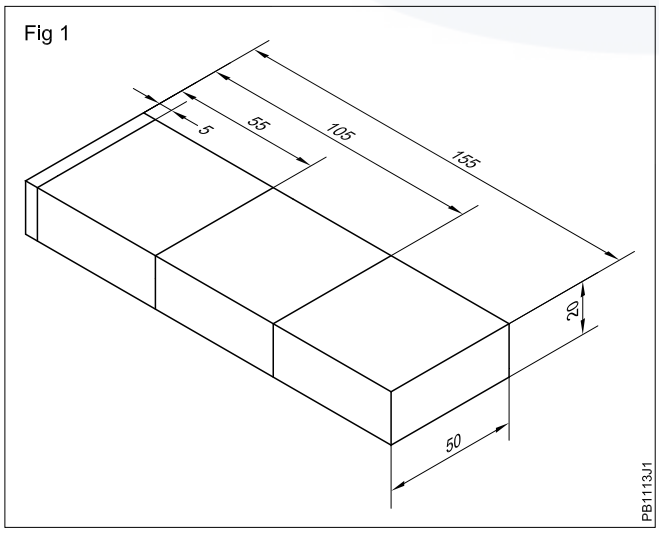
Marking sequence

1 Hold the job 160 x 50 x 25 on the bench or vice.

2 Plane it to size 160 x 50 x 20

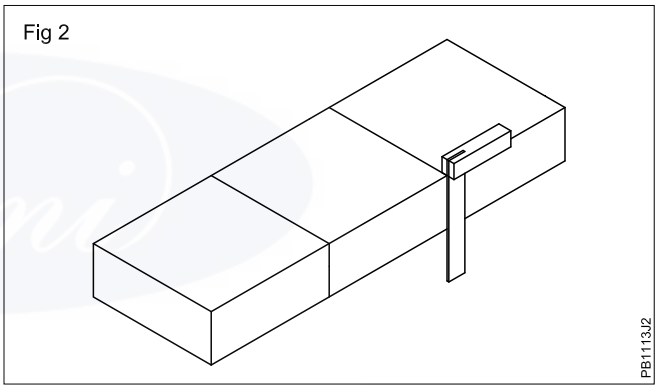
3 With try square and steel rule mark 5mm, 55mm, 105mm and 155mm from one end of the job Fig.1.

Fig 1



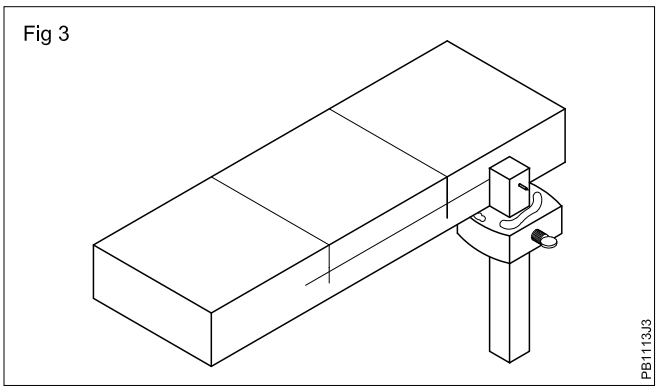
4 Hold the stock of the try square closely in contact with face edge mark lines with scriber on the measurements of 5mm, 55mm, 105mm & 155mm on all four sides. Fig 2.

Fig 2



5 Set the marking gauge to 10mm scribe in the middle of face edge and its opposite side Fig. 3

Fig 3



6 For the end side chisel 5mm width on all four sides slowly upto a depth of 3mm. than top to 5mm and chisel off the waste end with formar chisel.

Wood sawing

Objectives : At the end of this exercise you shall be able to
- **mark lines on wooden planks/battens, using try square, straight edge and steel rule, and test flatness and squareness.**
- **cut the given battens, boards, and laminates with a handsaw to the required sizes**
- **cut the given boards, battens to the required shape/size with a tenon-saw**
- **hold the jobs in different holding tools.**

Requirements

Tools/Instruments

- Handsaw 450mm - 1 No.
- Straight edge 600 mm - 1 No.
- Try square 200 mm - 1 No.
- G. Clamp No. 6 - 1 No.
- Tenon-saw 350mm - 1 No.
- Steel rule 300mm - 1 No.

Materials

- Hardwood 340 x 200 x 30mm - 1 piece

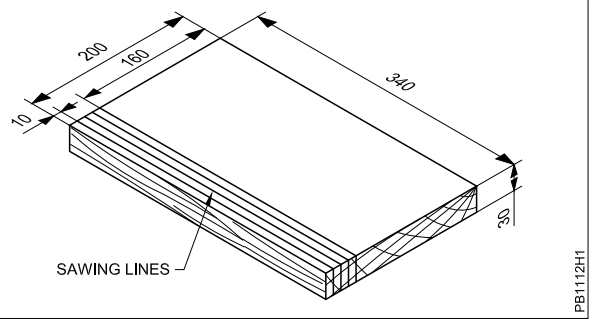
PROCEDURE

TASK 1:

1 Check the raw material size.

2 Draw 4 lines parallel to the edge along the grain with 10mm spacing between the lines using pencil and straight edge on one face of the given wooden piece. Extend these lines to both ends using a try square and connect them on the other face, using a straight edge. (Fig 1)

Fig 1

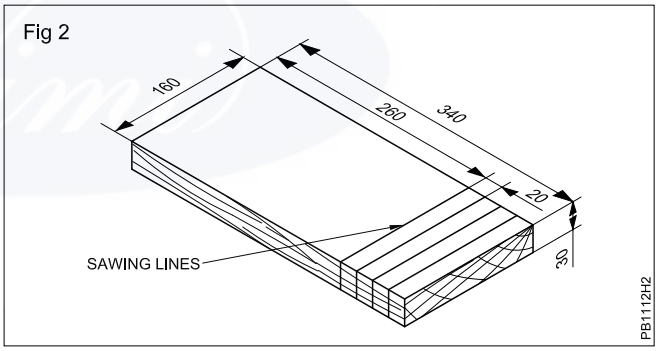


3 Draw 4 lines across the grains on one face from one end with 20mm spacing between the lines using a pencil and try square and extend these lines on both edges and the other face using a try square. (Fig 2)

4 Fix the piece on the workbench top with a 'G' clamp. See that the cut along the grain-marked portion is clear of the workbench top.

Do not overtighten the 'G' clamp.

Fig 2



5 Start cutting along the grain on the first line from the edge with a hand saw.

6 Repeat sawing on the remaining 3 lines, one after the other.

Use a well shapened saw for good results.

Saw with even strokes using the full length of the saw blade.

Keep your ey on the line being cut.

Keep your left hand away from the cutting edge of the saw while sawing.

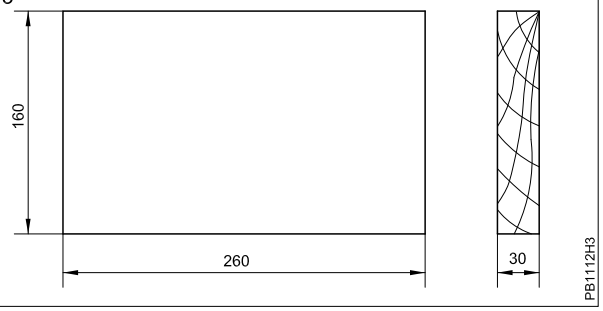
7 Remove the 'G' clamp and fix the wooden piece such that the marked portion across the grain is clear of the workbench top.

8 Start cutting across the grain on the first line from the end with a tenon-saw.

9 Repeat sawing on the remaining 3 lines, one after the other. Check whether the board size is 260 x 160 mm (Fig 3).

10 Repeat sawing the wood every day to produce atleast 6mm thick and 300mm long from 25mm thickness plank.

Fig 3



TASK 2

1 Identify the grain direction of the piece prepared under Task 1.

2 Draw a line parallel to the edge along the grain using a steel rule/straight edge and a pencil keeping the width of the board 155mm.

3 Draw a line across the grains from one end measur ing 245mm length of the board.

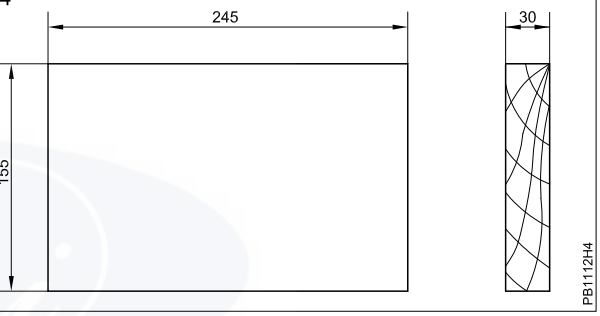
4 Saw along the grains to the marked line with a hand saw.

5 Saw across the grain to the marked line with a tenon-saw.

Saw with even strokes using the full length of the saw blades.

6 Check the piece with a straight edge/steel rule and try square for squareness and size of 155 x 245 x 30mm (Fig 4)

Fig 4



Skill Information

Use of try square

Objectives : This shall help you to

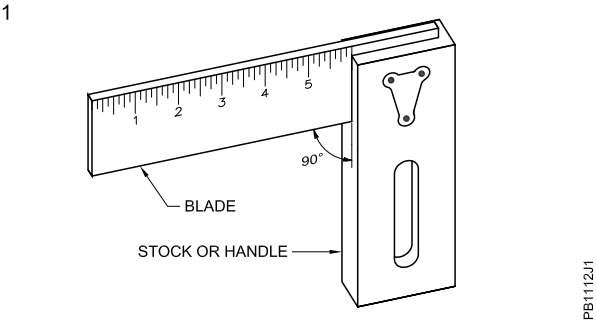
- **mark lines on wooden boards/battens**
- **test flatness and squareness using a try square.**

A try square is used for testing the squareness and to mark lines at right angles to the given surface and edges.

The try square has two parts. (Fig 1)

- Stock or handle
- Blade

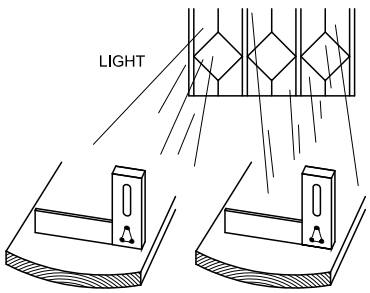
Fig 1



Common Uses

To test surfaces: Hold the try square in the reverse position and keep one edge of the blade vertical on the surface to be tested. Look through between the edge of the try square and the surface being tested (Facing source of light). This will show the high and low spots. (Fig 2)

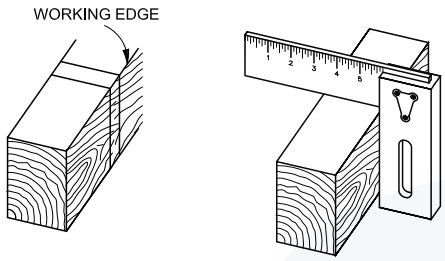
Fig 2



PB1112J2

To test the squareness of edges: Place the stock against the face firmly. Then lower the inner edge of the blade on the edge to be tested and look through between the surface of the edge and the edge of the blade of the try square. (Fig 3)

Fig 3

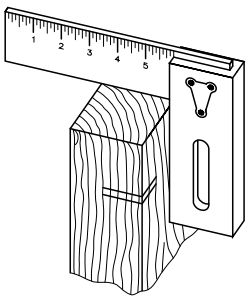


PB1112J3

To test the squareness of ends: Test fromt he face and the edge. Hold the try square as shown in Figs 4 and 5.

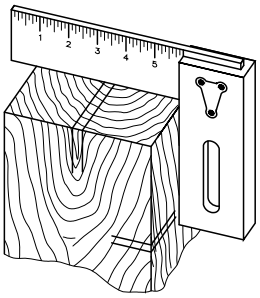
When testing the squareness hold the handle firmly against the surface.

Fig 4



PB1112J4

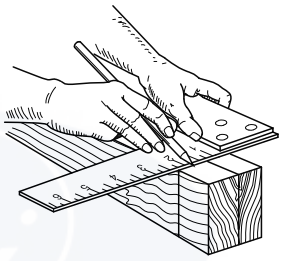
Fig 5



PB1112J5

To mark lines: To mark lines on the edge or face at right angles, hold the try square as shownin Fig 6.

Fig 6



PB1112J6

Use a marking knife or pencil and draw the lines.

Skill Information

How to handle a handsaw

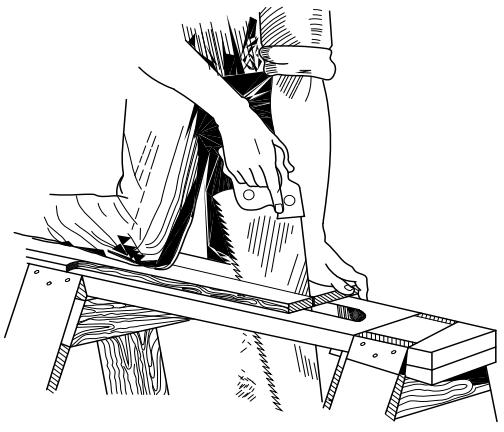
Objective : This shall help you to

- **cut the given battens, boards etc. with a hand-saw.**

Saws are used to cut wood pieces to required sizes. Proper holding of the saw gives a better control of the saw during use.

How to hold? Hold the handle by inserting 3 fingers of the right hand in the opening of the handle unit, holding the opposite side with the thumb. Keep the index finger along the face of the handle point towards the length of the blade. (Fig 1)

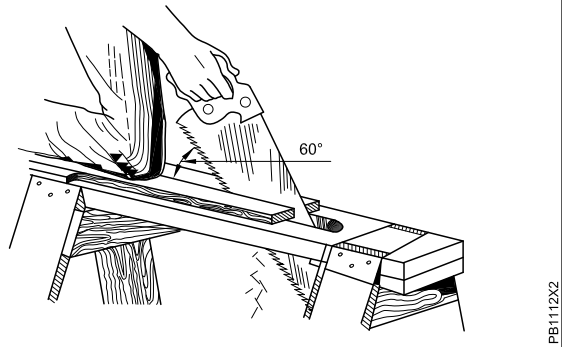
Fig 1



PB1112X1

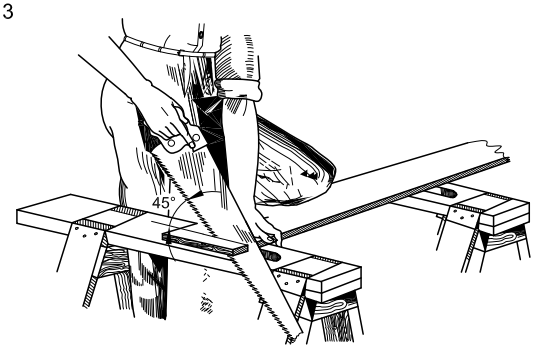
For sawing along the grain, keep the cutting edge of the saw at an angle of approximately 600 to the face of the board being cut. (Fig 2)

Fig 2



For sawing across the grain, keep thecutting edge of the saw at an angle of 450 to the face of the board being cut. (Fig 3) Hold the piece by the left hand at the finishing cut.

Fig 3



Skill Information

How to handle a tenon-saw

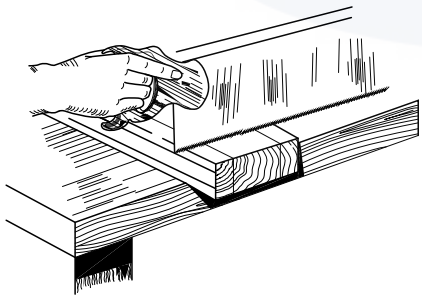
Objective : This shall help you to

- **cut the given board and batten to the required shape/size with a tenon-saw.**

A tenon-saw is used for sawing both across and along the grain, and is particularly suitable for fine cutting for light jobs.

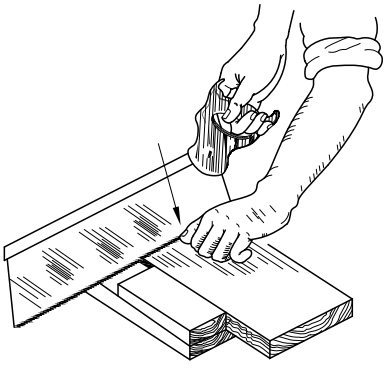
How to hold a tenon-saw? : Hold the handle by inserting 3 fingers of the right hand in the opening of the handle while holding the opposite side with the thumb. Keep the index finger along the handle pointing towards the blade length. (Fig 1)

Fig 1



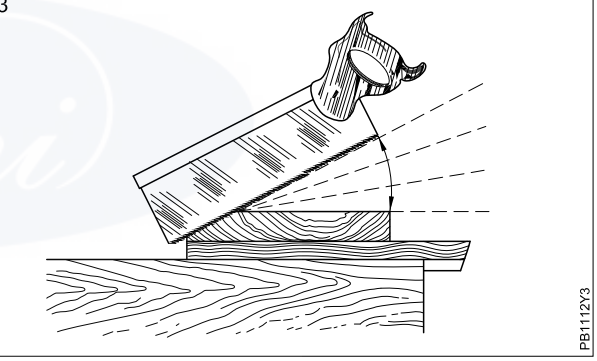
When starting a cut, guide the saw cutting edge to the marked line by the left hand thumb as shown in Fig 2.

Fig 2



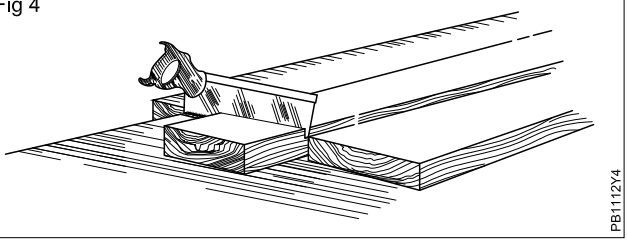
Initially marka 'Kerf' at the starting point by taking one or two back strokes, and then start sawing using forward strokes. (Fig 3)

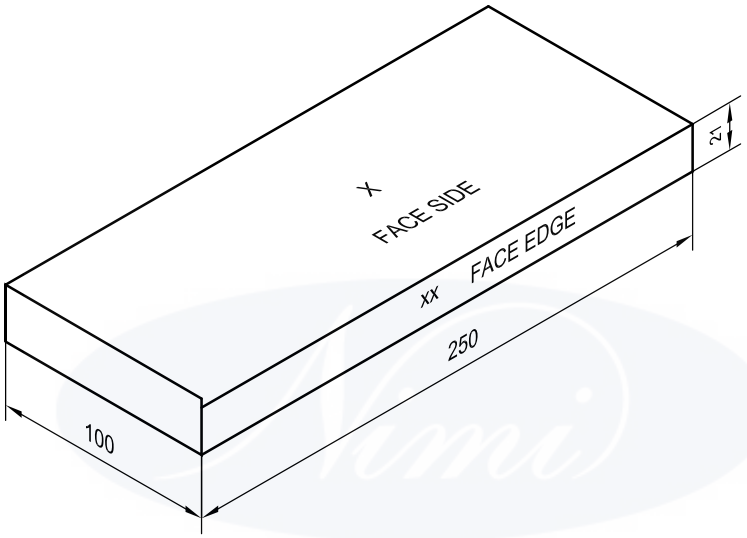
Fig 3



Gradually bring the cutting edge of the saw parallel to the surface of the piece being cut. (Fig 4) Exert moderate pressure on the forward strokes but reduce the pressure on the return strokes. Reduce the pressure and make short and light strokes while finishing the cut.

Fig 4





1	120 x 25 x 250		HARD WOOD			2 (B)
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**PLANING TO SIZE**				TOLERANCE ±2.0 mm	TIME 5h
					CODE NO. MB1706E1	

Planing to size

Objectives : At the end of this exercise you shall be able to
- **plane the face side**
- **plane the face edge**
- **mark and plane the width of the job**
- **mark and plane the thickness of the job**
- **check the flatness and squareness of the job.**

Requirements

Tools/Instruments

- Carpender pencil
- Four fold wooden rule
- Jack plane 450mm
- Hammer - 1 pound
- Marking gauge
- Try square
- Work bench with vice
- Bench stop
- Pair of winding sticks
- Oil can
- Oil stone

Materials

- Hard wood(Koungu wood)
  125 x 25 x 250mm = 1 No.

PROCEDURE

1 Set the jack plane for planing

2 Place the job on the work bench or hold the job on the carpenter's vice with face side up.

3 Keep the packing piece between the job and the vice.

4 Keep the job horizontally flat in the vice.

5 Start planing the face side with jack plane.

6 Check its flatness with try square.

7 Mark the face side on the job using pencil.

8 Place the face edge up and hold it in the vice with packing piece.

9 Plane it along the face edge.

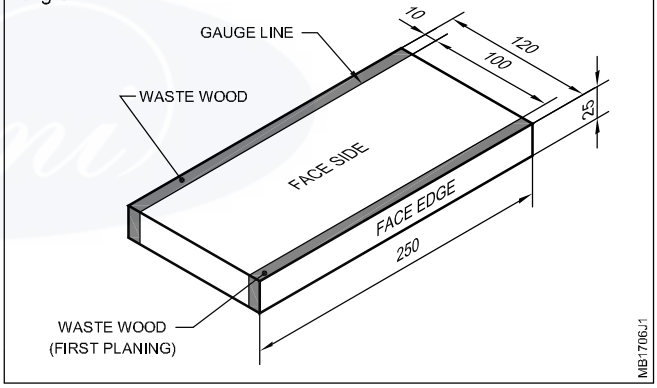
10 Check its squareness and flatness of the job.

11 Mark the face edge on the job using pencil.

Note: While planing keep the left foot in for ward position and parallel to the work bench. Right foot obliquely under the work bench. Right fore arm should be in line with the plane. Left hand is held on the front part of the plane. Planing should be in the direction of grain.

12 Gauge to the required width of 100mm on both sides using the marking gauge from the face edge. Plane down the gauge lines. Test for straightness and squareness. (Fig 1)

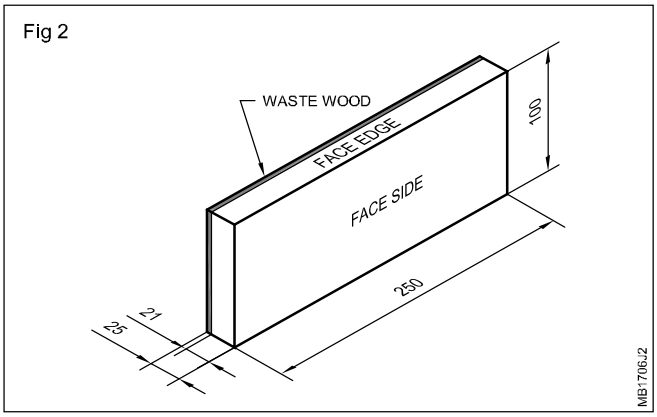
Fig 1



13 Set the marking gauge 21mm for the required thickness.

14 Gauge to the required thickness of 21mm from the face side using marking gauge on both the edges. Plane down the gauge lines. Test for flatness. (Fig 2)

Fig 2



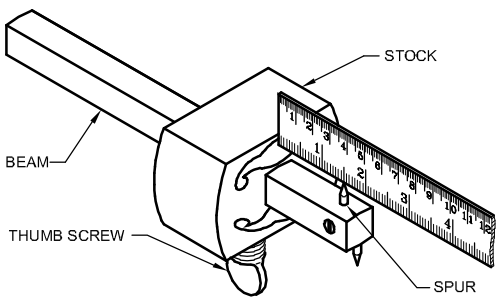
Skill sequence 1

Objective : This shall help you to
- **mark the job using marking gauge.**

1 Hold the gauge in left hand keeping the spur up.

2 Hold the foot rule in right hand and set the required distance between stock and spur. Keep the graduation of foot rule in front. (Fig 1)

Fig 1



3 Adjust the stock with the help of left hand thumb, and index finger. Now the marking gauge is set. Tighten the thumb screw.

4 Check the measurement of accuracy.

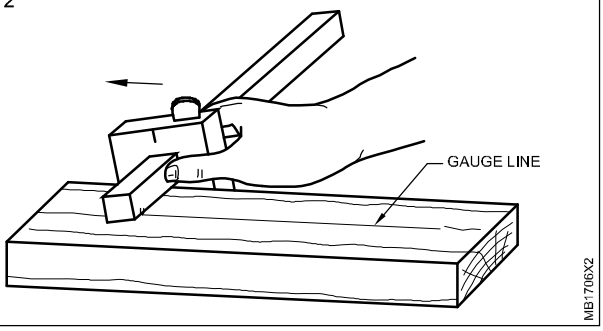
5 Hold the gauge stock in right hand thumb on top.

6 Place one end of the piece against the bench stop and other end in left palm.

7 Place gauge stock in contact with the face edge of the piece and spur touching the piece lightly in slanting position.

8 Give forward stroke on the stock near the end (Fig 2)

Fig 2



9 Hold the piece in left hand and complete the gauge mark.

10 Check the gauge mark with foot rule.

Precautions

Do not use a long spur for gauging.

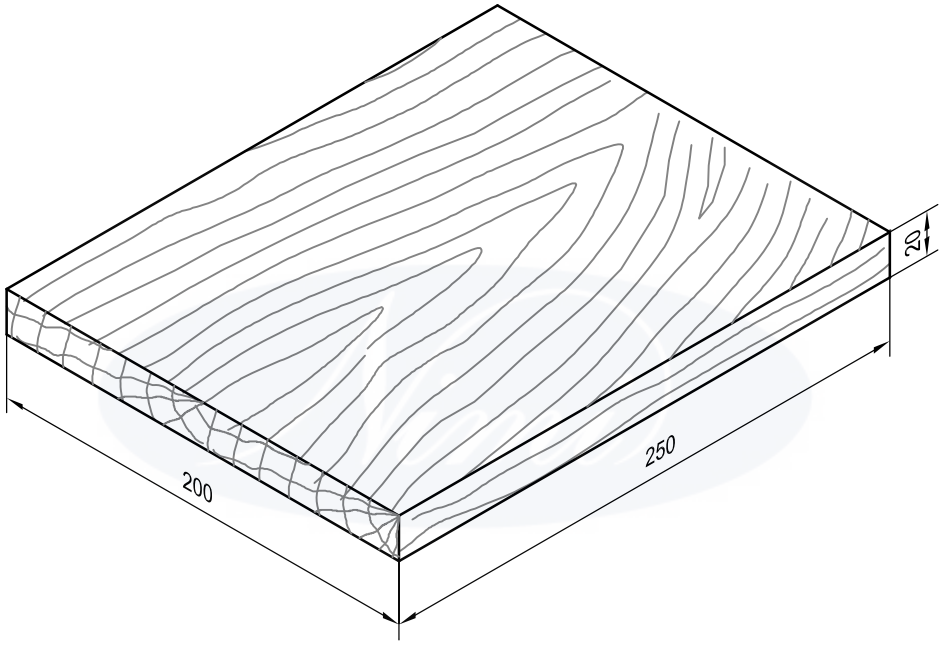
Do not see the distance by keeping the rule flat.

Do not press spur while gauging.

Do not try to make a deep gauge.

Keep the stock face rubbing against the straight edge.

Do not put the spur at right angles with the face.



1	200 x 25 x 250		HARD WOOD			2 (C)
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**PLANING ACROSS THE GRAIN**				TOLERANCE ±2.0 mm	TIME 5h
					CODE NO. MB1707E1	

Planing across the grain

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

- **plane across the grain.**

Requirements

Tools/Equipments

- Carpender pencil
- Four fold wooden rule
- Jack plane 450mm
- Smoothing plane
- Hammer - 1 pound
- Marking gauge
- Try square
- Firmer chisel
- Work bench with vice
- Bench stop
- Oil can
- Oil stone

Materials

- Hard wood(Koungu wood)
  200 x 25 x 250mm - 1 No.

PROCEDURE

1 Set the jack plane for planing.

2 Place the job on the work bench or hold the job on the carpenter's vice with face side up.

3 Hold the job 200 x 25 x 250mm in the vice.

4 Tight the job 15mm above the vice, keeping the pack ing piece side wared.

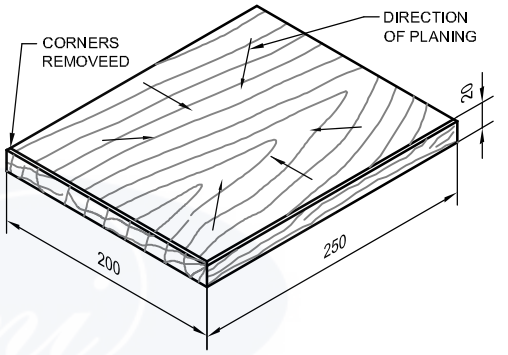
5 Trim off the corners with firmer chisel to avoid splin tering.

6 First plane along the grain in one edge. Then plane from the other edge.

7 Plane diagonally from one edge corner to the other.

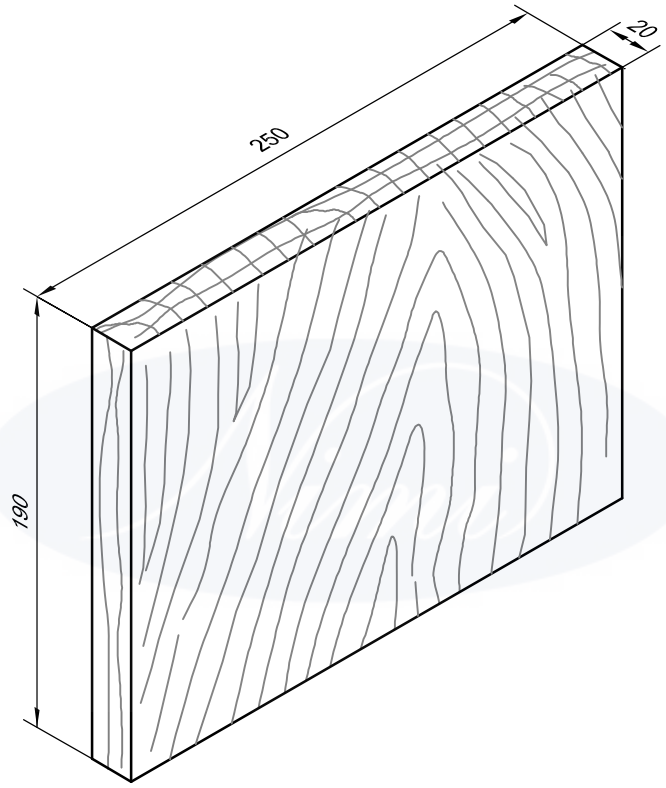
8 Plane towards the middle from the edges(Fig 1). Check flatness with try square and straight edge.

Fig 1



9 Plane again if high spots are found repeat the proce dure till you get a levelled surface with measurement of 200 x 20 x 250mm.

Keep the blade sharp to plane across the grain.



1	200 x 20 x 250		HARD WOOD			2 (D)
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**PLANING THE END GRAIN**				TOLERANCE ±2.0 mm	TIME 5h
					CODE NO. MB1708E1	

Planing the end grain

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

- **plane across the end grain.**

PROCEDURE

1 Check the measurements of the job.

2 Trim off the corner with firmer chisel to avoid splin tering.

3 Hold the job in the vice.

4 Before starting to plane clamp a waste piece of wood behind the corner to avoid splintering the job. (Fig 1)

5 Start planing from one end.

6 Continue the planing till you get a levelled surface.

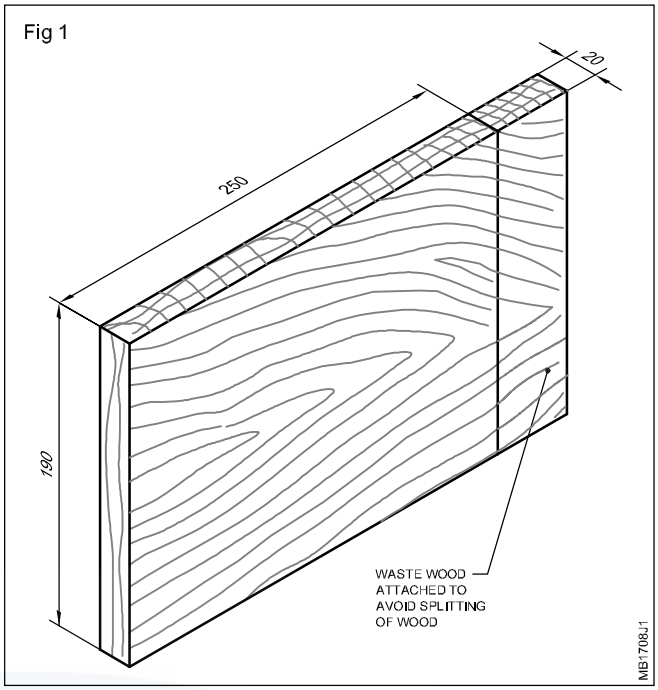
7 Start planing from the other end.

8 Continue the planing from both end towards middle till you get a levelled surface.

9 Remove the waste wood attached at the end.

10 Check the levelled surface with a try square.

Fig 1



'T' Half lap joint

Objectives : At the end of this exercise you shall be able to
- **make the pin and socket on the wood**
- **make the halving or half lap joint.**

Requirements

Tools/Instruments

- Pencil
- Scriber
- Jack plane
- Try square
- Four fold wooden rule
- Marking gauge
- Firmer chisel 25mm, 35mm
- Tenon saw
- Hammer
- Bench hook
- Mallet
- Work bench with vice
- 'G' Clamp

Material

- Hard wood(Koungu wood)
  60 x 25 x 300mm - 1 No.

PROCEDURE

Note : Check the size of the given piece.

1 Plane the piece as per required size 50 x 20 x 300mm.

2 Saw it int o two pieces of sizes 50 x 20 x 180 (socket) and 50 x 20 x 120mm (pin).

Job sequence for pin piece

3 Mark both the pin and socket pieces as per the drawing.

4 Check the markings as per drawing. Fig.1

5 Hold the piece in the vice.

6 Cut the shoulder line down to the centre of face edge using tenon saw. (Fig 1a)

Fig 1a

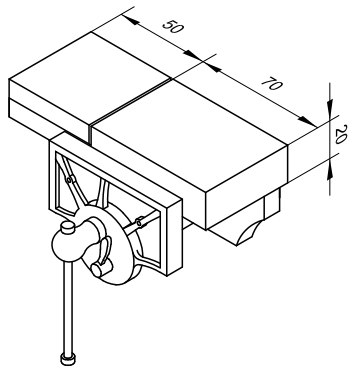
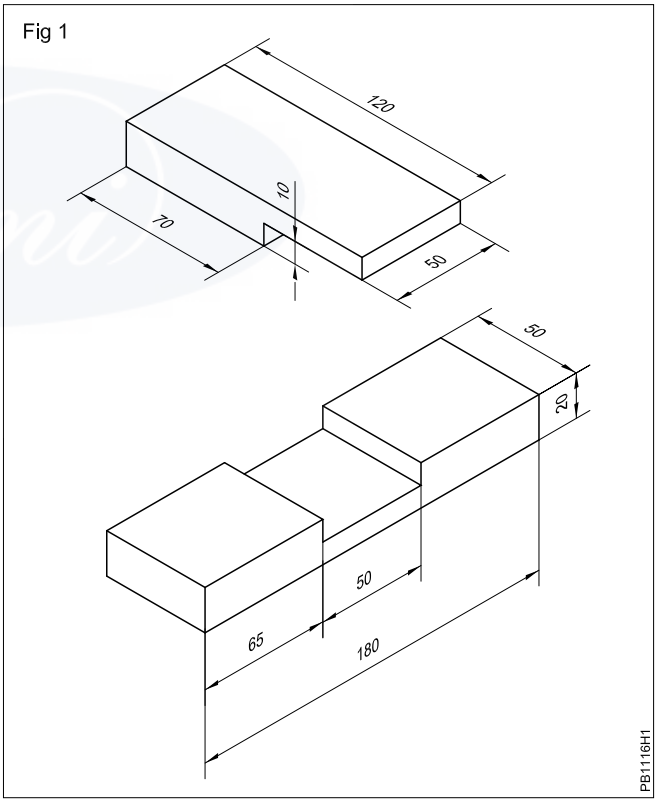


Fig 1

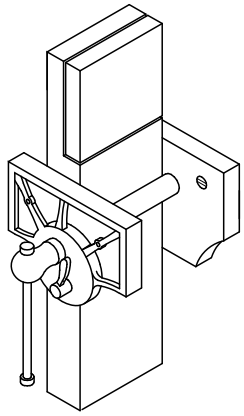


7 Cut on the waste side on the line.

8 Hold the piece in vertical position in the vice. (Fig 2)

9 Cut the centre line down to the shoulder. (This cut should be on the waste side of the line).

Fig 2

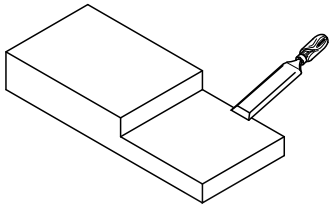


PB1316H3

10 Complete the cut.

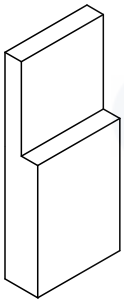
11 Smooth the surface with parting chisel as shown in Fig.3 and Fig.4 and complete it.

Fig 3



PB1116H4

Fig 4



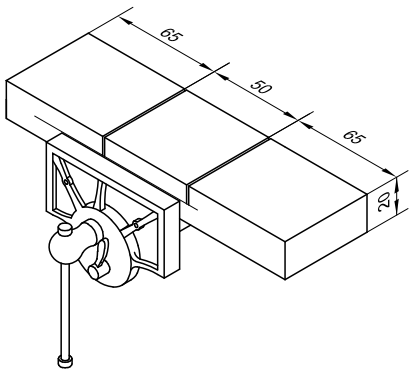
PB1116H5

Socket piece

12 Hold the socket piece in the vice.

13 Saw close to the marked line (shoulder line) upto the depth of 10mm using tenon saw. (Fig.5)

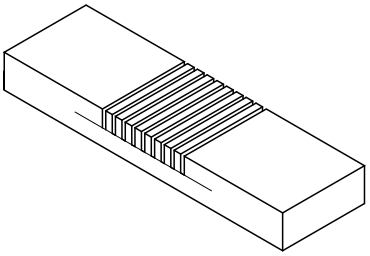
Fig 5



PB1116H6

14 Make several saw cuts as shown in Fig 6.

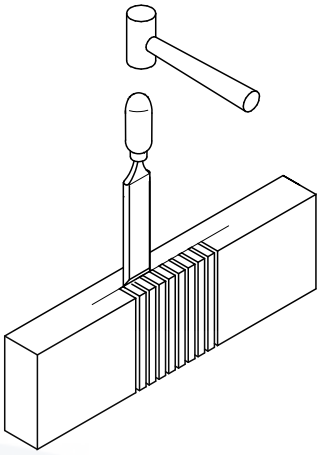
Fig 7



PB1316H7

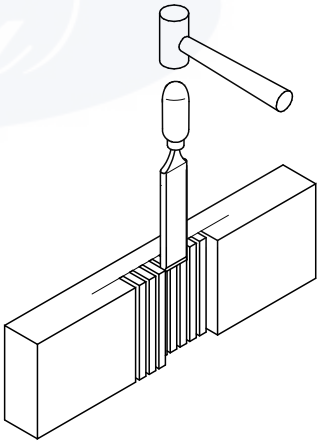
15 Chisel off the waste portions. (Fig 7 and 8)

Fig 7



PB1116H8

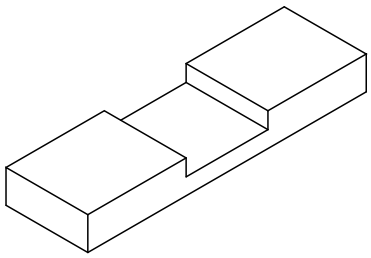
Fig 8



PB1116H9

16 Smooth the trench surface side and side walls with firmer or parting chisel. (Fig 9)

Fig 9

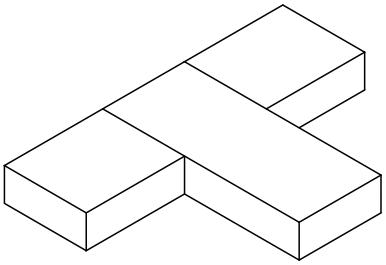


PB1116HA

17 Assemble the pin and socket pieces together. (Fig 10)

18 Check the squareness of the job/joint.

Fig 10



PB1116HB

Corner half lap joint

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

- **make a corner half lap joint**

Requirements

Tools/Instruments

- Pencil
- Scriber
- Jack plane
- Try square
- Four fold wooden rule
- Marking gauge
- Firmer chisel 50mm
- Tenon saw
- Hammer
- Bench hook
- Mallet
- Work bench with vice
- 'G' Clamp
- Oil stone

Material

- Hard wood(Koungu wood) 60 x 25 x 250mm - 1 No.

Preparation of material

Check the size of wooden piece of size 60x25x250 -1No.

Plane it to size 50 x 20 x 250.

Cut with tenon saw in two pieces of size 50 x 20 x 125.

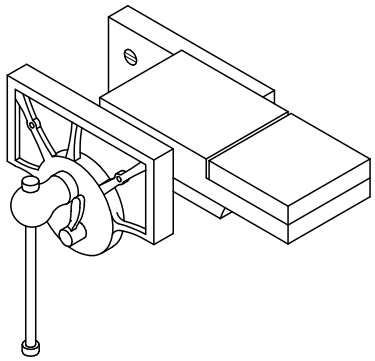
PROCEDURE

1 Mark the job as per drawing.

2 Hold the wooden piece of size 50 x 20 x 125mm in the vice.

3 Cut the shoulder line 50mm in width and 10mm in thickness with a tenon saw. (Fig 1)

Fig 1



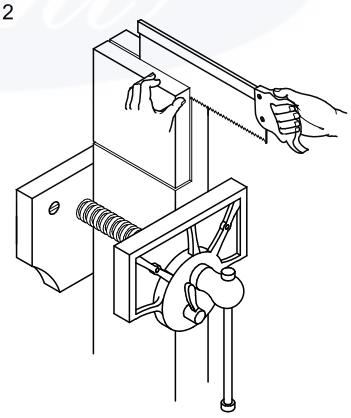
PB1114H1

4 Hold the saw perpendicular to the wood to have square cut.

5 Hold the wooden piece in the vice in the vertical position.

6 Cut the end line of 10mm down to the shoulder line 50mm using tenon saw. (Fig 2)

Fig 2

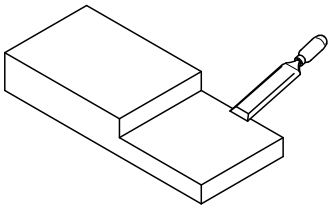


PB1114H2

7 Make the cut on the waste side of the line.

8 Chisel out the excess material and smoothen it with firmer chisel. (Fig 3)

Fig 3



PB1114H3

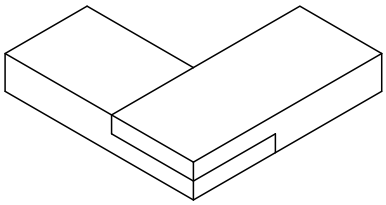
9 Repeat the process of marking, sawing, chiseling and smoothening for the second piece in the same w a y . Saw both pieces to the required length of 115mm using tenon saw.

10 Place the two pieces together to form a joint.

11 If the lap is too thick make it smaller with firmer chisel.

12 Assemble the joint until it fits snugly. (Fig 4)

Fig 4



PB1114H4

Plumber - Gas Welding — Exercise 1.3.01

Induction training

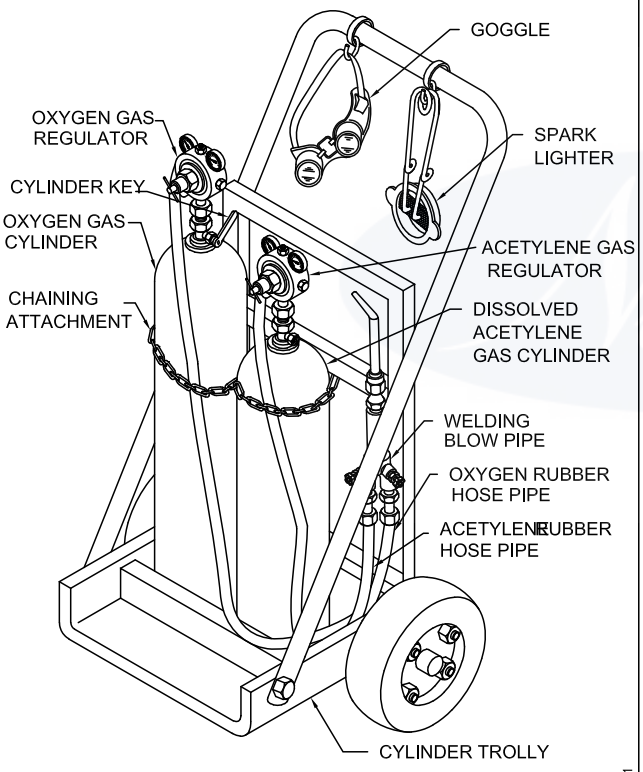
Objectives: At the end of this exercise you shall be able to

- **identify the different equipment/parts of an oxy-acetylene welding plant**
- **move gas cylinders safely**
- **setup the oxy-acetylene gas welding plant connecting all components**
- **test for gas leakages at all connections**
- **set the required gas pressures on the regulators**
- **ignite and extinguish the gas flame without backfire**
- **set neutral, oxidising and carburising flames**
- **close down the oxy-acetylene gas welding plant maintaining correct sequence**
- **observe all safe practices while using the oxy-acetylene gas welding plant.**

PROCEDURE

Setting up oxy-acetylene plant Fig.1

Fig 1



SETTING OF OXY-ACETYLENE PLANT

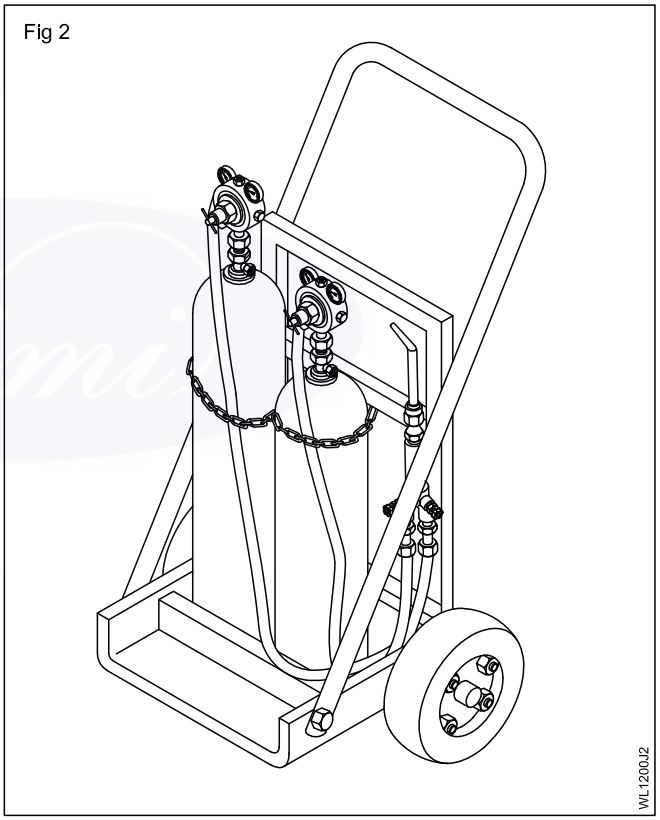
Move oxygen and acetylene cylinders with the caps from the store to the gas welding area. An oxygen cylinder is identified by the black colour painted on it. An acetylene cylinder is identified by the maroon colour painted on it. Also the oxygen cylinder will be taller than an acetylene cylinder and the diameter of oxygen cylinder will be less than the diameter of an acetylene cylinder.

Ensure full cylinders are kept separately from the empty cylinders.

Position the gas cylinders in a trolley and secure them with a chain.

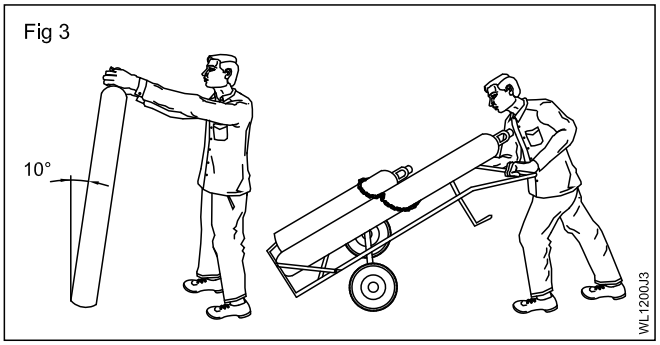
Always keep the cylinders upright/vertically in the cylinder stand/on the floor. (Fig.2)

Fig 2



While moving, the gas cylinders should be kept slightly inclined to the vertical position and the protector cap used to avoid damage to the cylinder valves. (Fig.3)

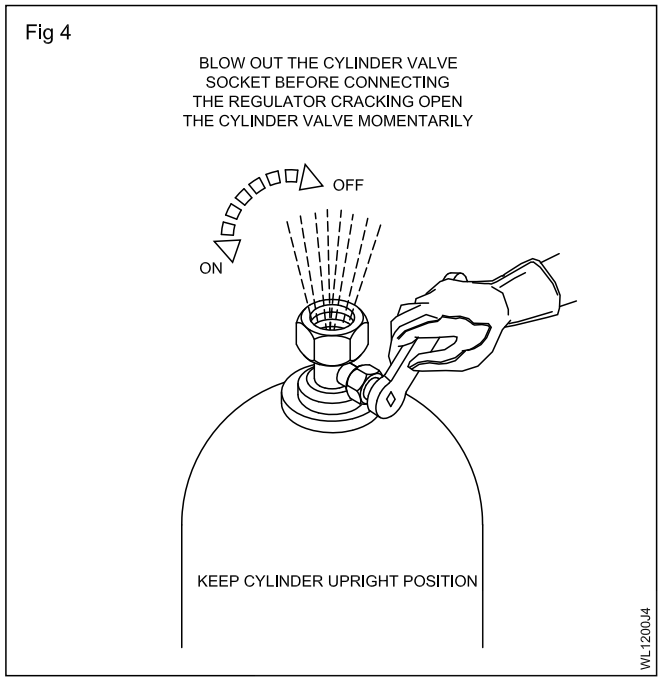
Fig 3



Do not roll the cylinders horizontally on the ground.

Remove the cylinder caps. Crack the gas cylinder valves by quickly opening and closing them using the cylinder key. Fig.4.

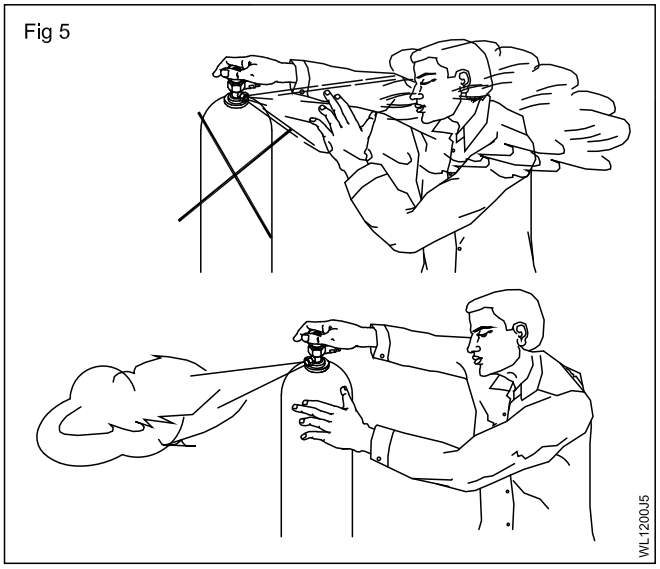
Fig 4



Dirt and dust particles from the cylinder valve sockets are cleaned by cracking the cylinder valve. This will avoid leakage of gas due to improper seating of the cylinder valve and also to prevent the dust particles from entering into the regulators which may cause damage to the regulators.

Always stand opposite to the valve outlet while cracking the cylinders. (Fig.5)

Fig 5



Ensure that your hands are free from grease or oil.

Connect the oxygen regulator to the oxygen gas cylinder (right hand threads).

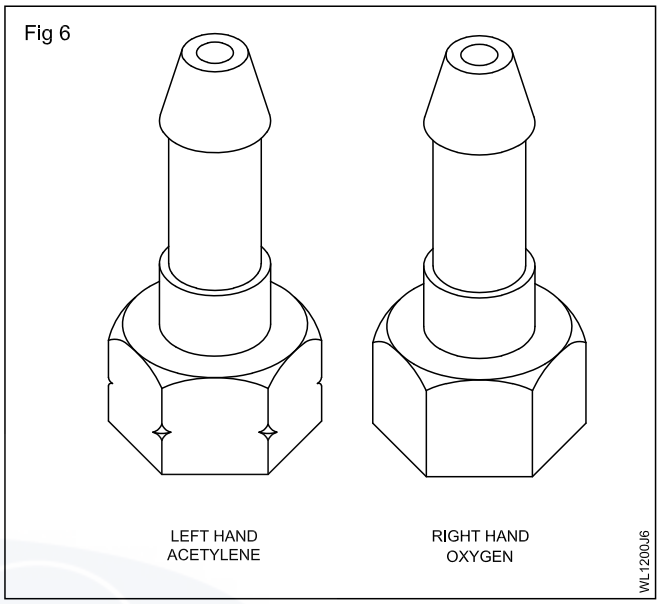
Connect the acetylene regulator to the acetylene gas cylinder (left hand threads).

Ensure the pressure adjusting screws of both regulators are in a released condition.

Be sure to connect the correct regulator on cylinders. Acetylene connections have left hand thread and oxygen has right hand thread.

The acetylene regulator connecting nut will have a groove cut on it (Fig.6) and the pressure gauge dial will be of maroon colour.

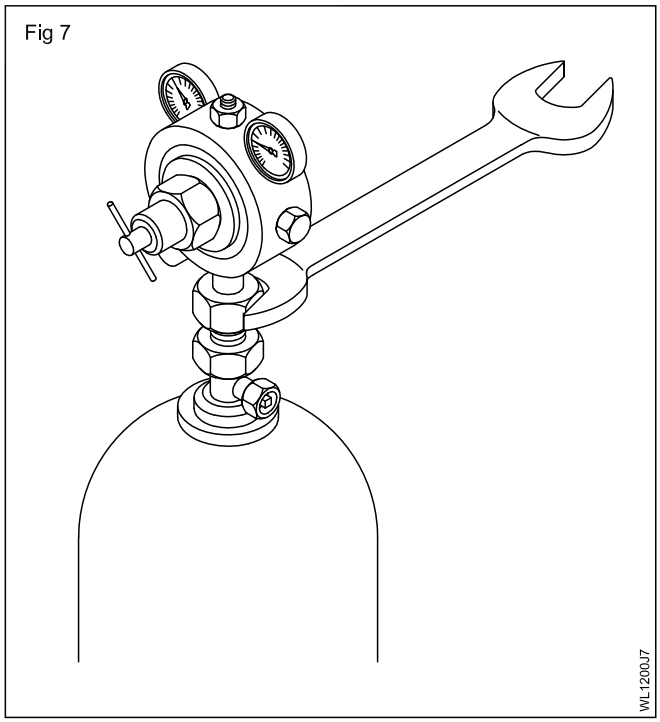
Fig 6



All threaded connections should be fixed initially by tightening by hands and then only a spanner should be used. This will help to avoid assembly with cross thread leading to damage to threads.

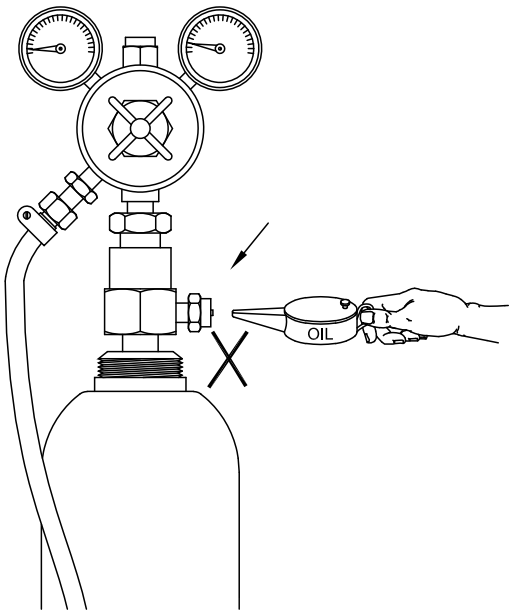
Always use the correct size spanner to prevent damage to the threads. (Fig.7)

Fig 7



It is dangerous to apply lubricants in the threaded assemblies of gas welding equipment as it can cause fire. (Fig.8)

Fig 8



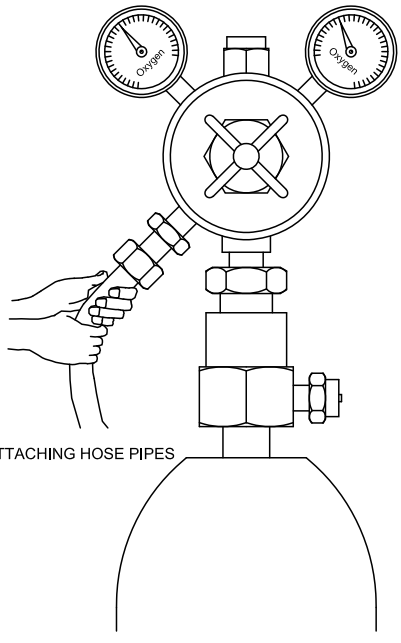
While tightening avoid undue force. The connections should be just tight.

Connect the hose connector at the regulator end and the hose-protectors at the blowpipe end.

(Use black hose for oxygen line and maroon hose for acetylene line.)

Acetylene connections have left hand threads with a cut on the corners of the nut while oxygen connections have right hand thread without a cut.

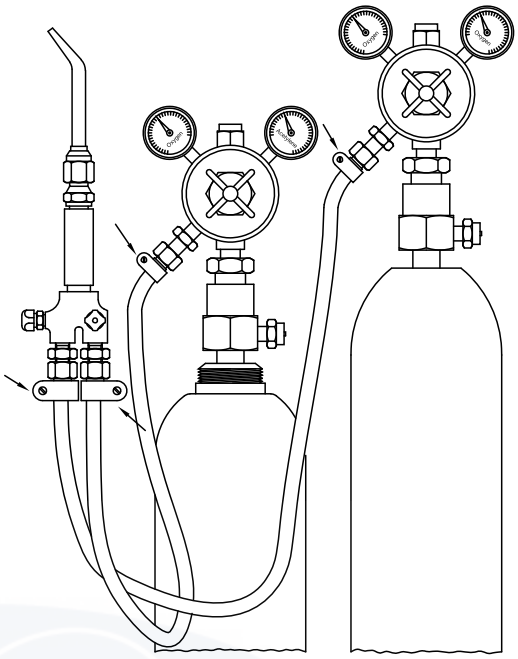
Fig 9



Attach one end of the black hose-pipe to the oxygen regulator outlet and the maroon coloured hose-pipe to the acetylene regulator outlet. (Fig.9)

Secure the joints using hose-clips to ensure good grip and to avoid gas leakage. (Fig.10)

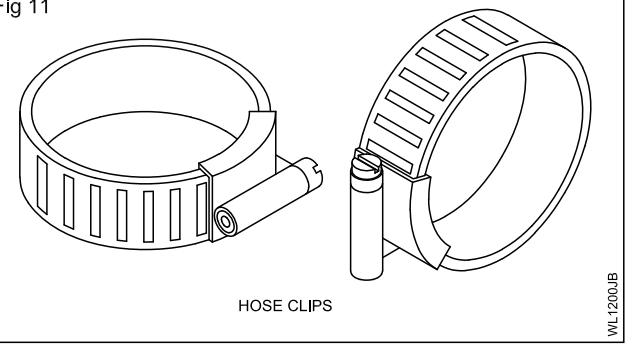
Fig 10



Use a screwdriver to tighten the hose-clips.

Always use the correct size hose-clips. (Fig.11)

Fig 11

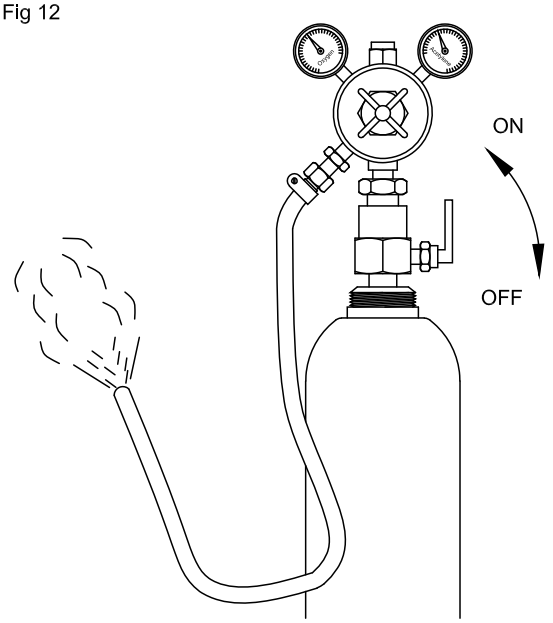


Turn on the pressure adjusting screw of the regulator to which the oxygen hose pipe is connected.(Fig.12)

Exert sufficient pressure to blow out dust or dirt particles if any are tapped inside the hose-pipe and then release the pressure adjusting screw.

Repeat the same for the acetylene hose also.

Fig 12



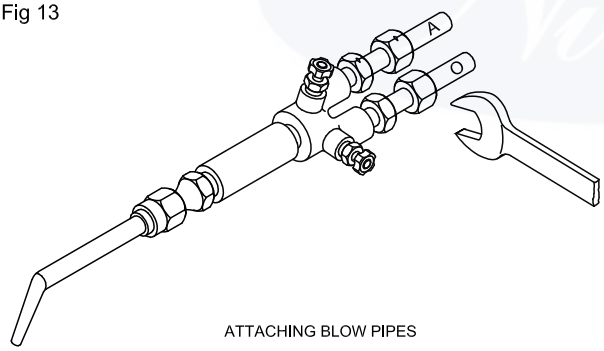
ATTACH NEW HOSES TO REGULATORS
AND TO DISPEL DUST ETC., QUICKLY
PASS PRESSURISED GAS TO ATMOSPHERE
MOMENTARILY.
NOTE: THIS SHOULD BE DONE BEFORE
FITTING HOSE PROTECTORS

WL1200JC

Attaching blowpipe

The other end of the hose-pipe is to be attached to the blowpipe inlets. (Fig.13)

Fig 13



ATTACHING BLOW PIPES

WL1200JD

Fix the hose-protectors at the blowpipe ends. The hose-protectors with a groove at the corners are fixed on the acetylene hose-pipe and connected to the acetylene inlet of the blowpipe. The hose-protectors without cutting marks are fixed on the oxygen hose-pipe and connected to the oxygen inlet of the blowpipe. (Fig.14)

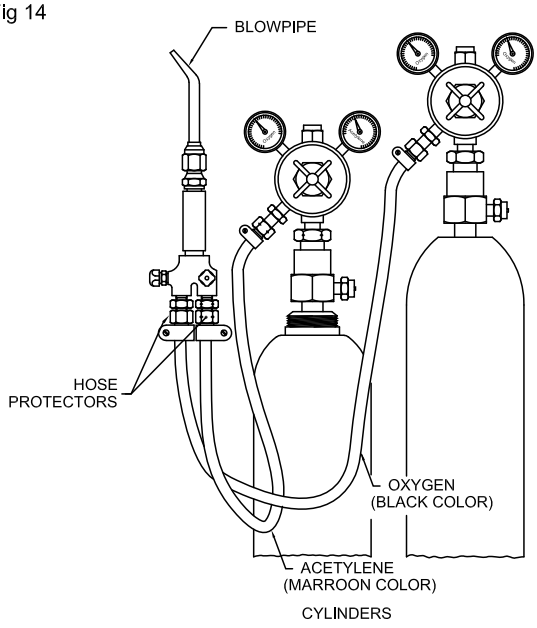
The hose-protectors protect against the return flow of gas from the blowpipe to the rubber hoses. They act as non-return valves.

Adjusting the gas pressure

The gas pressure for both oxygen and acetylene has to be adjusted at regulators according to the size of the nozzle.

The size of the nozzle is selected according to the job material and thickness.

Fig 14

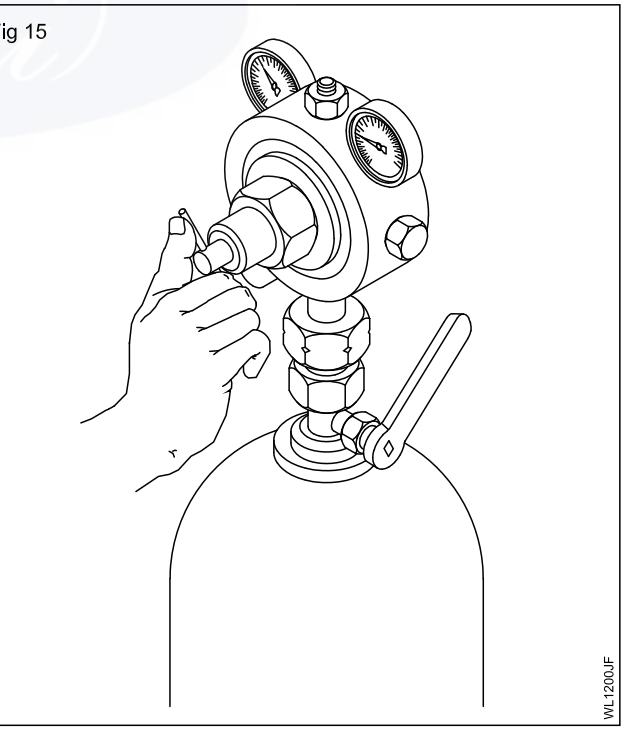


WL1200JE

For adjusting the gas pressure, open the valves of both the cylinders slowly by one turn and set the pressure on both regulators as 0.15 kg /cm^2 for small size nozzles, by tightening the pressure adjusting screws. (Fig.15) Ensure the blow pipe control valves are kept open while setting the gas pressure.

The pressure can be read on the working pressure gauge of gas regulators.

Fig 15



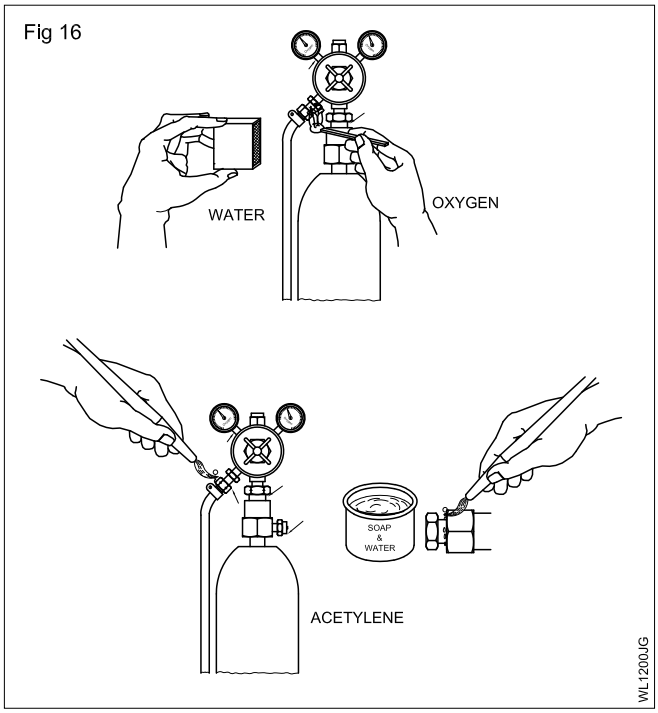
WL1200JF

Testing for leakage

All connections must be tested for leakage.

Apply soap water solution for acetylene connections and fresh water for oxygen connections. (Fig.16)

Fig 16



Use of soap water on oxygen connections may lead to fire hazards.

Never use matches or flame light during leakage test.

Lighting the flame

Attach the recommended size of nozzle to the neck of the welding blowpipe i.e nozzle No.3.

Open the gas cylinders and adjust the recommended gas pressures on the regulators.

The pressure of oxygen and acetylene is 0.15 kgs/cm^2 for nozzle No.3.

Open cylinder valves very slowly.

While setting pressure on the regulator, keep the blowpipe control valve open for accurate setting.

Open the acetylene control valve 1/4 turn on the blowpipe and ignite with a spark lighter. (Fig.17) Acetylene burns using the oxygen in the atmospheric air with a black smoke.

Avoid using any other source of fire other than the spark lighter.

Point the blowpipe in a safe direction in the open space, away from you and others.

Increase the acetylene till the black smoke disappears. (Fig.18)

Observe the flame and add oxygen by opening the oxygen control valve of the blowpipe. Now a bright white cone starts appearing at the tip of the nozzle. (Fig.19)

Fig 17

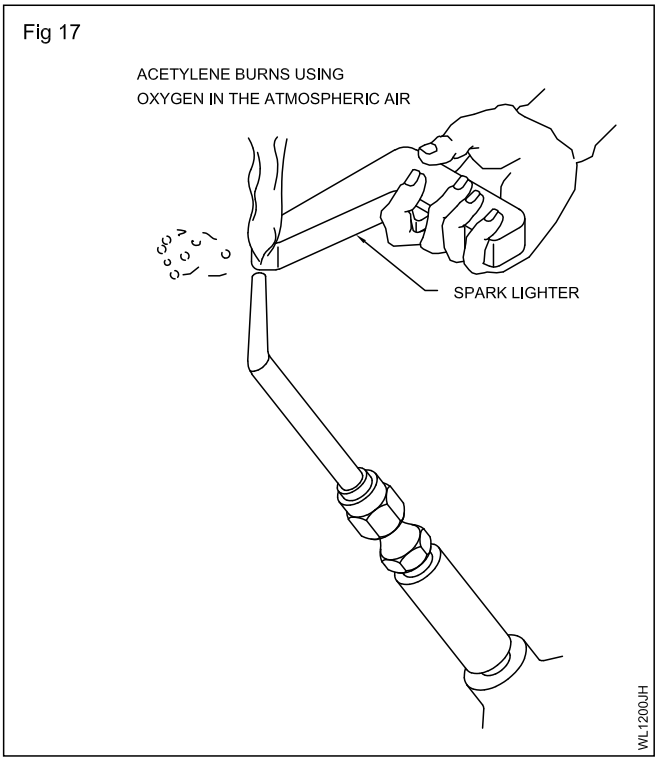


Fig 18

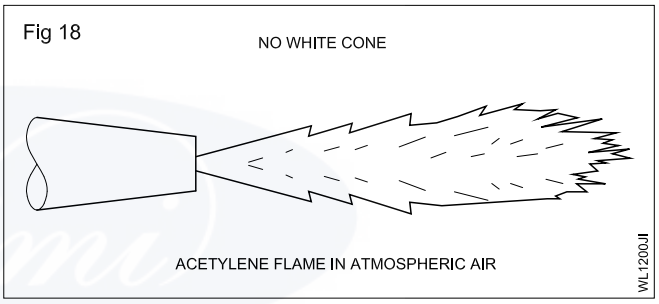
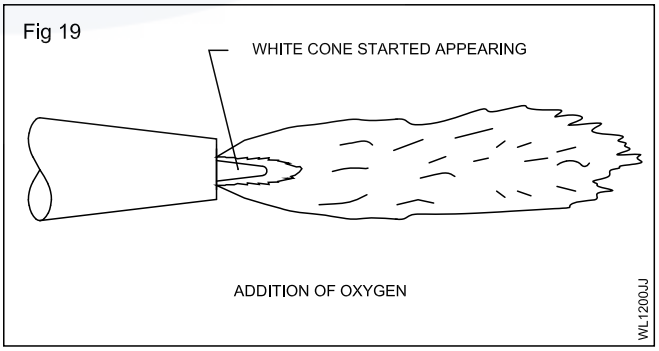


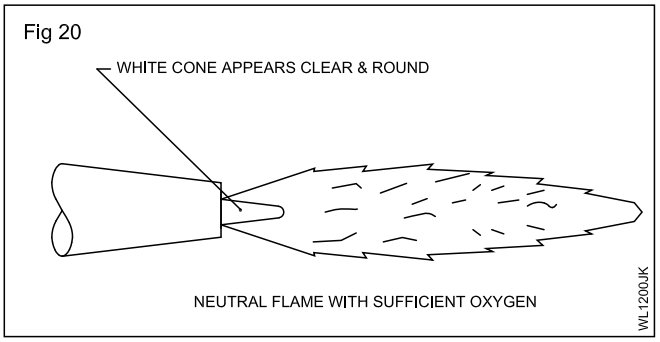
Fig 19



Flame adjusting to set different types of oxy-acetylene flames.

To adjust the neutral flame, add sufficient oxygen to make the white cone clear and round. (Fig.20)

Fig 20



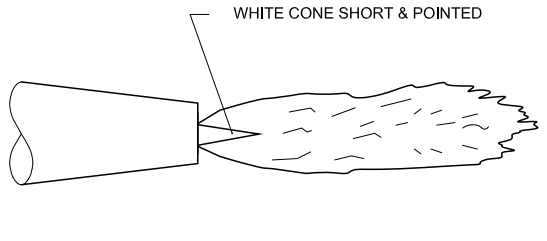
The gas mixture from the blowpipe has equal volume of oxygen and acetylene.

To adjust the oxidising flame, from neutral flame decrease acetylene flow.

The white cone will become short and sharp.

The flame will produce a hissing sound and will have a short length. (Fig.21)

Fig 21



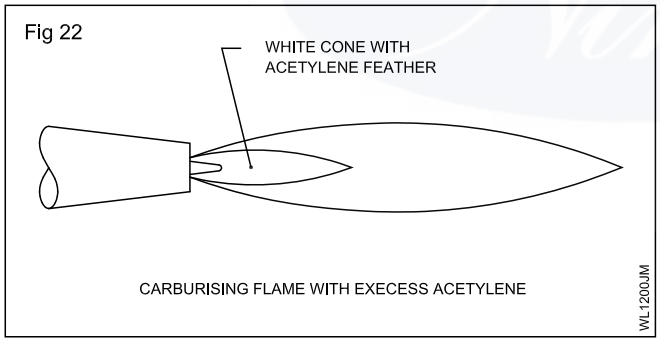
The gas mixture from the blowpipe has more volume of oxygen than acetylene.

To adjust the carburising flame, adjust the flame to neutral and then add acetylene.

The white cone will become long surrounded by a feather-like portion.

The flame will burn quietly having more length. (Fig.22)

Fig 22

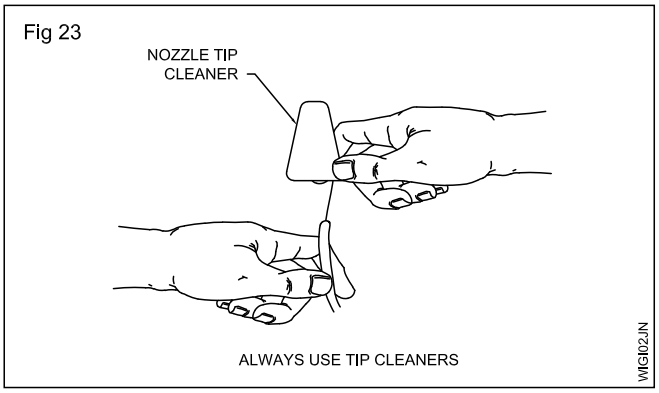


The gas mixture from the blowpipe has more volume of acetylene than oxygen.

After continuous use of the blow pipe during welding the nozzle may get blocked by metal particles or spatters. This blockage has to be removed to get continuous flow of gases by using a nozzle cleaner. (Fig.23)

Repeat the setting of flames till you manage to set the flame without any backfire or flash back.

Fig 23



Extinguishing the flame

To extinguish the flame close the acetylene control valve (blowpipe) first and then the oxygen control valve.

Closing down the plant

At the close of work, shut off the plant in the sequence given below.

Close the acetylene cylinder valve.

Close the oxygen cylinder valve.

Open the blowpipe acetylene valve and release all the gas pressure.

Open the blowpipe oxygen valve and release all the gas pressure.

Both the pressure gauges on the regulators should read zero.

Release the acetylene regulator pressure adjusting screw.

Release the oxygen regulator pressure adjusting screw.

Close the blowpipe acetylene valve.

Close the blowpipe oxygen valve.

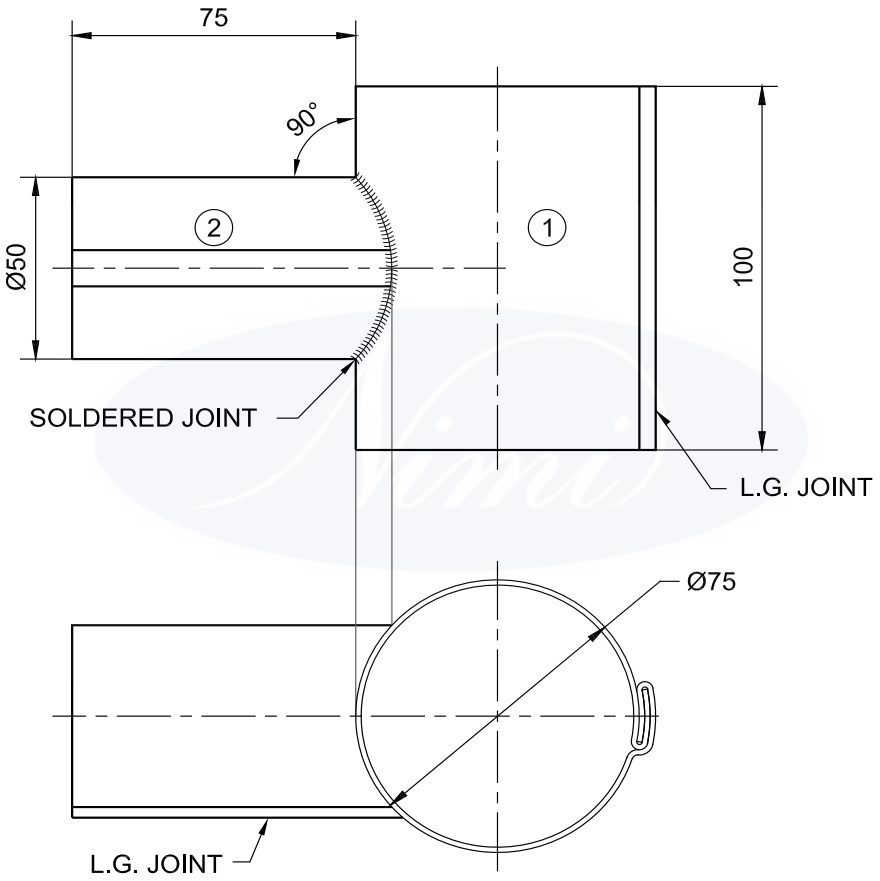
Ensure

– there is no fire around the equipment
– the gas is completely exhausted by dipping the nozzle in water.

Pipe Tee Joint (Unequal diameter)

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

- **develop and layout the pattern for a 90° Tee unequal dia pipes by parallel line development**
- **cut and prepare the pipes as per the job drawing**
- **check the pipes as per the job drawing**
- **clean the pipe end which is to be soldered**
- **tack the pipe by soldering, check the angle and solder the joint.**



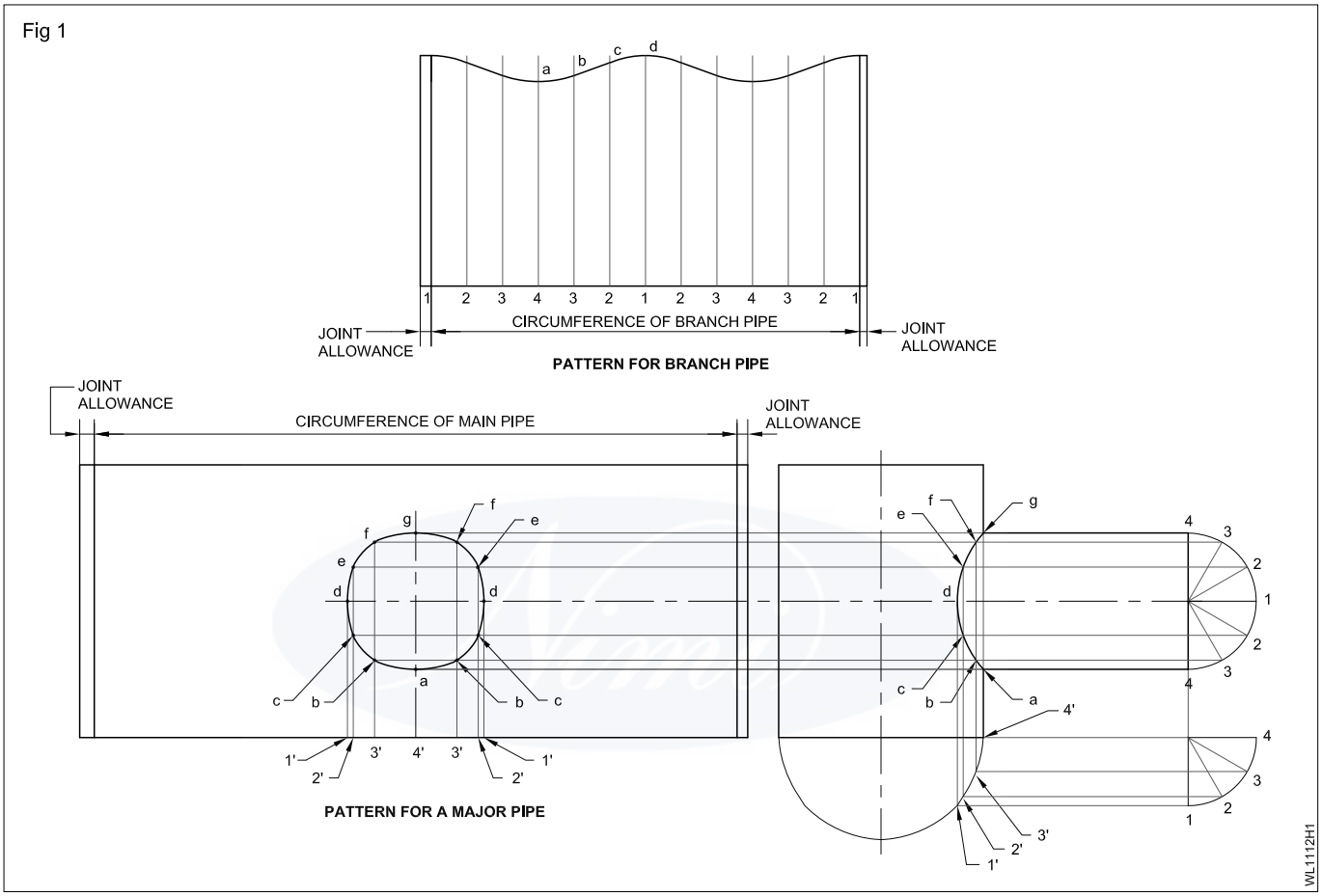
--	--		SOFT SOLDER 60:40			
1	ISSH 175 x 0.6 - 100		G.I SHEET		2	
1	ISSH 250 x 0.6 - 110		G.I SHEET		1	1.12
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**90° PIPE "T" JOINT - UNEQUAL DIAMETER**	TOLERANCE ±1	TIME 5h
		CODE NO. WL1112E1	

Job Sequence

- Develop and layout the pattern for the 90° Tee pipes with cutout on the main pipe by parallel line development. (Fig 1)
- Cut, form and lock groove the joints of the pipe as per the job drawing.
- Check, set and align the two pipes as per job drawing.
- Tack the joint by soldering and check for perpendicularity using a trysquare.
- Complete the joint by soldering. (Fig 1)
- Wash the job to avoid corrosion.

Fig 1



Skill sequence

Draw the front and end elevation. (Fig 1)

Describe semi-circles on the bases of the front and end elevation. (Fig 2)

Divide the semi-circles into 6 equal parts and number them 1 to 7 as in Fig 2.

Point 1 on the elevation becomes the middle point of the end elevation as in Fig 2.

Draw perpendicular lines from these points to cut the major pipe.

Fig 1

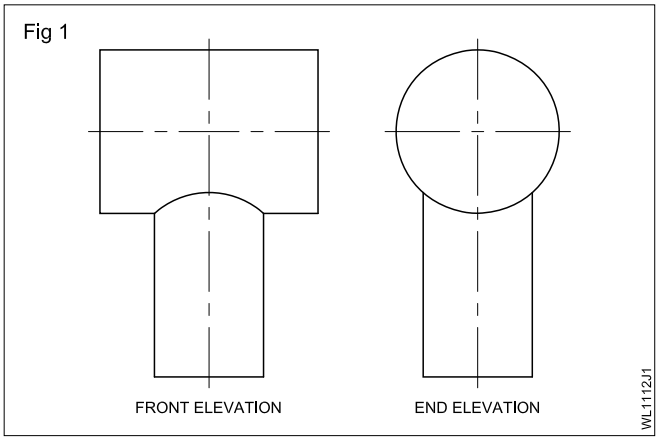
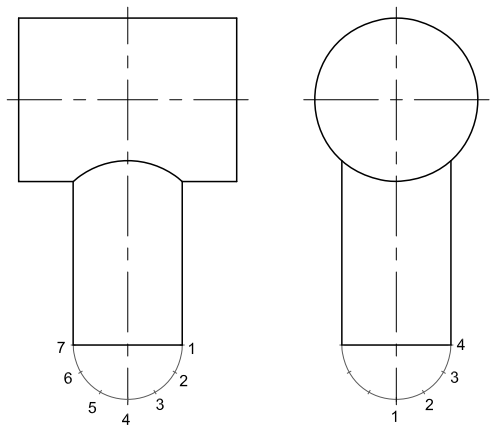


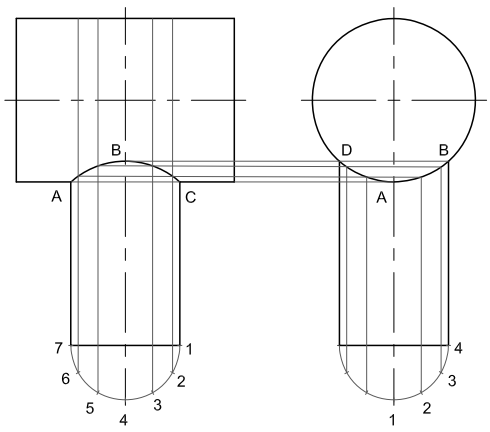
Fig 2



From the points where these lines meet, cut the circle of the small major pipe (End elevation). Project lines horizontally to meet the corresponding vertical lines in the front elevation.

A curve drawn through the meeting points from A to B, B to C will give the line of intersection. (Fig.3)

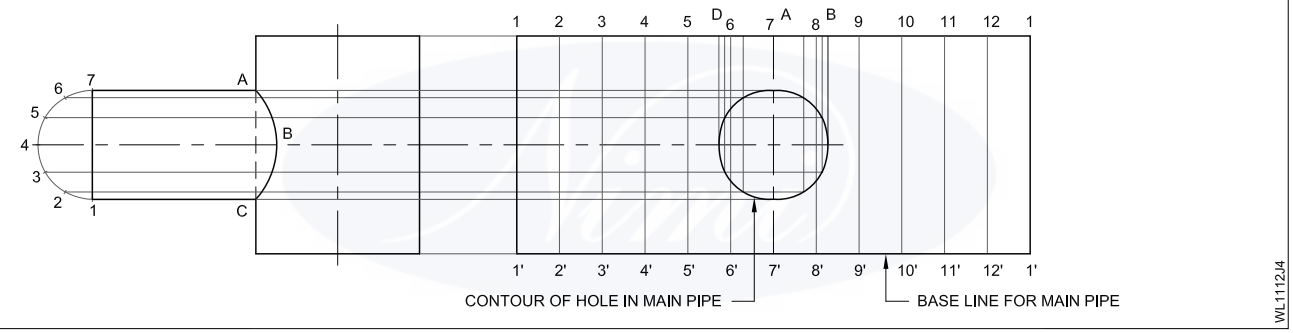
Fig 3



To layout the pattern development for the branch pipe, project the base line horizontally and mark off 12 spaces $1^{1}2^{1}$ and so on upto $12^{1}1^{2}$ as in Fig.4.

From the points $1^{1}2^{1}$....$12^{1}1^{2}$ on the base line, erect perpendicular lines to meet those projected horizontally, from the major circle as in Fig.4.

Fig 4



A smooth curve drawn through the points of intersection $C^{1}B^{1}A^{1}D^{1}C^{2}$ will give the contour of the intersecting line in the pattern.

To develop the pattern layout with cutout, for the main pipe, divide the diameter of the main pipe into 12 equal parts. 3 equal parts are shown in Fig.4.

Produce the ends of the main pipe and step off 12 spaces and name them 1-1' as in Fig.4.

Take the divisions round the curve from D to B in the end elevation and mark them off above and below the centre line point 7 as shown in Fig.4.

Through these points, draw horizontal lines to meet the perpendicular lines projected from the front elevation.

Draw a smooth curve through the points of intersections which will give the contour of the hole in the main pipe.

The hole will be slightly elliptical in this case.

Give necessary joint allowances for both the pipes for making the locked grooved joint.

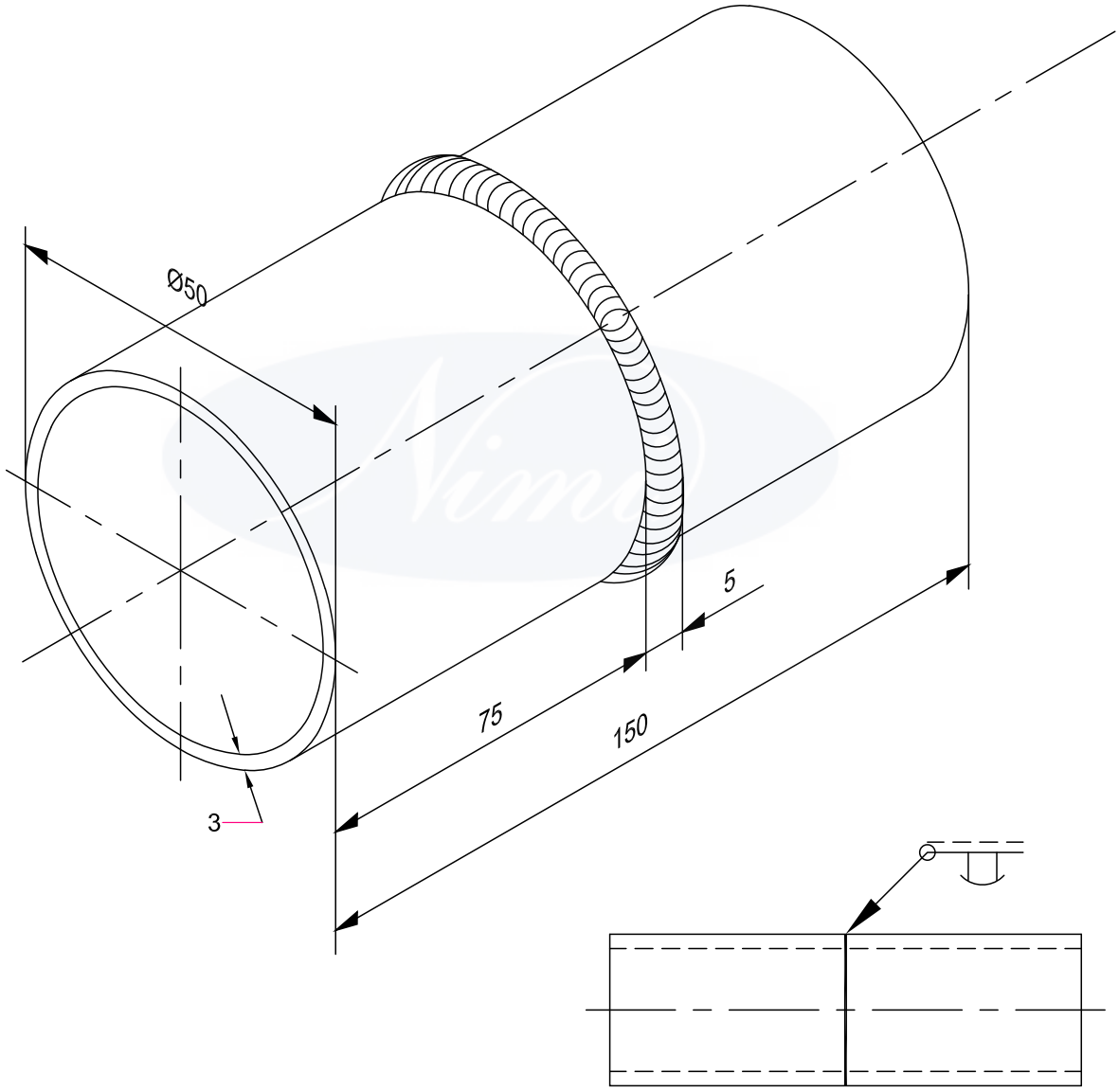
Ensure that the branch pipe is set at 90^{0} with the main pipe and the edges of the pipes to be joined are set without any gap between them.

Apply flux to the joint and the filler rod. Use an electric soldering iron and a soldering bead wire to join the 2 pipes at 90^{0}. Clean the soldered joint by water and wire brush.

Pipe butt joint on MS pipe ø50mm 3mm wall thickness position IG (rolling)

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

- **cut and prepare the MS pipe as per the dimension given in the drawing**
- **align the axis of the pipes in flat position as a pipe butt joint**
- **select nozzle, filler rod sizes, gas pressures and flame**
- **set the root gap and tack weld the pipes**
- **set the tack welded pipes with their axes horizontal**
- **weld the butt joint in segments ensuring proper root penetration, bead size, profile and reinforcement**
- **clean and inspect for surface defects.**



2	Ø50 x 3 - 77		Fe 310 - W			G - 37
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PIPE BUTT JOINT ON M.S.PIPE (Ø50) 3mm WALL THICKNESSPOSITION IG (ROLLING)	TOLERANCE ±1	TIME 15 Hrs
		WL121JE1	

Job Sequence

- Cut the pipes to 77mm length by hacksaw and file its end square to 75mm length. Chamfer the outside edge of the pipe to 30 - 35^0 angle leaving a root face/land of 1.5mm at the bottom edge of the pipe.
- Clean the inside and outside surfaces of the cut pipes after deburring.
- Fix no.5 size nozzle, select 1.6mmø CCMS filler rod and set 0.15 kg/cm^2 pressure for both gases.
- Set the 2 pipes on an angle or channel fixture to form a co-axial pipe butt joint with proper root gap.
- Follow necessary safety precautions.
- Set neutral flame.
- Tack weld in 3 places (120^0 apart) keeping 1.5mm root gap between the pipes.
- Divide the pipe circumference into four segments. Keep the pipe horizontally on the fixture.
- Deposit the root run starting from 3 0'clock position to 12 0'clock position using proper blowpipe and filler rod angles. (I segment)
- Turn the pipe joint in the clockwise direction so that the end of the root run already made in I segment comes to the 3 0'clock position.
- Continue to weld the root run for the second quarter segment as done for the first segment.
- Similarly, complete root run of 3rd and 4th segments.
- Ensure the root penetration by maintaining a keyhole at the root throughout the root run.
- Clean the root run by steel wire brush.
- Fix No.7 size nozzle, select 3mmø CCMS filler rod and set 0.15 kg/cm^2 gas pressure.
- Set neutral flame and fill the V groove by depositing the 2nd run using slight weaving to the blowpipe so that both the faces of the Vee and the root run will fuse properly.
- Ensure proper bead size, profile and weld reinforcement as well as avoid undercut and other weld defects.
- Clean the joint and inspect for external defects.

Skill Sequence

Pipe welding is a highly skilled welding operation, which involves correct alignment and good penetration by equally melted edges of the pipes. As the welding is to be done on a curved surface, the position of the blow pipe and filler rod will continuously change as the welding progresses along the joint. To do this you have to put some extra efforts to get the special skill of welding a pipe joint.

Preparation and setting: Check and ensure correct size of pipes. Prepare two M.S. pipes 50 mmø and 75 mm long by hacksaw cutting. As the end faces of a pipe cut by a hacksaw may not be at 90^0 to the pipe axis, file the end faces of the pipe to get the 90^0 angle. Bevel the ends of the pipes by filing.

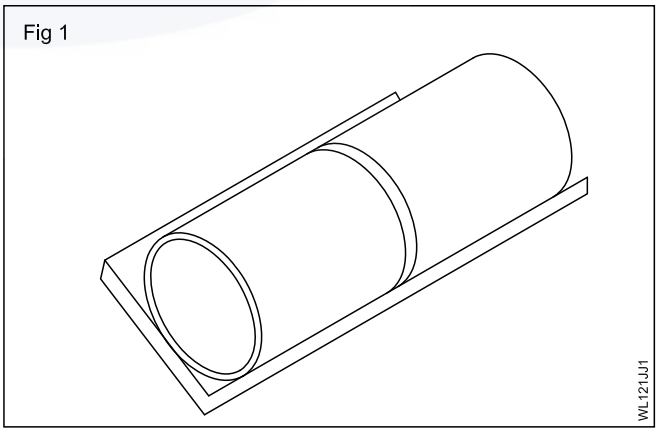
Clean the pipes and remove burrs, if any. Align the pipes in flat position as shown in Fig 1. Tack the weld joint by inserting 1.5 mm wire to maintain a uniform root gap. (Fig 2a and 2b) Ensure the tack welded pipes are co-axial. (i.e., the axis of both the pipes are the same.)

Select the angle iron or channel fixture according to the diameter of the pipe.

Place the tacked pipes on the fixture.

To ensure proper root penetration select nozzle No. 5 and a 1.6 mm C.C.M.S. rod for the root run.

Fig 1

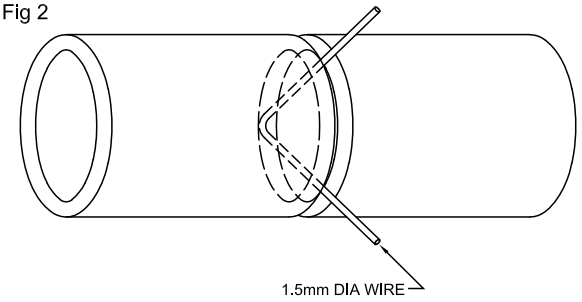


Start welding as shown in the figure and complete the first segment. (Figs 3 and 4) The blowpipe and the filler rod angles are as shown in Fig.4 at the "start of the weld" and have to be changed to those angles shown at the "stop weld" continously and gradually. i.e weld from 3 0'clock position to 12 0'clock position.

After completion of I segment welded, rotate the pipe joint in clockwise direction until the II segment will come to the position of I segment.

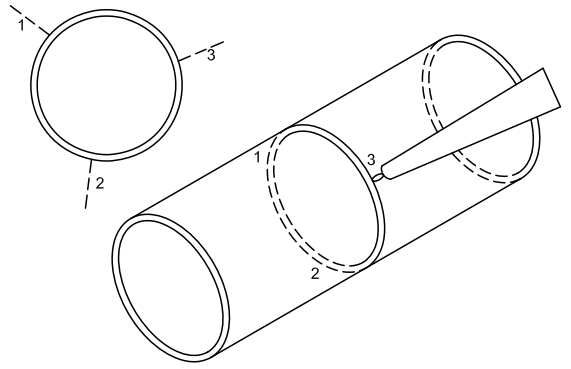
Deposit the root run on the II segment similar to the I segment.

Fig 2



USE OF BENT WIRE OR SUITABLE SPACER TO SET ROOT GAP

(A)

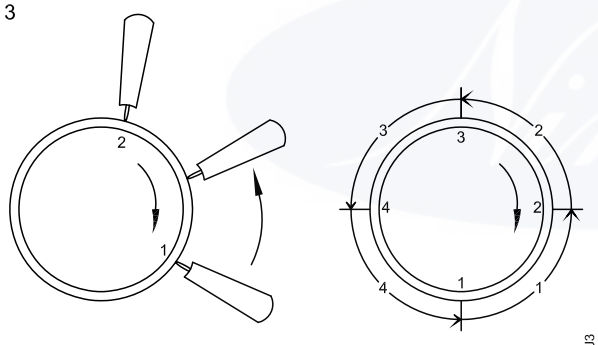


(B)

TACK WELDS AT POINTS 1, 2, AND 3

WL121JJ2

Fig 3



TORCH POSITION AND TURNING THE PIPE

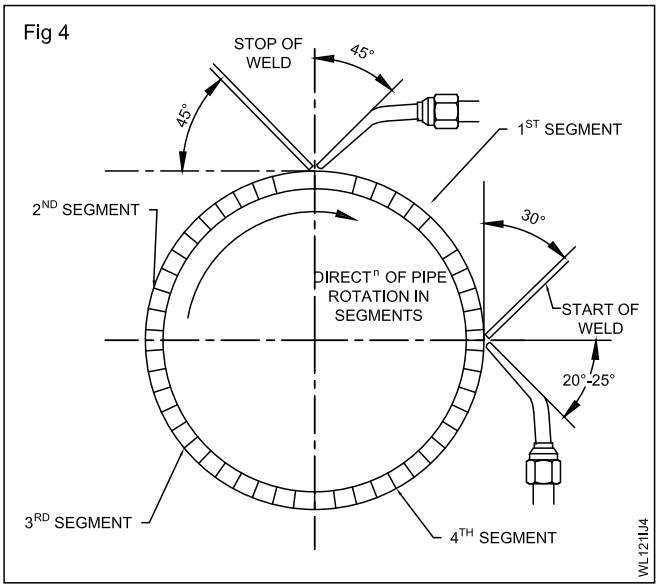
WL121JJ3

Further welding is done by rotating the pipe to the III and IV segment.

Ensure proper melting of tacks for good penetration and surface appearance.

It is very important to maintain a key-hole ahead of the molten pool at the root of the joint which will ensure root penetration. Refer Fig.2 of skill sequence of the previous Ex.No.G.29 (2.15).

Fig 4



Remove the workpiece from the rotating fixture.

Clean the weld bead and inspect the root run for root penetration and weld defects.

Keep the pipe joint on the rotating fixture and fix no.7 nozzle, set 0.15 kg/cm^2 pressure for the gases and use 3mmø CCMS filler rod.

Deposit the final run over the root run using neutral flame.

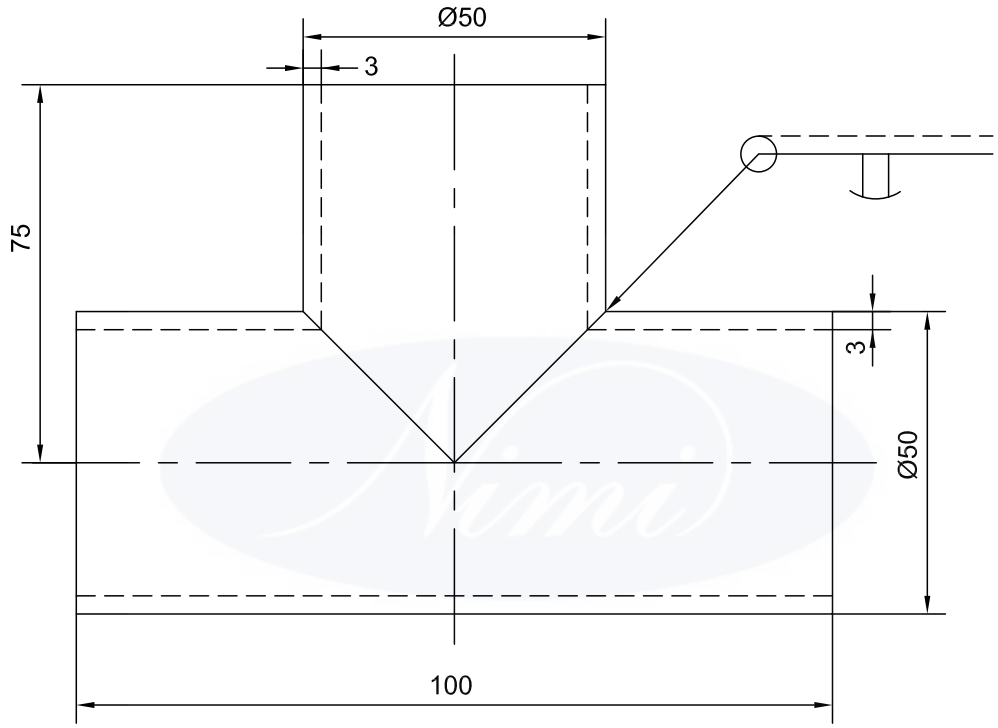
Follow the same welding technique used for the root run except maintaining a keyhole. Ensure proper fusion of the root run and the side walls of the Vee groove by proper movement of blow pipe and filler rod.

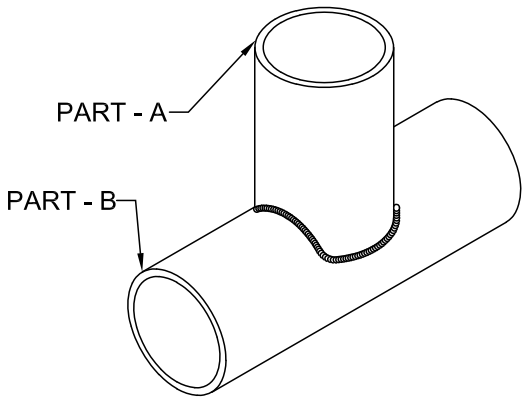
Ensure undercuts are avoided and proper bead profile, size and reinforcement is maintained. Clean the joint and inspect for weld defects.

Pipe 90^0 Tee joint. MS pipe 50mm dia. 3mm W.T. position flat

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

- **draw the development for 90^0 T branch**
- **cut and prepare the pipes as per dimensions**
- **set 90^0 angle of the branch pipe using try square**
- **tack-weld the pipe and recheck the angle**
- **start and complete the weld in two halves**
- **manipulate the blowpipe and filler rod holding them at the required angles during welding**
- **clean and inspect for external weld defects.**





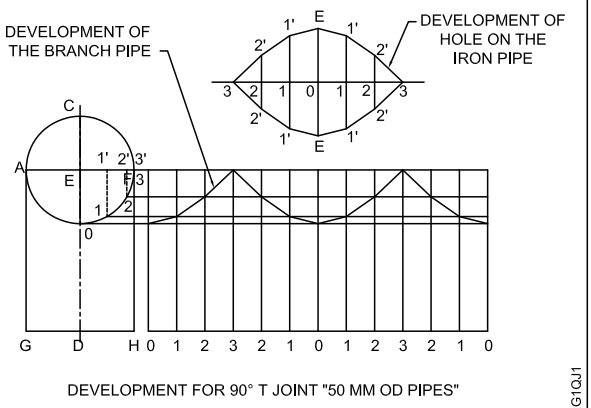
1	Ø50 x 3 - 80		Fe 310 - W		B	G - 41
1	Ø50 x 3 - 150		Fe 310 - W		A	
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PIPE 90° TEE JOINT M.S.PIPE Ø50 3mm WALL THICKNESS POSITION FLAT	TOLERANCE ±1	TIME 15 Hrs
		WL2G1LE1	

Job Sequence

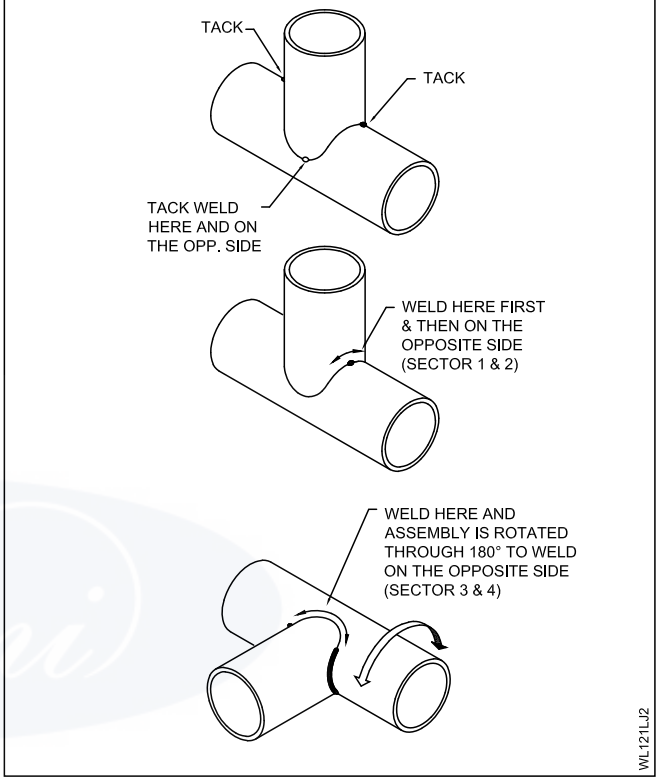
- Ensure the correct size of pipes are used.
- Prepare development for 90° branch. (Fig 1) on a drawing sheet.

Fig 1



- Cut and paste it on the pipes.
- Punch mark the profile of the development on both pipes. Cut the branch pipe along the punch marked profile and file it. Cut the profile marked on the main pipe by gas cutting and file it.
- Deburr the gas cut edges and file the edges.
- Clean the surface of the pipe to remove any oxide and other contaminants.
- Set and align the branch pipe with the main pipe at an angle of 90°. (Fig 2)
- Select no.7 nozzle, ø3mm CCMS rod and use neutral flame.
- Follow necessary safety precautions.
- Tack-weld the joint at 4 place with 90^0 interval and with a 2 mm root gap to ensure root penetration.
- Weld the joint by manipulating the blow pipe and filler rod without rotation of the pipe.
- Compete the weld in 4 sectors 1, 2, 3 and 4 along the curved joint using leftward technique. Fig.2

Fig 2



Avoid excess penetration.

- Clean the weld and inspect the weldment for defects.

Skill Sequence

Ensure the tacked pipe "T" joint is positioned properly to make it convenient to manipulate the blow pipe and filler rod without any obstruction.

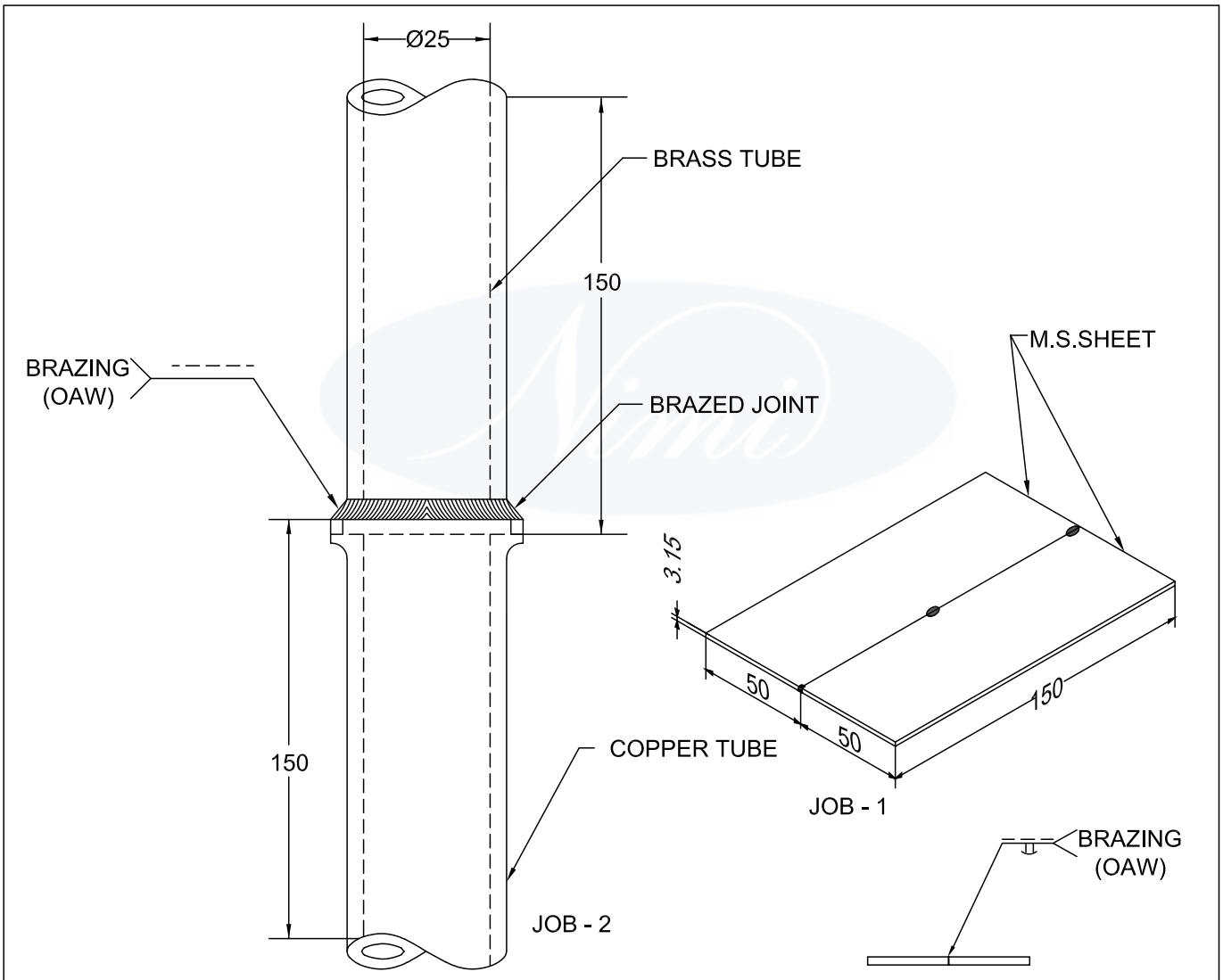
Maintain keyhole throughout the welding and give side to side motion to the blow pipe to ensure good root penetration and fusion of both the edges of the joint.

Take care to properly fuse the crater of the previous sector welded with the starting of the new sector.

Brazing of M.S.sheet 3.15mm - Butt joint . Brazing of copper to brass tube (bell mouth joint) copper and brass tube 25mm OD x 2mm wall thickness position flat

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

- **braze an M.S. square butt joint using oxidising flame and brazing filler rod and flux**
- **prepare a bell mouth by heating the tip of the pipe and by using a mandrel**
- **remove the surface oxide and other impurities with wire wool**
- **select nozzle, filler rod, flux and flame for brazing**
- **tack the bell mouth joint and position it for welding**
- **braze the joint using pipe welding technique**
- **clean the joint and inspect for surface defects.**



NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
2	ISST 50 x 3.15 - 150		Fe310 - W			G - 57
1	Ø25 x 1.23 - 150		CuZn39 - IS: 2378			
1	Ø25 x 1.29 - 150		CuDPA - IS: 2378			

SCALE NTS	BRAZING OF M.S.SHEET 3.15mm-BUTT JOINT (JOB - 1) BRAZING OF COPPER TO BRASS TUBE(BELL-MOUTHJOINT) 25mm DIA. 2mm WALL THICKNESS - POSITION 2G(JOB - 2)	TOLERANCE ±1	TIME 10 Hrs
		WL121TE1	

Practicing the skill of brazing an M.S. square butt joint will help in learning the skills needed to do this exercise. Hence brazing of an M.S butt joint is included alongwith this Exercise NoG-57/2.29.

Job Sequence

- Cut the sheets as per drawing and file the edges to be joined square.
- Clean the joint area.
- Set the sheets as a square butt joint without root gap
- Select nozzle, filler rod, gas pressures, flux.
- Set oxidising flame.
- Use leftward technique.
- Preheat the sheets and joint area to about 800^0C.
- Dip the hot filler rod in flux and melt the filler rod into the joint ensuring proper wetting conditions.
- Avoid application of too much heat into the joint.
- Finish the joint in one run only.
- Clean the joint and inspect for weld defects like porosity etc and for slight root penetration and proper bonding.
- Prepare a copper and a brass tube as per dimension.
- Expand the copper pipe to form as a bell mouth.
- Clean and remove the surface oxides by wire wool.
- Select the nozzle No.5 and 1.6mmø silicon bronze filler rod.
- Apply flux to the filler rod.
- Set the oxidising flame.
- Insert the brass tube into the bell mouth of copper tube and tack at 3 places.
- Keep the tack welded pipes with their axes vertical.
- Start welding at the mid point of two tack welds and end the first run after welding half the circumference of the pipe.
- Weld the other half of the circumference of the pipe as second run.
- Manipulate the blowpipe and filler rod with flux applied on it using proper angles to fill the bell mouthed groove.
- Clean and remove the flux residue.
- Inspect for external weld defects.

Skill Sequence

Brazing of MS sheet (Job-1)

Oxidising flame is used to avoid evaporation of zinc while brazing. Fig.1

The blow pipe and filler rod is held at angles as shown in Fig.1.

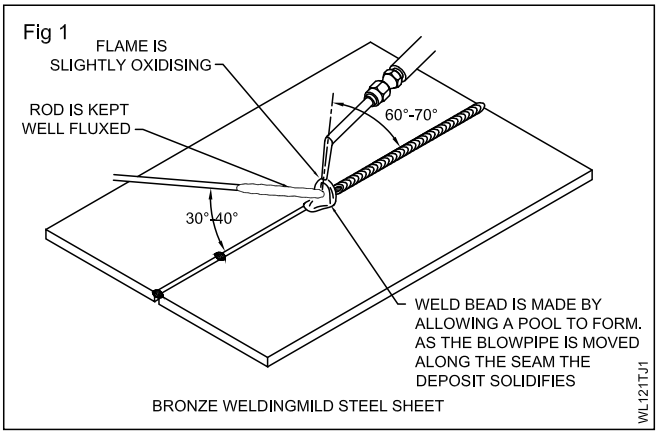
A No.3 size nozzle is used as the base metal is not melted, but heated to around 800^0C.

A 1.6mmø silicon bronze rod is used which helps free flow of molten filler metal.

Direct the flame to the joint edges and tack weld at the ends and centre of the joint. Fig.1.

Preheating the sheets to the correct temperature helps in proper wetting/spreading of the filler metal into the joint to get good bonding. Fig.1

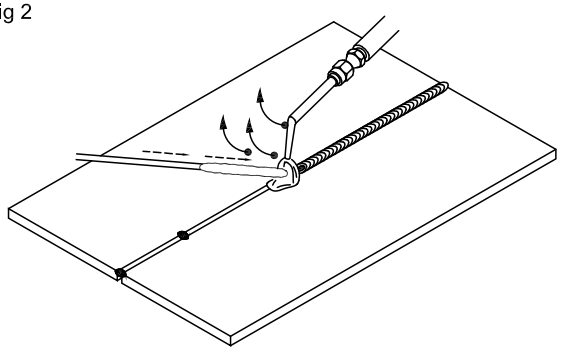
Fig 1



The flame has to be directed only on the melting filler rod or the weld deposit in order to prevent oxidation or overheating of MS sheet.

After establishing the molten pool the flame is withdrawn slightly (Fig.2) to permit the deposited metal freeze partially. Again reintroduce the filler rod to melt further deposit. Observe the brazed area carefully to ensure proper bonding is obtained and a uniform weld size is achieved.

Fig 2



BRONZE WELDINGMILD STEEL SHEET

WL121TJ2

To avoid crater at the end of the weld the filler rod is continued to be added into the molten pool at the finishing point and the flame is withdrawn.

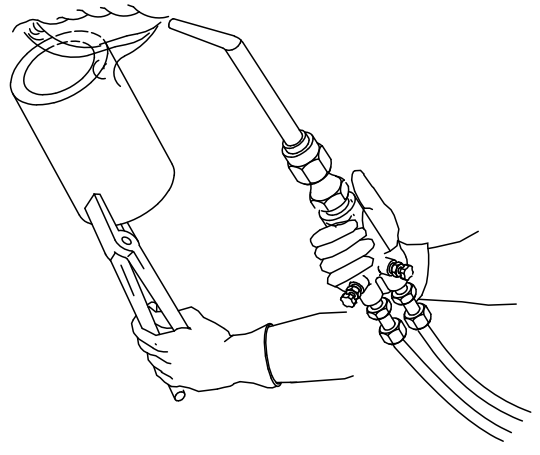
It is essential to remove any unused and residual flux on the finished weld to avoid corrosion later on.

Check the joint for proper bonding of filler metal with the basemetal and proper root penetration by the filler metal. Check for weld defects like surface porosity, etc.

Brazing of copper to brass tube (Job-2)

Soften the end of copper tube to be bell-mouthed by heating.(Fig.3)

Fig 3



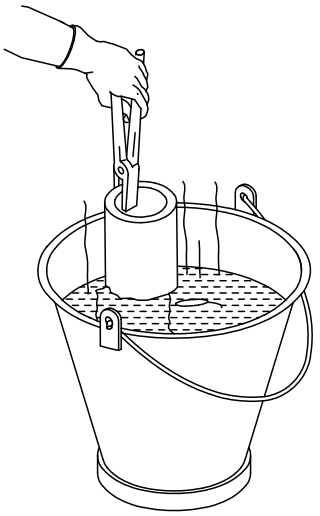
WL121TJ3

Dip the heated end in water and remove the oxides.(Fig.4)

Use a mandrel to form the bell mouth.(Fig.5)

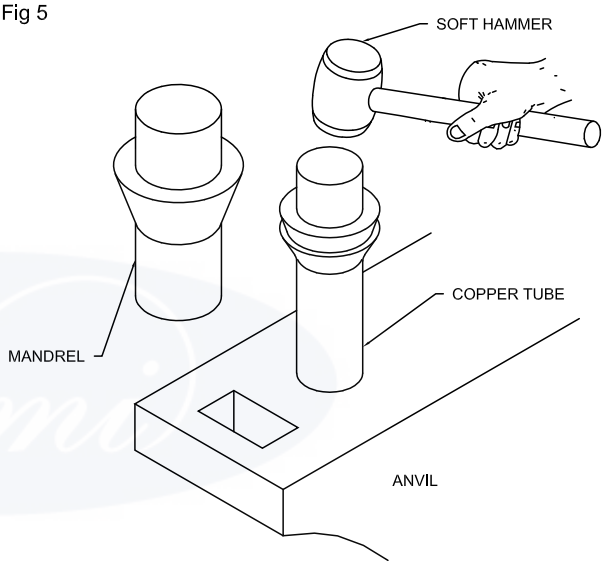
Insert the mandrel and drive into the softened end of the tube by hammering.(Fig.5)

Fig 4



WL121TJ4

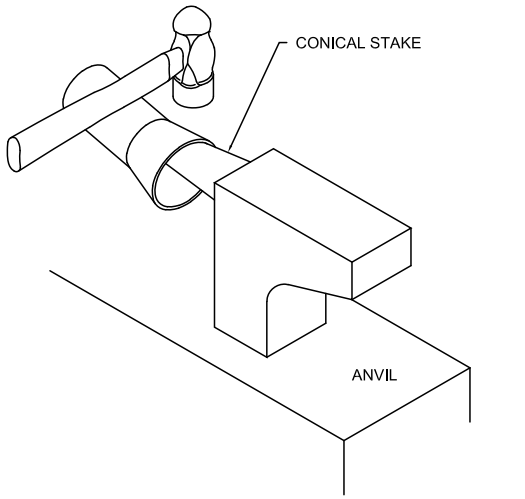
Fig 5



WL121TJ5

Remove any unevenness of the bell mouth.(Fig.6)

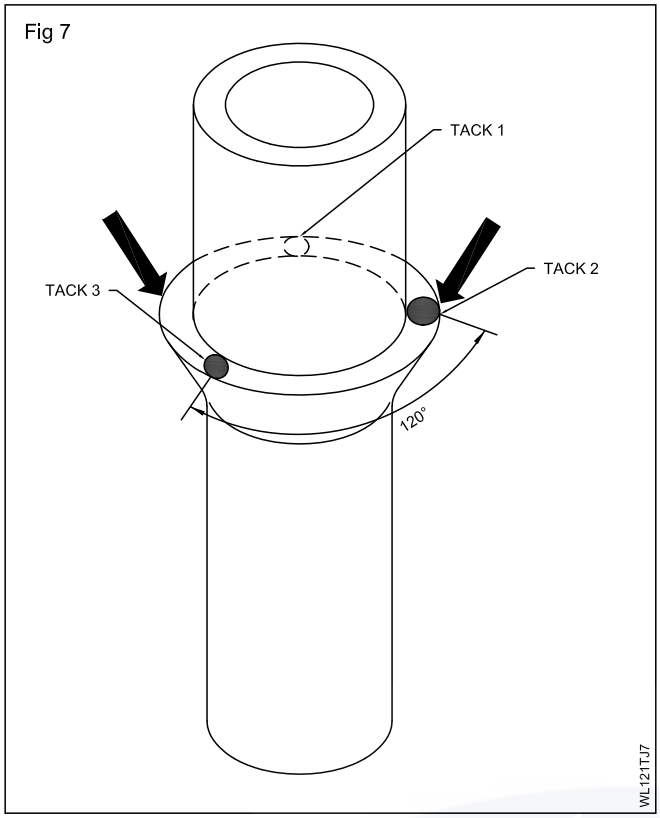
Fig 6



WL121TJ6

Insert the brass tube into the bell mouth and tack it at 3 points.(Fig.7)

Fig 7



keep the tack welded pipe assembly vertically and heat it until the colour of the tube starts changing.

Make a thin run on the line formed by the outer circumference at the bottom end of the brass tube and the inner circumference at the bottom of the bell mouth of copper tube (i.e tip of the bell mouth).

Make the first deposit starting from the tack weld 1 and ending at the midpoint of the tack welds 2 and 3 covering half the circumference of the bell mouth. (Fig.8)

Clean the deposit.

Make the second deposit starting from the commencement point of deposit 1 and ending at the finishing point of the deposit 1 which will cover the remaining half circumference of the bell mouth.

Ensure the deposit 2 merges with the deposit 1 at both ends (i.e. terminal points) properly by withdrawing the filler rod and manipulating the flame over these merging points.(Fig.8)

Ensure that the weld deposit is of the correct profile and it completely covers and bonds (without over spilling the outer edge of the bell contour. (Fig.9)

Clean the bead and the joint and remove the flux residue thoroughly.

Fig 8

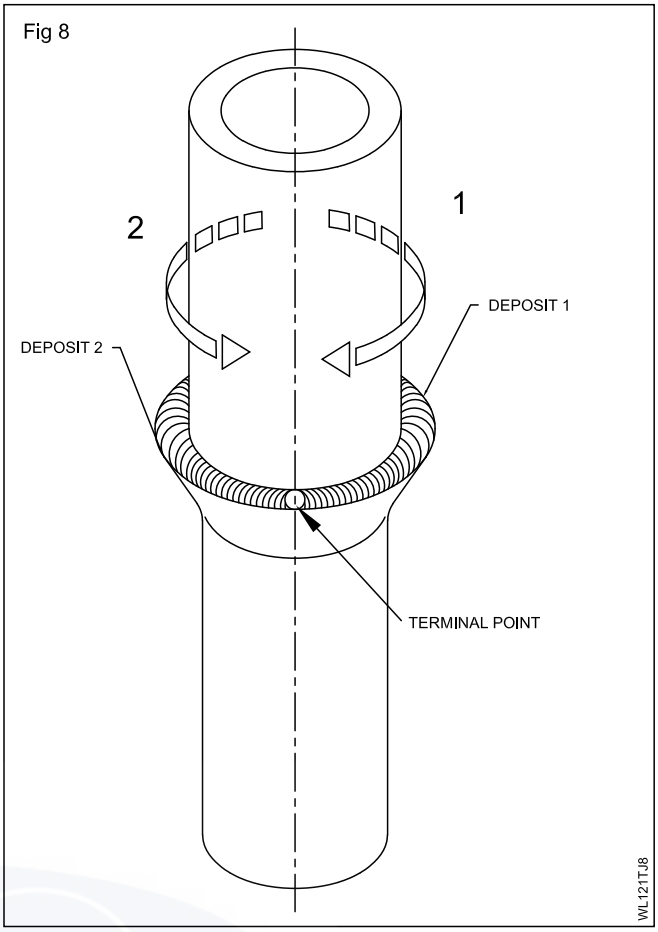
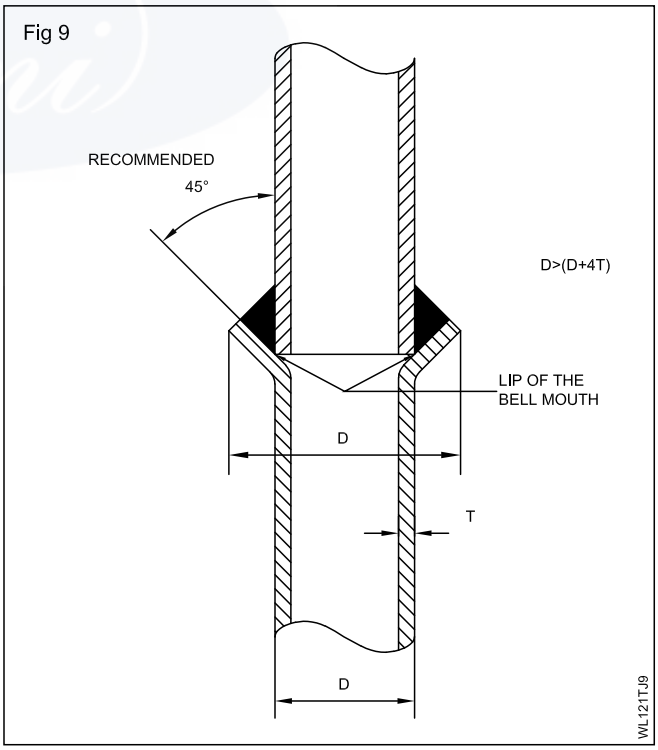


Fig 9



Inspect the weld deposit for uniform size and weld defects like porosity, etc.

Identification of tools and equipment used in masonry work

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

- **identify masonry tools**
- **identify measuring tools**
- **identify basic layout tools.**

Requirements

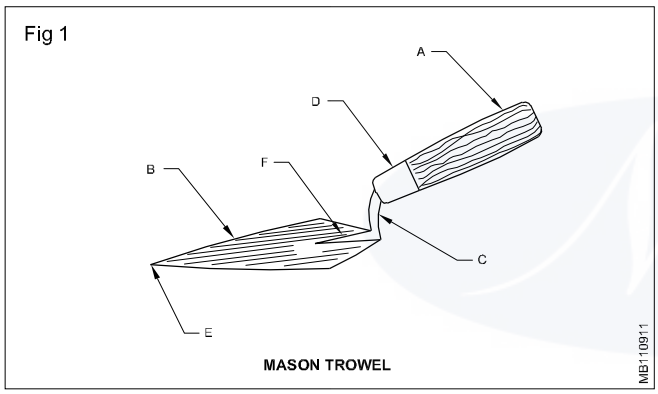
Tools

• Mason trawel	- 1 No.	• Tape measure	- 1 No.
• Builders square	- 1 No.	• Wooden peg	- 2 Nos
• Plumb bob set	- 1 No.	• Wooden profile	- 1 No.
• Masons square	- 1 No.	• Hammer	- 1 No.

PROCEDURE

TASK 1: **Identify masonry tools**

Fig 1



Mason Trowel Fig. 1

A _____

B _____

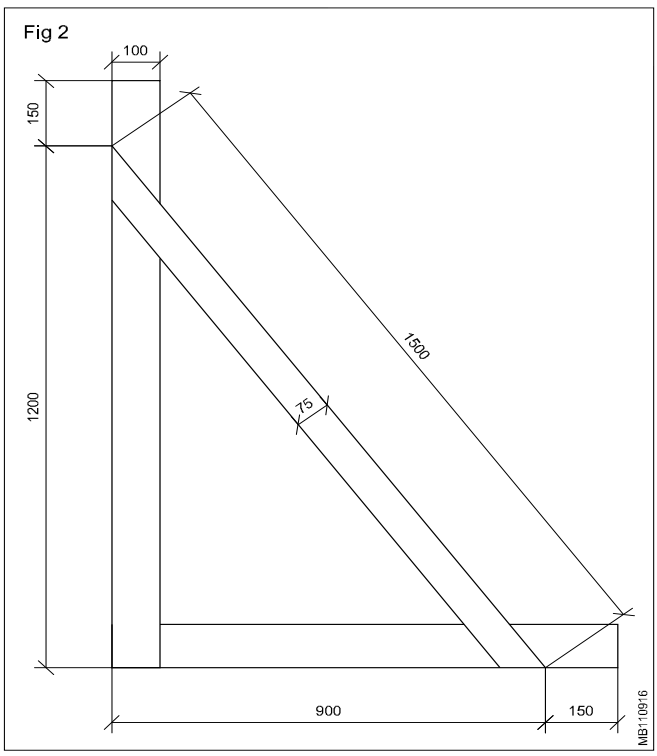
C _____

D _____

E _____

F _____

Fig 2



Builder's Square Fig. 2

A _____

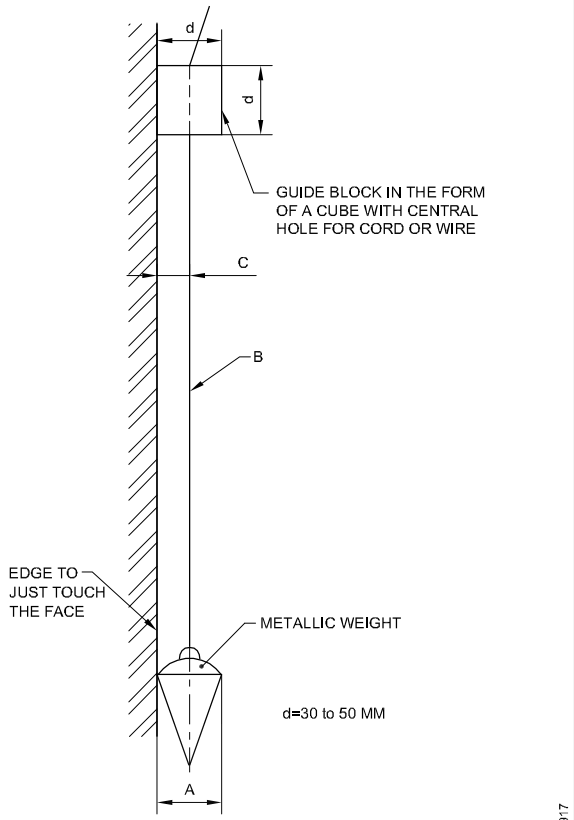
B _____

C _____

D _____

E _____

Fig 3



PLUMB BOB SET AND ITS SUSPENSION

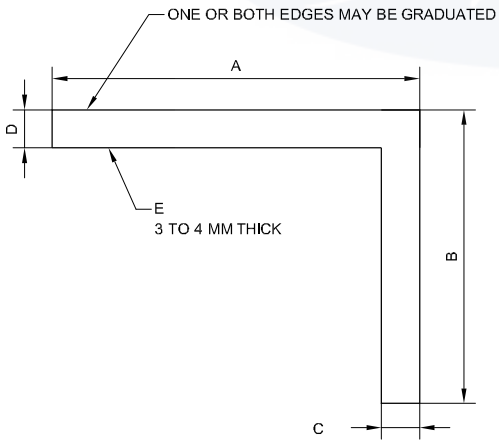
Plum Bob Fig. 1

A _____

B _____

C _____

Fig 4



MASON'S SQUARE

Mason's square Fig. 4

A _____

B _____

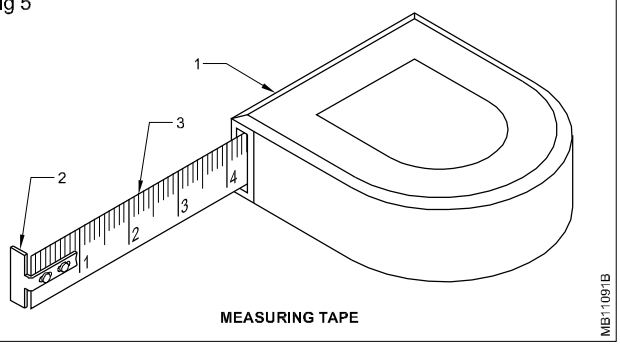
C _____

D _____

E _____

TASK 2: **Identify marking tools**

Fig 5



Steel tape Fig. 5

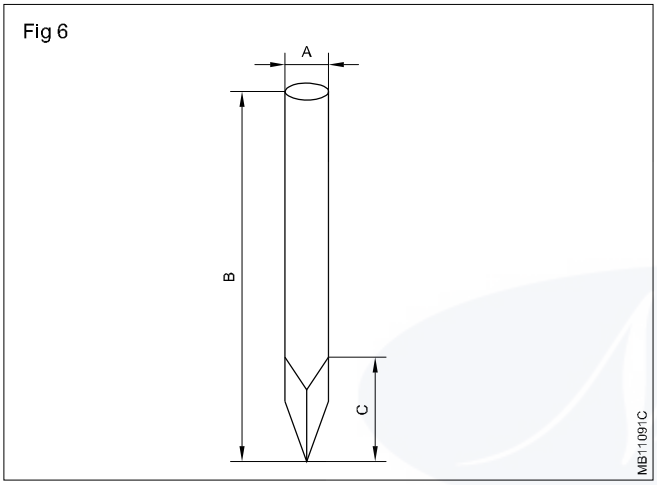
1 _____

2 _____

3 _____

TASK 3: **Identify base layout wooden peg tools**

Fig 6



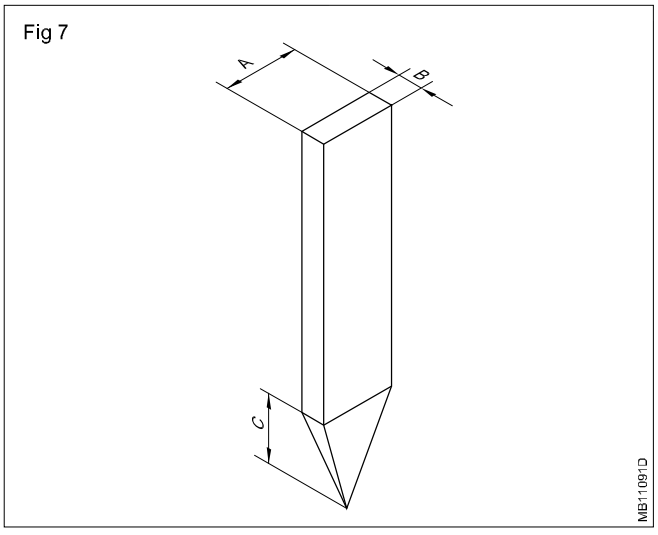
Wooden peg Fig. 6

A _____

B _____

C _____

Fig 7



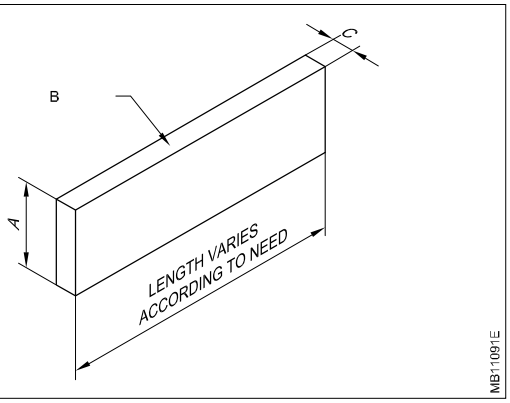
Peg Fig. 7

A _____

B _____

C _____

Fig 8



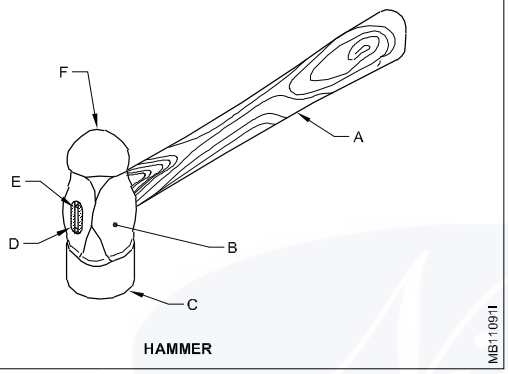
Wooden profile Fig. 8

A _____

B _____

C _____

Fig 9



Hammer Fig. 9

A _____

B _____

C _____

D _____

E _____

F _____

Set out a building - Marking first and second line

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

- **drive wooden pegs**
- **stretch thread line**
- **obtain first, second line of the building.**

Requirements

Tools

- Builders square
- Nylon marking thread
- Hammer
- Measuring tape
- Spade
- Plumb bob

Materials

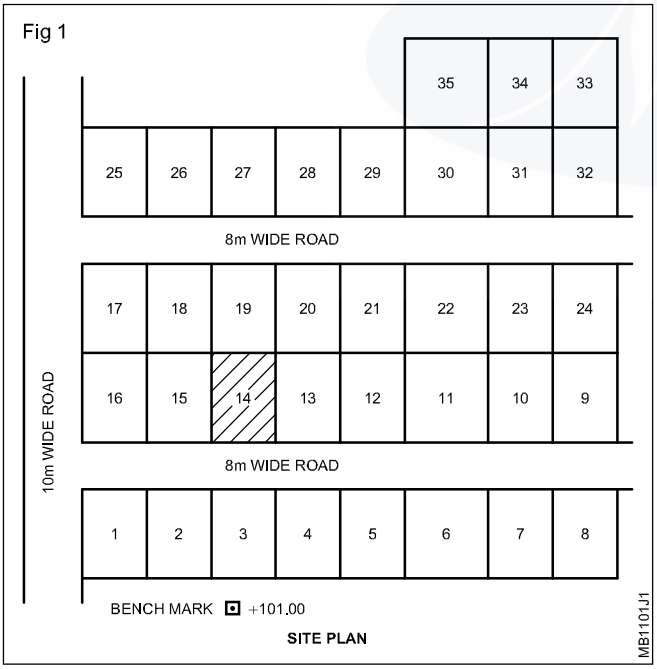
- Wooden pegs (about 80 to 100mm diameter and 450 to 600mm casurina poles), 35mm long wire nails and lime powder

PROCEDURE

TASK 1: **Study and inspect the plot and drawing**

- Inspect the plot where setting out is to be done.
- Study plot layout drawing.(Fig 1) Plot 14

Fig 1



- Study Building drawing (Fig 2)
- Locate boundary points A,B,C,D of the plot

  (Set back layout)(Fig 3)
- Clear vegetation, and debris
- Level the ground to required gradient.
- Study orientation of the building.
- Calculate and note the overall length and breadth of the building Measure width of the road.
- Mark center of the Road at several points and produce line RM (see Fig 3)

  Note road widening measurements.

  Note local authority frontage (minimum three meter) and side set back (minimum one and half meter) rules.
- Calculate building frontage ie half road width including widening plus three meter
- Have left side back as one and half meter.
- Prepare layout sketch showing set back dimensions (Fig 3)

— — — — — — — — —

TASK 2 : **Marking first lines of building**

Marking Firstline (base line) (See Fig 3)

Calculate half of road width including future widening (four meter) and add three meter to get the measurement of Frontage (ie Seven meter)

Locate points Y1 and Y2 on line RM so as to cover the overall diamensions of the front side of buildings and also foundation excavation width plus safe distance.

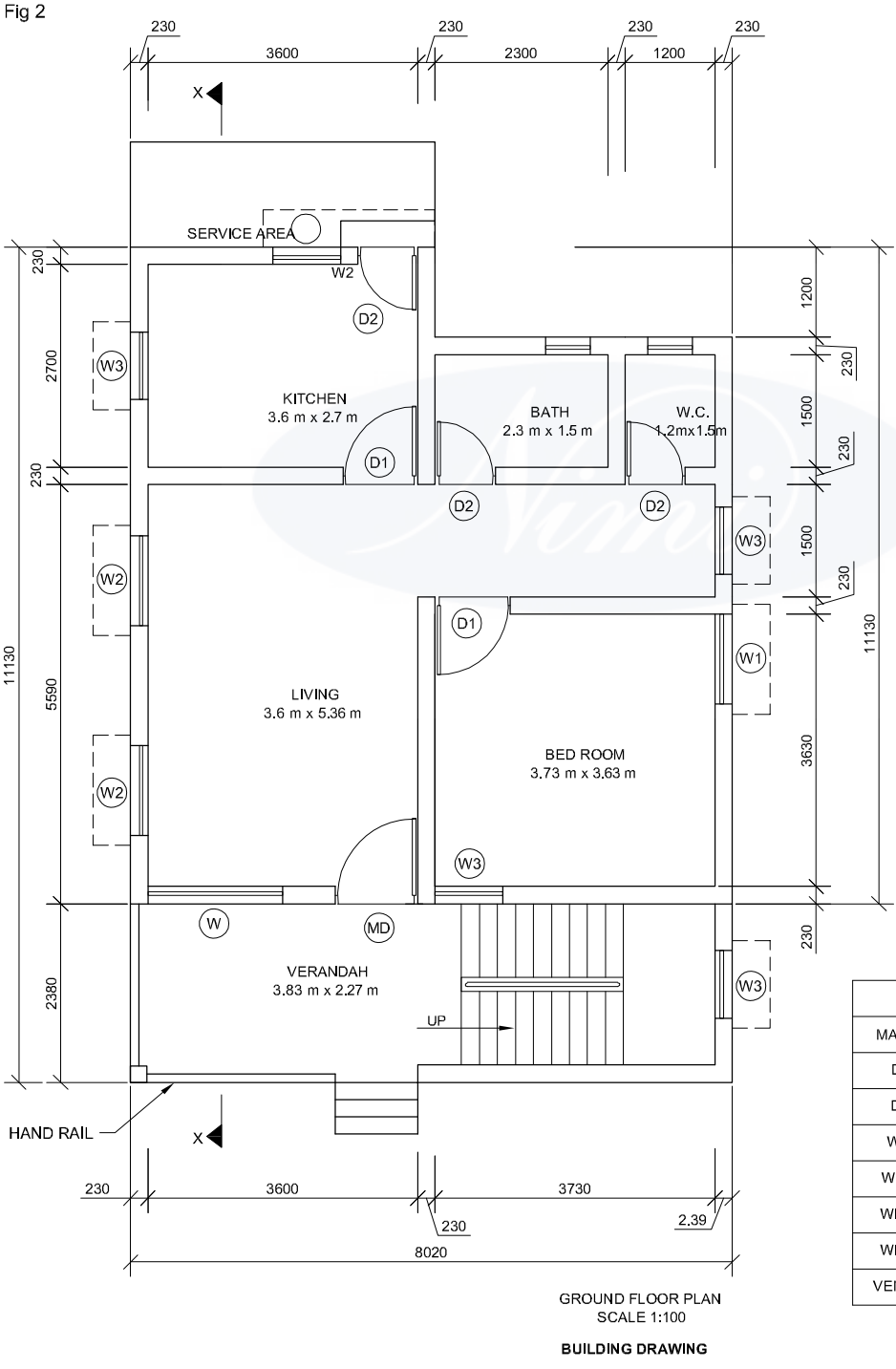
- Locate points Y1 and Y2 on line RM so as to cover the overall dimensions of the front side of the building and also foundation excavation width plus safe distance.
- Measure an arbitary distance of five meter at point Y1 at right angle to line RM and mark piont P1 and drive wooden peg firmly into the ground.
- Measure an equal distance of five meter at point Y2 at right angle to line RM and mark point P2 and drive wooden peg firmly into the ground.
- Plumb at point Y1 and measure five meter and mark on the top of peg at point P1 and drive nail.
- Tie line thread on the nail at peg P1 and stretch thread to appear on the peg at P2.
- Plumb at point Y2 and measure five meter and mark on the top of peg at point P2 and drive nail so as to be at center of line thread

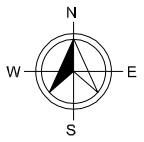
Caution:

Verify correctness of measurement and adjust thread line and nail point only at peg P2

Tie the line thread on the nail in peg P2 and obtain the first line (Base line) P1 P2 parallel to road center line RM

Fig 2





NOTE:
1. ALL DIMENSIONS ARE IN mm.
2. ALL WALLS ARE 230 mm THICK.

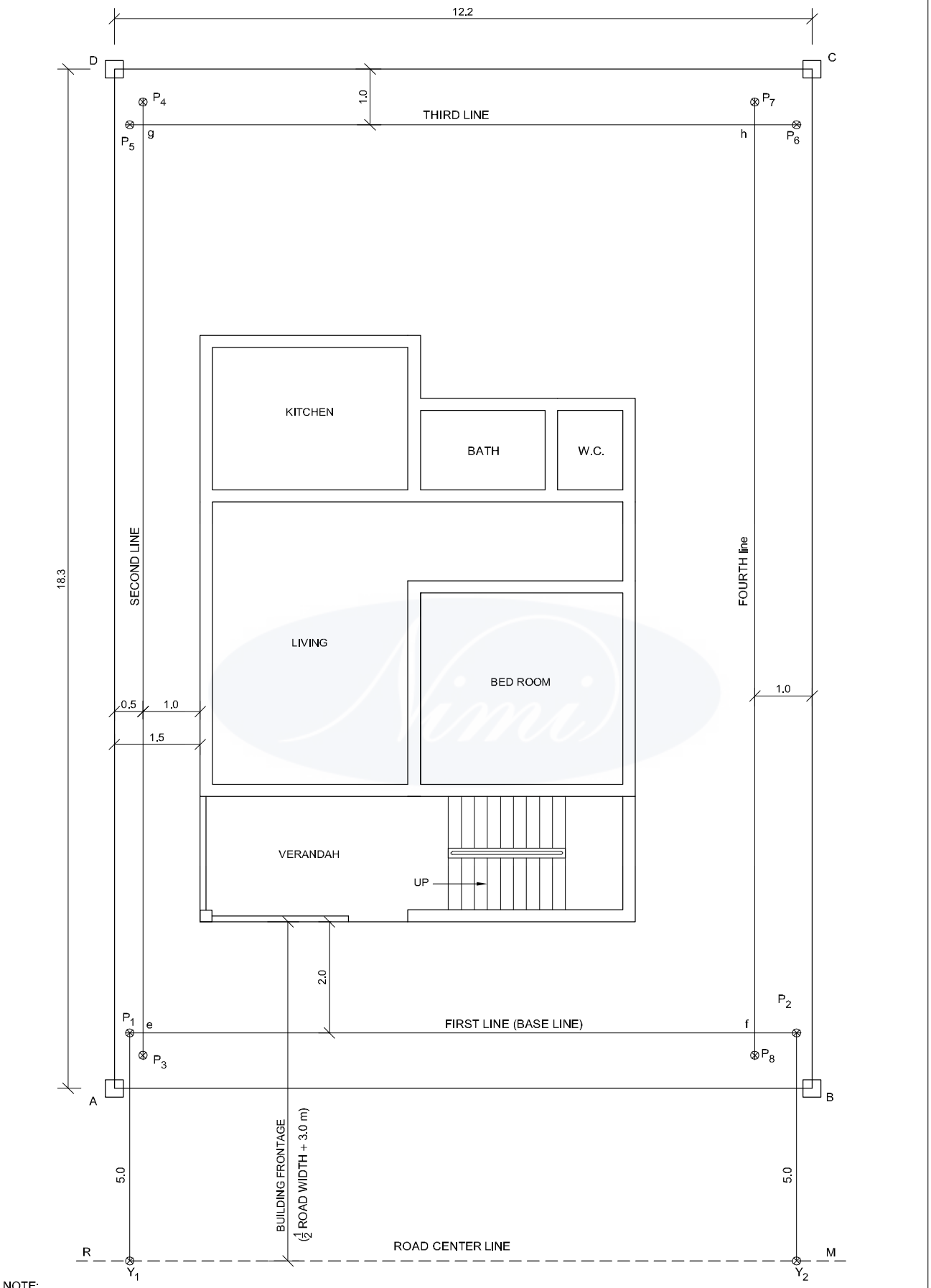
SCHEDULE OF JOINERY		
MAIN DOOR	MD	1000 x 2100 mm
DOOR-1	D1	900 x 2100 mm
DOOR-2	D2	750 x 2100 mm
WINDOW	W	1800 x 1350 mm
WINDOW-1	W1	1500 x 1350 mm
WINDOW-2	W2	1200 x 1350 mm
WINDOW-3	W3	900 x 1350 mm
VENTILATOR	V	600 x 600 mm

GROUND FLOOR PLAN
SCALE 1:100

BUILDING DRAWING

MB1101J2

Fig 3



NOTE:
1. WIDTH OF ROAD INCLUDING WIDENING = 8.0 m
2. ALL DIMENSIONS ARE IN METER

SET BACK LAYOUT

MB1101-J3

TASK 3 : **Marking second line of the building** (See Fig 3)

- Measure an arbitary distance of half metre from boundary AD and locate points p3 and p4 so as to cover the overall dimensions of the left side of the building and also foundation excavation width and safe distance.

Caution:

While measuring stretch and hold the steel tape without sag, and as low as possible, clear above the ground and truly horizontal to the ground

- Drive pegs at points P3 and P4
- Drive nail on center of peg P3 and tie line thread
- Stretch the line thread at right angles using the builders square (see Fig 3) to line P1,P2 and to appear on peg at P4
- Locate nail point on peg P4 and drive nail so as to be at center of line thread.

Caution:

Verify correctness of measurement and adjust the line thread and nail point only at peg P4

Tie the line thread on the nail in peg P4 and obtain the second line P3 P4 at right angles to line P1 P2

— — — — — — — —

Skill Sequence 1

Objective : This exercise shall help you to
• drive wooden pegs in the ground.

Steps

1 Cut one end of the wooden pegs flat (see Fig 1)using a hand saw.

2 Measure the total length of the peg and mark one third length from the opposite end.

3 sharpen the one third length to a conical shaped edge (see Fig 1)using a knife.

4 Mark the center points on the ground where the pegs have to be driven.

5 Hold the prepared peg on one hand with the sharpened edge kept on the center mark (see Fig 1)

6 Use hammer and gently strike the first few blows on the flat edge (see Fig 1) to drive the sharpened edge little into the ground.

7 Use plumb bob and check the verticality of the driven peg (see Fig 1)

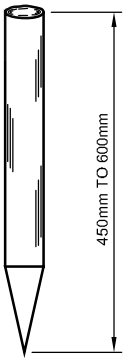
If the peg thus driven is not vertical, tilt to the required side using the hammer.

8. When the peg is vertical, strike a few hard blows with hammer on the flat surface followed by few gentle final blows to fix the peg to the required depth.

Caution :

All the pegs to be driven up to the conical shape marking so that the peg top shall be at the uniform height from ground level (see Fig 1)

Fig 1



WOODEN PEG

MB1101X1

Skill sequence 2

Objectives: This exercise shall help you to

- **use builders square**
- **obtain right angle**
- **check back for square.**

Steps

1 Hold builders square on both hands firmly (see Fig)

2 Place side a,b parallel and abutting the first line (See Fig 1)

3 Keep corner “a” at the point where right angle turn is required.

4 Keep side a,c pointing in the direction of right angle turn is required.

5 Stretch second line parallel and abutting builders square side a,c (see Fig 1)

6 When second line is parallel to side a,c keeping the first line parallel side a,b the right angle turn has been obtained.

7 Turn builders square and keep side a,b on second line, and verify whether side a,c is parallel to first line (see Fig 2) and if it is parallel check back for square has been done.

Caution

Adjust only second line to achieve true alignment parallel to builders square side a,c hold builders square without much shake.

Fig 1

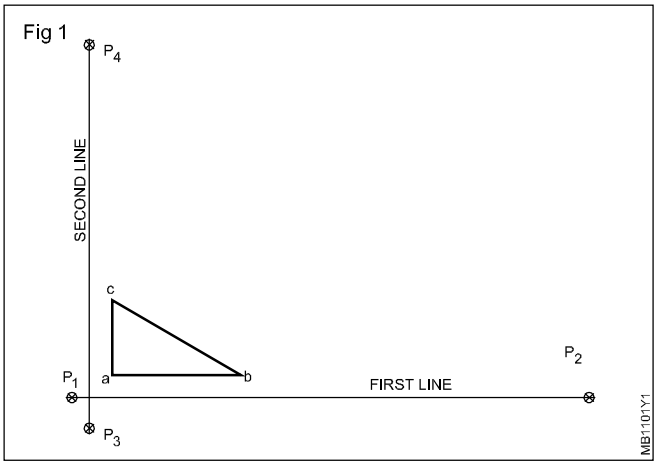
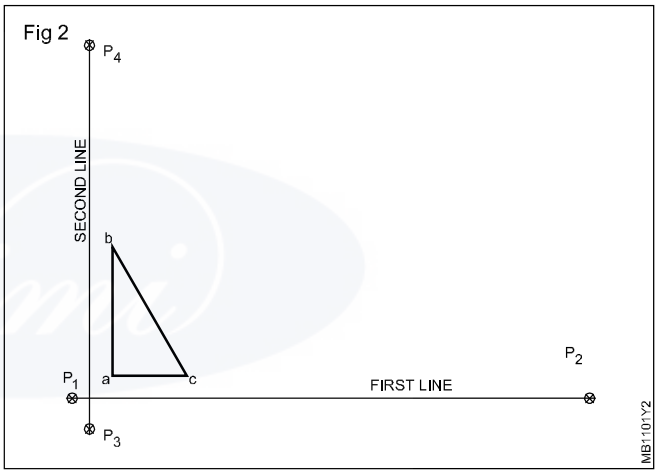


Fig 2



Set out a building - Marking third and fourth line

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

- **Mark third line of the building.**
- **Mark fourth line of the building.**

Requirements

Tools

- Builders square steel 75 cm X 50 cm 1 No.
- Nylon marking thread
- Hammer Mason (club) 11/2 / 1 lbs 1 No.
- Measuring tape 30 m 1 No
- Plumb bob 1 No.

Materials

- Wooden pegs (about 80 to 100mm diameter and 450 to 600mm casurina poles), 35mm long and wire nails

PROCEDURE

TASK 1: **Mark third line of the building (see Fig 1)**

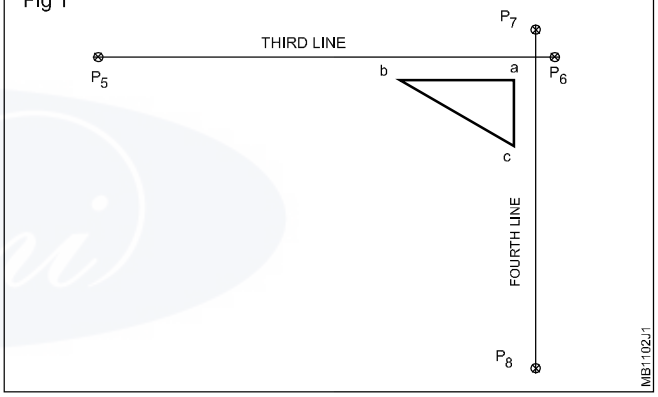
- Measure an arbitary distance of one meter from boundary DC and locate points P5 and P6 so as to cover the overall diamensions of the rear side of the building and also foundation excavation width and safe distance.

While measuring, stretch and hold the steel tape without sag, and as low as possible clear above the ground and truly horizontal to the ground.

- Drive pegs at points P5 and P6
- Drive nail on center of peg P5 and tie line thread
- Stretch the line thread at right anlges using the builders square (see Fig 1) to line P3, P4 and to appear on peg at P6
- Locate nail point on peg P6 and drive nail so as to be at center of line thread.

Verify correctness of measurement and adjust the line thread and nail point only at peg P6

Fig 1



Tie the line thread on the nail in peg P 6 and obtain the Third line P5 P6 at right angles to line P3 P4 and parallel to line P1 P2

— — — — — — — —

TASK 2 : **Mark fourth line of the building (see Fig 1)**

- Measure an arbitary distance of one meter from boundary C B and locate points P7 and P8 to as to cover the overall dimensions of the right side of the building and also foundation excavation width and safe distance.

While measuring, stretch and hold the steel tape without sag, and as low as possible clear above the ground and truly horizontal to the ground.

- Drive pegs at points P 7 and P 8
- Drive nail on center of Peg P 7 and tie line thread
- Stretch the line thread at right angles using the builders square (see Fig 1) to line P5 P6 and to appear on peg at P 8
- Locate nail point on Peg P8 and drive nail so as to be center of line thread.

Verify correctness of measurement and adjust the line thread and nail point only at peg P 8

Tie the line thread on the nail in Peg P 8 and obtain the Fourth line P7 P8 at right angles to line P5 P6 and parallel to the line P3P4

Note

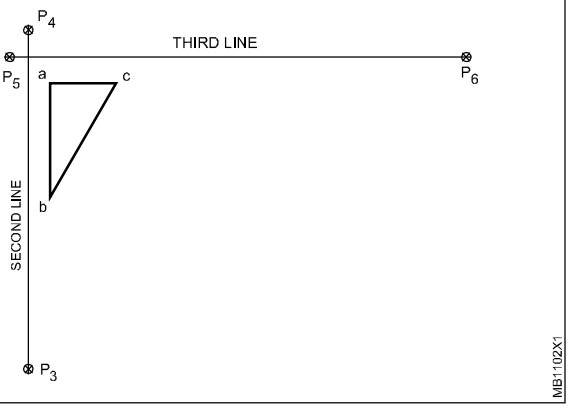
- Measure diagonal distance between intersection points e, and h (see Fig 3 in Ex. No.1.01)

- Measure diagonal distance between intersection, points g and f (See Fig.3 in Ex.No.1.01)

The diagonal distances thus verified must be equal, if not correct right angle turnings and arrive at equality between diagonals.

- All the line threads must travel at same level and seperated only by thickness of threads.
- Use Builders square to turn and check the back right angle of thread line as shown in Fig (a,b,c and d)

Fig 1



Skill sequence 1

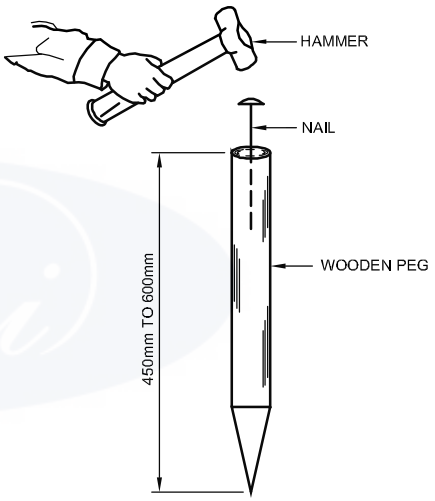
Objective: This exercise shall help you to

• drive nails on the pegs.

Steps

- Mark with a pencil the approximate center point of the flat surface of the driven peg.
- Hold the nail vertical with the sharp point on the center mark.
- Strike gently with a claw hammer the nail head and fix. (Fig 1)

Fig 1



DRIVING NAIL USING HAMMER

Skill sequence 2

Objectives: This exercise shall help you to

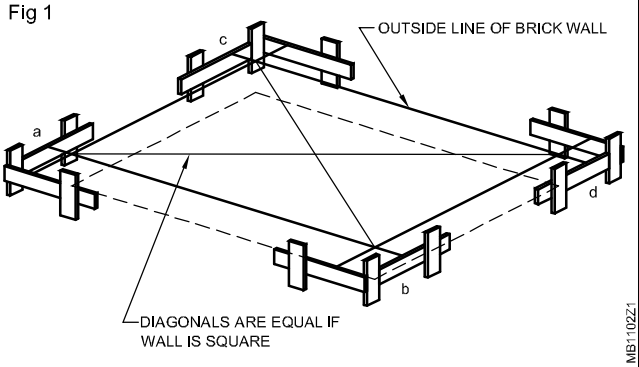
• verify diagonal distance between profile markings.

Steps

- Tie thread lines between profiles to run on the center line mark.
- Obtain intersection points on the line thus stretched.
- Measure the distance between diagonally opposite intersection points.
- The distance between two such pairs should be equal

If the two diagonal distance's are not equal, verify all right angles obtained at the intersection points and correct where necessary keeping any one line between two intersecting points as base not to be altered.

Fig 1



Set out a building - Marking the center line layout of the building

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

- **produce center lines of the building on the profiles**
- **transfer center line mark, on the ground.**

Requirements

Tools

- Builders square
- Nylon line thread
- Hammer
- Measuring tape
- Steel tri square
- Plumb bob
- Spirit level

Materials

- Wooden profiles
- Wire Nails
- Lime powder

PROCEDURE

TASK 1 : **Mark centre line in layout of the building**

- Trace center line plan of the building (Fig 1) and orientation of the building.
- Tie all line threads at almost same level (Levels separated only by thread thickness) between pegs P1 P2, P3 P4, P5 P6 and P7 P8 (Ref Fig 3 of ex.1.01)
- Calculate half wall width ie 115mm plus the balance two meter = 2115mm for locating the center line pegs for the front wall of the building.
- Measure this distance of 2115 mm on the line thread P3 P4 from the intersection point e (see Fig 3) and locate and drive peg P9
- Measure once again the distance 2115 mm from the inspection point e and locate the nail point on peg P9 and drive nail
- Repeat the process from intersection point f and locate peg P10 and drive nail.
- Now tie line thread between P9 P10
- Mark a safe distance (say half a meter) in front of peg P9 towards the building and drive a profile.
- Repeat the same procedure in front of peg P10 and drive another profile.
- Mark the center line on these profiles.
- Remove line thread P9 P10 and tie between these two profiles and obtain center line of the building front wall.
- Repeat process to obtain all other center lines as per the center line drawing.

— — — — — —

Skill sequence 1

Objective: This exercise shall help you to

- **tie line thread to nails.**

Steps

- Form a loop in the line thread as shown in step 1 of (Fig 2)
- Hold the loop apart over the thumb and forefinger of the left hand and the bottom with the right hand and form a triangular shape step 2
- Turn the left hand downward, holding the thumb and forefinger together and this forms a loop around these two fingers Step 3
- Pull downward firmly with the right thumb and forefinger until the two loops have almost reached each other step 4
- Push the loops on the nail and draw the loops tightly against the nail to form the tie. step 5

Method of cutting bricks

Objectives : At the end of this exercise you shall be able to
- **cut the brick in two equal pipes in cross wise**
- **cut aqueen closer brick (in longitutional direction).**

Requirements

Tools

- Chisel or bolster 100mm wide - 1 No.
- Hammer 1kg - 1 No.
- Marking scale - 1 No.
- Marking pencil - 1 No.
- Fibre board or timber - 1 No.

Materials

- Brick 9” x 4½ x 3”
  or
  20cm x 10cm x 10cm - 2 Nos.

PROCEDURE

TASK 1 **: Cut the brick in two equal pieces in cross wise**

- Lay timber board or fibre board on the floor.
- keep the brick on fiber board as flat.
- Mark the face of the brick for cutting using the width another brick as a guide as shown in Fig. 1.
- Place the bolster along the cutting line.
- Place the bolster along the cutting line.
- Keep the botster firmly in left hand.
- Strike a medium blow with a hammer.
- Turn the brick to the other header face.
- Repeat until to cut into two pieces. (Fig. 2)

Causion

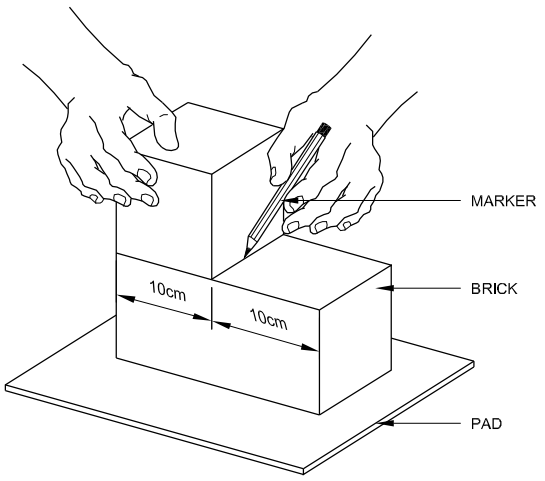
- Keep away finger from the chisel head.
- Care should be taken while blow with hammer, otherwise may spoil the finger.
- Brick should be rest on a fibre of soft wood pad to reduce unnecessary fractures.

— — — — — — — — —

TASK 2: **Cut a queen closer brick (in longitudinal direction)**

- lay the fibre board or pad on the floor.
- Keep the brick vertically on fibre board. (Fig. 3)
- Mark the face of the brick in longitudinal direction by using marking scale.
- Place the bolster along the cutting line. (Fig. 4)
- Strike a medium blow with hammer.
- Turn the brick to the other longitudinal face.
- Repeat until to cut into two pieces as queen clsoer.

Fig 1



HALF BAT

Fig 2

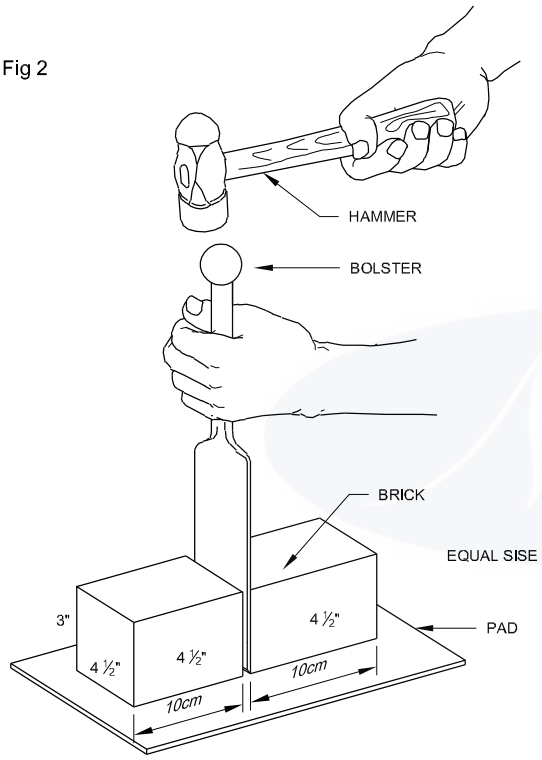
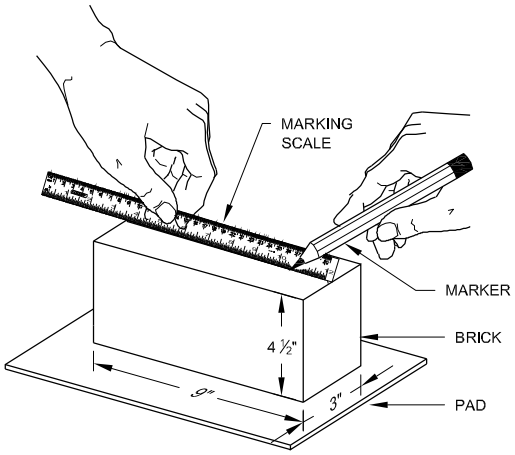
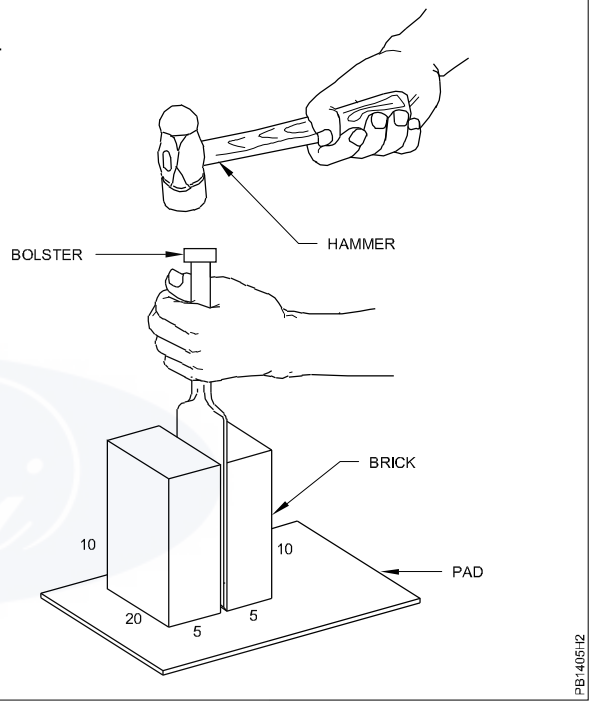


Fig 2



QUEEN CLOSER

Fig 4



Mix the cement mortar

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

- **prepare cement mortar 1:4 by manually**
- **follow correct safety practices.**

Requirements

Tools

- Spade - 1 No.
- Bucket - 1 No.
- Mug - 1 No.
- Mortar pan - 1 No.
- Measuring box 300 X 300 X 300 - 1 No.
- Mason trowel 25 cm long - 1 No.

Materials

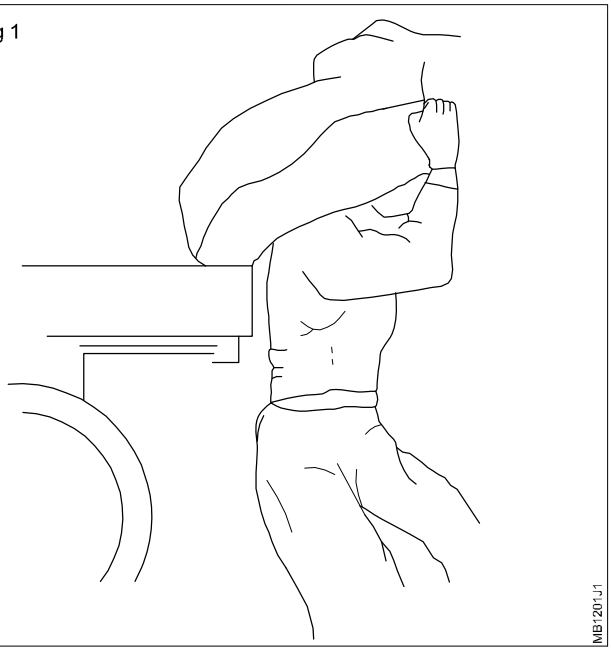
- Cement - 50 kg
- Sand - 2 box
- potable water
- G.I sheets (for platform) - 1 No.

PROCEDURE

TASK 1 : **Prepare a cement Mixing mortar 1:4 by manually**

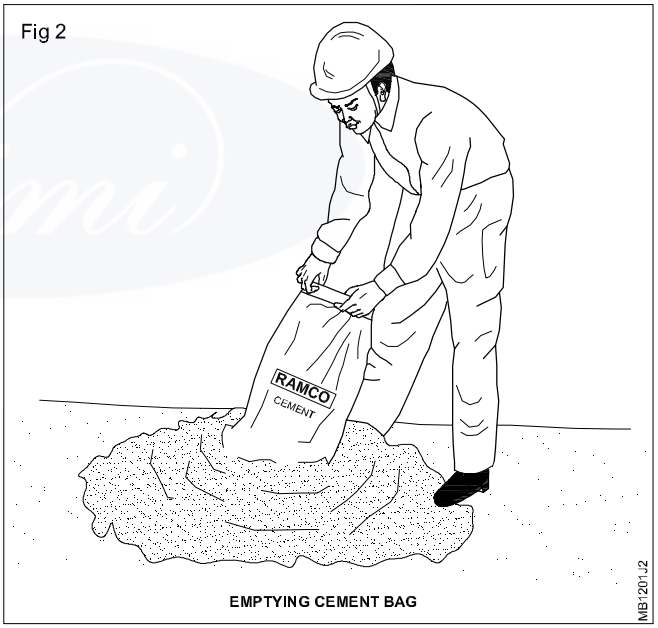
- Level the area where mixing is to be done
- Place adequate numbers of G.I sheets on the levelled ground
- Collect one bag of cement, adequate sand, water near the mixing area
- Measure and using measuring box two times of sand and spread on the platform in a heap (G.I placed)
- Transport cement bags and place on the heap of sand as shown in (Fig 1)

Fig 1



- Cut open the cement bag pour and spread slowly the cement evenly on the sand as shown in (Fig 2)

Fig 2



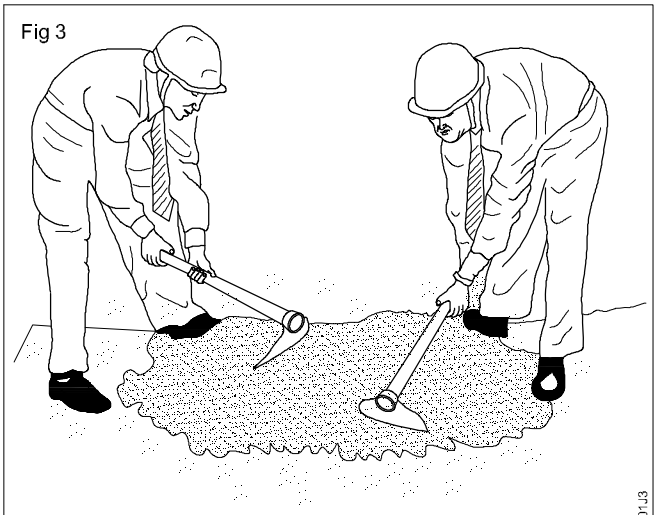
EMPTYING CEMENT BAG

Wear dust mask

Cut cement bags without Spoiling the bag use spade and mix the contents uniformly as shown in (Fig 3)

- Mix all ingredients till to get uniform colour (Fig 3)
- Using spade again Dry mix all the ingredients mixed well until uniform colour is achieved.
- Mix the entire ingredient to be heaped and made a shallow dent in the centre of the heap as shown in (Fig 4)

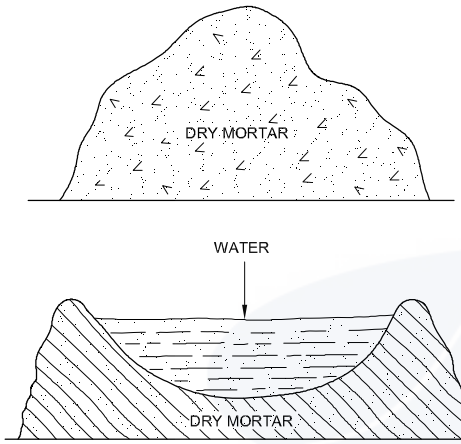
Fig 3



DRY MIXING OF CEMENT AND SAND

MB1201J3

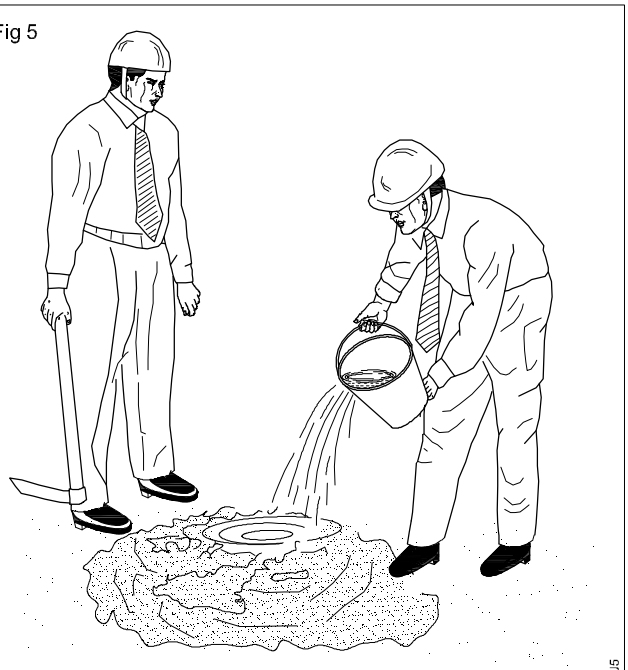
Fig 4



MORTAR DEEP OPENED OUT

MB1201J4

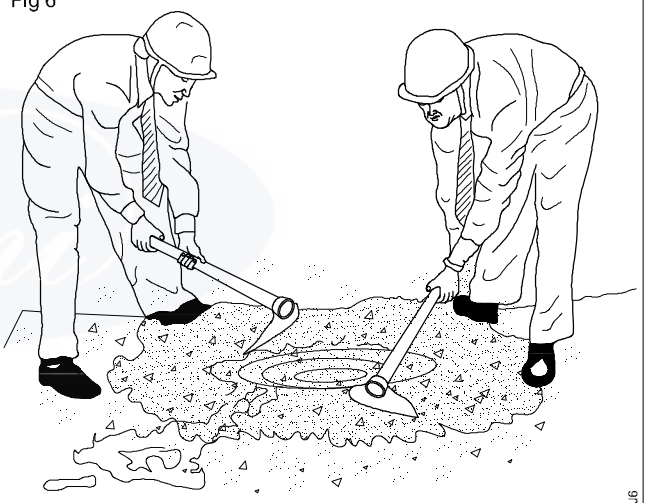
Fig 5



ADDING WATER IN DRY MIX

MB1201J5

Fig 6



WET MIXING

MB1201J6

- Measure half the quantity of water reqired and pour in this shallow dent as shown in (Fig 5).
- Without allowing the water to seep out of the heap. mix quickly.(Fig 6)

— — — — — —

TASK 2 : **Follow safety precaution**

Caution

- When mixing is poorly ventilated area wear a dust mask Once again form a heap and again make a shallow dent in the center of the heap
- Again pour the balance quantity of water using mug slowly mug by mug and same time continue mixing
- Keep mixing until uniform colour and consistency of mortar is obtained (Cement mortar 1:2)

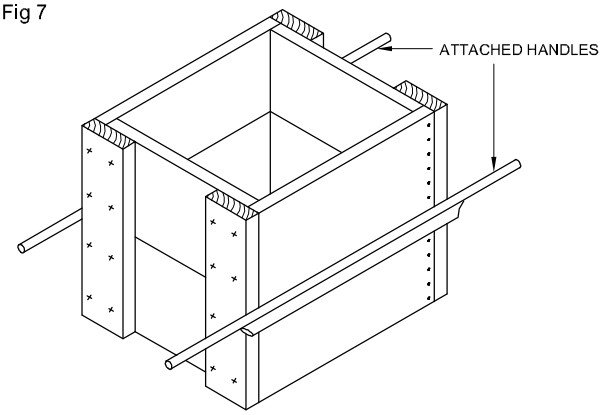
Caution

- Donot pour additional water since mix will become lean

Caution

- Always mix only quantity of mortar that can be utilized without balance left for a long duration.
- Measuring boxes are used to measure aggregates of sand and coarse aggregate (Stone jelly) as shown in (Fig 7) wooden measuring box and (Fig 8) steel measuring box

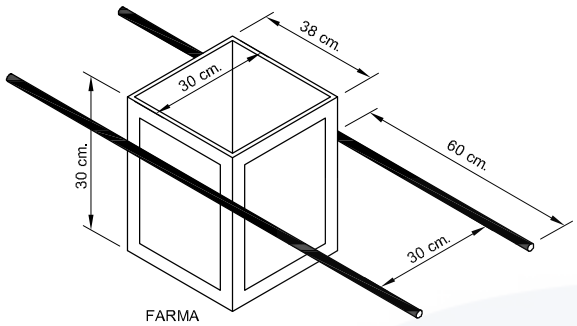
Fig 7



WOODEN MEASURING BOX

MB1201J7

Fig 8

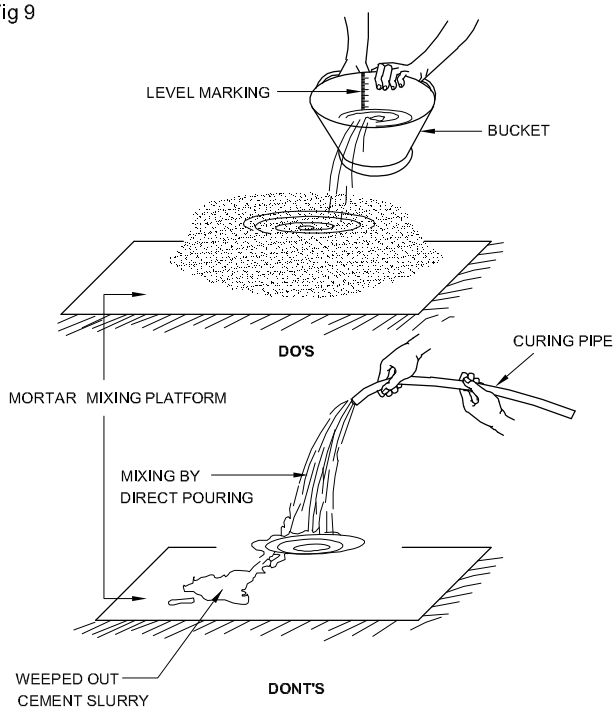


STEEL MEASURING BOX

MB1201J8

- Mixing water (Fig 9)

Fig 9



MIXING WATER (DO'S & DONT'S)

MB101J9

Skill sequence - 1

Objectives : At this exercise you shall be able to

- **measure ingredients using measurement box**
- **transport ingredients.**

Steps

- Keep the measurement box near the heap of sand.
- Use mortar pan and fill sand in layers in the measurement bx
- Use trowel when the box is full, and tirm of excess sand to level of box.

Caution

- Shake the measurement box when full to enable ingredients to full slightly to voids
- Two persons to hold the handles on both sides of the measurement box and lift it and transport

Caution

- Always lift weight by Bending in correct posture so as to keep back vetebrate in a straight posture always as shown in (Fig 1)

Skill sequence 2

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

- **mix mortar ingredients properly in Lay condition**
- **pour water and mix for consistency.**

Steps

- Place spade underneath the heap
- Lift ingredients using one hand slightly above and pour the contents
- While ingredients on dropping using the other hand and disturb the flow to pass through the fingers
- Repeat the above process as many times in on locations of the heap
- Measure the required water quantity and pour the same using the mug into dent in the heap slowly while keeping the mixing in progress
- Mix the mortor untill to get uniform colour

Caution

Measure water according to water cement ratio

Construction of gully trap

Objectives: At the end of this exercise you shall be able to
- **fix gully trap**
- **construct brick masonry chamber for the gully trap.**

Requirements

Tools

• Mason's Trowel 25 cm long	- 1 No.
• Mortar pan	- 1 No.
• Straight edge 1.5 long	- 1 No.
• Measuring steel tape 15m	- 1 No.
• Sprit level 15 m	- 1 No.
• Steel square 0.75 x 0.50m	- 1 No.
• Plumb bob	- 1 No.
• Line and thread	- 1 No.
• Crow bar 1.5 m	- 1 No.
• Spade	- 1 No.

Materials

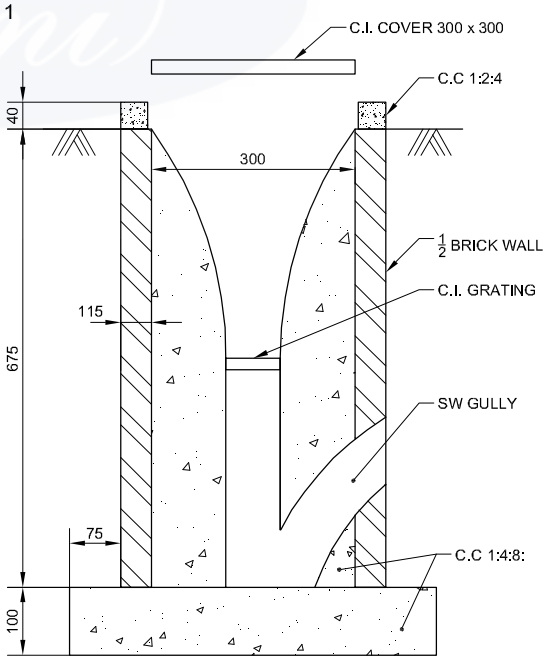
• Brick 230 x 110 x 70mm	- 120 nos
• Cement	- 2 bags
• Sand	- 5 box
• Stone aggregate 20mm	- 1 box
• Stone aggregate 40mm	- 1 1/2 box
• C.I. Cover 300 x 300mm	- 1 No.
• 8mm of mild steel	- 2.8m long

PROCEDURE

TASK 1: **Fix gully trap**

- Excavate for gully trap as per Fig.1 to dimensions and levels.
- Lay concrete as per drawing. (Fig.1).
- Check the quality of gully trap.
- Place gully trap in level.
- Connect gully outlet to the branch drain.(Refer S.W pipe joint)
- Test the gully and branch drain.
- Construct 115mm thick brick masonary chamber 300 x 300mm inside a round the gully trap. From top of the bed concrete upto ground level.
- Fill the gap between the chamber walls and trap with cement concrete.
- Plaster the upper portion of the chamber i.e. above the top level of the trap with cement morter 1:3 (1cement 3 sand).
- Finish the plaster area with a floating coat of neat cement. Round off the corners and bottom of the chamber so as to slope towards the grating.
- Fix C.I cover with frame 300 x 300 (inside) on top of the brick masonary with cement concrete 1:2:4 (1 cement 2 sand 4 graded stone aggregate 20mm.
- Render the concrete smooth. (Finished top level of cover shall be about 4cm above the adjacent ground level)

Fig 1



Construction of Inspection chamber

Objectives: At the end of this exercise you shall be able to
- **construct inspection chamber**
- **provide benching.**

Requirements

Tools

• Mason's Trowel 25 cm long	- 1 No.
• Mortar pan	- 1 No.
• Straight edge 1.5 long	- 1 No.
• Measuring steel tape 15m	- 1 No.
• Sprit level 15 m	- 1 No.
• Steel square 0.75 x 0.50m	- 1 No.
• Plumb bob	- 1 No.
• Line and thread	- 1 No.
• Crow bar 1.5 m long	- 1 No.
• Spade	- 1 No.

Materials

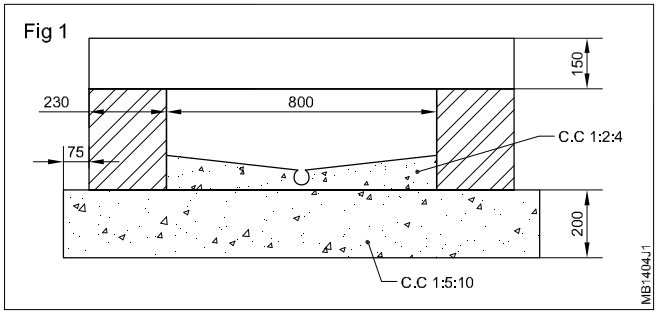
• Brick 230 x 110 x 70mm	- 120 nos
• Cement	- 2 bags
• Sand	- 5 box
• Stone aggregate 20mm	- 1 box
• Stone aggregate 40mm	- 1 1/2 box
• C.I. Cover 300 x 300	- 1 no
• 8mm of mild steel	- 2.8m long

PROCEDURE

TASK 1: **Construct inspection chamber**

- Excavate for the inspection chamber as per drawing true to dimension and level.
- Lay the concrete as per drawing. (Fig.1).

Fig 1



- Construct brick work with 1st class bricks in cement mortor 1:4 (1 cement : 4 course sand).
- Finish the external joints smooth.
- Make the joint of pipe and brick work leak proof.
- Block the pipe to prevent entry of foreign material.
- Plaster the inside walls with 12mm thick cement plaster 1:3 (1 cement 3 course sand)

— — — — — — —

TASK 2: **Provide benching**

- Provide channel and benching with cement concrete 1:2:4 (1 cement 2 fine and 4 coarse aggregate) 20mm normal size.
- Render smooth with neat cement (the depth of channel and benching shall be as per drawing).
- Fabricate and fix the reinforcement for cover.
- Fix the cast iron cover frame.
- Concrete the top cover.
- Cure the work.
- Fix man hole cover.
- Seal the man hole cover with grease.

Layout and build 1 brick thick square manhole 600mm x 600mm x 1000mm

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

- **setout the manhole**
- **lay bricks courses with bonding.**

Requirements

Tools

- Mortar pan - 1 No.
- Mason's Trowel 25 cm long - 1 No.
- Mixing tools - 1 No.
- Steel square 75 cm X 50cm - 1 No.
- Steel tape 3m long - 1 No.
- Spirit level 15 cm long - 1 No.
- Straight edge 1.5m - 1 No.
- Line and pins
- Brick hammer 1½ lbs - 1 No.
- Man hole 50cm ϕ - 1 No.
- Ball of nylon thread

Materials

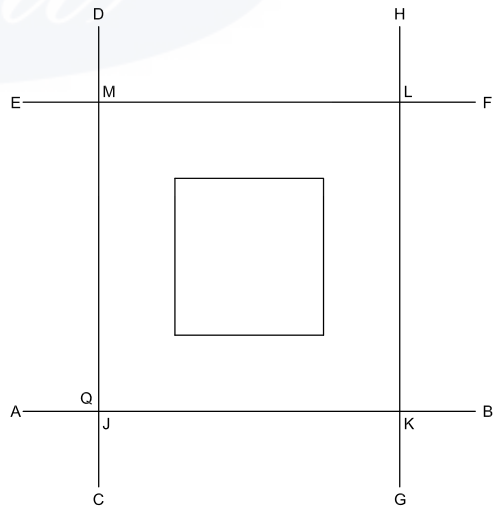
- Bricks 20 x 10 x 10 cm - 280 nos
- Cement concrete 1.5 x 1.5 x 0.15m - 0.34m^3
- Cement mortar
- RCC Slab 1.2 x 1.2 x 0.1 - 0.14m^3
- Cement
- 8 mm bar - 10 m
- Sand
- Water

PROCEDURE

TASK 1: **Set out the man hole**

- Draw AB straight line and mark point Q on the line AB
- From the point Q Draw a line CD as shown in Fig 1
- Mark 4 bricks length on the line CD and draw line EF perpendicular to the line CD and parallel to AB
- Draw perpendicular line GH and parallel to the CD
- Join "jklm" i s the required manhole square
- Excavate the square manhole as shown in Fig 1 at a depth of 1 metre.
- Place the base concrete 1:5:10 for the thickness of 15cm and rammed well.
- Level top surface of the concrete bed with the aid of straight edge

Fig 1



SETTING OUT MANHOLE

MB1311H1

TASK 2: **Lay brick courses with binding**

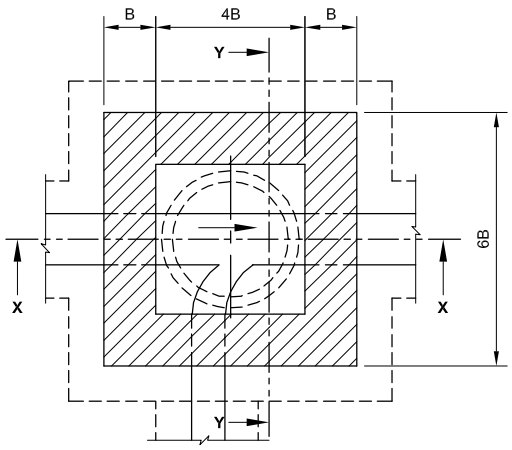
- Lay dry bricks to suit the benching and diamensions square manhole
- Place pipes in the centre of manhole as shown in Fig 2
- Flush the pipe inside the face of the manhole
- Continue brick work with cement mortar until required as shown in(Fig 2)
- Fill up all the joints inside as well as outside wall

Take care no load shall be provided on the pipes placed in the manhole.

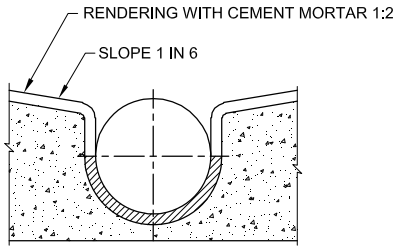
All brick work in manhole chambers and shafts shall be carefully laid with bricks in English bond

- Cut the bricks according to the template
- Check all the roussoires joints

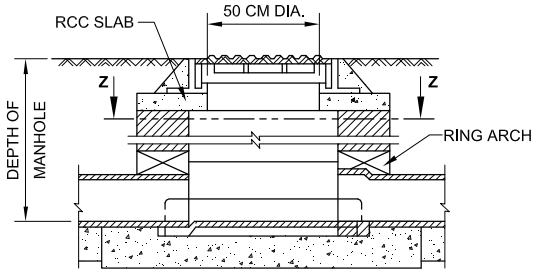
Fig 2



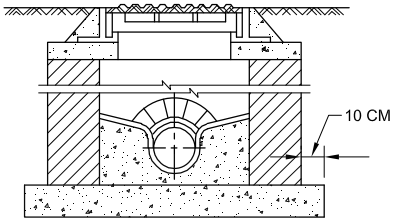
SECTIONAL PLAN AT ZZ



DETAIL OF BENCHING



SECTION XX

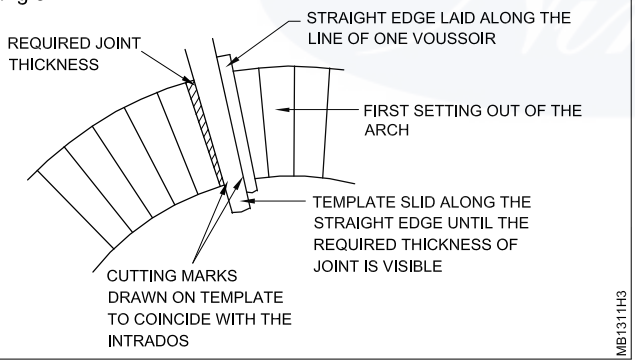


SECTION YY

DETAILS OF MANHOLE (DEPTHS 1 M AND BELOW)

MB1311H2

Fig 3

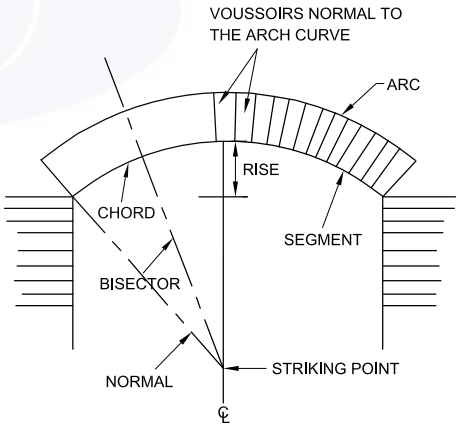


MB1311H3

The method of construction procedure are similar to the semi circular arch

The skewback should be constructed in bricks by forming an angle of 60^0 as shown in (Fig 4)

Fig 4



MB1311H4

The walls of manholes shall be plastered both inside and outside with cement mortar 1:3

- Lay the jointing faces of each brick being well buttered with cement mortar.

Prepare of surface for external plastering

Objective : At the end of this exercise you shall be able to
• erect scaffolding

Requirements

Tools required

- Hammer 1/2 / lbs - 1 No.
- Chisel 12 mm - 1 No.
- Plumb bob - 1 No.
- Line and pins
- 'U' Nails
- Measuring steel tape 3m - 1 No.

Materials

- Scaffolding material
- Ledger wooden /tubuler - 4 Nos.
- Putlog wooden/tubuler - 4 Nos.
- Bamboos (cross) - 4 Nos.
- Wooden planks - 2 Nos.
- Coconut coir
- Wire brush - 4 Nos.

PROCEDURE

TASK 1 : **Erect scaffolding**

- Erect and make scaffolding work in advance, where the plaster is to be done.
- Rrect double scaffolding or independent to work having two sets of vertical supports.

The vertical supports shall be sound and strong.

The horizontal ledger and putlogs are tied with vertical supports by using coconut coirs firmly or tightly.

Before tied the coconuts coir or rope should be wetted.

Scaffolding wooden planks are laid and fixed firmly.

Gaurd board and diagonal bracing are also fixed for preauctionary measures

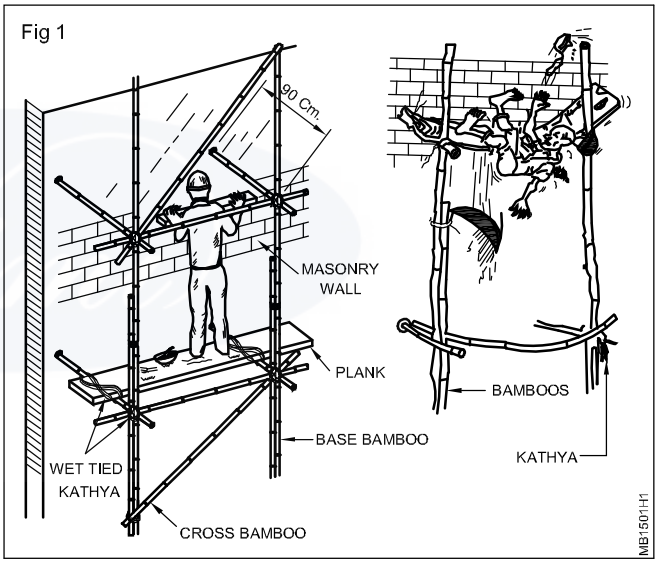
- Check the scaffolding carefully before starting plasterwork.
- Wooden planks and wooden vertical poles should not be old and weak to avoid probable accidents.
- Scaffolding erect is in plumb for vertical as shown in (Fig 1)

In case of tubler scaffolding all joints should well tied and fixed with couplers.

And necessary diagonal bracing are provided for additional strength and to avoid tilting.

- The joints should be raked out properly for 20mm depth
- Remove dust and loose mortar with brush.
- The plaster surface washed throughly with water.
- Cleaned and kept wet before plastering is commenced.

Fig 1



- Fill the gaps or holes in masonry and joints of wall and slab or beam etc should be filled up well with rich cement mortar 1:3
- Check masonry work horizontally as well as vertically using line and thread from top to bottom at all the edges.

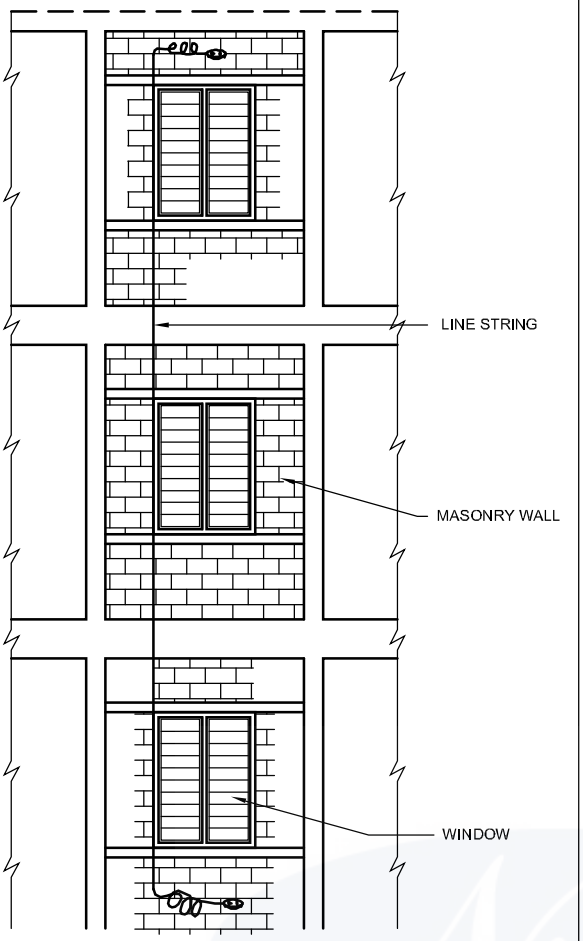
This will give an idea of thickness of plaster work. as shown in Fig 2. Plaster work confirming to these lines will give the finished surface

All concrete old plaster and stone surface if they seem too smooth, must be suitably roughened to provide necessary bonding for the plaster

If beam or column is bulged out then chiseling is to be done by chisel and hammer

- Fix the chicken mesh to the all joints of masonry and

Fig 2

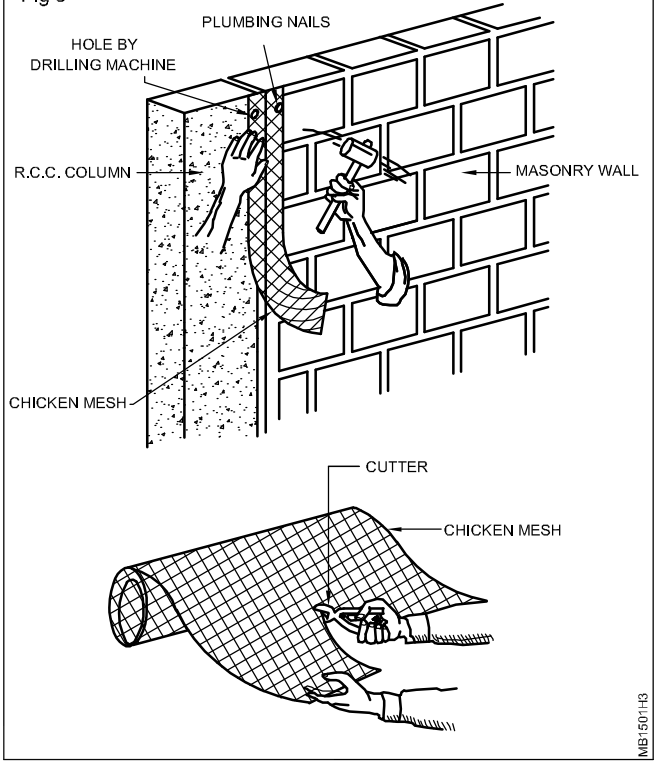


CHECKING OF WINDOW EDGES BY LINE STRING

R.C.C work such as masonry wall, column and beam using by 'U' nails

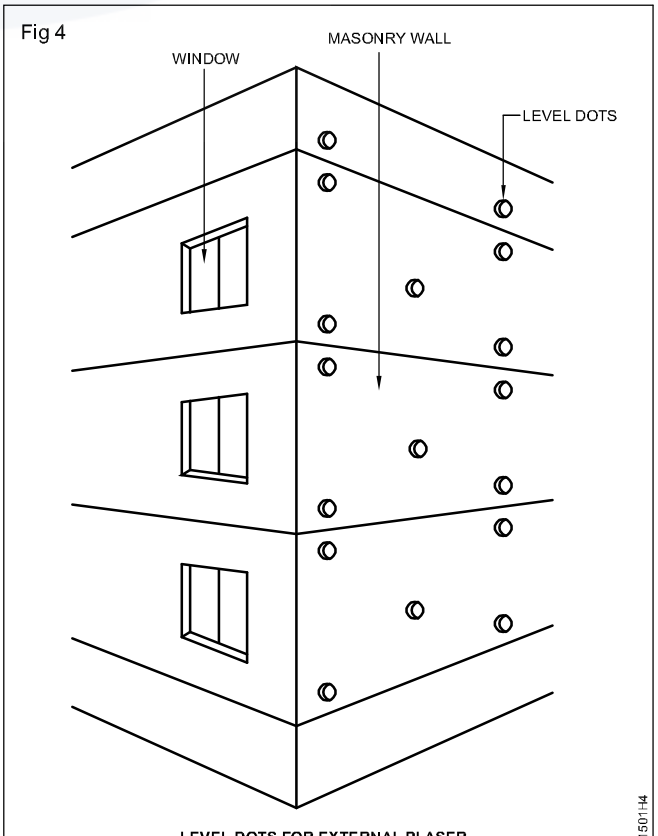
- Cut and fix chicken mesh in minimum 20mm size by cutter as shown in (Fig 3)
- Fix half width of chicken mesh will be on masonry wall and half will be on R.C.C structures.
- Chicken mesh tightly in both directions vertical and horizontal as shown in (Fig 3)
- Wet the wall surfaces with fresh water in advance before plastering
- Check all the windows, door frames for plumb, line and level (Fig 2)
- Rectify If any defect is found before plastering.
- Check the levels from the top of parapet wall to the bottom surface of masonry wall.
- Fix the level dots or spot points 10cm x 10cm as specified thickness
- Fix level dots should be 1.8m centre to centre equally as shown in (Fig 4)

Fig 3



- Put line thread from top slab to bottom level of all corners of walls. Corners of window line of elevational features, line of R.C.C grill and all straight lines inthat portions.
- Use washed sand .

Fig 4



LEVEL DOTS FOR EXTERNAL PLASER

Method of external plaster

Objectives: At the end of this exercise you shall be able to
- **prepare cement mortan**
- **apply of plastering.**

Requirements

Tools/ Equipments

- Plastering Trowel 25 cm long - 1 No.
- Pointing Trowel 15 cm long - 1 No.
- Mortar pan - 1 No.
- Hammer 1 1/2 lbs - 1 No.
- Chisel 12mm - 1 No.
- PVC water level tube
- Wooden float - 1 No.
- Steel float - 1 No.
- Measuring steel tape 5m - 1 No.
- Straight edge (Aluminium) 1.5m - 1 No.
- Right angle small and Big
- Line and Thread
- Wooden straight edge 1metre long - 1 No.
- Spade - 1 No.

Materials

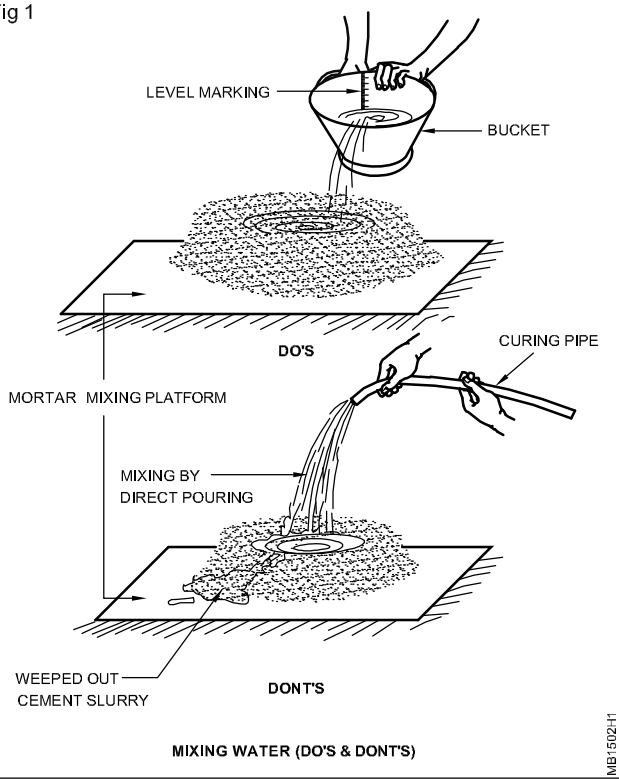
- Fine sand - 1 box
- Cement - 20 kg
- Screen for sieving sand
- Water
- Bucket - 1 No.
- Mug or Jar - 1 No.
- Sponge - 1 No.

PROCEDURE

TASK 1: **Prepare cement mortan**

- Mix mortar as specified ratio mentioned in drawing usually 1:5 (1 part of cement and 5 parts of sand)
- Before mixing cement mortar sand must be sieved and cleaned well
- Mix dry mortar for minimum three times throughly
- Add sufficient quantity of water and mixed well by using spade or showel as shown in (Fig 1)
- Check and verify the level dots both in horizontal and vertical

Fig 1



MIXING WATER (DO'S & DONT'S)

TASK 2: **Apply plastering**

- Cement mortar dash against brick masonry wall between two level dots. just above the thickness required.
- Tamped slightly by using small strip of wooden straight edge or by wooden float to ensure through filling of joints.

Then the surface brought to a true surface by working a wooden straight edge or Aluminium hollow section reach acrossing the level dots. This is called as a mortar screed.

Take care and see that no uneven surface is observed.

- Repeat the process for another two level dots and the surface should be finished.
- Laid or dashed the mortar on the wall between mortar screed.
- Checked plaster surface with line and thread on respective level dots.
- Make rough surface by wires for better bonding to second coat as shown in the (Fig 2)

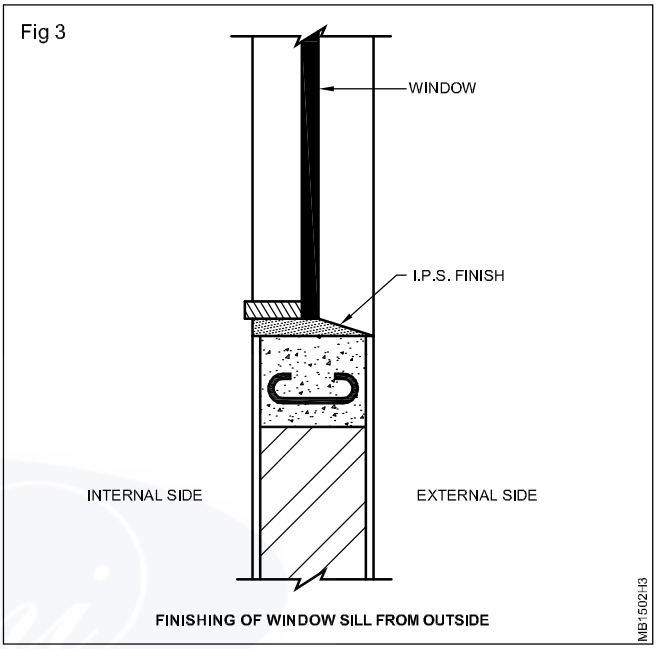
Fig 2

ROUGHNING OF PLASTER SURGACE

MB1502H2

- Second coat of plaster is applied on the wall where the first coat is already applied.
- The thickness of two coats plaster is 18mm. ie first coat is 12mm thick and second coat is minimum 6mm thick
- Use wooden straight edge to get uniform plain surface reaching across the level dots. with small upward and sideways movements at a time.
- Finally the surface shall be finished off true with trowel or wooden float according as a smooth
- After the second coat, remove scaffolding step by step and fill the holes with mortar if any on the masonry wall.
- Clean all the surfaces of adjacent wall window, R.C.C grills etc.
- All the corners arrises, angles and junctions shall be truely vertical or horizontal must be carefully finished.
- Sills of windows to be finish with Indian Patent stone (IPS) smooth finish in sloping form, from outside, as shown in (Fig 3)

Fig 3

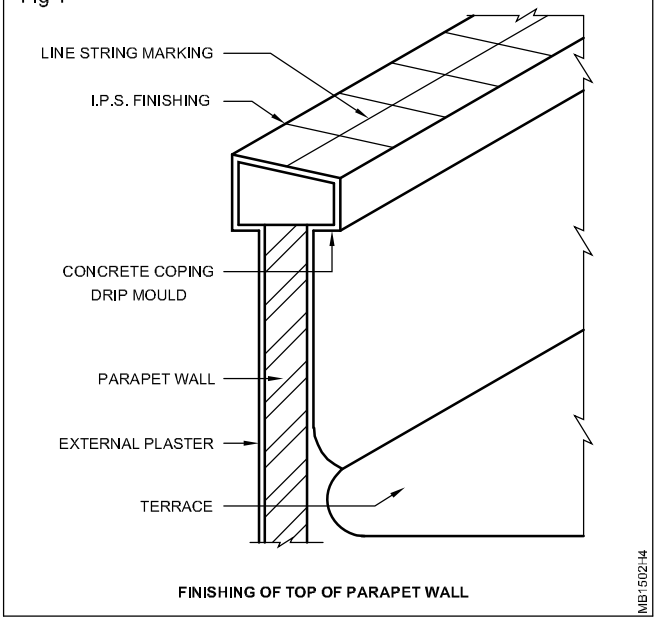


FINISHING OF WINDOW SILL FROM OUTSIDE

MB1502H3

- Sunshade projections over the window Lintel level should be finished with drip mould at bottom of the sunshade, and should be finished with smooth finish as per the specification.(Fig 4)

Fig 4

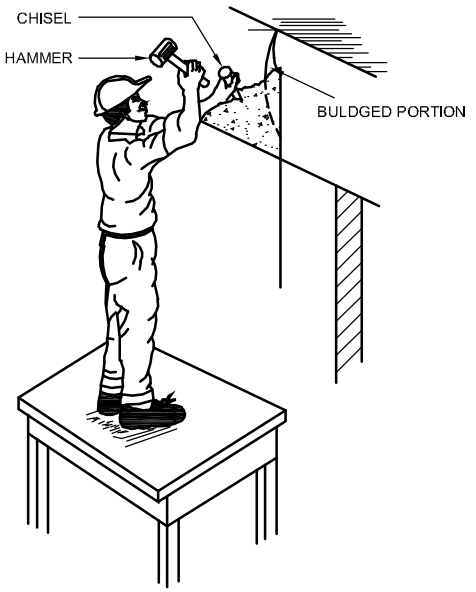


FINISHING OF TOP OF PARAPET WALL

MB1502H4

- The top of the parapet wall must be finished with smooth surface and line square cheques.
- Top should be sloping inside for minimum 12mm slope
- The second coat finished should be with sponge for uniform texture and finish
- Curing is required for minimum two days.
- The bulged portion of R.C.C beam, column and slab must be cut off before plaster work take place as shown in Fig 5
- Rounding or chamfering corners, arrises provision of grooves at junctions etc should be done very carefully by using M.S corners and mouldings.
- Any projected band of parapet wall should be cut in slope. This will help to keep the rain water away from wall
- The plaster should be finished to a true and plumb surface and to the proper degree of smoothness.

Fig 5



CHISELLING OF BULGED PORTION

Cutting G.I pipe

Objectives: At the end of this exercise you shall be able to
- **hold G.I pipe in pipe vice tightly**
- **mark the required length in G.I pipe with paper, tap and pencil**
- **step cut G.I pipe for depth of 5, 10, 15, 20, 25mm with hacksaw**
- **cut the G.I pipe with pipe cutter**
- **cut the G.I pipe at 45^0 with hacksaw.**

PROCEDURE

1 Hold G.I pipe in pipe vice tightly.

2 Mark the required lengths as per drawing.

3 Step cut G.I pipe for depth of 5, 10, 15, 20,25 mm.

4 Cut the pipe with pipe cutter.

Skill Sequence

Holding pipe in a pipe vice(S.S.1)

Objectives: This shall help you to
- **clean and check the vice for its functioning**
- **adjust the movable jaw of pipe vice to suit for the pipe.**
- **rest the pipe on the fixed jaw keeping the part to cut close to jaw.**
- **tighten the pipe using movable jaw.**

Marking the required length S.S.2

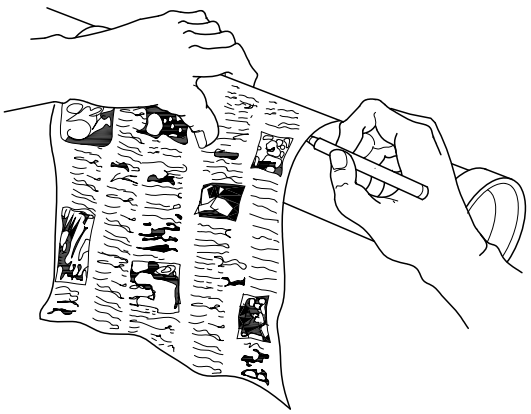
1 Measure length for cutting as per drawing.

2 Wrap a sheet of rectangular size paper at marked place around the pipe. Fig.1.

3 Bring the edges of paper together.

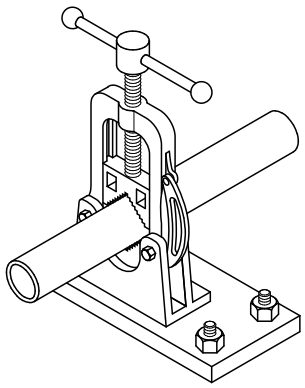
4 Mark around the edge of paper with pencil.

Fig 1



PB1301H1

Fig 2

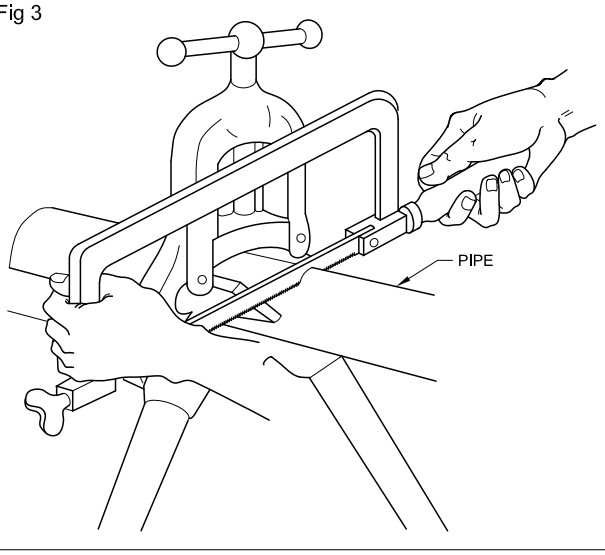


PB1306H2

9 Hold hack saw frame in left hand.

10 Move the blade to and fro on the marked groove @ 40 - 50 stroke per minute for full length of blade. Fig.3.

Fig 3



11 Apply cooland during cutting.

Cutting large diameter pipes

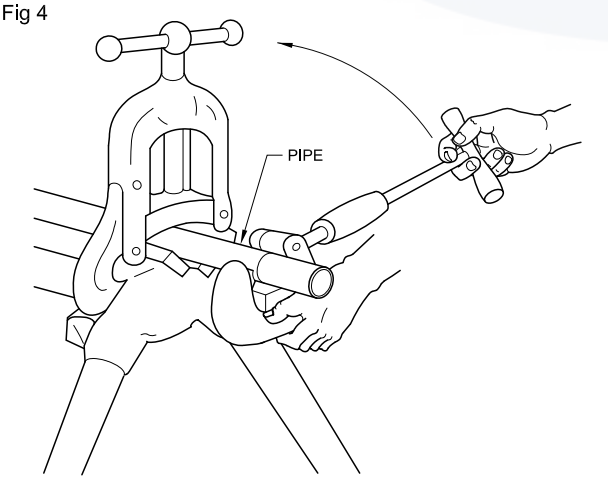
12 Rotate the pipe after cutting half depth.

13 Repeat the procedures.

Cutting with pipe cutter

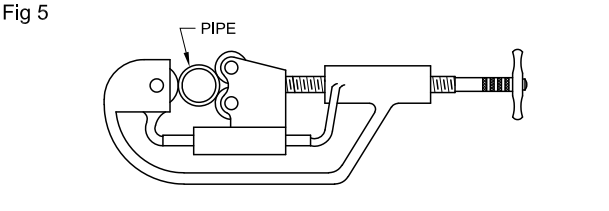
14 Fix the pipe in pipe cutter. Fig.4.

Fig 4



15 Rotate the handle to adjust the cutter till 3 wheels are in contact with pipe.Fig.5.

Fig 5



16 Rotate the pipe cutter around the pipe.

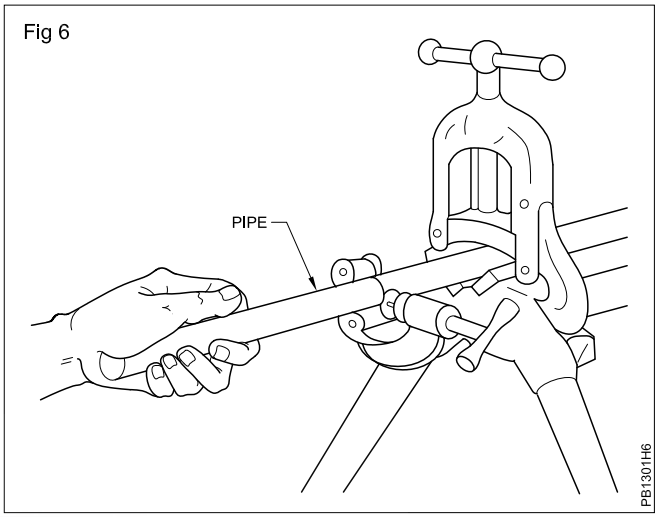
17 Check whether cutting wheel is sitting exactly on scribed line after one or two turns.

18 Put extra pressure on cutting wheel after two or three turns.

19 Continue the procedure.

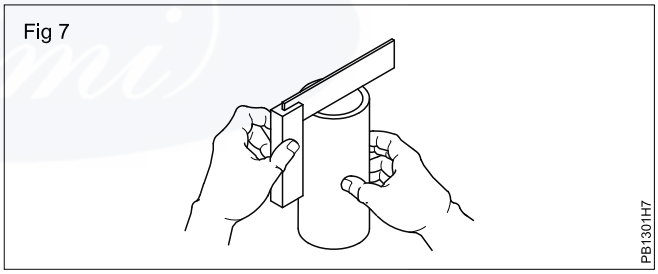
20 Support the pipe with free hand to avoid fall of pipe.Fig.6.

Fig 6



21 Continue to procedure till it is cut. Check the squareness of end. Fig.7.

Fig 7

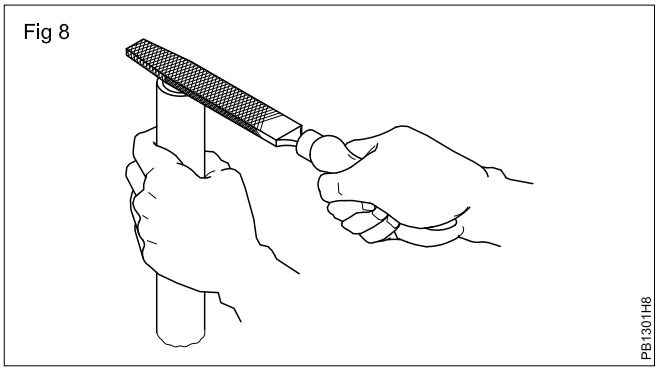


22 File square by using a half round file. Fig.8.

23 Check condition of cutter.

24 Clean it throughly.

Fig 8



Cutting AC pipe

Objectives: At the end of this exercise you shall be able to
- **rest A.C pipe over wooden/concrete block**
- **mark the given length with wetted, chalk and steel rule**
- **cut to the given length with chisel and hammer.**

PROCEDURE

1 Place the wooden/concrete block over level ground.

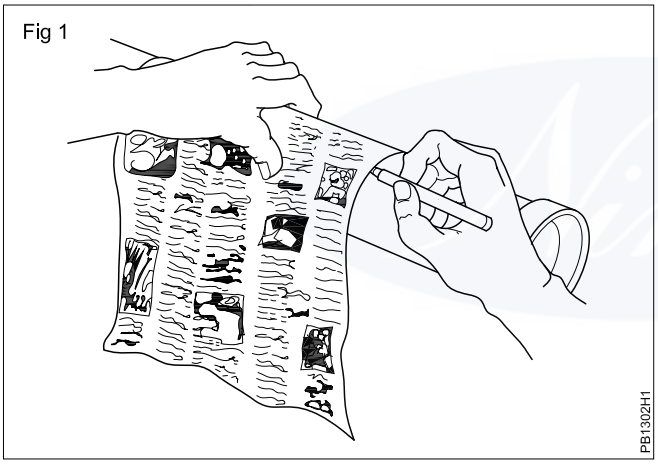
2 Place the pipe over the block.

3 Mark the given length from the edge of the pipe.

4 Wrap a sheet of rectangular size paper around the pipe and bring the edges together.

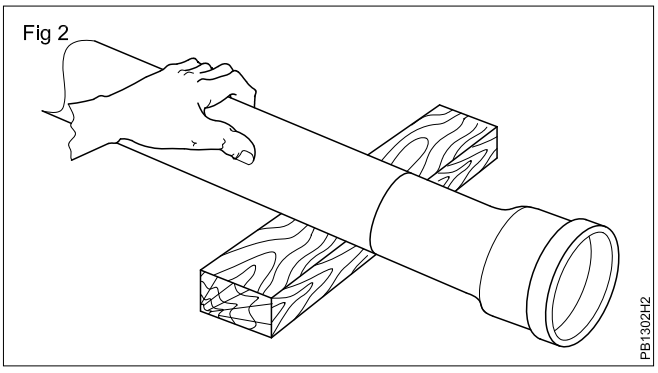
5 Mark around the edge with a piece of wetted chalk. (Fig.1)

Fig 1



6 Position the block just to the rear of the chalk mark. (Fig.2)

Fig 2

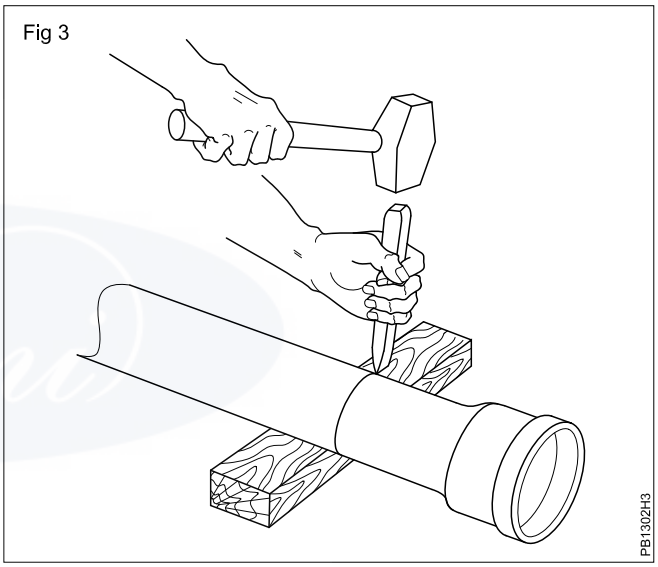


7 Align the chisel with the chalk mark.

8 Wear safety glass before starting chiselling.

9 Give hammer blowes lightly to the pipe. Repeat the process rotating the pipe.(Fig.3)

Fig 3

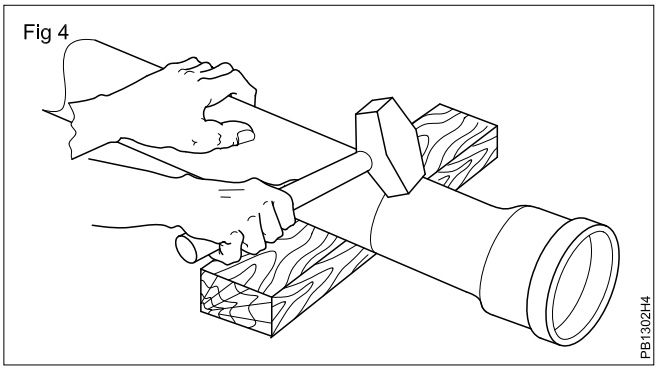


10 Tap the pipe gently with the hammer near the cut mark.(Fig.4)

11 Continue taping and rotating the pipe till the piece breaks off.

12 Clean the edge of the cut pipe by rubbing the piece gently against cement floor.

Fig 4



Cutting SW pipe

Objectives: At the end of this exercise you shall be able to
- **rest SW pipe over sand bed**
- **mark the given length with wetted chalk and steel rule**
- **cut to the given length with chisel and hammer.**

PROCEDURE

1 Place the pipe over the sand, bed.

2 Place the pipe over the block.

3 Mark the given length from the edge of the pipe.

4 Wrap a sheet of rectangular size paper around the pipe and bring the edges together.

5 Mark around the edge with a piece of wetted chalk.

6 Position the block just to the rear of the chalk mark. (Fig.1,2)

Fig 1

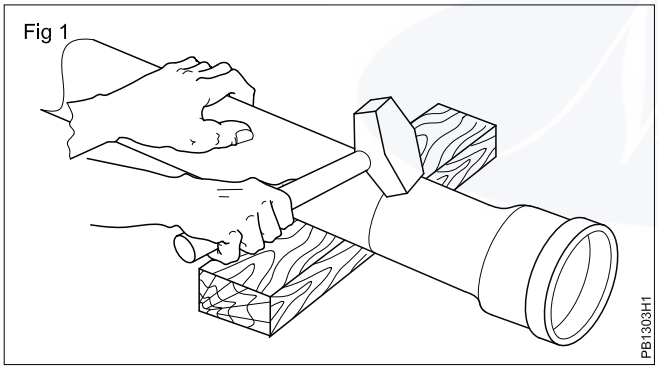
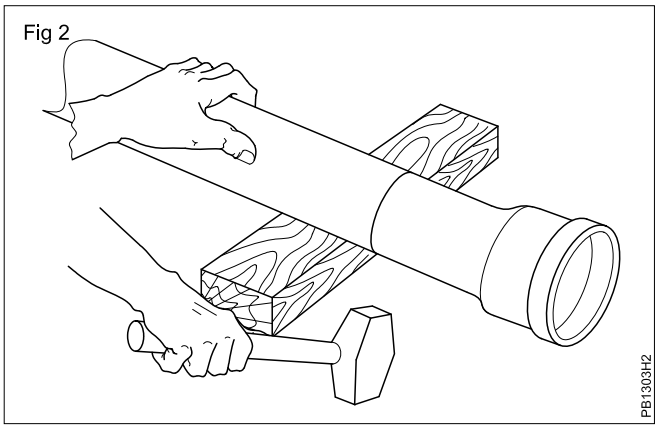
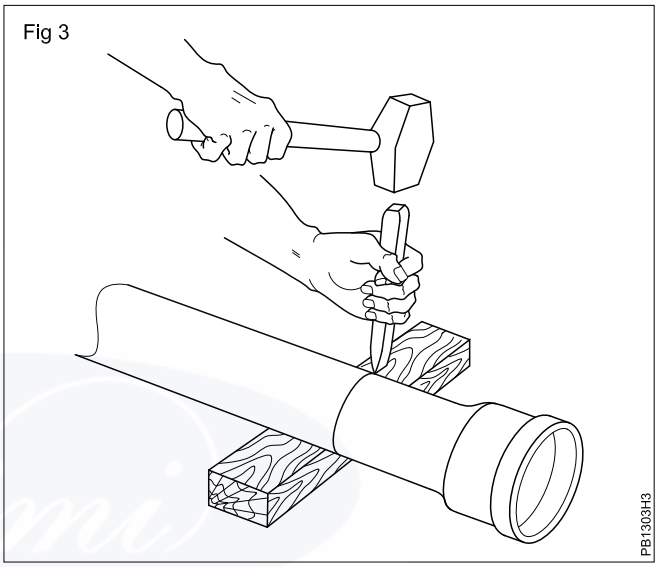


Fig 2



7 Align the chisel with the chalk mark.(Fig.3)

Fig 3



8 Wear safety glass before starting chiselling.

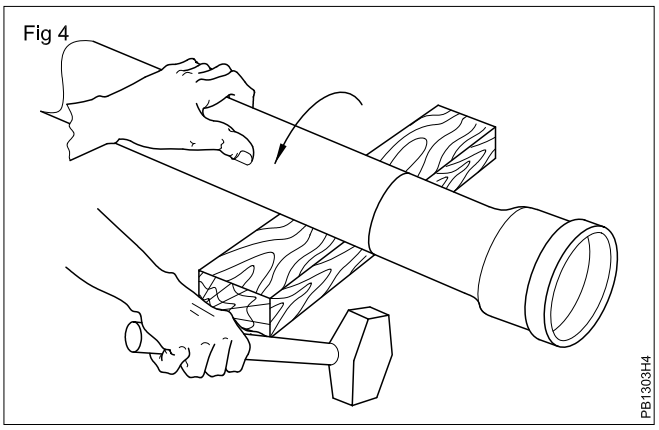
9 Give hammer blowes lightly to the pipe. Repeat the process rotating the pipe.

10 Tap the pipe gently with the hammer near the cut mark.(Fig.4)

11 Continue taping and rotating the pipe till the piece breaks off.(Fig.4)

12 Clean the edge of the cut pipe by rubbing the piece gently against cement floor.

Fig 4



Cutting of cast iron pipe

Objectives: At the end of this exercise you shall be able to
- **cut any given length of cast iron pipe using hammer and chisel to accuracy of 1.2mm**
- **produce a cut that is square and free of any cracks or other defects**
- **remove any sharp edges on the end of the cut pipes.**

PROCEDURE

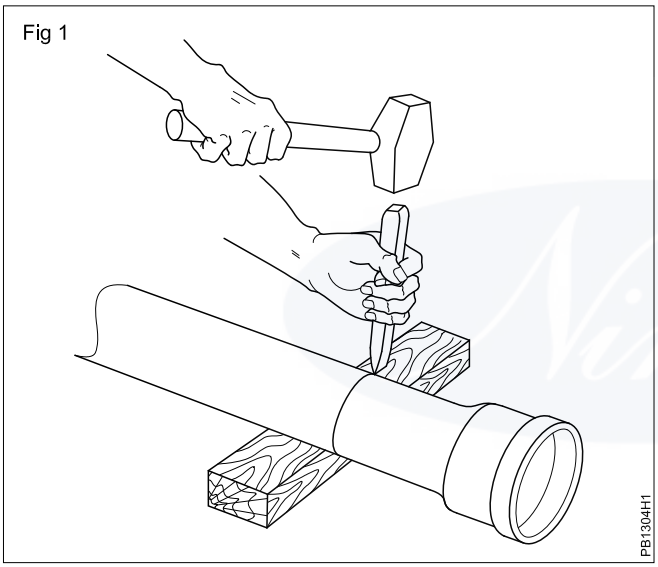
1 Measure accurately length of pipe required.

2 Make square round the pipe.

3 Place the pipe over wooden "V" block.

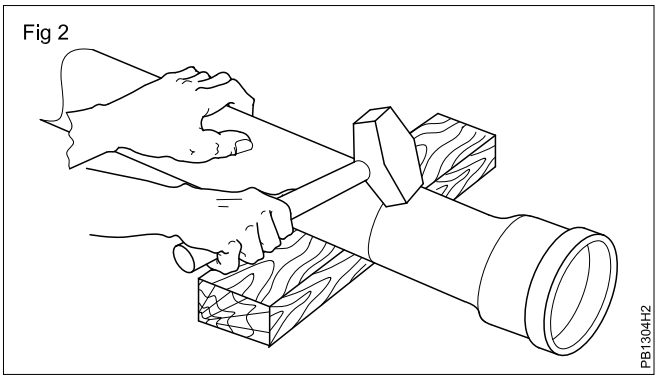
4 Cut the pipe along the mark. Fig.1

Fig 1



5 Tap the end of pipe after 3 or 4 cut around the pipe.Fig.2.

Fig 2

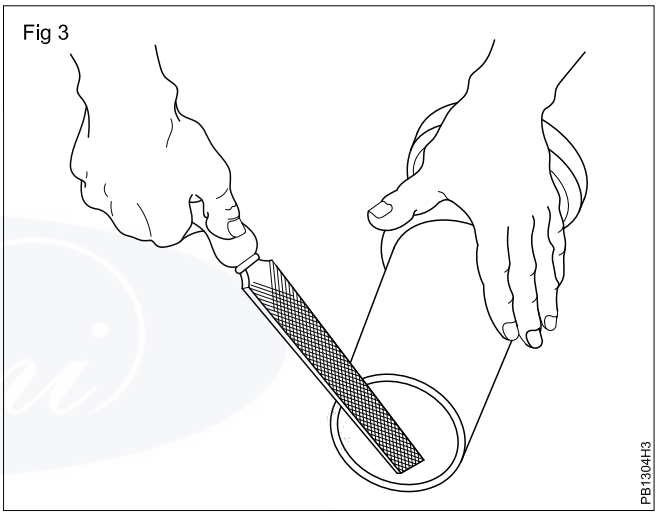


6 Rotate the pipe if the cut does not break.

7 Repeat cutting and taping till pipe is cut.

8 File the edge with flat file. Fig.3

Fig 3



To unroll, cut and bend soft copper tubing

Objectives: At the end of this exercise you shall be able to
- **unroll copper tubing from the roll**
- **cut the copper tube for the given size**
- **bend the copper tube according to the fig.**

Requirement

Tool/Instruments

- Mallet or plastic hammer
- Tube cutter (0.25 mm)
- Reaming tool
- Spring bender (6 mm)
- Lever type bender (6 mm)
- Metal tape or steel rule
- Triangular file 15 mm

Materials

- Copper tube ∅ 6 mm - 1 coil
- Cotton waste
- A small quantity of oil

PROCEDURE

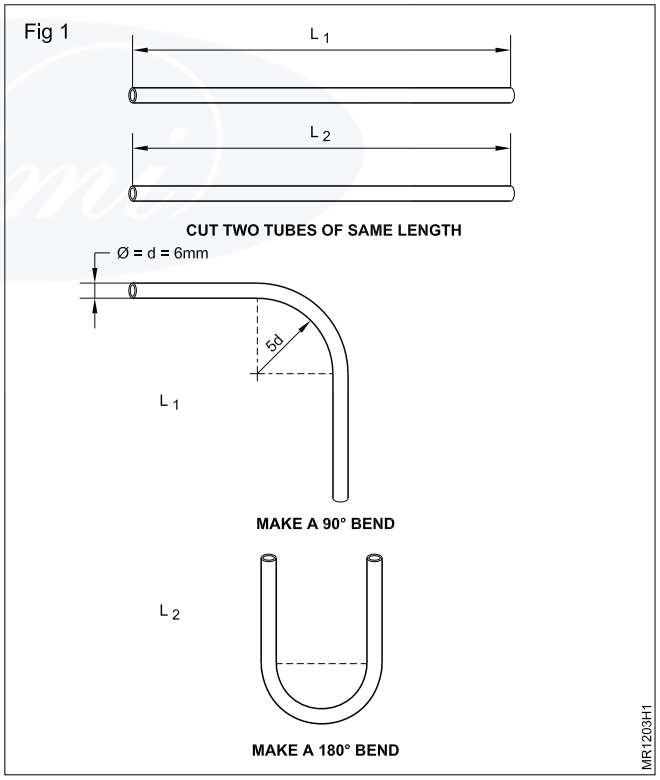
TASK 1 **: Unrolling**

1 Place the tube on the flat clean surface

2 Unroll tube to the required length

3 If any bend in the tube straighten the tube with light blows from mallet or plastic hammer

Fig 1



Observation Table

Sl.No.	Parameter	Remarks
1	Straightness of the tube	Excellent/Very good/Good/Average
2	Safe handling of the tube	Excellent/Very good/Good/Average
3	Unrolling other sizes of tube	Excellent/Very good/Good/Average
	Note : Repeat it for various sizes of tubes	

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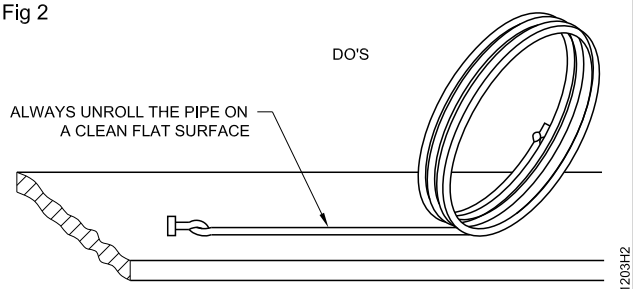
TASK 2 **: Tube cutting**

1 Carefully measure the length of pipe needs and mark the outside (where you are going to cut with the edge of a file.

2 Place the pipe between the bottom rollers and the top cutting wheel. (Fig 2)

Fig 2



3 Position the pipe so that the cutting wheel is in line with the mark that you made with the file.

4 Tighten the handscrew until the cutting wheel just touches the outside of the pipe.

5 Turn the pipe cutter slowly around the pipe so that the cutting wheel cuts gradually into the outside.

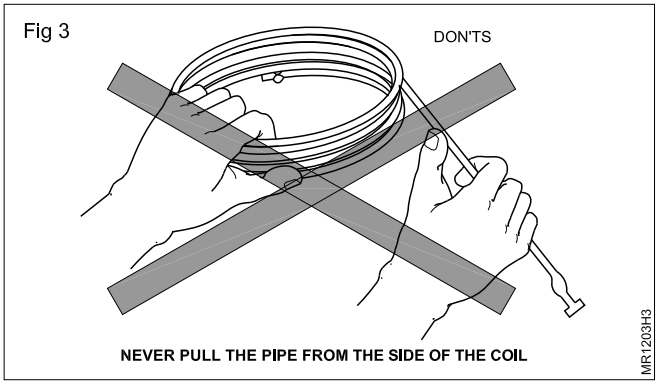
6 Turn the handscrew to increase the pressure of the cutting wheel and then turn the cutter around the pipe again. (See Fig 2).

7 Continue the cutting by gradually increasing the pressure of the cutting wheel. Work slowly and carefully. Do not use too much pressure or you may damage the pipe.

8 When the cut is complete seal the open end and roll the pipe back into a coil.

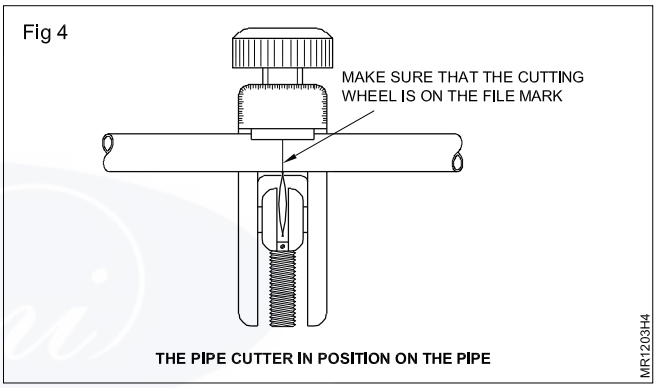
9 To remove all rough edges from the end of the pipe, use the reaming tool. (Fig 3)

Fig 3



10 Hold the open end of the pipe to be reamed down (so that pieces of copper will not get inside the pipe). Turn the reaming tool until all rough edges have been removed from the inside of the pipe. (Fig 4)

Fig 4



Observation Table

Sl.No.	Parameter	Remarks
1	Length of the tube cut	Excellent/good/average
2	Cleaned edges of the tube	Excellent/good/average
	Note : Repeat the exercises for various sizes of tubes.	

Observation Table

Sl.No.	Parameter	Remarks
1	Angle of the bend 1	Correct/ not correct
2	Angle of the bend 2	Correct/ not correct
	Note : Repeat the same procedure for various sizes of tubes.	

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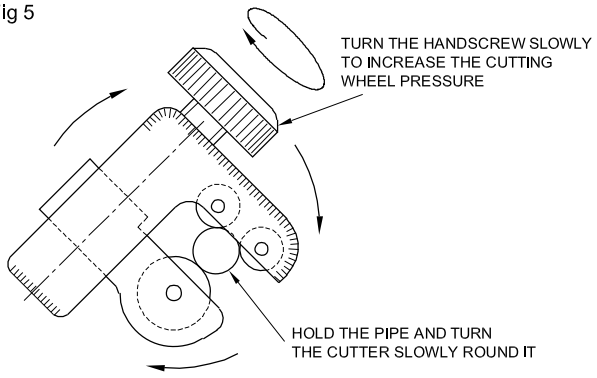
TASK 3: **How to bend the pipe**

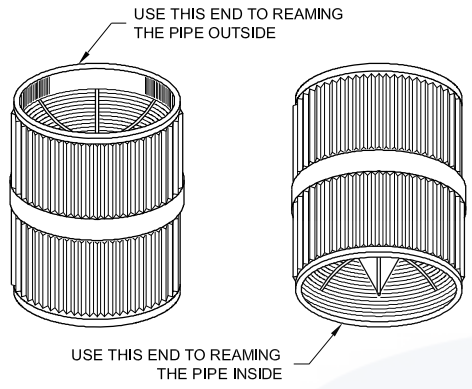
Fig 5



MR1203H5

USING THE PIPE CUTTER

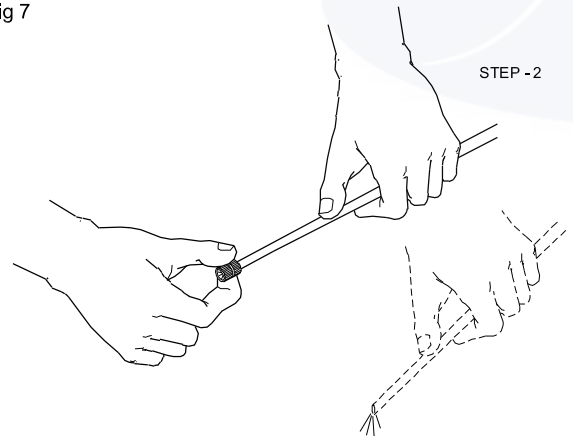
Fig 6



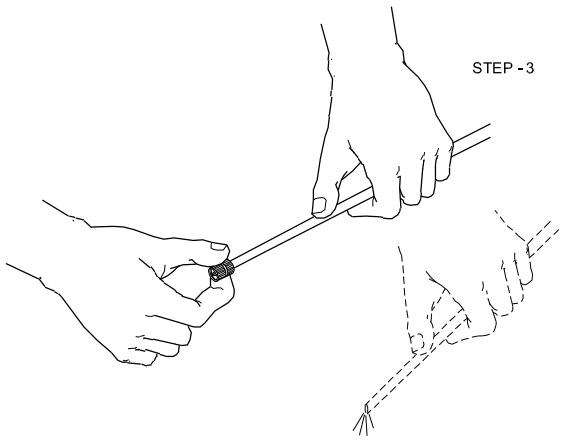
MR1203H6

THE PIPE REAMING TOOL

Fig 7



REAMING THE INSIDE OF THE PIPE



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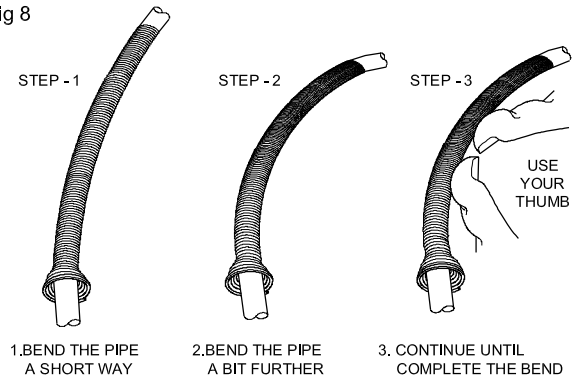
REAMING THE OUTSIDE OF THE PIPE

Fig 8



MR1203H8

BENDING THE COPPER TUBING USING SPRING BENDER

Fig 9

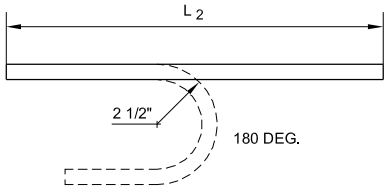


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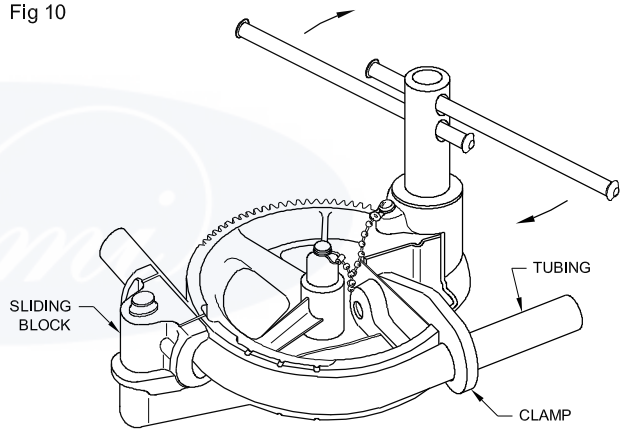
Fig 10



MR1203HA

ACCURATE TUBE BENDER

1 Refrigeration pipe is soft and can be bent by hand. Because it is soft it can be easily damaged when bending.

2 If the pipe is hard and will not bend easily, it must be annealed before use.

3 Push a bending spring onto the outside of the pipe (see drawing). This helps the pipe to bend evenly.

4 Bend the pipe a little at a time using your thumbs (see drawing). Do not try to complete the bend with one movement. This will cause the pipe to buckle.

5 Do not make a sharp bend in the pipe. If the pipe diameter is 1/4 inch (6 mm), the sharpest bend that you can make without risk of damaging the pipe is 1 inch (2.5mm) radius (see drawing). Not less than 5 times of its diameter.

6 Pipe that cracks, splits, wrinkles or flattens during bending must not be used.

7 Bend the pipe so that it fits onto the connection easily (see drawing).

To swage and make a brazed joint on copper tubing of same size

Objectives: At the end of this exercise you shall be able to
- **swage a copper tube (6 mm OD pipe)**
- **make a brazed joint**

Requirement

Tool/Instruments

- Flaring block
- Swaging tool set
- Ball pane hammer 225 gms
- Blow lamp or Gas welding set

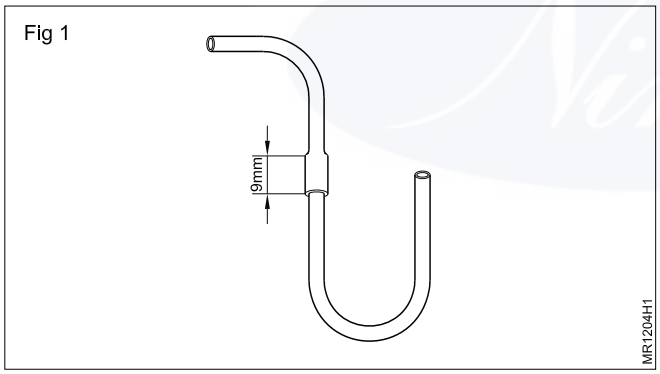
Materials

- Brazing rod
- Brazing flux
- A small quantity of oil
- Cotton waste
- Kerosene (if blow lamp used)
- Gas with cylinder (for welding)
- Match box
- Stove box
- Copper tube (two pieces 6mm OD)

PROCEDURE

TASK 1 **: How to swage the end of the pipe**

Fig 1



1 To join two pieces of pipe of the same size together one must be made larger so that the other fits inside

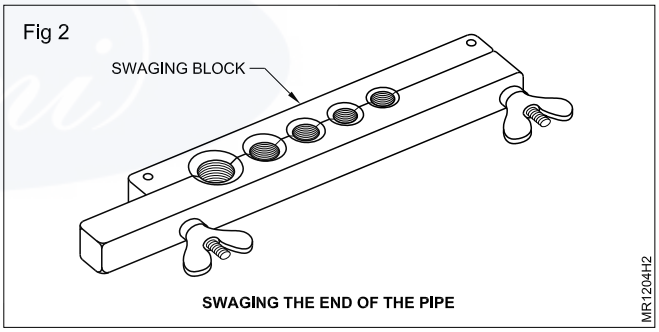
2 Making the end of a pipe larger is called swaging

3 The tool used for swaging is shown in the drawings opposite. Examine the pipe swaging tool and compare it with the drawings. Make sure that you understand how it works before starting to swage the end of a pipe

4 Place the pipe in the tool (See Fig 4). Make sure that you have choosen the correct size hole to fit the pipe

5 Position the pipe so that the end is “the outside diameter of the pipe plus 1/8 inch (3 mm) above the top of the swaging block (Fig 2). For 1/4 inch (6 mm) pipe this will be 1/4 inch (6mm) + 1/8 inch (3 mm) = 3/8 inch (9 mm), as shown.

Fig 2

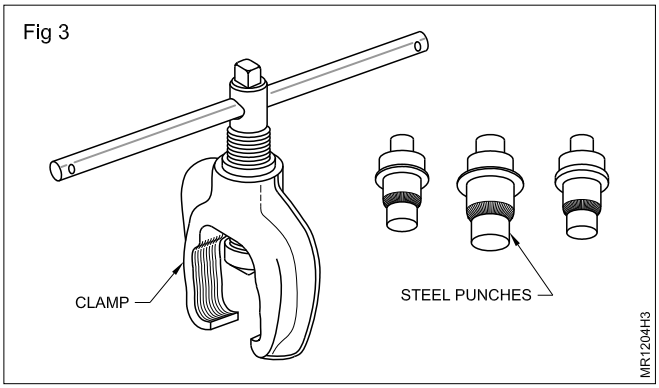


SWAGING THE END OF THE PIPE

6 Tighten the nuts at each end of the swaging block

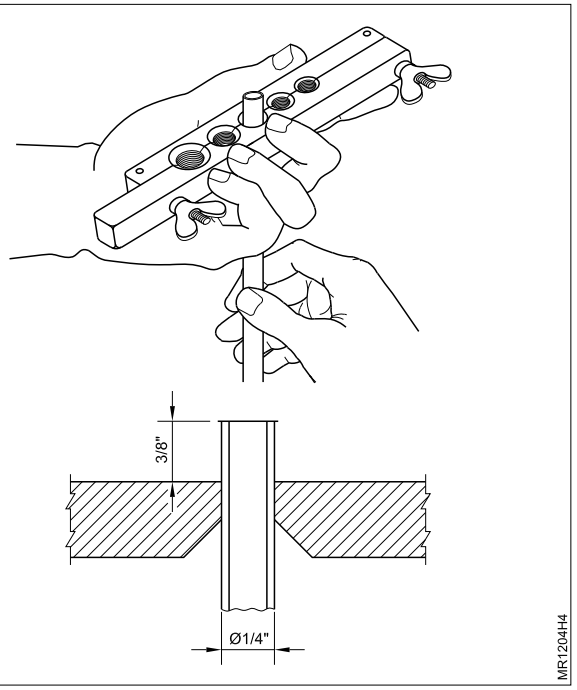
7 Choose a punch of the right size to swage out the end of the pipe so that another piece fits inside. Oil the punch. Fit the clamp and punch onto the swaging block. Force the punch into the pipe (Fig 3).

Fig 3



8 The punch will open out the end of the pipe (Fig 4).

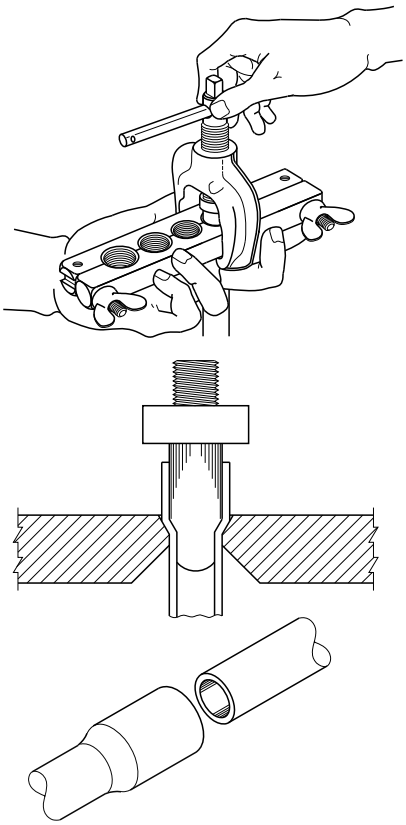
Fig 4



9 Remove the pipe from the swaging block. Another piece of pipe can be fitted into the swaged end (Fig 5).

10 If the pipe does not fit easily into the swaged end, use the reaming tool to clean the inside of the swage.

Fig 5



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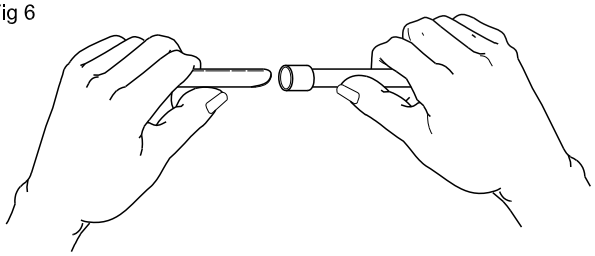
TASK 2**: How to braze a swaged joint**

1 Make sure that the pipe enters the swage properly. It must be an “easy” fit. If it is a tight fit there will not be sufficient space for the brazing material. If it is a loose fit the joint will be weak (Fig 6).

Fig 6



2 Mix a little flux powder with spirit (or water) to make a stiff paste.

3 Apply a small amount of flux to the surfaces to be joined. Only a small quantity is necessary. Too much will contaminate the system. (Fig 7)

If “self-fluxing” brazing rods are being used this stage of the work is not necessary

4 Push the end of one pipe into the swage of the other as far as possible. Turn the pipes to spread the flux. (Fig 8)

Fig 7

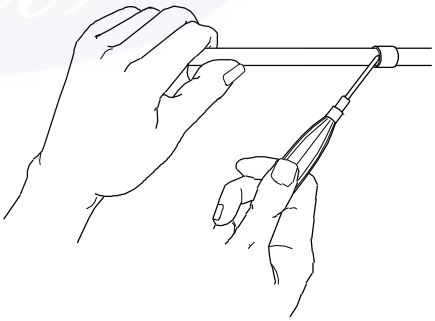
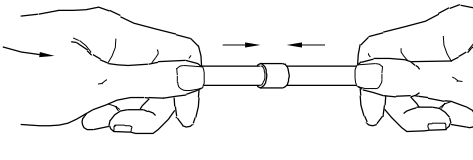
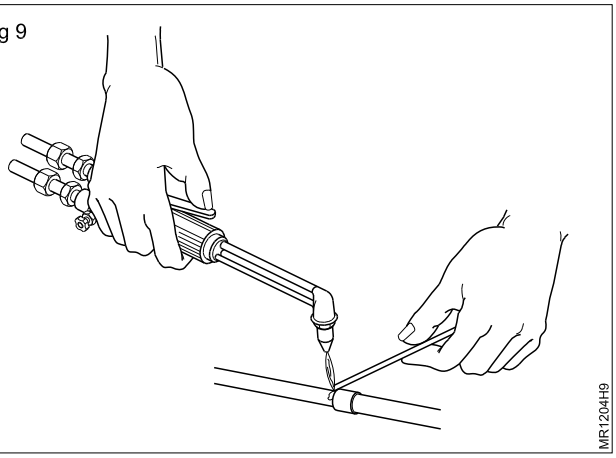


Fig 8



5 Heat the joint with the blow torch. Use a flame of the right size. (Fig 9)

Fig 9



6 Wait until the joint is dull red. When the brazing rod starts to melt the joint is at the right temperature. This temperature is found by touching the brazing rod onto the joint from time to time while heating. Do not overheat the joint. Do not leave the brazing rod in the flame. The brazing rod must be melted by the heat of the joint and not by the flame.

7 When the right temperature has been reached touch the joint with the brazing rod at several points

8 Molten brazing rod will be drawn into the joint and fill the space between the outside of one pipe and the swaged end of the other. When a complete ring of brazing material can be seen at the end of the swage remove the blow torch.

9 Allow the joint to cool. Do not move either pipe until the brazing material has hardened.

Observation Table

Sl.No.	Parameter	Remarks
1	Testing the swaging	Excellent/Good/Average
2	Testing the brazed joint	Firm/ Blow holes
3	Time taken	Slow/Medium/Fast
4	Materials waste	Less/Very less/No waste
	Note: Repeat the same exercise for various sizes of tube and test the improvement.	

To make flare joints and test them with flare fittings

Objectives: At the end of this exercise you shall be able to
- **make flaring at the end of the tube**
- **join the flare fittings**
- **test the flared and brazed joints.**

Requirement

Tool/Instruments

- Flaring block with yoke
- Adjustable wrench - 200 mm
- Valve key 6 mm (cylinder valve opener)
- Pressure gauge with adapter
- Flat file smooth - 200 mm
- Cylinder with pressure

Materials

- Copper tubes
- Flare nut 6 mm size
- Thread seal tape
- Soap solution with stirrer
- A small quantity of oil

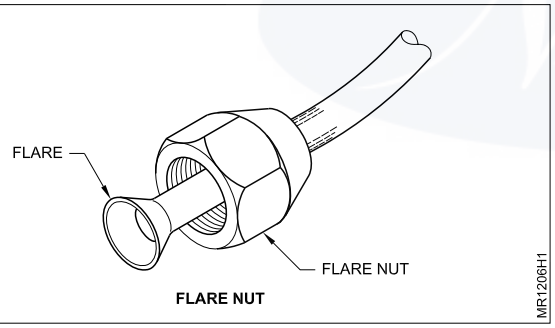
PROCEDURE

TASK 1: **Flaring**

1 Refrigerator pipes are sometimes jointed to fittings by making a flared connection

2 The end of the pipe is opened out to form a cone (Fig 1).

Fig 1



3 Always place the special flare nut on the pipe first before flaring.

4 Examine the pipe flaring tool. Make sure that you understand how it works before starting to flare the end of a pipe.

5 Make sure that the end of the pipe is free of rough edges before flaring

6 Place the pipe in the tool (Fig 2). Make sure that you have:

a Place the flare nut on the pipe

b Chose the correct size hole in the flaring tool to fit the pipe; (there are 5 holes to fit different sizes of pipe.)

7 If the pipe is 1/4 inch (6 mm) in diameter, position the pipe so that the end is at least 2 mm above the top of the flaring block (Fig 3). (This distance is calculated as “pipe diameter divided by 3”; in this case, 6 mm divided by 3 = 2mm).

Fig 2

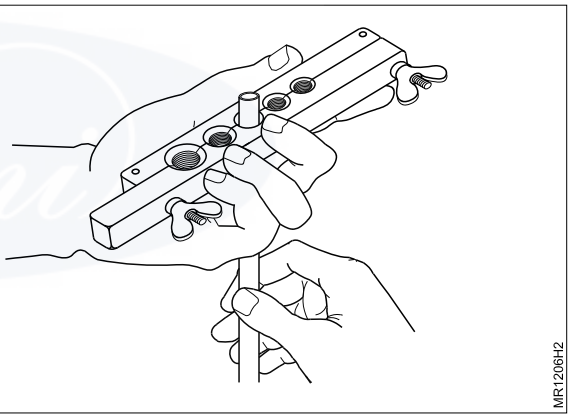
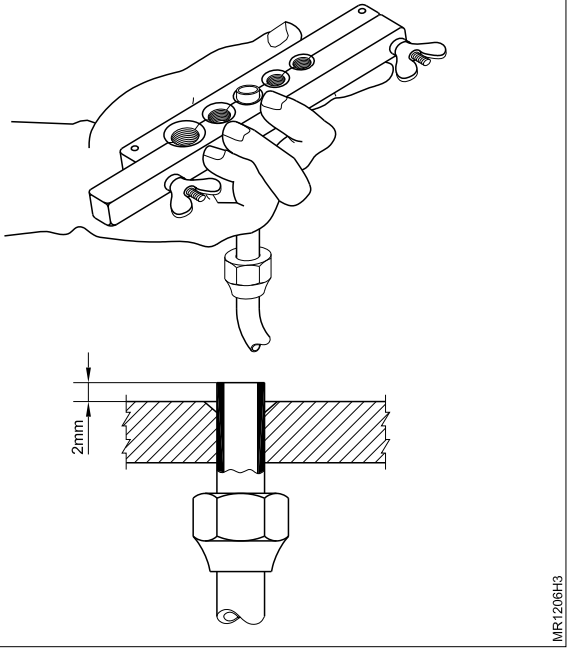


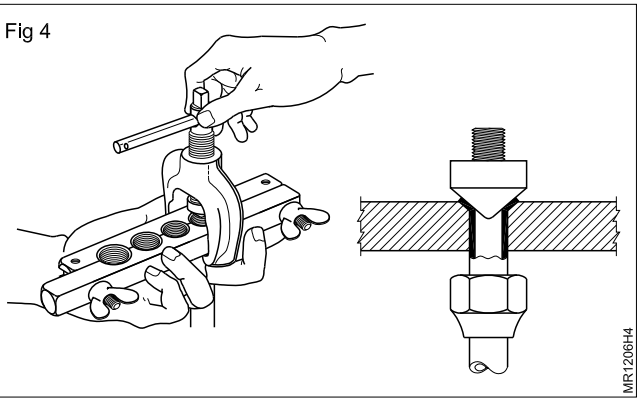
Fig 3



8 Tighten the nuts at each end of the flaring block (see drawing).

9 Fit the yoke to the flaring block (Fig 4)

Fig 4



10 Oil the cone and slowly screw it into the end of the pipe

11 The end of the pipe will be formed into a flare (Fig 2)

12 Remove the flared pipe from the block.

13 Examine the flare. If it has cracked, the cone was screwed down too quickly.

14 Make sure that the flare is the correct size. It should just fit inside the flare nut. If it is too loose, cut off the flare and start again at instruction 5.

At instruction 7, use 3 mm instead of 2 mm. Repeat until the flare is the correct size for the flare nut - not too loose and not too tight.

Observation Table - 1

Sl.No.	Skills	Remarks
1	Checking Flaring	Cracked/uneven/too small/too long/correct
2	Number of attempts	One/two/three
	Note : Repeat the steps to the various sizes of copper tube	

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TASK 2**: Joining with flare fittings**

1 Put thread seal tape on the thread

Push back the flare nut and place the flared tube on the fitting, then tighten the nut using adjustable wrench or suitable double end spanner.

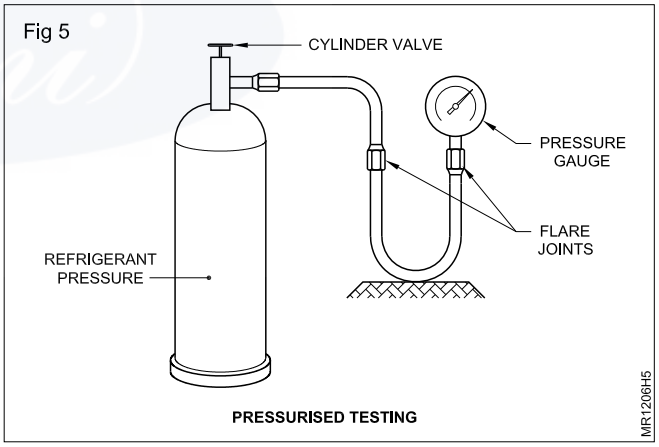
2 Tighten the one end of the tube to the cylinder with the flare nut. (Fig 5)

3 Connect a pressure gauge at the other end of the tube with flare nut.

Note :

- **Do not give more pressure while tightening since this will spoil flare.**
- **Make sure that they should not be loose in the tube.**

Fig 5



PRESSURISED TESTING

Observation Table - 2

Sl.No.	Skills	Remarks
1.	Selection of correct fittings	Correct/not correct
2	Joining method	Excellent/good/fair
3	Time taken	Less/very less/more

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TASK 3**: Joining with flare fittings**

1 After joined the tube firmly, open the cylinder valve with help of valve key or ratchet.

2 The pressure will be shown in the pressure gauge.

3 Then close the cylinder valve. Major leaks will make noise and that needs the nut to be tightened.

4 If there is no leak, the pressure in the pressure gauge will remain constant.

5 If it decreases, check the joints with soap solution foam. Leak will bubble, then tight the joints. If it stands still then there is no leak.

Observation Table - 3

Sl.No.	Skills	Remarks
1.	Selection of tools	excellent/good/average
2	Detecting leak and arresting	excellent/good/average

Instructor

Trainee

To pinch off copper tubing and test for leak

Objectives: At the end of this exercise you shall be able to
- **pinch off copper tubings, braze the end of the tube and test for leaks**
- **pinch off the copper tube using pinching tool.**

Requirement

Tool/Instruments

- Tube cutter with reamer
- Small triangular file
- Pinch off tools
- 3/4" double end
- Steel rule

Materials

- Soft tubing 1/4",3/8",1/2" - 1 Roll each
- Clean cloth

PROCEDURE

TASK 1**: Pinch Off tool**

1 Unroll 1/4" soft copper tubing so that a 3" piece may be cut.

2 Measure 3" piece long tube using the steel ruler and mark it by nicking the face with a triangular file.

3 Cut the copper tube by placing the tubing in 'V-guide' of the cutter

4 Tighten the thumb screw until considerable pressure is applied

5 Revolve cutter slowly around the tubing

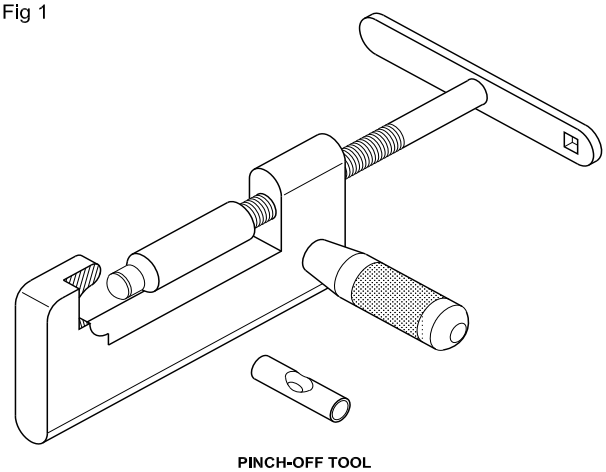
6 Seal the end of the tubing coil after cutting off the required piece

7 Ream and file the edges of the tubing

8 Repeat with other sizes using 3/8" and 1/2" tubes (steps 1 to 7)

9 Place copper tube in the pinch off section of the tool apply even pressure by turning screws equally by hand. (Figs 1 & 2)

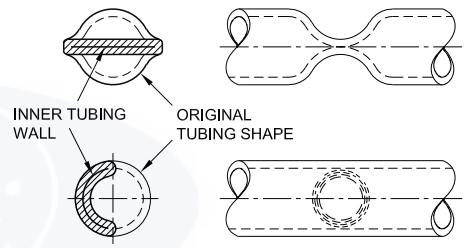
Fig 1



PINCH-OFF TOOL

MR1207H1

Fig 2



ACTION OF PINCH-OFF TOOL

MR1207H2

10 Take a part turn on one screw and then an equal amount on the other

11 The tightening process must carry on until the two blocks are evenly seated

12 The tube is then pinched shut

Safety precautions

13 Do not unroll the tube too much as rolling and unrolling tends to induce work hardening

14 Do not tighten the thumb screw too much to avoid pinch in the tube

15 Observe other general safety conditions

Brazing

16 Carry out the brazing as detailed in Ex. 204

Test for leaks

17 Check for the leaks by using soap solution; apply soap solution on the brazing, find any bubbles coming out after application, if yes, rework to rectify.

To braze copper and MS tube

Objective : At the end of this exercise you shall be able to
- **braze copper with MS tube**

Requirement

Tool/Instruments

- Tube cutter
- Flaring block
- Triangular file (small)
- Wire brush
- Cylinder wrench

Equipments

- Oxy-acetylene welding set

Materials

- Sand paper
- Silver brazing flux
- Silver brazing rod
- Copper tube
- MS tube
- Clean cloth

PROCEDURE

TASK 1**: Cut the copper tube**

1 Place the tube in V-guide of cutter

2 Tighten the thumb screw until considerable pressure is applied

3 Revolve the cutter slowly around the tube so that the sharp cutting wheel feeds gradually on the tubings to apply pressure thumb screw till tube is completely cut

4 Ream and file the edges of the tubing

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TASK 2 **: Brazing**

1 Use sand paper to clean the outer surface of the tube and clean inside by wire brush

2 Make a paste of silver brazing flux by mixing it with little bit of water and apply a thin coat of flux to outside of the fitting

3 Insert the pipe into MS pipe and see that the fit is not too easy (Fig 1)

4 Clamp the pipe in the flaring block and mount the block in the vice

5 Light the oxy-acetylene torch using the spark lighter

6 Heat the connection at safe distance from the joint until the water vapourizes

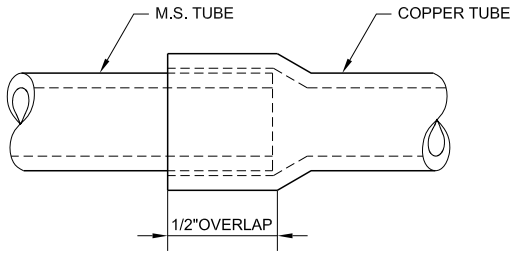
7 Continue heating until the flux turns milky and finally turns clean (Fig 2)

8 Apply the silver solder to both edges of the MS tube until the solder flows on both pipes

9 Remove silver solder rod and allow the joint to cool

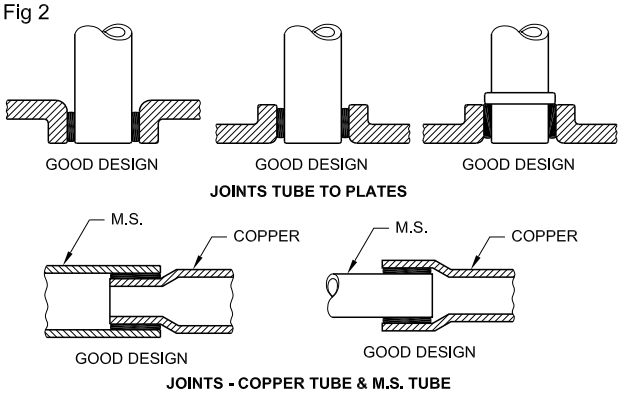
10 After cool the assembly and test the connector to 10.5 kg/cm^2 pressure.

Fig 1



SILVER BRAZING TO MAKE CONNECTING JOINTS

Fig 2



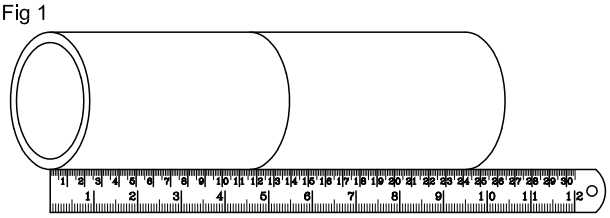
Bending pipes

Objective : At the end of this exercise you shall be able to
- **bend pipe in cold condition using a pipe bending machine.**

PROCEDURE

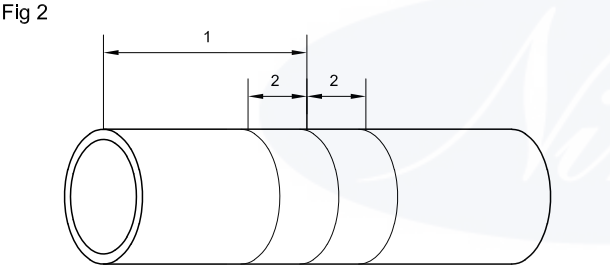
1 Check the pipe for squareness and ensure it is free from burrs. Measure and mark off the centre of the bend. (Fig 1)

Fig 1



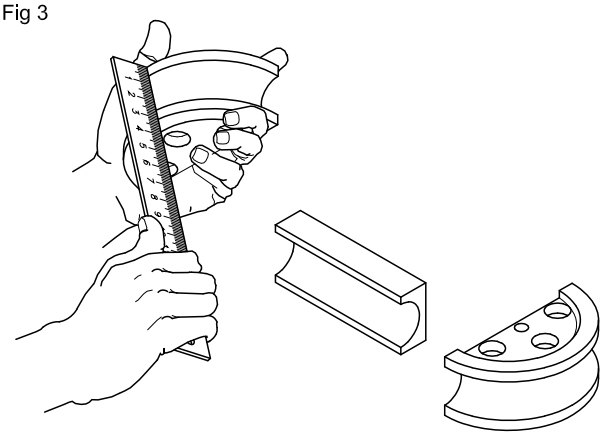
2 Mark off the beginning and the end of the bend from the centre line. (Fig 2)

Fig 2



3 Select the former to suit the size of the pipe.(Fig 3)

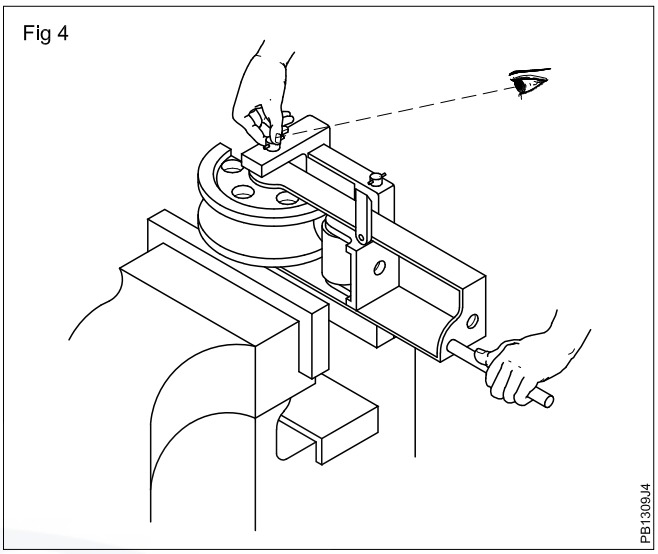
Fig 3



4 Clamp the bending machine in a bench vice.

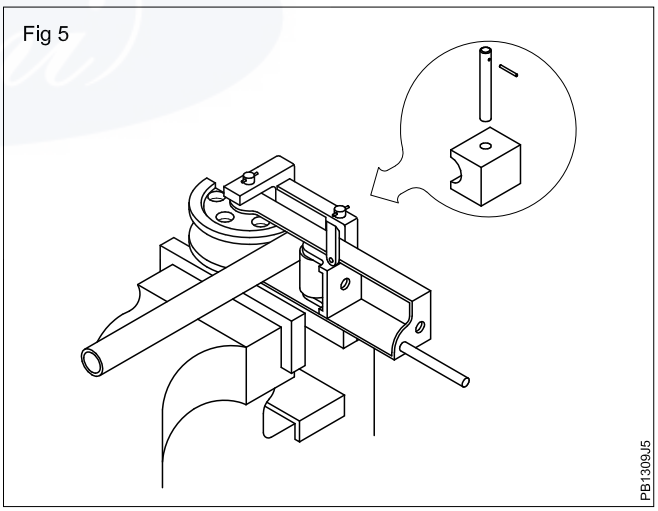
5 Keep the former in position and lock with a pin. (Fig 4).

Fig 4



6 Fix the back-stop with a pin. (Fig 5)

Fig 5



7 Place the pipe in the bending machine, passing it through the bending arm and ensuring that it is seated with the groove of the former and against the back-stop, (Fig 6) and set the roller on the bending arm by adjusting the screw and lock nut. (Fig 7)

Fig 6

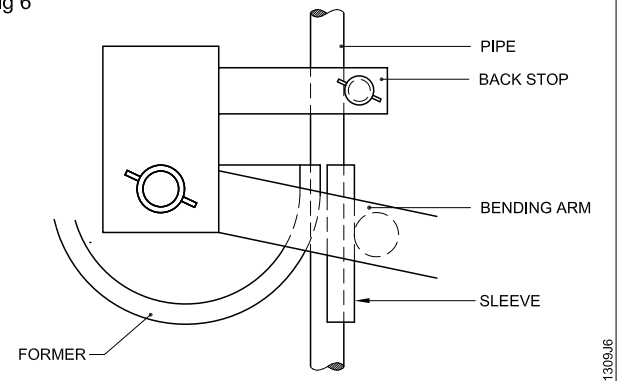
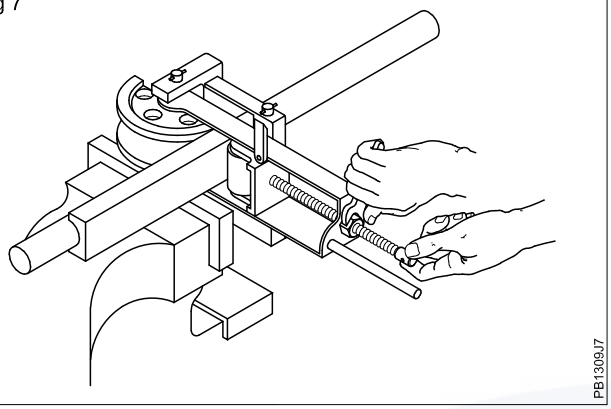
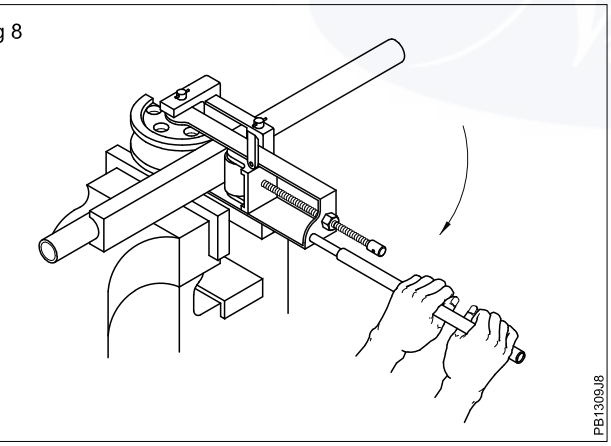


Fig 7



8 Bend the pipe by pulling the bending arm towards your body.(Fig 8)

Fig 8



Ensure that the stance is properly balanced while bending.

9 Check the angle and radius of bend using templates. (Fig 9 & 10)

Fig 9

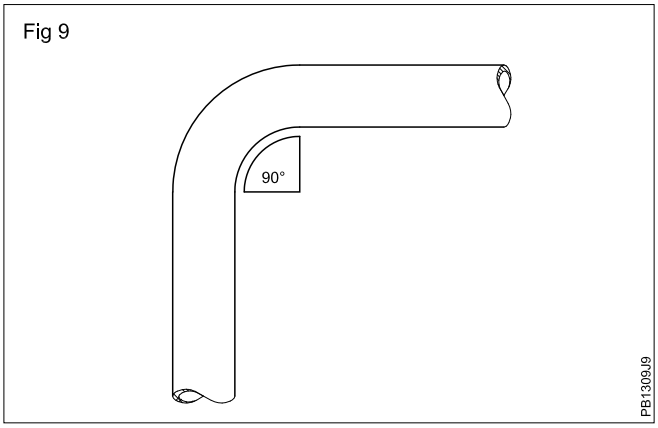
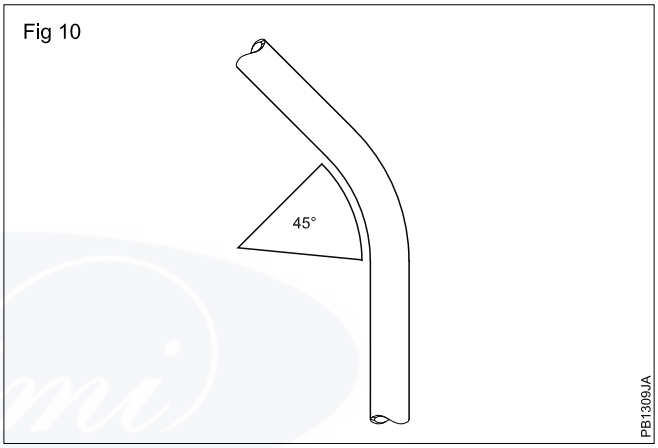


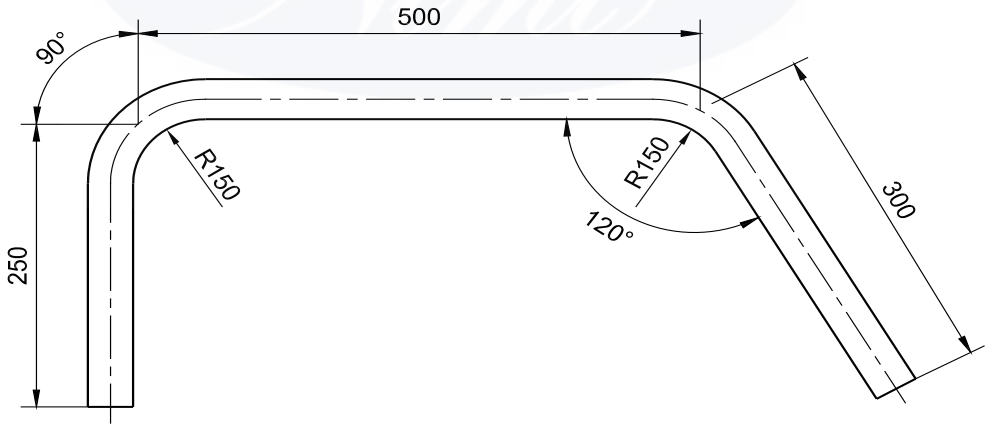
Fig 10



Pipe bending by cold method

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

- **prepare a layout for pipe bending job**
- **bend the pipe to the desired angle using pipe bending fixture**
- **check the bend pipe for the correctness of angle**
- **bend the pipe using hydraulic pipe bending machine**
- **check the correctness of the second bend.**



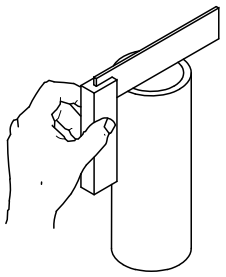
1	Ø25 x 4.5 - 820	--	Fe310-O	--	--	4
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PIPE BENDING (BY COLD METHOD)	DEVIATIONS ±0.5	TIME 5h
		CODE NO. MM1304E1	

PROCEDURE

File the pipe ends and check up its squareness. (Fig. 1)

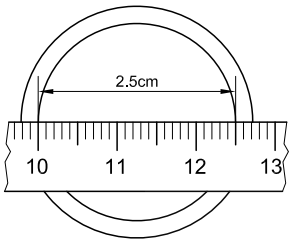
Fig 1



MM1304H1

Check the inside dia. of the pipe by using steel rule. (Fig. 2)

Fig 2



MM1304H2

Please change the reading from inside diameter from 10cm. Measure the length of the pipe as per drawing

r=radius of bend (i.e) 150mm

Ø=angle of bend

l=length of curved portion

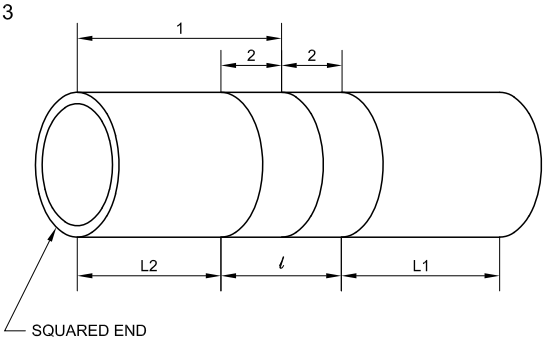
then

$$l = \frac{\pi \times D \times Ø}{360}$$

L = Total length
= L1 + l + L2

Mark off the beginning and the end of the bend from the centre line. (Fig. 3)

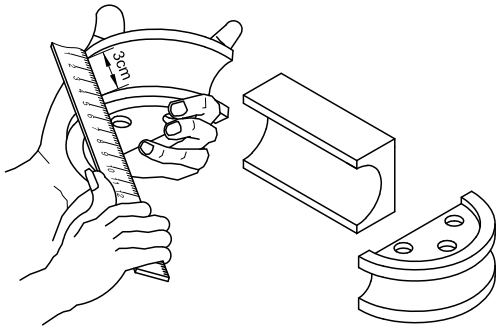
Fig 3



MM1304H3

Select the standard former to suit the size of the pipe. (Fig. 4)

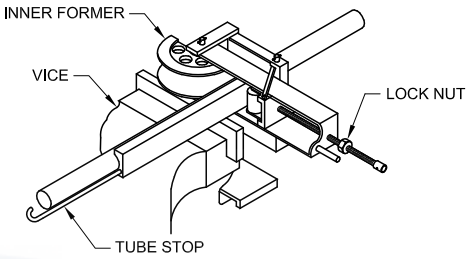
Fig 4



MM1304H4

Fix the bending machine in a benchvice and ensure it is tightened properly. Locate the tube stop bar at the required position. (Fig. 5)

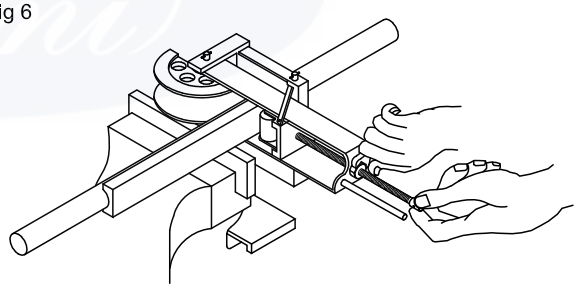
Fig 5



MM1304H5

Set the roller on the bending arm by adjusting the screw and lock nut. (Fig. 6)

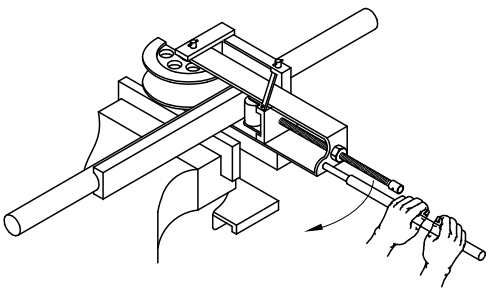
Fig 6



MM1304H6

Bend the pipe by pulling the bending arm towards your body. (Fig. 7)

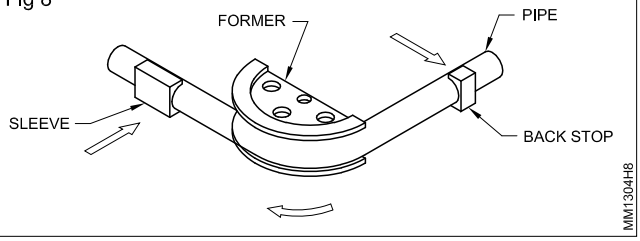
Fig 7



MM1304H7

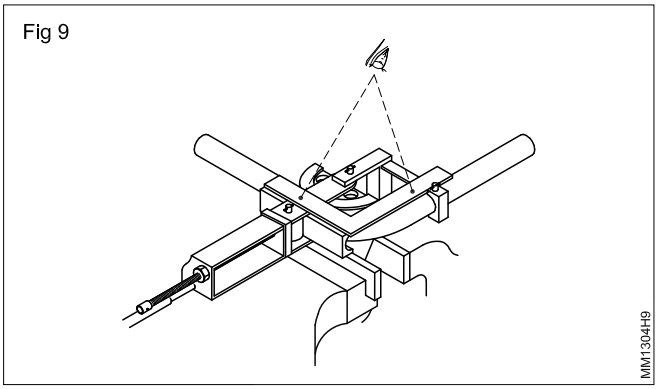
The sleeve bends the pipe round the former as the bending arm is pulled. The back stop holds the tails end of the pipe in position. (Fig. 8)

Fig 8



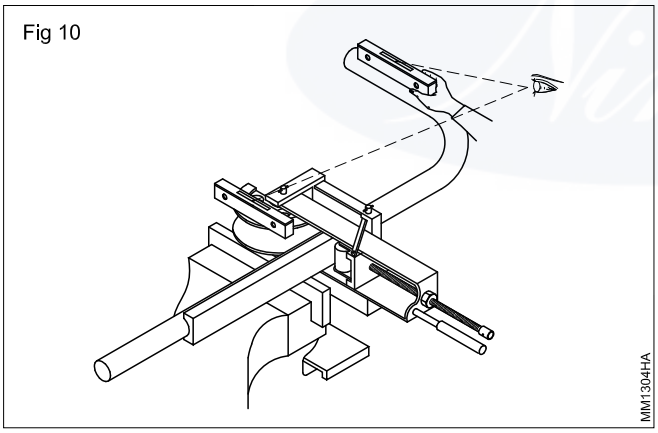
Check the bend for squareness use a set square as shown. (Fig. 9)

Fig 9



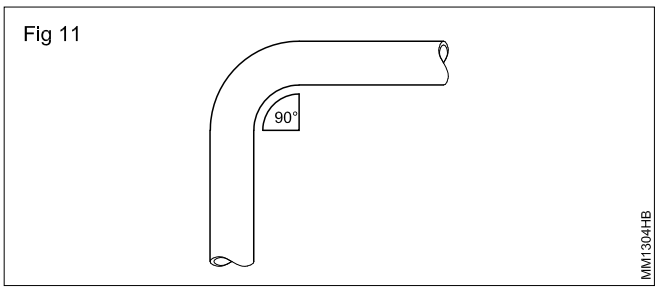
Check level of former and first leg (90° bend) with spirit level by placing spirit levels as shown in Fig. 10.

Fig 10



Check the angle of bend and radius using standard template. (Fig. 11)

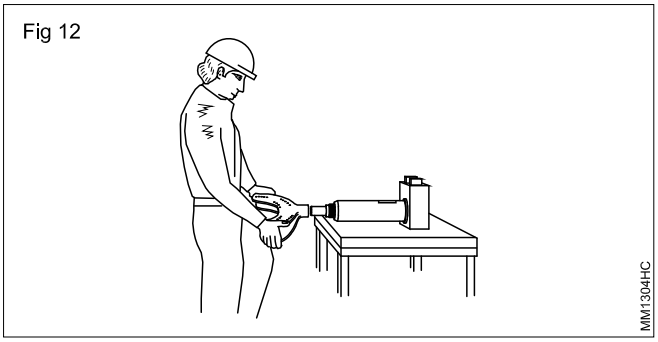
Fig 11



Bending 120° by Hydraulic bending machine

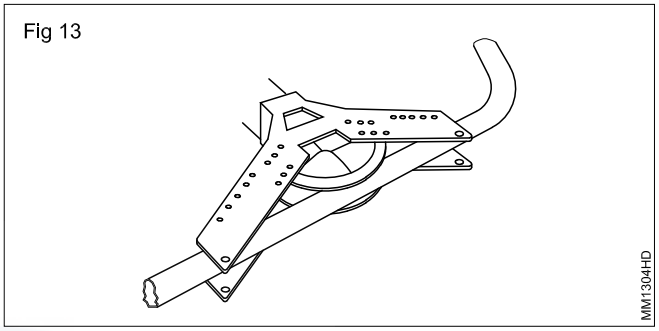
Fit the pipe former on to the cylinder arm. (Fig. 12)

Fig 12



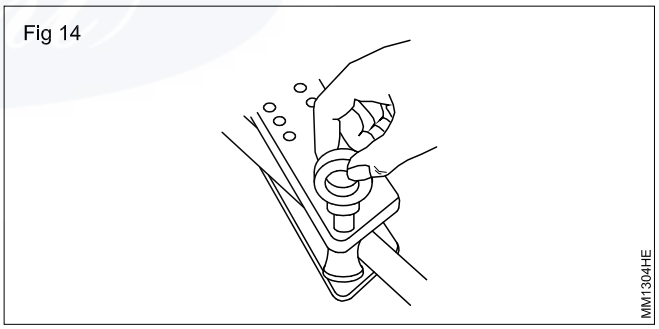
Place the pipe between the forming head plates and against the former. (Fig. 13)

Fig 13



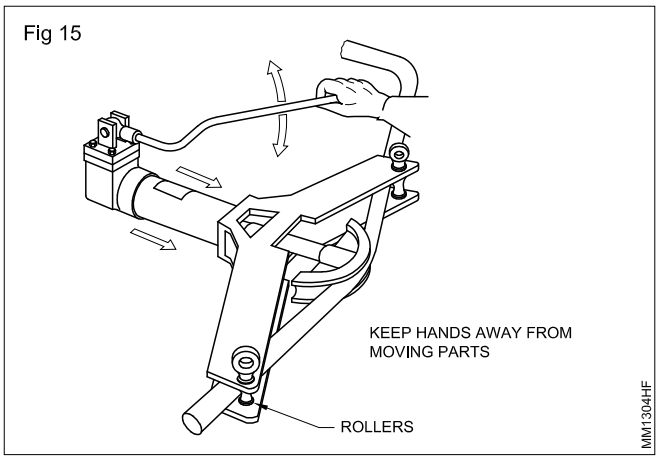
Support the pipe and fit dollies (or rollers) between the upper and lower plates of the forming head. Locate them in position by inserting pins through the plates and the dollies. (Fig. 14)

Fig 14



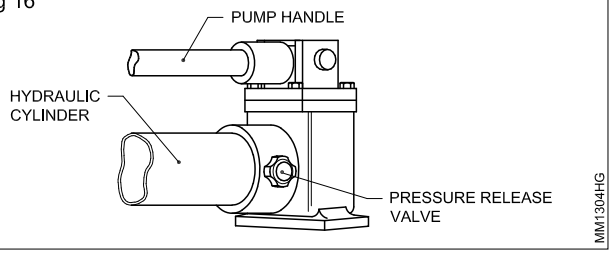
Close the pressure release valve on the pump body then start pumping to push the former against the pipe. (Fig. 15)

Fig 15



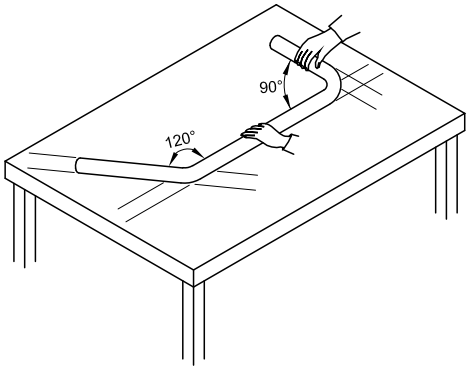
Turn the pressure release valve anti-clockwise to release the pressure in the hydraulic cylinder. When the arm has moved back about 6 mm to 10 mm close the pressure release valve to hold the ram steady. (Fig. 16)

Fig 16



Check both bends 90° and 120°by placing pipe on the layout. (Fig. 17)

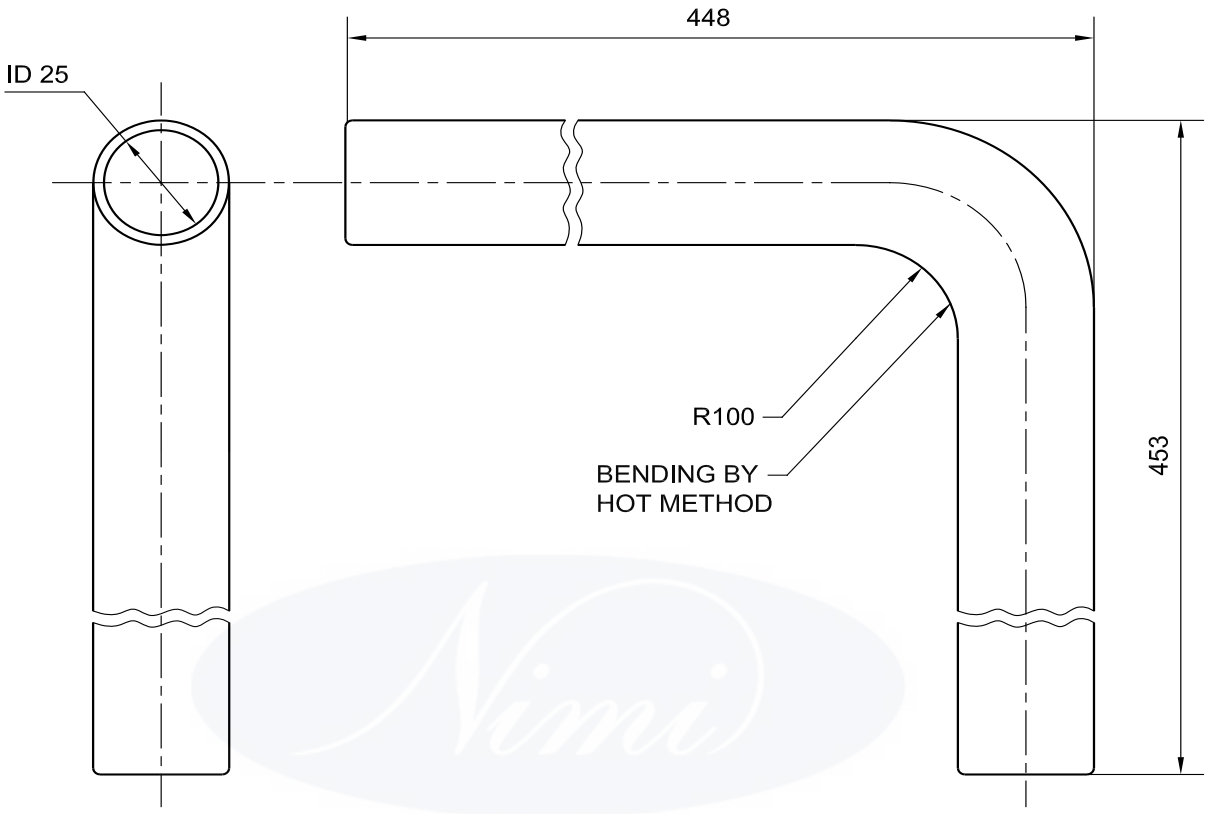
Fig 17

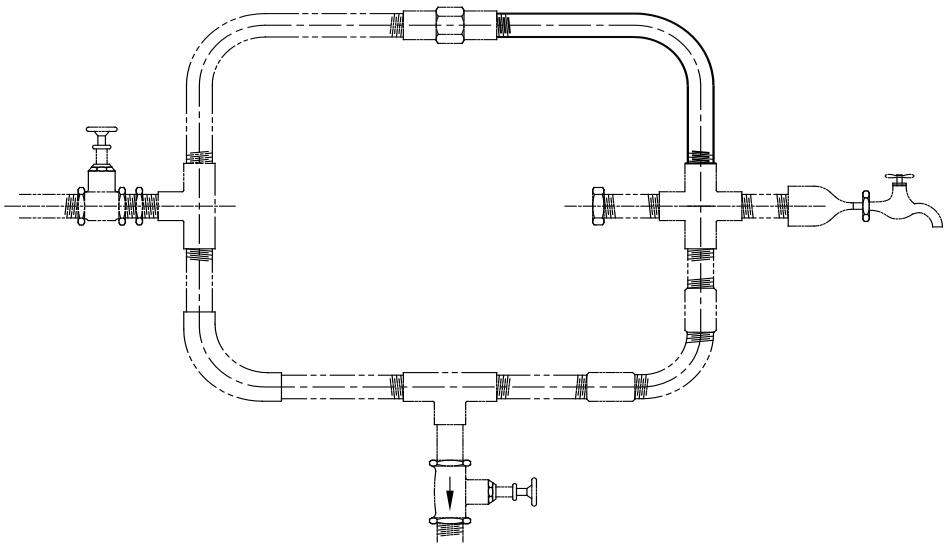


Bending G.I. pipes by hot method

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

- **bend G.I. pipe by hot method using sand and pegs.**





1	–	–	–	–	–	5
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PIPE BENDING (HOT METHOD)	DEVIATIONS ±0.5	TIME 5h
		CODE NO. MM1305E1	

Skill sequence

Bending G.I pipes by hot method

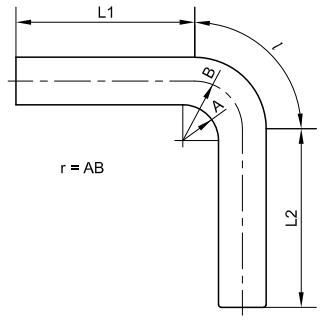
Objective: This shall help you to

- **bend G.I pipe by hot method using sand and pegs.**

File the pipe ends square and remove burrs.

Calculate the length of pipe. (Fig. 1)

Fig 1



If D = diameter of bend

Ø = angle of bend

l =length of curved portion

then, $l = \frac{\pi \times D \times Ø}{360}$

If OA = inner radius of bend (R)

AB = radius of pipe (r)

OB = radius of bend (R+r)

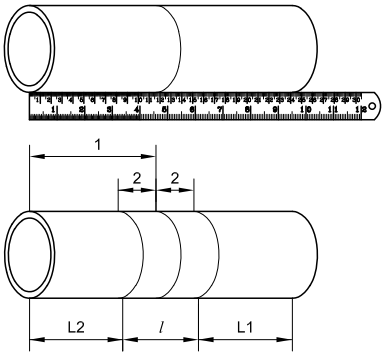
then, l = (R+r) x Ø x 0.01745

Total length of pipe = $L_1 + L_2 + l$

Measure and mark off the:

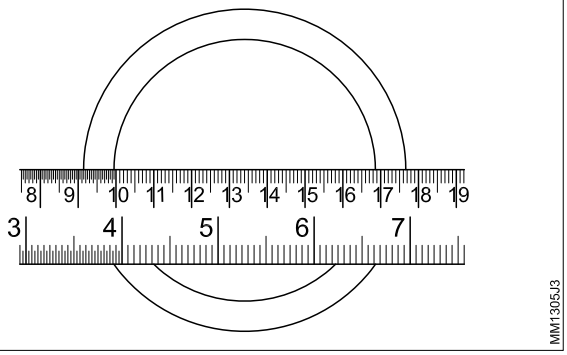
- centre of the bend (Fig. 2)
- beginning and end of the bend from the centre line

Fig 2



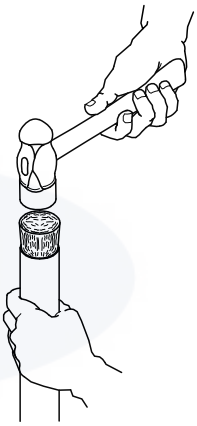
Measure the inside diameter of the pipe and select two suitable wooden pegs for the pipe. (Fig. 3)

Fig 3



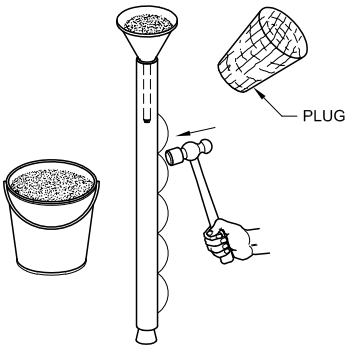
Plug one end of the pipe with a wooden peg. (Fig. 4)

Fig 4



Fill the pipe with clean, dry and fine sand [Compress the sand by tapping the pipe up and down with a soft hammer]. (Fig. 5) and plug the end.

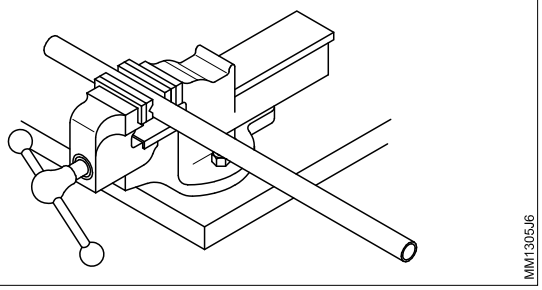
Fig 5



Ensure that the entire pipe is filled with sand

Clamp one end of the pipe in a vice and protect the clamped portion of the pipe with lead or copper shims. (Fig. 6).

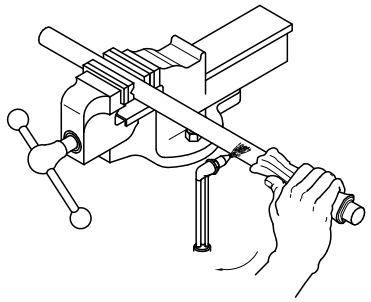
Fig 6



MM1305J6

Heat the area to be bend with oxy-acetylene torch evenly until it glows dull red. (Fig. 7)

Fig 7

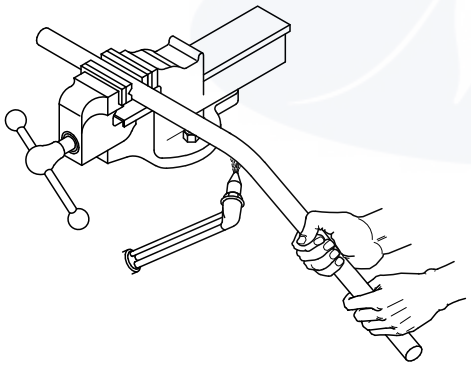


MM1305J7

The bend area should not be overheated

Pull down the pipe gently in the direction of the bend. (Fig. 8)

Fig 8

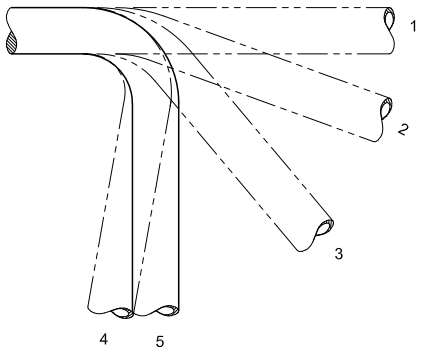


MM1305J8

Take short pull until the correct bend angle is reached. (Fig. 9-1,2,3)

Apply heat throughout the whole operation and over bend slightly and straighten out the final bend. (Fig. 9)

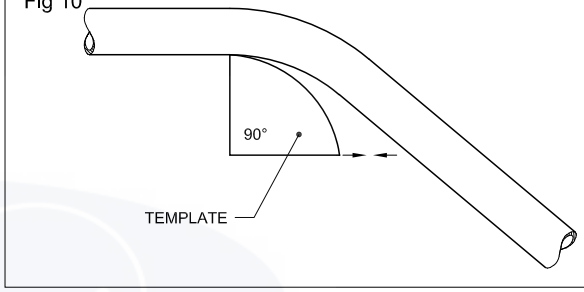
Fig 9



MM1305J9

Check the bend radius with a template. (Fig. 10)

Fig 10



MM1305JA

Remove one end of the plug.

Ensure that the pipe is cooled before removing the plug.

Remove the sand by tapping the pipe gently with a hammer.

Bending G.I pipes using sand and pegs

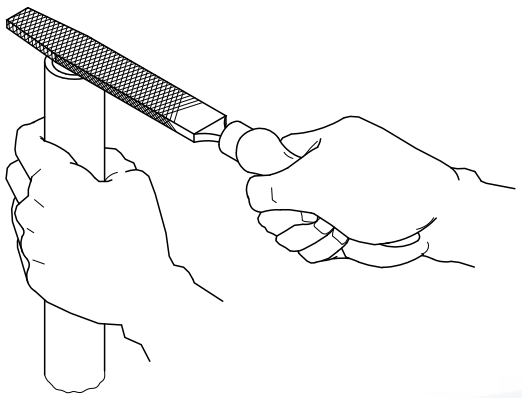
Objective : At the end of this exercise you shall be able to
- **bend G.I pipe by hot method.**

PROCEDURE

1 File the pipe ends square. (Fig 1)

2 Remove burrs.

Fig 1



PB1308J1

3 Calculate the length of pipe.(Fig 2)

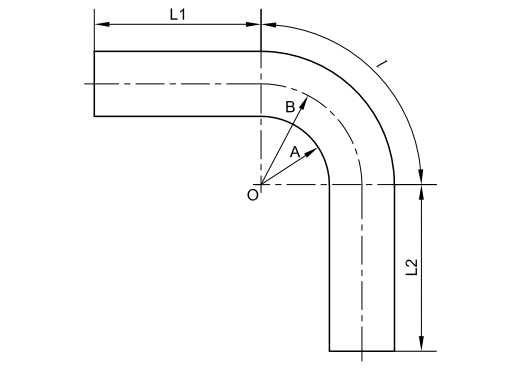
If D = diameter of bend
ϕ = angle of bend
l = length of curved portion

$$\text{then, } l = \frac{\pi \times D \times \phi}{360}$$

If OA = inner radius of bend (R)
AB = radius of pipe (r)
OB = radius of bend (R+r)
then, l = (R+r) x 0.01745 x ϕ.

Total length of pipe = $L_1 + L_2 + l$.

Fig 2



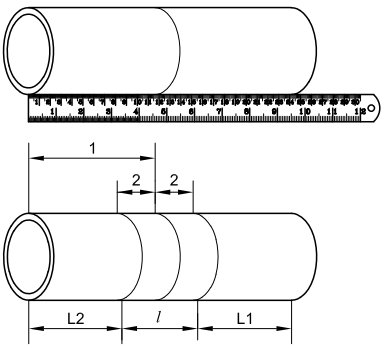
PB1308J2

4 Measure and mark off the:

– centre of the bend (Fig 3)

– beginning and end of the bend from the centre line.

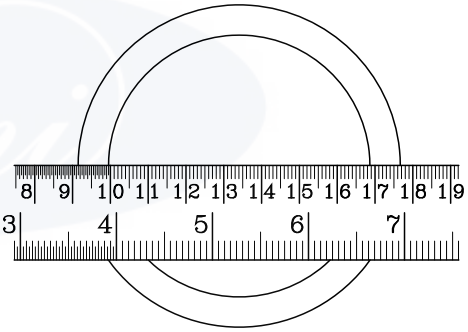
Fig 3



PB1308J3

5 Measure the inside diameter of the pipe and select two suitable wooden pegs for the pipe. (Fig 4)

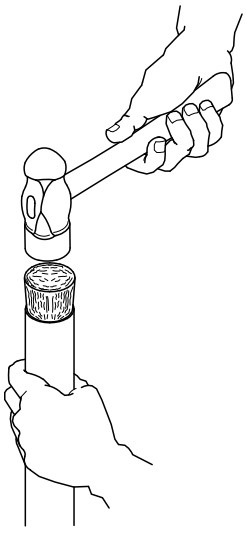
Fig 4



PB1308J4

6 Plug one end of the pipe with a wooden peg.(Fig 5)

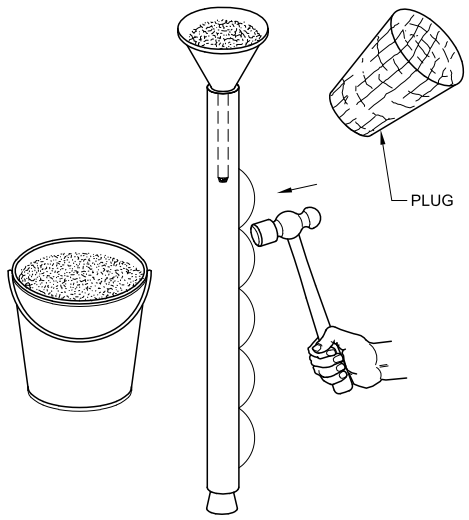
Fig 5



PB1308J5

7 Fill the pipe with clean, dry and fine sand (Compress the sand by tapping the pipe up and down with a soft hammer.) (Fig 6) and plug the other end.

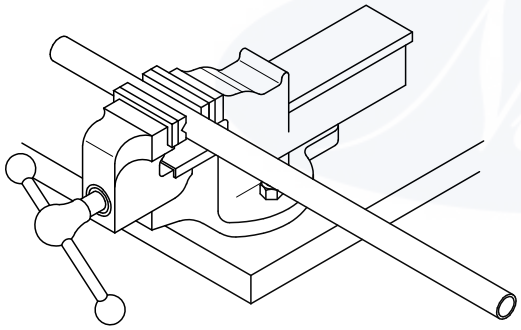
Fig 6



Ensure that the entire pipe is filled with sand.

8 Clamp one end of the pipe in a vice and protect the clamped portion of the pipe with lead or copper shims. (Fig 7)

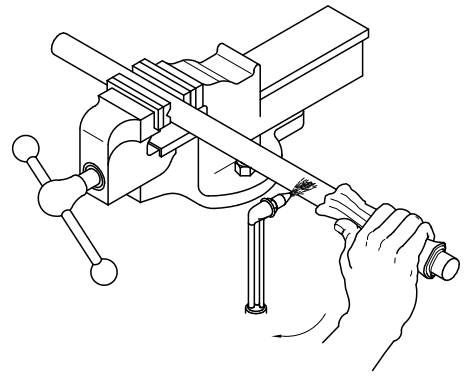
Fig 7



9 Heat the area to be bent with oxy-acetylene torch evenly until it glows dull red. (Fig 8)

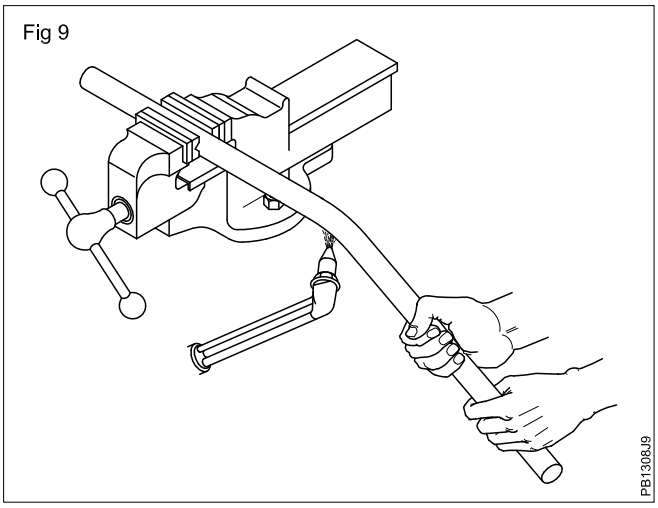
The bend area should not be overheated.

Fig 8



10 Pull down the pipe gently in the direction of the bend.(Fig 9)

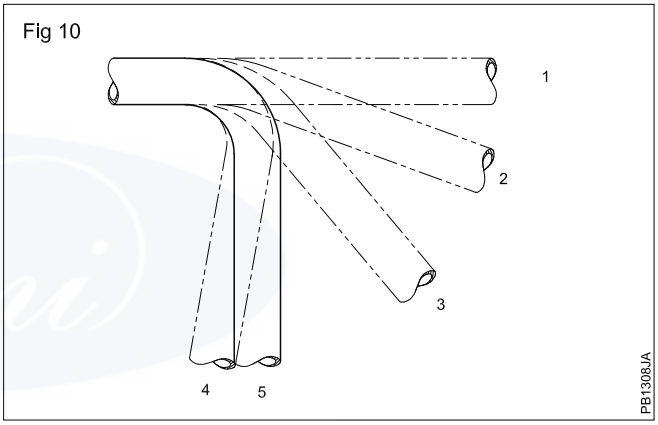
Fig 9



11 Take short pulls until the correct bend angle is reached.(Fig 10-1,2,3,5,4)

12 Check the bend radius with a template. (Fig 10)

Fig 10



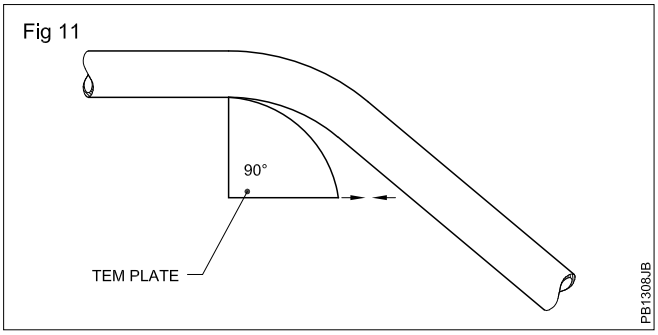
13 Apply heat throughout the whole operation and overbend slightly and straighten out the final bend. (Fig 11)

14 Remove one end of the plug.

Ensure that the pipe is cooled before removing the plug.

15 Remove the sand by tapping the pipe gently with a hammer.

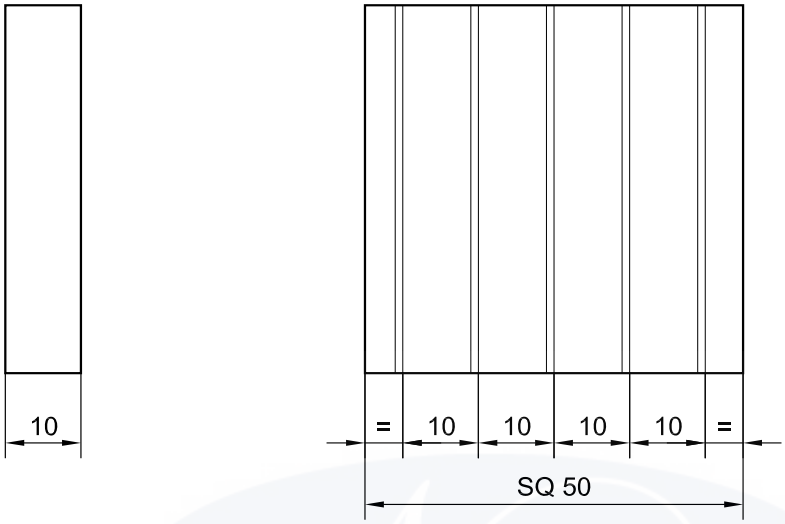
Fig 11



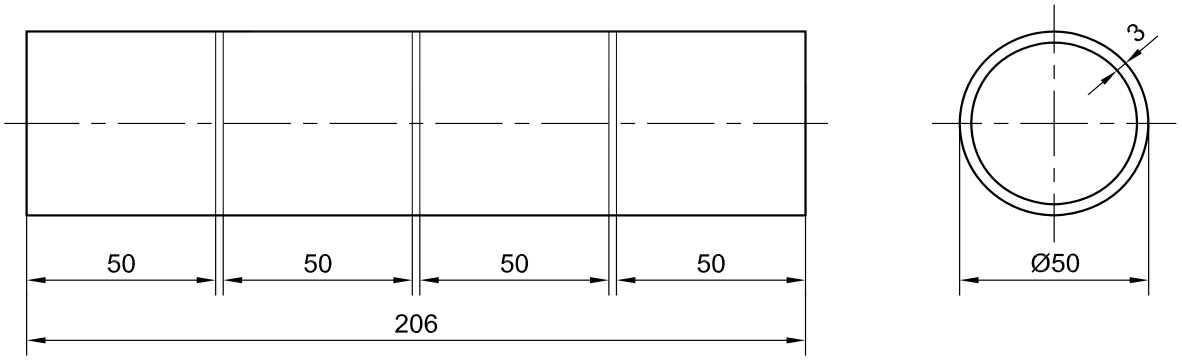
Hack sawing

Objectives: At the end of this exercise you shall be able to
- **cut a mild steel flat along a straight line using a hacksaw.**
- **cut a mild steel pipe perpendicular to its axis by a hacksaw.**

A



B

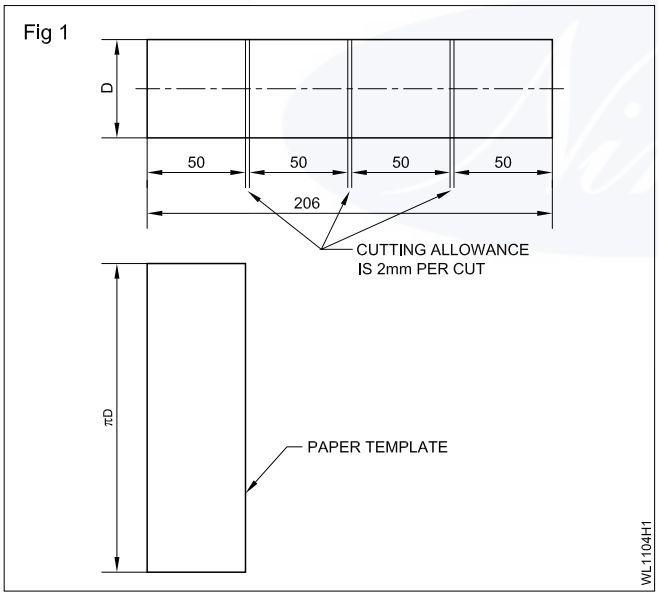


1	Ø50 x 3 - 206		Fe 310		B	
1	50 ISF 10 - 50		Fe 310		A	1.04
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS		HACK SAWING			TOLERANCE ±0.5	TIME 5h
					CODE NO. WL1104E1	

PROCEDURE

- Check the size of the given M.S flat Job-A and M.S pipe Job-B.
- Apply copper sulphate solution and allow it to dry.
- Layout lines as per drawing using a scriber taking measurement from the edge and punch mark the lines using a dot punch and hammer.
- Fix the plate on a bench vice such that the punch marked lines are vertical and projecting outside the vice jaws.
- Cut by hacksaw along the lines.
- Remove burrs, if any by filing.
- Apply marking media on the pipe outside surface Job-B.
- Mark lines as per drawing using a paper template and punch mark the line Fig.1 and Fig.2.
- Use 'V' block as support while marking the pipe.

Fig 1



- Cut across the pipe axis with a hacksaw and holding the pipe between the vice jaws using two angle iron support pieces.
- Rotate the pipe and cut in small sections.
- Remove burrs from the pieces.

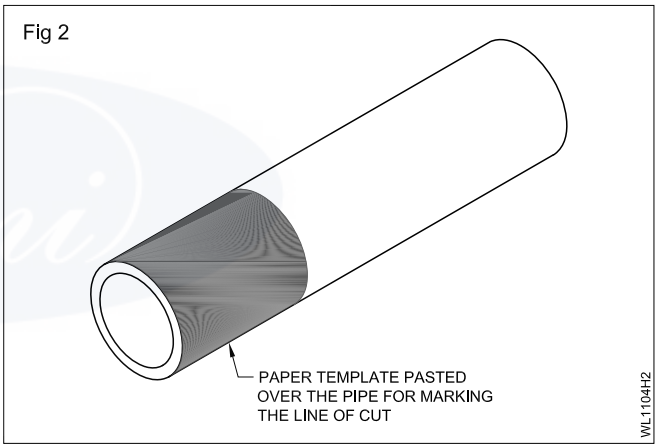
Do not hold the pipe very rigidly while sawing because the pipe may change to oval shape with excessive force.

Select the correct pitch of blade.

(A fine pitch blade is suitable.)

- **Use the full length of the blade while cutting.**
- **Do not cut too fast.**
- **Cut very slowly while cutting through.**

Fig 2

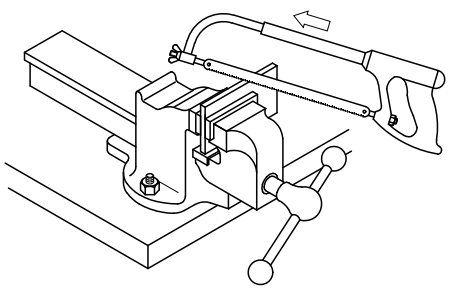


– – – – – – – – – –

Holding the workpiece: Position the metal to be cut according to the cross-section i.e a plate, a pipe or a channel for hacksawing.

As far as possible the job is held so as to be cut on the flat side rather than the edge or the corner. This reduces the blade breakages. (Figs.1, 2 and 3)

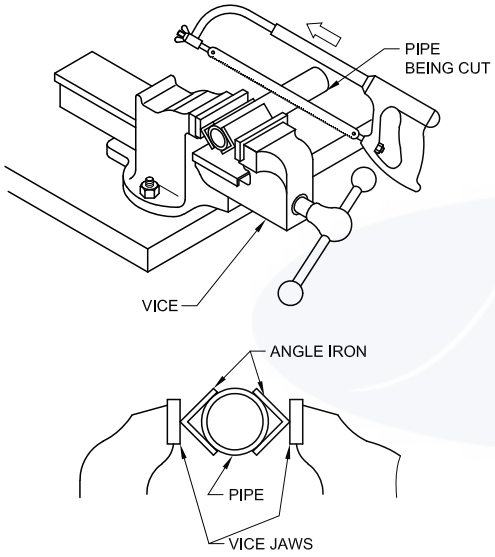
Fig 1



HOLDING A PLATE

WL1104J1

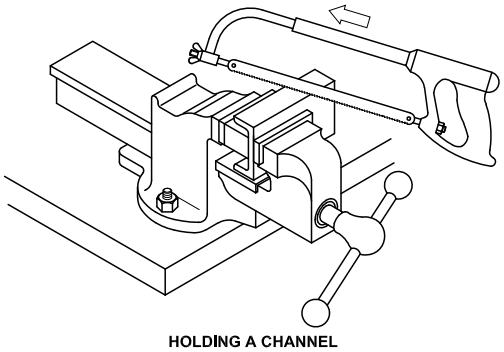
Fig 2



SUPPORT FOR HOLDING THE PIPE

WL1104J2

Fig 3



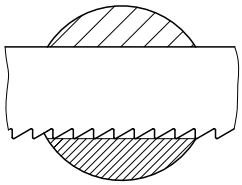
HOLDING A CHANNEL

WL1104J3

The selection of the blade depends on the shape and hardness of the material to be cut.

Pitch Selection: For soft materials such as bronze, brass, soft steel, cast iron etc. use a 1.8 mm pitch blade. (Fig.4)

Fig 4

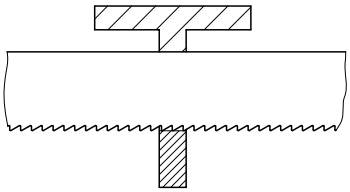


MORE CHIP CLEARANCE

WL1104J4

For steel use a 1.4 mm pitch. For angle iron, brass tubing, copper, iron pipe etc. use a 1 mm pitch blade. (Fig.5)

Fig 5

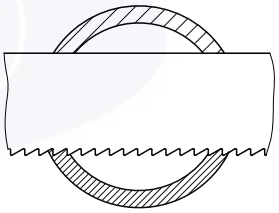


TWO OR MORE TEETH ON SECTION

WL1104J5

For conduit and other thin tubing, sheet metal work etc. use a 0.8 mm pitch. (Fig.6)

Fig 6

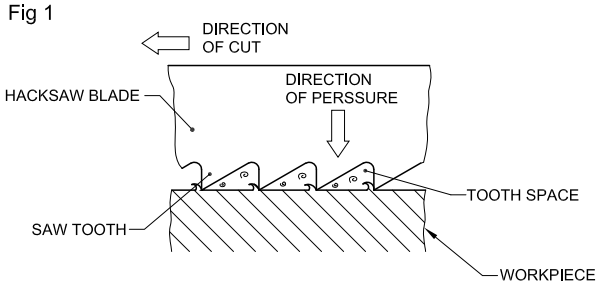


TWO OR MORE TEETH ON SECTION

WL1104J6

Fixing of Hacksaw Blades: The teeth of the hacksaw blade should point in the direction of the cut and away from the handle. (Fig.1)

Fig 1

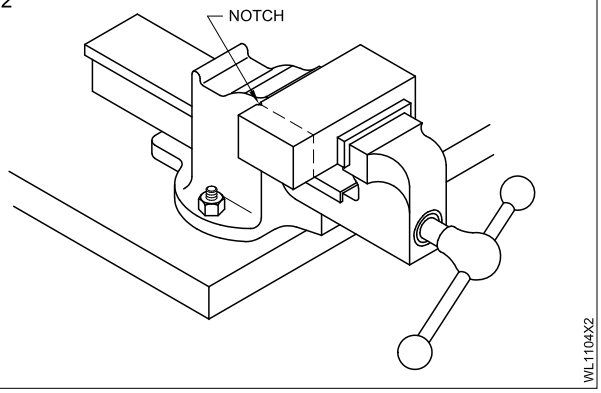


WL1104X1

The blade should be held straight, and correctly tightened before starting.

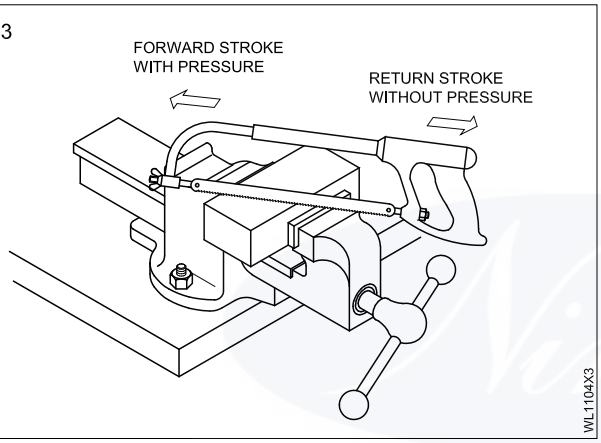
While starting the cut make a small notch. (Fig.2)

Fig 2



Apply pressure only during the forward stroke. (Fig.3)

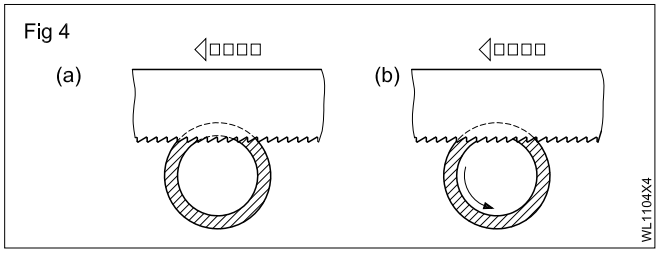
Fig 3



Atleast two to three teeth should be in contact with the work while cutting. Select a fine pitch blade i.e 0.8 or 1mm pitch for thin work and for cutting pipes. (Fig.4a)

Turn and change the position of the pipe while hacksawing (Fig.4b)

Fig 4



While cutting pipes by hacksawing a paper template is made and wrapped over the pipe to get the line of cut marked on the circumference of the pipe.

Normally, a coolant is not necessary while hacksawing.

Do not move the blade too fast. While finishing a cut, slow down to avoid breakage of the blade and injury to yourself and others.

Laying of floor traps in house drainage

Objective : At the end of this exercise you shall be able to
- **fix floor traps.**

Requirements

Tools

• Measuring steel tape 15m	- 1 No.
• Plumb bob	- 1 No.
• Trowel 25 cm long	- 1 No.
• Spirit level15 cm	- 1 No.
• Spade	- 1 No.

Materials

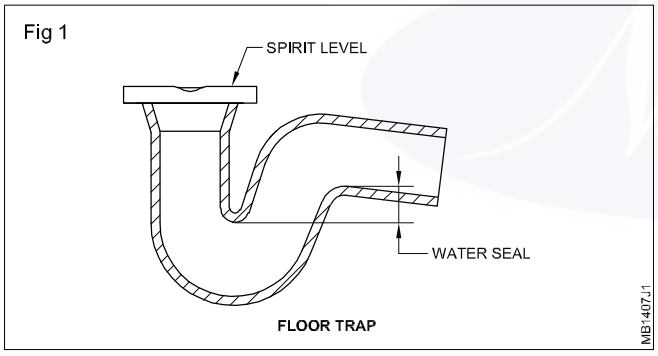
• Floor trap	- 1 Nos.
• Grating	- 1 no
• Cement Concrete	
• Cement	- 20 kg
• Sand	- 1 box
• Stone aggregate	- 2 box

PROCEDURE

TASK 1: **Fix floor traps**

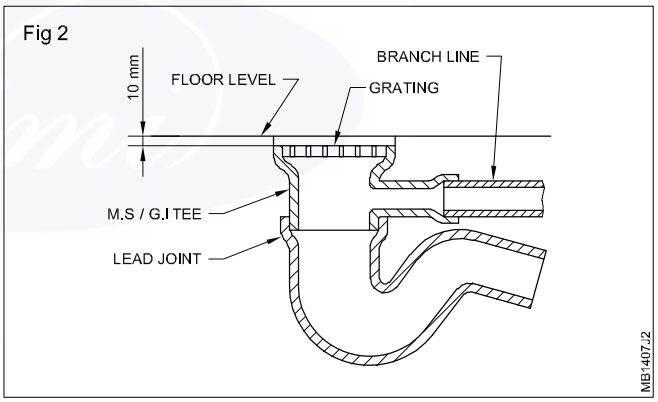
- Choose the correct type of floor trap.Fig.1.

Fig 1



- Check the water seal depth.
- Mark the position of floor trap (it shall be near external wall and away from doors).
- Dig for the required depth considering branch connection and depth of floor trap.Fig.2.
- Place bed concrete.

Fig 2



- Place the trap in level at top.
- Join M.S or G.I tee in lead wool joint if branch to join.
- Place the grating 10mm below the floor level.

In case of upper floors slabs shall be sink at the time of slab casting, to the required depth.

Assembly of G.I pipes with standard pipe fittings

Objectives: At the end of this exercise you shall be able to
- **fit elbow with G.I pipe**
- **fit union with G.I pipe**
- **fit valves with G.I pipe**
- **assemble pipe with other standard fittings.**

PROCEDURE

1 Join pipe No.2 with the 4-way cross.(B)

2 Fit pipe No.3 with the "Cross"

3 Join plain coupling (G) to the other end of the pipe No.3.

4 Assemble G.I bend (H) to the plain coupling.

5 Fit the ribbed coupling (I) to the other end of the bend.

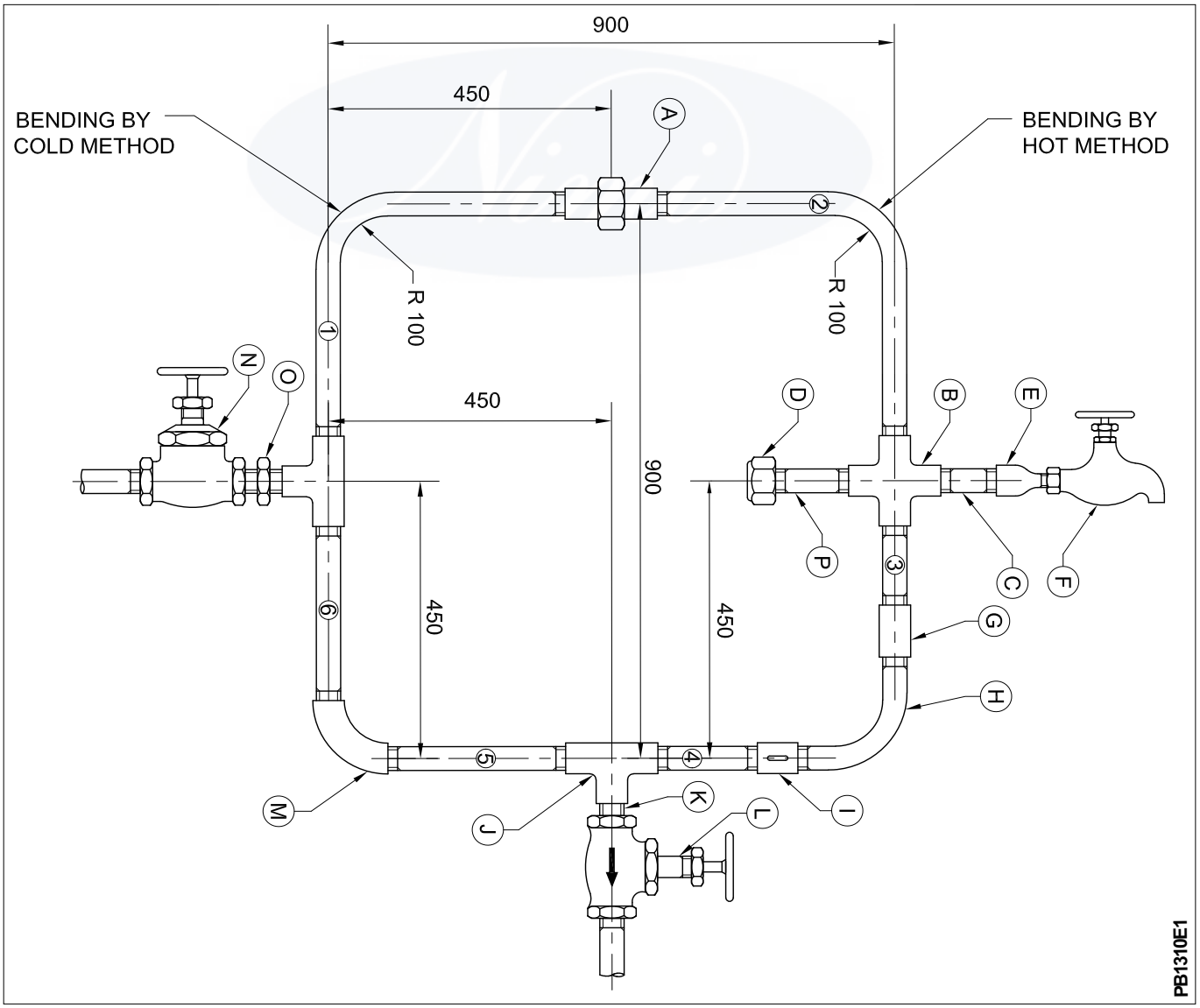
6 Join pipe No.4 to the ribbed coupling.

7 Fit "T" (J) with pipe No.4.

8 Join pipe No.5 to the opposite end of "T".

9 Assemble elbow (M) with pipe No.5.

10 Fit pipe No.6 with the other end of the elbow.



11 Join "T" with pipe No.6.

12 Fit pipe No.1 with the opposite end of "T".

13 Join pipe Nos.1 & 2 with union.(A).

14 Fit 150mm barrel nipple (P) to the left side of the "cross" and put cap (D) for it.

15 Put another 100mm barrel nipple (C) to the right side of the cross.

16 Join the reducer (E) to the barrel nipple.

17 Assemble the bib-cock(F) to the other end of the reducer.

18 Fit 100mm barrel nipple(K) to the bottom "T".

19 Assemble the globe valve (L) to the nipple.

20 Put the hexagonal nipple (O) to the left side "T".

21 Assemble the gate-valve (N) to the nipple.

22 Test the joints for leakage.

Skill Sequence

Assemble G.I pipes with standard fittings

Objective : This shall help you to
- **assemble pipe and pipe fittings.**

1 Hold the pipe No.2 in a pipe vice.

2 Wind the hemp packing/cotton thread material on the external threads of the pipe.

3 Apply sealing compound over the pipe threads.

4 Fit the 4-way cross to pipe No.2 and tighten it using a pipe wrench.

Wind the hemp packing to external threads of all the pipes and standard fittings and apply sealing compound over the threads before joining with the other one.

5 Fit pipe No.3 with the cross.

6 Join the plain coupling to the other end of the pipe No.3.

7 Fit the G.I. bend to the plain coupling.

8 Assemble the ribbed coupling to the other end of the G.I.bend.

9 Connect pipe No.4 to the nibbed coupling.

10 Fit 'T' with pipe No.4.

11 Connect pipe No.5 to the opposite end of 'T'.

12 Assemble the elbow with pipe No.5.

13 Fit pipe No.6 with the other end of the elbow.

14 Connect 'T' with pipe No.6.

15 Fit pipe No.1 with the opposite end of 'T'.

16 Fit the rubber washer into the union.

17 Set pipe Nos. 1 & 2 with the union.

18 Hold one side of the union in one pipe wrench and the ring of the union in the other.

19 Turn the two pipe wrenches gently in opposite directions and assemble.

Use grease or vaseline on the union joint for easy dis-connection.

20 Fit a 150 mm barrel nipple to the left side of the cross and put a cap for it.

21 Join another 150 mm barrel nipple to the right side of the cross.

22 Connect the reducer to the barrel nipple.

23 Assemble a bib-cock to the other end of the reducer.

24 Fit a 100 mm barrel nipple to the bottom side of 'T'.

25 Assemble the gate-valve to the 100 mm barrel nipple.

26 Allow a clearance between the valve and pipe.

27 Join a hexagonal nipple to the left side 'T'.

28 Assemble a globe valve to the hexagaonal nipple.

29 Check the joint for leakage.

Do not overtighten the fittings as this may cause the threads to the split.

Joining cast iron pipe

Objectives: At the end of this exercise you shall be able to
- **select and prepare the materials necessary to make or mould joint runner for pouring molten lead into a joint**
- **assemble or build the joint runner in position or locations to be specified**
- **pour the joint and dismantle the runner prior to caulking the joint.**

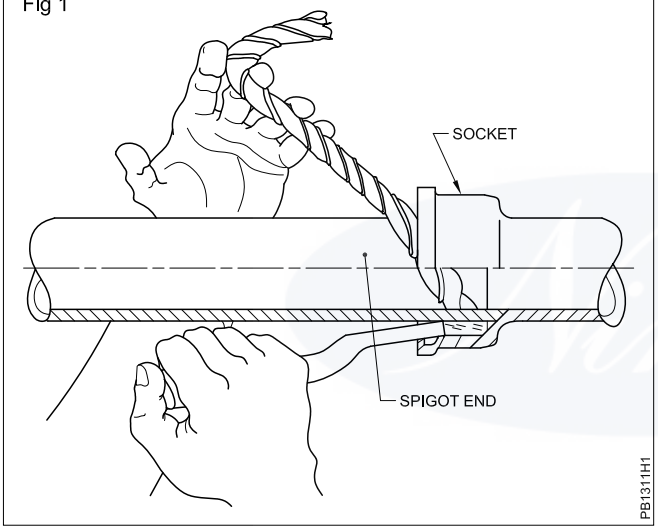
PROCEDURE

1 Clean the socket inside and outside of pipe (spigot end) to be jointed.

2 Place the spigot end inside the socket. Fig.1

3 Yarn the joint tightly to a depth of 1/3 the socket lengths.

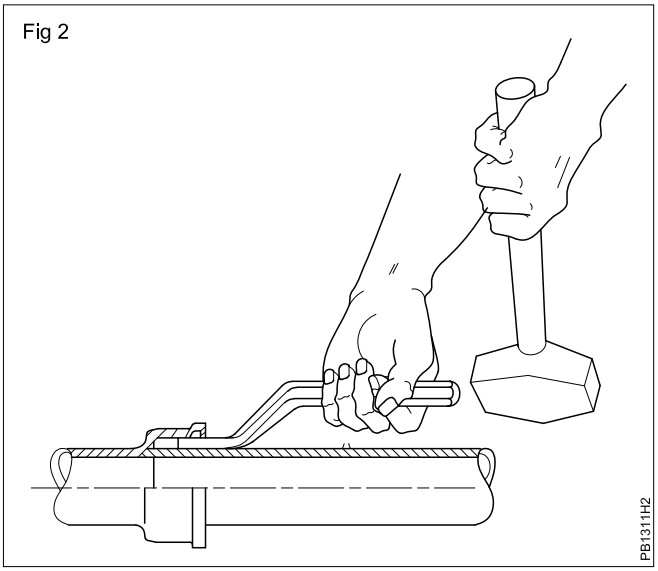
Fig 1



4 Compact the yarning material solidly right around the joint with right yarning iron.Fig.2

5 Burn off any loose strand of material. Sticking up from the joint.Fig.3.

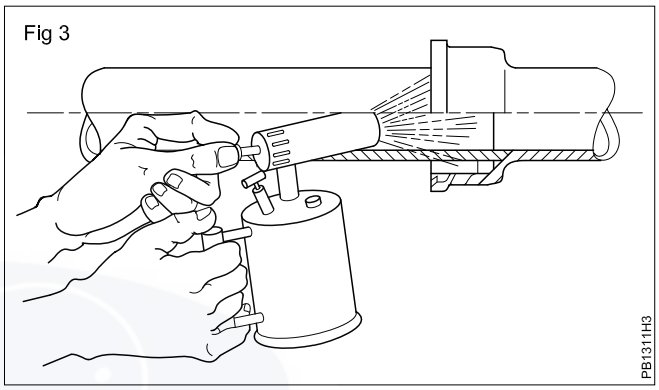
Fig 2



6 Apply powdered resin or a small amount of glease to the joint.

(In case of vertical joints molten lead can be poured now).

Fig 3

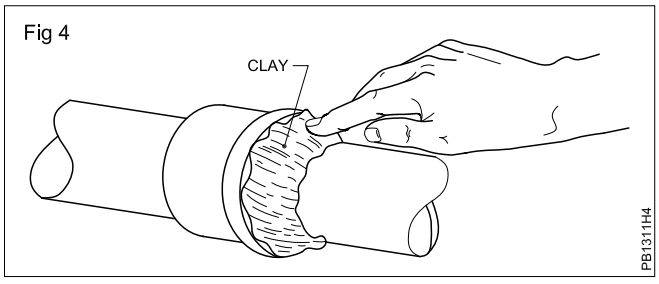


7 Place flexible asbestors cord/rope approximately 25mmϕ around the pipe.

8 Push the cord firmly up in the socket.

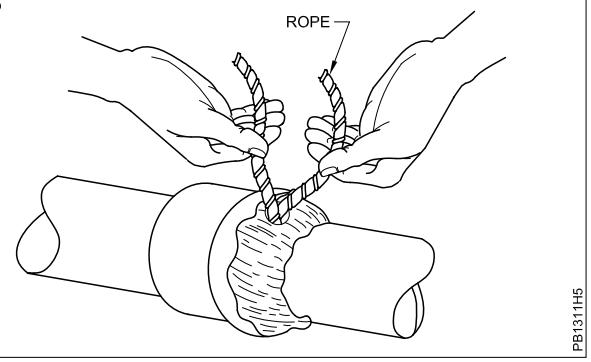
9 Wrap stiff clay around the rope. Shape the mould by wet thumb.Fig.4.

Fig 4



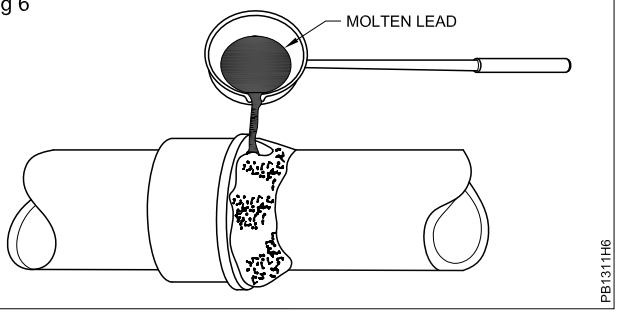
10 Remove rope carefully leaving the pour hole on top of the pipe.Fig.5.

Fig 5



11 Pour hot moulten lead slowly but continuously into the joint through the pouring hole.Fig.6.

Fig 6

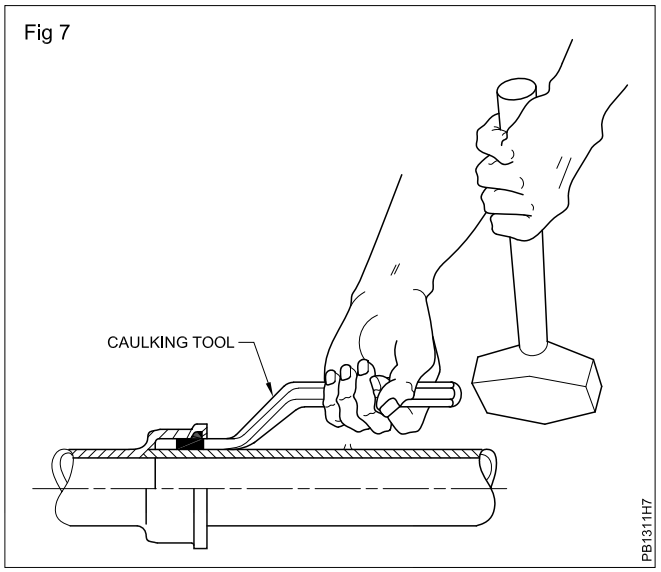


12 Remove the clay mould. Cut away the lump of lead that formed in the pouring hole.

13 Chisel away the lead plug.

14 Hammer the caulking around the joint using caulking tool and hammer.(Fig.7) Check the joint has been correctly caulked all round.

Fig 7



G.I pipe fittings

Objective : At the end of this exercise you shall be able to
- **fix the G.I pipes with fittings as per drawing.**

PROCEDURE

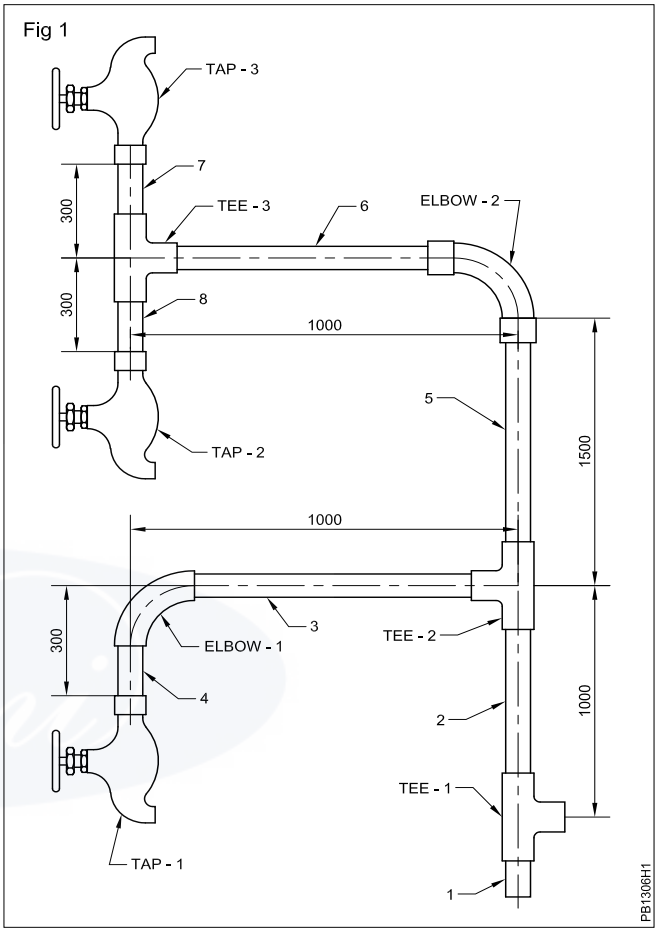
1 Calculate the length of pipes required based on drawing. Fig.1.

2 Cut the pipes as per calculated length using pipe cutter/ hacksaw.

3 Cut thread at the end of pipe using die stock.

4 Assemble pipe with standard fittings.

Fig 1

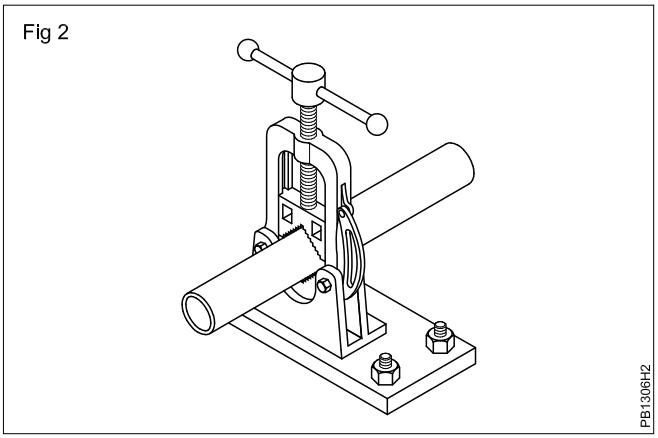


Skill Sequence

Objective : This shall help you to
- **assemble pipe and pipe fittings.**

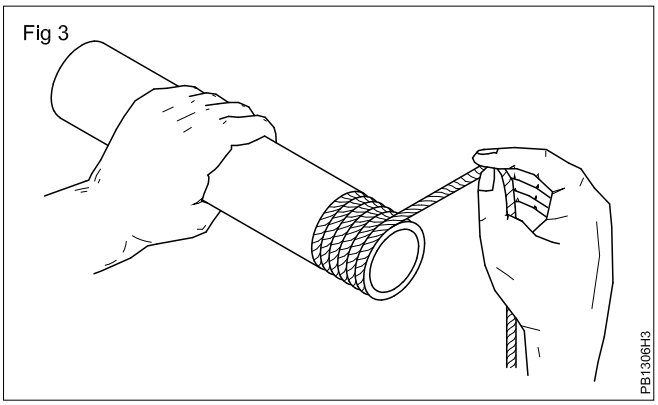
1 Hold the pipe 1 in a pipe vice. Fig.2

Fig 2



2 Wind the hemp packing/cotton thread material on the external threads of the pipe. Fig.3.

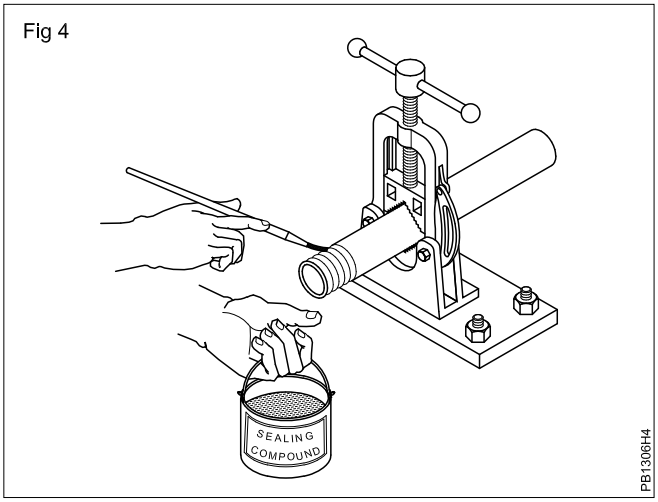
Fig 3



3 Apply sealing compound over the pipe threads.Fig.4.

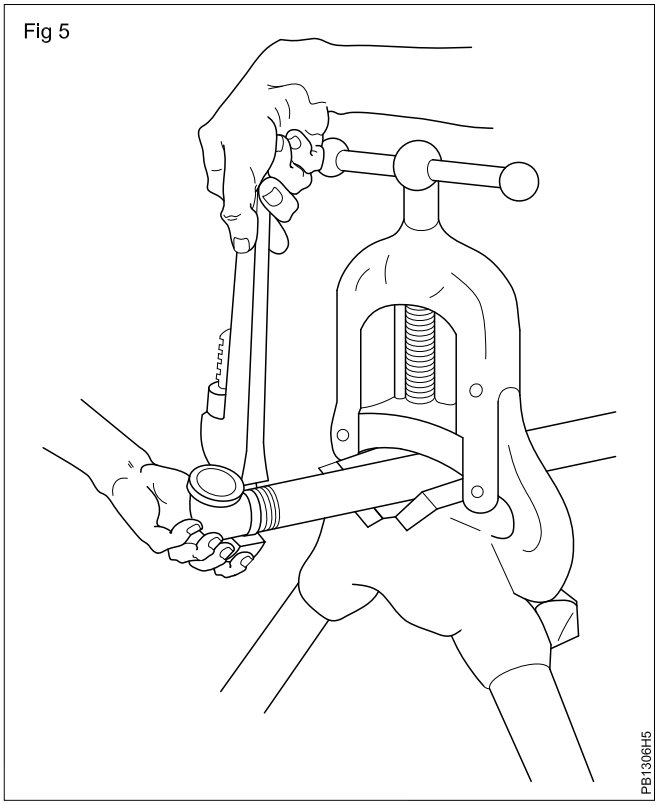
4 Adjust the pipe wrench to suit the pipe/pipe fittings.

Fig 4



5 Continue the screwing process till full threads are inside. Fig.5.

Fig 5



Skill Sequence

Objective : This shall help you to
- **fit fittings to pipe.**

1 Fit tee 1 to the pipe I using pipe wrench.

2 Fit the pipe 2 to tee 1 using pipe wrench after adopting the procedure.

3 Fit tee 2 to pipe 2 using pipe wrench after adopting the procedure.

4 Fit pipe 3 to tee 2 using pipe wrench after adopting the procedure.

5 Fit elbow to pipe 3 using pipe wrench after adopting the procedure.

6 Fit pipe 4 to elbow using pipe wrench after adopting the procedure.

7 Fit a socket to pipe 4 using pipe wrench after adopting the procedure.

8 Fit bibcock to socket using pipe wrench after adopting the procedure.

9 Fit pipe 5 to tee 2 using pipe wrench after adopting the procedure.

10 Fit socket to pipe 5 using pipe wrench after adopting the procedure.

11 Fit bend to socket using pipe wrench after adopting the procedure.

12 Fit socket to bend using pipe wrench after adopting the procedure.

13 Fit pipe 6 to socket using pipe wrench after adopting the procedure.

14 Fit tee 3 to pipe 6 using pipe wrench after adopting the procedure.

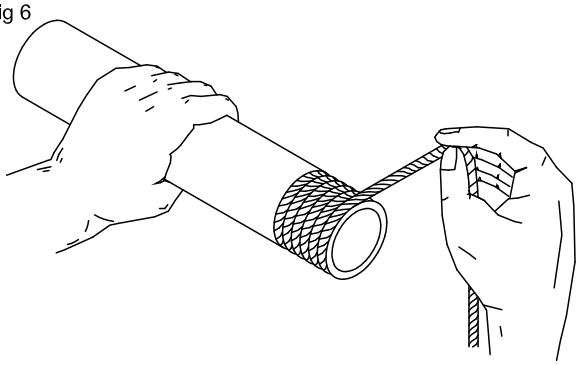
15 Fit pipe 7and 8 to tee using pipe wrench after adopting the procedure..

16 Fit socket to pipe 7 and 8 using pipe wrench after adopting the procedure.

17 Fit bibcock to sockets using pipe wrench after adopting the procedure.

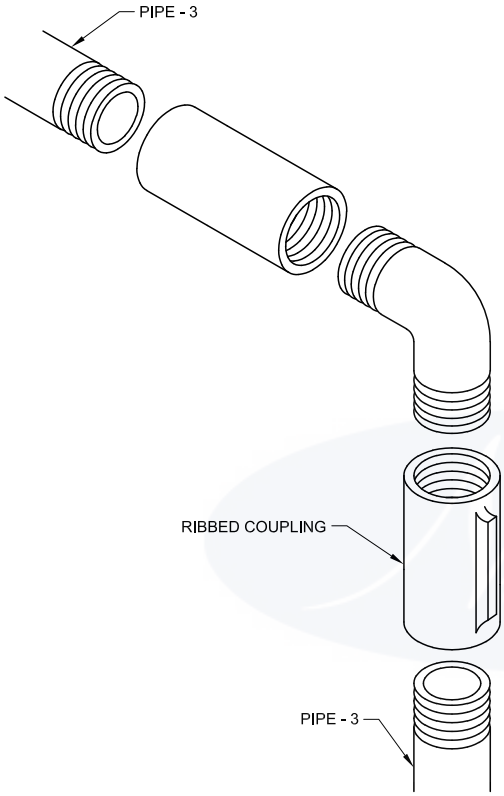
18 Remove any excess hemp, string or sealing tape after completing the joints, using hacksaw blade or a blow lamp.

Fig 6



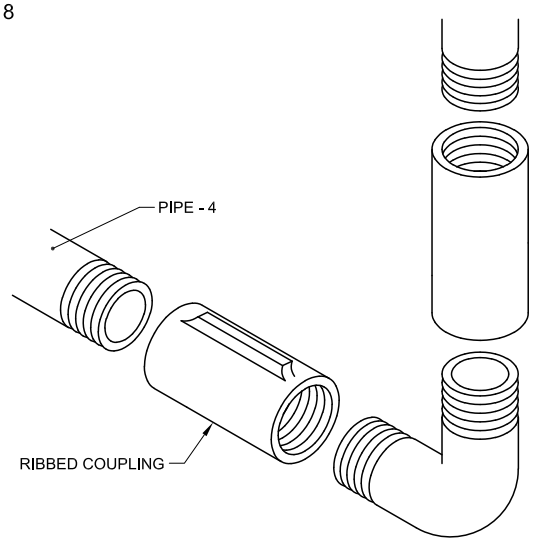
PB1306H6

Fig 7



PB1306H7

Fig 8



PB1306H8

Fig 9

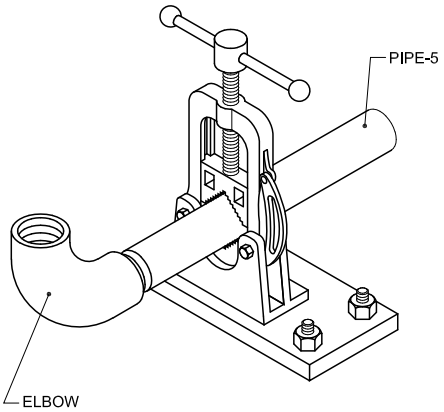


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Fig 10

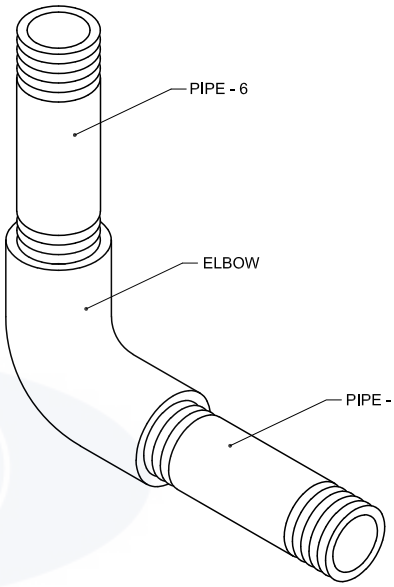

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Fig 11

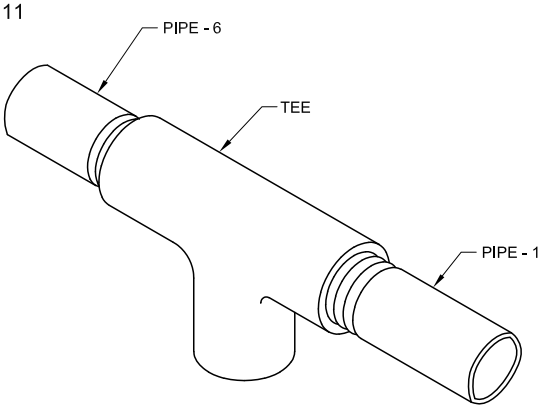

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Fig 12

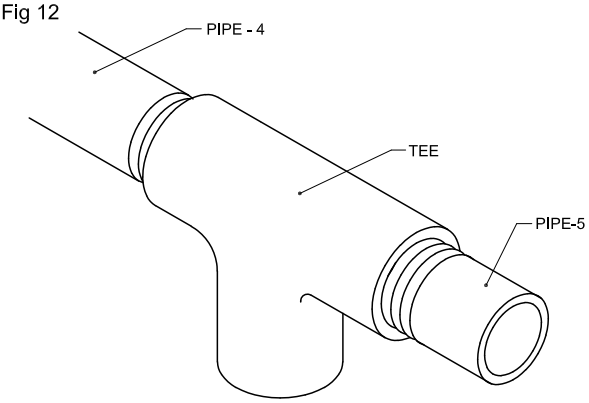


Fig 13

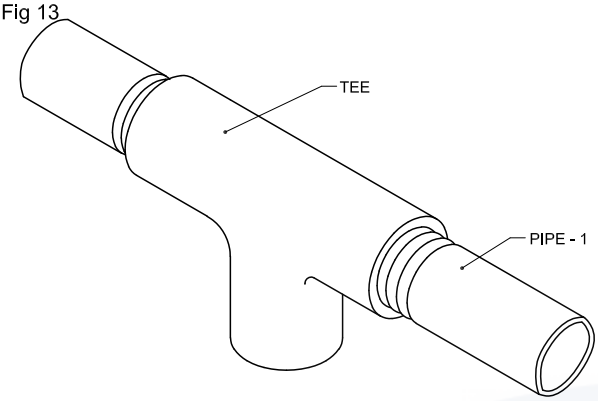


Fig 14

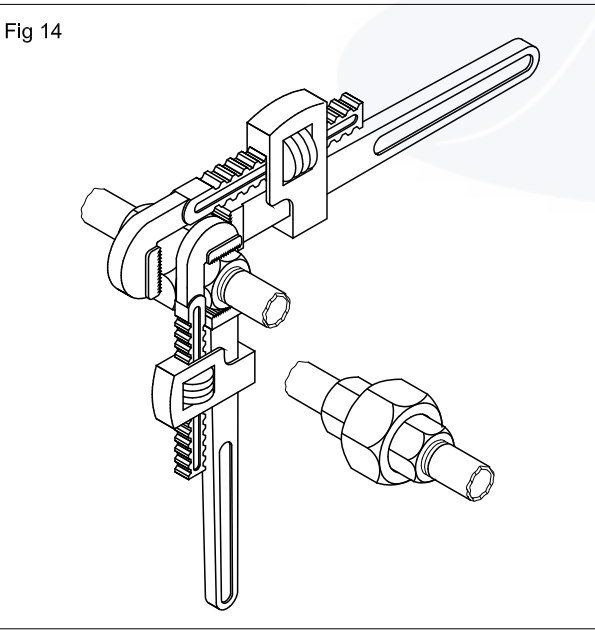


Fig 15

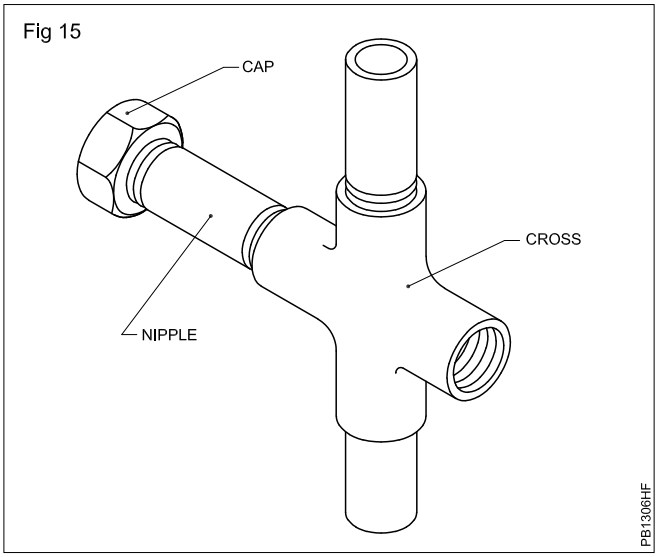


Fig 16

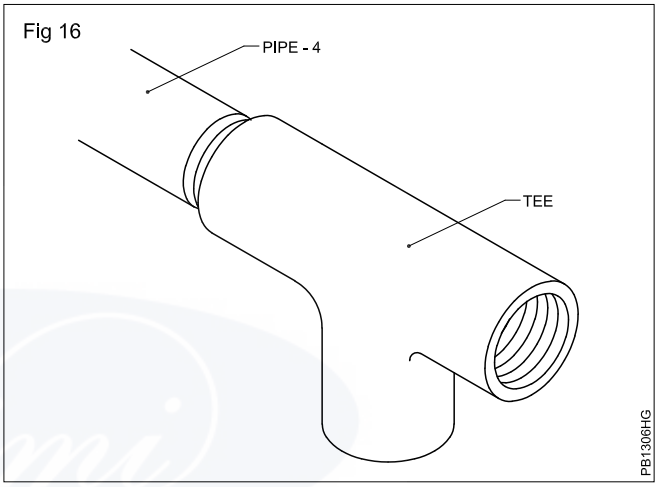


Fig 17

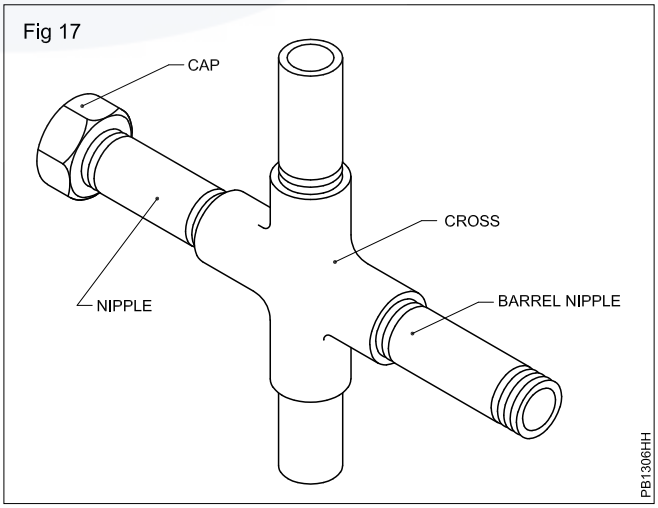


Fig 18

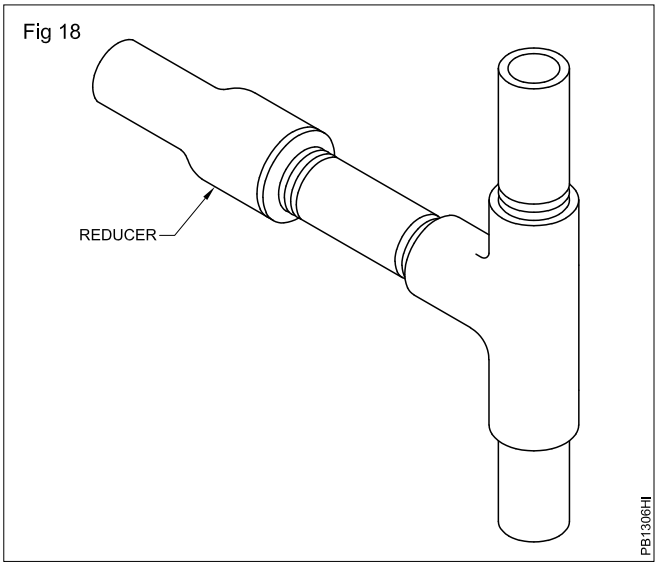


Fig 19

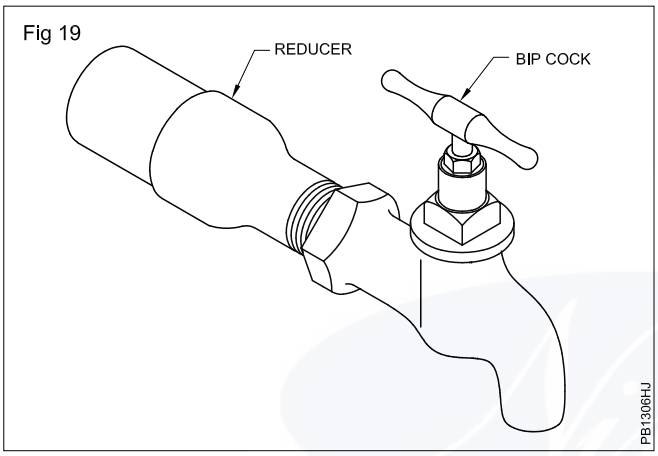
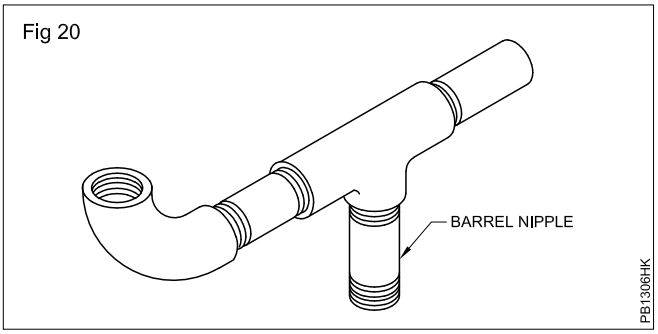


Fig 20



Cutting PVC pipe

Objectives : At the end of this exercise you shall be able to
- **hold PVC pipe in pipe vice**
- **mark the required length in PVC pipe with paper, tap and pencil**
- **step cut PVC pipe for depth of 10, 15, 20, 25, 30, 35, 40, 45mm with hacksaw**
- **cut the PVC pipe at 45^0 with the hacksaw.**

PROCEDURE

1 Hold PVC pipe in pipe vice tightly.

2 Mark the required lengths as per drawing. Fig.1.

3 Step cut PVC pipe for depth of 5, 10, 15, 20, 25, 30, 35, 40, 45, 50mm.

4 Cut the PVC pipe with hacksaw.

Holding PVC pipe in a pipe vice (S.S.1)

Marking the required length (S.S.2)

Cutting of PVC pipe

5 Mark the place of cutting. (S.S.2)

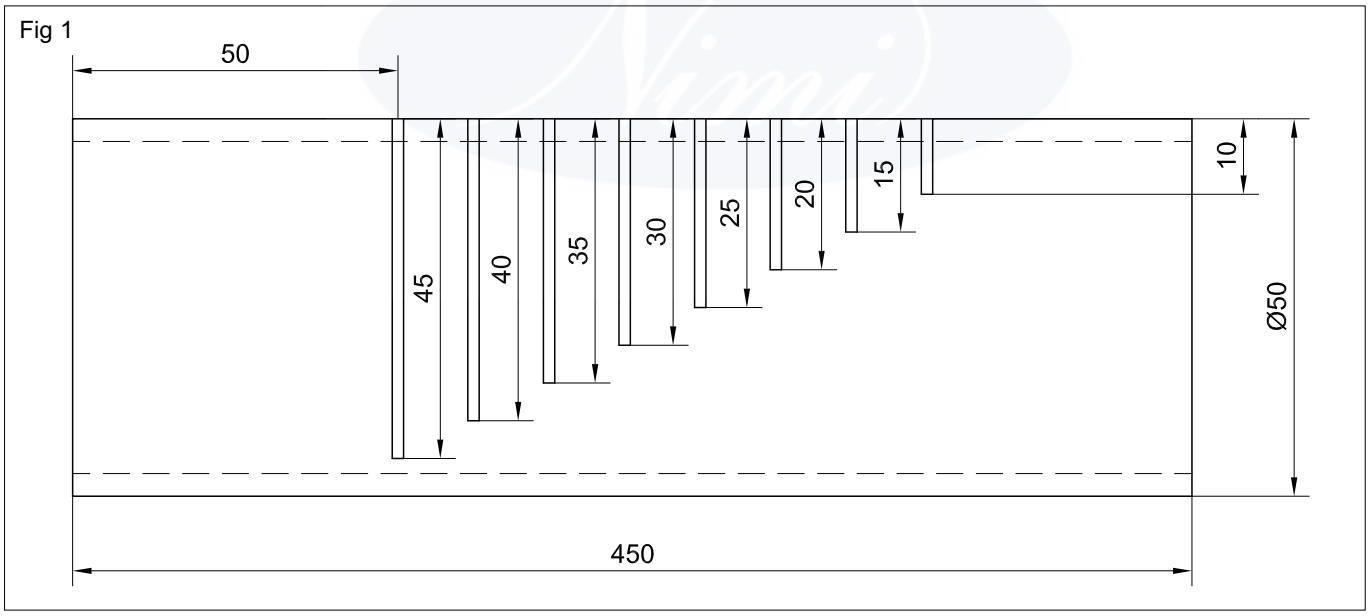
6 Fix fine tools blade in hacksaw.

7 Hold hacksaw handle in right hand.

8 Hold hacksaw frame in left hand.

9 Move the blade to and fro on the mark @ 40 strokes per minutes for full length of blade.

Fig 1



PVC welding

Objectives : At the end of this exercise you shall be able to
- **prepare the surface of pipe**
- **make the welding.**

Requirements

Tools/Instruments

- Gas heated type Torch - 1 No.

Material

- Filler rod - 1 No.
- PVC pipe - as required.

PROCEDURE

TASK 1 : **Prepare the surface of pipe**

- Clean the surfaces from oil, grease and dirt.
- Remove all the sharp edges from the edge which is to be welded.

Use fine abrasive paper, detergent cleaner and a cloth.

TASK 2 : **Make the welding**

- Place the pipe on fire brick or other heat resistant material for welding.
- Make the welding unit capable of heating the surface to weld at a temperature of 550^0F or 288^0C.
- Keep the position of welding filler rod at an angle of about 750 to the weld surface.
- Weld one or two beads over the hole in the pipe (Fig-1)

PPR, Pipe welding joint

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

- **PPR pipe welding joint.**

Requirements

Tools/Instruments

- Work Bench - 1 No.
- Welding gun - 1 No.
- Ele. power source
- Smooth File
- Gloves and google
- Gum boot

Material

- Filler rod - 1 No.
- Flux
- PVC pipe length
- Soft cloth
- Alcohol

PROCEDURE

TASK 1: **PPR pipe welding joint**

- Pipe length should be marked as required.
- Attach the PPR fusion welder & work bench using bench vice.
- Seat the fusion welder in the bench stand.

Ensure that fusion welder is firmly attached to the bench stand.

- Attach aquaplast welder.
- The extension should be throughly secured to avoid moment during welding.
- Power 'on' is indicated by Red/green lights.
- When the equipment attain temperature of 260^0C green lamp will pulse continuosly.
- Allow extension for further 10 minutes for temperature stabilisation before welding.
- Warning up time starts when both components are simultaneously pressed.
- Adopting time starts when components are removed from welder.
- Connection time is the components being pushed with each other with lateral pressure.

When connecting do not twist the components only lateral pressure need to be applied.

- Handling time is the joint to get cooled and free from physical stresses.
- Use clean cloth or tissue with an alcohol to remove any oils or grease may be on to surface of the components.
- After allowing the required hardening time, the joint is completed and free from stresses.

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Laying and jointing of PVC pipes

Objectives : At the end of this exercise you shall be able to
- **lay and joint PVC pipe in external work**
- **lay and PVC pipe (internal work)**
- **PPC flanged joint.**

Requirements

Tools/Instruments

- Crow bar - 1 No.
- Showel - 1 No.
- Mortor pan - 1 No.

Material

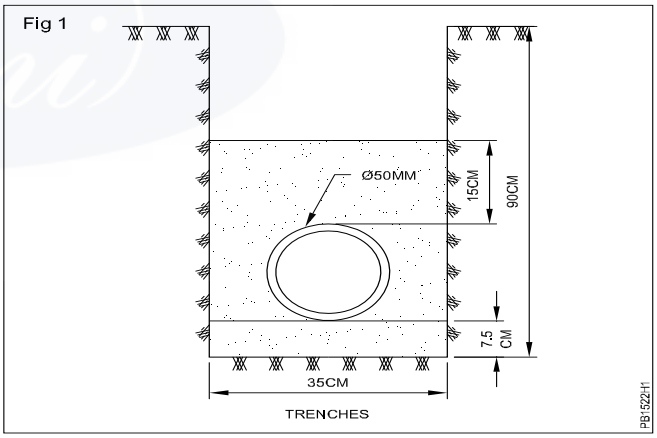
- 50mm of PVC pipe - 2 m.
- 65mm of PVC pipe - 2 m.
- Brush
- Soft paper
- Rubber gasket - 2 nos.
- Metal flange
- PVC pipe solvent

PROCEDURE

TASK 1: **Lay and joint PVC pipe in External work (Fig 1)**

- Execute a bench of size 35cm x 90cm.
- Excavate the length of trench 200cm.
- Check the botoom of trench carefully the presence of hard object such as flints, rock projections or tree roots, etc.
- Lay PVC pipe on bedded sand or soft soil free from rock and gravel.
- Fill the soil remain portion of trench.

Fig 1



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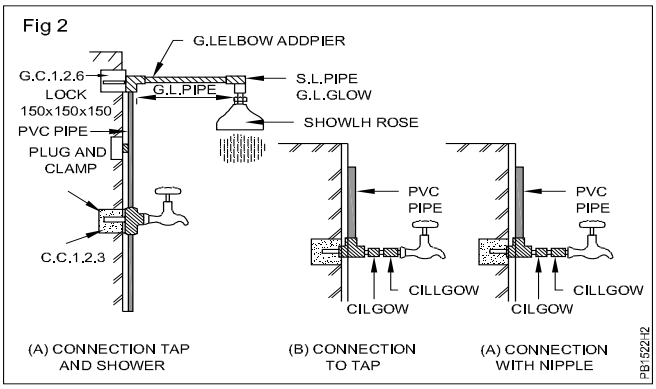
TASK 2: **Lay and joint PVC pipes Internal work (Fig 2)**

- Lay the pipe and clamped to wooden pegs fixed above the surface of the wall.
- Fix the support at close interval.
- Aligned PVC pipes properly before fixing them on the wooden plugs with clamps.
- Check the alignment of PVC pipe before clamping.

Fig 2



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TASK 3: **PVC Flanged Joint: (Fig 3)**

- Apply a coating of solvent cement shall be evenly applied on the inside of the fitting around the circumference.
- Rup the outside of the pipe end upto the marked line with non-synthetic brush of suitable dimension.
- Push the pipe into the fitting socket and held for 1 or 2 minutes.
- Wiped out the surplus cement on the pipe surface.

If the solvent cement has dried up too much or the tapering of the socket is too sleep. Joining will not be proper and pipe will come out of the fitting.

Fig 3