ENGINEERING WORKSHOP PRACTICE

A. K. Sarathe

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by A. K. Sarathe

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FOREWORD

Engineering has played a very significant role in the progress and expansion of mankind and society for centuries. Engineering ideas that originated in the Indian subcontinent have had a thoughtful impact on the world.

All India Council for Technical Education (AICTE) had always been at the forefront of assisting Technical students in every possible manner since its inception in 1987. The goal of AICTE has been to promote quality Technical Education and thereby take the industry to a greater heights and ultimately turn our dear motherland India into a Modern Developed Nation. It will not be inept to mention here that Engineers are the backbone of the modern society - better the engineers, better the industry, and better the industry, better the country.

NEP 2020 envisages education in regional languages to all, thereby ensuring that each and every student becomes capable and competent enough and is in a position to contribute towards the national growth and development.

One of the spheres where AICTE had been relentlessly working from last few years was to provide high-quality moderately priced books of International standard prepared in various regional languages to all it's Engineering students. These books are not only prepared keeping in mind it's easy language, real life examples, rich contents and but also the industry needs in this everyday changing world. These books are as per AICTE Model Curriculum of Engineering & Technology – 2018.

Eminent Professors from all over India with great knowledge and experience have written these books for the benefit of academic fraternity. AICTE is confident that these books with their rich contents will help technical students master the subjects with greater ease and quality.

AICTE appreciates the hard work of the original authors, coordinators and the translators for their endeavour in making these Engineering subjects more lucid.

(**Anil D. Sahasrabudhe**)

Acknowledgement

The author is grateful to AICTE for their meticulous planning and execution to publish the technical book for Diploma students.

I sincerely acknowledge the valuable contributions of the reviewer of the book Prof. Hamid Zaheer, for making it students' friendly and giving a better shape in an artistic manner.

This book is an outcome of various suggestions of AICTE members, experts and authors who shared their opinion and thoughts to further develop the engineering education in our country.

It is also with great honour that I state that this book is aligned to the AICTE Model Curriculum and in line with the guidelines of National Education Policy (NEP) -2020. Towards promoting education in regional languages, this book is being translated in scheduled Indian regional languages.

Acknowledgements are due to the contributors and different workers in this field whose published books, review articles, papers, photographs, footnotes, references and other valuable information enriched us at the time of writing the book.

Finally, I like to express my sincere thanks to the publishing house, M/s. Khanna Book Publishing Company Private Limited, New Delhi, whose entire team was always ready to cooperate on all the aspects of publishing to make it a wonderful experience.

A. K. Sarathe

Preface

The "Engineering Workshop Practice Manual" is the result of my teaching, teacher-training and practical experience in this area. The AICTE model curriculum 2019 for diploma engineering & technology courses has been considered in developing this manual and all the units are covered in a proper and systematic way in this manual. All the units are supported with relevant theory, figures and photographs to help students to understand the unit in a better way.

There are total five units in the manual. First unit deals with the carpentry, second unit is about fitting, third unit focuses on welding, fourth unit discuss about sheet metal working and the fifth unit deals with electrical house wiring. The manual comprises of total seventeen workshop practical from P1 to P17 and the same are arranged in hierarchical manner from simple to complex so that students are not only focus on completing the practical and getting the marks / grades but are also motivated to create useful products incorporating their creative and critical thinking as well.

The manual format has been fine tuned by senior NITTTR Bhopal faculty to ensure alignment with outcome based education philosophy. The purpose of writing this manual is to introduce basic workshop practices to first year engineering diploma students to gain practical experience in using tools, equipment, instruments, machinery and processes correctly in various engineering shops. Efforts are made to present basic workshop practice in simplest possible way.

While preparing this manual, different standard text books and manuals of workshop technology are referred to handle workshop practice problems using critical thinking and performing procedures correctly. Students are encouraged to explore more information about workshop practice by advising them to refer standard books on workshop technology and through online links related to workshop activities.

I, sincerely hope that this engineering workshop practice manual will inspire students to take active participation in learning various workshop processes, as well as it will motivate teachers to make students learn with passion.

I am thankful to all suggestions made by stack holders to make this manual beneficial to all concerned.

It is really a great pleasure to cover and complete this manual for students as well as for teachers.

A. K. Sarathe

Outcome Based Education

For the implementation of an outcome based education the first requirement is to develop an outcome based curriculum and incorporate an outcome based assessment in the education system. By going through outcome based assessments, evaluators will be able to evaluate whether the students have achieved the outlined standard, specific and measurable outcomes. With the proper incorporation of outcome based education there will be a definite commitment to achieve a minimum standard for all learners without giving up at any level. At the end of the programme running with the aid of outcome based education, a student will be able to arrive at the following outcomes (as per NBA guidelines):

1. **Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

2. **Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.

3. **Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

4. **Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

5. **Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.

6. **Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

7. **Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.

Course Outcomes

CO-1. Use carpentry tools to make simple carpentry jobs

CO-2. Use fitting tools and instruments to make simple jobs.

CO-3. Prepare simple butt and lap joints using Arc, Gas, MIG welding equipment

CO-4. Undertake simple sheet metal jobs using relevant operations and tools safely.

CO-5. Undertake electric wiring works for various domestic applications.

Mapping of Course Outcomes with Programme Outcomes to be done according to the matrix given below:

Course Outcomes	EXPECTED MAPPING WITH COURSE OUTCOMES (1- Weak Correlation; 2- Medium Correlation; 3- Strong Correlation)						
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7
CO-1	2	-	-	3	1	-	1
CO-2	3	-	1	3	2	-	1
CO-3	3	1	1	3	2	-	1
CO-4	3	1	1	3	2	-	1
CO-5	2	1	2	3	2	1	1

Abbreviations and Symbols

List of Abbreviations

Abbreviations and Symbols	Full form
Amp	Ampere
cm	Centimeter
kW	Kilowatt
m	Meter
mm	Millimeter
V	Volt
W	Watt
"	Inch
'	Feet

List of Figures

Guidelines for Teachers

To implement Outcome Based Education (OBE) knowledge level and skill set of the students should be enhanced. Teachers should take a major responsibility for the proper implementation of OBE. Some of the responsibilities (not limited to) for the teachers in OBE system may be as follows:

- Within reasonable constraint, they should manoeuvre time to the best advantage of all students.
- They should assess the students only upon certain defined criterion without considering any other potential ineligibility to discriminate them.
- They should try to grow the learning abilities of the students to a certain level before they leave the institute.
- They should try to ensure that all the students are equipped with the quality knowledge, practical skills as well as competence after they finish their education.
- They should always encourage the students to develop their ultimate performance capabilities.
- They should facilitate and encourage group work and team work to consolidate newer approach.
- They should assess the students based on suggested assessment scheme provided at the end of all the practical. If necessary, the suggested performance indicators can be changed as per requirement of the practical.

Bloom's Taxonomy

Level	Teacher should Check	Student should be able to	Possible Mode of Assessment
Creating	Students ability to create	Design or Create	Mini project
Evaluating	Students ability to Justify	Argue or Defend	Assignment
Analysing	Students ability to distinguish	Differentiate or Distinguish	Project/Lab Methodology
Applying	Students ability to use information	Operate or Demonstrate	Technical Presentation/ Demonstration
Understanding	Students ability to explain the ideas	Explain or Classify	Presentation / Seminar
Remembering	Students ability to recall (or remember)	Define or Recall	Quiz

Guidelines for Students

Students should take equal responsibility for implementing the OBE. Some of the responsibilities (not limited to) for the students in OBE system are as follows:

- Students should be well aware of each PrO before the start of each practical of every unit.
- Students should be well aware of each CO before the start of the course.
- Students should be well aware of each PO before the start of the programme.
- Students should think critically and reasonably with proper reflection and action.
- Learning of the students in practicals should be connected and integrated relevant theory and real life situations.
- Students should be well aware of their competency at every level of OBE.

Contents

1 CARPENTRY

RELEVANT COURSE OUTCOME(S) AND PO

CO-1: Use carpentry tools to make simple carpentry jobs.

Course Outcome	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium Correlation; 3- Strong Correlation)						
	PO-1: Basic and discipline specific know-ledge	PO-2: Problem analysis	PO-3: Design/ deve-lopment of solutions	PO-4: Engi-neering tools, experi-mentation and testing	PO-5: Engi-neering practices for society, sustain-ability and environ-ment	PO-6: Project manage-ment	PO-7: Life-long learning
CO-1: Use carpentry tools to make simple carpentry jobs.	2	-	-	3	1	-	1

P1 Wood Working Tools and Machines

1.1 Practical Statement

Use relevant tools to prepare carpentry work pieces as per given dimensions.

1.2 Practical Significance

Carpentry is the process of making wooden components and finished goods such as patterns for casting, cabinets, racks, furniture, roofs, floors, partitions, doors and windows. Carpentry involves proper selection of raw materials and tools to produce desired wooden items of the required quality for the intended purpose. Through this workshop experience student will be able to use basic carpentry tools and machines for preparing parts and sub parts of the given carpentry product such as photo frame, stool etc.

1.3 Relevant Theory

Wood is naturally available in the form of trees. For the purpose of carpentry, the wood is obtained from well-grown trees. After cutting and proper seasoning treatment, it is cut into various sizes for engineering and construction purposes.

Wood can be broadly classified into hard wood and soft wood. Hard wood is generally used for furniture, door, window flooring, etc. and soft wood is generally used for paneling, building components such as fixtures and fittings etc. Examples of hard wood - conifers, kair, deodar, chir, walnut, teak, sal. Examples of soft wood - oak, shisham, beach, ash, mango, neem and babul

1.3.1 Carpentry shop tools

Tools used in carpentry shop are broadly categorised as-

i. Marking and Measuring Tools
ii. Work Holding Devices / Clamping Tools.
iii. Cutting and Planning Tools.
iv. Striking Tools.
v. Miscellaneous Tools.

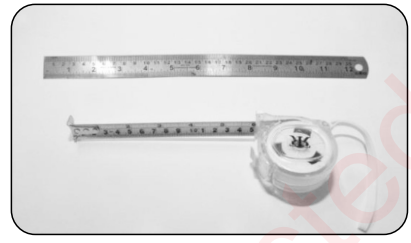
i. Marking and Measuring Tools

Marking tools are used to transfer the dimensions given in a sketch or drawing to a given work piece(s). Measuring instruments are used to take rough as well as accurate measurements. Accurate measurements are required when preparing various joints. Marking tools and measuring instruments are shown in Fig.1.1

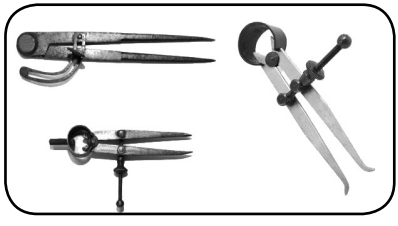
S.N.	Name of Tool with Description.
1	***Marking Knife*** • Size- 4" to 6" • Used for marking visible lines on work pieces or a guide line for sawing, chiseling.
2	***Marking Gauge*** • Size- 6" • Use to scribe a line parallel to a reference edge or surface.
3	***Mortise Gauge*** • Size- 6" • Use to scribe a pa rallel lines for mortise and tenon joints. Shown in Fig.1.1(a)
4	***Steel Rule*** • Size- 6" or 12" • Use as guides for laying out lines. Shown in Fig.1.1(b).
5	***Measuring Tape*** • Size- 3 meters • Use for measurements, graduate in mm, which is ideal for cutting plywood and lumber or measuring molding and trim. Shown in Fig.1.1(b)
6	***Calipers Set (Outside and Inside)*** • Size- 4" and 6". • Use to measures the distance between two opposite sides of an object. Calipers provide quick measurements of inside & outside dimensions, depth and thickness. Accurate measurements are required by woodworkers to prepare tight joints. Shown in Fig.1.1(c).
7	***Wing Compass*** • Size- 6"/8"/10" and 12". • For making circles, use for drawing circles and arcs. Also suitable for scribing arcs and circles. Shown in Fig.1.1(d)
8	***Try Square*** • Size- 6" to 12" • Use for measure 90° and to check of squareness of two surfaces and blade alignment. Shown in Fig.1.1(e)

9	***Bevel Square*** • Blade size 6" to 9" • Use to mark angular positions. Used for measuring desired angle and transferring angles. Shown in Fig.1.1(d)

(a)



(b)



(c)

(d)

(e)

Fig.1.1: Marking and Measuring Tools

ii. **Work Holding Devices/Clamping Tools.**

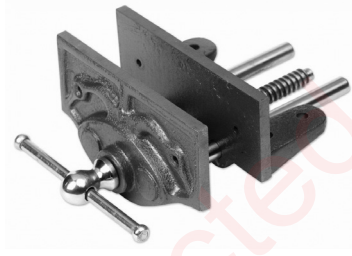
Carpentry work is carried out at different places, but usually most of the operations are done using a workbench. The workbench is a sturdy, heavy and hardwood table.

Other holding and clamping devices are also used for carpentry processes. Work holding devices are shown in Fig.1.2

S.N.	Name of Tool with Description.
1	***Workbench*** • Size- Approximate size is o Length 160-200 cm, Width 90-110 cm, Height 75 - 85 cm Shown in Fig.1.2(a)
2	***Carpentry Bench Vice*** • Size- 8" (width of jaws) • Use to hold work pieces in position. Shown in Fig.1.2(b)
3	***T Bar Clamp*** • Size- 4" to 6" • Use for clamping of long length work pieces for joining using adhesive. Shown in Fig.1.2(c)

4	***C Clamp*** • Size- 4" to 12" • Use to hold work pieces, it consists of a frame with a jaw on one end and a movable jaw. Shown in Fig.1.2(d).

(a)



(b)

(c)

(d)

Fig.1.2: Work Holding Devices

iii. Cutting and Planing Tools.

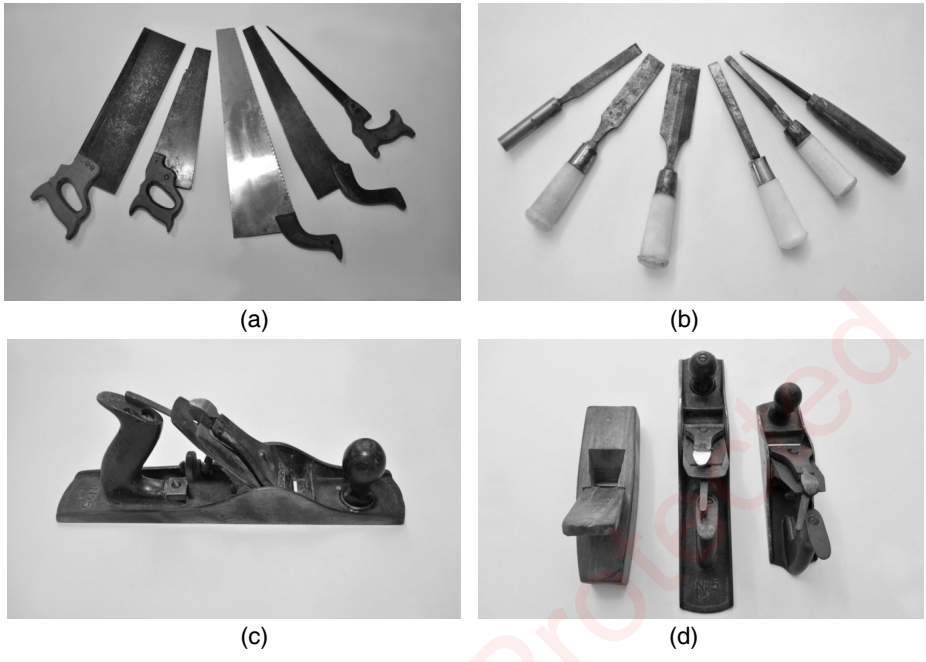
Sawing Tools – A saw consist of a toughened blade, with a hard toothed edge. It is used to cut wood. The cut is made by placing the toothed edge against the material and moving it forcefully forward and less forcefully backward and same action is repeated for cutting. The different types of saws are shown in Fig.1.3(a)

Chipping Tools – They are used to cut excess wood for shaping and joint making. These tools are shown in Fig.1.3(b).

Planing Tools – Planing tools are used to flatten, reduce the thickness of, and impart a smooth surface to a rough piece of lumber or timber. Planing is also used to produce horizontal, vertical, or inclined flat surfaces on work pieces. Various types of planing tools are shown in Fig.1.3(c) and Fig.1.3(d)

S.N.	Name of Tool with Description.
1	***Hand Saws/ Rip Saw*** • Size- 8" to 24" • Used for sawing operation for rough cutting. Selection of saw depends on the thickness of material. Upto 4" thickness of the work piece saw of 18" size can be used.

2	***Tenon Saw*** • Size- 10" to 16" • Used for finish cutting. Selection of saw depends on the thickness of material. Upto 2" thickness of the work piece saw of 12" size can be used.
3	***Key Hole Saw*** • Size- 8" to 12" • Used for cutting circles and slots. Used up to 2" Thickness of the work piece.
4	***Hack Saw*** • Size- 12" (Single side or both sides teeth) • Used for parting of material. Generally use in dismantling work
5	***Jack Plane*** • Size- 16" • Used for removing of rough stock and maintaining flatness. Max 0.5mm depth can be removed at one stroke.
6	***Smoothing Plane*** • Size- 8" • Used for smooth finishing. Max 0.1mm depth can be removed at one stroke.
7	***Rebate Plane*** • Size- 8" • Used for groove cut or recess into the edge of work piece.
8	***Firmer Chisel*** • Size- ½" to 2" • Used for heavy duty wood work.
9	***Bevel Chisel*** • Size- ¼" to 1 ½" • Used for rough chipping.
10	***Mortise Chisel*** • Size- ¼" to 1 ½" • Used to cut mortise joint.



(a) (b)

(c) (d)

Fig.1.3: Cutting and Planning Tools

iv. Striking Tools

Striking tools are basic hand tools, used to drive nails and chisels. Shown in Fig.1.4.

S.N.	Name of Tool with Description.
1	***Ball Peen Hammer*** • Size - 450 grams. • Use for nailing and striking work. It consists of a weighted head usually metallic, while the opposite end is rounded. This round end is called a peen.
2	***Claw Hammer*** • Size - 900 grams. • Useful for sticking and removing of nails. This hammer has 'V shaped claw' on the end opposite to the face is known as claw hammer.
3	***Mallet*** • Made of hard wood material. • Useful for soft hammering in fitting operations. A mallet resembles a hammer, but the difference lies in its non-metallic head.

Fig.1.4: Striking Tools

v. Miscellaneous Tools.

S.N.	Name of Tool with Description.
1	***Carpenter's Hand Drill Machine*** • Size- ¼" capacity • Useful for drilling holes. Shown in Fig.1.5(c)
2	***Portable Power Drill Machine*** • Size- Drill bits of 2 mm to 6 mm can be used as per requirements. • Useful for drilling holes. Shown in Fig.1.5(d)
3	***Rasp File*** • Size- 8" to 14". • Used for rapid removing of material. Rasp files are available in various shapes such as rectangular, round and half-round. • The different types of file used in carpentry are Shown in Fig.1.5(a).
4	***Flat File Bastard*** • Size- 12" • Used for removal of rough material and semi finish work.
5	***Flat File Smooth*** • Size- 12" • Used for finishing of material and smooth finish work.
6	***Half Round File Bastard*** • Size- 12" • Used for removal of rough material and for rounding out holes as well as suitable on concave, convex surfaces.

7	***Half Round File Smooth*** • Size- 12" • Used for finishing of material and for rounding out holes as well as suitable on concave, convex surfaces for smooth finish work.
8	***Triangular File Smooth*** • Size- 6" • Used for finishing of material and teeth sharpening of saws.
9	***Screw Drivers*** • Size- 6" to 18" • For screwing purpose and shown in Fig.1.5(b)
10	***Sand and Emery Papers*** • 80 No. 120 No. • Use for de-burring, polishing and also for rough and finishing work.
11	***Pincers and Plier*** • Size- 8" • For removing nails. Plier Shown in Fig.1.5(d)
12	***Electric Planer (Hand)*** • Size- 3" blade size • Use to smooth the surface of work piece. Shown in Fig.1.5(e)
13	***Electric Circular Saw (Hand)*** • Size-4" cutter size • Use to cut or parting the wood material. Shown in Fig.1.5(f)

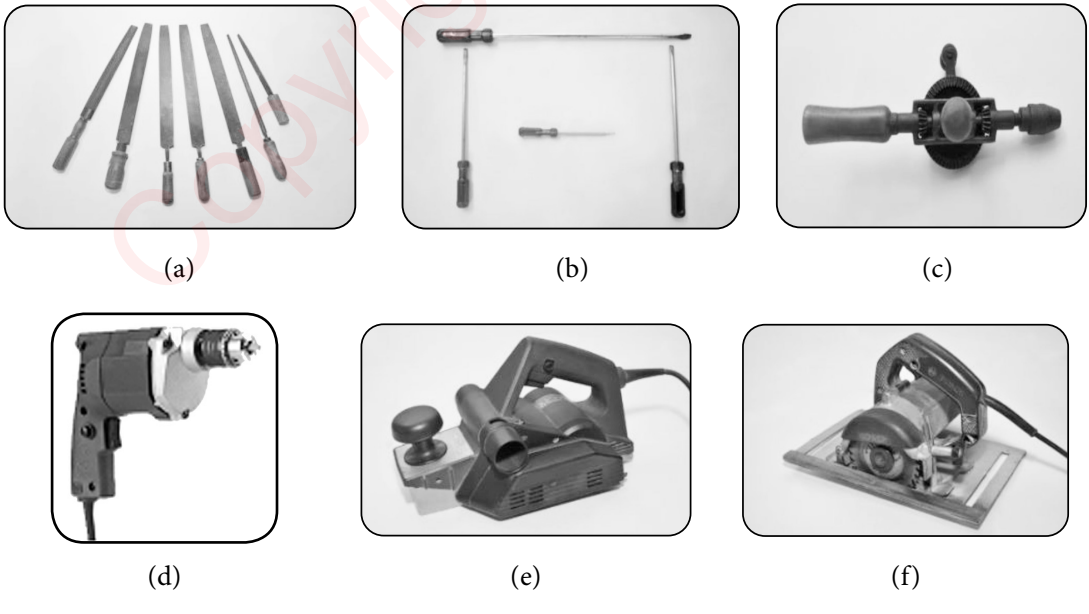


Fig.1.5: Miscellaneous Tools

1.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Select the relevant tools and instruments for given job.

PrO2: Use the relevant carpentry tools correctly.

PrO3: Follow safe practices .

PrO4: Work as a team member.

PrO5: Use of environment friendly approaches.

1.5 Practical Setup (Sketch/Work Situation)

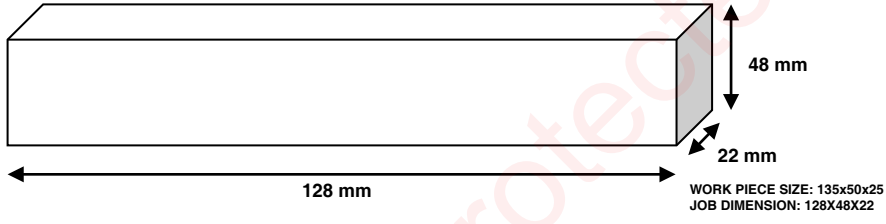


Fig.1.6: Job Dimensions

1.6 Resources Required

(For this practical student will select the relevant tools and instruments for a Job.shown in Fig.1.6)

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1					
2					
3					
4					
5					
6					
7					
8					

9					
10					
11					
12					
13					

1.7 Precautions

1. Loose clothes should be avoided.
2. The tools being used should be well sharpened
3. Ensure that work-piece should be free from knots, splits and nails.
4. While performing cutting and chiseling operation direction of the tool should always be away from your body.
5. Ensure that tool handles are properly attached to the tool before using them.
6. Due care should be taken while using the thumb as a guide during sawing.

1.8 Suggested Procedure

1. Check the dimensions of the wooden plank which is relatively long rectangular piece of wood.
2. Carryout the marking as per required dimensions of the work pieces.
3. Hold the job in carpentry vice.
4. Plane all surfaces of the wooden plank till job attains the required dimension.
5. Check squareness using try square.
6. Now, do the sawing operation and cut the wooden plank using saw to have the two work pieces of required size shown in Fig.1.6 and plane the cut surface using jackplane
7. These work pieces will be used for other carpentry practicals.
8. If required, under the instructions of the teacher more work pieces can be prepared by repeating steps 1 to 6.

1.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.			% Error
1			
2			

1.10 Results and/or Interpretation

(to be filled by student)

.....

.....

1.11 Conclusions and/or Validation

(to be filled by student)

.....

.....

1.12 Practical Related Questions

(Use separate sheet for answer) (to be filled by student)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-determined course outcome

1. Name the saw and planer used for this practical with major specifications.
2. Name the instruments used for checking of the work pieces
3. Write any three latest tools used in carpentry shop.
4. Write any three examples of soft wood.
5. Write major specifications of electric circular saw.

1.13 Disposal of Waste

(to be filled by student)

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Name of item
Biodegradable waste	Green bin	
e-Waste	Black bin	
Plastic and metal waste	Blue bin	
Any Other		

1.14 Environment Friendly Approach: Reuse, Reduce and Recycle

The workpiece in this practical can be reused by reducing the dimensions appropriately.

1.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promotors & Publishers Pvt. Ltd., Delhi, Latest Edition
2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Sons, Delhi, Latest Edition

3. Carpentry Tools:
4. Latest Carpentry Tools

1.16 Suggested Assessment Scheme

(to be filled by teacher) Note: The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 6 Marks - 60%			
1	Selection of tools and instruments	15%	
2	Marking and measuring	10%	
3	Checking the work pieces before submission.	20%	
4	Following safe practices	5%	
5	Working in team	5%	
6	Practicing environment friendly approach(es)	5%	
Product related: 4 Marks - 40%			
7	Writing result and/or interpretation	5%	
8	Conclusions	5%	
9	Correctness of the job	10%	
10	Practical related questions	15%	
11	Submitting the journal in time	5%	
	Total	**100 %**	

**Marks and percentage weightages for product and process assessment will be decided by the teacher.*

Name of the Student: ..... Marks Awarded			**Signature of Teacher with date**
Process Related	Product Related	Total	

P2 Half Lap Joint

2.1 Practical Statement

Use relevant tools to prepare Half Lap Joint according to given dimensions.

2.2 Practical Significance

Every diploma engineer should be aware of the simple carpentry jobs which s/he is required to be done/checked in his career. In wood working applications a half-lap joint is frequently used which consists of two work pieces reduced to half of their thickness where they lap over each other. This joint is stronger to dowel-reinforced butt joint. This joint is used in many applications due to easy in making and due to their strength such as cabinet door frames, workbench leg frames, outdoor furniture, and internal web frames for furniture such as dressers. Therefore, doing this practical will give a feel to the student of the type of wood, the precision of the joint to be seen and the time required to do that job.

2.3 Relevant Theory

A lap joint is a very popular method to join wood, plastic, or metal. A lap joint can be used in woodworking for joining wood together. A lap joint can be divided as a full lap joint or a half lap joint. In a full Lap Joint no material is removed from the members to be joined. They simply overlap each other & then can be joined using adhesive & nails. In a half lap joint also called as halving joint, material need to be removed from both of the members so that the resulting joint has the same thickness of the thickest member.

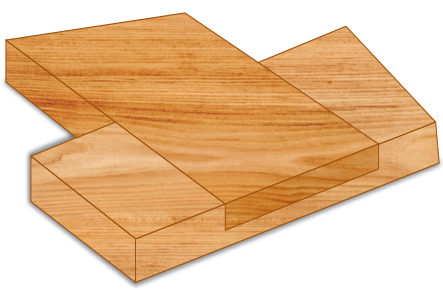


Fig.2.1: Finished Half Lap Joint

2.3.1 Application of lap joints

Lap joints can be used for temporary framing, tabling, frame assembly in cabinet making, and timber frame construction.

2.3.2 Types of lap joints

Following are the major types of lap joint used in woodworking for various applications.

i. Halving Lap Joint

The halving type of lap joints used extensively in cabinetry for framing. It is easy and fastest lap joint to make and it provides high strength through the good long grain to long grain gluing surface. The shoulders also provide some resistance to racking. Halving lap joint may be reinforced with dowels or mechanical fasteners to avoid twisting of the wood.

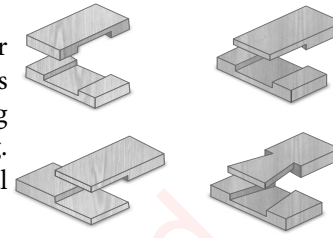


Fig.2.2: Halving Lap Joint

ii. Cross Lap Joint

The cross type of lap joint are used for internal cabinet frames and simple framing and bracing. The cross lap is much similar to the basic half lap but the main difference between them is that the joint occurs in the middle of both pieces. The pieces are at right angles to each other and one member may terminate at the joint or can be extended. When one of the members terminates at the shin then it is referred to as tee lap or middle lap. In the situation where both pieces extend beyond the joint, each of the pieces contains two shoulders and one cheek.

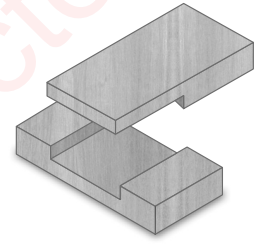


Fig.2.3: Cross Lap Joint

iii. Dovetail Lap Joint

The dovetail lap joint is used on framing applications where tension forces could pull the joint apart. The joint contains a housing that is cut at an angle to resists withdrawal of the stem from the cross-piece.

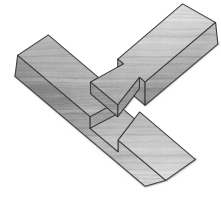


Fig.2.4: Dovetail Lap Joint

iv. Mitred Half-Lap Joint

The mitred half-lap joint is used for visible framing applications where a mitred corner is needed. The joint appears as one of the weakest as the gluing surface is less.

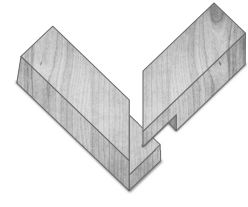


Fig.2.5: Mitred Half-Lap Joint

v. End Lap Joint

The end lap joint is also known as pull lap and also called a corner lap when the joint forms a corner, that's in a rectangular frame. It is the basic form of the lap joint which is used to join pieces end to end either parallel or at right angles. The corner lap is the most common form of end lap and is used in framing. In half lap joint, the pieces are parallel, the joint is known as half-lap splice. It is a splice joint which an alternative to scarfing when joining shorter pieces end to end. This joint is used for internal cabinet frames and visible frames when the frame pieces are to be shaped.

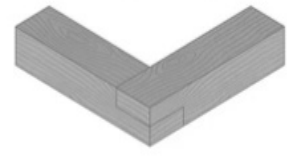


Fig.2.6: End Lap Joint

2.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Check the raw material/work piece to its size.

PrO2: Select the relevant tools and instruments for the preparation of half lap joint.

PrO3: Use the tools/machines/instruments following the correct procedure.

PrO4:: Follow safe practices.

PrO5: Work as a team member.

PrO6: Use of environment friendly approaches.

2.5 Practical Setup (Drawing/Work Situation)

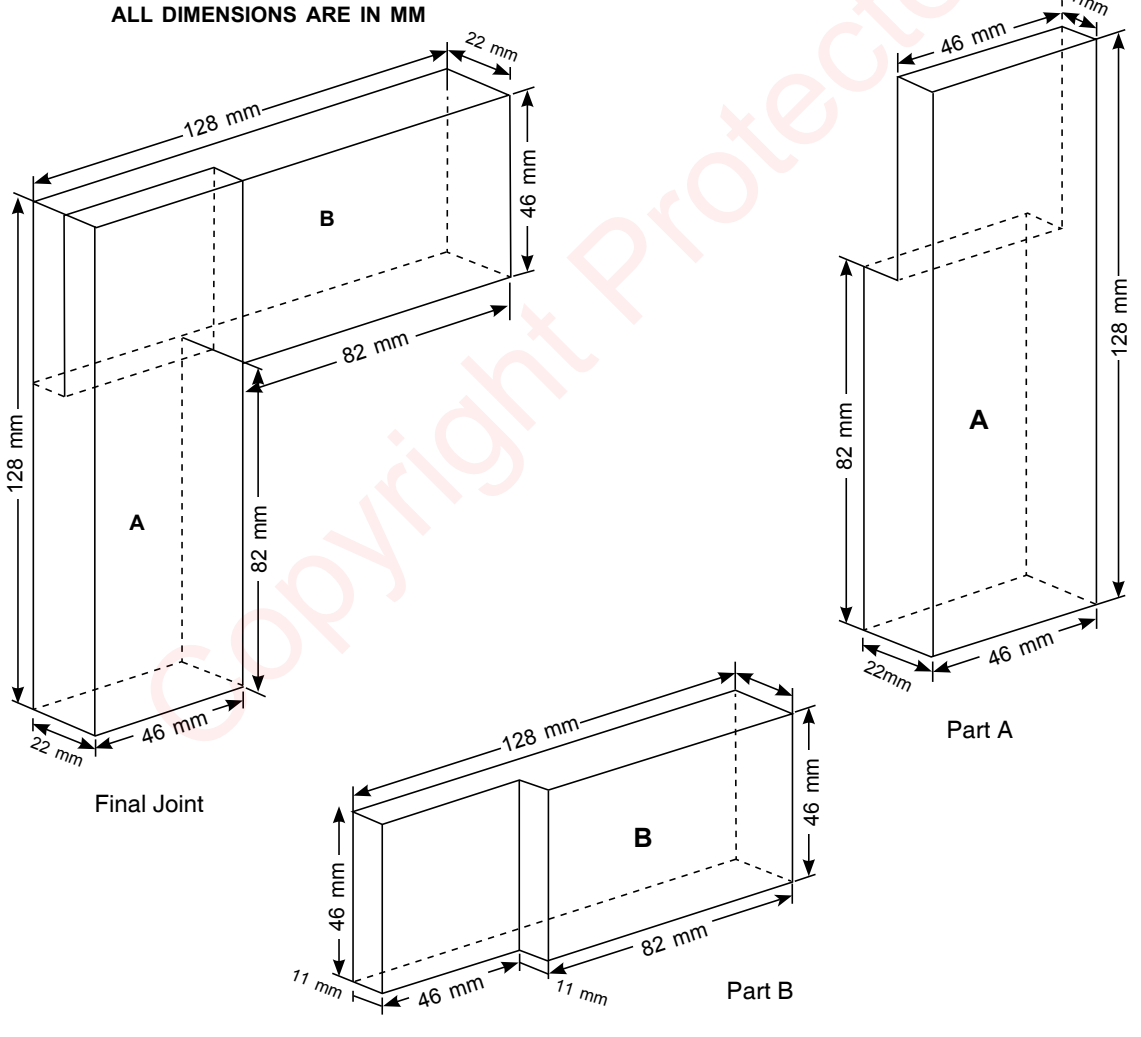


Fig.2.7: Half Lap Joint Dimensions

2.6 Resources Required

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Jack plane 8"	1 No.			
2	Steel rule 12"	1 No.			
3	Marking gauge 6"	1 No.			
4	Try square 8"	1 No.			
5	Rip saw 12"	1 No.			
6	Clamp - to hold normal size objects	1 No.			
7	Carpentry vice- to hold normal size objects	1 No.			
8	Firmer chisel- 1/2", 3/8" and 1.25"	1 Each			
9	Cross peen/Claw hammer -450 grams	1 No.			
10	Rough flat file – Suitable size	1 No.			
11	Sand paper 120 No./ Smooth file	1 No.			

2.7 Precautions

1. Loose clothes should be avoided.
2. The tools being used should be well sharpened
3. Ensure that work-piece should be free from knots, splits and nails.
4. While performing cutting and chiseling operation direction of the tool should always be away from your body.
5. Ensure that tool handles are properly attached to the tool before using them.

6. Tools that are not in use should always be kept at their proper places.
7. Due care should be taken while using the thumb as a guide during sawing.

2.8 Suggested Procedure

1. Check the dimensions of two wooden work pieces and note.
2. Hold the job in carpentry vice.
3. Plane all surfaces of the work piece till job attains the required dimension of 128 mm x 46 mm x 22 mm.
4. Check squareness using try square.
5. Prepare the second work piece by following steps 2 to 4 and mark the pieces as Part 'A' and 'B' as shown in Fig.2.7.
6. Mark at the corner of Part 'A' and 'B', a rectangular shape as per given drawing i.e. 46mm x 11mm extra material which is to be removed for making a corner half lap joint. Marking is done using steel rule and marking gauge.
7. Cut the unwanted material from Part 'A' and 'B' using rip saw.
8. Make the surfaces smooth from which the material has been removed using firmer chisel and sandpaper.
9. Join Part 'A' and 'B' using adhesive & nails.

2.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.			% Error.
1			
2			

2.10 Results and/or Interpretation

(to be filled by student)

.....
.....

2.11 Conclusions and/or Validation

(to be filled by student)

.....
.....

2.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-determined course outcome(s)

1. Name the important tools used in carpentry shop?
2. The wooden plank / work piece used for given joint should have planed surface in this practical? Give reason.
3. Which joint has more strength full lap joint or half lap joint?
4. Give the domestic/industrial application of any two types of lap joints.
5. Describe rip saw with the help of neat sketch.

2.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Name of item
Biodegradable waste	Green bin	
e-Waste	Black bin	
Plastic and metal waste	Blue bin	
Any Other		

2.14 Environment Friendly Approach: Reuse, Reduce and Recycle

The workpiece in this practical can be reused by reducing the dimensions appropriately.

2.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promotors & Publishers Pvt. Ltd., Delhi, Latest Edition
2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Sons, Delhi, Latest Edition
3. Carpentry Joint
4. Half lap Joint

2.16 Suggested Assessment Scheme

(to be filled by teacher)

Note: The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 6 Marks - 60%			
1	Marking and cutting	15%	
2	Handling of the tools / instruments	20%	
3	Checking the work piece before preparing joint using suitable gauge / instrument	10%	
4	Working in team	5%	
5	Following safe practices	5%	
6	Practicing environment friendly approach(es)	5%	
Product related: 4 Marks - 40%			
7	Writing result and/or interpretation	5%	
8	Conclusions	5%	
9	Correctness of the job	10%	
10	Answering practical related questions	15%	
11	Submitting the journal in time	5%	
	Total	**100%**	

** Marks and percentage weightages for product and process assessment will be decided by the teacher.*

Name of the Student: …….. **Marks Awarded**			**Signature of Teacher with date**
Process Related	Product Related	Total	

P3 Mortise-and-Tenon Joint

3.1 Practical Statement

Use relevant tools and instruments to prepare Mortise-and-Tenon Joint according to given dimensions

3.2 Practical Significance

In field and industries, Mortise-and-Tenon Joint is used to connect two pieces of wood or wooden material when the adjoining pieces connect at right angles. Mortise-and-tenon joints are commonly used to fit without using glues, this enables the wood to expand and contract due to moisture. Mortise-and-tenon joint is one of the strongest joint in woodworking, which is used for wooden frame construction, chairs, tables and other furniture etc.

3.3 Relevant Theory

It is a joint made up of two parts. The 'Tenon' portion of the joint serves as the peg, and the 'Mortise' is the hole or slot into which the tenon is inserted as shown in Fig.3.1

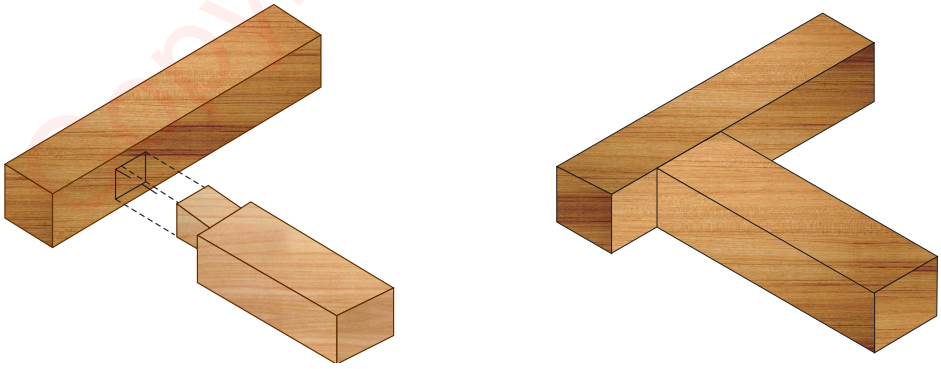


Fig.3.1: Mortise-and-Tenon Joint

3.3.1 Application of mortise and tenon joints

Mortise-and-Tenon Joint can be used for making of wooden cot, chair, table and cabinets assembly

3.3.2 Types of mortise and tenon joints

Following are the common types of mortise and tenon joint used in woodworking for various applications.

i. Through Mortise and Tenon Joint

When the 'tenon' completely passes through the mortise and is projected on the surface. (Fig.3.2)

ii. Stub Mortise and Tenon Joint

When the 'tenon' is not through the mortise. Hence the 'tenon' is not visible once the joint is assembled.(Fig.3.3)

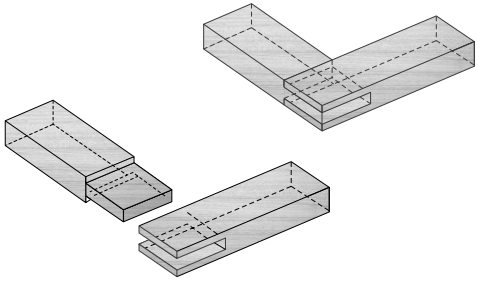


Fig.3.2: Through Mortise and Tenon Joint

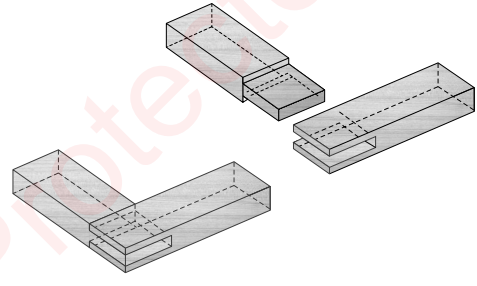


Fig.3.3: Stub Mortise and Tenon Joint

iii. Haunched Mortise and Tenon Joint

When the entire mortise does not extend to full depth and shallow portion is filled by projection of tenon left for this purpose. (Fig 3.4)

iv. Open Slot Mortise and Tenon Joint

Open slot Mortise and Tenon Joint is also known as Bridle Joint. In this top of the mortise is open. (Fig.3.5)

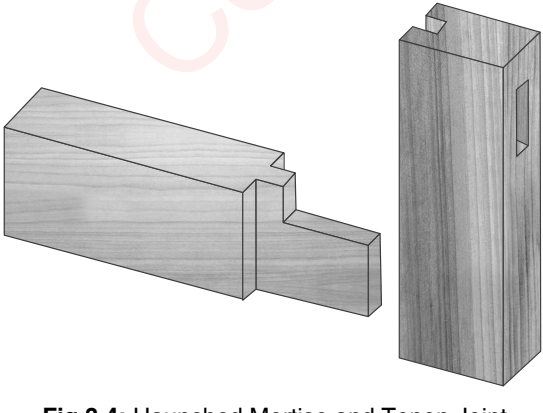


Fig.3.4: Haunched Mortise and Tenon Joint

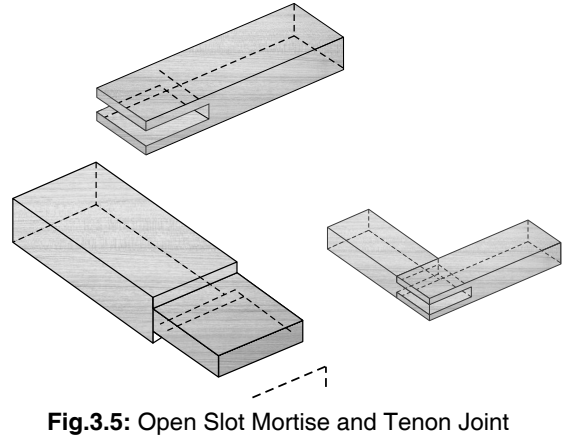


Fig.3.5: Open Slot Mortise and Tenon Joint

3.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Check the raw material/work piece to its size.

PrO2: Select the relevant tools and instruments for the preparation of Mortise-and-Tenon Joint

PrO3: Use the tools/machines/instruments following the correct procedure.

PrO4: Follow safe practices.

PrO5: Work as a team member/leader.

PrO6: Use of environment friendly approaches.

3.5 Practical Setup (Drawing/Work Situation)

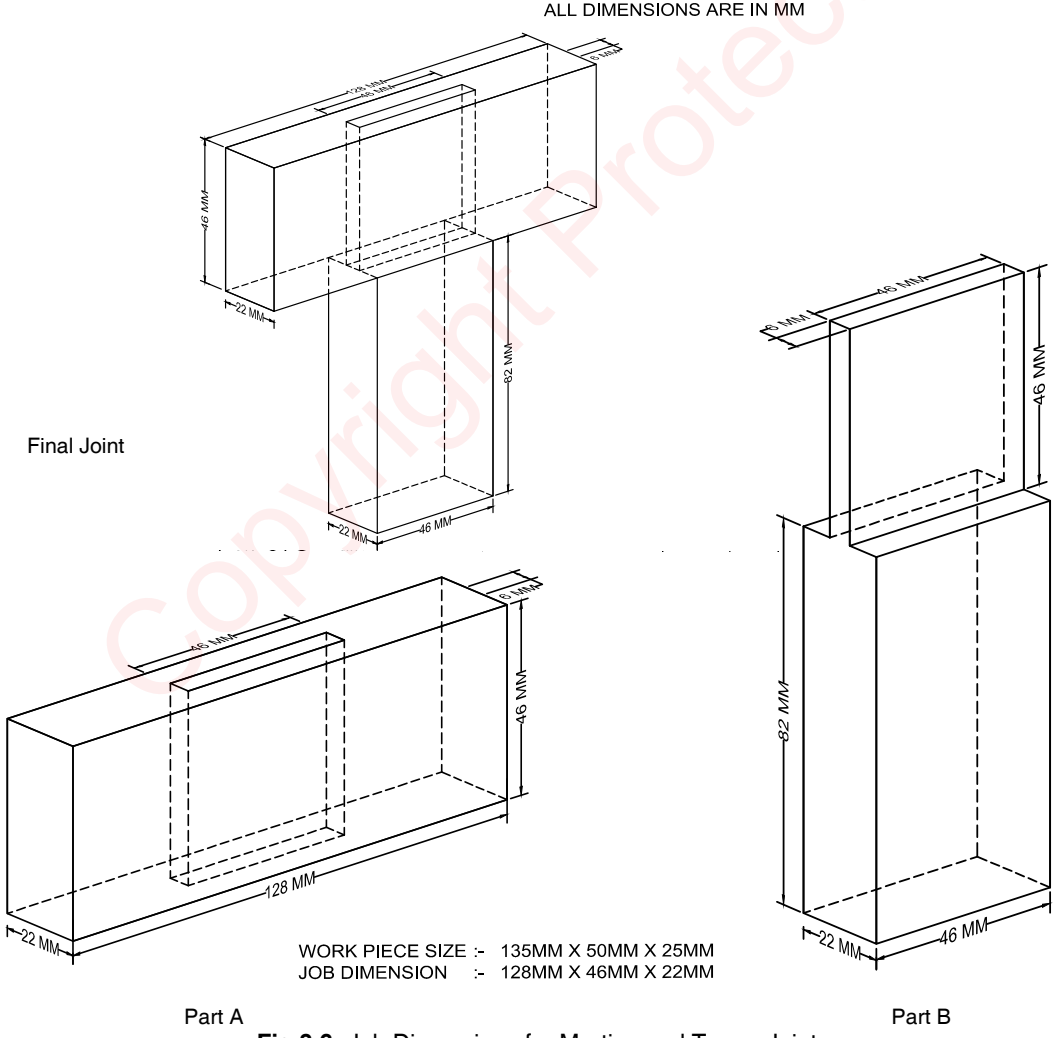


Fig.3.6: Job Dimensions for Mortise and Tenon Joint

3.6 Resources Required

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Jack plane 8"	1 No.			
2	Steel rule 12"	1 No.			
3	Marking gauge 6"	1 No.			
4	Mortise gauge 6"	1 No.			
5	Try square 8"	1 No.			
6	Rip saw 12"	1 No.			
7	Tenon saw - suitable size	1 No.			
8	Carpentry vice- To hold normal size objects	1 No.			
9	Firmer chisel- 1/2", 3/8" and 1.25"	1 Each			
10	Cross peen / Claw hammer - 450 grams	1 No.			
11	Rough flat file – suitable size	1 No.			
12	Sand paper 120 No./ smooth file	1 No.			

3.7 Precautions

1. Loose clothes should be avoided.
2. The tools being used should be well sharpened
3. Ensure that work-piece should be free from knots, splits and nails.
4. While performing cutting and chiseling operation direction of the tool should always be away from your body.

5. Ensure that tool handles are properly attached to the tool before using them.
6. Tools that are not in use should always be kept at their proper places.
7. Due care should be taken while using the thumb as a guide during sawing.

3.8 Suggested Procedure

1. Check and note the dimensions of two wooden work pieces.
2. Hold the job in carpentry vice.
3. Plane all surfaces of the work piece till job attains the required dimension of 128 mm x 46 mm x 22 mm and check correctness using Try square.
4. Check the squareness of all the surfaces with their adjacent surfaces.
5. Prepare the second work piece by following steps 2 to 4. Mark the pieces as 'Part A' and 'Part B'.
6. Mark 'Part A' for the Mortise and 'Part B' for the Tenon according to the given dimensions as shown in Fig.3.6.
7. Using Mortise Chisel & Mallet cut a material throughout the depth.
8. Use firmer Chisel to maintain width of the Mortise.
9. Clean sides of the Mortise using Rasp file if required.
10. Make the surfaces smooth with sandpaper.
11. Join pieces 'Part A' and 'Part B' firmly as per Fig.3.6.

3.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.			% Error.
1			
2			

3.10 Results and/or Interpretation

(to be filled by student)

.....
.....

3.11 Conclusions and/or Validation

(to be filled by student)

.....
.....

3.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Can the other carpentry joints be prepared using the same resources? Justify the answer.
2. State any two types of mortise-tenon joints with neat sketch.
3. Give the field application of any two types of mortise-tenon joints.
4. Describe tenon saw with the help of neat sketch.
5. Describe mortise gauge with the help of neat sketch.

3.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Name of item
Biodegradable waste	Green bin	
e-Waste	Black bin	
Plastic and metal waste	Blue bin	
Any Other		

3.14 Environment Friendly Approach: Reuse, Reduce and Recycle

The workpiece in this practical can be reused by reducing the dimensions appropriately.

3.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promotors & Publishers Pvt. Ltd., Delhi, Latest Edition
2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Sons, Delhi, Latest Edition
3. Making of Mortise and Tenon Joint
4. Making of Mortise and Tenon Joint

3.16 Suggested Assessment Scheme

(to be filled by teacher)

Note: The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 6 Marks - 60%			
1	Marking and cutting	15%	
2	Handling of the tools / instruments	20%	
3	Checking the work piece before preparing joint using suitable gauge / instrument	10%	
4	Working in team	5%	
5	Following safe practices	5%	
6	Practicing environment friendly approach(es)	5%	
Product related: 4 Marks - 40%			
7	Writing result and/or interpretation	5%	
8	Conclusions	5%	
9	Correctness of the job	10%	
10	Answering practical related questions	15%	
11	Submitting the journal in time	05%	
	Total	**100%**	

** Marks and percentage weightages for product and process assessment will be decided by the teacher.*

Name of the Student: …….. **Marks Awarded**			**Signature of Teacher with date**
Process Related	Product Related	Total	

P4 Dovetail Joint

4.1 Practical Statement

Use relevant tools and instruments to prepare Dovetail Joint as per given dimensions.

4.2 Practical Significance

A dovetail joint is commonly used in woodworking applications because of their ease of making and their strength. It connects two wooden pieces of furniture which is used in many useful furniture items for strength and longer fit. Therefore, by doing this practical the student will get an idea about the correctness of the joint and the time taken to do that task.

4.3 Relevant Theory

4.3.1 Dovetail joint

It is a joint formed by one or more tapered projections on one piece which interlock with corresponding notches or recesses in another. It is also known as an interlocking joinery technique used by carpenters. dovetail joints use pins and tails to interlock together, where one side has a pin that locks into the other side's tail, and then glued together for a solid dovetail construction.

Dovetail joints are extremely strong due to the way their pins and tails are shaped. The interlocking pins and tails make it more difficult to pull apart the joint and almost impossible to pull apart after gluing.

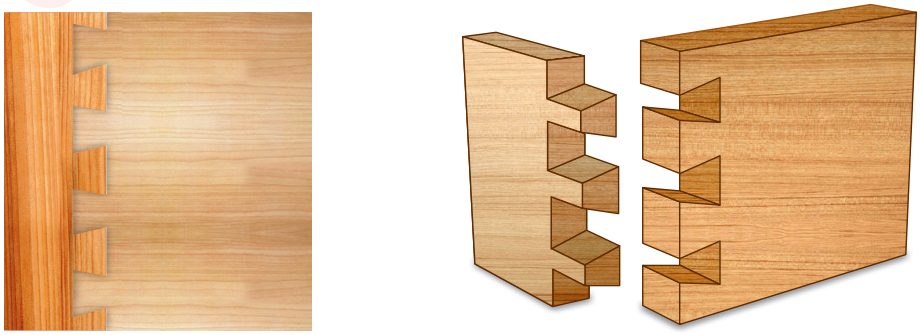


Fig.4.1: Dovetail Joint

4.3.2 Applications of dovetail joints

Dovetail joints are used to create cabinets, furniture, drawers, timber framing etc. Dovetail joints are known for their strength and durability. Dovetail joints are commonly used in jewellery boxes, dovetail drawers, furniture, and cabinets where more strength is needed.

4.3.3 Types of dovetail joints

Following types of dovetail joints are used in woodworking processes..

i. Through Dovetail Joint

A through joint in which the end grain is visible from both boards is called through dovetail joint. Through dovetail joints are most commonly used on box construction and carcass (framework of the piece). This joint is also called a plain dovetail by many in the woodworking community. In the past the ends showing through would have been masked by a veneer. Today they are a sign of exceptional quality and are left showing with pride.

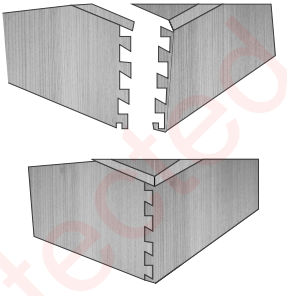


Fig.4.2: Through Dovetail Joint

ii. Half-Blind Dovetail Joints

A half-blind dovetail joint is also known as single-lap dovetail joint is exactly opposite of a through joint because the end grain is not visible on the boards. Sockets house the tails at the end of the boards so the dovetail ends are invisible. Half-blind dovetail joints are commonly used for attaching drawer fronts.

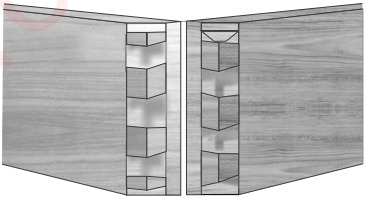


Fig.4.3: Half-blind Dovetail Joint

iii. Secret Mitred Dovetail Joints

A secret mitred joint is also known as a full-blind mitred dovetail and full-blind dovetail joint. Secret mitred joints are used in box work and in cabinet construction and offers the best strength out of all of the dovetail joints. These joints are used for box work or fine cabinet construction where strength is needed without a joint you can see.

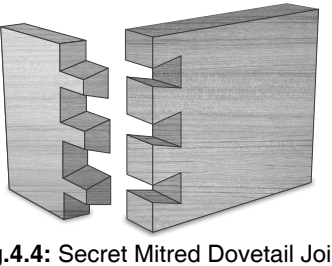


Fig.4.4: Secret Mitred Dovetail Joint

iv. Secret Double Lapped Dovetail Joints

The secret double-lapped dovetail joint is kind of the like the mitred joint but has a visible section of end grain on a single edge of the joint. Similar to the secret mitred dovetail, but presents a very thin section of end grain on one edge of the joint. Secret double-lapped joints are used for box construction and carcass construction to hide the dovetails.

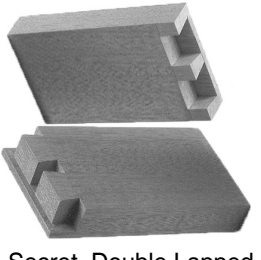


Fig.4.5: Secret Double Lapped Dovetail Joint

v. Sliding Dovetail Joint

The sliding dovetail joint is created by joining 2 wood boards at 90 degree angles, where they intersect different than other types of dovetail joints. They intersect by sliding the tail of one board into the middle socket of the other. Sliding dovetail joints are commonly referred to French Dovetail joints. Sliding joints are commonly used to join cabinet sides to shelves, sides to cabinet bottoms, shelves to horizontal partitions, table frames to adjacent sections, sides to drawer fronts, cabinet sides to front rails, body and neck in guitars and violins.

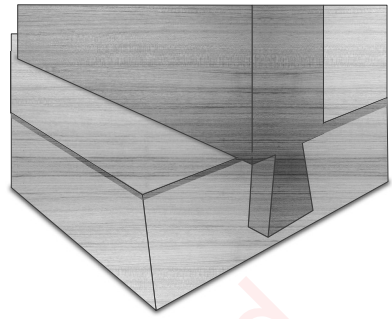


Fig.4.6: Sliding Dovetail Joint

4.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Select the relevant tools and instruments for the preparation of Dovetail Joint.

PrO2: Use the tools and instruments by following the correct procedure.

PrO3: Check the prepared dovetail joint to its size and fit.

PrO4: Follow safe practices.

PrO5: Work as a team member/leader.

PrO6: Use of environment friendly approaches.

4.5 Practical Setup (Drawing / Work Situation)

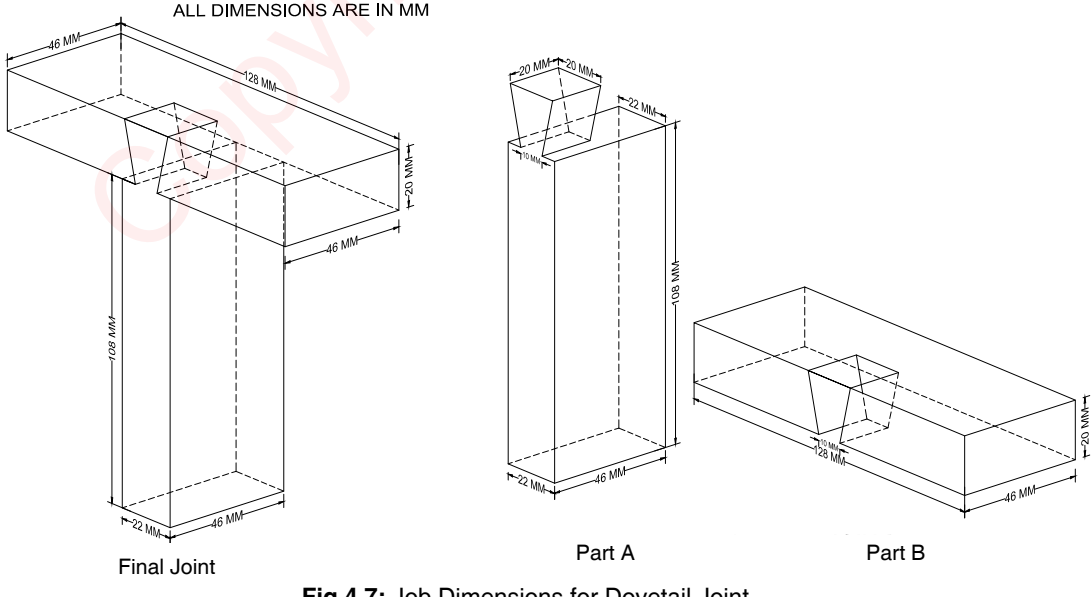


Fig.4.7: Job Dimensions for Dovetail Joint

4.6 Resources Required

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Jack plane 8"	1 No.			
2	Steel rule 12"	1 No.			
3	Marking gauge 6"	1 No.			
4	Try square 8"	1 No.			
5	Rip saw 12"	1 No.			
6	Carpentry vice- to hold normal size objects	1 No.			
7	Clamp - To hold normal size objects	1 No.			
8	Cross peen / Claw hammer - 450 grams	1 No.			
9	Firmer chisel- 1/2", 3/8" and 1.25"	1 Each			
10	Carpentry file – suitable size	1 No.			
11	Dovetail chisel – suitable size	1 No.			
12	Sand paper 120 No. / smooth file	1 No.			

4.7 Precautions

1. Loose clothes should be avoided.
2. The tools being used should be well sharpened
3. Ensure that work-piece should be free from knots, splits and nails.
4. While performing cutting and chiseling operation direction of the tool should always be away from your body.
5. Ensure that tool handles are properly attached to the tool before using them.
6. Tools that are not in use should always be kept in their proper places.
7. Due care should be taken while using the thumb as a guide during the sawing.

4.8 Suggested Procedure

1. Check the given wooden work pieces for dimensions and note.
2. Hold the job in carpentry vice.
3. Plane all surfaces of the work piece till job attains the required dimension of 128 mm x 46 mm x 22 mm.
4. Check squareness using try square.
5. Prepare the second work piece by following steps 2 to 4 and mark the pieces as 'Part A' and 'Part B'.
6. Set the marking gauge and mark the lines at 46 mm and 22 mm as shown in Fig.4.7.
7. Extra material be removed by chiselling and then planed to correct size as per sketch.
8. The mating dimensions of the 'Part A' and 'Part B' are marked as per given drawing in Fig.4.7.
9. The ends of both the parts are chiselled to the required lengths exactly.
10. Join piece 'Part A' and 'Part B' to obtain slightly tight joint.

4.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.			% Error.
1			
2			

4.10 Results and/or Interpretation

(to be filled by student)

.....
.....
.....

4.11 Conclusions and/or Validation

(to be filled by student)

.....

.....

4.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Describe any two types of dovetail joints with neat sketch.
2. In making dovetail joint what precautions you have followed?.
3. Name any five field applications of dovetail joint.
4. Describe dovetail chisel with the help of neat sketch.
5. Write major precaution followed during practical work.

4.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Name of item
Biodegradable waste	Green bin	
e-Waste	Black bin	
Plastic and metal waste	Blue bin	
Any Other		

4.14 Environment Friendly Approach: Reuse, Reduce and Recycle

The workpiece in this practical can be reused by reducing the dimensions appropriately.

4.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promotors & Publishers Pvt. Ltd., Delhi, Latest Edition
2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Sons, Delhi, Latest Edition

4.16 Suggested Assessment Scheme

(to be filled by teacher)

Note: The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 6 Marks - 60%			
1	Marking and cutting	15%	
2	Handling of the tools / instruments	20%	
3	Checking the work piece before preparing joint using suitable gauge / instrument	10%	
4	Working in team	5%	
5	Following safe practices	5%	
6	Practicing environment friendly approach(es)	5%	
Product related: 4 Marks - 40%			
7	Writing result and/or interpretation	5%	
8	Conclusions	5%	
9	Correctness of the job	10%	
10	Practical related questions	15%	
11	Submitting the journal in time	5%	
	Total	**100%**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student: ..... Marks Awarded			**Signature of Teacher with date**
Process Related	Product Related	Total	

2 FITTING

RELEVANT COURSE OUTCOME(S) AND PO

CO-2: Use fitting tools and instruments to make simple jobs.

Course Outcome	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium Correlation; 3- Strong Correlation)						
	PO-1: Basic and discipline specific know-ledge	PO-2: Problem analysis	PO-3: Design/ deve-lopment of solutions	PO-4: Engi-neering tools, experi-mentation and Testing	PO-5: Engi-neering practices for society, sustain-ability and environ-ment	PO-6: Project manage-ment	PO-7: Life-long learning
CO-2: Use fitting tools and instru-ments to make simple jobs.	3	-	1	3	2	-	1

P5 Fitting Shop Tools

5.1 Practical Statement

Use relevant tools & instruments to prepare job as per given dimensions.

5.2 Practical Significance

Every Mechanical Diploma Engineer should be aware of the tools and procedures of fitting shop which are required to assemble the parts after bringing the dimensions or shape to the desired shape to secure the required fit. Usually the work required for this is done on a workbench and is called fitting work. Fitting works are necessary for mating/matching, repair & manufacturing purposes. So by doing this practical, the student will get exposure to fitting work.

5.3 Relevant Theory

Fitting Shop Tools:

Tools instruments used in fitting shop are broadly categorised as-

i. Marking and Measuring Tools
ii. Work Holding Devices / Clamping Tools
iii. Cutting and Finishing Tools
iv. Miscellaneous Tools

5.3.1 Marking and measuring tools

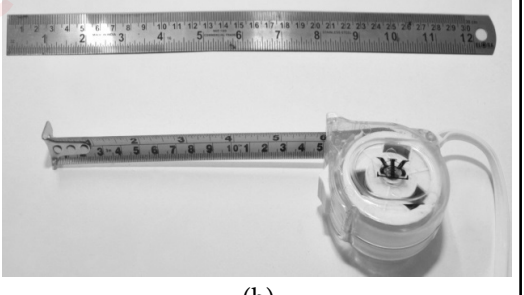
Marking tools are used to transfer the dimensions given in a sketch or drawing to a given metallic work piece(s).

Measuring tools/instruments are used to take rough as well as accurate measurements. Accurate measurements are required when preparing various joints. Marking tools and measuring instruments are shown in Fig.5.1

S.N.	Name of Tool with Description.
1	There are three types of marking tools commonly used in fitting shop – scriber, dot punch and center punch. ***Scriber*** • A scriber is a steel tool, used to scribe or mark lines on metal work-pieces. • It can also be used in conjunction with Tri Square
2	***Dot Punch*** • It is used to create path of cutting and then by using dot punch, the path is punched by a hammer. • Dot punch is ground to a conical angle and have 60 degrees included angle. Shown in Fig.5.1(a)
3	***Center Punch*** • Center punch is similar to the dot punch, except it is ground to a conical point 118 degrees included angle. • It is used to mark the location of holes for drilling operation. Shown in Fig.5.1(a)
4	***Steel Rule*** • Size- 6" or 12" • Use as guides for laying out lines. Shown in Fig.5.1(b)
5	***Measuring Tape*** • Size- 3 meters • A measuring tape is a flexible ruler used to measure linear dimension. The tape is marked along the tape edge in inches, centimeter and meter. Shown in Fig.5.1(b)
6	***Surface Plate*** • Size- Most common surface plate sizes are 18"x24", 24"x36", 36"x48" and 48"x72". • A surface plate provides a flat plane, which is used as a horizontal reference point for dimensional measurements. Shown in Fig.5.1(c)
7	***Angle Plate*** • Size- Angle plates are available in Standard Sizes as per IS -2554-1971 and Non Standard Sizes from 75x75x75 mm to 600x600x600 mm. • Angle plate is a device used as a fixture in metal working; it is used to hold the work piece square on the table during marking operation. For measurement purpose angle plate is also used with surface plate. Shown in Fig.5.1(d)

8	***Try Square*** • Size- 6" to 12" • Use for measure 90° and to check of squareness of two surfaces and blade alignment. Shown in Fig.5.1(e)
9	***Odd Leg Caliper*** • Size- 4", 6" and 8". • It is also known as "Jenny Caliper" or "Hermaphrodite". It is used for making parallel lines from a finished edge and also for locating the centre of round bars specified by height of the leg upto the hinge point e.g. 100 or 150 mm. Shown in Fig.5.1(f)
10	***Vernier Caliper*** • Size- It is available in 0-150 mm, 0-200 mm, 0-300 mm and 0-600 mm. • Vernier Caliper is used to measure outside as well as inside dimensions of a job accurately. It can be used for depth measurement. Shown in Fig.5.1(g)
11	***Vernier Height Gauge*** • Size- It is available in the range of 150 to 500 mm. • Vernier height gauge is used to measure height of the object /job accurately. It can also be used for depth, width and length of the object / job. Shown in Fig.5.1(h)

(a)



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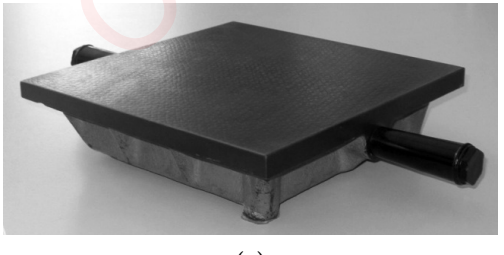

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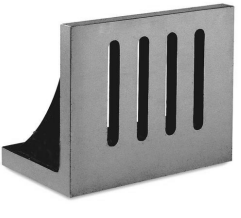

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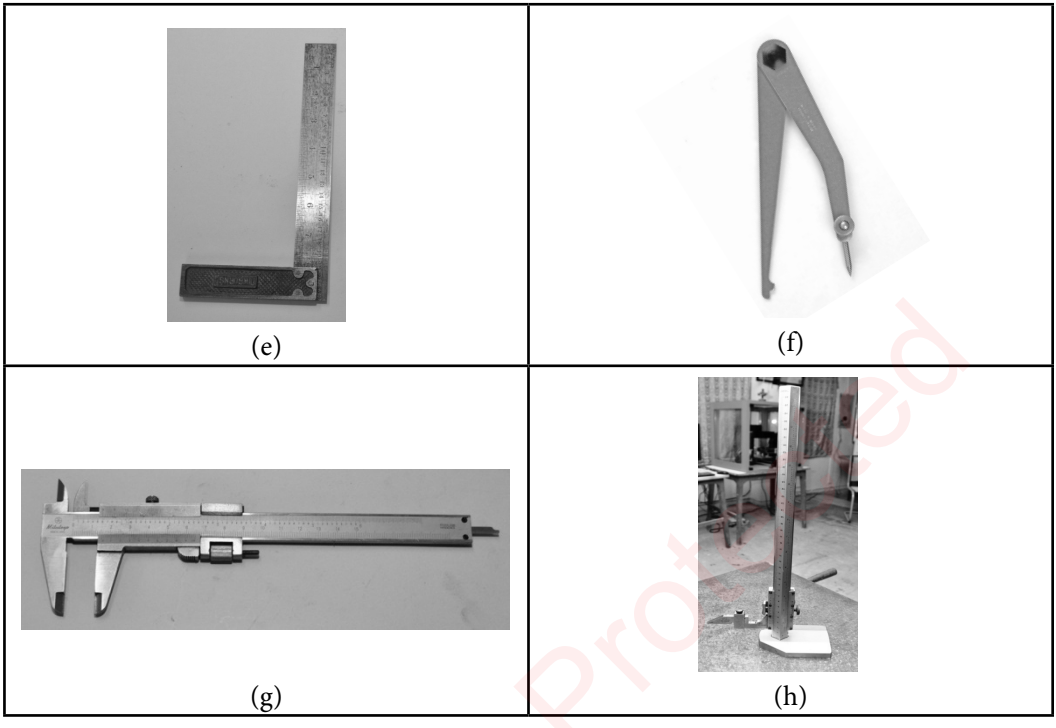
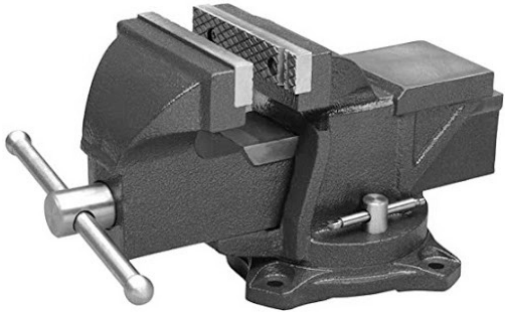


Fig.5.1: Marking and Measuring Tools

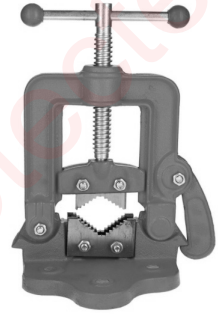
5.3.2 Work holding devices/clamping tools

S.N.	Name of Tool with Description.
1	***Bench Vice*** • Size- It size specified by the maximum width that can be held or maximum opening between the moving and fixed jaws and varies from 75 mm to 300 mm. • It is a device mainly used for holding the work piece/pieces. Vice handle is rotated in clockwise direction, which force moving jaw to press work piece against the fixed jaw Shown in Fig.5.2(a)
2	***V-Block*** • It is a rectangular or square block having V-groove on one side or both sides opposite to each other and angle of the V is 90 degree. • Used to hold circular objects with the help of C clamp. Shown in Fig.5.2(b)
3	***Pipe Vice*** • Size- Its size depends on size/ diameter of the circular/cylindrical component. • It is similar to Bench Vice but suitable for holding circular/cylindrical components between the upper and lower jaws due to the curvature of existing jaws. Shown in Fig.5.2(c)



(a)

(b)



(c)

Fig.5.2: Work Holding Devices / Clamping Tools

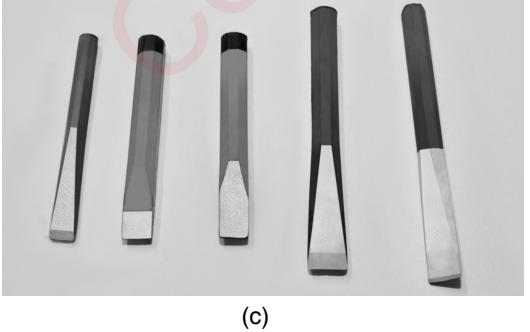
5.3.3 Cutting and finishing tools

S.N.	Name of Tool with Description.
1	***Hack Saw*** • Size- Hacksaw frame size specified by the length of the hacksaw blade which is noemally 10" to 12 ". • Hacksaw is used for cutting metal manually and has a frame, which hold a blade tightly in position. The length of the blade or Teeth per Inch (TPI) is chosen on the basis of work pieces, material and thickness. Blade has staggered teeth for cutting slot easily and prevent the blade from jamming. Shown in Fig.5.3(a)
2	***Chisels*** • Chisels are used for removing excess material or for cutting thin sheets. Chisels are annealed and hardened to produce tough shank and hard cutting edge. • Common chisel set is used for chipping and cutting off their sheet metal. Shown in Fig.5.3(b)

3	***Twist Drill*** • Twist drills are used for making holes, for this purpose straight and taper shank twist drills are used. • Straight and taper shank twist drills Shown in Fig.5.3(d).
4	***Taps and Tap Wrenches*** • Size- Generally taps are available in sets of three in each diameter and thread size. • Taps are made of High Speed Steel or Carbon Steel and used for cutting of internal threads in a drill hole. Shown in Fig.5.3(e)
5	***Dies and Die Holders*** • Size- Generally dies are available in different diameter and thread size. • Dies are made of Steel or High Carbon Steel and used for cutting of external threads Shown in Fig.5.3(f)
6	***Rough and Smooth Files*** • Size- 100 mm to 250 mm and they are classified according to their shape, cutting teeth and pitch of teeth. • Rough files are used to remove more material whereas smooth files are used to finish the work pieces. Shown in Fig.5.3(g)

(a)

(b)



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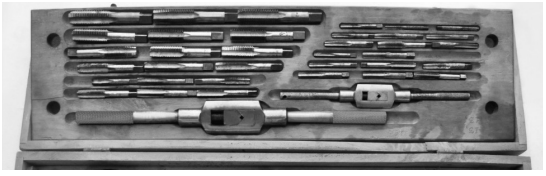
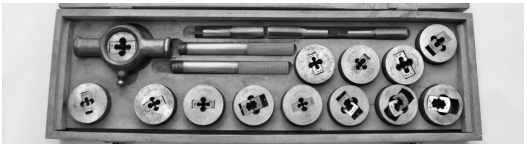
(d)



(e)



(f)

(g)

Fig.5.3: Cutting and Finishing Tools

5.3.4 Miscellaneous tools

S.N.	Name of Tool with Description.
1	***Spanners*** • Size- Normally spanner set consist of six to ten spanners and used to dismantle or tight nut or bolts of a specific size. • There are different types of spanners- open end, double ended, ring, socket and combination type. etc. • Open double ended spanner set and ring spanner set are shown in Fig.5.4(a) and (b) respectively.
2	***Ball Peen Hammer*** • Size- Hammers are normally specified by their weight i.e. 250-450 gms. • Hammers are named based on their shape and material. Ball peen hammer has a flat face for general work and ball end on other end. Shown in Fig.5.4(c)
3	***Screw Drivers*** • Size- Screw driver size is determined by the length of the body (range from 1.5" to 18") which is measured from the tip to the beginning of the the ferrule and width of the tip (range from 3/16" to 1/2"). • Usually, hand operated and used for turning screws with slotted heads. General purpose screwdrivers are shown in Fig.5.4(d)
4	***Drill Machine*** • Drill machine is used to make a hole of different sizes on a job and it's a metal removing process. Various size of drill bits are used as per job requirements. • General type of drill machine is shown in Fig.5.4(e)

(a)

(b)

(c)

(d)

(e)

Fig.5.4: Miscellaneous Tools

5.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Select the relevant tools and instruments for the preparation of given job.

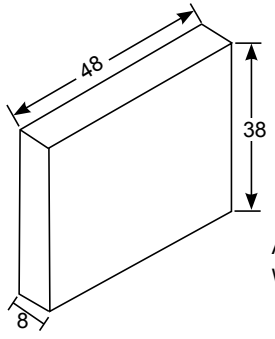
PrO2: Use the relevant tools correctly.

PrO3: Follow safe practices.

PrO4: Work as a team member.

PrO5: Use of environment friendly approaches.

5.5 Practical Setup (Sketch/Work Situation)



All Dimensions are in mm
Workpiece Size = 50 × 40 × 10

Fig.5.5: Fitting Job Dimensions

5.6 Resources Required

(For this practical student will select the relevant tools and instruments for a Job shown in Fig.5.5)

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					

5.7 Precautions

1. Loose clothes should be avoided and always wear shoes in workshop
2. Do not keep sharp tools and metal workpiece in pocket.
3. The tools being used should be well sharpened
4. During cutting and filing apply force in forward stroke and release the force in backward stroke.
5. Do not hold workpiece in hand while cutting.
6. Do not use vice as an anvil.
7. Clean the vice after use.

5.8 Suggested Procedure

1. First cut the workpiece from long mild steel strip using hacksaw.
2. Check the dimensions of the work piece.
3. Clean the jaws of the bench vice and fix the job tightly in a bench vice.
4. Do filing work, prepare one side properly using rough flat file first then the smooth flat file. After preparation of one side repeat the same for adjacent side.
5. Now, check the right angle of the two adjacent sides using Try-square.
6. Chalk is then applied on the surface of the work piece. Mark the given dimensions by scriber and with reference to the two datum sides by using Vernier height gauge, Angle plate and Surface plate.
7. Using the dot punch, dots are punched along the above scribed lines.
8. The two sides are then filed, by fitting the job in the bench vice; followed by checking the flatness of the surfaces. Material removal through filing is relatively less, filing is done instead of sawing.

5.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.	----------	----------		% Error
1				

5.10 Results and/or Interpretation

(to be filled by student)

1. ……
2. ……

5.11 Conclusions and/or Validation

(to be filled by student)

.....

.....

5.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Explain the importance of fitting shop in the context of industrial products.
2. Scriber is a.....tool.
3. Name two measuring instruments with neat sketch
4. Describe the correct process of filing
5. Internal threads can be made by using ..... .

5.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Details
Biodegradable waste	Green Bin	
e-Waste	Black Bin	
Plastic and metal waste	Blue Bin	
Any Other		

5.14 Environment Friendly Approach: Reuse, Reduce and Recycle

1. The workpiece in this practical can be reused by reducing the dimensions appropriately.
2. Fine metal particles obtained during filing may be used for "Magnetic Crack Detection" equipment of Material Testing Laboratory.

5.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promotors & Publishers Pvt. Ltd., Delhi, Latest Edition
2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Sons,Delhi, Latest Edition
3. Marking Tools
4. Different Files

5.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 7 Marks - 70%			
1	Marking and cutting	20%	
2	Handling of the tools / instruments	20%	
3	Checking the work piece	10%	
4	Working in team	5%	
5	Follow safe practices	5%	
6	Practicing environment friendly approach(es)	10%	
Product related: 3 Marks - 30%			
7	Writing result and/or interpretation	5%	
8	Conclusions	5%	
9	Correctness of the job	5%	
10	Practical related questions	10%	
11	Submitting the journal in time	5%	
	Total	**100 %**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student:..... Marks Awarded			**Signature of Teacher with date**
Process Related	Product Related	Total	

P6 Step Fitting

6.1 Practical Statement

Use relevant tools & instruments to prepare job of step fitting as per given dimensions.

6.2 Practical Significance

Every Mechanical Diploma Engineer should be aware of the fitting operations used in the mechanical industries. This practical of step fitting will help students develop skills related to the operation of fittings such as measurement, marking, sawing, filing and assembly of parts.

6.3 Relevant Theory

- To perform this practical, the student must select the appropriate tools and equipment and follow the necessary procedures in a safe manner. The equipment and procedures have already been discussed in practical P5 drilling and tapping operations will give exposer about use of drilling machine and tapes.
- By performing drilling and tapping operations students will learn the use of drilling machine and power tools. Drilling is a cutting operation which uses a drill bit to cut a hole of circular cross-section in solid materials.
- Tapping is creating a thread inside of a hole by using a set of taps. By performing tapping student will learn use of fasteners also.

6.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Select the relevant tools and instruments for the preparation of step fitting job according to dimensions.

PrO2: Use the relevant tools and instruments correctly.

PrO3: Check the correctness of the step fitting job.

PrO4: Follow safe practices

PrO5: Work as a leader

PrO6: Use of environment friendly approaches

6.5 Practical Setup (Drawing/Work Situation)

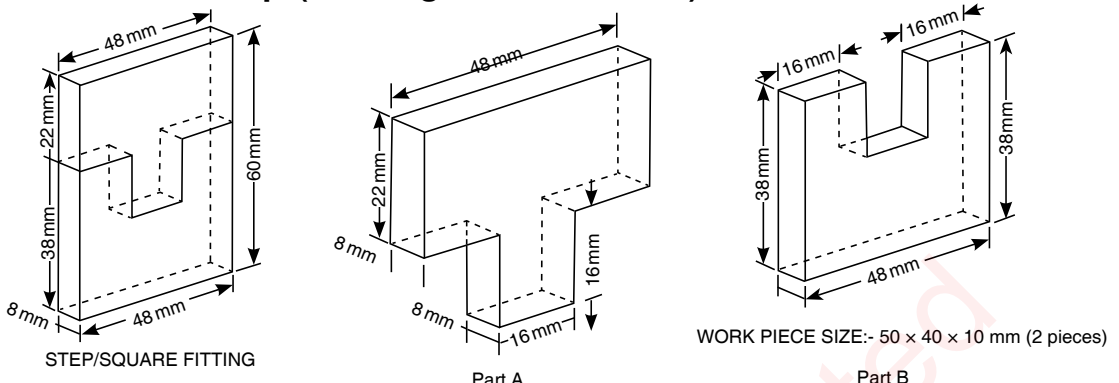


Fig.6.1: Step Fitting Job Dimensions

6.6 Resources Required

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Steel rule 12"	1			
2	Try square 6"	1			
3	Ball peen hammer 450 gram	1			
4	Dot punch	1			
5	Odd leg caliper	1			
6	Hack saw frame with blade	1			
7	Rough file and Smooth file	1			
8	Smooth square file	1			
9	Flat chisel	1			
10	Fitting vice	1			
11	Drill machine with 5 mm bit	1			
12	Tap wrench with 6 mm tap	1			

6.7 Precautions

1. Loose clothes should be avoided and always wear shoes in workshop.
2. Do not keep sharp tools and metal workpiece in pocket.
3. The tools being used should be well sharpened
4. During cutting and filing apply force in forward stroke and release the force in backward stroke.
5. Do not hold workpiece in hand while cutting.
6. Do not use vice as an anvil.
7. Clean the vice after use.

6.8 Suggested Procedure

1. Check the dimensions of the work piece.
2. The sides of MS Flat be filed with rough flat file then with smooth file to obtained required size.
3. Then flatness of the side is checked with try square
4. The other side is checked for its squareness with try square
5. Marking be carried out using odd leg caliper as per job dimensions shown in Fig.6.1.
6. Dots are marked by punches along the lines as shown in sketch
7. With the help of hacksaw blade cutting is done along the dotted lines.
8. Filing is done to check squareness of part 'A'.
9. Holes are drilled in part 'B' to remove extra material.
10. Filing is done on all sides to match part 'A'.
11. Part 'A' and 'B' are held together in fitting vice to file and finish both faces.
12. Now check and assemble both parts to obtain required fitting.
13. Finally do drilling of 5 mm for 6 mm tapping as per directives of the teacher on Part 'B'.

6.9 Observations and Calculations

S.N.	----------	----------		% Error
1				

(may be modified depending on the practical; to be filled by student)

6.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

6.11 Conclusions and/or Validation

(to be filled by student)

.....

.....

6.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Describe least count.
2. In this practical smooth square file is used for .....
3. Draw neat sketch of smooth flat file used in this practical.
4. Write industrial/field applications of step fitting.
5. Describe filing process.

6.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Details
Biodegradable waste	Green Bin	
e-Waste	Black Bin	
Plastic and metal waste	Blue Bin	
Any Other		

6.14 Environment Friendly Approach: Reuse, Reduce and Recycle

1. The workpiece in this practical may be reused by reducing the dimensions appropriately.
2. Fine metal particles obtained during filing can be used for "Magnetic Crack Detection" equipment of Material Testing Laboratory.

6.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promotors & Publishers Pvt. Ltd., Delhi, Latest Edition
2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Sons,Delhi, Latest Edition
3. Fitting
4. Step fitting

6.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 6 Marks - 60%			
1	Marking and cutting	15%	
2	Handling of the tools / instruments	15%	
3	Checking the work piece	10%	
4	Working in team	5%	
5	Follow safe practices	5%	
6	Environment friendly approach	10%	
Product related: 4 Marks - 40%			
7	Writing result and/or interpretation	5%	
8	Conclusions	5%	
9	Correctness of the job	10%	
10	Answering practical related questions	15%	
11	Submitting the journal in time	5%	
	Total	**100 %**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student:..... Marks Awarded			**Signature of Teacher with date**
Process Related	Product Related	Total	

P7 Straight Fitting

7.1 Practical Statement

Use relevant tools & instruments to prepare job of straight fitting as per given dimensions.

7.2 Practical Significance

Every Mechanical Diploma Engineer should have complete knowledge of fitting shop. Fitting means preparing matching parts as needed to touch/join each other in such a way that one part goes into the other and slides over the other or it holds the parts tightly. Measurement and inspection of job parts is also a very important job in a fitting shop. So by doing this practical, the student will get exposure to fitting shop.

7.3 Relevant Theory

To perform this practical, the student must select the appropriate tools and equipment and follow the necessary procedures in a safe manner. The equipment and procedures have already been discussed in practical P5.

7.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Select the relevant tools and instruments for given straight fitting job.

PrO2: Use the relevant tools correctly.

PrO3: Follow safe practices

PrO4: Work as a leader

PrO5: Use of environment friendly approaches

7.5 Practical Setup (Drawing/Work Situation)

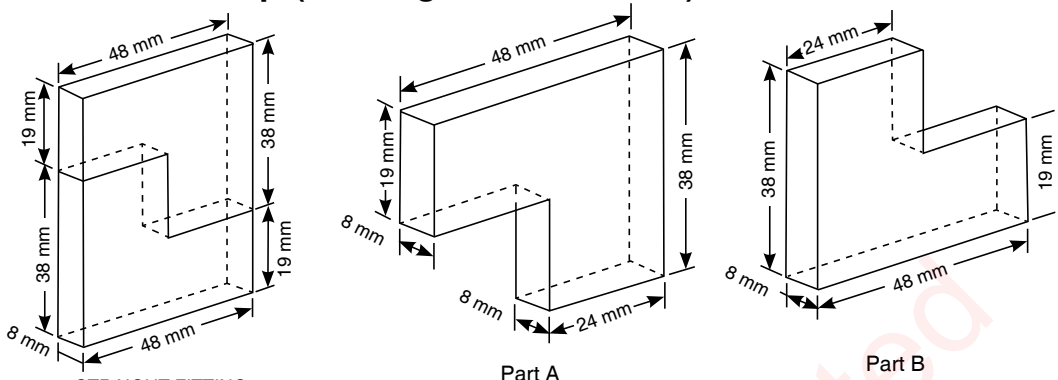


Fig.7.1: Straight Fitting Job Dimensions

7.6 Resources Required

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Steel rule 12"	1			
2	Try square 6"	1			
3	Ball peen hammer 450 grams	1			
4	Dot punch	1			
5	Odd leg caliper	1			
6	Hack saw frame with blade	1			
7	Rough file	1			
8	Smooth file	1			
9	Smooth square file	1			
10	Flat chisel	1			
11	Fitting vice	1			

7.7 Precautions

1. Loose clothes should be avoided and always wear shoes in workshop
2. Do not keep sharp tools and metal workpiece in pocket.
3. The tools being used should be well sharpened
4. During cutting and filing apply force in forward stroke and release the force in backward stroke.
5. Do not hold workpiece in hand while cutting.
6. Do not use vice as an anvil.
7. Clean the vice after use..

7.8 Suggested Procedure

1. Check the dimensions of the work piece.
2. The sides of MS Flat size of filed with rough flat file then with smooth file
3. Then flatness of the side is checked with try square
4. The other side is checked for its squareness with try square
5. Both the side of 48 mm and 38 mm and steps are marked with odd leg caliper.
6. Dots are marked by punches along the lines as shown in sketch
7. With the help of hacksaw blade cutting is done along the dotted lines.
8. Filing is done to check squareness of part 'A'.
9. Holes are drilled in part 'B' to remove extra material.
10. Filing is done on all sides to match part 'A'.
11. Part 'A' and 'B' are held together in fitting vice to file and finish both faces.
12. Now check and assemble both parts to obtain required fitting job.

7.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.	----------	----------		% Error
1				

7.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

7.11 Conclusions and/or Validation

(to be filled by student)

.....

.....

7.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Jaws are provided on bench vice, state the reasons.
2. In this practical rough flat file is used for .....
3. Name the tools to check squareness of fitting parts
4. Draw neat sketch of hacksaw with blade.
5. Describe flatness and squareness.

7.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Details
Biodegradable waste	Green Bin	
e-Waste	Black Bin	
Plastic and metal waste	Blue Bin	
Any Other		

7.14 Environment Friendly Approach: Reuse, Reduce and Recycle

1. The workpiece in this practical can be reused by reducing the dimensions appropriately.
2. Fine metal particles obtained during filing can be used for "Magnetic crack detection" equipment of Material testing laboratory.

7.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promotors & Publishers Pvt. Ltd., Delhi, Latest Edition
2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Sons, Delhi, Latest Edition
3. Fitting
4. Fitting

7.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 6 Marks - 60%			
1	Marking and cutting	15%	
2	Handling of the tools / instruments	15%	
3	Checking the work piece	10%	
4	Working in team	5%	
5	Follow safe practices	5%	
6	Environment friendly approach	10%	
Product related: 4 Marks - 40%			
7	Writing result and/or interpretation	5%	
8	Conclusions	5%	
9	Correctness of the job	10%	
10	Answering practical related questions	15%	
11	Submitting the journal in time	5%	
	Total	**100 %**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student:..... Marks Awarded			**Signature of Teacher with date**
Process Related	Product Related	Total	

3 WELDING

RELEVANT COURSE OUTCOME(S) AND PO

CO-3: Prepare simple butt and lap joints using Arc, Gas, MIG welding equipment.

Course Outcome	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium Correlation; 3- Strong Correlation)						
	PO-1: Basic and Discipline specific know-ledge	PO-2: Problem Analysis	PO-3: Design/ deve-lopment of solutions	PO-4: Engi-neering Tools, Experi-mentation and Testing	PO-5: Engi-neering practices for society, sustain-ability and environ-ment	PO-6: Project Manage-ment	PO-7: Life-long learning
CO-3: Prepare simple butt and lap joints using Arc, Gas, MIG welding equip-ment..	3	1	1	3	2	-	1

P8 Welding Tools and Equipment

8.1 Practical Statement

Use suitable welding tools and machines to carry out welding operation to make rectangle grill.

8.2 Practical Significance

In manufacturing, various joining processes are used to form two or more solid elements to form a component and there are two categories of joining processes; permanent and temporary. Welding falls under the category of permanent joining process, in which two or more solid metals can be joined permanently. Welding is widely used in manufacturing industries and building construction works. So, by doing this practical the diploma student will get required knowledge about the welding processes and its related tools/equipment to do the job.

8.3 Relevant Theory

Welding is a material joining process which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone, and with or without the use of filler material. Welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, tanks, furniture, boilers, general repair work and ship building. Welding is usually the most economical way to join components in terms of material usage and fabrication costs.

Types of welding: There are two major groups of welding.

- **Plastic Welding or Pressure Welding:** The piece of metal to be joined are heated to a plastic state and forced together by external pressure like in the case of Resistance Welding.
- **Fusion Welding or Non-Pressure Welding:** The material at the joint is heated to a molten state and allowed to solidify like in the case of Electric Arc Welding and Gas Welding.

8.3.1 Arc welding

Arc welding is the welding process, in which heat is generated by an electric arc struck between an electrode and the work piece. Electric arc is luminous electrical discharge between two electrodes through ionized gas.

Any arc welding method is based on an electric circuit consisting of the following parts:

a. Power supply (AC or DC);
b. Welding electrode;
c. Work piece;
d. Welding leads (electric cables) connecting the electrode and work piece to the power supply.

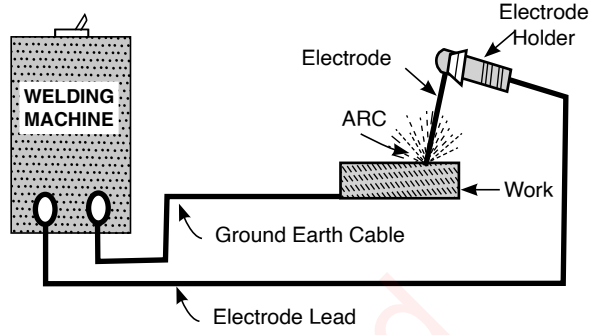


Fig.8.1: Arc Welding Setup

8.3.1.1 Welding machine

It consists of a rectangular steel tank mounted on three wheels. It works on both AC & DC. Transformer reduces supply mains voltage to welding voltage as per requirement. The output of transformer can be varied by rotating on hand wheel which alters the air gap in the core of the choke resulting in steeples regulation of current between 50 and 400.the welding current setting can be directly read at the window top cover. The set can be connected to the lines of 400/440 volts, 3- phase,50 cycle ac supply. It requires about 10gm liters of class B transformer.

Fig.8.2: Welding Machine

8.3.1.2 Welding electrode

Both consumable & non-consumable electrodes are used for welding. Non-consumable electrode may be made of carbon, graphite or tungsten which does not get consumed during welding operation. Consumable electrodes may be made of various metals depending upon their purpose & chemical composition of the metal to be welded.

Fig.8.3: Electrodes

8.3.1.3 Electrode holder

Electrode holder or stringers come in variety of sizes. They are generally made to size of head which is in twined matched to the amperage output of the arc welding electrode. Commonly used size range is from 50 to 500 amps. They are means of securing the electrode properly. Shown in Fig.8.4

Fig.8.4: Electrode Holder

8.3.1.4 Earth clamp

Earth clamps are also known as ground clamps which are used to connect ground cables to the work piece or work bench on which the work pieces are located. Ground clamp being a part of welding circuit must be able to carry welding current without overheating. Shown in Fig.8.5.

8.3.1.5 Cable and cable connectors

The cables that carry welding current to the work are very flexible and are generally made of copper and aluminum. Connectors are used to facilitate carrying welding current from electrode lead to cable as per designed capacity and it avoids the occurrence of electric spark. Mechanical connectors are easily assembled and disassembled and provide good connectivity. Shown in Fig.8.6

Fig.8.5: Earth Clamp

Fig.8.6: Cable & Cable Connectors

8.3.1.6 Chipping hammer

The main implement for chipping the weld bed are the chipping hammers. Chipping hammer is chisel-shaped and is pointed on one end to aid in the removal of slag. Shown in Fig.8.7

8.3.1.7 Wire brush

The wire brush which removes small particles or slag is generally made of stiff steel wire embedded in wood. Power wire wheels, when available may be used in place of wire brush. Shown in Fig.8.8

Fig.8.7: Chipping Hammer

Fig.8.8: Wire Brush

8.3.2 Personal Protective Equipment(PPE)

PPE protects the welder during welding operation, minimizing the risk of injury. Following are some examples-

8.3.2.1 Welding helmet and hand held shield

The welding helmet and the hand-held face shield are commonly used in arc-welding.

The welding helmet fits over the head and folds up when not welding. It is made of pressed fiber insulating material and in general, it is dull black in colour.

The hand-held shield provides the same protection as the helmet but is held in position by the handle. Generally, helmet face shield as well as hand held shield covers the entire face. It protects from infrared and UV rays. Shown in Fig.8.9

8.3.2.2 Hand gloves

Generally, in welding shop, long gauntlet gloves are used to protect the hands from UV & infrared radiation as well as heat that is given off by the air column. Shown in Fig.8.10.

8.3.2.3 Protective clothing

Protective clothing is essential for welding operation. will vary with the size, nature, and location of the work to be performed. It is made of leather, fire-resistant material, or other suitable material should be worn for protection against spatter of molten metal, radiated heat, and sparks. Clothing should always be kept dry, including gloves.

Fig.8.9: Welding Helmet and Hand held shield

Fig.8.10: Hand Gloves

Fig.8.11: Protective Clothing

8.3.3 Gas Welding

A fusion welding process which joins metals, using the heat of combustion of an oxygen /air and fuel gas (i.e. acetylene, hydrogen propane or butane) mixture is usually referred as 'gas welding'. The intense heat (flame) thus produced melts and fuses together the edges of the parts to be welded, generally with the addition of a filler metal. Details of Gas welding equipment are given from 8.3.3.1 to 8.3.3.5

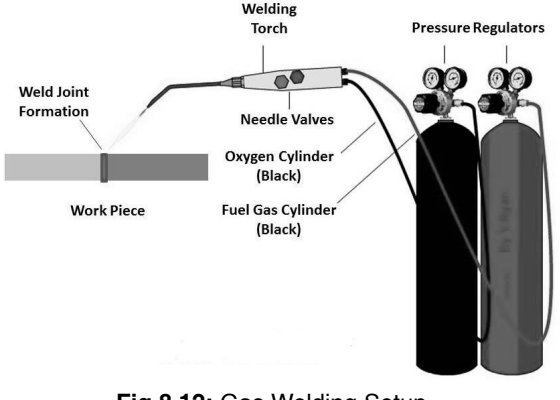


Fig.8.12: Gas Welding Setup

8.3.3.1 Welding torch

The torch is the tool that the welder holds and manipulates to make the weld. It has a connection and valve for the fuel gas and a connection and valve for the oxygen, a handle for the welder to grasp, and a mixing chamber (set at an angle) where the fuel gas and oxygen mix, with a tip where the flame forms. Shown in Fig.8.13.

Fig.8.13: Welding Torch

8.3.3.2 Welding pins

Weld pins are designed with a long narrow shaft that is spot welded to a metal surface, primarily to fasten duct liner to metal ductwork, or other materials onto metal surfaces. As shown in Fig.8.14

8.3.3.3 Pressure regulator

A pressure regulator is a control valve that reduces the input pressure of a fluid to a desired value at its output. Regulators are used for gases and liquids, and can be an integral device with an output pressure setting. As shown in Fig.8.15

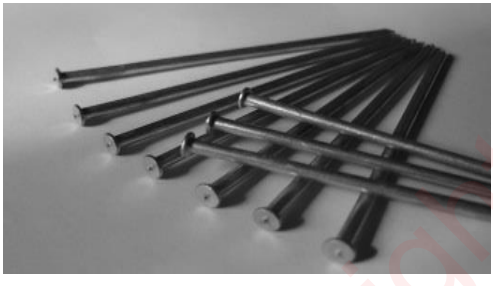


Fig.8.14: Welding Pin

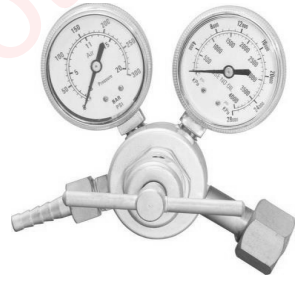


Fig.8.15: Pressure Regulator

8.3.3.4 Oxygen acetylene cylinder

Acetylene gas is commonly used for gas welding because of its simplicity in production and transportation and its ability to achieve high temperature in combustion (e.g. around 5,000o F). Shown in Fig.8.16

8.3.3.5 Spark lighter

A spark lighter is a tool used to ignite flammable gas appliances such as Bunsen burners, welding torches, and gas grills. A spark lighter produces a spark having sufficient heat to ignite flammable gas vapor. Shown in Fig.8.17

Fig.8.16: Oxygen Acetylene Cylinder

Fig.8.17: Spark Lighter

8.3.4 Window Grill

Window Grill are decorative pattern on a window or door consisting of horizontal and/or vertical bars that divide the larger sheet of glass into smaller panes.

8.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Select suitable welding process for a given window grill.

PrO2: Select the relavant welding machine & equipment.

PrO3: Use the relevant tools and equipment correctly.

PrO4: Follow safe practices in welding shop.

PrO5: Work as a team member.

PrO6: Use environment friendly approaches

8.5 Practical Setup (Sketch/Work Situation)

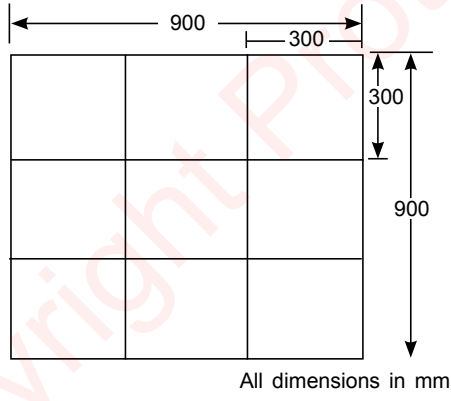


Fig.8.18: Grill Design

8.6 Resources Required

(For this practical, student will select the relevant welding method, related tools and equipment for the welding job shown in Fig.8.18

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1					
2					

3					
4					
5					
6					
7					
8					
9					

8.7 Precautions

1. Loose clothes should be avoided, always wear leather shoes in workshop.
2. Welding area must always be kept dry to avoid electric shock.
3. Do not touch bare electrodes.
4. While welding always use face shield or goggles.
5. Never operate a machine unless you are authorized to do so.
6. Use equipment and tools correctly.

8.8 Suggested Procedure

1. See the job shown in Fig.8.18, select and cut the required sizes of 8 or 10mm square bars to complete the grill.
2. Select the welding machine and positioned the work pieces on welding table.
3. Fit the electrode in the electrode holder and set the welding current as per job requirement.
4. Connect grill bar at 90 degree and tack weld.
5. Put pieces alongside length and Tack weld at both ends, so that pieces do not shift during welding process.
6. Remove the Slag using Chipping Hammer.
7. Clean the job with the help of a steel wire brush.
8. Clean the table and keep the tools in proper place.

8.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.	----------	----------		% Error
1				

8.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

8.11 Conclusions and/or Validation

(to be filled by student)

.....

.....

8.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1 Discribe welding process.

2 State the two basic types of welding.

3 Write important safety precautions to be observed in this practical.

4 Describe the working principle of welding equipment used in this practical.

8.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Details
Biodegradable waste	Green Bin	
e-Waste	Black Bin	
Plastic and metal waste	Blue Bin	
Any Other		

8.14 Environment Friendly Approach: Reuse, Reduce and Recycle

The work piece in this practical can be reused by reducing the dimensions appropriately.

8.15 Suggested Learning Resources

1. Workshop Practice Vol-I byHazra& Choudhary, Media Promoters & Publisher Pvt.Ltd. Mumbai, 14th edition 2010
2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Co.(P) Ltd. Delhi 2014
3. Welding Processes and Technology by R. S. Parmar, Khanna Publishers Delhi, Latest Edition
4. Welding Tools and Equipment:

8.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 6 Marks - 60%			
1	Marking and cutting	15%	
2	Handling of the tools / instruments	15%	
3	Checking the work piece	10%	
4	Working in team	5%	
5	Follow safe practices	10%	
6	Practicing environment friendly approach(es)	5%	
Product related: 4 Marks - 40%			
7	Writing result and/or interpretation	10%	
8	Conclusions	5%	
9	Correctness of the job	10%	
10	Practical related questions	10%	

11	Submitting the journal in time	5%	
	Total	**100 %**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student:..... Marks Awarded			**Signature of Teacher with date**
Process Related	Product Related	Total	

P9 Lap Joint

9.1 Practical Statement

To prepare lap welding joint as per given dimensions using Arc Welding method.

9.2 Practical Significance

Every Mechanical Diploma Engineer should be aware of various welding methods, welding equipment, types of weld joints, welding positions, use of relevant tools and equipment to prepare lap joint. Lap joints are often used to join pieces of different thicknesses of two metals. This practical of Lap Welding Joint will help the students to develop skills related to operation of welding equipment to prepare Lap Joint.

9.3 Relevant Theory

9.3.1. Weld Joint

The term 'weld joint' refers to the way pieces of metal are put together or aligned with each other. Each joint's design affects the quality and cost of the completed weld. Selecting the most appropriate joint design for a welding job requires special attention and skill.

There are five basic welding joint types commonly used in the industry and shown in Fig.9.1.

1. Butt joint
2. Tee joint
3. Corner joint
4. Lap joint
5. Edge joint

9.3.1.1 Butt joint

The butt joint is obtained by welding the ends or edges of the two plates, which

are approximately in the same plane with each other. In butt welds, the plate edges do not require bevelling if the thickness of plate is less than 5 mm. On the other hand, if the plate thickness is 5 mmto 12.5 mm,the edges should be bevelled to V or U-groove and plates having thickness above12.5mm should have a V or U-groove on both sides.

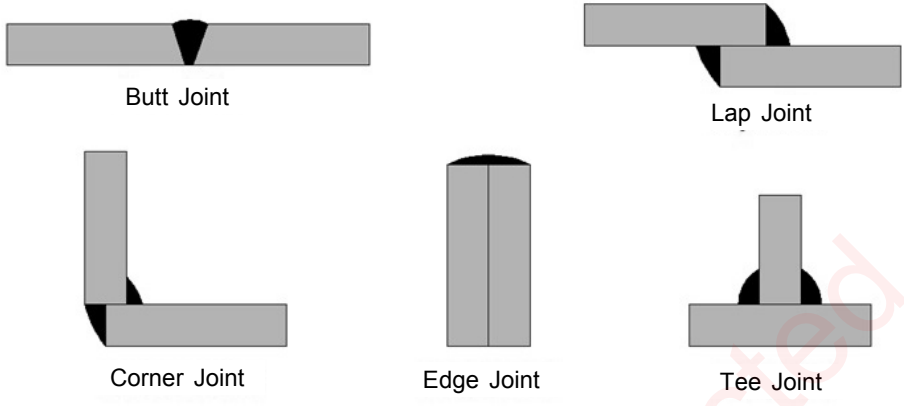


Fig.9.1: Welding Joints

9.3.1.2 Lap joint

As the name implies is used to join the tow overlapping plates so that the edge of each plate is weld to the surface of the other. Common lap joints are single lap and double lap suitable for thickness less than 3 mm.

9.3.1.3 T-Joint

It is used to weld two parts or sectional whose surfaces are at approximately right angles to each other. Plates or surfaces should have good fit up in order to ensure uniform penetration & fusion.

9.3.1.4 Corner joint

It is used to join the edges of two sheets or plates whose surface are at an angle of approximately 90 degree to each other . It is common in the construction of boxes, tanks, frames & other similar items.

9.3.1.5 Edge joint

This consists of joining two parallel plates by means of a weld. This joint is often used in sheet metal work.It is economical for plates having thickness less than 6 mm.

9.3.2. Welding Positions

The welding positions are classified as follows:

9.3.2.1 Flat position (F)

In this position, the filler metal is deposited from the upper side of thejoint with the face of the weld horizontal.

9.3.2.2 Horizontal position(H)

In this position, the weld is deposited upon the side of a horizontaland against a vertical surface.

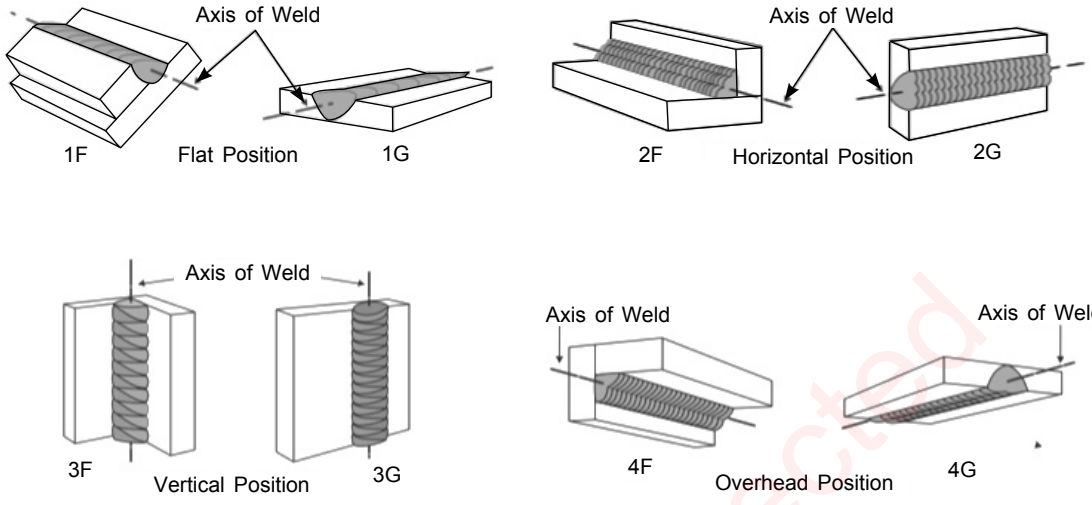


Fig. 9.2: Welding Positions

9.3.3 Vertical position(V)

In this position, the line of welding is in a vertical plane and the weld isdeposited upon a vertical surface.

9.3.4 Overhead position(O)

In this position, the weld is deposited from the under side of the jointand the face of the weld is horizontal. It is the reverse of flat welding.

9.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Select appropriate welding machine, tools, related electrode and other items to prepare lap joint.

PrO2: Select suitable welding parameters to prepare given lap joint.

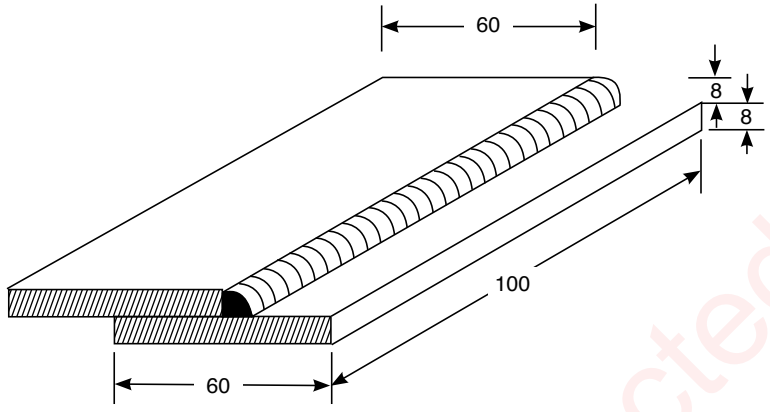
PrO3: Use selected welding equipment and tools correctly.

PrO4: Follow safe practices

PrO5: Work as a team member/leader.

PrO6: Use of environment friendly approaches

9.5 Practical Setup (Sketch /Work Situation)



All dimensions are in mm.
Workpiece size = 100 × 60 × 8 (2 Nos.)

Fig.9.3: Lap Joint Welding Job Dimensions

9.6 Resources Required

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Mild steel work pieces 100 x 60 x 8 mm	2			
2	Arc Welding machine 200 amp	1			
3	Welding electrodes 2.5 -3 mm	5			
4	Electrode holder	1			
5	Ground clamp	1			
6	Flat nose Tong	1			
7	Face shield Suitable size	Minimum 1			

8	Apron Suitable size preferably leather	1			
9	Hand gloves Suitable size	1			
10	Metallic work Table 2.5 x 5 feet	1			
11	Bench vice 100 mm	1			
12	Rough flat file Bastard Cut Flat File with PVC Handle 10" (250 mm)	1			
13	Try square 6"	1			
14	Steel rule 30 cm	1			
15	Wire brush Nominal size	1			
16	Ball peen hammer 500 gram	1			
17	Chipping hammer Dimensions (LxW)12.9x28	1			
18	Cable and Cable Connectors	As per requirement			

9.7 Precautions

1. Ensures the proper connection of welding machine and it should be earthed properly.
2. Check for broken insulation on cables and electrode holder
3. Always use rubber sole shoes in welding shop.
4. Welding area must always be kept dry to avoid electric shock.
5. Do not touch bare electrodes.
6. Use goggles, gloves in order to protect the human body.
7. Always use a face shield during welding operations.
8. Maintain the constant arc length.

9.8 Suggested Procedure

1. Take the two mild steel pieces of given dimensions and clean the surfaces thoroughly from rust, dust particles, oil and grease.
2. Remove the sharp corners and burrs by filing or grinding and prepare the work pieces.
3. Position the work pieces on the welding table to form a lap joint as per drawing.
4. Fit the electrode in the electrode holder and set proper value of welding current.
5. Fasten the ground clamp to the welding table.
6. Align the work pieces as per given drawing.
7. Hold the over lapped work pieces properly during practical.
8. The arc is struck and the work pieces are tack-welded at the end of both the sides.
9. Welding is then carried out throughout the length of the lap joint, on both the sides.
10. Maintain a gap of 3 mm between the plates and the electrode for proper arc length.
11. Remove the slag, spatters and clean the joint.
12. Clean the table and keep the tools in proper place.

9.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.	----------	----------		% Error
1				

9.10 Results and/or Interpretation

(to be filled by student)

1. ……
2. ……

9.11 Conclusions and/or Validation

(to be filled by student)

……

……

9.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1 State the field/industrial applications of welding Lap joint.

2 State reason to maintain gap between plate and electrodes.

3 Describe the process of selection of welding parameters.

4 Write major specifications of welding machine used in this practical.

9.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Details
Biodegradable waste	Green Bin	
e-Waste	Black Bin	
Plastic and metal waste	Blue Bin	
Any Other		

9.14 Environment Friendly Approach: Reuse, Reduce and Recycle

1 The workpiece of this practical can be reused for basic welding operations.

2. Used workpiece may be recycled.

9.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promoters & Publisher Pvt.Ltd. Mumbai, 14th edition 2010
2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Co.(P) Ltd. Delhi 2014
3. Welding Processes and Technology by R. S. Parmar, Khanna Publishers Delhi, Latest Edition
4. Permanent Joints
5. Types of Welding Positions

9.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 6 Marks - 60%			
1	Preparing the Workpiece	5%	
2	Setting of welding machine	15%	
3	Performing welding operation	15%	
4	Working in team	5%	
5	Follow safe practices	10%	
6	Practicing environment friendly approach(es)	10%	
Product related: 4 Marks - 40%			
7	Writing result and/or interpretation	10%	
8	Conclusions	5%	
9	Correctness of the job	10%	
10	Answering practical related questions	10%	
11	Submitting the journal in time	5%	
	Total	**100 %**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student:..... Marks Awarded			**Signature of Teacher with date**
Process Related	Product Related	Total	

P10 Butt Joint

10.1 Practical Statement

To prepare butt weld joints with mild steel strips using MIG/MAG welding process as per given dimensions.

10.2 Practical Significance

In industries, various welding processes are used for joining, repair and maintenance purposes. MIG/MAG welding processes are widely used in heavy and medium industries, such as ship building, manufacturers of steel structures and pipelines. So, by doing this practical work, the diploma student will get the necessary knowledge about the operation of the related tools and equipment to do the work.

10.3 Relevant Theory

10.3.1 MIG welding

Metal Inert Gas (MIG) / Metal Active Gas (MAG) welding refers to a group of arc welding processes that use the heat generated by a DC electric arc to fuse the metal in the joint area. A continuous electrode (the wire) is fed by powered feed rolls (wire feeder) into the weld pool.

An electric arc is created between the tip of the wire and the weld pool. The wire is progressively melted at the same speed at which it is being fed and forms part of the weld pool. Both the arc and the weld pool are protected against atmospheric contamination by a shield of inert (non-reactive) gas.

10.3.1.1 Principle of MIG welding process

- MIG works on basic principle of heat generation due to electric arc as shown in Fig.10.1.
- This heat is further used to melt consumable electrode and base plates metal which solidify together and makes a strong joint.
- The shielded gases are also supplied through nozzle which protect the weld zone from other reactive gases. This gives good surface finish and a stronger joint.

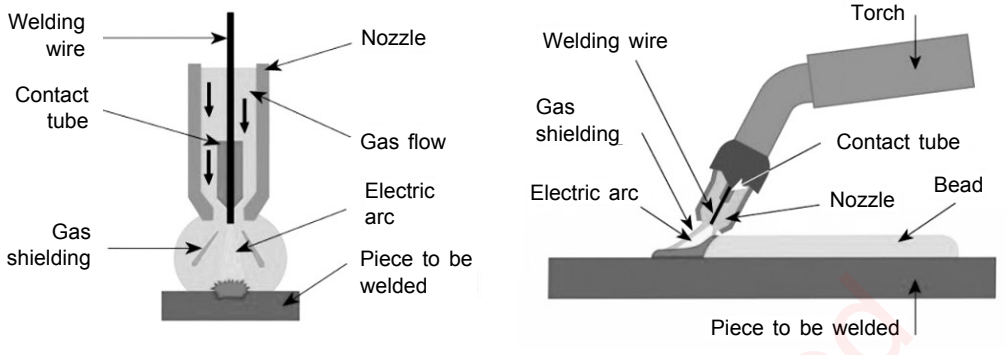


Fig.10.1: Principle of MIG Welding Process

10.3.1.2 MIG welding equipment

MIG welding setup is shown in Fig.10.2. Basic components are power source, MIG torch, shielding gas system and wire feeding system.

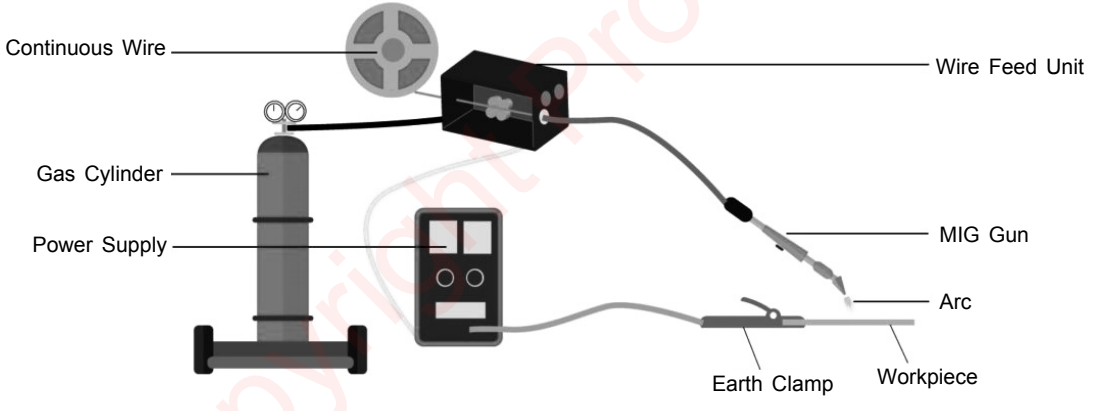


Fig.10.2: MIG Welding Setup

a) Power Source

In this type of welding process, a DC power supply is used with reverse polarity. Reverse polarity means the electrode or in case of MIG welding electrode wire is connected to positive terminal and work piece to negative terminal.It is due to principle of electric circuit which state that 70% of heat is always librated on positive side. So reverse polarity ensures that the maximum amount of heat liberateat tool side which melt the filler metal in proper way. Straight polarity can cause unstable arc that result into large spatter. The power source consists a power supply, a transformer, a rectifier which change AC into DC and some electronic controls which control the current supply according to weld requirement.

Fig.10.3: Power Source

b) MIG Torch

In this torch, there is a mechanism which holds the wire and supplies it continuously with the help of wire feed. The front end of the torch is fitted with a nozzle. The nozzle is used to supply inert gases. These gases form a shielding area around the weld zone and protect it from oxidization. The welding torch is air cooled or water cooled according to the requirement. For high current supplied, the torch is water cooled and for low supply it is air cooled.

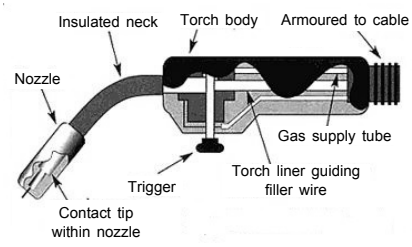


Fig.10.4: MIG Welding Torch

c) Shielding Gas Supply System

The primary function of shielding gases is to protect weld area from other reactive gases like oxygen etc. which can affect the strength of welding joint. These shielding gases are also form plasma which helps in welding. The choice of gas is depending on the welding material. Mostly argon, helium and other inert gases are used as shielding gas.

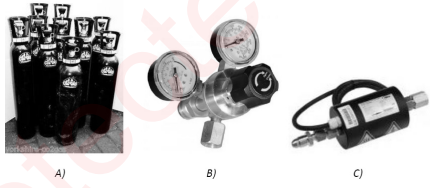


Fig.10.5: CO_2 gas cylinder, Regulator and Preheater

d) Wire Feeder System

MIG welding needs continuous consumable electrode supply for welding two plates. This consumable electrode used in form of wire. This wire is continuously supplied by wire feed mechanism or system. It controls the speed of the wire and also pushes the wire form welding torch to welding area. These are available in different shapes and sizes. It consists a wire pool holder, a driving motor, a set of driving rollers and wire feed controls. The wire feed speed is directly control the current supply through power supply. If the wire feeding speed is high, it required more current in welding zone to produce proper heat for melting of it.

Fig.10.6: Wire Feeder System

10.3.2 MAG welding

MAG stands for Metal Active Gas. It is pretty similar to MIG welding in its application. The main difference is in the type of gas used. MAG welders generally use Carbon Dioxide or a mix of CO2, Argon, and Oxygen to get the desired result. Shown in Fig.10.7

10.3.2.1 MAG welding working principle

MAG welding machine operates by supplying a constant voltage to the gun that holds the feeding wire. The electric current creates a plasma arc between the workpiece and the welding wire.The arc heats up to a very high temperature and melts both the material that you are welding and the wire that is being fed through the spool. So, the welding wire works both as the electrode and the consumable. The welding wire is on a rolled-up reel that is placed in the welding machine and it is mechanically fed to the torch as it gets consumed.

10.3.2.2 Types of Arcs used in MIG/MAG welding

a) **Short Arc Welding:** Short arc welding is used if you are working with really thin metal sheets, delicate projects, and soft metals or if you are welding from a difficult position. A short arc weld produces a fine droplet, creates low sputter, and results in a smooth material deposit.

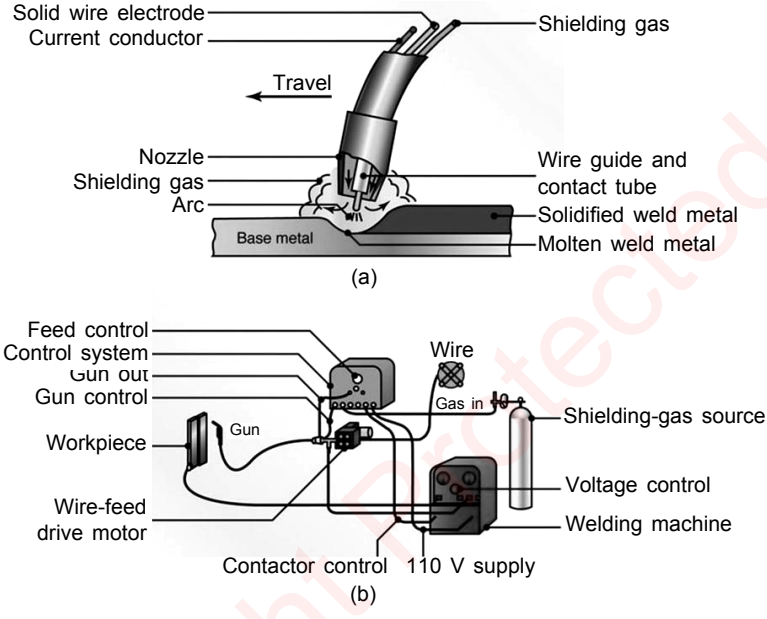


Fig.10.7: MAG Welding Principle & Equipment

b) **Long Arc Welding:** The long welding arc is used for thick metal sheets and plates. It generates a long arc and uses a spatter-intensive technique that produces a coarse material deposit.

c) **Spray Arc Welding:** Generally, spray arc welding is used by expert MAG welders. It is used for welding together thicker sheets and plates with the help of an argon-based mixture of gases.

d) **Pulsed Arc Welding:** The pulsed arc welding is used for all types of sheet and plate thicknesses. It uses shielding gases that are mixed with pure argon to increase weld and arc protection. Pulsed current is supplied through the wire that creates droplets during the welding process. The speed of the pulses can be adjusted based on project requirements. The result is a uniform flow of fine droplets and very low spatter. It creates practically short-circuit free material deposits.

10.3.3 Difference between MIG and MAG welding

- In MIG welding, only inert gases or gas mixtures are used for shielding gas purposes.

  Commonly used inert gases include argon and helium. In MIG shielding gas does not disintegrate during welding.

- In MAG welding, metal active gases are used for shielding the weld puddle. Commonly used gases include a mixture of argon, carbon dioxide, and oxygen. In MAG, CO_2 shielding gas disintegrates due to extreme arc heat and reacts with the molten metal. Moreover, MAG welding is relatively cheaper.

10.3.4 Butt Weld Joint

A butt weld is one of the simplest and versatile types of weld joint designs. The joint is formed simply by placing two pieces of metal end-to-end and then welding along the join. Importantly, in a butt joint, the surfaces of the work pieces being joined are on the same plane and weld metal remains within the planes of the surfaces.

10.3.5 Types of Butt Weld Joints

Butt weld joints are known by their shape, as shown in Fig 10.8.

The various joints include single V, double V, double & single bevel, double & single U, double & single J.

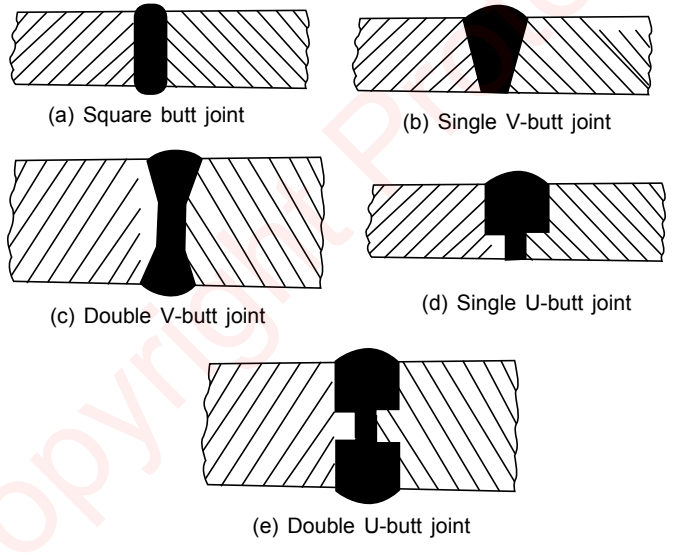


Fig.10.8: Types of Butt Joint

10.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Select suitable welding parameters to prepare butt joint as per given dimensions

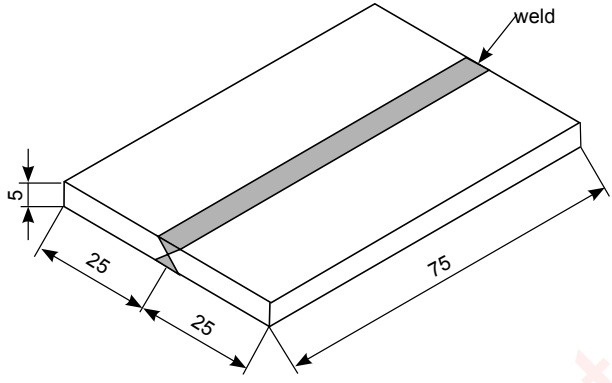
PrO2: Use the MIG/MAG welding equipment correctly by following safety precautions.

PrO3: Prepare the butt joint as per given dimensions

PrO4: Work as team member/leader.

PrO5: Use of environment friendly approaches.

10.5 Practical Setup (Sketch/Work Situation)



All dimensions in mm

Fig.10.9: Butt Welding Joint Dimensions

10.6 Resources Required

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Mild steel pieces 75 x 25 x 5 mm	2 Nos.			
2	Power Source	1			
3	MIG Torch	1			
4	Shielding Gas supply system	1			
5	Wire feeder system	1			
6	Helmet	1			
7	Hand Gloves	1			

8	Apron Suitable size preferably leather	1			
9	Wire Brush	1			

10.7 Precautions

1. Always wear leather shoes in welding shop.
2. Welding area must always be kept dry to avoid electric shock.
3. Use personal protective equipments.
4. Welding area should be covered properly so that people working around do not affected by the ultra violet radiation.
5. Never operate a machine unless you are authorized to do so.
6. Use equipment and tools correctly as per instructions.

10.8 Suggested Procedure

1. Clean the mild steel flat pieces to be joined by wire brush.
2. Arrange the flat pieces properly providing the gap for full penetration for butt joint(gap ½ thicknesses of flats).
3. Practice striking of arc, speed and arc length control
4. Set the welding current, voltage according to the type of metal to be joined.
5. Strike the arc and make tacks at the both ends to hold the metal pieces together during the welding process
6. Lay weld beads as per drawing along the joint maintaining proper speed and arc length (Speed 100-150 mm/min).
7. Complete the welding process by removing slag using wire brush andchipping hammer.
8. Clean the table and keep the tools in proper place.

10.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.	----------	----------		% Error
1				

10.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

10.11 Conclusions and/or Validation

(to be filled by student)

.....

.....

10.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1 Prepare the line diagram of MIG welding setup.

2 State any three field/industrial applications of MIG welding.

3 Differentiate MIG and MAG welding.

4 Write the steps for selection of welding parameters used in this practical.

5 Write names of any five tools/accessories used in this practical to prepare butt joint.

10.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Details
Biodegradable waste	Green Bin	
e-Waste	Black Bin	
Plastic and metal waste	Blue Bin	
Any Other		

10.14 Environment Friendly Approach: Reuse, Reduce and Recycle

1 The workpiece of this practical can be reused for basic welding operations.

2. Used workpiece may be recycled.

10.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Co.(P) Ltd. Delhi, Latest edition.
2. Workshop Practice Vol-I by Hazra & Choudhary, Media Promoters & Publisher Pvt.Ltd. Mumbai, Latest edition.
3. Welding Processes and Technology by R. S. Parmar, Khanna Publishers Delhi, Latest Edition

4. MIG Welding

10.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and product related marks

Performance indicators		Weightage	Marks Awarded
Process related: 6 Marks - 60%			
1	Preparing the Workpiece	5%	
2	Setting of welding machine	15%	
3	Performing welding operation	15%	
4	Working in team	5%	
5	Follow safe practices	10%	
6	Practicing environment friendly approach(es)	10%	
Product related: 4 Marks - 40%			
7	Writing result and/or interpretation	10%	
8	Conclusions	5%	
9	Correctness of the job	10%	
10	Answering practical related questions	10%	
11	Submitting the journal in time	5%	
	Total	**100 %**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student:..... Marks Awarded			**Signature of Teacher with date**
Process Related	Product Related	Total	

P11 Rebuilding of Broken Parts using Welding

11.1 Practical Statement

To repair the broken portion of the gate using a suitable welding machine.

11.2 Practical Significance

Welding processes are commonly used to repair, update and rework the original parts to maintain the usefulness. This practical experience of rebuilding broken parts will help the students to develop skills related to the selection of suitable welding process and related equipment in the given situation.

11.3 Relevant Theory

11.3.1 Repair and Maintenance

Repair and maintenance of parts and components is a major activity in any process industry. Repair welding can be carried out as a logical procedure that ensures the part is usable and safe. If repairs are done with proper care or precautions, it can avoid premature failures, large warranty claims, safety of property and personnel and result in satisfied customers. Weld repair is commonly used to improve, update, and rework parts so that they equal or exceed the usefulness of the original part. This is normally attained, with the possible exception of weld-repaired cast iron parts that are subjected to heating and cooling.

11.3.2 The need for weld repair

Parts break and wear out continually. It may be impossible to obtain another part exactly like the one that broke or wore out. This is particularly true of older industrial machinery, construction machinery, agricultural machinery, machine tool parts, and even automobiles. Repaired parts may be more serviceable than the original part, since they can be reinforced and the weaknesses of the original part corrected. It is often more economical to weld repair since the delay in obtaining the replacement part could be excessive and the cost of the new part would normally exceed the cost of repairing the damaged part.

11.3.3 Selection of Welding process & equipment

The selection of the appropriate preparation process and welding process depends on the same factors that are considered in selecting a welding or cutting process for the original manufacturing operation. It is absolutely essential that we know the type, specification, or composition of the metal that we are planning to weld. As mentioned above, it may be unwise to weld repair certain metals. But we should not weld on any metal unless we know its composition.

In the case of repair welding, there are usually limitations, such as the availability of equipment for a one-time job and the necessity of obtaining equipment quickly for emergency repair work. This limits the selection and it is for this reason that the shielded metal arc welding process, the gas metal arc welding process, the gas tungsten arc welding process, and oxyacetylene welding and torch brazing are most commonly used.

However, for many routine and continuous types of repair work some of the other welding processes may be the most economical. For example, submerged arc welding is widely used for building up the surface of worn parts. The electro slag process has been used to repair and resurface parts for hammer mills, for construction equipment, and for rebuilding rolls for steel mills. Thus there is a difference in the selection of the welding process for the routine, continuing types of repair and surfacing work versus the one-of-a-type or breakdown emergency repair job.

11.3.4 Broken Job

The gate is part of the architecture, the big door as the entrance of a building. In this practical we take gate which is old and broken to repair. Selection of welding type and Weld metal by observing pieces which we want back on to the gate if they are broken. We have to Inspect the gatepost supporting the gate. If necessary replace a broken gate hinge. Align the latch with the gate so that gate properly set.

11.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Assess the given situation of repairing/rebuilding.

PrO2: Select the suitable welding process based on given job/work situation.

PrO3: Select the relavent welding equipment and tools to carry out repairing/rebuilding work.

PrO3: Use the relevant equipment correctly.

PrO6: Follow safe practices.

PrO7: Work as a team member/leader.

PrO8: Use of environment friendly approaches

11.5 Practical Setup (Sketch/Work Situation)

*Sample work situation alongwith resources required under 11.6 are given. Other work situation/jobs may be decided by the teacher with full details such as applicable resources required. So that student will complete the given task.

Fig.11.1: Broken Gate*

11.6 Resource Required

(For this practical student will select the relevant welding method and related tools and equipment for the given job/work situation shown in Fig.11.1

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Mild steel work pieces 100 x 60 x 8 mm	As per requirement			
2	Arc Welding machine 200 amp	1			
3	Welding electrodes 2.5 -3mm	5			
4	Electrode holder	1			
5	Ground clamp	1			
6	Flat nose Tong	1			
7	Welding goggle Suitable size	1			

8	Apron Suitable size preferably leather	1			
9	Hand gloves Suitable size	1			
10	Metallic work Table 2.5 x 5 feet	As per requirement			
11	Bench vice 100 mm	1			
12	Rough flat file Bastard Cut Flat File with PVC Handle 10" (250 mm),	1			
13	Try square 6"	1			
14	Steel rule/Measuring tape 30 cm / 5 meter	1			
15	Wire brush Nominal size	1			
16	Ball peen hammer 500 gram	1			
17	Chipping hammer Dimensions (LxW)12.9x28	1			
18	Cable and Cable Connectors	As per requirement			

11.7 Precautions

1. Ensures the proper connection of welding machine.
2. Always use rubber sole shoes in work shop.
3. Welding area must always be kept dry to avoid electric shock.
4. Use goggles, gloves in order to protect the human body.

11.8 Suggested Procedure

1. First visit the workplace and study the actual parts that requires repair.
2. Prepare the information concerning the specifications and design of the parts requires repair based on the analysis of the work situation.
3. Make a list of all the facts related to failure of the part (s) for remedial steps.
4. Identify the suitable welding process and its associated equipment based on the situation.
5. Splice any broken wires on the metal gate with a double loop of smooth, bendable wire.
6. Weld metal pieces back on to the gate if they are broken.
7. Inspect the gatepost supporting the gate.
8. Replace a broken gate hinge.
9. Adjust a sagging gate by adjusting the hinge bolt.
10. Align the latch with the gate.
11. Fit the electrode in the electrode holder and the welding current is set to a proper value
12. The ground clamp is fastened to the gate.
13. Wear the apron, hand gloves, using the face shield and holding the over lapped pieces
14. The arc is struck and the work pieces are tack-welded at the ends of both the sides
15. Remove the slag, spatters and clean the joint.

11.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

11.10 Results and/or Interpretation

S.N.	----------	----------		% Error
1				

(to be filled by student)

1. .....
2. .....

11.11 Conclusions and/or Validation

(to be filled by student)

.....

.....

11.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1 State the reason in support of selected welding process for carrying out repair work.

2 Explain the criteria of selection of weld machine and tools.

3 Write the dimension of broken gate with sketch.

4 Name the alternative method of repairing, if any.

5 Mention the type of electrode used by you.

11.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Details
Biodegradable waste	Green Bin	
e-Waste	Black Bin	
Plastic and metal waste	Blue Bin	
Any Other		

11.14 Environment Friendly Approach: Reuse, Reduce and Recycle

By repairing of the given gate can be reused.

11.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra& Choudhary, Media Promoters & Publisher Pvt.Ltd. Mumbai, 14th edition 2010
2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Co.(P) Ltd. Delhi 2014
3. Welding Processes and Technology by R. S. Parmar, Khanna Publishers Delhi, Latest Edition
4. Welding and Fixing Iron Door

11.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 5 Marks - 50%			
1	Selection of welding process based on the situation	15 %	
2	Selection of associated welding equipment	10%	
3	Handling of the tools / instruments	15%	
4	Working in team	5%	
5	Follow safe practices	5%	
Product related: 5 Marks - 50%			
6	Writing result and/or interpretation	10%	
7	Conclusions	5%	
8	Correctness of the job	10%	
9	Answering practical related questions	10%	
10	Submitting the journal in time	5%	
	Total	**100 %**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student:..... Marks Awarded			**Signature of Teacher with date**
Process Related	Product Related	Total	

4 SHEET METAL WORKING

RELEVANT COURSE OUTCOME(S) AND PO

CO-4: Undertake simple sheet metal jobs using relevant operations and tools safely.

Course Outcome	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium Correlation; 3- Strong Correlation)						
	PO-1: Basic and Discipline specific knowledge	PO-2: Problem Analysis	PO-3: Design/ development of solutions	PO-4: Engineering Tools, Experimentation and Testing	PO-5: Engineering practices for society, sustainability and environment	PO-6: Project Management	PO-7: Life-long learning
CO-4: Undertake simple sheet metal jobs using relevant operations and tools safely.	3	1	1	3	2	-	1

P12 Sheet Metal Tools and Equipment

12.1 Practical Statement

Prepare sheet metal job by using relevant sheet metal tools and machines as per given dimensions.

12.2 Practical Significance

Most manufacturing industries such as home appliances, automotive, energy and electronics rely on some form of sheet metal fabrication. Many engineering and household items such as hoppers, guards, covers, boxes, bins, funnels, ducts are made from a flat sheet of metal. So, by doing this practical the diploma student will get required knowledge about the sheet metal processes and its related tools/ equipment to do the job.

12.3 Relevant Theory

12.3.1 Sheet metal work

Sheet metal is one of the basic forms used in metalworking and can be cut and bent into a variety of shapes. Countless everyday items are made from sheet metal. Thickness can vary greatly; Extremely thin thickness is considered foil or leaf, and pieces thicker than 3 mm are considered plate. Sheet metal is available in flat pieces or coiled strips.

12.3.2 Sheet metal material

A variety of metals are used in a sheet metal shop such as black iron, galvanized iron, copper, tin, aluminum and stainless steel. A sheet of soft steel, which is coated with molten zinc, is known as galvanized iron. The zinc coat forms a coating that resists rust, improves the appearance of the metal and permits it to be soldered with greater ease.

12.3.3 Sheet metal tools and machines

Various marking, measuring, supporting tools and machines are used in sheet metal shop.

a) Hand Tools

The common hand tools used in sheet metal workshop are steel rule, usually of 60 cm length, Vise gauge, dot punch, scriber, trammels, ball peen hammer, and straight peen hammer, cross peen hammer, mallets, snips and soldering iron. Some of these have already been explained in

the earlier units of this manual and the rest are given below.

b) Trammels

Sheet metals layouts require marking of arcs and circles. This may be done by using the trammels. The length of the beam decides the maximum size of the arc that can be scribed. As shown in Fig.12.1

c) Wire Gauge

The thickness of the sheet metal is referred in numbers known as standard wire gauge (SWG). The gaps in the circumstance of the gauge are used to check the gauge number. As shown in Fig.12.2

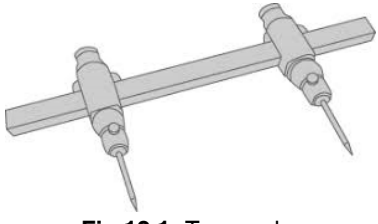


Fig.12.1: Trammels

Fig.12.2: Wire Gauge

d) Snips

Snips are hand shears, varying in length from 200mm to 600mm. 200mm to 250mm being the commonly used. The two main types of snips are tin snips and aviation snips. Both are used to cut sheet metal and other tough materials. As shown in Fig.12.3.

e) Ball Peen Hammer

Ball peen hammer has a cylindrical slightly curved face and a ball head straight peen and similar to the cross peen, but it is positioned paralleled to the handle which can be used conveniently for certain operations of folding. As shown in Fig.12.4.

f) Raising Hammer

Raising Hammer has two wide, flat rectangular faces to create seamless forms in metals without thinning. As shown in Fig.12.5.

Fig.12.3: Snips

Fig.12.4: Ball Peen Hammer

Fig.12.5: Raising Hammer

g) Riveting Hammer

Riveting Hammer is used for heading the rivets in riveted joints and shown in Fig.12.6.

h) Stakes

The stake is a sort of anvil, which supports the sheet metal work. Various types of stakes are used to form the metal sheets into different types of shapes and shown in Fig.12.7.

i) Bench Shears

Sheet metal may be cut by shearing action. In this the force is applied through a compound lever, making it possible to cut sheet metal up to 4mm thick. The chopping hole can shear a mild steel rod up to 10mm diameter. Shown in Fig.12.8.

Fig.12.6: Riveting Hammer

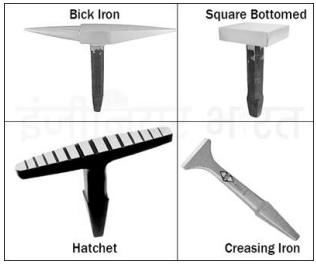


Fig.12.7: Stakes

Fig.12.8: Bench Shear

12.3.4 Sheet metal joints

Various types of joints are used in sheet metal work to suit the varying requirement. These are self-secured joints, formed by joining together two pieces of sheets metal and using the metal itself to form the joints. These joints are to be used on sheets of less than 1.6 mm thickness. Shown in Fig.12.9.

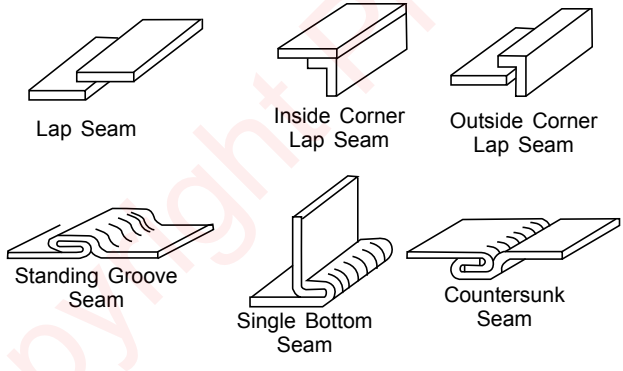


Fig.12.9: Sheet Metals Joints

12.3.5 Riveting

Rivets are used to fasten two of more sheets of metal together. It is the common practice to use the rivets of the same material as that of the sheets having fastened.

12.3.6 Sheet metal screws

These are used in sheet metal work to join and install duct work for ventilation air conditioning etc. These screws are also known as self-tapping screws since they cut their own threads.

12.3.7 Soldering

Soldering is one method of joining two pieces of metal with an alloy that melts at a lower temperature than the metals to be joined for a good job. The metals to be joined must be free from dirt, grease

and oxide. Solder is made of tin and lead in equal proportions. It comes either in the form of wire and bar. Following are the uses of soldering-

1. Electrical components in television, radio, transistor and tape recorders
2. Electronic components like printed circuit boards
3. Automobile parts like radiators and copper pipes
4. Sheet metal works
5. Utensil repairs

12.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Interpret the given job sketch / drawing.

PrO2: Select the appropriate tools & equipment.

PrO3: Use the relevant tools and equipment correctly.

PrO4: Work as a team member/leader

PrO5: Follow safe practices.

PrO6: Use of environment friendly approaches.

12.5 Practical Setup (Sketch/Work Situation)

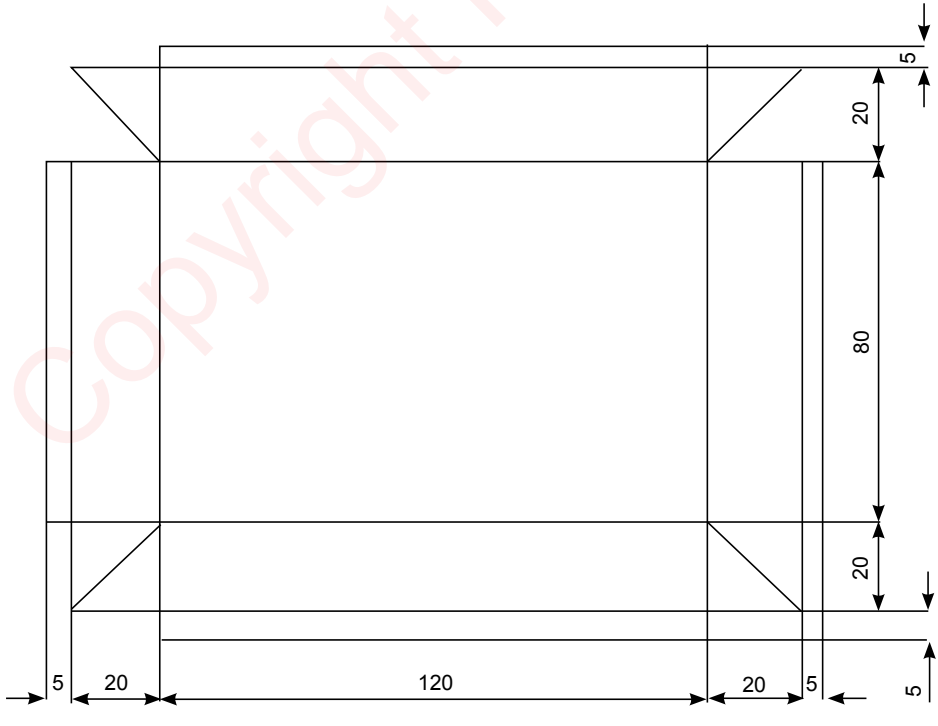


Fig.12.10: Sheet Metal Job Dimensions

12.6 Resources Required

(For this practical student will select the appropriate tools and equipment for the given sheet metal job shown in Fig. 12.10)

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

12.7 Precautions

1. Always wear full covered shoes with rubber sole in the sheet metal shop.
2. Handle metal sheets carefully
3. Sheet shavings should be kept at proper place.
4. Use sharp scriber for marking.
5. Avoid excessive hammering of sheets it may cause warping.
6. Check the dimensions time to time during layout marking and sharing.
7. Use appropriate stake.

12.8 Suggested Procedure

1. Interpret the sketch or drawing given in Fig. 12.10 and note the dimensions for marking.
2. Collect tools and sheet metal of required size as shown in Fig. 12.10.
3. Draw the layout on the work material.
4. Cut the Sheet along the marked out line.
5. Check the edges of sheet for straightness and perpendicularity with the help of try square.
6. Mark all the necessary line to make the required model.
7. Cut the sheet along the lines with straight snips.
8. Do all the bending operations to get the square as vertical sides.
9. Bent all edges to avoid sharp corners and edges for safety.
10. Straighten the four sides and then finish the model.
11. Check all the dimensions and finish.

12.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.			% Error.
1			
2			

12.10 Results and/or Interpretation

(to be filled by student)

……
……
……

12.11 Conclusions and/or Validation

(to be filled by student)

……
……

12.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1 Specify the reasons for selection of stake in this practical.

2 Write any two types of sheet metal joints.

3 State two field/domestic applications of sheet metal joints.

4 State brief process of prepararion of flush joint.

5 Describe working of bench shear.

12.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Name of item
Biodegradable waste	Green bin	
e-Waste	Black bin	
Plastic and metal waste	Blue bin	
Any Other		

12.14 Environment Friendly Approach: Reuse, Reduce and Recycle

The metal sheets used in this practical can be reused by reducing the dimensions appropriately

12.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promoters & Publisher Pvt.Ltd. Mumbai, 14th edition 2010
2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Co.(P) Ltd. Delhi 2014
3. Sheet Metal Tools
4. Sheet Metal Operations

12.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 6 Marks - 60%			
1	Layout marking and cutting	10%	
2	Handling of the tools / equipment	15%	

3	Measuring the job time to time during operation	10%	
4	Checking the work piece	10%	
5	Working in team	5%	
6	Follow safe practices	5%	
7	Practicing environment friendly approach(es)	5%	
Product related: 4 Marks - 40%			
8	Writing result and/or interpretation	5%	
9	Correctness of the job	15%	
10	Answering practical related questions	15%	
11	Submitting the journal in time	5%	
	Total	**100%**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student: …….. **Marks Awarded**			**Signature of Teacher with date**
Process Related	Product Related	Total	

P13 Sheet Metal Joint

13.1 Practical Statement

Prepare a locked grooved joint as per the given dimensions.

13.2 Practical Significance

Apart from its industrial applications, sheet metal is one of the most widely used materials in household products such as metal trays, cabinets, boxes, wheat canning tanks, etc. due to the unique characteristics of low weight, strong and durable.

A variety of joints are used in sheet metal work to suit different needs for the manufacture of these household products. So by doing this practical the student will get exprience regarding sheet metal joint and the time taken to do that work.

13.3 Relevant Theory

13.3.1 Sheet metal operations

Many engineering and house hold articles such as hoppers, guards, covers, boxes, cans, funnels, ducts, etc., are made from a flat sheet of metal; the process being known as tin smithy or sheet metal work. For this, the development of the article is first drawn on the sheet metal, then cut and folded, to form the required shape of the article.

Sheet metal operations may be grouped into following two categories:

1) **Cutting Operations:** In these operations the work piece is stressed beyond its ultimate strength the stressed caused in the metal by the applied forces will be shearing stresses.
2) **Forming Operations:** In these operations the stresses are below the ultimate strength of the metal there is no cutting of the metal but the shape of the work piece is changed to get the desired product

13.3.2 Different sheet metal operations

a) Sheet Cutting

Sheet metal cutting operations remove the sheet metal material from larger sheets by applying

high forces on the cutting edge. The material is cut if the shear stress exceeds the shear strength of the material.

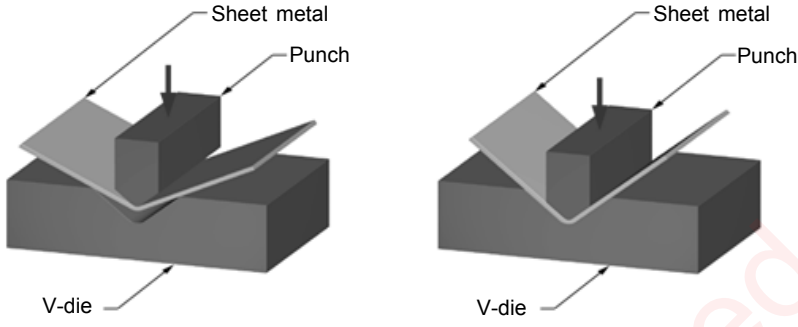


Fig.13.1: Sheet Bending Process

b) Sheet Bending

Bending is a forming operation in which a sheet metal is subjected to bending stress thereby a flat straight sheet is made into a curved sheet. The sheet gets plastically deformed without change in thickness. Die and punch are used for bending. If a v shaped die and punch are used, the bending is called v-bending. Shown in Fig.13.2.

c) Sheet end Curling

Curling is a sheet metal forming process used to form the edges into a hollow ring. Curling can be performed to eliminate sharp edges and increase the moment of inertia near the curled end shown in Fig.13.2.

d) Punching

It is a cutting operation by which various shaped holes are made in sheet metal it is similar to blanking except that in punching the hole is the desired product and the material punched out to form the hole being the waste. Shown in Fig.13.3(a).

e) Blanking

This is the operation of cutting a flat shape from a sheet metal the article punched out is called the blank and is the required product of the operation the hole and the metal left behind is discarded as waste. Shown in Fig.13.3(b).

f) Slitting

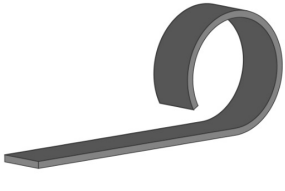


Fig.13.2: Sheet End Curling Process

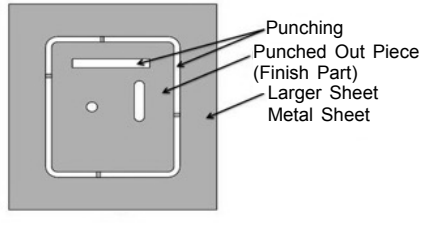


Fig.13.3(a): Punching

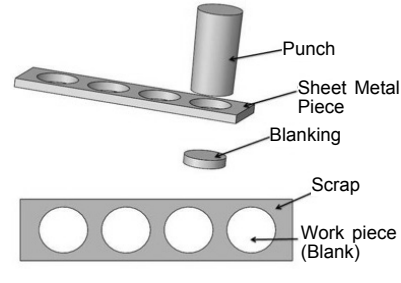


Fig.13.3(b): Blanking

Slitting is used to cut a wide coil of metal into a number of narrower coils as the main coil is moved through the slitter and shown in Fig.13.4.

g) Notching

Notching is a piercing operation that removes material from the edge of the work piece. and shown in Fig.13.5.

h) Nibbling

The nibbling process cuts a contour by producing a series of overlapping slits or notches. The nibbler is essentially a small punch and die that reciprocates quickly; around 300–900 times per minute and shown in Fig.13.6.

i) Perforating

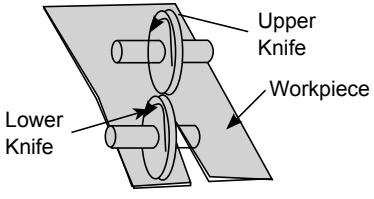


Fig.13.4: Slitting Process

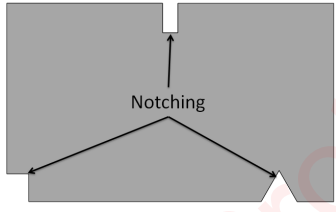


Fig.13.5: Notching Process

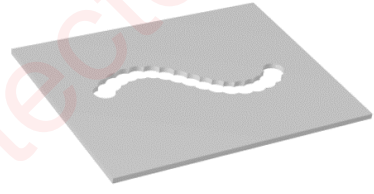


Fig.13.6: Nibbling Process

Perforating is an operation is which a number of uniformly spaced holes are punched in a sheet of metal. The holes may be of any size or shape. They usually cover the entire sheet of metal. Shown in Fig.13.7.

j) Lancing

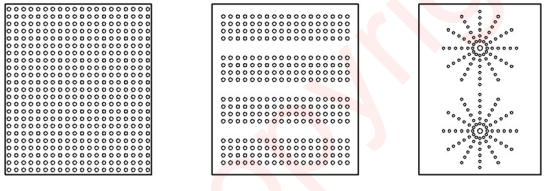


Fig.13.7: Perforating Process

Fig.13.8: Lancing Operation

Lancing is a piercing operation in which the work piece is sheared and bent with one strike of the die. A key part of this process is that there is not reduction of material, only a modification in its geometry. This operation is used to make tabs, vents etc. Shown in Fig.13.8.

k) Shaving

The shaving process is a finishing operation where a small amount of metal is sheared away from an already blanked part. Its main purpose is to obtain better dimensional accuracy, but secondary purposes include squaring the edge and smoothing the edge and shown in Fig.13.9.

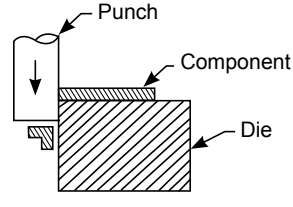


Fig.13.9: Shaving Process

13.3.3 Sheet metal joining process

Joining process including brazing, soldering, riveting and adhesive bonding of materials are used to produce permanent joint between the parts to be assembled. They cannot be separated easily by application of forces. They are mainly used to assemble many parts to make a system.

13.3.3.1 Brazing Process

It is a joining process in which a filler metal is melted and distributed by capillary action between the faying (contact) surfaces of the metal parts being joined. Base material does not melt in brazing, only the filler melts. In brazing, the filler metal has a melting temperature (liquidus) above 450°C, but below the melting point (solidus) of base metals to be joined.

Following are advantages of brazing.

- Brazing can be used to join a large variety of dissimilar metals.
- Pieces of different thickness can be easily joined by brazing.
- Thin-walled tubes & light gauge sheet metal assemblies not joinable by welding can be joined by brazing.
- Complex & multi-component assemblies can be economically fabricated with the help of brazing.
- Inaccessible joint areas which could not be welded by gas metal or gas tungsten arc spot or seam welding can be formed by brazing.

13.3.3.2 Soldering Process

Soldering is similar to brazing and can be defined as a joining process in which a filler metal with melting point (liquidus) not exceeding 450°C is melted and distributed by capillary action between the faying surfaces of the metal parts being joined. As in brazing, no melting of the base metals occurs, but the filler metal wets and combines with the base metal to form a metallurgical bond. Filler metal, called Solder, is added to the joint, which distributes itself between the closely fitting parts.

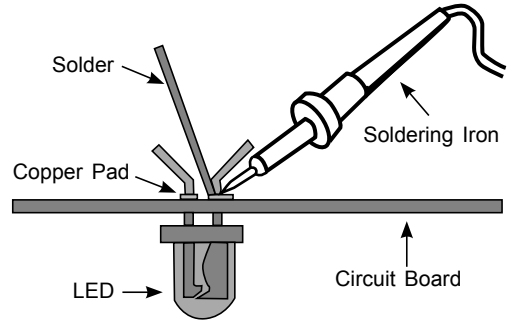


Fig.13.10: Soldering Process

Types of Soldering Processes:

(i) **Soft Soldering:** It is used in sheet metal work and it has less strength.

(ii) **Hard Soldering:** It is employed when stronger joint is required.

Based on the method of heating source, the soldering processes may be, resistance soldering, torch soldering, furnace soldering etc.

a) Application

It is mainly used in joining wires in radios, tape-recorders, printed circuit boards etc.

b) Advantages

1. It produces liquid and gas-tight joints quickly.
2. The cost of the joint is quite low.
3. The temperature of soldering is low.

4. The equipment used for soldering is simple, cheap and easy to handle.
5. It is the most economical method.

c) Drawbacks:

The joints are not strong enough to withstand the constant jerks and pulls, which is the main drawback of the process.

13.3.3.3 Riveting Process

Riveting is a forging process that may be used to join parts together by way of a metal part called a rivet. The rivet acts to join the parts through adjacent surfaces. A straight metal piece is connected through the parts. Then both ends are formed over the connection, joining the parts securely. The metal work piece used to form the connection may be hollow or it may be solid. Rivets have many uses, such as in the construction and sheet metal industries.

13.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Interpret the given job sketch / drawing.

PrO2: Select the appropriate tools & equipment.

PrO3: Use the relevant tools and equipment correctly.

PrO4: Work as a team member/leader

PrO5: Follow safe practices.

PrO6: Use of environment friendly approaches.

13.5 Practical Setup (Sketch/Work Situation)

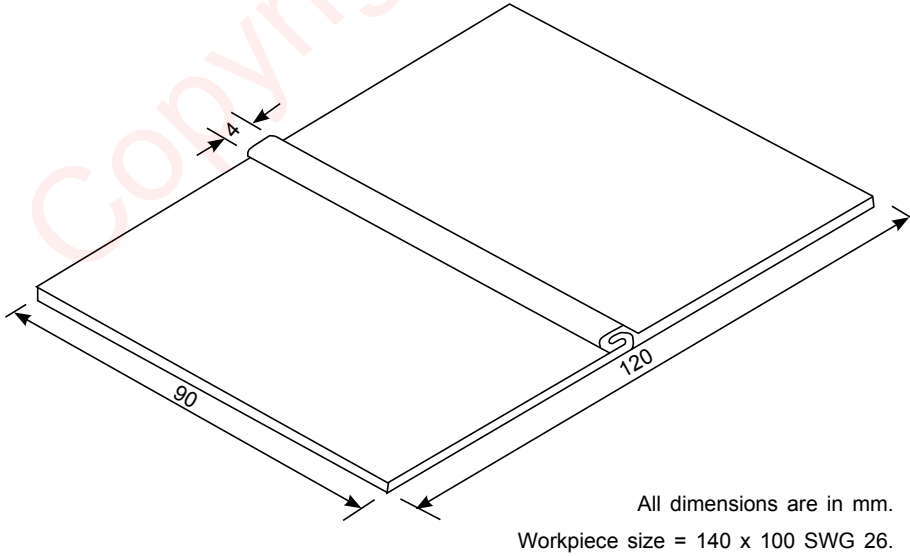


Fig.13.11: Sheet Metal Joint Dimensions

13.6 Resources Required

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	G.I sheet 140 X 100 mm of 26 swg	1 No.			
2	Steel rule 30 cm	1 No.			
3	Mallet	1 No.			
4	Punch	1 No.			
5	Scriber	1 No.			
6	Straight snips	1 No.			
7	Bench shear	1 No.			
8	Try square	1 No.			
9	Protractor	1 No.			
10	Bench vice	1 No.			
11	Anvil 25 kg	1 No.			
12	Different Stakes As per Job requirement	1 Each			
13	Hand groover	1 No.			
14	Smooth file	1 No.			

13.7 Precautions

1. Always wear full covered shoes with rubber sole in the sheet metal shop.
2. Handle metal sheets carefully.
3. Sheet shavings should be kept at proper place.
4. Use sharp scriber for marking.
5. Avoid excessive hammering of sheets it may cause warping.
6. Check the dimensions time to time during layout marking and sharing.
7. Use appropriate stake.

13.8 Suggested Procedure

1. Interpret the sketch or drawing given in Fig. 13.11 and note the dimensions for marking.
2. Collect tools and sheet metal of required size as shown in Fig.13.11.
3. Draw the layout on the work material.
4. Cut the Sheet along the marked out line.
5. Check the edges of sheet for straightness and perpendicularity with the help of try square.
6. Mark all the necessary lines to make the required model of size132 X 90mm.
7. Cut the sheet into two of size 66 X 90mm.
8. Mark the necessary line to form the hook on each, need for bending.
9. The hooks were fold together to form the joint by striking with mallet.
10. Locked the joint with the help of hand groover and finished the model.
11. Finish the model and check all the dimensions.

13.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.			% Error.
1			
2			

13.10 Results and/or Interpretation

(to be filled by student)

.....

.....

.....

13.11 Conclusions and/or Validation

(to be filled by student)

.....

.....

13.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1 Write field applications of soldering and riveting.

2 Write precautions followed in this practical.

3 State bending and sharing operations with example.

4 State nibbling process used in sheet metal shop.

5. Explain sheet metal joints with neat sketch.

13.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Name of item
Biodegradable waste	Green bin	
e-Waste	Black bin	
Plastic and metal waste	Blue bin	
Any Other		

13.14 Environment Friendly Approach: Reuse, Reduce and Recycle

The metal sheets used in this practical can be reused by reducing the dimensions appropriately

13.15 Suggested Learning Resources

1. Workshop Practice Vol-I byHazra& Choudhary, Media Promoters & Publisher Pvt.Ltd. Mumbai, 14th edition 2010

2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Co.(P) Ltd. Delhi 2014

3. Sheetmetal Job

4. Single Grooved Joint

13.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 6 Marks - 60%			
1	Layout marking and cutting	10%	
2	Handling of the tools / equipment	15%	
3	Measuring the job time to time during operation	10%	
4	Checking the work piece	10%	
5	Working in team	5%	
6	Follow safe practices	5%	
7	Practicing environment friendly approach(es)	5%	
Product related: 4 Marks - 40%			
8	Writing result and/or interpretation	5%	
9	Correctness of the job	15%	
10	Answering practical related questions	15%	
11	Submitting the journal in time	5%	
	Total	**100%**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student: ..... Marks Awarded			**Signature of Teacher with date**
Process Related	Product Related	Total	

P14 Riveted Joint

14.1 Practical Statement

Prepare riveted joint (lap joint) between two given metal plate as per the given dimensions.

14.2 Practical Significance

In sheet metal works, usually welding, bolt connection, riveting, soldering are used to join or join two or more sheet metal parts. These connection methods are commonly used in the field of mechanical manufacturing. Among these methods, riveting is an easy, economical and permanent way of joining two or more metal sheets together as per the requirement. So this practical will help the students to develop skills related to sheet metal riveting

14.3 Relevant Theory

14.3.1 Rivets joint

Often small machine components are joined together to form a larger machine part. Design of joints is as important as that of machine components because a weak joint may spoil the utility of a carefully designed machine part. Mechanical joints are broadly classified into two classes viz., non-permanent joints and permanent joints. Non-permanent joints can be assembled and dissembled without damaging the components. Examples of such joints are threaded fasteners (like screw-joints), keys and couplings etc.

Fig.14.1: Rivets

Permanent joints cannot be dissembled without damaging the components. These joints can be of two kinds depending upon the nature of force that holds the two parts. The force can be of mechanical origin, for example, riveted joints, joints formed by press or interference fit etc, where two components are joined by applying mechanical force. The components can also be joined by molecular force, for example, welded joints, brazed joints, joints with adhesives etc. Not until long ago riveted joints were very often used to join structural members permanently. However, significant improvement in welding and bolted joints has minimal use of these joints. Even then, rivets are used in structures, ship body, bridge, tanks and shells, where high joint strength is required.

14.3.2 Rivets and riveting

A Rivet is a short cylindrical rod having a head and a tapered tail. The main body of the rivet is called shank. Shown in Fig.14.2.

Riveting is an operation whereby two plates are joined with the help of a rivet. Adequate mechanical force is applied to make the joint strong and leak proof. Smooth holes are drilled (or punched and reamed) in two plates to be joined and the rivet is inserted. Necessary force is applied at the tail end with a die until the tail deforms plastically to the required shape. Depending upon whether the rivet is initially heated or not, the riveting operation can be of two types: (a) cold riveting is done at ambient temperature and (b) hot riveting rivets are initially heated before applying force. After riveting is done, the joint is heat-treated by quenching and tempering in order to ensure leak-proof joints.

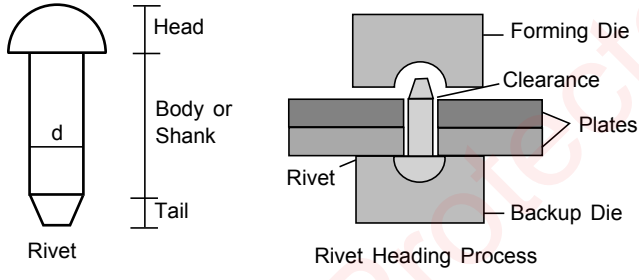


Fig.14.2: Rivet & Rivet Heading Process

14.3.3 Types of rivet joints

Riveted joints are mainly of two types 1. Lap joints 2. Butt joints.

a) Lap Joints

The plates that are to be joined are brought face to face such that an overlap exists, as shown in Fig.14.3. Rivets are inserted on the overlapping portion. Single or multiple rows of rivets are used to give strength to the joint. Depending upon the number of rows the riveted joints may be classified as single riveted lap joint, double or triple riveted lap joint etc. When multiple joints are used, the arrangement of rivets between two neighbouring rows may be of two kinds. In chain riveting the adjacent rows have rivets in the same transverse line. In zig-zag riveting, on the other hand, the adjacent rows of rivets are staggered.

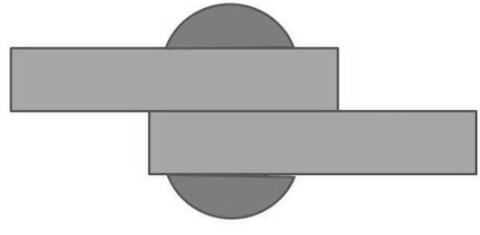


Fig.14.3: Lap Joint

b) Butt Joints

In this type of joint, the plates are brought to each other without forming any overlap. Riveted joints are formed between each of the plates and one or two cover plates. Depending upon the number of cover plates the butt joints may be single strap or double strap butt joints. A single strap butt joint is shown in Fig.14.4. Like lap joints, the arrangement of the rivets may be of various kinds, namely, single row, double or triple chain or zigzag.

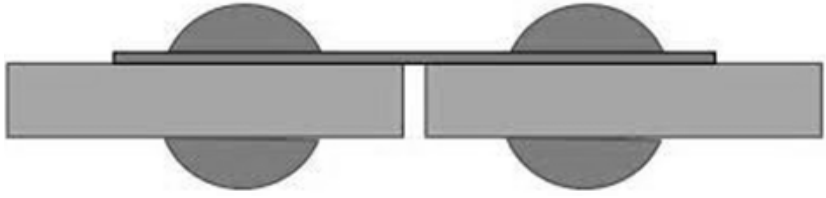


Fig.14.4: Butt Joint

14.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Interpret the given job sketch / drawing.

PrO2: Select the appropriate tools & equipment.

PrO3: Use the relevant tools and equipment correctly.

PrO4: Work as a team member/leader

PrO5: Follow safe practices.

PrO6: Use of environment friendly approaches.

14.5 Practical Setup (Sketch/Work Situation)

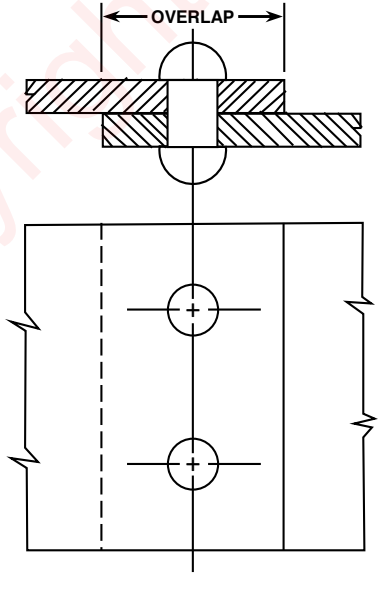


Fig.14.5: Single Riveted Lap Joint

14.6 Resources Required

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Two aluminum plate 60 x 90 x 6 mm (In place of above, according to Fig.14.5 work piece size may be decided by the teacher)	1 No.			
2	Steel rule 30 cm	1 No.			
3	Rivets Aluminum	4 No.			
4	Mallet	1 No.			
5	Center punch	1 No.			
6	Scriber	1 No.			
7	Straight snips	1 No.			
8	Bench vice	1 No.			
9	Try square	1 No.			
10	Protractor	1 No.			
11	Bench vice	1 No.			
12	Anvil 25 kg	1 No.			
13	Drilling Machine with drill bids	1 No.			
14	Riveting hammer	1 No.			

14.7 Precautions

1. Always wear full covered shoes with rubber sole in the sheet metal shop.
2. Handle metal sheets carefully
3. Sheet shavings should be kept at proper place.
4. Use sharp scriber for marking.
5. Avoid excessive hammering of sheets it may cause warping.
6. Check the dimensions time to time during layout marking and sharing.

14.8 Suggested Procedure

1. Interpret the sketch given in Fig.14.5 and as per instructions of the teacher decide the dimensions for marking.
2. Collect tools and required materials as per job shown in Fig.14.5.
3. Take the given Aluminum sheet and cut it in to the required dimension with the help of sheet metal cutter,
4. Place the cut end aluminum sheet in the bench vice and files for the right angles,
5. Mark the dimensions of the rivet hole with the help of the scriber, dot punch and center punch,
6. Drill the holes on the two aluminum plates with the help of the drilling machine,
7. Now take the rivets and punch them with the ball peen hammer in the required holes,
8. Before driving the rivets, clamp them properly and make the riveting and be sure that the plates are properly joined,

14.9 Observations and Calculations

S.N.			% Error.
1			
2			

(may be modified depending on the practical; to be filled by student)

14.10 Results and/or Interpretation

(to be filled by student)

……
……
……

14.11 Conclusions and/or Validation

(to be filled by student)

.....
.....

14.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1 State types of rivets used in sheet metal.

2 Write the purpose of riveting.

3 Describe in brief the process adoppted for riveting in this practical.

4 State any three demerits of riveting in sheet metal shop.

5 Describe any three types of general purpose rivet heads with neat sketch

14.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Name of item
Biodegradable waste	Green bin	
e-Waste	Black bin	
Plastic and metal waste	Blue bin	
Any Other		

14.14 Environment Friendly Approach: Reuse, Reduce and Recycle

The metal sheets used in this practical can be reused by reducing the dimensions appropriately

14.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promoters & Publisher Pvt.Ltd. Mumbai, Latest edition.
2. Workshop Practice Vol-I by Raghuvanshi, Dhanpat Rai & Co.(P) Ltd. Delhi, Latest edition.
3. Basic Riveting Fundamentals
4. Riveting

Basic Riveting Fundamentals

Riveting

14.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 5 Marks - 50%			
1	Layout marking and cutting	10%	
2	Handling of the tools / equipment	20%	
3	Checking the work piece	5%	
4	Working in team	5%	
5	Follow safe practices	5%	
6	Practicing environment friendly approach(es)	5%	
Product related: 5 Marks - 50%			
7	Writing result and/or interpretation	5%	
8	Correctness of the job	15%	
9	Writing conclusion	10%	
10	Answering practical related questions	15%	
11	Submitting the journal in time	5%	
	Total	**100%**	

*Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student: …….. **Marks Awarded**			**Signature of Teacher with date**
Process Related	Product Related	Total	

5 ELECTRICAL HOUSE WIRING

RELEVANT COURSE OUTCOME(S) AND PO

CO-5: Undertake electric wiring works for various domestic applications.

Course Outcome	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium Correlation; 3- Strong Correlation)						
	PO-1: Basic and Discipline specific know-ledge	PO-2: Problem Analysis	PO-3: Design/ deve-lopment of solutions	PO-4: Engi-neering Tools, Experi-mentation and Testing	PO-5: Engi-neering practices for society, sustain-ability and environ-ment	PO-6: Project Manage-ment	PO-7: Life-long learning
CO-5: Under-take electric wiring works for various domestic appli-cations.	2	1	2	3	2	1	1

P15 Electrical Wiring Tools and Materials

15.1 Practical Statement

Use relevant tools to assemble one lamp controlled by one switch by surface conduit wiring as per given circuit diagram.

15.2 Practical Significance

Electricity has become a basic necessity of human life. Every home needs light to illuminate its living room, work area mainly in the night hours.

To illuminate the rooms and work area, we need to fix the lighting system by using suitable wires, conduit, holder, bulb, switch board and switch to control the switching of lighting system. The wiring system for the particular premises mainly depends on the purpose of the wiring and the local environmental conditions. Common types of wiring systems used are concealed wiring and surface wiring. Light fittings, fixtures and switch boards are fixed at a particular height and locations following the safety norms. Therefore, by doing this practical student will get the experience of doing surface conduit wiring using relevant tools, instruments and wiring material.

15.3 Relevant Theory

Electric power is supplied to domestic installations in a single-phase supply and three phase supply. In a single-phase supply is a 230 V supply through two wires (one called phase and another neutral) and 3-phase supply is 415 V supply through 4 wires(three phase wires and one neutral wire).

15.3.1 Electrical Wiring

Electrical wiring can be termed as a system of electrical conductors, components and devices for transmitting electrical power from the source to the point of use.

15.3.1.1 Types of electrical wiring

Electrical wiring may be classified into two categories namely internal and external.

a) Internal Wiring

Internal wiring is used for domestic and industrial purposes. For both purposes, it can be used as concealed or front mounted with conduit and capping casings. Multi strand copper wire is available in a variety of sizes that can be used for internal wiring. Wires of different sizes are shown in

Fig. 15.1. Common sizes are 0.75sq mm, 1sq mm, 1.5sqmm,2.5sqmm,4sqmm,6sqmm,10sqmm, 16sqmm,25sqmm,

b) External Wiring

External wiring is used for outside of the building and is laid underground with hume pipe and surface with armoured cable. Cut view of the cable is shown in Fig.15.2. There are different size and types of aluminum cable such as 4 core, 3 ½ core, 2 core cable, 6 sq mm, 10 sq mm, 16 sq mm, 25 sq mm, 35 sq mm, 50 sq mm, 70 sq mm, 95sq mm, 120 sq mm, 150 sq mm, 185 sq mm, 220 sq mm, 270 sq mm, 300 sq mm, 400 sq mm, 500 sq mm.

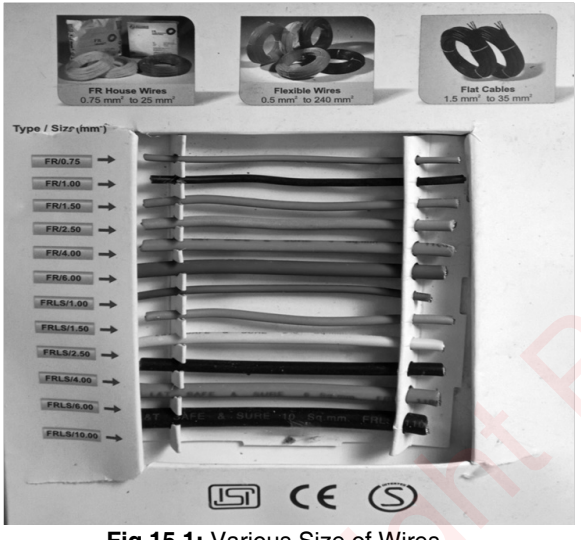


Fig.15.1: Various Size of Wires

Fig.15.2: Armoured Cable

15.3.1.2 Tools, Instruments and Material

To carry out the electrical wiring works, we need some basic hand tools and special tools. Various tools, machines, and wiring material are depend on wiring diagram. Details given below-

S.N.	Name of Tools and Instruments with Description
1	***Measuring Tape*** • Size- 3-5 meters • Used for measurements, graduate in mm, measure the length of the wire and also to mark the positions of the switches and other electrical fittings. Shown in Fig.1.1(b) of Unit-1
2	***Line Tester*** • Size- Available in various sizes such as 100 / 130 mm. It is fully insulated and having neon bulb which indicates the presence of power supply. • Used to check the supply of power or phase at any point of circuit. Shown in Fig.15.3(a). It can also be used as a screw driver to tighten small screws in switches.

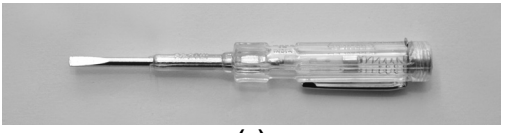
3	***Screw Drivers*** • Screw drivers are used to tighten screws in the switches and electrical machines. Screw drivers of various sizes are used. Normally screw drivers used in electrical work are insulated. Shown in Fig.15.3(b)
4	***Hammers*** • Ball peen and claw hammers are commonly used in electrical work where greater power is required striking. Hammers are shown in Fig.1.4 of Unit-1.
5	***Plier*** • Pliers are used to cut wire and also to hold it. Pliers have an insulated handle. Long nose pliers are used to hold wires in small space and also to tighten or loose small nuts. Shown in Fig.15.3(c)
6	***Flat Nose Plier*** • Used for holding jobs or holding wires. It has got only two slotted jaws, which are tapered. Thus it is used for tightening or loosening small nuts. Shown in Fig.15.3(d)
7	***Side Cutting Plier*** • Used for cutting of thin wires and removing insulations from them. It has got cutting edge on its one of its sides. Shown in Fig.15.3(e)
8	***Round Nose Plier*** • Used only to hold or cut the wires. It has no gripping jaws. Its cutting edge is long and rounded on the top. Shown in Fig.15.3(f)
9	***Wire Stripper*** • For removing a insulation from conductor, without losing conductor core. Shown in Fig.15.3(g)
10	***Portable Power Drill Machine*** • To make holes with using drilling bits of required sizes. Normally for wiring purpose 1 to 8 mm drill bits are used as per situation. Shown in Fig.15.3(j)
11	***Hacksaw*** • Hacksaw frame size specified by the length of the hacksaw blade which is normally 10" to 12".A hacksaw is used to cut conduit pipes, cables, etc. it has a frame where the blade is tightened by means of a wing nut. Shown in Fig.5.3(a) of Unit-2
12	***Multimeter*** • Multimeter is a instrument used to measure AC/DC voltage, AC/DC current, resistance, capacitance, frequency, and duty cycle. Shown in Fig.15.3(h). Tong tester is also used for measurement of current and Shown in Fig.15.3(i)

Wiring Material

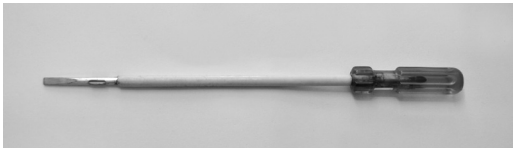
Selection of material will depend upon work situation and requirement of the circuit diagram. Following are the common type of materials used for Light circuits for residential purposes-

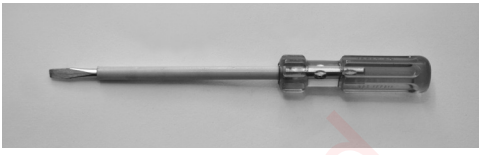
13	***Wires*** • An electric wire is a copper or aluminum insulated wire and has one or more twisted stands. Vulcanized Indian Rubber (VIR) wire, cotton flexible or rubber flexible wire and poly vinyl chloride (PVC) wires are commonly used in domestic wiring. Generally, size of the wire depends on proposed current carrying capacity or load, such as for point connection 1 mm wire is used. Shown in Fig.15.4(a)
14	***Insulation Tapes*** • Insulation electrical tapes are available in variety of colors and are used for marking wires and for attaching cables to a fish tape. Shown in Fig.15.4(b)
15	***Lamp Holder*** • Lamp holder is a device for holding the a lamp, lamp holder is fitted with electric terminals. • Various types of lamp holders are available in the market such as Batten Holder Pendant Holder, Angle Holder, Slanting Holder etc. Angle Holder is shown in Fig.15.4(c)
16	***Lamp*** • Lamp is an artificial source of light and it has become an integral part of our life. • Various types of lamp are available in the market such as Incandescent Lamps Tungsten Halogen Lamps, Compact Fluorescent Lamps(CFL), and LED lamps. Incandescent Lamps and LED lamps are shown in Fig.15.4(d) & (e) respectively.
17	***PVC Capping and Casing*** • Many years ago, wooden battens were used for laying wire on the surface, now a days, PVC pipes or PVC casings and capping are used for wiring purposes which are easy to use. PVC casing and capping are available in different sizes like 0.75", 1", 1.5" etc. The 1" PVC casing and capping is shown in Fig.15.5(a) .

18	***Switch and Socket*** • In electricity, a switch is an electrical device or component that can connect or disconnect a conducting path in an electrical circuit and is available in various capacities such as 5 Amp, 15 Amp (one way and two side). Now, modular switches are popular and their appearance is attractive. • An electrical socket is a device that allows electrical equipment to be connected to a primary power supply. Sockets can vary in voltage and current rating, size, shape and type of connectors. Switch and socket 5 Amp is shown in Fig.15.5(b).
19	***SS Combine*** • It is a combination of switch and socket as single entity. And having properties same as switch and socket. Shown in Figure 15.5(c). SS combine are available in the market in 5 amp and 15 amp capacity. Presently SS combines are also equipped with indicating lamp and fuse which safeguard the appliances in case of any short circuits situations.
20	***Ceiling Rose*** • It is an electrical accessories used to make junction points for branching out wires at different places in a wiring circuit and shown in Figure 15.5(d).
21	***PVC Gulli (peg)*** • It is a combination of switch and socket as single entity. And having properties same as switch and socket. Shown in Figure 15.5(e).
22	***Modular Switch Board*** • An electric switchboard is a device that transmits electricity from one or more sources of supply to several small areas of use. • It is switch, socket and regulator and other devices in a single modular sheet and used for wiring circuit and shown in Figure 15.5(f).
23	***LED Tubelight*** • LED stands for Light Emitting Diode An LED bulb produces light by passing an electric current through a semiconductor material – a diode – which then emits photons (light) through the principle of electroluminescence. LED tubelights are available in various size and shapes which can be selected based on need.

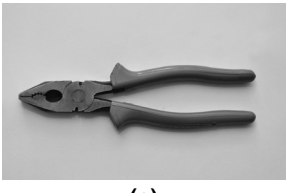


(a)

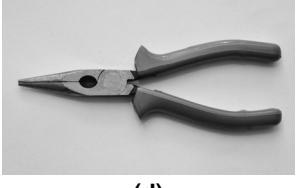




(b)



(c)



(d)

(e)

(f)

(g)

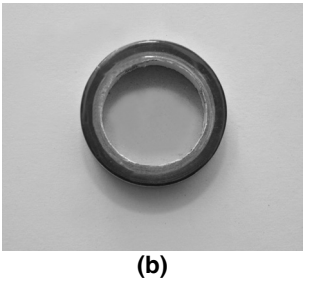
(h)

(i)

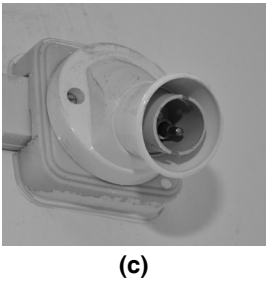
(j)

Fig.15.3: Wiring Tools and Instruments

(a)



(b)



(c)

(d)

(e)

Fig.15.4: Wiring Material

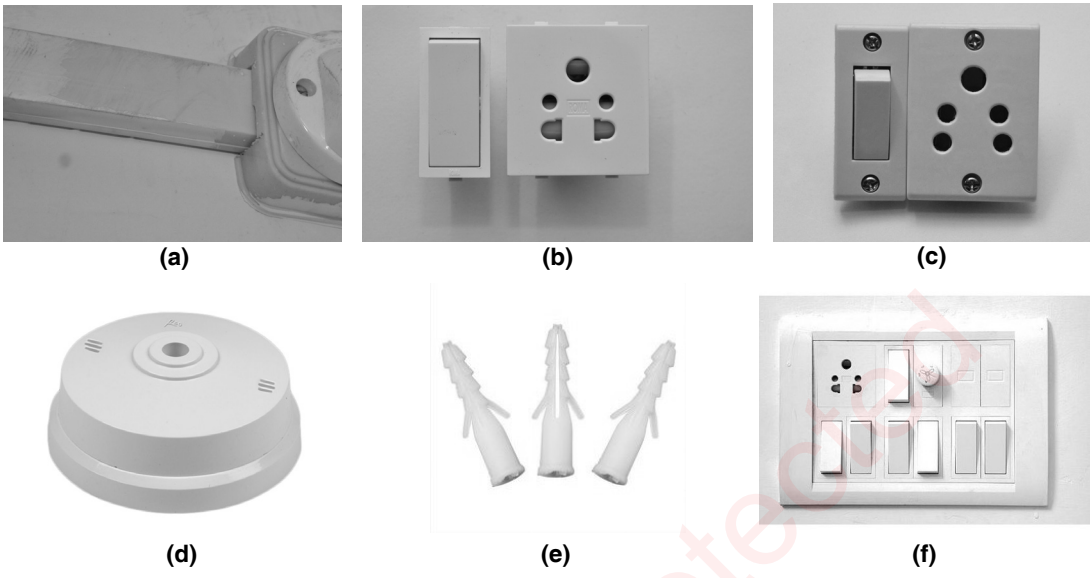


Fig.15.5: Other Wiring Material

15.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Select relevant tools, instruments and electrical wiring materials for given wiring job.

PrO2: Check wiring material with the given requirement.

PrO3: Lay electrical wiring using tools and material correctly.

PrO4: Follow safe practices.

PrO5: Work as a team member.

PrO6: Use environment friendly approaches.

15.5 Practical Setup (Circuit Diagram/Work Situation)

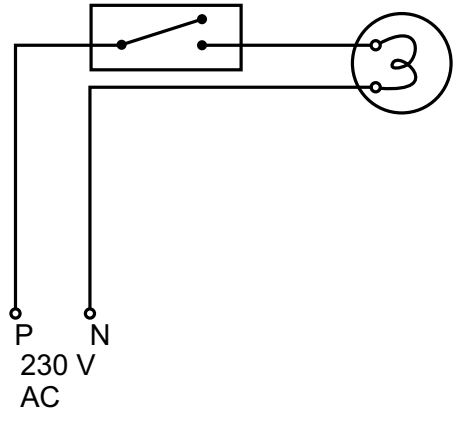


Fig.15.6: Circuit Diagram - One Lamp Control using One Switch

15.6 Resources Required

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Measuring tape 3 meter	1 No.			
2	Plier Standard make insulated combination Plier	1 No.			
3	Screw driver 6" /8" size	1 No.			
4	Phase tester standard ISI marked	20 No.			
5	Portable power drill machine with bits Small size for hammering purpose	1 No.			
6	Insulation electric tape	1 No.			
7	Casing nail ½" size	1 No.			
8	Ball peen hammer 450 grams	1 No.			
9	Screw 0.75" / 1"	10 each			
10	PVC wall gulli 6/8 mm	15 No.			

11	Lamp holder Angle holder	1 No.			
12	Lamp 9 Watt (LED)	1 No.			
13	Switch 5 Amp modular	1 No.			
14	PVC casing and capping 2" size,	10ft.			
15	Multistrand copper wire 1 sq mm - red color and black color	1 bundle each			
16	Switch board modular	1 No.			

15.7 Precautions

1. Always wear rubber sole shoes.
2. Never work in damp areas or in wet clothes
3. Avoid to work under poor light or improper light.
4. Use approved tools, equipment's and protective devices.
5. Keep tools and equipment's clean and in good working condition.
6. Read all instructions carefully before using the appliances and instruments.
7. Avoid operating electrical appliance with a damaged / broken cord or plug.
8. Check the electric power supply from the switch position.
9. Fitting should be tightly fitted.
10. Connection should be tight.
11. Wire should be on the conduit, power gripped properly.

15.8 Suggested Procedure

1. Collect tools, instruments and wiring material
2. Check the wiring material and layout plan as per circuit diagram requirement.
3. Fix the switch board base plate and casing from the switch board to the lamp holder position as per layout and fix the lamp holder.
4. Take required length of red wire for phase line and black wire for neutral.

5. Connect the switch as per circuit diagram and finally, connect both the wires from holder terminal to switch.
6. Fix the lamp in lamp holder
7. Connect switch board circuit with the distribution board shown in the wiring diagram.
8. Now check all the connections, if loose then tighten them correctly .
9. Switch on, then if the lamp will light up, it means that the wiring is done correctly.
10. Keep tools, equipment and wiring materials in their proper places.

15.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.			% Error.
1			
2			

15.10 Results and/or Interpretation

(to be filled by student)

……
……
……

15.11 Conclusions and/or Validation

(to be filled by student)

……
……
……

15.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Switch is always connected with phase wire. Give reasons.
2. Write the criteria for selection of wire size used in this practical.
3. Write the size of drill bit used in this practical for fixing casing.
4. Describe the process of fixing modular switch board.
5. Describe the working of LED tube light.

15.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Name of item
Biodegradable waste	Green bin	
e-Waste	Black bin	
Plastic and metal waste	Blue bin	
Any Other		

15.14 Environment Friendly Approach: Reuse, Reduce and Recycle

1. Same material can be reused by changing circuit layout appropriately.
2. Used aluminum and copper wires can be recycled.

15.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promotors & Publishers Pvt. Ltd., Delhi, Latest Edition
2. Workshop Practice Manual by K Venkata Reddy, BS Publications, Hyderabad, Latest Edition
3. Concealed Wiring vs Open Wiring.

Concealed Wiring vs Open Wiring

15.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and

Performance indicators		Weightage	Marks Awarded
Process related: 7 Marks - 70%			
1	Marking of wiring layout	10%	
2	Execute wiring as per requirement	20%	
3	Handling of the tools / instruments	15%	

4	Checking the circuit	10%	
5	Follow safe practices	10%	
6	Use of environment friendly practices	5%	
Product related: 3 Marks - 30%			
7	Getting results	10%	
8	Writing and interpretation of results	5%	
9	Answering Practical related questions	10%	
10	Submitting the journal in time	5%	
	Total	**100%**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student: …….. **Marks Awarded**			**Signature of Teacher with date**
Process Related	Product Related	Total	

P16 Staircase Wiring

16.1 Practical Statement

Undertake stair case wiring controlled by two way switch using surface conduit wiring as per circuit diagram.

16.2 Practical Significance

In the multi-storey buildings, light fittings are fitted floor wise in staircase. These lights are controlled from more than one location as per the requirement and to minimize the power consumption. We can control the switching of lights fitted in different floor by using suitable wiring scheme and switches. Normally two-way switches are used for this purpose.

The main purpose of using two-way switches are to control the lights fitted in particular floor from two different locations. If we are in ground floor, we need illumination in ground floor area. But, when we are in upper floor we need illumination in upper floor area and same time we have to switch off the ground floor light. This can be achieved by using two switches. Therefore, by doing this practical student will get the experience of doing staircase wiring using relevant tools, instruments and wiring material.

16.3 Relevant Theory

16.3.1 Staircase wiring

Sometimes, it is desirable to control the lamp from two different locations such as the beginning of the stair case and the end of the staircase on the next floor. Staircase wiring is also termed as two way switching connection. This type of wiring is also suitable for long corridors, bedroom lighting etc. Following are the major advantages of two-way switching wiring-

- To connect and control AC appliances and equipments from two separate locations.
- It is mostly used in staircase wiring where a light bulb can be control (Switch ON / Switch OFF) from different places, no matter you are in the upper or lower portion of stair.
- It is used to control any electrical (AC or DC) appliance or equipment like fan, light bulbs etc from two different places.

16.3.2 Tools and Instruments

The relevant theory of electrical wiring tools and materials have been discussed in practical no. P15 and the same may be reffered as and when required.

16.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Select relevant tools, instruments and electrical wiring materials for staircase wiring as per circuit diagram.

PrO2: Check wiring material with the given requirement.

PrO3: Lay electrical wiring using tools and material correctly as per circuit diagram.

PrO3: Follow safe practices

PrO4: Work as a team member

PrO5: Use environment friendly practices

16.5 Practical Setup (Circuit Diagram/Work Situation)

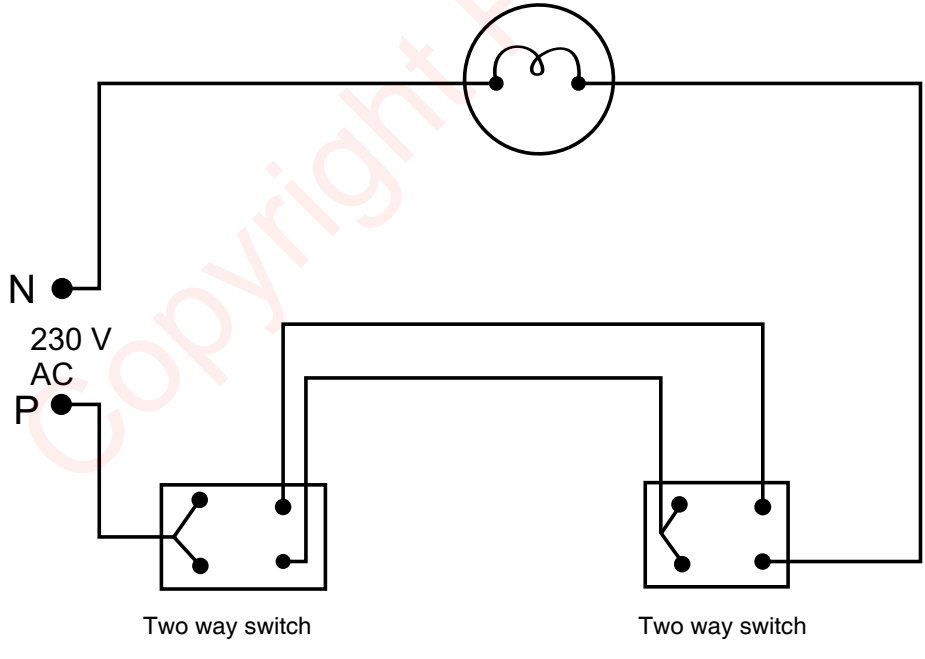


Fig.16.1: Stair Case Wiring Diagram

16.6 Resources Required

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Measuring tape	1 No.			
2	Plier Standard make Insulated combination plier	1 No.			
3	Screw driver 6" /8" size	1 each			
4	Phase tester Standard ISI marked	1 No.			
5	Portable drill machine with bits Small size for hammering purpose	1 No.			
6	Insulation electric tape	1 No.			
7	Casing nail ½" size	30 No.			
8	Ball peen hammer 450 grams	1 No.			
9	Screw 0.75"/1"	Minimum 25 numbers or as per actual.			
10	PVC wall gulli 6/8 mm	Minimum 30 numbers or as per actual			

11	Lamp holder	1 No.			
12	LED lamp 09 / 11 Watt	1 No.			
13	Two way switch 5 Amp modular	2 No.			
14	PVC casing and capping 2" size including bend and Tee	Minimum 35' or as per requirement based on given situation of staircase.			
15	Multistrand copper wire 1 sq mm- red color and black color	1 bundle each			
16	Switch board modular Modular single and double way switch	2 each			

16.7 Precautions

1. Always wear rubber sole shoes.
2. Never work in damp areas or in wet clothes
3. Avoid to work under poor light or improper light.
4. Use approved tools, equipment's and protective devices.
5. Keep tools and equipment's clean and in good working condition.
6. Read all instructions carefully before using the appliances and instruments.
7. Avoid operating electrical appliance with a damaged / broken cord or plug.
8. Check the electric power supply from the switch position.
9. Fitting should be tightly fitted.
10. Connection should be tight.
11. Wire should be on the conduit, power gripped properly

16.8 Suggested Procedure

1. Collect and check tools, instruments and wiring materials according to the circuit diagram
2. Plan the casing and wiring according to the circuit requirements
3. Fix the switch board base plate and casing from the switch boards to the lamp holder position and fix the lamp holder.
4. Share wire ends of required length using pliers and stripper.
5. Connect the one phase red wire to the central pin of the two-way switch.
6. Connect the remaining ends to the corresponding other two way switch and another black wire direct switchboard to lamp terminal finally connect both the wires form holder terminal to switch.
7. Fix the lamp in lamp holder. Connect the switch board circuit to the distribution board shown in wiring layout.
8. Put PVC capping on the casing to cover the exposed wiring.
9. Switch ON and OFF the two switches alternatively to the bulb for circuit testing.
10. Keep tools, equipment and wiring materials in their proper places.

16.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.			% Error.
1			
2			

16.10 Results and/or Interpretation

(to be filled by student)

……
……
……

16.11 Conclusions and/or Validation

(to be filled by student)

……
……
……

16.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. State the field / domestic applications of staircase wiring.
2. Describe two way switch with neat sketch.
3. Write the applications of multimeter in domestic wiring.
4. Differentiate between AC and DC.
5. State major precautions followed in this practical.

15.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Name of item
Biodegradable waste	Green bin	
e-Waste	Black bin	
Plastic and metal waste	Blue bin	
Any Other		

16.14 Environment Friendly Approach: Reuse, Reduce and Recycle

1. Same material can be reused by changing circuit layout appropriately.
2. Used aluminum and copper wires can be recycled.

16.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promotors & Publishers Pvt. Ltd., Delhi, Latest Edition
2. Workshop Practice Manual by K Venkata Reddy, BS Publications, Hyderabad, Latest Edition
3. Staircase Wiring.

16.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 7 Marks - 70%			
1	Marking of wiring layout	10%	
2	Execute wiring as per requirement	20%	
3	Handling of the tools / instruments	15%	
4	Checking the circuit	10%	
5	Follow safe practices	10%	
6	Use of environment friendly practices	5%	
Product related: 3 Marks - 30%			
7	Getting results	10%	
8	Writing and interpretation of results	5%	
9	Answering Practical related questions	10%	
10	Submitting the journal in time	5%	
	Total	**100%**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student: …….. **Marks Awarded**			**Signature of Teacher with date**
Process Related	Product Related	Total	

P17 LED Tubelight Wiring

17.1 Practical Statement

Use relevant tools to assemble LED tube light system controlled by one switch as per circuit diagram.

17.2 Practical Significance

Different types of tube light systems are installed in different campuses. Presently, LED tube lights are very popular, as it consumes less power than other types of tube light fittings. In conventional tube light systems, the choke and starter are mounted separately. But, in the case of LED tube light systems, the manufacturing mechanism is completely different, as it is controlled electronically. After doing this practical, students will be able to complete the LED Tube Light Connection with confidence and comfort.

17.3 Relevant Theory

17.3.1 LED

LED stands for Light Emitting Diode.

An LED bulb produces light by passing an electric current through a semiconductor material – a diode – which then emits photons (light) through the principle of electroluminescence. It indicates that a material (a diode) emits light when electricity is applied to it. Electrons jump from one side (an electron-deficient side) to the other (an electron-deficient side) across a junction ("p-n junction"). When power is applied to the p–n junction, the side lacking electrons seeks to fill up with charged electrons from the other side, and when power is applied the electrons become eager to move. Light is created during this process.

17.3.2 Tools and Instruments

The theory relating to electrical wiring as well as the description of instruments, tools and materials are discussed in 15.3 of Unit 5, which may be referred as and when required.

17.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Select relevant tools, instruments and materials for assembly of LED tubelight system.

PrO2: Check the assembly of LED tubelight.

PrO3: Follow safe practices

PrO4: Work as a team member

PrO5: Use environment friendly practices

17.5 Practical Setup (Circuit Diagram/Work Situation)

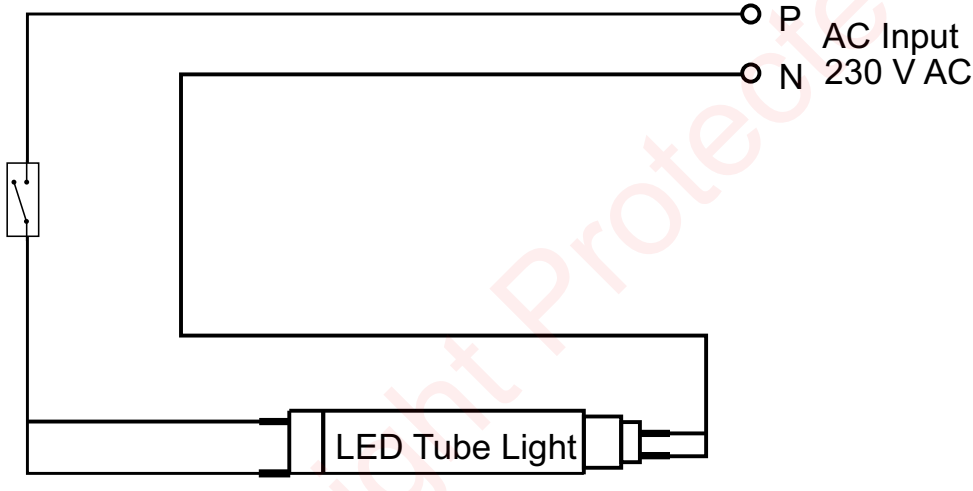


Fig.17.1: LED Tubelight Circuit Diagram

17.6 Resources Required

S.N.	Suggested Resources Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Plier Standard make insulated combination plier	1 No.			
2	Screw driver 6" /8" size	1 each			

3	Phase tester Standard ISI marked	1 No.			
4	Portable drill machine with bits Small size for hammering purpose	1 No.			
5	Insulation electric tape	1 No.			
6	Ball peen hammer 450 grams.	1 No.			
7	Screw 0.75"/1"	Minimum 25 numbers or as per actual.			
8	PVC wall gulli 6/8 mm	Minimum 30 numbers or as per actual			
9	LED tubelight with base fitting	1 No.			
10	Multistrand copper wire 1 sq mm - red color and black color	1 bundle each			

17.7 Precautions

1. Always wear rubber sole shoes.
2. Avoid to work under poor light or improper light.
3. Keep tools and equipment's clean and in good working condition.
4. Read all instructions carefully before using the appliances and instruments.
5. Avoid operating electrical appliance with a damaged / broken cord or plug.
6. Check the electric power supply from the switch position.
7. Fitting should be tightly fitted.
8. Connection should be tight.

17.8 Suggested Procedure

1. Collect and check tools, instruments and materials according to the circuit diagram.
2. Plan the connection according to the circuit requirements.
3. Complete connection of the LED light/amp with the help of circuit diagram.
4. Mark the position of LED tubelight.
5. Use drill machine make a hole and fix PVC gulli.
6. Connect the switch board circuit to the distribution board shown in wiring layout.
7. Switch ON and OFF the two switches alternatively to the bulb for circuit testing.
8. Keep tools, equipment and wiring materials in their proper places.

17.9 Observations and Calculations

(may be modified depending on the practical; to be filled by student)

S.N.			% Error.
1			
2			

17.10 Results and/or Interpretation

(to be filled by student)

……
……
……

17.11 Conclusions and/or Validation

(to be filled by student)

……
……

17.12 Practical Related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. State the working principle of LED.
2. Describe constructional features of LED tubelight with sketch.
3. Give any two examples of energy efficient lighting system.
4. State the functions of Bureau of Energy Efficiency.
5. Differentiate between CFL and LED.

17.13 Disposal of Waste

Classify the waste materials to be thrown in this practical in the following bins:

Type of Waste	Colour of Bins	Name of item
Biodegradable waste	Green bin	
e-Waste	Black bin	
Plastic and metal waste	Blue bin	
Any Other		

17.14 Environment Friendly Approach: Reuse, Reduce and Recycle

1. Used aluminum and copper wires can be recycled.

17.15 Suggested Learning Resources

1. Workshop Practice Vol-I by Hazra & Choudhary, Media Promotors & Publishers Pvt. Ltd., Delhi, Latest Edition
2. Workshop Practice Manual by K Venkata Reddy, BS Publications, Hyderabad, Latest Edition
3. How to install led tube light.

17.16 Suggested Assessment Scheme

(to be filled by teacher)

The given performance indicators should serve as a guideline for assessment regarding process and product related marks.

Performance indicators		Weightage	Marks Awarded
Process related: 6 Marks - 60%			
1	Marking and measuring	5%	
2	Execute connection as per requirement	20%	
3	Handling of the tools / instruments	15%	
4	Checking the connection	10%	
5	Follow safe practices	5%	

6	Use of environment friendly practices	5%	
Product related: 4 Marks - 40%			
7	Getting results	10%	
8	Writing and interpretation of results	10%	
9	Answering Practical related questions	15%	
10	Submitting the journal in time	5%	
	Total	**100%**	

* Marks and percentage weightages for product and process assessment will be decided by the teacher.

Name of the Student: ..... Marks Awarded			**Signature of Teacher with date**
Process Related	Product Related	Total	

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