MECHANIC DIESEL

NSQF LEVEL - 4 Revised in 2017

1st Year (Volume I of II)

TRADE PRACTICAL

SECTOR: Automobile

Directorate General of Training

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

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

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FOREWORD

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

The National Instructional Media Institute (NIMI), Chennai has now come up with instructional material to suit the revised curriculum for **Mechanic Diesel - Trade Practical NSQF Level - 4 in Auto Mobile Sector under Semester Pattern.** The NSQF Level - 4 Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 4 trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 4 the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

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

Jai Hind

RAJESH AGGARWAL
Director General/ Addl. Secretary
Ministry of Skill Development & Entrepreneurship,
Government of India.

New Delhi - 110 001

PREFACE

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

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

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

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

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

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

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

R. P. DHINGRA
EXECUTIVE DIRECTOR

Chennai - 600 032

ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisations to bring out this Instructional Material **(Trade Practical)** for the trade of **Mechanic Diesel** under **Automobile** Sector for ITIs.

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NIMI records its appreciation for the Data Entry, CAD, DTP operators for their excellent and devoted services in the process of development of this Instructional Material.

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

NIMI is also grateful to everyone who has directly or indirectly helped in developing this Instructional Material.

INTRODUCTION

TRADE PRACTICAL

The trade practical manual is intented to be used in practical workshop . It consists of a series of practical exercises to be completed by the trainees during the First Semester Course of the Mechanic Diesel Trade supplemented and supported by instructions/ informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in compliance with NSQF LEVEL - 4 syllabus are covered.

This manual is divided into Seven modules. The distribution of time for the practical in the Seven modules are given below.

Module 1	Safety workshop practices	50 Hrs
Module 2	Measuring & marking Practice	100 Hrs
Module 3	Fastening & Fitting	125 Hrs
Module 4	Electrical and Electronics	100 Hrs
Module 5	Arc & Gas welding	75 Hrs
Module 6	Hydraulics and Pneumatics	50 Hrs
Module 7	Specifications and service equipments	25 Hrs
	Total	525 Hrs

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

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

TRADE THEORY

The manual of trade theory consists of theoretical information for the First Semester Course of the Mechanic Diesel Trade. The contents are sequenced according to the practical exercise contained in NSQF LEVEL - 4 syllabus on Trade practical. Attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This correlation is maintained to help the trainees to develop the perceptional capabilities for performing the skills.

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

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

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

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LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

- **Check & perform measuring & marking by using various measuring & marking tools. (Vernier callipers, micrometre, telescope gauges, dial bore gauges, dial indicators, straightedge, feeler gauge, thread pitch gauge, vaccum gauge, tire pressure gauge.)**
- **Plan & perform basic fastening & fitting operation by using correct hand tools, machine tools & equipment.**
- **Trace and test all electrical & electronic components & circuits and assemble circuit to ensure functionality of system.**
- **Join components by using Arc & Gas welding.**
- **Trace & test hydraulic and pneumatic components**
- **Check & interpret vehicle specification data and VIN, select & opearte various service station equipment.**

Identify the machines/equipment in diesel mechanic trade

Objective: At the end of this exercise you shall be able to
- **identify the air compressor, jib crane, bench drill.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipments/Machines

- Air compressor - 1 No.
- Jib crane - 1 No.
- Drilling machine - 1 No.

Materials

- Cotton waste - as reqd.
- Soap oil - as reqd.

PROCEDURE

1 Take the participants around the workshop.

2 Identify the major workshop machinery like compressor, drilling machines.

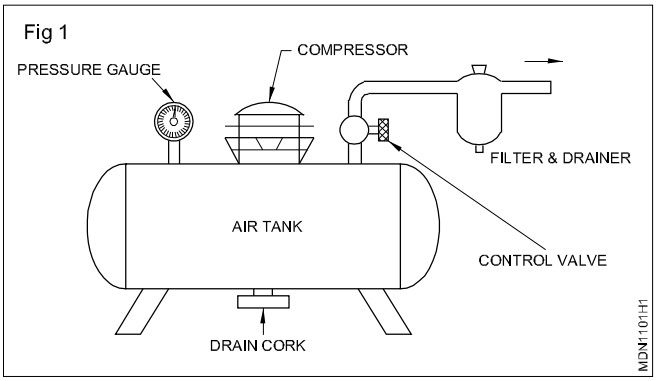
3 Explain the constructional features and the use of compressor, air receiver.

4 Explain the use of compressed air and its applications.

5 Explain bench drilling machine, pillar drilling machine.

6 Explain through display charts, the features of all equipments in an automobile workshop.

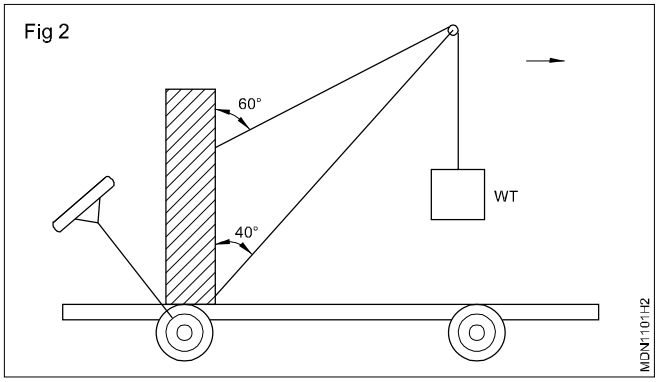
Air compressor (Fig 1)



Compressor is an equipment to produce compressed air at required pressure through air hoses.

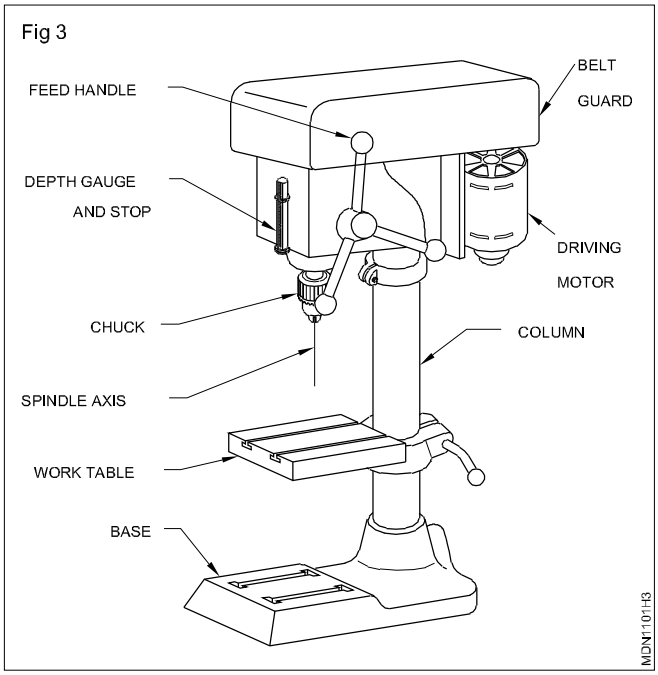
Jib crane (Fig 2)

Jib crane is used to transport the objects, from one place to another shop floor.



Sensitive bench drilling machine. (Fig 3)

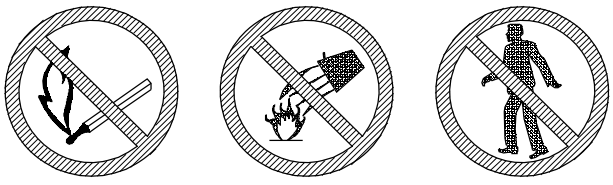
This machine is capable of drilling holes up to 12.5 mm diameter. The drills are fitted in the chuck or directly in the tapered hole of the machine spindle.



For normal drilling, the work-surface is kept horizontal. If the holes are to be drilled at an angle, the table can be tilted.

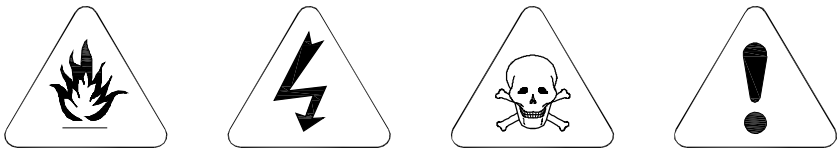
Identify Personal Protective Equipments (PPE)

Objective : At the end of this exercise you shall be able to
- **identify the four basic catagories of safety sign**
- **identify the meanings of the safety sign**
- **read and interpret the different types of personal protective equipments from the chart.**

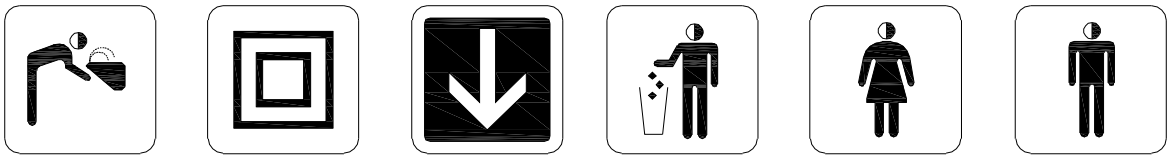


SMOKING AND NAKED FLAMES PROHIBITED | DO NOT EXTINGUISH WITH WATER | PEDESTRIANS PROHIBITED

WEAR HEAD PROTECTION | WEAR EYE PROTECTION | WEAR HEARING PROTECTION



RISK OF FIRE | RISK OF ELECTRIC SHOCK | TOXIC HAZARD | GENERAL WARNING RISK OF DANGER



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NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE	IDENTIFY THE CATEGORIES OF THE SAFETY SIGN	DEVIATIONS	TIME
		CODE NO. MDN1102E1	

TASK 1 : **Safety sign**

Instructor may provide various safety signs chart categories and explain their categories and their meaning, description. Ask the trainee to identify the sign and record in table

- Identify the safety sign from the chart.
- Record the name of the category in table1.
- Mention the meaning description of the safety sign in table1.

Table 1

Fig No.	Basic categories/ safety sign	Meaning - descriptions
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Get it checked by your instructor

TASK 2 : **Personal protective equipments**

Fig 1

Note: The instructor may provide or arrange the different types of personal protection equipment or chart and explain how to identify and select the PPE devices suitable for the work and ask the trainees to write names in the given table.

1 Read and interpret the personal protective equipments by visually on real devices or from the charts.

2 Identify and select the personal protection equipment used for suitable type of protection.

3 Write the name of the PPE to the corresponding type of protective safety equipments in Table 2.

Table 2

S.No.	Name of the PPE	Hazards	Type of protection
1			
2			
3			
4			
5			
6			
7			
8			
9			

Get it checked by your instructor.

— — — — — — —

TASK 3 :

Instructor may brief the various types of occupational hazards and their causes.

1 Identify the occupational hazard to the corresponding situation with a potential harm given in table3.

Table 3

S.No.	Source or potential harm	Type of occupational hazards
1	Noise	
2	Explosive	
3	Virus	
4	Sickness	
5	Smoking	
6	Non control device	
7	No earthing	
8	Poor house keeping	

Fill up and get it checked by your instructor.

— — — — — — —

TASK 4 : **PPE Instruction and uses**

1 Some cleaning agents are toxic. Refer to the information about handling; use and storage of chemicals that may be hazardous, follow any recommendations made by the supplier before using it.

2 Do not use flammable cleaners or water on electrical equipment.

3 Make sure designated walkways are kept clear of any obstructions.

4 Always wear protective clothing and the appropriate safety equipment.

5 Make sure that you understand and observe all legislative and personal safety procedures when carrying out the following tasks. If you are unsure of what these procedures are, ask your instructor.

— — — — — — —

Workshop maintenance

Objectives : At the end of this exercise you shall be able to
- **carryout the maintenance of equipment**
- **clean the tools and equipment.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Materials

- Cleaning solvent - as reqd.
- Washing powder - as reqd.
- Cotton waste - as reqd.
- Brush - as reqd.

PROCEDURE

TASK 1 : **Maintenance of tools and equipment**

1 Clean tools and equipment and work more efficiently. At the end of each working day clean the tools and equipment used and check them for any damage. If you note any damage, tag the tool as faulty.

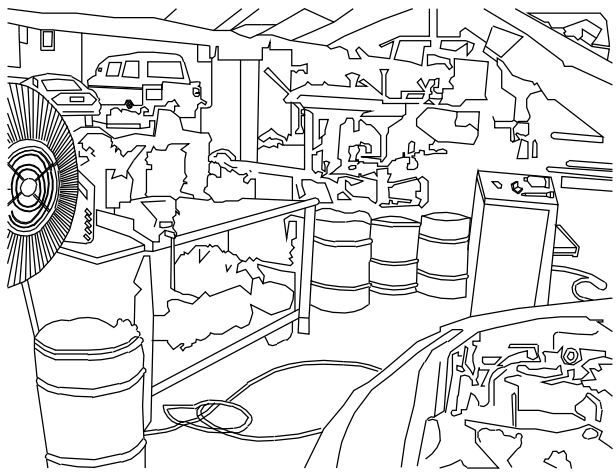
2 Electrical current can travel over oily or greasy surfaces. Keep electrical power tools free from dust and dirt and make sure they are free of oil and grease.

3 All workshop equipment should have a maintenance schedule. Always complete the tasks described on the schedule at the required time. This will help to keep the equipment in safe working order.

4 Store commonly used tools in an easy-to-reach location.

5 If a tool, or piece of equipment, is too difficult to be returned, it could be left on a workbench or on the floor where it will become a safety hazard. (Fig 1)

Fig 1

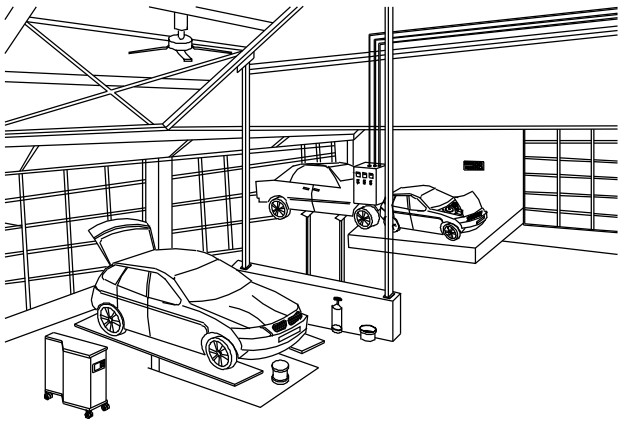


UNORGANIZED WORKSHOP

MDN1103H1

6 Keep your work area cleanly. This will help you work more efficiently and safely. (Fig 2)

Fig 2



ORGANIZED WORKSHOP

MDN1103H2

7 Have a waste bin close to your work area and place any waste in it as soon as possible.

8 Dispose of liquid and solid waste, such as oils, coolant and worn components, in the correct manner.

9 Do not pour solvents or other chemicals into the sewage system. This is both environmentally damaging and illegal.

9 Always use chemical gloves when using any cleaning material because excessive exposure to cleaning materials can damage skin.

10 Some solvents are flammable. Never use cleaning materials near an open flame or cigarette.

11 The fumes from cleaning chemicals can be toxic, so wear appropriate respirator and eye protection whereveryou are using these products.

TASK 2 : **Cleaning hand tools, jack, power tool and machinery**

1 Clean hand tools.

Keep your hand tools in, clean condition with two sets of cabinet. One cabinet should be lint-free to handle precision instruments or components.

The other should be oily to prevent rust and corrosion.

2 Clean floor jacks.

Wipe off any oil or grease on the floor jack and check for fluid leaks. If you find any leaks, rectify the leaks and top up the hydraulic fluid.

Occasionally, apply a few drops of lubricating oil to the wheels and a few drops to the posts of the safety stands.

3 Clean electrical power tools.

Keep power tools clean by brushing off any dust and wiping off excess oil or grease with a clean rag.

Inspect any electrical cables for dirt, oil or grease, and for any chafing or exposed wires.

With drills, inspect the chuck and lubricate it occasionally with machine oil.

4 Clean air powered tools.

Apply a few drops of oil into the inlet of your air tools every day. Although these tools have no motor, they need to do regular lubrication of the internal parts to prevent wear.

5 Clean hoists and heavy machinery.

Locate and checklist or maintenance record for each hoist or other major piece of equipment before carrying out cleaning activities.

Clean operating mechanisms and attachments of excess oil or grease.

— — — — — — —

Handling and testing of workshop equipments and disposal of used engine oil

Objectives: At the end of this exercise you shall be able to
- **demonstrate safe handling of lifting equipments**
- **do the periodic testing of lifting equipments**
- **safety measures in disposal of used engine oil.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipments

- Air compressor - 1 No.
- Vehicle - 1 No.

Materials

- Oil - as reqd.
- Water - as reqd.
- Kerosene - as reqd.
- Cotton waste - as reqd.

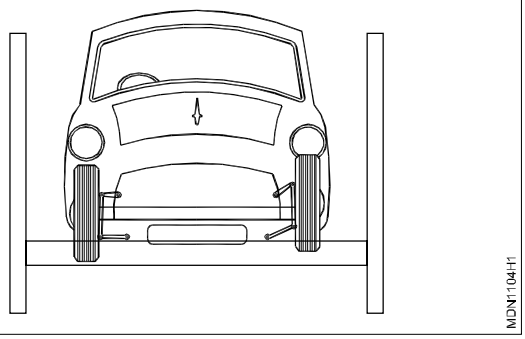
PROCEDURE

TASK 1 :

Check the test certificate.

The lifting equipment is subjected to statutory Testing and Certification. (Fig 1) the test calibration certificate should be attached to, or displayed near the lifting equipment that it refers to. Before using this equipment, make sure that the most recent inspection record is still within the prescribed time limit, and ensure that the certificate has not expired.

Fig 1



M/s. ABCD.

Vehicle Hoist Service.

044-12345678.

Chennai - 78.

SERVICE.

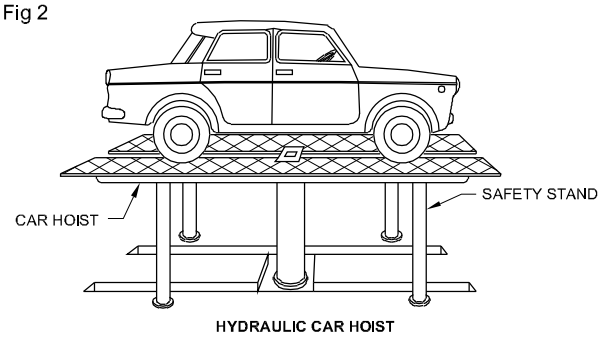
Date Serviced: 20/05/2018

Next Service : 19/05/2019

Check the equipment

1 Carry out regular periodic checks on the service ability of all of the hydraulic lifting equipment. (Fig 2)

Fig 2



HYDRAULIC CAR HOIST

2 Refer to the manufacturer's handbook to find out how often they recommend maintenance tests and make sure that these occur.

3 Check whether the test equipment for its proper functioning.

4 Ensure that there are no leakage in the hose, control valves and oil pump

5 Before operating the lift, ensure that the car is correctly placed in the platform.

6 Check whether it is lifting properly.

7 And also check whether it is holds the oil or not.

Note : Vehicle hoist is not included in the equipments list. This practical can be give at any service station.

8 After the commpletion of the work, lower the ram to its normal position.

TASK 2 :

1 Wear protective clothing, such as gloves, mask, shoes, apron etc.,

2 Do not spill any oil or grease on the ground.

3 Put your used motor oil in a clean plastic container with a tight lid. Never store used oil in a container that once held chemicals, food, or beverages.

4 Do not mix the oil with anything else, such as antifreeze, solvent, or paint.

5 Take used motor oil to a service station or other location that collects used motor oil for recycling.

Recycled used motor oil can be re-refined into new oil, processed into fuel oils and used as raw materials for the petroleum industry.

6 While storing used oil, meant for disposal keep them in a separate place with proper identification mark in the container. (Fig 1)

Never keep the used oil near the hot area or near flame.

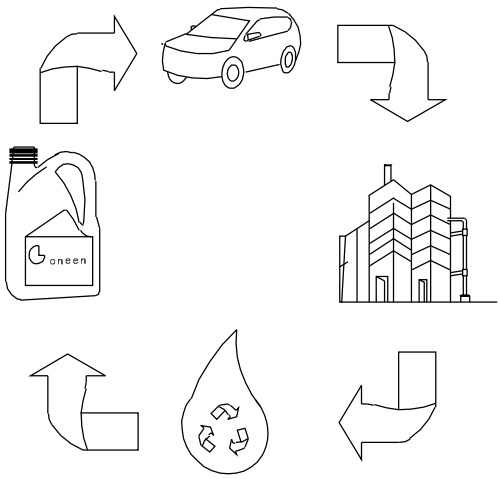
While transporting ensure that there is no spillage of oil. (Fig 2)

7 Maintain a record of oil disposed for reference and record as shown in Table below.

Fig 1

MDN1104J1

Fig 2



MDN1104J2

Table

Sl. No	Date	Qty per can (litre)	No of cans delivered	Total qty. disposed in litres	Remarks
1	Example 23 - 7 -18	2	05	100	
2	-	-	-	-	
3					
4					
5					

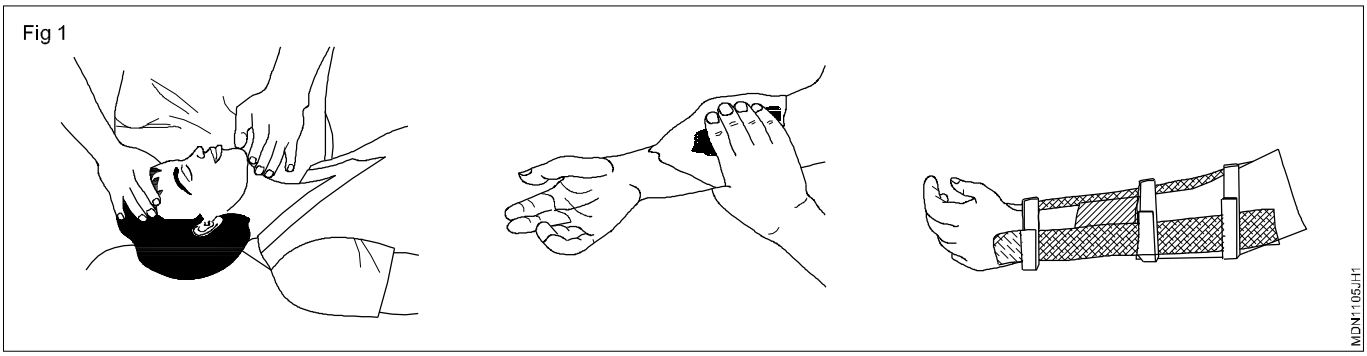
Demonstrate occupational safety and first aid

Objectives: At the end of this exercise you shall be able to
- **rescue breathing for an unconscious victim of different condition**
- **perform treatment for stopping of bleeding.**

PROCEDURE

TASK 1: **Prepare the victim to receive artifical respiration**

Fig 1



Assumption - For easy manageability, Instructor may arrange the trainees in group and ask each group to perform one method of resuscitation.

1 Loosen the tight clothing which may interfere with the victim's breathing.

2 Remove any foreign materials or false teeth from his mouth and keep the victim's mouth open.

3 Bring the victim safely to the level ground, taking necessary safety measures. (Fig 1)

4 Start artificial respiration immediately without delay. Do not waste too much time in loosening the clothes or trying to open the tightly closed mouth.

5 Avoid violent operations to prevent injury to the internal parts of the victim.

6 Send to a doctor immediately.

TASK 2 : **Resuscitate the victim by Nelson's arm - Lift back pressure method**

Nelson's arm - lift back pressure method must not be used in case there are injuries to the chest and belly.

1. Place the victim prone (that is face down) with his arms folded with the palms one over the other and the head resting on his cheek over the palms. Kneel on one or both knees near the victim's hand. Place your hands on the victim's back beyond the line of the armpits, with your fingers spread outwards and downwards, thumbs just touching each other as in(Fin 1).

2 Gently rock forward keeping your arms straight until they are nearly vertical, and steadily pressing the victim,s back as shown in (Fig 2) to force the air out of the victim's lungs.

3 Synchronise the above movement of rocking backwards with your hands sliding downwards along the victim's arms, and grasp his upper arm just above the elbows as shown in (Fig 3). Continue to rock backwards.

Fig 1

4 As you rock back, gently raise and pull the victim's arms towards you as shown in (Fig 4) until you feel tension in his shoulders. To complete the cycle, lower the victim's arms and move your hands up to the initial position.

Fig 2

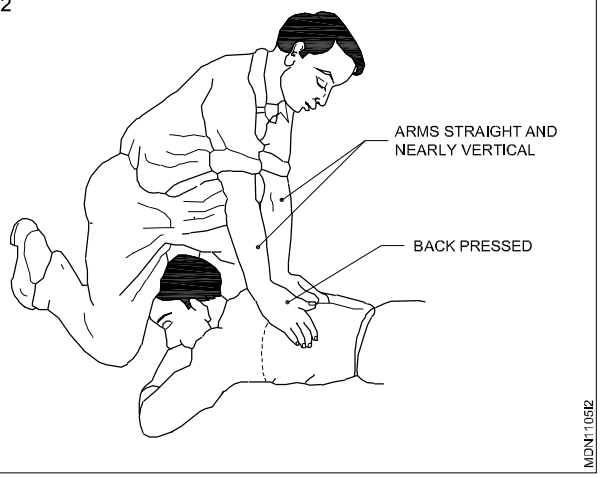


Fig 3

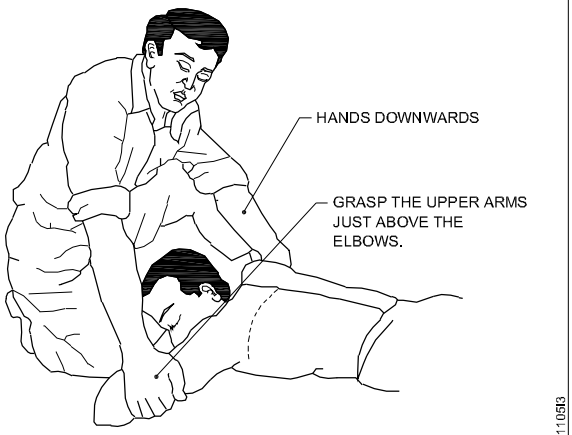
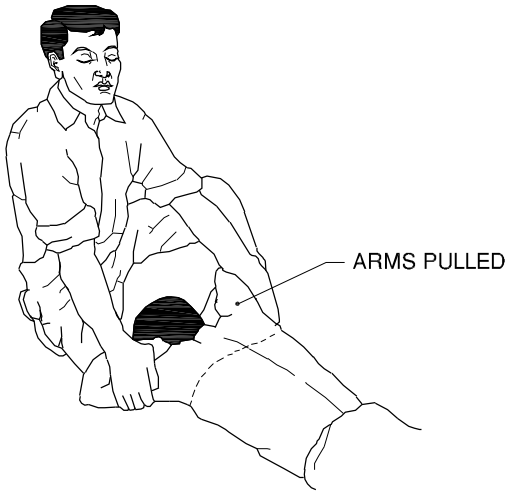


Fig 4



5 Continue artificial respiration till the victim begins to breathing naturally. Please note, in some cases, it may take hours.

6 When the victim revives, keep the victim warm with a blanket, wrapped up with hot water bottles or warm bricks; stimulate circulation by stroking the insides of the arms and legs towards the heart.

7 Keep him in the lying down position and do not let him exert himself.

Do not give him any stimulant until he is fully conscious.

— — — — — — —

TASK 3: **Do not use this method in case of injuries to victim on the chest and belly.**

1 Lay the victim on his belly, one arm extended direct forward, the other arm bent at the elbow and with the face turned sideward and resting on the hand or forearm as shown in (Fig 1).

2 Kneel astride the victim, so that his thighs are between your knees and with your fingers and thumbs positioned as in (Fig 1).

3 With the arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the lower ribs of the victim to force the air out of the victim's lungs as shown in (Fig 2).

4 Now swing backward immediately removing all the pressure from the victim's body as shown in (Fig 3) thereby, allowing the lungs to fill with air.

5 After two seconds, swing forward again and repeat the cycle twelve to fifteen times a minute.

Fig 1

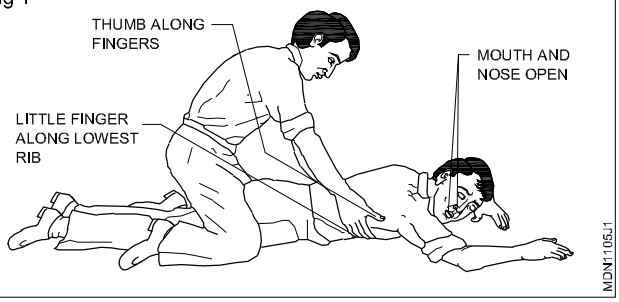
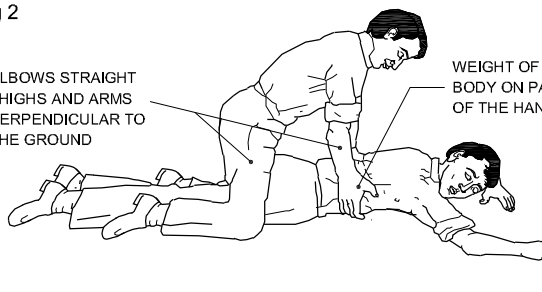
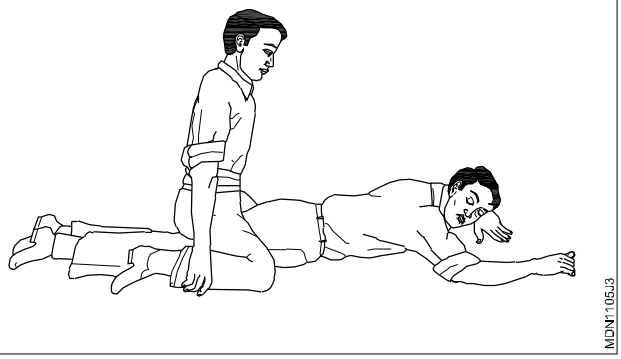


Fig 2



6 Continue artificial respiration till the victim begins to breathe naturally.

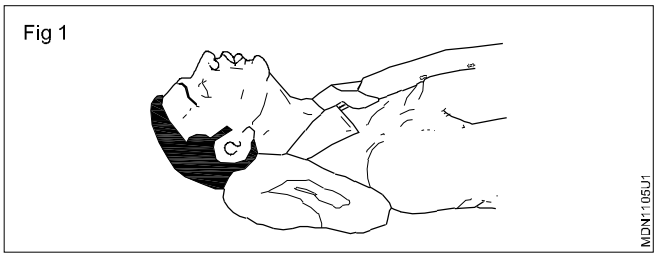
Fig 3



TASK 4 : **Resuscitate the victim by mouth-to-mouth method**

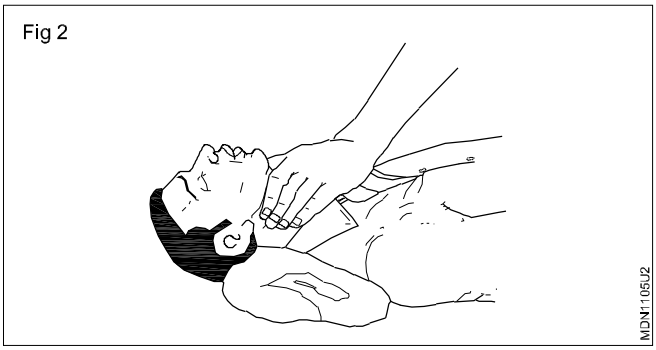
1 Lay the victim flat on his back and place a roll of clothing under his shoulders to ensure that his head is thrown well back. (Fig 1)

Fig 1



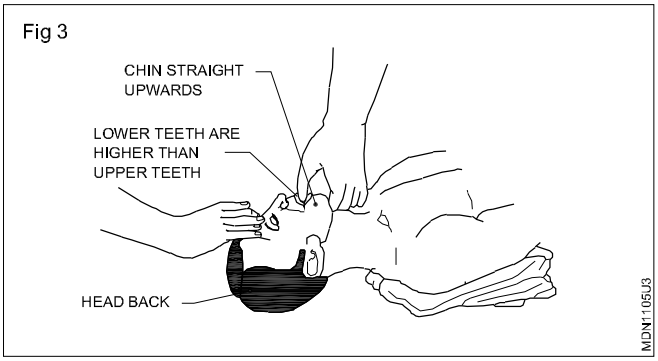
2 Tilt the victim's head back so that the chin points straight upward. (Fig 2)

Fig 2



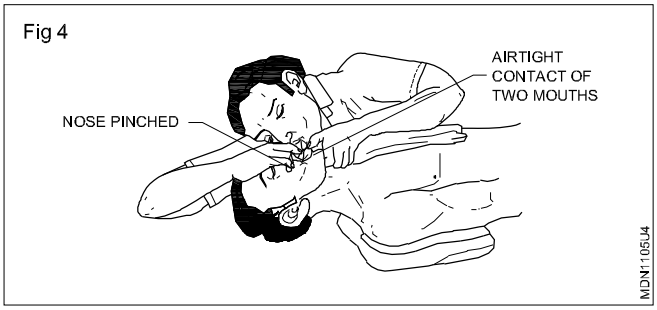
3 Grasp the victim's jaw as shown in (Fig 3), and raise it upward until the lower teeth are higher than the upper teeth; or place fingers on both sides of the jaw near the ear lobes and pull upward. Maintain the jaw position throughout the artificial respiration to prevent the tongue from blocking the air passage.

Fig 3



4 Take a deep breath and place your mouth over the victim's mouth as shown in (Fig 4) making airtight contact. Pinch the victim's nose shut with the thumb and forefinger. If you dislike direct contact, place a porous cloth between your mouth and the victim's. For an infant, place your mouth over his mouth and nose. (Fig 4)

Fig 4



5 Blow into the victim's mouth (gently in the case of an infant) until his chest rises. Remove your mouth and release the hold on the nose, to let him exhale, turning your head to hear the rushing out of air. The first 8 to 10 breathings should be as rapid as the victim responds, thereafter the rate should be slowed to about 12 times a minute (20 times for an infant).

If air cannot be blown in, check the position of the victim's head and jaw and recheck the mouth for obstructions, then try again more forcefully. If the chest still does not rise, turn the victim's face down and strike his back sharply to dislodge obstructions.

Sometimes air enters the victim's stomach as evidenced by a swelling stomach. Expel the air by gently pressing the stomach during the exhalation period.

TASK 5 : **Resuscitate the victim by Mouth-to-Nose method**

Use this method when the victim's mouth will not open, or has a blockage you cannot clear.

1 Use the fingers of one hand to keep the victim's lips firmly shut, seal your lips around the victim's nostrils and breathe into him. Check to see if the victim's chest is rising and falling. (Fig 1)

2 Repeat this exercise at the rate of 10 - 15 times per minute till the victim responds.

3 Continue this exercise till the arrival of the doctor.

Fig 1

MDN1105X1

— — — — — — —

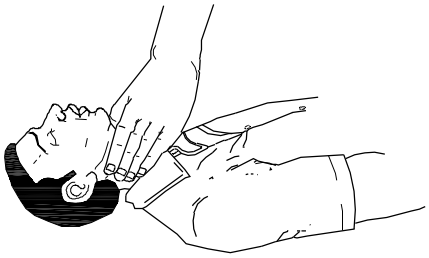
TASK 6 : **Resuscitate a victim who is under cardiac arrest (CPR) cardio pulmanory.**

In cases where the heart has stopped beating, you must act immediately.

1 Check quickly whether the victim is under cardiac arrest.

Cardiac arrest could be ascertained by the absence of the cardiac pulse in the neck (Fig 1) blue colour around lips and widely dilated pupil of the eyes.

Fig 1

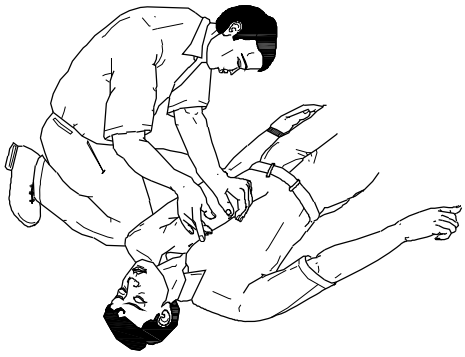


MDN1105Y1

2 Lay the victim on his back on a firm surface.

3 Kneel alongside facing the chest and locate the lower part of the breastbone. (Fig 2)

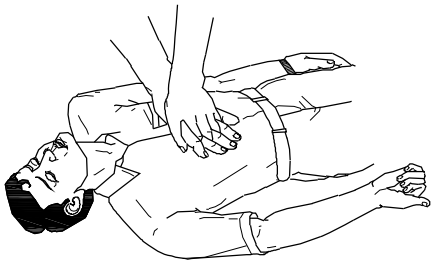
Fig 2



MDN1105Y2

4 Place the palm of one hand on the centre of the lower part of the breastbone, keeping your fingers off the ribs. Cover the palm with your other hand and lock your fingers together as shown in (Fig 3).

Fig 3



MDN1105Y3

5 Keeping your arms straight, press sharply down on the lower part of the breast bone; then release the pressure. (Fig 4)

Fig 4

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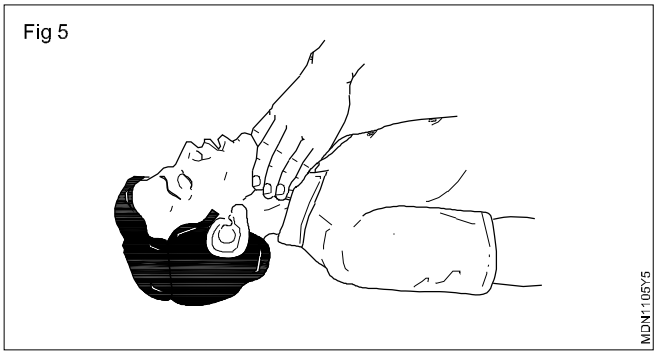
6 Repeat step 5, fifteen times at the rate of atleast once per second.

7 Check the cardiac pulse. (Fig 5)

Fig 5



8 Move back to the victim's mouth to give two breaths (mouth-to-mouth resuscitation). (Fig 6)

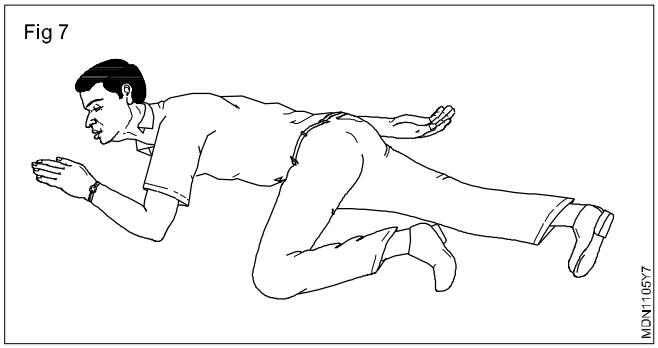
Fig 6

9 Continue with another 15 compressions of the heart followed by a further two breaths of mouth-to-mouth resuscitation, and so on, check the pulse at frequent intervals.

10 As soon as the heart beat returns, stop the compressions immediately but continue with mouth-to-much resuscitation until natural breathing is fully restored.

11 Place the victim in the recovery position as shown in (Fig 7). Keep him warm and get medical help quickly.

Fig 7



Other steps

1 Send for a doctor immediately.

2 Keep the victim warm with a blanket, wrapped up with hot water bottles or warm bricks; stimulate circulation by stroking the insides of the arms and legs towards the heart.

TASK 7 : **Treatment for bleeding victim**

1 Determine the location of the bleeding.

2 Elevate the injured area above the heart if possible.

3 Apply direct pressure to the bleeding area with sterile cloth.

4 Keep the pressure on for 5 seconds.

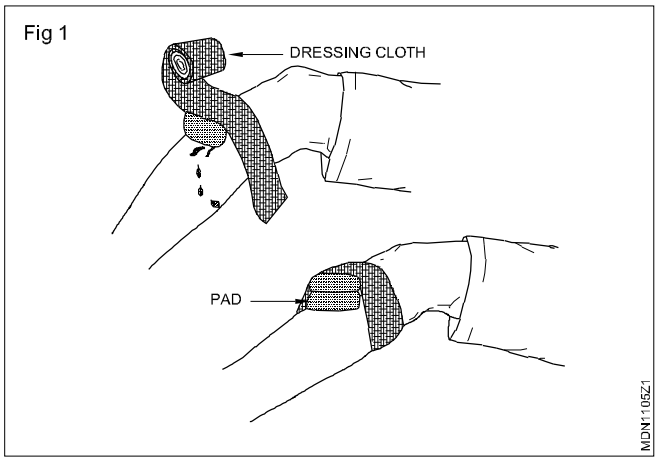
5 Check to see if the bleeding has stopped if not apply further pressure for 15 minutes.

6 Clean the wound.

7 Bandage the wound with pad of soft material. (Fig 1)

8 Advice victim to take treatment from doctor.

Fig 1



Practice on fire safety

Objectives: At the end of this exercise you shall be able to;
- **as a leader of the group**
- **as a member of the fire-fighting team.**

Requirements

Equipments

- Fire extinguishers (different type) - 1 No each.

PROCEDURE

General procedure to be adopted in the event of fire.

1 Raise an alarm. Follow the method written below for giving an alarm signals when fire breakes out.
   - by raising your voice and shouting Fire! Fire! to call theattention of others.
   - running towards fire alarm/bell to actuate it.
   - other means.

2 On receipt of the alarm signal.
   - stop working.
   - turn off all machinery and power.
   - switch off fans/air circulators/exhaust fans. (Better switch off the main)

3 If you are not involved in fighting the fire.
   - leave calmly using the emergency exit.
   - evacuate the premises.
   - assemble at a safe place along with the others.
   - check if anyone has gone to inform about the fire break to the concerned authority.
   - close the doors and windows, but do not lock or bolt.

4 If you are involved in fire fighting.
   - take instructions/give instructions for an organised way of fighting the fire.

   If taking instructions.
   - follow the instructions, and obey, if you can do so safetly; do not risk getting trapped.

   If giving instructions.
- assess the class of fire
- send for sufficient assistance and inform the fire brigade
- locate locally available suitable means to put out the fire
- judge the magnitude of the fire, ensure emergency exit paths are clear of obstructions and then attempt to evacuate. (Remove explosive materials, substances that can serve as a ready fuel for fire within the vicinity of the fire break)
- fight out the fire with assistance to put it out, by naming the person responsible for each activity.

5 Report the fire accident and the measures taken to put out the fire, to the authorities concerned.

Reporting all fires however small helps in the investingation of the cause of the fire. It helps to prevent the same kind of accident occuring again.

Note : Perform this exercise with the support of fire service station.

Practice on fire extinguishers

Objectives: At the end of this exercise you shall be able to
- **select the fire extinguisher according to the type of fire**
- **operate the fire extinguisher**
- **extinguish the fire.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipments

- Cut - Models of fire extinguisher - as reqd.
- Fire extinguisher (different type) - as reqd.

Materials

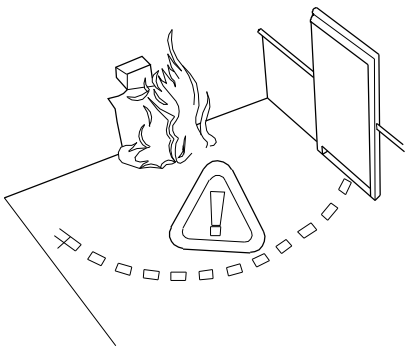
- Old tyre - as reqd.
- Wood, Paper, Cloth & Grease - as reqd.
- Gas and Liquified gas - as reqd.
- Metal and Electrical equipment - as reqd.

PROCEDURE

1 Alert people surrounding by shouting fire, fire, fire when you observe fire. (Fig 1a)

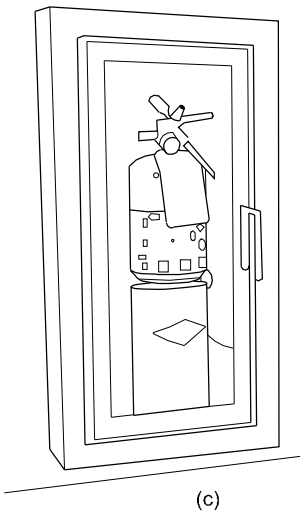
2 Inform Fire Service or arrange to inform immediately. (Fig 1b)

Fig 1

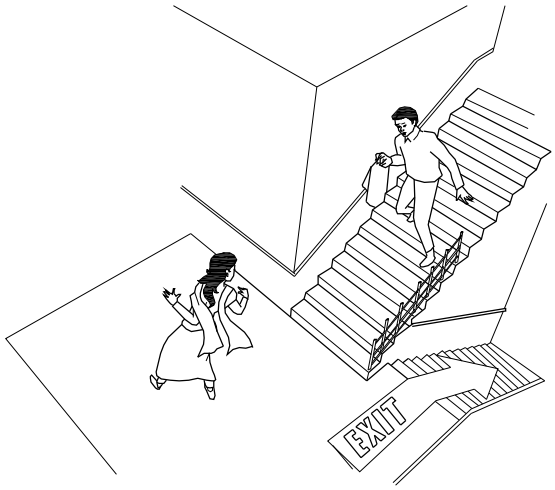


(a)

(b)



(c)



(d)

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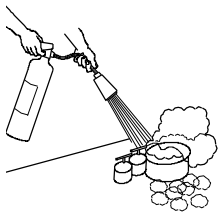
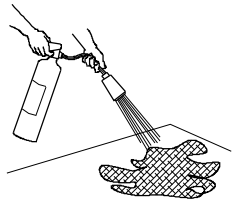
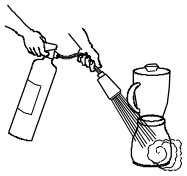
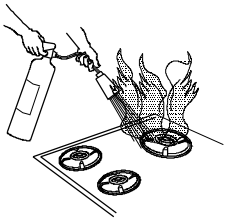
3 Open emergency exit and ask them to go away. (Fig 1c & 1d)

4 Put "Off" electrical power supply.

Do not allow people to go nearer to the fire

5 Analyze and identify the type of fire. Refer Table1.

Table1

Class 'A'	Wood, paper, cloth, solid material	
Class 'B'	Oil based fire (grease, gasoline, oil) & liquefiable solids	
Class 'C'	Gas and liquefied gases	
Class 'D'	Metals and electrical equipment	

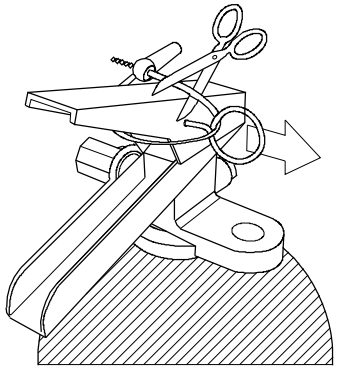
Assume the fire is 'B' type (flammable liquefiable solids)

6 Select CO_2 (carbon dioxide) fire extinguisher

7 Locate and pick up CO_2 fire extinguisher. Check for its expiry date.

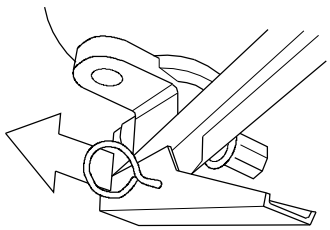
8 Break the seal. (Fig 2)

Fig 2



9 Pull the safety pin from the handle. (pin located at the top of the fire extinguisher) (Fig 3)

Fig 3



10 Aim the extinguisher nozzle or hose at the base of the fire. (this will remove the source of fuel fire) (Fig 4)

Keep your self low.

11 Squeeze the handle lever slowly to discharge the agent (Fig 5)

12 Sweep side to side approximately 15 cm over the fuel fire until the fire is put off.

Fire extinguishers are manufactured for use from the distance.

Fig 4

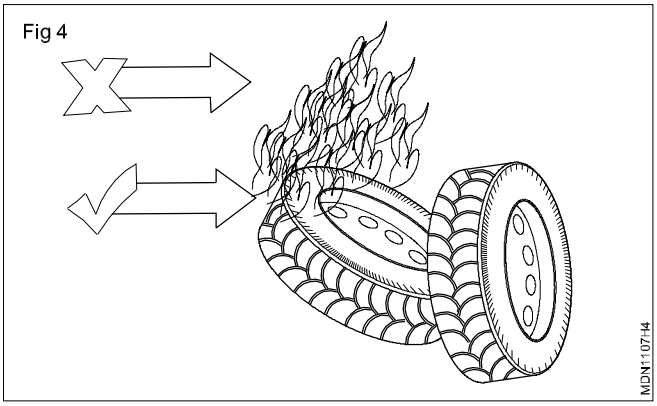
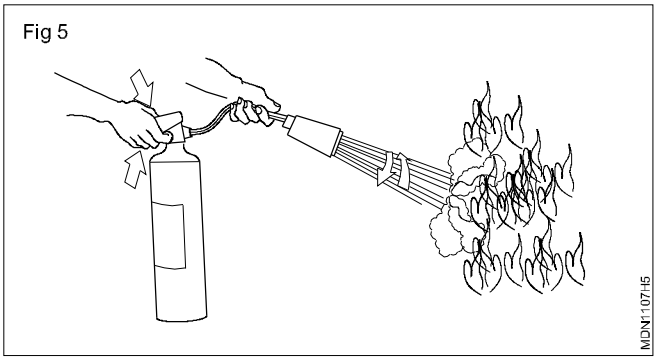


Fig 5



Caution

1 While putting off fire, the fire may flare up.

2 Do not be panic so long as it put off promptly

3 If the fire doesn't respond well after you have used up the fire extinguisher move away your self away from the fire point.

4 Do not attempt to put out a fire where it is emitting toxic smoke, leave it to the professionals.

5 Remember that your life is more important than properly. So don't place yourself or others at risk.

In order to remember the simple operation of fire extinguisher.

Remember.

P.A.S.S. This will help to use fire extinguisher.

P for pull.

A for aim.

S for squeeze.

S for sweep.

Practice on saving electrical energy

Objectives: At the end of this exercise you shall be able to
- **prepare the table and list the device used in ITI building**
- **calculate the amount of energy that is required in the ITI premises on day to day basis**
- **perform different way of energy conservation.**

PROCEDURE

TASK 1 : **Determine the energy conservaton**

1 Survey the ITI building premises for lights, fans and other appliances.

2 Use the table- 1 below for listing the devices with their actual energy ratings (wattage) and hours of use.

Table 1

Applications	Approimate Load (watts)	No of equipment	Total load (watts)	Average hours / day	No. of days in a month	Approximate units / months
	A	B	C = A x B	D	E	Unit=CxDxE/1000
CFL Lamp	5					
	8					
	11					
	15					
	20					
Regular lamp	25					
	40					
	60					
	100					
Tube lights	36					
	40					
Table fan /	60					
Ceiling fan	100					
Exhaust fan	150					
Air conditione	1000					
	1500					
Refrigerator (165 liters)	150					
Refrigerator (210 liters)	270					
Computer						
Other	200					

3 Record and compare the current year consumption with last year consumption and determine the saved energy in Table 2.

Table 2

Month	Last year (A)		Current Year (B)		Units saved / Excess (B-A)
	No. of Units	Bill Amount (Rs.)	No. of Units	Bill Amount (Rs.)	Amount Saved / Excess (Rs) (B-A)
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					

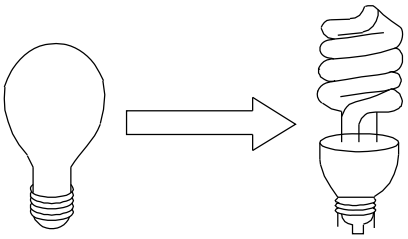
— — — — — — —

TASK 2 : **Perform different way of energy conservation**

1 Make sure you are not still using tungsten light bulbs. Replace them with CFL bulbs. CFLs reduce energy consumption by about 75% completed with tungsten bulbs, and they last longer.

2 Upgrade older fluorescent light fittings with modern high frequency fluorescent fittings. (Fig 1)

Fig 1



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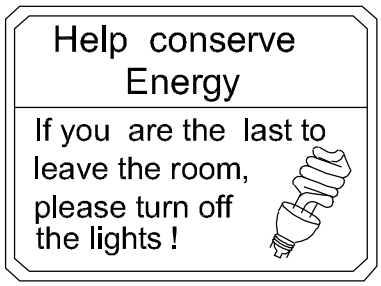
3 Post a friendly reminder in each room to prompt students and teachers to turn off lights when not in use. (Fig 2)

Fig 2



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4 Lighting in class rooms can use a lot of electricity, which costs money. Classrooms can often be lit with daylight instead. (Fig 3)

5 It is best to open the blinds when possible, and switch off the lights whenever there is enough daylight.

6 At the end of every day, turn off computers and screens.

7 Turn off the screens between classes, at break time, and at lunch time.

8 Use the Power-Saving options in your computer operating systems. (Fig 4)

Fig 3

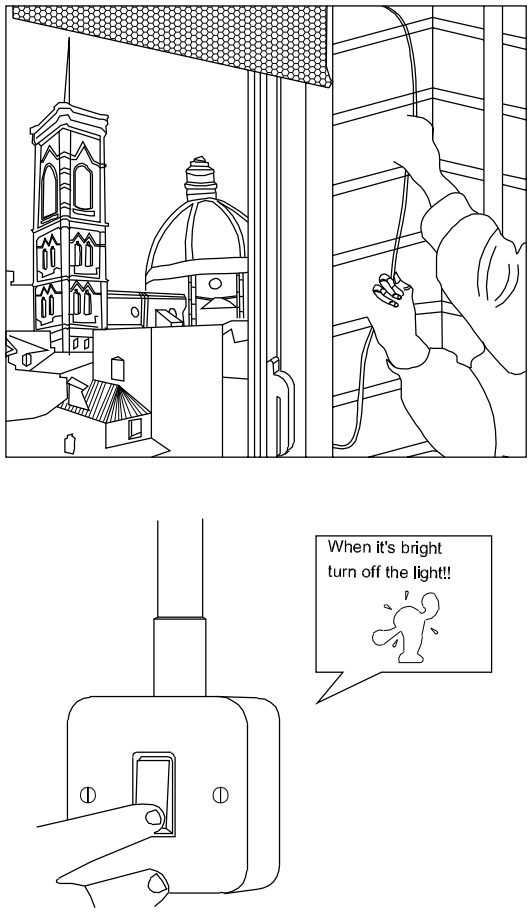


Fig 4

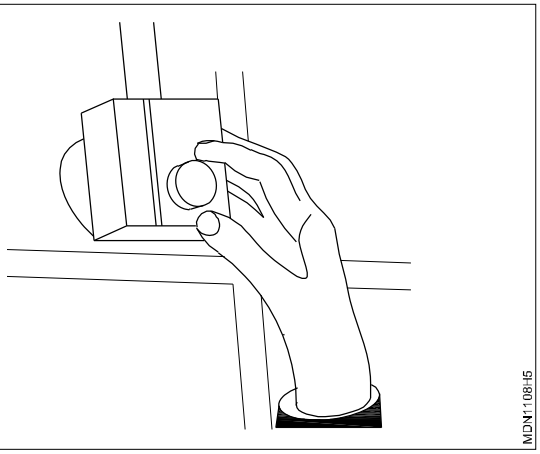
9 If your classroom is too hot and the heating is on, don't open the window to get rid of the heat. Turn the thermostat down instead.

10 Give some thought to what can be switched off before holidays, mid-term breaks and weekends, especially long weekends.

11 Printers, copiers, overhead projectors, computers, electrical water heaters, water boilers, and lots of other things can be switched off. (Fig 5)

12 Read your electricity, gas, oil and water meters often; at least monthly.

Fig 5



13 Start by reading the meters at the beginning and end of each day for the first week, and weekly from then on

14 Make a project to keep records of the meter readings and draw graphs of consumption per month, and compare each month with the same month last year. Compare the total for the year too.

15 By measuring and monitoring your energy and water use, you are more likely to be able to reduce costs.

16 use eco-friendly materials and place recycling bins in all rooms.

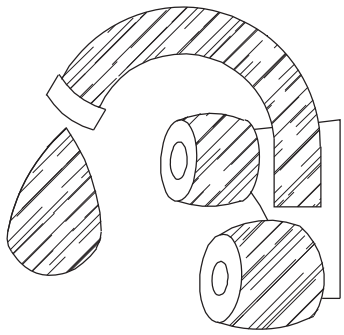
17 Water costs money, so savings it is a good idea.

18 Install water displacement devices in WC cisterns.

19 Turn off urinals during the holidays, or install automaticsystems to turn off the urinals.

20 Repair leaking taps. (Fig 6)

Fig 6



21 Start a ITI sustainability club and promote energy efficiency within the building and community.

22 They are either no-cost or low-cost measures. By implementing the above Top-Ten Energy Saving Tips, your ITI management can save money.

Marking practice on the given job

Objectives: At the end of this exercise you shall be able to
- **draw lines on metallic surfaces by scribers**
- **draw parallel lines on metallic surfaces by jenny calipers**
- **draw parallel lines with a surface gauge supporting the job against the angle plate**
- **draw angles with a simple protractor and scriber**
- **bisect the angles with a divider**
- **draw circles with a divider**
- **draw curves and tangents with dividers steel rule and scribers**
- **register the profile by dot punching**
- **punch the centre of the circle with a centre punch and ball-peen hammer.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipments

- Scriber, Divider, 'V' groove - 1 No. each
- Bevel Protactor - 1 No.
- Centre punch & Angle plate - 1 No. each
- Surface gauge & Depth gauge - 1 No. each
- Outside, Inside & Jenny caliper - 1 No. each
- Surface plate - 1 No

Materials

- Chalk powder - as reqd.
- MS Plate - as reqd.

PROCEDURE

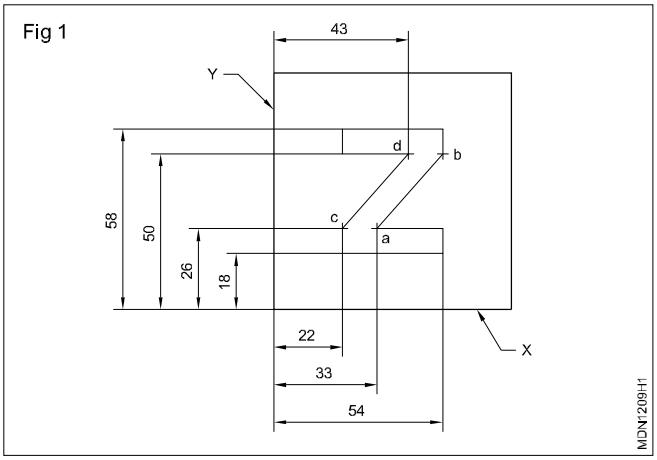
Marking 1

1 Check the raw material for its size and its squareness.

2 Apply copper sulphate solution on one side of the job and allow it to dry.

3 Scribe parallel lines to the edges 'x' and 'y' using a surface gauge. (Fig 1)

Fig 1

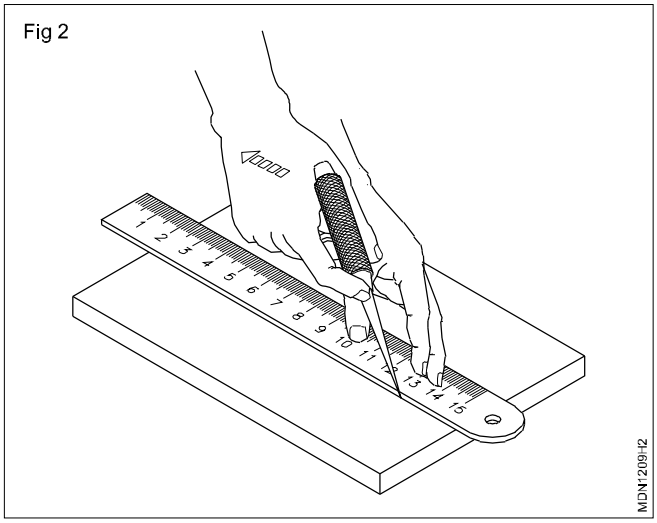


To avoid confusion, do not scribe the line longer than necessary.

4 Scribe two lines by joining points ab and cd, using a steel rule and scriber. (Fig 2)

5 Punch witness marks and complete 'Z' shape

Fig 2

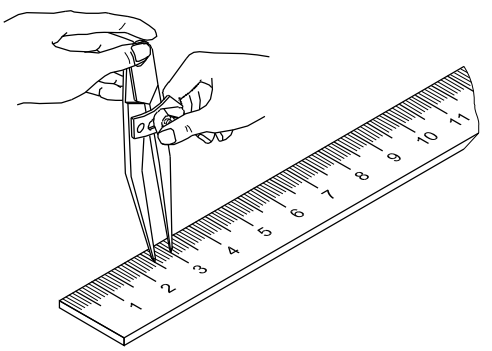


Marking 2

6 Apply the marking medium on the other side of the job and allow it to dry.

7 Mark the centre lines of three circles and one semicircle using the jenny caliper.

Fig 3



MDN1209H3

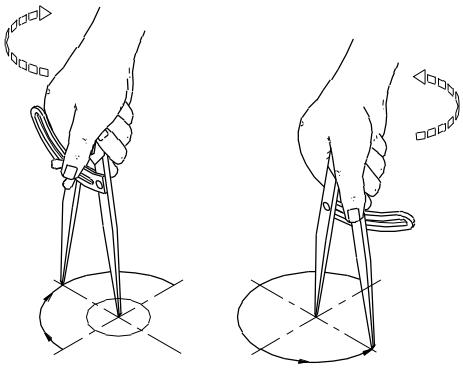
8 Punch all the four centres using a 30° prick punch. (Fig 5)

9 Open and set the divider to 5 mm. (Fig 3)

Make sure that both the legs of the divider are of equal length.

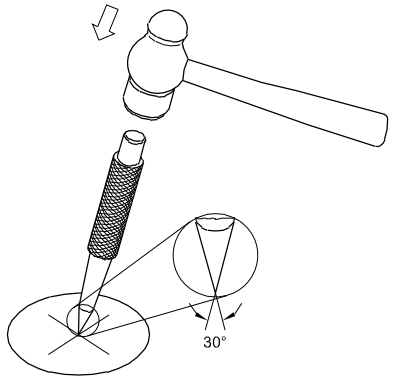
10 Draw two circles of ø10 using the divider. (Fig 4)

Fig 4



MDN1209H4

Fig 5



MDN1209H5

11 Set the divider and draw ø12 circle and R35 semicircle.

12 Punch witness marks on the circles and semicircles.

Reuse the same material for marking 3 and 4

Marking 3

13 File and finish one of the marked surfaces flat and deburr.

14 Apply copper sulphate solution on the finished side.

15 Butt the job against the angle plate.

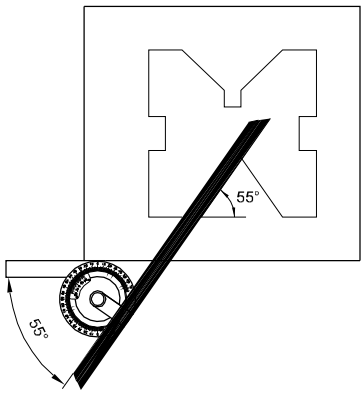
16 Mark all the parallel lines to the edges using the surface gauge.

17 Also mark the starting points of the Vee groove.

18 Set and lock the bevel protractor at 55°.

19 Butt the bevel protractor on to the edge of the job and mark one side of the Vee groove. (Fig 6)

Fig 6



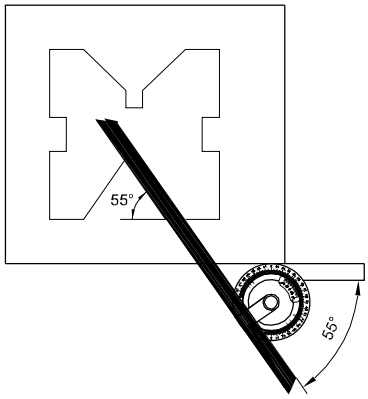
MDN1209H6

20 Continue the same procedure and complete the 44° Vee groove.

21 Complete the Vee block marking.

22 Bisect any two sides of the triangle formed by the 55° Vee groove, and get the centre and radius of the circle. (Fig 7)

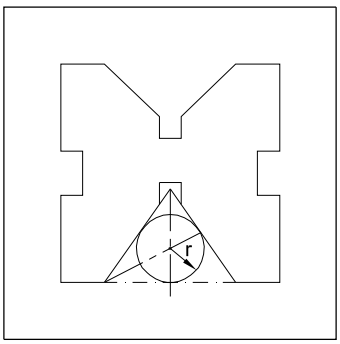
Fig 7



MDN1209H7

23 Draw the circle on the 55° Vee groove. (Fig 8)

Fig 8



MDN1209H8

24 Similarly draw the circle on the 44° Vee groove.

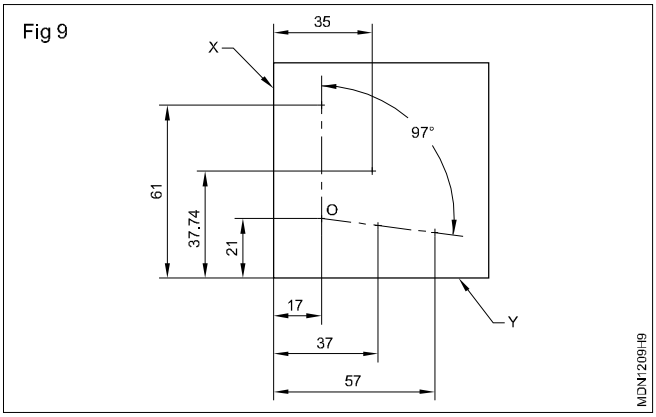
25 Punch witness marks.

Marking 4

26 File and finish the other surface flat,deburr and apply the marking medium.

27 Scribe the centre lines and parallel lines to the edges 'x' and 'y'. (Fig 9)

Fig 9

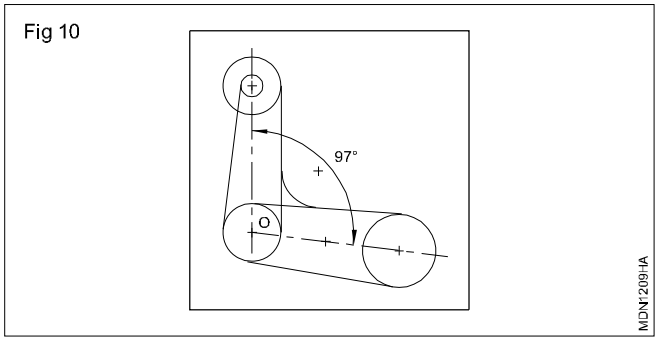


28 Set 97° on the bevel protractor.

29 Mark 97° line through point '0' and get the centres of the other two circles. (Fig 10)

30 Punch centre marks on all the four circles.

Fig 10



31 Draw all the four circles using a divider.

32 Draw R8, R8 and R10 curves a little more than the length required.

33 Draw two tangents close to the edges of the 'x' and 'y' circles using a steel rule and scriber. (Fig 10) and complete the marking as per shape given.

34 Punch witness marks.

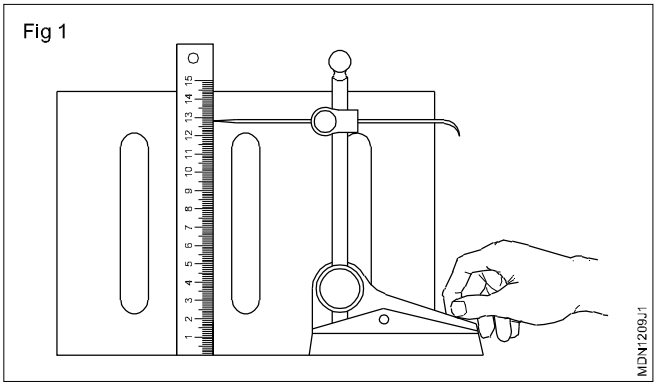
Skill sequence

Marking parallel lines using surface gauge

Objectives: This shall help you to
- **mark parallel lines using a surface gauge**
- **set the surface gauge to any height dimension.**

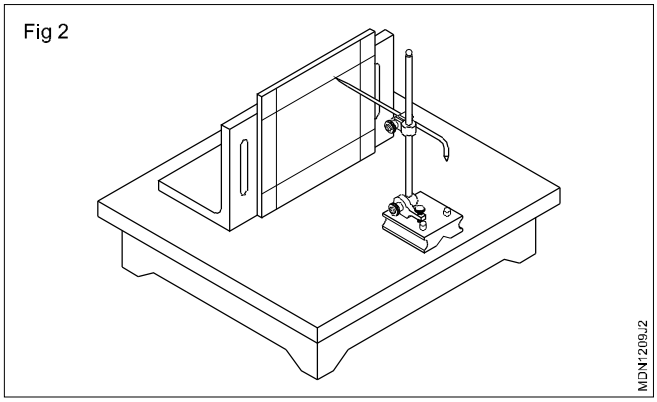
- Check the free movement of the scriber and other sliding units.
- Clean the base of the surface gauge.
- Keep the surface firmly on the surface plate.
- Rest the steel rule against the angle plate and set the scriber to the size to be marked. (Fig 1)

Fig 1



- Make sure that the job has no burrs and has been properly cleaned.
- Apply a thin and even coating of the marking media.
- Butt the job against the angle plate.
- Hold the job in one hand and move the scriber point touching the surface across the work and mark. (Fig 2)

Fig 2



Marking lines parallel to the edge of the job

Objectives: At the end of the exercise you shall be able to;
- **mark parallel lines using a jenny caliper.**

Apply marking medium on the surface to be marked.

Set the jenny caliper to the size to be marked (i.e. dimension) with the help of a steel rule. (Fig 1)

Transfer the set dimension to the job. (Fig 2)

Incline slightly and move the jenny caliper with uniform speed and mark lines.

Make witness marks on the lines marked using a 60° prick punch. The witness marks should not be too close to one another.

Note to the instructor : Provide old exercise and models as much as possible to the trainess for acquiring measuring skills with simple measuring instruments.

Fig 1

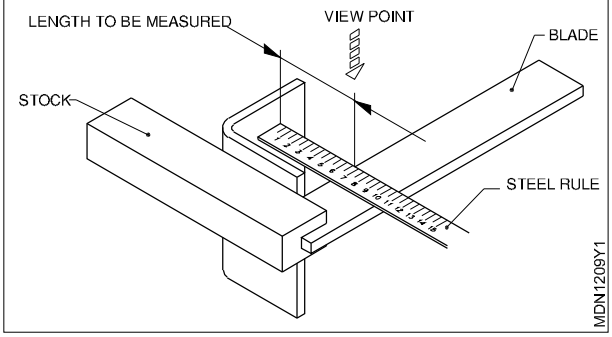


Fig 2

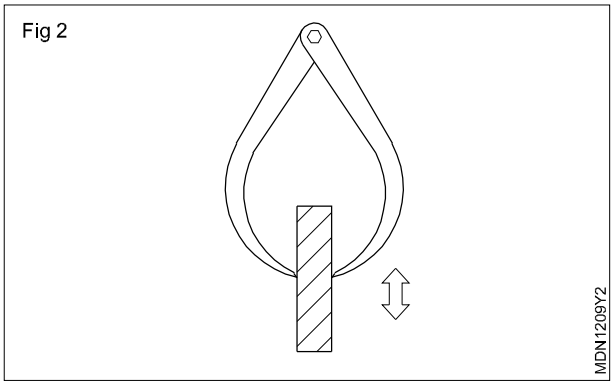


Fig 3

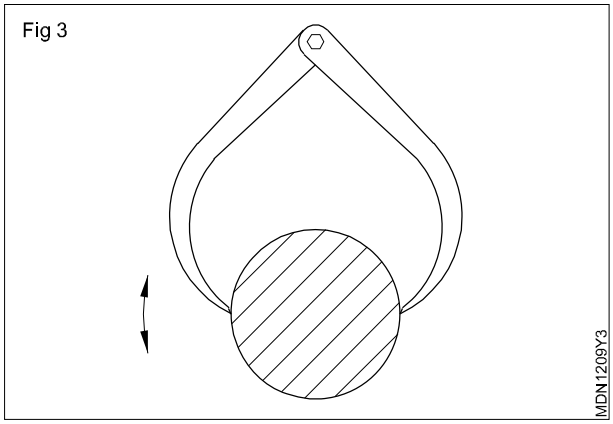


Fig 4

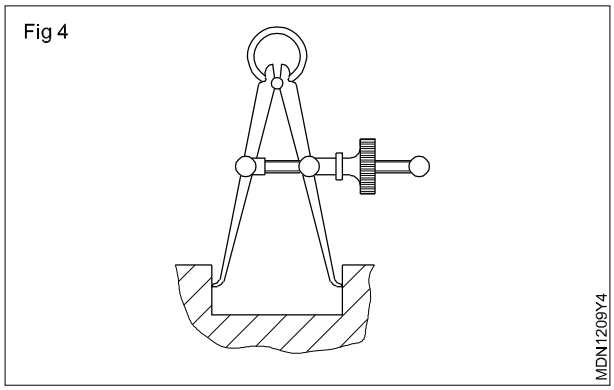


Fig 5

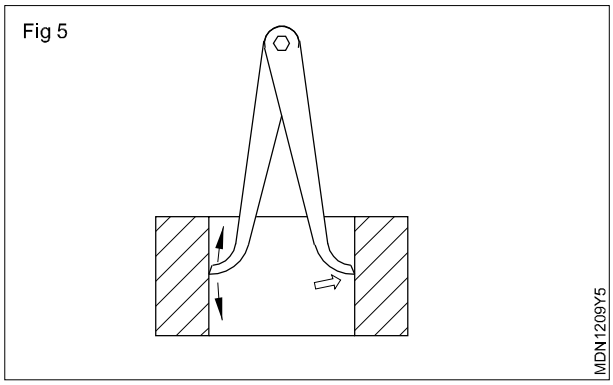
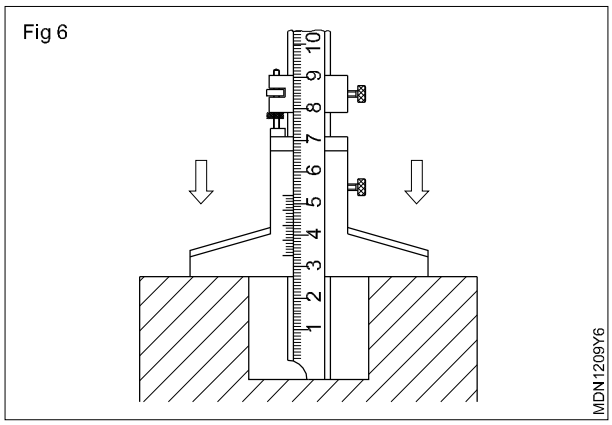


Fig 6



Measure wheel base of a vehicle

Objective: At the end of this exercise you shall be able to
- **measure the wheel base of a vehicle.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Measuring tape and Plumb bob - 1 No each.

Equipments

- Vehicle - 1 No.

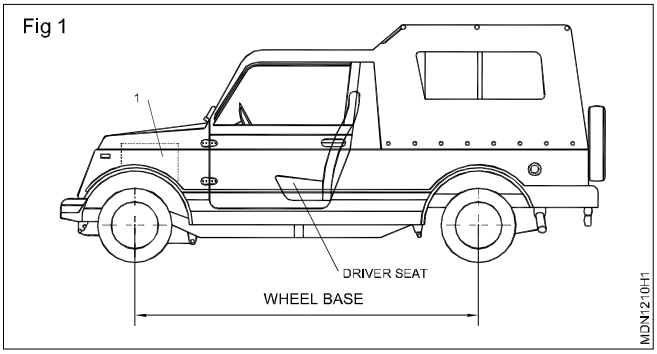
Materials

- Cotton waste - as reqd.

PROCEDURE

1 Place the vehicle on a plain ground (Fig 1)

Fig 1



2 Make the wheels straight ahead

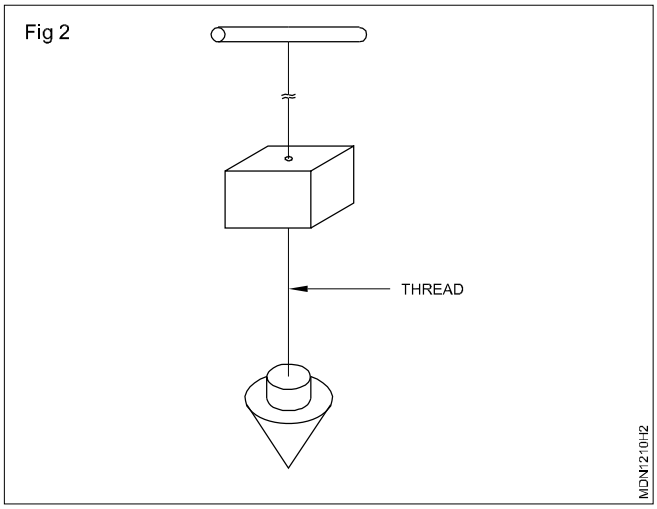
3 Apply the vehicle hand brake

4 Apply wheel chokes on front and rear wheels

5 Close all the doors

6 Use the plumb bob and mark the vehicle front wheel centre (from the side view of vehicle) on the ground. (Fig 2)

Fig 2



7 Similarly mark the vehicle rear wheel centre (from the same side view of the vehicle) on the ground

8 Measure the wheel base using measuring tape between the two markings

Skill sequence

Practice on use of tape and plumb bob

Objective: This shall help you to
- **measure wheel base front overhang and rear overhang.**

Select the correct measurement tape (Fig 4)

Select the proper length of measuring tape

Release the lock of the tape & pull it out for measurement

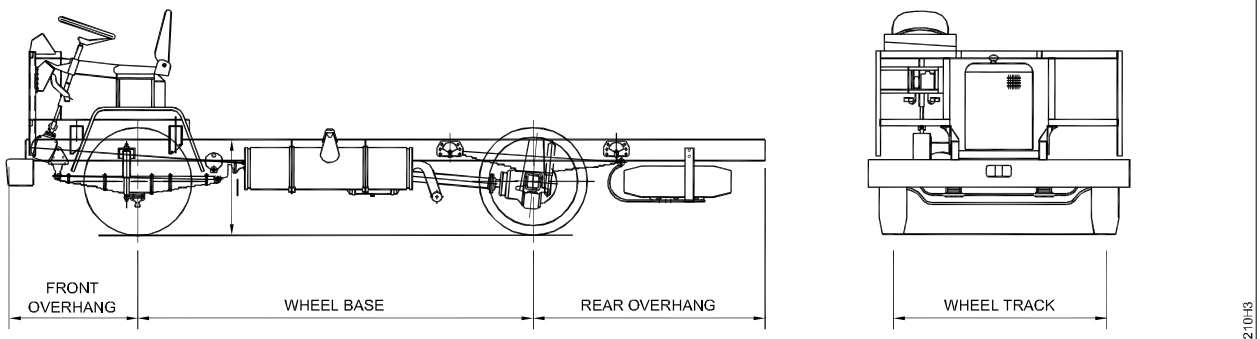
Front end of the tape should be coincide with the centre mark line on the ground

Keep the tape straight till the other end of the marked line

Note down the measurement line of the tape coincide with the marked line on the ground

Take the measurement & check with the manufacturer's specified wheel base data. (Fig 5)

Fig 3



Measure the distance between centre of front wheel so center of rear wheel, which wheels are in straight ahead position. This is wheel base. (Fig 3)

Measure the distance between center of from LH tyre to center of front RH tyre. This is wheel track. (Fig 3)

Measure the distance between center of front wheel to the farthest point of the vehicle in front direction. This is front overhang. Measure the distance between center of rear wheel to the farthest point in the rear (normally rear bumper). This is rear overhang. (Fig 3)

Fig 4

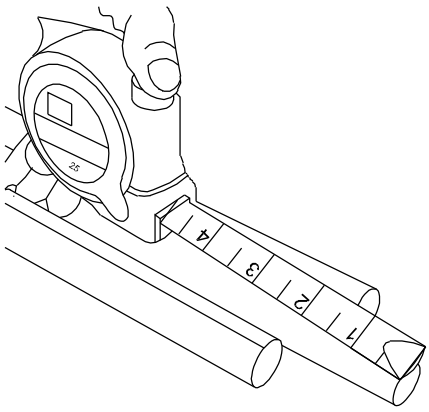
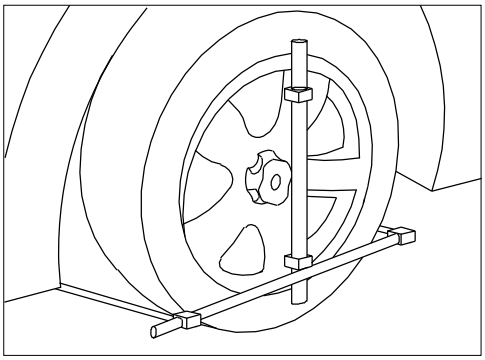


Fig 5



Check the valve spring tension

Objective: At the end of this exercise you shall be able to
- **check the spring tension on spring tester.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipments

- Work table - 1 No.
- Coil spring tension tester - 1 No.

Materials

- Cotton waste - as reqd.
- Kerosene - as reqd.
- Valve spring - as reqd.

PROCEDURE

1 Clean the spring to be tested

2 Place the spring (1) vertically on the spring tester. (Fig 1) Ensure that the moveable spindle (2) does not touch the spring (1).

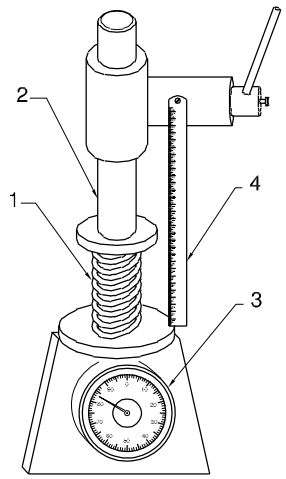
3 Note down the height of the spring (1) on the graduated scale (4). This is the free length of the spring.

4 Press the spring (1) by moving the column (2) downward. The gauge (3) will show the load on the spring. Press column (2) till the testing load (spcified by the manufacturer) is obtained.

5 Note down the height of the spring (1) at the testing load.

6 Replace the spring, if the free length of the spring and the height at the testing load (or either of these two) is less than the minimum limit specified by the manufacturer.

Fig 1



Note down the free length of the spring and the height of the testing load in Table 1.

Table 1

Sl. No.	Free length of used spring	Testing load height of spring
1		
2		
3		
4		
5		

Practice on removing wheel lug nuts

Objectives: At the end of this exercise you shall be able to
- **handle an air impact wrench**
- **loosen and tighten wheel nuts**
- **set the required torque.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Air impact wrench - 1 set.

Equipments

- Vehicle - 1 No.
- Air Compressor unit - 1 No.

Materials

- Cotton waste - as reqd.
- Wheel nut - as reqd.

PROCEDURE

1 Park the vehicle on level ground.

2 Apply Hand Brake.

3 Close all the doors.

4 Put wheel chocks to all the wheels.

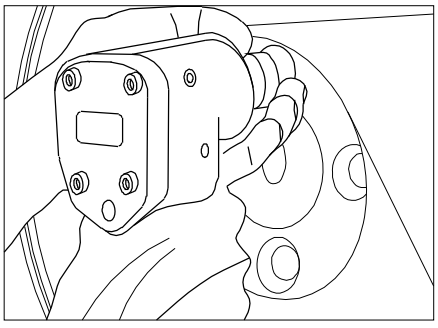
5 Remove the wheel cap.

6 Check the Air impact wrench is connected to the Air lines.

7 Select correct size of socket/special socket for wheel lug nut which can with-stand sudden impact force (six point Impact Socket).

8 Fit the socket on the Air-impact wrench. (Fig 1)

Fig 1



MDN212H1

9 Set the direction of spin forward or backward with the help of wrench lever.

10 Set the torque by turning the valve to increase or decrease.

11 Insert impact socket on the wheel lug nut.

12 Trigger the switch of the impact wrench to loosen and remove the wheel lug nuts.

13 After removing all wheel nuts, place one or two nuts on the wheel bolt to avoid slipping of the wheel while jackup the vehicle for wheel removing.

Do not use an Impact wrench to tighten the wheel lug nuts

Wear ear protection device such as ear muffs and ear plugs

Wear safety glasses for eye protection

Apply a few drops of oil to inlet of the air impact wrench before using

Ensure there is no air-leakage on the line and adequate air pressure is available.

Practice on handling workshop tools and power tools

Objectives: At the end of this exercise you shall be able to
- **identify screw driver for specific purpose and handle it**
- **identify spanner & wrenches for specific purpose and handle it**
- **identify pliers for specific purpose and handle it**
- **tightening locking devices**
- **make flare joints & fittings**
- **select the puller for removing gear and bearing from shaft.**

Requirements

Tools / Instruments

• Trainees tool kit	- 1 No.
• Screw driver	- 1 Set.
• Ring and D/E spanners	- 1 Set.
• Pliers	- 1 Set.

Equipments

• Pullers	- 1 No.
• Air compressor	- 1 No.
• Car washer	- 1 No.
• Jack mechanical and hydraulic	- 1 No.
• Hydraulic press	- 1 No.
• Flaring equipments	- 1 No.

Materials

• Kerosene	- as reqd.
• Cotton waste	- as reqd.
• Pipe	- as reqd.
• Steel wire	- as reqd.

PROCEDURE

TASK 1 : **Identify the screw driver for specific purpose**

Checking the condition of the fastener to be removed

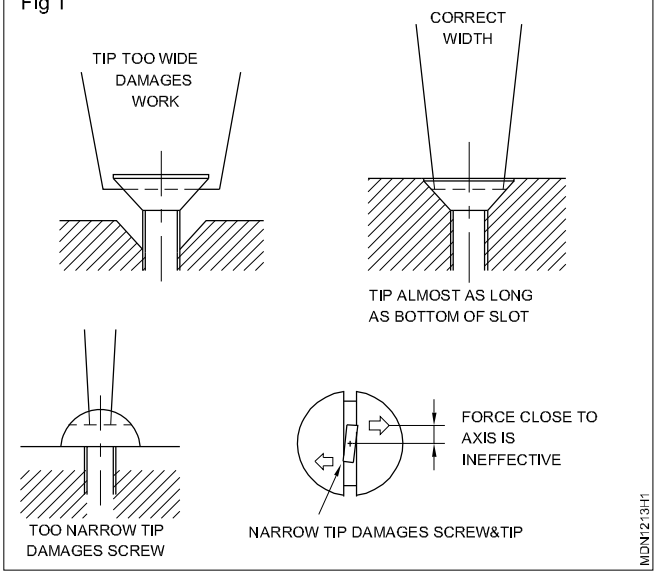
1 Clean the surface of the fastener to be removed by using kerosene, of banian cloth.

2 Check the cornering faces of the fastener for any wear or damage.

3 If it is found good, then proceed as follows

4 Select the correct size screwdriver to suit the screw slot. (Fig 1)

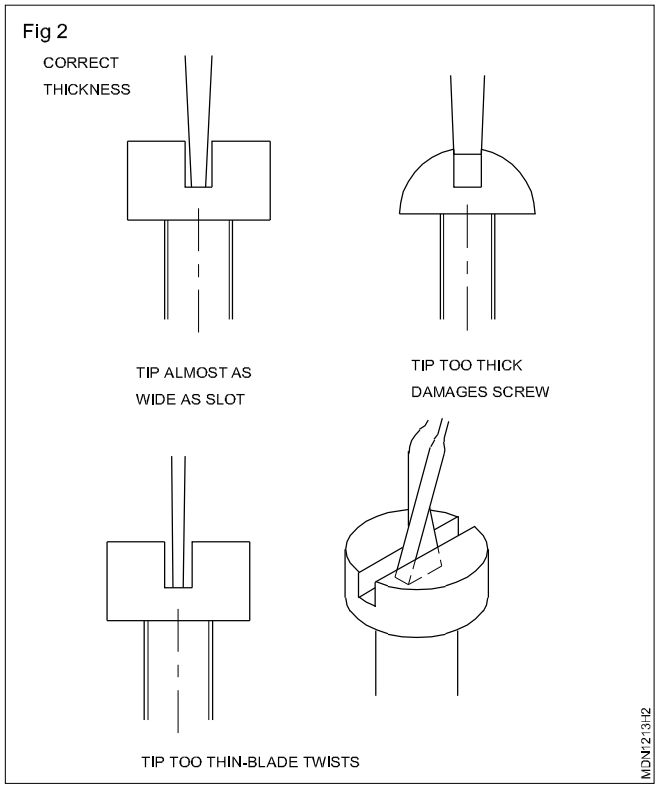
Fig 1



5 Select the longest suitable screwdriver with that size of tip. (Fig 2)

Make sure your hands and the handle are dry and not greasy.

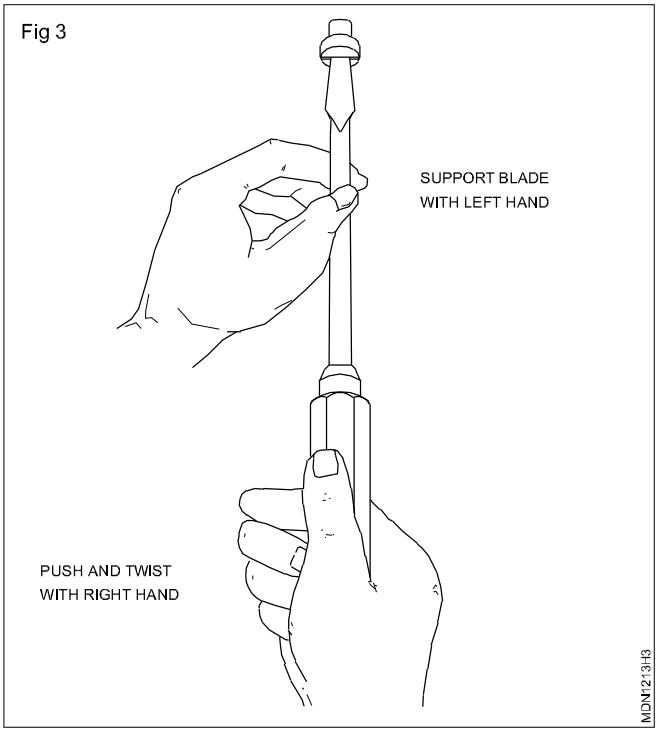
Fig 2



6 Hold the screwdriver with its axis in line with the axis of the screw.

7 Guide the blade with the left hand. Apply a little pressure with the right hand to keep the tip in the slot. (Fig 3)

Fig 3



8 Twist firmly and steadily.

Keep the tip centered in the slot and the axis of the blade in line with the axis of the screw.

Always brace small works against the bench or other firm support before using a screwdriver.

Never hold a small work in your hand while using a screw driver.

9 Turn large screws, use a screwdriver with a square blade. Apply extra twisting force with the aid of a close fitting spanner. (Fig. 4)

Never use pliers or toothed wrenches to apply twisting force to a screwdriver.

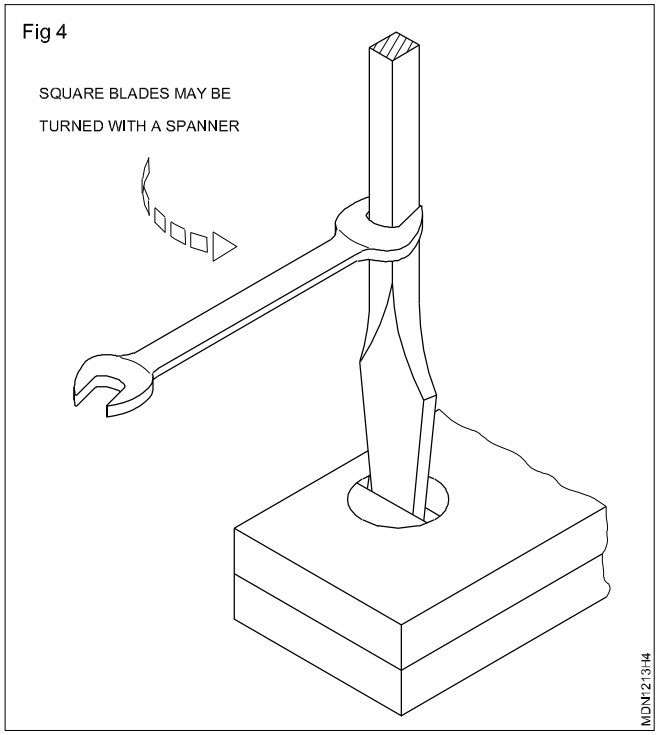
10 A Standard screwdriver blade should be ground to 9° so that the faces will be almost parallel with the sides of the screw slot. The end of the blade should be made as thick as the slot in the screw will permit.

Do not grind the blade to a chisel point, as it has a tendency to slip out of the screw slot.

11 Grind the width on both sides to an angle of 11°. The width should be equal to the diameter of the head.

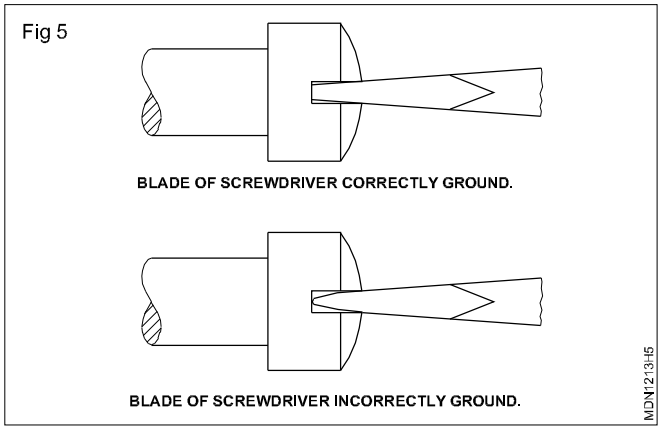
Never grind screwdrivers on a silicon carbide grinding wheel.

Fig 4



Standard screwdrivers (Fig 5) can be dressed by filing if they are worn out. Begin filing on the end of the tip. After dressing, the tip must be symmetrical about the axis of the blade. All corners must be square. The end must be at right angles to the axis in both planes.

Fig 5

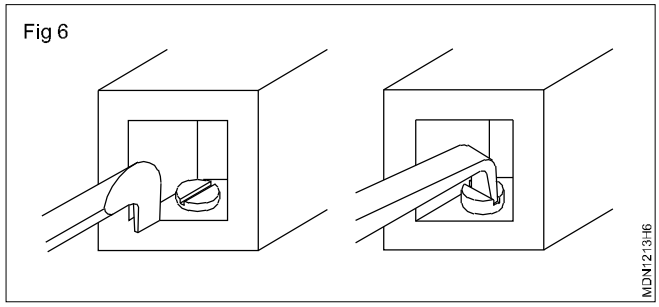


12 Use offset screw driver (Fig 6) in a restricted place.

13 Reverse the screwdriver after one end to get on quarter turn on .

14 Use the other end to get the next quarter turn and so on.

Fig 6

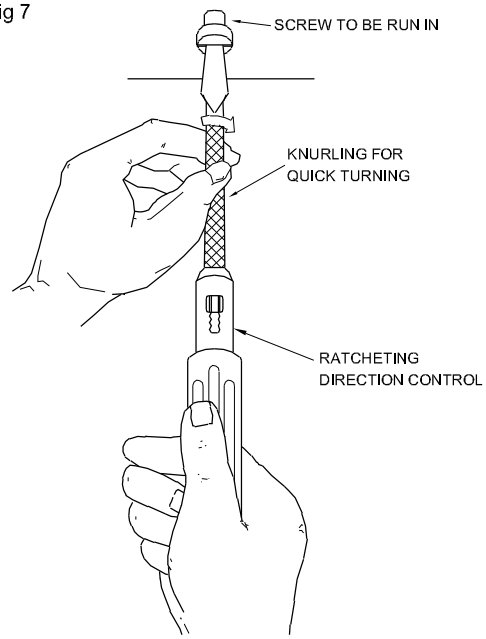


Keep pressing the tip into the slot as you turn.

15 Use ratchet screwdriver (Fig 7) for quick turning.

16 Keep the left hand on knurling, right hand on the ratchet head.

Fig 7



RATCHET SCREWDRIVER

Change the direction of control depending on your movement.

Phillips (cross-recess) screwdrivers (Figs 8 &9)

Fig 8

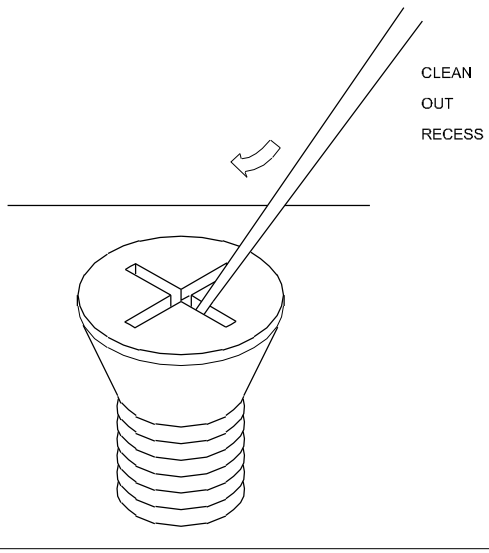
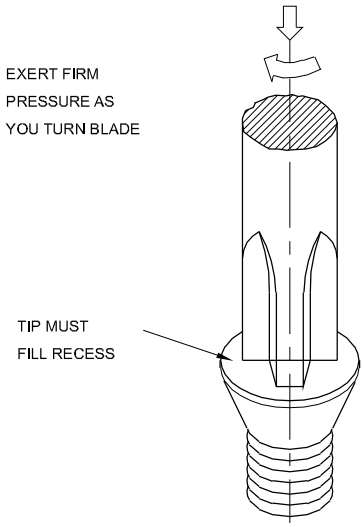


Fig 9



AXES OF SCREW AND THE SCREW DRIVER BE IN LINE

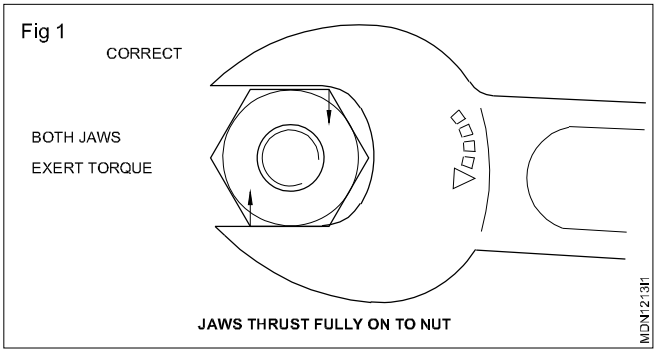
— — — — — — —

TASK 2 : **Identify spanner & wrenches for specific purpose**

Identifying the correct size of the tool

1 Determine the distance across the flats of a nut or bolt to be removed. (Fig 1)

Fig 1

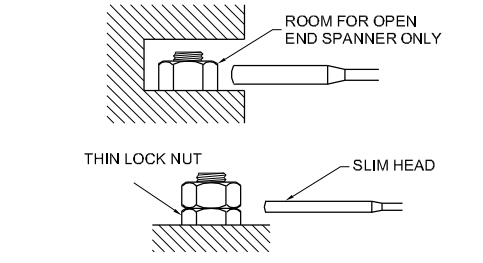


JAWS THRUST FULLY ON TO NUT

2 Decide the size of the spanner.

3 Choose the spanner that allows sufficient room without excess clearance for use. (Fig 2)

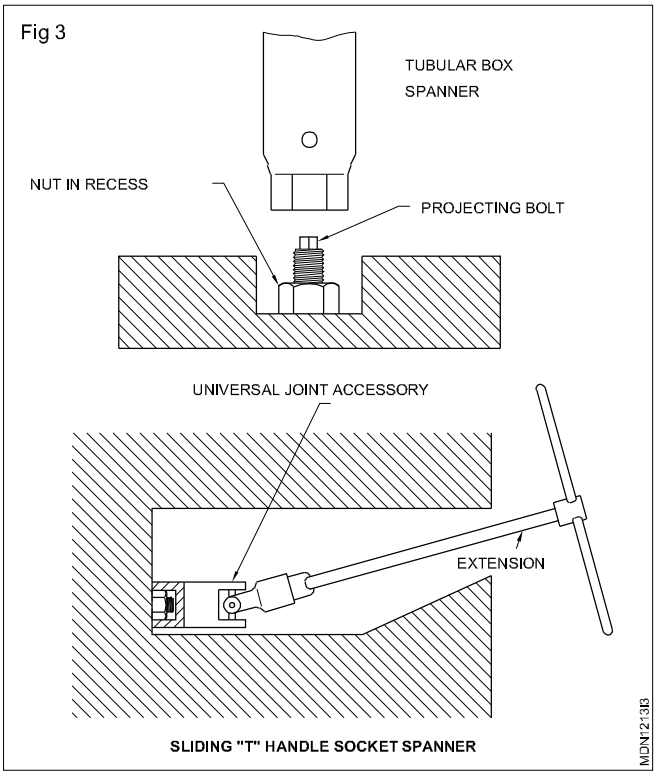
Fig 2



Handling the Tool excess clearance will cause slipping of spanner & fasteners corners gets damaged.

4 Select the correct size of the socket. (Fig 3)

5 Take a sliding offset handle and insert the drive attachment with square driving ends of a socket.

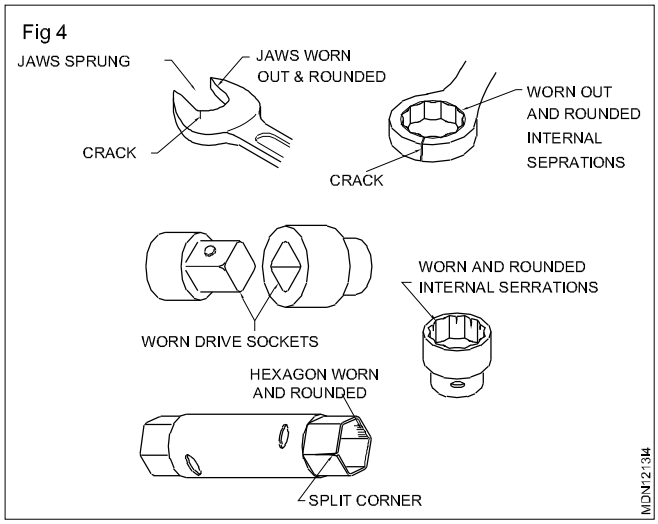


6 Insert the socket wrench on the bolt or nut and confirm whether it inserts fully.

7 Keep the position of the handle perpendicular to your forearm which enables you maximum leverage.

8 Pull the socket handle and drive out the nut/bolt head.

If the socket wrench is not usable for that particular fastener, then use ring spanner. (Fig 4)



9 Insert the ring spanner on the bolt or nut.

10 Keep the position of the shank perpendicular to your forearms which enables you maximum leverage.

11 Use D.E. Spanner where ring spanner is not suitable.

Always try to pull the spanner.

If you are forced to push the spanner, use the base of your hand and keep your hand open.

Use both hands for large spanner.

Keep yourself balanced and firm to avoid slipping.

— — — — — — —

TASK 3 : **Handling of Plier**

1 Select a component with lock wire to nut, which is to be removed.

2 Use the combination plier flat grip for untwist the lock wire.

3 After untwisting, pull the lock wire from the nut.

4 Remove the nut with proper spanner.

5 Select a brake pipe line to be removed from a junction.

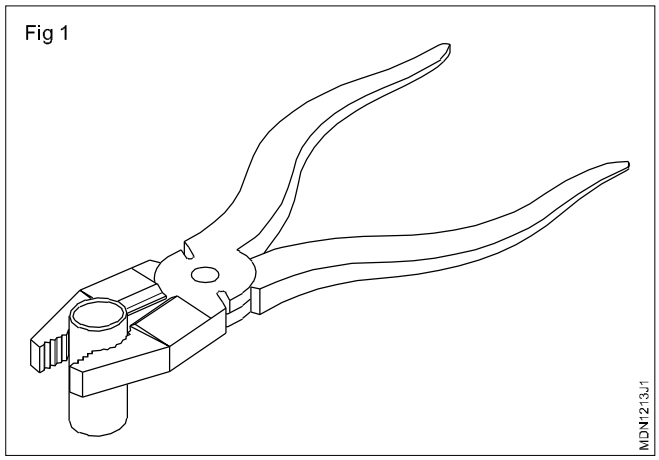
6 Hold the brake pipe line with serrated pipe grip portion at combination pliers. (Fig 1)

7 Select proper size of proper double open end spanner & remove the union nut.

8 Select a 3 mm electrical wire to be cut.

9 Place the wire between joint cutters at the point which is to be cut. (Fig 2)

10 Press the handle to cut the wires.



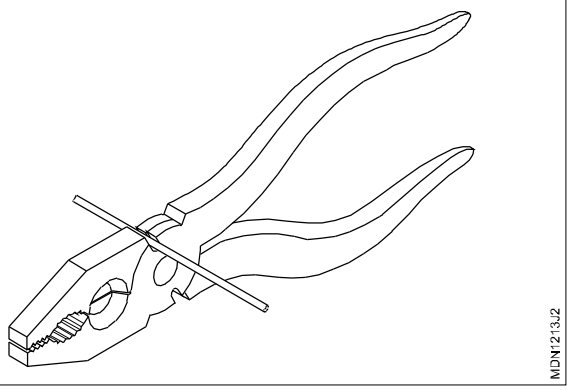
11 Select a steel wire to be cut. (Fig 3)

12 Place the steel wire in between side cutter.

13 Press the handle to cut the wire.

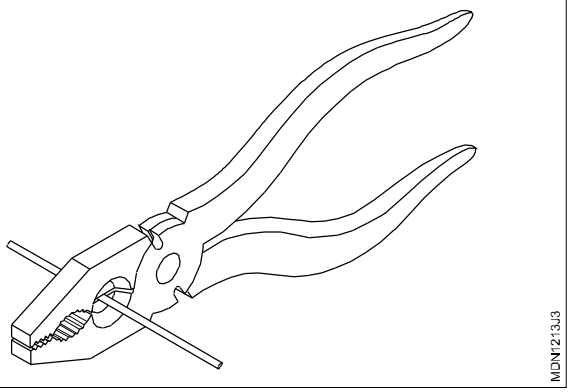
14 Select a nut with tab washer to be removed.

Fig 2



MDN1213J2

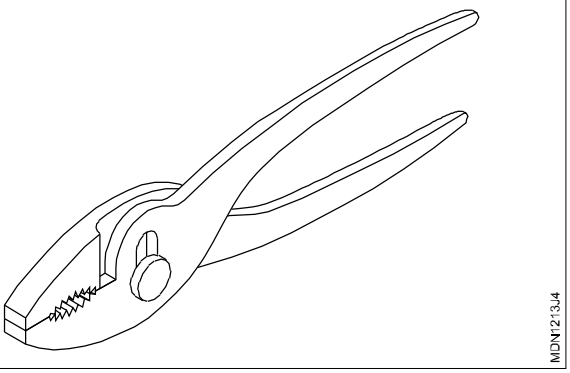
Fig 3



MDN1213J3

15 Unfold the tab washer with help of flat nose pliers. (Fig 4)

Fig 4



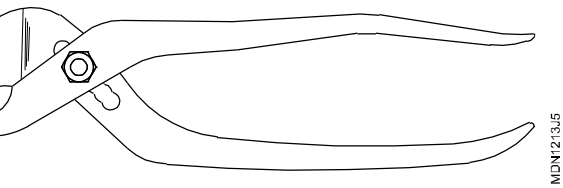
MDN1213J4

16 Use a proper spanner to remove the nut.

17 Select a cylindrical component with nut.

18 Hold the cylindrical shaft with help of slip joint pliers jaws. (Fig 5)

Fig 5



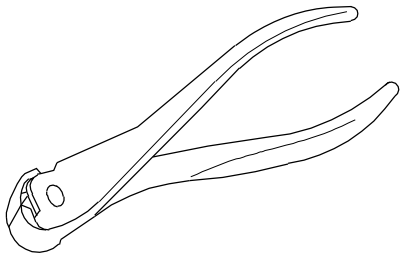
MDN1213J5

19 Remove the nut with proper spanner.

20 Select a wire to be trimmed.

21 Place the end of the wire to be trimmed by end cutting plier in between the cutting end. (Fig 6)

Fig 6



MDN1213J6

22 Apply pressure on handles to cut the wire.

23 Select the steel wire to be cut close to the component surface.

24 Cut the steel wire by slip joint multi gripplier applying pressure on the handles.

25 Use the cutting pliers to spread the cotter pin.

26 Select a stead with lock nut, from which lock nut has to be removed.

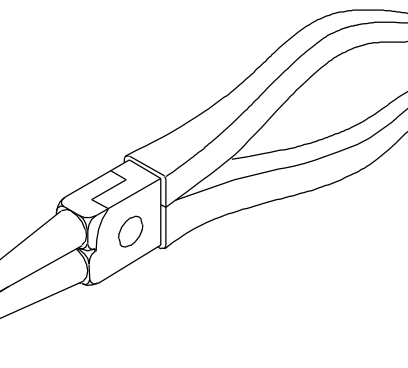
27 Hold the stead by locking pliers adjusting the screw in the handle lock with lever.

28 Use a proper spanner to remove the locking nut.

29 Select a wire which has to be converted into loop.

30 Hold the wire between the jaws. (Fig 7)

Fig 7



MDN1213J7

21 Form a loop by tuning the round nose pliers.

Skill Sequence

Tightening locking devices

Objective: This shall help you to
- **use different types of locking devices correctly.**

Split pin (Fig 1)

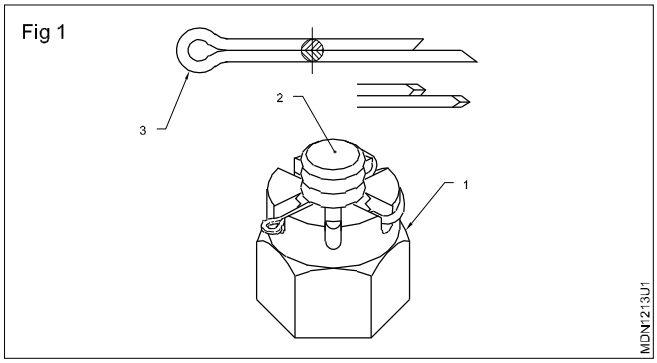
Tighten the nut (1) at the specified torque.

Check the bolt's (2) holes and nut's (1) slot alignment, if not aligned, align the hole by tightening the nut (1) slightly.

Insert a new suitable split pin (3) in the slot and hole. So that the loop on vertical plane.

Drive the split pin (3) fully inside with the help of a copper drift or rod and hammer.

Fig 1



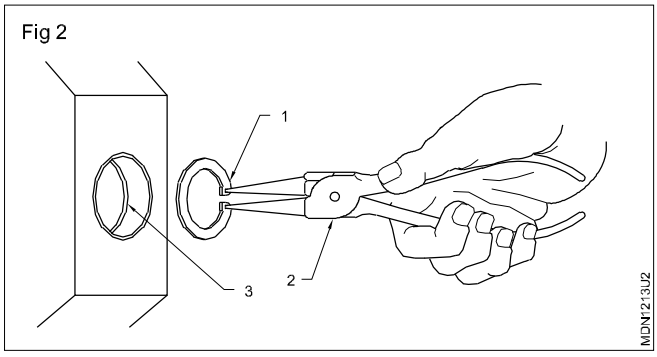
Spread open the long side of the split pin and bend it on the nut.

Inside circlip or snap ring (Fig 2)

Hold an internal circlip on hole face (1) with the help of an internal circlip plier (2).

Press the circlip (1) with the help of the plier (2) so that its diameter will be smaller than the hole diameter.

Fig 2



In this position insert the circlip in such a manner that it will sit squarely in the groove (3).

Take out the plier (2) after checking rotation of clip.

Outside circlip or snapping (Fig 3)

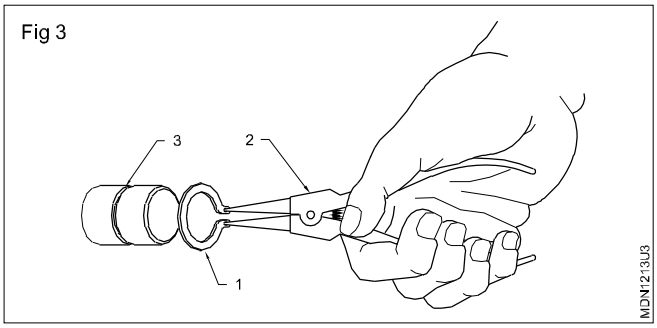
Hold an outside circlip shaft end (1) with the help of an external circlip plier (2).

Press the external circlip plier (2) so that the circlip (1) will enlarge in diameter.

While sliding, set it in the shaft groove (3). Ensure that the circlip sits squarely in groove (3) and rotate freely.

Take out the plier (2).

Fig 3



Wire ring hose clamp (Fig 4)

Clean the outside surface where the hose-pipe is to be set.

Apply grease inside the starting end surface for easy insertion.

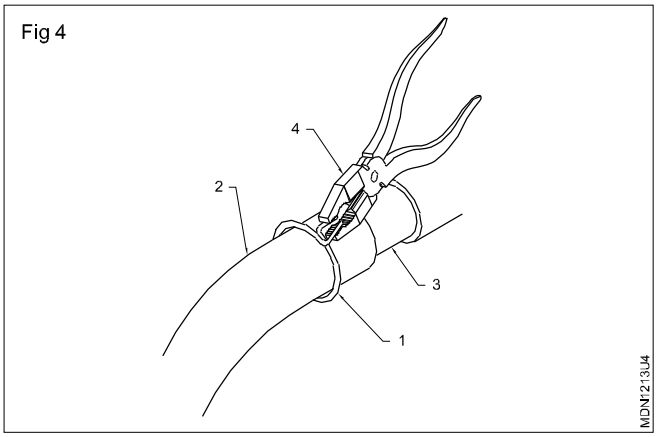
Set the wier spring hose clamp (1) on the hose-pipe (2).

Slide the hose-pipe (2) on the metal pipe (3).

Press the hose clamp (1) with the help of a plier (4) and slide it on the joint of the hose-pipe (2) and metal pipe (3).

Take out the plier (4)

Fig 4



Skill Sequence

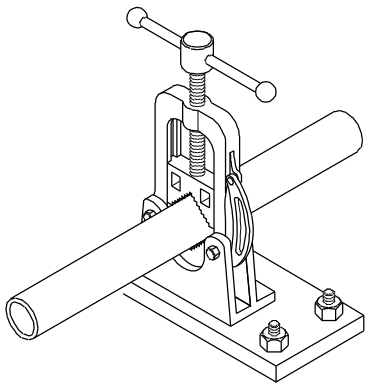
Handling of pipe flaring & cutting tools

Objective: This shall help you to
- **cut a G.I. pipe using a pipe cutter.**

Measure the required length of pipe and mark it with chalk.

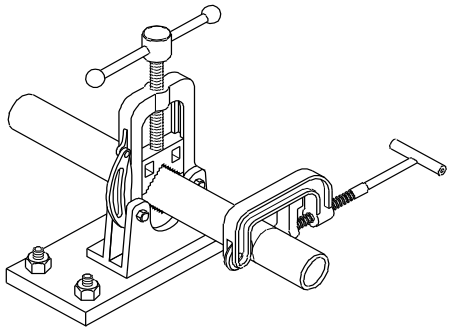
Keep the pipe in the pipe vice and tighten it. (Fig 1)

Fig 1



Fit the pipe cutter on the G.I. pipe (on the scribed line) and tighten the jacking screw so that the cutting wheel is touching the pipe. (Fig 2)

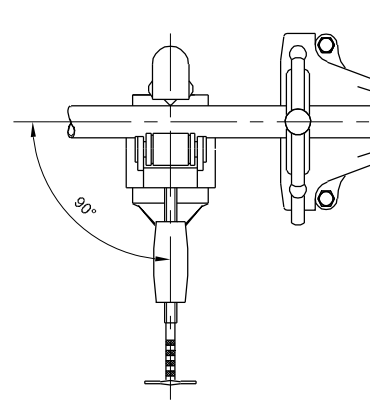
Fig 2



Ensure that the pipe is kept horizontal and parallel to the serrations such that the marking is visible at the top.

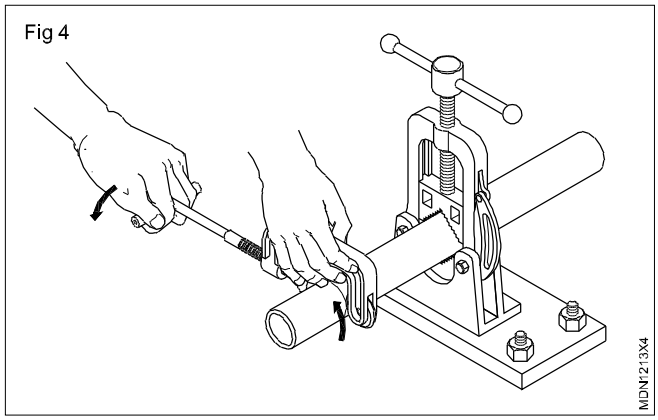
Rotate one or two turns to ensure that the cutting wheel is sitting exactly on the scribed line at 90° to the pipe. (Fig 3)

Fig 3



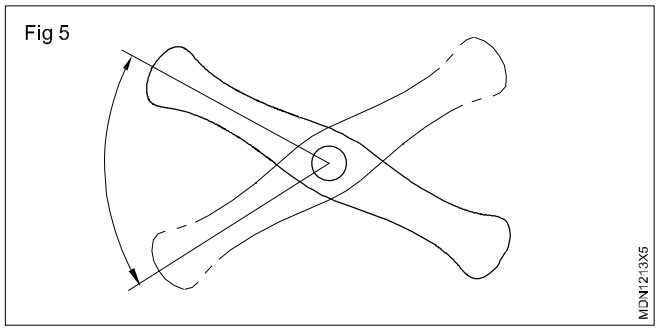
Rotate the pipe cutter around the pipe. (Fig 4)

Fig 4



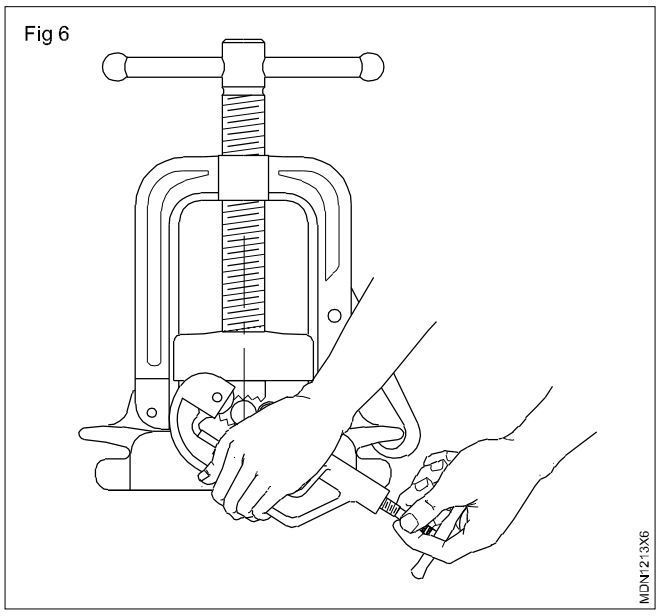
After two or three turns use the jacking screw to apply pressure on the cutting wheel. (Fig 5)

Fig 5



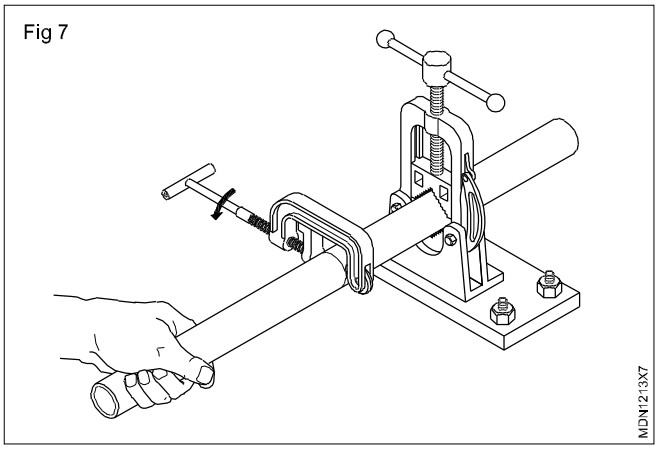
Keep rotating the pipe cutter around the pipe. Increase the pressure to the cutter by repeating the cycle until the pipe is cut through. (Fig 6)

Fig 6



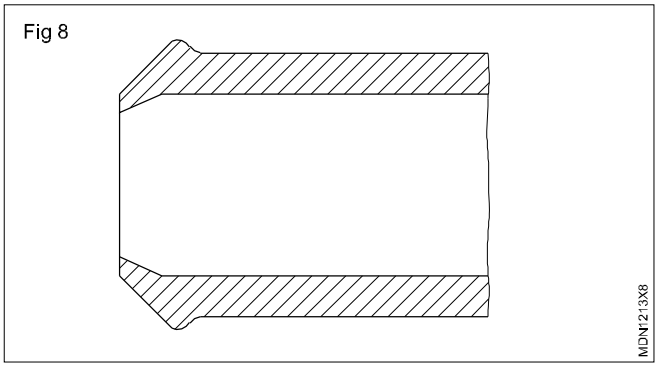
Support the pipe with your left hand so that the free end of the pipe does not fall. (Fig 7)

Fig 7



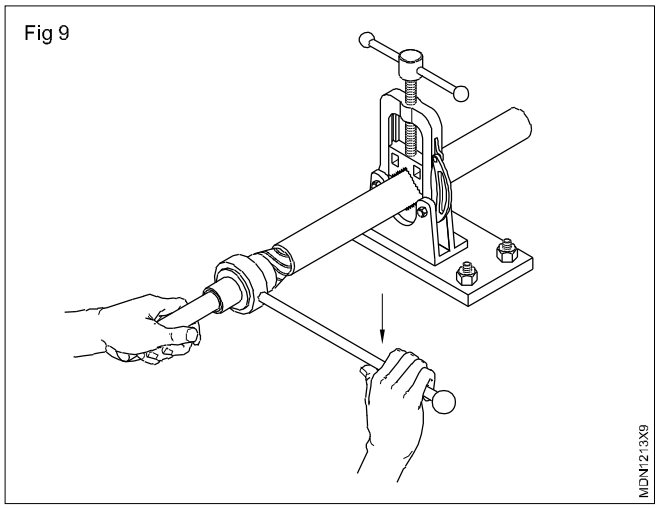
The cut portion of the pipe will appear as shown in Fig 8.

Fig 8



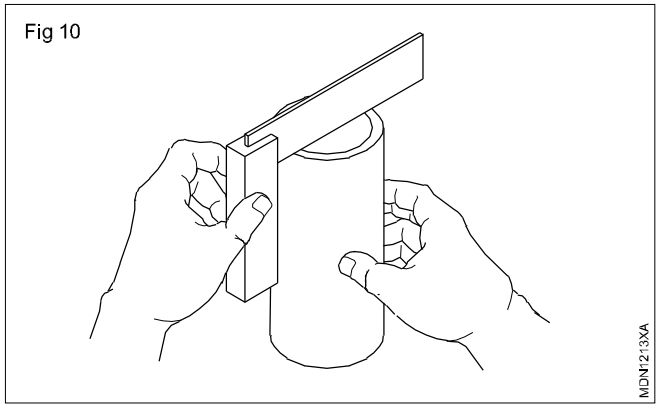
Remove burrs using a pipe reamer. (Fig 9)

Fig 9



Check that the pipe ends are square. (Fig 10)

Fig 10



Skill sequence

Make flare joints and test them with flare fittings

Objectives: This shall help you to
- **flare the end pipe**
- **joint flare nut with flare fitting and test it.**

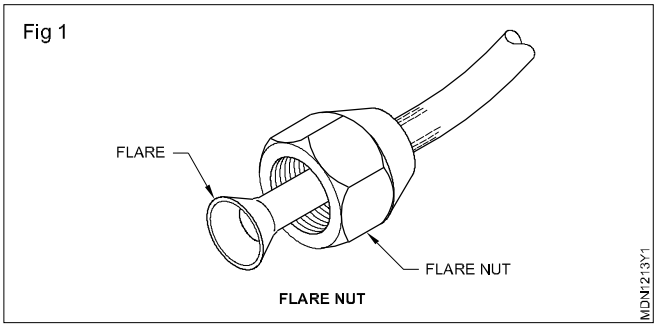
Flaring

Brake line pipes / Fuel pipe lines / Air conditioner pipe lines are sometimes jointed to fittings by making a flared connection.

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

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

Fig 1



FLARE NUT

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

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

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

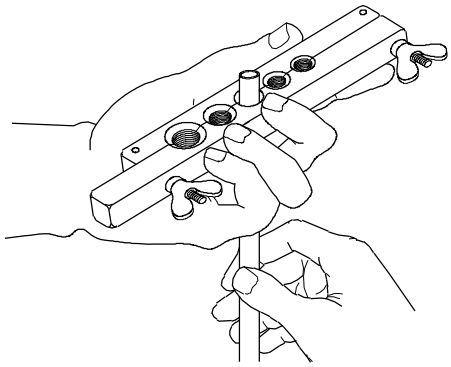
a) Place the flare nut on the pipe

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

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

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

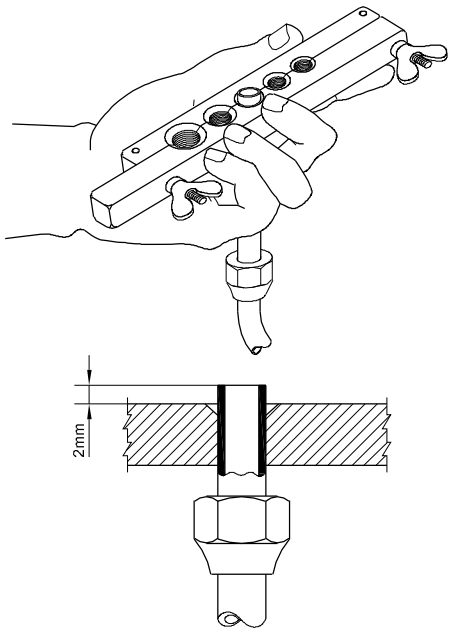
Fig 2



MDN1213Y2

Fit the yoke to the flaring block (Fig 3)

Fig 3

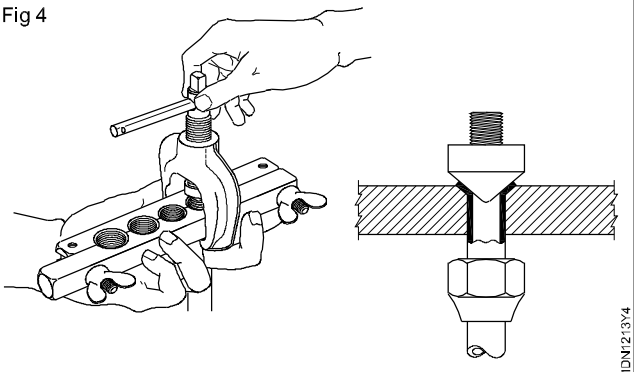


MDN1213Y3

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

The end of the pipe will be formed into a flare (Fig 4).

Fig 4



MDN1213Y4

Unscrew & remove the flaring block remove the flared pipe from the block.

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

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

Use 3 mm instead of 2 mm. Repeat until the flare is the correct size for the flare nut - not too loose and not too tight.

Observation Table 1

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

Joining with flare fittings

Put thread seal tape on the thread

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

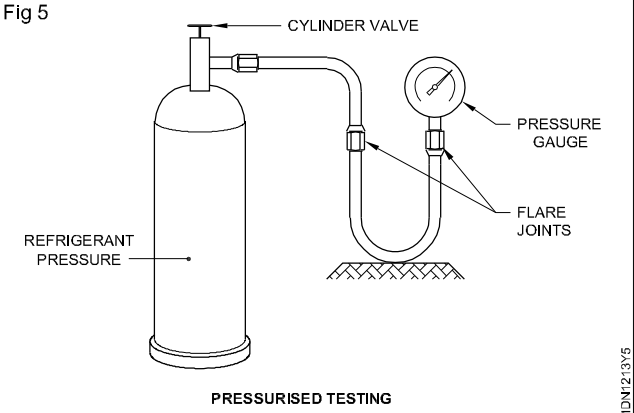
Tighten the one end of the tube to the cylinder with the flare nut. (Fig 5)

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

Do not give more pressure while tightening since this will spoil flare.

Make sure that they should not be loose in the tube.

Fig 5



MDN1213Y5

Observation Table 2

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

The pressure will be shown in the pressure gauge.

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

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

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

Observation Table 3

Sl. No.	Skills	Remarks
1	Selection of tools	Excellent/Good/Average
2	Detecting leak and arresting	Excellent/Good/Average

Skill sequence

Handling of puller, gear & bearing

Objectives: This shall help you to
- **select, install to use a puller for removing gear from shaft**
- **select install to use of puller for removing bearing from shaft.**

Identify the object to be removed, i.e. Gear / Bearing.

Determine the size of the Gear / Bearing to be removed.

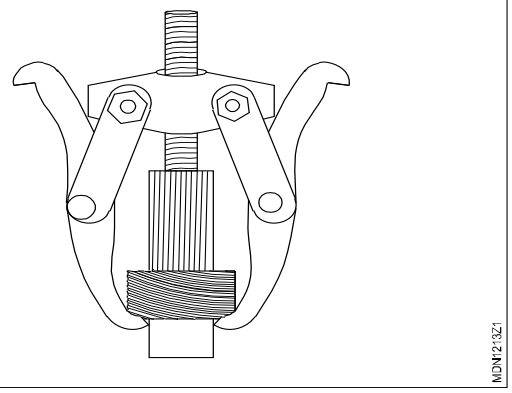
Choose a puller according to Gear / Bearing i.e, 2 or 3 Jaw & External or Internal Jaw puller.

Unscrew the forcing screw of the puller to the optimum length.

Split open the jaw of the puller.

Position the jaws of the puller over gear as shown in the diagram. (Fig 1)

Fig 1



Position the tip of forcing screw on the shaft, as shown in the diagram. (Fig 2)

Tighten the forcing screw till the forcing screw end touches the shaft.

Check the puller is not going to slip of from the center of shaft & readjust if necessary.

Tighten the forcing screw till the gear comes all of the shaft.

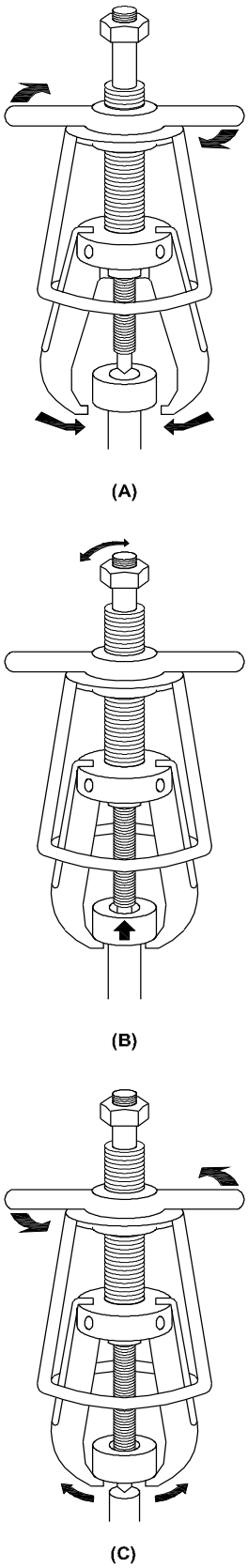
Warnings

Always wear proper personal protective gear (i.e gloves, safety glasses)

Never use a tool to strike the puller. Hitting the puller may cause if to break.

Applying heat to the puller may damage it.

Fig 2



Practice on measuring outside diameters

Objectives: At the end of this exercise you shall be able to
- **measure cam height using outside micrometer**
- **measure camshaft journal diameter using outside micrometer**
- **measure crankshaft journal diameter using outside micrometer**
- **measure valve stem diameter using outside micrometer**
- **measure piston pin & piston skirt diameter using outside micrometer.**

Requirements

Tools/Instruments

- Outside micrometer (0 - 25mm) - 1 No.

Equipments

- Work bench - 1 No.
- V blocks - 1 Pair

Materials

- Camshaft - 1 No.
- Crankshaft - 1 No.
- Valve - 1 Set.
- Piston - 1 Set.
- Piston pin - 1 Set.
- Cotton waste - as reqd
- Kerosene - as reqd

PROCEDURE

TASK 1 : **Check the cam height**

1 Check the camshaft visually for crabs

2 Clean the camshaft using a small brush with recommended cleaning solvent

3 Clear sludge and gum deposit

4 Blow out the passages with compressed air with the help of micrometer measure the reading

5 Before taking the measurement, ensure that micrometer is adjusted for zero setting

6 Record the main scale reading and thimble reading

7 Check the cam shaft at 2 or 3 places on the table and arrive at the observed value.

Measuring on Cam height, Camshaft Journal dia, crankshaft journal dia, Valve stem dia, piston diameter, and piston pin dia with outside Micrometers.

8 Using a micrometer, measure the cam lobe height and record the results in a table 1 below (Fig 1)

Fig 1

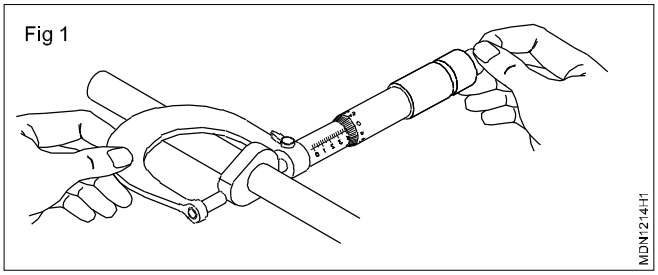


Table 1

Component Name	Main scale Reading	Coinciding Thimble scale (div)	Least count	Result
	(a)	(b)	(c)	R = a + (b x c)
Cam lob height			0.01	

— — — — — — —

TASK 2 : **Check the cam shaft journal diameter**

1 Inspect the journal diameter of the camshaft and record the results in a table 2 below. (Fig 2)

Fig 2

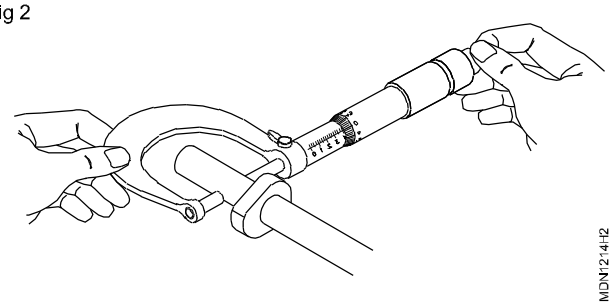


Table 2

Component Name	Main scale Reading	Coinciding Thimble scale (div)	Least count	Result
	(a)	**(b)**	**(c)**	**R = a + (b x c)**
Cam shaft journal diameter			0.01	

— — — — — — —

TASK 3 : **Check the crankshaft journal diameter**

1 Use a micrometer to measure crankshaft journal diameter at two places, 180 apart and at two points along its length. Record the result in a Table 3.

2 Put the bearing caps at their respective places with the same bolts.

3 Clean the crankshaft using a small brush with the recommended cleaning solvent.

4 Clear sludge and gum deposits from the drilled oil passages in the crankshaft by the wire brush.

5 Blow out the passages with compressed air

With the help of a micrometer measure the journal diameter at '1' '2' '3' & '4'. The difference in reading between '1' & '3' and '2' & '4' will give the ovality. (Fig 1)

Fig 1

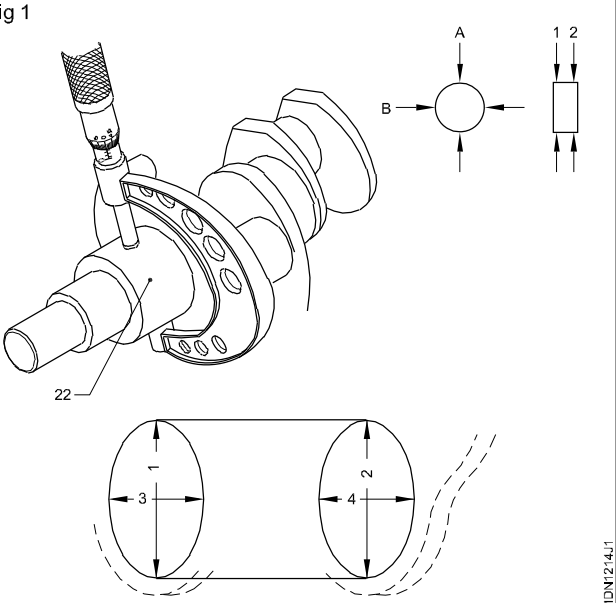


Table 3

Component Name	Main scale Reading	Coinciding Thimble scale (div)	Least count	Result
	(a)	**(b)**	**(c)**	**R = a + (b x c)**
Crank shaft journal Diameter			0.01	

6 Measure the oil clearance between the crankshaft main journal and the bearing shell.

TASK 4 : **Check the diameter of the valve stem**

Fig 1

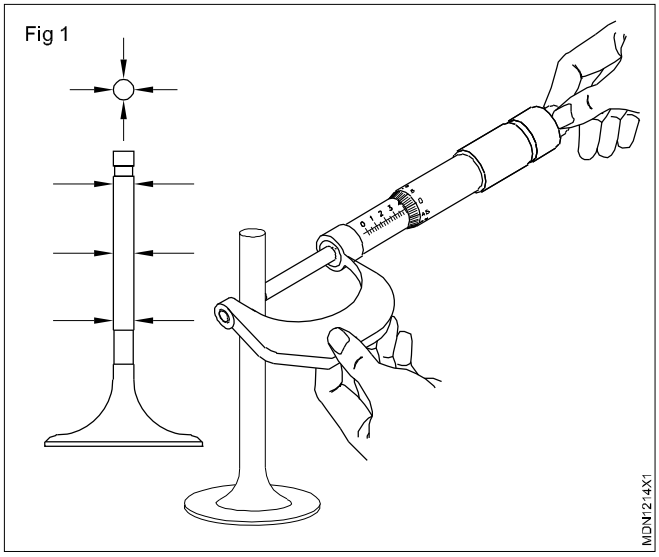


Table 4

Component Name	Main scale Reading	Coinciding Thimble scale (div)	Least count	Result
	(a)	(b)	(c)	R = a + (b x c)
Valve stem diameter			0.01	

— — — — — — —

1 Use a micrometer to measure the diameter of the valve stem and record the results in a table 4 below. (Fig 1)

TASK 5 : **Check the piston & piston pin (Fig 5 & Fig 6)**

1 Use a micrometer to measure the piston diameter at right angles to the piston pin center line, and at a

Fig 1

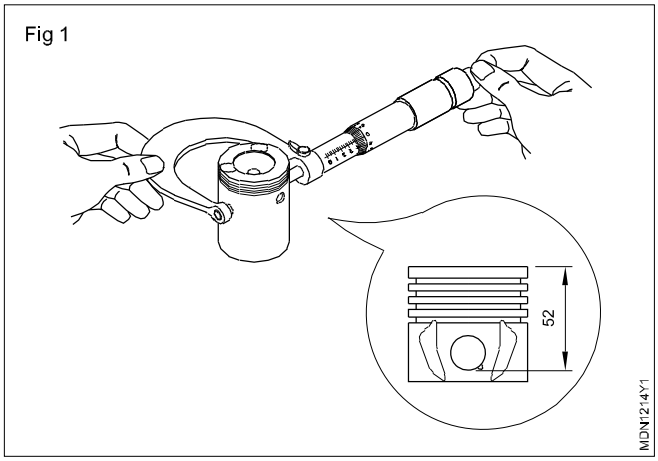


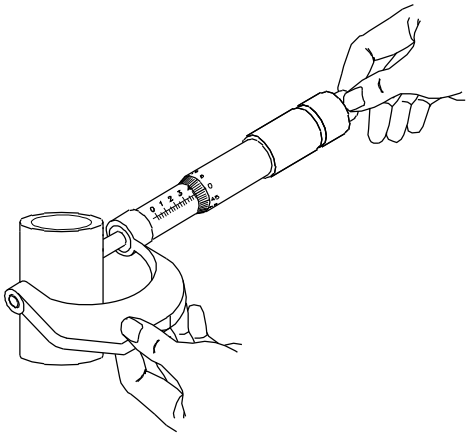
Table 5

Component Name	Main scale Reading	Coinciding Thimble scale (div)	Least count	Result
	(a)	(b)	(c)	R = a + (b x c)
Piston diameter			0.01	

position 52 mm (2.05 in.) from the top of the piston head and record the results in a table 5 below. (Fig 1)

2 Use a micrometer to measure the external diameter of the piston pin and record the results. (Fig 2)

Fig 2



MDN1214Y2

Table 6

Component Name	Main scale Reading	Coinciding Thimble scale (div)	Least count	Result
	(a)	(b)	(c)	R = a + (b x c)
Piston pin diameter			0.01	

— — — — — — —

Practice on measuring height by using depth micrometer

Objectives: At the end of this exercise you shall be able to
- **measure the height of the rotor of an oil pump.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.

Equipments

- Depth micrometer - 1 Set.

Materials

- Oil pump rotor body - 1 No.
- Cotton waste - as reqd.
- Kerosene - as reqd.

PROCEDURE

TASK 1 : **Measure the depth of the oil pump body**

1 Check the zero reading of the depth micrometer. (Fig 2)

2 Fix the frame surface with surface of the oil pump rotor body.

3 Rest your left hand on the surface of the work being measured and hold the anvil to touch the surface. (Fig 1)

4 Turn the micrometer thimble with your thumb and finger until you feel the anvil to touch the surface of the oil pump rotor body.

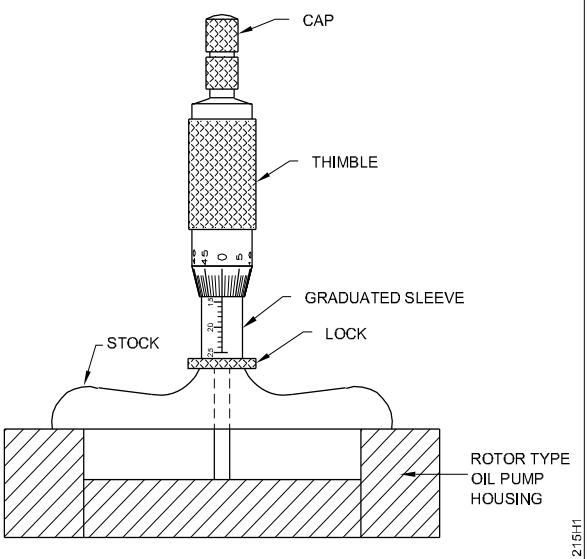
5 Read the actual reading hidden by thimble.

When you are satisfied with the feel.

Lift the micrometer carefully from the gap.

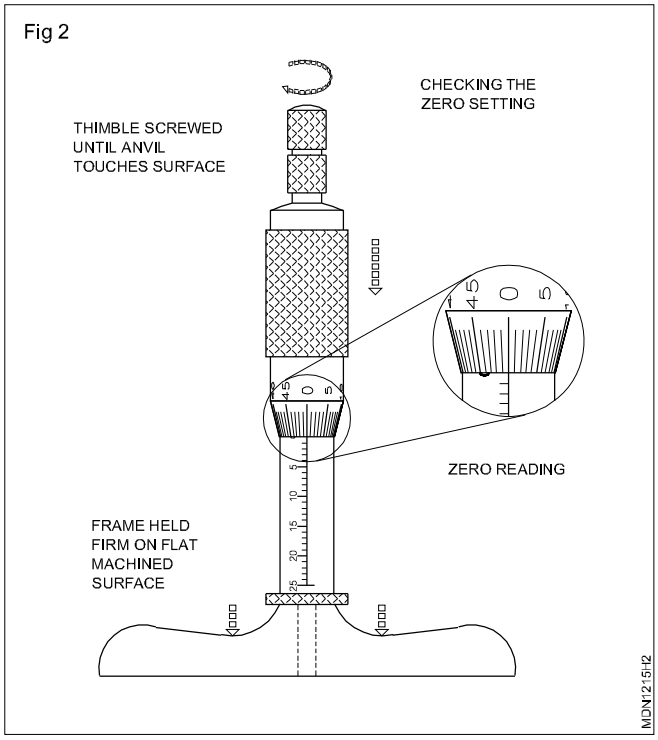
Zero graduation of the sleeve is on the top. (Fig 2)

Fig 1



DEPTH MICROMETER

Fig 2

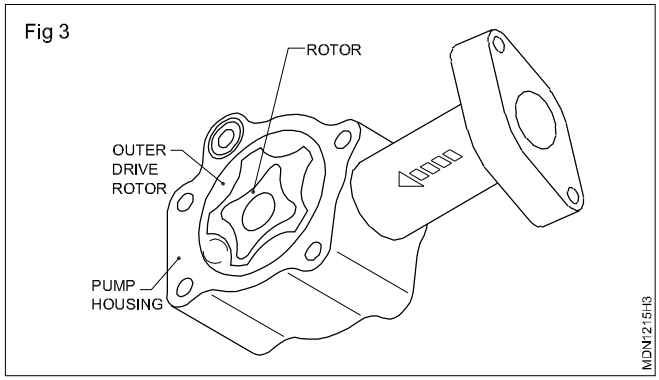


Rotor type oil pump

6 Measure the actual reading in the gap between housing surface to rotor's surface.(Fig 3)

7 Measure the actual reading the height of the rotor from the surface of the oil pump housing

Fig 3



Practice on measuring the valve spring free length

Objectives: At the end of this exercise you shall be able to
- **measure the valve spring free length.**

Requirements

Tools/Instruments

• Trainee's tool kit	- 1 No.
• Valve spring tester	- 1 No.

Materials

• Valve springs	- as reqd
• Cotton waste	- as reqd.
• Kerosene	- as reqd.

PROCEDURE

1 Clean the valve spring to be measure.

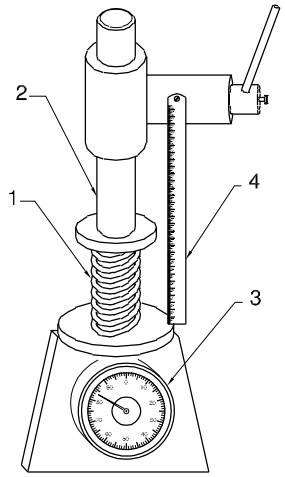
2 Clean the spring tester. (Fig 1)

3 Place the spring (1) vertically on the spring tester as shown in the fig. Ensure that the moveable spindle (2) does not touches the spring (1).

4 Note down the free length (height) of the spring (1) on the graduated scale (4).

5 Compare the valve spring free length with service manual specified limit.

Fig 1



Practice on measuring inside diameter by using telescopic gauge

Objectives: At the end of this exercise you shall be able to
- **measure the cylinder bore diameter using telescopic gauge**
- **measure the connecting rod big end diameter using telescopic gauge**
- **measure the camshaft bearing inside diameter using telescopic gauge.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.

Equipments

- Out side micrometer - 1 No.
- Telescopic gauge - 1 Set.

Materials

- Engine block - 1 No.
- Cotton waste - as reqd.

PROCEDURE

TASK 1 : **Measure the inside diameter of a bore using telescopic gauge**

1 Clean the cylinder bore with a piece of cloth.

2 Measure the approximate size of the cylinder bore.

3 Select the suitable range of a telescopic gauge.

4 Press the moving leg gently and place it inside the cylinder bore.

5 Release the pressure and allow both the legs to touch on the wall of the cylinder bore.

6 Keep the telescopic gauge perpendicular to the diameter of the cylinder bore. (Fig 2)

7 Move the gauge slightly inside the hole and correct ' feel'.

8 Lock the telescopic gauge.

Remove it gently from the cylinder bore.

Transfer the measurement to an outside micrometer and read.

Take the measurement at A_1, A_2 and note down. (Fig 1)

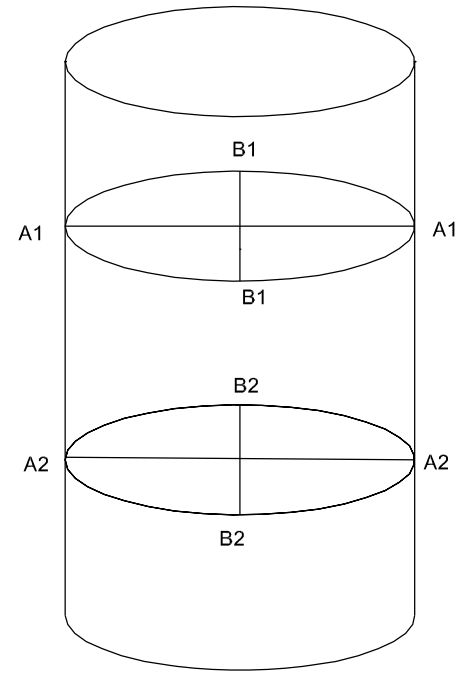
Take the measurement at B_1, B_2 and note down.

Sl. No.	A	B
1	A_1	B_1
2	A_2	B_2

A = NonThrust side.

B = thrust side.

Fig 1

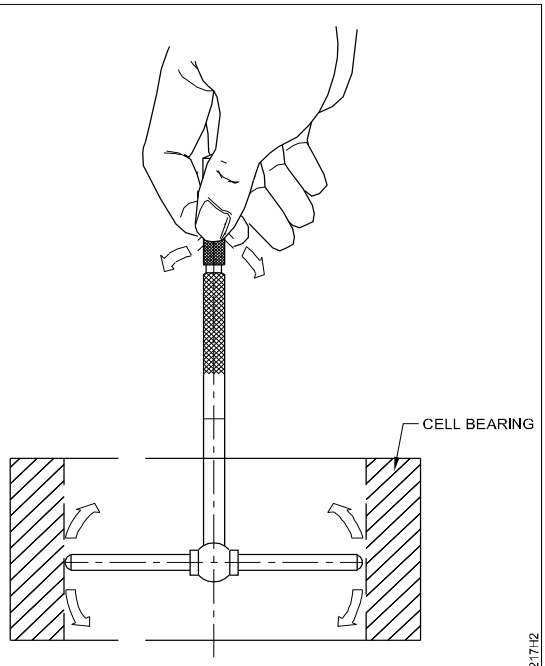


The difference of measurement between A_1 - B_1 and A_2 - B_2 are the ovality

The difference in measurement between A_1 - A_2 and B_1 - B_2 is the tapper.

Note down the maximum ovality and tapper. If any one of it is found more than the specified limit by the manufacturer, then recommend for reboring or replacement of the liner.

Fig 2



MEASURING THE BORE DIAMETER USING TELESCOPIC GAUGE

TASK 2 : **Measure the connecting rod big end diameter using telescopic gauge**

1 Measure the approximate size of connecting rod bore with steel rule.

2 Select a suitable range of a telescopic gauge(1) (Fig 1).

3 Press the moving leg gently and place it inside the connecting rod bore (2).

4 Release the press and alow both the legs to touch on the wall of the connecting rod bore (2).

5 Keep the telescopic gauge perpendicular to the diameter of the connecting rod bore.

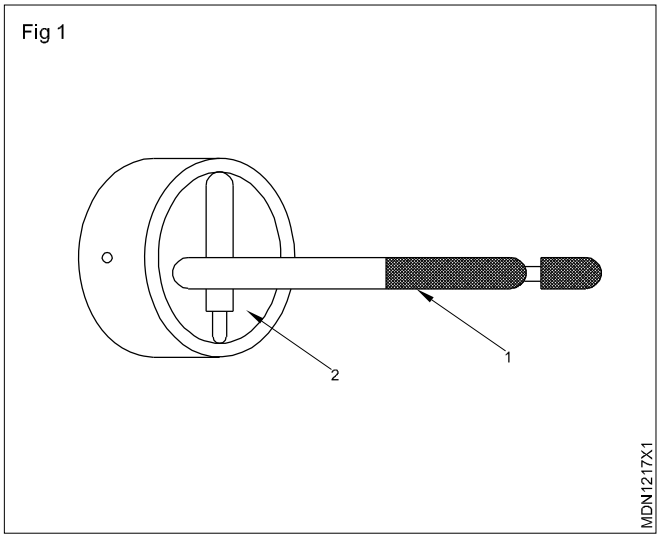
6 Move the gauge slightly inside the connecting rod bore and get the correct feel.

7 Lock the telescopic gauage (1).

8 Remove it gently from the connecting rod bore.

9 Transfer the measurement to an o/s micrometer & read compare the reading with service manual specified limit.

Fig 1



TASK 3 : **Measuring practice on inside diameter of a cam-shaft bearing with telescopic gauge**

1 Measure the approximate size of cam-shaft bearing (2) with steel rule.

2 Select a suitable range of a telescopic gauge (1). (Fig 1)

3 Press the moving legs gently and place it inside cam-shaft bearning (2).

4 Release and press and allow both legs to touch on the wall of the cam-shaft bearing (2).

5 Keep the telescopic gauge perpendicular to the diameter of the cam-shaft bearing.

6 Move the gauge slightly inside the cam-shaft bearing & get the correct feel.

7 Lock the telescopic gauge.

8 Remove it gently from the cam-shaft bearing.

9 Transfer the measurement to an o/s micro-meter & read the measurement and compare with manufactures standard specification.

Practice on measuring cylinder bore

Objectives: At the end of this exercise you shall be able to
- **remove the connecting rod with piston**
- **clean the cylinder bore**
- **measure the cylinder bore diameter, wear/ovality/tapperness with a micrometer and bore dial gauge.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Bore diagauge - 1 No.

Equipments

- Engine block - 1 No.

Materials

- Banian cloth - as reqd.
- Cotton waste - as reqd.
- Paper - 1 No.
- Pencile - 1 No.

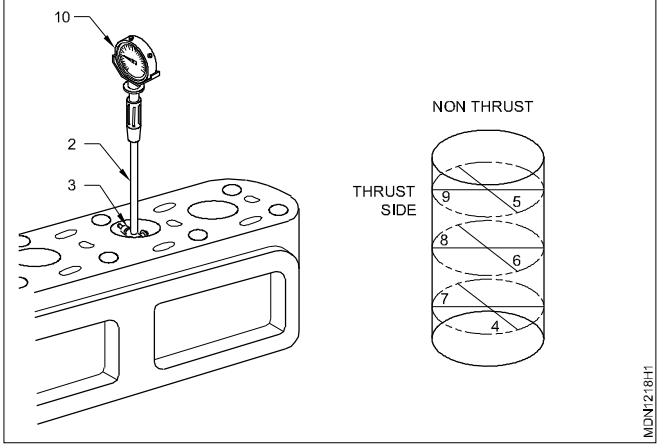
PROCEDURE.

Checking taper ovality of cylinder bore. (Fig 1)

Clean cylinder bore with a piece of cloth.

Measure inside diameter of the bore with an inside micro meter

Fig 1



Select the correct size of extension rod (1) which is more than measuring range.

Assemble the extension rod on the stem of the dial test indicator (2) and with the help of 75-100mm outside micrometer set "0".

Press the spring loaded plunger end (3).

Tilt the bore gauge and insert into the bore, check gauge parallel to measuring spindle note the needle returning point.

Take measurement at (5) with the bore gauge and note down the reading.

Take another reading at 6 & 4 note down the reading.

Repeat above at three places (9, 8 & 7).

The difference in measurement between (9) & (5), (8) & (6) and (7) & (4) is ovality. The difference in measurement between (9) and (8), (8) and (7), and (9) and (7) is taper.

Note down maximum ovality and taper. If any one of them is more than the specified limit, recommend for reboring/ replacement of liner.

Practice on measuring runout and end play of crank shaft

Objectives: At the end of this exercise you shall be able to
- **check wear of crank shaft**
- **check end play of crank shaft**

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 No.
• Out side micrometer	- 1 No.
• Feeler gauge	- 1 No.
• Dial indicator	- 1 No.
• Magnetic base	- 1 No.

Equipments

• Diesel Engine	- 1 No.
• Work bench	- 1 No.

Materials

• Banian cloth	- as reqd.
• Cotton waste	- as reqd.
• Crank shaft	- 1 No.
• Valve guide	- 1 No.
• Fly wheel	- 1 No.

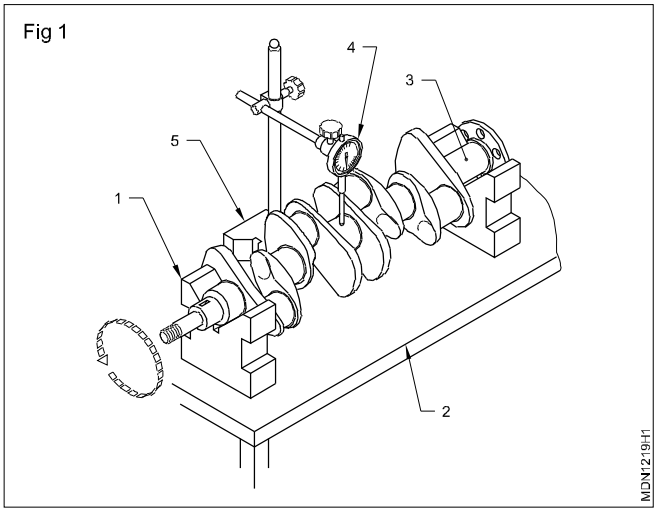
PROCEDURE

TASK 1 : **Check wear of crank shaft (Fig 1)**

Place two 'V' blocks (1) on the surface table (2).

Place the shaft(3) on the 'V' blocks and adjust the distance between the 'V' blocks in such a way that on either side of the 'V' block the shaft does not over hang more than 1/ 10th of its total length

Fig 1



Place the dial indicator with the magnetic base (5) on the surface table.

Bring the dial indicator (4) at the centre of the shaft (3)

Push the dial indicator's (4) needle on the shaft so that the needle shows some deflection.

Adjust the indicator's needle to 'O' position by rotating the dial.

Rotate the shaft (3) by hand and note down the deflection of the needle. This will give the bend of the shaft at the centre.

Repeat the above steps at three places, so as to cover the complete length of the shaft (3).

Note down the maximum wear at all the places.

Replace the shaft, if the maximum bend at any one or more places is found more than the limit specified by the manufacturer.

— — — — — — —

TASK 2 : **Checking crankshaft end play (Fig 1)**

Fix the magnetic base (10) on the cylinder block (11) or on inspection table.

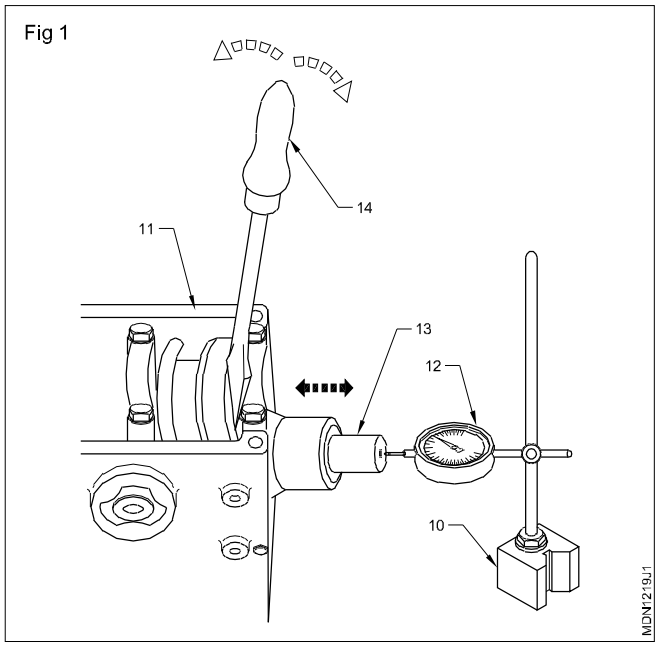
Set the dial gauge (12) on the crankshaft flange (13)

Set the dial gauge for 'O' (zero).

By using the lever (14) move the crankshaft forward and backward.

Note down the crankshaft end play and compare with the manufacturer's specifications.

Fig 1



TASK 3 : **Check the wear of valve guides**

Place the dial indicator with a magnetic base on the face of the cylinder head (Fig 1).

Fig 1

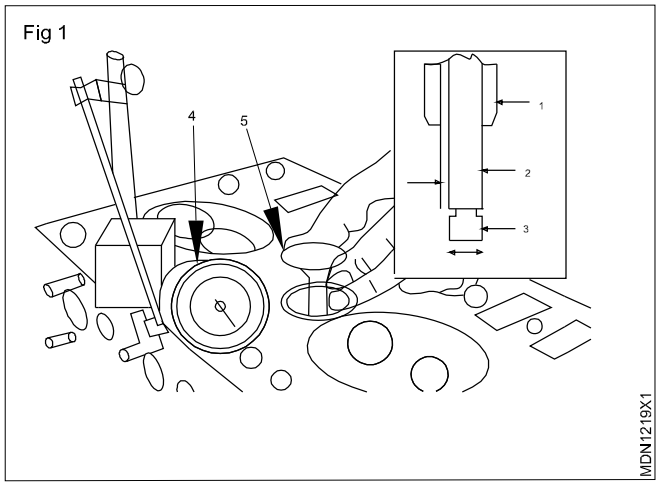
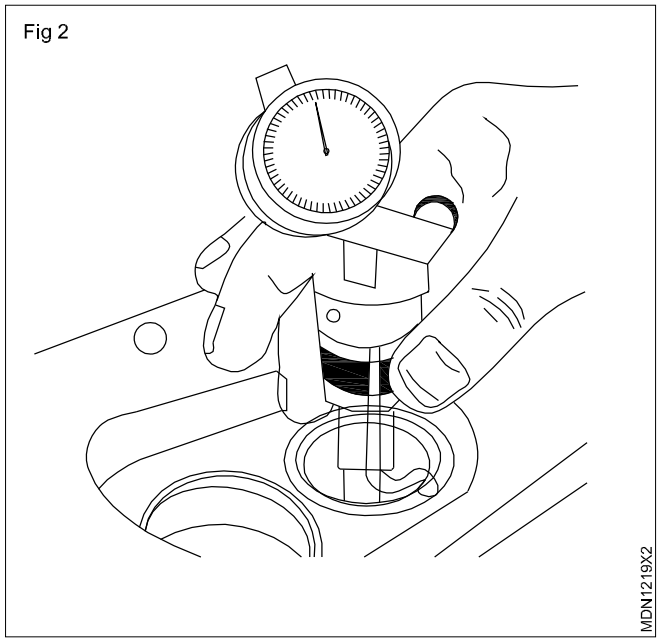


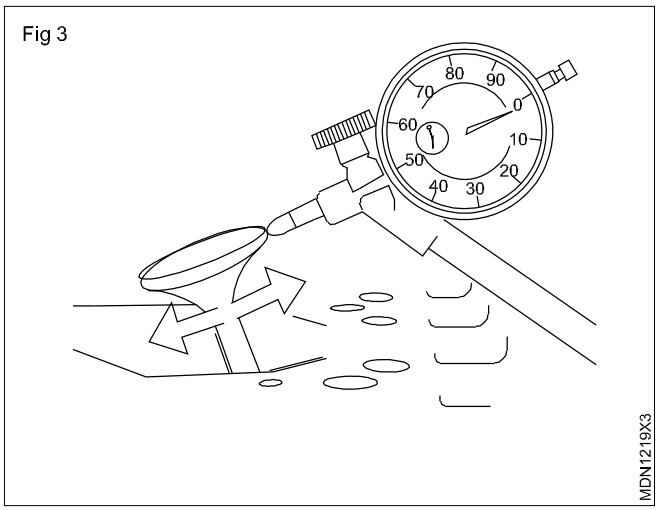
Fig 2



1 Set the position of the needle of the dial indicator to zero (Fig 2).

2 Move the valve in a radial direction away from the dial indicator as far as possible (Fig 3).

Fig 3



3 Possition the contact point of the dial indicator on the edge of the valve head (Fig 3).

4 Move the valve in a radial direction towards the dial indicator as far as possible (Fig 3).

5 Note the distance of movement on the dial indicator.

If the distances is greater than the maximum clearance of the valve in the valve guide, replace the valve guide. This is called service wear.

Note : All 'lubricant must be removed from the outside of the inlet and exhaust valve guides before the valve seal in installed. Do not cut valve seat before the valve guide is installed.

Practice on measuring cylinder head flatness

Objectives: At the end of this exercise you shall be able to
- **check flatness of surface by straight edge and feeler gauge.**

Requirements

Tools/Instruments

- Trainee's tools kit - 1 No.
- Straight edge - 1 No.
- Long leaf feeler gauge - 1 No.

Equipments

- Work table - 1 No.

Materials

- Cylinder head - 1 No.
- Banian cloth - as reqd.
- Cotton waste - as reqd.

PROCEDURE

Check engine head flatness by feeler gauge

1 Clean the cylinder head surface to be checked. (Fig 1)

2 Place part (1) on a plain surface, so that surface, to be checked, faces upward.

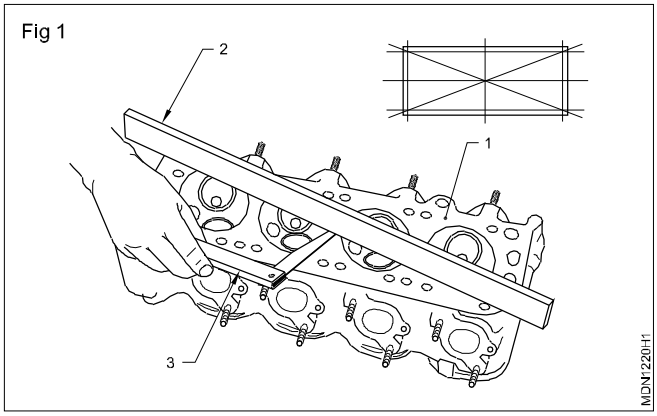
3 Keep the straight edge (2) on surface and press the straight edge at the centre with your left hand.

4 Insert the feeler gauge (3) leaves between the straight edge (2) and the surface.

5 Note down the thickness of the thickest leaf/leaves which can be inserted between the straight edge (2) and the surface. This thickness gives the maximum face out in that direction.

6 Repeat the above steps in 4 directions and note down the maximum face out in all the 4 directions.

Fig 1



7 Recommend for resurfacing/replacement of parts (1) if maximum face out in any one or more directions is more than the limit specified by the manufacturer.

Measuring piston ring end gap and piston to cylinder clearance

Objectives: At the end of this exercise you shall be able to
- **check the piston ring end gap**
- **check piston to cylinder wall clearance.**

Requirements

Tools/Instruments

- Trainee's tools kit - 1 No.
- Feeler gauge - 1 No.

Equipments

- Diesel engine - 1 No.
- Work table - 1 No.

Materials

- Piston - 1 No
- Piston rings - 1 No.
- Engine block with liner - 1 No.
- Banian cloth - 1 No.
- Cotton waste - 1 No.

PROCEDURE

Check end gap of piston ring and piston to cylinder wall clearance with the feeler gauge (Fig 1)

1 Clean the cylinder bore (1) thoroughly.

2 Insert the piston ring inside the cylinder bore squarely.

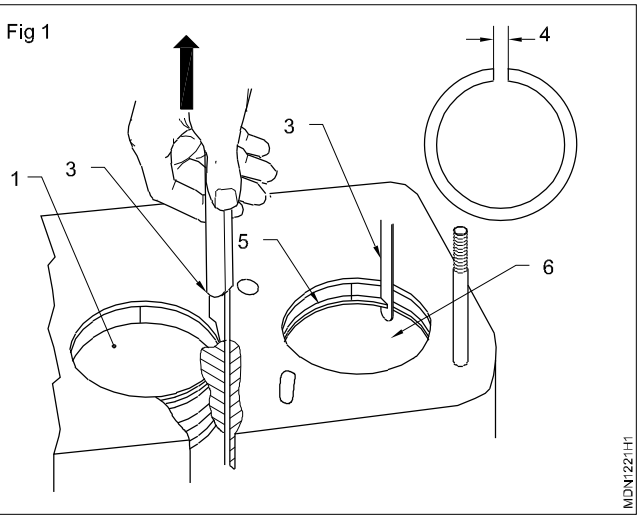
3 Use a bore piston to place the piston ring square in the liner/bore.

4 Insert feeler gauge and measure the piston ring end gap (4).

5 Remove the piston ring and Clean the cylinder bore.

6 Insert the piston without piston ring inside the cylinder bore. (Fig 1)

Fig 1



7 Insert long leaf feeler gauge between piston and cylinder bore.

If it is tight, reduce the thickness of feeler gauge and verify with the bore piston.

If the bore piston moves very free, increase the feeler gauge thickness.

8 Calculate the thickness of feeler gauge, which allows movement of piston with a slight pressure.

This thickness is the piston to cylinder wall clearance match the same with the company specification.

9 Remove the piston from the cylinder bore.

Perform engine vacuum test

Objectives: At the end of this exercise you shall be able to
- **check the engine vacuum test.**

Requirements

Tools/Instruments

• Trainee's tool kit	- 1 Set.
• Vacuum gauge	- 1 No.

Equipments

• Running Engine Petrol / Diesel	- 1 Set.

Materials

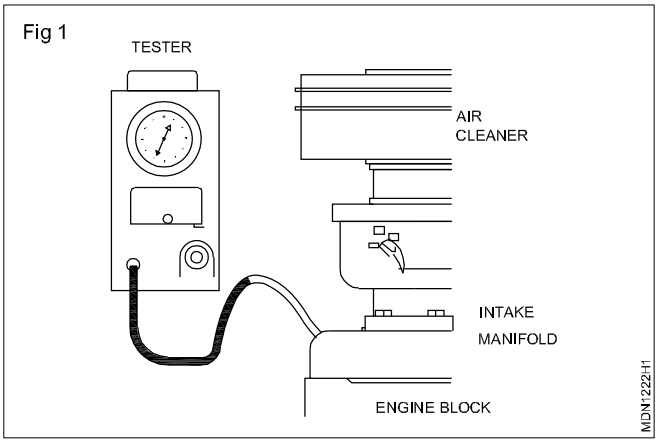
• Rubber hose	- as reqd.
• Cotton waste	- as reqd.
• Paper A4 sheet	- 1 Sheet.
• Pencil/Pen	- 1 No.

PROCEDURE

1 Warm up the given engine.

2 Connect the vacuum gauge to the intake manifold (disconnect vacuum booster is used) (Fig 1).

Fig 1



3 Read the vacuum gauge reading at idle speed, normal speed & high speed.

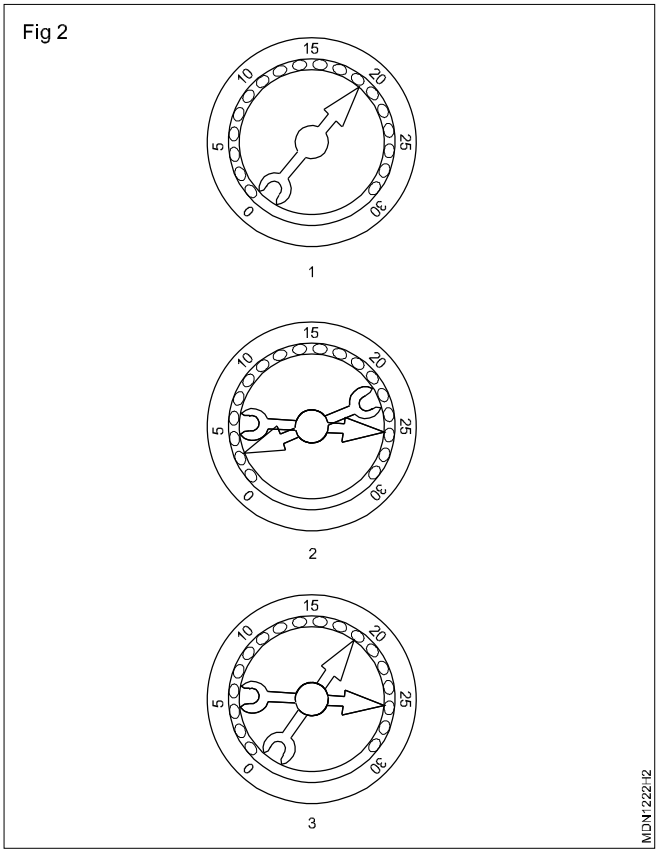
List the reading (measurement) one by one.

Adjust the gauge damper until needle moves easily without excessive flutter.

Normal reading: needle between 15 and 22 in holding steady. (Fig 2)

Intake leak: A low, steady reading can be caused by an air intake manifold or carburetor mounting flange gasket leak.

Fig 2



Blown head gasket: A regular drop of fair magnitude can be caused by a blown head gasket or wrapped head the block surface.

Deduct 1 inch for each 1,000 feet of elevation.

Check tyre air pressure

Objectives: At the end of this exercise you shall be able to
- **check existing tyre pressure on a vehicle.**

Requirements

Tools/Instruments

- Trainee's tools kit - 1 No.
- Tyre pressure gauge - 1 No.
- Air pressure inflating unit - 1 No.
- Air valve remover - 1 No.

Equipments

- Running Vehicle - 1 No.

Materials

- Cotton waste - as reqd.
- Air valve - as reqd.
- Valve cap - as reqd.

PROCEDURE

1 Remove valve cap / clean the valve externally.

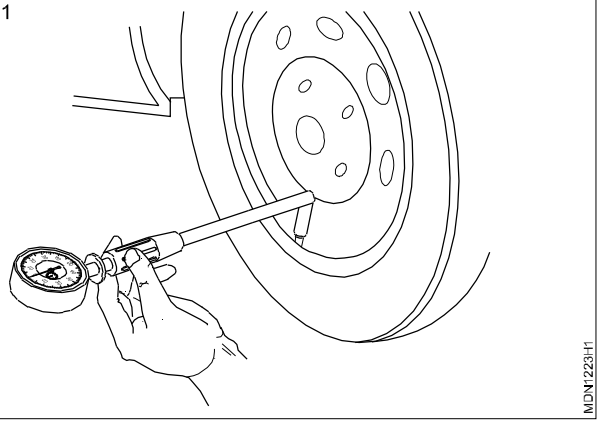
2 Insert tyre pressure gauge & take the reading. (Fig 1)

3 Compare with the recommended pressure.

4 Check if tyre needs inflation or deflection.

5 If it is to be inflated, insert the air inflator & watch the tyre pressure reading in the gauge.

Fig 1



Some equipments than the facility to preset the air pressure. Once the preset pressure is achieved, it automatically trips.

6 Check if the air valve is leaking.

7 If there is no leak, replace the cap.

Caution:

1 Never check tyre pressure, when tyre is hot after a long run.

2 Ensure there is sufficient air in Air tank and free from contamination like water, oil, dust etc.

Cleaning and checking the fastners

Objectives: At the end of this exercise you shall be able to
- **fasten castle nut on axle shaft**
- **fasten self locking nut on propeller shaft**
- **fasten hexagonal nut on two flat surfaces**
- **fasten hexagonal nut with collar on tappet cover.**

Requirements

Tools/Instruments

- Spanner (DE & Ring) - 1 Set each.
- Nose plier, copper drift - 1 Set each.

Equipments

- Work bench & vice - 1 No.

Materials

- Kerosene & Cotton waste - as reqd.
- Axle shaft and castle nuts - as reqd.
- Propeller shaft and self locking bolt - as reqd.
- Hexagonal nut with washers - as reqd.

PROCEDURE

TASK 1 : **Fasten castle nut**

1 Clean the Axle Shaft threaded end.

2 Note down the thread size & type of thread.

3 Select the proper size of castle nut. (Fig 1)

4 Tighten the castle nut by hand, one or two threads only.

5 Select proper spanner for tightening the castle nut.

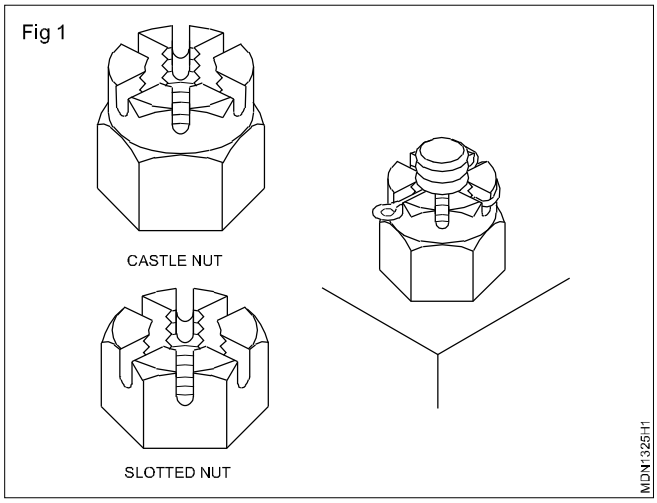
6 Tighten the castle nut.

7 Align the Axle Shaft hole and slot of the castle nut.

8 Insert a split pin through the Axle Shaft hole & slots of castle nut.

9 Spread the split ends of the split pin.

Fig 1



TASK 2 : **Fasten self locking nut**

1 Clean the flange of the propeller shaft.

2 Select the proper size of nut & bolt to be fitted.

3 Insert the bolt into the slot of the flange.

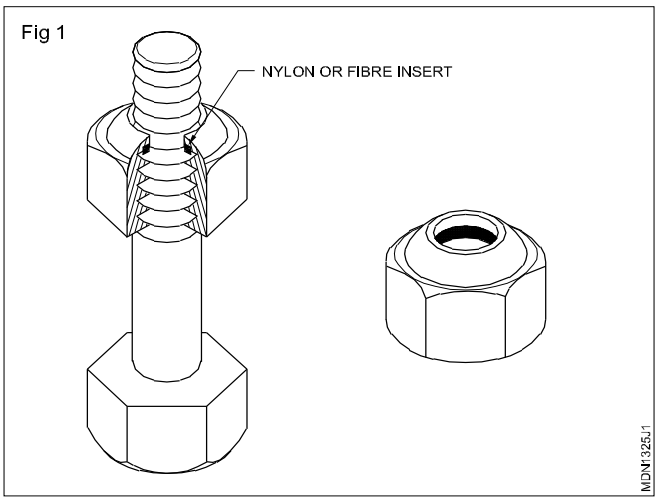
4 Tighten the self locking nut by hand one or two threads only. (Fig 1)

5 Select proper spanner for tightening the self locking nut.

6 Tighten the self locking nut.

Do not overtight on the self locking Nut

Fig 1

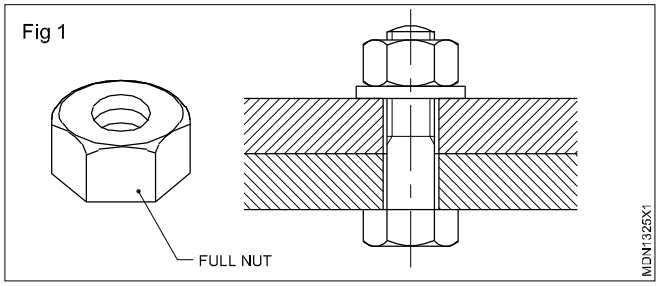


TASK 3 : **Fasten hexagonal nut**

1 Select the two flat surface components to be fastened.

2 Select a proper size of hexagonal Nut & Bolt. (Fig 1)

Fig 1



3 Insert the Bolt in the hole of matching components.

4 Place a flat washer at the threaded end.

5 Select the correct spanner to tighten the particular size of that nut.

6 Tighten the hexagonal nut.

7 Select a same size of hexagonal lock nut.

8 Tighten the lock nut by holding the earlier tighten nut with spanner.

Correct size of ring spanner should be used.

Nut & Spanner should be free of oil and dirt.

— — — — — — —

TASK 4 : **Fasten hexagonal nut with washer.**

1 Clean the Bolts of Tappet cover.

2 Select proper size of hexagonal nut with caller. (Fig 1)

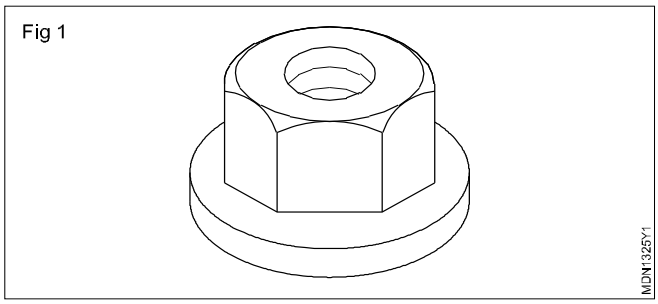
3 Tighten the hexagonal nut with collar by hand one or two threads only.

4 Select proper spanner for tightening the nut.

5 Tighten the nut with specified torque.

Do not overtighten.

Fig 1



Safety: Avoid using oversized spanner from slippage and getting hurt.

— — — — — — —

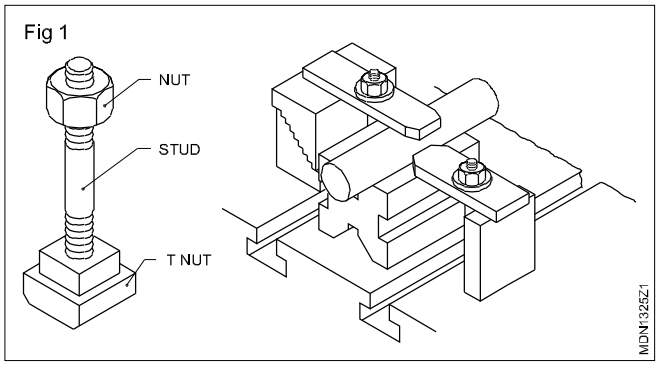
Skill sequence

Fastening of stud

Objectives: This shall help you to
- **measures the pitch of the thread**
- **select the correct size of stud**
- **fasten the given jobs with stud.**

Select the components to be joined. (Fig 1)

Fig 1



Select the correct size of stud, according to the tapping on the component.

Insert the stud on the tap and turn, the stud use 2 nuts to lock the stud.

Tighten the stud with help of a proper spanner.

After tightening the stud lock the stud shank with the vice grip plier.

Use two spanners to remove the nuts from stud.

Studs are used in assemblies which are to be separated frequently.

Safety precaution:

Before inserting the stud. Taps holes & stud threads to be cleaned properly.

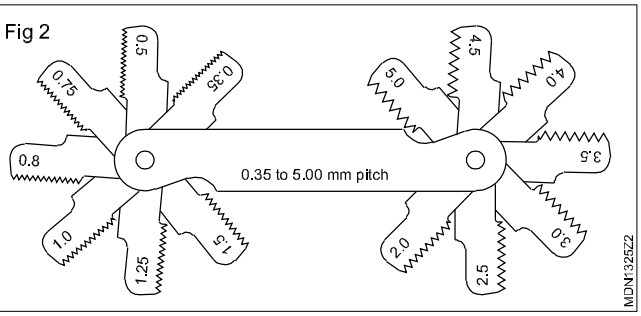
Measure the thread with the thread Pitch Gauge (Fig 2)

Select the stud of internal thread to be measured.

Clean the surface of the thread.

Select any one of the blade from the screw pitch gauge.

Fig 2



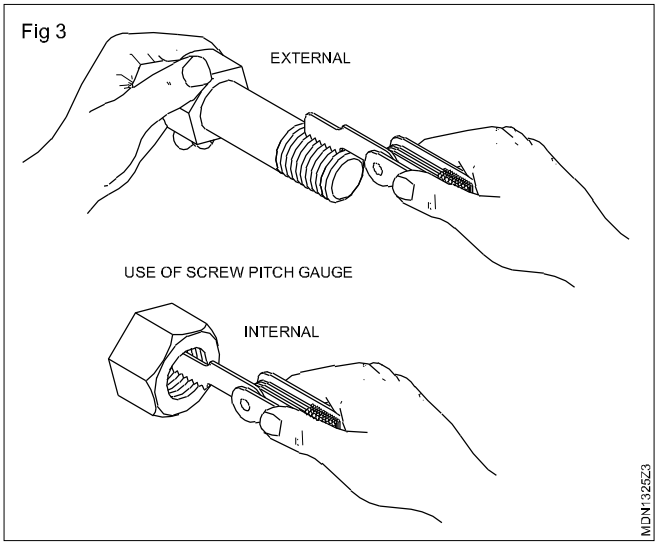
Place the blade on the thread to be measured. (Fig 3)

If the pitch matches with the thread then the pitch of the thread will be the same as marked on the blade.

If not, select other blades and identify the blade perfectlymatches with the thread.

The number marked on the blade which matches perfectly the same will be the pitch of the thread.

Fig 3



For accurate results, the full length of the stud to be placed on the threads.

Removing broken stud/bolt

Objectives: At the end of this exercise you shall be able to
- **remove the broken stud below the surface using the ezy-out (stud extractor).**

Requirements

Tools/Instruments

- Trainee's tools kit - 1 No.
- Tap wrench - 1 Set.
- Stud extractor - 1 Set.

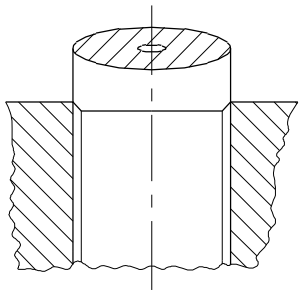
Materials

- Cylinder block with broken stud - 1 No.
- Cotton waste - as reqd.

PROCEDURE

1 File flat on the top surface of the stud. (Fig 1)

Fig 1

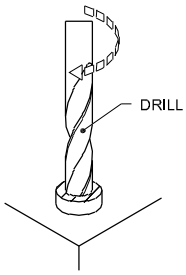


2 Locate the centre and centre punch it.

3 Select the ezy-out and the recommended drill size from Table 1.

4 Drill a hole on the centre punch mark. (Fig 2)

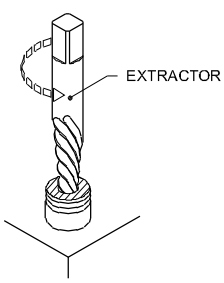
Fig 2



5 Check the hole is perpendicular.

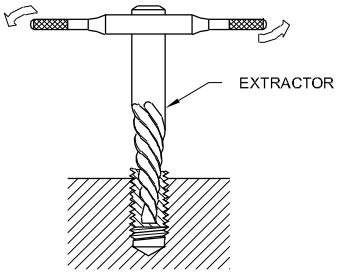
6 Set the ezy-out (stud extractor) on the drilled hole. (Fig 3)

Fig 3



7 Turn it anticlockwise by a tap wrench. (Fig 4)

Fig 4



As the ezy-out penetrates into the stud, the grip increases and gradually the broken stud portion unscrews.

8 Replace a new stud in position after lubricating the threads.

9 File two sides of the studs flat above the surface.

10 Use a wrench and unscrew to remove the broken stud out. (Fig 4)

Table 1

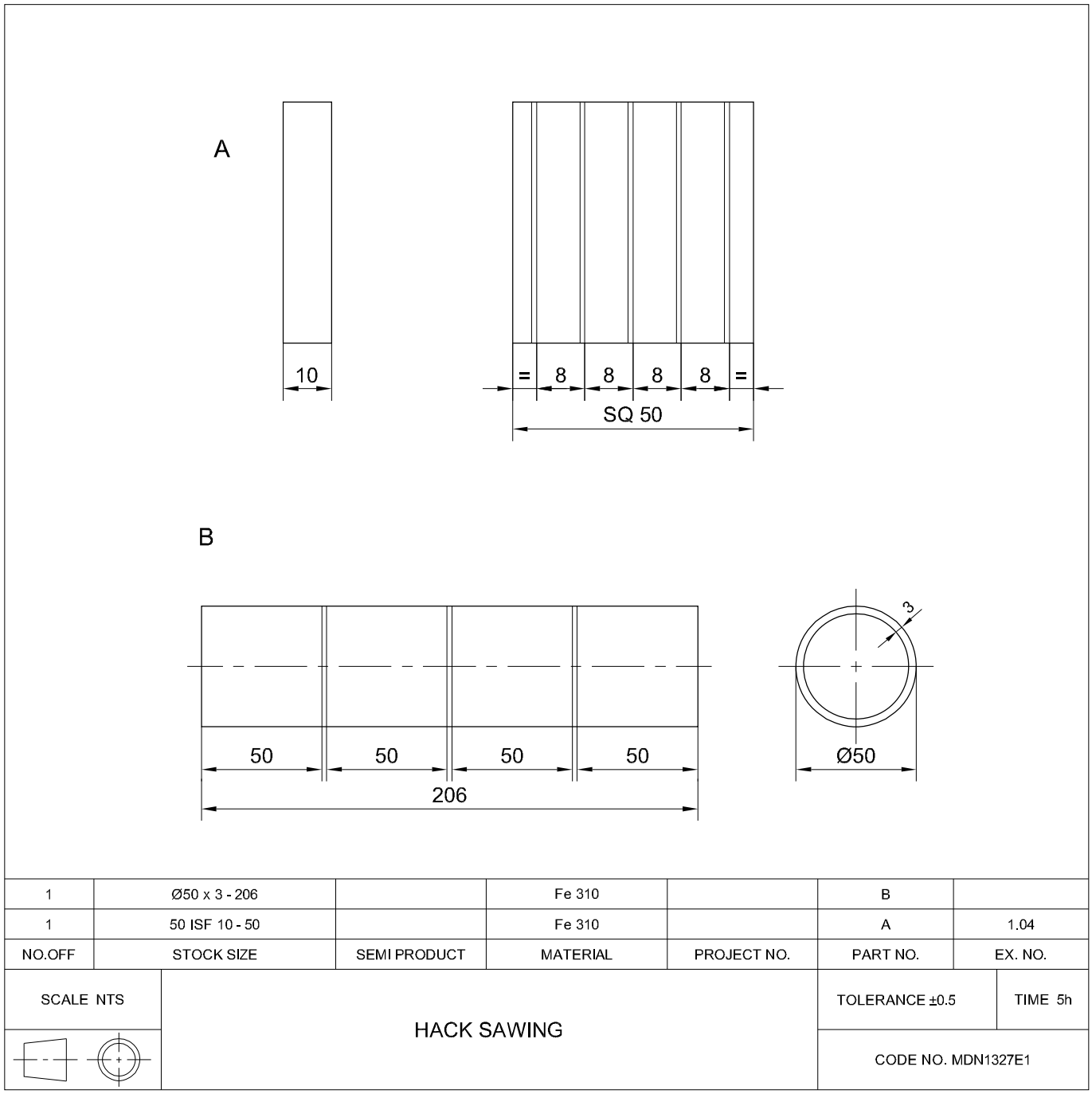
Recommended drill and Ezy-out size for the extraction of broken stud and bolt.

Suitable for screw size	Drill size to be used	Ezy-out No. to be used
1/8" to 1/4" (3 to 6 mm)	5/64" (2 mm)	1
Over 1/4" to 5/16" (6 to 8 mm)	7/64" (2.8 mm)	2
Over 5/16" to 7/16" (8 to 11 mm)	5/32" (4 mm)	3
Over 7/16" to 9/16" (11 to 14 mm)	1/4" (6.3 mm)	4
Over 9/16" to 3/4" (14 to 19 mm)	17/64" (6.7mm)	5

Practice on using various cutting tools

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

- **cut a mild steel flat along a straight line using a hack saw**
- **flat filing practice along with flatness checking**
- **cut the given m.s. sheet in to two pieces along its length using chisel**
- **sharpening of chisel in grinder**
- **sharpening of center punch in grinder**
- **safety precaution in grinding tools.**

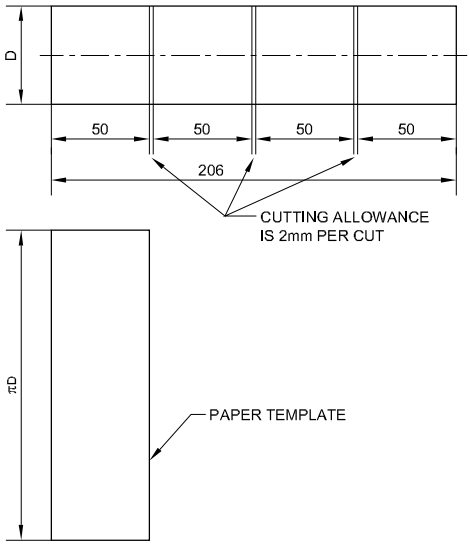


1	Ø50 x 3 - 206		Fe 310		B	
1	50 ISF 10 - 50		Fe 310		A	1.04
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	HACK SAWING				TOLERANCE ±0.5	TIME 5h
					CODE NO. MDN1327E1	

PROCEDURE

- Check the size of the given M.S flat Job.
- Apply copper sulphate solution and allow it to dry
- Layout lines as per drawing using a scriber taking measurement from the edge and punch mark the lines using a dot punch and hammer.
- Cut by hacksaw along the lines.
- Remove burrs, if any by filling.
- Mark lines as per drawing using a paper template and puch mark the line. (Fig 1)

Fig 1



Skill Sequence

Holding the workpiece

Objectives: This shall help you to
- **holding the work piece**
- **fixing of hacksaw blades.**

Holding the workpiece: Position the metal to be cut according to the cross-section i.e a plate, a pipe or a channel for hacksawing.

As far as possible the job is held so as to be cut on the flat side rather than the edge or the corner. This reduces the blade breakages. (Fig 1, 2 and 3)

Fig 1

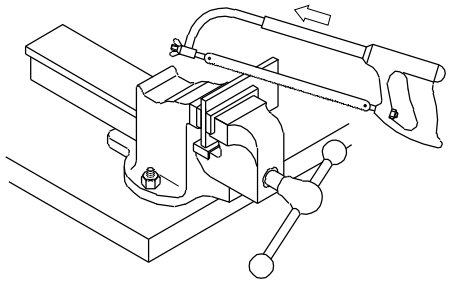


Fig 3

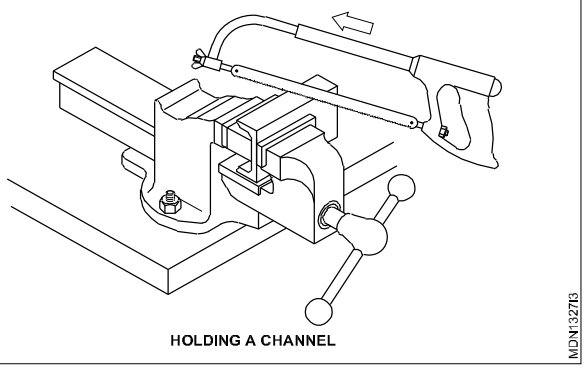
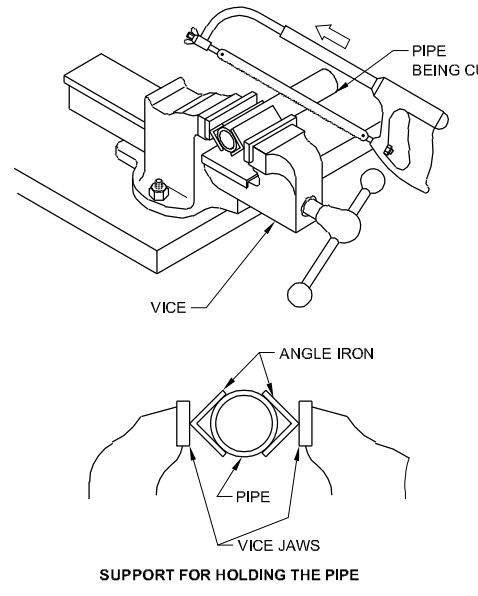


Fig 2



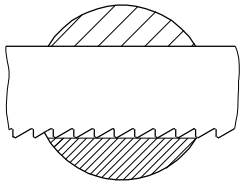
The selection of the blade depends on the shape and hardness of the material to be cut.

Pitch selection: For soft materials such as bronze, brass soft steel, cast iron etc. use a 1.8 mm pitch blade. (Fig.4)

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

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

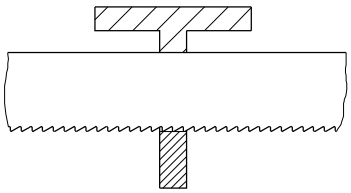
Fig 4



MORE CHIP CLEARANCE

MDN1327I4

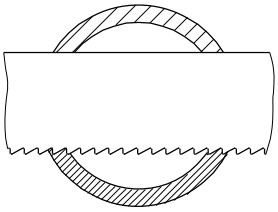
Fig 5



TWO OR MORE TEETH ON SECTION

MDN1327I5

Fig 6

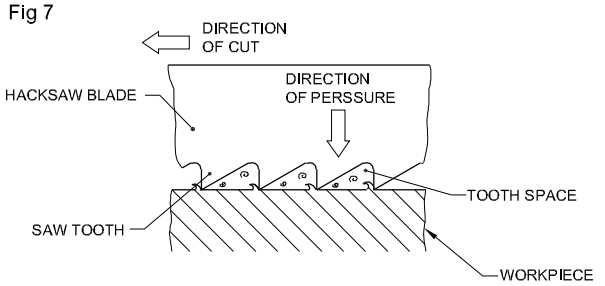


TWO OR MORE TEETH ON SECTION

MDN1327I6

Fixing of Hacksaw Blades: The teeth of the hacksaw blade should point in the direction of the cut and away from the handle. (Fig 7)

Fig 7



MDN1327I7

The blade sholud be held straight, and correctly tightened before starting.

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

Notch means a small groove on the job surface.

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

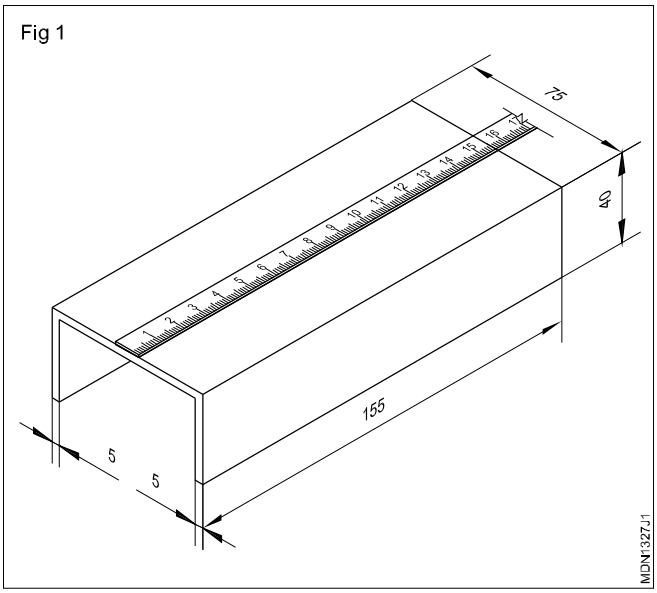
Skill Sequence

Filing and hacksawing

Objectives: This shall help you to
- **file M.S. channel**
- **cutting pipe by hacksaw.**

- Check the material size 155 x 75 x 40 mm equal angle MS channel. (Fig 1)

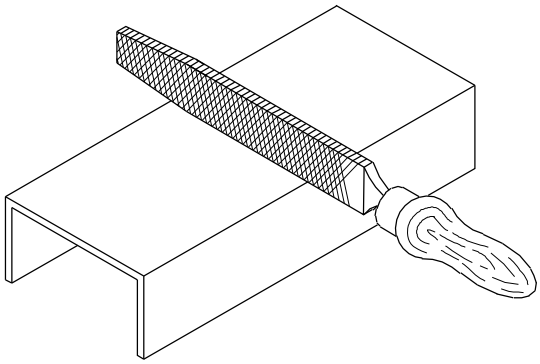
Fig 1



MDN1327J1

- Remove all the rust from all the surfaces by the edge of file, clean by cotton waste. (Fig 2)

Fig 2



MDN1327J2

- Hold the file handle with thumb will be placed firmly to grip the file, left leg will be in forward direction right leg will 300 mm from the front leg. Also check the height of your vice should be on the level of your elbow as in Fig 3.
- Hold the job in bench vice grip firmly from width of the channel. (Fig 4)

Fig 3

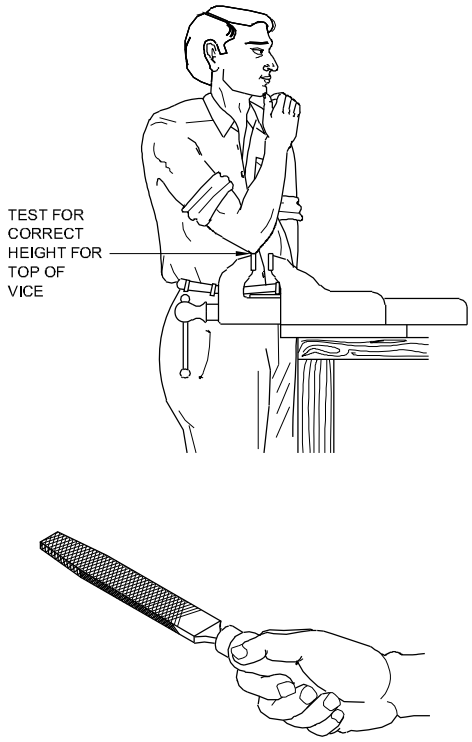
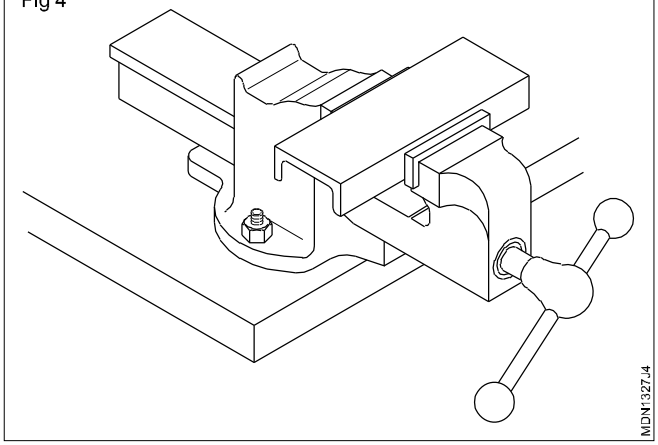
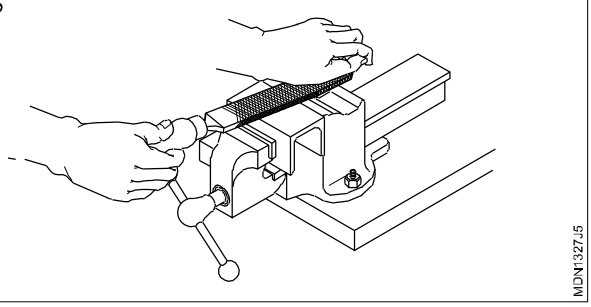


Fig 4



- Place file on the job and start filing while file will go in forward direction develop pressure on job, at return stroke release (Fig 5) the pressure and changes the place file and go for next area. (Fig 6) Like that complete operation and check flatness with the help of trysqure blade.

Fig 5



- Open the job and start on (A) side filing as directed previously. Check the squareness along with (B). (Fig 7)

Fig 6

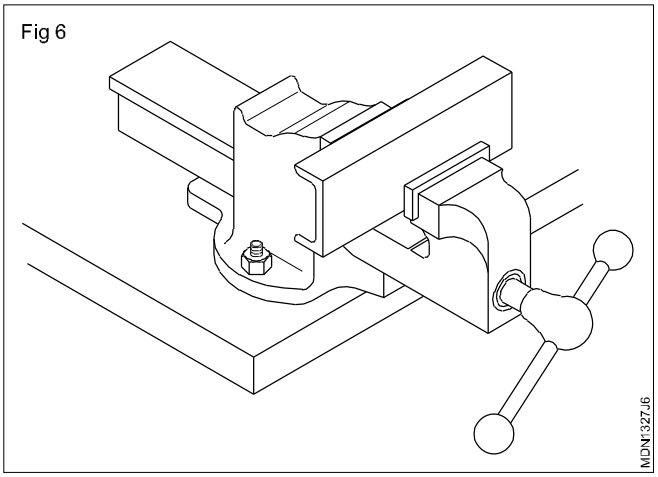
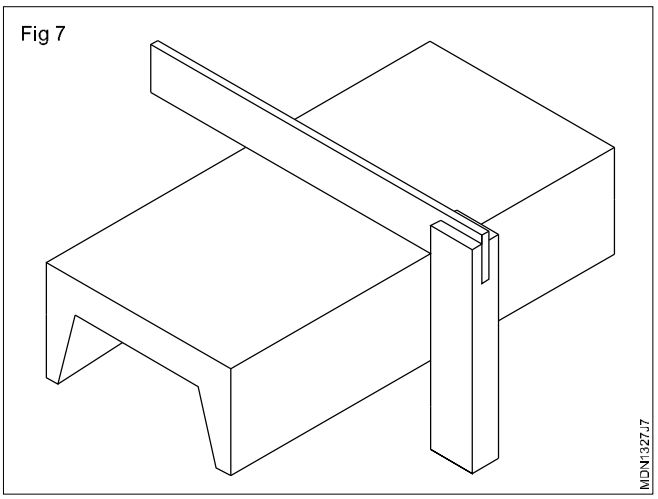
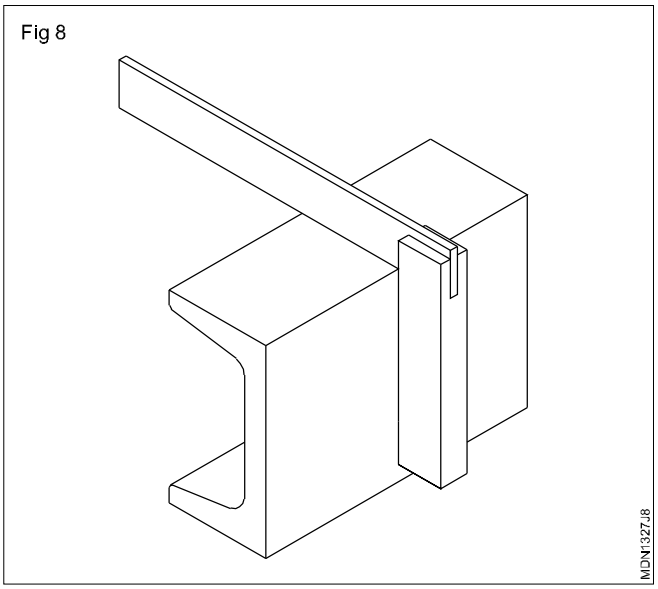


Fig 7



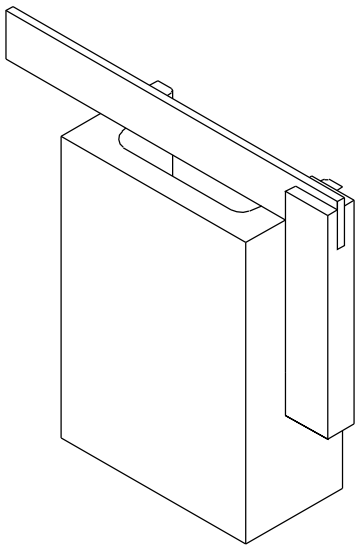
- Open the job and start on (D) (Fig 6) side filing as directed previously. Check the squareness along with (A). (Fig 8)

Fig 8



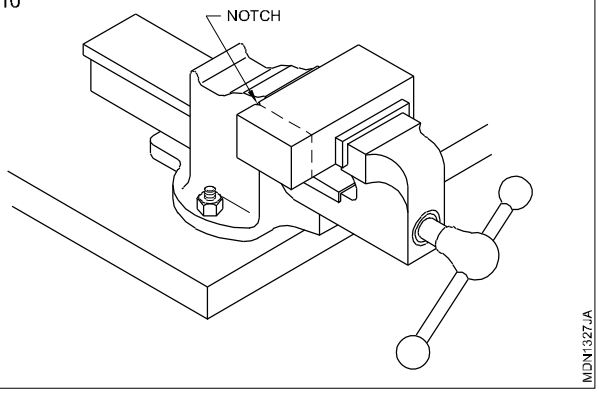
- Open the job and start on (C) side filing as directed previously. Check the squareness along with (A,B&D). (Fig 9)
- Open the job and start on (F) side filing as directed previously. Check the squareness along with (AB&D). (Fig 10)

Fig 9



MDN1327J9

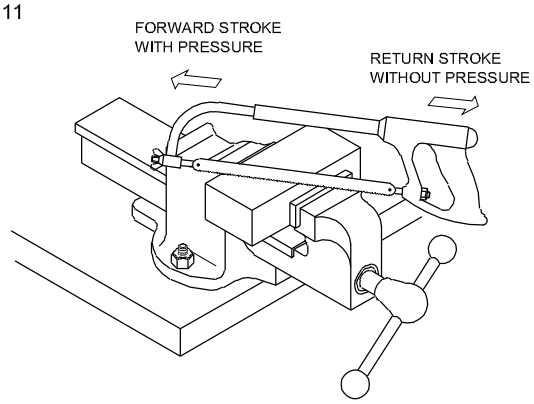
Fig 10



MDN1327JA

- Apply pressure only during the forward stroke. (Fig 11)

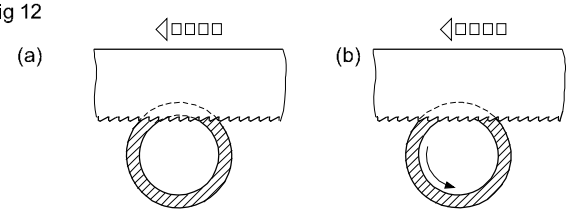
Fig 11



MDN1327JB

- Atleast two to three teeth should be in contact with the work while cutting. Select fine pitch blade i.e 0.8 or 1 mm pitch for thin work and for cutting pipes. (Fig. 12a)
- Turn and change the position of the pipe while hacksawing (Fig.12b)

Fig 12



MDN1327JC

- While cutting pipes by hacksawing a paper template is made and wrapped over the pipe to get the line of cut marked on the circumference of the pipe.
- Normally, a coolant is not necessary while hacksawing.

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

Skill Sequence

Cutting M.S. sheet by chisel

Objectives: This shall help you to
- **cut the M.S. sheet by chisel**
- **sharp the chisel**
- **sharpen the centre punch**
- **check the centre punch angle.**

Cutting M.S.sheet by chisel

A hard and strong support is essential under the sheet to ensure the chisel properly penetrates into the job and cuts the sheet. (Fig 1)

The chisel has to be held vertically to get an effective cutting action.

Sometimes the job is clamped to the work bench or to the steel pad by “C” clamps so that the job will not slip while chiselling. After making cut on the marked line, move the chisel approximately for 80% of the length of the first cut and again make a cut. This is done to ensure that the cutting action continues progressively along the marked line and no portion of metal will be left uncut. In addition the cutting edge of the chisel can be positioned properly along the line of cut which will avoid a zig zag cutting. (Fig 2)

Proceed to make cuts by the flat chisel as explained above until the entire length (i.e 150mm) of the job is cut on the punch marked line.

Fig 1

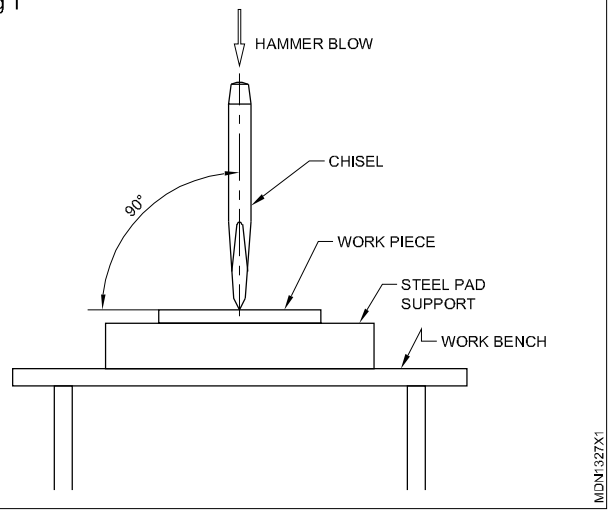
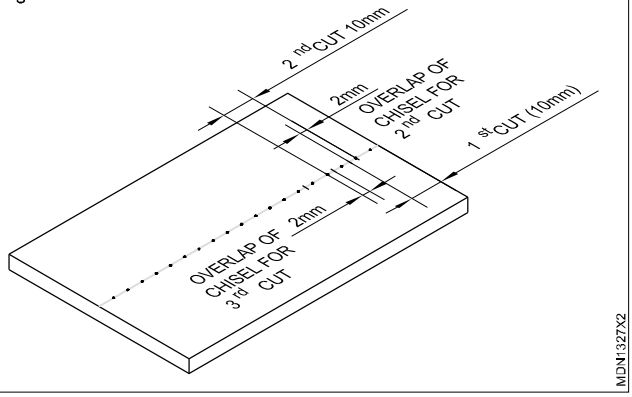


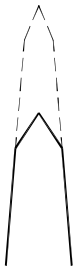
Fig 2



Sharpening the chisel

Chisels will become blunt due to use. For efficiency in chipping, the chisels are to be re-sharpened regularly. (Fig 3)

Fig 3



Chisels are sharpened on grinding machines. (Fig 4)

Inspect the tool-rest. If there is too much of a gap between the tool-rest and the wheel, adjust it, and position it as close to the wheel as possible. (Fig 5)

Ensure that there is sufficient coolant in the container.

While grinding, rest the body of the chisel on the tool-rest (A), and allow the point to touch the wheel.

Fig 4

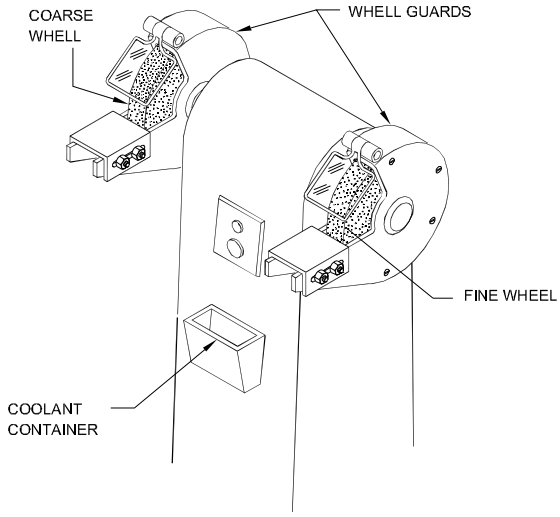
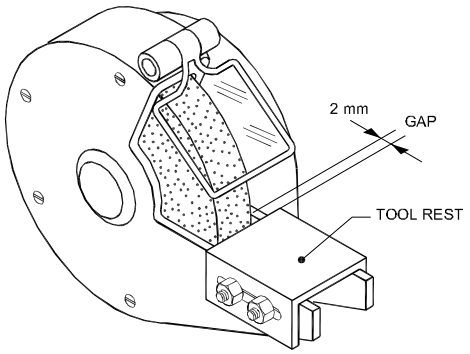


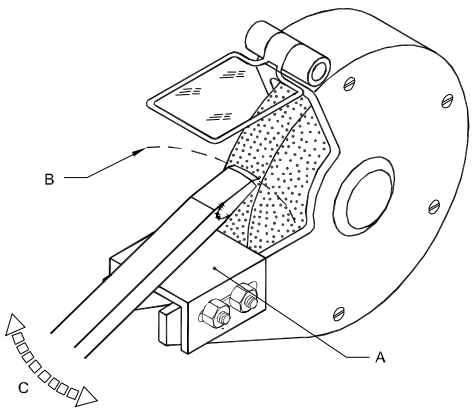
Fig 5



Rock the point slightly on both sides in an arc (B) to provide a slight convexity at the cutting edge. This will help to avoid digting in of the sides while chipping.

Keep moving the chisel across the face (C) to prevent formation of curves and grooves at the cutting edge. (Fig 6)

Fig 6



After re-grinding many times, the cutting edges become too thick. Such chisels are unsuitable for resharpening. They should be forged and brought to shape before grinding.

Check the wheel guards are in place, and are securely fastened.

Inspect the condition of the grinding wheel for breakage and cracks.

Wear safety goggles.

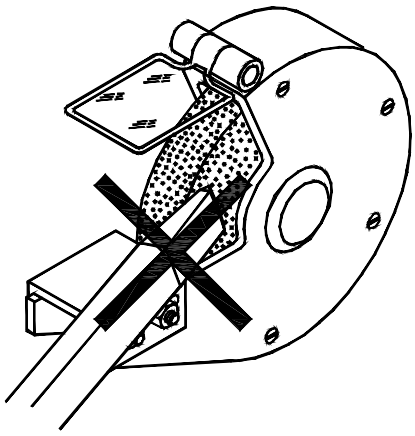
When switching on the grinding machine, stand aside until the wheel reaches the operating speed.

Dip the chisel frequently in the coolant to avoid overheating. Overheating will draw the temper of the chisel.

Clean by grinding, If the chisel-head is mushroomed.

Use only the front of the grinding wheel. Do not grind on the sides. (Fig 7)

Fig 7



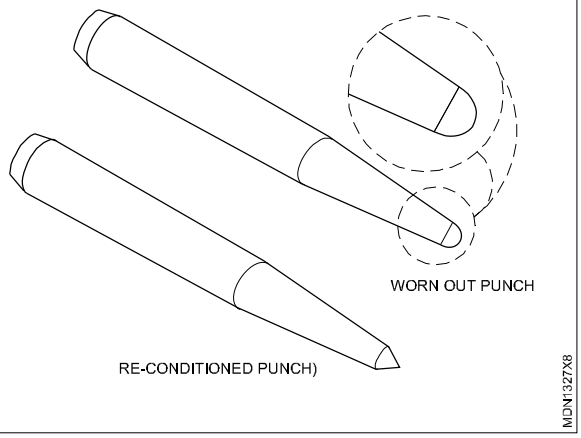
Report to instructor, if any damage to the grinding wheel is noticed.

Do not use cotton waste or other material for holding the chisel while grinding.

Sharpen the centre punch

Arrange workplace & prepare working material. (Fig 8)

Fig 8



Saw the round material to length (only if a original tool is not available).

Face grind on one face:

Press the workpiece in vertical direction against the wheel and turn it slowly arround its axis.

Grind 4 mm chamter on face (Horizontal or Vertical Position)

Press workpiece against the wheel with a setting angle or 45°, in doing so, turn it speedily and uniformly arround its axis.

Grind on a 50 mm long taper proceeding from the other face horizontal positon:

The right hand guides the workpiece, the left fore finger lies between the workpiece and the grinding support - press workpiece in horizontal direction against the wheel, turn it speedly as well as turn it forward and back.

Grind the point - vertical position (Fig 9)

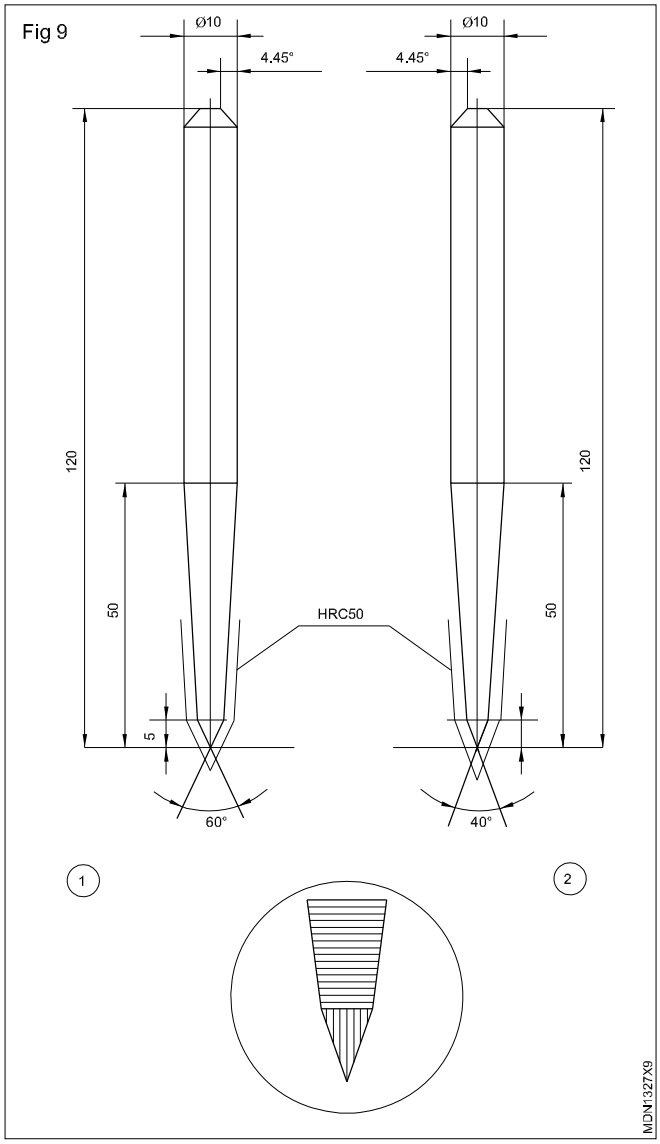
(i) Centre punch 60°

(ii) Scribing / Prick punch 40°

Press against the wheel only slightly with quick turning or it arround its axis.

Check it finally for angle accuracy (as per drawing).

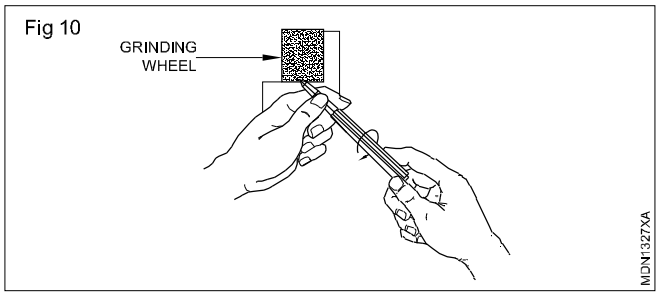
Fig 9



Check the centre punch angle

Sharpen a centre punch hold the end of the punch between the index finger and thumb or one hand as shown in Fig 10, resting that hand on the tool rest or the grinder.

Fig 10



Move the punch into light contact with the rotating wheel or the grinder with the centre line or the punch forming about it 45° angle with the face or the wheel. This will give the approximate 90° included angle required for a centre punch.

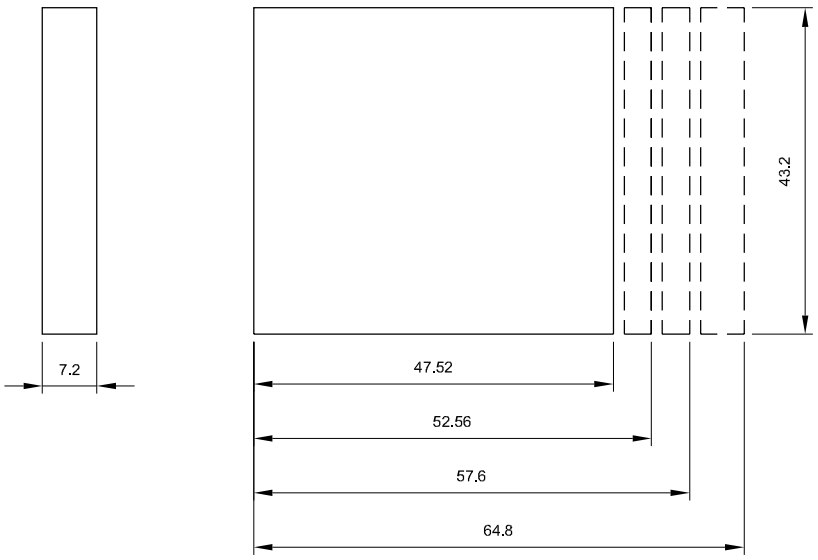
Rotate the punch as shown by the direction arrow in Fig 10 with the thumb & index finger or the other hand

Keep the point cool by using only light pressure on the wheel and by frequently dipping the punch in a can of cooling water.

Sharpening a prick punch in the same way only with the exception that the included angle should be 30° other than 90°, the angle between the centre of this punch and the wheel should be about 15°.

Practice on hacksawing and filing

Objectives: At the end of this exercise you shall be able to
- **mark straight lines using a scribing block**
- **cut on marked lines using a hacksaw blade.**



1		From exercise 2	Fe 310			
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO1.3.08.
SCALE NTS	HACK SAWING				TOLERANCE ±0.5	TIME 5h
					CODE NO. MDN1328E1	

PROCEDURE

1 Check the raw material for its size.

2 File flat and square to finish the block 55 x 10 x 80.

3 Mark centre lines for the holes as per drawing.

4 Drill a pilot hole for concave profile.

5 Saw cut to remove the excess metal for the profile.

6 File with flat file the two sides.

Practice on soldering and brazing

Objectives: At the end of this exercise you shall be able to
- **make a joint by soft soldering**
- **brazing with M.S. plate.**

Requirements

Tools/Instruments

• Trainee's tool kit	- 1 Set
• Blow lamp	- 1 No.
• Eye protector	- 1 No.
• Soldering Iron	- 1 No.
• Gas welding plant	- 1 No.
• welding work table	- 1 No.

Materials

• Wire brush	- 1 No.
• Solder	- as reqd.
• Flux	- as reqd.
• M.S. plate	- as reqd.
• Brazing rod	- as reqd.

PROCEDURE

TASK 1 **: Soft soldering**

1 Clean the area to be joined thoroughly.

2 Where a lap joint is required on mild steel, both sides of the top lap should be cleaned and tinned, to assist heat transfer when soldering.

3 Heat the copper of the soldering iron until the flame is bright green. Keep the edge of the copper bit upward. (Fig 1)

Fig 1

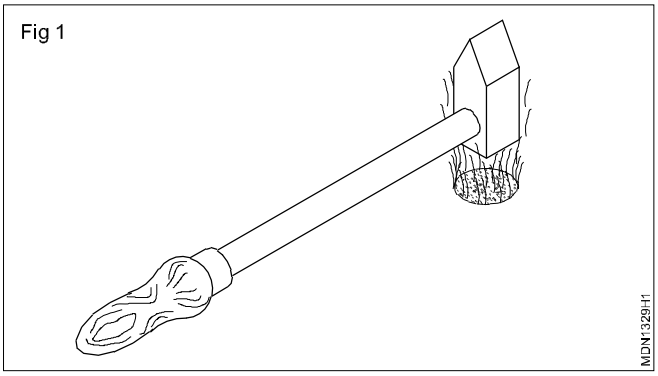
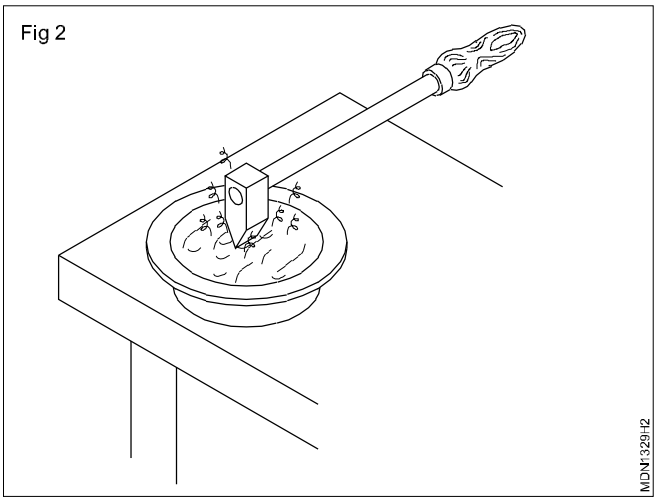


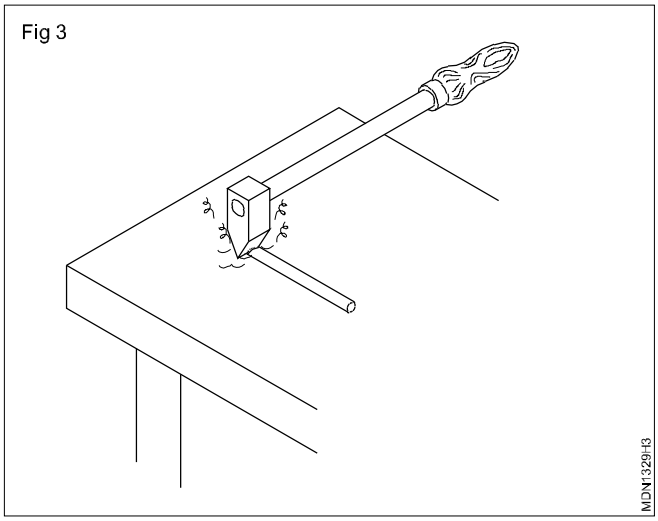
Fig 2



4 Dip the edge of the bit in flux (solder-acid). (Fig 2)

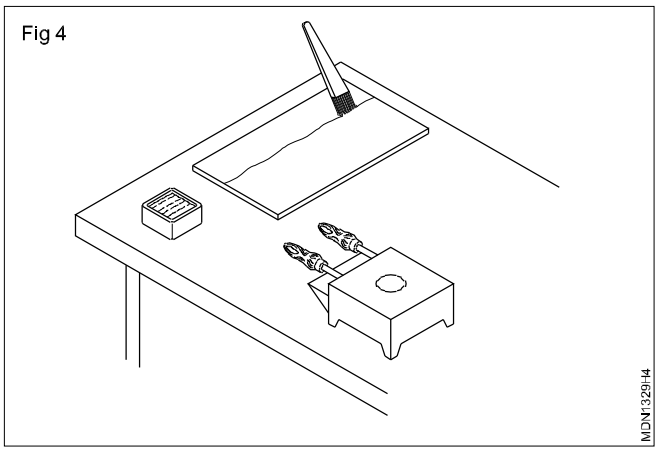
5 The tip is tinned by rubbing it along the solder. (Fig 3)

Fig 3



6 Place the sheet on a soldering bench. (Fig 4)

Fig 4



7 Apply the flux on the area to be joined.

8 Heat the soldering iron until the flame is green, keep the tip of the copper bit upwards.

9 Dip the point into the flux. This will remove the oxide film from the tinned faces.

10 Apply the solder to the point. (Fig 5)

11 Apply the bit to the work.

12 Spread the solder evenly on the surfaces.

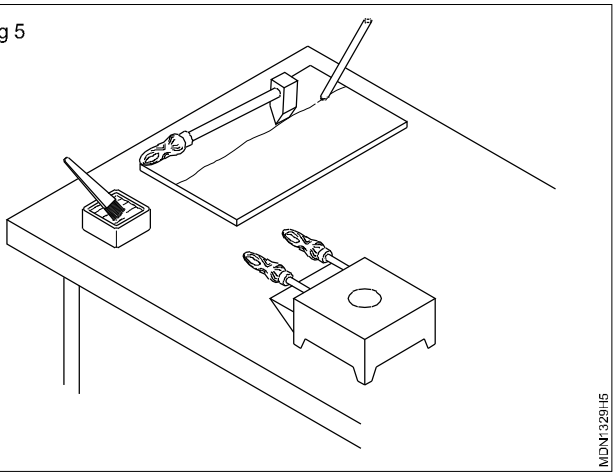
13 Keep the tinned face of the bit flat, to obtain maximum, heat transfer.

14 Apply more solder as required.

15 Turn the sheet over and tin the other lap area in the same manner.

16 Using a wet rag, clean off the excess flux.

Fig 5



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TASK 2 : **Brazing**

1 Cut the sheets as per drawing and file the edges to be joined square.

2 Clean the joint area.

3 Set the sheets as a square butt joint without root gap

4 Select nozzle, filler rod, gas pressures, flux.

5 Set oxidising flame.

6 Use leftward technique.

7 Preheat the sheets and joint area to about 800°C.

8 Dip the hot filler rod in flux and melt the filler rod into the joint ensuring proper wetting conditions.

9 Avoid application of too much heat into the joint.

10 Finish the joint in one run only.

11 Clean the joint and inspect for weld defects like porosity etc and for slight root penetration and proper bonding.

12 Select the nozzle No.5 and 1.6mm** silicon bronze filler rod.

13 Apply flux to the filler rod.

14 Set the oxidising flame.

15 Manipulate the blowpipe and filler rod with flux applied on it using proper angles to fill the bell mouther groove.

16 Clean and remove the flux residue.

17 Inspect for external weld defects.

— — — — — — —

Skill Sequence

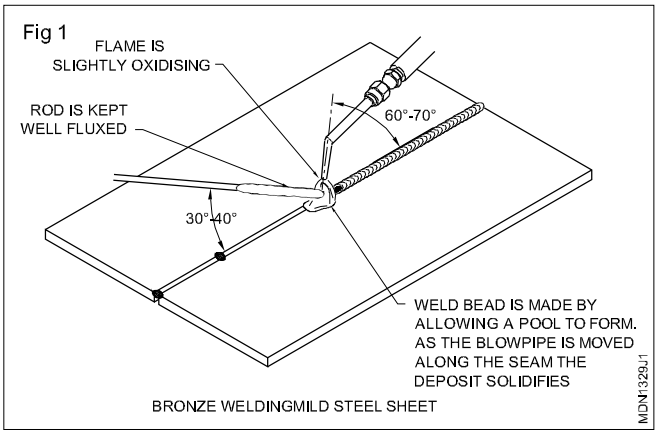
brazing

Objective: This shall help you to
- **brazing of MS sheet.**

Brazing of MS sheet

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

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



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

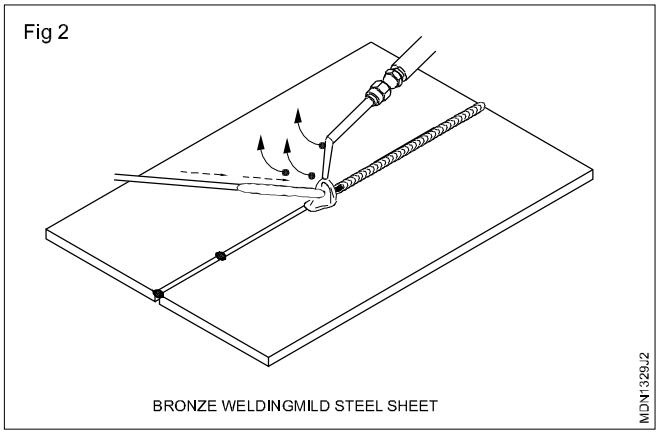
Direct the flame to the joint edges and tack weld at the ends and centre of the joint. (Fig 1)

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

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

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

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



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

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

Practice on making gaskets

Objectives: At the end of this exercise you shall be able to
- **make and fit engine sump gasket.**

Requirements

Tools/Instruments

• Trainees tool kit	- 1 No.
• Hollow punch	- 1 No.
• Wooden block	- 1 No.
• Hammer (250 kg)	- 1 No.
• Scissor	- 1 No.

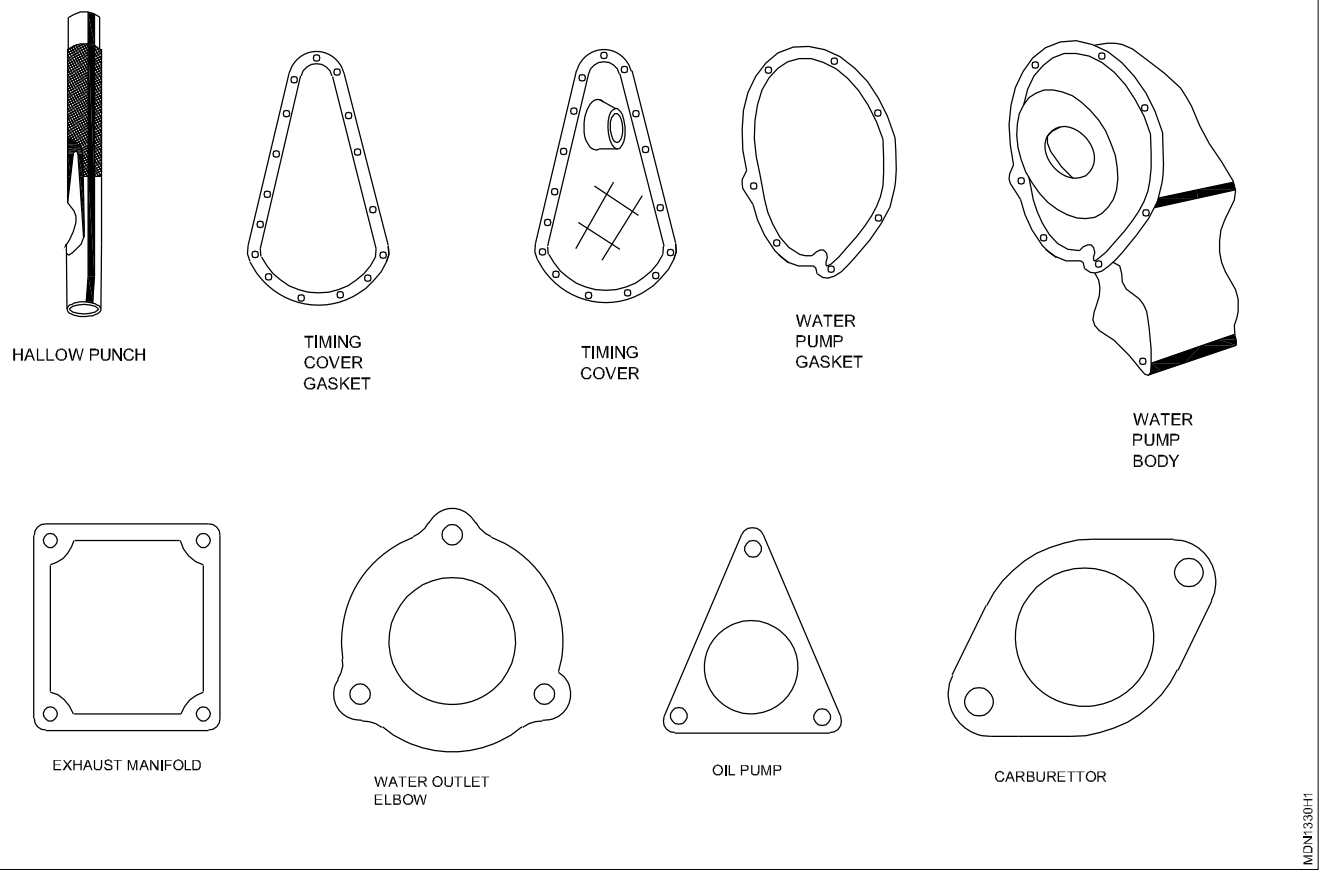
Equipments

• Work table	- 1 No.
oil sump, intake mani fold, water pump tappert cover	- as reqd.

Materials

• Cork sheet	- as reqd.
• Joining sheet	- as reqd.
• Packing paper	- as reqd.
• Grease	- as reqd.
• Cotton waste	- as reqd.
• Shell lock liquid	- as reqd.

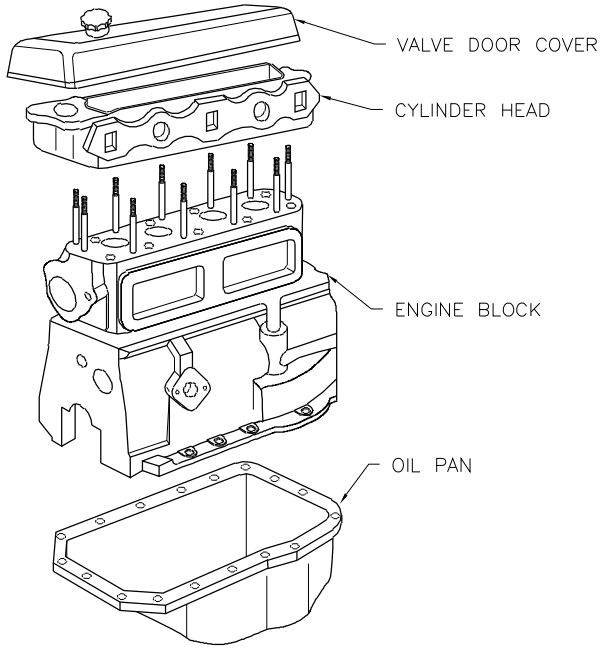
Fig 1



PROCEDURE

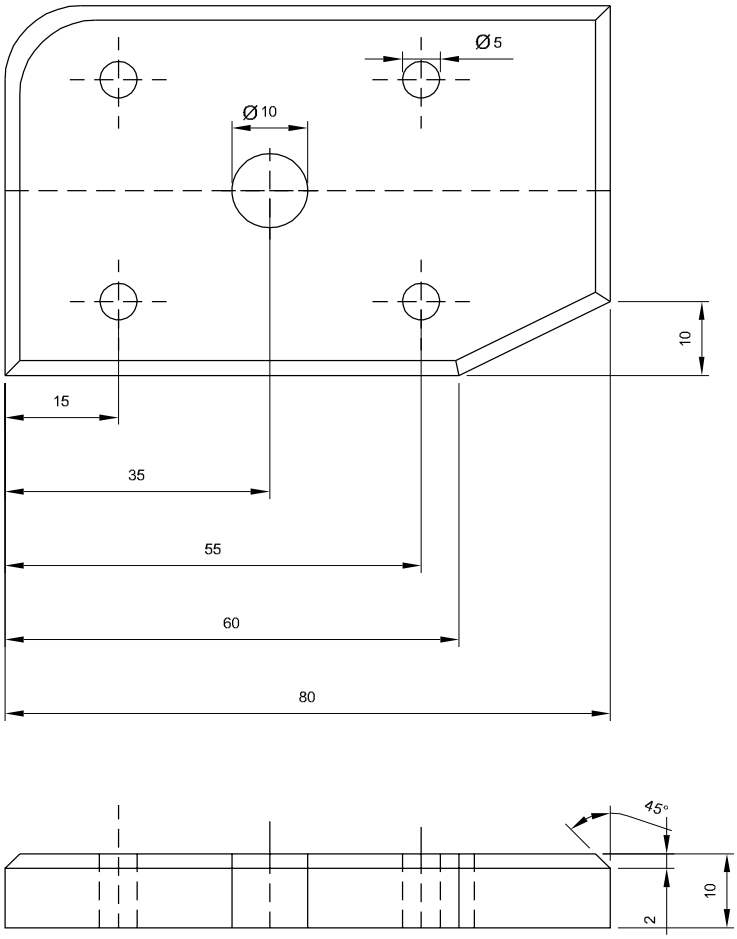
- Clean the oil sump and place it on the working table (Fig 2)
- Select the gasket meterial (Press pan sheet).
- Apply marking media on the joint of sump.
- Place the gasket material on the joint of sump.
- Apply hand press on it.
- Remove the gasket sheet from the pan.
- Place it on a plain and even wooden plank.
- Punched of its meterials with the help of hammer & cut it with scissor.
- Place the prepared gasket on the oil sump joint.
- Check the shape and size of the gasket
- Punched the stud holes by ball pein hammer/hollow punch.
- Select the gasket material depend on its function and component. (Fig 1)

Fig 2



Practice on marking and drilling

Objectives: At the end of this exercise you shall be able to
- **file surfaces flat within + 0.5 mm**
- **file angular surfaces**
- **chamfer edges by filling**
- **file concave surfaces**
- **file convex surfaces**
- **drill through holes.**



1	65ISF12x85		Fe 310			
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	
SCALE NTS	DRILLING AND FILING RADIUS				DEVIATIONS ±0.1	
					CODE NO. MDN1331E1	

PROCEDURE

1 Check the raw material for its size.
2 File flat the top face first.
3 File the two adjacent sides flat and square to each other as well as with top surface.
4 Mark the dimension as per the drawing file and finish the block.
5 Mark horizontal, vertical angular curved lines as per the drawing using scriber block and dividers.
6 Fix the M.S. plate in a vice.
7 File the radius and angle.
8 Locate the centres for holes to be drilled.
9 Drill ϕ 5mm and 10mm through holes as per drawing.
10 File with knife edge file to finish the surface.

Skill sequence

Drilling through hole

Objective : This shall help you to
- **drill through hole to the required size.**

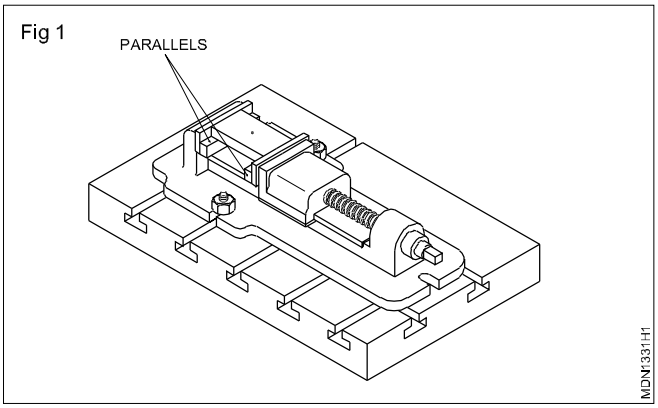
Method of Drilling

Check the given raw material for its size.

Mark and locate the centres for the hole to be drilled.

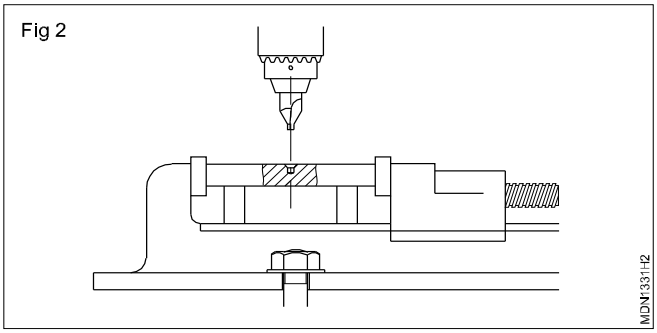
Mount the job in the machine vice on the parallels and clamp it securely to the drill-press-table. (Fig 1)

Fig 1



Set the work table (Fig 2) in such a manner that a drill can be fixed and removed without disturbing the vice or the job.

Fig 2



Fix the centre drill on the drilling machine spindle and align with the centre mark on the job.

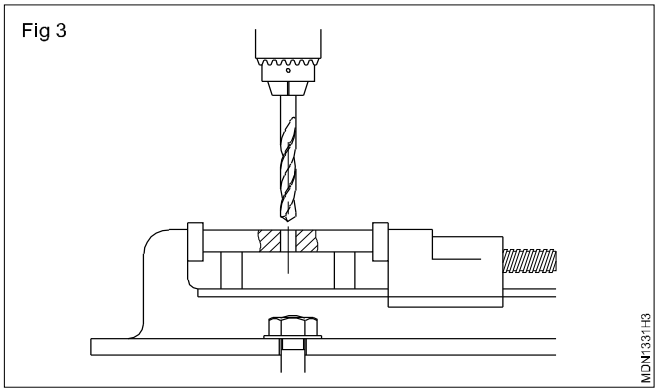
Spot the hole location with a centre drill.

Remove the centre drill and fix 8 mm drill for pilot hole.

Start the drilling machine.

Feed the drill and drill through hole. (Fig 3)

Fig 3



Set the spindle speed of the drilling machine to the nearest calculating r.p.m.

$$V = \frac{\pi d \times n}{1000}$$

Remove drill from the machine without disturbing the set up.

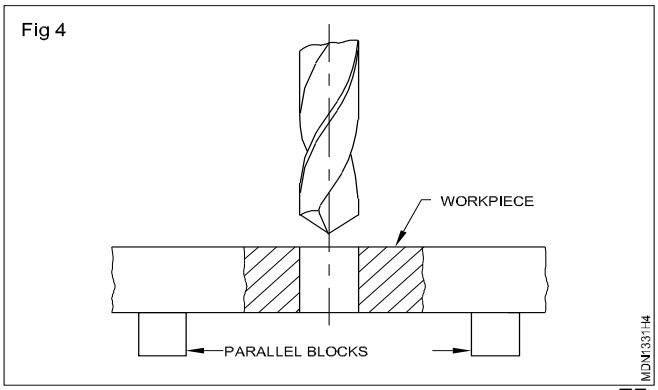
Fix 14.5 mm drill and drill through hole.

While drilling use cutting fluid.

Release the drill frequently from the hole for the chips to be flushed out by the cutting fluid.

Remove the drill and job from the machine. (Fig 4)

Fig 4



Skill sequence

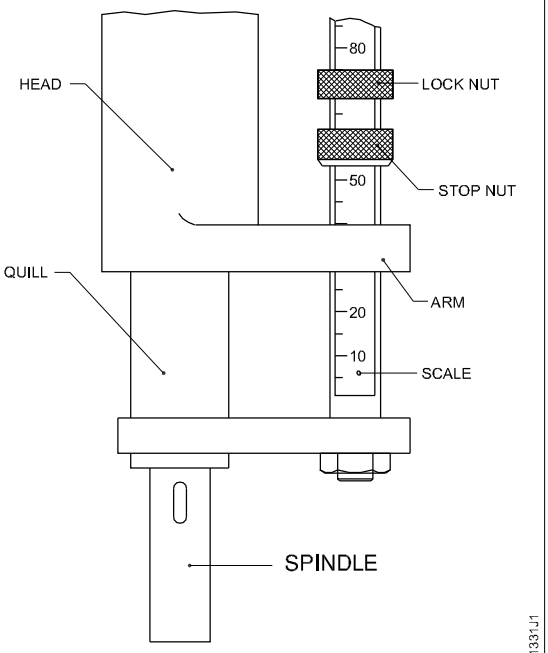
Drilling blind holes

Objective : This shall help you to
- **drill blind holes to the required depth using the depth stops.**

Method of controlling depth of blind holes

While drilling blind holes, it is necessary to control the feed of the drill. Most machines are provided with a depth stop arrangement by which the downward movement of the spindle can be controlled. (Fig 1)

Fig 1



Most depth stop arrangements will have graduations by which the advancement of the spindle can be observed.

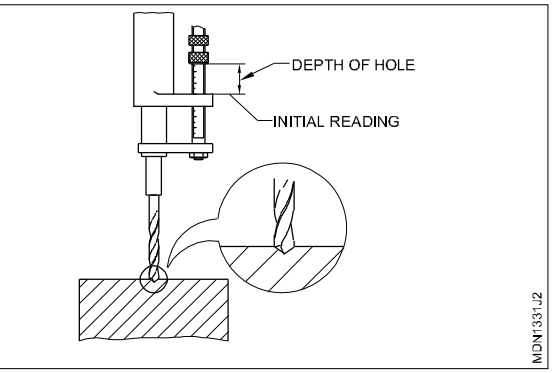
Generally the blind hole depth tolerances are given up to 0.5 mm accuracy.

Setting for drilling blind holes

For blind hole-depth setting, first the work is held on the machine and the hole is located correctly.

The drill is started, and it drills until the full diameter is formed. Note down the initial reading at this point. (Fig 2)

Fig 2



Add the initial reading to the depth of the blind hole to be drilled.

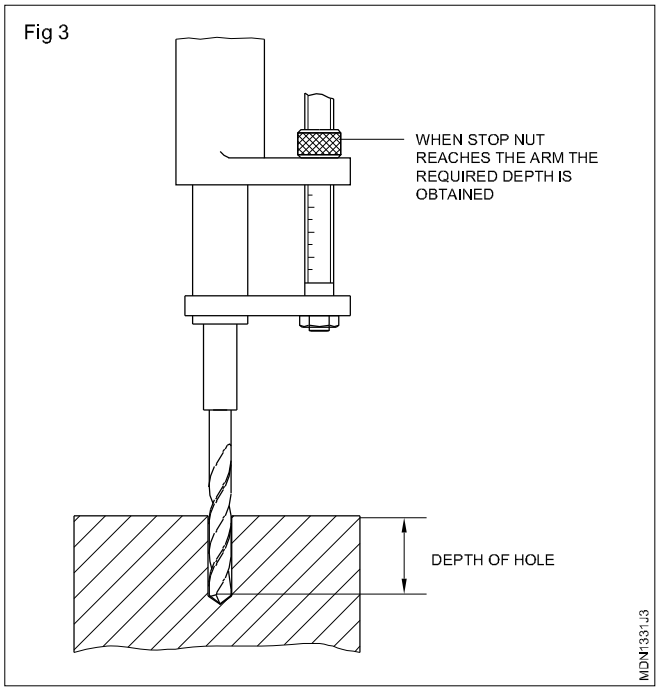
Initial Reading + Depth of Hole = Setting

Adjust the stop next to the required setting, using the scale.

Tighten the lock nut to prevent the setting from being disturbed.

Start the machine and feed the drill. When the stop nut reaches the arm the blind hole is drilled to the required depth. (Fig 3)

Fig 3



While drilling, release the drill frequently from the hole for the chips to be flushed out by the cutting fluid.

Do not drill on a light component without clamping. If not clamped, the job will rotate along with drill.

Skill sequence

Re-sharpening a twist drill

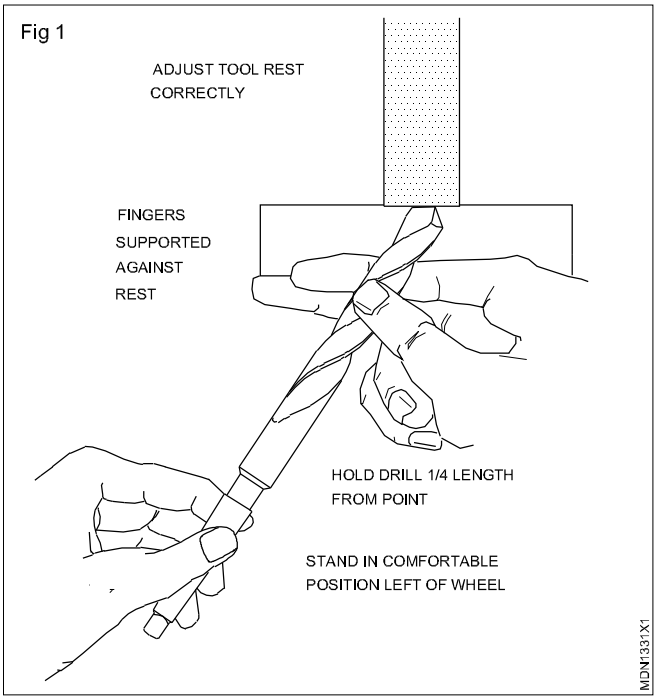
Objectives : This shall help you to
- **re-sharpen a twist drill**
- **test the drill that has been re-sharpened by drilling a through hole.**

A twist drill can be successfully sharpened on a bench or pedestal grinder by adopting the following procedure.

Check that the surface of each wheel is running true and that the wheels are dressed clean.

Ensure that the tool-rests are adjusted correctly and tightened. (Fig 1)

Fig 1



Wear safety goggles.

Stand in a comfortable position in front of the machine.

Hold the drill at about one quarter of its length from the point, between the thumb and the first finger of the right hand.

Keep both elbows against the side.

Position youself in such a way that the drill makes a angle of 59° to 60° to the wheel face. (Fig 2)

Hold the drill level. Twist it until one cutting edge is horizontal and parallel to the wheel face. (Fig 3)

Swing the shank of the drill slightly downwards and to the left with the left hand. The right hand is on the tool-rest.

Watch the cutting edge against the wheel. Note that, as the shank swings down, the cutting edge comes slightly upwards and away from the wheel face. (Fig 4 & Fig 5)

Fig 2

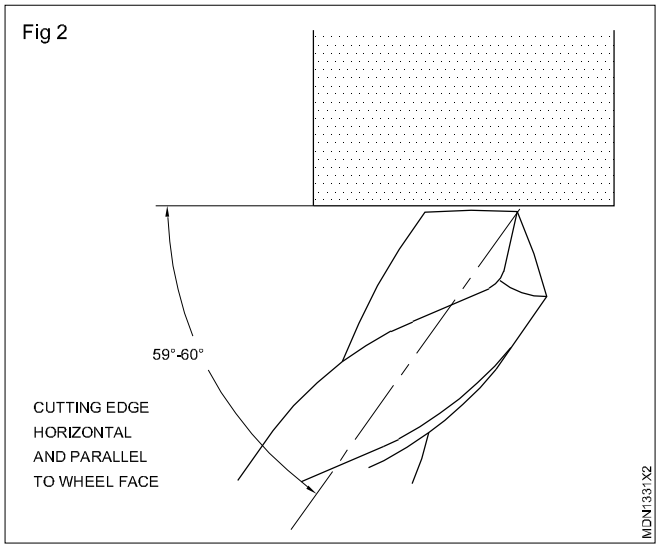


Fig 3

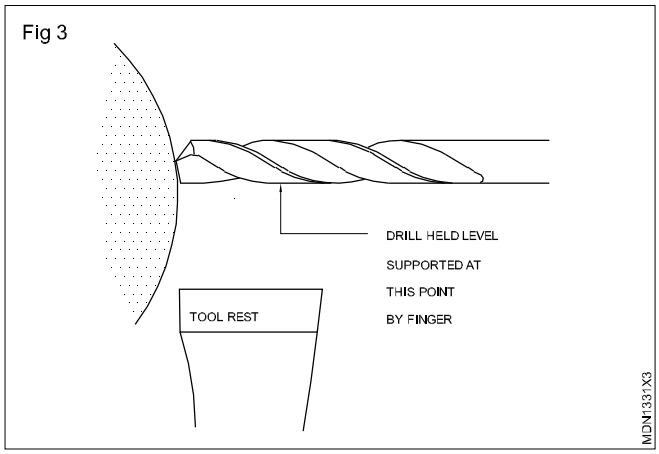
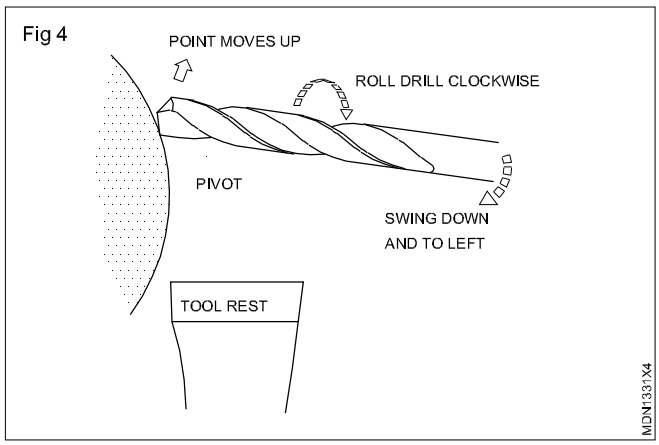
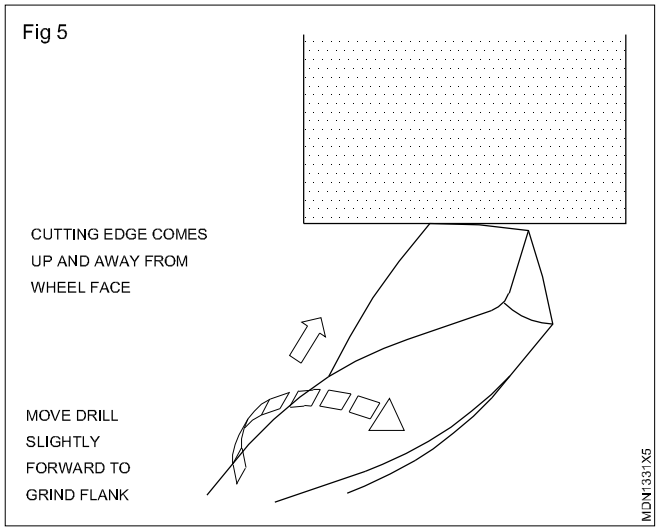


Fig 4





Supply a slight forward motion to your hands.

This will bring the flank of the point against the wheel to produce a lip clearance.

Coordinate the three movements of swinging down, twisting clockwise and forward movement. These movements should not be heavy movements. If they are performed correctly, they will produce a cutting edge that has the correct lip clearance and cutting angle.

Practice these movements against a stationery wheel, using a new or correctly sharpened drill.

Notice how only a small movement is required to produce the required clearance.

Also not that, if the drill is twisted too far, the other cutting edge will swing down to contact the wheel face.

Proceed now to sharpen one edge, removing as little metal as possible.

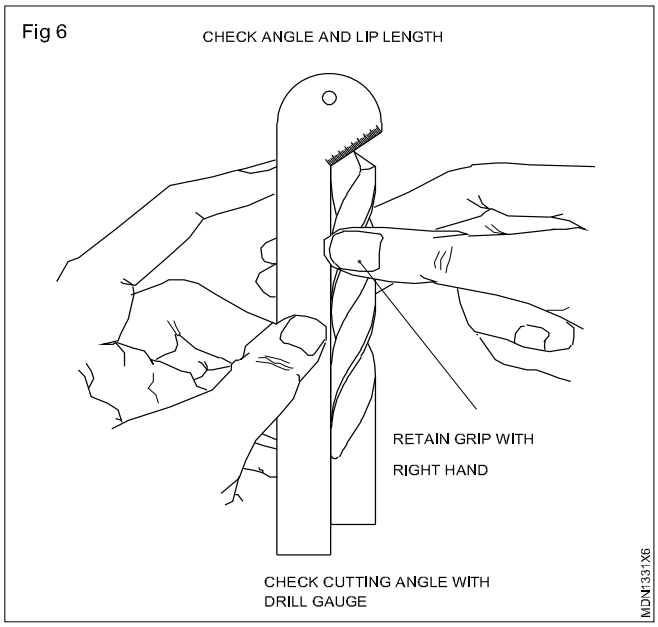
Procedure to obtain equal angles

Move the drill back, clear of the wheel face.

Turn the drill over without moving the position. This presents the second edge to the wheel face at the same angle as the first cutting edge.

Proceed to sharpen the second cutting edge, using the same amount of drill movement as before. When these actions are carried out carefully, the drill will be sharpened with equal cutting angles. The lip clearance will be correct and equal.

Use a drill angle gauge to check that the cutting angle is correct (118° for mild steel), the cutting edges are of equal length and the lip clearances are equal and correct (about 12°). (Fig 6)



Lift the drill off the wheel face. Retain the grip on the drill with the right hand.

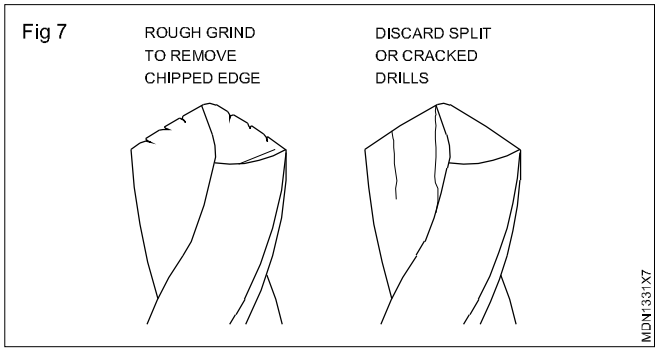
Make such inspection or checks as are necessary. Move the right hand back on the tool-rest in the same position as before.

Hold the drill shank again in the left hand with the elbows against the side. The drill will locate back against the wheel face in the same position and at the same angle as before.

Points to be considered when sharpening drills

Grind as little as possible from the drill. Remove only enough to sharpen the cutting edges.

Rough down the drill point with a coarse grit wheel when the edges are badly chipped. (Fig 7)

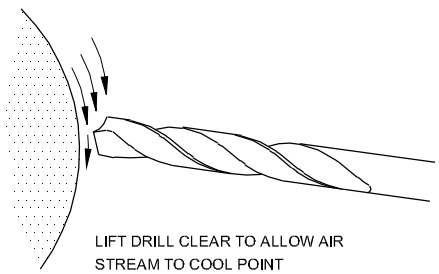


Never re-sharpen a cracked or split drill.

Avoid overheating the drill.

Apply light pressure against the wheel face. Lift the edge clear of the wheel face frequently. This allows the air stream produced by the wheel to cool the drill point. (Fig 8)

Fig 8

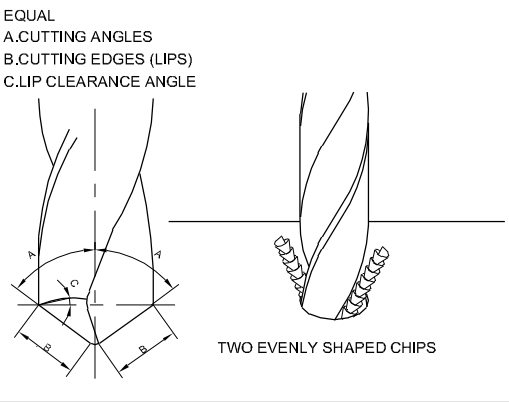


Cooling a drill rapidly by quenching in cold water may cause cracking of the cutting edge.

Re-sharpening of very small drills required great skill. They require proportionally less movement to produce the cutting angles.

Set the spindle revolution of the drilling machine to give a cutting speed of 25 to 30 meters per minute. A drill that has been re-sharpened correctly will: (Fig 9)

Fig 9

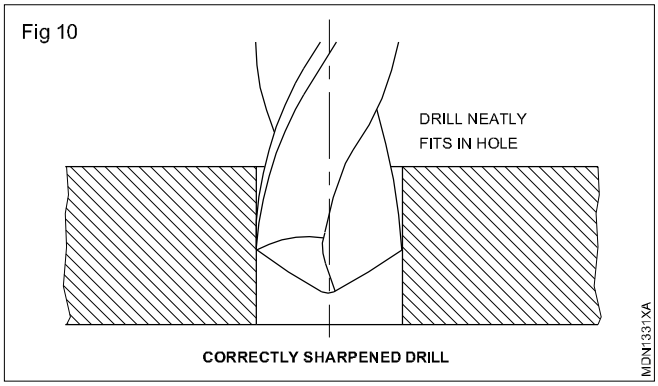


Produce two evenly curled chips from its cutting edges.

Require only moderate pressure to feed it into the work.

If the drill fits without any play it means that (Fig 10)

Fig 10

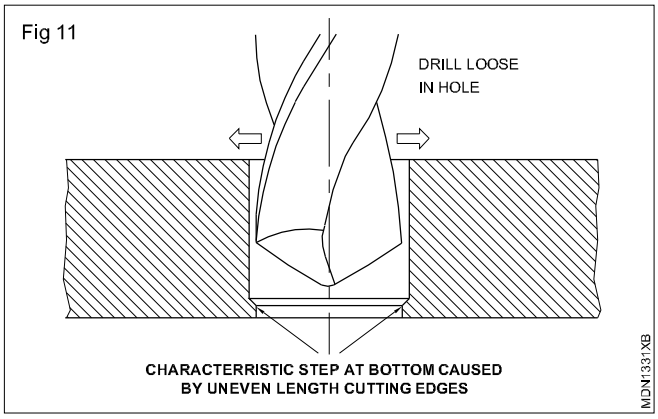


The cutting edges and angles are equal

The drill has produced a hole of the correct size.

Any looseness of the drill in the hole means: (Fig 11)

Fig 11



The cutting edges are of uneven length

The drill has produced an oversized hole.

A drill that has been ground with uneven or too great a clearance will

Tend to chatter during starting

Produce an out-of round hole.

Skill Sequence

Following the safety precautions while using drilling machine

Objectives: This shall help you to
- **follow personal safety**
- **follow drilling machine safety**
- **follow job safety**
- **follow drill bit safety.**

Wear a dress suitable for work

Ensure that the spindle head and table is locked properly.

The workpiece and the drill should be rigidly held.

Switch off power when not in use.

Clean and oil the machine after use.

Use a brush to clean the chips and swarf.

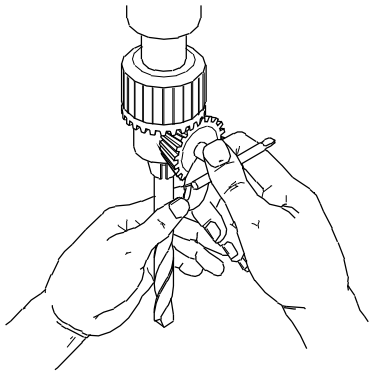
Select proper cutting speed according to material.

Select proper cutting fluid according to material.

Remove the workpiece only after getting cooled or with a tong.

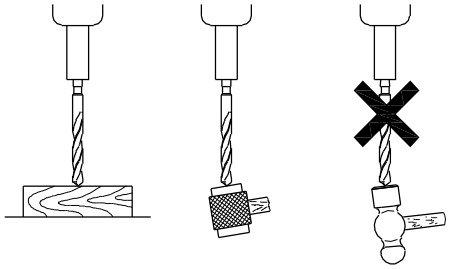
While fixing the drill in a socket or sleeve, the tang portion should align in the slot. (Fig 1 & Fig 2) This will facilitate the removal of drill or sleeve from the machine spindle.

Fig 1



MDN1331Y1

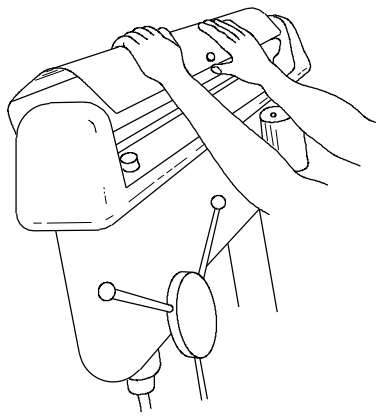
Fig 2



MDN1331Y2

Ensure the belt safe Guard properly placed before Drilling (Fig 3)

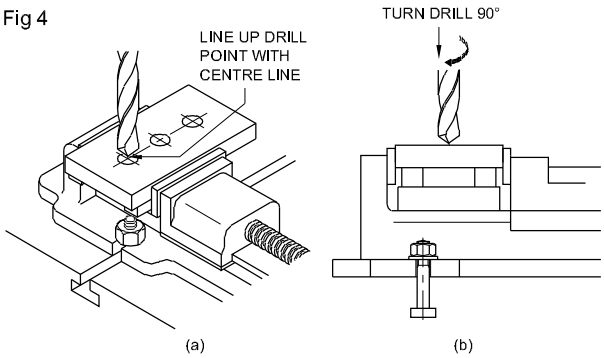
Fig 3



MDN1331Y3

Before Drilling ensure that Drill point tip properly sits on the punched marking of the job (Fig 4)

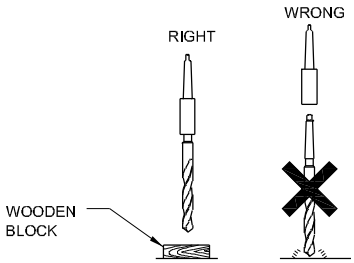
Fig 4



MDN1331Y4

While removing the drill from the sockets/sleeves, don't allow it to fall on the table or jobs. (Fig 5)

Fig 5

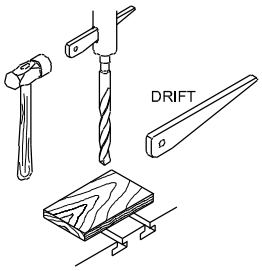


REMOVING A TAPER SHANK DRILL

MDN1331Y5

Use a drift to remove drills and sockets from the machine spindle. (Fig 6)

Fig 6



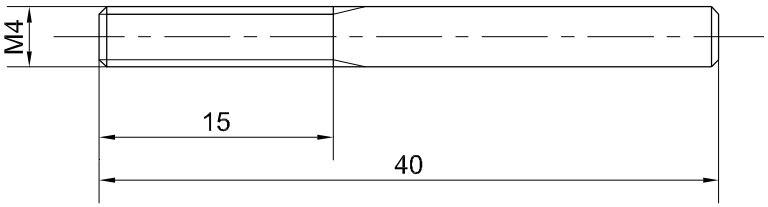
MDN1331Y6

Practice on forming internal & external threads

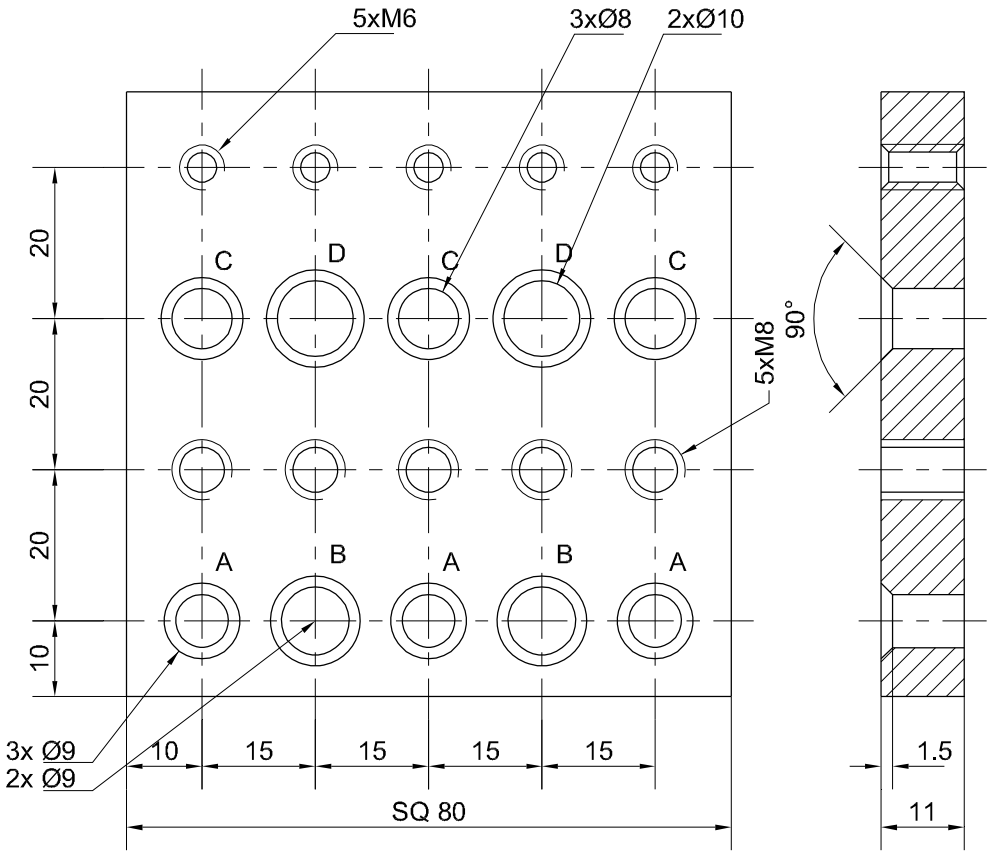
Objectives: At the end of this exercise you shall be able to

- **file surfaces flat within + 0.5 mm**
- **file angular surfaces**
- **chamfer edges by filling**
- **file concave surfaces**
- **file convex surfaces**
- **drill through holes.**

1



2



1	5x45		Fe310		1	1.3.14
1	90ISF12x85	-	Fe310		2	1.3.14
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex.No.
SCALE 1:1	CUTTING INTERNAL THREADINGS				DEVIATIONS ±0.1	
					CODE NO. MDN1332E1	

PROCEDURE

1 Check the raw material for its size.

2 File and finish the plate 80 x 11 x 80 within + 0.2 mm.

3 Locate centres for holes to be drilled, tapped and countersunk.

4 Centre punch the centres.

5 Drill five, ø 5 mm tapping drill size holes for M6 tapping.

6 Drill five, ø 6.8 mm tapping drill size holes for M8 tapping.

7 Drill four ø 8 mm through holes as per drawing. Enlarge by drilling ø 10 mm the 2nd and 4th hole of the second row.

8 Drill five ø 7 mm through holes as per drawing.

9 Enlarge the 2nd and 4th holes by drilling ø 9 mm on the 4th row

10 Countersink ø 8 and ø 10 holes with 90° countersink as per standard. (Refer to the table.)

11 Countersink ø 7 and ø 9 mm holes with 120° countersink as per5 standard. (Refer to the table.)

12 Cut M6 internal thread in the four ø 5 mm drilled holes.

13 Countersink 120° all the four ø 6.8 mm holes on both sides as per drawing.

14 Cut M8 internal threads in all the five ø 6.8 mm drilled holes with M8 taps.

15 Check M6 and M8 tapped holes with the supplied M6 and M8 screws, respectively.

16 Hold cylindrical blank on vice.

17 Cut M4 external thread using M4 dies on part 2.

Skill sequence

Internal threading of through holes using hand taps

Objectives: This shall help you to
- **determine the tap drill sizes for internal threading**
- **cut internal threads using hand taps.**

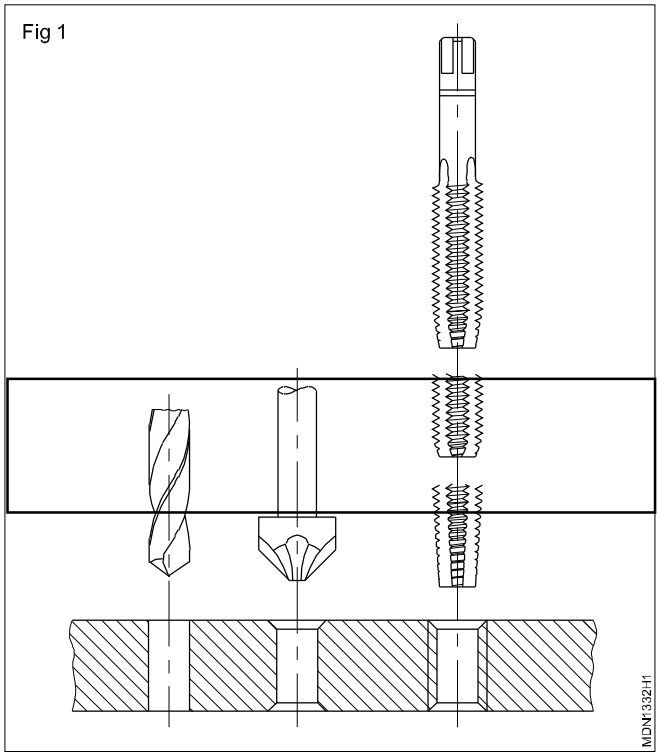
Determining the tap drill size

For cutting internal threads, it is necessary to determine the size of the hole (tap drill size). This can be calculated using a formula or can be chosen from the table of tap drill sizes.

Drill the hole to the required tap drill size.

Do not forget to give the chamfer required for aligning and starting the tap. (Fig 1)

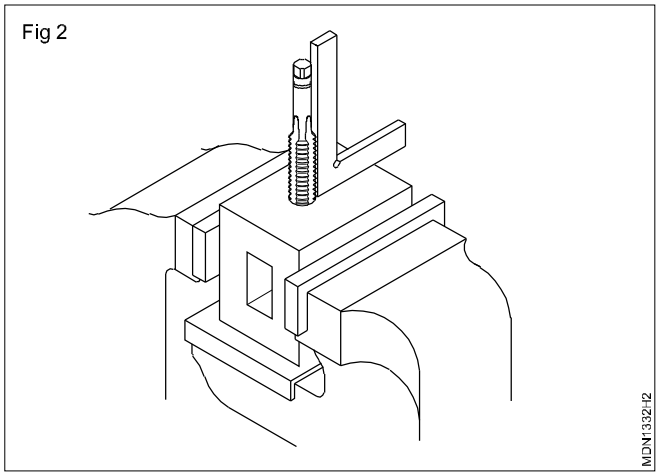
Fig 1



Hold the work firmly and horizontally in the vice. The top surfaces should be slightly above the level of the vice jaws.

This will help in using a try square without any obstruction while aligning the tap. (Fig 2)

Fig 2



Use soft jaws while holding the finished surface on a vice.

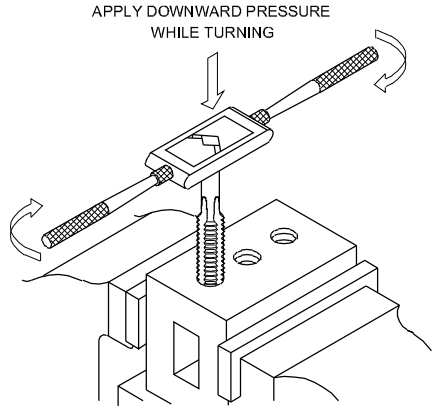
Fix the first tap (Taper tap) in the wrench.

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

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

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

Fig 3



STARTING THE TAP

When you are sure of starting of the thread, remove the tap wrench without disturbing the tap alignment.

Check and make sure the tap is vertical, use a small try square for help. Place the try square in two positions, 90° to each other. (Fig 4 & Fig 5)

Fig 4

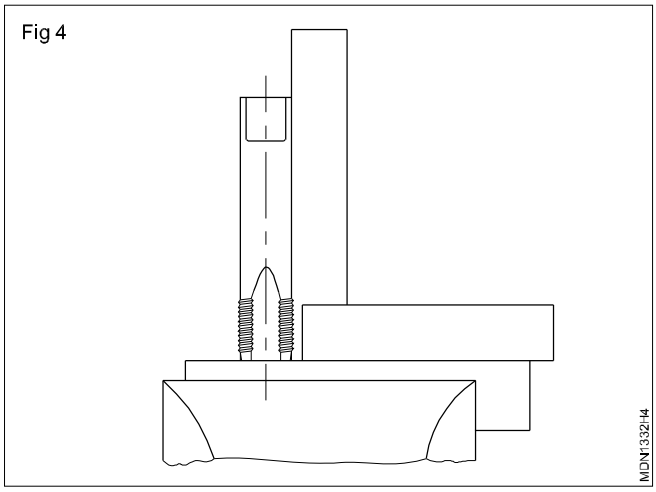
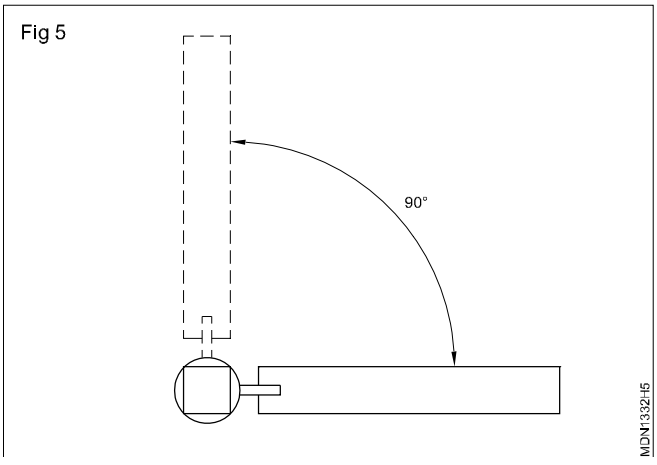


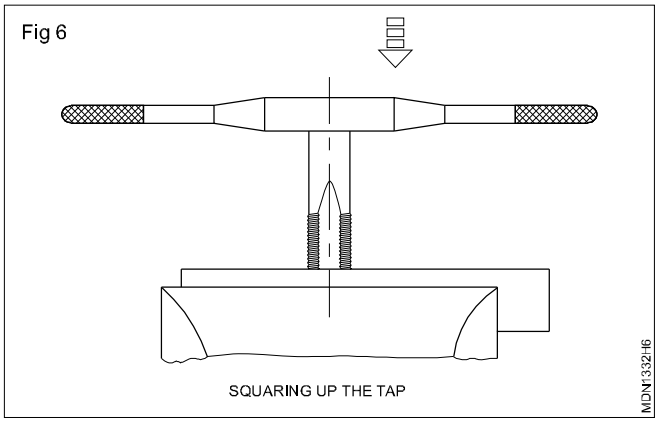
Fig 5



Make corrections, if necessary. This is done by exerting slightly more pressure on the opposite side of the tap inclination. (Fig 6)

Never apply side pressure without giving a turning motion to the tap.

Fig 6



SQUARING UP THE TAP

Check the tap alignment again with a try square.

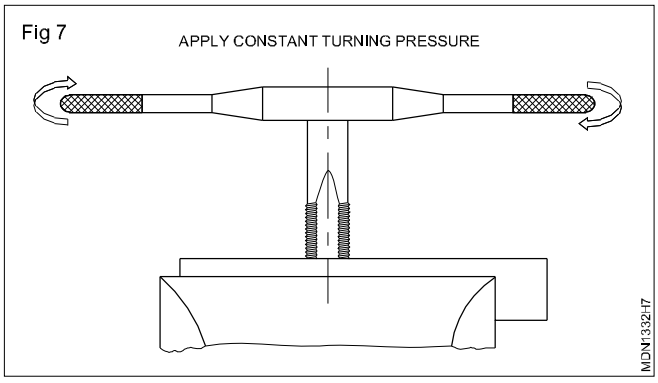
Fit the tap wrench, and tighten without disturbing the tap alignment.

Make one or two turns and check the alignment.

The tap alignment should be corrected within the first few turns.

After the tap is positioned vertically, turn the wrench lightly by holding the ends of the wrench handles without exerting any downward pressure. (Fig 7)

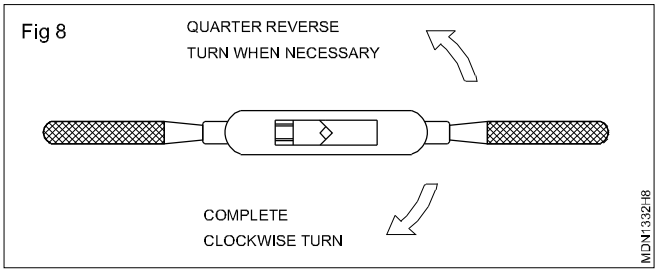
Fig 7



While turning the wrench, the movement should be well balanced. Any extra pressure on one side will spoil the tap alignment and can also cause breakage of the tap.

Continue cutting the thread. Turn backwards frequently, about quarter turn to break the chip. Stop and turn backward also when some obstruction to movement is felt. (Fig 8)

Fig 8



Use a cutting fluid while cutting the thread.

Cut the thread until the tap is fully inside the hole being threaded.

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

Remove chips from the work with a brush.

Check the threaded hole with a matching screw.

Clean the tap with a brush, and place it back on the stand.

Skill sequence

Internal threading blind holes using hand taps

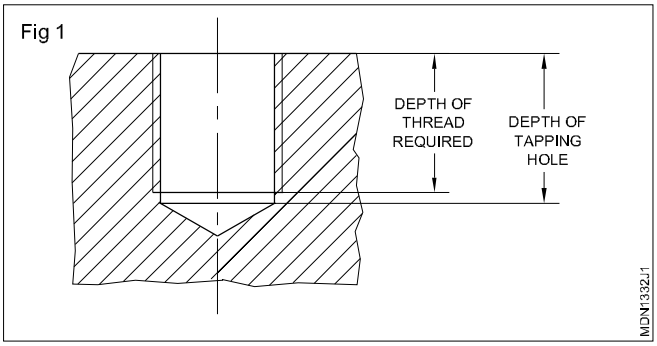
Objective: This shall help you to
- **cut internal threads in blind holes.**

Drilling a blind hole

Determine the tapping drill size using the table for tapping drill sizes.

Drill a blind hole (Fig 1) using the depth stop arrangement. The depth of the tapping hole should be slightly more than the depth of the required thread.

Fig 1



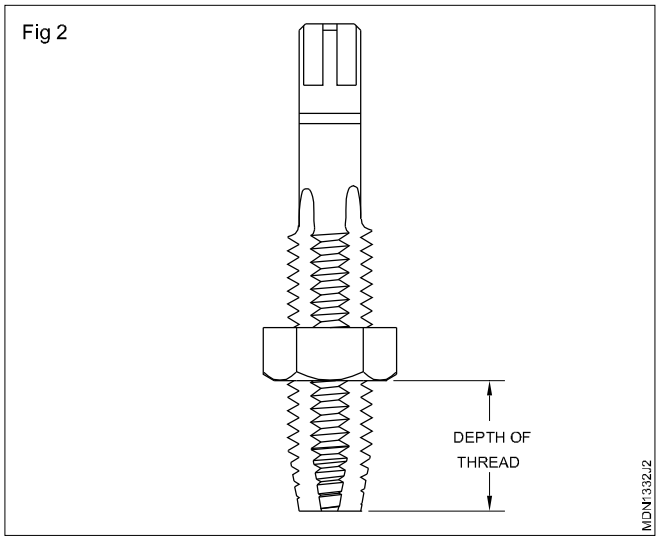
Procedure for threading

Remove metal chips, if any, from the blind hole by turning it upside down and slightly tapping it on a wooden surface.

Do not clear chips by blowing as it can cause injury to your eyes.

Screw a matching nut on the first tap to act as a depth stop. (Fig 2)

Fig 2

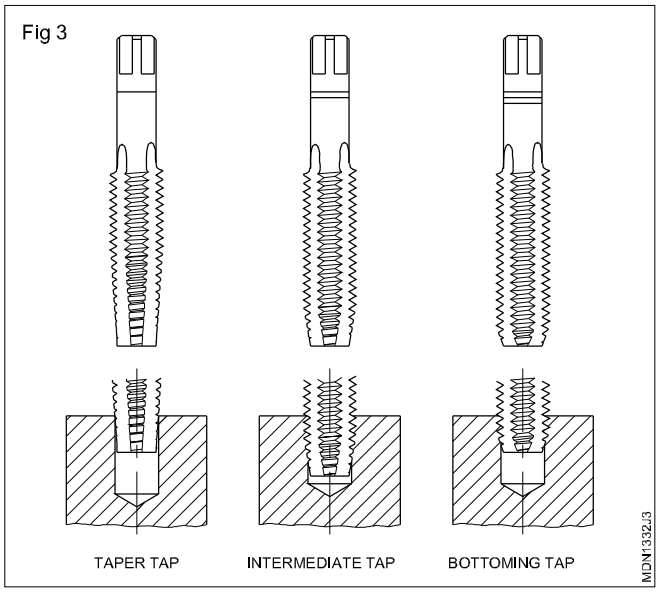


Thread the blind hole until the nut touches the plate surface.

Remove the chips from the hole frequently, using a flattened and bent wire.

Finish tapping the hole with intermediate and bottoming tap. Set nut to control the depth of thread. (Fig 3)

Fig 3



Skill sequence

External threading using dies

Objective: This shall help you to
- **external threading using dies.**

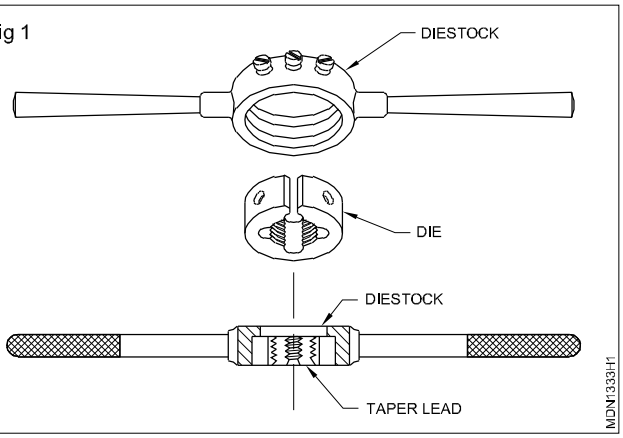
External threading using dies

Check blank size

Blank size = thread size - 0.1 x pitch of thread

Fix the die in the die stock and place the leading side of the die opposite to the step of the die stock. (Fig 1)

Fig 1



Use false jaws for ensuring a good grip in the vice.

Project the blank above the vice-just the required thread length only.

Place the leading side of the die on the chamfer of the work. (Fig 2 & Fig 3)

Fig 2

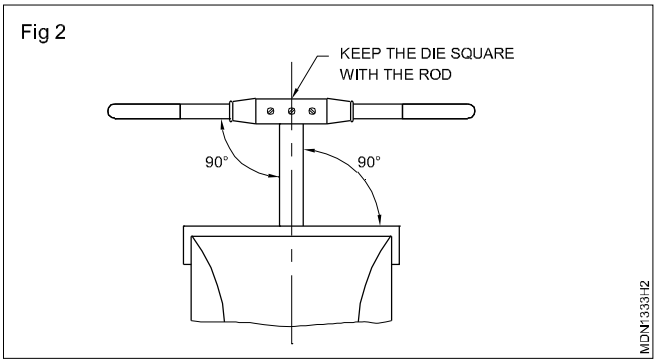
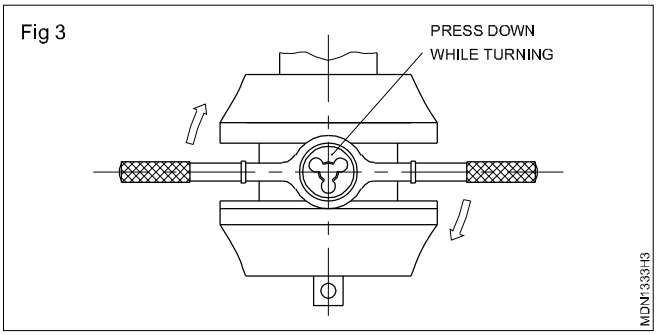


Fig 3



Make sure that the die is fully open by tightening the centre screw of the die stock. (Fig 4 & Fig 5)

Fig 4

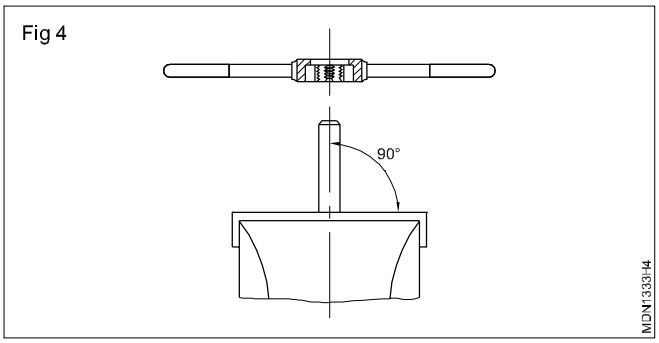
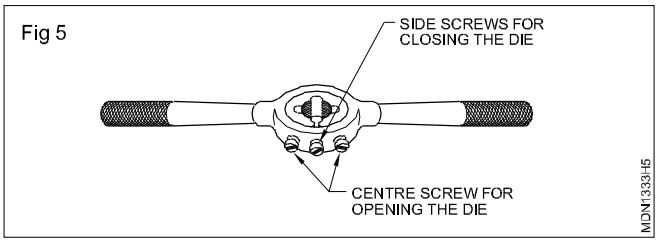


Fig 5



Start the die, square to the bolt centre line.

Apply pressure on the die stock evenly and turn in the clockwise direction to advance the die on the bolt blank.

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

Use a cutting lubricant.

Increase the depth of the cut gradually by adjusting the outer screws.

Check the thread with a matching nut.

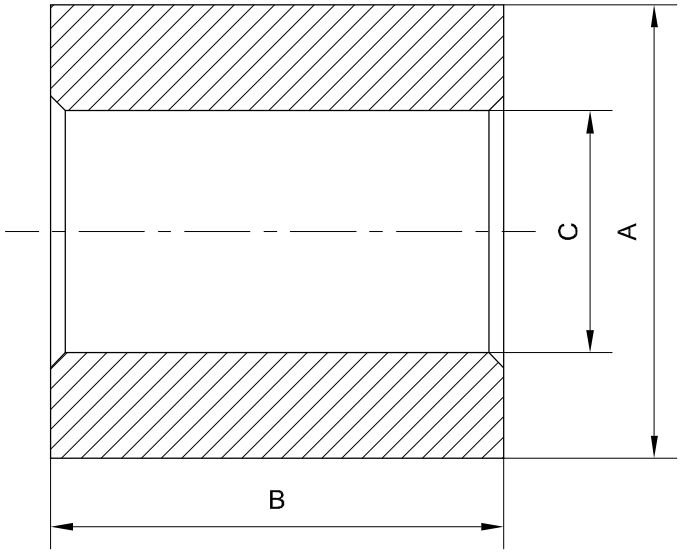
Repeat the cutting until the nut matches.

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

Clean the die frequently to prevent the chips from clogging and spoiling the thread.

Practice on reaming a hole

Objectives: At the end of this exercise you shall be able to
- **ream through hole with a hand reamer**
- **check the reamed hole by using a plug gauge.**



A			
B			
C			

1	-	-	Fe310	-	-	1.3.15
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex No.
SCALE 1:1	REAMING				DEVIATIONS ±0.1	
					CODE NO. MDN1333E1	

PROCEDURE

1 Hold the job in a vice.

2 Select the correct type and size of reamer

3 Hold the reamer in tap wrench

4 Ream the hole by using sufficient coolant.

5 Give uniform hand feed while reaming.

6 Check the hole with a 'Go' and 'No-Go' plug gauge.

Skill sequence

Reaming drilled holes using hand reamers

Objective: This shall help you to
- **ream through holes within a limits and check reamed holes with cylindrical pins.**

Determining the drill size for reaming

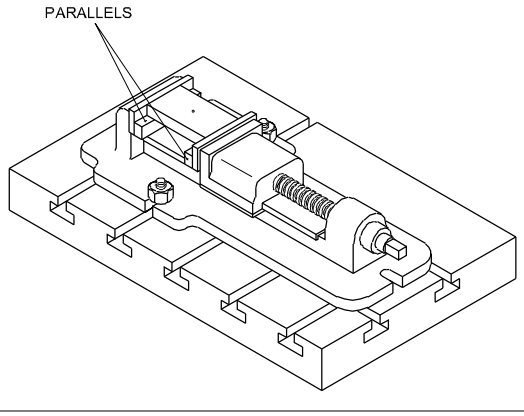
Use the formula,

Drill diameter = reamed hole size. (undersize + oversize) [Refer to the table for the recommended undersizes in related theory on drill sizes for reaming. (See table 1.)]

Procedure for hand reaming

Drill holes for reaming as per the sizes determined.

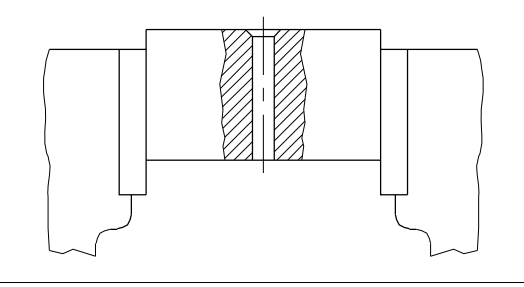
Fig 1



Place the work on parallels while setting on the machine vice. (Fig 1)

Chamfer the hole ends slightly. This removes burrs, and will also help to align the reamer vertically. Fix the work in the bench vice. Use vice clamps to protect the finished surfaces. Ensure that the job is horizontal. (Fig 2)

Fig 2

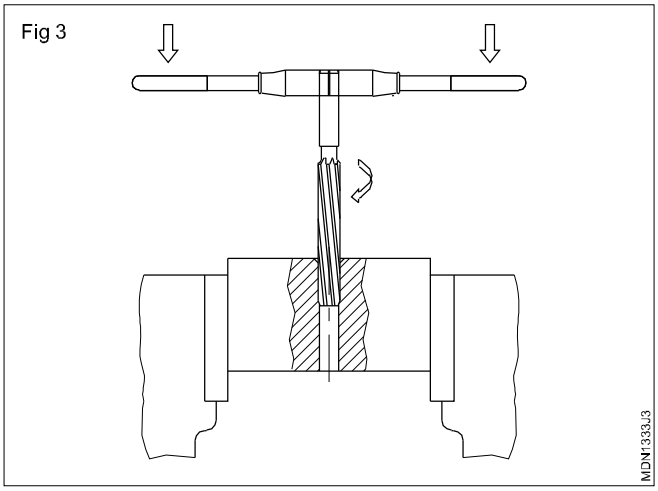


Fix the tap wrench on the square end and place the reamer vertically in the hole. Check the alignment with a try square. Make corrections, if necessary. Turn the tap wrench in a clockwise direction applying a sligh downward pressure at the same time. Apply pressure evenly at both ends of the tap wrench.

Apply cutting fluid.

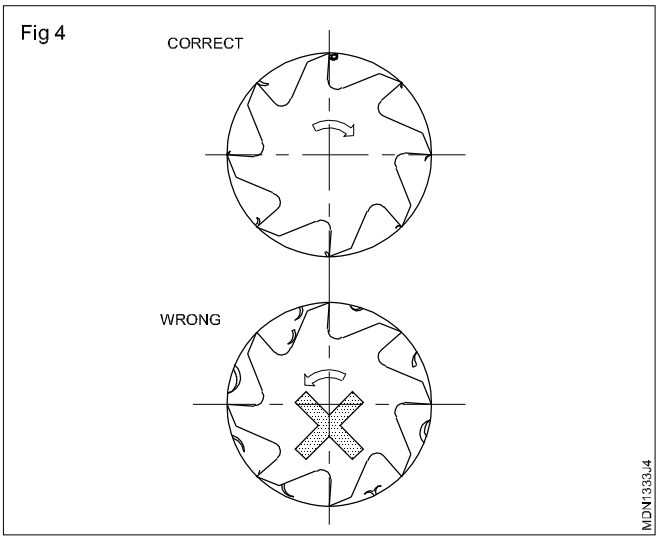
Turn the tap wrench steadily and slowly, maintaining the downward pressure. (Fig 3)

Fig 3



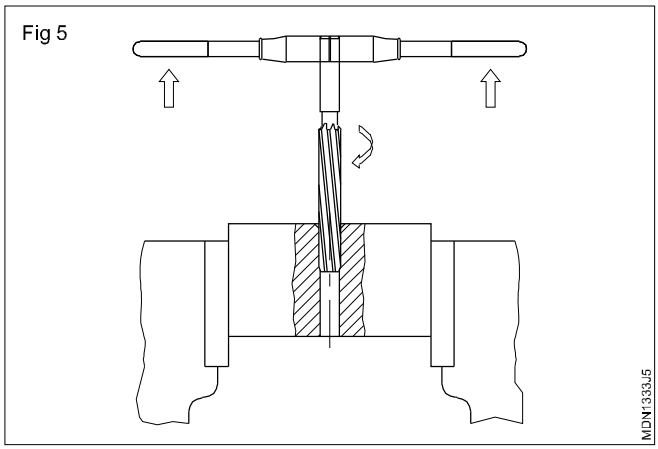
Do not turn in the reverse direction for it will scratch the reamed hole. (Fig 4)

Fig 4



Ream the hole through. Ensure that the taper lead length of the reamer comes out well and clear from the bottom of the work.

Do not allow the end of the reamer to the strike on the vice.



Remove the reamer with an upward pull until the reamer is clear of the hole. (Fig 5)

Remove the burrs from the bottom of the reamed hole.

Clean the hole. Check the accuracy with the cylindrical pins supplied.

Skill Sequence

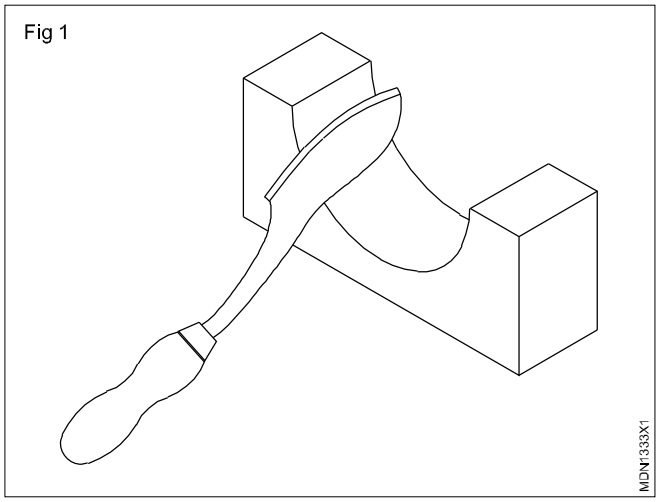
Scraping curved surfaces

Objective : This shall help you to
- **scrape and test curved surfaces.**

A half round scraper is the most suitable scraper for scraping curved surfaces. This method of scraping differs from that of flat scraping.

Method

For scraping curved surfaces the handle is held by hand in such a way as to facilitate the movement of the scraper in the required direction. (Fig 1)



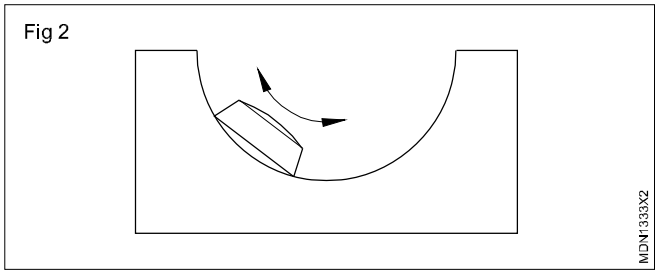
Pressure is exerted with the other hand on the shank for cutting.

Rough scraping will need excessive pressure with longer strokes.

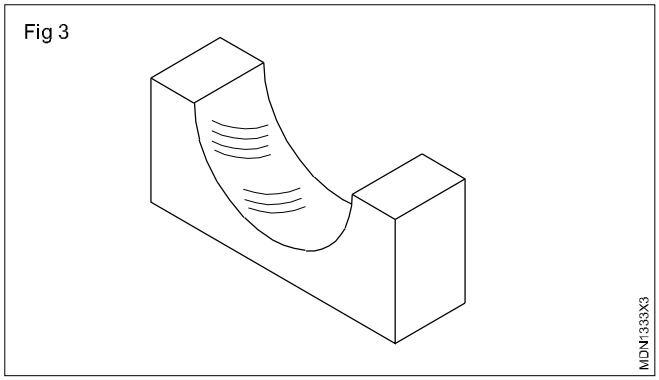
For fine scraping, pressure is reduced and the stroke length also becomes shorter.

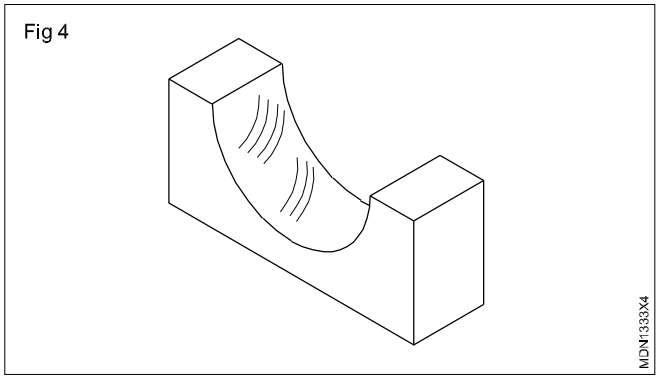
Cutting action takes place both on forward and return strokes. (Fig 2)

During the forward movement one cutting edge acts, and on the return stroke, the other cutting edge acts.



After each pass, change the direction of cutting. This ensures a uniform surface. (Figs 3 & 4)

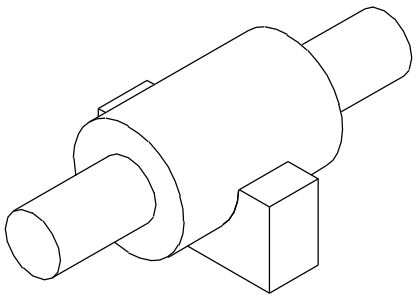




Use a master bar to check the correctness of the surface being scraped. (Fig 5)

Apply a thin coating of Prussion blue on the master bar to locate the high spots.

Fig 5



MDN1333X5

Skill sequence

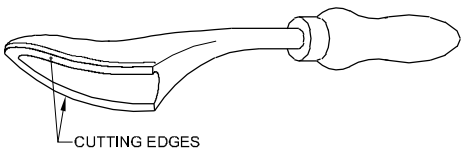
Sharpening scrapers

Objectives : This shall help you to
- **sharpen a half round scraper.**
- **sharpen a three-square scraper.**

Sharpening half round scrapers

Locate the two cutting edges on the rounded back (Fig 1) for the half round scrapers.

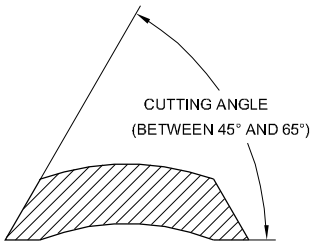
Fig 1



MDN1333Y1

Check the cutting edges are formed by the bottom surface, and the flat surfaces are ground on the rounded back of the scraper. (Fig 2)

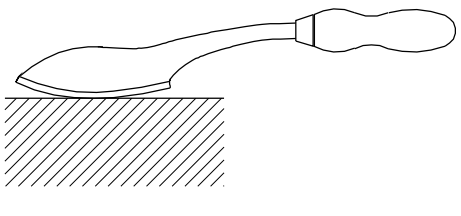
Fig 2



MDN1333Y2

Grind the bottom surfaces with a slight curve. This helps the cutting edges to make point contact on the surfaces being scraped. (Fig 3)

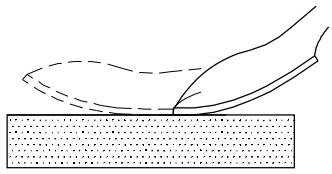
Fig 3



MDN1333Y3

Rub the bottom surface with a rocking motion on the oilstone for re-sharpening. (Fig 4)

Fig 4



MDN1333Y4

Re-sharpened by grinding the bottom surface, when the cutting edge is blunt.

As far as possible avoid grinding of the edges. (Flat surface ground on the rounded back.)

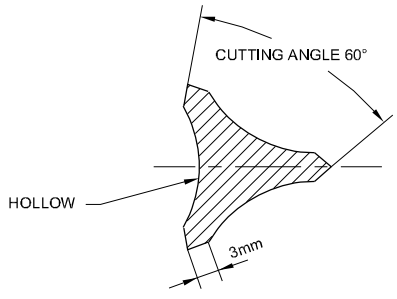
These scrapers have triangular cross-section which tapers to a point. (Fig 5)

Fig 5

MDN1333Y5

The centre of each face is hollow and this makes sharpening easy. (Fig 6)

Fig 6



MDN1333Y6

The angle of each cutting edge is 60°.

Re-sharpening is done on an oilstone and the method adopted is similar to that for the half round scraper.

While grinding, the movement should be such that it tapers to a point with a uniform movement.

The cutting edges of three-square scrapers are likely to be overheated quickly as they are very thin.

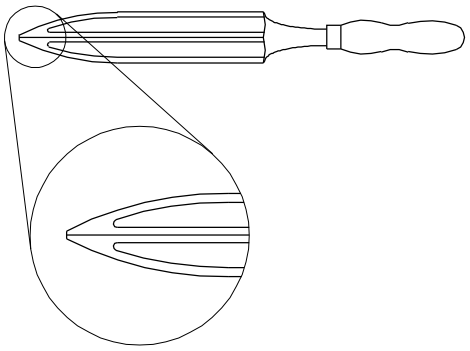
Apply only light pressure.

Maintain the cutting edge width to about 3 mm. (Fig 6)

A three-square scraper is very sharp instrument and has to be handled carefully.

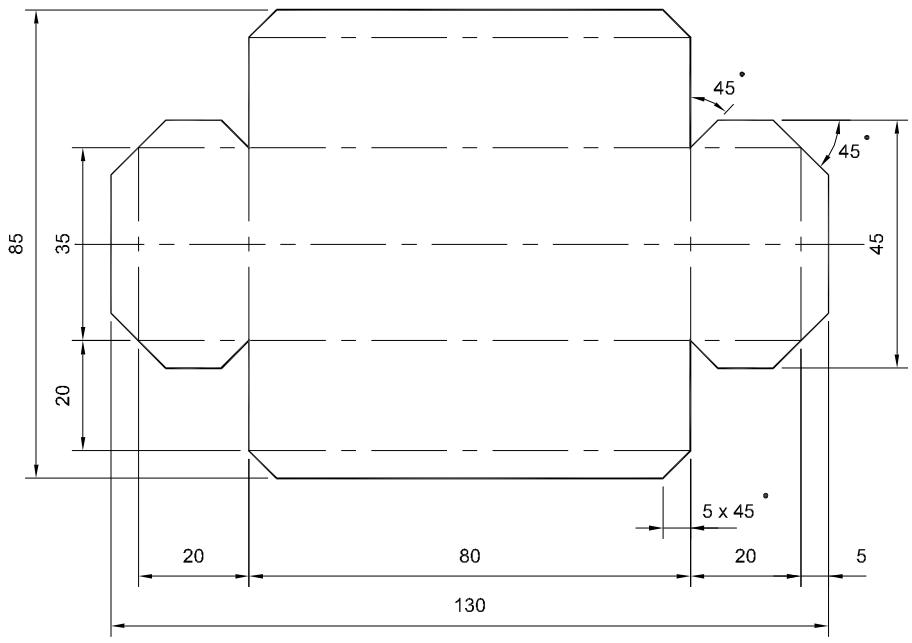
Flatten the sharp tip for about 1 mm for safety while handling. (Fig 7)

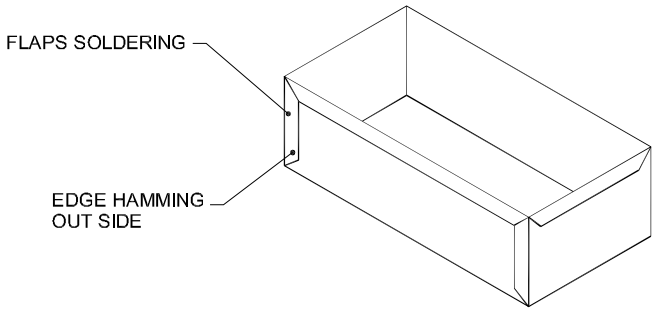
Fig 7



Practice on makeng rectangular tray

Objectives: At the end of this exercise you shall be able to
- **develop a rectangular tray by the parallel line method**
- **shape and size the sheet metal using straight snips**
- **make single hemming using a man's anvil**
- **bend the sheet to 90° using a Tin man's anvil**
- **solder lap joint maintaining uniform flow of solder and penetration.**





1	ISSH 135 x 90 x 0.5		G.I. SHEET	1		8
No. OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	TITLE MARKING RECTANGULAR TRAY WITH FLAPS SOLDERING	TOLERANCE ±0.5	TIME 5 hrs
		CODE No. MDN1334E1	

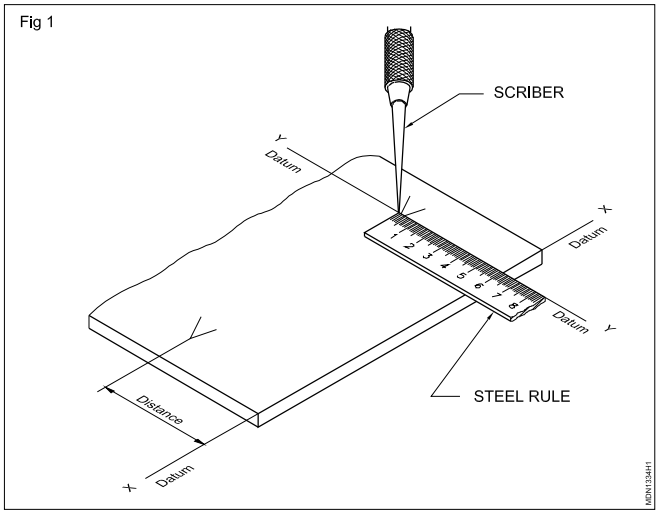
Skill Sequence

Mark lines parallel to an edge

Objective: This shall help you to
- **mark a straight line on the sheet.**

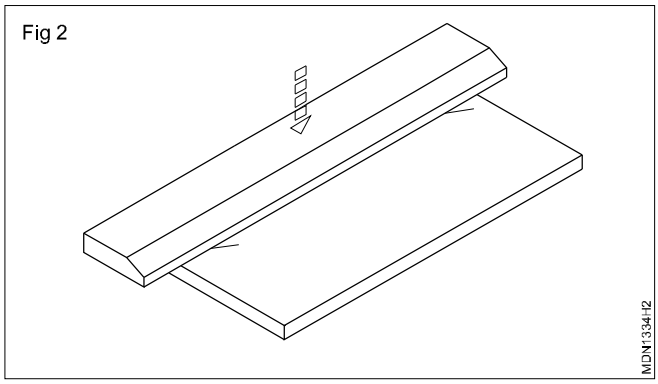
Mark off two 'V' marks from the datum xx at a distance as required by measurement, using a steel rule and a scriber. Datum xx is at right angle to datum yy. (Fig 1)

Fig 1



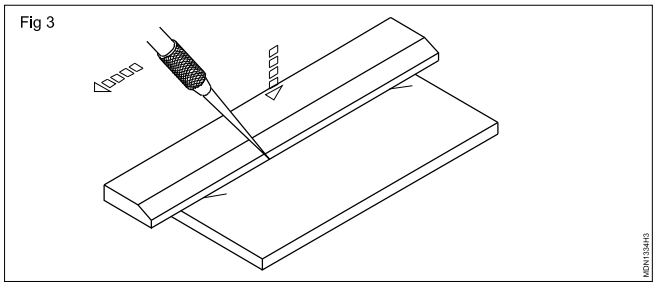
Set the straight edge in between the 'V' marks and press with your fingers. (Fig 2)

Fig 2



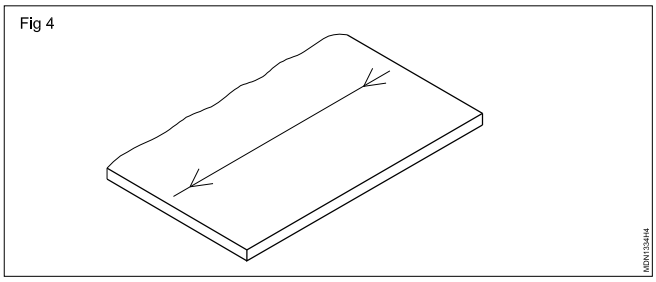
Scribe the line towards you with a proper inclination of the scriber on the level edge of the straight edge. (Fig 3)

Fig 3



The line AB is the parallel line to the datum xx. (Fig 4)

Fig 4



Draw parallel lines as per dimensions following the above procedure.

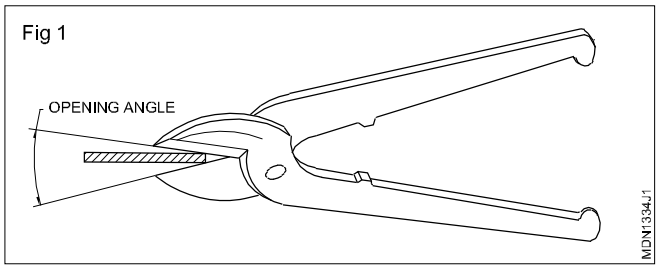
Skill sequence

Cutting sheet by snips

Objective : This shall help you to
- **cut sheet metal by a straight snip.**

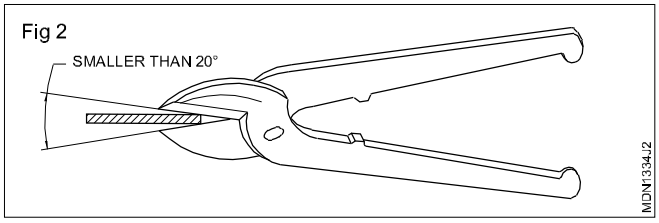
Hold the sheet by one hand, and with the other hand, hold the snip handle at the end, and place the upper blade of the snip on line by keeping a smaller opening angle. (Fig 1)

Fig 1

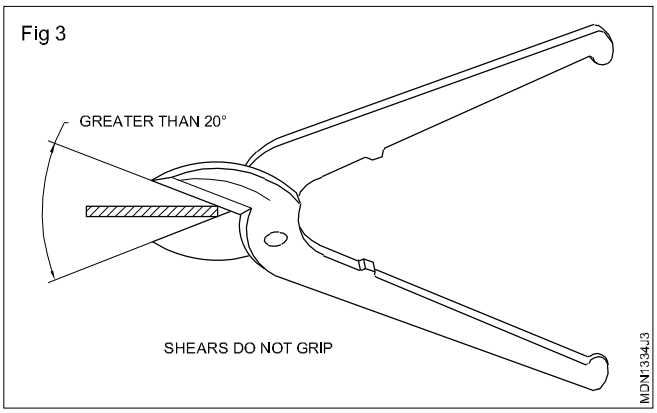


Maintain the gap in between the blades, less than 20°. (Fig 2)

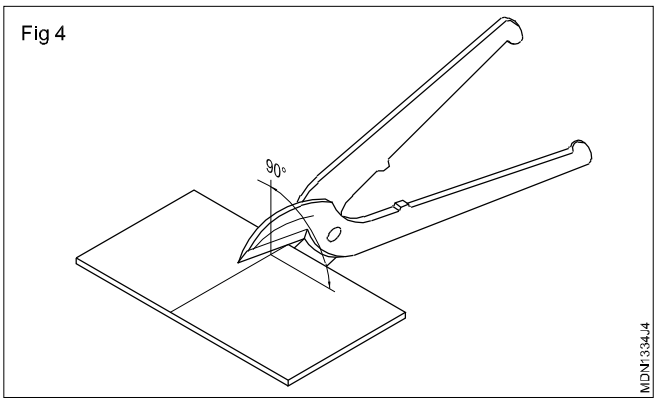
Fig 2



If the blade gap is more than 20°, shears cannot be gripped properly. (Fig 3)

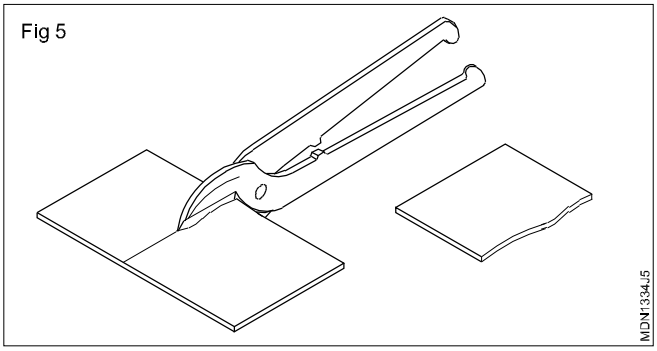


Keep the blade perpendicular to the surface of the sheet metal. Hold the snips straight. (Fig 4)

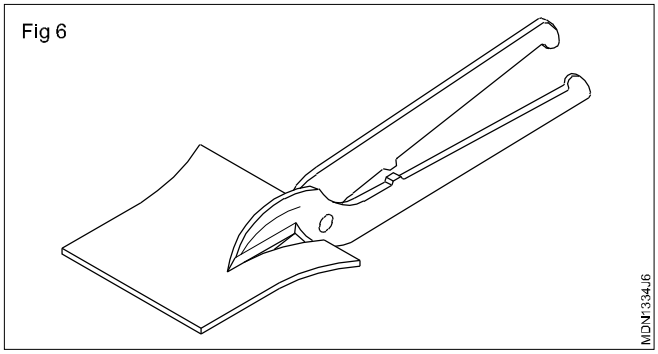


Caution

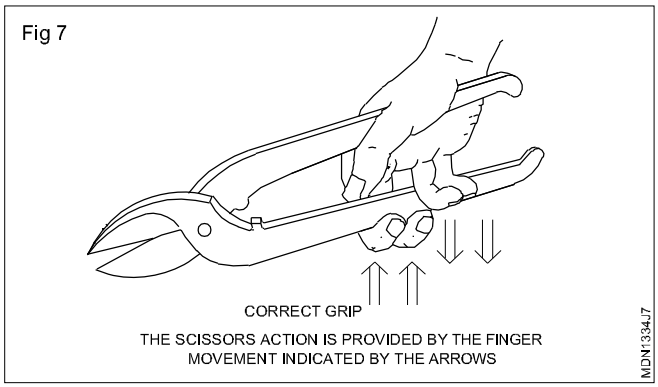
Do not use the full length of the blade by a single stroke. (Fig 5)



If you use the full length of the blade by a single stoke, then the cutting or shearing line will not be straight. (Fig 6)



Keep less metal (sheet) as far as possible on the left hand side at the time of-cutting the sheet. (Fig 7)

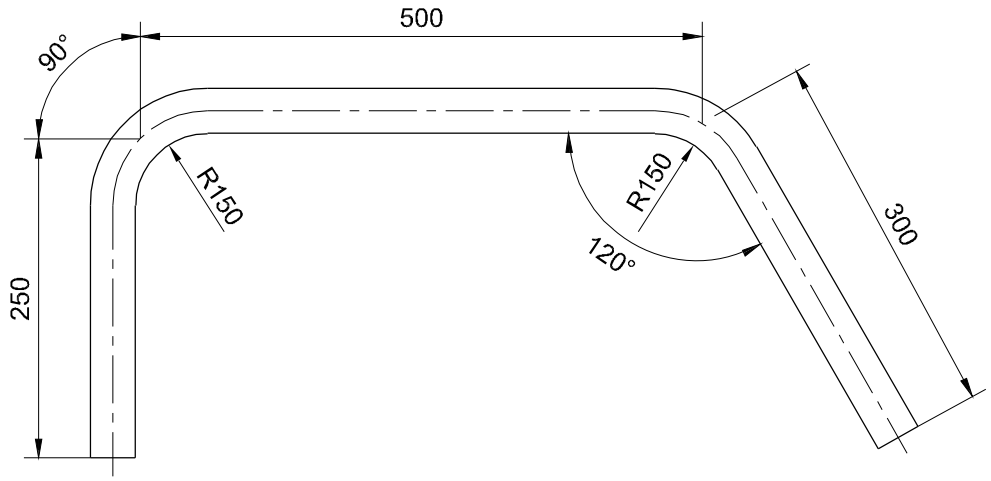


Where stops are not fitted, care should be taken not to pinch the palm of the hand between the turned-in ends of the handles when closing the cutting blades.

Practice on pipe bending and pipe fitting

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

- **prepare a layout for pipe bending job**
- **bend the pipe to the desired angle using pipe bending fixture**
- **check the bend pipe for the correctness of angle.**



1	Ø25 x 4.5 - 820	--	Fe310-O	--	--	
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	
SCALE NTS	PIPE BENDING (BY COLD METHOD)				DEVIATIONS ±0.5	
					CODE NO. MDN1335E1	

PROCEDURE

1 Cut the pipe end square with a pipe cutter.

2 Remove the burr from inside and outside of the pipe with a reamer.

3 Fix the bending machine in a benchwise and ensure it is tightened properly.

4 Set the roller on the bending arm by adjusting the screw and lock nut.

5 Bend the pipe as per drawing

6 Check the correction of the second bend.

Skill Sequence

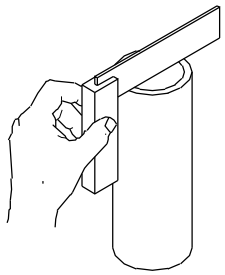
Bend the pipe to the desired angle using pipe bending fixture

Objectives: This shall help you to
- **prepare the pipe to the desired angle using fixture.**
- **bend pipe using hydraulic bending machine**
- **fitting union in pipes.**

File the pipe ends and check up its squareness. (Fig 1)

Check the inside dia. of the pipe by using steel rule.

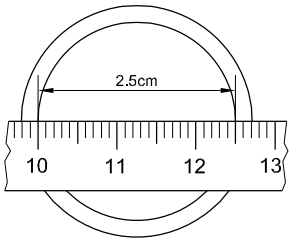
Fig 1



MDN1335-H1

(Fig 2)

Fig 2



MDN1335-H2

Take the reading of inside diameter from 10cm. Measure the length of the pipe as per drawing & measure in difference between initial & final readings.

r = radius of bend (i.e) 150mm

Ø = angle of bend

l = length of curved portion

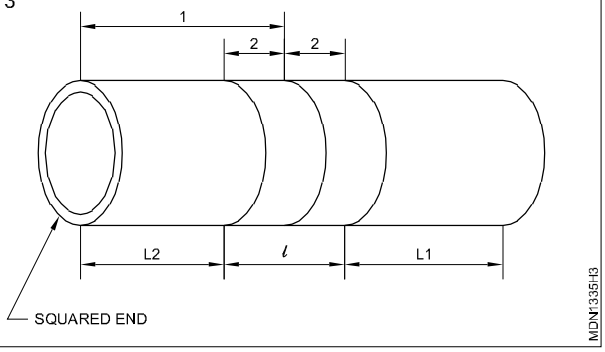
then

$$l = \frac{\pi \times D \times Ø}{360}, \quad L = \text{Total length},$$

$= L1 + l + L2$

Mark off the beginning and the end of the bend from the centre line. (Fig 3)

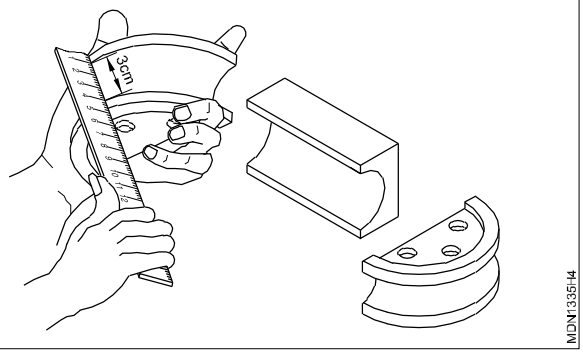
Fig 3



MDN1335-H3

Select the standard former to suit the size of the pipe. (Fig 4)

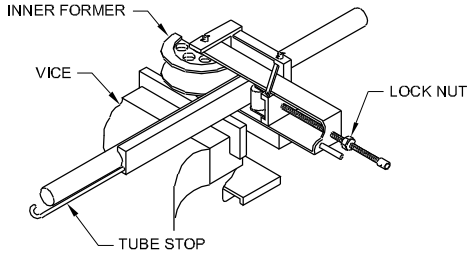
Fig 4



MDN1335-H4

Fix the bending machine in a benchvice and ensure it is tightened properly. Locate the tube stop bar at the required position. (Fig 5)

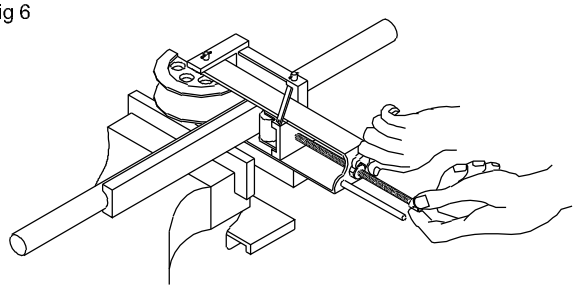
Fig 5



MDN1335-H5

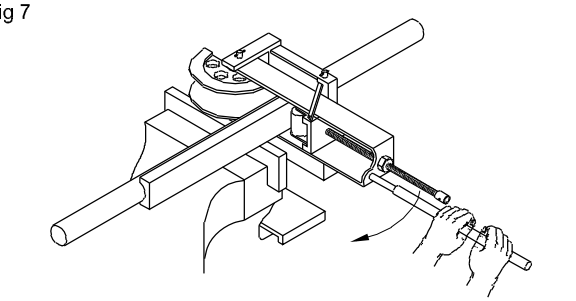
Set the roller on the bending arm by adjusting the screw and lock nut. (Fig 6)

Fig 6



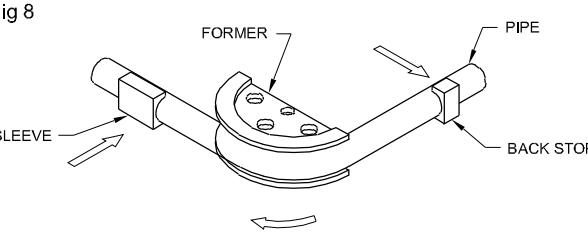
Bend the pipe by pulling the bending arm towards your body. (Fig 7)

Fig 7



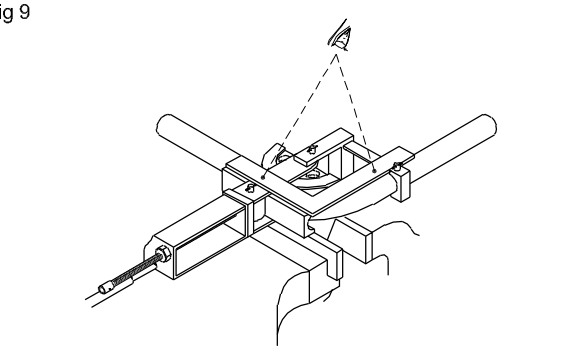
The sleeve bends the pipe round the former as the bending arm is pulled. The back stop holds the tails end of the pipe in position. (Fig 8)

Fig 8



Check the bend for squareness use a set square as shown. (Fig 9)

Fig 9



Check level of former and first leg (90° bend) with spirit level by placing spirit levels as shown in Fig 10.

Check the angle of bend and radius using standard template. (Fig 11)

Fig 10

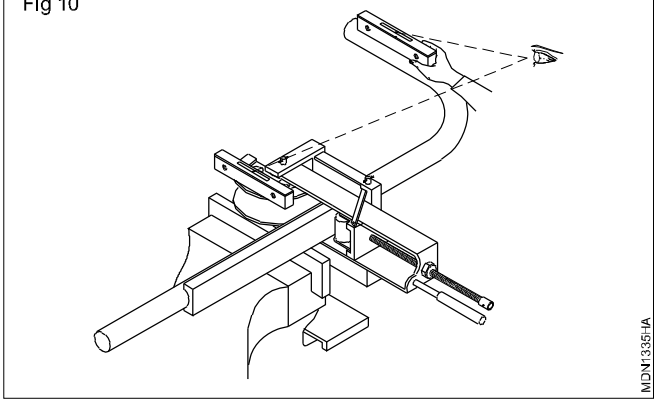
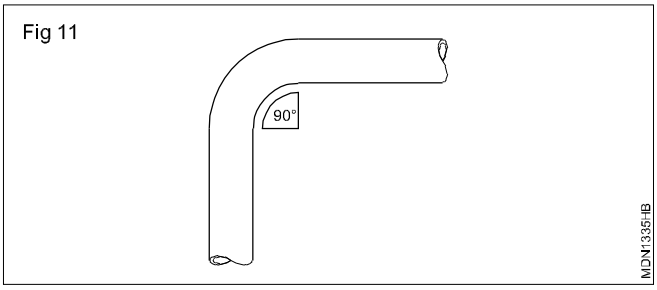


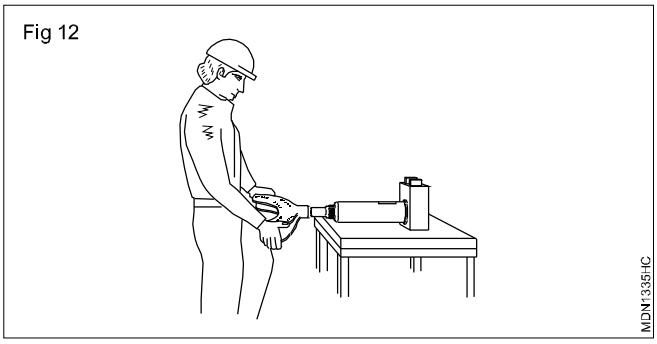
Fig 11



Bending 120° by hydraulic bending machine

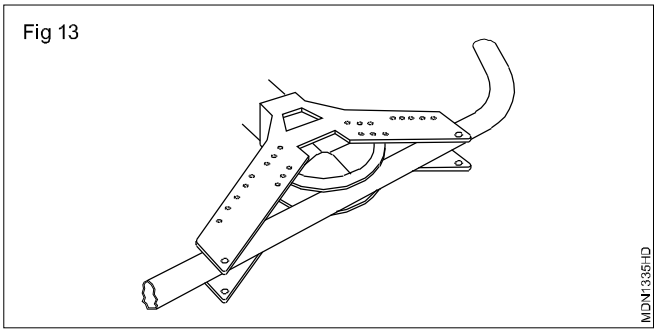
Fit the pipe former on to the cylinder arm. (Fig 12)

Fig 12



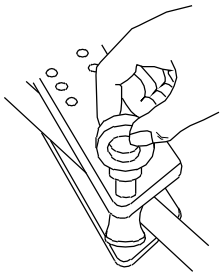
Place the pipe between the forming head plates and against the former. (Fig 13)

Fig 13



Support the pipe and fit dollies (or rollers) between the upper and lower plates of the forming head. Locate them in position by inserting pins through the plates and the dollies. (Fig 14)

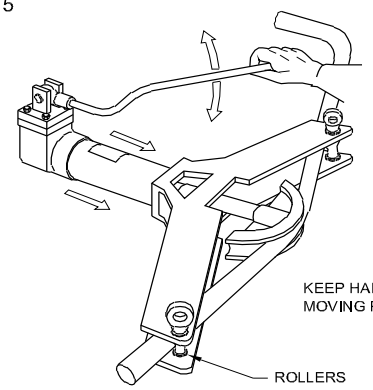
Fig 14



MDN1335HE

Close the pressure release valve on the pump body then start pumping to push the former against the pipe. (Fig 15)

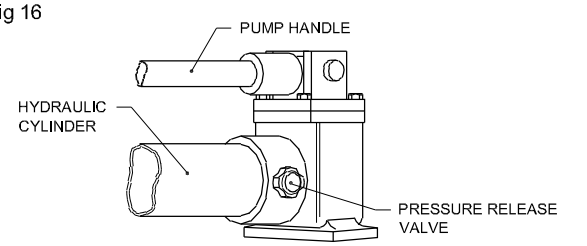
Fig 15



MDN1335HF

Turn the pressure release valve anti-clockwise to release the pressure in the hydraulic cylinder. When the arm has moved back about 6 mm to 10 mm close the pressure release valve to hold the ram steady. (Fig 16)

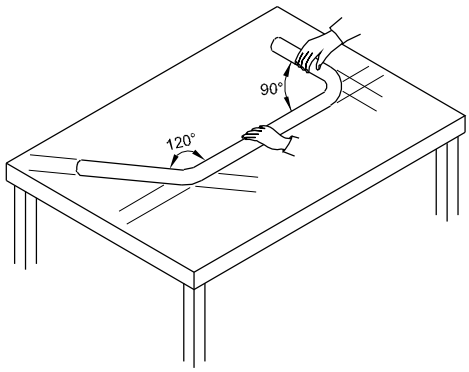
Fig 16



MDN1335HG

Check both bends 90° and 120°by placing pipe on the layout. (Fig 17)

Fig 17



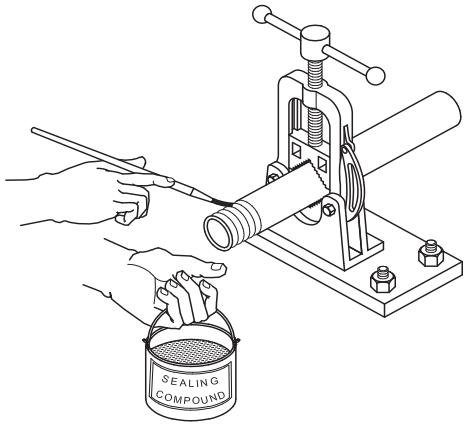
MDN1335HH

Fitting union in pipe line

Hold the pipe in a vice.(Fig 18)

Apply sealing compound over the nipple thread (Fig 18).

Fig18



MDN1311HI

Adjust the pipe wrench to suit the union sleeve nut.

Screwing the union nut on the nipple threads.

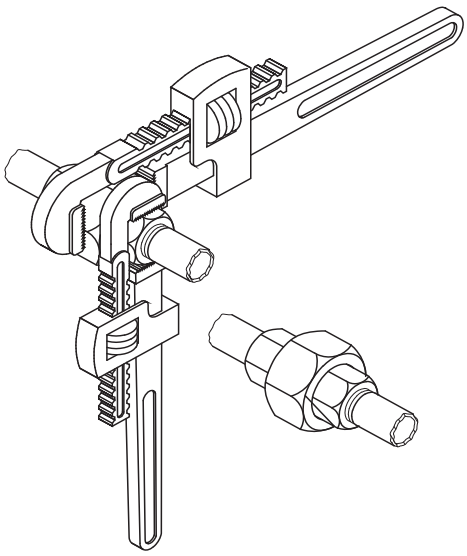
The same process repeated to the another nipple with nut.

Apply sealing compound on the union threads.

Hold both nipple with nut by pipe wrench.

Tighten the nut up to air tight. (Fig 19)

Fig19



MDN1311HJ

Practice on soldering & brazing of pipes

Objectives: At the end of this exercise you shall be able to
- **lay copper pipes using different jointing methods**
- **capillary joint (end feed capillary fittings)**
- **capillary joint (internal solder ring fittings).**
- **braze copper with M.S tube**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 Set.
- Soldering Iron - 1 No.
- Blow lamp - 1 No.
- Tong - 1 No.

Equipments

- Work bench - 1 No.
- Anvil - 1 No.
- Oxy - acetylene welding set - 1 No.

Materials

- M.S. Tube - as reqd.
- Solder - as reqd.
- Brazing rod - as reqd.
- Flux - as reqd.
- Water - as reqd.
- Bucket - as reqd.
- Sand paper - as reqd.
- Silver braging flex - as reqd.
- Silver braging rod - as reqd..
- Copper tube - as reqd.
- M-3 tube - as reqd.
- Clean cloth - as reqd.

PROCEDURE

TASK 1 : **Capillary fitting**

1 Cut the pipe end. Square with a pipe cutter.

2 Remove the burr from inside and outside of the pipe with a reamer.

3 Clean the outside of pipe and inside of the fitting with sand paper.

4 Apply a thin film of flux to the outside of pipe and inside of fittings with brush.

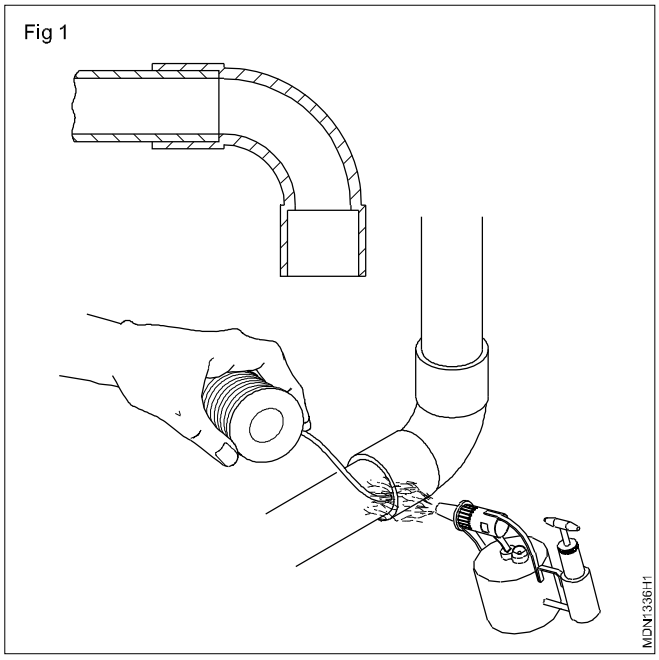
5 Insert the pipe into the fitting cup till the pipe end touches the base of the fitting cup.

6 Apply heat to the pipe and fitting.

7 Add the solder to the side which is opposite to the heat when the flux begins to boil. (Fig 1)

8 Wipe of excess solder.

Fig 1



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TASK 2 : **Using capillary joint (Integral solder ring fitting) (Fig 1)**

1 Cut the pipe with a cutter.

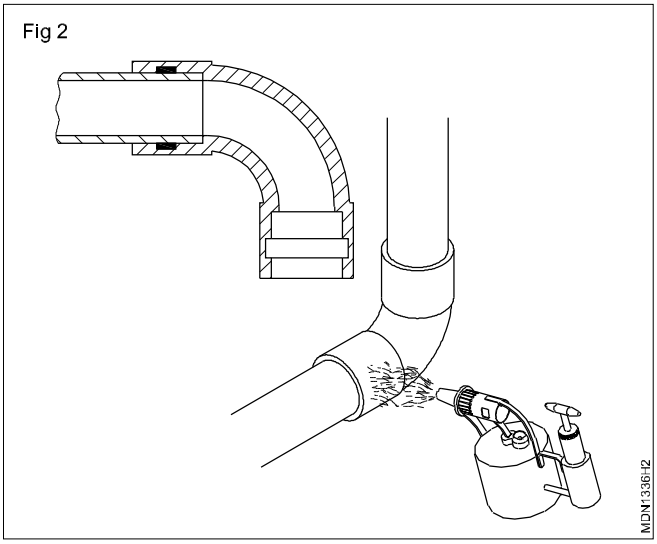
2 Remove the burr from inside the pipe with a reamer.

3 Clean the outside of the pipe and inside of the fittings with sand paper.

4 Apply flux on outside surface of pipe and inside of fittings.

5 Heat the fittings and pipe until a complete ring of solder appears at the mouth of the fittings. Fig. 2.

Fig 2



6 Allow the joint to cool without disturbance.

Non manipulate compression fittings

7 Cut tube to correct length.

8 Remove burrs from pipe and fittings.

9 Insert tube into fittings until it makes contact with the tube stop.

10 Choose the correct size grip jaw.

11 Compress the fitting until the grip jaw stops.

12 Check the joints by pulling them apart with the hands.

Manipulate compression fittings

13 Slip the compression fitting nut and compression ring over the tube.

14 Flare the end of the pipe.

15 Place the cone end of adopter piece on the flared pipe end.

16 Engage the compression nut onto the body thread.

17 Tighten with spanner.

TASK 3: Brazing

1 Place the tube in V- guide of cutter

2 Tighten the thumb screw until considerable pressure is applied

3 Revolve the cutter slowly around the tube so that the sharp cutting wheel feeds gradually on the tubings to apply pressure thumb screw till tube is completely cut

4 Ream and file the edges of the tubing

5 Use sand paper to clean the outer surface of the tube and clean inside by wire brush

6 Make a paste of sliver brazing flux by mixing it with little bit of water and apply a thin coat of flux to outside of the fitting

7 Insert the pipe into MS pipe and see that the fit is not too easy (Fig 1)

8 Clamp the pipe in the flaring block and mount the block in the vice

9 Light the oxy - acetylene torch using the spark lighter

10 Heat the connection at safe distance from the joint until the water vapourizes

11 Continue heating until the flux turns milky and finally turns clean (Fig 2)

12 Apply th esliver solder to both edges of the MS tube until the solder flows on both pipes

13 Remove silver solder rod and allow the joint to cool

14 After cool the assembly and test the connector to 10.5 kg/cm^2 pressure.

Fig 1

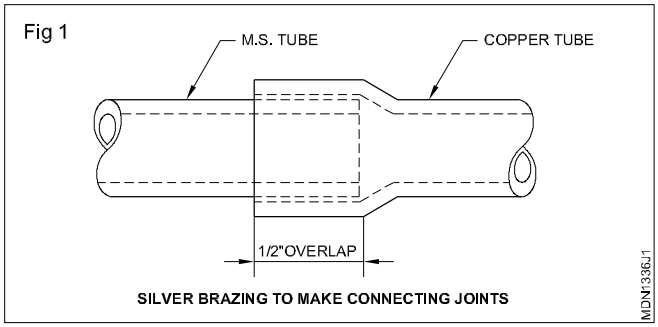
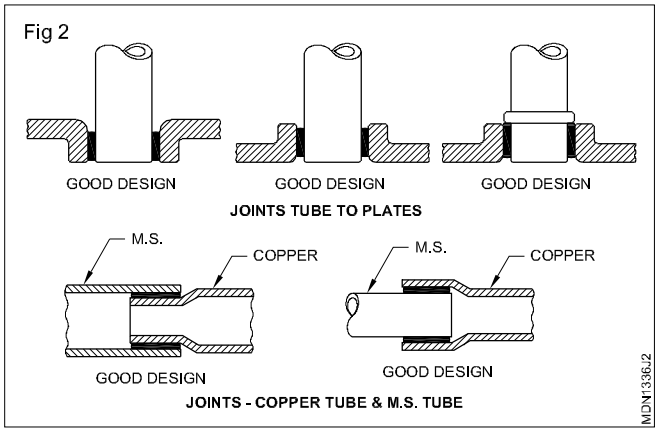


Fig 2



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Practice on soldering wires

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

- **identify the air compressor, jib crane, bench drill, sparkless tester and wheel balancer.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Crimping plier - 1 No.
- Blow lamp - 1 No.
- Tong - 1 No.
- Combination plier - 1 No.

Materials

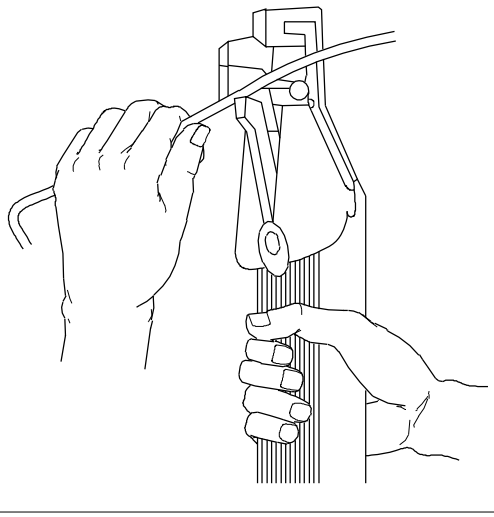
- Cotton waste - as reqd.
- Wooden plank - as reqd.
- Solder - as reqd.
- Brick - as reqd.
- Insulating sleeve - as reqd.
- Flux - as reqd.
- Lug socket - as reqd.
- Cloth/Cotton tape - as reqd.
- Grade sandpaper - as reqd.
- Copper and Aluminium conductors - as reqd.

PROCEDURE

TASK 1 : **Prepare the crimping joints with connector**

1 Strip off the required length of insulation from the cable that suits the terminal size. (Fig 1)

Fig 1



Be sure hot to cut or damage the wire core, and use correct size wire stripper blade. (Fig 2)

2 Twist the strands of the wire slightly clockwise. (Fig 3)

3 Clamp the spade connector with the crimping pliers in the matching position of the jaws. (Use a suitable spade connector and crimping plier.) (Fig 4)

4 Insert the wire far enough in the connector.

5 Apply slight pressure to create a light impression on the connector.

Fig 2

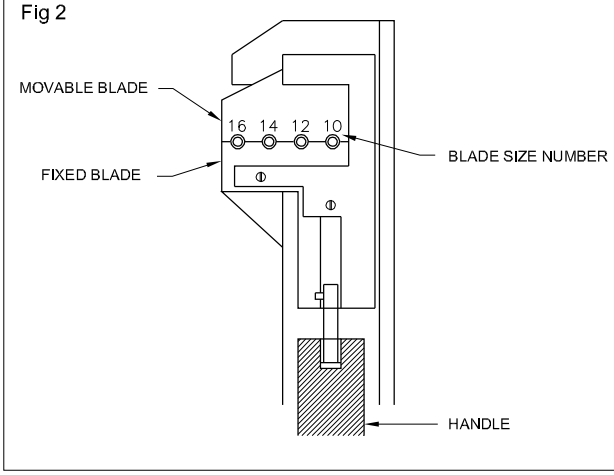
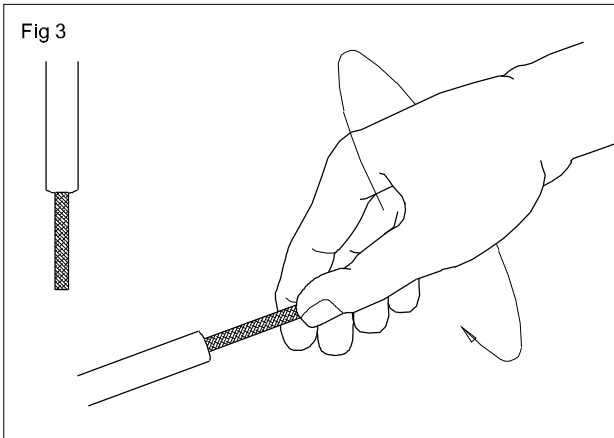


Fig 3



6 Check whether the connector is located in the middle of the band of the connector, and, if necessary, make final adjustments.

7 Apply sufficient pressure in the handle to press the connector fully. (Fig 5)

Fig 4

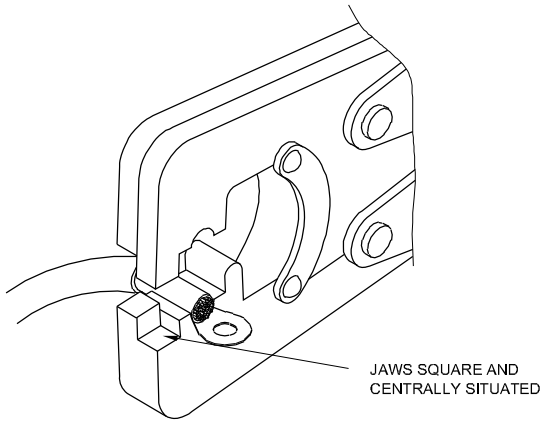
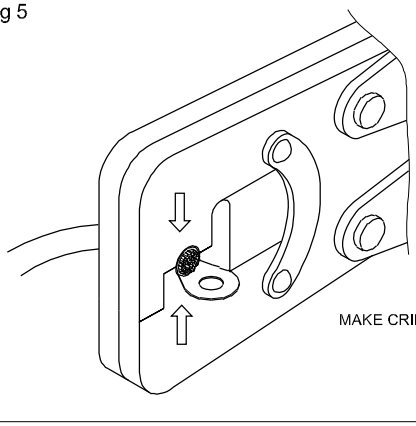


Fig 5



8 Check whether the prepared crimping joint is firm by pulling the cable and connector.

9 Repeat the crimping of connectors for various sizes of copper and aluminium conductors of different lengths.

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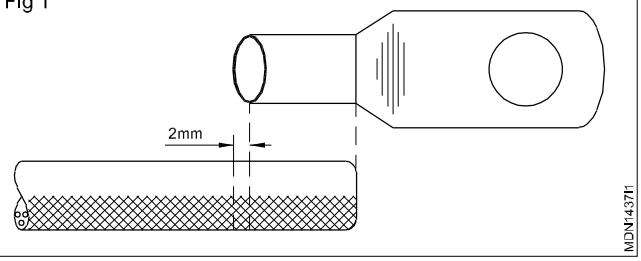
TASK 2 : **Solder the cable lugs by using blow lamp**

1 Solder a lug to a copper conductor. (Fig 1)

Fig 1

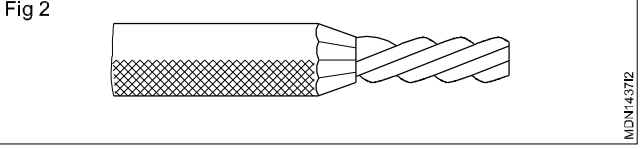


2 Clean the inner surface of the cable lug using 00 grade sandpaper.

3 Put the cable lug to one end of the cable and mark the cable according to the depth of the cable lug. Add about 2 mm to the marking.

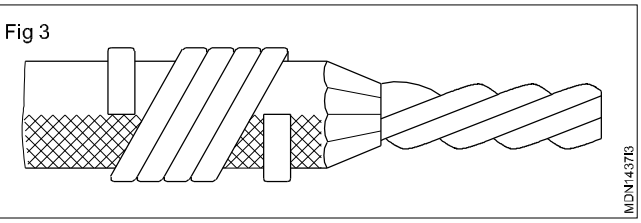
4 Remove the insulation from the cable and clean the strands. (Avoid damage to the strands of the cable while skinning.) (Fig 2)

Fig 2



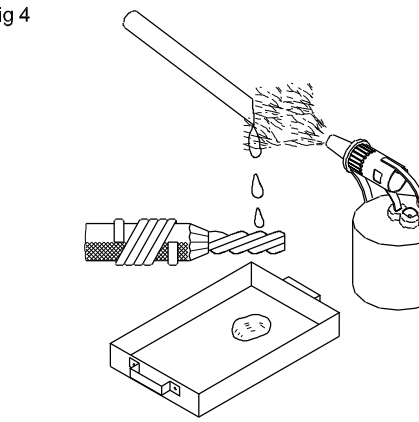
5 Wrap a cloth/cotton tape on the insulation of the cable to a length of 30 mm and wet it with water. (Use minimum water to wet the cloth/tape. Do not allow water to drip). (Fig 3)

Fig 3



6 Light the blowlamp and let it emit a blue flame. (Fig 4)

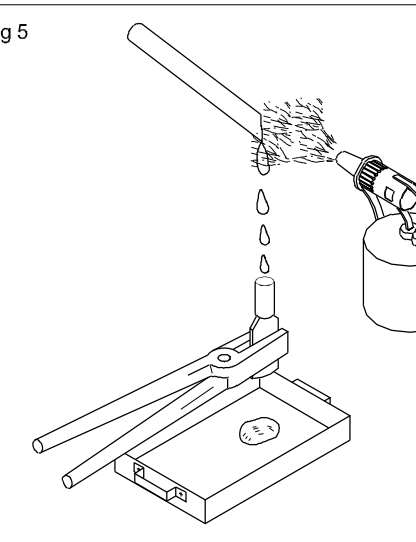
Fig 4



7 Apply a thin coat of flux to the cable end.

8 Tin the cable end by monitoring the blowlamp on the solder stick and by allowing the molten solder to fall on the bar stranded cable end. Place a clean tray below the cable end to collect the excess solder.

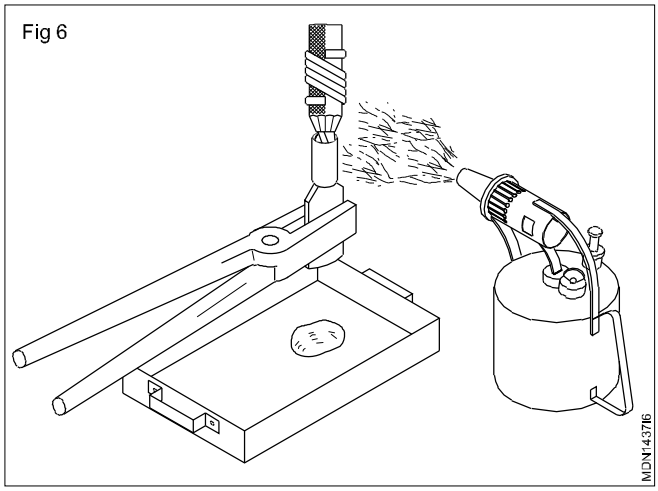
Fig 5



9 Apply a small quantity of flux inside the lug socket. Tin the lug by melting the solder stick to fill the socket and collect the excess molten solder in the tray. (Fig 5)

10 Apply some flux to the cable end and socket interior. (Fig 6)

Fig 6

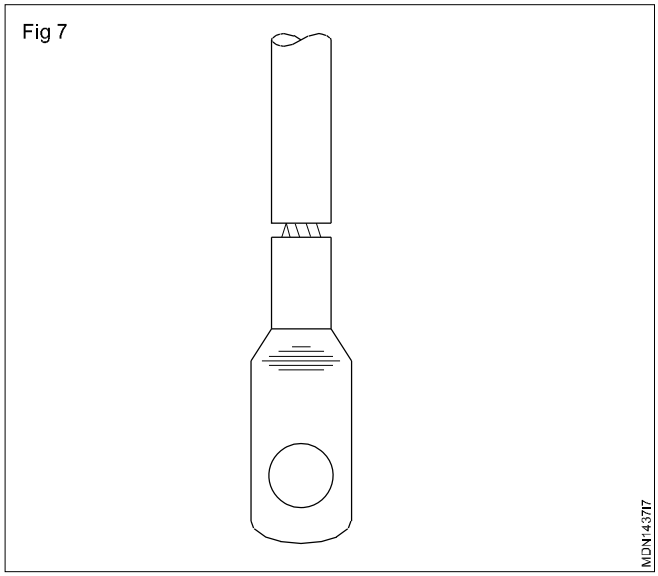


11 Fill up the socket of the lug with the molten solder.

12 Monitor the blowlamp flame on the socket; insert the cable in the socket and hold the cable vertically.

13 Remove the blowlamp and hold the cable and socket without shaking. (Fig 7)

Fig 7



14 Remove the extra solder from the lug and the cable by wiping with a piece of cotton cloth while the solder is still hot.

15 Keep holding the cable and lug until the solder solidifies.

Do not use water to cool the lug.

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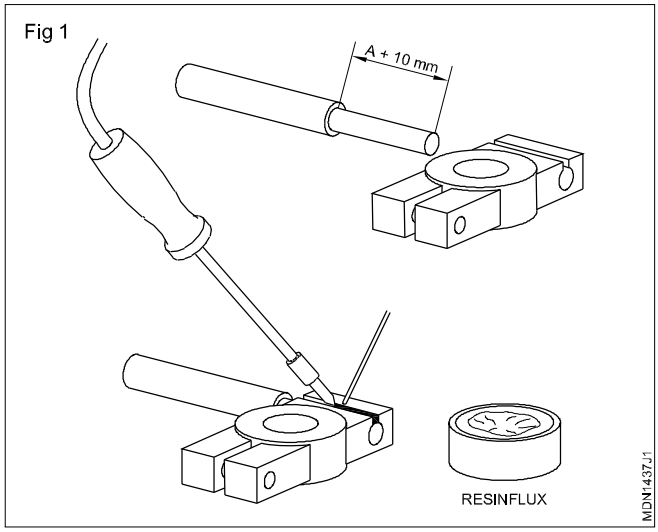
TASK 3 : **Solder the cable using soldering iron**

1 Clean the strands and get a copper face free from sulphate.

2 Insert the wire end as shown in the Fig 1.

Fig 1



3 Hold the clamp in a vice in between two wooden blocks to prevent heat flow to vice.

4 Connect a 1000w/220v soldering iron to an AC source. Keep the iron on a brick.

Do not over heat the iron. Overheating would impair wetting of iron. Wetting means coating soldering iron with solder.

5 Solder the end with clamp face with molten solder.

6 Hold the clamp horizontally and solder the split and close the split with solder.

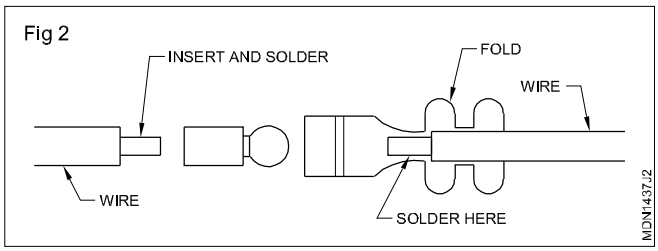
7 Hold the clamp as shown in the Fig 13 and solder around the cable without melting the insulating sleeve.

Wound the insulation material with a wet cloth near the soldering end to prevent melting.

Soldering the circuit wire terminals

1 Remove the insulation as shown in the Fig 2 without cutting conductor strands.

Fig 2



2 Connect a soldering iron of 300w/220v to an AC supply and keep the iron on a brick.

3 Clean the copper strands with emery paper.

4 Twist the end neatly.

5 Keep the end on a wooden plank.

6 Wet the iron with soft solder.

Do not over heat the iron

7 Coat the end with solder.

8 Insert the end into the small loop on the eyelet terminal.

9 Fold the terminal tabs one by one and crimp with a tool.

10 Now keep the clamp on wooden plank.

11 Keep the iron so that a wide area of contact is achieved for better heat transfer to obtain a molten flow of soft solder.

12 Wait for solidification of solder and inspect the result. Repeat the same operation for other terminal soldering.

Insulting the wires and cables

For small wires and cables various sizes of insulation sleeves are available. These sleeves can be inserted before soldering the terminals.

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Practice on measuring electrical parameters in circuits

Objectives : At the end of this exercise you shall be able to
- **form DC series circuits and verify its characteristics**
- **form DC parallel circuits and verify its characteristics.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Ohmmeter/Multimeter - 1 No.

Equipments

- Battery 12V, 6V - 1 No..

Materials

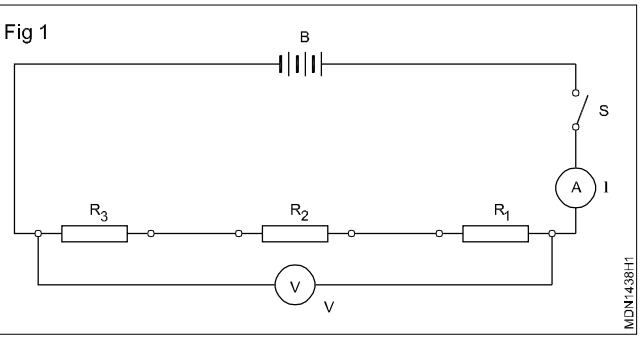
- Wires 4mm - as reqd.
- Insulation tape - as reqd.

PROCEDURE

TASK 1: **Connect DC series circuit (Fig 1) and Verify its characteristics**

1 Form a circuit as shown in the Fig 1.

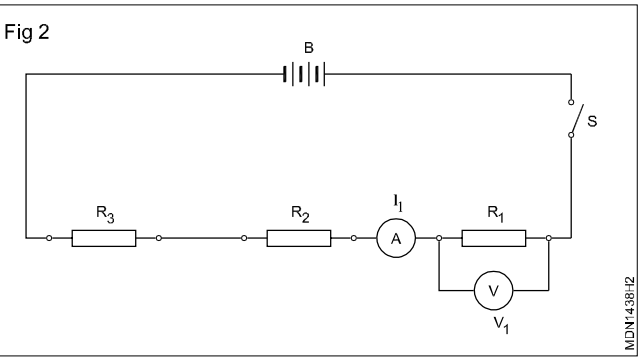
Fig 1



2 Close the switch 'S', measure the current 'I' and voltage 'V'.

3 Enter the measured values in Table No.1.

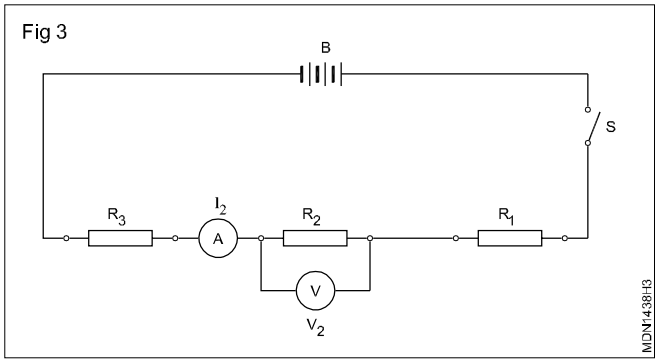
Fig 2



4 Switch off the supply, connect the ammeter and voltmeter as shown in the Fig 2. Switch on the supply and measure voltage V_1 and current I_1, through R_1.

5 Switch off the supply, connect the ammeter and voltmeter as shown in the Fig 3. Switch on the supply and measure the voltage V_2 and the current I_2 in R_2.

Fig 3



6 Draw a circuit diagram showing the position of 'A' and 'V' in the circuit to measure the current I_3 and voltage V_3 across R_3.

7 Connect and measure I_3 and V_3 across R_3.

8 Enter the measured values in Table 1.

9 Verify the characteristics of current, voltage and total resistance.

Table 1

Values	Total circuit	R_1=10	R_2= 20	R_3= 10
Current	I =	I_1 =	I_2=	I_3=
Voltage	V =	V_1 =	V_2=	V_3=
Res. R=	R = _____ =	R_1=_____ =	R_2=_____ =	R_3=_____ =

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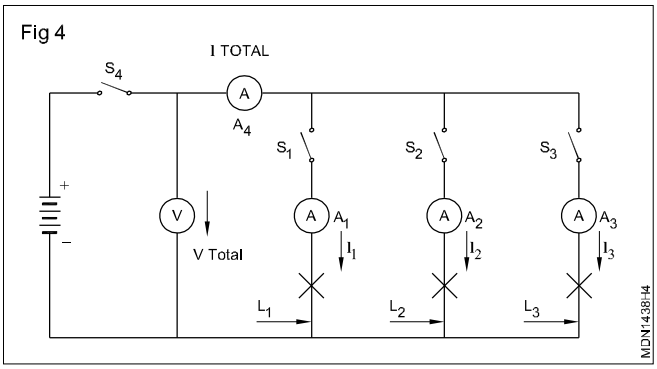
TASK 2 : **Connect DC parallel circuit (Fig 4) and Verify its characteristics**

Fig 4



1 Form the branches 1, 2, 3 by connecting the torch lamps L1, L2, L3 (150 mA, 6v) with a holder, an ammeter A4 (500 mA) and switch 'S4' in series Fig 4.

2 Connect the lamp terminals of the three branches together.

3 Connect the leads of each branch together and also connect with the lead of the switch S4.

4 Form the circuit as shown in circuit diagrams with voltmeter (V), ammeter (A4), switch 'S4' and battery.

5 Close the switch 'S4' and switch 'S1' in branch 1.

6 Read the ammeters 'A4' and 'A1' and record the values in Table 2.

7 Close the switches 'S4' 'S1' and 'S2' in branch 2.

8 Read the ammeters 'A4' 'A1' and 'A2' and record the values in Table 2.

9 Close the switches 'S4' 'S1' and 'S2' in branch 3.

10 Read the ammeters 'A4' 'A1' 'A2' and 'A3' and record the values in Table 2.

11 Repeat the above steps after clamping the torch lamp in any one branch with 6v 300 mA lamp and record the results in Table 2.

12 Repeat the exercise by replacing all the three 'lamps with holder' by 'wire-wound resistors' (two numbers of 100 ohms and one of 150 ohms).

13 Verify the characteristics of current, voltage and resistance.

Table 2

Sl. No.	I_1	I_2	I_3	I_{Total}	Switches closed	Components in the branches
1					S_4, S_1	3 lamps of 150 mA.
2					S_4, S_1, S_2	,,
3					S_4, S_1, S_2, S_3	,,
4					S_4	,,
5					S_4, S_1	2 lamps of 150 m and one lamp 300 mA.
6					S_4, S_1, S_2	,,
7					S_4, S_1, S_2, S_3	,,
8						Resistors - two 100 ohms and one 50 ohms.
9					S_4, S_1, S_2	,,
10					S_4, S_1, S_2, S_3	,,

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Practice on continuity test

Objectives : At the end of this exercise you shall be able to
- **check the fuses of all the lighting units**
- **find out the open and short circuits in the lighting circuit**
- **use of jumper wire**
- **check the fusible links**
- **check the circuit breakers.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Multimeeter - 1 No.
- Wire cutter - 1 No.

Equipments

- Battery 12V - 1 No..
- Vehicle - 1 No.

Materials

- Auto fuses - as reqd.
- Test lamp - 1 No.
- Cable/Wire - as reqd.
- Fusible links - as reqd.
- Circuit breaker - as reqd.

PROCEDURE

TASK 1 : **Check the fuses of all the lighting units**

1 Check the battery for its charge.

2 Connect the test lamp clip to a good ground.

3 Touch the probe of the test lamp on either end of the fuse. If the test lamp lights, the fuse is in good condition.

If the test lamp lights only while touching one side that means the fuse is defective. If the test lamp does not light even on touching both the sides that means the power source is not on or the ground connection is bad.

4 Remove the fuse from its spring clip. Check whether it is blown or not.

If it is blown we can see through the glass tube.

If the fuse is blown due to short circuit the colour of glass tube becomes black (1) and the fuse wire melts like small balls. (Fig 1)

If the fuse is blown (2) due to overload the fuse wire is simply cut off. (Fig 2)

Fig 1

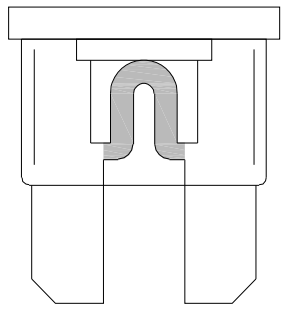
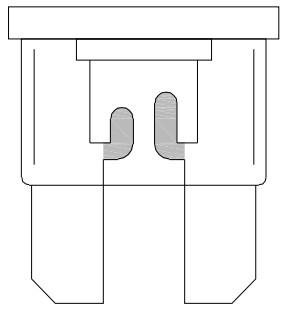


Fig 2



TASK 2 : **Fine out open and short circuit in the lighting circuit**

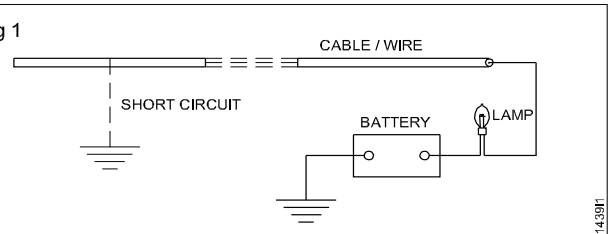
1 Check the wiring for open circuit by connecting an ohmmeter between the two terminals.

If there is an open circuit the ohmmeter reading will be more.

2 Trace the open circuit and rectify.

3 Check the wiring for short circuit with the test lamp. (Fig 1)

Fig 1



TESTING OF SHORT CIRCUITS IN A WIRING CIRCUIT

If there is a short circuit the test lamp will glow before the circuit is completed and also the fuse will be blown off.

TASK 3 : **Identify the fuse unit in the panel board (Fig 1)**

1 **Engine 7.5 A :** Alternator voltage regulator (IG terminal), fuel cut solenoid, intake shutter, indicator light.

2 **Heater 20 A :** Heater blower motor, air conditioner.

3 **Tail 15 A :** Instrument panel lights, license plate lights, parking lights, tail lights.

4 **Head (RH) 15 A :** High beam indicator light, right hand headlights.

5 **Charge 7.5 A :** Alternator voltage regulator, (L terminal), discharge warning light.

6 **AC 20 A :** Air conditioner.

7 **HAZ-HORN 15 A :** Emergency flashers, emergency flasher indicator lights, horn, turn signal indicator lights, turn signal lights.

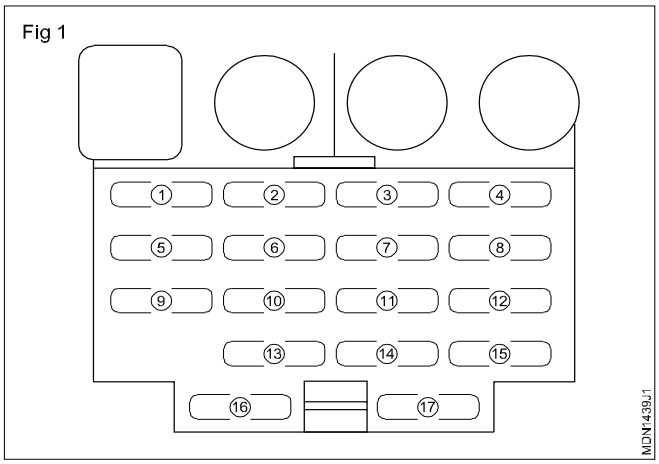
8 **Head (LH) 15 A** : High beam indicator light, left hand head lights.

9 **CIG 15 A :** Cigarette lighter, clock digital type.

10 **Wiper 15 A :** Windshield wipers and washer.

11 **Stop 15 A :** Stop light

Fig 1



12 **Radio 7.5 A :** Radio, stereo cassette tape player

13 **Gauge 7.5 A :** Back-up lights, engine temperature gauge, fuel gauge, warning lights, warning buzzers.

14 **Dome 7.5 A :** Clock (digital type), interior light.

15 **16 7.5 A and 15 A :** Spare fuses

16 Write the name of the parts in the Table 1.

Table 1

Sl. No.	Lable No.	Name of the Parts and its rating
1	2	
2	5	
3	4	
4	1	
5	3	
6	11	
7	15	
8	12	
9	14	
10	6	
11	7	
12	9	
13	13	
14	16	
15	10	
16	8	

TASK 4 : **Jumper Wire**

1 Park the vehicle, on level ground and apply hand brake.

2 Open the bonnet and secure with the holding lever.

3 Place the fully charged battery adjacent to the vehicle discharge battery.

4 Connect the two battery terminal in parallel by using jumber wire cables as shown in Fig 8.

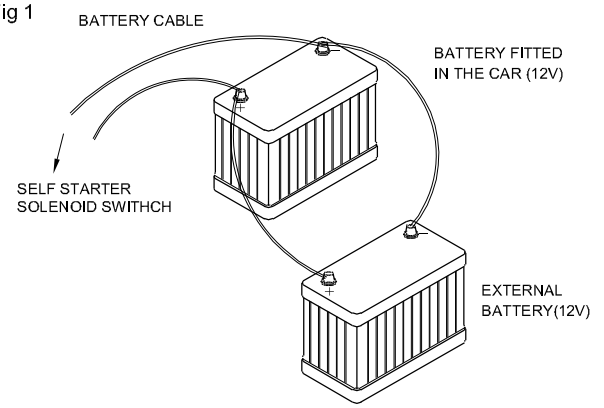
5 Start the vehicle run for some times.

6 Disconnect the jumber cables from the vehicle battery terminal.

7 Now the vehicle will run with its own battery.

8 Close the bonnet, securely.

Fig 1



JUMP STARTING OF AN ENGINE BY USING EXTERNAL BATTERY IN PARALLEL CONNECTION

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TASK 5: **Checking of fusible link**

1 Visually inspect the fusible link for burnout, disconnect, and damaged.

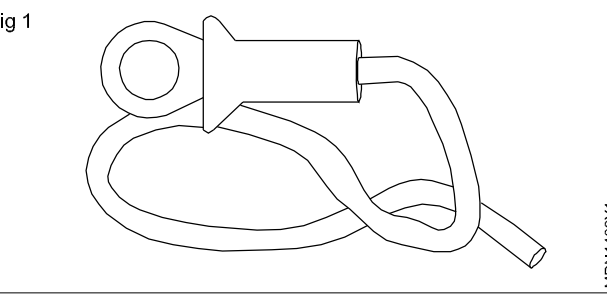
2 Check with the multimeter for continuity test.

3 Replace the fusible link if damaged, burnout or disconnected

Replacing fusible links (Fig 1) is little bit complex than simply pulling a fuse, since they are bolted in place and are sometimes difficult to reach.

Using the right tools and finding the blown fusible link location is important.

Fig 1



And also it is very important to use the correct replacement of fusible link's size and length.

Never replace fusible link with normal electrical wire.

— — — — — — — —

Diagonize electrical circuits

Objectives : At the end of this exercise you shall be able to
- **check the DC series circuit joints**
- **check the DC parallel circuit joints**
- **DC series parallel circuit.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Multimeeter - 1 No.
- Ohm meter - 1 No.

Equipments

- Battery 12V - 1 No..

Materials

- Wires 4 mm - as reqd.
- Insulation tape - as reqd.

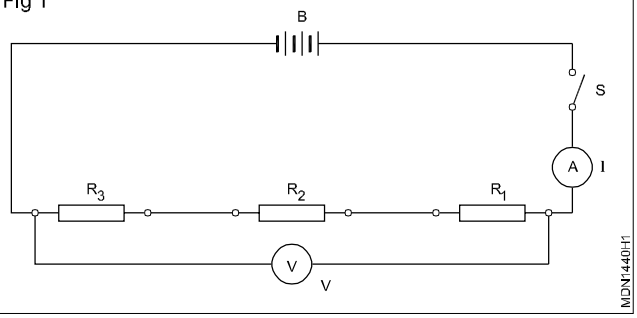
PROCEDURE

TASK 1 : **DC series circuit**

1 Prepare the D.C series circuit diagram

2 From a circuit as shown in the Fig 1.

Fig 1



3 Close the switch 'S', measure the current 'I' and voltage 'V'.

4 Enter the measured values in Table 1.

5 Switch off the supply, connect the ammeter and voltmeter as shown in the Fig 2. Switch on the supply and measure voltage V_1 and current I_1 through R_1.

6 Switch off the supply, connect the ammeter and voltmeter as shown in the Fig 3. Switch on the supply and measure the votage V_2 and the current I_2 in R_2.

7 Draw circuit diagram showing the position of 'A' and'V' in the circuit to measure the current I_3 and voltage V_3 across R_3.

Fig 3

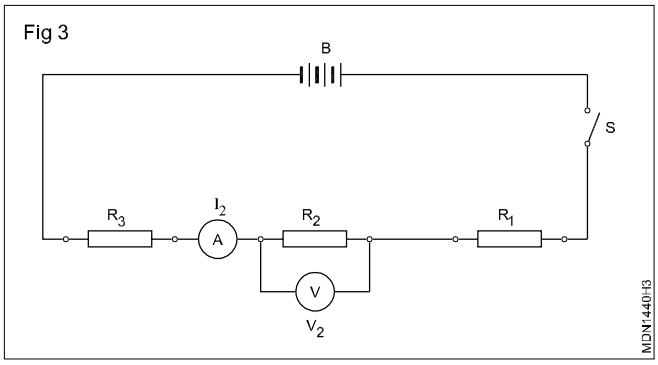
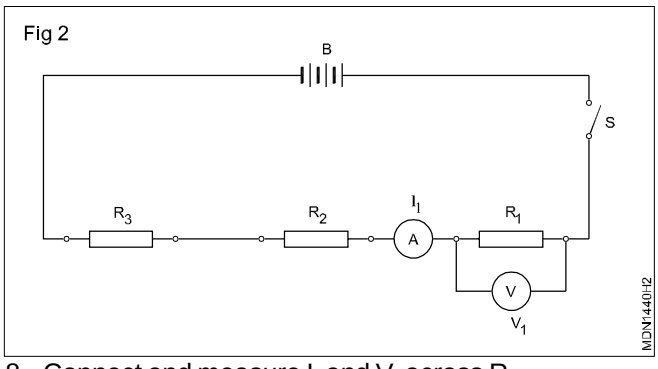


Fig 2



8 Connect and measure I_3 and V_3 across R_3.

9 Enter the measured values in Table 1.

Table 1

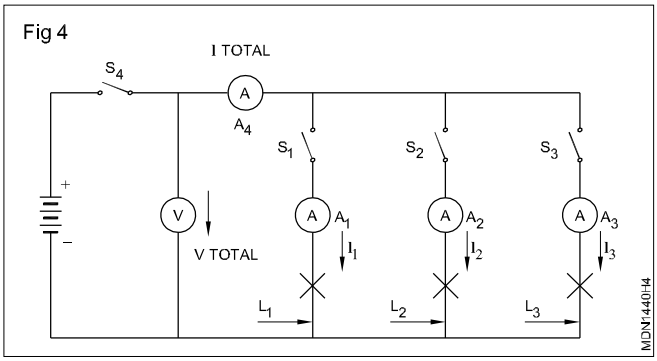
Values	Total circuit	$R_1 = 10$	$R_2 = 20$	$R_3 = 10$
Current	I =	I_1 =	I_2 =	I_3 =
Voltage	V =	V_1 =	V_2 =	V_3 =
Resistance	R =	R_1 =	R_2 =	R_3 =

TASK 2 : **DC parallel circuit**

1 Prepare the D.C parallel circuit diagram

2 Form the branches 1,2,3 by connecting double contact single filament 20W bulbs L_1, L_2, L_3 with a holder, an ammeter A4 of 0-30 Amp DC (1 Amp.DIV) and switch 'S_4' in series. (Fig 4)

Fig 4



3 Connect the lamp terminals of the three branches connect with the lead of the switch S_4.

4 Form the circuit as shown in circuit diagrams with volmeter (V), ammeter (A_4), switch 'S_4' and battery.

5 Close the switch 'S_4' and switch 'S_1' in branch 1.

6 Read the ammeters 'A_4' and 'A_1' and record the values in Table 2.

7 Close the switches 'S4' , 'S1' and 'S2' in branch 2.

8 Read the ammeters 'A4' 'A1' and 'A2' and record the values in Table 2

9 Close the switches 'S4', 'S1', 'S2', and 'S3' in branch 3.

10 Close the swiches 'S4', 'S1', 'S2' and 'S3' in branch 3.

11 Read the ammeters 'A4' 'A1' 'A2' and 'A3' and record the value in Table 2.

12 Repeat the above steps after clamping the torch lamp in any one branch with 6v 300 mA lamp and record the results in Table 2.

13 Repeat the exercise by replacing all the three 'lamps with holder' by wire-wound resistors' (two numbers of 100 ohms and one of 150 lhms).

Table 2

Sl. No.	I_1	I2	I3	I	Total	Switches closed	Components in the branches
1						S_4, S_1	3 lamps of 1.7 Amps each
2						S_4, S_1, S_2	"
3						S_4, S_1, S_2, S_3	"
4						S_4	"
5						S_4, S_1	2 lamps of 1.7 Amps lamp and one 300mA
6						S_4, S_1, S_2	"
7						S_4, S_1, S_2, S_3	"
8						S_4, S_1	Resistors two-one 100 ohms and another 150 ohms
9						S_4, S_1, S_2	"
10						S_4, S_1, S_2, S_3	"

TASK 3 : **DC Series parallel circuit.**

Prepare the D.C series parallel circuit diagram

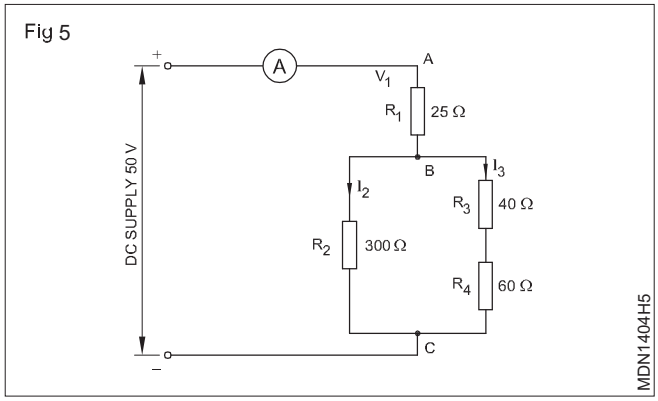
1 Calculate the voltage and currents for the series parallel circuit shown in Fig 5. Enter the values in Table 3.

2 Calculate the total resistance R_T and total current I_s for V_s = 50V and enter in Table 4.

3 Set the value of the rheostat resistances equal to the value given in Fig 6 (i.e. R_1 = 25 ohms, R_2 = 300 ohms, R_3 = 40 ohms and R_4 = 60 ohms by measuring the resistance value between one end and the variable point of the rheostat)

4 Form the circuit and measure the voltage and current. Record them in your note book.

Fig 5



5 Calculate the value of R_T from V_s and I_s and record them in your note book and Compare with the value obtained in step 3.

Table 3

		V_{RI}	I_S	I_2	V_{R2}	I_3	V_{R2}	I_3	V_{R3}	R_3+R_4	$R_2 \mid\mid (R_3+R_4)$
V_s = 50V R_1 = 25W	Calculated Values										
R_2 = 300W R_3 = 40W R_4 = 60W	Measured Values										

Table 4

Calculatee Values	$R_T = R_1 + R_1\{R2 \mid\mid (R_3 + R_4)\}$ =
Measured Values	

— — — — — — —

Check the electrical circuit using test lamp

Objectives : At the end of this exercise you shall be able to
- **check the electrical circuits with the test lamp**
- **solenoid electrical circuit with a test lamp**
- **check the wiper motor electrical circuit.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.

Equipments/Machinery

- Battery. Test lamp - 1 No..
- Starting motor with solenoid - 1 No..
- Brake light assembly - 1 No..

Materials

- Wires 4 mm - as reqd.
- Insulation tape - as reqd.

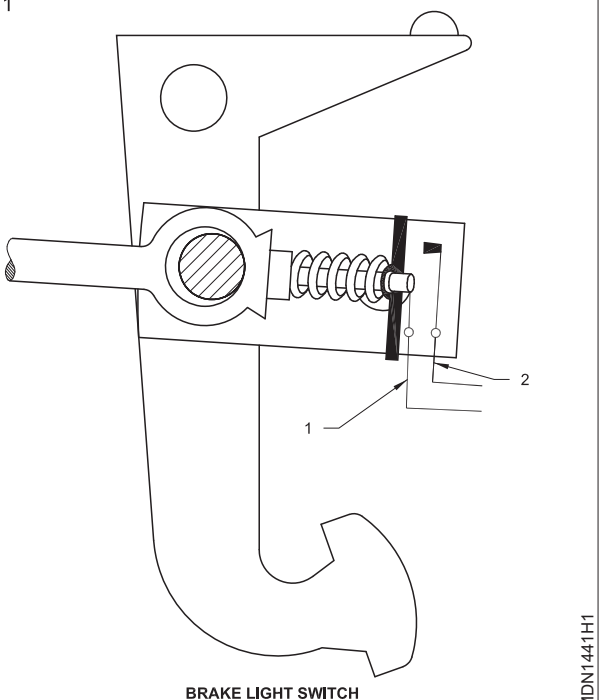
PROCEDURE

TASK 1 : **Solenoid circuit**

1 Check the brake light and solenoid switch visually . If there is any damage externally, replace.

2 Check the brake light switch terminal (1)&(2) and clean It. (Fig 1)

Fig 1



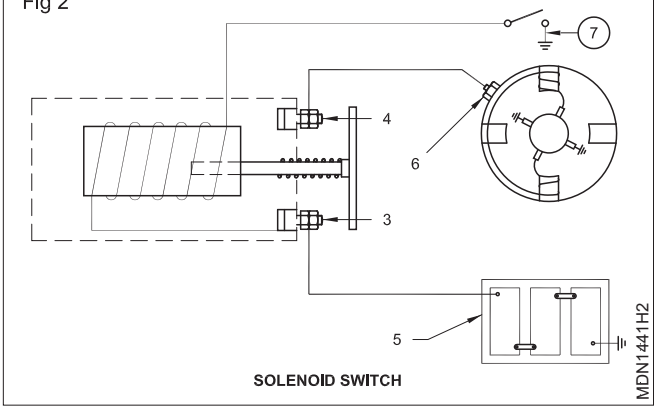
BRAKE LIGHT SWITCH

3 Check the wire connections from the brake light switch terminals (1 & 2) to the brake light lamp. Tighten, if they are found loose.

4 Check the battery cable connections from the battery (5) to the solenoid switch terminal (3). Tighten, if they are found losse.

5 Check the battery cable from the solenoid switch terminal (4) to the starting motor terminal (6). Tighten it if found loose. (Fig 2)

Fig 2



SOLENOID SWITCH

6 Check the wire connection from the solenoid switch terminal to the starting switch (7).

7 Connect the test lamp to the brake light switch terminal (1 & 2). If the switch is not closed, the lamp will glow.

8 Disconnect the cable wires from the solenoid switch.

9 Connect one end of the test lamp with the solenoid switch terminal (3) and ground the other end of the test lamp.

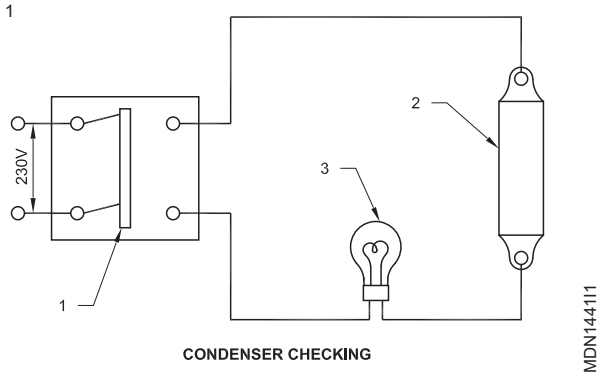
10 It will burn, but this test will not indicate short circuit.

11 Connect one end of the test lamp with starter switch terminal and the other end to the earth with switch open. If the lamp burns birght, the solenoid is shorted. Replace the switch.

TASK 2 : **Condenser checking**

- Check the fibre head for wear; if necessary replace it. Connect the condenser as shown in the Fig 1. One side of the double pole, double throw switch (1) must be connected to the main, and the other side must be connected to the condenser (2) and test bulb (3) in series.

Fig 1



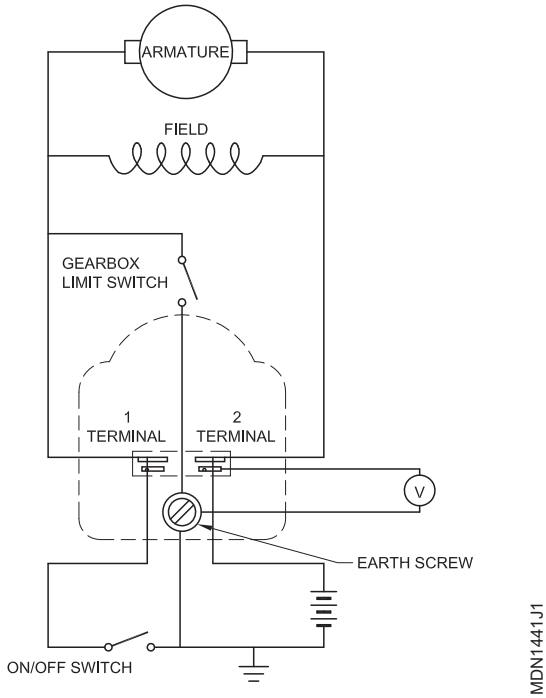
CONDENSER CHECKING

- Put on the switch (1). If the bulb glows the condenser must be replaced by a new one.
- If the bulb is not glowing then the condenser is in proper condition.
- Visually, check the cam, and replace, if required.
- Check the magneto coils for open and short cirucit with the help of an AVO meter. If found damaged replace the coil with a new one.

TASK 3 : **Testing wiper motor circuit**

- To measure the supply voltage, connect the wiper as shown in Fig 1. Switch on the motor and meaure the voltage between the motor supply terminal (2) and the good earthing point with a volmeter.

Fig 1



If the reading is low, check the battery cable connections and the panel switch (1).

- Disconnect the cable rack and measure the no-loand running circuit with an ammeter connected in the supply line. (2.5 A to 3.5 A)

No-load test

- Connect the wires to the motor and effect supply check at what voltage the motor starts functioning no-load.

For a 12 volt system the motor should start running from 4 volts.

Checking the cable rack

- Check the maximum force to move the cable rack by hooking the spring balance.

The maximum permissible force is 2.7 kgs.

Final checking

- Test the wiping speed of the motor. It should be between 45 and 50 cycles/minute.

Test voltage drop in a circuit

Objective: At the end of this exercise you shall be able to
- **test voltage drop in a circuit.**

Requirements

Tools/Instruments

• Trainee's tool kit	- 1 No.
• Voltmeter MC 0 - 300 V	- 1 No.
• Multimeter	- 1 No.

Equipments

• Auto electrical wiring circuit	- 1 No.
• Battery	- 1 No.

Materials

• Fuse	- as reqd.
• Switch	- as reqd.
• Cable/Wire	- as reqd.

PROCEDURE

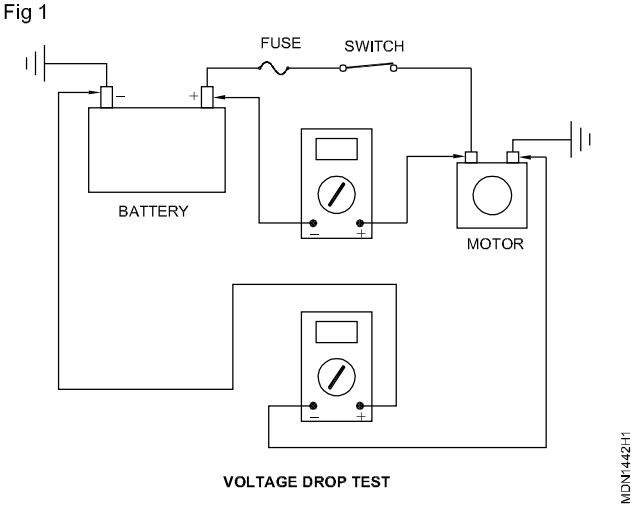
Voltage Drop Test in Head light circuit

1 Clean all the terminals, connectors in the auto electrical wiring circuits

2 Check, whether battery is fully charged condition.

3 Connect the multimeter at shown in Fig 1 in the auto electrical wiring circuit.

Fig 1



VOLTAGE DROP TEST

4 Connect (+)ve lead to the input terminal of the motor.

5 Connect (-)ve lead to the battery +ve terminal

6 Reed the voltage in the multimeter.

7 Remove, clean and refit (or) Replace the terminal if voltage drop exceed 0.2 V.

8 Select a low scale on the voltmeter.

Measuring voltage drop in head light circuit

1 Connect the voltmeter across the part of the circuit in which high resistance is suspected.

2 Measure the voltage drop across the HL ground.

3 Connect the voltmeter positive lead to the HL ground and Negative lead to the -ve terminal of battery. (Fig 2)

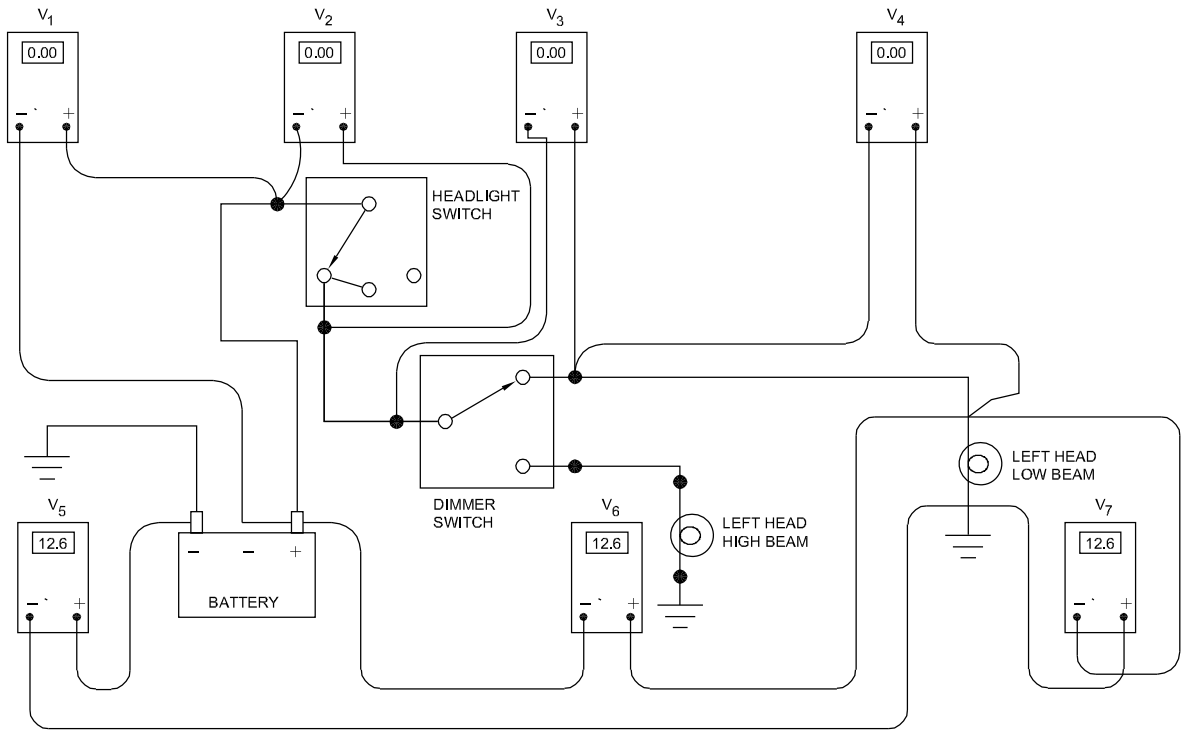
4 Measure the voltage drop shown in meter.

5 Compare the measured value with the rated value.

6 Replace, Clean and reconnect the lead if the voltage drop excel W o.2 Volt.

7 Repeat the same volt drop test task to check the voltage drop in all the other Electrical accessories.

Fig 2



MEASURING VOLTAGE DROP IN A HEADLIGHT CIRCUIT

Trouble shoot electrical circuit problem

Objective: At the end of this exercise you shall be able to
- **test the auto electrical components by using vehicle wiring circuits.**

Requirements

Tools/Instruments

• Trainee's tool kit	- 1 No.
• Test lamp	- 1 No.
• Multimeter	- 1 No.

Equipments

• Auto electrical wiring circuit	- 1 No.
• Battery	- 1 No.

Materials

• Fuse	- as reqd.
• Switch	- as reqd.
• Cable/Wire	- as reqd.

PROCEDURE

1 Identify the electrical (1-34) Components in the vehicle by using the automobile wiring circuits as shown in Fig. 1.

2 Draw the starting circuit.

3 Draw the ignition circuit.

4 Draw the charging circuit.

5 Draw the flasher circuit.

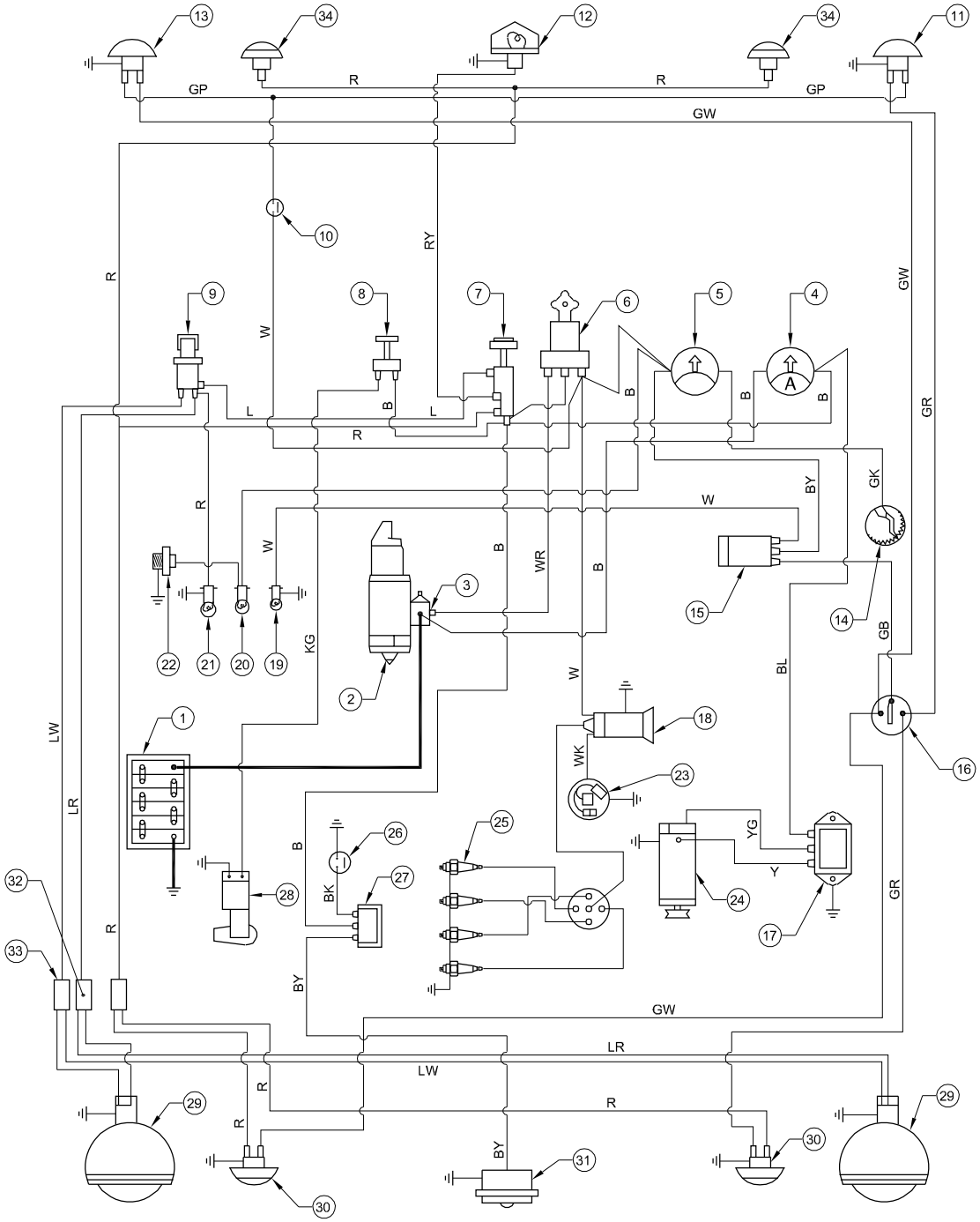
6 Draw the lighting circuit.

7 Place the auto wiring board on the work bench.

8 Connect with battery.

9 Check its function.

Fig 1



Cleaning and top - up of lead acid battery

Objectives : At the end of this exercise you shall be able to
- **clean the battery terminals and the body of the battery**
- **check the level of the electrolyte and top-up**
- **check the specific gravity of the electrolyte with hydrometer**
- **measure the cell voltage & the battery voltage.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Hydrometer - 1 No.
- Multimeter - 1 No.
- Lead acid battery 6V or 12V 80AH - 1 No.

Equipments

- Battery Charger - 1 No.

Materials

- Distilled water - as reqd.
- Vaseline - as reqd.
- Cotton rag - as reqd.
- Sand paper - as reqd.
- Soda bicarbonate - as reqd.

PROCEDURE

Cleaning and Top-up of lead acid battery.

1 Clean the battery terminals, if corroded, with sandpaper: if sulphated, clean with wet cotton waste or with soda bicarbonate.

Do not damage the battery terminal by scraping with any metal strip.

2 Unscrew all the vent plugs and check the level of the electrolyte.

Do not clean the battery top surface keeping the vent plugs open. The accumulated dirt may fall inside the cells and form sediments.

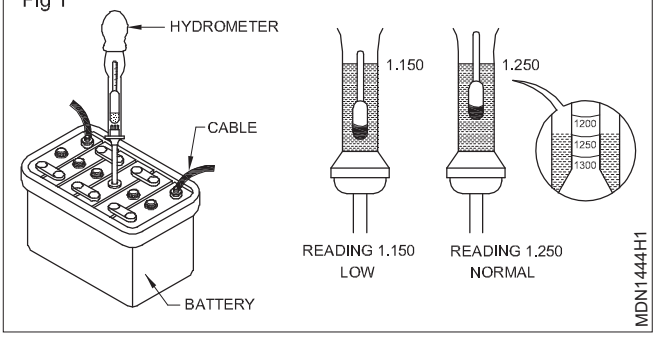
3 Top up the electrolye to the marked level in all the cells with distilled water.

No electrolyte to be used to top up battery.

4 Open seal cap of battery and keep Hydrometer inside. Pump electrolyte upto reference mark.

5 Check the initial specific gravity of the electrolyte of each cell using a hydrometer (Fig 1)

Fig 1



Check the specific gravity of a battery

Objectives : At the end of this exercise you shall be able to
- **clean the battery terminals and the body of the battery**
- **test the battery with a hydrometer**
- **test the battery with a volt meter.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Hydrometer - 1 No.

Equipments

- Vehicle - 1 No.

Materials

- Vaseline - as reqd.
- Battery acid - as reqd.
- Distilled water - as reqd.

PROCEDURE

TASK 1 : **Check the specific gravity and open circuit voltage test**

1 Disconnect the negative cables first from the battery terminal.

2 Disconnect the positive cables from the battery terminal.

3 Remove the mounting clamp nuts.

4 Lift the battery from the vehicle.

5 Clean the top of the battery with water and cotton rag.

6 Clean the battery terminals by a non-metalic wire brush or emery-paper.

7 Check and top up the electrolyte level with distilled water. (if necessary)

8 Keep the battery on a leveled wooden workbench.

9 Remove all the vent plugs.

10 Hold the hydrometer vertically. (Fig 1)

11 Place the nose of the hydrometer in the cell. Ensure that the nose is dipped in the electrolyte.

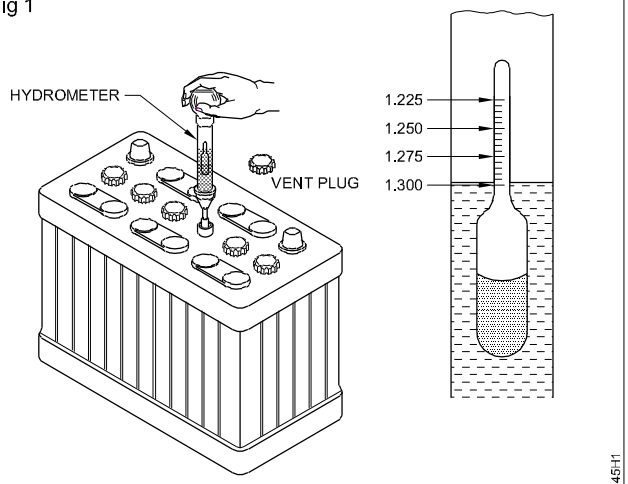
12 Press the rubber bulb of the hydrometer.

13 Release it to draw the electrolyte upwards. Ensure that the electrolyte does not come into the bulb.

14 Note the float level which is floating in the electrolyte.

15 Record the reading in Table 1.

Fig 1



TESTING SPECIFIC GRAVITY OF A BATTERY

Table 1

1	2	3	4	5	6

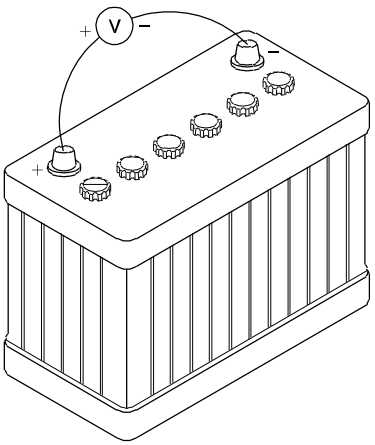
16 Repeat the same procedure for all the cells and record the readings.

The above reading should not vary more than 25 points between cells.

Protect your hands and clothes from the battery acid.

17 Connect the leads of the DC voltmeter (2) to the battery terminal (+ve to -ve). (Fig 2)

Fig 2



18 Take the reading from the voltmeter and record.

19 The voltmeter should read atleast 13.2 volts per battery. After carrying out the above tests compare the readings with the manufacturer's specifications. Recharge/ replace the battery if it is in poor condition.

20 Clean the vent holes and tighten all the vent plugs.

21 Smear the battery terminals with Vaseline.

22 Place the battery in its position in the vehicle.

23 Tighten the battery mounting clamp nuts.

24 Clean the battery lugs with baking soda solution and water.

25 Connect the battery +ve cable first and tighten it.

26 Connect the battery -ve cable and tighten it.

27 Start the engine. Check whether the battery supplies sufficient current.

Disconnect the ground cable (-ve cable) first. This will minimize the possibility of arcing and a resultant battery explosion.

— — — — — — —

Charge the battery

Objectives : At the end of this exercise you shall be able to
- **connect the battery to charger**
- **constant current method**
- **constant volt method.**

Requirements

Tools/Instruments

• Trainee's tool kit	- 1 Set.
• Hydrometer	- 1 No.
• Volt meter	- 1 No.

Equipments

• Battery charger	- 1 No.
• Vehicle	- 1 No.

Materials

• Vaseline	- as reqd.
• Battery acid	- as reqd.
• Cable/Wire	- as reqd.
• Distilled water	- as reqd.
• Cotton rag	- as reqd.
• Water emery	- as reqd.

PROCEDURE

TASK 1 : **Battery charging**

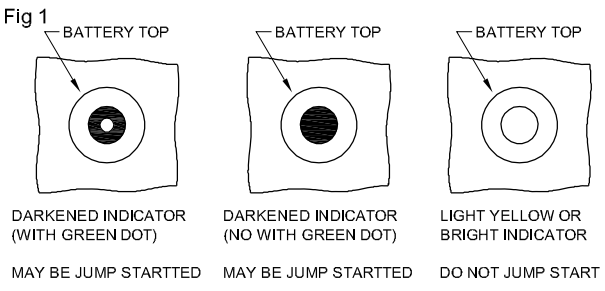
1 Place the battery on the charging table.

2 If the battery is not sealed, check the electrolyte level in all of the cells and adjust the level if necessary.

Do not attempt to charge a battery that appears to be frozen or if ice crystals are visible in the electrolyte. Allow the battery to become unfrozen fully before charging is attempted.

3 If the battery is sealed battery, check the built in hydrometer. Do not attempt to charge the battery if the indicator appears clear or light yellow. (Fig 1)

Fig 1



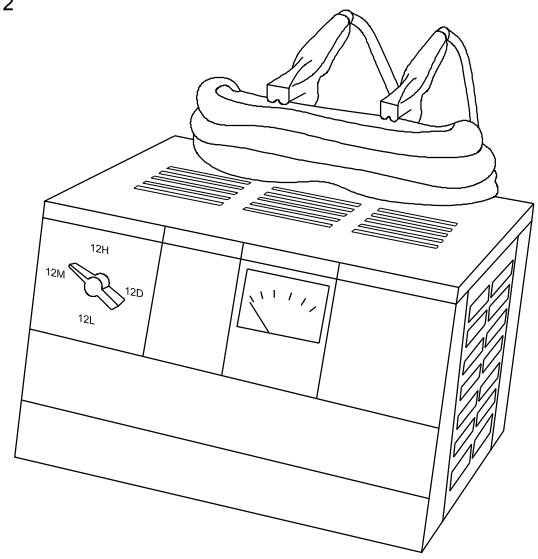
4 Clean the battery terminals and the battery top.

5 Consult an appropriate manual and determine the charging rate and time for the battery.

6 Turn off the charger switch. (Fig 2 & Fig 3)

Connect the charger leads to the battery. The positive (+) lead must be connected to the positive (+) terminal.

Fig 2



A TYPICAL SLOW CHARGER

The negative (-) lead must be connected to negative (-) terminal.

7 Turn on the charger switch.

On some chargers, the timer must be set to turn on the charger.

8 Adjust the charging rate.

9 Adjust the timer.

10 Check the charging rate and the battery temperature after the battery has been charging for about 15 minutes. Adjust the charging rate if required.

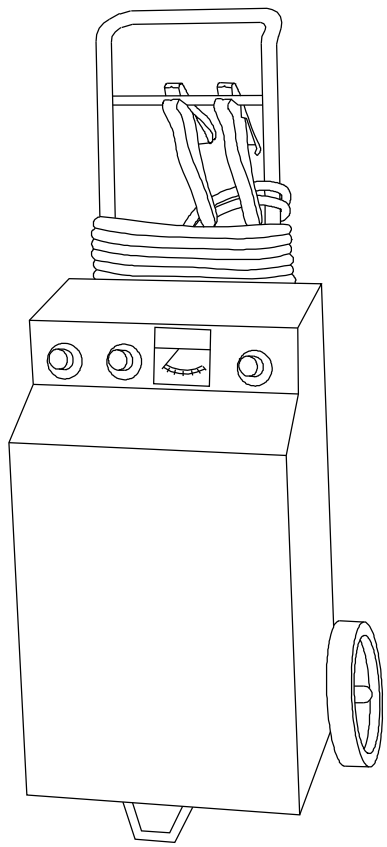
11 Continue charging until the allotted time or until the battery is fully charged.

12 Turn off the charger switch.

13 Disconnect the charger leads from the battery.

Watt rating	5 Amperes	10 Amperes	20 Amperes	30 Amperes	40 Amperes	50 Amperes
Below 2450	10 Hours	5 Hours	2 ½ Hours	2 Hours	-	-
2450-2950	12 Hours	6 Hours	3 Hours	2 Hours	1 ½ Hours	-
Above 2950	15 Hours	7 ½ Hours	3 ¼ Hours	2 Hours	1 ¾ Hours	1 ½ Hours

Fig 3



A TYPICAL FAST CHARGER

MDN1446H3

To avoid damage, charging rate must be reduced or temporarily halted if:

Electrolyte temperature exceeds 125F.

Violent gassing or spewing of electrolyte occurs.

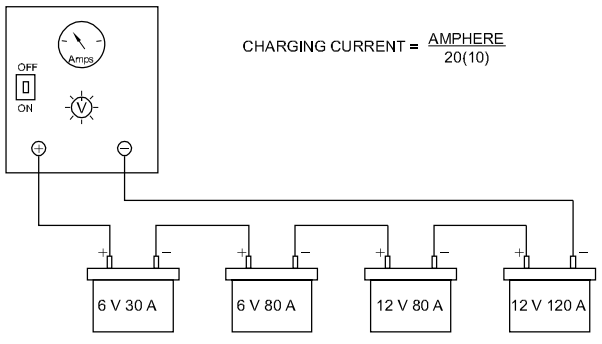
Battery is fully charged when over a two hour period at a low charging rate in amperes all cells are gassing freely and no change in specific gravity occurs. For the most satisfactory charging, the lower charging rates in amperes are recommended.

Full charge specific gravity is 1.260-1.280 corrected for temperature with electrolyte level at split ring.

TASK 2 : **Constant current method**

1 Connect all the batteries in series as shown in Fig 1.

Fig 1



CONSTANT CURRENT METHOD

MDN1446H1

2 Connect the charger to batteries.

3 Set the voltage rate in charger according to no. of batteries.

4 Charge the battery.

5 Switch off the battery charger

6 Test the specific for gravity of each battery.

7 Record the reading in Table. 1

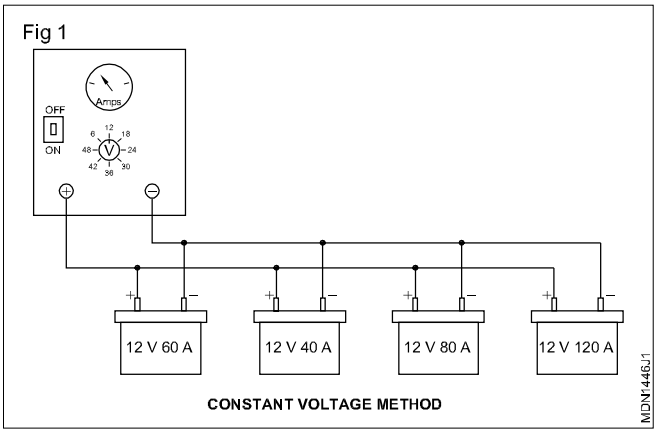
Table 1

Cell Battery	1	2	3	4	5	6
1						
2						
3						
4						

TASK 3 : **Constant Voltage method (Fig 1)**

1 Connect all the batteries in parallel as shown in Fig 1

Fig 1



CONSTANT VOLTAGE METHOD

2 Connect the charger to batteries.

3 Set the current rate by varying the voltage to be charged.

4 Charge the battery till full charging

5 Switch off the battery charger

6 Record the readings in Table 2.

7 Parasitic draw (Switch off) of battery

8 Check the battery for self discharge by checking the battery charged condition periodically.

9 Check the battery, for discharge, externally as follows

10 Switch off the ignition switch

11 Check and clean the impurities and contaminated water layer on the top of the battery

12 Clean the top surface of the battery after topup the battery

13 Check any loose contact between battery post & terminals

14 Check any loose contact in the auto vehicle wiring circuit

15 Check and Replace the defective contact of all switches in the vehicle

16 Check and clean the shulper formation of battery terminals

Table 2

Cell Battery	1	2	3	4	5	6
1						
2						
3						
4						

Practice parasitic battery drain test

Objectives : At the end of this exercise you shall be able to
- **check the causes of parasitic draw of battery**
- **rectify the parasitic draw.**

Requirements

Tools/Equipments/Instruments

- Trainee's tool kit
- Battery hydrometer - 1 No./each.
- Lead-acid storage battery, 6V or 12V 80Ah - 1 No./each.

Materials/Components

- Sandpaper - as reqd.
- Cleaning cloth - as reqd.
- Banking soda - as reqd.
- Petroleum jelly - as reqd.
- Distilled water - as reqd.
- Cleaning brush, 2 inch - 1 No./batch.

PROCEDURE

TASK 1 : **Check the specific gravity and open circuit voltage test**

1 From the name plate or from the code number on the cell identify and record the following in O&T sheet;
   - Manufacturer
   - Outputvoltage
   - Number of cells
   - Type number
   - Ah capacity
2 Check the battery terminal and metal links for the following defects if any, and record defects if found;
   - Broken or lifted terminals
   - White or grey colour sulphation on and near the terminals
   - Salt formation on the battery top
   - Cell links cracked
   - Cracked or warping of batter top
3 Check for the pressure of vent plugs. If absent record in O&T sheet.
4 Open the vent plug. Check and record the specific gravity of electrolyte in each cell.
5 Using battery hydrometer check and record the specific gravity of electrolyte in each cell.
6 Measure and record the voltage across each cell and the total voltage across battery terminals.

If cell voltage is less than 1.6, that cell is called Dead cell.

7 Get your readings checked by your instructor.

— — — — — — —

TASK 2 : **Remedies for parasitic draw of battery**

1 Clean the impurities and contaminated water layer on the top of the battery
2 Clean the top surface of the battery after topup.
3 Check & tight the loose contact terminals
4 Replace the defective switches.
5 Keep the battery terminals free from sulpher formation.

If acceptable causes to discharge of battery is also causes to parasitic draw of battery

If the discharge rate of battery is more than 0.050 A at Ideal condition is said to be parasitic draw of battery.

— — — — — — —

Check the relays and solenoid

Objectives : At the end of this exercise you shall be able to
- **check the condition of the solenoid switch in the starting system**
- **check the condition of the relay in the wiring circuit.**

Requirements

Tools/Instruments

• Trainee's tool kit	- 1 No.
• Test lamp	- 1 No.
• Multimeter	- 1 No.

Equipments

• Vehicle	- 1 No.
• Battery	- 1 No.

Materials

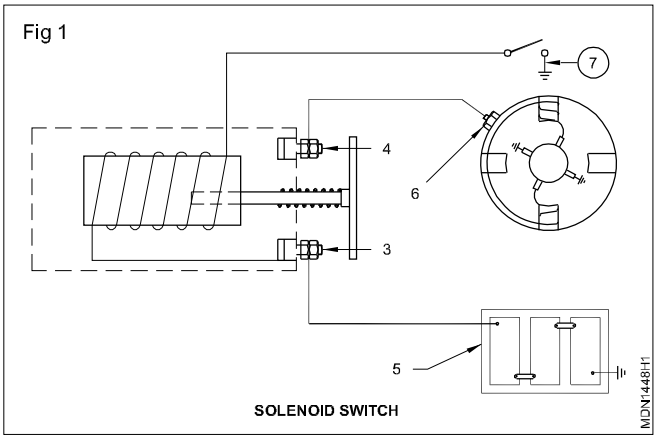
• Fuse	- as reqd.
• Switch	- as reqd.
• Cable/Wire	- as reqd.
• Insulation tape	- as reqd

PROCEDURE

TASK 1: **Checking solenoid switch**

1 Check the solenoid switch terminals (3&4) and clean them. (Fig 1)

Fig 1



2 Check the battery cable connections from the battery (5) to the solenoid switch terminals (3). Tighten if found loose.

3 Check the battery cables from the solenoid switch terminals (4) to the starter motor terminals (6). Tighten it if formal loose.

4 Check the wire connection from the solenoid switch terminals to the starting switch (7).

5 Connect the test lamp to the brake light switch terminal (1&2). If the switch is not closed, the lamp will glow.

6 Disconnect the cable wires from the solenoid switch.

7 Connect one end of the test lamp with the solenoid switch terminal (3) and ground the other end of the test lamp.

8 It will burn, but this test will not indicate short circuit.

9 Connect one end of the test lamp with starter switch terminal and the other end to the earth with switch open. If the lamp burns bright, the solenoid is shorted. Replace the switch.

— — — — — — —

TASK 2 : **Checking the relay in horn circuit**

1 Disconnect the electrical connection from the horn. relay (5) as shown in Fig 2.

2 Loosen the mounting nuts of the horn relay and remove it

3 Check the condition of the horn relay using a rheostat and volt meter.

4 Connect the rheostat (1) in series to the battery and horn relay (3) (Fig 3)

5 Connect the volt meter (2) across the winding of the relay (3) to measure the closing voltage as shown in Fig (3)

6 Start the full resistance in the circuit. Slide the knob to increase or decrease the voltage on the relay winding.

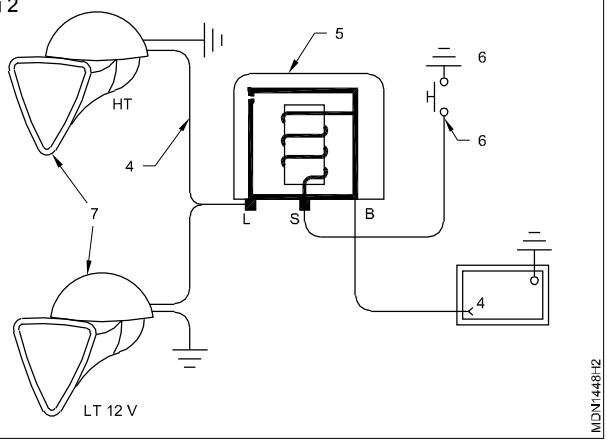
If there is an error when the relay point closes, adjust by bending the armature spring post

[Increasing the spring tension increases the closing voltage]

7 Replace the relay, if necessary.

8 Place the horn relay in its position and tighten the mounting nuts.

Fig 2



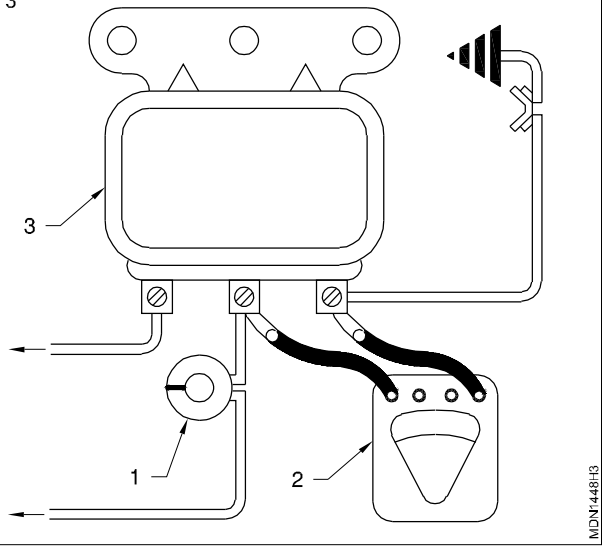
9 Refit the spring and the horn switch.

10 Fit the retainer and press it.

11 Connect the wires to the switch of the horn relay and sound the horn.

12 Operate the horn switch and test for the correct horn note.

Fig 3



Checking HL & Wiper motor relay.

Repeat the Task of checking the Relay.

Test power and signal connectors

Objectives : At the end of this exercise you shall be able to
- **identify the power and signal connector**
- **verify selected connector continuity.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Multi meter - 1 No.

Equipments

- CRDI - Engine with all accesorres of electronic unit - 1 No.

Materials

- Cable connector - as reqd.
- Sensors - as reqd.
- Insulation tap - as reqd.
- Cables - as reqd.

PROCEDURE

Power & signal connection for continuty

Open circuit check

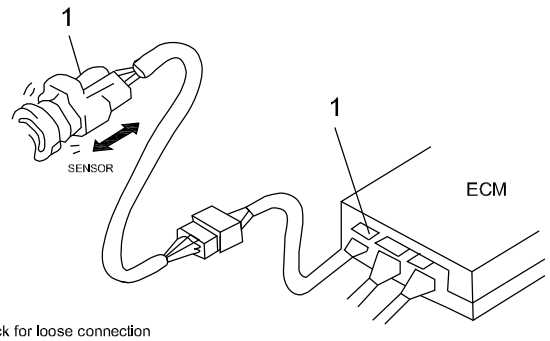
- Loose connection of connector
- Poor contact of terminal (due to dirt, corrosion or rust on it, poor contact tension, entry of foreign object etc.
- Wire harness being open

Check for loose connection (Fig 1)

1 Disconnect negative cable from battery.

2 Check each connector at both ends of the circuit being checked for loose connection (Fig 1). Also check lock condition of connector if equipped with connector lock.

Fig 1



1.Check for loose connection

3 Using a test male terminal, check both terminals of the circuit being checked for contact tension of its female terminal. by dirt, corrosion, rust entry of foreign object, etc) (Fig 2)
At the same time, check to make sure that each terminal is locked in the connector fully. (Fig 3)

Fig 2

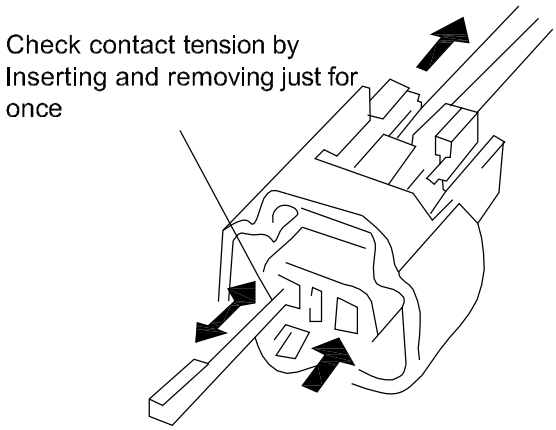
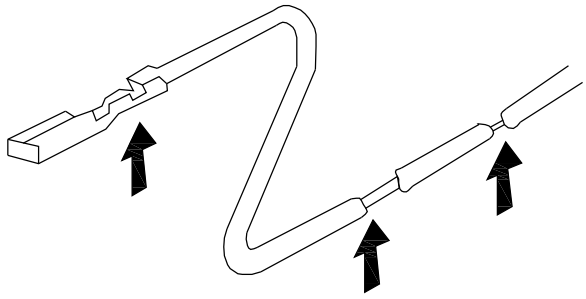


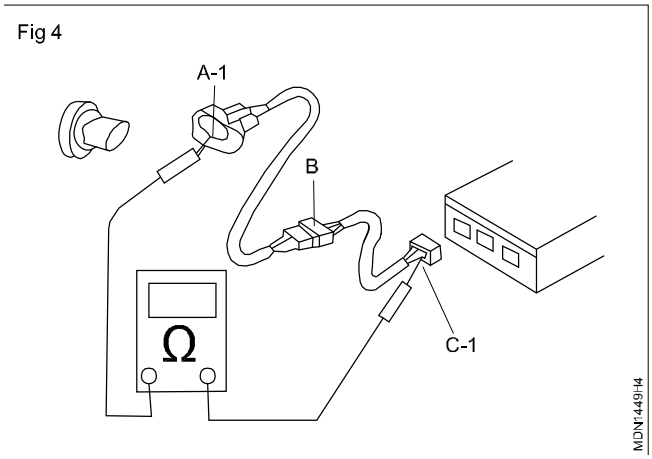
Fig 3



1.Looseness of crimping
2.Open
3.Thin wire (single strand of wire)

4 Using continuity check or voltage check procedure described in the following, check the wire harness for open circuit and poor connection with its terminals. Locate abnormality, if any. (Fig 4)

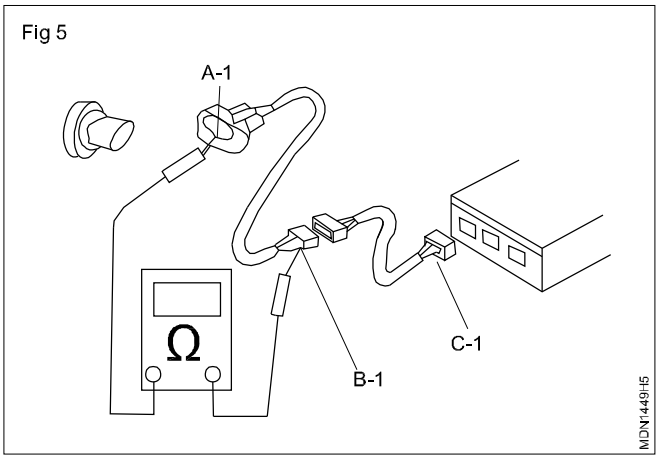
Fig 4



Continuity check

5 Measure resistance between connector terminals at both ends of the circuit being checked (between A-1 and C-1 in the figure).
If no continuity is indicated (infinity or over limit), that means that the circuit is open between terminals A-1 and C-1. (Fig 5)

Fig 5



6 Disconnec t the connector included in the circuit (connector-B in the figure) and measure resistance between terminals A-1 and B-1.

If no continuity is indicated, that means that the circuit is open between terminals A-1 and B-1. If continuity is indicated, there is an open circuit between terminals B-1 and C-1 or an abnormality in connector-B.

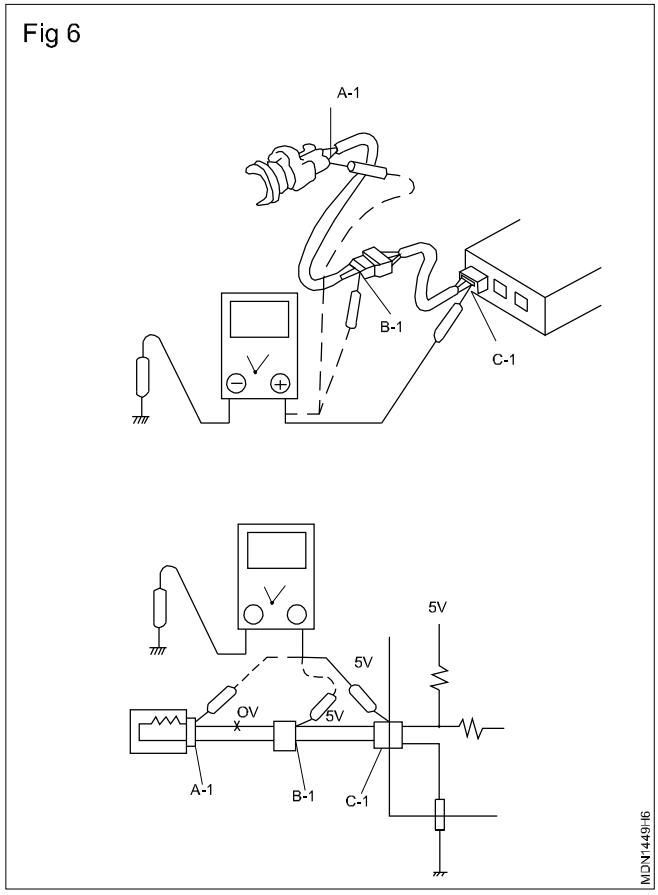
Voltage check (Fig 6)

If voltage is supplied to the circuit being checked, Voltage check can be used as circuit check.

7 With all connectors connected and voltage applied to the circuit being checked, measure voltage between each terminal and body ground.

If measurements were taken as shown in the figure at the left and results were as listed below, it means that the circuit is open between terminals B-1 and A-1.

Fig 6



Voltage Between:

C-1 and body ground: Approx. 5V
B-1 and body ground: Approx. 5V
A-1 and body ground: 0V

Also, if measured values were as listed below, it means that there is a resistance (abnormality) of such level that corresponds to the voltage drop in the circuit between terminals A-1 and B-1.

Voltage Between:

C-1 and body ground: Approx. 5V
B-1 and body ground: Approx. 5V 2V voltage drop
A-1 and body ground: Approx.3V

Short circuit check (Wire harness to ground) (Fig 7)

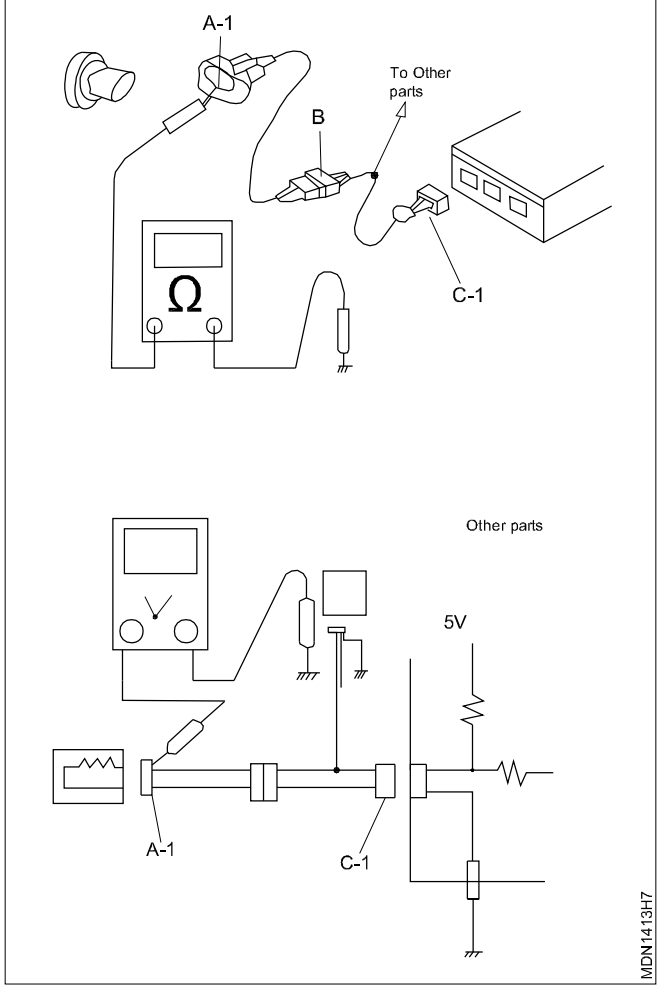
8 Disconnect negaive cable from battery.

9 Disconenct connectors at both ends of the circuit to be checked.

Note : If the circuit to be checked is connected to other pars, disconnect all connectors of those parts. Otherwise, diagnosis will be misled.

10 Measure resistance between terminals at one end of circuit (A -1 terminal in figure) and body ground. If continuity is indicated, it means that there is a short to ground between terminals A-1 and C -1 of the circuit.

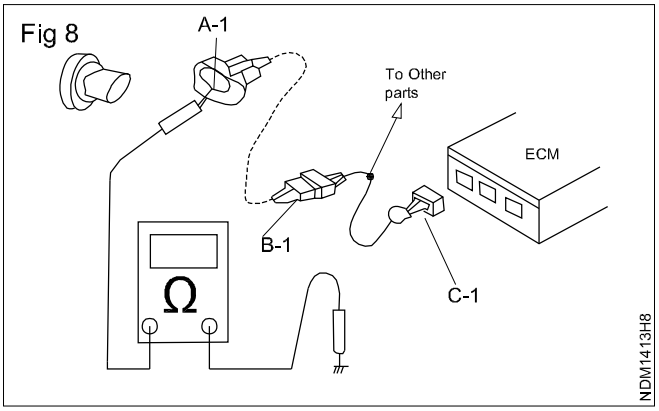
Fig 7



11 Disconnect the connector included in circuit (connector B) and measure resistance between A-1 and body ground. (Fig 7)

If continuit is indicated, it means that the circuit is shorted to the ground between terminals A-1 and B-1.(Fig 8)

Fig 8

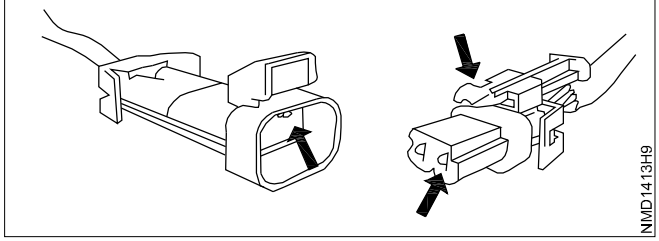


Intermittents and poor connection (Fig 9, 10)

Most intermittents are caused by faulty electrical connections or wiring, although a sticking relay or solenoid can occasionally be at fault. When checking it for proper connection, perfrom careful check of suspect circuits for:

12 Poor mating of connector halves, or terminals not fully seated in the connector body (backed out).

Fig 9

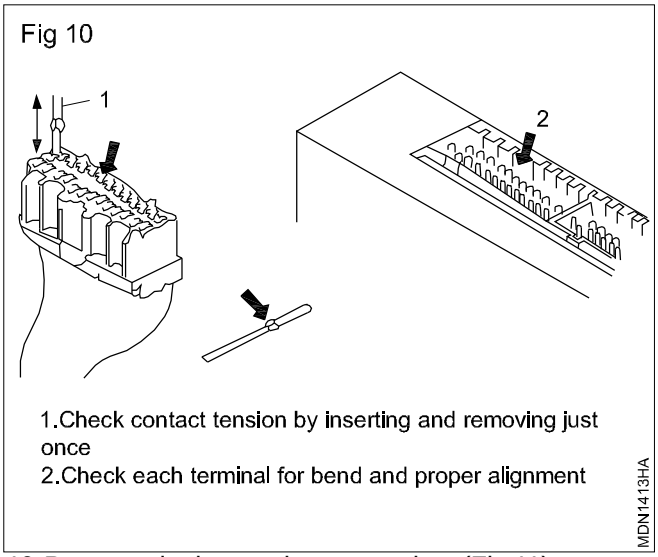


13 Dirt or corrosion on the terminals. The terminals must be clean and free of any foreignmaterial which could impede proper terminal contact.

14 Damaged connector body, exposing the terminals to moisture and dirt, as well as not maintaining proper terminal orienation with the component or mating connector.

15 Improperly formed or damaged terminals.
Check each connector terminal in problem circuits carefully to ensure good contact tension by using the corresponding mating terminal.
If contact tension is not enough, reform it to increase contact tension or replace.

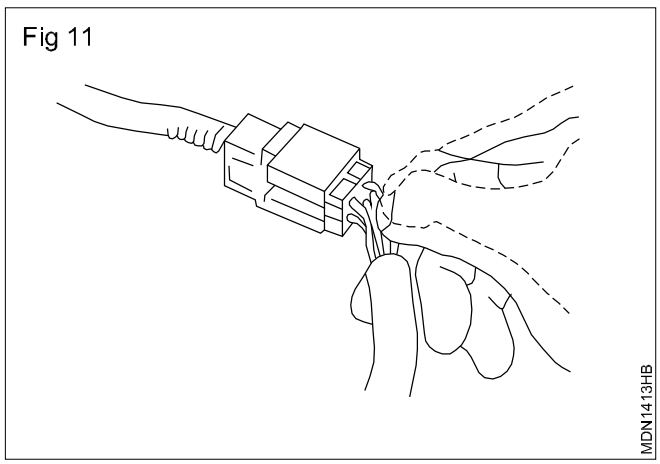
Fig 10



16 Poor terminal - to - wire connection. (Fig 11)

Check each wire harness in problem circuits for poor connection by shaking it by hand lightly. If any abnormal condition is found, repair or place.

Fig 11



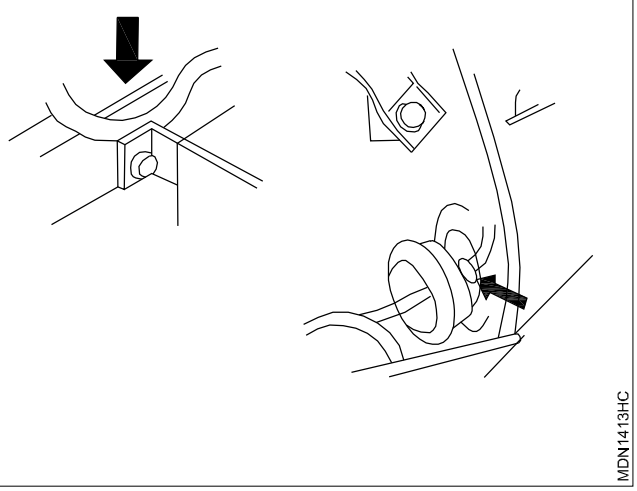
17 Wire insulation which is rubbed through, causing an intermittent short as the bare area touches other wiring or parts of the vehicle.

18 Wiring broken inside the insulation (Fig 12). This condition could cause continuity check to show a good circuit, but if only 1 or 2 strands of a multi-strand-type wire are intact, resistance could be far too high.
If any abnormality is found, repair or replace.

Precautions for electrical circuit service

19 When disconnecting and connecting coupler, make

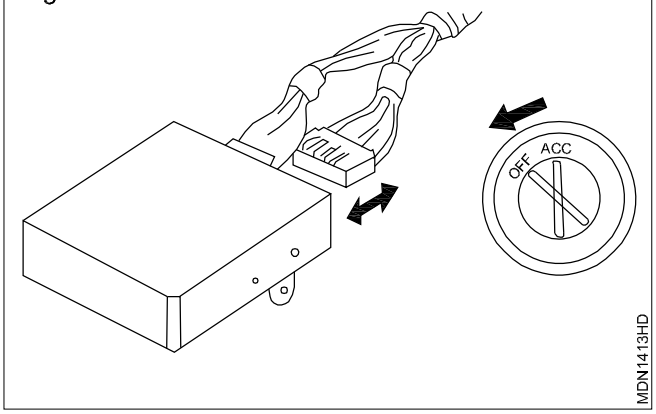
Fig 12



sure to turn ignition switch OFF, or electronic parts may get damaged.

20 Be careful not to touch the electrical terminals of parts which use microcomputers (e.g. electronic control unit

Fig 13



like as ECM, P/S controller, etc.). The static electricity from your body can damage these parts.(Fig 13)

21 When disconencting couplers, don't pull wire harness but make sure to hold coupler itself. With lock type coupler, be sure to unlock before disconnection. Attempt to disconnect coupler without unlocking may result in damage to coupler. When connecting lock type coupler, insert it till clicking sound is heard and connect it securely.

22 Never connect any tester (voltmeter, ohmmeter,) to electronic control unit when its coupler is disconnected. Attempt to do it may cause damage to it.(Fig 14)

Fig 14

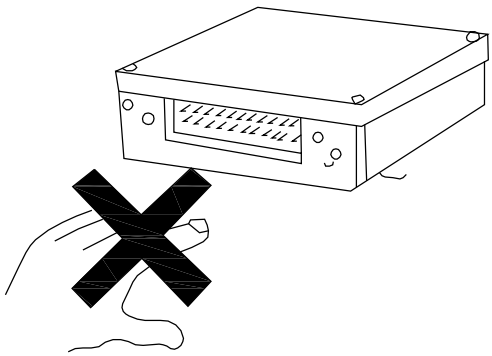
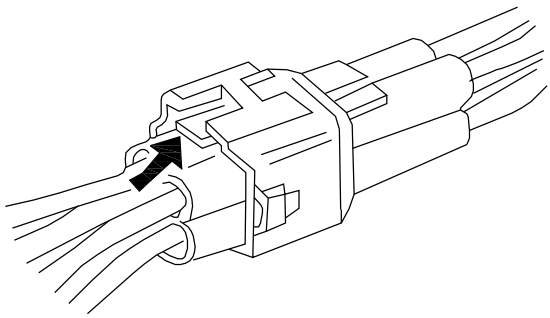


Fig 15

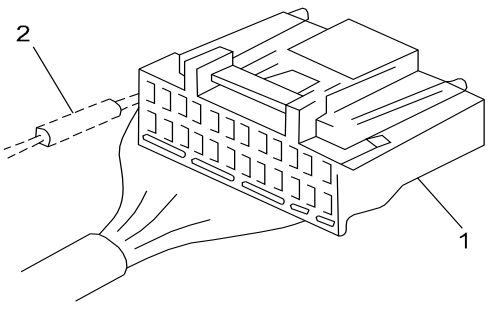


23 Never connect an ohmmeter to electronic control unit with its coupler connected to it. Attempt to do it may cause damage to electronic control unit and sensors.(Fig 15)

24 Be sure to use a specified voltmeter/ohmmeter. Otherwise, accurate measurements may not be obtained or personal injury may result. If not specified, use a voltmeter with high impedance (MΩ/V minimum) or a digital type voltmeter.

25 When taking measurements at electrical connectors using a tester probe, be sure to insert the probe (2) from the wire harness side (backside) of the connector (1).(Fig 16)

Fig 16



Practice on testing diodes

Objectives : At the end of this exercise you shall be able to
- **identify the type of package**
- **determine the forward to reverse resistance ratio of diodes**
- **identifying transistor**
- **testing transistor**

Requirements

Tools/Instruments/Equipments

- Trainee's tool kit - 1 No.
- Multimeter - 1 No.
- Transistor - as reqd.
- Data book - 1 No.

Materials/Components

- Assorted types of diodes/Transistor - 20 No./each.
- Blue, yellow, black Red colour Red colour sleeve wire - 10 cms.each
- Patch cords - as reqd.

PROCEDURE

TASK 1 : **Identify diode package and terminals**

1 Pick any one diode from the given assorted lot. Record the code number printed on the diode in O&T sheet.

2 For the chosen diode, refer chart 1 and identify and record the type of package (such as glass/plastic/ ceramic/metal etc.).

3 For the chosen diode referring to Chart 1, identify and put a small red colour sleeve over the anode terminal of the diode.

4 Repeat step 1 to 3 for atleast 5 diodes of different types and get your work checked by your instructor.

TASK 2 : **Checking diodes using ohmmeter/multimeter**

1 Set the ohmmeter/multimeter to x100 ohms range. Carryout resistance-zero-setting of meter.

Choose other ohms range if necessary.

2 Pickup one of the identified diodes in Task 1. Connect the ohmmeter probes across the diode terminals as shown in Fig 1a. Record the resistance reading shown by the meter in Table 1 of O&T sheet.

3 Reverse the meter probes connected to the diode as shown in Fig 1b and record the reading shown by the meter in the Table 1.

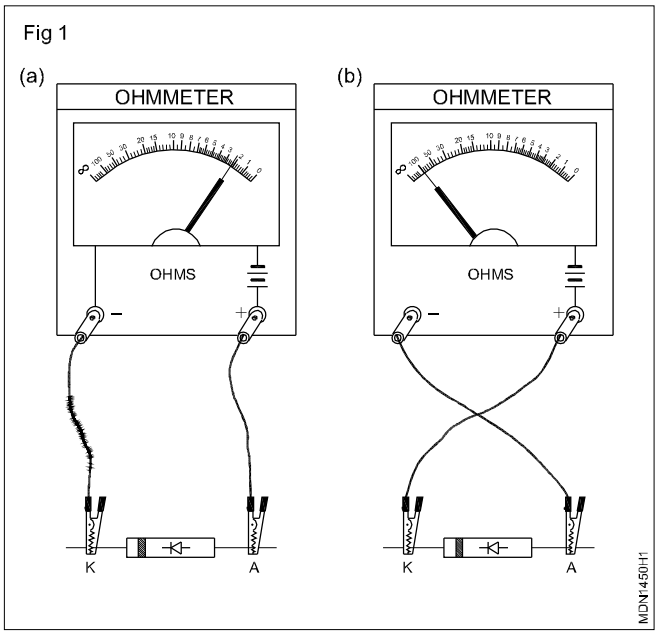
4 From the readings noted in steps 2 and 3, calculate and record the ratio between forward and reverse resistance.

5 From the recorded information give your conclusion about the condition of the diode. Use the tips given below for making conclusion;

– In good diodes, resistance will be less than 100 ohms in one direction and very high or almost infinity/open in the other direction. In the worst cases the ratio between low to high resistance could be at least 1:1000.

– Shorted diodes show zero or very low resistance in both directions.

Fig 1



– Open diodes shows infinity/open in both directions.

6 Repeat step 2 to 4 for atleast ten more given diodes of different types.

7 Get the work checked by your instructor.

Observation & Tabulation Sheet

Table - 1

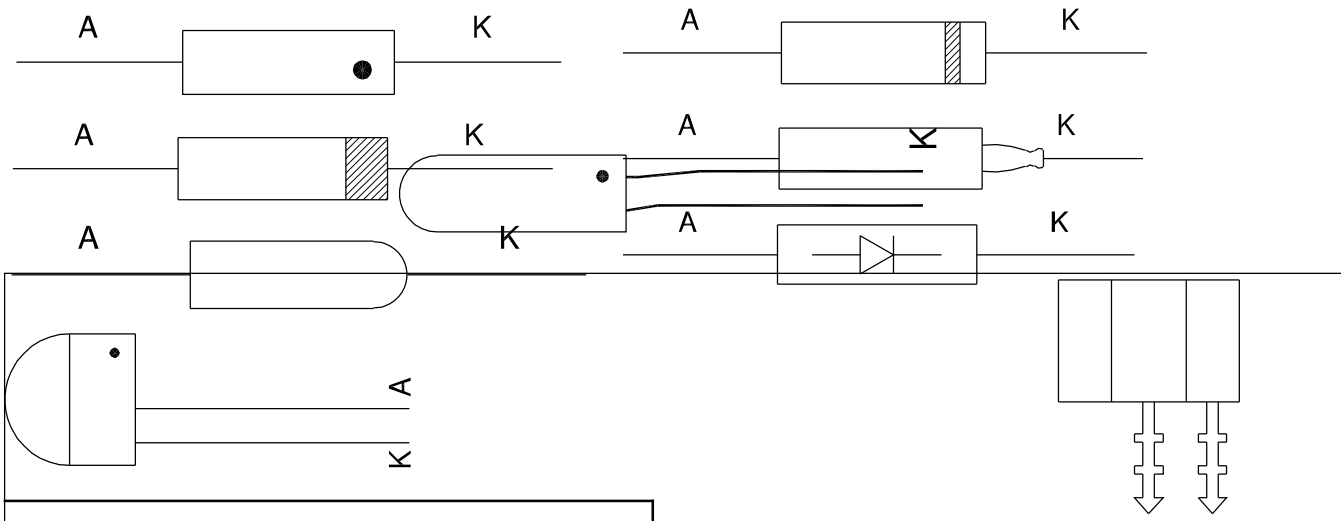
Label Number	Code Number printed on the DIODE	Type of package	Resistance value in		Ratio between forward and reverse resistance	Condition of diode FIT/UNFIT
			one direction	opposite direction		

(Trainee) (Instructor)

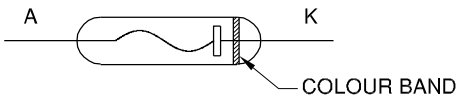
CHART - 1

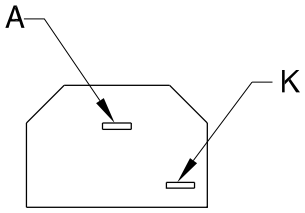
TYPES OF DIODES AND PACKAGING

LOW POWER - PLASTIC PACKAGE DIODES

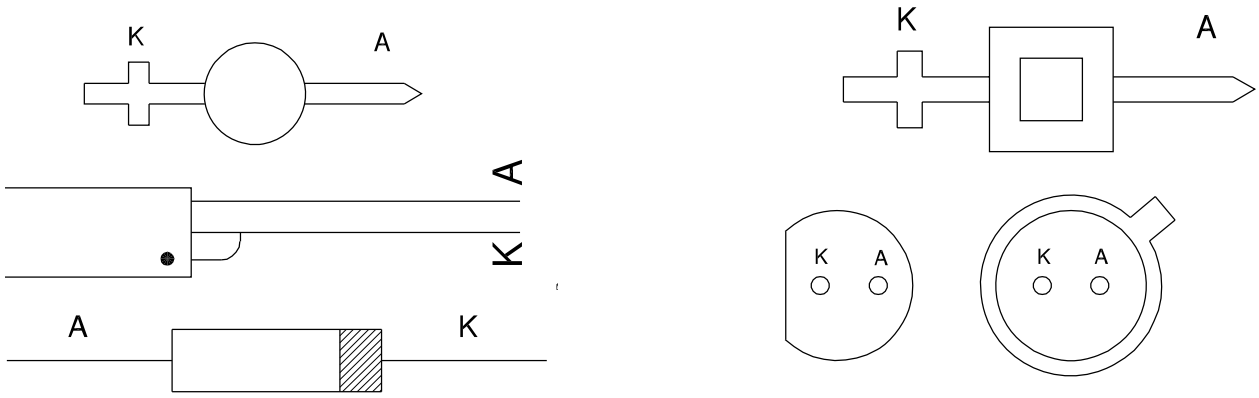


VERY LOW POWER - GLASS PACKAGE DIODE

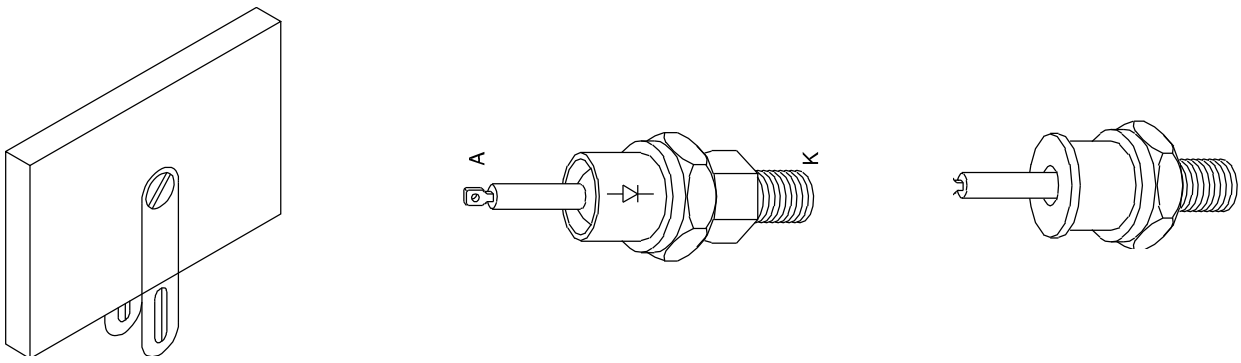




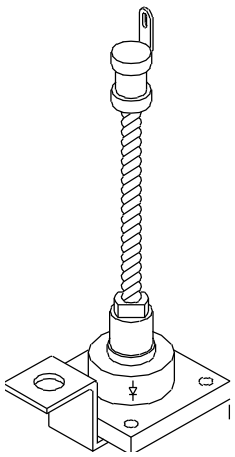
LOW POWER - METAL PACKAGE DIODE

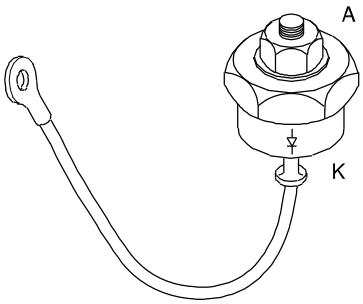


HIGH POWER - METAL PACKAGE DIODE



VERY LOW POWER - METAL PACKAGE DIODES





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TASK 3 : **Identifying transistor type and leads, referring to data manual**

1 Take any one transistor from the given assorted lot, enter its label number and transistor type number in Table 1.

2 Refer to transistor data manual and find and record the following details of the transistor in Table 1 of O&T sheet.

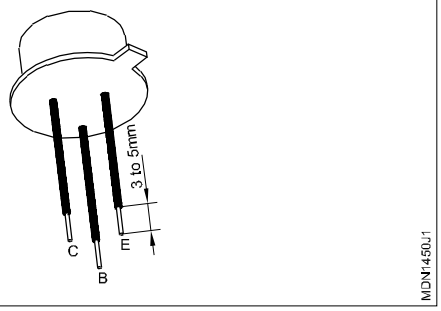
- Whether silicon or germanium
- Whether NPN or PNP
- Type of packaging or case outline (Example: TO5,TO7 etc.)

3 From the type of package recorded, the transistor data manual and draw the pin diagram indicating base, emitter and collector for the transistor, in Table 1.

4 Put sleeves of suitable length, as shown in Fig 1, to the identified pins of the transistor using the colour scheme given below.

Base	-	Blue colour sleeve
Emitter	-	Red colour sleeve
Collector	-	Yellow colour sleeve
Shield	-	Black colour sleeve

Fig 1



Note: In some power transistors, the metal body itself will be the collector. In such cases mark 'C' on the metal body using a pencil. All transistors will not have shield pin.

5 Repeat steps 1 to 4 for atleast five transistors of different types in the given lot and get your work checked by your instructor.

— — — — — — —

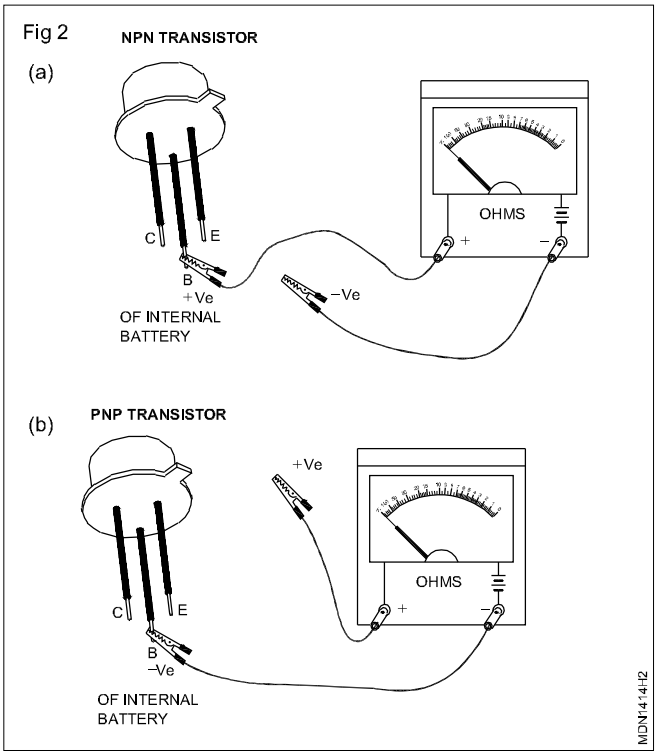
1 Identify which terminal of the ohmmeter being used is connected to the +ve terminal of the internal battery of the meter. Set the meter range to Rx100W.

Ohmmeters in very low or very high ohms range can produce excessive current/voltage and may damage low power transistors while testing.

2 Take a transistor whose pins are identified and sleeved at Task 3. Depending on whether the chosen transistor is NPN or PNP, clip/hold the +ve or -ve of the meter prod to the base of the transistor as shown in Figs 2a and 2b.

3 Clip the other meter prod to the emitter. Check if the base-emitter junction diode of transistor shows low resistance (few tens of ohms) or very high resistance (few tens of kiloohms). Record your observation in Table 1.

4 Reverse the polarity of the prod connected across the base-emitter and check if the base-emitter junction diode of transistor shows low resistance or very high resistance. Record your observation in Table 1.



5 From the recorded observations in steps 3 and 4, and referring to the table given below, conclude and record, the condition of the base-emitter junction diode of the transistor as GOOD, **open** or **shorted** in Table 1 of O&T sheet.

Note: If the resistance of the junction measured in both directions is high, in addition to the condition of the junction given in table, one other possibility is, your identified base pin may be wrong. You may be measuring resistance across emitter-collector. In case of doubt, recheck the identified pins of the transistor and repeat steps 2, 3 and 4.

Table 1

Resistance of P-N junction with meter prods in one direction	Resistance of P-N junction with meter in reversed direction	Condition of P-N junction
Low	Very High	Good
Low	Low	Shorted
Very High	Very High	Open (See note above)

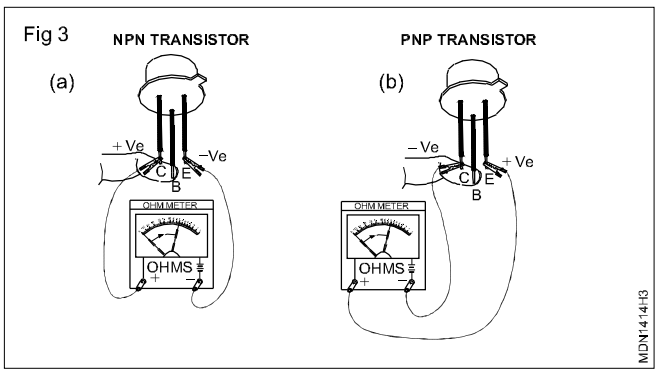
6 Repeat the steps 2,3,4 and 5 and check the condition of the base-collector junction diode of the transistor.

7 Measure the resistance across the emitter-collector and record the observation as V-HIGH (> 1MW) or LOW (< 500W).

Note: In a good transistor the resistance between the emitter and collector will be very high. A low resistance indicates that the transistor is leaky.

8 Clip the meter across the emitter-collector with correct polarity as shown in Fig 3. Touch the base-collector with moist fingers as shown in Fig 3 and check if the resistance shown by the meter decreases indicating that the transistor is turning ON. Record your observation as YES or NO in Table 1 of O&T sheet.

9 From the observations recorded at steps 5,6,7 and 8, give your conclusion on the overall condition of the transistor under test.



10 Repeat steps 1 to 9 for atleast five more transistors of different types.

11 Get your work checked by your instructor.

— — — — — — —

Construct and test logic gates

Objectives : At the end of this exercise you shall be able to
- **connect the circuit with resistor and transistor**
- **construct AND, NOT, OR gate**
- **circuits and verify the truth table.**

Requirements

Tools/Instruments

- Trainees tool kit - 1 No.

Equipments

- Battery 12V - 1 No.

Materials

- Relay 12V - as reqd.
- Lamp 12V, 10W - as reqd.
- Switches - as reqd.
- Resistors - as reqd.
- Transistor NPN 2A - as reqd.
- Wire - as reqd.

PROCEDURE

TASK 1 : **Construct OR gate circuits and verify the truth table**

1 Connect the transistors as shown in Fig 1.

2 Connect the switches in parallel.

3 Connect the bulb at the output.

4 Connect battery.

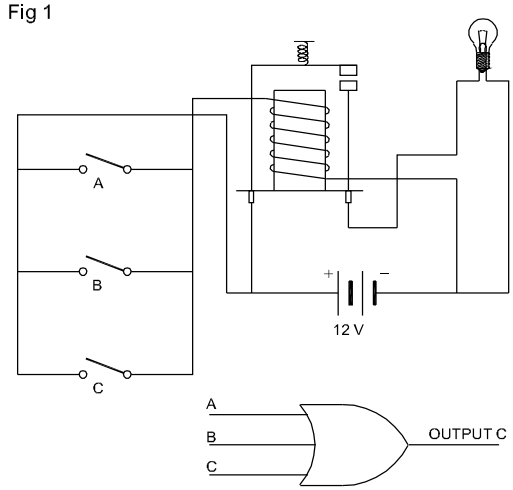
5 Operate the switches look at the bulb and make truth table 1.

6 Get the work checked by your instructor.

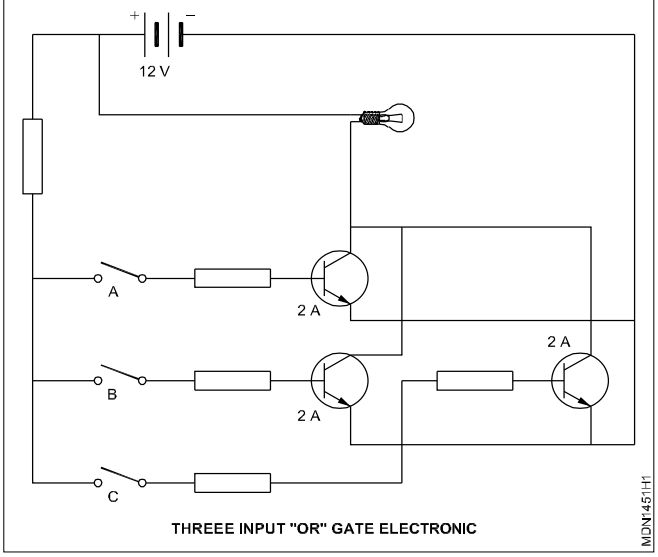
Table 1

A	B	C	ON/OFF condtion of bulb
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Fig 1



THREEE INPUT "OR" GATE ELECTRICAL



THREEE INPUT "OR" GATE ELECTRONIC

TASK 2 : **Construct an AND gate circuits and verify the truth table**

1 Connect two on-off switch.

2 Connect 21 W/12 V bulb as load.

3 Connect battery 12V.

4 Connect solenoid 12 V (No) with suitable wires as shown in Fig 1.

5 3 NPN 2A transistors connected with suitable resistors.

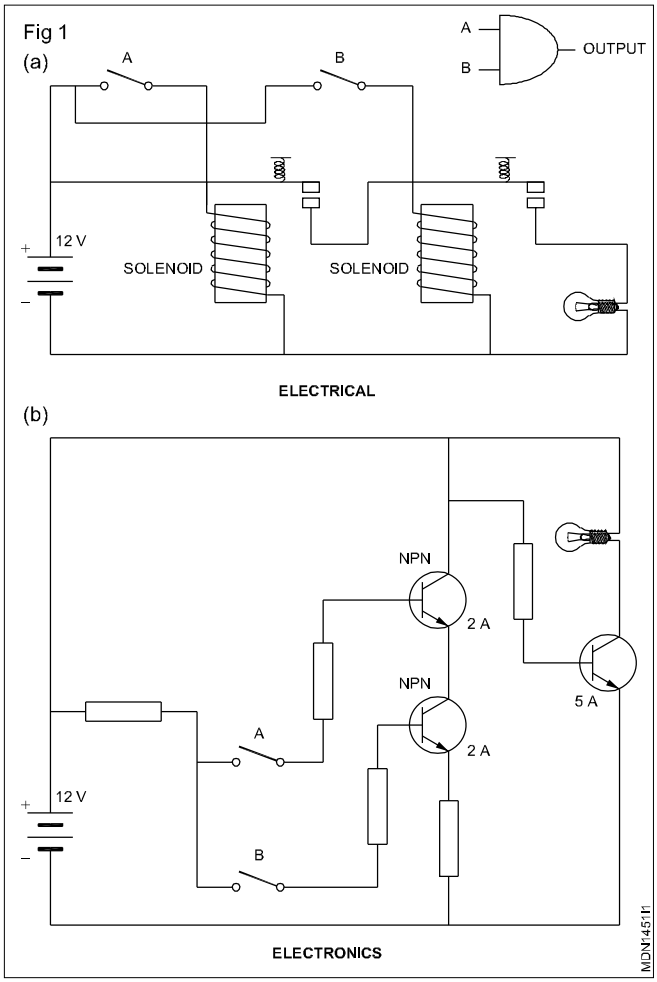
6 Operate the switches and look at the bulb for its function.

7 Prepare a truth table 1.

8 Get the work checked by your instructor.

Table 1

A	B	ON/OFF condtion of bulb
0	0	
0	1	
1	0	
1	1	



TASK 3 : **Construct NOT gate and verify the truth table**

1 Use 1 mm wires and make the NOT gate electrical circuit (Figs 1 and 2)

12V 21W double contact bulb, 12V relay (B,L,S) with the terminal normally closed tape.

2 Connect the 12V battery.

3 Connect the bulb at the output.

4 Operate the switches and look at the bulb for its function.

5 Get the work checked by your instructor.

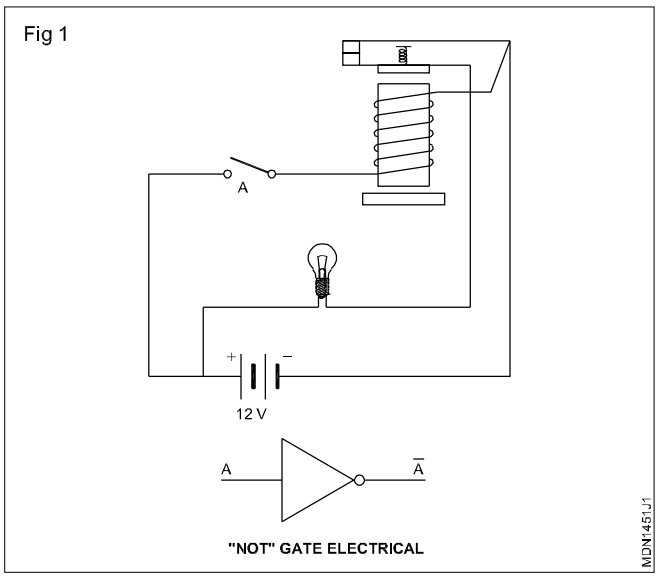
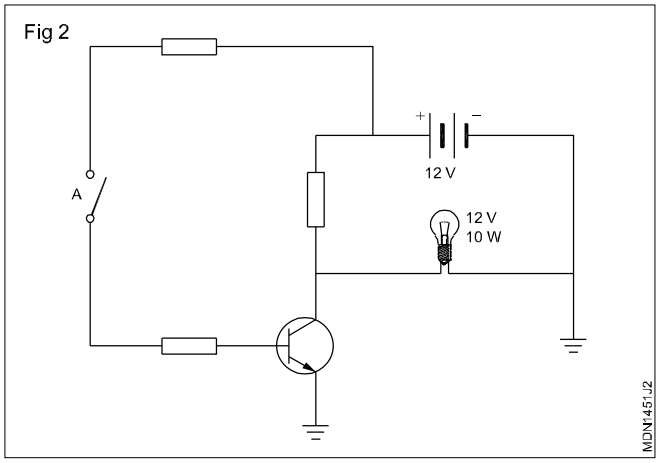


Fig 2



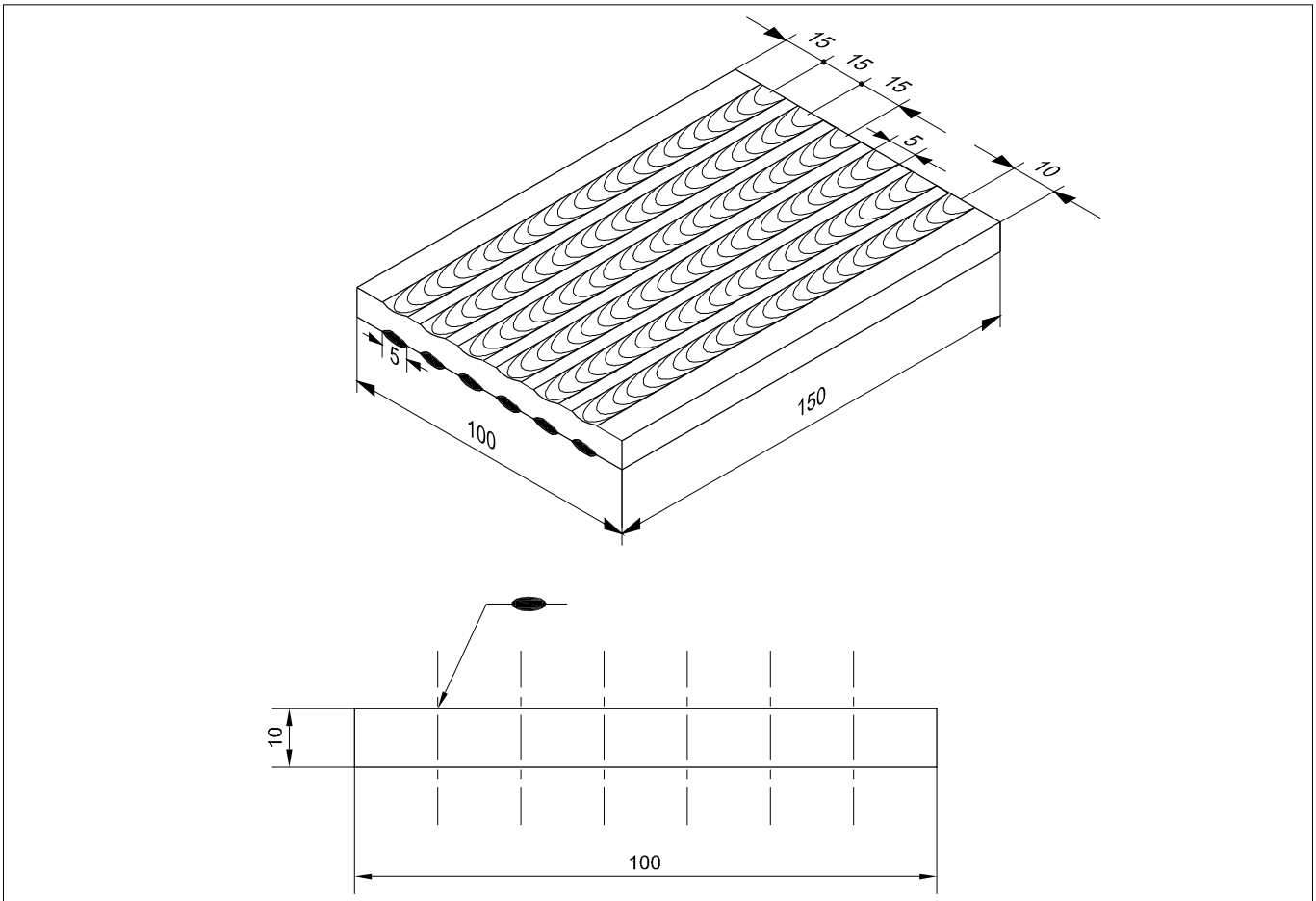
Truth Table

I/P	O/P
0 (OFF)	1 (ON)
1 (ON)	0 (OFF)

Practice on arc welding

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

- **prepare and set job pieces for straight line beading**
- **select the electrode, current and polarity for depositing the weld beads**
- **deposit uniform straight bead in flat position by arc welding**
- **maintain constant arc length, electrode angle and travel speed**
- **restart a broken arc and fill the crater properly**
- **remove and clean the slag and spatter from the weld bead using a chipping hammer and wire brush**
- **inspect deposited beads for any surface defects.**



1	100 ISF 10 - 150		Fe 310 - W			1.5.52
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	STRAIGHT LINE BEADS ON M.S.PLATE 10mm POSITION FLAT				TOLERANCE ±1	TIME 10 Hrs
					MDN1552E1	

PROCEDURE

TASK 1 : **Weld straight line beads on M S plate 10 mm in flat position**

1 Prepare the plates to size (as per drawing) by Hacksaw cutting and grinding.

2 Clean the plate surface (job) with a carbon steel wire brush and remove the burrs by filing.

3 Lay out parallel lines on both sides of the job surface as per sketch and mark with a centre punch.

4 Set the plate on the welding table in a flat position.

Ensure the plate is contacting well with the welding table and the earth clamp is not loosely connected with the work table.

5 Wear protective clothing (safety apparels).

Ensure the filter glass of the welding shield is in good condition.

6 Fix a 4 mm ø M.S. electrode in the holder.

7 Set the welding current to 150 to 160 amps approximately.

8 Connect the electrode cable with the transformer welding machine. In case of a DC welding generator or rectifier, connect it to the negative terminal.

9 Connect the earth clamp on the right extreme end of the job/work table.

10 Start the welding machine

11 Strike the arc on a scrap piece for trial and observe the current setting.

Ensure the burning of the electrode is normal and the arc is smooth.

12 Readjust the welding current if necessary.

13 Use a short arc.

14 Deposit straight line beads on the workpiece along the punched line from the left hand end to the other end.

15 Hold the electrode at 70^0 to 80^0 to the line of weld. Move it along the line of weld and towards the job at uniform speed.

16 Restart the bead whenever the arc is broken and ensure to fill the crater.

17 Fill the crater at the end of the bead without fail.

18 Remove slag from the weld bead using a chipping hammer and clean with steel wire brush.

19 Use a chipping screen while de-slagging.

20 Inspect deposited beads for:

- uniform width and height
- slag inclusion
- straightness
- uniform ripples
- unfilled crater
- porosity
- undercut

21 Repeat the exercise on the otherside of the plate.

— — — — — — —

Skill Sequence

Weld straight line beads on 10mm MS plate

Objectives: This shall help you to
- **prepare job piece for straight line beads**
- **select the electrode, current and polarity**
- **maintain constant arc, angle and trave speed**
- **remove slag for chipping hammer and wire brush**
- **inspite deposit beads.**

Prepare a M.S. plate piece 100 x 150 x 10mm using a hacksaw and file.

Mark straight line, punch the line keeping 15mm distance in between. (Fig.1)

Set the job on the welding table in a flat position with the punched surface facing up.(Fig.1)

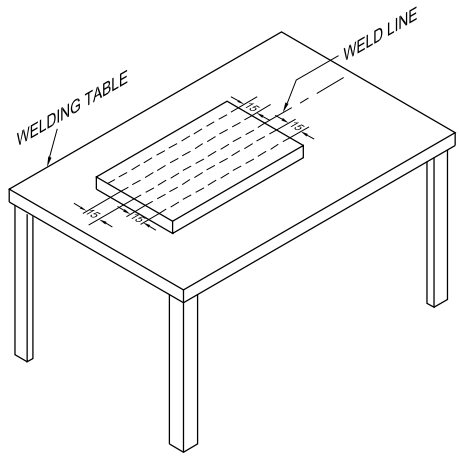
The bottom surface of the job should be perfectly clean to get good electrical contact between the job and the welding table.

Always follow the current range according to the diameter of the electrode, as given in the electrode packet by the electrode manufacturer.

Check for proper melting of the job and electrode on a scrap metal piece.

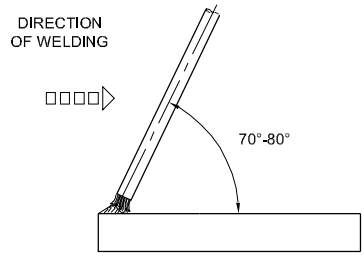
Hold the electrode at an angle of 70° to 80° with weld line/ punched line. (Fig 2)

Fig 1



MDN1552H1

Fig 2



ELECTRODE ANGLE WITH WELD LINE

MDN1552H2

When a DC welding machine is used connecting the earth cable at the right end of the job or work table will help to deposit the weld metal at the correct place in the joint.

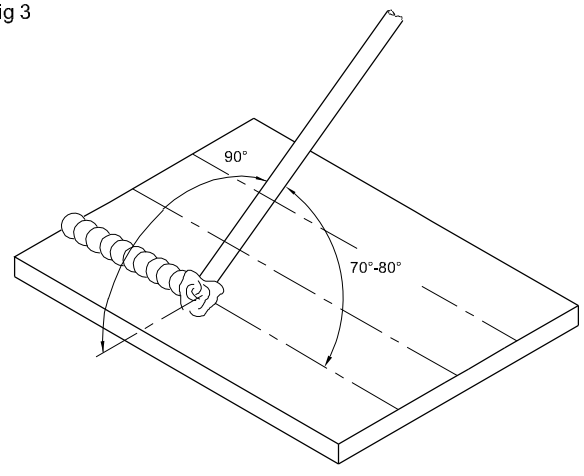
Deposit straight line beads taking the punched lines as a guide maintaining:

– the medium arc length (L) (i.e. equal to dia. of electrode used (d). If a DC welding machine is used then use of a short arc length will help to reduce the deviation of the molten metal from its intended path.

– correct travel speed (approximately 150 mm per minute)

– correct electrode position/angles.Fig 2 and 3

Fig 3



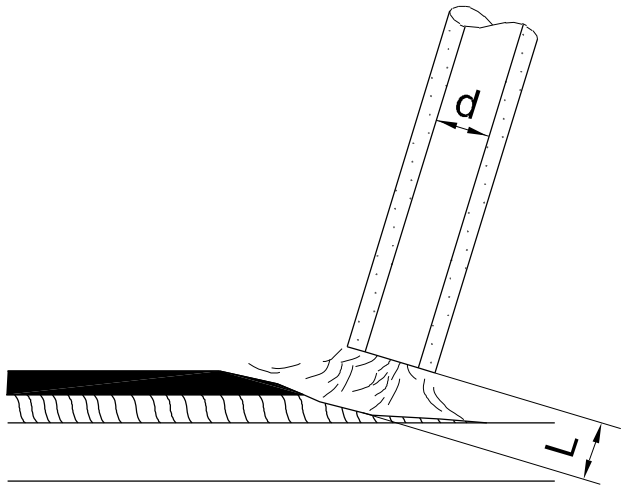
MDN1552H3

The electrode should be moved towards the job to maintain a gap between the tip of the electrode and the molten pool. (Fig 4)

Welding screen glasses should be clean enough to see the arc action on the molten pool and punched line mark.

Listen to the arc's steady sharp crackling sound while welding. It indicates uniform burning of the electrode.

Fig 4



(L) ARC LENGTH = DIAMETER OF ELECTRODE (d)

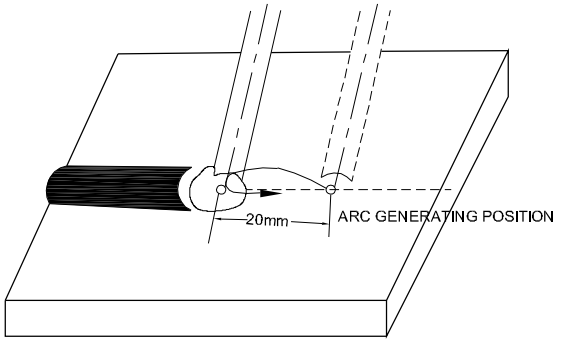
MDN1552H4

Adjust the travel speed by watching the electrode melting rate and flowing through the molten pool to form the deposited metal. The uniform travel speed of the electrode along and towards the line of the weld gives a uniform bead.

Whenever the arc is broken a depression called crater is formed at the breaking point and this crater has to be filled first while restarting the arc. So clean the crater and generate an arc at about 20mm ahead of the crater and return to the crater at a faster rate.

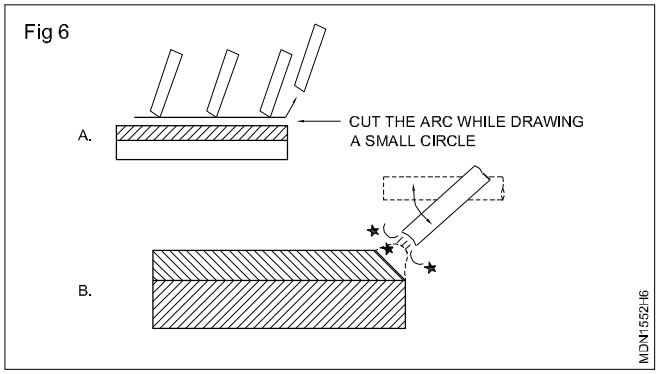
Build the deposit so that it fills the crater, then move the electrode ahead. Fig 5.

Fig 5



MDN1552H5

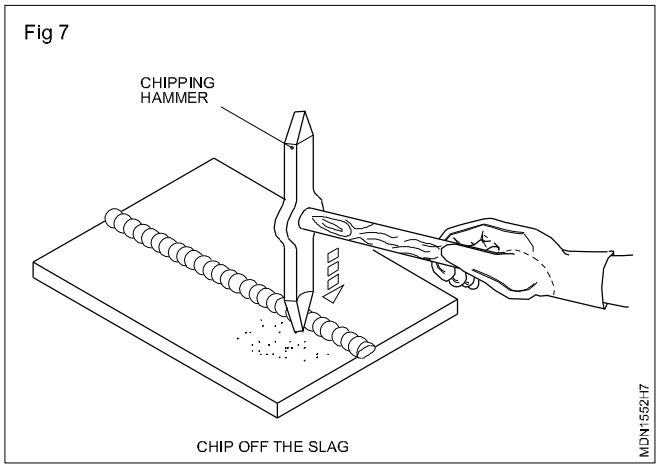
Also after completion of each bead fill the crater as follows. Fig 6

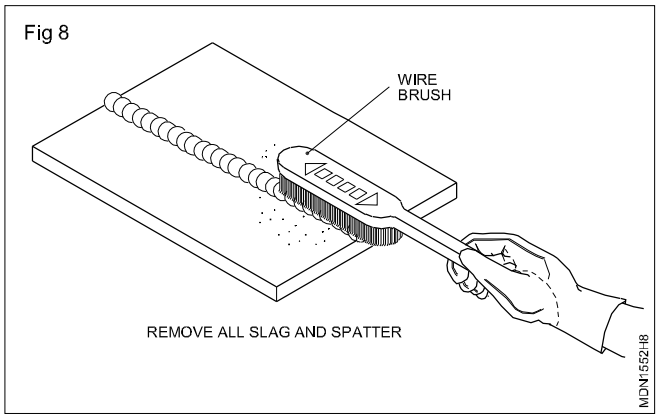


Build the deposit on the crater so that it is the same level as the welding bead.

– Let the arc length be shorter at the end of the run and draw a small circle 2 to 3 times.
– Repeat Off and On the arc at the end to fill the crater shown in Fig 6

Remove the slag and spatters from the weldment using a chipping hammer and wire brush, so that the metal surface of the bead is exposed for checking for any defects. (Figs 7 and 8)

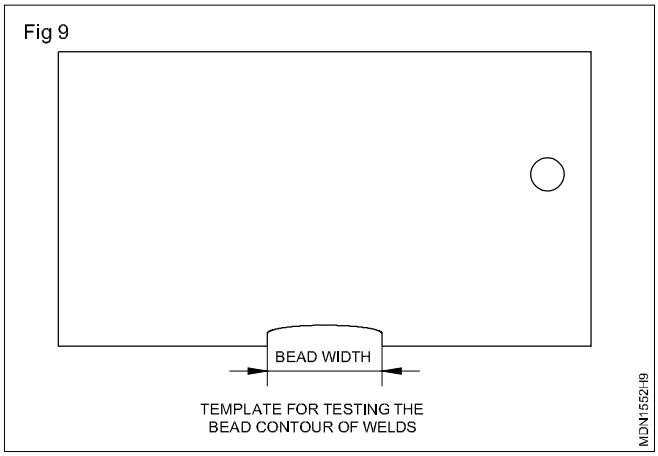




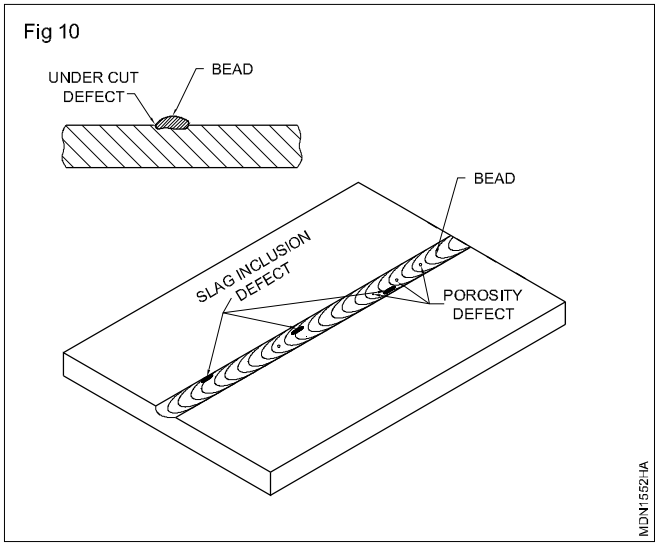
Determine the causes for the above weld defects and use the remedial/prevention methods in further deposits.

Check the deposited beads and note any variation in the:

– width and height using a template Fig 9.



– depth of fusion
– straightness of the run
– check for surface defects such as slag inclusion, surface porosity, undercut, improper bead profile etc. (Fig 10)



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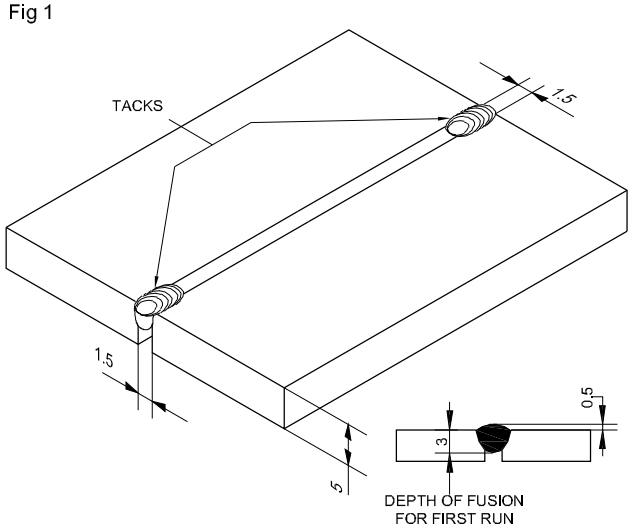
Skill Sequence

Open square butt joint

Objectives: At the end of this exercise you shall be able to
- **set and tack-weld the pieces as open square butt joint**
- **hold the electrode at the required angle and move it at uniform speed along the joint**
- **clean and inspect the open square butt weld.**

Tack at both ends is done so that the joint will be in proper alignment (Fig 1). A higher current of 110 ampere current is set to ensure good fusion of the edges and avoid defects at the tacks.

Fig 1



SET UP WITH EDGES PARALLEL 1.5mm APART

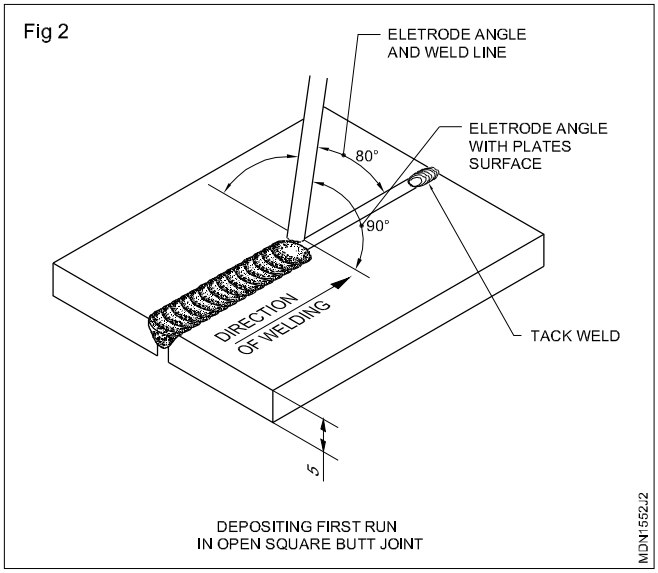
Selection of a 3.15mm dia. medium coated MS electrode and 110 amps current setting will help to maintain smaller molten pool.

Proper angles of electrode is essential to ensure the molten slag can be kept away from the weld pool and the fusion will be to the required depth. Fig 2

To get good ripple formation, to avoid more metal deposition at the same place move the electrode steadily forward with a uniform speed of travel.

Be very careful to keep the centre line of arc exactly on the centre of the edges to be fused so that both the edges of the joint are fused simultaneously.

Fig 2

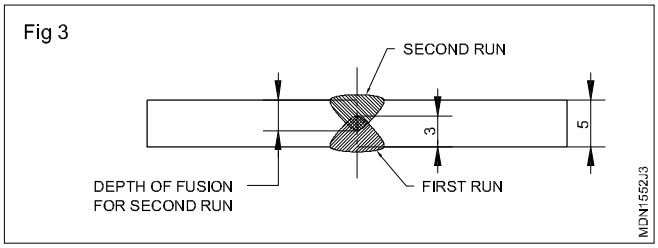


DEPOSITING FIRST RUN
IN OPEN SQUARE BUTT JOINT

The slag at the root of the first run will have to be cleaned properly, otherwise slag inclusion defect will occur, when welding is done on the otherside of the joint.

While depositing the second run ensure proper fusion to a depth of 3 to 3.5mm is obtained so as to avoid lack of fusion defect at the meeting point of the 2 beads. Fig.3

Fig 3



In both the runs molten puddle has to be controlled by proper mainpulation of the electrode to avoid slag inclusions in the weld metal.

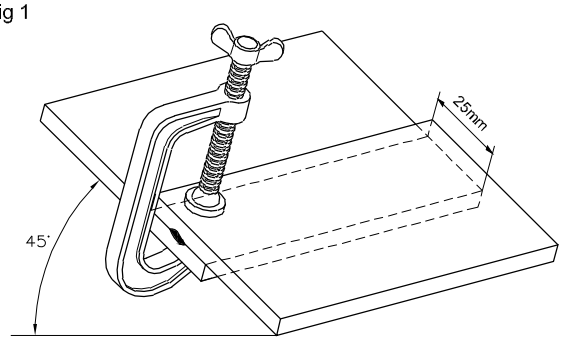
Skill Sequence

Fillet weld lap joint on MS plate 10mm

Objectives: This shall help you to
- **prepare plate pieces by gas cutting and by grinding to size**
- **set plates as a lap joint and tack weld at both ends**
- **deposit root run of proper size and ensure penetration.**
- **clean and inspect the lap fillet weld for surface defects.**

Setting and tacking the lap joint (Fig 1)

Fig 1



SETTING TACKING A LAP JOINT.

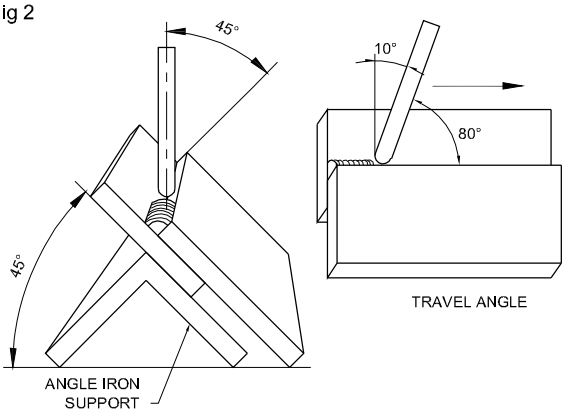
Set the lap joint with an overlap of 25mm.

The overlap may vary based on the plate thickness.

Tack-weld on both ends. (Fig 1) Ensure the 2 lapping surfaces are perfectly cleaned and they contact each other properly. Use a 3.15mmø MS electrode with 120 amp current for tacking.

Set the joint in a flat position using angle iron (Fig 2).

Fig 2



Welding the lap fillet joint in flat position

Deposit root run with a 3.15mmø medium coated MS electrode with 100-110 amp. current.

Maintain 80° angle to the line of the weld and 45° between the weld faces. (Fig 2)

Maintain a short arc to get uniform fusion and root penetration.

Avoid side-to-side movement of the electrode.

De-slag and clean the root bead thoroughly.

Deposit the final covering run with a 4mmø medium coated MS electrode and 160 amp current.

Give side-to-side movement to the electrode not more than 2.5 times its dia.

Use the same electrode angle as was used for the root bead.

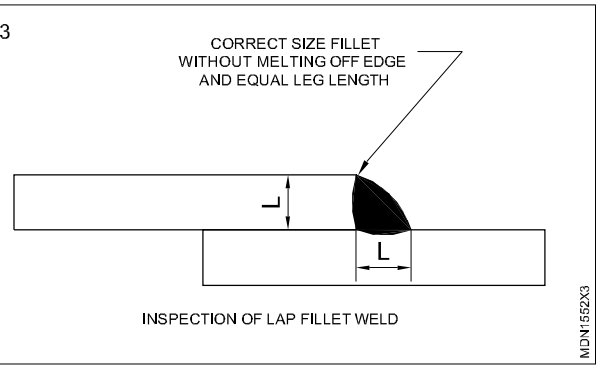
Prevent the upper edge of the plate from melting off by not allowing the arc to concentrate more on the upper edge.

Remove the slag with a chipping hammer.

Clean the weld with a steel wire brush.

Inspect the lap fillet weld (Fig 3) and ensure:

Fig 3



INSPECTION OF LAP FILLET WELD

– it has equal leg length with slight convexity
– the upper edge of the plate has not melted off
– it is free from surface defects.

Skill Sequence

Fillet weld 'T' joint

Objectives: This shall help you to
- **set and tack pieces in alignment as 'T' joint**
- **deposit root run in 'T' joint**
- **clean the weldment and inspect surface defects.**

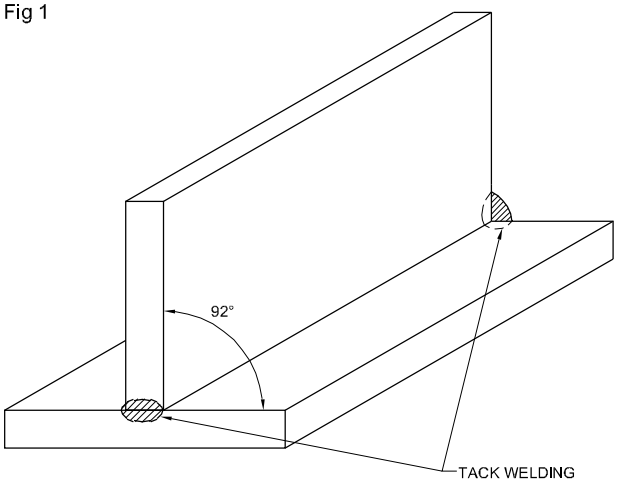
Setting and tacking of a 'T' joint (Fig 1)

Set the pieces in alignment forming 92° between the plates Fig 1. This preseting to 92^0 is done to compensate the effect of shrinkage forces when weld deposit cools down.

Tack-weld the pieces at both ends of the 'T' joint by using a 3.15mm dia. medium coated M.S. electrode and 110/120 amps welding current.

Ensure the tacks are well fused at the root.

Fig 1



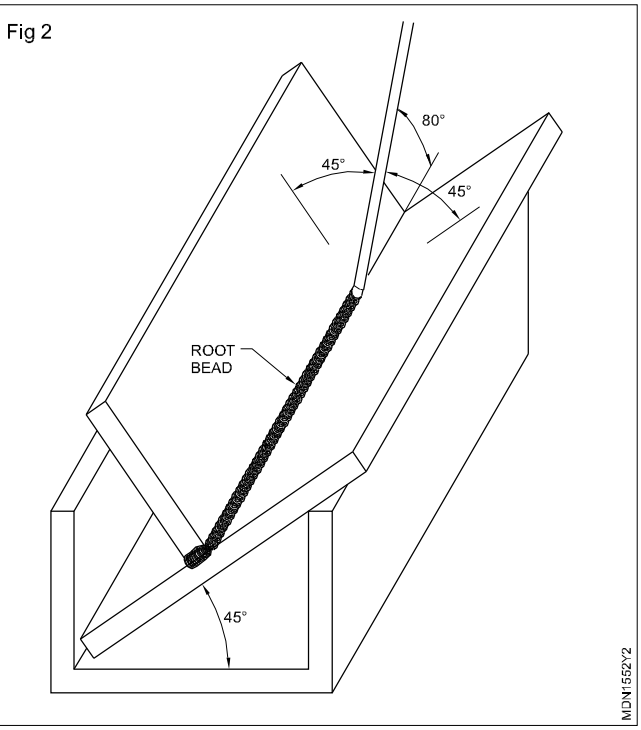
SETTING AND TACKING A TEE JOINT

Check the alignment of the 'T' joint after tacking.

Welding a 'T' fillet joint

Use a channel to place the joint in a flat position. (Fig 2)

Fig 2



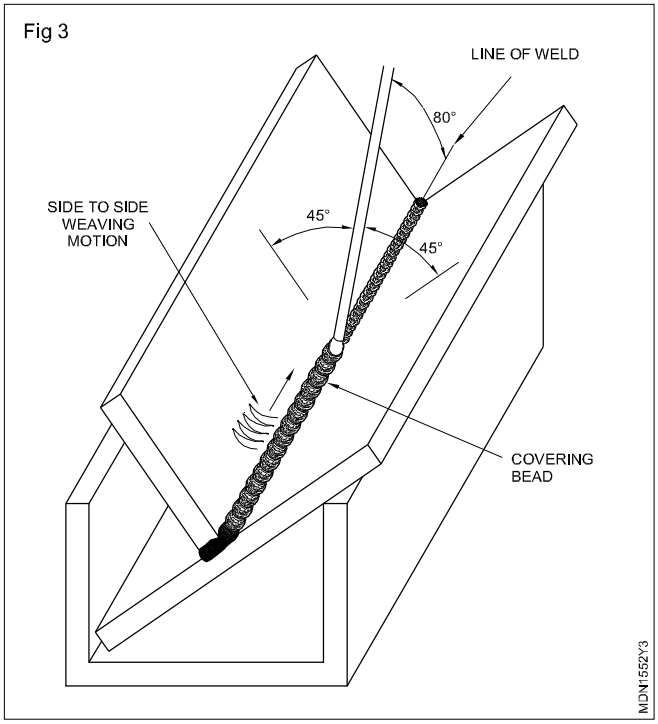
The electrode angle of 45^0 will help to fuse both plates equally and the 80^0 angle will help to get a good root penetration.

Proceed along the welding line with uniform travel speed and short arc to get uniform fusion and root penetration.

The slag has to be removed thoroughly from the root run so that the slag inclusion defect can be avoided in the next run.

Use a slightly side-to-side weaving motion. (Fig.3) The width of weave should give a leg size of 10mm.

Fig 3



Maintain the same electrode angle as in the root bead.

If the leg size is less than 10mm then deposit a third run using the same technique used for the second run.

Clean the final covering bead thoroughly.

Stop the electrode weaving for a moment at the toes of the weld to avoid undercut. Fill the crater at the end of the bead.

Inspection of fillet weld

Inspect the fillet welds for defects, correct shape and size of fillet and equal leg length on either side of the weld.

Practice on gas welding

Objectives: At the end of this exercise you shall be able to
- **identify the different equipment/parts of an oxy-acetylene welding plant**
- **move gas cylinder safely**
- **setup the oxy-acetylene gas welding plant connecting all components**
- **test for gas leadkages at all connections**
- **set the required gas pressures on the regulators**
- **ignite and extinguish the gas flame without backfire**
- **set neutral, oxidising and carburising flames**
- **close down the oxy-acetylene gas welding plant maintaining correct sequence**
- **observe all safe practices while using the oxy-acetylene gas welding plant.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Spanner D/E - 1 No.
- Cylinder key - 1 No.
- Pressure gauge - 1 No.
- Trolley - 1 No.

Equipments

- Oxy-acetylene plant - 1 No.
- Regulator (Left and Right threads) - 1 No each.
- Nozzle cleaner - 1 No.

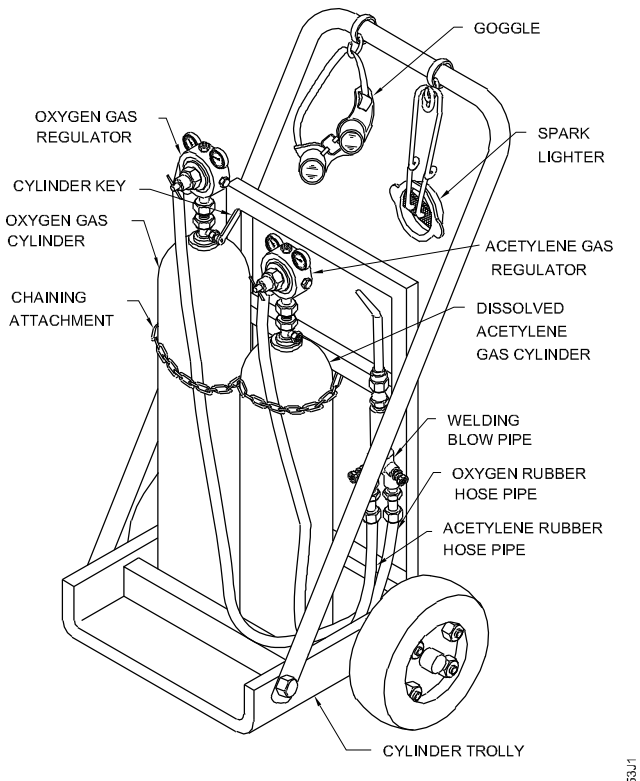
Materials

- Cotton rag - as reqd.

PROCEDURE

Setting up oxy-acetylene plant Fig 1

Fig 1



SETTING OF OXY-ACETYLENE PLANT

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

Ensure full cylinders are kept separately from the empty cylinders.

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

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

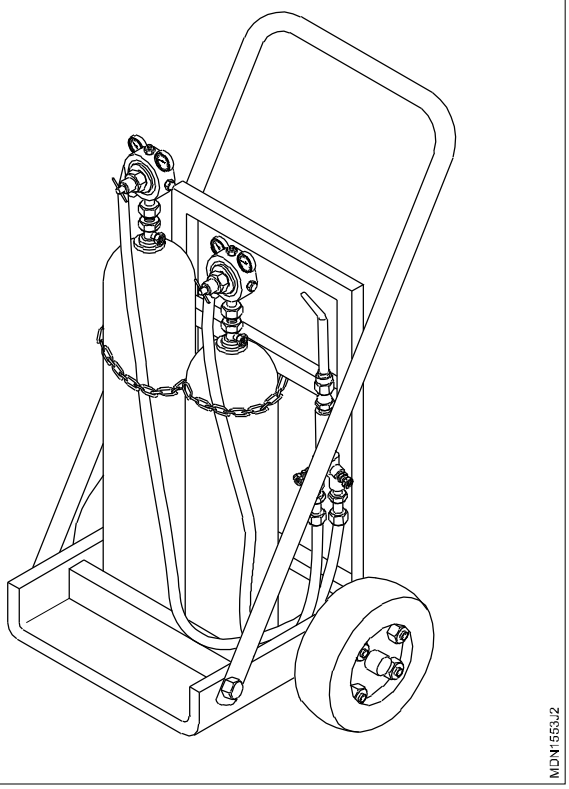
While moving, the gas cylinder should be kept slightly inclined to the vertical position and the protector cap used to avoid damage to the cylinder valves. (Fig 3)

Do not roll the cylinder horizontally on the ground.

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

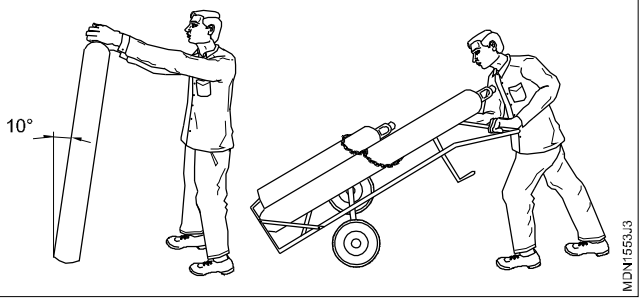
Dirt and dust particles from the cylinder valve sockets are cleaned by cracking the cylinder valve. This will avoid leadage of gas due to improper seating of the cylinder valve and also to prevent the dust particles from entering into the regulators which may cause damage to the regulators.

Fig 2



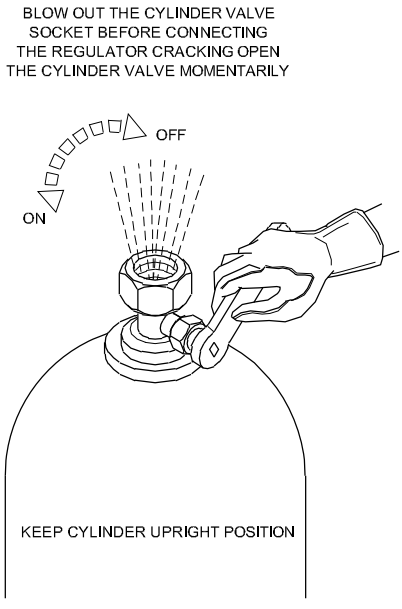
MDN1553J2

Fig 3



MDN1553J3

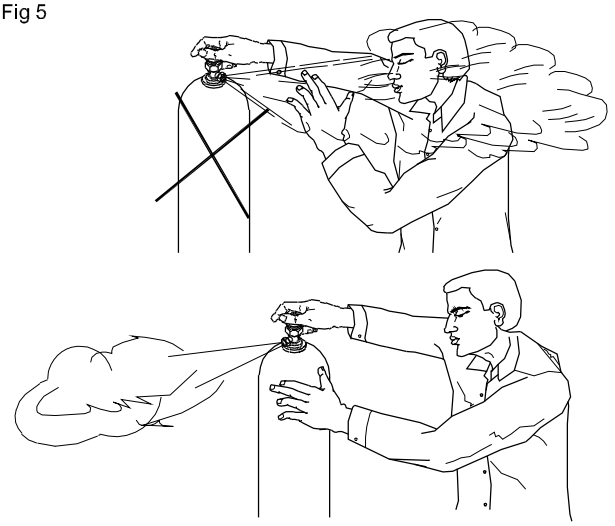
Fig 4



MDN1553J4

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

Fig 5



MDN1553J5

Ensure that your hands are free from grease or oil.

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

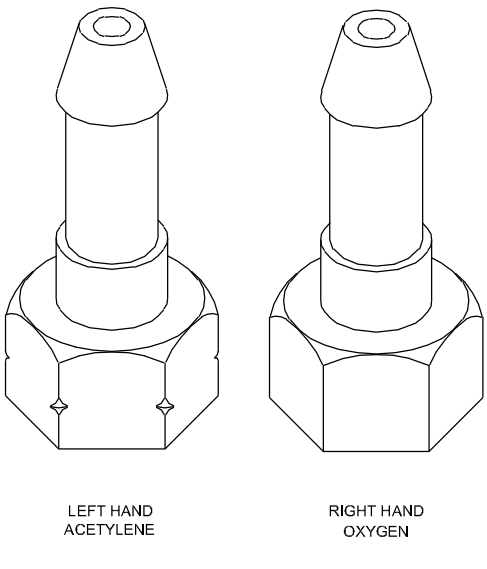
Connect the acetylene regulator to the acetylene gas cylinder (left hand threads)

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

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

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

Fig 6

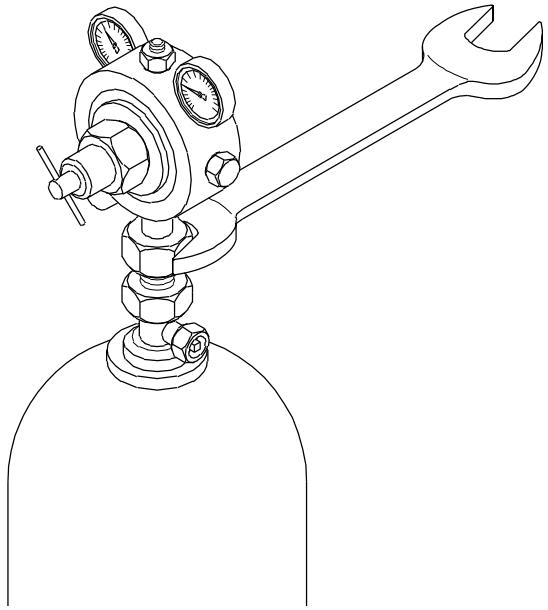


MDN1553J6

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

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

Fig 7

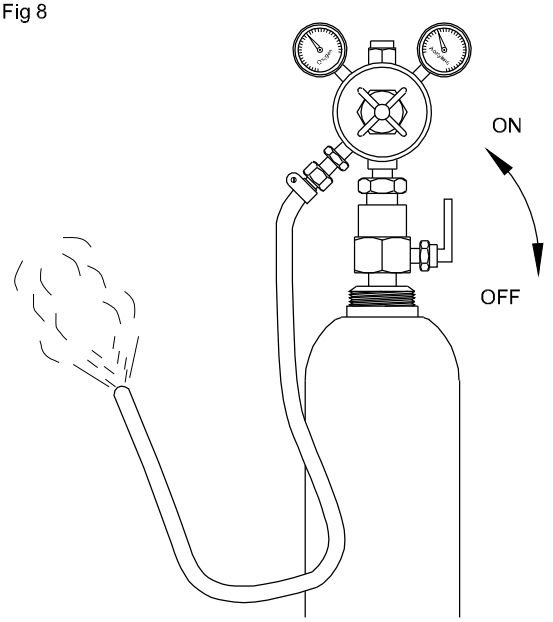


MDN1553J7

Attaching blowpipe

The other end of the hose-pipe is to be attached to the blowpipe inlets. (Fig 8)

Fig 8

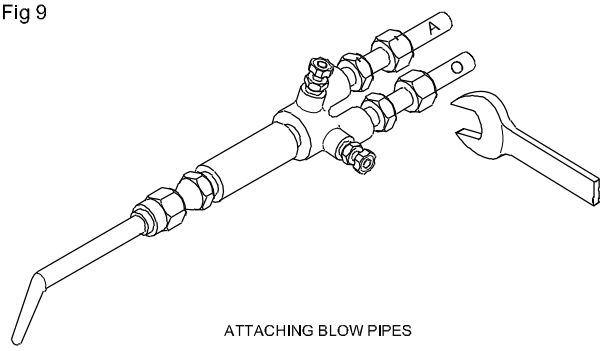


ATTACH NEW HOSES TO REGULATORS
AND TO DISPEL DUST ETC., QUICKLY
PASS PRESSURISED GAS TO ATMOSPHERE
MOMENTARILY.
NOTE: THIS SHOULD BE DONE BEFORE
FITTING HOSE PROTECTORS

MDN1553J8

Fix the hose-protectors at the blowpipe ends. The hose-protectors with a groove at the corners are fixed on the acetylene hose-pipe and connected to the acetylene inlet of the blowpipe. The hose-protectors without cutting marks are fixed on the oxygen hose-pipe and connected to the oxygen inlet of the blowpipe. (Fig 9)

Fig 9



ATTACHING BLOW PIPES

MDN1553J9

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

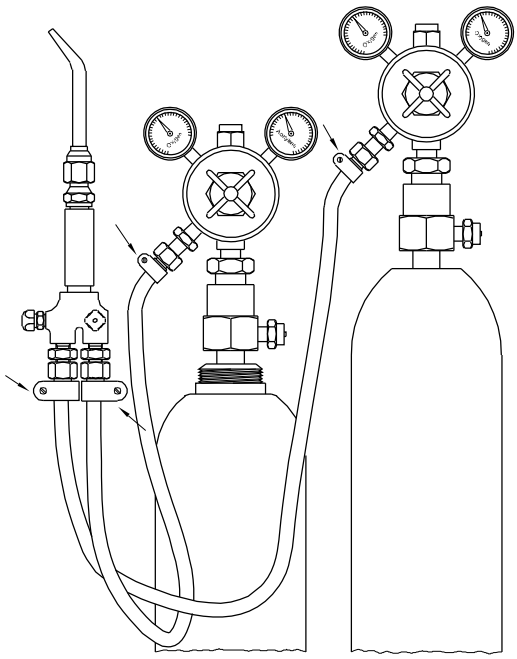
Adjusting the gas pressure

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

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

For adjusting the gas pressure, open the valves of both the cylinders slowly by on turn and set the pressure on both regulators as 0.15 kg / cm^2 for small size nozzle tightening the pressure adjusting screws. (Fig. 10) Ensure the blow pipe control valves are kept open while setting gas pressure.

Fig 10



USE HOSE CLIPS BEFORE
CONNECTING TO REGULATOR
AND BLOW PIPE

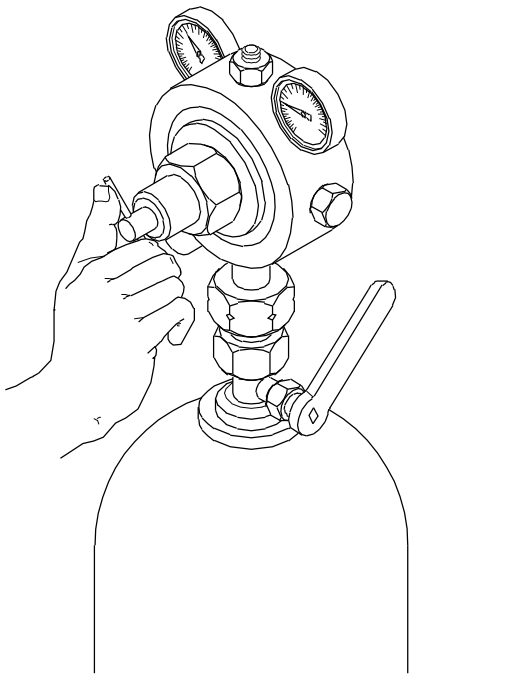
MDN1553JA

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

Testing for leakage

All connections must be tested for leakage.

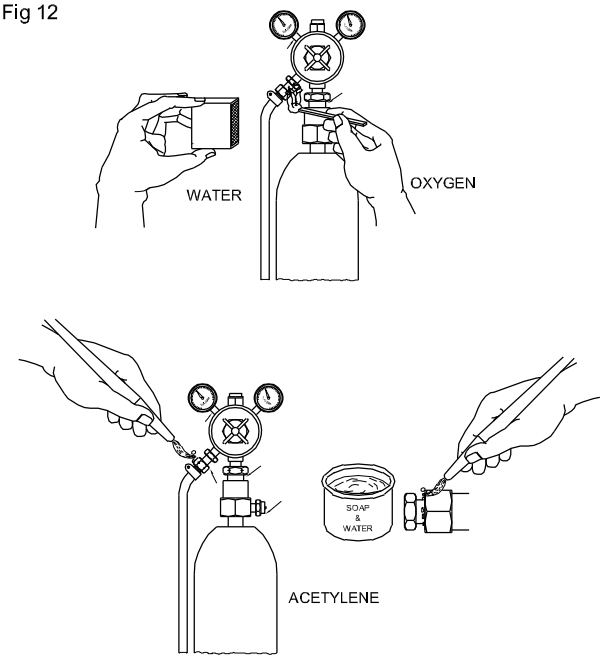
Fig 11



MDN1553JB

Apply soap water solution for acetylene connections and fresh water for oxygen connections. (Fig 11)

Fig 12



MDN1553JC

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

Never use matches or flame light during leakage test.

Lighting the flame

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

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

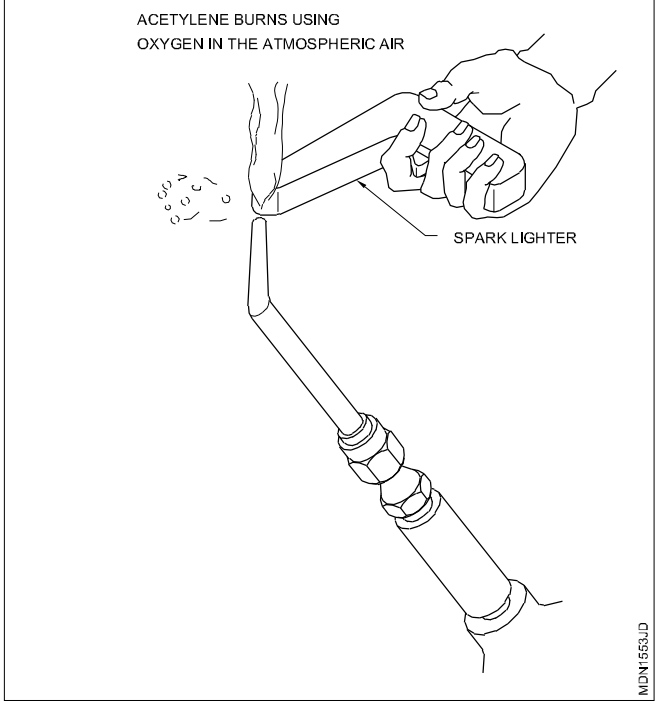
The pressure of oxygen and acetylene is 0.15kgs/cm^2 for nozzle No.3.

Open cylinder valves very slowly.

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

Open the acetylene control valve 1/4 turn on the blowpipe and ignite with a spark lighter. (Fig 12) Acetylene burns using the oxygen in the atmosheric air with a black smoke.

Fig 13



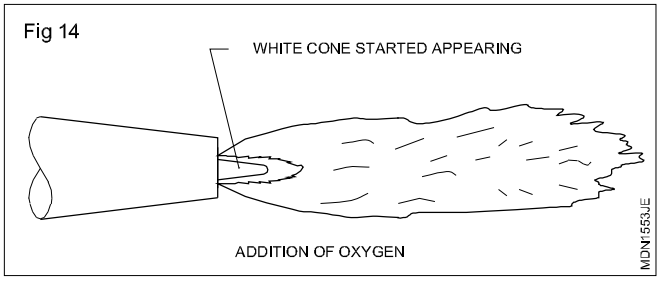
MDN1553JD

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

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

Increase the acetylene till the black smoke disappears. (Fig 13)

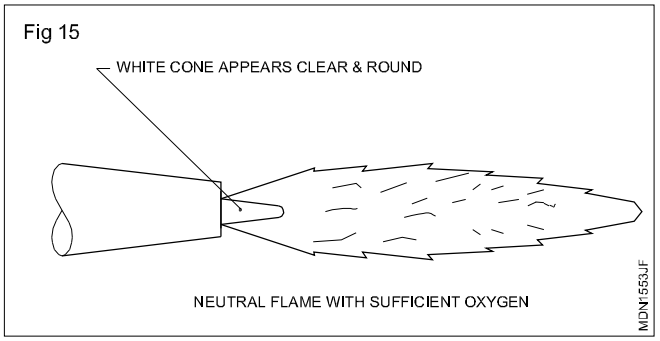
Fig 14



MDN1553JE

Observe the flame and add oxygen by opening the oxygen control vlave of the blowpipe. Now a bright white cone starts appearing at the tip of the nozzle. (Fig 14)

Fig 15

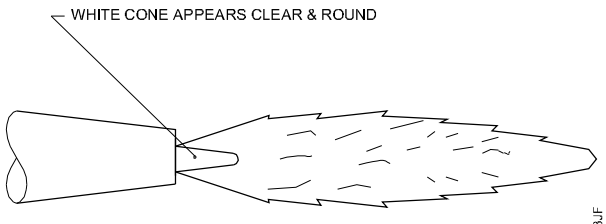


MDN1553JF

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

To adjust the neutral flame, and sufficient oxygen to make the white cone clear and round. (Fig 15)

Fig 15



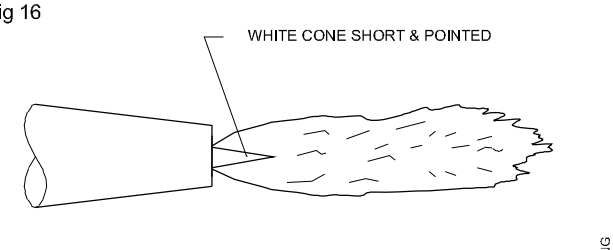
The gas mixture from the blowpipe has equal volume of oxygen and acetylene.

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

The white cone will become short and sharp.

The flame will produce a hissing sound and will have a short length.(Fig 16)

Fig 16



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

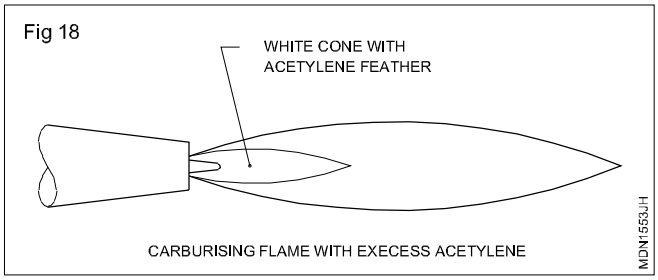
To adjust the carburising flame, adjust the flame to neutral and then add acetylene.

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

The flame will burn quietly having more length. (Fig 17)

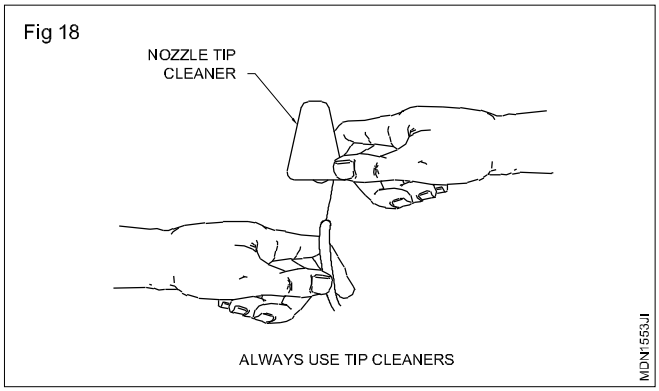
The gas mixture from the blowpipe has move volume of oxygen than acetylene than oxygen.

Fig 18



After continuous use of the blow pipe during welding the nozzle may get blocked by metal particles or spatters. This blockage has to be removed to get continuous flow of gases by using a nozzle cleaner. (Fig 18)

Fig 18



Close the acetylene cylinder valve.

Close the oxygen cylinder valve.

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

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

Both the pressure gauges on the regulators should read zero.

Release the acetylene regulator pressure adjusting screw.

Close the blowpipe acetylene valve.

Close the blowpipe oxygen valve.

Ensure

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

Skill Sequence

Fusion runs without filler rod in flat position

Objectives: At the end of this exercise you shall be able to
- **fusion runs without filler rod in flat position**
- **fusion runs with filler rod in flat position.**

Fusion runs without filler rod in flat position

1 Mark and cut the M.S. sheet pieces of size 152 x 122 x 3.15mm using a hand lever shear.

Care should be taken to keep the fingers off from the shearing blades. Wear gloves to avoid injury.

- Straighten the cut pieces by hammering on an anvil.
- File and finish the sheet to dimensions as per drawing.
- Mark and punch parallel lines on the sheet surface as per sketch and set the job piece on the welding table in flat position with fire brick support.
- Select and attach nozzle size 3 to the blowpipe.

Wear safety apparels and gas welding goggles.

- Set acetylene and oxygen pressure 0.15 kg/cm^2 on the regulators.
- Ignite the oxy-acetylene gases and adjust the neutral flame.
- Hold the blowpipe on the job at its right hand end at the required angle.
- Start heating the surface on the right end of the sheet with slight circular motion to the blowpipe and produce a molten pool on the marked line.
- Move the blowpipe from right to left direction maintaining a uniform speed and blow pipe angle.
- Avoid excessive concentration of heat at any one point.

If the metal becomes too hot, lift the blowpipe momentarily away from the molten pool.

Do not touch the inner cone with the molten pool, to avoid backfire and flashback.

12 Keep the molten pool in correct size by adjusting the rate of travel and giving slight circular motion to the blowpipe.

13 Stop at the left end and lift the blowpipe quickly.

14 Extinguish the flame and cool the blowpipe in water.

15 Clean the fused surface with a steel wire brush and inspect for the uniformity of fusion runs.

If the speed of travel and blowpipe motion are correct, the fusion runs will appear with uniform width and even ripples.

Repeat the above 4 more times to achieve uniform fusion and better manipulation of blow pipe.

Fusion run with filler rod in flat position

- Select and fix the nozzle size 5 and set acetylene / oxygen pressure 0.15 kg/cm$^{2.}$
- Select copper-coated, mild steel, (CCMS) filler rod of ø1.6 mm.
- Wear safety apparels and gas welding goggles.
- Ignite the oxy-acetylene gases and set the neutral flame.
- Hold the blowpipe on the right hand at an angle of 60° - 70° with the punched line of the job and make a small molten pool at the right hand edge of the line.
- Keep the flame cone distance 2.0 to 3.0 mm above the job surface.
- Hold the filler rod in the left hand, pointing near the molten pool with an angle of 30° - 40° with the line of weld.
- Melt the base metal at the right end of a punched line and create a molten pool/puddle.
- Fuse the end of the filler rod by dipping at the centre of the molten pool and add filler metal on the job surface to form a weld bead.
- Move both the blow pipe and the filler rod towards left with uniform speed along the punched line with a slight circular motion to the blowpipe.
- Move the filler rod up and down (piston like motion) at a constant speed.
- Add enough rod into the molten pool to build up the bead evenly in height and width.

13 Adjust the rate of travel of the blowpipe with the filler rod to control the size of the bead and the required penetration/depth of fusion.

- Keep the filler rod end within the flame outer flame to avoid oxidation.
- Stop at the left hand end of the punched line by filling the crater properly.
- Extinguish the flame and cool the nozzle.
- Clean the weld surface. Inspect for even ripples and uniform width/height of weld bead.
- Repeat this for the remaining 4 more punched lines to achieve better manipulation of blow pipe and filler rod.

Practice on non destructive test

Objectives : At the end of this exercise you shall be able to
- **conduct liquid penetrate testing**
- **conduct magnetic particle testing.**

Requirements

Tools/Instruments/Equipments

- Electromagnetic yoke - 1 No.
- Engine block - 1 No.
- Other auto components - as reqd.
- Cylinder head - 1 No.
- Dye penetrant, cleaning cloth and detergent cleaner - as reqd.
- Wire brush, Putty knife - 1 No.

Materials

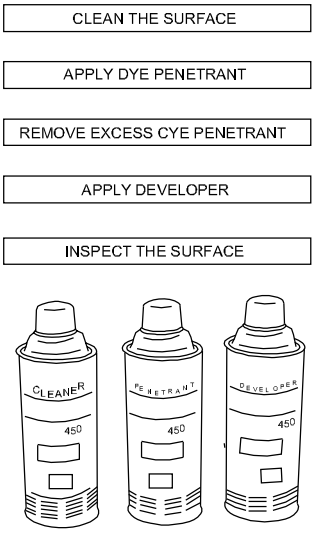
- Iron powder - as reqd.
- Cleaning cloth - as reqd.
- Detergents - as reqd.
- Organic solvents - as reqd.

PROCEDURE

TASK 1 : **liquid penetrate testing**

1 To inspect for cracks, use a dye penetrant, to check the combustion chambers, intake ports, exhaust ports and cylinder block surface. (Fig 1)

Fig 1



The surface must be free of oil, grease, water, or other contaminants that may prevent penetrant from entering flaws.

2 Remove organic oils with cleaner. Remove scale, rust and dirt by using scrach brissle with a putty knife and wire brush. (Fig 2 & Fig 3)

Spray Cleaner/Remover directly on the surface, saturating the contaminants area. Let it remain for about 30 seconds, while organic soils dissolve.

Fig 2

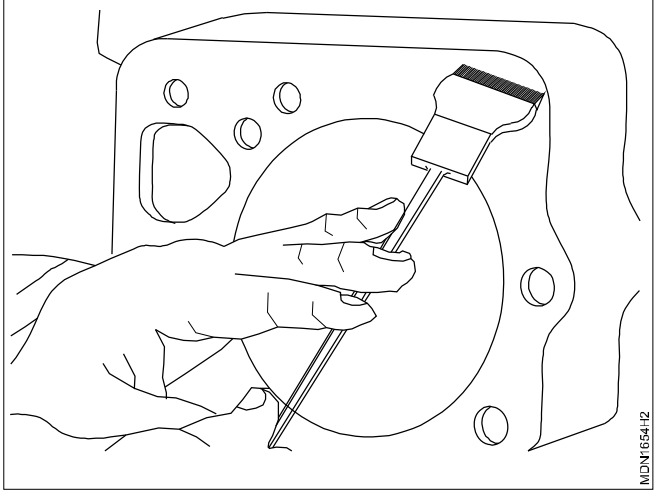
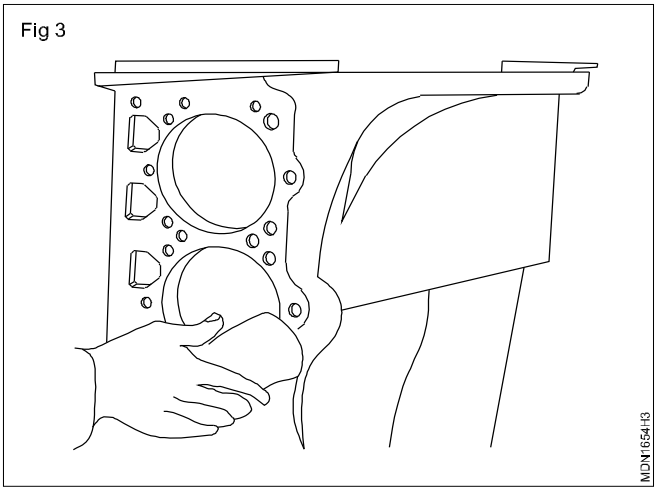


Fig 3



3 Wipe clean with a dry towel or cloth before the Cleaner/ Remover evaporates completely. Repeat until clean.

Important: Following the cleaning process, allow sufficient time for the cleaner/Remover to evaporate completely from cracks or other surface openings before applying Dye penetrant. (Fig 4 & Fig 5)

Fig 4

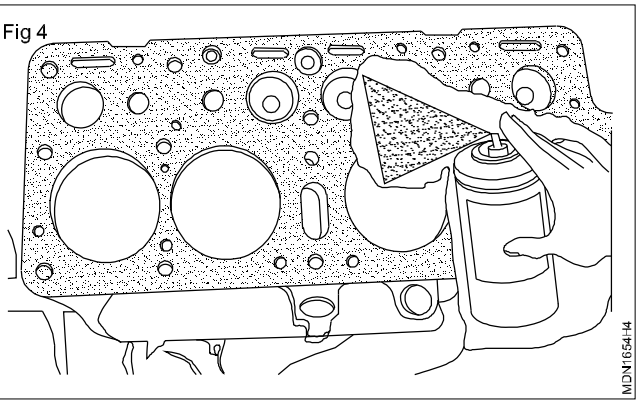
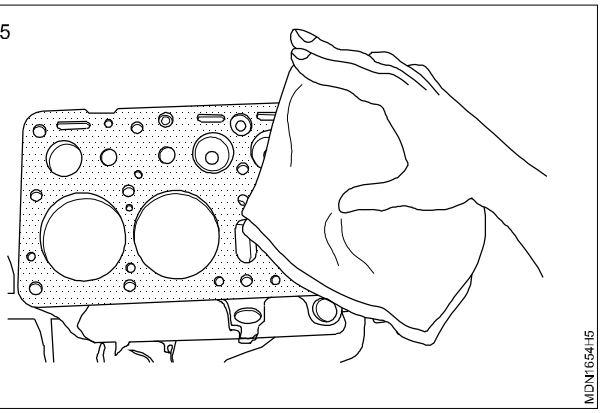
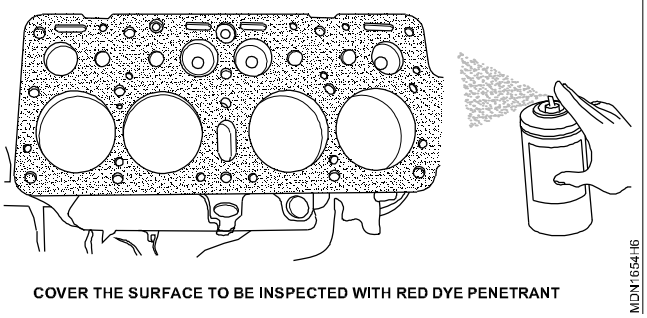


Fig 5



4 Once the surface has been thoroughly cleaned and dried, the apply penetrant material by spraying, brushing, or immersing the part in a penetrant bath. (Fig 6)

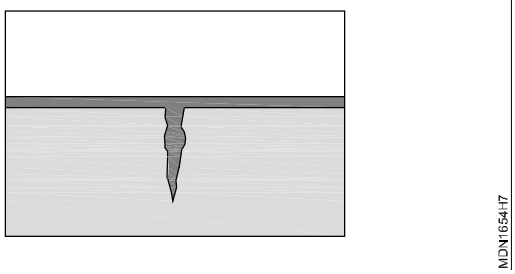
Fig 6



5 Spray dye penetrant on a clean, completely dry surface. Allow it to remain for 5 minutes/10 minutes.

This will allow the dye to penetrate the crack more deeper if especially suspect there are types cracks. (Fig 7)

Fig 7



Dye penetrant is pulled into the crack by capillary force.

After the dye has been given enough time to penetrate the suspected area of defect or cracking, use clean cloths and wipe the area clean of dye as best you can.

6 Use the cloths repeatedly to wipe away the excess dye. Once the test area is free of visible dye,spray the aerosol cleaner on another clean cloth and wipe the test area thoroughly and then let the cleaner evaporate.

Important: Do not spray Cleaner/Remover directly on the surface to remove excess dye penetrant. Doing so risks removing penetrant from flaws.

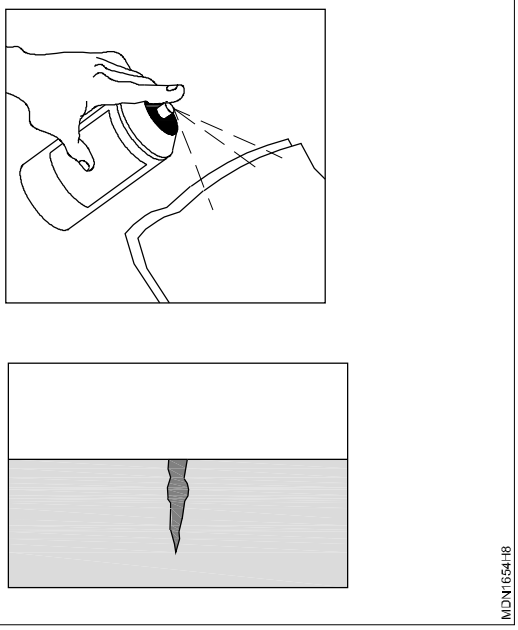
7 Shake the spray vigorously can to restore fully the white developer particle suspension.

8 Spraying is the ONLY recommended method of applying developer.

9 Apply an even, light, slightly damp coating.

The goal is to spray a light, even coat which is slightly damp when it contacts the surface. It should be slightly damp, so the volatile solvent will couple the flaw-entrapped dye penetrant to the powder and speed the penetrant's return to the surface for viewing. (Fig 8)

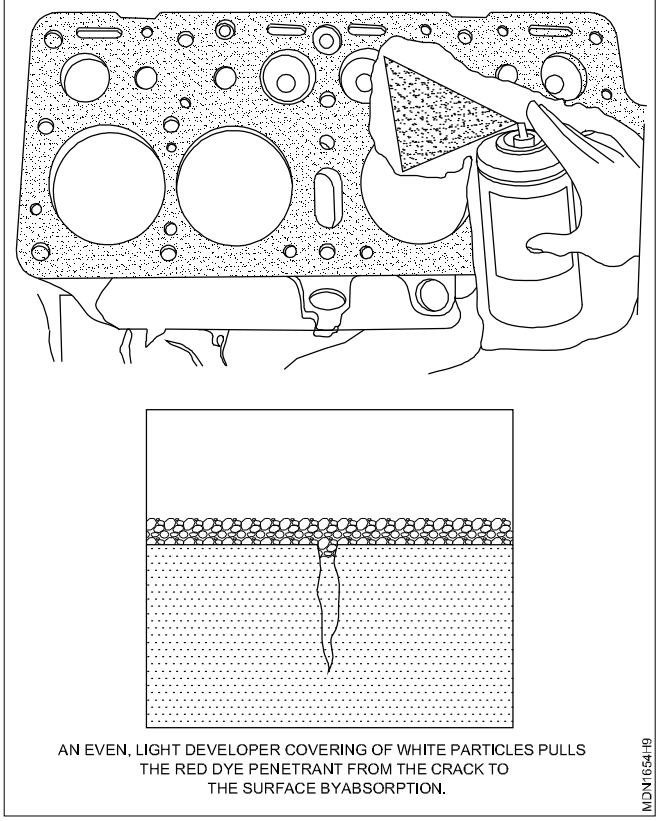
Fig 8



10 Allow the developer for few minutes so that it pulls the red colored dye from the crack (or cracks, in my case.)

A red line, usually a meandering red line, will show the crack or cracks. The red dye and white developer have a very high contrast, making the smallest of cracks easy to see. But if the area looks like a field of snow, your part is good and acceptable for service. (Fig 9 & 10)

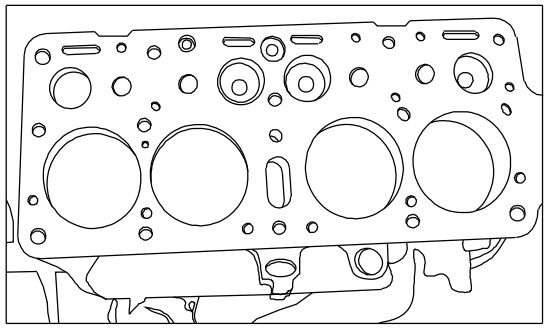
Fig 9



AN EVEN, LIGHT DEVELOPER COVERING OF WHITE PARTICLES PULLS THE RED DYE PENETRANT FROM THE CRACK TO THE SURFACE BYABSORPTION.

MDNT654H9

Fig 10



AFTER THE APPLICATION OF DEVELOPER

MDNT654HA

11 Spray the developer in 2 or 3 light applications, slightly damp on contact from a distance of 8 to 12 inches.

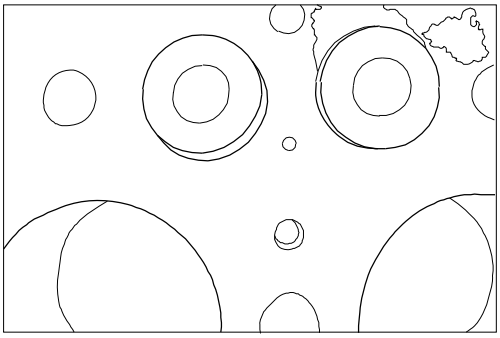
12 Notice the dye being pulled out of the outside center head bolt hole at the top of block. Leave a little extra dye in that bolt hole to show how well the developer can pull out the dye.

13 Allow time for flaw indications to appear completely.

As soon as the developer has dried, indications of flaws (if present) will appear. (Fig 1)

The need for a longer developing time is essential if extremely tight cracks are suspected.

Fig 1



MDNT654J1

14 Observe a vertical crack at the head bolt hole which is running to small water jacket hole above it that is between the valves, and also observe cracks running to the value seat inserts.

It is plain to see that the developer did a good job of pulling the dye out of these cracks so they could be seen.

14 Repair/Replace the part if you observe red lines on it.

15 Remove the white developer powder remaining on the surface before subsequent processing or use of the part. After this final step, the surface is extremely clean and treat the metal to prevent corrosion.

Use respirator pad to avoid direct inhalation of chemicals and vapours.

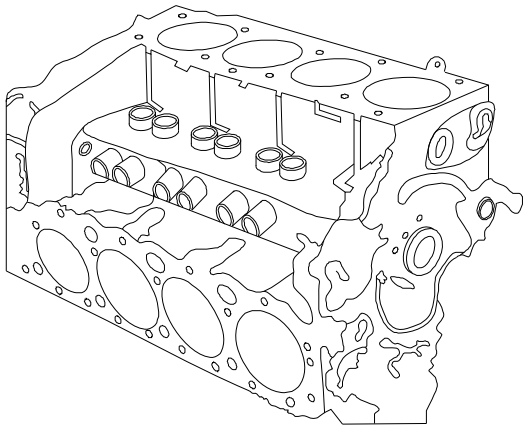
— — — — — — —

TASK 2 : **Magnetic particle testing method**

1 Clean the surface using detergents, organic solvents, de-scaling soloutions, paint removers, sand or grit lasting methods.

Surface preparation by grinding, machining, or other methods may be necessary where surface irregularities could mask the interpretation (Fig 1)

Fig 2



INSPECTION OF ENGINE BLOCK - CLEANING

MDN1654J2

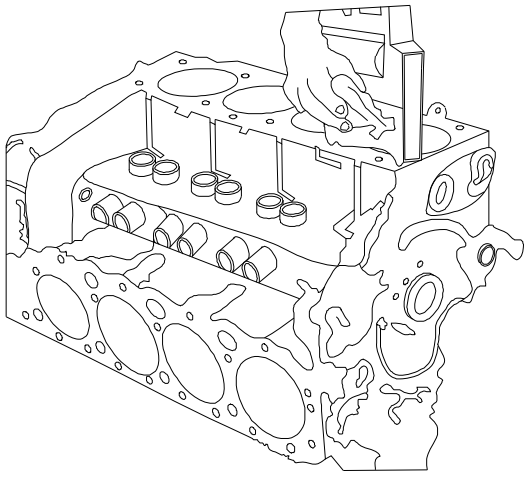
2 Use electromagnetic yoke to magnetization with pole spacing between 3 inches and 8 inches.

Shorter spacing to compensate for the geometry of area being examined. (Leg spacing less than 3 inches (76.2 mm) is not recommended due to the strength of the longitudinal magnetic field at the poles.)

3 Place the Yoke shall be placed in contact with the surface of the Engine block to be examined and energized.

4 Apply the dry particles (Iron Powder) to the area between the poles in one direction as shown in Fig 2. While maintaining the magnetic field .

Fig 3



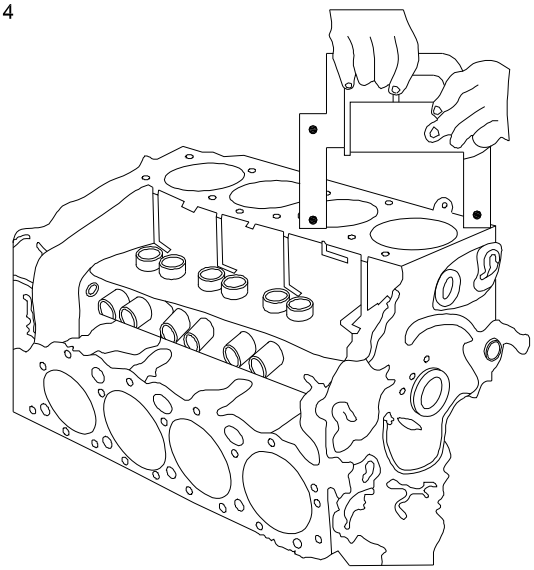
INSPECTION OF CYLINDER BLOCK USING ELECTROMAGNETIC YOKE IN ONE DIRECTION

MDN1654J3

5 Repeat the above procedure for other direction i.e 90 deg opposite to the previous direction as shown in Fig 3.

6 Stop the application of the dry particles and remove the excess of the examination medium before the yoke is de-energized.

Fig 4



INSPECTION OF CYLINDER BLOCK USING ELECTROMAGNETIC YOKE IN 90° TO THE PREVIOUS DIRECTION

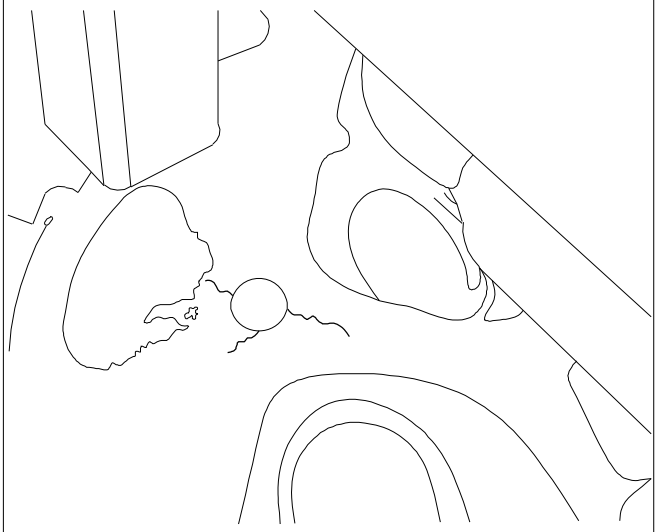
MDN1654J4

Accumulations of excess dry particles in examinations shall be removed with a light air stream from a bulb or syringe or other source of low pressure dry air.

The examination magnetization field shall be maintained while removing the excess particles.

7 Observe for any magnetic particle pattern on the surface of the part (Fig 4). This indicates cracks on the surfaces.

Fig 5



THE ENGINE BLOCK SHOWS A CRACK DURING TESTING

MDN1654J5

8 Demagnetized the part and remove the iron powder from the surface (Fig 5).

Demagnetization is necessary :

To prepare for inspection.

To prevent damage to moving parts.

To prepare for subsequent magnetization.

To prevent instrument interference.

9 Clean the finished parts immediately and dry the parts to prevent the chances of surface corrosion or wear between moving parts.

Identification of hydraulic and pneumatic components

Objectives : At the end of this exercise you shall be able to
- **identify the hydraulic clutch components in a vehicle**
- **identify the components of pneumatic brake system in a vehicle.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.

Equipments

- Hydraulic clutch vehicle - 1 No.
- Pneumatic brake - 1 No.

Materials

- Hydraulic oil - as reqd.
- Cotton waste - as reqd.

PROCEDURE

TASK 1 : **Locating of hydraulic clutch components on a vehicle**

1 Place the vehicle on the level ground.

2 Support the vehicle tyre with stoppers (wooden block)

3 Apply hand brakes.

4 Open the bonnet.

5 Remove the negative battery cable.

6 Trace the hydraulic clutch system and locate the components i.e. Master cylinder reservoir, Master cylinder, Slave cylinder, Hydraulic lines and Throw-cut lever.

7 Identify the parts in the system as shown in Fig 1.

8 Write the name of the parts in the Table 1.

Fig 1

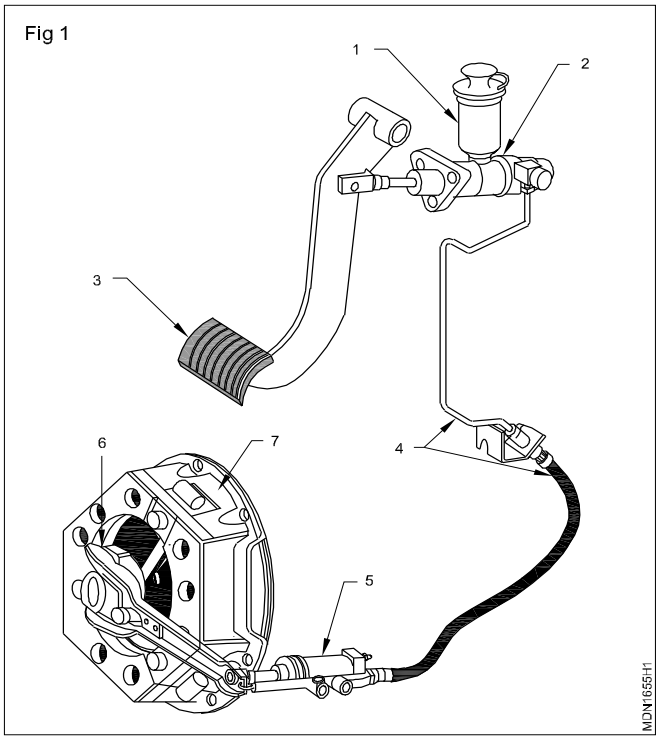


Table 1

Sl. No.	Lable No.	Name of the Parts
1	2	
2	5	
3	4	
4	1	
5	3	

TASK 2 : **Tracing pneumatic components in a vehicle**

1 Identify the air compressor in the Fig. 1 which provide compressed air.

2 Locate air tank , which receives the compressed air from air compressor.

3 Locate unloader valve which unloads excess air, once the set air prssure is reached in air tank.

4 Identify brake valve which permits air to flow, apply brake, when brake pedal is pressed.

5 Locate 2 front braker chambers and 2 rear brake chambers which pushes slack adjuster for application of front & real bracker

6 Locate black adjusters , for front & rear braker.

7 Layout diagram of air braker system.

8 Identify air pressure gauge, which indicated the pressure of air, in the air tank.

9 Write the parts in the table - 2

Fig 1

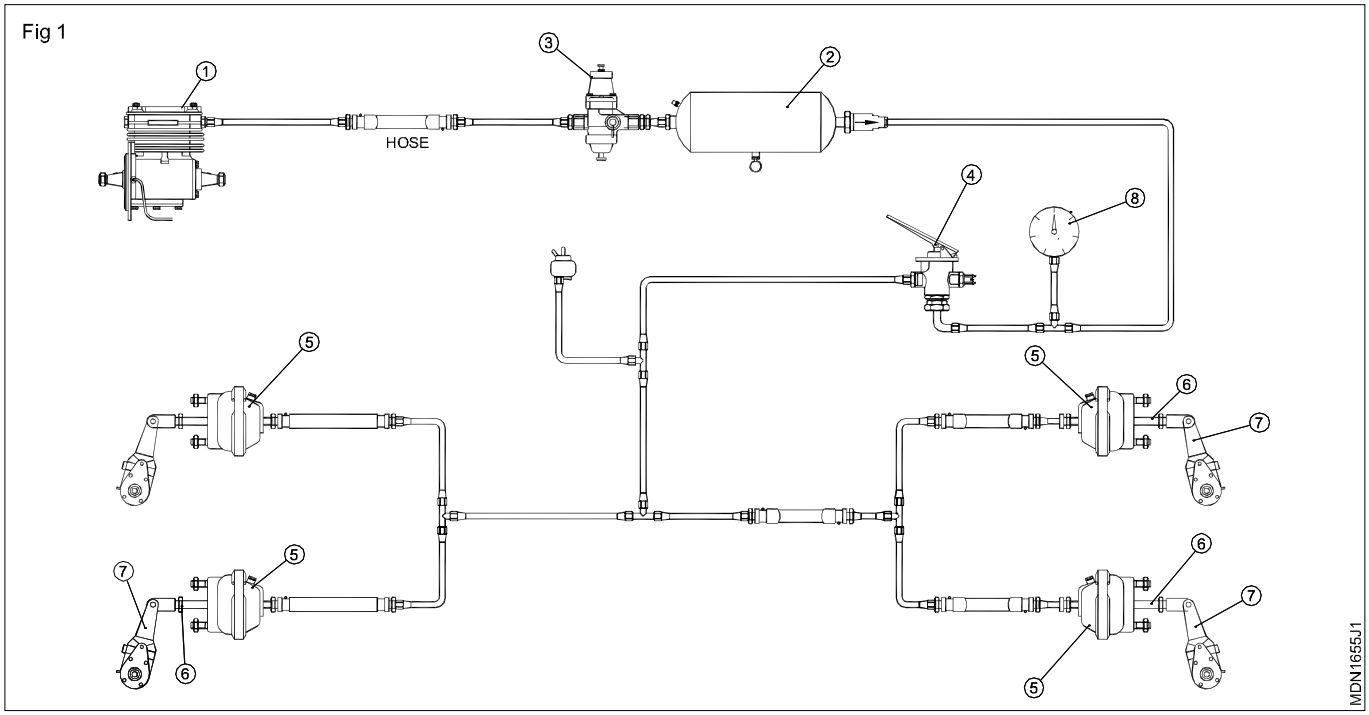


Table - 2

Sl. No.	Name of the Parts	Location
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

— — — — — — —

Tracing and Studying of hydraulic circuits

Objectives : At the end of this exercise you shall be able to
- **identify the parts of hydraulic jack,**
- **identify the parts of hydraulic power steering**
- **identify the parts of hydraulic brake**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 Set.
- Bleeding kit - 1 No.

Equipments

- Hydraulic jack trolley type - 1 No.
- Hydraulic power steering in vehicle - 1 No.
- Hydraulic brake in vehicle - 1 No.

Materials

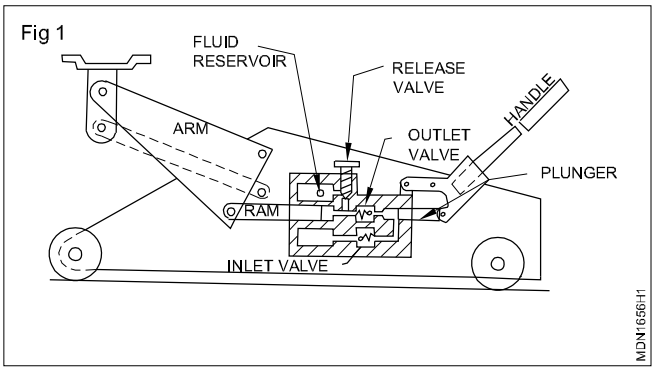
- Cotton waste - as reqd.
- Hydraulic fluid - as reqd.

PROCEDURE

TASK 1 : **Hydraulic jack**

1 Place the cut section model of the hydraulic jack on the work bench. (Fig 1)

Fig 1



2 Trace the hydraulic jack system and locate the components i.e, re servoier, plunger, Non return valve Ram, Relief valve and shut off valve,

3 Identify the parts in the system as shown in Fig 1

4 Write the name of the parts in the table 1

5 The following parts should be matched as given below column (a), arm (b), fluid reservoier (c), Release valve (d), out let valve (e) handle (f) plunger (g) & Inlet valve (h).

Table 1

Sl. No.	Lablel word	Name of the parts
1	f	
2	d	
3	b	
4	g	
5	e	
6	a	
7	c	

— — — — — — — —

TASK 2 : **Tracing and Identify the hydraulic components in power assisted steering**

1 Place the cut-section model of the hydraulic power assisted steering (PAS) on the work bench.

2 Draw the line diagram of hydraulic power assisted steering system

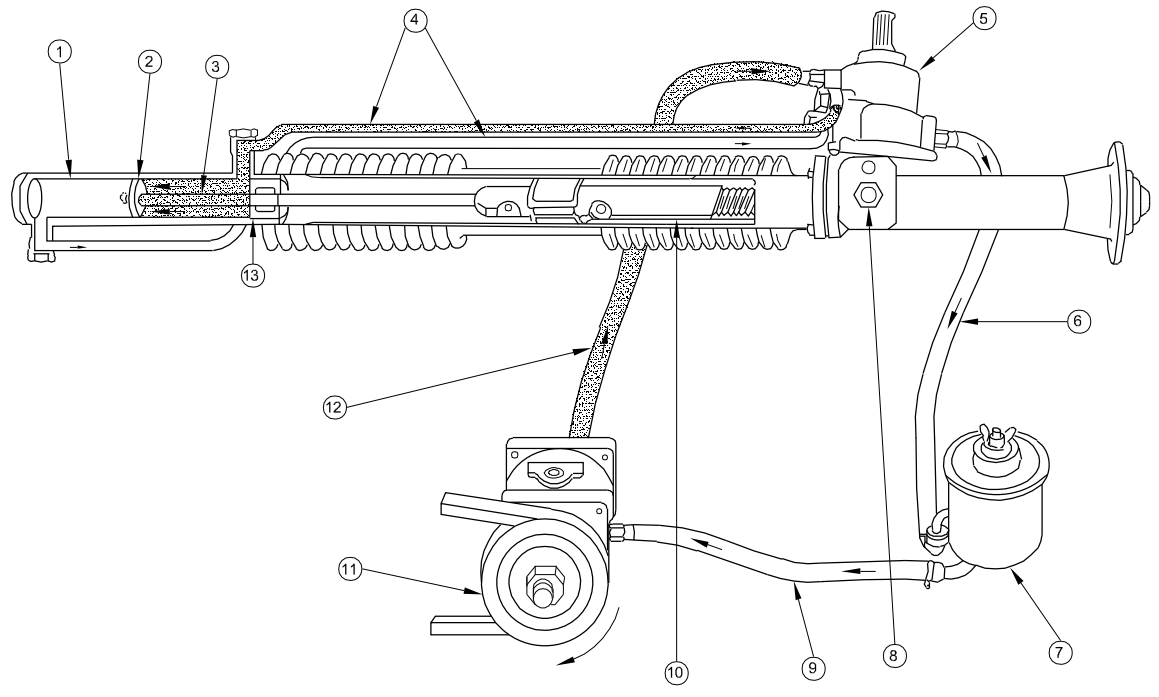
3 Locate the parts of the hydraulic power assisted steering system (Fig 1) i.e. Suction line, Hose, Seal mount with sealing ring, Cylinder, Piston rod, Steering gear, Return line, Piston, Pressure pad adjusting screw, High pressure pump, Rack and Pressure lines

4 Write the name of the parts in the Table 1.

Table 1

Sl. No.	Lablel No.	Name of the parts
1	2	
2	5	
3	4	
4	1	
5	3	
6	11	
7	6	
8	9	
9	12	
10	7	
11	10	
12	13	
13	8	

Fig 1



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TASK 3 : **Identify the components of the hydraulic brake system**

1 Place the cut-section model of the hydraulic brake system on the work bench.

2 Draw the line diagram of hydraulic brake system.

3 Locate the parts of the hydraulic brake system (Fig 1) and drum braking system. (Fig 2 & 3) i.e.Brake pipe line unions, Brake push-rod, Brake flexible hoses, Brake pedal return spring, Master cylinder, Hold down spring, Brake lining, Brake steel pipe lines, Brake adjuster, Shoe return spring, Stop light switch,Hand brake lever, Pivot, Brake plate carrier, Wheel cylinder, Parking brake cable, Brake shoe, Brake pedal, Lock nut and Clevis.

Fig 1

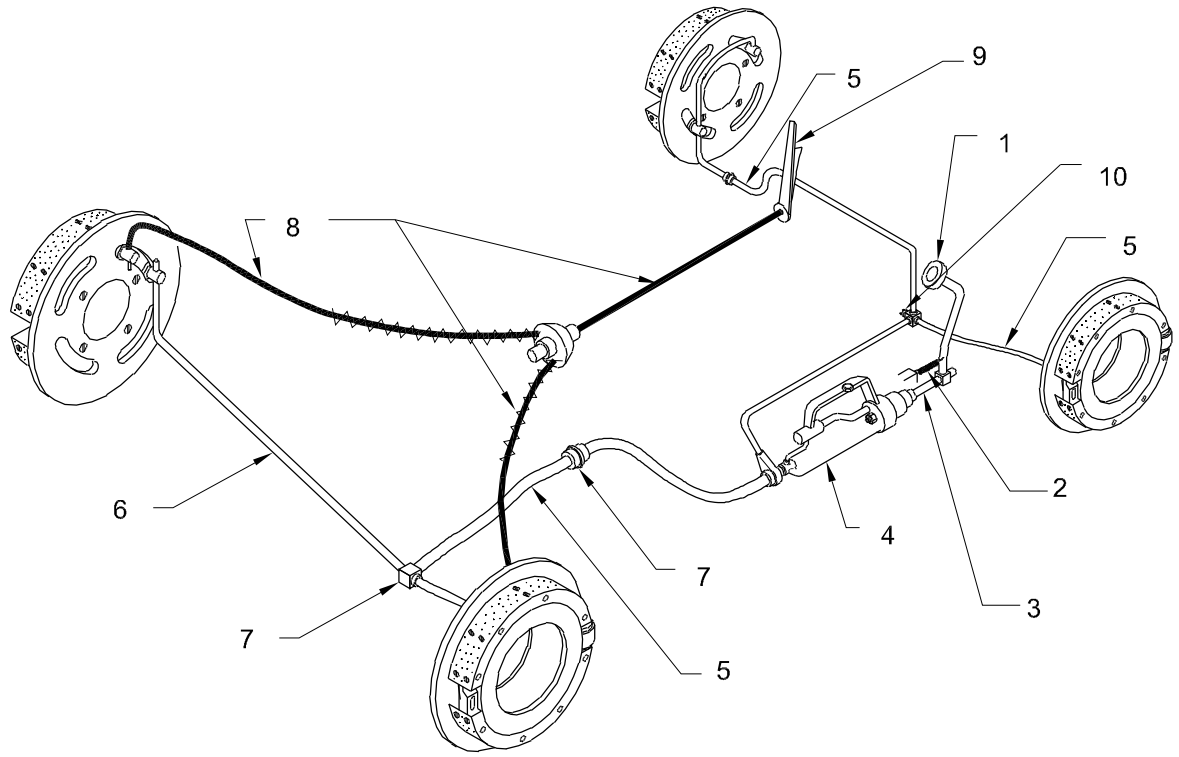


Fig 2

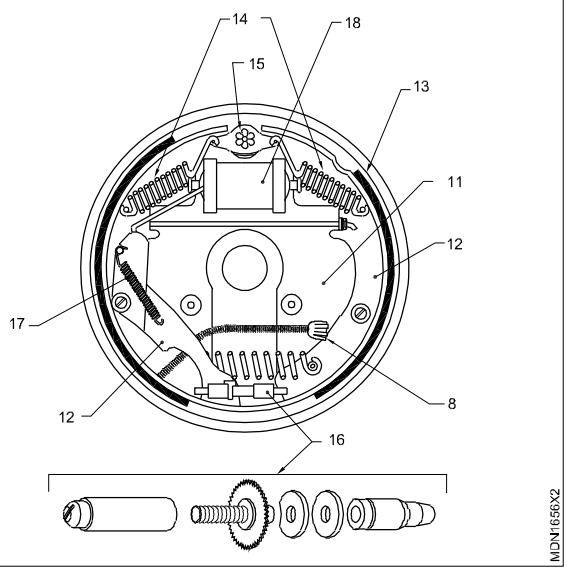
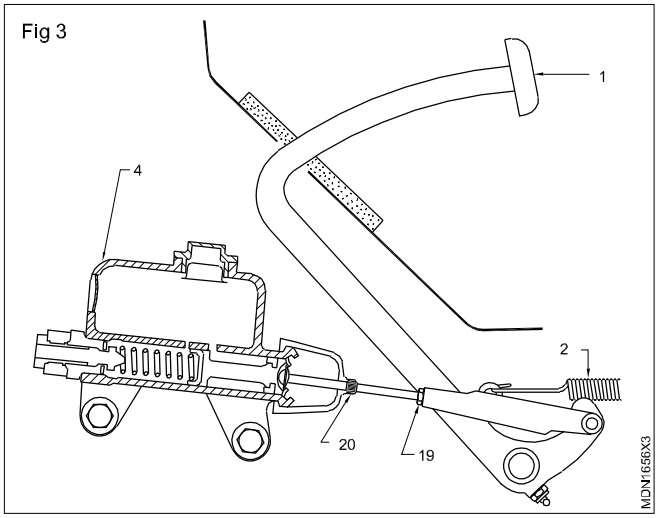


Fig 3



4 Write the name of the parts in the Table 1.

Table 1

Sl. No.	Lable No.	Name of the Parts
1	2	
2	5	
3	4	
4	1	
5	3	
6	11	
7	15	
8	17	
9	12	
10	18	
11	14	
12	19	
13	6	
14	20	
15	7	
16	9	
17	13	
18	8	
19	10	
20	15	

Tracing and studying of air brake system

Objectives : At the end of this exercise you shall be able to
- **identify the components of pneumatic brake system in a vehicle.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 Set.

Equipments

- Vehicle with air brake system - 1 No.

Materials

- Cotton waste - as reqd.

PROCEDURE

1 Locate the parts of the pneumatic brake system. Air tank, air compressor, unloader valve service reserviors, protective valve or brake valve, hand control valve brake chamber, air union.

2 Write the name of the parts in the Table 1.

Fig 1

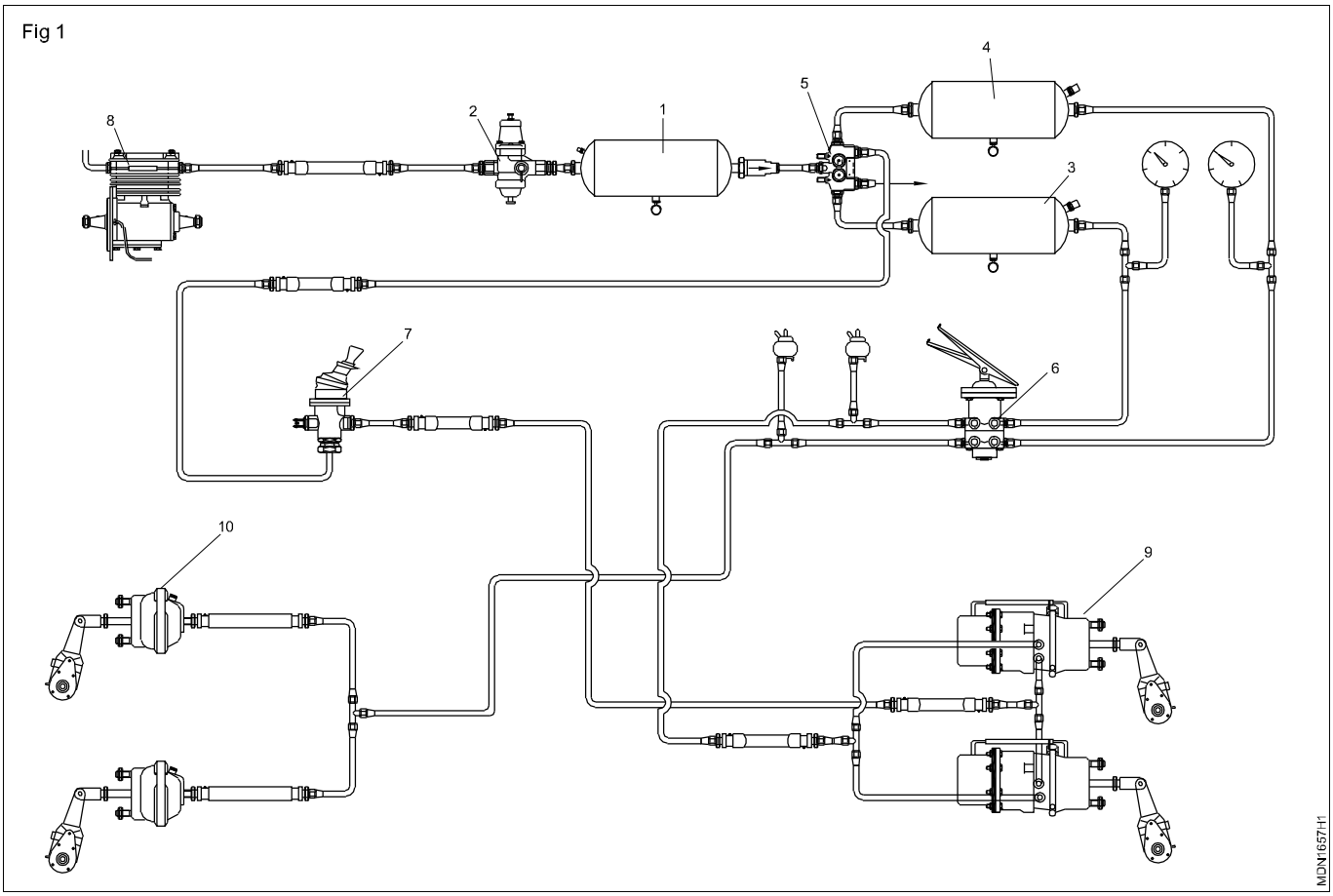


Table 1

Sl. No.	Lable No.	Name of the Parts
1	2	
2	5	
3	4	
4	1	
5	3	
6	6	
7	7	
8	9	
9	10	
10	8	

Identify the different types of vehicle

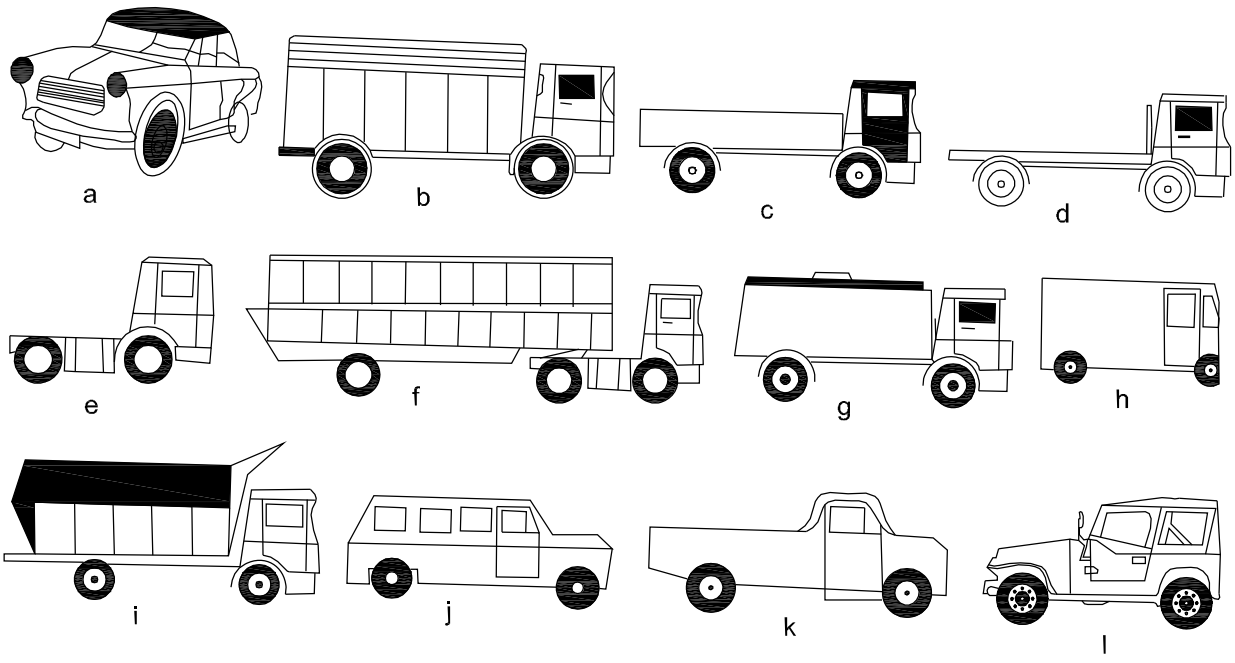
Objective: At the end of this exercise you shall be able to
- **identify the different types of vehicle.**

PROCEDURE

1 Locate the type of vehicle name. (Fig 1)

a) Car b) Truck punjab body or straight truck c) Truck half body d) Truck Flat form type e) Tractor f) Tractor with articulated trailer g) Tanker h) delivery van i) Dumper truck j) Station wagon k) Pick up l) jeep

Fig 1



2 Write the name of the parts in Table 1.

Table 1

Sl.No.	Match word	Vehicle name	Sl.No.	Match word	Vehicle name
1	b		11	i	
2	a		12	f	
3	e				
4	d				
5	c				
6	g				
7	h				
8	l				
9	k				
10	j				

Studying vehicle specification data

Objectives : At the end of this exercise you shall be able to
- **identify the parts of the vehicle**
- **check the specification of the parts as per vehicle specification data.**

Requirements

Tools/Instruments

• Trainee's tool kit	- 1 No.
• Compression gauge	- 1 No.
• Measuring tape	- 1 No.
• Vacuum gauge	- 1 No.
• Bore dial gauge	- 1 No.
• Hydro meter	- 1 No.
• Voltage tester	- 1 No.

Equipment

• Vehicle	- 1 No.

Materials

• Cotton waste	- as reqd.
• Engine oil	- as reqd.
• Hydraulic fluid	- as reqd.

Note : Instructor demonstrate of vehicle specification

Mahindra Balero GLX

Engine	XD-3PF IDiesel
Type	4-stroke oversquare, 4-cylinder, in line
Bore	94.0 mm
Stroke	90.0 mm
Cubic Capacity	2498 cc
Compression Ratio	23 : 1
Max. Gross Power	72.5 hp at 4000 R.P.M. (DIN 70020)
Max. Gross Torque	15.3 kg-m at 2000 R.P.M
Fuel Injection System	Distributor pump
Weight of Engine (dry)	200 kg with flywheel and starter
Cooling System	By Belt driven pump on cylinder head, thermostat controlled
Transmission	5-speed,All synchromesh
Ratios	1st Gear : 4.03 :1 2nd Gear : 2.39 :1 3rd Gear : 1.52 :1 4th Gear : 1.00 :1 5th Gear : 0.84 :1 Reverse : 3.76 :1
Transfer Case	For 4WD only
Ratios	High - 1 : 1, Low - 2.48 :1
Suspension	
Front	2WD : Independent, Coil Spring, Double acting telescopic shock absorber and anti roll bar
	4WD : Semi-elliptical leaf type,stabilizer bar at front
Rear	Semi-elliptical leaf type
Frame	Rectangular tubular section 5 intermediate cross members (6 for IFS). Rear bumper
Steering	Power steering - worm & roller type with universal joints
Turning Radius	5.4 mts.
Clucth	Hydraulic, single dry plate 235mm (9.25" dia)
Brakes	
Type	Hydraulic with tandem master cylinder with vacuum assisted servo
Front	13 mm disc and calliper type
Rear	Drum : 27.4 x 50.8 mm (11" x 2")
Parking	Internal expanding type on rear wheels.Hand lever and cable type.
Axle	
Front	IFS-2WD: Stub Axle 4WD : Full flating hypoid type
Capacity/Ratio	1000 kg / 4.88 : 1
Rear	Full floating hypoid type

Capacity/Ratio	1700 kg / 4.88 : 1
Electricals	
Battery	12 volts, negative earth
Capacity	70 amp. hr
Alternator	65 amp. with built-in regulator and vacuum pump
Drive	Belt drive
Wheels and Tyres	
Wheels	Rim size 6J x 15
Tyre	P215 / 75 R 15 radial
Fuel System	
Capacity	60 litres fitted with electrical float unit
Weights	
Kerb weight	1615 kg (2 WD) 1695 kg (4 WD)
G.V.W.	2200 kg (2 WD) 2280 kg (4 WD)

Identify the vechicle parts and check the specification of parts under guide line of instructor

— — — — — — —

Identification of Vehicle Information Number (VIN)

Objectives : At the end of this exercise you shall be able to
- **identify the vehicle of identification number specification**

Requirements

Tools/Instruments
- Measuring Tape - 1 No's.

Equipments
- Car - 1 No.

Materials
- Cotton waste - as reqd.
- Paper - as reqd.
- Pencil - 1 No.
- Eraser - 1 No.

General information for VIN

Vehicle Identification Number (VIN) is composed of 17 digits and classified into three large groups such as WMI, VDS and VIS. Example:- MALBB5 IBC AMI 73752

	Digt	Passenger Car	MPV	BUS
WMI	1	Geographic Zone		
	2	Manufacturer		
VDS	3	Vehicle Type		
	4	Series		
	5	Body Style and Version		
	6	Body Type		
	7	Restraint System	GVWR	Brake System
	8	Engine Type		
	9	Check Digit / Drive Side		
VIS	10	Model Year		
	11	Plant of product		
	12-17	Serial number		

- WMI: World Manufacturer Identifier
- VDS: Vehicle Descriptor Section
- VIS : Vehicle Indicator Section
- MPV: Multipurpose Passenger Vehicle (Ex : MPV,SUV,RV)
- GVWR : Gross Vehicle Weight Rating

Note: Vehicle code may be vary depend upon manufactuer

Check the VIN number in your institute vechicle under guide line of instructor.

- Place a car in a plain ground
- Apply hand brake and chock the wheels
- Identify the location of VIN number in your vechicle
- Note the VIN Number of your vehicle on plain paper
- Decode the VIN Number details as per the manufactures general informations

Studying of garage service equipments

Objectives : At the end of this exercise you shall be able to
- **operate the air compressor**
- **operate the hydraulic car hoist**
- **operate a car washer**
- **operate the mechanical/hydraulic jack and jack stand**
- **operate a grease gun**
- **operate an oil spray gun**
- **operate the mechanical press**
- **operate the hydraulic press**
- **operate the two post car hoist**
- **operate the four post car lift**
- **operate the engine hoist.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No's
- Measuring Tape - 1 No's.

Equipments

- Car - 1 No.
- Air compressor - 1 No.

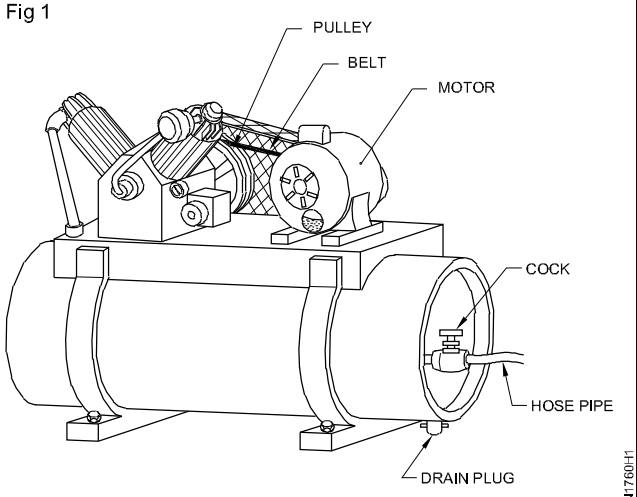
Materials

- Cotton waste - as reqd.
- Soap oil - as reqd.

PROCEDURE

Air compressor (Fig 1)

Fig 1



AIR COMPRESSOR

1 Check the oil level.

2 Check the belt's(1) tension connecting the motor(2) and the compressor's pulley(3).

3 Ensure that the belt guard is fixed in its position.

4 Drain the water through the drain plug (4) and tighten the drain plug.

5 Inspect the electrical connections visually for looseness, disconnections or cuts.

6 Switch 'on' the compressor

7 Observe the sound of the compressor. If any abnormal sound is found, stop the compressor immediately. (Consult your instructor)

8 Switch 'off' the compressor.

9 Hold the hose-pipe (5) and open the cock (6). Use compressed air wherever needed.

10 Close the cock after using the compressed air.

Skill Sequence

Hydraulic car hoist

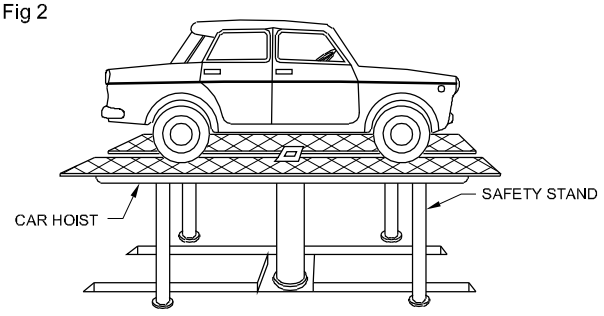
Objectives: This shall help you to
- **operate service station equipments**

Hydraulic car hoist (Fig 2)

Park the vehicle in the centre of the car hoist.

Clamp the front and rear axle or check wheels.

Fig 2



HYDRAULIC CAR HOIST

Open the air cock gradually and observe that the car hoist(1) is moving upwards.

Close the cock when it reaches the required height.

Provide safety stands(2)underneath the hoist. Open the outlet cock slowly so that the vehicle moves down without jerk. Ensure that the hoist side rail sits firmly on the stand.

After finishing the required job, slightly open the inlet cock and raise the car hoist slightly up. Close the inlet cock.

Remove the safety stands.

Ensure that nobody is present underneath the vehicle.

Open the outlet cock slowly so that the hoist comes down without disturbing the vehicle's position.

Remove the clamps/chocks and remove the vehicle from the hoist.

Car washer

Check the oil level.

Check the belt tension.

Check the belt guard for its position.

Inspect the electrical connection visually for looseness, disconnections or cuts.

Open the water tank.

Check the water level.

Hold the gun before starting the car washer.

Switch 'ON' the car waher and adjust the pressure gauge for the required pressure.

Open the water gun.

Check the water jet and adjust for force and spray at an angle to body panel.

After completing the cleaning, stop the car waher.

Close the water intake cock (water supply).

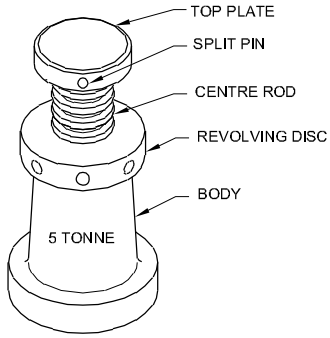
Mechanical jack (Fig 3)/Hydraulic jack (Fig 4)

Park the vehicle on level ground.

In case of jacking up the front anxle, chock the rear wheels and vice versa.

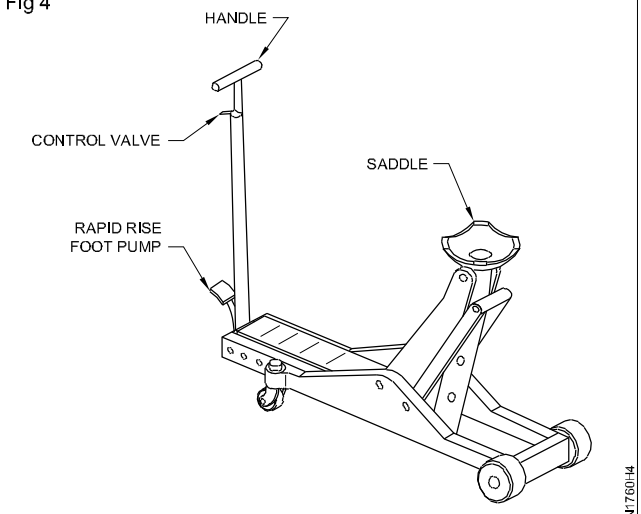
Check the free movements of threads in a mechanical jack by hand and in the hydraulic jack. Check the oil level and its operations.

Fig 3



MECHANICAL JACK

Fig 4



HYDRAULIC JACK

Place the jack under the vehicle in specified place.

Rotate the screw gradually with the jack lever and lift the vehicle and in the case of hydraulic jack move the jack's lever slowly so that the axle jacks up without any jerk.

Place the suppor/horses below the chassis frame/axle.

Lower down the jack and remove it.

After completing the specific job jack up again.

Remove the support/horses.

Lower down the jack and remove it.

Safety:

1 Never work under a vehicle supported only by a floor jack.

2 Lift saddles must be properly located and in secured contact.

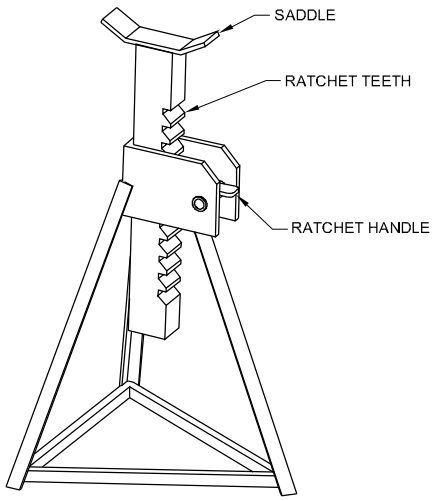
3 Always check for equipments, parts or personnel beneath the car before lowering.

Jack stand (Fig 5)

The height of the jack stand is adjusted by the ratchet adjustment.

Stands must be properly and securely placed.

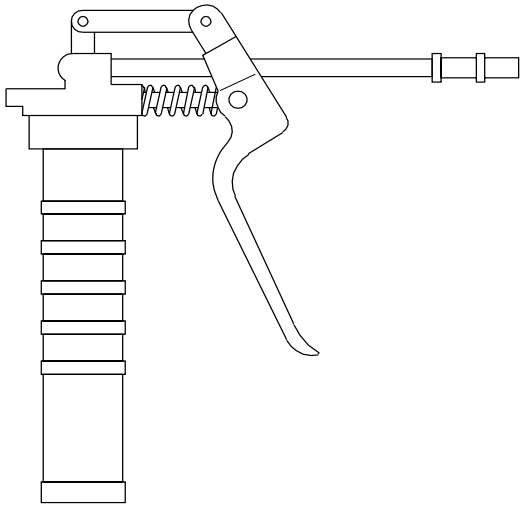
Fig 5



TYPICAL ADJUSTABLE JACK STAND

Grease gun (Fig 6)

Fig 6



GREASE GUN

Select the grease gun nipple accoring to the vehicle. (Consult your instructor)

Check visually, the grease nipple holder for any damage.

Fill up the gun with the specified grease.

Close the grease gun and operate the lever till the grease comes out continuously from the nipple with pressure.

Use the gun for the required purpose.

Oil spray gun

Check visually the oil spray gun nozzle, nozzle holder, operating lever, air hose for any damage.

Fill the spray gun with SAE20W/40 and kerosene mixture in the ratio of 1:20.

Connect the oil spray gun to the quick release coupler.

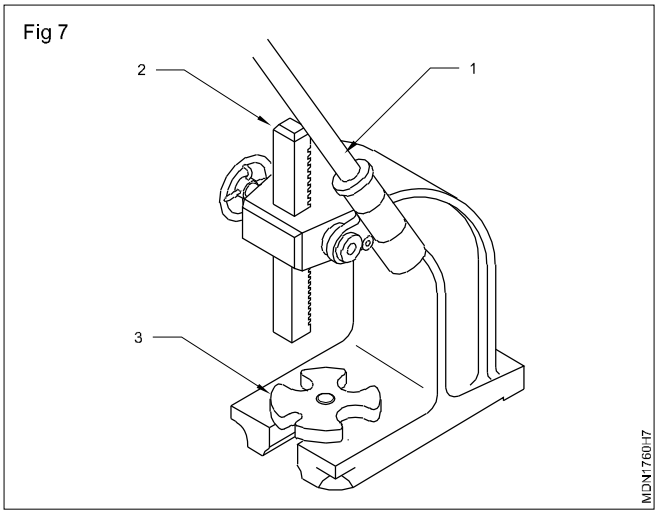
Operate the oil spray gun.

See that the oil is sprayed at pressure and spray over panel joints and moving part only.

Close the air-hose connections and takeout the oil spray gun.

Arbor press (Fig 7)

Fig 7



Check for easy movement of the operating lever(1) and rack if necessary lubricate.

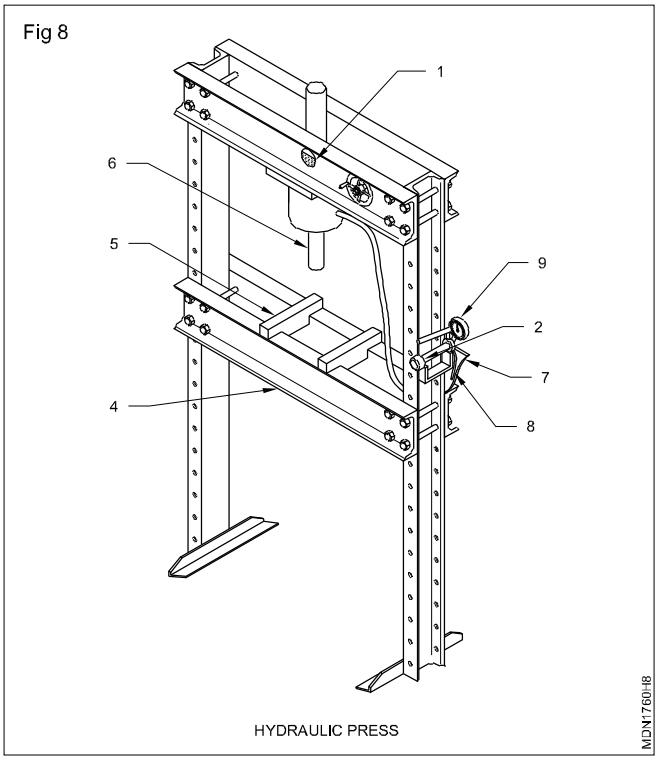
Select the plate(3)according to the work.

Place the component on the plate.

Press the work slowly and listen for abnormal noise.

Hydraulic press (Fig 8)

Fig 8



HYDRAULIC PRESS

Clean the press.

Check the oil level(1) if necessary topup with hydraulic oil

Check the hydraulic press for its free function and leakage

Lock the cylinder plunger releasing knob(2).

Adjust the bed(4) to the required height so that, after placing the job, there will be 100mm clearance between the

plunger(6) and the bed(4).

Align the anvil(5) according to the job.

Place the job on the anvil(5).

Select the distance piece in such a way that while pressing the shaft/bush, it does not touch the body (minimum 10mm gap to be given between the plunger(6) and the distance piece)

Place the distance piece on the shaft/bush. Ensure that it does not touch the body.

Operate the low pressure lever(7) and make the plunger(6) to have a contact on the job,

Operate the heavy pressure lever(8), observe the load on the gauge(9) and the job simulaneously. Ensure the job comes out gradually.

If the load exceeds more than the specified limit, stop the pressing.

Safety

1 Shield brittle parts such as bearings to protect against flying parts.

2 After finishing the work loosen the plunger releasing knob(2).

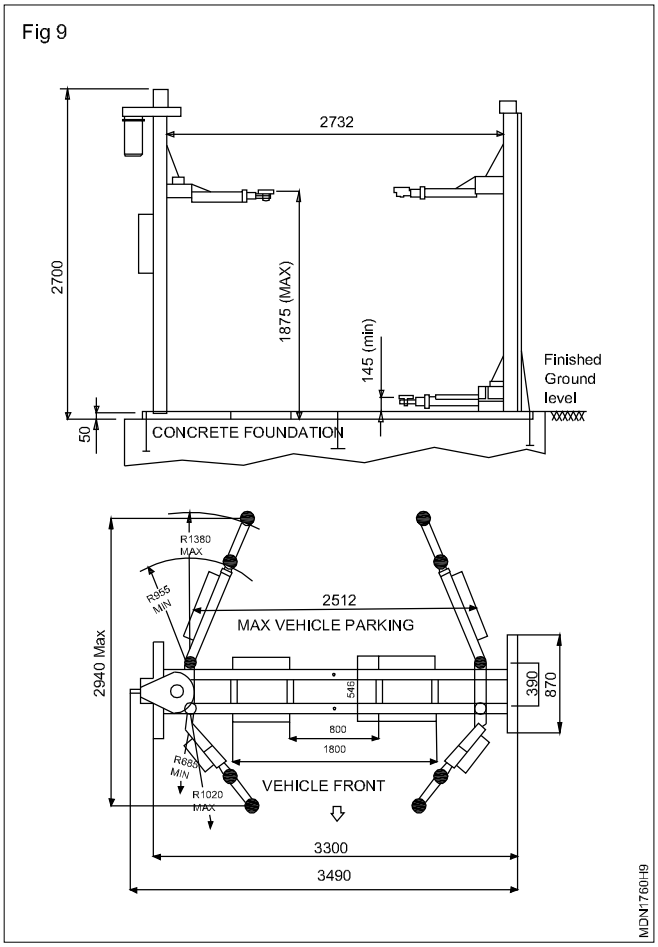
3 Remove the job and clean.

Two post lift hoist

1 Park the vehicle in the centre of the electro mechancial.

2 Adjust and fix the telescopic two post lift lifting arm.

Fig 9



3 Use the automatic arms locking and releasing device while lifting and lowering.

4 Set safty mechanism to prevent uneven lifting.

5 Use the extra safty nut.

6 Check the chain drive and operatethe lifting switch.

7 Use the anchoring bolts for safty. (Fig 9).

Four post lift

1 Drive the vehicle on the leveled ramp of the four post lift.

2 Check the vehicle parked correctly are not on the romp & use wooden block as a stoper

3 Check the vehicle door & glases are closed & pull up hand brake lever of vehicle.

4 Drive the hydraulic cylinder in stable & lowering.

5 Offering pull range mechanical protection by using safety block

6 Connected by using steel cables, Forced synchronized movement of the lift in order to effectively prevent the sloping of the vehicle

7 4 Ton with extended run way length for LCV & Bigger vehicle.

Fig 10

Engine hoist

1 Keep the vehicle on level ground.

2 If firm ground is not there use big wooden block under the base of hoist.

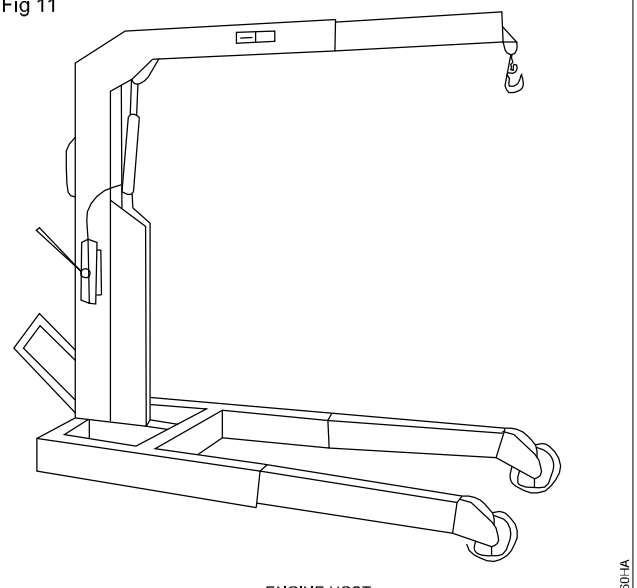
3 Pull up hand brake lever of vehicle.

4 Place the hoist on firm ground & fix a rope to such part of engine.

5 Lift the hoist slowly till free from the vehicle.

6 Slowly role the wheel hoist and lake hoist to work shop. (Fig 11)

Fig 11



ENGINE HOST

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