MECHANIC TWO & THREE WHEELER

NSQF LEVEL - 3

TRADE PRACTICAL

SECTOR: AUTOMOTIVE

(As per revised syllabus July 2022 - 1200 Hrs)

Directorate General of Training

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

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

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

Sector : **Automotive**

Duration : **1 Year**

Trade : **Mechanic Two & Three Wheeler - Trade Practical - NSQF LEVEL - 3 (Revised 2022)**

Developed & Published by

National Instructional Media Institute
Post Box No.3142
Guindy, Chennai - 32
INDIA
Email: chennai-nimi@nic.in
Website: www.nimi.gov.in

First Edition : July 2022 Copies : 500

Rs.300/-

FOREWORD

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

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Mechanic Two & Three Wheeler - Trade Practical - NSQF Level - 3 (Revised 2022) in Automotive Sector under Annual Pattern.** The NSQF Level - 3 (Revised 2022) 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 - 3 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 3 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these Instructional Media Packages IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

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

Jai Hind

SHRI. ATUL KUMAR TIWARI., I.A.S.,

Secretary

Ministry of Skill Development & Entrepreneurship

Government of India.

New Delhi - 110 001

PREFACE

The National Instructional Media Institute (NIMI) was established in 1986 at Chennai by then Directorate General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under 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.

In order to perform the skills in a productive manner instructional videos are embedded in QR code of the exercise in this instructional material so as to integrate the skill learning with the procedural practical steps given in the exercise. The instructional videos will improve the quality of standard on practical training and will motivate the trainees to focus and perform the skill seamlessly.

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

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

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

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

Chennai - 600 032 **EXECUTIVE DIRECTOR**

ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisations to bring out this Instructional Material **(Trade Practical)** for the trade of **Mechanic Two & Three Wheeler - NSQF Level - 3 (Revised 2022)** under **Automotive** Sector for ITIs.

MEDIA DEVELOPMENT COMMITTEE MEMBERS

Shri. S. Devakumar	-	Principal (Retd), Govt.I.T.I. Nettapakkam - Pondicherry.
Shri. A . Thangavelu	-	Asst.Training officer (Retd), Govt.I.T.I. Guindy, Chennai -32.
Shri. P.N. Sivakumar Rav	-	Asst. Training Officer, Govt. I.T.I, Chengalpattu.
Shri. A. Muthuvel	-	Junior Training Officer, Govt. I.T.I, Nagapattinam.
Shri. N. Bharath Kumar	-	Junior Training Officer, Govt. I.T.I, Ulundurpet.
Ms. G. Pavithra	-	Junior Training Officer, Govt. I.T.I, Sankarapuram.

NIMI - CO-ORDINATORS

Shri.Nirmalya nath	-	Deputy General Manager, NIMI- Chennai - 32.
Shri. S.Gopalakrishnan	-	Assistant Manager, NIMI - Chennai -32.

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 Course of the **Mechanic Two and Three Wheeler** 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 - 3 (Revised 2022) syllabus are covered. This manual is divided into Ten modules.

Module 1	Workshop Safety Practice
Module 2	Basic Workshop Practice
Module 3	Basic Electrical and Electronics
Module 4	Manufacturing Process
Module 5	Hydraulics and Pneumatics
Module 6	Engine Overview
Module 7	Steering and Suspension System
Module 8	Brake and Transmission System
Module 9	Ignition and Lighting System
Module 10	Emission Control and Electrical Vehicle

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 Course of the **Mechanic Two and Three Wheeler** Trade. The contents are sequenced according to the practical exercise contained in NSQF LEVEL - 3 (Revised 2022) 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.

CONTENTS

Exercise No.	Title of the Exercise	Learning Outcome	Page No.
	Module 1 : Safety workshop practice		
1.1.01	Identify the machines/equipments installed in the trade		1
1.1.02	**Practice on safety signs and personal protective equipments (QR code Pg.No.3)***		3
1.1.03	Practice on of workshop toolls and equipments		6
1.1.04	Practice to handling and testing of lifting equipment	1	8
1.1.05	**Demonstrate on human health and safety (QR code Pg.No.10)***		10
1.1.06	Practice on occupational safety and first aid		11
1.1.07	**Practice to use the fire extinguishers (QR code Pg.No.17)***		17
1.1.08	**Determine the energy consumption (QR code Pg.No.19)***		19
	Module 2 : Basic workshop practice		
1.2.09	Marking practice on the given job		22
1.2.10	**Layout and marking (QR code Pg.No.27)***		27
1.2.11	Practice to measure wheel base by using tape and plumb bob		32
1.2.12	**Remove wheel nut by using impact wrench (QR code Pg.No.34)***		34
1.2.13	**Practice on handling general workshop tools (QR code Pg.No.35)***	2	35
1.2.14	Practice on use of nuts, bolts & studs		43
1.2.15	**Removing broken stud/Bolt from blind hole (QR code Pg.No.47)***		47
1.2.16	Practice on using various cutting tools		48
1.2.17	**Practice on hacksawing and filing (QR code Pg.No.56)***		56
1.2.18	Practice on filing and drilling	3	57
1.2.19	Safety precautions while using drilling machine		63
1.2.20	Practice on forming internal and external threads		64
1.2.21	Cutting the external thread on a bolt/studs by using dies		68
1.2.22	Practice on reaming a hole		69
	Module 3 : Basic Electrical & Electronics		
1.3.23	Practice on crimping and soldering of wires		73
1.3.24	Construct the simple electrical circiut		77
1.3.25	Practice on measuring electrical parameters in circuits	4	78

Exercise No.	Title of the Exercise	Learning Outcome	Page No.
1.3.26	Practice on continuity test		80
1.3.27	Perform the electrical circuits by using Ohm's Law		83
1.3.28	Test voltage drop in a circuit	5	86
1.3.29	**Cleaning and top - up of lead acid battery (QR code Pg.No.88)***		88
1.3.30	**Charge the battery (QR code Pg.No.90)***		90
1.3.31	Practice parasitic battery drain test	6	93
1.3.32	Test the power and signal connectors		95
1.3.33	Identify and check different types of diodes		99
1.3.34	Practice to inspection & assembling the bridge rectifier/regulator		102
1.3.35	Identification and checking transistor	7	103
	Module 4 : Manufacturing Processes		
1.4.36	Practice on gas welding	8	107
	Module 5 : Hydraulics & Pneumatics and Classification of vehicle		
1.5.37	Identify hydraulic clutch components		114
1.5.38	Practice on check the function of garage and service station equipments	9	115
1.5.39	Demonstration of garage and service station equipments		117
	Module 6 : Engine		
1.6.40	Identify the part and water service of two & three wheeler		121
1.6.41	Practice on dismantle, clean, check the two wheeler engine		125
1.6.42	Practice on reassembling the two wheeler engine		128
1.6.43	Practice on adjust drive chain tension of to wheeler	10	131
1.6.44	Practice on dismantling and inspection of three wheeler engine		133
1.6.45	Performing measurement of piston ring gap		136
1.6.46	Practice on trouble shooting in engine	11	138
1.6.47	Practice to identify valves and condition of valve seat		139
1.6.48	Servicing of cylinder head assembly		141
1.6.49	Check the valve clearance and setting ignition timing		143
1.6.50	Practice on engine trouble shooting	12	144
1.6.51	Practice on checking the throttle cable and throttle grip free plug		146
1.6.52	Checking engine compression		147
1.6.53	Practice on over hauling of carburetor		149
1.6.54	Adjust the throttle grip free play		152

Exercise No.	Title of the Exercise	Learning Outcome	Page No.
1.6.55	Practice on removing and cleaning of air cleaner, oil filter, fuel line & spark plug	13	153
1.6.56	**Practice on servicing of fuel tank and petrol tap (QR code Pg.No.156)***	14	156
1.6.57	Practice on servicing of petrol tap & strainer		157
1.6.58	Perform engine tune up	14	158
	Module 7 : Steering and Suspension System		
1.7.59	Identify the steering system components		160
1.7.60	Practice on removal inspection and assembling of handle bar		162
1.7.61	Practice on of front fork assembly		164
1.7.62	Practice on steering stem adjustment		166
1.7.63	Practice on inspect the condition of fork		167
1.7.64	Identify the suspension components		168
1.7.65	Practice on remove and re-assemble the rear shock absorber		170
1.7.66	Practice on servicing swing arm of two wheeler		171
1.7.67	Practice on servicing of two wheeler's shock absorber suspension system	15	173
1.7.68	Perform removal of front wheel assembly		174
1.7.69	Practice on servicing of rear wheel assembly		177
1.7.70	Practice on dismantling and repairing of tube and tyre		180
1.7.71	Check and analyze the tyre wear pattern		182
	Module 8 : Brake system		
1.8.72	Adjust front and rear brake lever free play		183
1.8.73	Servicing of disc brake assembly		185
1.8.74	Practice on inspection of brake shoe and wheel drum		188
1.8.75	Adjust clutch lever free play	15	189
1.8.76	Practice on replacing the defective parts of two wheeler clutch assembly		190
1.8.77	Inspect and repair work of two and three wheeler automatie transmission system		193
1.8.78	Practice on removal of crank shaft and replacing tining sproket		196
1.8.79	Remove the kick starter inspect and assemble	16	198
1.8.80	Servicing of gear box assembly		200
1.8.81	Practice on dismantling and assembling of oil pump		202
1.8.82	Practice on dismantling and assembling of gear shift linkage		203

Exercise No.	Title of the Exercise	Learning Outcome	Page No.
	Module 9 : Brake system		
1.9.83	Practice on A.C generator removing and refiting in two wheeler		204
1.9.84	Practice on removing and reinstalation of cam chain tensioning	17	206
1.9.85	Practice on trace the electrical circuit of two and three wheeler		208
1.9.86	Practice on measure the resisstance of ignition coil DC voltage and DC current		210
1.9.87	Practice on measurement of charging voltage and leakage current		213
1.9.88	Practice oon headlight removing and reinstalation		214
1.9.89	Remove speedometer and refit		215
1.9.90	Practice to check the horn, head light, and indicator circuits		217
1.9.91	Practice on adjusting head lights focus	17	218
1.9.92	Practice on spark plug cleaning and gap adjustment		219
1.9.93	Practice on measure the resistance of ignition coil windings		221
1.9.94	Practice to check the performance of ignition coil		222
1.9.95	Practice on inspect the AC generetor and C.D.I unit		224
1.9.96	Adjust the ignition timing in electronic ignition system		226
1.9.97	Check handle bar switches and front and rear brake light switches	18	228
	Module 10 : Electrical System		
1.10.98	Identify the various parts of LPG/CNG kit		230
1.10.99	Practice on engine tune up and smoke testing	19	233
1.10.100	Practice on servicing electrical vehicle		235
1.10.101	Identify the basic propulsion system of electrical vehicle		236
1.10.102	Practice on diagnose, repair and test power electric circuit of electric vehicle	20	237
1.10.103	Practice on diagnose, repair and test motor controls		238
1.10.104	Practice on Diagnose, repair and test high voltage battery		239
1.10.105	Practice on storage, dispose the high voltage battery		240

LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

S.No.	Learning Outcome	Ref. Ex.No
1	Comply environment regulations and housekeeping in the workshop following safety precautions.	1.1.01 - 08
2	Check & perform Measuring & marking by using various Measuring & Marking tools.	1.2.09 - 13
3	Plan & perform basic fastening & fitting operation by using correct hand tools, Machine tools & equipments.	1.2.14 - 22
4	Construct electrical circuits and test its parameters by using electrical measuring instrument.	1.3.23 - 26
5	Perform basic electrical testing in two and three wheelers.	1.3.27 - 28
6	Perform battery testing and charging operation.	1.3.29 - 31
7	Construct basic electronic circuits and testing.	1.3.32 - 35
8	Join components by using Arc & Gas welding.	1.4.36
9	Check & Interpret Vehicle Specification data and VIN, Select & operate various Service Station Equipments.	1.5.37 - 39
10	Carry out the general servicing of two & three wheelers.	1.6.40 - 43
11	Carryout engine overhaul of two wheeler& three wheelers.	1.6.44 - 46
12	Overhauling of cylinder head assembly.	1.6.47 - 50
13	Diagnose and troubleshoot for excessive smoke, engine overheating and abnormal noise.	1.6.51 - 55
14	Carry out servicing of fuel tank.	1.6.56 - 58
15	Carryout overhauling of steering and suspension system.	1.7.59 to 1.8.74
16	Overhaul automatic/manual transmission of two and three wheelers.	1.8.75 - 82
17	Overhaul AC generator.	1.9.83 - 91
18	Check ignition circuit for proper functioning.	1.9.92 - 97
19	Overhaul the LPG/CNG fuel system and check exhausts smoke.	1.10.98 - 99
20	Carryout servicing and maintenance of electric two and three wheelers.	1.10.100 to 1.10.105

SYLLABUS FOR MECHANIC TWO & THREE WHEELER

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 50Hrs; Professional Knowledge 10 Hrs.	Comply environment regulations and housekeeping in the workshop following safety precautions.	1 Demonstration of Machinery used in the trade. (09 hrs.) 2 Identification to safety equipment and their use etc. (05 hrs.) 3 Importance of maintenance and cleanliness of Workshop. (05 hrs.) 4 Demonstration on safe handling and Periodic testing of lifting equipment, and Safety disposal of used engine oil. (10 hrs.) 5 Demonstration with health centre. (05 hrs.) 6 Demonstration fire service station to provide demo on First aid and Fire safety. (05 hrs.) 7 Perform use of fire extinguishers. (05 hrs.) 8 Energy saving Tips of ITI electricity Usage. (06 hrs.)	- Importance of trade Training. - General discipline in the - Institute - Elementary First Aid. - Importance of Mechanic 2 & 3 wheelers in Industry - Safety precautions to be followed while in handling machineries. - Energy conservation - Safety disposal of used engine oil, Electrical safety tips. - Safe handling of Fuel Spillage. - Fire extinguishers used for different types of fire. - Safe disposal of toxic dust, - Safe handling and Periodic testing of lifting equipment - Authorization of Moving & road testing vehicles. (10 Hrs.)
Professional Skill 100 Hrs; Professional Knowledge 20 Hrs.	Check & perform Measuring & marking by using various Measuring & Marking tools.	9 Perform practice using all marking aids, like steel rule with spring calipers, dividers, scriber, punches, Chisel etc. (25 hrs.) 10 Perform layout a work piece- for line, circle, arcs and circles. (15 hrs.) 11 Perform to measure a wheel base of bike & auto with measuring tape. (20 hrs.) 12 Perform to remove wheel lug nuts with use of an air impact wrench. (20 hrs.) 13 Perform Practice on General workshop tools & power tools. (20 hrs.)	Hand & Power Tools: - - Marking scheme, marking material-chalk, Prussian blue. - Cleaning tools- Scraper, wire brush, Emery paper, - Description, care and use of Surface plates, steel rule, measuring tape, try square. Calipers-inside and outside. Dividers, surface gauges, scriber, - Punches-prick punch, centre punch, pin punch, hollow punch, number and letter punch. - Chisel-flat, cross-cut. Hammer-ball pein, lump, mallet. Screwdrivers blade screwdriver, Phillips screw driver, Ratchet screwdriver. - Allen key, bench vice & C clamps, - Spanners- ring spanner, open end spanner & the combination spanner, universal adjustable open end spanner. - Sockets & accessories,

			- Pliers ,Combination pliers, multi grip, long nose, flat-nose, - Air impact wrench, air ratchet, wrenches- Torque wrenches, pipe wrenches, car jet washers Pipe flaring & cutting tool, pullers - Gear and bearing. (10 Hrs.) Systems of measurement, Description, care & use of - Micrometers - Outside and depth micrometer, - Micrometer adjustments, - Vernier calipers, Telescope gauges - Dial bore gauges, Dial indicators, straightedge, feeler gauge, thread pitch gauge, - Vacuum gauge, tire pressure gauge. (10 Hrs.)
Professional Skill 120 Hrs.; Professional Knowledge 10 Hrs.	Plan & perform basic fastening & fitting operation by using correct hand tools, Machine tools & equipments.	14 Perform general cleaning, checking and use of nut, bolts, & studs etc. (10 hrs.) 15 Perform of removal of stud/bolt from blind hole. (10 hrs.) 16 Perform cutting tools like Hacksaw, file, chisel, Sharpening of Chisels, center punch, safety precautions while grinding. (15 hrs.) 17 Perform hacksawing and filing to given dimensions. (25 hrs.)	- Fasteners- Study of different types of screws, nuts, studs & bolts, locking devices, such as lock nuts, cotter, split pins, keys, circlips, lock rings, lock washers and locating where they are used. - Washers& chemical compounds can be used to help secure these fasteners. Function of Gaskets - Selection of materials for gaskets and packing, oil seals. - Cutting tools:- Study of different type of cutting tools like Hacksaw, File- Definition, parts of a file, specification, Grade, shape, different type of cut and uses., - OFF-hand grinding with sander, bench and pedestal grinders, safety precautions while grinding. - Limits, Fits &tolerances:-Definition of limits, fits &tolerances with examples used in auto components (05 Hrs.)
		18 Perform marking and drilling clear and Blind Holes, Sharpening of Twist Drills. (10 hrs.) 19 Check safety precautions to be observed while using a drilling machine. (05 hrs.) 20 Perform tapping a Clear and Blind Hole, Selection of tape drill Size. (15 hrs.)	Drilling machine - Description and study of Bench type drilling machine, Portable electrical Drilling machine, drill holding devices, - Work Holding devices, Drill bits. Taps and Dies: Hand Taps and wrenches, Calculation of Tap drill sizes for metric and inch taps. Different type of Die and Die stock.

		21 Use of stud-extractor. Cutting Threads on a Bolt/ Stud. (15 hrs.) 22 Adjustment of two piece Die, Reaming a hole/ Bush to suit the given pin/ shaft, scraping a given machined surface.(15 hrs.)	- Screw extractors. Hand Reamers, different Type of hand reamers, Drill size for reaming, Lapping, Lapping abrasives and type of Laps. (05 Hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Construct electrical circuits and test its parameters by using electrical measuring instrument.	23 Perform joining wires using soldering Iron. (05 hrs..) 24 Construction of simple electrical circuits. (05 hrs.) 25 Perform measure of current, voltage and resistance using digital multimeter. (05 hrs.) 26 Perform continuity test for fuses, jumper wires, fusible links and circuit breakers. (10 hrs.)	- Voltmeter, ammeter, Ohmmeter Mulitmeter, Conductors & insulators, Wires, Shielding, Resistor ratings. (07 Hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Perform basic electrical testing in two and three wheelers.	27 Perform series, parallel, series parallel circuits using Ohm's law, (10 hrs..) 28 Check electrical circuit with a test lamp, perform voltage drop test in circuits using multimeter, measure current flow using multimeter /ammeter, use of service manual wiring diagram for troubleshooting. (15 hrs.)	- Fuses & circuit breakers, Ballast resistor, - Stripping wire insulation, cable colour codes and sizes, Resistors in Series circuits , - Capacitors and its applications, Capacitors in seriesand parallel. (07 Hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Perform battery testing and charging operation.	29 Cleaning and topping up of a lead acid battery, testing battery with hydrometer. (05 hrs.) 30 Perform connection battery to a charger for battery charging, Inspecting & testing a battery after charging. (10 hrs.) 31 Measure and troubleshoot the cause(s) of excessive Key-off battery drain (parasitic draw) and do corrective action. Testing of relay and solenoids and its circuit. (10 hrs.)	- Batteries & cells, Lead acid batteries & Stay Maintenance Free (SMF) batteries, - Thermistors, Thermo couples, - Relays, Solenoids, Primary & Secondary windings, - Transformers, stator and rotor coils. (07 Hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Construct basic electronic circuits and testing.	32 Identify and test power and signal connectors for continuity. (05 hrs.) 33 Identify and test different type of Diodes. (05 hrs.) 34 Perform regulator /rectifier, inspection, and assembling. (05 hrs.) 35 Check NPN&PNP Transistors for its functionality, Construct and test simple logic circuits OR, AND & NOT Logic gates using as switches. (10 hrs.)	- Basic electronics: Description of Semiconductors, - Solid state devices- Diodes, transistors, Thyristors, Uni Junction Transistors (UJT), Metal Oxide Field Effect Transistors (MOSFETs), - Logic gates-OR, AND & NOT and Logic gates using switches. (07 Hrs.)

Professional Skill 16 Hrs.; Professional Knowledge 04 Hrs.	Join components by using Arc & Gas welding.	36 Setting of Gas welding flames, practice to make a straight beads and joints Oxy- Acetylene welding. (16hrs.)	- Introduction to welding and - Oxy - Acetylene welding, principles, equipment, welding parameters, edge preparation & fit up and welding techniques. - Heat Treatment Process (04 Hrs.)
Professional Skill 20 Hrs.; Professional Knowledge 04 Hrs.	Check & Interpret Vehicle Specification data and VIN, Select & operate various Service Station Equipments.	37 Identify of different type of Vehicle. (05 hrs.) 38 Demonstrate of vehicle specification data; Identification of vehicle information Number (VIN). (05 hrs.) 39 Demonstrate of Garage, Service station equipments.- (10 hrs.)	- Auto Industry - history, leading manufacturers, development in automobile industry, trends, new product. Brief about Ministry of Road transport &Highways, - The Automotive Research Association of India (ARAI), National Automotive Testing and R&D Infrastructure Project (NATRIP), & Automobile - Association. Definition: - Classification of vehicles on the basis of load as per central motor vehicle rule, wheels, final drive, and fuel used, axles, position of engine and steering transmission, body and load. - Brief description and uses of Vehicle hoists (04 Hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 06 Hrs.	Carry out the general servicing of two & three wheelers.	40 Identify the parts &general servicing of Two Wheeler and Three wheeler, washing, cleaning, oiling, greasing and lubricating. (05 hrs.) 41 Dismantle the two wheeler SI engine, cleaning and inspecting the parts, checking engine bore, piston rings, connecting rod, bearings, crankshaft. (05 hrs.) 42 Assemble all the parts after assembling inspect Engine oil level, clutch cable free play. (08 hrs.) 43 Adjust Drive chain tension, check performance of electrical system. (07 hrs.)	- Two wheelers and three wheelers auto Industry in India - Leading manufacturers, new product. Introduction to Engine: - Description of internal & external combustion engines, Classification of IC engines, Principle & working of 2&4-strokediesel engine Compression ignition Engine(C.I), - Principle of Spark Ignition Engine(SI), differentiate between 2-strokeand 4 stroke, C.I engine and S.I Engine, - Direct injection and Indirect injection, - Technical terms used in engine, Engine specification. - Study of various gauges/instrument on a dash board of a vehicle-Speedometer, Tachometer, Odometer and Fuel gauge, and Indicators such as gearshift position. (06 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 06 Hrs.	Carryout engine overhaul of two wheeler& three wheelers.	44 Perform dismantling three wheeler engine and inspection of cylinder head, piston, piston ring, connecting rod. (05 hrs.) 45 Perform measurement of piston ring gap, the piston ring to groove clearance, piston OD, cylinder to piston clearance, piston pin OD, piston pin hole ID in an X and Y	- Basic engine components Engine cams & Description & functions of pistons, piston rings, connecting rod and piston pins and materials. Used recommended clearances for the rings and its necessity, precautions while fitting rings, common troubles and remedies of piston.

		axis, piston to pin clearance connecting rod small end ID, connecting rod small end to piston pin clearance and compare the measurements with service manual. (10 hrs.) 46 Perform trouble shooting of low compression, High compression, Excessive noise, and poor idling. (10 hrs.)	- Description and function of Crank shaft, Engine bearings. - Trouble shooting procedure for low compression, High compression, Excessive noise, and poor idling. (06 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 06 Hrs	Overhauling of cylinder head assembly.	47 Identify valves and condition of valve and seat. Inspection of rocker arm and rocker arm shaft, camshaft, valve spring, valve guide, valve guide replacement, valve seat inspection and replacing. (05 hrs.) 48 Perform cylinder head assembly. (05hrs.) 49 Perform inspection of valve clearance and Ignition timing and setting. (05 hrs.) 50 Perform trouble shooting of Excessive smoke, overheating, knocking or abnormal noise. Troubleshooting of cam chain noise and cam chain slack excessively. (10 hrs.)	Valves & Valve Trains - Function of Engine Valves, different types, materials, Type of valve operating mechanism, Importance of Valve seats, Valve-timing setting. - Description of Camshafts & drives, importance of Cam lobes, Timing belts &chains. - Trouble shooting procedure for Excessive smoke, overheating, knocking or abnormal noise. Troubleshooting procedure for cam chain noise, and cam chain slack excessively. (06 hrs.)
Professional Skill 28 Hrs.; Professional Knowledge 10 Hrs.	Diagnose and troubleshoot for excessive smoke, engine overheating and abnormal noise.	51 Perform checking the throttle cable for deterioration, damage or kinks, measure the throttle grip free play, and adjustments. Check the carburetor idle speed and adjust as per manual. (05 hrs.) 52 Perform compression test. Practice on throttle valve disassembly, check the throttle valve and jet needle surfaces for presence of dirt, scratches or wear and assemble the throttle valve. (06 hrs.) 53 Perform removal of carburetor, float, float valve, jet clean, inspect and adjust the flat level as per manual and assemble the carburetor. (10 hrs.) 54 Adjust the throttle grip free play and carburetor as per manual. (02 hrs.) 55 Perform removing and cleaning of air cleaner, Checking of Engine oil level, oil filter screen cleaning. Inspection of fuel lines, Spark plug. (05 hrs.)	Intake & exhaust systems - Carbureted systems, - Principle of Carburetor, type of carburetor working of constant velocity type carburetor, - Carburetor operation-Carburetion, carburetor systems, - Metering jets, Accelerating, Carburetor barrels, Carburetor filter Diesel fuel Injection system, Tanks & lines, Fuel lines. Idle speed circuit, slow speed circuit, high speed circuit, air cleaners, Intake manifolds. Importance of Cooling systems & Lubrication system. Cooling system and lubrication system overview. - Function of engine oil, Grades of oil, Lubrication points. - Trouble shooting procedure for Oil level too low and Oil contamination. - Liquid cooling system description and its working - Pressure oil system description and working. (10 hrs.)

Professional Skill 25 Hrs; Professional Knowledge 05 Hrs.	Carry out servicing of fuel tank.	56 Perform removal of fuel tank; check that fuel flow freely from the petrol tap. (05 hr.s) 57 Perform removal of petrol tap and clean the strainer and assemble. (05 hrs) 58 Diagnose - causes and remedy for engine not starting, high fuel consumption, Practice on engine tune. (15 hrs..)	Gasoline Fuel Systems: - Gasoline fuel characteristics, Difference between Gasoline. - Controlling fuel burn, Stoichiometric ratio (air-fuel ratio), Air density, Fuel supply system, Pressure & vacuum. - Trouble shooting procedure for Engine cranks but would not start, Lean mixture, Engine idles roughly, stalls or turns poorly, and Rich mixture. (05 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	Carryout overhauling of steering and suspension system.	59 Identify steering system components in two and three wheelers. (05 hrs.) 60 Practice on handle bar removal, inspection and assembling of handlebar. (05 hrs.) 61 Perform removal of front fork, inspection of front fork spring, fork tube, piston, slider and assembling of front fork. (5hrs) 62 Practice on steering stem removal, steering stem adjustment. (05 hrs.) 63 Inspect condition of fork and adjust rake of front fork, dismantle trailing link, adjust and service of heavy duty thrust races. (05 hrs..)	- Introduction to steering Principles of steering: Description of different types of steering & handle, fork mounted over races. - Description, construction and function of steering stem. - Troubleshooting Procedure for Hard steering Steers to one side or does not track strain, front wheel wobbling, Soft suspension, Hard suspension, Front suspension noise. (05 hrs.)
		64 Identify suspension system components in two and three wheelers. (05 hrs.) 65 Practice on rear shock absorber removal, inspection of shock absorber spring and assembling of shock absorber. (05 hrs.) 66 Perform removal of swing arm, inspection of pivot bolt, swing arm. (10 hrs.) 67 Inspect condition of shock absorbers. Servicing of suspension, changing bush. (05 hrs.)	Suspension Systems - Principles of suspension, Suspension force, Description, location, suspension-description, construction and working principle of telescopic front suspension, suspension oil, oil seal installation, Shock absorber types - Hydraulic shock absorbers, Gas-pressurized shock absorbers, Load-adjustable shock absorbers, - Manual adjustable rate shock absorbers, Electronic adjustable-rate shock absorbers, Automatic load-adjustable shock absorbers. (05 hrs.)
		68 Perform removal of front wheel from vehicle, inspection of front wheel axle run-out, front wheel bearing inspection, front wheel rim run-out, brake drum inspection, and assembling of front wheel. (10 hrs.) 69 Practice on removing rear wheel from vehicle, inspection of rear wheel axle run-out, rear wheel	Wheels &Tyres - Function of wheel and construction, Wheel types-spoke, cast wheel& sizes, Wheel balancing, Rim sizes &designations, Tyre function and structure, size and designation, Radial ply tyres, Tubeless tyre, Center of gravity, Relation between tyre pressure and life, Tube size, TUFFUP tube. Aspect ratio of tyre,

		bearing inspection, rear wheel rim run-out, brake drum inspection, driven sprocket inspection, driven sprocket removal, and assembling of rear wheel, driven sprocket installation. Check the chains lack and adjust as per manual. (10 hrs.) 70 Dismantle tyres and tubes checking puncture. Assembling inflating to correct pressure. Checking & adjusting tire pressure by use of air or by Nitrogen Wheel truing, alignment. (10 hrs.) 71 Analyze tyre wear patterns. Checking the wheel bearings and greasing. (07 hrs.)	- Puncture procedure, Repair of TUFFUP tube. Tyre construction - Types of tyre construction, Tyre materials, Tyre sizes &designations, Tyre information, Tyre tread designs, Effects of air pressure and uneven wear pattern. - Descriptions Tire wear Patterns and causes, Nitrogen vs atmospheric air in tyres. (07 hrs.)
		72 Perform following practical on Two and three wheelers.- Measure the front brake lever free play and adjust as per manual, Measure the rear brake pedal free play and adjust as per manual. (10 hrs.) 73 Perform Servicing of brake system, cleaning, checking, greasing and assembling. (10 hrs.) 74 Inspect the shoes and wheel drums, changing of brake lining. Repairing and maintenance of hydraulic disc brake used in Motorcycles. (15 hrs.)	Braking Systems - Braking fundamentals Principles of braking, description, construction and operation of Drum & disc brakes, advantage over drum brake, - Description and working principle of master cylinder, Hydraulic pressure & force, Brake fade - Braking system components- Brake pedal/lever , Brake fluid hose, Brake fluid, - Bleeding, Applying brakes, Brake force, Brake light switch - Disc brakes & components -Disc brake system, Disc brake operation, Disc brake rotors, Disc brake pads, Disc brake calipers, Brake friction materials, - Comparison of Drum brake and Disc brake. ABS Drum brakes & components. (07 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	Overhaul automatic/ manual transmission of two and three wheelers.	75 Adjust clutch lever free play and adjust as per manual, removing clutch assembly from Two-wheeler & three wheeler cleaning and inspecting parts. (05 hrs.) 76 Replace defective parts. Fitting clutch assembly. (05 hrs.) 77 Inspect and repair work of Automatic clutch and automatic transmission used in two wheeler & three wheeler. (10 hrs.) 78 Practice on removal of crankshaft, inspection of crank shaft, timing sprocket replacement & installation, (05 hrs.)	Clutches & Transmission:- - Clutch principles, Wet & dry clutches Single plate clutches, Multi-plate clutches, Operating mechanisms, Description of cam chain mechanism. Automatic clutch - Gearbox layout & operation Gearbox layouts, description of gear shift mechanism, gear ratio, Gearbox operation, Gear drive position - Neutral, 1st to 5thposition. - Trouble shooting procedure for Clutch slip when accelerating, clutch will not disengage, motor cycle creeps with clutch disengaged,

		79 Practice on kick starter disassembly, inspection and assembly. (05 hrs.) 80 Perform disassembly of transmission, inspection of main shaft, counter shaft, gearshift drum, shift fork, guide pin and gears and assembly of transmission. (10 hrs.) 81 Removal of oil pump and inspection and assembly of oil pump. (05 hrs.) 82 Gearshift linkage disassembly, inspection and assembly of gearshift linkage. (05 hrs.)	- Excessive lever pressure, clutch lever pressure, clutch operation feels rough, Hard to shift, Gearshift pedal does not return, and Transmission jumps out of gears. - Automatic transmission used in two wheeler and three wheeler. (10 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 11 Hrs.	Overhaul AC generator.	83 Practice on A.C. Generator removal, inspection and installation. (05 hrs.) 84 Perform removal of cam chain tensioner, inspection of tensioner spring and pushrod, installation. (10 hrs.) 85 Trace the A.C /D.C electrical circuit in a two wheeler and three wheeler. (05 hrs.) 86 Perform measurement of Resistance, DC voltage measurement, DC Current measurement, pulse generator, (5hrs.) 87 Inspect leakage current, measurement of charging voltage. (05 hrs.) 88 Practice on headlight removal, headlight bulb replacement and installation. (05 hrs.) 89 Practice on removal of speedometer, indicator lamp replacement. (05 hrs.) 90 Check horn, head light and indicator and rectify the circuit. (05 hrs.) 91 Practice on adjusting head light focus. Identifying wiring harness. (05 hrs.)	Auto electrical - Thermistor, Description and function of ignition switch, alternator, Regulator/ rectifier, Ignition principles, Ignition components, - Battery power source, Ignition coil, DC/ ACCDI, TCI Contact breaker, capacitor /condenser, Distributors, Distributor types, - High-tension leads, Spark plugs, Spark plug components, Principal of electronic ignition, advantage of electronic ignition. - Starter motor, Fuse, throttle position switch, source coil & pulser coil Power relay, Silicon rectifier, - Description of Charging system, starting system, Lighting system, Lamps/light bulbs, Lamp/light bulb information, Indicators, Headlights, Circuit diagrams. (11 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 04 Hrs.	Check ignition circuit for proper functioning.	92 Inspection of spark plug gap and adjustments. (05 hrs) 93 Measurement the resistance of the ignition primary and secondary coil. (02 hrs.) 94 Perform checking the performance of ignition coil, (03 hrs.) 95 Inspect of A.C generator, practice on removal of C.D.I unit (Capacitive Discharge Ignition), inspection of C.D.I unit & assembling.(05 hrs.) 96 Servicing of electronic Ignition system, Inspection of ignition timing and adjustment. (05hrs.)	Troubleshooting procedure - for No sparks at plugs, Engine starts but runs poorly, - No lights come on when ignition switch is turned ON, - All lights come on but dimly when ignition switch is turned ON - Headlight beams do not shift when HI-LO switch is operated. Misfiring. (04 hrs.)

		97 Inspect ignition switch, handlebar switches, front brake & rear brake stoplight light switch. (05 hrs.)	
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Overhaul the LPG/ CNG fuel system and check exhausts smoke.	98 Identify the various parts of LPG/ CNG kit and Troubleshooting of the same. (10 hrs.) 99 Practice on Starting engine, tuning for slow speed, perform exhaust emission test using gas analyzer/smoke tester and tuning the vehicle for recommended emission levels. (15 hrs.)	- Study about LPG / CNG powered engines used in Three Wheelers. Safety while handling gas units. Emission Control - Sources of emission, Combustion, Hydrocarbons, Hydrocarbons in exhaust gases, Oxides of nitrogen, Particulates, Carbon monoxide, Carbon dioxide, Sulphur content in fuels, crankcase emission control system, Evaporative emission control, - Catalytic converter Regulated emissions standard. (07 hrs.)
Professional Skill 34 Hrs.; Professional Knowledge 07 Hrs.	Carryout servicing and maintenance of electric two and three wheelers.	100 Electric 2 & 3 Wheler Maintenance Operate equipment according to safety protocols and identify tools, tests equipment and service procedures used in the servicing of EV . (07 hrs.) 101 Identify basic propulsion systems and power transfer systems including AC and DC motor technology used in EV (0 7 hrs.) 102 Diagnose, repair, and test power electronic circuitry for electric drive systems. (05hrs.) 103 Diagnose, repair, and test motor control electronic hardware. (05hrs.) 104 Diagnose, repair, and test high voltage battery systems. (05hrs.) 105 Perform safe storage, handle, and dispose of high voltage battery systems and Check Inverter Assembly variable voltage system. (05hrs.)	Introduction: Electric Vehicle Electric Vehicle Architecture Design Electric Drive and controller Energy Storage Solutions (ESS) Battery Management System (BMS)/ Energy Management System (EMS) Control Unit: Function of CU, Development Process. (07 hrs.)

Identify the machineries/equipment installed in the trade

Objectives: At the end of this exercise you shall be able to
- **identify the machines/equipment installed like compressor and drilling machine**
- **identify spark plug tester, smoke tester and wheel balancer.**

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.

Equipment / Machinery

- Air compressor - 1 No.
- Jib crane - 1 No.
- Drilling machine - 1 No.
- Spark plug tester - 1 No.
- Wheel balancer - 1 No.

Materials / Components

- Cotton waste - 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 air compressor, and jib crane.

4 Explain the use of compressed air and its applications.

5 Demonstrate the importance of wheel alignment.

6 Explain bench drilling machine, pillar drilling machine.

7 Explain about the need for wheel balancing machine.

8 Explain the component of a spark plug tester.

9 Demonstrate the gap measurement in a spark plug.

10 Explain through display charts, the features of all equipments in an auto workshop.

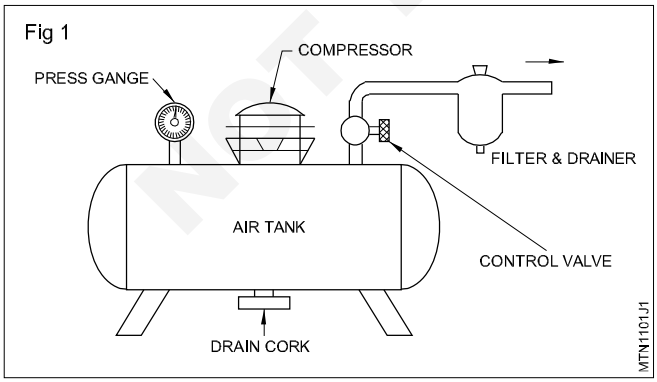
Skill Sequence

Identify the machines/equipments

Objective: This shall help you to
- **identify the air compressor, jib crane, bench drill, sparkles tester and wheel balancer.**

Compressor is an equipment to produce compressed air at required pressure through air hoses. (Fig 1)

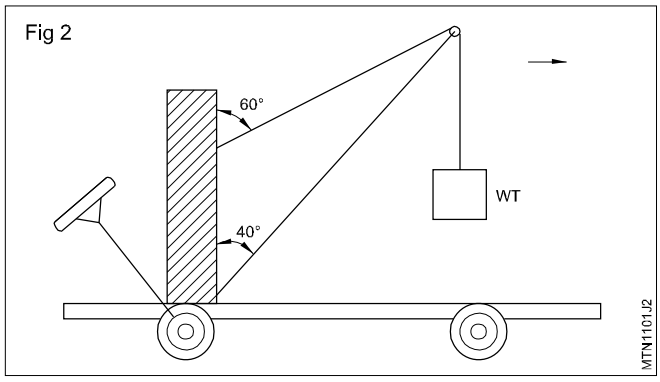
Fig 1



Jib crane is used to transport some objects, from one place to another in the shop floor. (Fig 2)

The sensitive bench drilling machine (Fig 3)

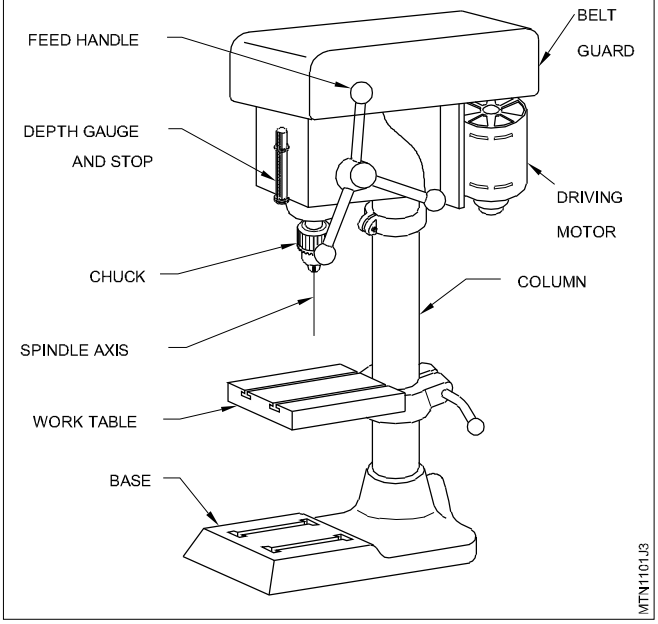
Fig 2



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.

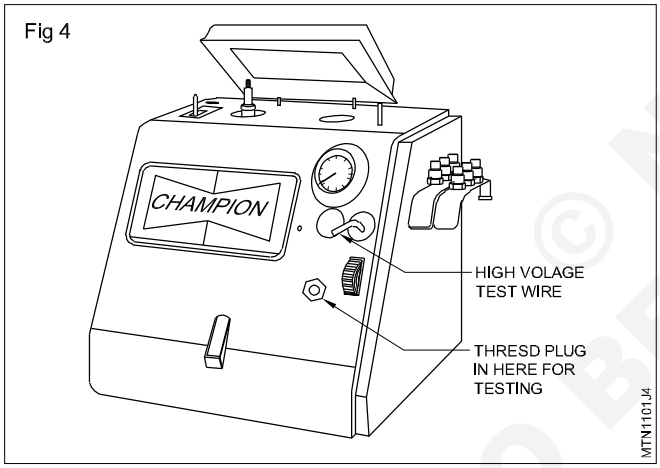
Fig 3



Spark plug tester (Fig 4)

Spark plug tester usually cleans the spark plug. The spark plug gap adjusted to manufacturers specification externally using filler gauge. Check the sparking voltage in the tester.

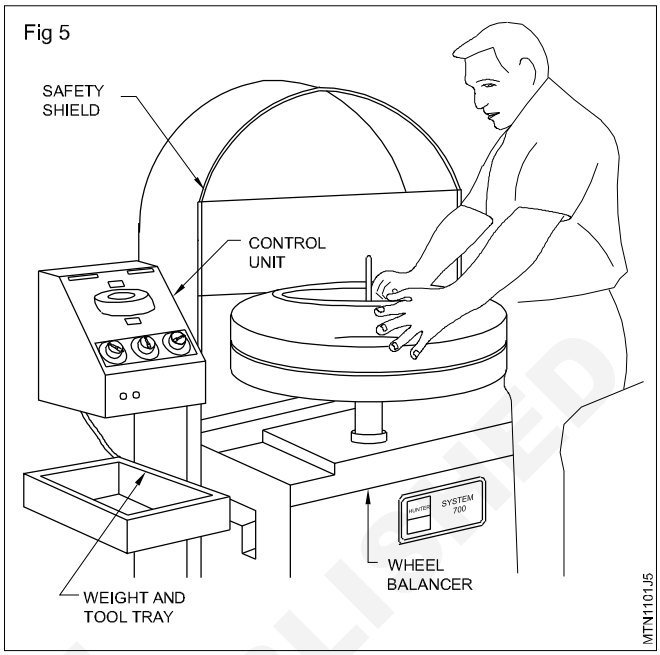
Fig 4



Wheel balancer (Fig 5)

The extent of imbalance is worked out and a balance weight of the same is fixed in appropriate place of the rim as indicated by the balance machine.

Fig 5



Note : Safety shield is pulled down to cover tire before unit is started. This stops stones and wheel weights which can fly off with lethal force.

Practice on safety signs and personal protective equipments

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

Scan the QR code to view the video for this exercise

PROCEDURE

TASK1: **Identify the safety signs (Fig 1)**

Fig 1

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

1 Identify the safety sign from the chart.

2 Record the name of the category in table1.

3 Mention the meaning description of the safety sign in table1.

Table1

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

TASK2: **Personal protective equipments**

Fig 2

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 protection equipment 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 protection in table2.

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.

— — — — — — — — —

TASK3: **Occupational hazards**

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.

— — — — — — — — —

Importance of maintenance and cleanliness of workshop

Objectives: At the end of this exercise you shall be able to
- **carryout the maintenance of equipment**
- **note any damage, tag the tool as faulty**
- **clean the tools and equipment you used.**

PROCEDURE

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

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

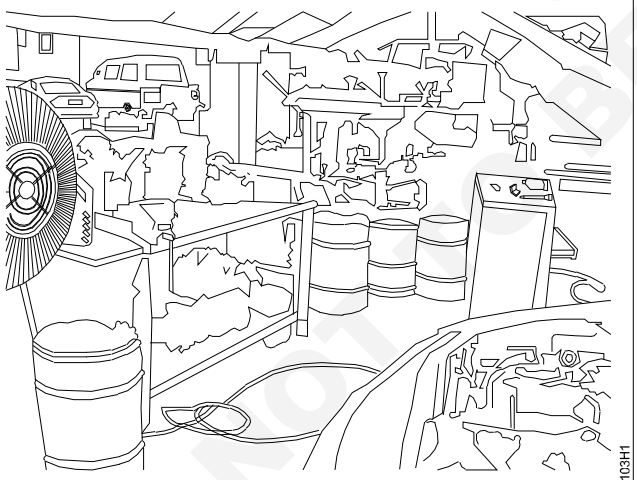
2 Electrical current can travel over oily or greasy surfaces. Keep electrical power tools free from dust and dirt and make sure they are free of oil and grease.

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

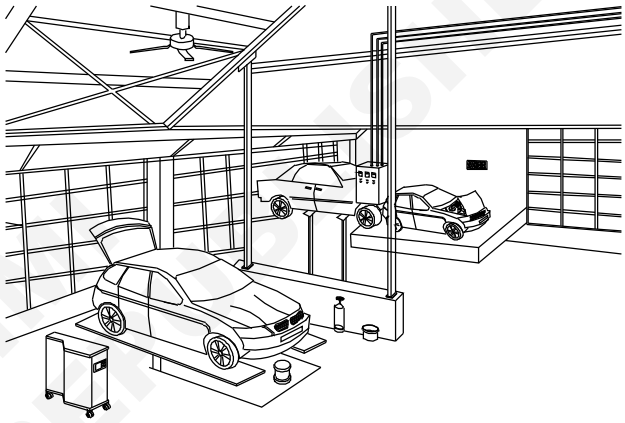


UNORGANIZED WORKSHOP

MTN1103H1

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

Fig 2



ORGANIZED WORKSHOP

MTN1103H2

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 as a cleaning materials near open flame or cigarette.

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

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

1 Keep your hand tools in good, 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 Wipe off any oil or grease on the floor jack and check for fluid leaks. If you find any, top up the hydraulic fluid.

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

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

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

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

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

8 Locate the 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.

— — — — — — — — —

TASK 3 : **Practical related safety in work place**

1 It is your responsibility to follow the work safety to protect yourself from injuries.

2 Always use personal protective equipment to avoid accidents in the work place.

3 Avoid the malfunction of a machine operation or tools handing.

4 Don't work in poor working environment.

5 Always use proper wearing of cloth during work in workshop.

6 Use safety shoes with non-slip soles.

7 Always use safety measure against injury or burns.

8 Use hand gloves - when you are lifting heavy rough surface items or removing hot parts of a vehicle.

— — — — — — — — —

TASK 4 : **Workshop safety rules**

1 Always keep the work place neat and clean before and after the work.

2 Dispose the used waste items or materials in the place for repair work.

3 Use proper tools to check electrical circuits and components.

4 Don't leave the tools and parts on the work place. Make a habit of putting them on a work bench or work stant.

5 Don't install the electrical components temporarily in the vehicle.

6 Clean up spilled fuel, oil, grease immediately to prevent slip on the work place.

7 Clean the tools after finishing a job, check item by item and stored in the tool box.

8 Remove the dirt and oil from the special service tool, tester and gauges and put them in safe place.

9 Follow the safety precautions while handling electrical equipment as your instructors guideline.

— — — — — — — — —

Practice to safe handling and testing of lifting equipments

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 / Machinery

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

Materials / Components

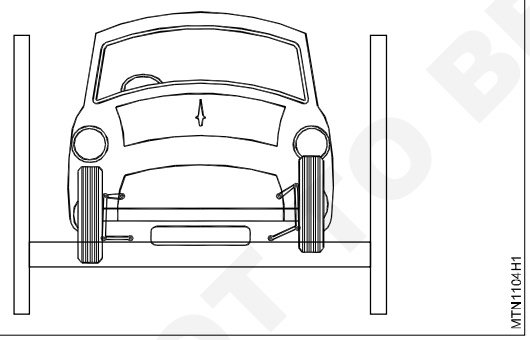
- Oil - as reqd.
- Water - as reqd.
- Kerosene - as reqd.
- Cotton waste - as reqd.
- Soap oil - as reqd.

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.

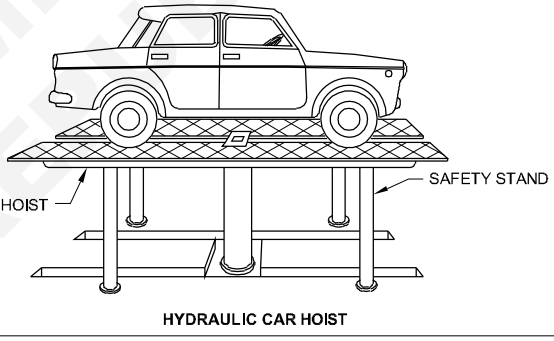
Date serviced: 20/03/2021

Next service: 19/03/2025

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 equipment list. This practical can be give at any service station.

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

Skill Sequence

Practice on safe disposal of used engine oil

Objectives: This shall help you to
- **dispose the used engine oil**
- **carryout the safety measures in disposal.**

Wear protective clothing, such as gloves, mask, shoe, apron etc.,

Do not spill any oil on the ground.

Put your used motor oil in a clean plastic container (Fig 1) with a tight lid. Never store the used oil in a container that once held chemicals, food, or beverages.

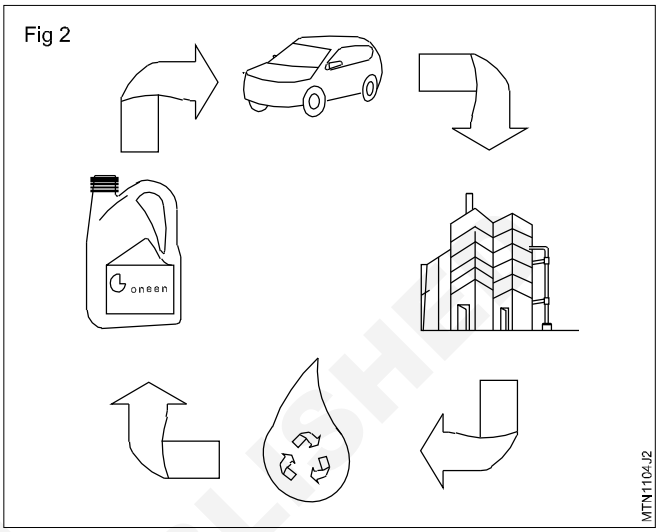
Do not mix the oil with anything else, such as antifreeze, solvent, or paint.

Take used motor oil to a service station or other location that collects used motor oil for recycling. (Fig 2)

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

Fig 1

Fig 2



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

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

While transporting ensure that there is no spillage of oil.

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

Table 1

S. No	Date	Qty per can (litre)	No of cans delivered	Total qty. disposed in litres	Remarks
1	Example 23.5.2014	20	5	100	
2	---	----	---	-----	
3	---	----	---	-----	

Demonstration on human health and safety

Objective: At the end of this exercise you shall be able to
- **state the health and safety in the work place.**

Scan the QR code to view the video for this exercise

Requirements

Tools / Instruments

- Oxygen kit - 1 No.
- Face mask - 1 No.
- Hand gloves - 1 set.
- Safety boot - 1 pair.
- First aid kid - 1 No.
- Medical apron kit - 1 No.

Equipments / Machinery

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

Materials / Components

- Cotton - as reqd.
- Tinger - as reqd.
- Bandage - as reqd.
- Medicines - as reqd.
- Soap oil - as reqd.

PROCEDURE

1 Health and safety in work place

2 Visit to nearest health centre or call the expert to your institute.

3 Ask the health centre expert to give demo on health and safety measures in the work place.

4 Observe the introduction of safety equipment functions.

5 Observe the demo of the safety equipment usage work place.

6 Observe the causes for the hazards during work.

7 Note the awareness points on human health effect, due to bad workmanship.

8 Observe the first aid treatment procedures of injured person in work place.

9 Observe demo on safety measures during work.

10 Note the points of diseases and symptoms.

11 Write the name of diseases and symptoms in table 1.

Table 1

S.No.	Name of diseases	Symptoms	Remarks
1			
2			
3			
4			
5			
6			
7			

Practice on occupational safety and first aid

Objectives: At the end of this exercise you shall be able to
- **state the health and safety in the work place**
- **state the health and safety in the work place.**

Scan the QR code to view the video for this exercise

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- First aid kit - 1 No.

Equipments / Machines

- Fire extinguishers (different type) - 1 No each.
- Cut - Models of fire extinguisher - as reqd.

Materials / Components

- Old tyre - as reqd.
- Wood, Paper, Cloth & Grease - as reqd.
- Gas and Liquefied gas - as reqd.
- Metal and Electrical equipment - as reqd.
- Soap oil - as reqd.
- Bandage - as reqd.

PROCEDURE

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

1 Ask the nearest health center staff to give demo on first aid and the practice on first aid.

Assumption - For easy manageability, Instructor may arrange the trainees in group and ask each group to perform one method of resuscitation as per health center demo on first aid.

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

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

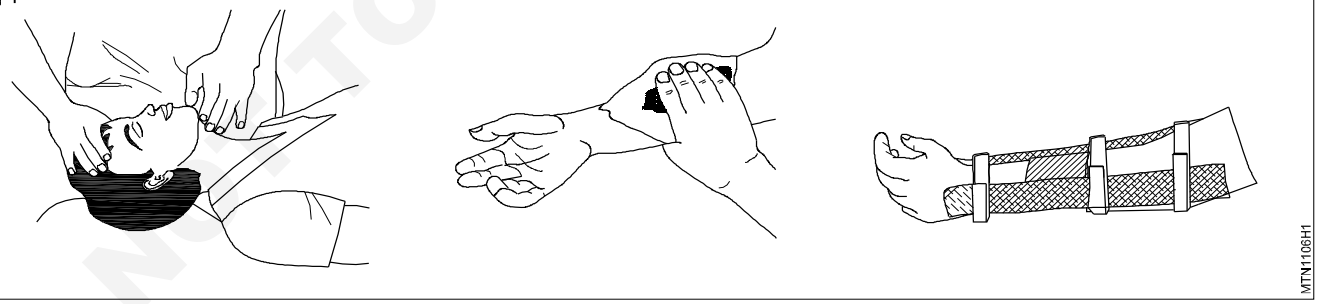
4 Bring the victim safely to the level ground, taking necessary safety measures. (Fig 1)

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

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

7 Send to a doctor immediately.

Fig 1



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 (Fig 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.

Fig 1

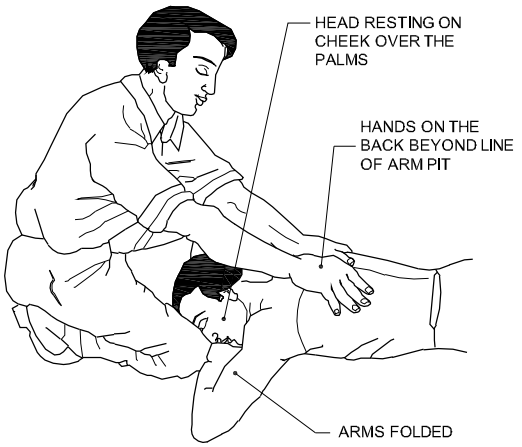
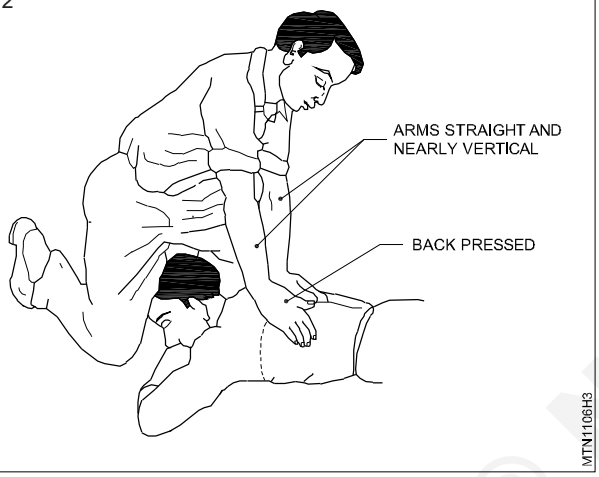


Fig 2



3 Synchronize 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.

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.

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

Fig 3

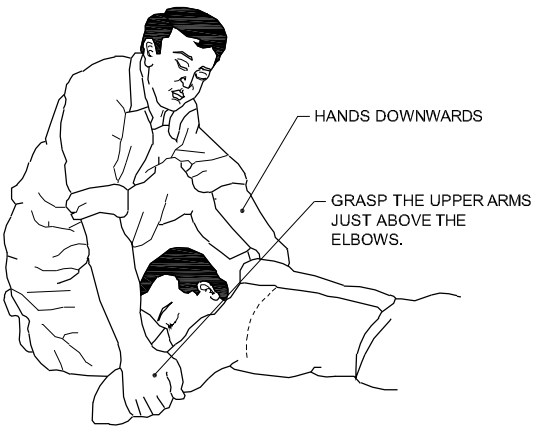
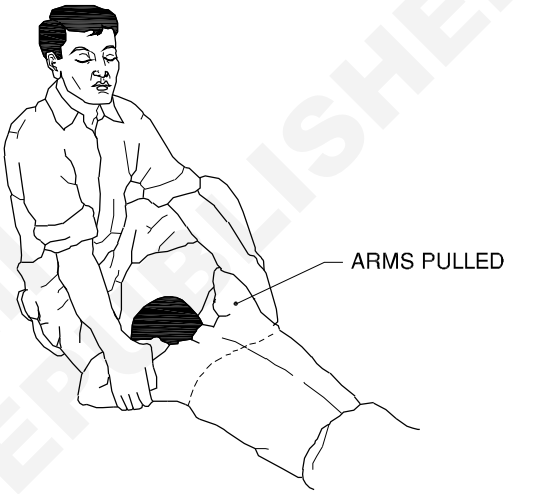


Fig 4



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 expert 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).

Fig 1

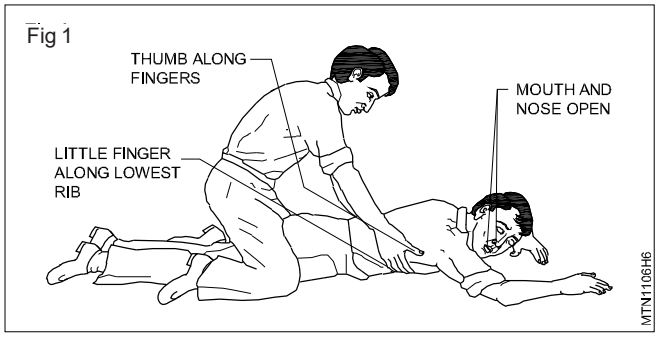
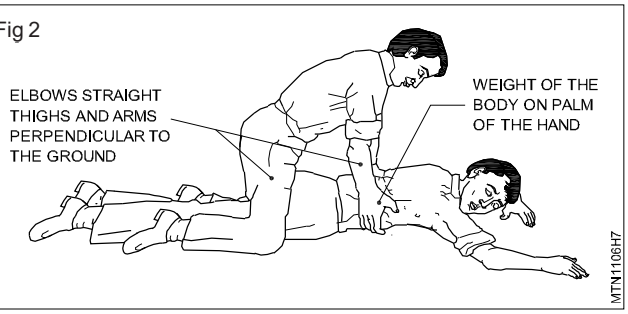


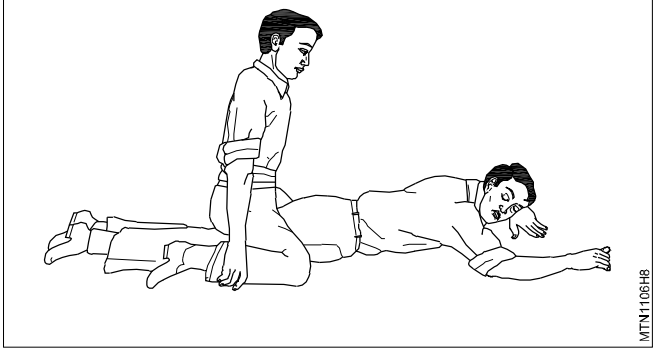
Fig 2



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 3



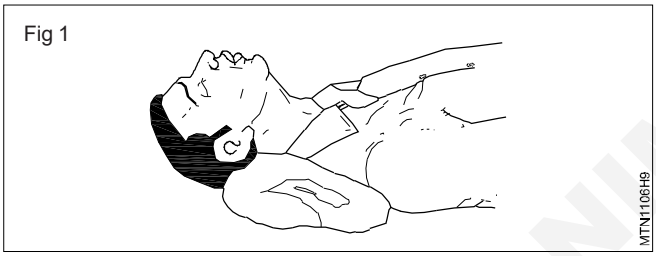
6 Continue artificial respiration till the victim begins to breathe naturally.

— — — — — —

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

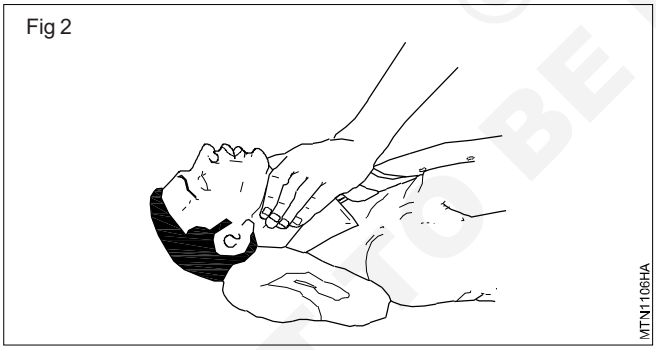
1 Lay the victim flat on his back and place a roll of clothing under his shoulders to ensure that his head is thrown well back. (Fig 1)

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.

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 3

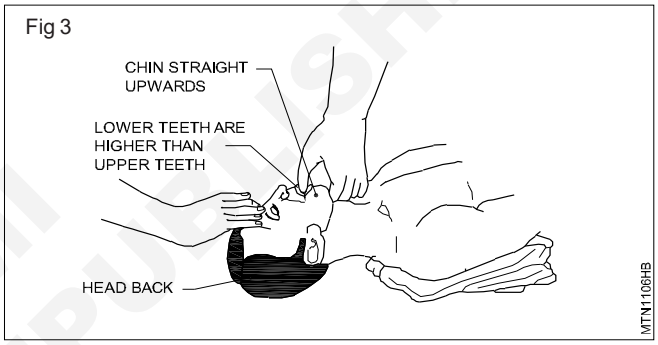
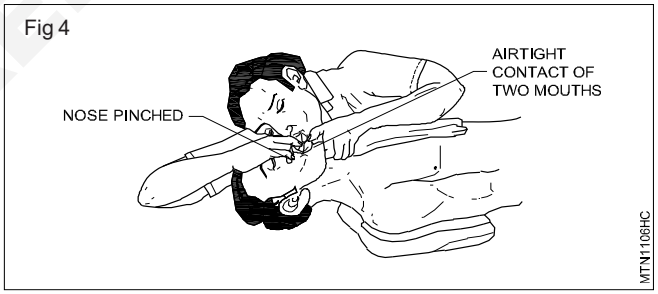


Fig 4



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

MTN1106HD

— — — — — — — —

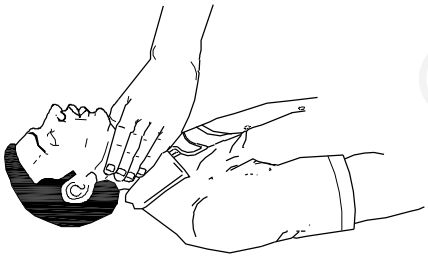
TASK 6: **Resuscitate a victim who is under cardiac arrest (CPR) cardio pulmonary.**

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

1 Check quickly whether the victim is under cardiac arrest. (Fig 1)

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

Fig 1

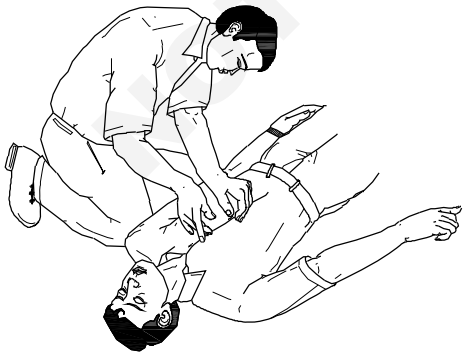


MTN1106HE

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)

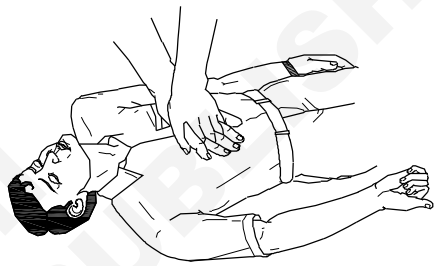
Fig 2



MTN1106HF

4 Place the palm of one hand on the center 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



MTN1106HG

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

Fig 4

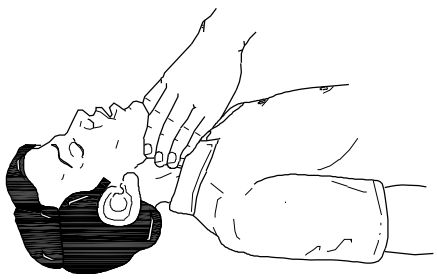
MTN1106HH

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

7 Check the cardiac pulse. (Fig 5)

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

Fig 5



MTN1106HI

Fig 6

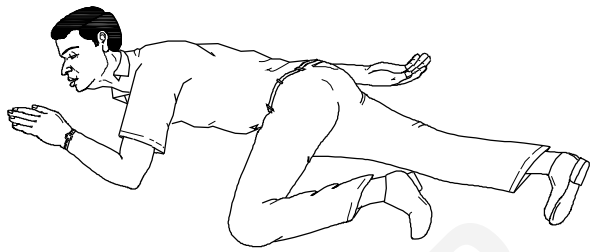
MTN1106HJ

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- mouth 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



MTN1106HK

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.

— — — — — — —

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 breakers out.
   a by raising your voice and shouting Fire! Fire! to call the attention of others.
   b running towards fire alarm/bell to actuate it.
   c other means.

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

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

4 If you are involved in fire fighting.
   a take instructions/give instructions for an organized way of fighting the fire. If taking instructions.
   b follow the instructions, and obey, if you can do so safely; do not risk getting trapped.

If giving instructions.
   c assess the class of fire
   d send for sufficient assistance and inform the fire brigade
   e locate locally available suitable means to put out the fire
   f 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)
   g 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 investigation of the cause of the fire. It helps to prevent the same kind of accident occurring again.

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

Skill Sequence

Fire safety

Objective: This shall help you to
- **state the fire safety.**

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

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

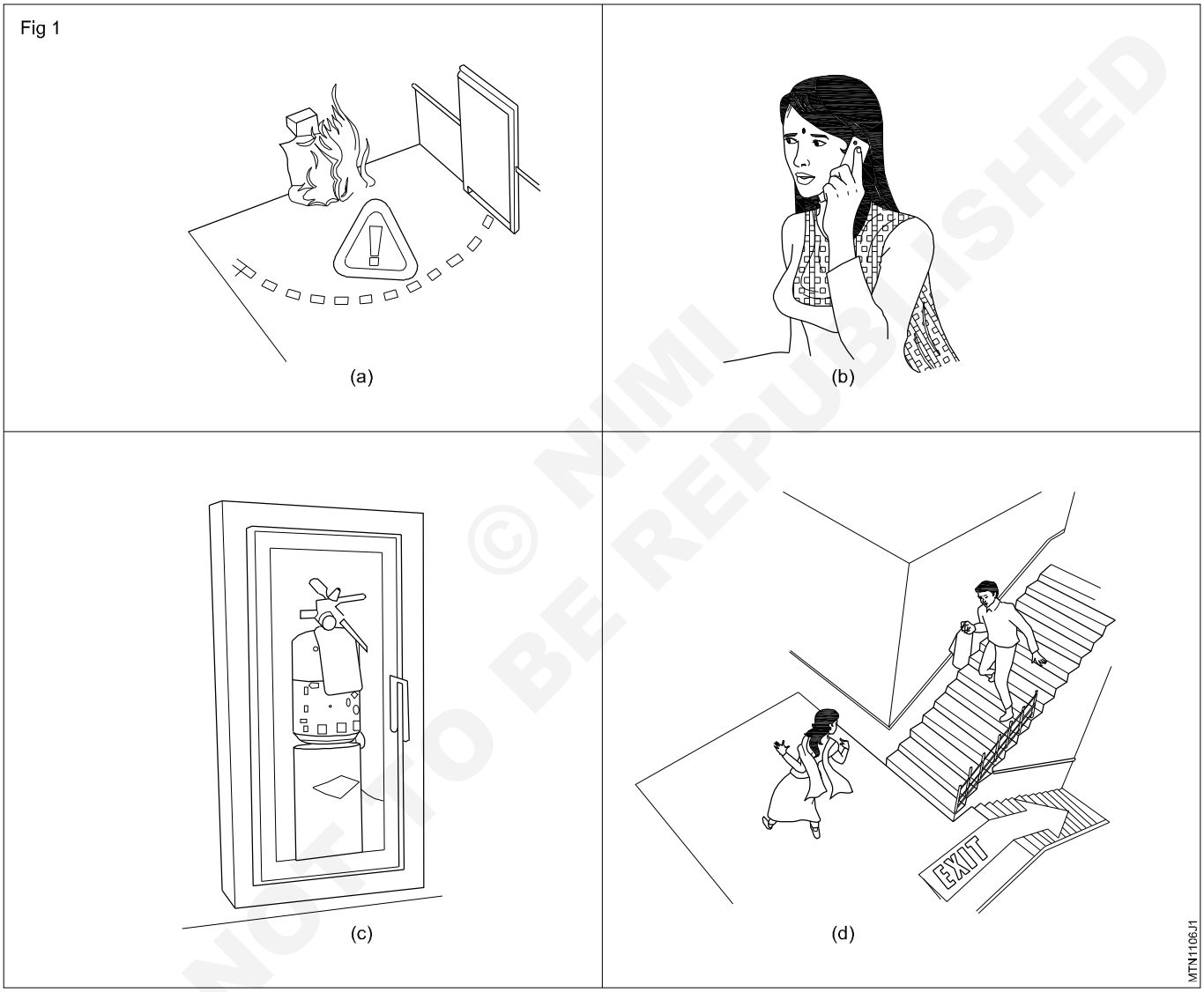
Open emergency exit and ask them to go away. (Fig 1c & 1d)

Put "Off" electrical power supply.

Do not allow people to go nearer to the fire

Analyze and identify the type of fire.

Fig 1



Practice on use the fire extinguishers

Objectives: At the end of this exercise you shall be able to
- **identify the type of fire**
- **operate the fire extinguishers.**

Scan the QR code to view the video for this exercise

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipments / Machines

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

Materials / Components

- Cotton waste - as reqd.
- Soap oil - as reqd.
- Used tyre - as reqd.
- Fire wood - as reqd.
- Kerosene - as reqd.

PROCEDURE

1 Identify the type of fire

2 Select the suitable fire extinguishers from Table - 1

3 Wear personal safety equipment

4 Follow the fire extinguisher operating procedure.

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

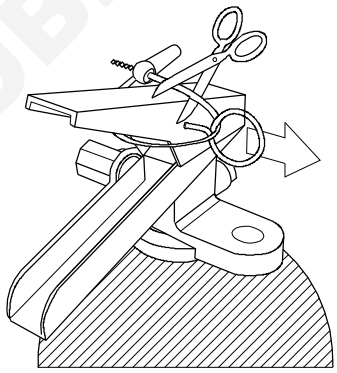
6 Select CO_2 (carbon dioxide) fire extinguisher

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

8 Break the seal. Fig 1

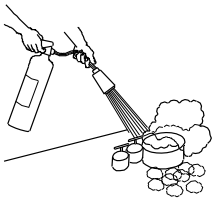
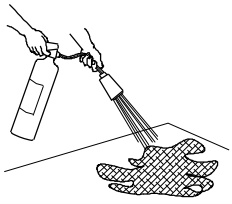
9 Pull the safety pin from the handle (Pin located at the top of the fire extinguisher) (Fig 2)

Fig 1



10 Aim the extinguisher nozzle or hose at the base of the fire (this will remove the source of fuel fire) (Fig 3)

Table1

Class 'A'	Wood, paper, cloth, solid material	
Class 'B'	Oil based fire (grease, gasoline, oil) & liquefiable solids	

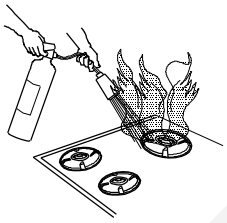
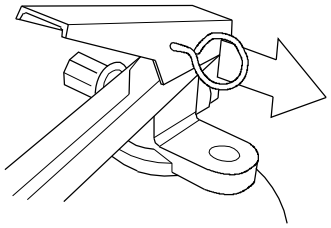
Class 'C'	Gas and liquefied gases	
Class 'D'	Metals and electrical equipment	

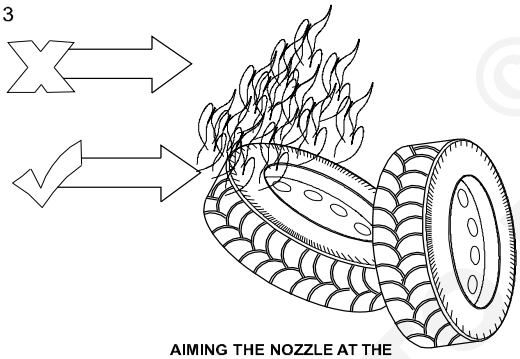
Fig 2



PULLING THE SAFETY PIN

MTN1107H2

Fig 3



AIMING THE NOZZLE AT THE BASE OF THE FIRE

MTN1107H3

Keep your self low

11 Squeeze the handle lever slowly to discharge the agent (Fig 4)

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.

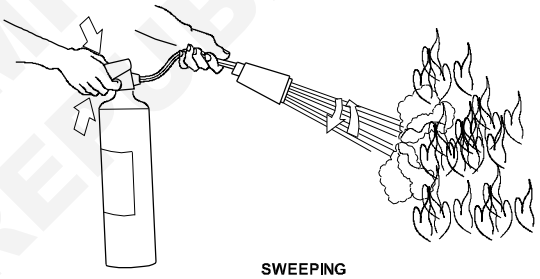
Caution

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 yourself away from the fire point.

Fig 4



SWEEPING

MTN1107H4

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.

Determine the energy consumption

Objectives: At the end of this exercise you shall be able to
- **prepare the table and list the devices 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 for listing the devices with their actual energy ratings (wattage) and hours of use.

Table 1

Applications	Approximate 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 Lamps	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 conditioner	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

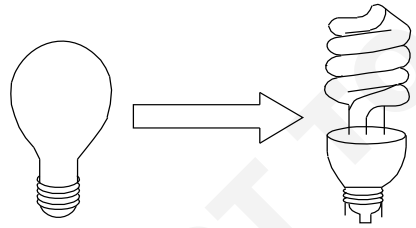
Month	Last year (A)		Current Year (B)		Units saved / Excess (B-A)
	No. of Units	Bill Amount (Rs)	No. of Units	Bill Amount (Rs)	Amount Saved / Excess (Rs) (B-A)
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					

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)

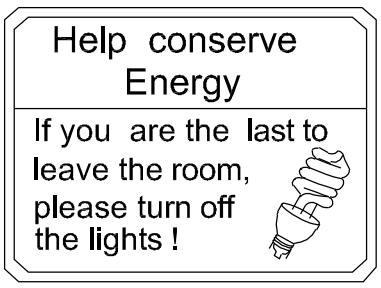
Fig 1



MTN1108H1

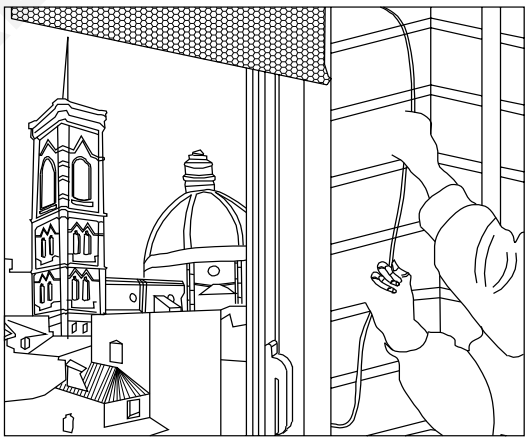
3 Post a friendly reminder in each room to prompt students and teachers to turn off lights when not in use. (Fig 2)

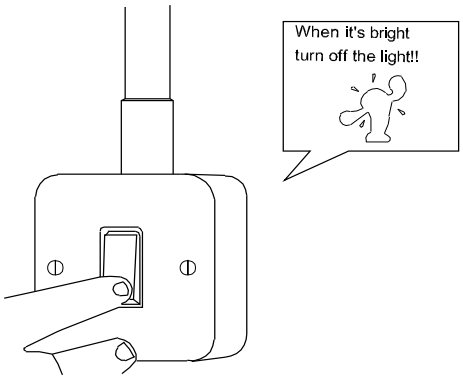
Fig 2



MTN1108H2

Fig 3





MTN1108H3

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)

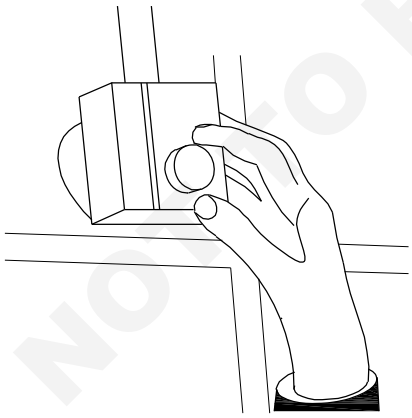
Fig 4

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)

Fig 5



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

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.

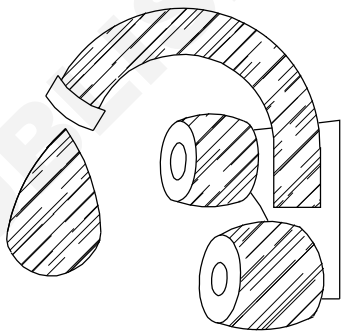
17 Water costs money, so savings it is a good idea.

18 Install water displacement devices in WC cisterns.

19 Turn off urinals during the holidays, or install automatic systems 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.
- Scriber, Divider, 'V' groove - 1 No. each
- Bevel Protractor - 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 / Components

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

PROCEDURE

Use various marking tools

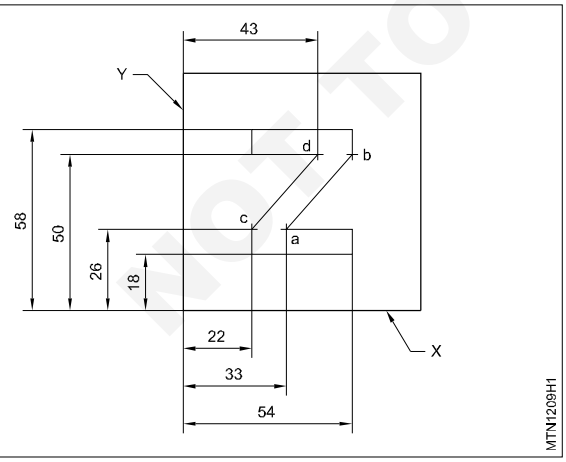
Marking 1

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)

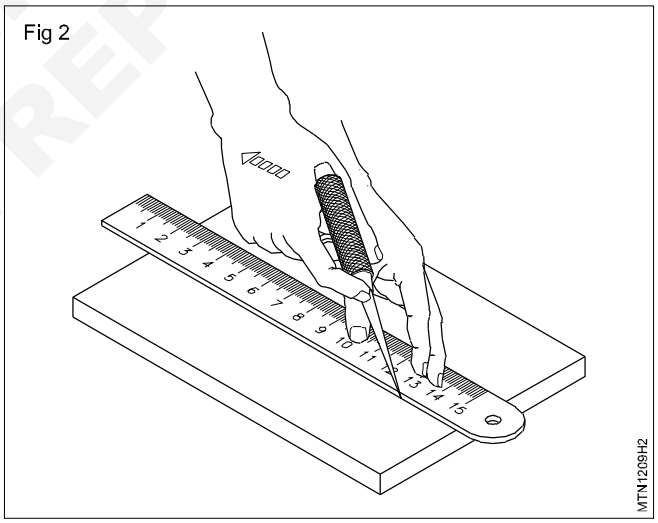
Fig 1



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)

Fig 2



5 Punch witness marks and complete 'Z' shape

Marking 2

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

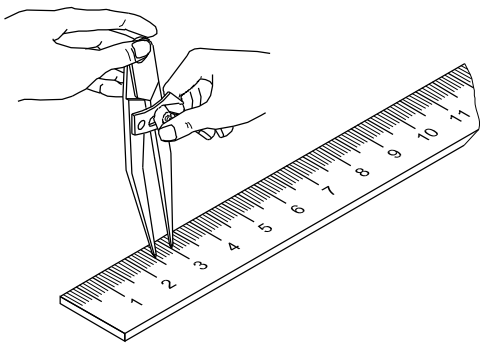
7 Mark the center lines of three circles and one semicircle using the jenny caliper.

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

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

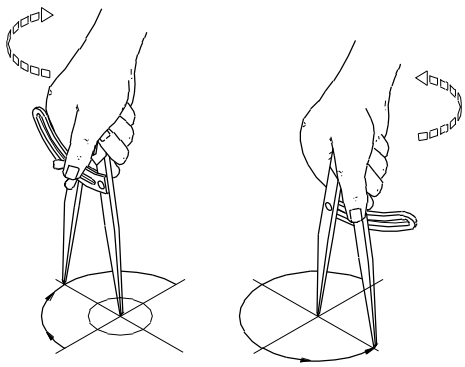
Make sure that both the legs of the divider are of equal length.

Fig 3



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

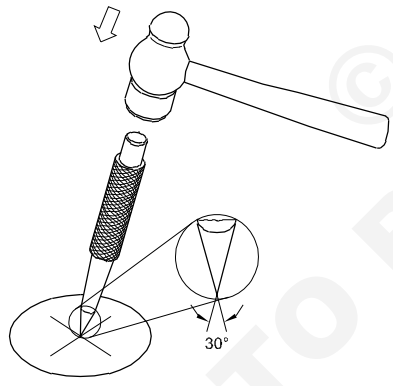
Fig 4



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

12 Punch witness marks on the circles and semicircles. (Fig 5)

Fig 5



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.

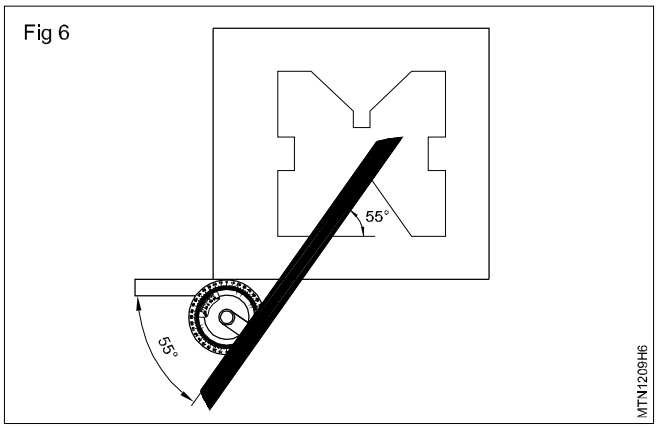
16 Mark all the parallel lines to the edges using the surface gauge.

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

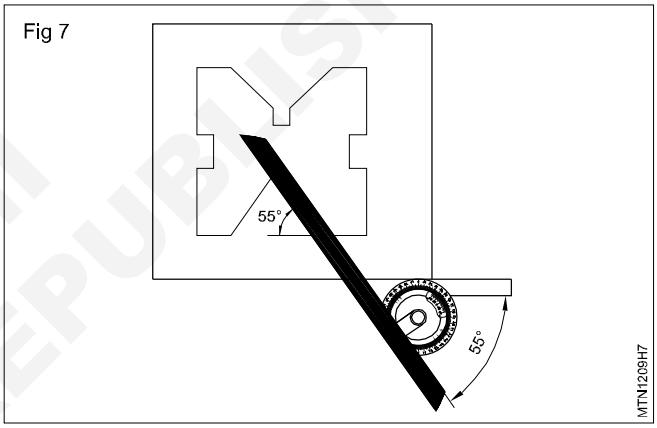


20 Continue the same procedure and complete the 44° Vee groove.

21 Complete the Vee block marking.

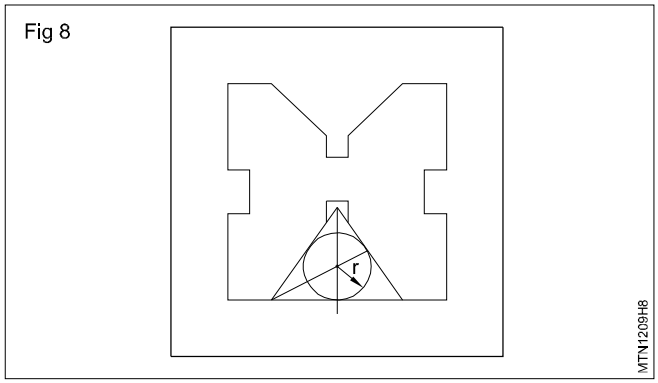
22 Bisect any two sides of the triangle formed by the 55° Vee groove, and get the center and radius of the circle. (Fig 7)

Fig 7



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

Fig 8



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

25 Punch witness marks.

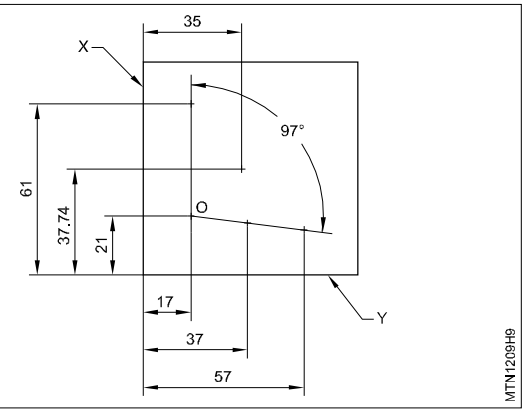
Marking 4

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

27 Scribe the center lines and parallel lines to the edges ‘x’ and ‘y’. (Fig 9)

28 Set 97° on the bevel protractor.

Fig 9



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

30 Punch center marks on all the four circles.

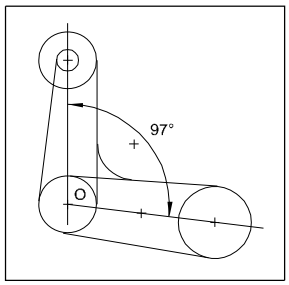
31 Draw all the four circles using a divider.

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.

Fig 10



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.**

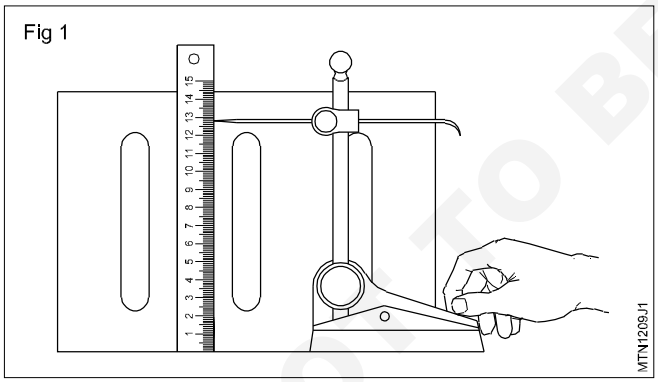
Check the free movement of the scriber and other sliding units.

Clean the base of the surface gauge.

Keep the surface firmly on the surface plate.

Reset 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.

But 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)

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 3)

Fig 2

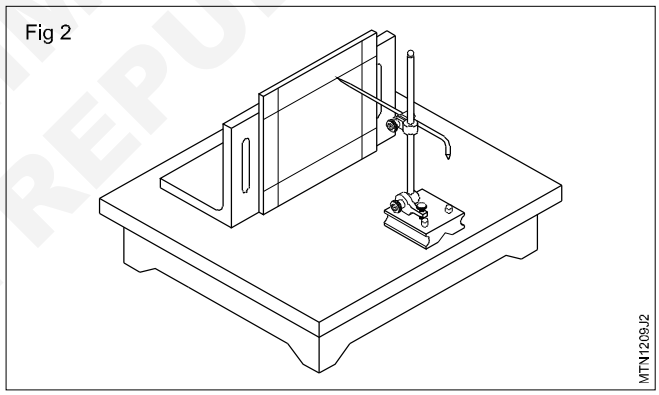
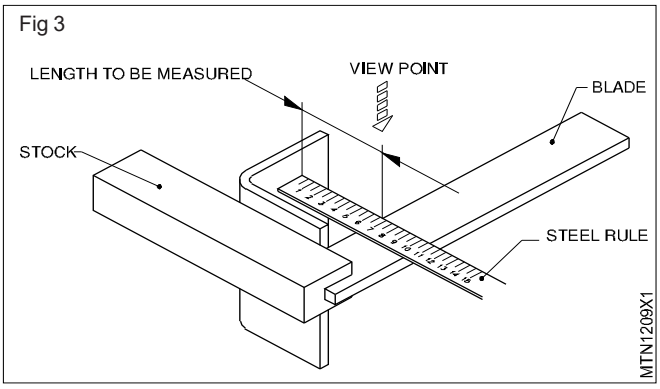


Fig 3

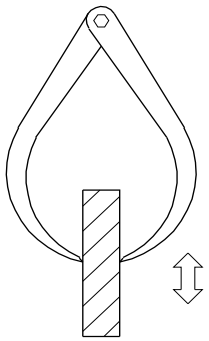


Transfer the set dimension to the job. (Fig 4)

Incline slightly and move the jenny caliper with uniform speed and mark lines. (Fig 5)

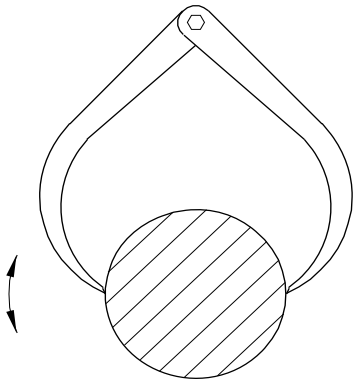
Make witness marks on the lines marked using a 60° prick punch. The witness marks should not be too close to one another. (Fig 6)

Fig 4



MTN1209X2

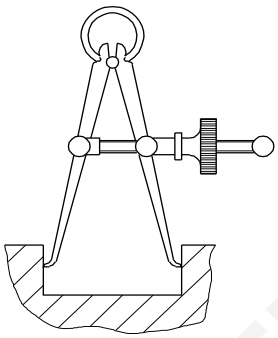
Fig 5



MTN1209X3

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

Fig 6



MTN1209X4

Practice on chipping

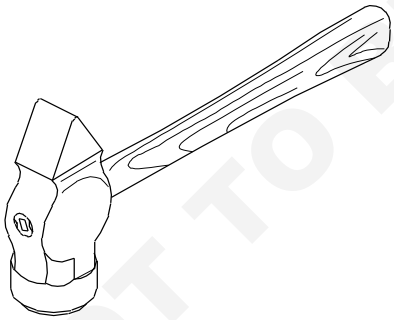
Objective: This shall help you to

- **chip metals observing safe practices.**

Remove burrs.

Before commencing the chipping operation we must ensure the following. (Fig 1)

Fig 1



MTN1209Y1

The hammer-head must be properly secured.

Wipe off oily substances, if any, from the face of the hammer.

The chisel head must be free from mushroom formation. (Fig 2)

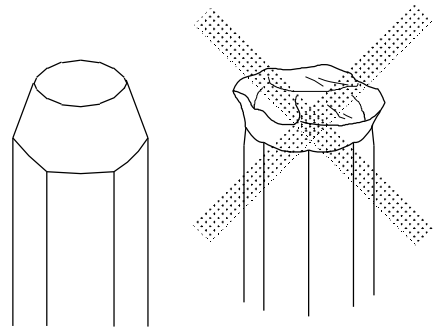
Wear safety goggles

Remove bangles & wrist watch.

Install chip-guard against chips flying off. (Fig 3)

The work must be properly gripped in the vice. If necessary, support the work on the wooden block. (Fig 4)

Fig 2



MTN1209Y2

While chipping, look at the cutting edge of the chisel, and not at the head of the chisel. (Fig 5)

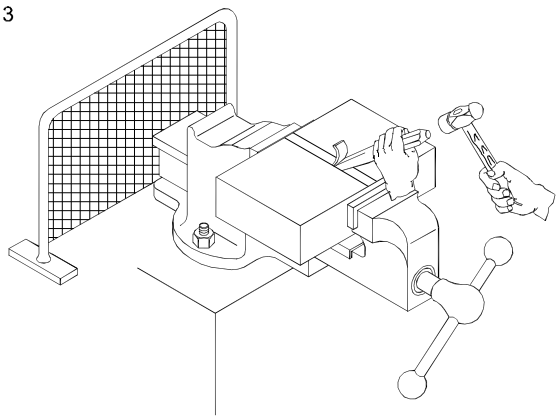
Position the chisel in such a way as to cut the metal in uniform thickness. (Fig 6)

Stop chipping before the end of the surface; otherwise, the edge of the job will break off.

To prevent this, chip the end of the job from the opposite direction. (Fig 7)

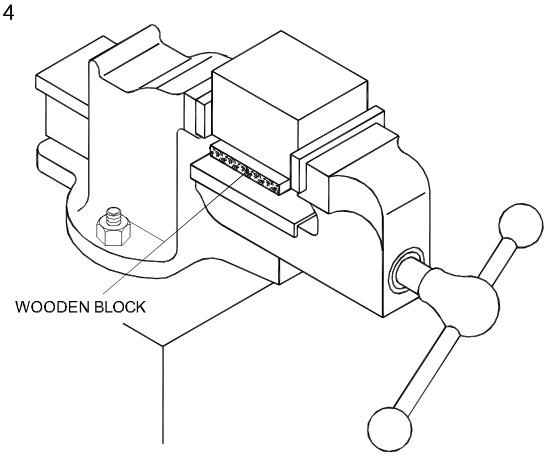
Hold the hammer at the end of the handle for maximum leverage. (Fig 8)

Fig 3



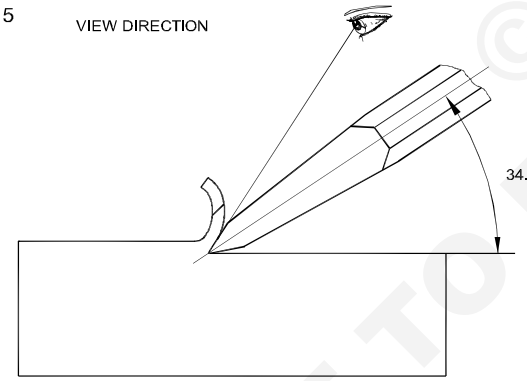
MTN1209Y3

Fig 4



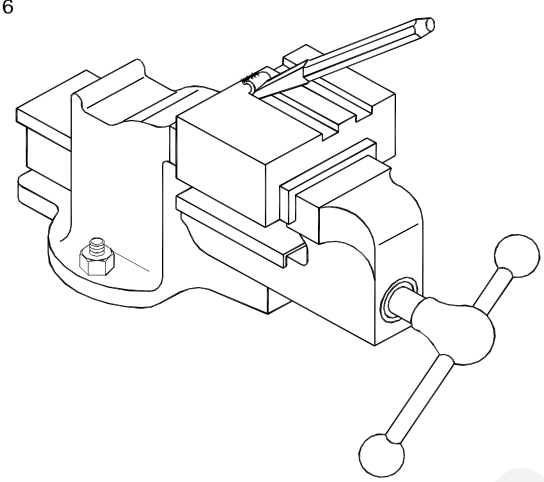
MTN1209Y4

Fig 5



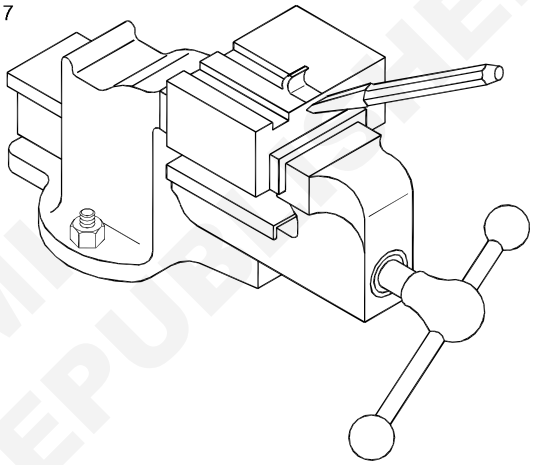
MTN1209Y5

Fig 6



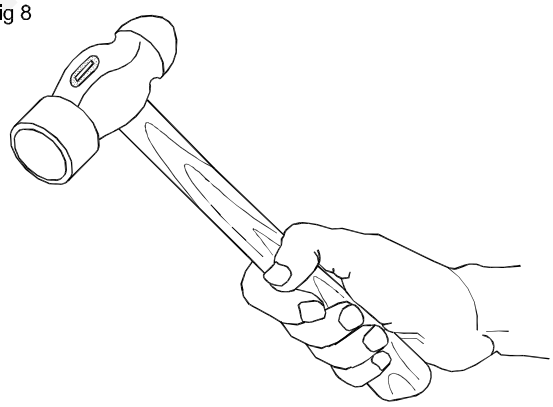
MTN1109X6

Fig 7



MTN1209Y7

Fig 8



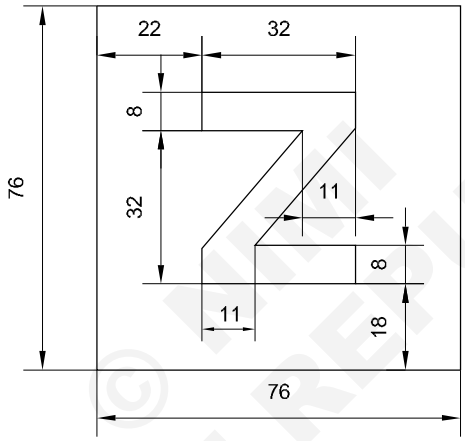
MTN1109X8

Layout and marking

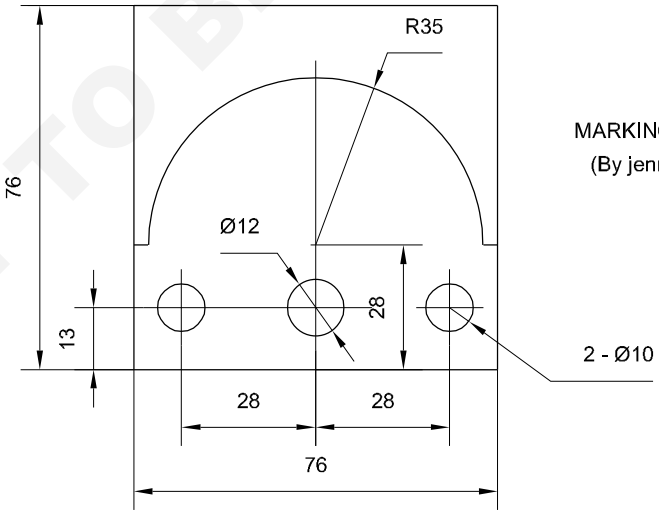
Objectives: At the end of this exercise you shall be able to

- **draw lines on metallic surfaces by scribers and 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 and draw circles with a divider**
- **draw curves and tangents with dividers steel rule and scribers**
- **register the profile by dot punching and punch the centre of the circle with a centre punch and ball-peen hammer.**

Scan the QR code to view the video for this exercise



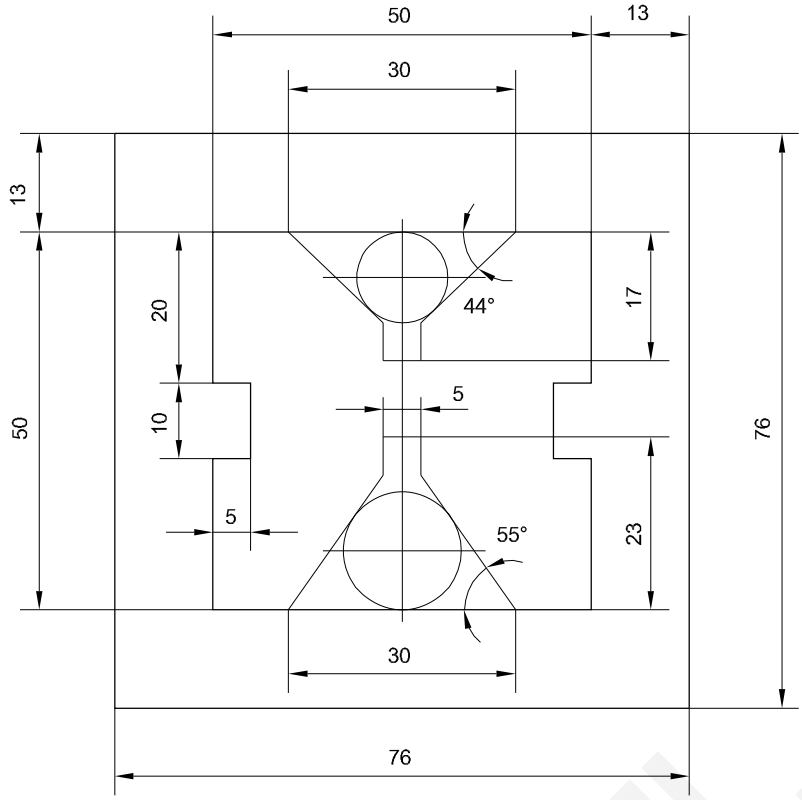
MARKING PARALLEL LINE
(By jenny caliper and scriber)



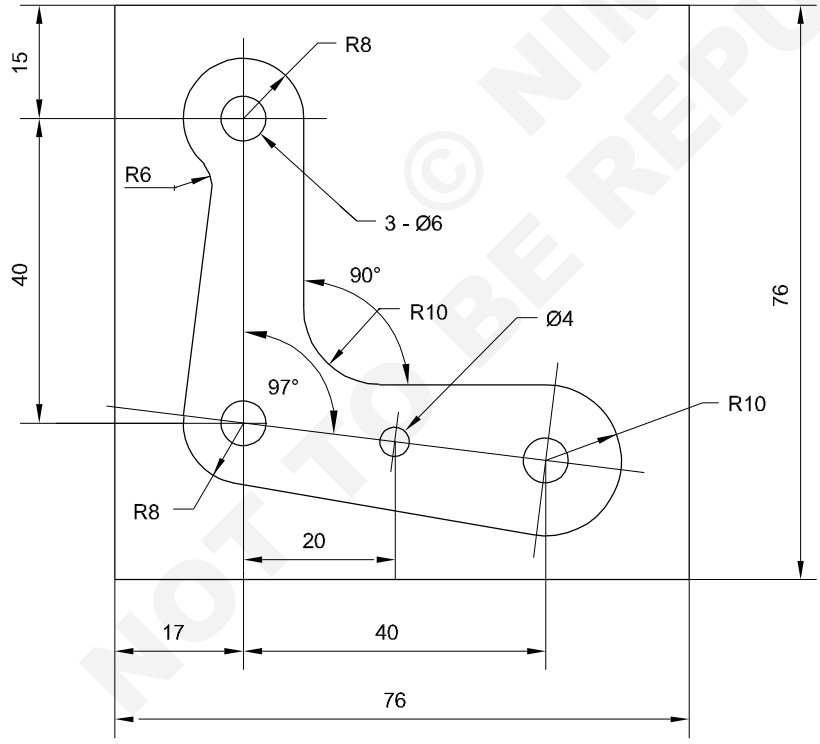
MARKING CURVES & CIRCLES
(By jenny caliper and divider)

1	-	1 - 05	Fe310	-	-	1.2.10
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX.NO.

SCALE 1:1	LAYOUT & MARKING	DEVIATIONS ±0.1
		CODE NO. MTN1210E1



MARKING ANGLES & CIRCLES



MARKING TANGENTS & ARCS

1	-	-	Fe310	-	-	1.2.10
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX.NO.

SCALE 1:1	LAYOUT & MARKING	DEVIATIONS ±0.1	
		CODE NO. MTN1210E2	

PROCEDURE

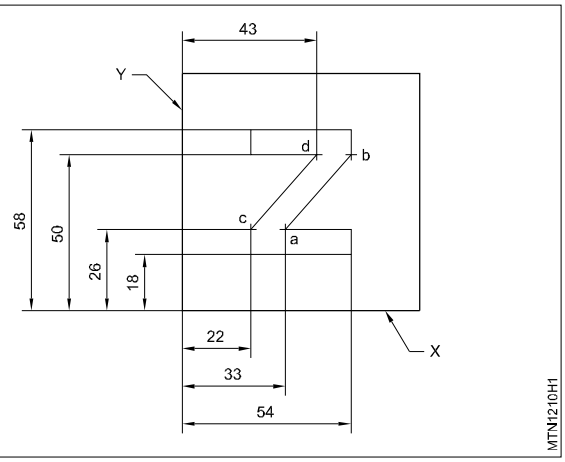
Marking 1

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)

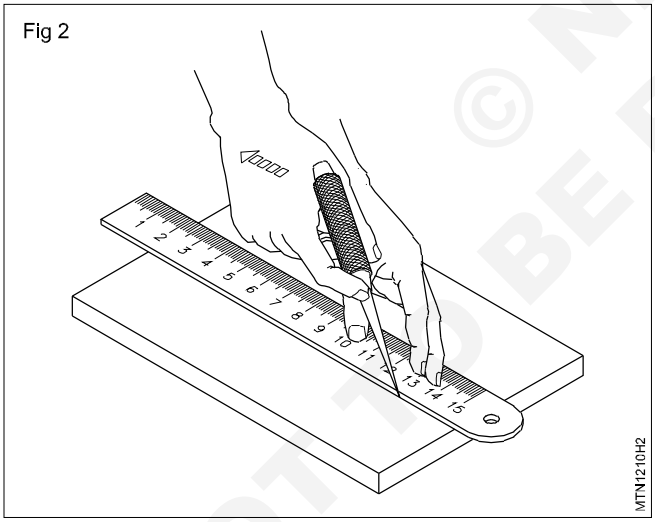
Fig 1



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

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

Fig 2



5 Punch witness marks and complete ‘z’ shape.

Marking 2

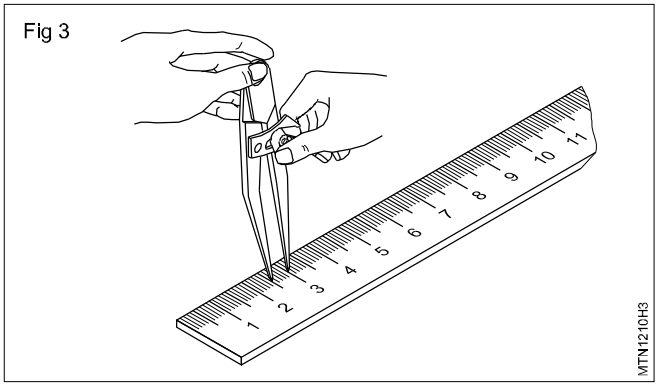
1 Apply the marking medium on the other side of the job and allow it to dry.

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

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

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

Fig 3



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

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

Fig 4

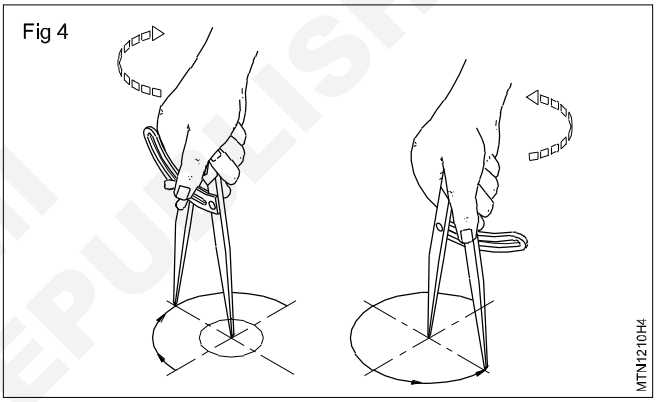
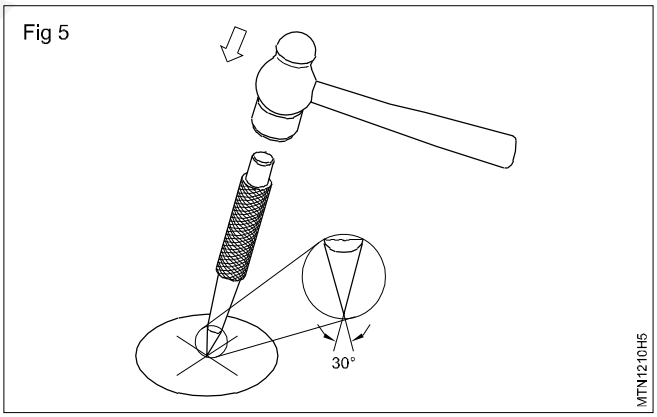


Fig 5



6 Set the divider and draw ∅ circle and R35 semicircle.

7 Punch witness marks on the circles and semicircles.

Reuse the same material for marking 3 and 4

Marking 3

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

2 Apply copper sulphate solution on the finished side.

3 Butt the against the angle plate.

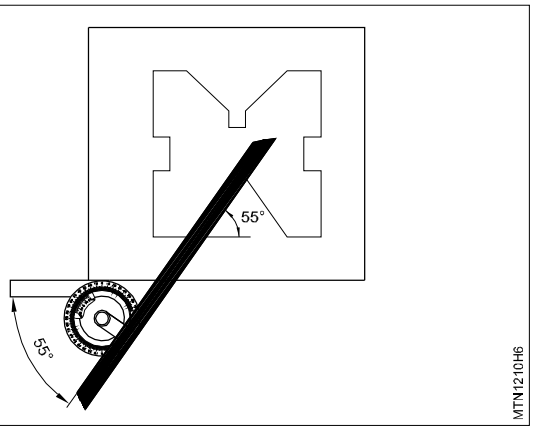
4 Mark all the parallel lines to the edges using the surface gauge.

5 Also mark the starting points of the Vee groove.

6 Set and lock the bevel protractor at 55°.

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

Fig 6

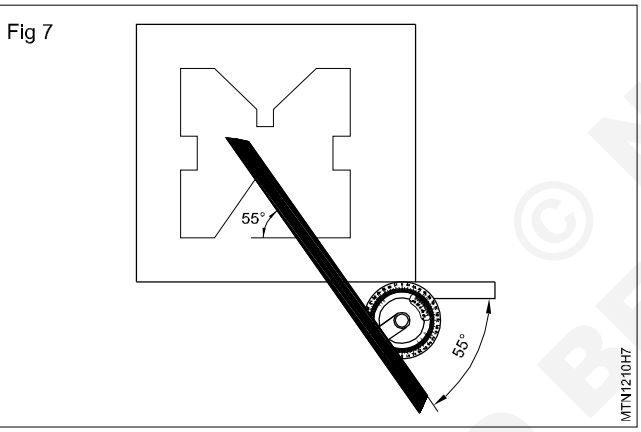


8 Continue the same procedure and complete the 44° Vee groove.

9 Complete the Vee block marking.

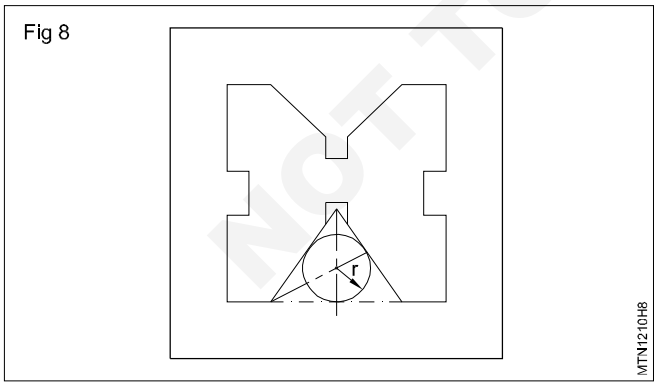
10 Bisect any two sides of the triangle formed by the 55° Vee groove, and get the centre and radius of the circle. (Fig 7)

Fig 7



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

Fig 8



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

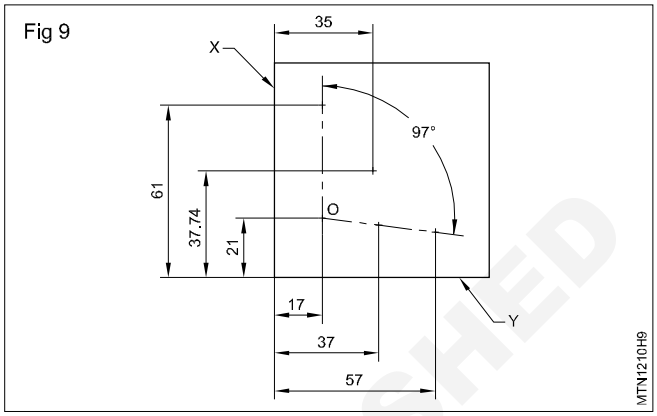
13 Punch witness marks.

Marking 4

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

2 Scribe the centre lines and parallel lines to the edges ‘x’ and ‘y’. (Fig 9)

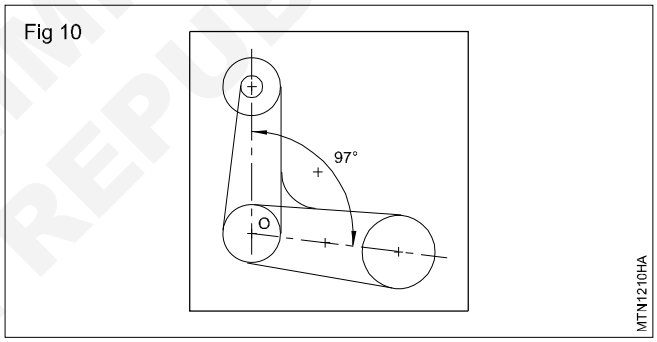
Fig 9



3 Set 97° on the bevel protractor.

4 Mark 97° line through point ‘O’ and get the centres of the other two circles. (Fig 10)

Fig 10



5 Punch centre marks on all the four circles.

6 Draw all the four circles using a divider.

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

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

9 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.

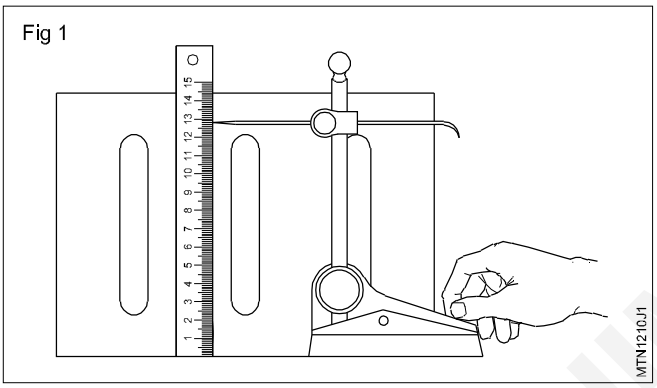
Clean the base of the surface gauge.

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)

Make sure that the job has no burrs and has been properly cleaned.

Fig 1

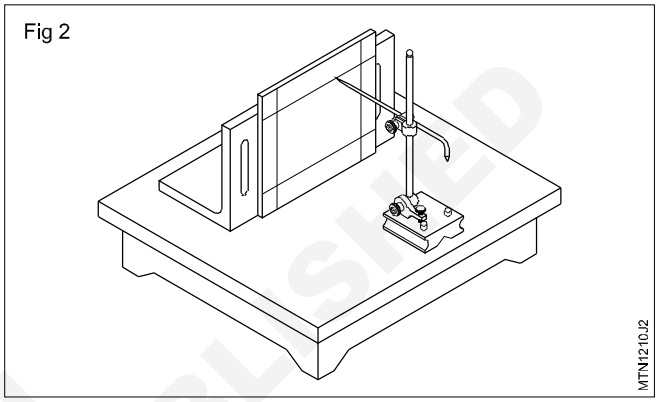


Apply a thin and even coating of the marking media.

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



Practice to measure wheel base by using tape and plumb bob

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

- **measure a wheel base of a motor cycle with a measuring tape and plumb bob.**

Requirements

Tools / Instruments

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

Equipments / Machinery

- Motor cycle - 1 No.

Materials / Components

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

PROCEDURE

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

2 Make the wheels straight ahead

3 Apply the vehicle brake

4 Apply wheel chokes on front and rear wheels

5 Use the plumb bob (Fig 2) and mark the motor cycle front wheel centre (from the side view of vehicle) on the ground. (Fig 1)

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

7 Select the proper length of measuring tape and release the lock of the tape and pull it out for measurement.

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

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

10 Measure the wheel base using measuring tape between the two markings. (Centre of front wheel and centre of rear wheel) (Fig 3)

11 Take the measurement and check with the manufactures specified wheel base data.

Fig 1

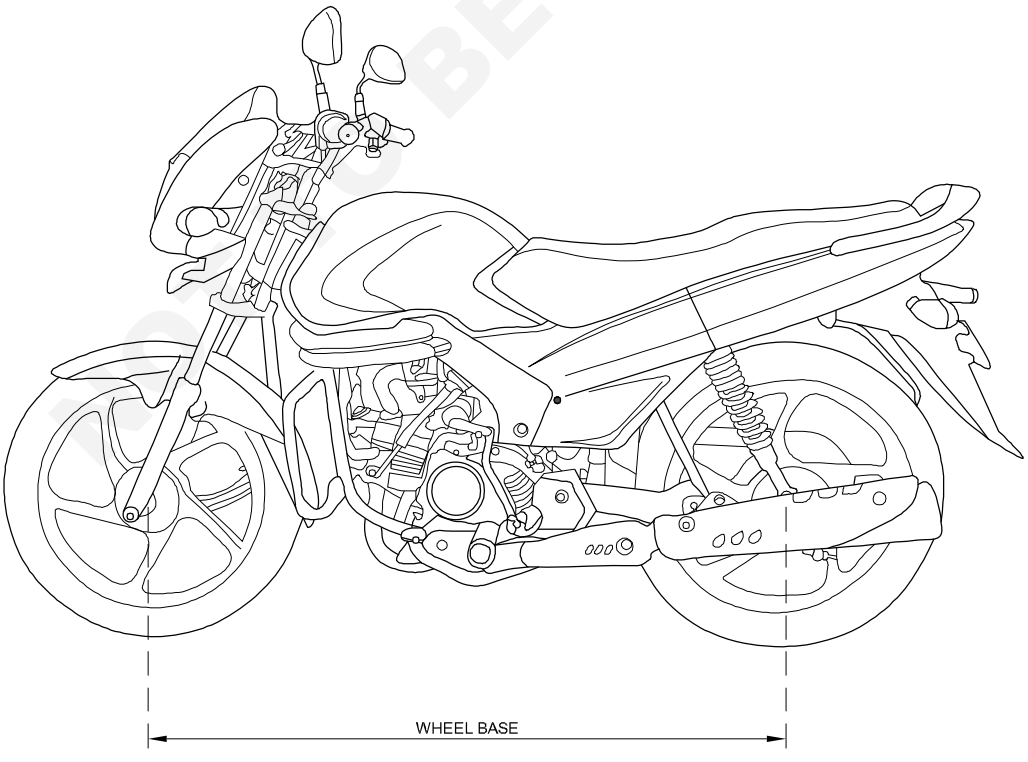
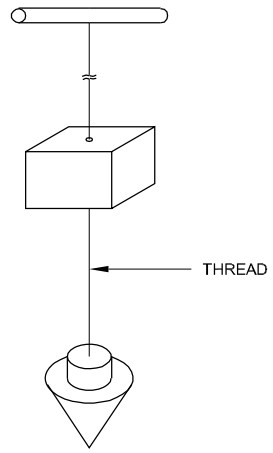
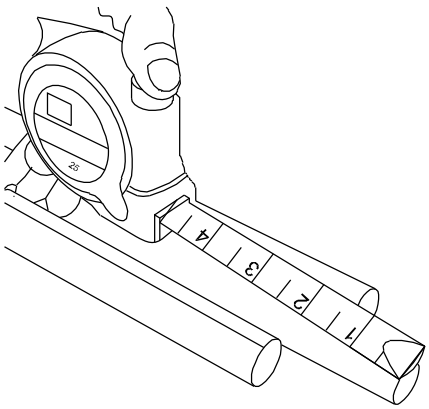


Fig 2



MTN1211H2

Fig 3



MTN1211H3

Remove wheel nut by using impact wrench

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.**

Scan the QR code to view the video for this exercise

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Air impact wrench - 1 Set.

Equipments / Machinery

- motor cycle - 1 No.
- Air compressor unit - 1 No.

Materials / Components

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

PROCEDURE

1 Removing wheel lug nut by using impact wrench

2 Park the vehicle on level ground.

3 Apply Hand Brake.

4 Close the all doors.

5 Put wheel chocks to all the wheels of three wheeler.

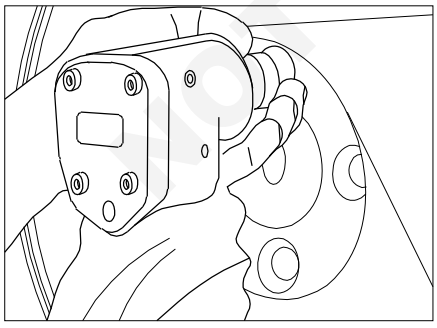
6 Remove the wheel cap.

7 Check the Air impact wrench is connected to the air lines.

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

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

Fig 1



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

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

12 Insert impact sockets on the wheel lug nut.

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

14 After removing all wheel nuts, place one or two nuts on the wheel bolt to avoid slipping of the wheel while jack up 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 general workshop tools

Objectives: At the end of this exercise you shall be able to
- **identify screw driver for specific purpose**
- **identify spanner & wrenches for specific purpose**
- **identify pliers for specific purpose**
- **operate workshop equipments.**

Scan the QR code to view the video for this exercise

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Screw driver - 1 Set.
- Try square - 1 No.

Equipments / Machinery

- Pipe vice - 1 No.
- Pipe cutter - 1 No.

Materials / Components

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

PROCEDURE

TASK 1 : **Identify the screw driver for specific purpose and handle it**

Checking the condition of the fastener to be removed

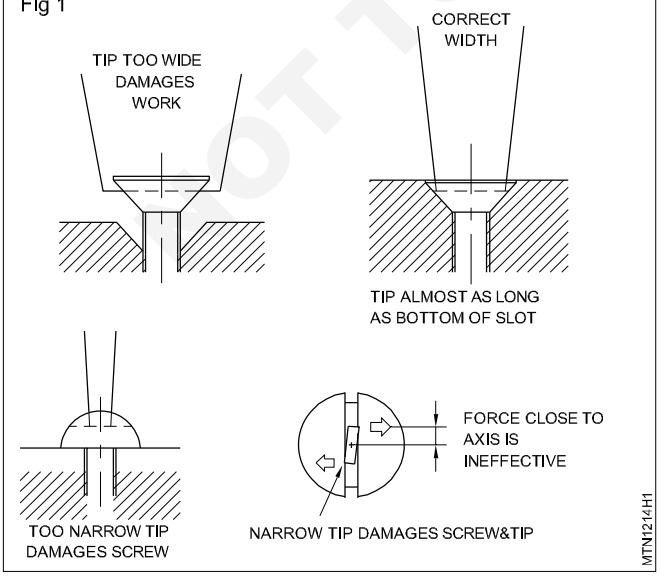
1 Clean the surface of the fastener to be removed by using kerosene, banian cloth.

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)

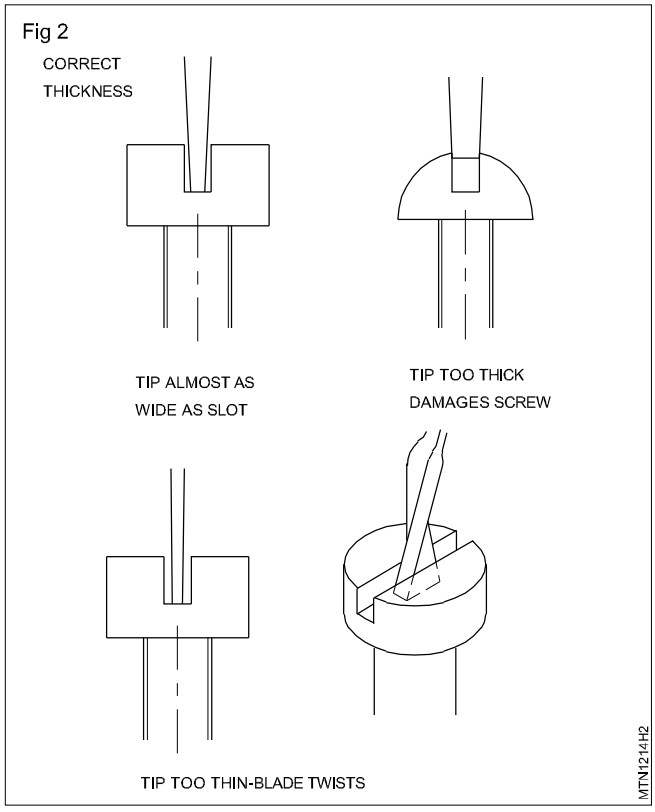
Fig 1



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.

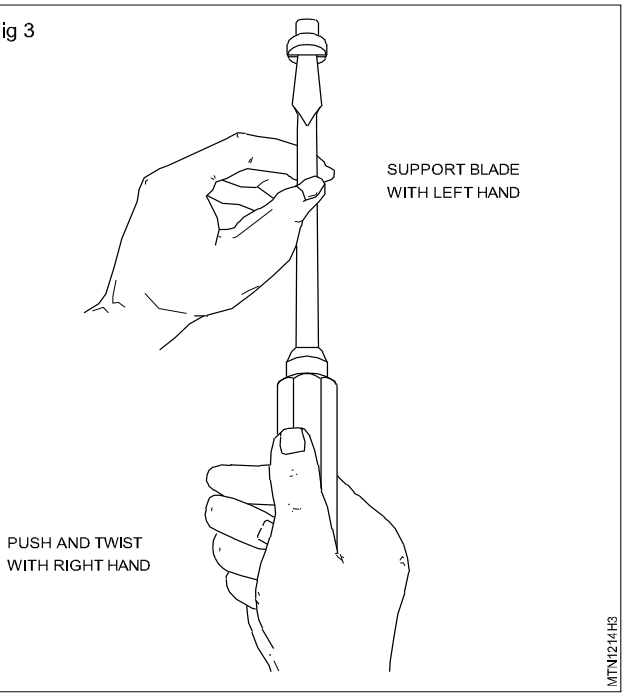
Fig 2



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.

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 4

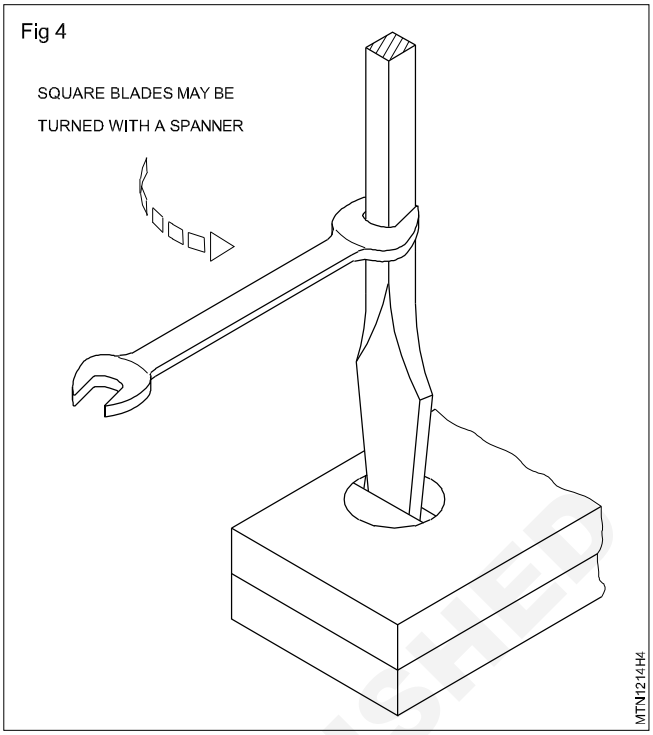
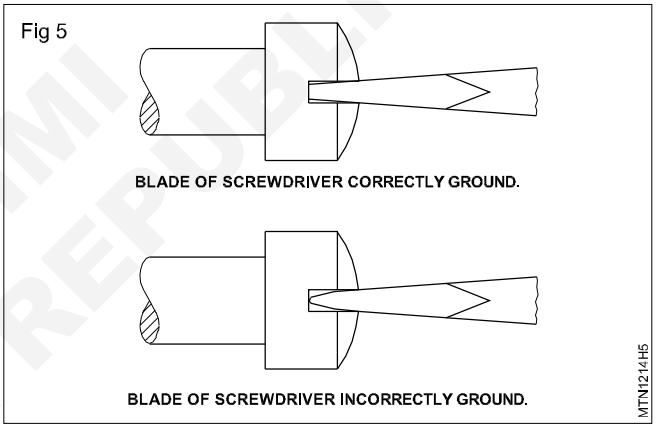
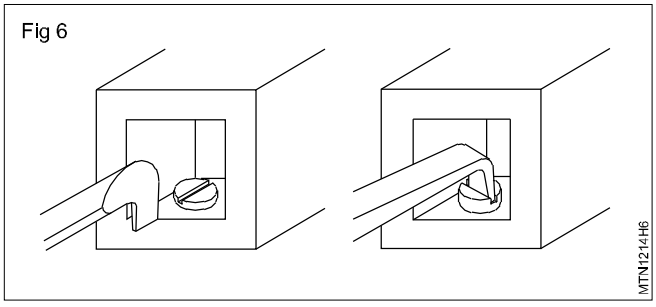


Fig 5



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

Fig 6



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

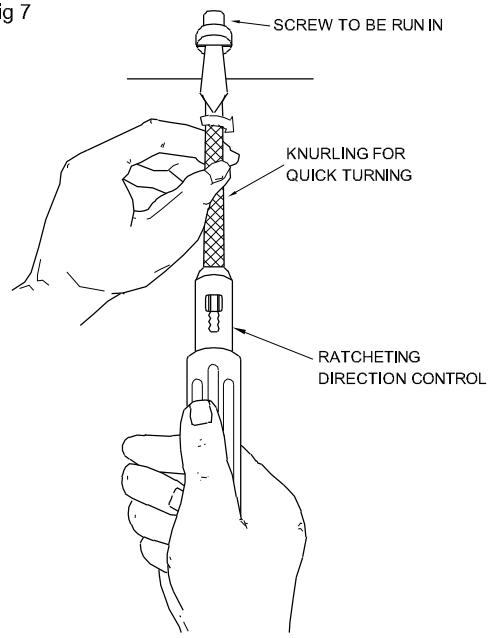
14 Use the other end to get the next quarter turn and so on.

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

17 Change the direction of control depending on your movement.

18 Clean out recess for proper grip (Fig 8).

19 Phillips (cross-recess) screwdrivers tip must fill recess (Fig 9)

Fig 8

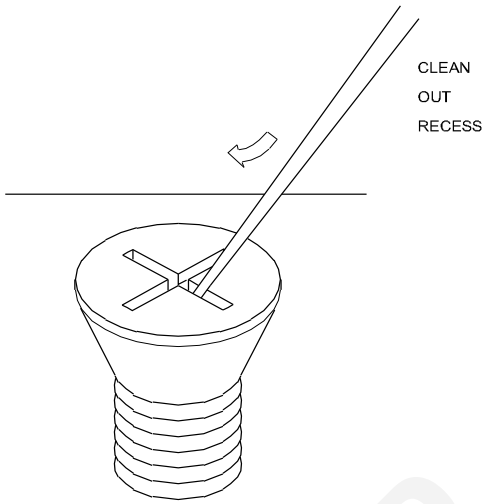
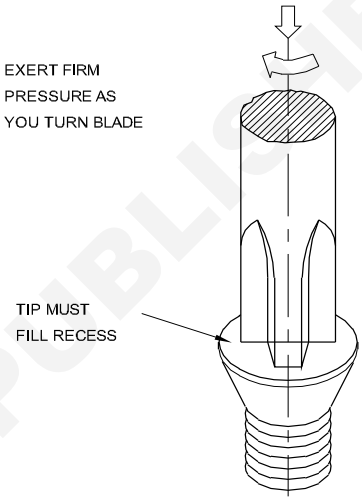


Fig 9



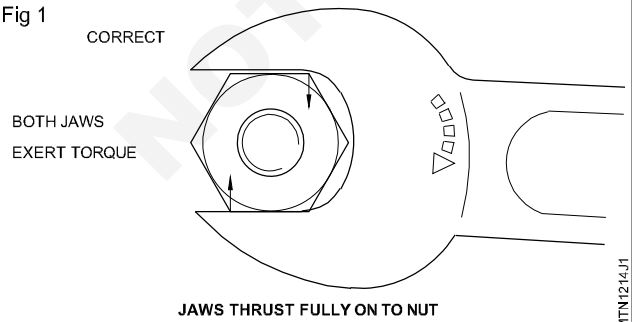
AXES OF SCREW AND THE SCREW DRIVER BE IN LINE

TASK 2 : **Identify spanner & wrenches for specific purpose and handle it**

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

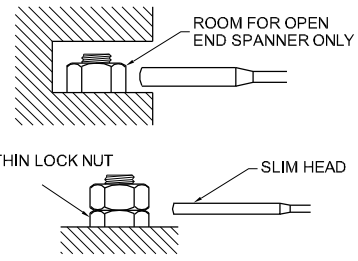


JAWS THRUST FULLY ON TO NUT

2 Decide the size of the spanner.

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

Fig 2



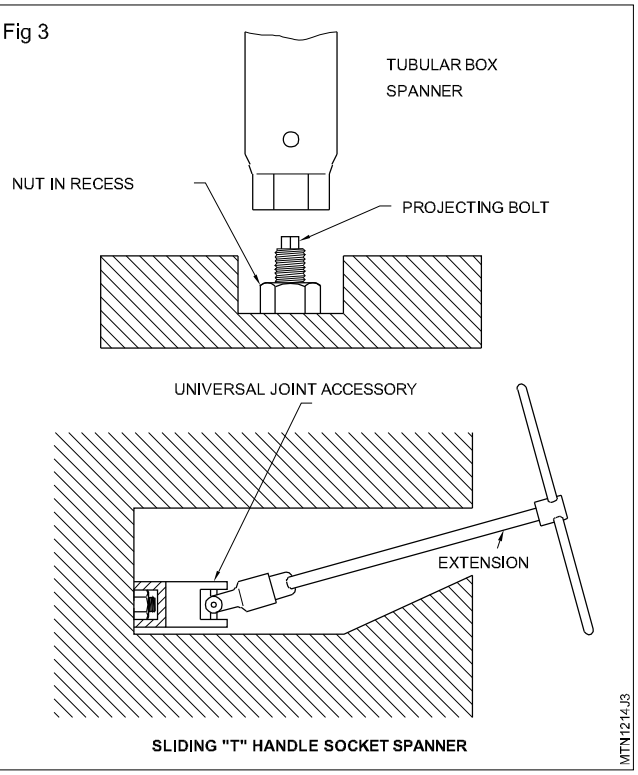
Handling the Tool excess clearance will cause slipping of spanner & fasteners corners gets damaged.

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

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.

Fig 3



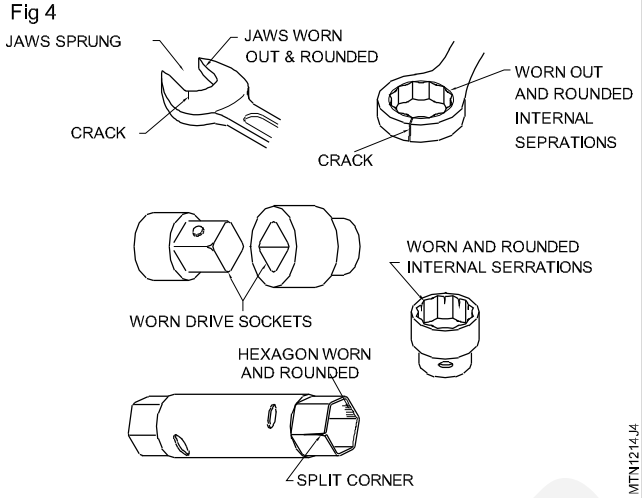
SLIDING "T" HANDLE SOCKET SPANNER

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.

Never use worn out or cracked spanners. They will slip and cause injury.

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**

Use of combination plier

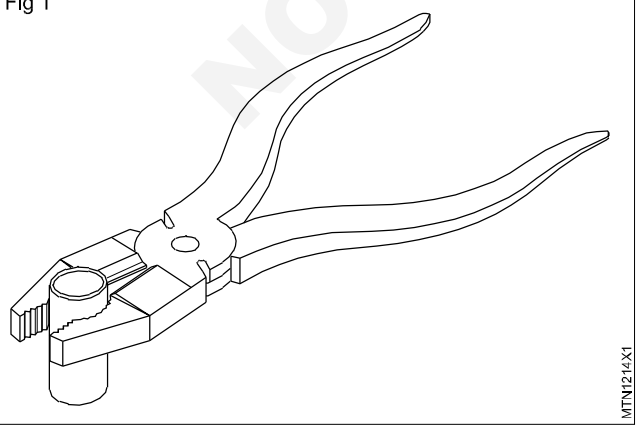
1 Select a component with lock wire to nut, which is to be removed.

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.

Fig 1



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

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

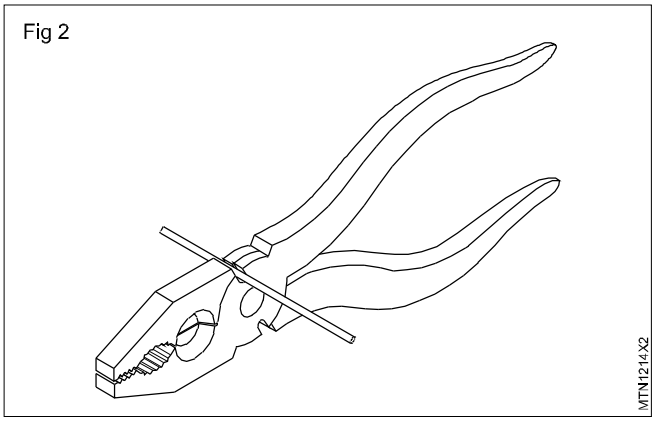
7 Select proper size of proper double open end spanner & remove the union nut.

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)

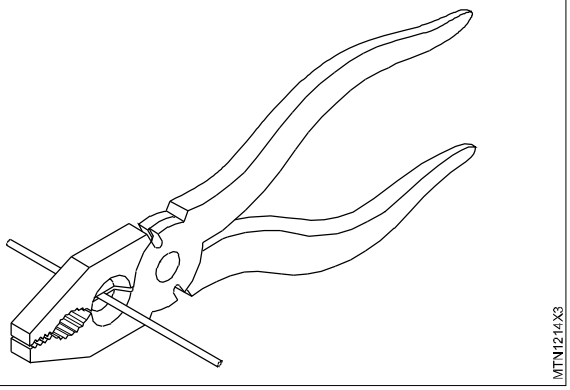
10 Press the handle to cut the wires.

Fig 2



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

Fig 3



12 Place the steel wire in between side cutter.

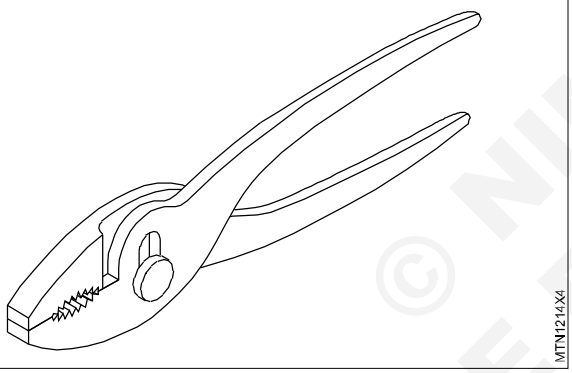
13 Press the handle to cut the wire.

Use of flat nose plier

1 Select a nut with tab washer to be removed.

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

Fig 4



3 Use a proper spanner to remove the nut.

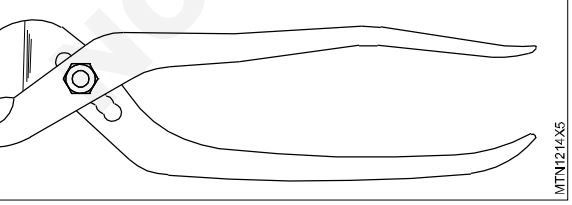
Use of slip joint plier

1 Select a cylindrical component with nut.

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

3 Remove the nut with proper spanner.

Fig 5



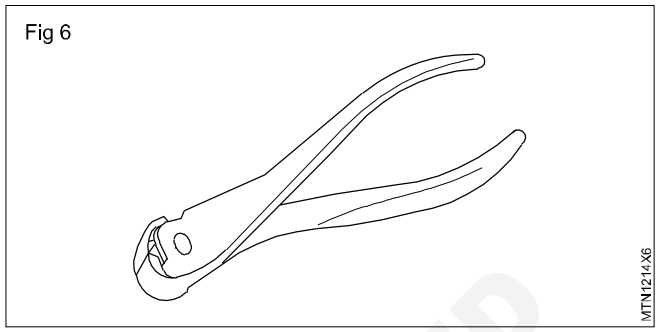
Use end cutting plier

1 Select a wire to be trimmed.

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

3 Apply pressure on handles to cut the wire.

Fig 6



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

5 Cut the steel wire by slip joint multigrip plier applying pressure on the handles.

6 Use the cutting pliers to spread the cotter pin.

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

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

9 Use a proper spanner to remove the locking nut.

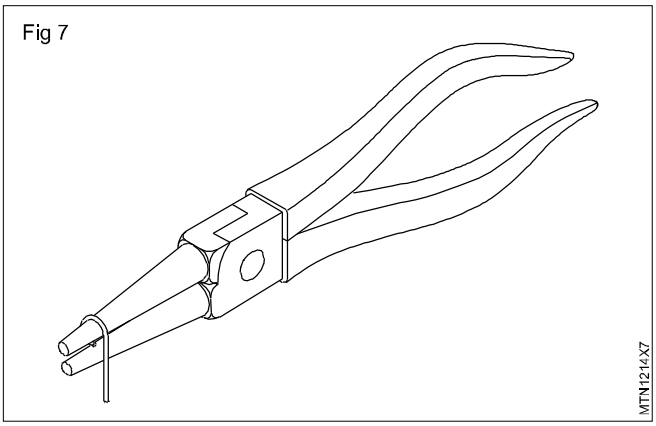
Use of round nose plier

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

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

3 Form a loop by tuning the round nose pliers.

Fig 7



Skill Sequence

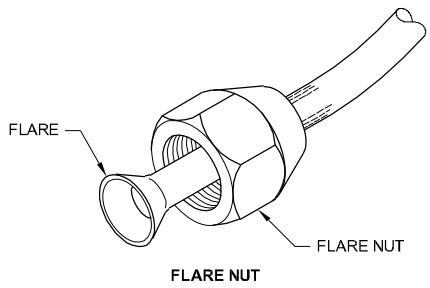
Make flare joints and test them with flare fittings

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

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

Examine the pipe flaring tool. Make sure that you understand how it works before starting to flare the end of a pipe. (Fig 1)

Fig 1



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

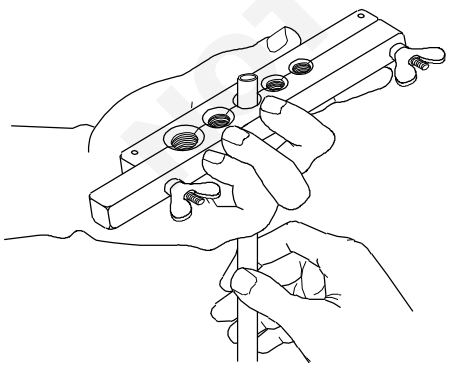
Place the pipe in the tool (Fig 2). Make sure that you have:

a Place the flare nut on the pipe

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

If the pipe is ¼ inch (6 mm) in diameter, position the pipe so that the end is at least 2 mm above the top of the flaring block (Fig 3). (This distance is calculated as "pipe diameter divided by 3"; in this case, 6 mm divided by 3 = 2 mm).

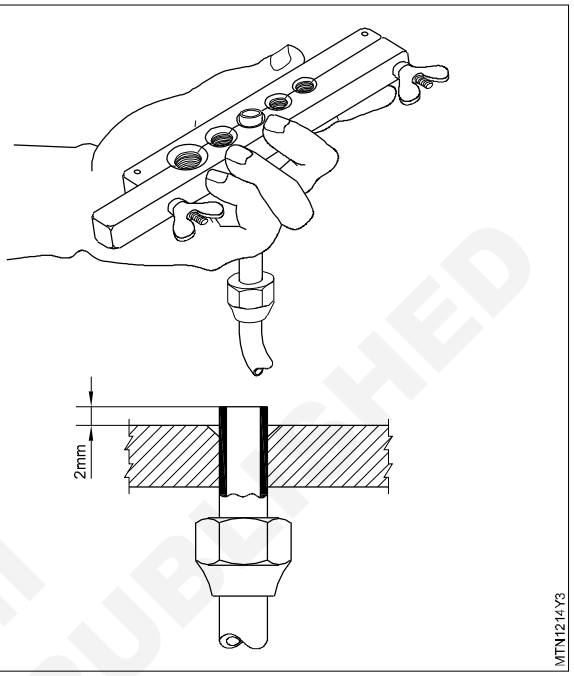
Fig 2



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

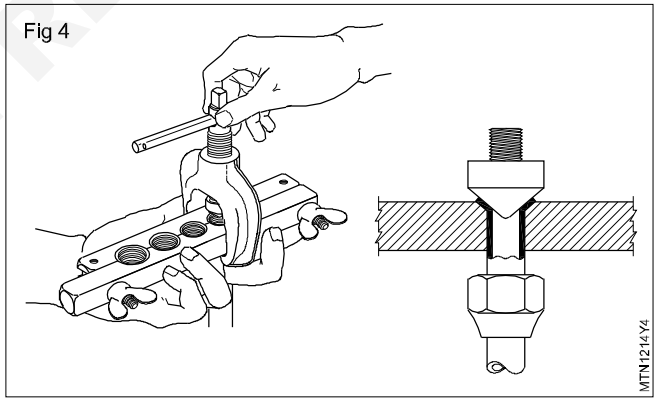
Fit the yoke to the flaring block (Fig 3)

Fig 3



Oil the cone and slowly screw it into the end of the pipe. (Fig 4)

Fig 4



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

Examine the flare. If it has cracked, the cone was screwed 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 at instruction 5.

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

Observation Table - 1

Sl. No.	Skills	Remarks
1	Checking Flaring	Cracked/uneven/too small/ too long/correct
2	Number of attempts	One/two/three

Note: Repeat the steps to the various sizes of copper tube

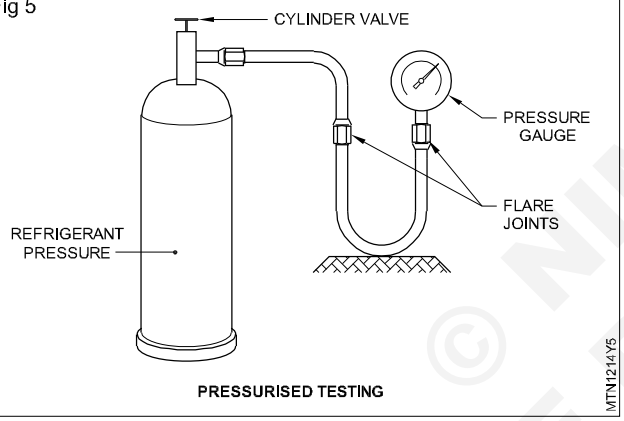
Joining with flare fittings

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)

Fig 5



PRESSURISED TESTING

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.

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

12 Joining the tube firmly, open the cylinder valve with help of valve key or ratchet.

The pressure will be shown in the pressure gauge.

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

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

15 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

Perform handling of puller

Objectives : This shall help you to

- **install to use a puller for removing gear from shaft and beating from shaft.**

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

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

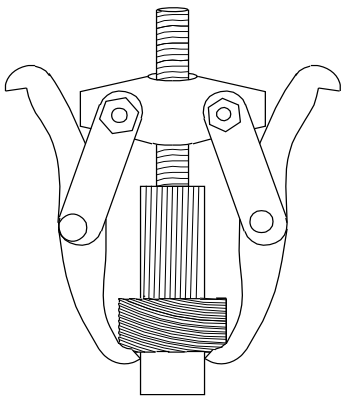
Choose a puller according to Gear / Bearing i.e, 2 or 3 Jaw & External or Internal Jaw puller.

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 from the center of shaft & readjust if necessary.

Tighten the forcing screw till the gear comes out from the shaft.

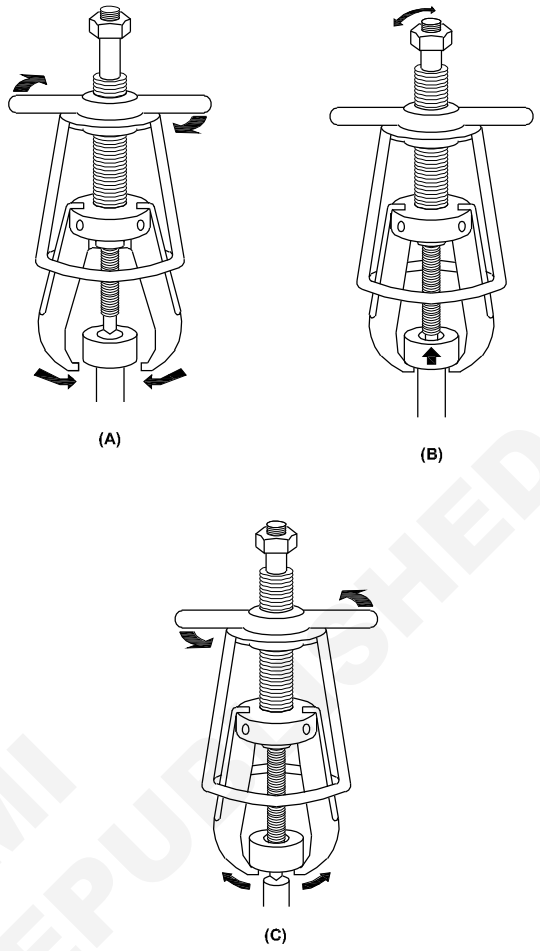
Warnings

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

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

Applying heat to the puller may damage it, causing the puller to fail at lower than rated load.

Fig 2



Practice on use of nuts, bolts & studs

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 / Machinery

- Work bench & vice - 1 No.

Materials / Components

- Kerosene, Cotton waste, Banian cloth - as reqd.
- Axle shaft and castle nuts - as reqd.
- Propeller shaft 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.

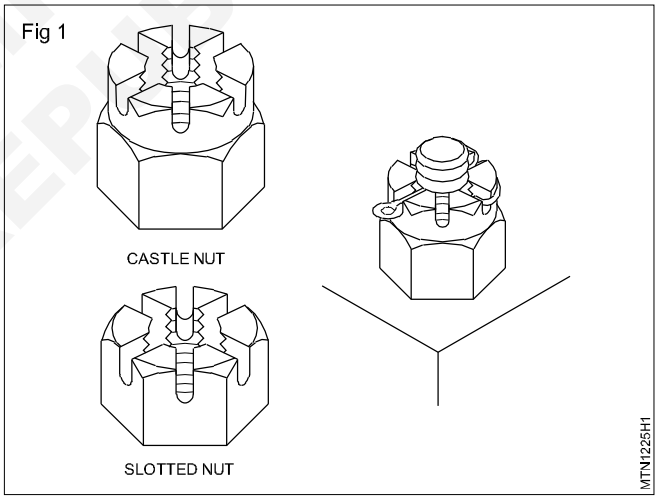
6 Tighten the castle nut.

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.

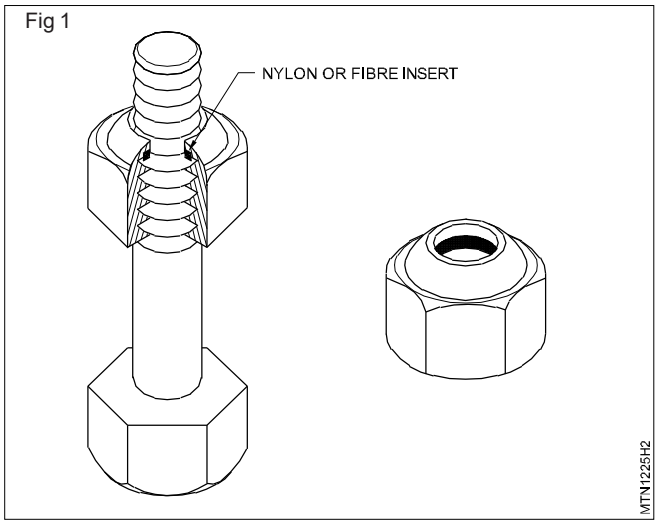
4 Tighten the self locking nut (Fig 1) by hand one or two threads only.

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

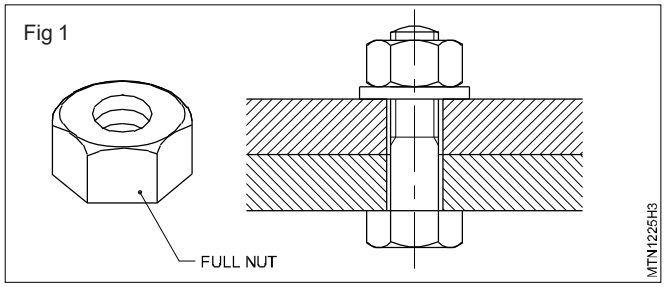


TASK 3 : **Fasten hexagonal Nut**

1 Select the two flat surface components to be fastened.

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

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 the 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.

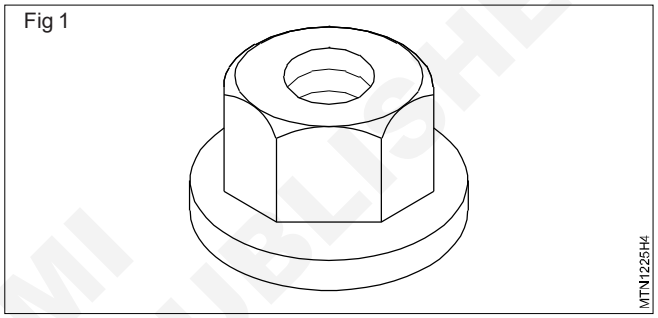
2 Select proper size of hexagonal nut with caller. (Fig 1)

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.



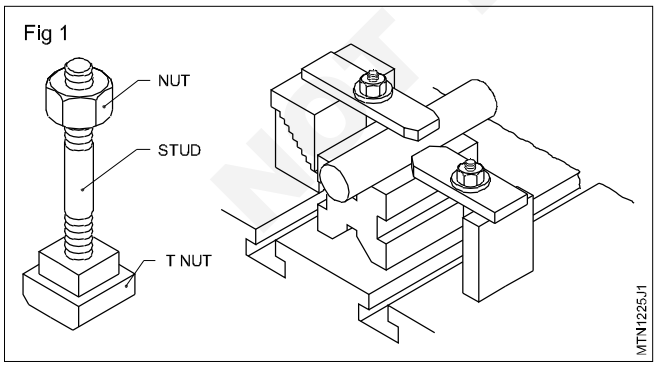
Safety: Avoid using oversized spanner from slippage and getting hurt.

Skill Sequence

Fastening of stud

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

Select the components to be joined. (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:

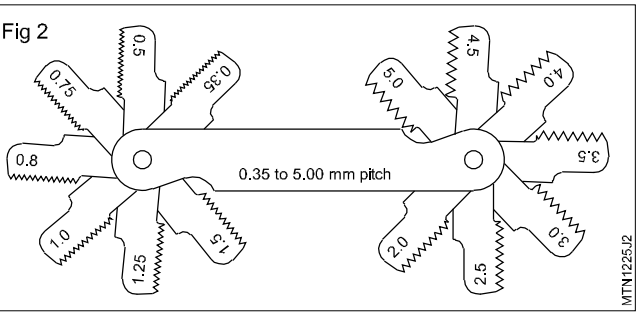
Before inserting the stud. Taps holes & stud threads to be cleaned properly.

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.

Fig 2



Select any one the blade from the screw pitch gauge.

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

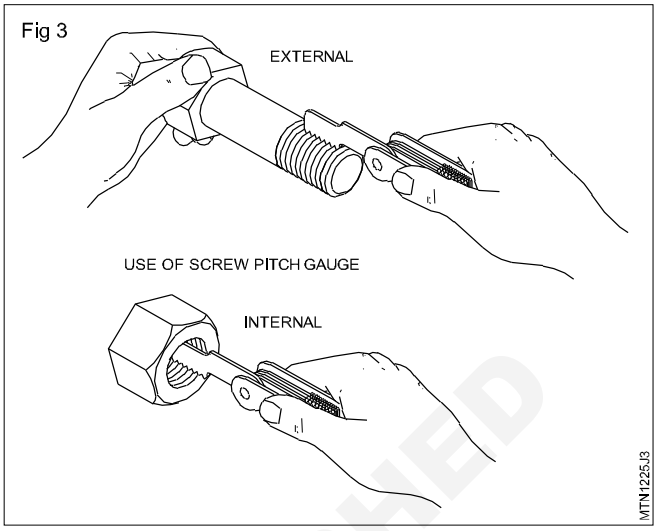
If the pitch matches with the thread then the pitch of the thread will be the same as marked on the blade.

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

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

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

Fig 3



Tightening locking devices

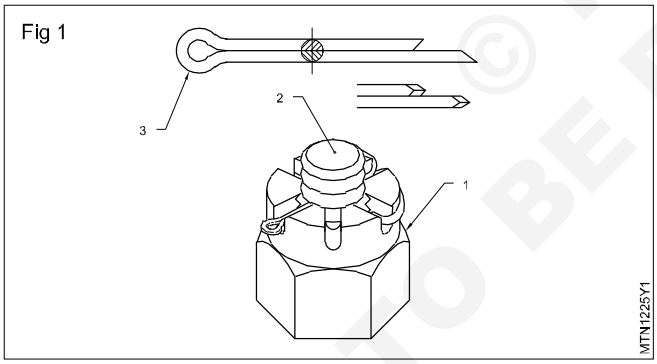
Objective: This shall help you to

- **use different types of locking devices correctly.**

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. (Fig 1)

Fig 1



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

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

Tighten the nut (1) at the specified torque.

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

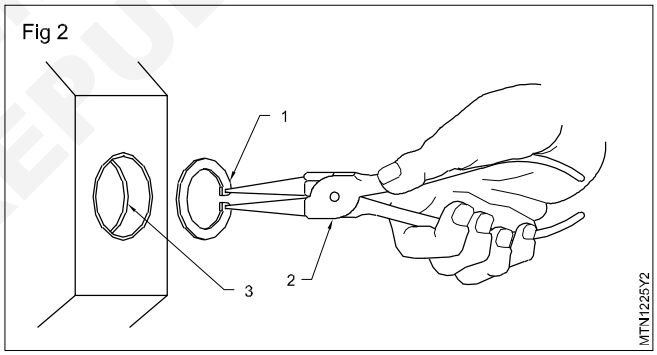
Press the circlip (1) with the help of the plier (2) so that its diameter will be smaller than the hole diameter. (Fig 2)

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

Take out the plier (2).

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

Fig 2



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

In the enlarged position of circlip slide it on the shaft. (Fig 3)

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

Take out the plier (2).

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 wire 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).

Fig 3

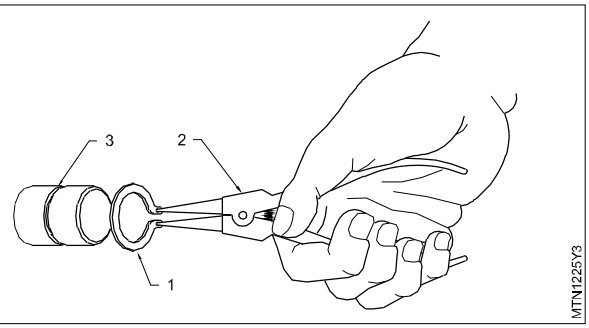
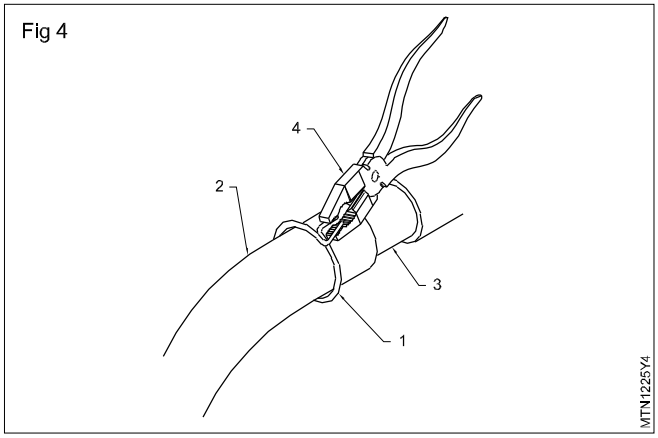


Fig 4



Removing broken stud/Bolt from blind hole

Objective: 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

- Trainees tool kit - 1 No.
- Tap wrench - 1 Set.
- Stud extractor - 1 Set.

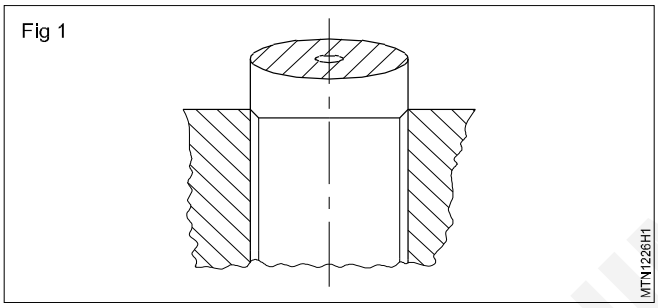
Materials / Components

- 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

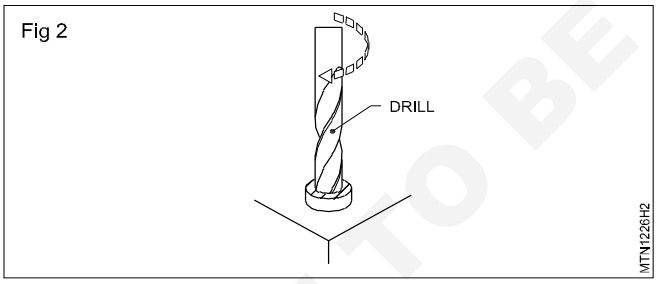


2 Locate the centre and centre punch it.

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)

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

Fig 3

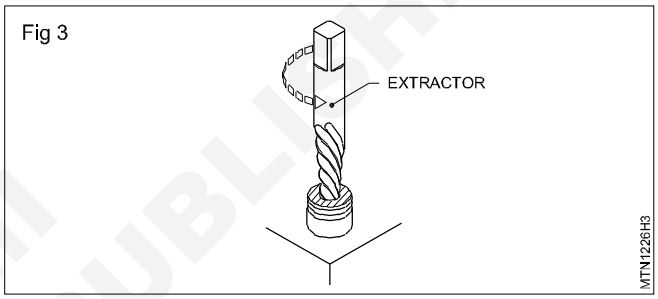
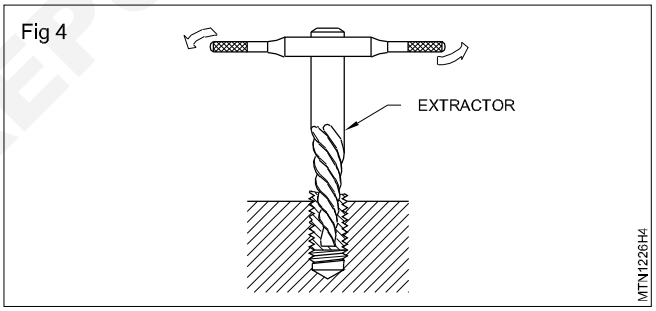


Fig 4



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.

Table 1

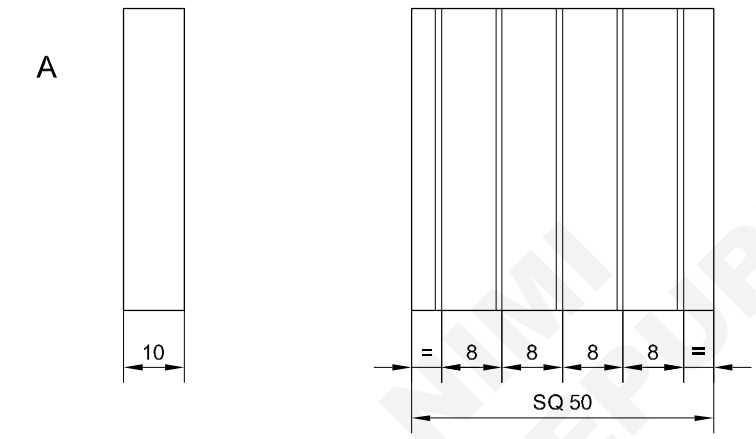
Recommended drill and Ezy-out size for the extraction of broken stud and bolt.

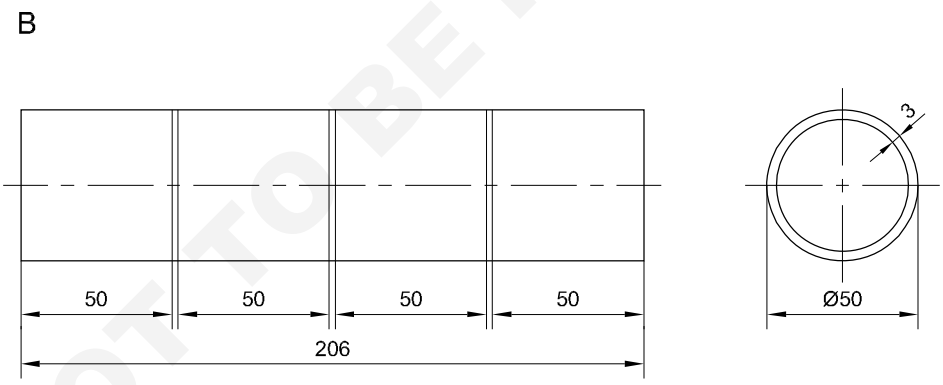
Suitable for screw size	Drill size to be used	Ezy-out No. to be used
1/8" to 1/4" (3 to 6 mm)	5/64" (2 mm)	1
Over 1/4" to 5/16" (6 to 8 mm)	7/64" (2.8 mm)	2
Over 5/16" to 7/16" (8 to 11 mm)	5/32" (4 mm)	3
Over 7/16" to 9/16" (11 to 14 mm)	1/4" (6.3 mm)	4
Over 9/16" to 3/4" (14 to 19 mm)	17/64" (6.7mm)	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. MTN1227E1	

PROCEDURE

1 Check the size of the given M.S flat Job.

2 Apply copper sulphate solution and allow it to dry

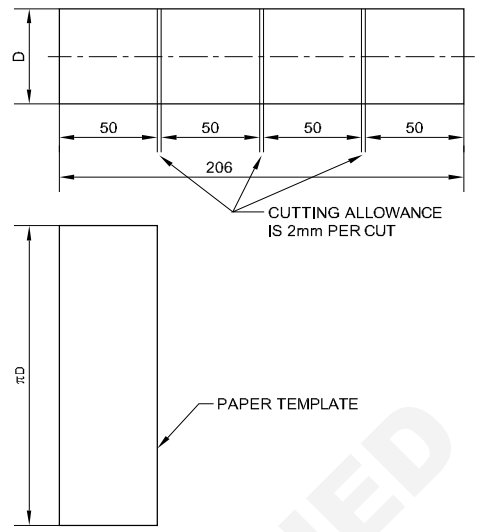
3 Layout lines as per drawing using a scriber taking measurement from the edge and punch mark the lines using a dot punch and hammer.

4 Cut by hacksaw along the lines.

5 Remove burrs, if any by filling.

6 Mark lines as per drawing using a paper template and punch mark the line. (Fig 1)

Fig 1



Skill Sequence

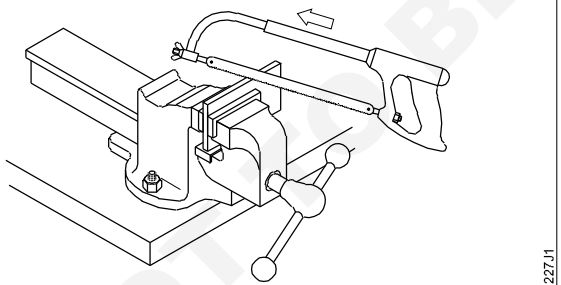
Holding the workpiece

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.

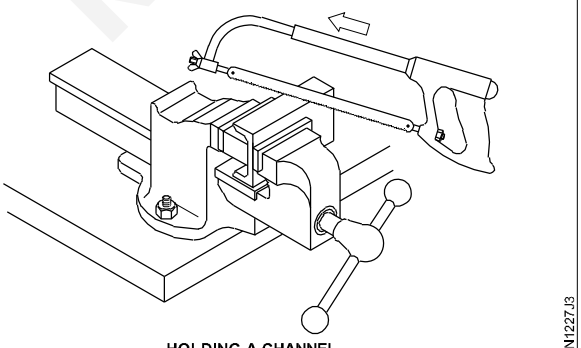
As far as possible the job is held so as to be cut on the flat side rather than the edge or the corner. This reduces the blade breakages. (Fig 1, 2 and 3)

Fig 1



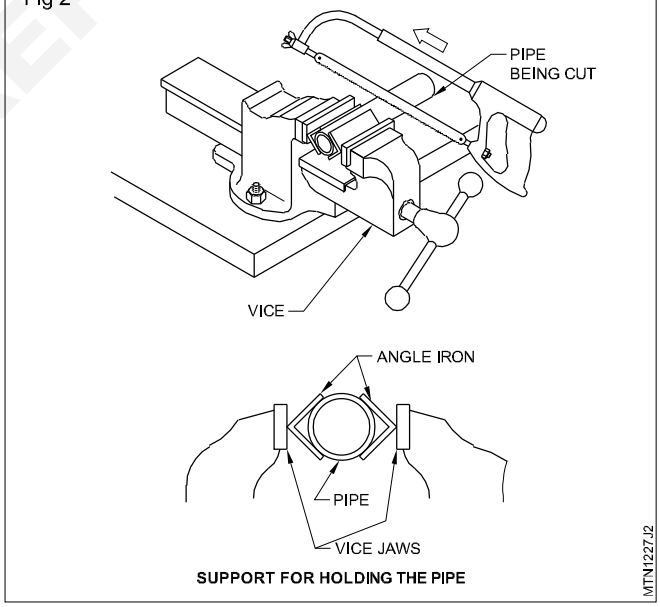
HOLDING A PLATE

Fig 3



HOLDING A CHANNEL

Fig 2



SUPPORT FOR HOLDING THE PIPE

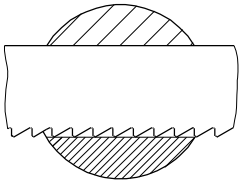
The selection of the blade depends on the shape and hardness of the material to be cut.

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)

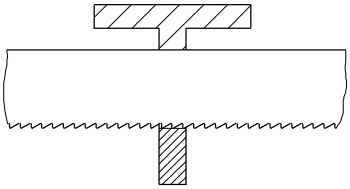
Fig 4



MORE CHIP CLEARANCE

MTN1227J4

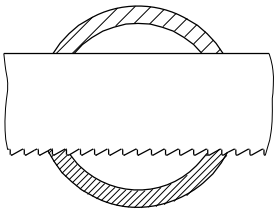
Fig 5



TWO OR MORE TEETH ON SECTION

MTN1227J5

Fig 6

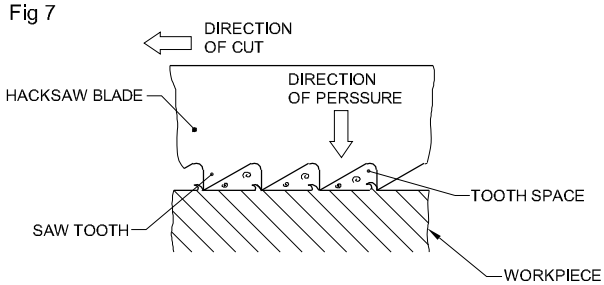


TWO OR MORE TEETH ON SECTION

MTN1227J6

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



MTN1227J7

The blade should 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.

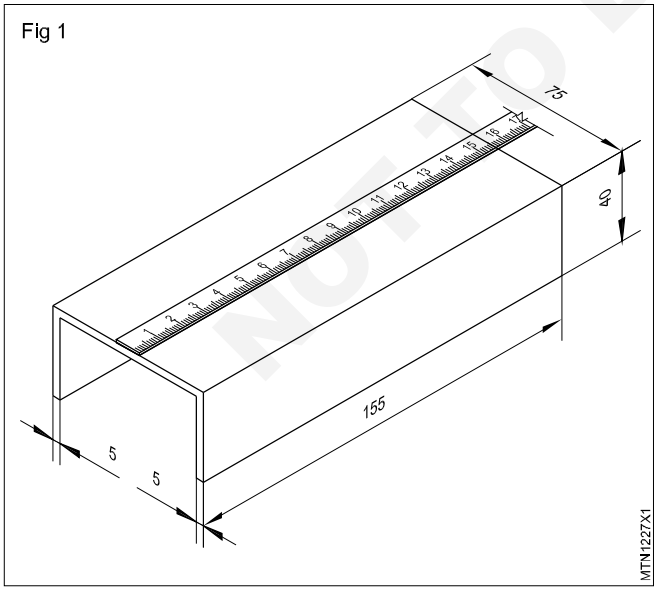
The cutting movement should be steady and the full length of the blade should be used.

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)

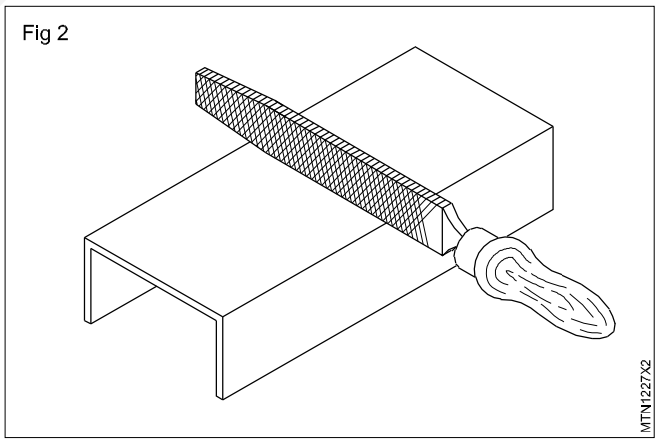
Fig 1



MTN1227X1

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

Fig 2

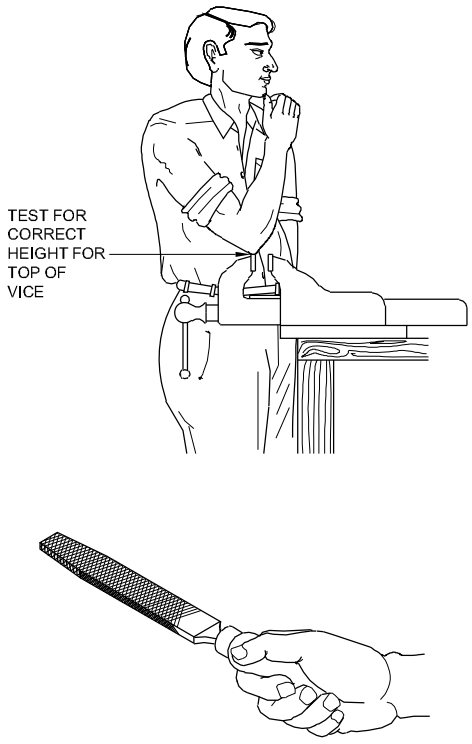


MTN1227X2

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.

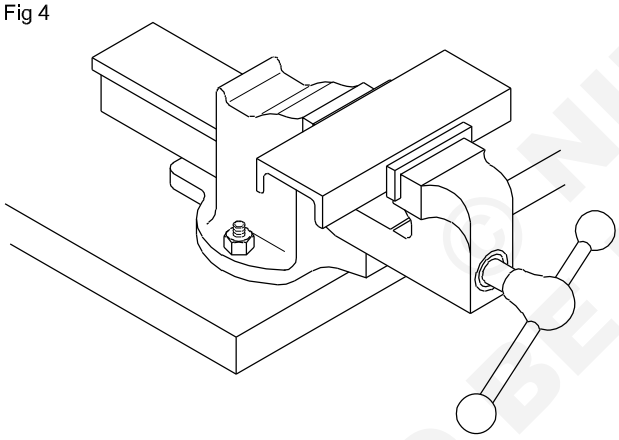
Hold the job in bench vice grip firmly from width of the channel. (Fig 4)

Fig 3



MTN1227X3

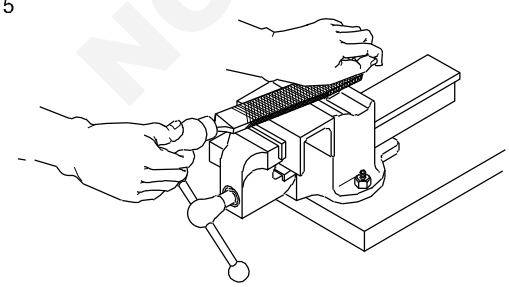
Fig 4



MTN1227X4

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.

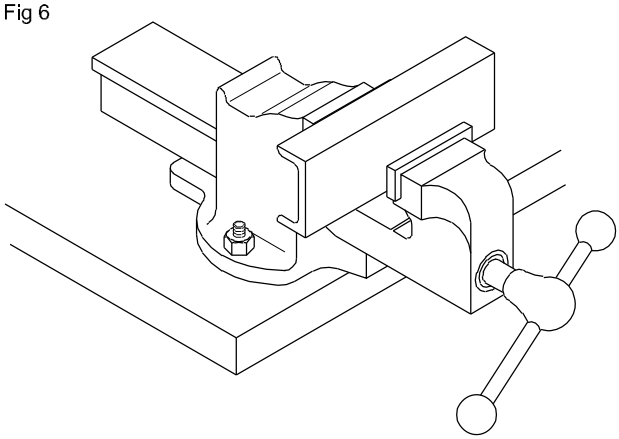
Fig 5



MTN1227X5

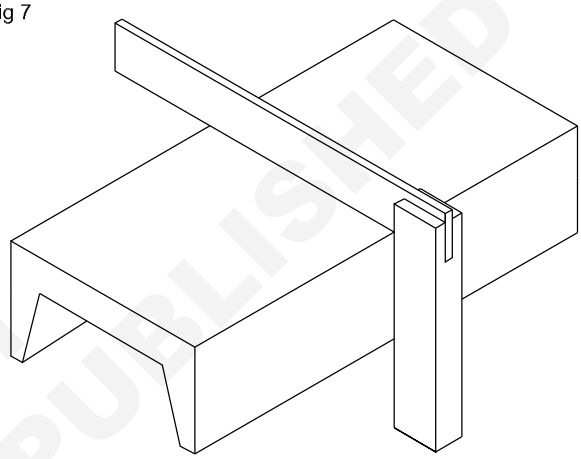
Open the job and start on (A) side filing as directed previously. Check the squareness along with (B). (Fig 7)

Fig 6



MTN1227X6

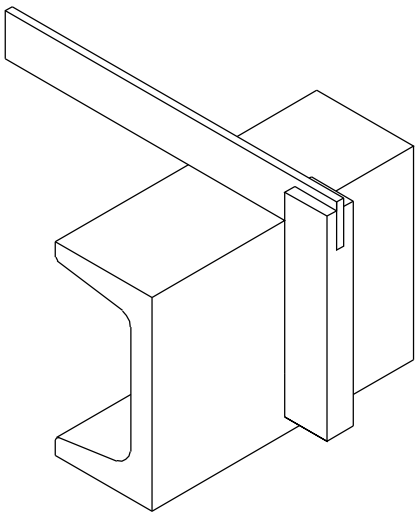
Fig 7



MTN1227X7

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

Fig 8

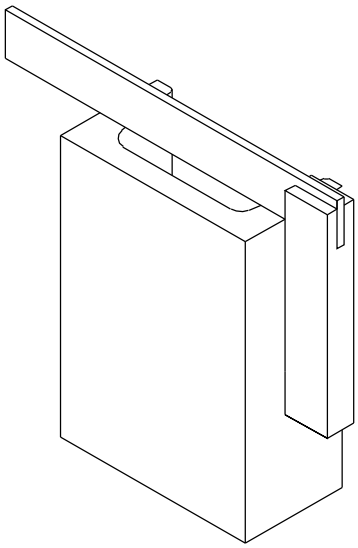


MTN1227X8

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

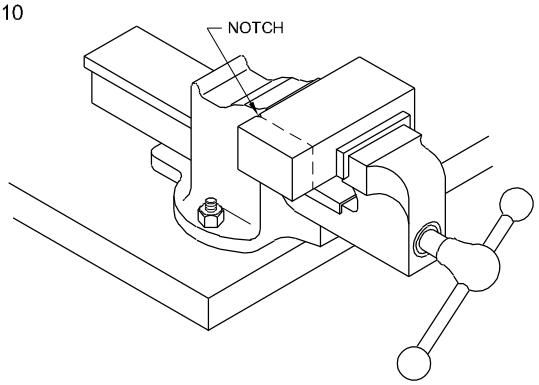
Open the job and start on (F) side filing as directed previously. Check the squareness along with (AB&D). (Fig 10)

Fig 9



MTN1227X9

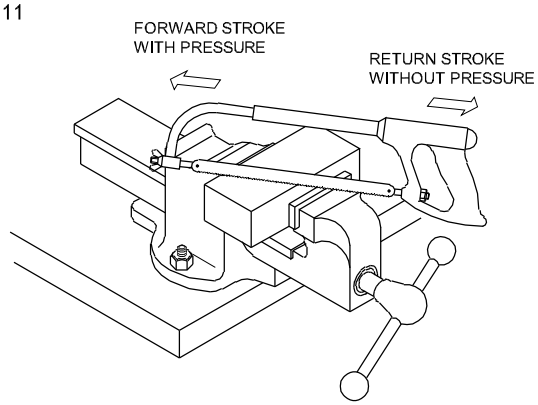
Fig 10



MTN1227XA

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

Fig 11

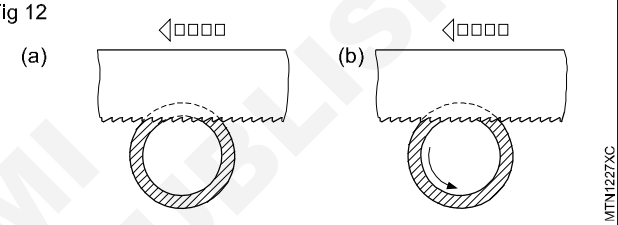


MTN1227XB

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



MTN1227XC

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.

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 chiseling. 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

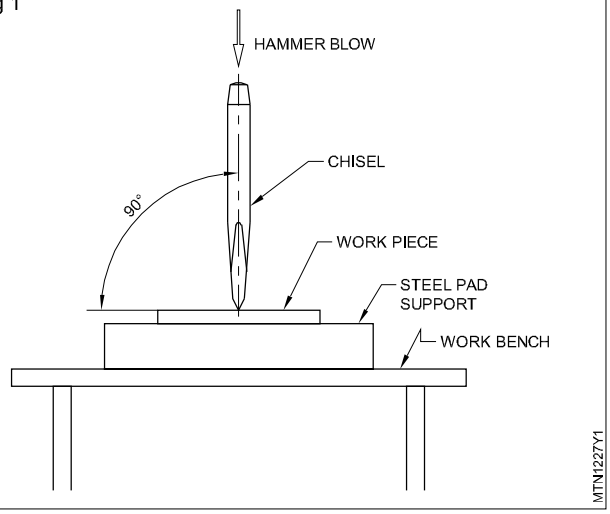
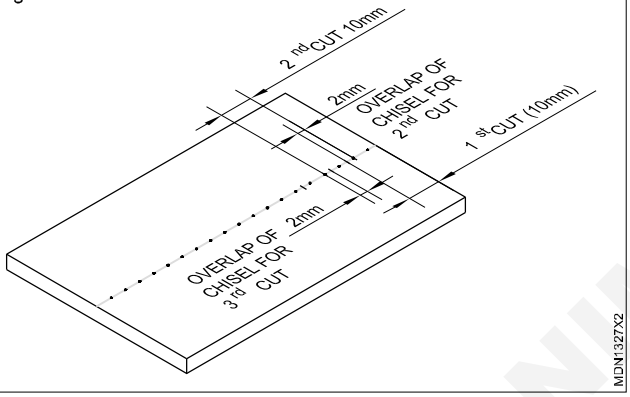


Fig 2



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

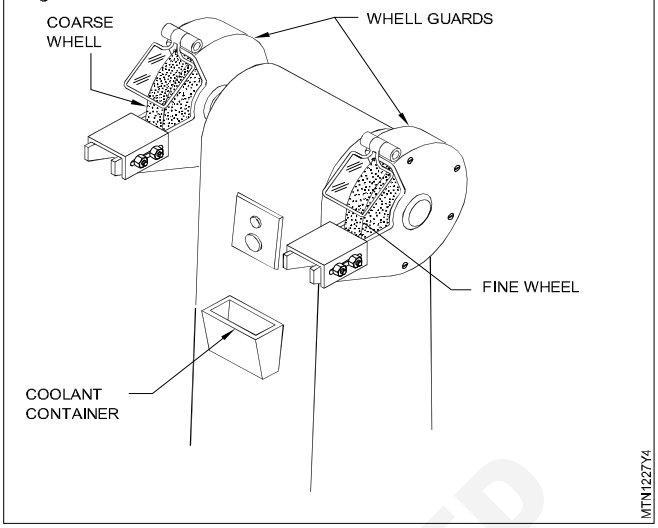
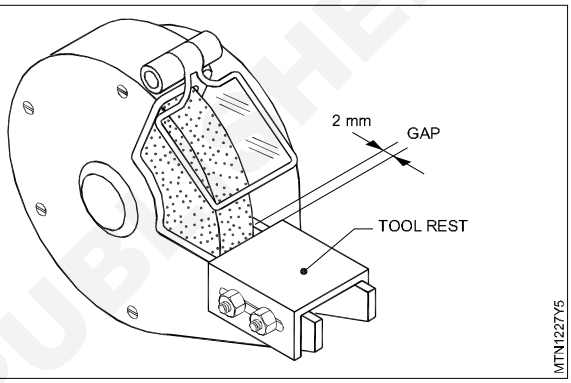


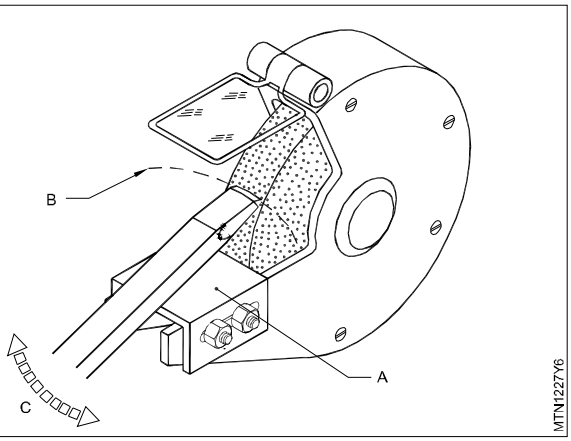
Fig 5



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 digging 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 re-sharpening. 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.

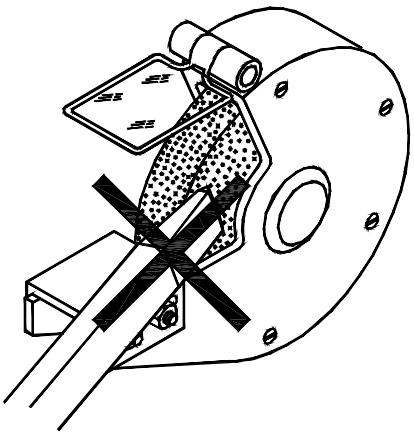
When switching on the grinding machine, stand aside until the wheel reaches the operating speed.

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



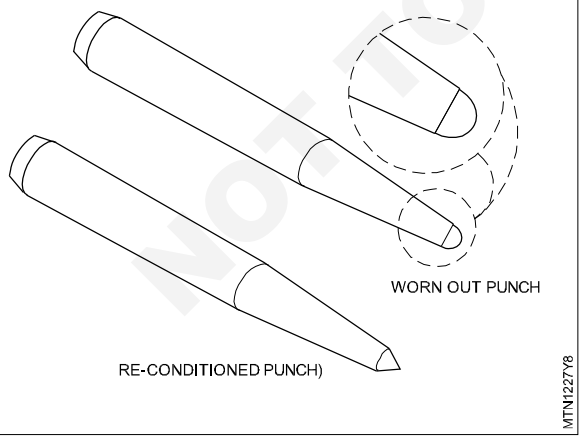
Report to instructor, if any damage to the grinding wheel is noticed.

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 around its axis.

Grind 4 mm chamber 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 around 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 speedily as well as turn it forward and back.

Grind the point - vertical position (Fig 9)

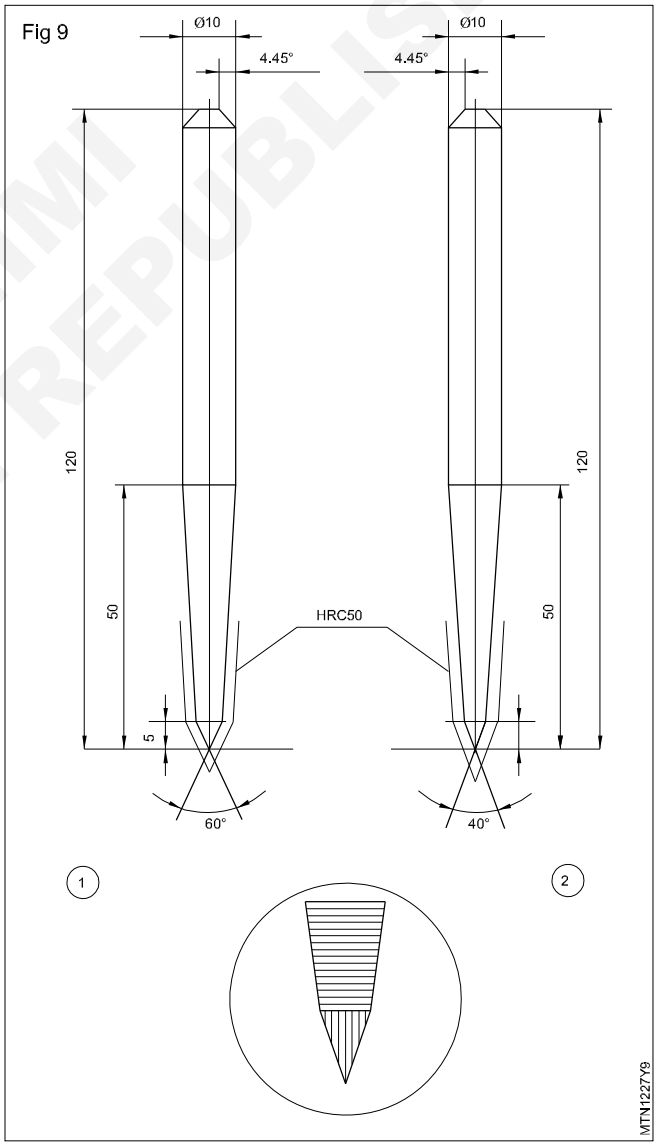
i Centre punch 60°

ii Scribing / Prick punch 40°

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

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

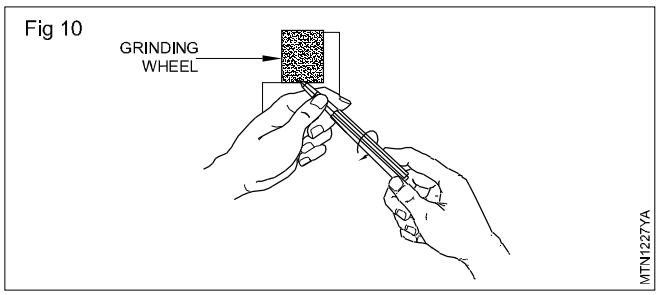
Fig 9



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

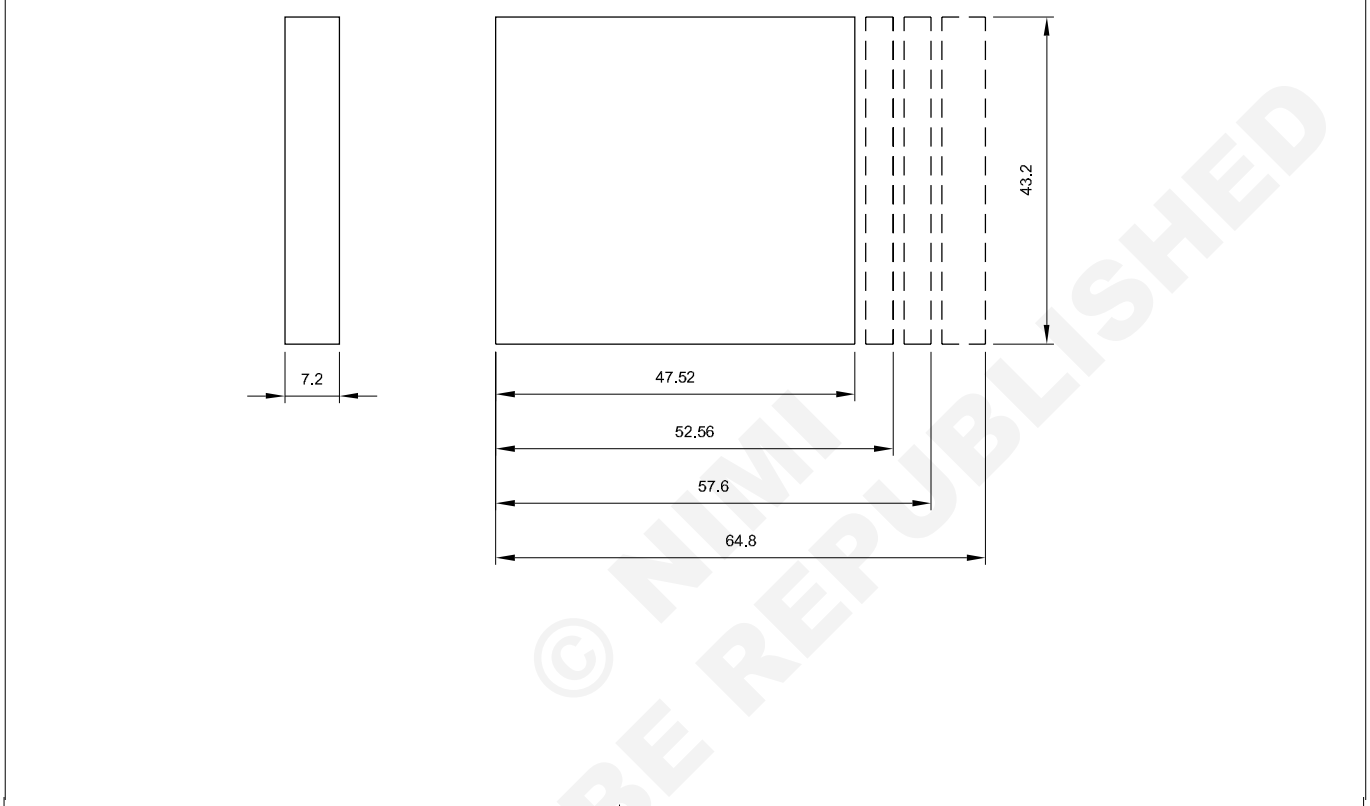
Keep the point cool by using only light pressure on the wheel and by frequently dipping the punch in a can of cooling water.

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. MTN1228E1	

PROCEDURE

Hacksawing and filing

1 Study the job drawing

2 Select the raw material for the job

3 Mark the dimension on the raw material with help of scriber

4 Punch on the line marking

5 Fix the raw material on the bench vice

6 Select the hacksaw blade and hacksaw frame

7 Fix the hacksaw blade on the hacksaw frame

8 Take suitable position to cut the marked raw material

9 Cut the raw material as per dimension marked on it

10 Cut and remove the raw material piece

11 Fix the raw material piece on the work bench

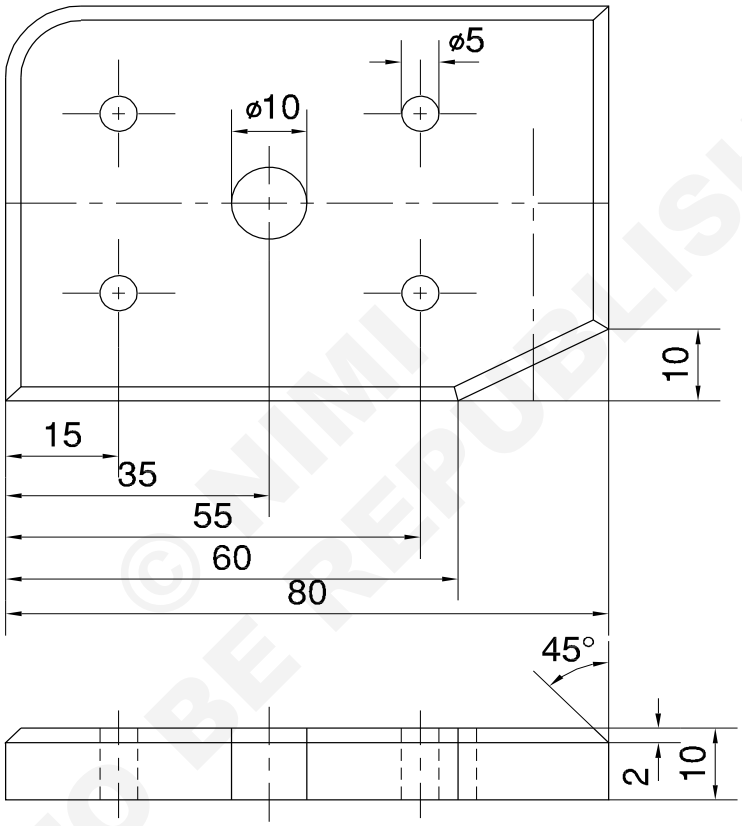
12 Select the suitable flat file

13 File and remove the excess metal for the correct dimension

14 File with flat file with both sides and ensure for correct given dimension on the work place.

Practice on filing 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.**



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 Mark the angular surface using a combination set.
5 Mark the concave profile as per the drawing
6 Centre punch the centres for the holes to be drilled.
7 Check the angle with a combination set.
8 Drill a pilot hole for concave profile.
9 Saw cut to remove the excess metal for the profile.
10 File with flat file the two sides.
11 File with round file for the concave profile and check with the gauge.
12 Chamfer the edges of the block for 1 mm width all over.
13 Remove the burrs from drill holes.

1	65ISF12x85	-	Fe310	-	-	
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	
SCALE 1:1	DRILLING AND FILING RADIUS				DEVIATIONS ±0.1	
					CODE NO. MTN1229E1	

Skill Sequence

Drilling through hole

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

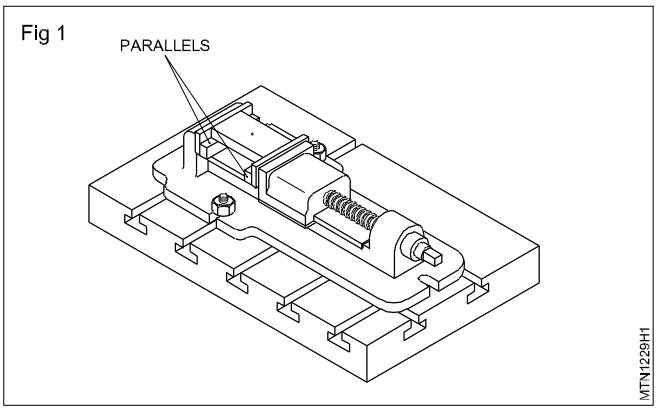
Method of Drilling

Check the given raw material for its size.

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

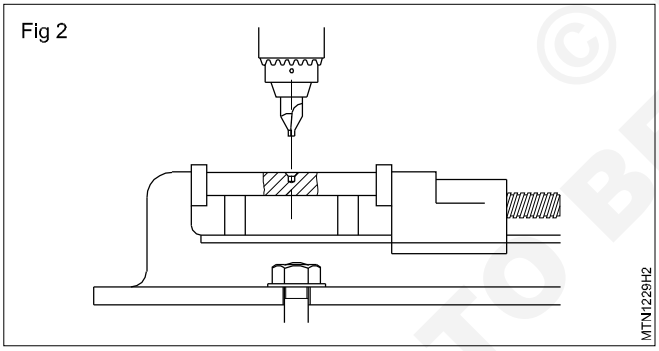
Mount the job in the machine vice on the parallel and clamp it securely to the drill-press-table. (Fig 1)

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.

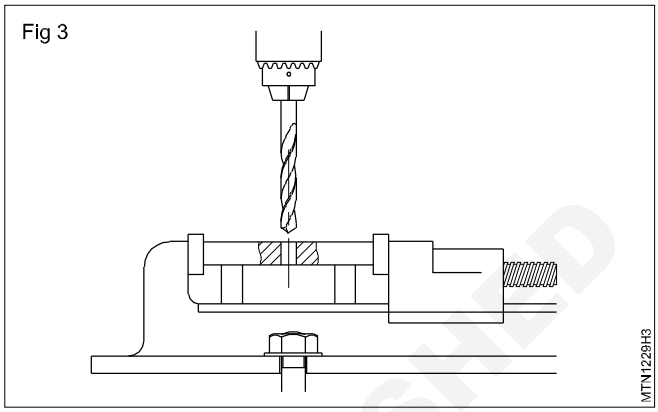
Spot the hole location with a centre drill.

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.

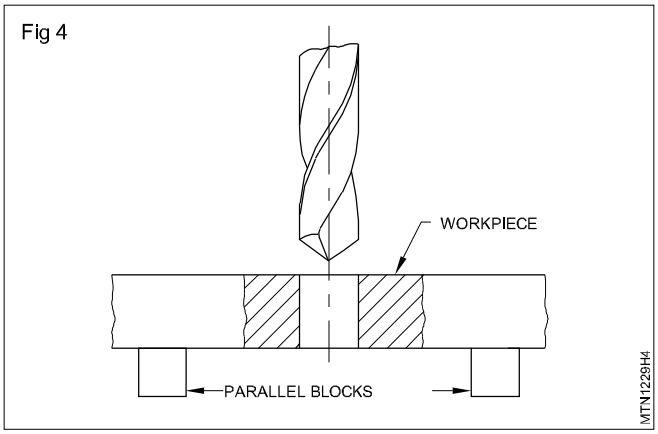
Fix 14.5 mm drill and drill through hole.

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



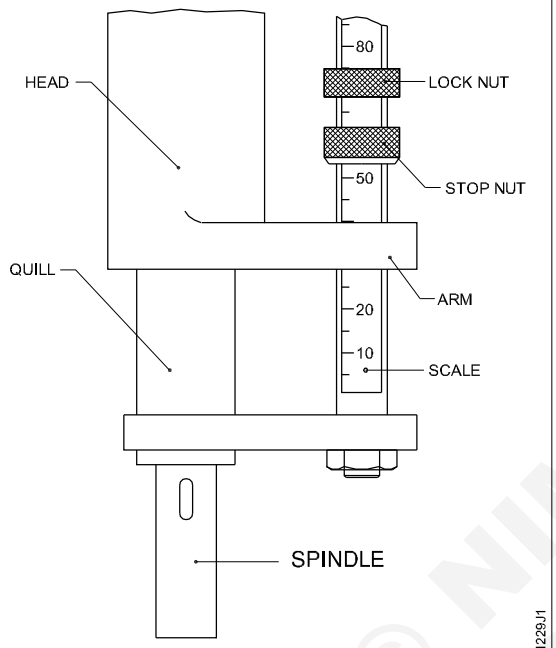
Drilling blind holes

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.

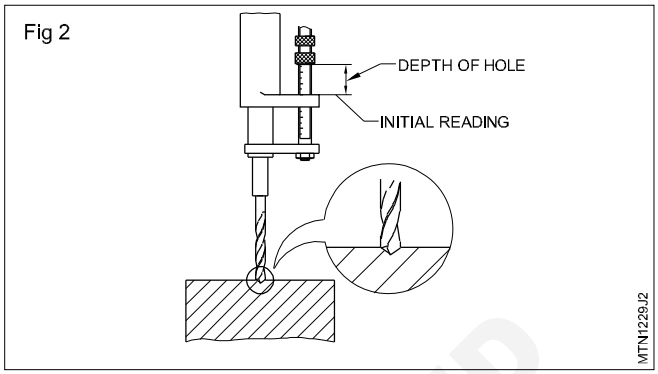
The drill is started, and it drills until the full diameter is formed. Note down the initial reading at this point. (Fig 2)

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.

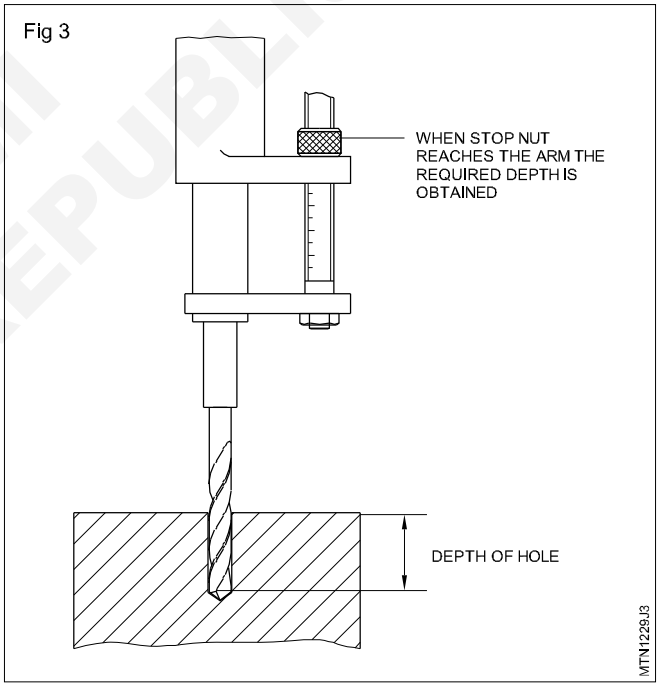
Fig 2



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.

Sharpening a twist drill

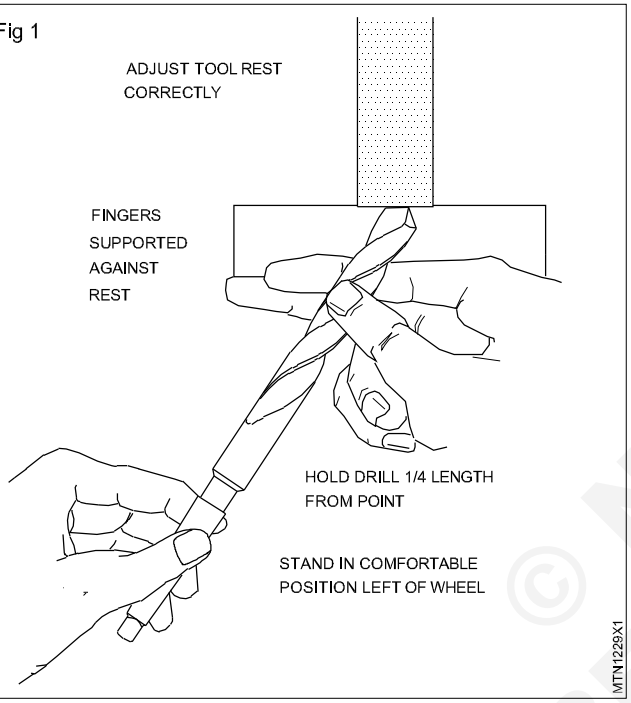
Objectives : This shall help you to
- **re-sharpen a twist drill**
- **test the drill that has been re-sharpened by drilling a through hole.**

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 yourself 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)

Supply a slight forward motion to your hands.

Fig 2

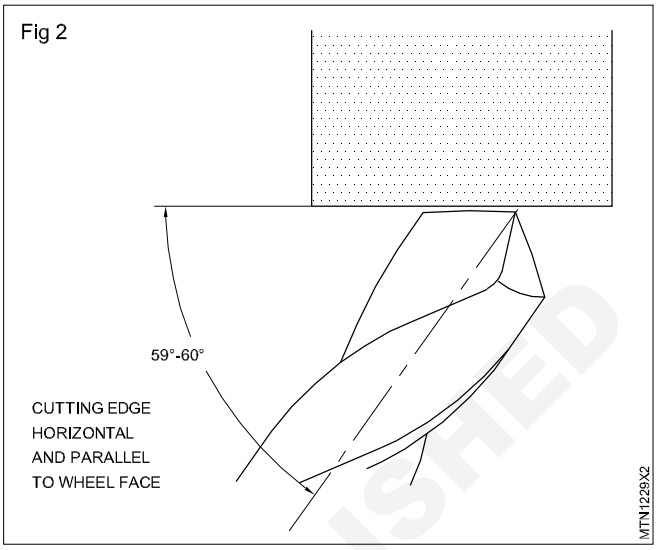


Fig 3

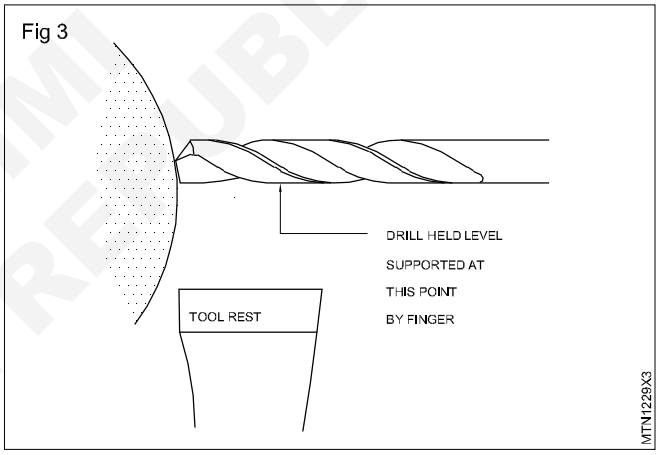


Fig 4

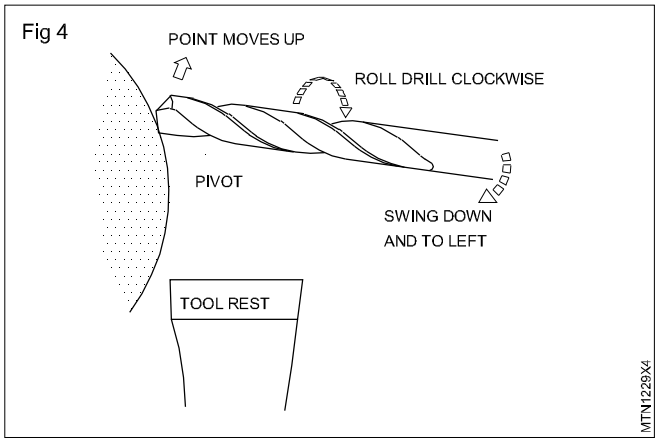
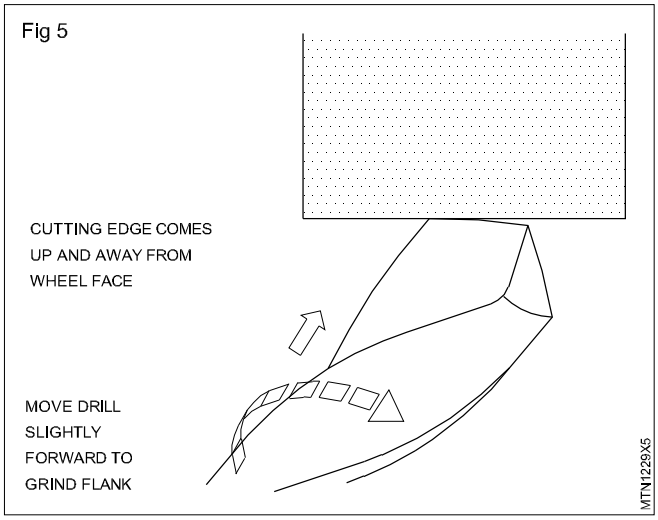


Fig 5



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.

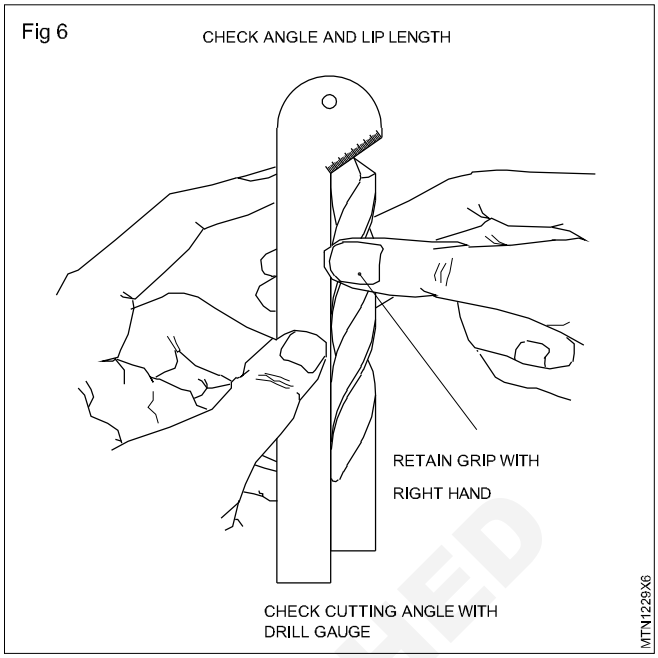
Proceed to sharpen the second cutting edge, using the same amount of drill movement as before. When these actions are carried out carefully, the drill will be sharpened with equal cutting angles. The lip clearance will be correct and equal.

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.

Fig 6



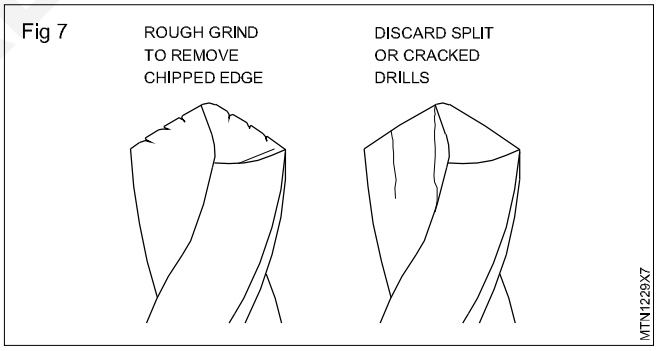
Hold the drill shank again in the left hand with the elbows against the side. The drill will locate back against the wheel face in the same position and at the same angle as before.

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)

Fig 7



Never re-sharpen a cracked or split drill.

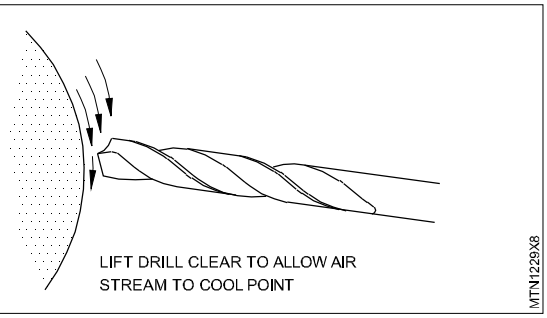
Avoid overheating the drill.

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)

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

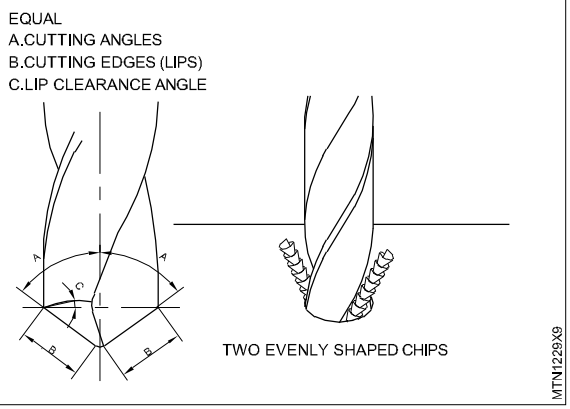
Re-sharpening of very small drills required great skill. They require proportionally less movement to produce the cutting angles.

Fig 8



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)

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 10

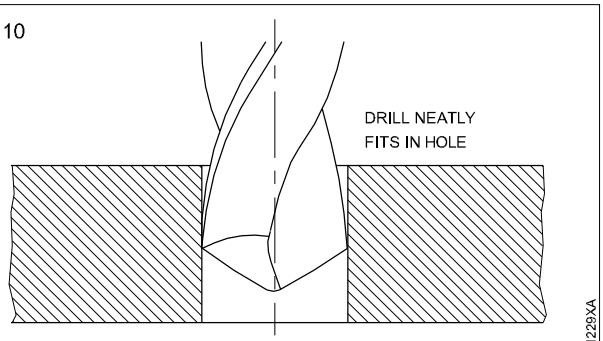
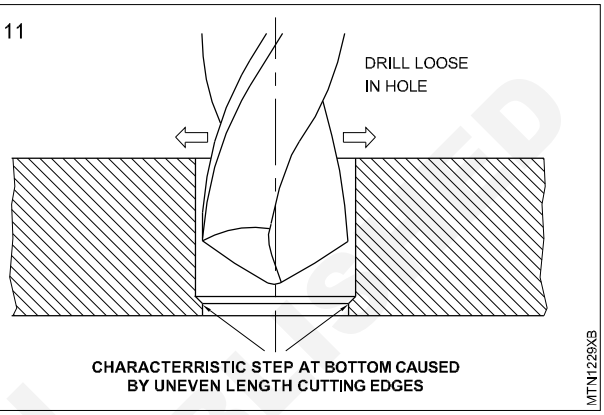


Fig 11



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.

— — — — — — — —

Safety precautions while using drilling machine

Objectives: At the end of this exercise you shall be able to
- **follow personal safety**
- **follow drilling machine safety**
- **follow job safety**
- **follow drill bit safety.**

PROCEDURE

1 Wear a dress suitable for work

2 Ensure that the spindle head and table is locked properly.

3 The workpiece and the drill should be rigidly held.

4 Switch off power when not in use.

5 Clean and oil the machine after use.

6 Use a brush to clean the chips and swarf.

7 Select proper cutting speed according to material.

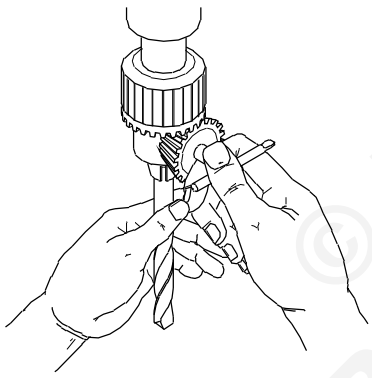
8 Select proper cutting fluid according to material.

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

10 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.

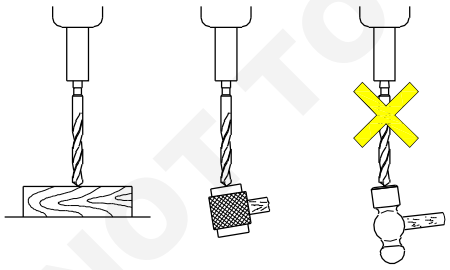
11 While removing the drill from the sockets/sleeves, don't allow it to fall on the table or jobs. (Fig 3 & Fig 4)

Fig 1



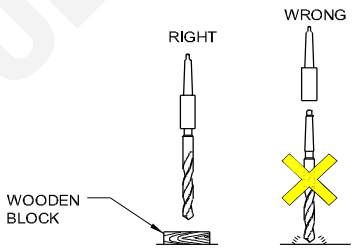
MTN1230H1

Fig 2



MTN1230H2

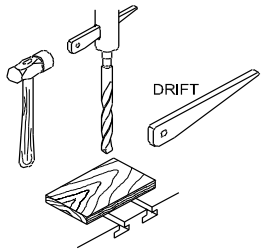
Fig 3



REMOVING A TAPER SHANK DRILL

MTN1230H5

Fig 4

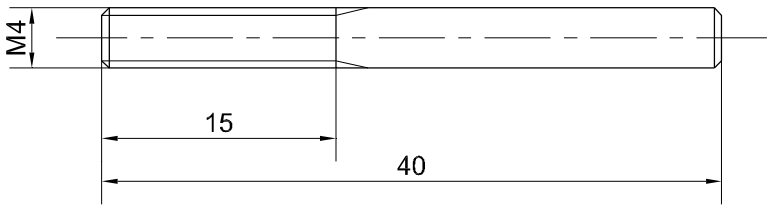


MTN1230H6

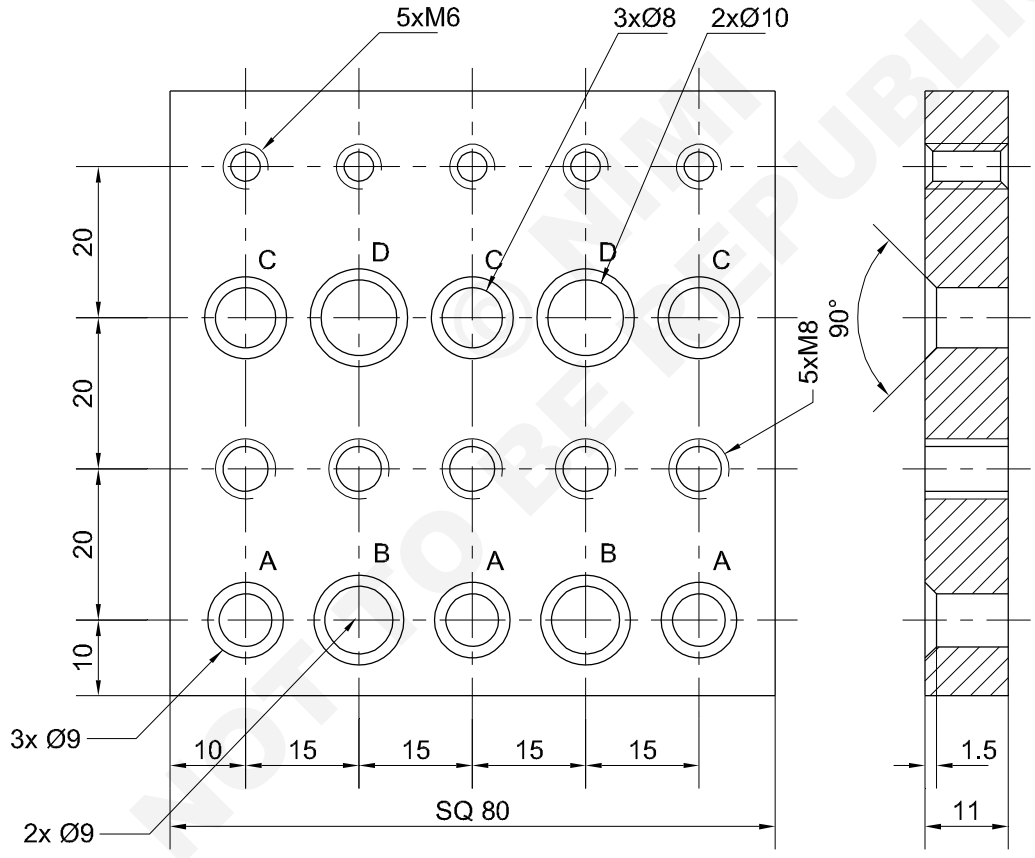
Practice on forming internal and external threads

Objectives: At the end of this exercise you shall be able to
- **file surfaces flat and parallel within ± 2 mm**
- **drill through holes**
- **countersink holes to fit standard screw heads**
- **cut internal threads using hand taps.**

1



2



1	5x45		Fe310		1	
1	90ISF12x85	-	Fe310		2	1.2.31
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex.No.

SCALE 1:1	CUTTING INTERNAL THREADINGS	DEVIATIONS ±0.1
		CODE NO. MTN1231E1

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 ø9 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)

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)

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

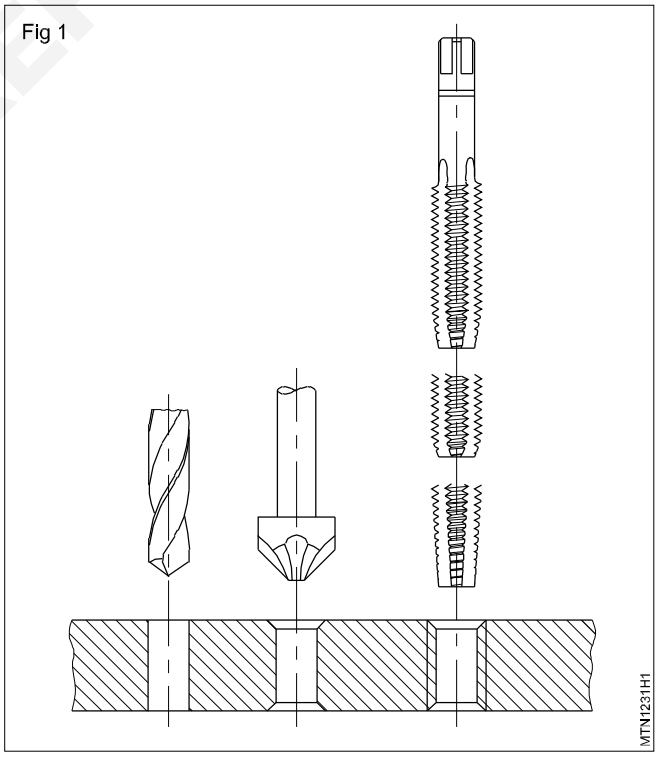
Fix the first tap (Taper tap) in the wrench.

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)

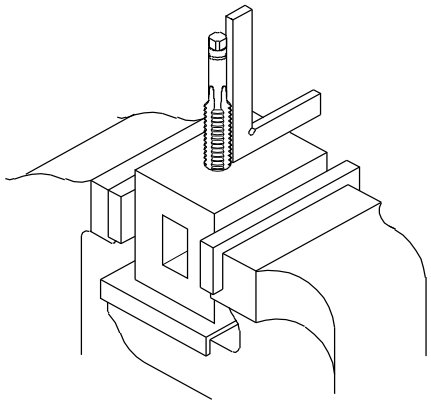
Fig 1



When you are sure of starting of the thread, remove the tap wrench without disturbing the tap alignment.

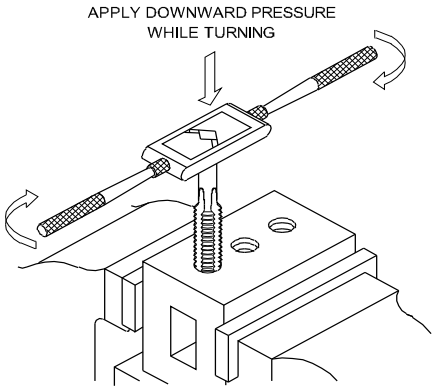
Check and make sure the tap is vertical, use a small try square for help. Place the try square in two positions, 90° to each other. (Fig 4 & Fig 5)

Fig 2



MTN1231H2

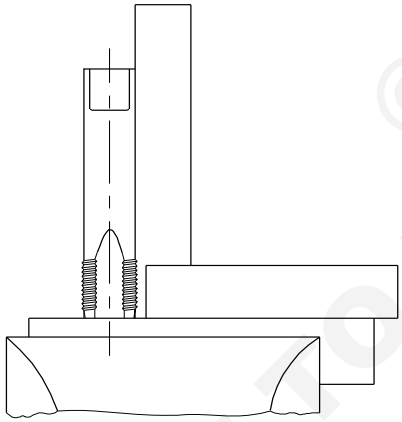
Fig 3



STARTING THE TAP

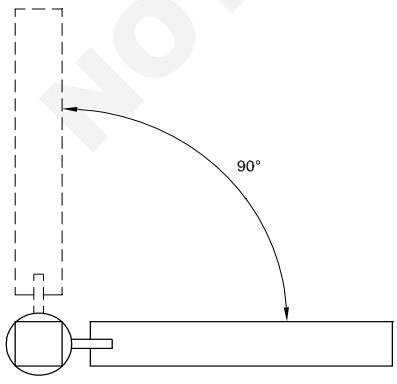
MTN1231H3

Fig 4



MTN1231H4

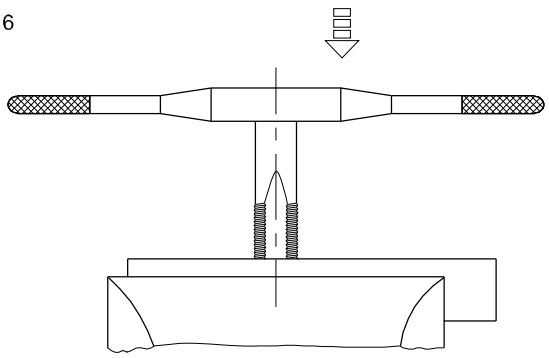
Fig 5



MTN1231H5

Make corrections, if necessary. This is done by exerting slightly more pressure on the opposite side of the tap inclination. (Fig 6)

Fig 6



SQUARING UP THE TAP

MTN1231H6

Never apply side pressure without giving a turning motion to the tap.

Check the tap alignment again with a try square.

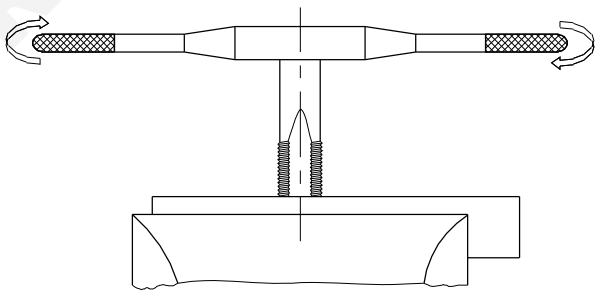
Fit the tap wrench, and tighten without disturbing the tap alignment.

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



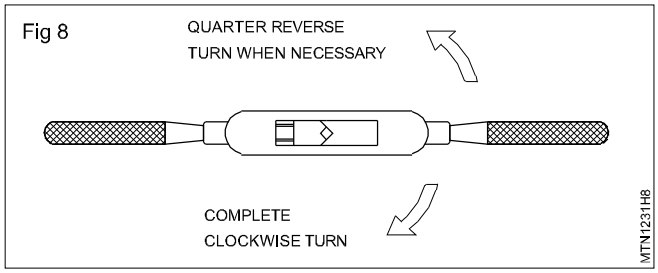
MTN1231H7

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)

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.

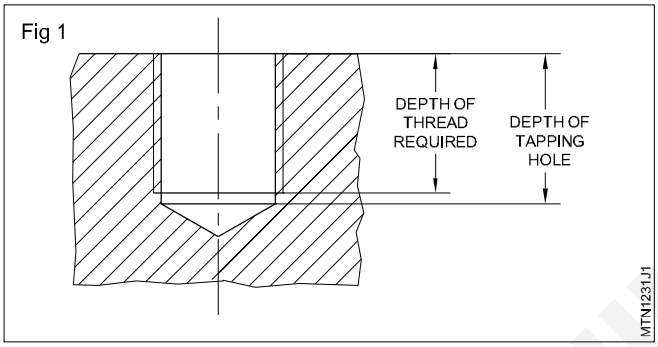
Clean the tap with a brush, and place it back on the stand.

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.

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.

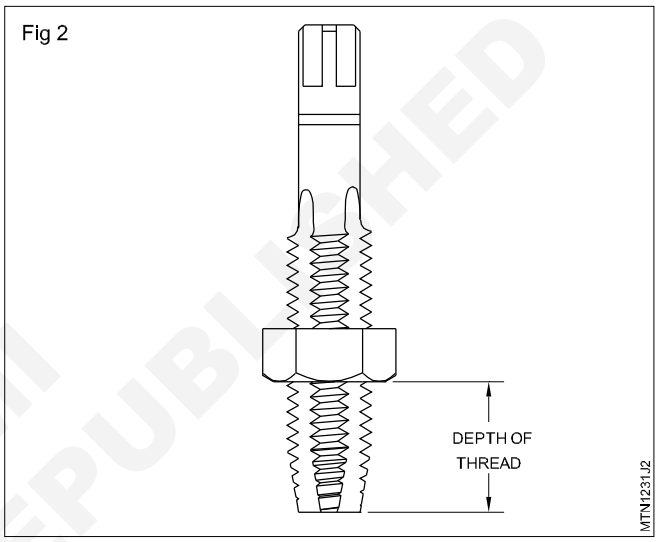
Do not clear chips by blowing as it can cause injury to your eyes.

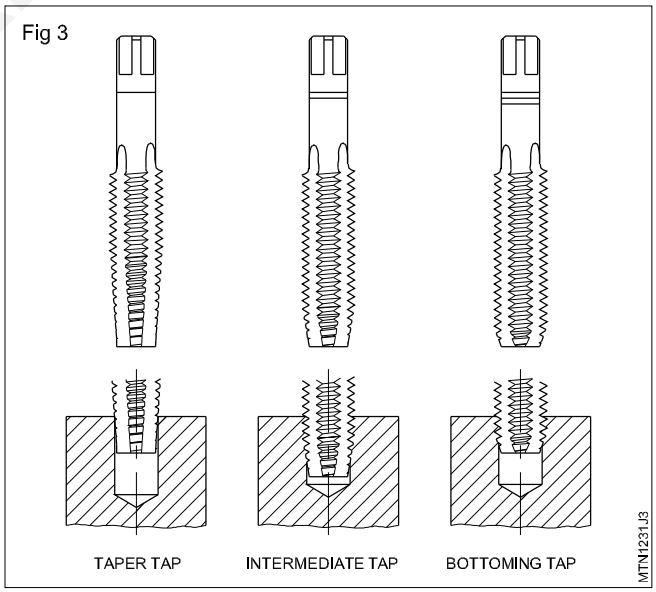
Screw a matching nut on the first tap to act as a depth stop. (Fig 2)

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)





Cutting the external thread on a bolt/studs by using dies

Objective: At the end of this exercise you shall be able to
- **cut external threads using dies.**

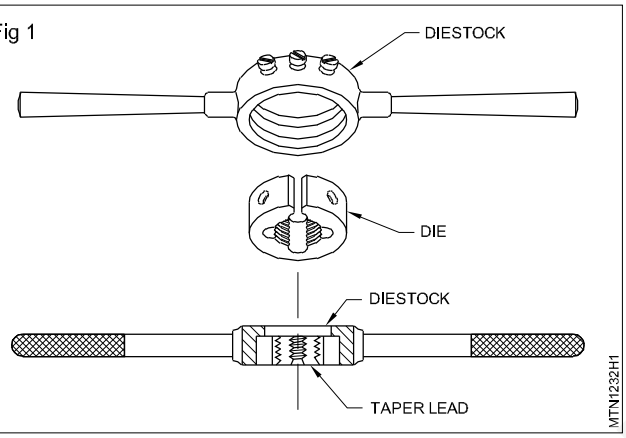
PROCEDURE

1 Check blank size

2 Blank size = thread size - 0.1 x pitch of thread

3 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.

4 Place the leading side of the die on the chamfer of the work. (Fig 2 & Fig 3)

Fig 2

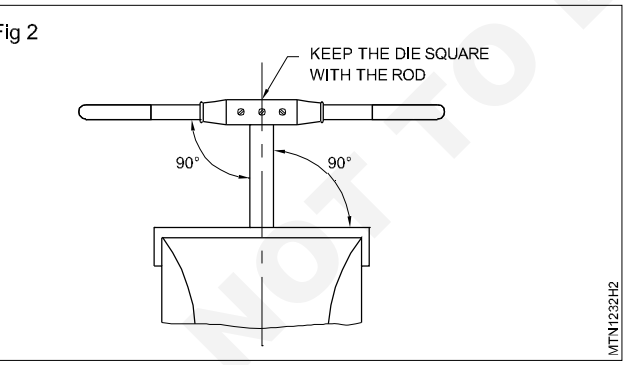
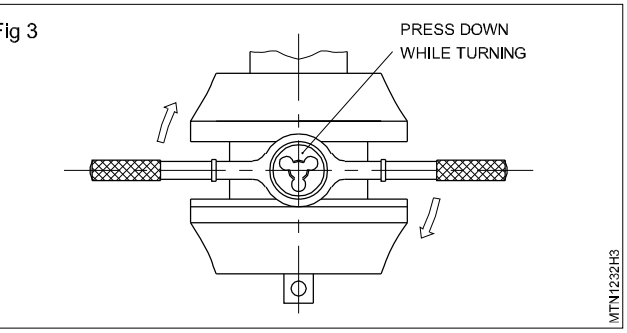


Fig 3



Make sure that the die is fully open by tightening the centre screw of the die stock. (Fig 4 & Fig 5)

Fig 4

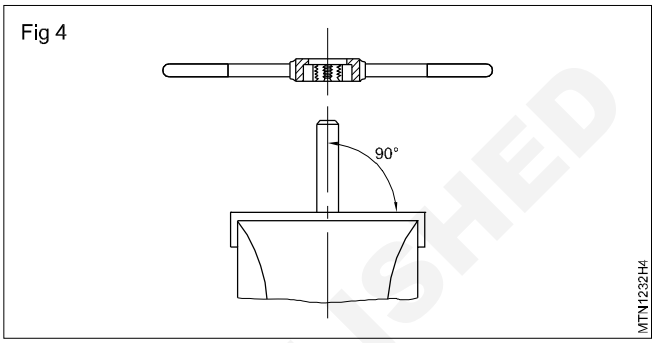
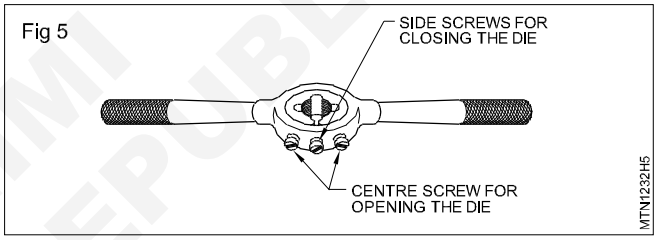


Fig 5



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.

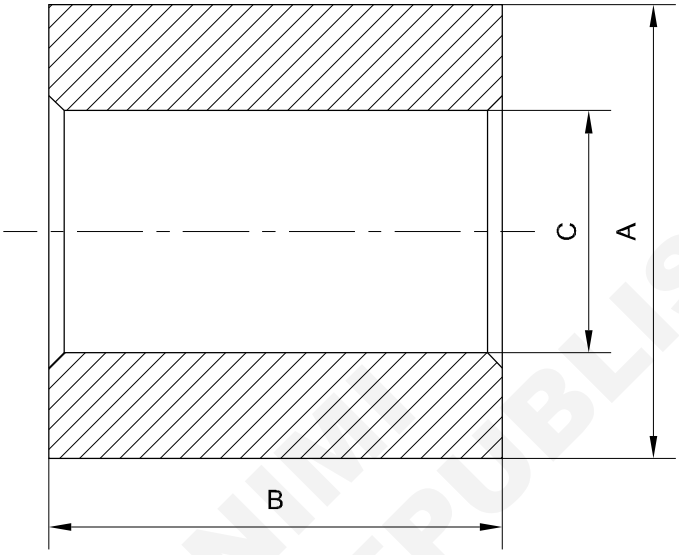
Repeat the cutting until the nut matches.

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 threads

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			

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.

1	-	-	Fe310	-	-	1.2.33
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex No.
SCALE 1:1	REAMING				DEVIATIONS ±0.1	
					CODE NO. MTN1233E1	

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,

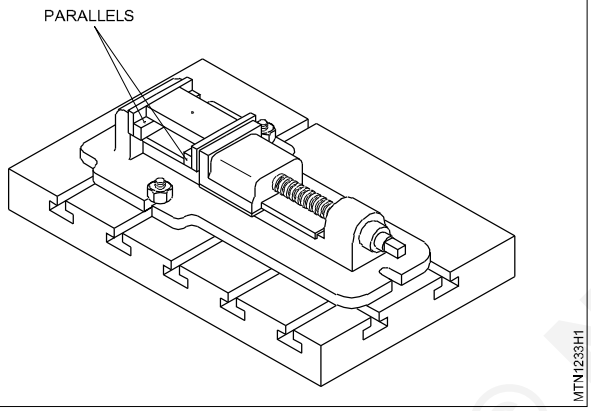
Drill diameter = reamed hole size. (undersize + oversize) [Refer to the table for the recommended undersize in Related Theory on drill sizes for reaming. (See table 1.)]

Procedure for hand reaming

Drill holes for reaming as per the sizes determined.

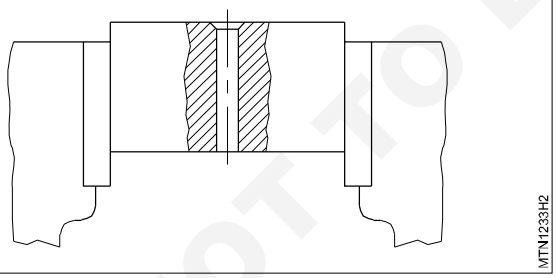
Place the work on parallels while setting on the machine vice. (Fig 1)

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 slight 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)

Do not turn in the reverse direction for it will scratch the reamed hole. (Fig 4)

Fig 3

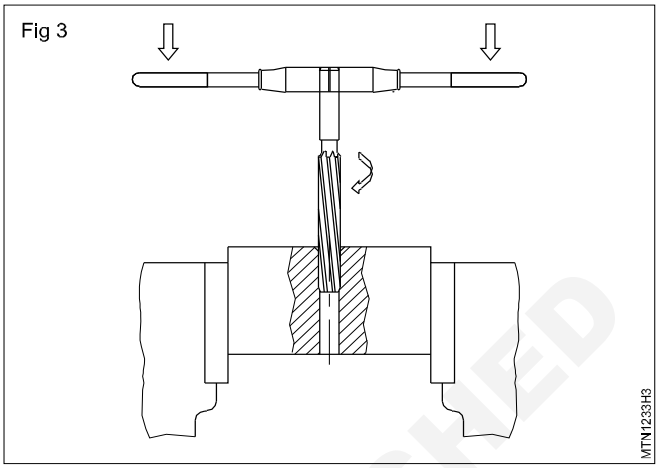
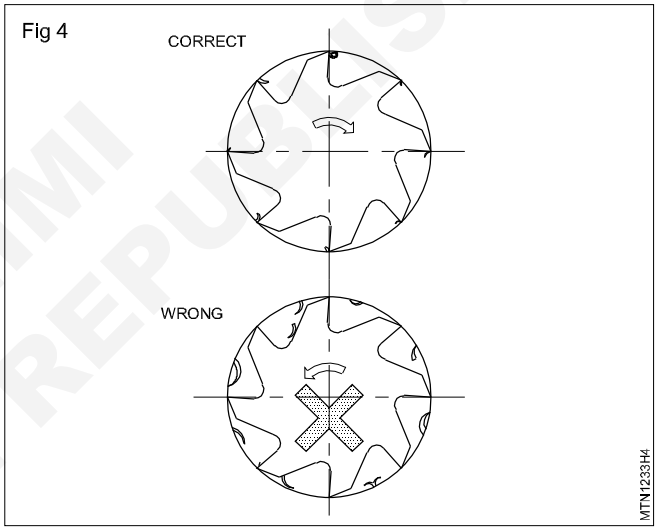


Fig 4

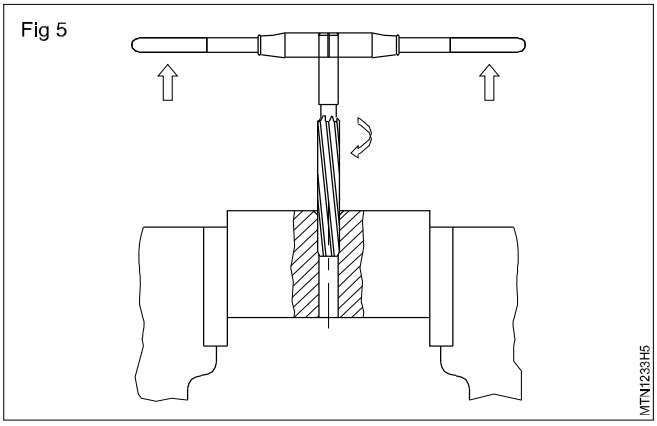


Ream the hole through. Ensure that the taper lead length of the reamer comes out well and clear from the bottom of the work.

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)

Fig 5



Scraping curved surfaces

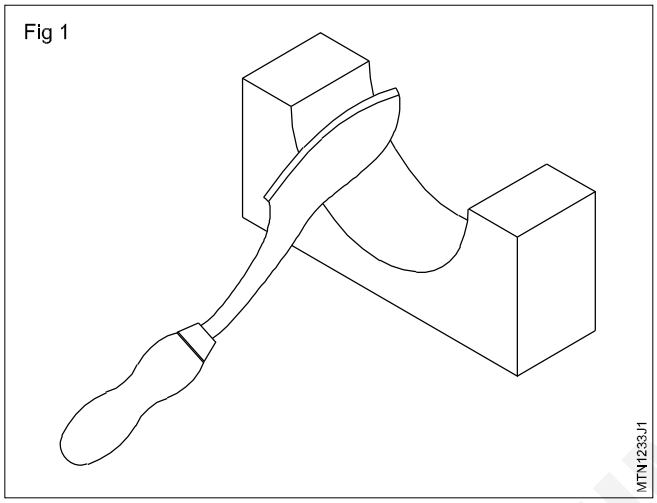
Objective : This shall help you to
- **scrape and test curved surfaces.**

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)

Fig 1



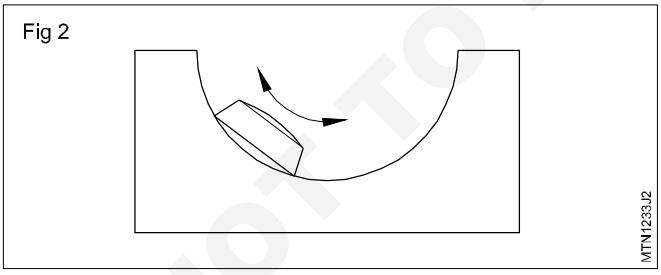
Pressure is exerted with the other hand on the shank for cutting.

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)

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)

Fig 3

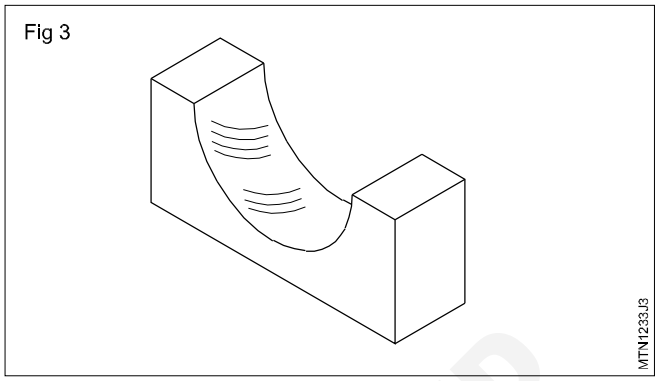
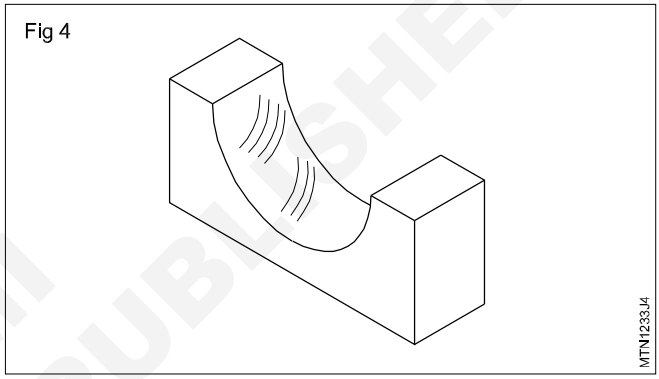
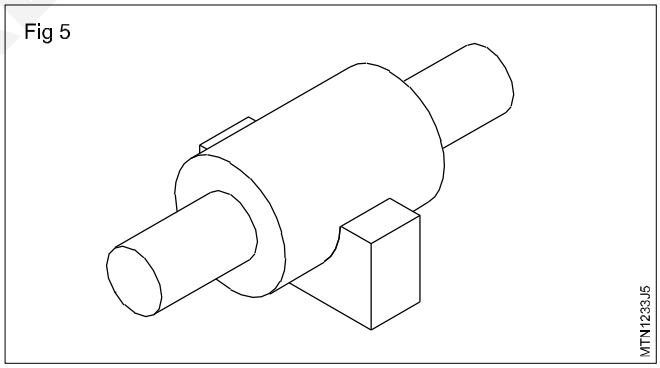


Fig 4



Use a master bar to check the correctness of the surface being scraped. (Fig 5)

Fig 5



Apply a thin coating of Prussion blue on the master bar to locate the high spots.

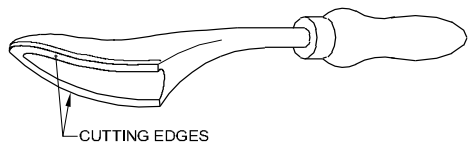
Sharpening scrapers

Objectives : This shall help you to
- **sharpen a half round scraper.**
- **sharpen a three-square scraper.**

Sharpening half round scrapers

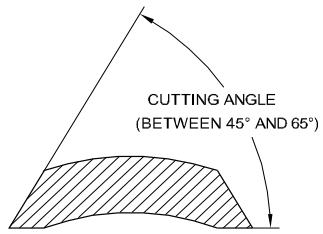
Locate the two cutting edges on the rounded back (Fig 1) for the half round scrapers.

Fig 1



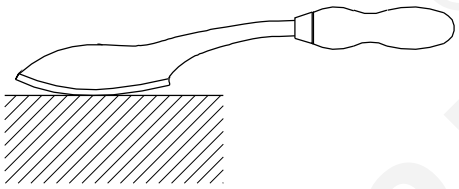
Check the cutting edges are formed by the bottom surface, and the flat surfaces are ground on the rounded back of the scraper. (Fig 2)

Fig 2



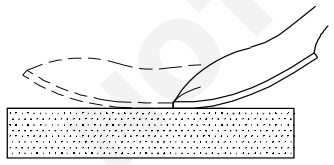
Grind the bottom surfaces with a slight curve. This helps the cutting edges to make point contact on the surfaces being scraped. (Fig 3)

Fig 3



Rub the bottom surface with a rocking motion on the oilstone for re-sharpening. (Fig 4)

Fig 4



Re-sharpened by grinding the bottom surface, when the cutting edge is blunt.

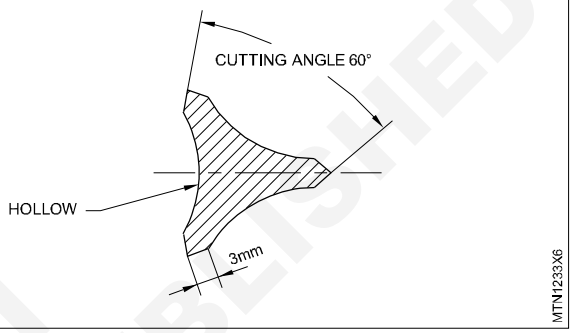
As far as possible avoid grinding of the edges. (Flat surface ground on the rounded back.)

These scrapers have triangular cross-section which tapers to a point. (Fig 5)

Fig 5

The centre of each face is hollow and this makes sharpening easy. (Fig 6)

Fig 6



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.

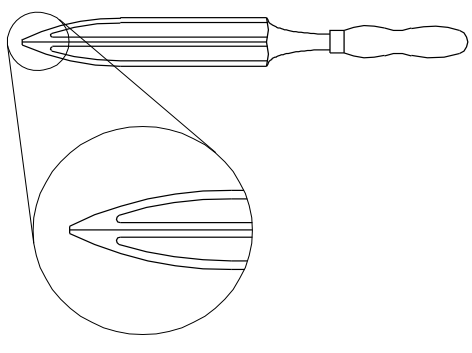
Apply only light pressure.

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 crimping and soldering of wires

Objectives: At the end of this exercise you shall be able to
- **prepare crimping joints on the connectors**
- **solder the cables by using blow lamp.**
- **solder the wires by using Electric soldering iron.**

Requirements

Tools/Instruments

- Trainees tool kit - 1 No.
- Crimping plier - 1 No.
- Blow lamp - 1 No.
- Tong - 1 No.
- Combination plier - 1 No.
- Soldering iron - 1 No.

Materials / Components

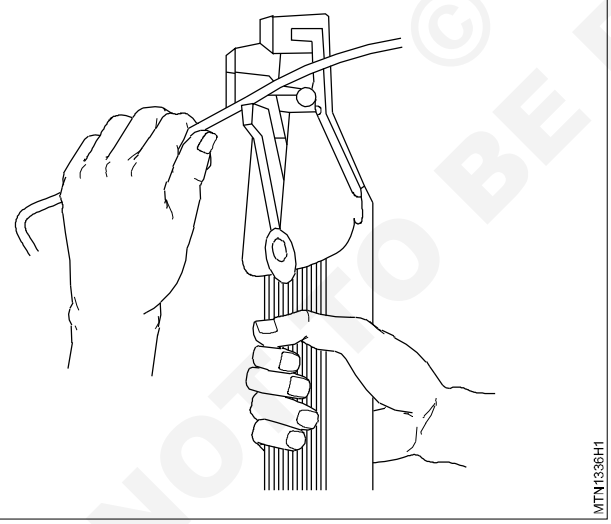
- Cotton rag - as reqd.
- Wooden plank - as reqd.
- Solder - as reqd.
- Brick - as reqd.
- Insulating sleeve - as reqd.
- Flux - as reqd.
- Lug socket - as reqd.
- Cloth/Cotton tape - as reqd.
- Grade sandpaper - as reqd.
- Copper and Aluminium conductors - as reqd.

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 not 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.

Fig 2

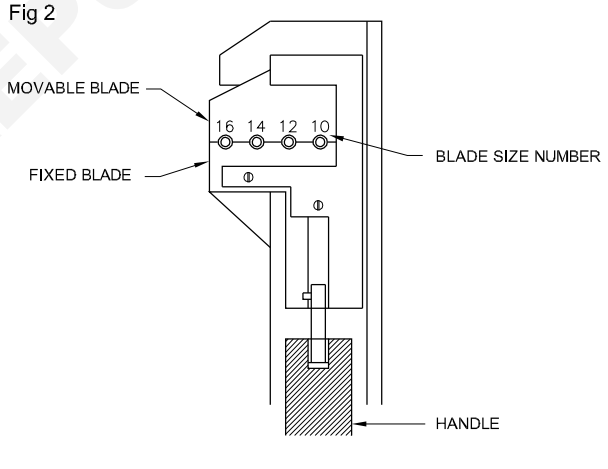


Fig 3

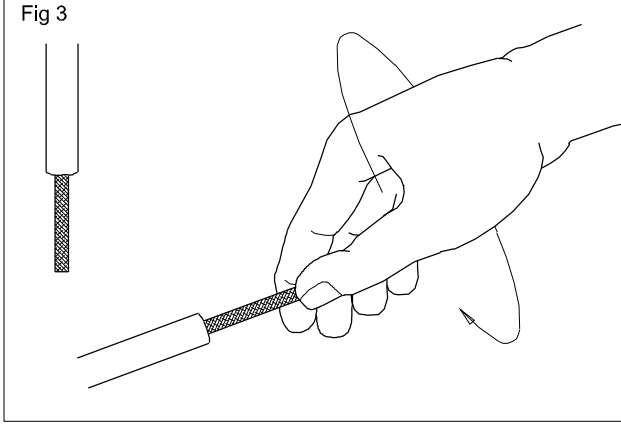
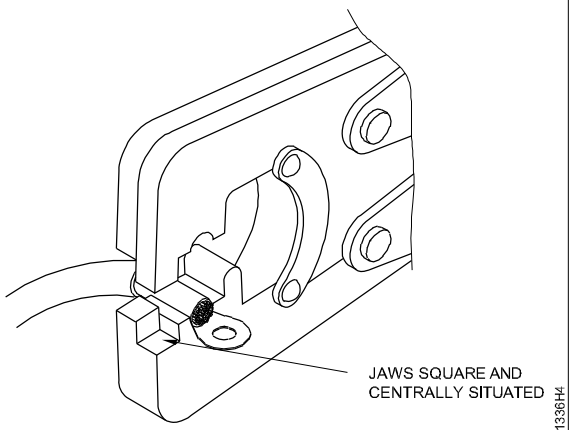


Fig 4

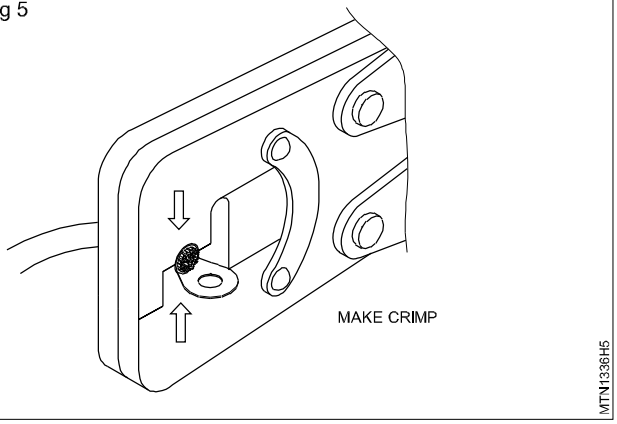


5 Apply slight pressure to create a light impression on the connector.

6 Check whether the press 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 5



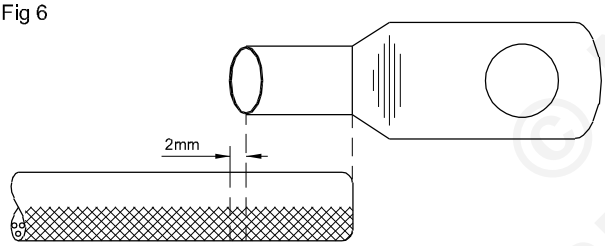
8 Check whether the prepared crimping joint is firm by pulling the cable and connector.

9 Repeat the crimping of connectors for various sizes of copper and aluminium conductors of different lengths.

TASK 2 : **Solder the cable lugs by using blow lamp**

1 Solder a lug to a copper conductor. (Fig 6)

Fig 6

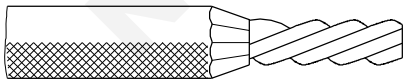


2 Clean the inner surface of the cable lug using 00 grade sandpaper.

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 7)

Fig 7



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 8)

6 Light the blowlamp and let it emit a blue flame. (Fig 9)

Fig 8

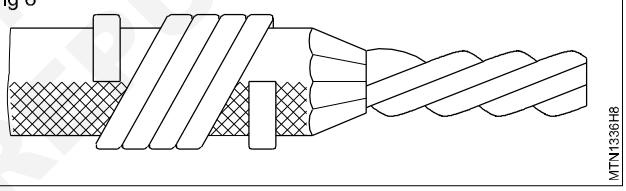
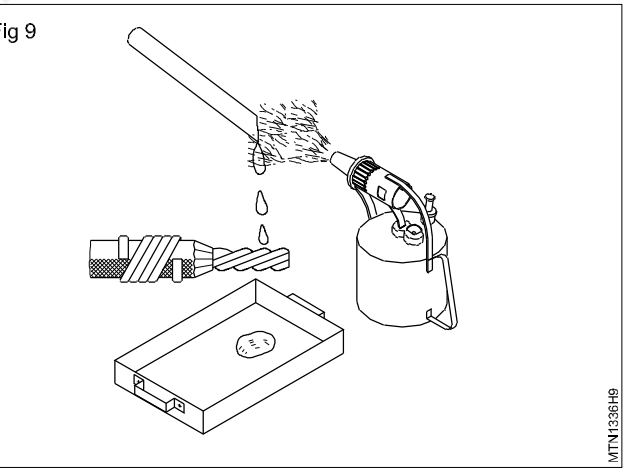


Fig 9

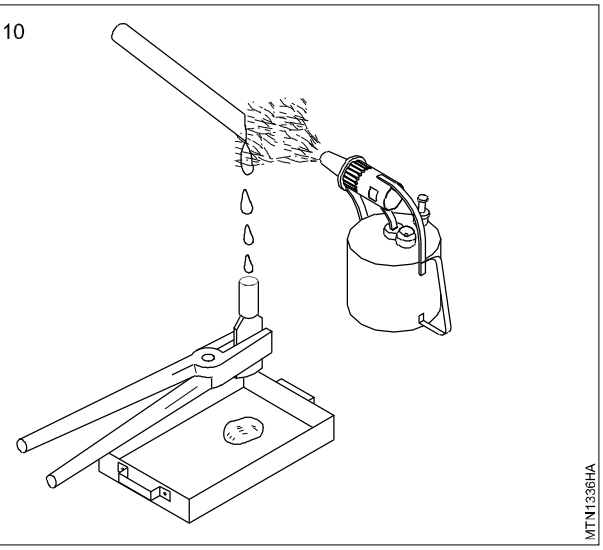


7 Apply a thin coat of flux to the cable end.

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.

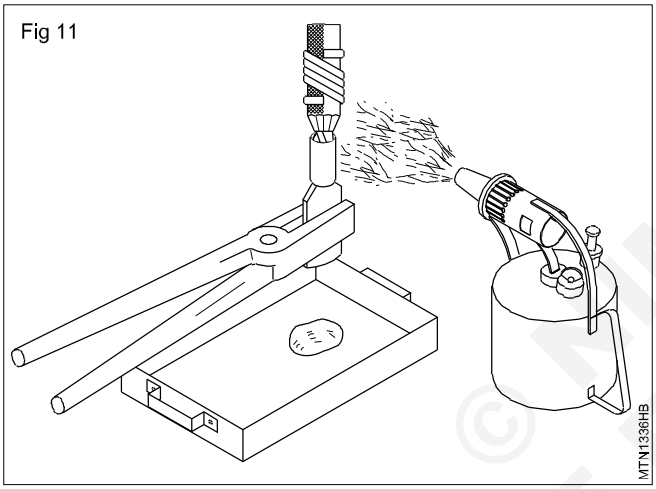
9 Apply a small quantity of flux inside the lug socket. Tin the lug by melting the solder stick to fill the socket and collect the excess molten solder in the tray. (Fig 10)

Fig 10



10 Apply some flux to the cable end and socket interior. (Fig 11)

Fig 11

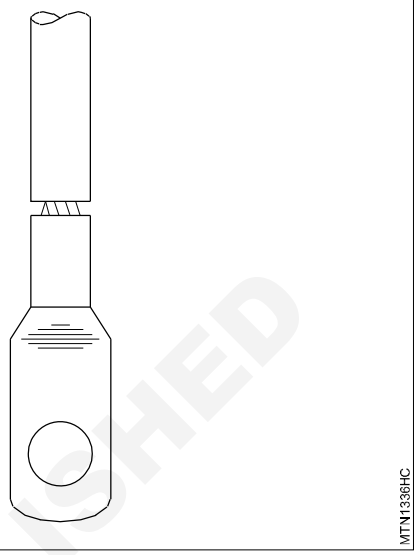


11 Fill up the socket of the lug with the molten solder.

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 12)

Fig 12



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.

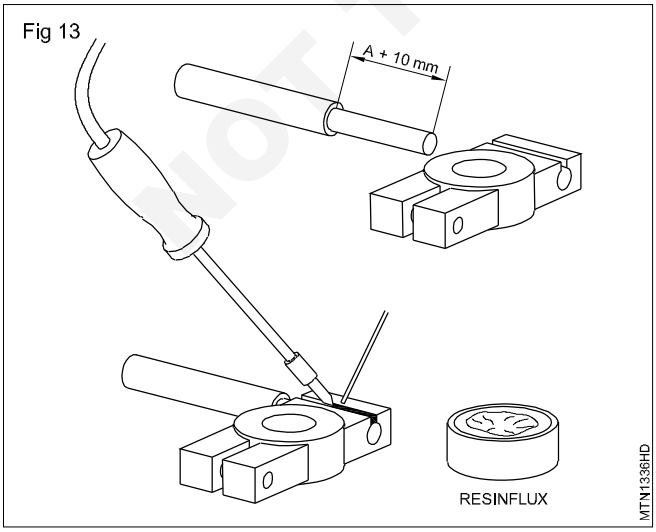
Do not use water to cool the lug.

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 13.

Fig 13



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.

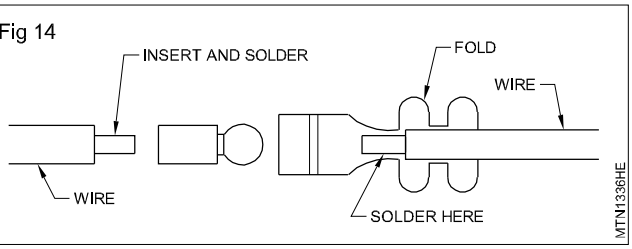
5 Solder the end with clamp face with molten solder.

6 Hold the clamp horizontally and solder the split and close the split with solder.

7 Hold the clamp as shown in the Fig 14 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.

Fig 14



Soldering the circuit wire terminals

1 Remove the insulation as shown in the Fig 14 without cutting conductor strands.

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.

Construct the simple electrical circuit

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

- **construct the simple electrical circuit.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipments / Machinery

- Battery. Test lamp - 1 No.

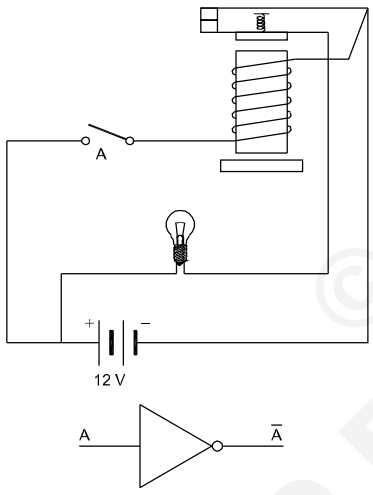
Materials / Components

- Wires 4 mm - as reqd.
- Insulation tape - as reqd.
- Switch - as reqd.
- Fuse - as reqd.
- Bulb - as reqd.

PROCEDURE

1 Select the raw materials for construct a simple electricals circuit.

Fig 1



2 Select the plywood board for construct the wiring on it.

3 Draw the wiring diagram on the paper and plywood board.

4 Collect raw materials for construct the simple electrical circuit.

5 Fix the wiring, ampiremeter relay, fuse and bulb on the plywood board diagram as per given (Fig 1) diagram

6 Connect the battary terminals with circuit.

7 Switch on the circuit and ensure the current flow through ampire or volt meter in the circuit.

8 Operate the switch ON/OFF and check the bulb glow.

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.
- Digital/Multimeter - 1 No.

Equipments / Mechinery

- Battery 12V, 6V - 1 No..

Materials / Components

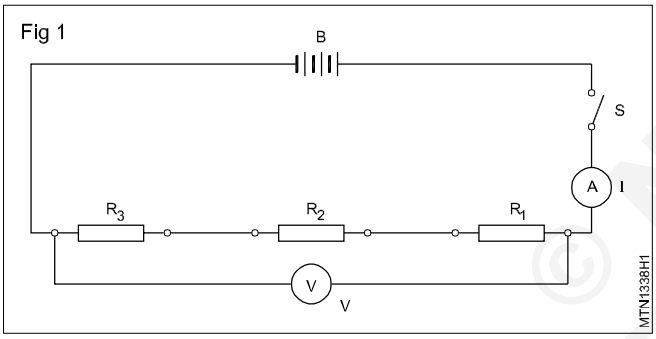
- Wires 4mm - as reqd.
- Insulation tape - as reqd.

PROCEDURE

TASK 1: **Connect DC series circuit (Fig 1) and Verify its characteristics**

1 Form a circuit as shown in the Fig 1.

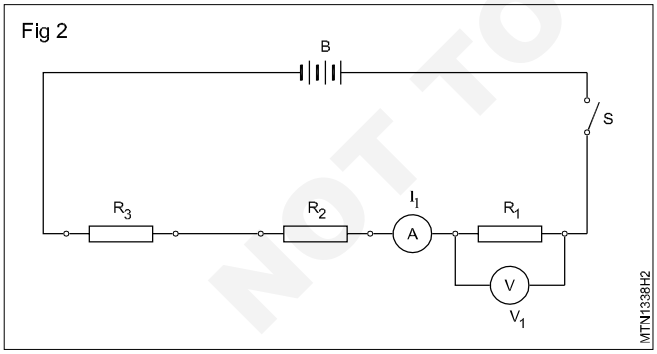
Fig 1



2 Close the switch 'S', measure the current 'I' and voltage 'V'.

3 Enter the measured values in Table No.1.

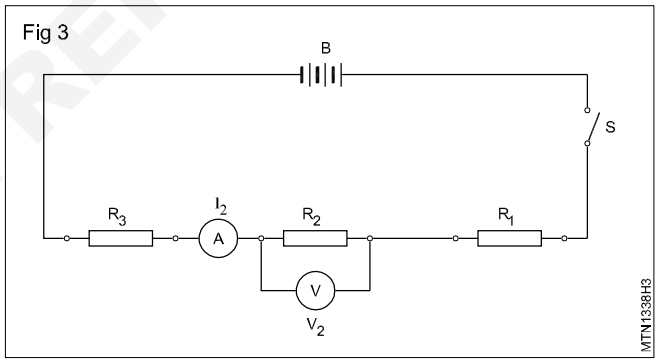
Fig 2



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.

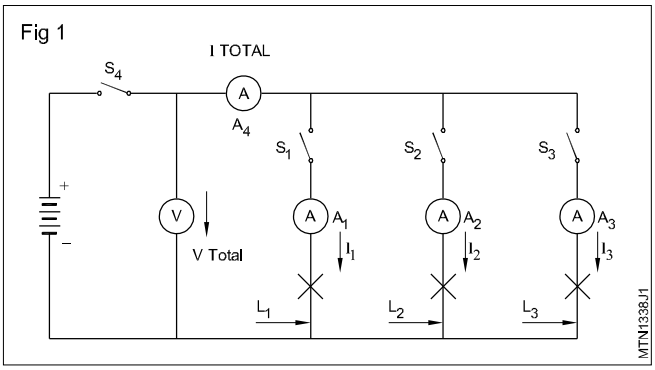
9 Verify the characteristics of current, voltage and total resistance.

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=_____ =

TASK 2 : **Connect DC parallel circuit (Fig 4) and Verify its characteristics**

Fig 1



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 1.

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	,,

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 / Machinery

- Battery 12V - 1 No..
- Vehicle - 1 No.

Materials / Components

- 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.

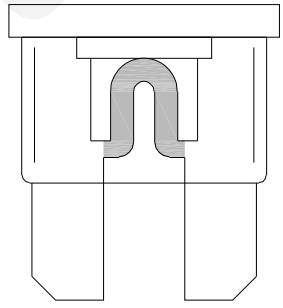
4 Remove the fuse from its spring clip. Check whether it is blown or not.

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)

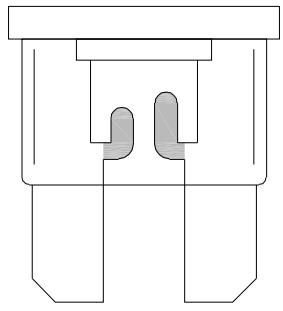
Fig 1



GOOD

MTN1339H1

Fig 2



BLOWN

MTN1339H2

TASK 2 : **Fine out open and short circuit in the lighting circuit**

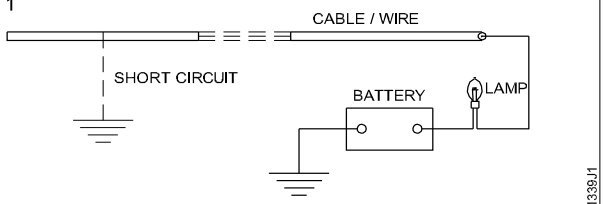
1 Check the wiring for open circuit by connecting an ohmmeter between the two terminals.

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.

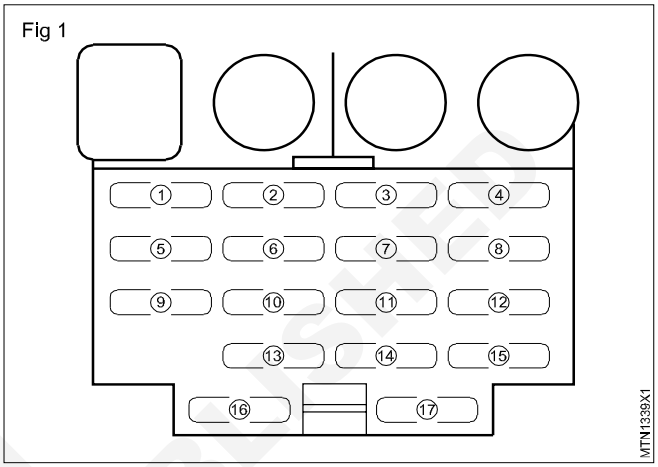
9 **CIG 15 A :** Cigarette lighter, clock digital type.

10 **Wiper 15 A :** Windshield wipers and washer.

11 **Stop 15 A :** Stop light

12 **Radio 7.5 A :** Radio, stereo cassette tape player.

Fig 1



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.	Label 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 jumper wire cables as shown in Fig 1.

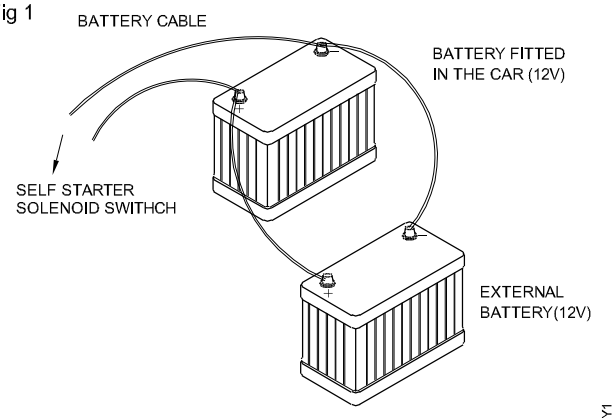
5 Start the vehicle run for some times.

6 Disconnect the jumper 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

— — — — — — —

TASK 5: **Checking of fusible link**

1 Visually inspect the fusible link for burnout, disconnect, and damaged.

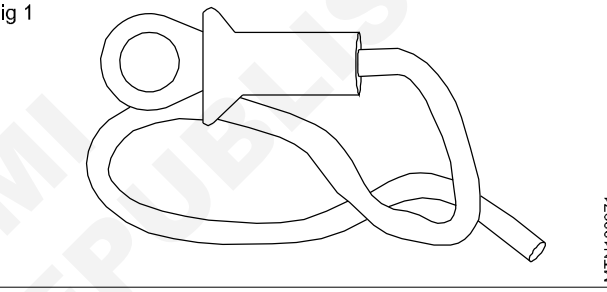
2 Check with the multimeter for continuity test.

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.

— — — — — — — —

TASK 6 : **Circuit breaker (Fig 1)**

1 Identify the circuit breaker in the electrical circuit

2 Check the function of circuit breaker

3 Check the bimetallic strip (1)

4 Check the moving contact point (2)

5 Check the fixed contact point (3)

6 Check the circuit breaker terminals (4) & (5)

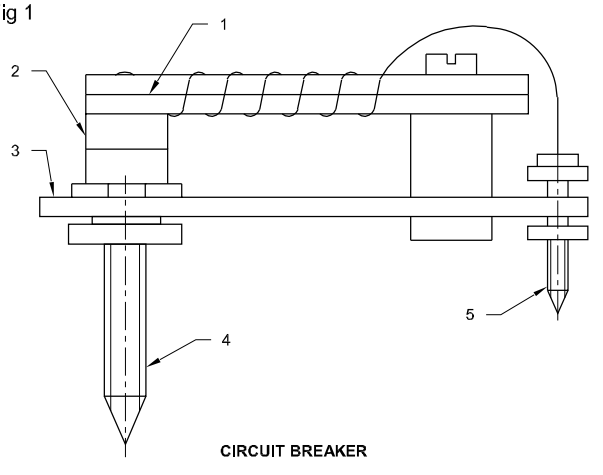
7 Check the current flow through contact point

8 Visually check the all electrical connection of circuit breaker

9 If found any damaged parts, replace the parts or assembly

10 Operate the circuit breaker and ensure the proper function

Fig 1



CIRCUIT BREAKER

Perform the electrical circuits by using Ohm's law

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.
- Multimeter - 1 No.
- Ohm meter - 1 No.

Equipments / Machinery

- Battery 12V - 1 No.
- Vehicle - 1 No.

Materials / Components

- Wires 4 mm - as reqd.
- Insulation tape - as reqd.
- Emery paper - as reqd.
- Soap oil - as reqd.
- Cotton waste - as reqd.
- Wire clip - as reqd.

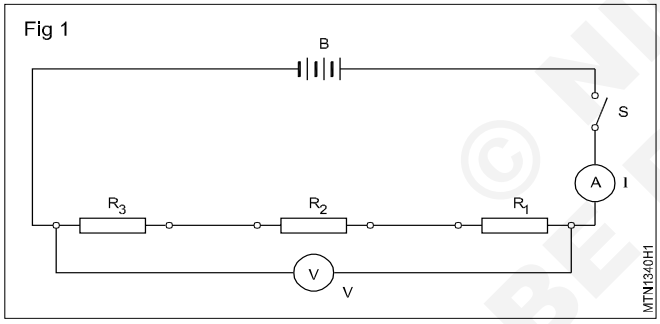
PROCEDURE

TASK 1: **DC series circuit**

1 Prepare the D.C series circuit diagram

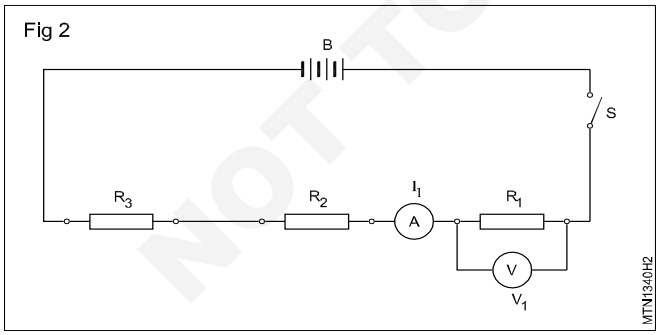
2 Form a circuit as shown in the Fig 1.

Fig 1



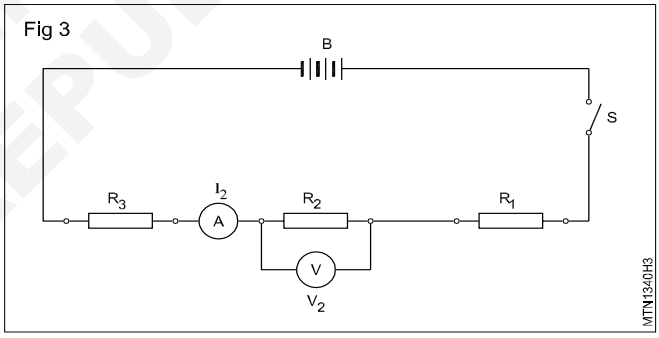
3 Close the switch 'S', measure the current 'I' and voltage 'V'.

Fig 2



4 Enter the measured values in Table 1.

Fig 3



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 voltage 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.

8 Connect and measure I_3 and V_3 across R_3.

9 Enter the measured values in Table 1.

Table 1

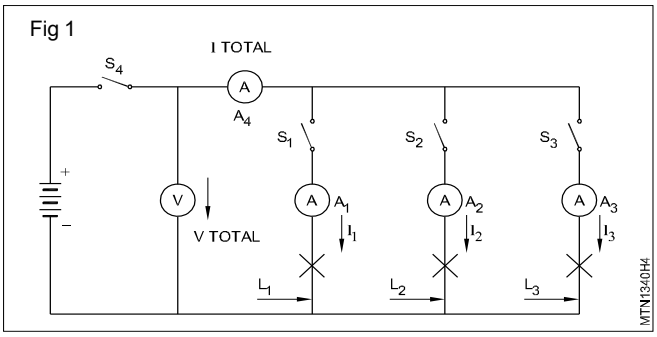
Values	Total circuit	$R_1 = 10$	$R_2 = 20$	$R_3 = 10$
Current	I =	I_1 =	I_2=	I_3=
Voltage	V =	V_1 =	V_2=	V_3=
Resistance	R =	R_1=	R_2=	R_3=

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 1)

Fig 1



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 voltmeter (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 switches '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 ohms).

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 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**

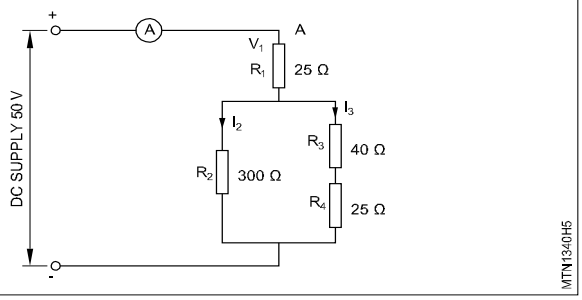
1 Prepare the D.C series parallel circuit diagram

2 Calculate the voltage and currents for the series parallel circuit shown in Fig 1. Enter the values in Table 3.

3 Calculate the total resistance R_T and total current I_s for V_s = 50V and enter in Table 4.

4 Set the value of the rheostat resistances equal to the value given in Fig 5 (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)

Fig 1



5 Form the circuit and measure the voltage and current. Record them in your note book.

6 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	$R_2 \angle\angle (R_3+R_4)$
V_s = 50V	Calculated										
R_1 = 25W	Values										
R_2 = 300W R_3 = 40W R_4 = 60W	Measured Values										

Table 4

Calculated Values	$R_T = R_1 + R_1\{R2 \angle\angle (R_3 + R_4)\}$ =
Measured Values	

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 / Machinery

• Auto electrical wiring circuit	- 1 No.
• Battery	- 1 No.

Materials / Components

• Fuse	- as reqd.
• Switch	- as reqd.
• Cable/Wire	- as reqd.

PROCEDURE

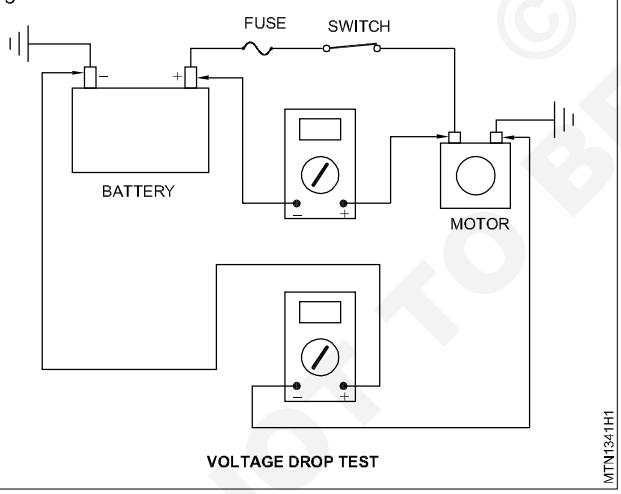
Voltage Drop Test in Head light circuit

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



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)

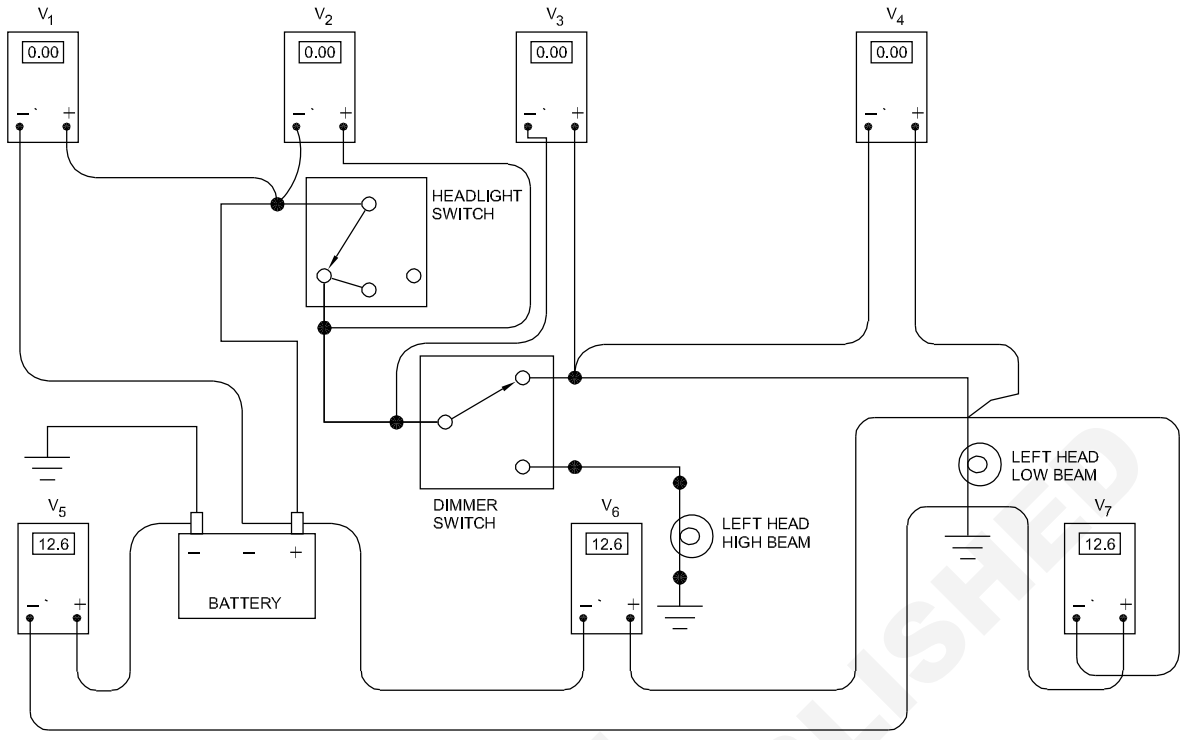
4 Measure the voltage drop shown in meter.

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

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 & battery voltage.**

Scan the QR code to view the video for this exercise

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 / Machinery

- Battery Charger - 1 No.

Materials / Components

- Distilled water - as reqd.
- Vaseline - as reqd.
- Cotton rag - as reqd.
- Sand paper - as reqd.
- Soda bicarbonate - as reqd.
- Cable / wire - as reqd.

PROCEDURE

1 Cleaning and Top-up of lead acid battery.

2 Clean the battery terminals, if corroded, with sandpaper: if sulphate, clean with wet cotton waste or with soda bicarbonate.

Do not damage the battery terminal by scraping with any metal strip.

3 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.

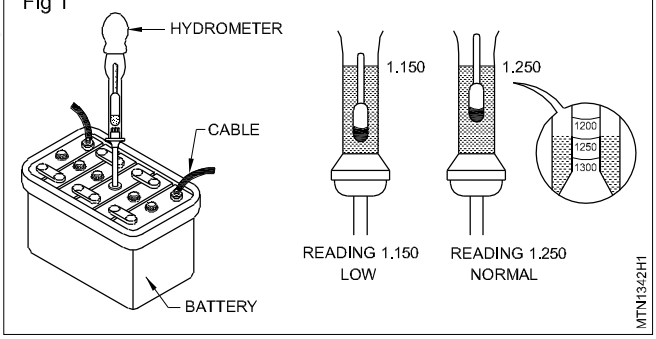
4 Top up the electrolyte to the marked level in all the cells with distilled water.

No electrolyte to be used to top up battery.

5 Open seal cap of battery and keep Hydrometer inside. Pump electrolyte upto reference mark.

6 Check the initial specific gravity of the electrolyte of each cell using a hydrometer (Fig 1)

Fig 1



Skill Sequence

Check the specific gravity of a battery

Objectives : This shall help you to
- **clean the battery terminals and the body of the battery**
- **test the battery with a hydrometer**
- **test the battery with a volt meter.**

Check the specific gravity and open circuit voltage test

Disconnect the negative cables first from the battery terminal.

Disconnect the positive cables from the battery terminal.

Remove the mounting clamp nuts.

Lift the battery from the vehicle.

Clean the top of the battery with water and cotton rag.

Clean the battery terminals by a non-metalic wire brush or emery-paper.

Check and top up the electrolyte level with distilled water. (if necessary)

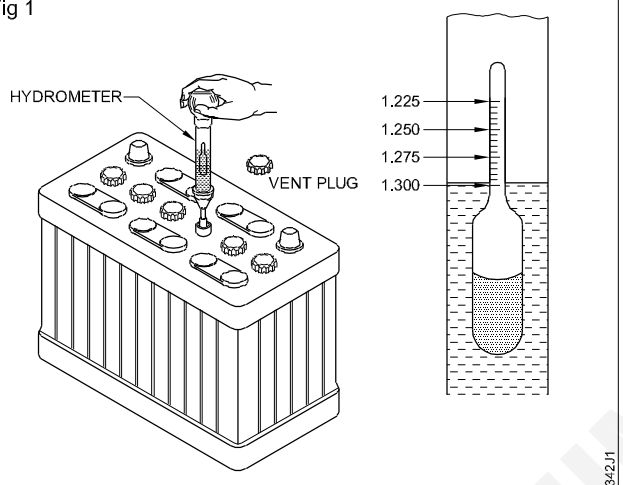
Keep the battery on a leveled wooden workbench.

Remove all the vent plugs.

Hold the hydrometer vertically. (Fig 1)

Place the nose of the hydrometer in the cell. Ensure that the nose is dipped in the electrolyte.

Fig 1



TESTING SPECIFIC GRAVITY OF A BATTERY

Press the rubber bulb of the hydrometer.

Release it to draw the electrolyte upwards. Ensure that the electrolyte does not come into the bulb.

Note the float level which is floating in the electrolyte.

Record the reading in Table 1.

Table 1

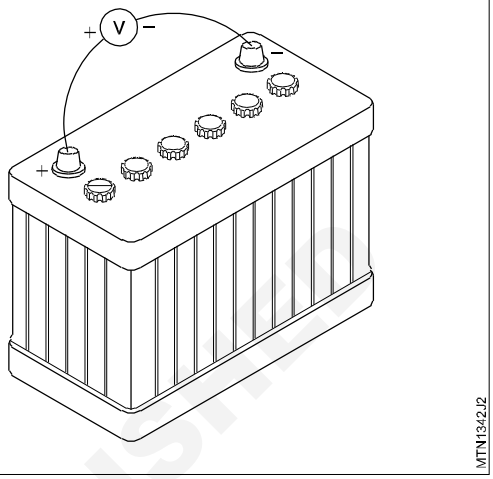
1	2	3	4	5	6

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.

Fig 2



Connect the leads of the DC voltmeter (2) to the battery terminal (+ve to -ve). (Fig 2)

Take the reading from the voltmeter and record.

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.

Clean the vent holes and tighten all the vent plugs.

Smear the battery terminals with Vaseline.

Place the battery in its position in the vehicle.

Tighten the battery mounting clamp nuts.

Clean the battery lugs with baking soda solution and water.

Connect the battery +ve cable first and tighten it.

Connect the battery -ve cable and tighten it.

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.**

Scan the QR code to view the video for this exercise

Requirements

Tools/Instruments

- Trainee's tool kit - 1 Set.
- Hydrometer - 1 No.
- Volt meter - 1 No.

Equipments / Machinery

- Battery charger - 1 No.
- Vehicle - 1 No.

Materials / Components

- 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**

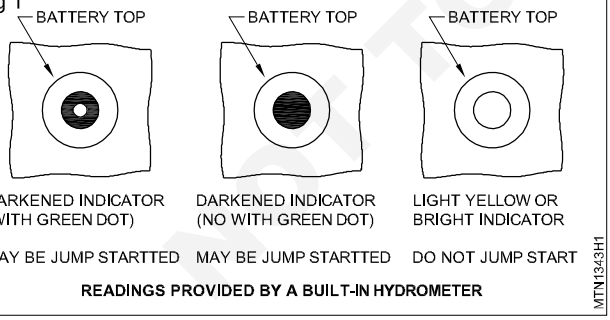
1 Place the battery on the charging table.

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.

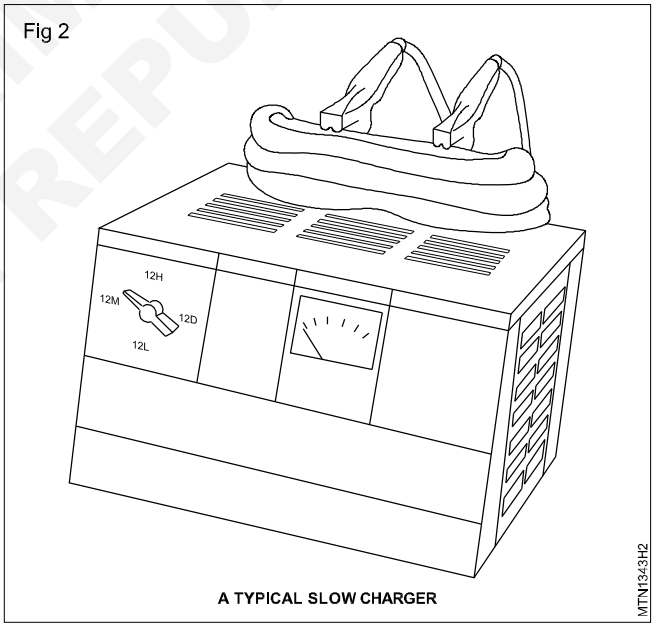
5 Consult an appropriate manual and determine the charging rate and time for the battery.

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.

The negative (-) lead must be connected to negative (-) terminal.

Fig 2



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.

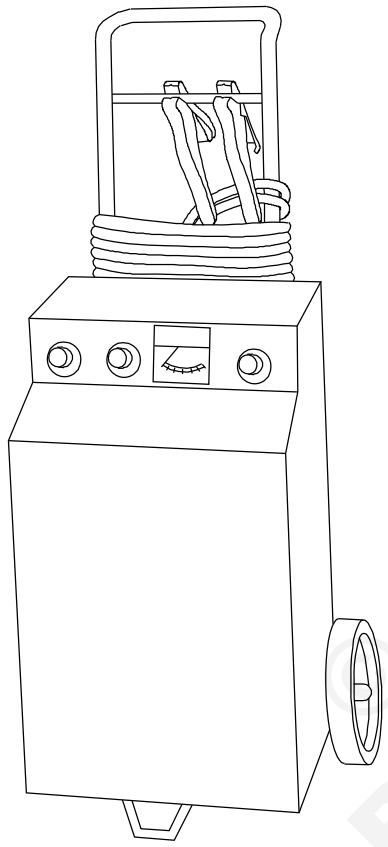
11 Continue charging until the allotted time or until the battery is fully charged.

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

MTN1343H3

To avoid damage, charging rate must be reduced or temporarily halted if:

Electrolyte temperature exceeds 125F.

Violent gassing or spewing of electrolyte occurs.

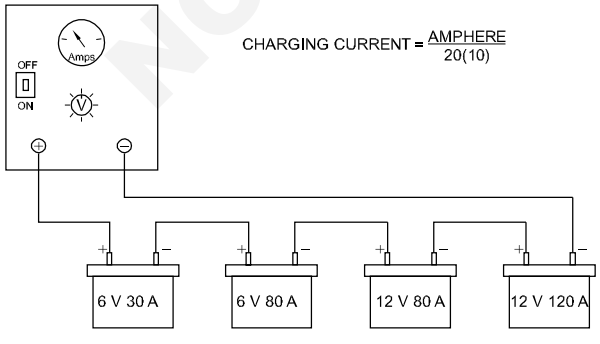
Battery is fully charged when over a two hour period at a low charging rate in amperes all cells are gassing freely and no change in specific gravity occurs. For the most satisfactory charging, the lower charging rates in amperes are recommended.

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

MTN1343J1

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

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

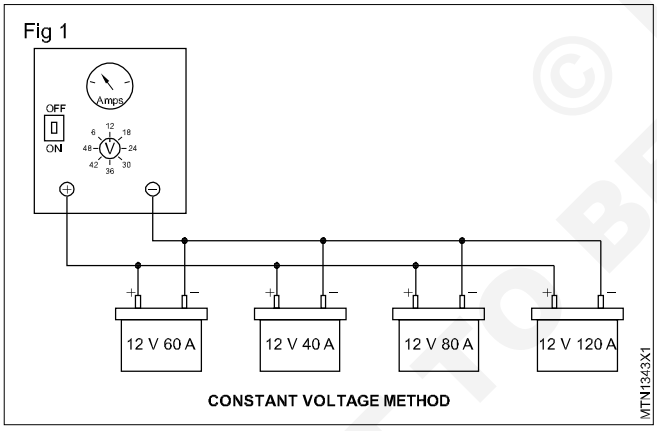
6 Record the readings in Table 2.

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

Fig 1



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 top up 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

Equipments / Machinery

- Trainee's tool kit - 1 No.
- Battery hydrometer - 1 No./each.
- Lead-acid storage battery, 6V or 12V 80Ah - 1 No./each.
- Mulitmeter - 1 No.
- Equipment - 1 No.
- Vehicle - 1 No.

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.
- Fuse - as reqd.
- Cable / wire - as reqd.
- Fuse, switch - as reqd.

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
   - Output voltage
   - 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 battery 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.

— — — — — — — —

Skill Sequence

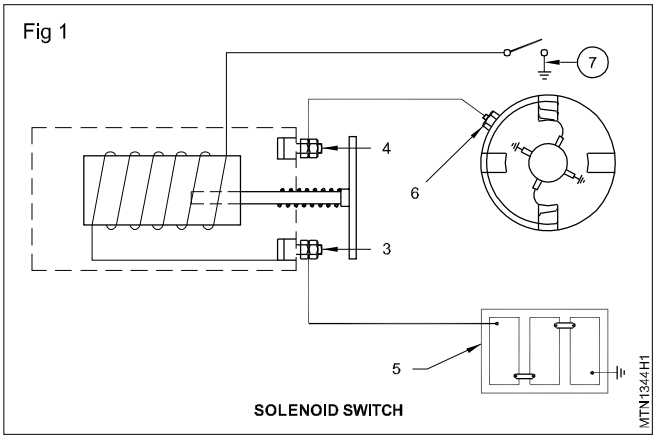
Checking of solenoid and relay

Objectives: This shall help you to
- **check the condition of the solenoid switch in the starting system**
- **check the condition of the Relay in the wiring circuit.**

Checking solenoid switch

Check the solenoid switch terminals (3&4) and clean them. (Fig 1)

Fig 1



Check the battery cable connections from the battery (5) to the solenoid switch terminals (3). Tighten if found loose.

Check the battery cables from the solenoid switch terminals (4) to the starter motor terminals (6). Tighten it if formal loose.

Check the wire connection from the solenoid switch terminals to the starting switch (7).

Connect the test lamp to the brake light switch terminal (1&2). If the switch is not closed, the lamp will glow.

Disconnect the cable wires from the solenoid switch.

Connect one end of the test lamp with the solenoid switch terminal (3) and ground the other end of the test lamp.

It will burn, but this test will not indicate short circuit.

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.

Checking the relay in horn circuit

Disconnect the electrical connection from the horn. relay (5) as shown in Fig 2.

Loosen the mounting nuts of the horn relay and remove it

Check the condition of the horn relay using a rheostat and volt meter.

Connect the rheostat (1) in series to the battery and horn relay (3) (Fig 3)

Connect the volt meter (2) across the winding of the relay (3) to measure the closing voltage as shown in Fig (3)

Fig 2

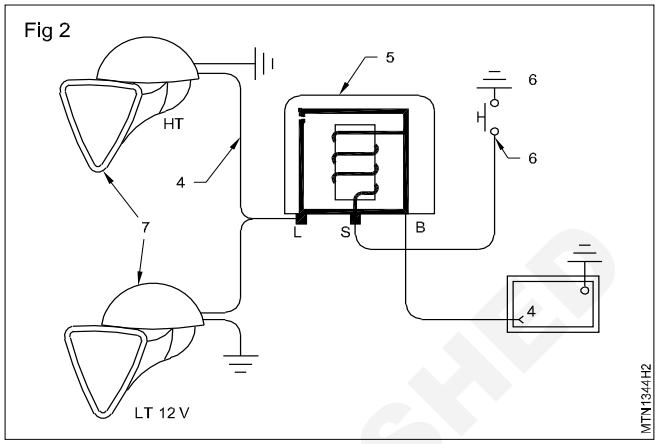
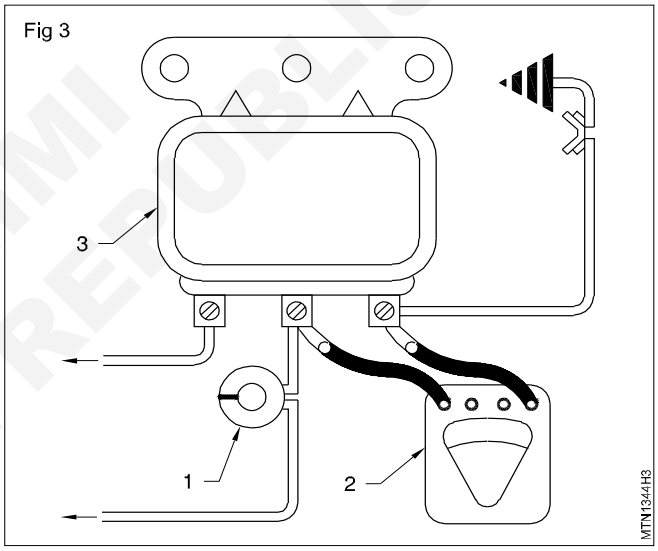


Fig 3



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]**

Replace the relay, if necessary.

Place the horn relay in its position and tighten the mounting nuts.

Refit the spring and the horn switch. Fit the retainer and press it.

Connect the wires to the switch of the horn relay and sound the horn.

Operate the horn switch and test for the correct horn note.

Checking HL & Wiper motor relay.

Repeat the Task of checking the Relay.

Test the 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 / Machinery

- CRDI - Engine - 1 No.

Materials / Components

- Cable connector - as reqd.
- Sensors - as reqd.
- Insulation tap - as reqd.
- Cables - as reqd.
- Wire colour sleeve - as reqd.

PROCEDURE

1 Identify the power and signal connectors

- Trace the wiring circuit and identify the power and signal connectors in the circuit

2 Open circuit check

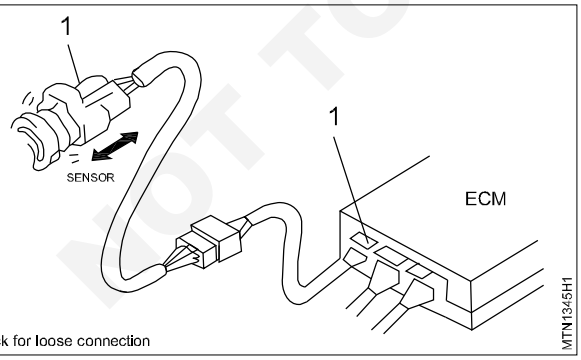
- Loose connection of connector
- Poor contact of terminal (due to dirt, corrosion or rust on it, poor contact tension, entry of foreign object etc.
- Wire harness being open

3 Check for loose connection (Fig 1)

4 Disconnect negative cable from battery.

5 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

6 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)

7 At the same time, check to make sure that each terminal is locked in the connector fully. (Fig 3)

Fig 2

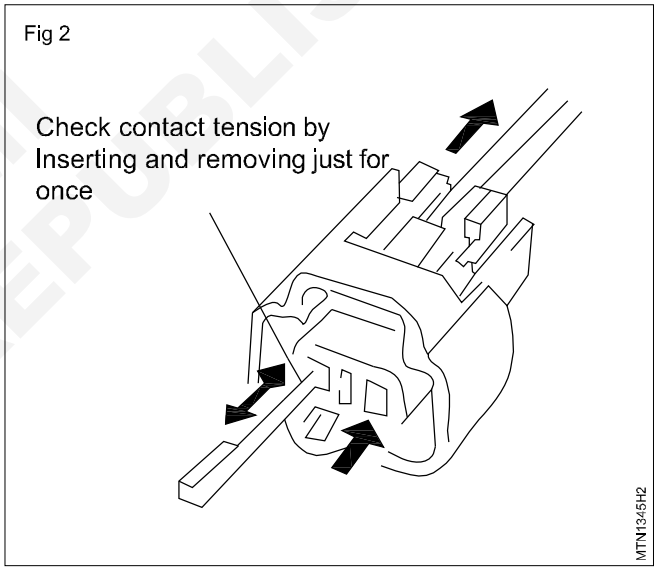
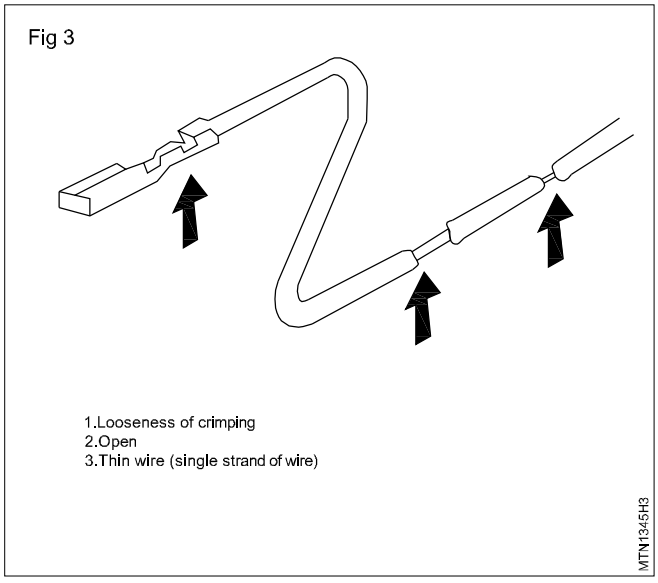
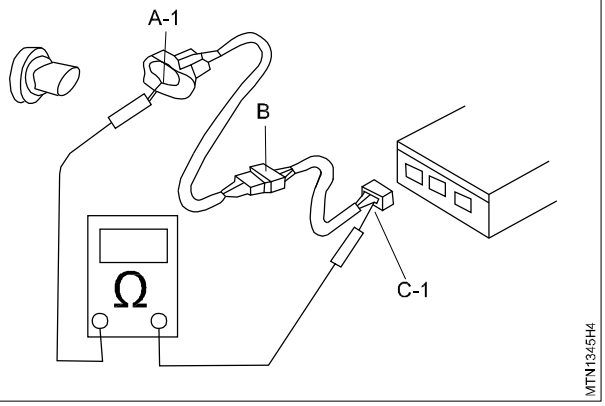


Fig 3



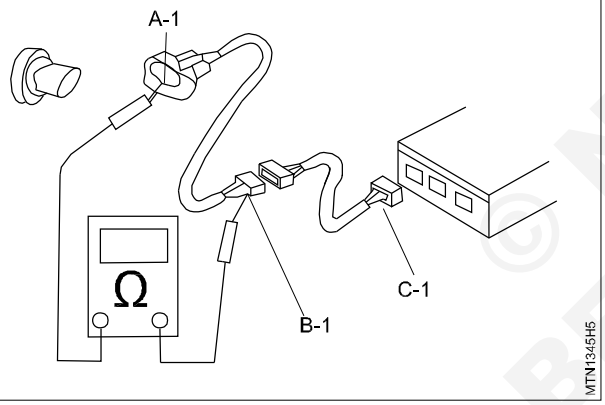
8 Using continuity check or voltage check procedure described in the following, check the wire harness for open circuit and poor connection with its terminals. Locate abnormality, if any. (Fig 4)

Fig 4



9 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

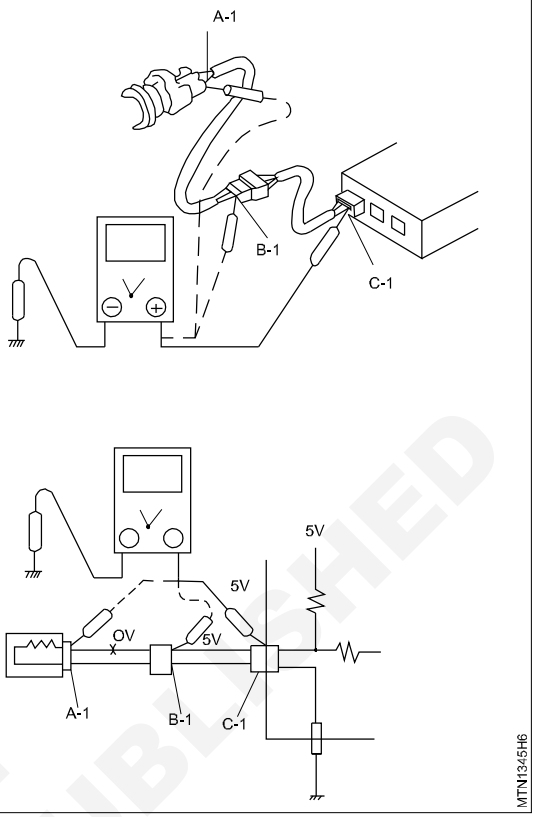


10 Disconnect the connector included in the circuit (connector-B in the figure) and measure resistance between terminals A-1 and B-1.If no continuity is indicated, that means that the circuit is open between terminals A-1 and B-1. If continuity is indicated, there is an open circuit between terminals B-1 and C-1 or an abnormality in connector-B.

11 Voltage check (Fig 6): If voltage is supplied to the circuit being checked, Voltage check can be used as circuit check.

12 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)

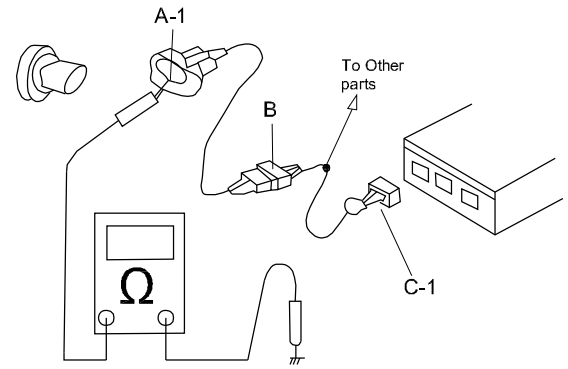
8 Disconnect negative cable from battery.

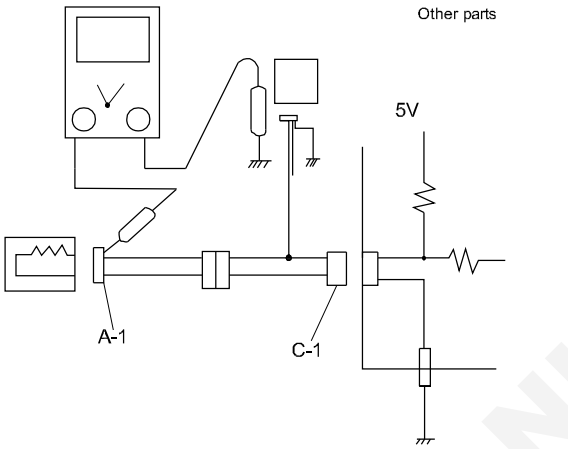
9 Disconnect connectors at both ends of the circuit to be checked.

Note : If the circuit to be checked is connected to other pars, disconnect all connectors of those parts. Otherwise, diagnosis will be misled.

13 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



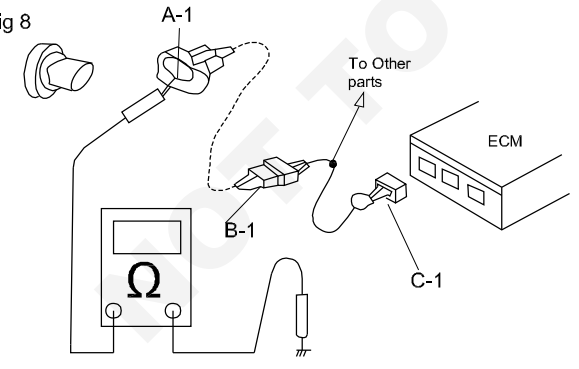


MTN1345H7

14 Disconnect the connector included in circuit (connector B) and measure resistance between A-1 and body ground. (Fig 7)

If continuity is indicated, it means that the circuit is shorted to the ground between terminals A-1 and B-1.(Fig 8)

Fig 8

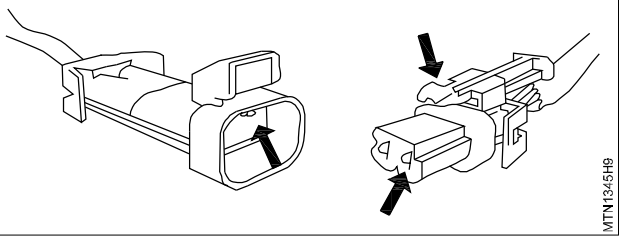


MTN1345H8

15 Most intermittent 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, perform careful check of suspect circuits. (Fig 9 & 10)

16 Poor mating of connector halves, or terminals not fully seated in the connector body (backed out).

Fig 9



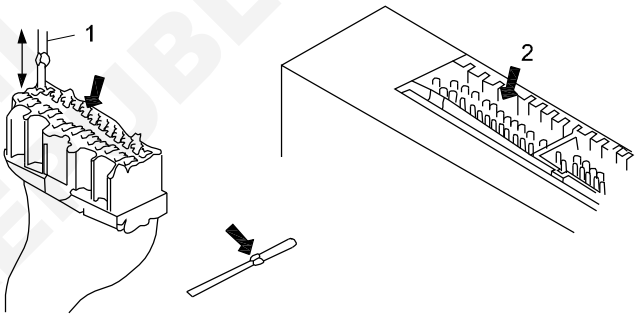
MTN1345H9

17 Dirt or corrosion on the terminals. The terminals must be clean and free of any foreign material which could impede proper terminal contact.

18 Damaged connector body, exposing the terminals to moisture and dirt, as well as not maintaining proper terminal orientation with the component or mating connector.

19 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



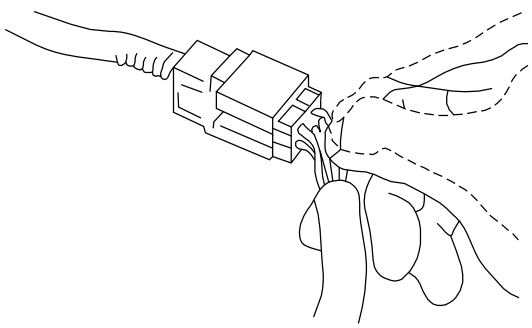
1.Check contact tension by inserting and removing just once
2.Check each terminal for bend and proper alignment

MTN1345HA

20 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

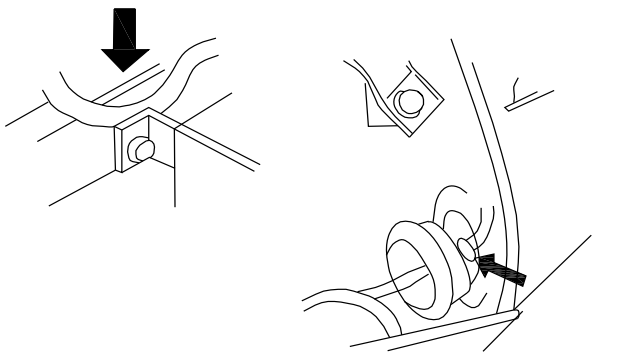


MTN1345HB

21 Wire insulation which is rubbed through, causing an intermittent short as the bare area touches other wiring or parts of the vehicle.

22 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.

Fig 12

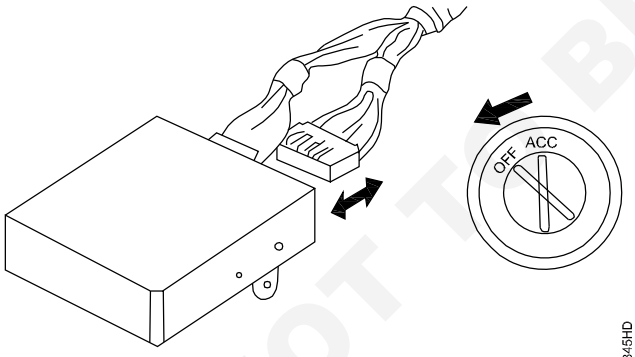


MTN1345HC

23 Precautions for electrical circuit service: When disconnecting and connecting coupler, make sure to turn ignition switch OFF, or electronic parts may get damaged.

24 Be careful not to touch the electrical terminals of parts which use microcomputers (e.g. electronic control unit like as ECM, P/S controller, etc.). The static electricity from your body can damage these parts.(Fig 13)

Fig 13

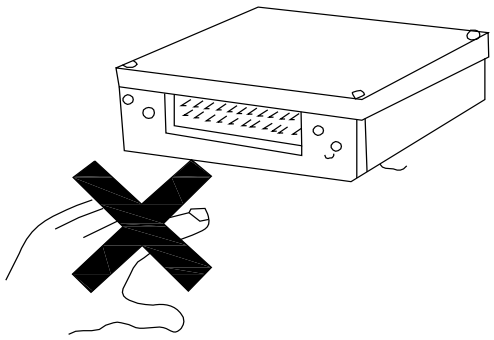


MTN1345HD

25 When disconnecting 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.

26 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)

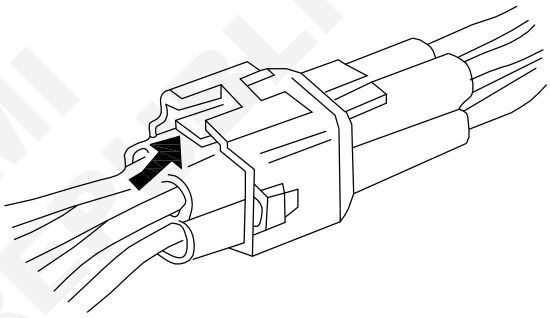
Fig 14



MTN1345HE

27 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)

Fig 15

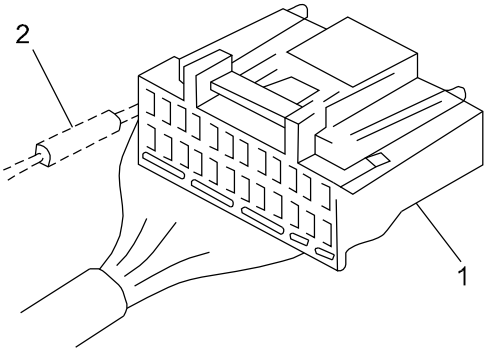


MTN1345HF

28 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.

29 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



MTN1345HG

Identify and check different types of 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**
- **identify good/bad diodes.**

Requirements

Tools/Instruments/Equipments

- Trainees tool kit - 1 No.
- Multimeter - 1 No.

Equipments / Machinery

- Vehicle - 1 No.

Materials / Components

- Assorted types of diodes - 20 Nos./batch.
- Red colour sleeve wire - 10 cms.
- 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 and identify and record the type of package (such as glass/plastic/ ceramic/metal etc.).

3 For the chosen diode referring to Chart 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 100 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.

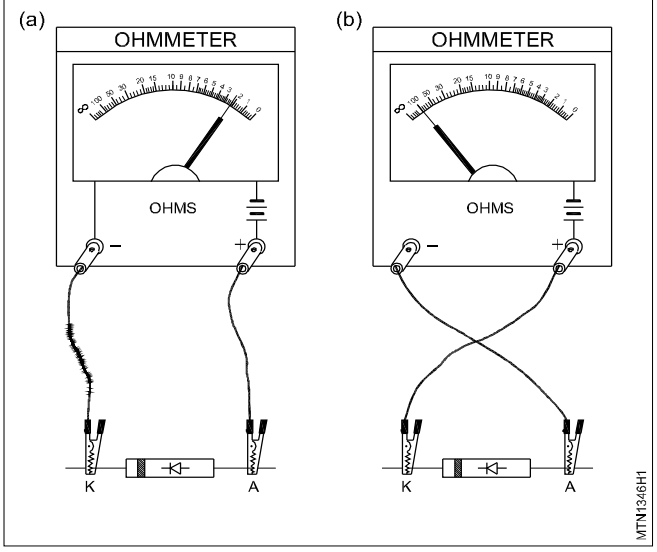
4 From the readings noted in steps 2 and 3, calculate and record the ratio between forward and reverse resistance.

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

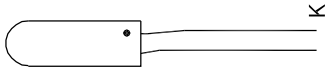
Table - 1

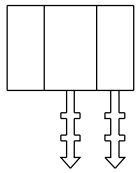
Label Number	Code Number printed on the DIODE	Type of package	Resistance value in		Ratio between forward and reverse resistance	Condition of diode FIT/UNFIT
			one direction	opposite direction		

CHART - 1

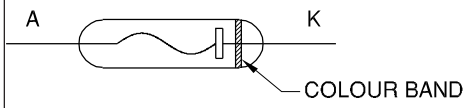
TYPES OF DIODES AND PACKAGING

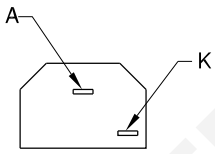
LOW POWER - PLASTIC PACKAGE DIODES



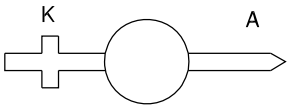


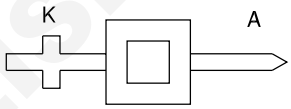
VERY LOW POWER - GLASS PACKAGE DIODE

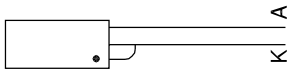


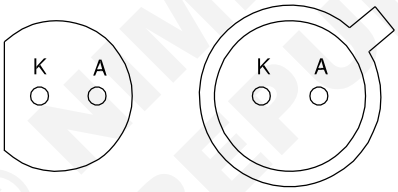


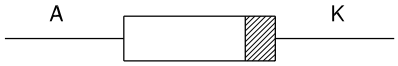
LOW POWER - METAL PACKAGE DIODE



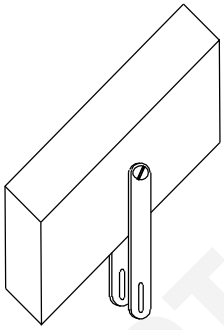


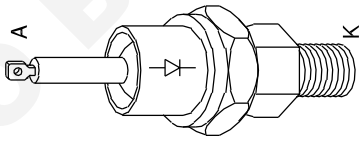


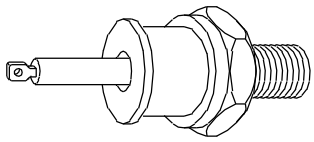




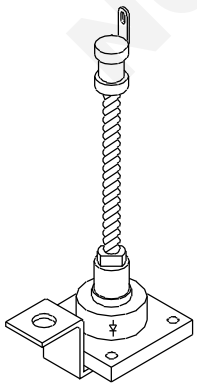
HIGH POWER - METAL PACKAGE DIODE

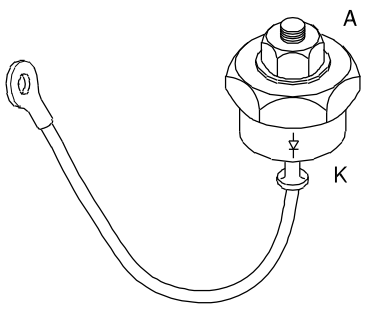






VERY HIGH POWER - METAL PACKAGE DIODES





Practice to inspection and assembling the bridge rectifier / regulator

Objective: At the end of this exercise you shall be able to
- **Inspection and assemble the rectifier / regulator.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Soldering iron - 1 No.

Equipments / Machinery

- Vehicle - 1 No.

Materials / Components

- Cotton waste - as reqd.
- Soldering flex - as reqd.
- Lead wire - as reqd.
- Insulation tape - as reqd.

PROCEDURE

1 Remove the alternator from the vehicle.

2 Dismantle the alternator and clean the dismantle parts.

3 Clean and inspect rectifier regulator.

4 Clean and inspect the ends of rotor for clean copper surface.

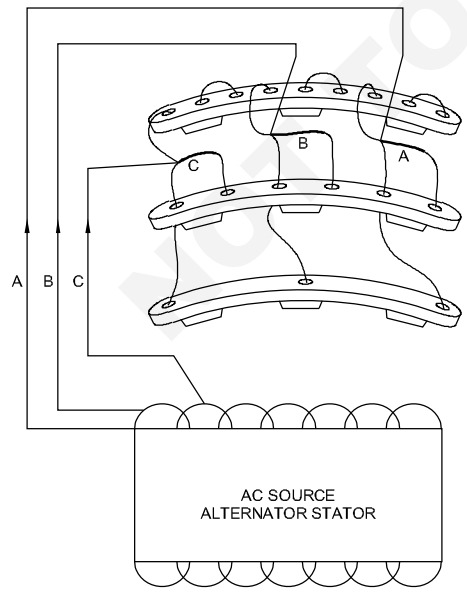
5 Clean the diode pig tall for easy soldering.

6 Heat the soldering iron suffiently so that solder sticks to it.

7 Wet the ends of each diode lead and stator leads.

While wetting diodes a heat damping clip should be used as shown in Fig to arrest heat flow to diode.

Fig 1



AC POWER SOURCE AND BRIDGE RECTIFIER GENERATION (ACTUAL PARTS)

MTN1347H1

8 Keep three diode leads together and solder A B C separately.

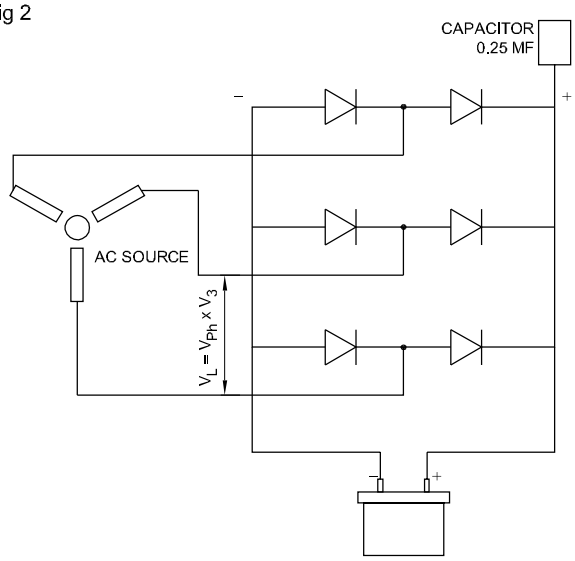
9 Solder ABC leads from stator to the each diode group (3 groups).

The stator leads should have sufficient length to reach rectifier and to fold their away from rotating rotor.

10 Check continuity as shown in the following Fig 1& 2 and switch the beads from + to negative.

11 after assemble the rectifiers test the power rectification system of an alternator.

Fig 2



POWER SOURCE AND BRIDGE RECTIFIER (SCHEMATIC LAYOUT)

MTN1347H2

Identification and checking of transistor

Objectives: At the end of this exercise you shall be able to
- **identify a transistor from its type-number the following informations referring to a data book**
  (a) silicon or germanium
  (b) PNP or NPN
  (c) Package type
  (d) base, emitter, collector pins
- **test the condition of a given transistor using ohmmeter.**

Requirements

Tools / Instruments

- Trainees kit - 1 No.
- International Transistors Data Book - 1 No.

Materials / Components

- Assorted type of transistors - 32 Nos./batch
- Sleeve wires of Red,Yellow, Blue and Black colours - 10 cm each
- Resistor, switches - as reqd.

PROCEDURE

TASK 1: **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.

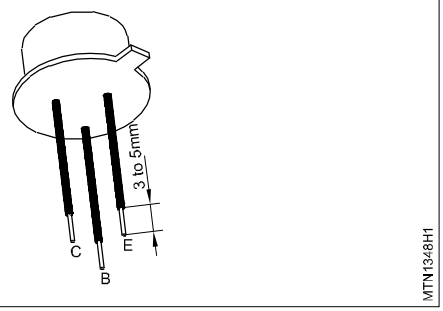
- Whether silicon or germanium
- Whether NPN or PNP
- Type of packaging or case outline (Example: TO5,TO7 etc.)

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.

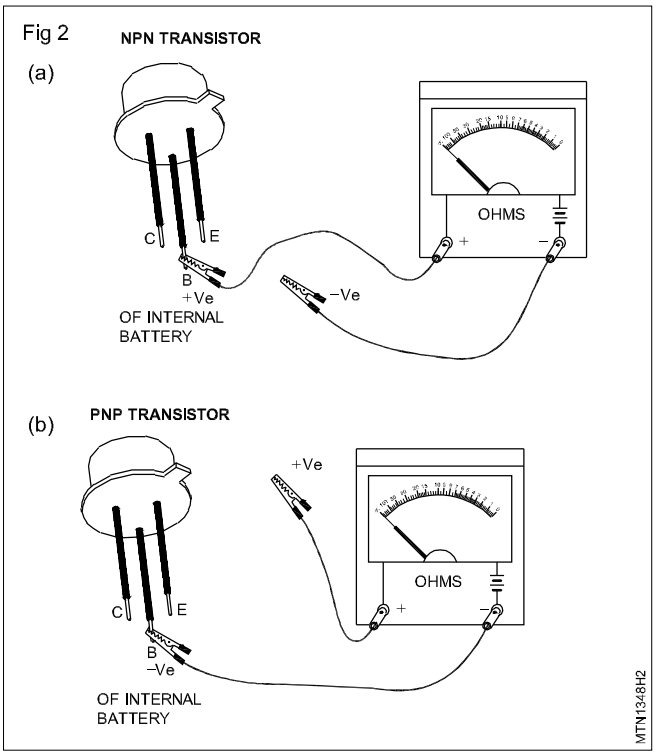
— — — — — — — —

TASK 2 : **Testing transistor junctions using ohmmeter**

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 1. 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 kilo ohms). 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)

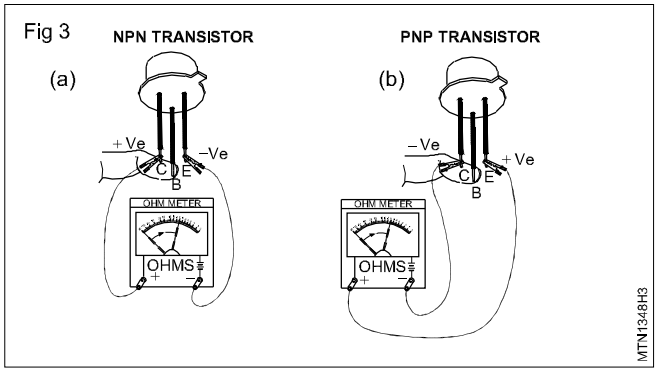
6 Repeat steps 2,3,4 and 5 and check the condition of the base-collector junction diode of the transistor.

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.

Skill Sequence

Construct OR gate circuits and verify the truth table

Objectives: This shall help you to
- **select resistors and transistors**
- **connect the circuit with resistor and transistor.**

Construct OR logic gate and verify the truth table

Connect the transistors as shown in Fig 1.

Connect the switches in parallel.

Connect the bulb at the output.

Connect battery.

Operate the switches look at the bulb and make truth table 1.

Get the work checked by your instructor.

Table 1

A	B	C	ON/OFF condition 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	

Construct an AND gate circuits and verify the truth table

Connect two on-off switch.

Connect 21 W/12 V bulb as load.

Connect battery 12V.

Connect solenoid 12 V (No) with suitable wires as shown in Fig 2.

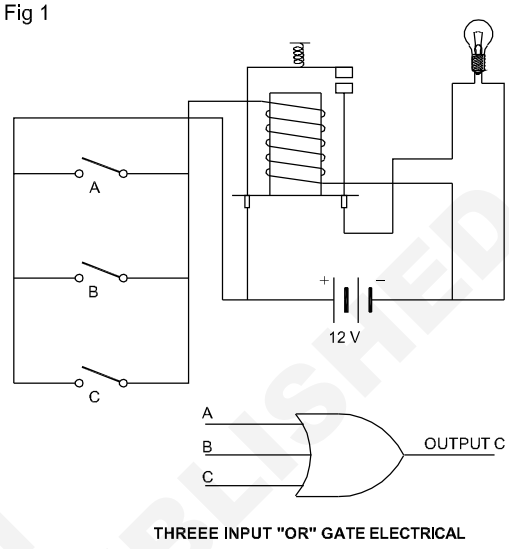
3 NPN 2A transistors connected with suitable resistors.

Operate the switches and look at the bulb for its function.

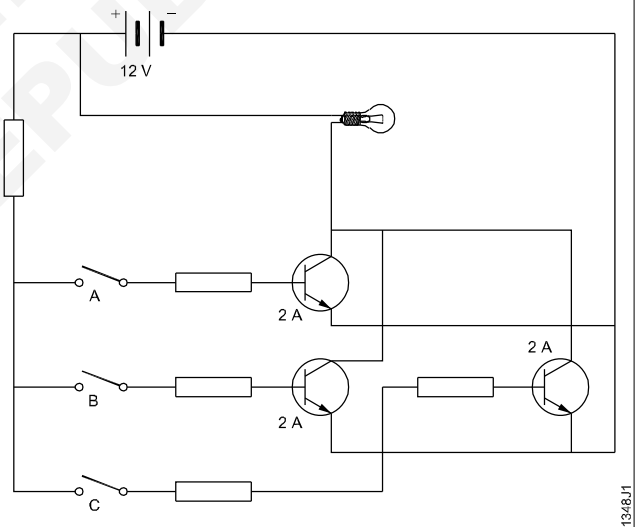
Prepare a truth table 2.

Get the work checked by your instructor.

Fig 1



THREEE INPUT "OR" GATE ELECTRICAL



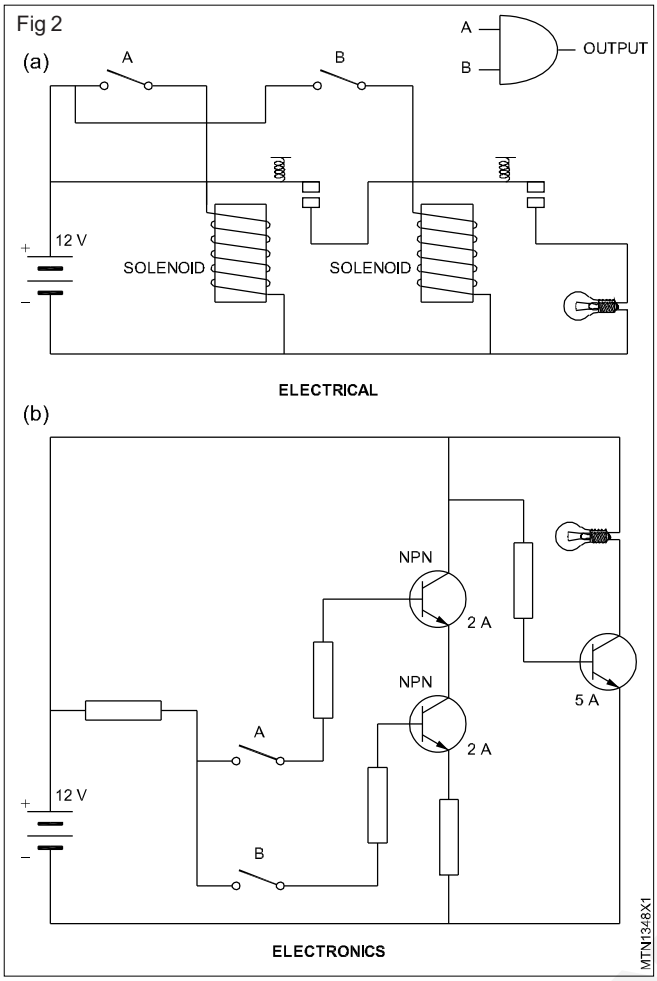
THREEE INPUT "OR" GATE ELECTRONIC

Table 2

Construct NOT gate and verify the truth table

A	B	ON/OFF condition of bulb
0	0	
0	1	
1	0	
1	1	

Fig 2



Use 1 mm wires and make the NOT gate electrical circuit (Figs 3 and 4)

12V 21W double contact bulb, 12V relay (B,L,S) with the terminal normally closed tape.

Connect the 12V battery.

Connect the bulb at the output.

Fig 3

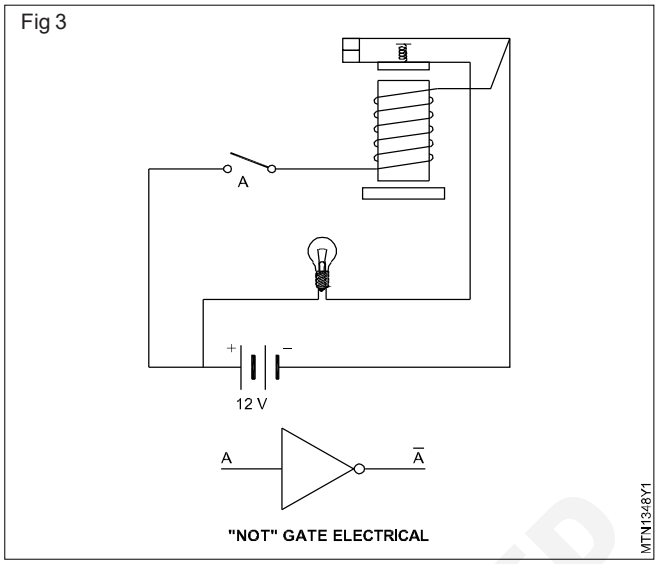
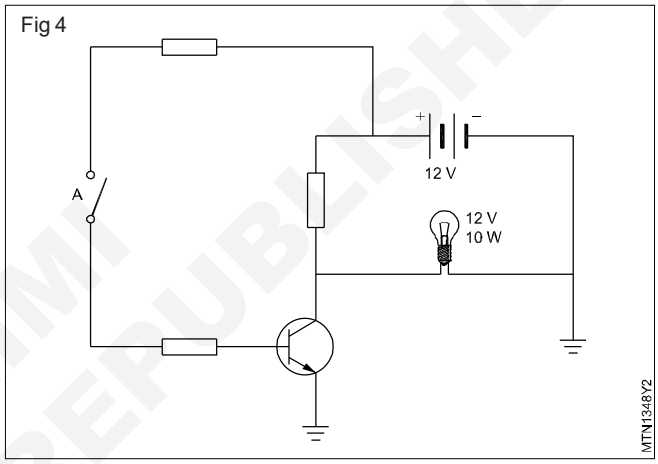


Fig 4



Operate the switches and look at the bulb for its function.

Get the work checked by your instructor.

Truth Table

I/P	O/P
0 (OFF)	1 (ON)
1 (ON)	0 (OFF)

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

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.

Equipment / Machinery

- Air compressor - 1 No.
- Oxy-acetylene plant - 1 No.
- Regulator (Left and Right threads) - 1 No each.
- Nozzle cleaner - 1 No.

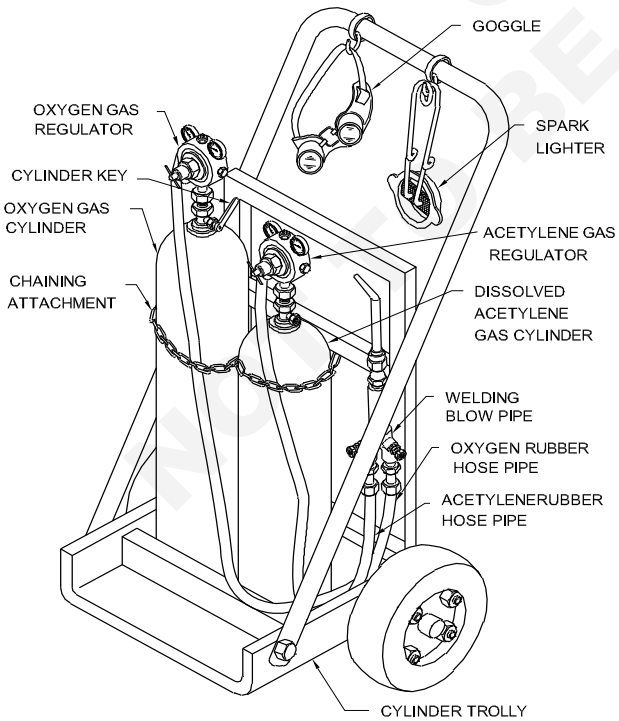
Materials / Components

- Soap oil - as reqd.
- Cotton rag - as reqd.
- Filler rod - as reqd.

PROCEDURE

1 Setting up oxy-acetylene plant Fig 1

Fig 1



SETTING OF OXY-ACETYLENE PLANT

2 Move oxygen and acetylene cylinders with the caps from the store to the gas welding area. An oxygen cylinder is identified by the black color painted on it. An acetylene cylinder is identified by the maroon color 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.

3 Ensure full cylinders are kept separately from the empty cylinders.

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

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

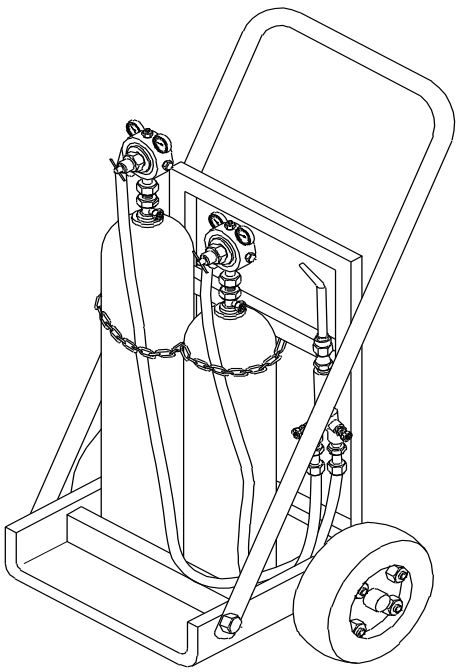
6 While moving, the gas cylinder should be kept slightly inclined to the vertical position and the protector cap used to avoid damage to the cylinder valves. (Fig 3)

7 Do not roll the cylinder horizontally on the ground.

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

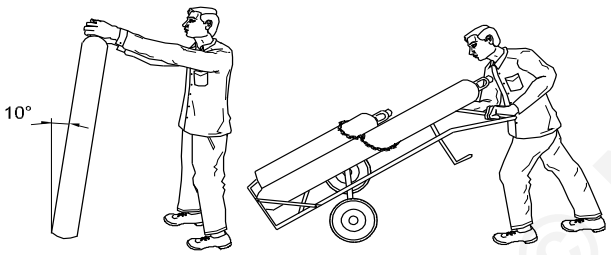
9 Dirt and dust particles from the cylinder valve sockets are cleaned by cracking the cylinder valve. This will avoid leakage of gas due to improper seating of the cylinder valve and also to prevent the dust particles from entering into the regulators which may cause damage to the regulators.

Fig 2



MTN1450H2

Fig 3



MTN1450H3

Fig 4

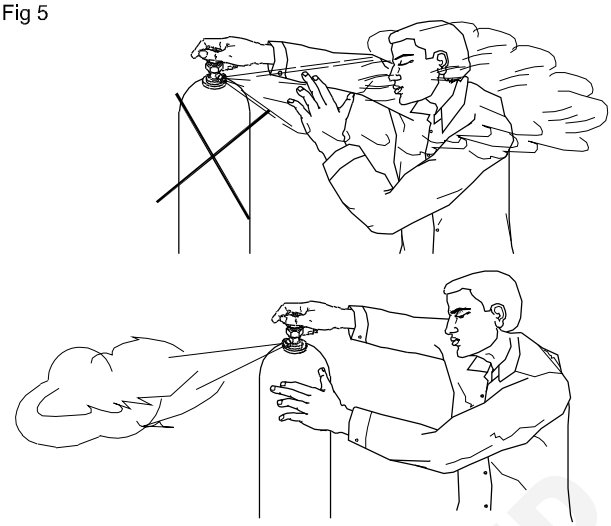
MTN1450H4

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

11 Ensure that your hands are free from grease or oil.

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

Fig 5



MTN1450H5

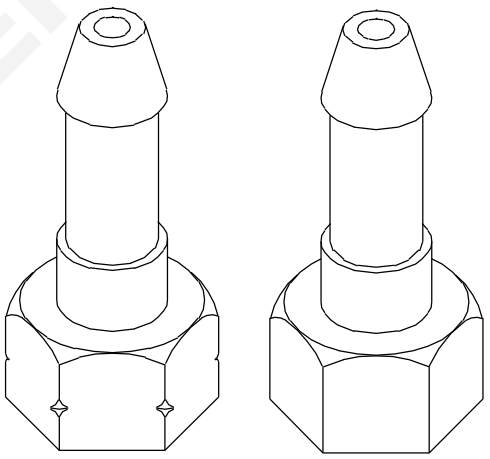
13 Connect the acetylene regulator to the acetylene gas cylinder (left hand threads)

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

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

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

Fig 6



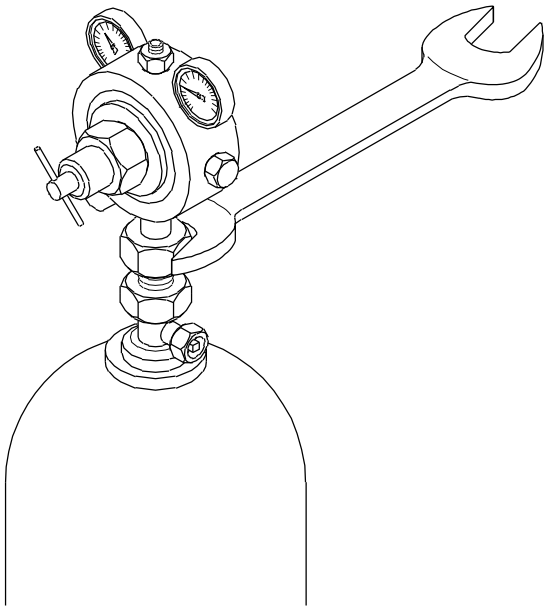
MTN1450H6

17 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)

18 Attaching blowpipe: The other end of the hose- pipe is to be attached to the blowpipe inlets. (Fig 8) 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

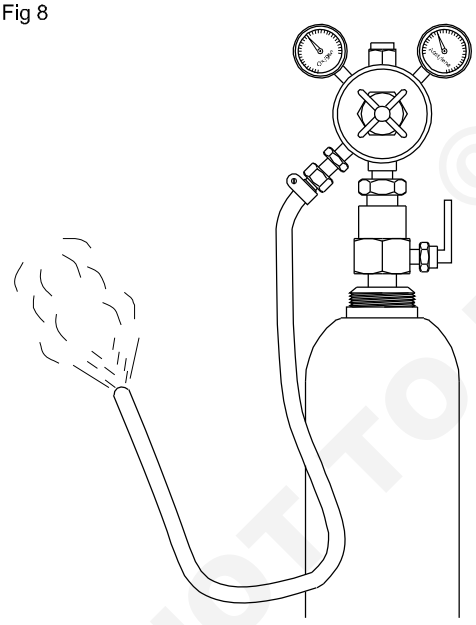
acetylene inlet of the blowpipe. The hose-protectors without cutting marks are fixed on the oxygen hose-pipe and connected to the oxygen inlet of the blowpipe. (Fig 9)

Fig 7



MTN1450H7

Fig 8

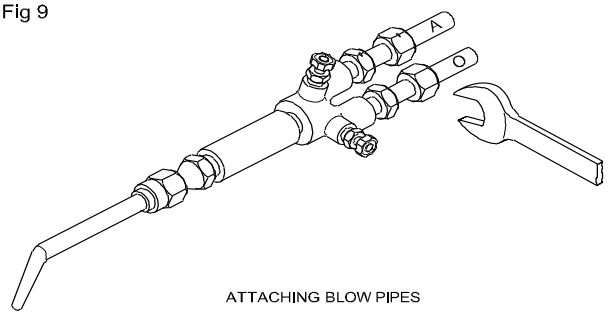


ATTACH NEW HOSES TO REGULATORS
AND TO DISPEL DUST ETC., QUICKLY
PASS PRESSURISED GAS TO ATMOSPHERE
MOMENTARILY.
NOTE: THIS SHOULD BE DONE BEFORE
FITTING HOSE PROTECTORS

MTN1450H8

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

Fig 9



ATTACHING BLOW PIPES

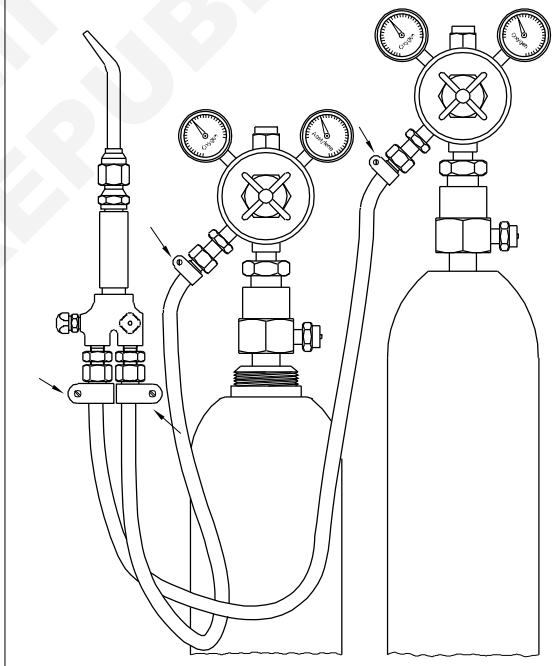
MTN1450H9

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

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

22 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

MTN1450HA

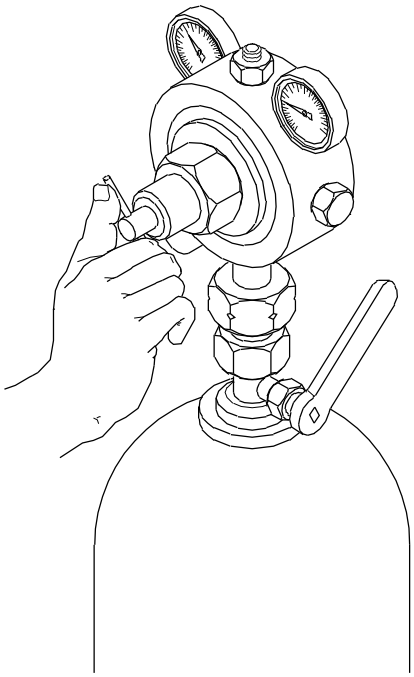
23 The pressure can be read on the working pressure of gas regulators.

24 Testing for leakage: All connections must be tested for leakage.

25 Apply soap water solution for acetylene connections and fresh water for oxygen connections. (Fig 11)

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

Fig 11



MTN1450HB

27 Never use matches or flame light during leakage test.

28 Lighting the flame: Attach the recommended size of nozzle to the neck of the welding blowpipe i.e nozzle No.3.

29 Open the gas cylinders and adjust the recommended gas pressure on the regulators.

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

31 Open cylinder valves very slowly.

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

33 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 atmospheric air with a black smoke.

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

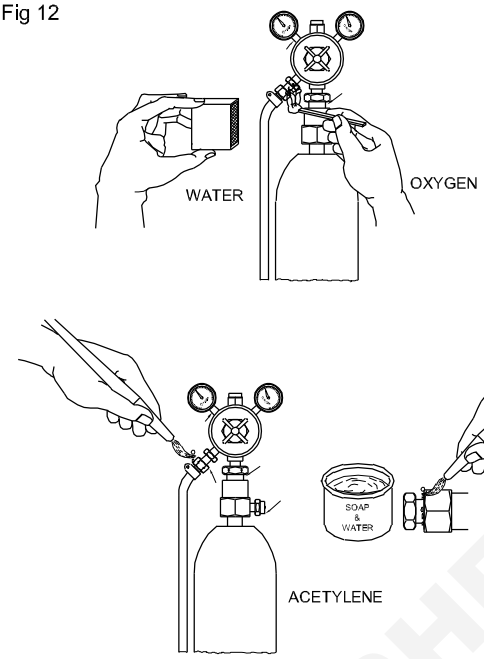
35 Point the blowpipe in a safe direction in the open space, away from you and others.

36 Increase the acetylene till the black smoke disappears. (Fig 13)

37 Observe the flame and add oxygen by opening the oxygen control valve of the blowpipe. Now a bright white cone starts appearing at the tip of the nozzle. (Fig 14)

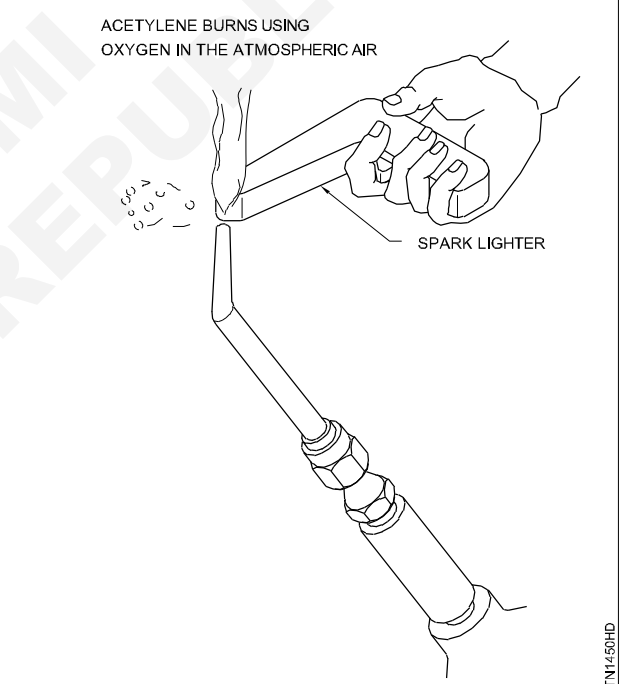
38 Flame adjusting to set different types of oxy-acetylene flames.

Fig 12



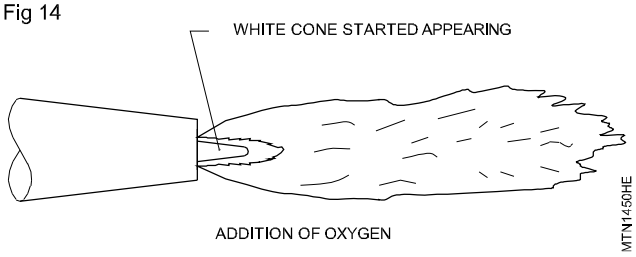
MTN1450HC

Fig 13



MTN1450HD

Fig 14

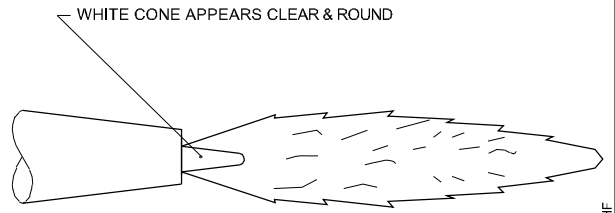


MTN1450HE

39 To adjust the neutral flame, and sufficient oxygen to make the white cone clear and round. (Fig 15)

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

Fig 15



NEUTRAL FLAME WITH SUFFICIENT OXYGEN

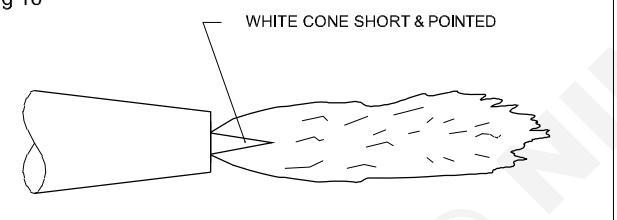
41 To adjust the oxidising flame, from neutral flame decrease acetylene flow.

42 The white cone will become short and sharp.

43 The flame will produce a hissing sound and will have a short length. (Fig 16)

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

Fig 16



OXIDISING FLAME WITH MORE OXYGEN

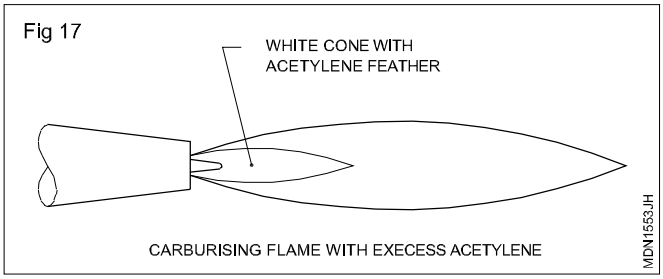
45 To adjust the carburising flame, adjust the flame to neutral and then add acetylene.

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

47 The flame will burn quietly having more length.(Fig 17)

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

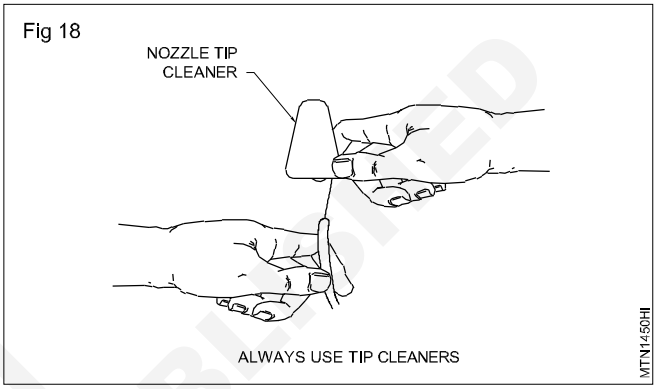
Fig 17



CARBURISING FLAME WITH EXECESS ACETYLENE

49 After continuous use of the blow pipe during welding the nozzle may get blocked by metal particles or spatters. 50This blockage has to be removed to get continuous flow of gases by using a nozzle cleaner. (Fig 18)

Fig 18



ALWAYS USE TIP CLEANERS

51 Close the acetylene cylinder valve.

52 Close the oxygen cylinder valve.

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

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

55 Both the pressure gauges on the regulators should read zero.

56 Release the acetylene regulator pressure adjusting screw.

57 Close the blowpipe acetylene valve.

58 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: This shall help you 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

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.

Keep the molten pool in correct size by adjusting the rate of travel and giving slight circular motion to the blowpipe.

Stop at the left end and lift the blowpipe quickly.

Extinguish the flame and cool the blowpipe in water.

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 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 center 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.

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.

Heat treatment process

Instructor provide the different type of heat treatment process video in the class room

Ask the trainees to write the purpose of heat treatment

Ask the trainees to write the different type of heat treatment process

Ask the trainees to write the name of auto components and type of heat treatment process.

Practice to make a straight beads and joints by gas welding (Fig 1)

- Cut the plate by gas cutting as per given specification.

Grind the edges square.

Use goggles while grinding.

Clean the joining edges and surface of the plates.

Wear the protective clothing.

Check the cut pieces edge straightness.

Prepare the gas welding unit and set the gas flame to straight line weld.

Select the type of welding to joint the metal pieces.

Select the welding rod and flux.

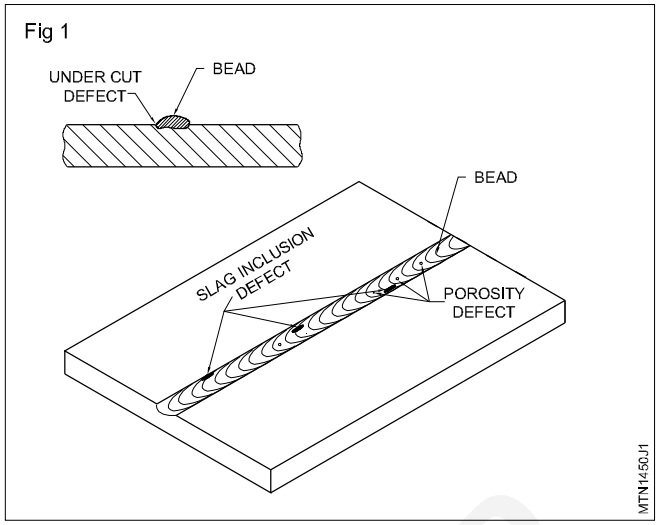
Set the pieces wit form of straight line as per job specification and tack - weld on both ends of work piece.

Weld the metal joints in straight line with chipping hammer and clean with wire brush.

cheek the welding joints, if improper welding correct it by rewelding.

Ensure the two metal pieces are joined properly as per given specifications.

Fig 1



— — — — — — — —

Identify different types of vehicle

Objectives: At the end of this exercise you shall be able to
• identify different types of vehicle name.

PROCEDURE

1 Locate the type of vehicle name shown in 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

2 Write the name of the vehicle in Table 1 with respect to Fig 1.

Fig 1

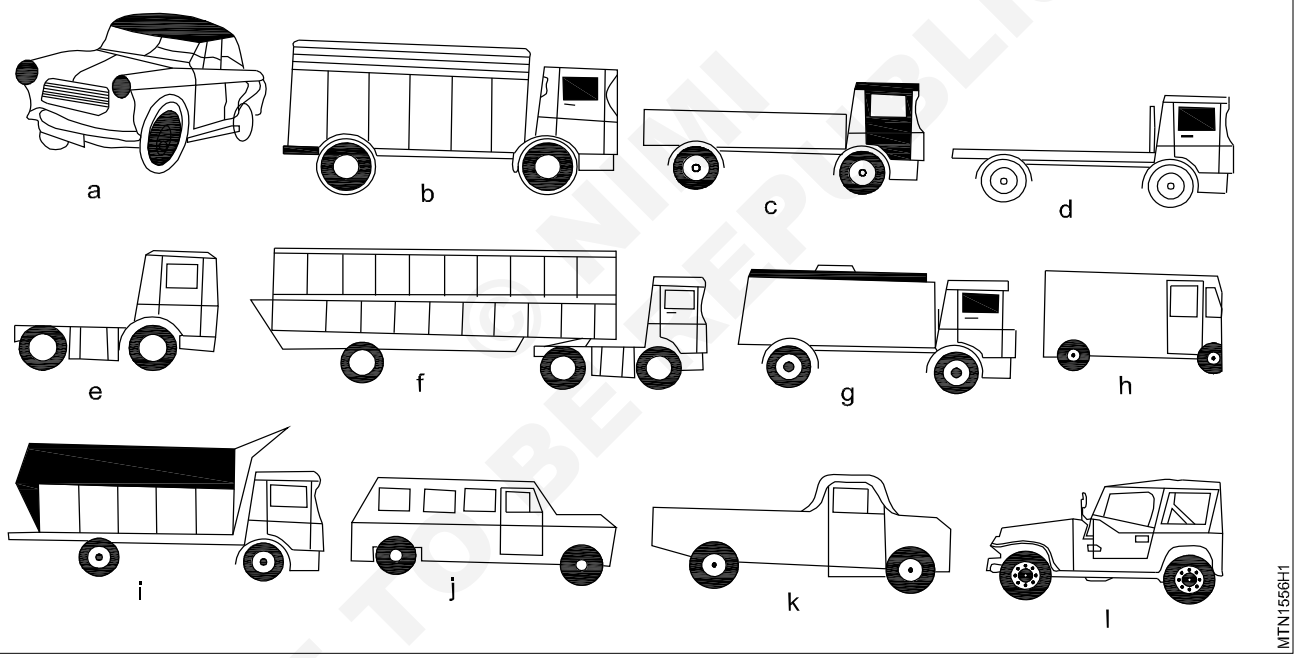


Table 1

Sl. No.	Match Word	Vehicle Name
1		
2		
3		
4		
5		
6		

Table 1 - Cont..

Sl. No.	Match Word	Vehicle Name
7		
8		
9		
10		
11		
12		

Practice on check the function of garage and sevice station equipments

Objectives: At the end of this exercise you shall be able to
- **identify the parts of the vehicle**
- **identify the vehicle specification data.**

Requirements

Tools / Instruments

• Trainees 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 / Machinery

• Vehicle	- 1 No.

Materials / Components

• Cotton waste	- as reqd.
• Engine oil	- as reqd.
• Hydraulic fluid	- as reqd.

PROCEDURE

Note : Instructor demonstrate of vehicle specification

Mahindra Balero GLX

Engine	XD-3PF I Diesel
Type	4-stroke over square, 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
4 WD : Semi -elliptical 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.
Clutch	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 floating 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)

Skill sequence

Identify the Vehicle Information Number (VIN)

Objectives: This shall help you to

- **identify the vehicle number specification.**

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

	Digit	Passenger Car/MPV/BUS
	1	Geographic Zone
WMI	2	Manufacturer
	3	Vehicle Type
	4	Series
	5	Body Style and Version
VDS	6	Body Type
	7	Restraint System/GVWR/ Brake System
	8	Engine Type
	9	Check Digit / Drive Side
	10	Model Year
VIS	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 manufacture

Check the VIN number in your institute vehicle 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 vehicle.

Note the VIN Number of your vehicle on plain paper.

Decode the VIN Number details as per the manufactures general information.

Demonstration of garage and service station equipments

Objective: This shall help you to
- **operate garage service station equipments.**

Requirements

Tools/Instruments

- Trainees tool kit - 1 No.

Equipment / Machinery

- Vehicle - 1 No.

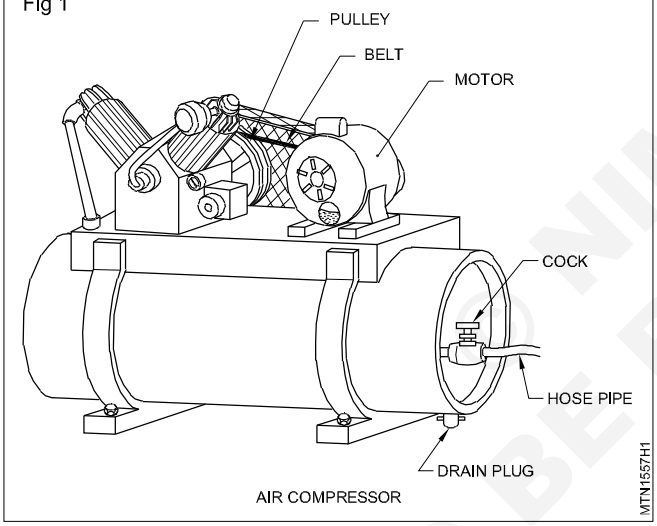
Materials / Components

- Cotton waste - 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.

5 Switch 'on' the compressor

6 Observe the sound of the compressor. If any abnormal sound is found, stop the compressor immediately. (Consult your Instructor)

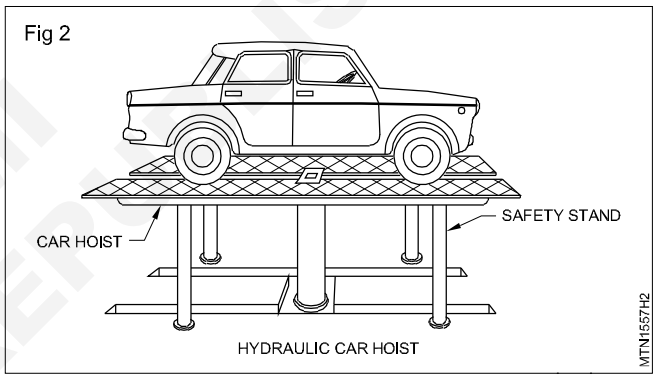
7 Switch 'off' the compressor.

8 Hold the hose-pipe (5) and open the cock (6). Use compressed air wherever needed.

9 Close the cock after using the compressed air.

Hydraulic car hoist (Fig 2)

Fig 2



HYDRAULIC CAR HOIST

1 Park the vehicle in the centre of the car hoist.

2 Clamp the front and rear axle or check wheels.

3 Open the air cock gradually and observe that the car hoist (1) is moving upwards.

4 Close the cock when it reaches the required height.

5 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.

6 After finishing the required job, slightly open the inlet cock and raise the car hoist slightly up. Close the inlet cock.

7 Remove the safety stands.

8 Ensure that nobody is present underneath the vehicle.

9 Open the outlet cock slowly so that the hoist comes down without disturbing the vehicle's position.

10 Remove the clamps/chocks and remove the vehicle from the hoist.

Car washer

1 Check the oil level.

2 Check the belt tension.

3 Check the belt guard for its position.

4 Inspect the electrical connection visually for looseness, disconnections or cuts.

5 Open the water tank.

6 Check the water level.

7 Hold the gun before starting the car washer.

8 Switch 'ON' the car washer and adjust the pressure gauge for the required pressure.

9 Open the water gun.

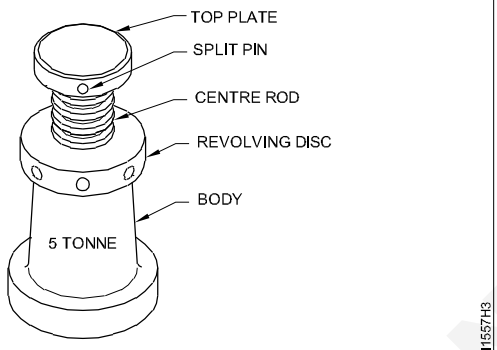
10 Check the water jet and adjust for force and spray at an angle to body panel.

11 After completing the cleaning, stop the car washer.

12 Close the water intake cock (water supply).

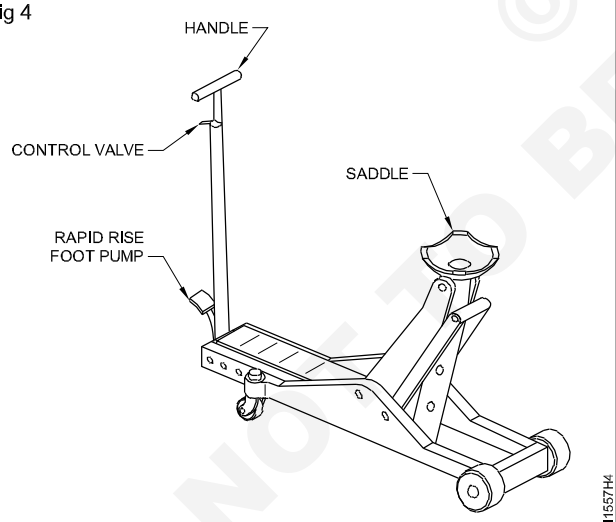
Mechanical jack (Fig 3) / Hydraulic jack (Fig 4)

Fig 3



MECHANICAL JACK

Fig 4



HYDRAULIC JACK

1 Park the vehicle on level ground.

2 In case of jacking up the front axle, chock the rear wheels and vice versa.

3 Check the free movements of threads in a mechanical jack by hand and in case of hydraulic jack, Check the oil level and its operations.

4 Place the jack under the vehicle in specified place.

5 Rotate the screw gradually with the jack lever and lift the vehicle and in case of hydraulic jack move the jack's lever slowly so that the axle jack up without any jerk.

6 Place the support horses below the chassis frame/ axle.

7 Lower down the jack and remove it.

8 After completing the specific job jack up again.

9 Remove the support/horses.

10 Lower down the jack and remove it.

Safety:

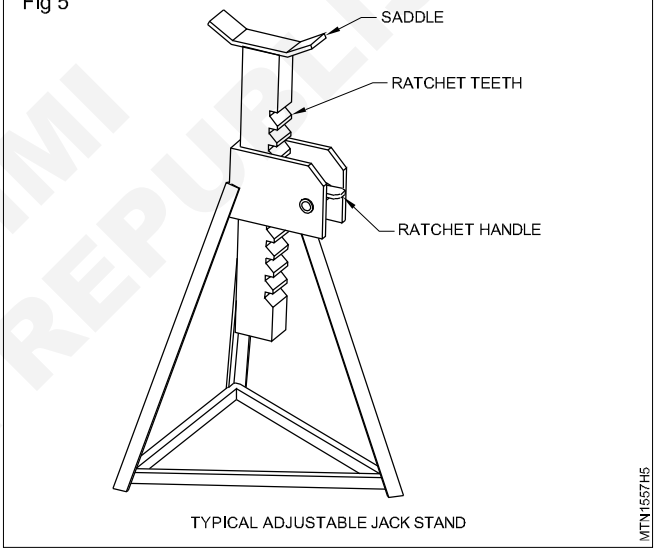
1 Never work under a vehicle supported only by a floor jack.

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)

Fig 5



TYPICAL ADJUSTABLE JACK STAND

1 The height of the jack stand is adjusted by the ratchet adjustment.

2 Stands must be properly and securely placed.

Grease gun (Fig 6)

1 Select the grease gun nipple according to the vehicle. (Consult your instructor)

2 Check visually, the grease nipple holder for any damage.

3 Fill up the gun with the specified grease.

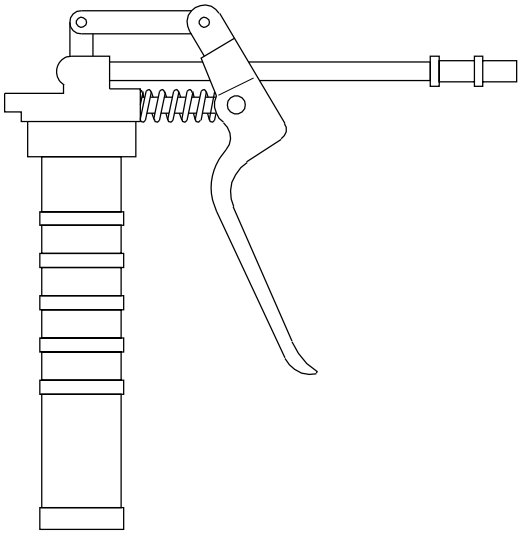
4 Close the grease gun and operate the lever till the grease comes out continuously from the nipple with pressure.

5 Use the gun for the required purpose.

Oil spray gun

1 Check visually the oil spray gun nozzle, nozzle holder, operating lever, air hose for any damage.

Fig 6



GREASE GUN

MTN1557H6

2 Fill the spray gun with SAE20W/40 and kerosene mixture in the ratio of 1:20.

3 Connect the oil spray gun to the quick release coupler.

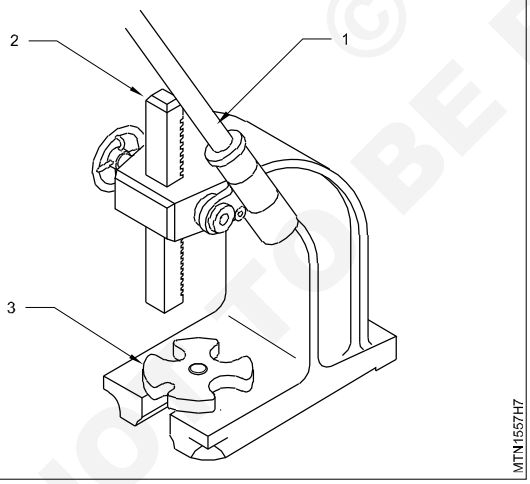
4 Operate the oil spray gun.

5 See that the oil is sprayed at pressure and spray over panel joints and moving part only.

6 Close the air-hose connections and takeout the oil spray gun.

Arbor press (Fig 7)

Fig 7



MTN1557H7

1 Check for easy movement of the operating lever (1) and rack if necessary lubricate.

2 Select the plate (3) according to the work.

3 Place the component on the plate.

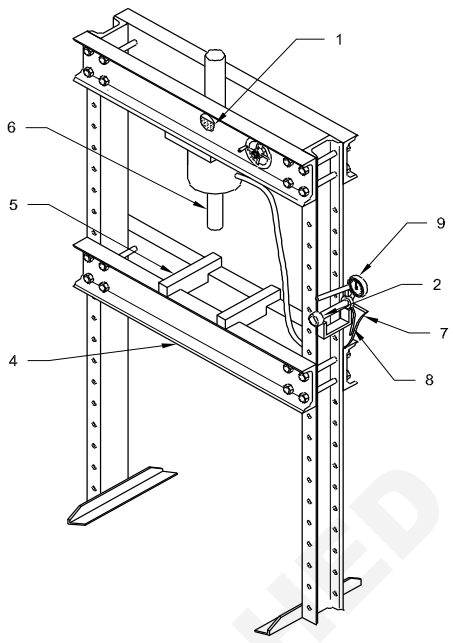
4 Press the work slowly and listen for abnormal noise.

Hydraulic press (Fig 8)

1 Clean the press.

2 Check the oil level (1) if necessary topup with hydraulic oil

Fig 8



HYDRAULIC PRESS

MTN1557H8

3 Check the hydraulic press for its free function and leakage

4 Lock the cylinder plunger releasing knob (2).

5 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).

6 Align the anvil(5) according to the job.

7 Place the job on the anvil (5).

8 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)

9 Place the distance piece on the shaft/bush. Ensure that it does not touch the body.

10 Operate the low pressure lever(7) and make the plunger(6) to have a contact on the job,

11 Operate the heavy pressure lever(8), observe the load on the gauge(9) and the job simultaneously. Ensure the job comes out gradually.

12 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 mechanical.

2 Adjust and fix the telescopic two post lift lifting arm.

3 Use the automatic arms locking and releasing device while lifting and lowering.

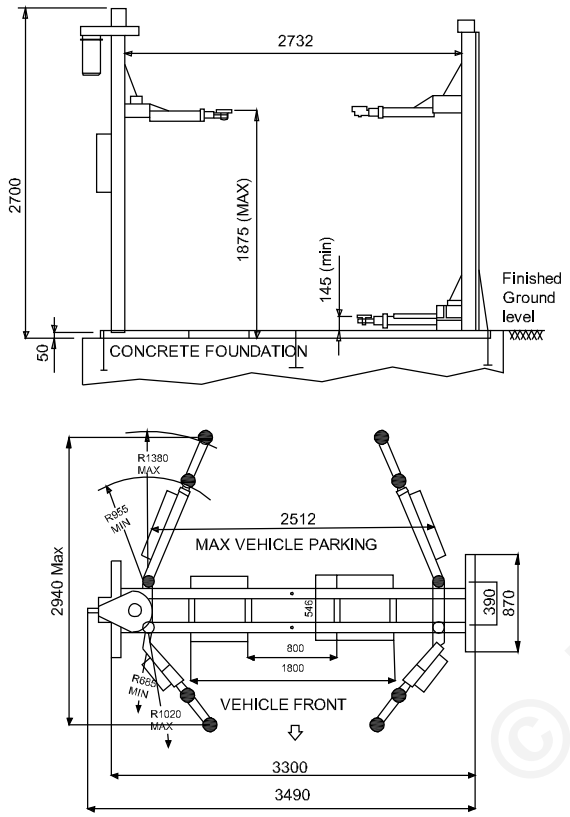
4 Set safety mechanism to prevent uneven lifting.

5 Use the extra safety nut.

6 Check the chain drive and operate the lifting switch.

7 Use the anchoring bolts for safety. (Fig 9).

Fig 9



Four post lift (Fig 10)

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 stopper

3 Check the vehicle door & glasses 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.

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.

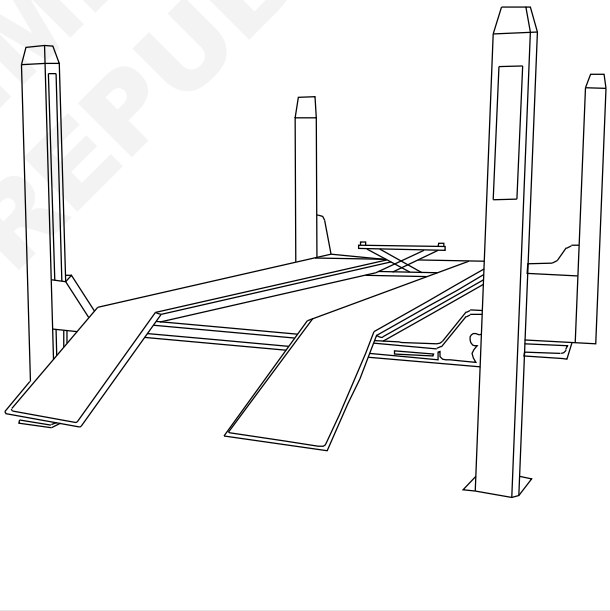
3 Pull up hand brake lever of vehicle.

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 10



Identify the part and water service of two & three wheeler

Objectives: At the end of this exercise you shall be able to
- **identify the part of two and three wheeler**
- **prepare for water washing**
- **identify and lubricate different part of the vehicle.**

Requirements

Tools / Instruments

- Oil can - 1 No
- Trainees tool kit - 1 No

Equipments / Machinery

- Car washer - 1 No
- Air compressor - 1 No
- Vehicle 2 wheeler or 3 wheeler - 1 No

Materials/Components

- Cotton waste - as reqd.
- Petrol & Kerosene - as reqd.
- Cleaning liquid - as reqd.
- Lubricate oil SAE - 90 - as reqd.
- Suitable covers to cover the electrical equipment - as reqd.
- Anti corrosive liquids - as reqd.

PROCEDURE

TASK 1 : **Identify the part name of motor cycle (Fig 1)**

1 Park the motor cycle on the shop floor.

2 Clean the motor cycle with compressed water.

3 Clean the two wheeler or three wheeler with compressed air for clean the water on it.

4 Refer the motor cycle circuit manual for identification of parts and location on the vehicle.

5 Identify the various parts of motor cycle with help of service manual under guidance of your instructor.

6 Identify the parts of a motor cycle shown in Fig 1.

7 Identify the parts of motor cycle shown in Fig 2.

8 Write down the parts name shown Fig 2 in given table 2.

9 Identify the parts marked in Fig 3.

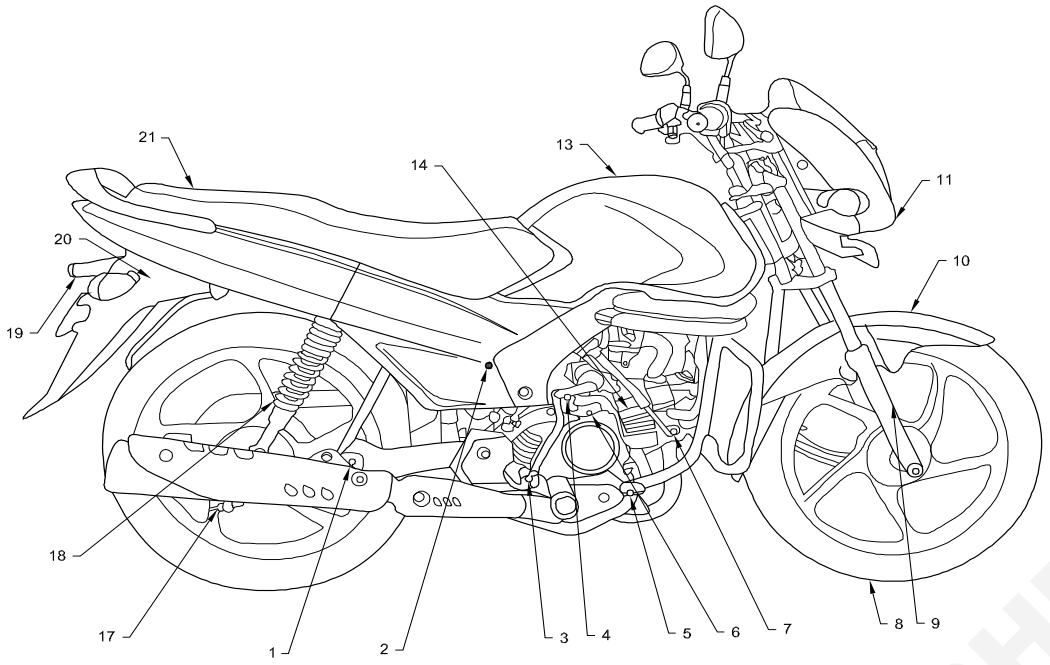
10 Write down the parts name marked in figure 3 at given table 3

Write down the parts name in given table 1

Table 1

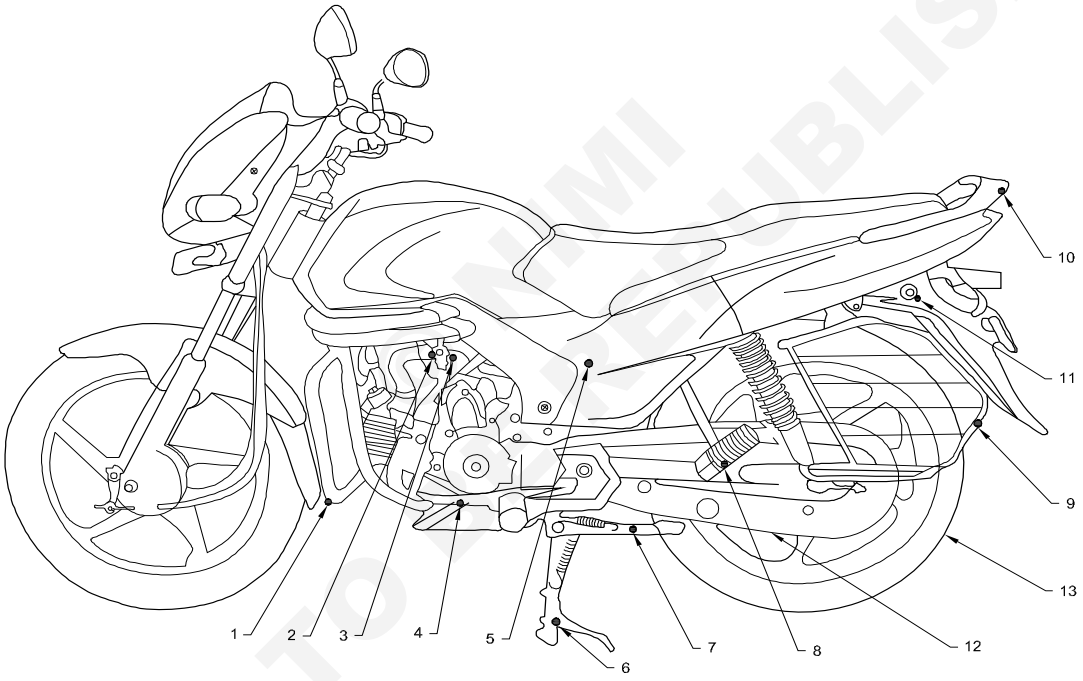
Part no	Name of the part
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Fig 1



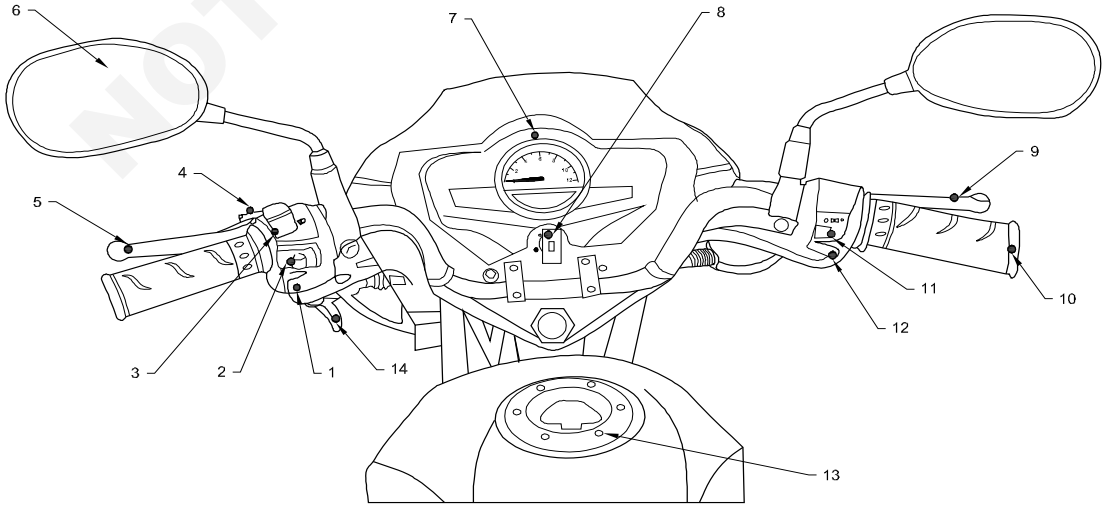
MTN1659H1

Fig 2



MTN1659H2

Fig 3



MTN1659H3

Table- 2

Part no	Name of the part
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	

Table - 3

Part no	Name of the part
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	

— — — — — — — —

TASK 2: **Preparing the vehicle for washing**

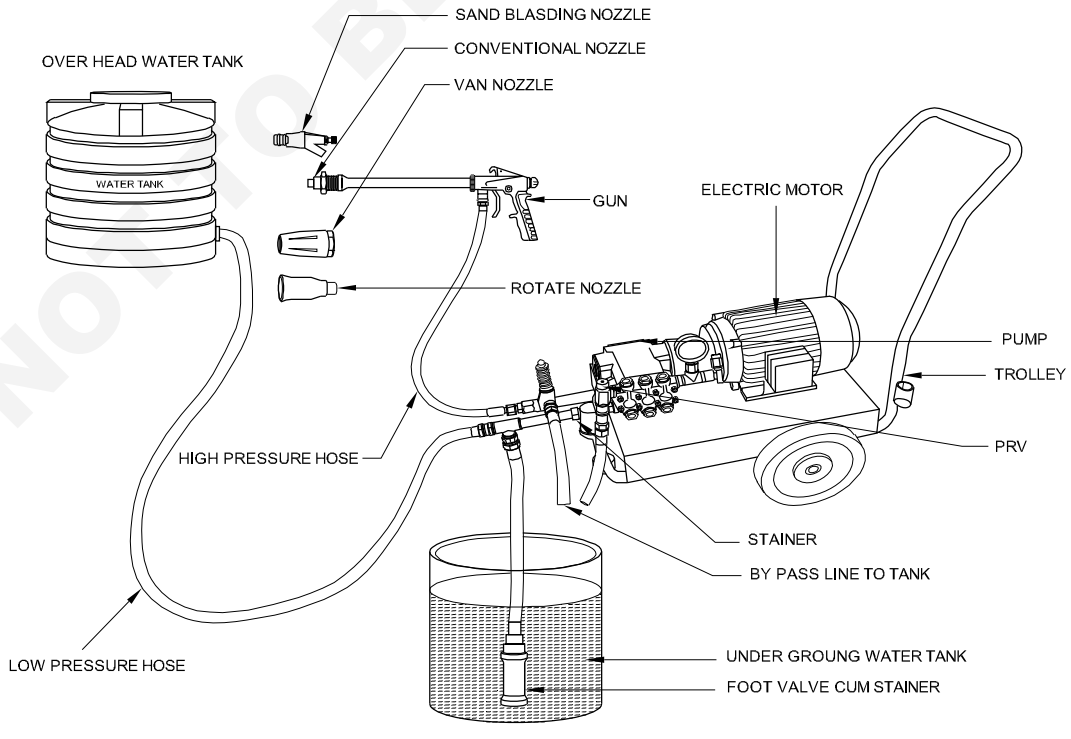
1 Move the two / three wheeler to the washing pit line.

2 Ensure that the vehicle is on flat rigid surface (Keep the vehicle on centre stand if it is a two wheeler and close the petrol tap)

3 Take proper precaution to cover up electrical equipments like switch, relays, using a suitable cover to ensure that water does not enter into the parts. Remove the battery by removing the securing bolt, and keep it under charging under recommended conditions.

4 Also remove any side box, seat cover etc., (if is a two wheeler). For 1 wheelers the engine will be at the rear end. Open the rear door and identify the areas to be cleaned. (Fig 1)

Fig 1



TASK 3 : **Adjusting Pressure setting on car washer and cleaning**

1 Switch on the pump by switching on the pump mains. Adjust the pump setting to the recommended pressure as specified in the service manual by adjusting the pressure setting gauge / switch. Ensure that the waterjet is pumped at the recommended pressure. (Fig 1)

2 Use soap/mild detergent for cleaning and use a medium pressure of water jet. Modern water washing systems have a nozzle where the pressure can also be adjusted by means of the nozzle head nut.

3 Clean the vehicle thoroughly keeping it upright. Then keep vehicle resting on the ground with a suitable support (a tyre as a cushion if it is a 2 wheeler)

4 Clean all the external parts which might be difficult if the vehicle is with stand.

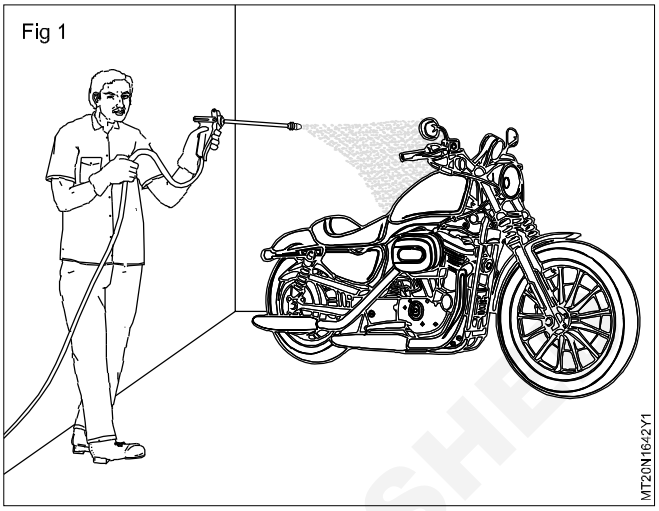
5 Switch off the pump. Again keep the vehicle upright and allow the water to drain

6 Then use compressed air to clean trapped water and move to the service lane.

7 Spray any suitable anti corrosive liquid over the vehicle to minimize rust formation.

8 Wipe the vehicle with a clean soft cloth thoroughly. Care to be taken not to damage the body painting.

Fig 1



— — — — — — — —

TASK 4 : **Lubricating the vehicle parts**

1 Lubricate the brake, linkage clutch, linkage and the drive chain, center stand, side stand and all moving parts.

2 Ensure all lubrication points are lubricated.

3 Fit the battery and start the vehicle just to ensure engine is working.

4 Move the vehicle check and ensure no noise from motor cycle.

— — — — — — — —

Practice on dismantle, clean, check the two wheeler engine

Objectives: At the end of this exercise you shall be able to
- **remove the engine from the vehicle**
- **dismantle the engine part and clean.**

Requirements

Tools / Instruments
- Trainees tool kit - 1 No
- Socket spanner set - 1 No

Equipments / Machinery
- Motor cycle - 1 No
- Two wheeler lift / hoist - 1 No

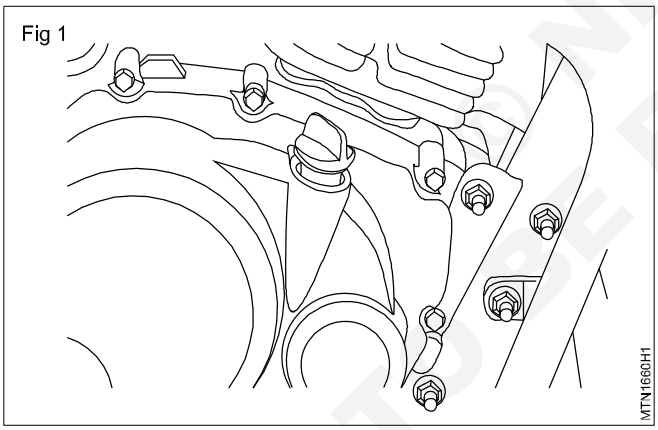
Materials / Component
- Container for collecting drained oil - as reqd.
- Kerosene - as reqd.
- Brush - as reqd.
- Petrol - as reqd.
- Tray - as reqd.
- Measuring jar - as reqd.
- Fuel container - as reqd.

PROCEDURE

TASK 1 : **Draining engine cum gear oil**

1 Start and run the engine till engine reaches its normal operating temperature. Run the engine at idle speed for few minutes. (Fig 1)

Fig 1



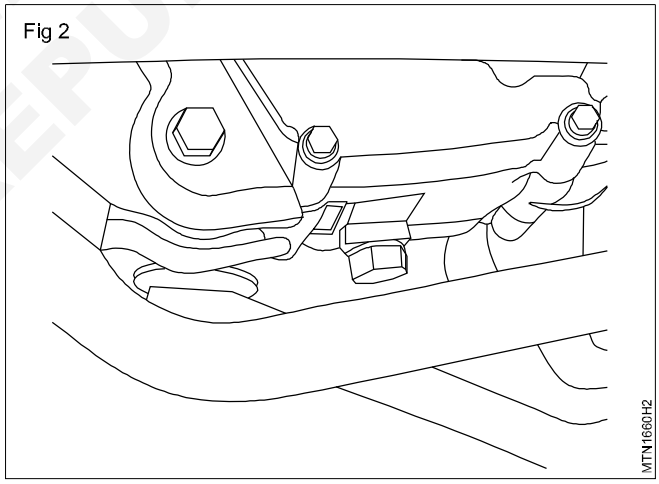
2 Remove the oil level gauge (1) from the engine.

3 Place a tray under the engine to collect the draining oil.

4 Loosen and remove the oil drain plug (2) which allows the oil to drain.

5 Collect the oil in the tray. (Fig 2)

Fig 2



6 Refill the drained oil in the measuring jar and note down the the oil quantity.

7 Clean the drain plug.

8 Inspect the drain plug. Check the drain plug's threads for damage. If the drain plug is damaged, replace it. Replace the drain plug washer every time.

— — — — — — — —

TASK 2 : **Removing the vehicle fittings covered over engine**

1 Unlock the seat and remove the seat.

2 Remove the side shields.

3 Disconnect the battery terminals.

4 Remove the battery and keep it in a safe place.

5 Turn the petrol tap in off position.

6 Disconnect the fuel supply hose from the carburettor.

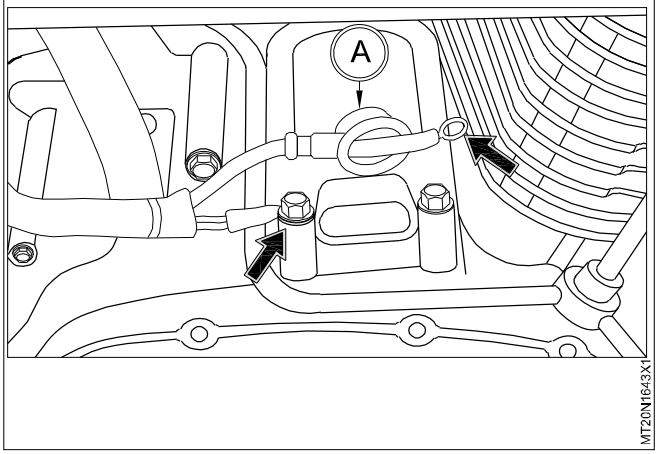
7 Drain the fuel from the tank and collect it in the fuel container.

8 Disconnect the fuel gauge socket from the fuel tank (if available).

9 Loosen the bolts holding the fuel tank with the frame and remove the fuel tank.

10 Disconnect the high tension lead (3) from the spark plug. (Fig 1)

Fig 1



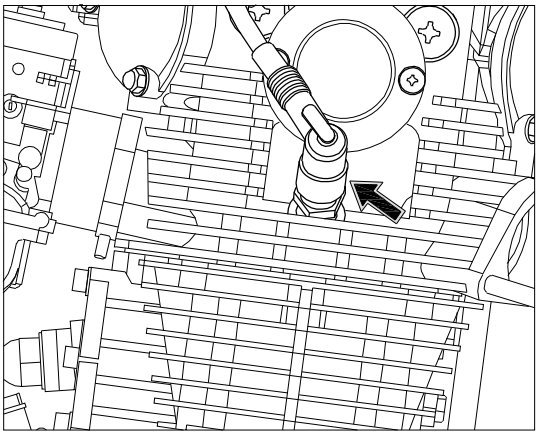
11 Disconnect the wiring socket from the magneto assembly.

12 Dislocate the boot, disconnect the wire from the starter motor assembly (if applicable).

13 Disconnect air induction hose from the engine by loosening.

14 Loosen the bolts and remove the crash guard the clamps. (Fig 2)

Fig 2



15 Loosen the bolts of the muffler front mounting from the engine.

16 Loosen the bolts from the rear muffler assembly.

17 Take out the muffler assembly by dislocate it from the cylinder head assembly.

18 Take out the muffler packing from the cylinder head.

19 Disconnect the secondary air induction pipe from the engine.

20 Loosen the bolt from the kick starter assembly

21 Pull out the kick starter lever assembly

— — — — — — —

TASK 3 : **Disconnecting cables**

1 Disconnect the clutch cable (5) by lifting the clutch release arm from the clutch cover.

Some vehicles use bolt to fit clutch release arm. Remove bolt from the arm in these models.

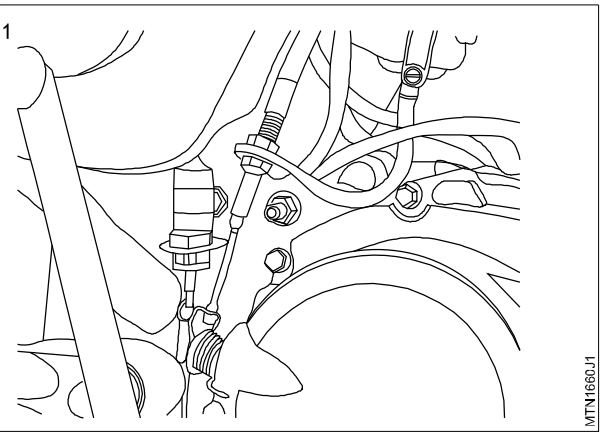
2 Disconnect the fuel supply hose from the fuel cock.

3 Remove the carburettor throttle cap with piston valve assembly and spring. Use grip plier for this use. (Fig 1)

After removing the cap, close the portion of carburettor with banyan cloth.

Unscrew and remove the cable in the case of diaphragm type carburettor.

Fig 1



— — — — — — — —

TASK 4 : **Removing drive chain**

1 Remove the screws and take out the engine sprocket cover.

2 Loosen the screws from the engine small sprocket lock plate.

3 Take out the lock plate (6) by dislocating it from the drive shaft grooves.

4 Pull out the chain assembly along with the engine sprocket.

5 Dislocate the sprocket from the drive chain.

6 Hang the drive chain in the frame itself.

— — — — — — — —

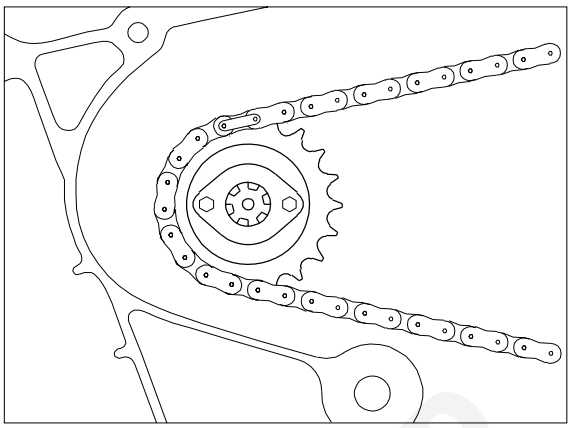
TASK 5 : **Remove the engine from the vehicle**

1 Loosen the bolts holding the engine with the frame.

2 Gently lift the engine assembly with both the hands and remove from the vehicle.

3 Place the engine on the engine holding fixture.

Fig 1



— — — — — — — —

TASK 6 : **Dismantle the engine**

1 Clean the cylinder block with clean cloth remove the spark plug and cylinder head assembly.

2 Dismantle the cylinder head and gasket.

3 Remove the exhaust pipe.

4 Remove the piston assembly and bearings.

5 Dismantle the crank case and crank shaft.

6 Dismantle the kick shaft and crank shaft.

7 Remove timing chain and crank shaft gear.

8 Dismantle the starter assembly bell housing clutch assembly and valve assembly.

9 Remove the magneto assembly can shaft with sprocket clean all the parts inspect and collect in a tray.

10 Check the cylinder bore with bore dial gauge.

11 Check the piston and piston rings.

12 Check the engine bearings.

13 Check the connecting rod and piston pin.

14 Check the oil pumps.

15 Check the cylinder head valve and valve seats.

16 Check the cylinder hear and bore air fins.

17 Check the crank and cam shaft.

18 Check the timing chain and sprockets.

19 Check the alternate/magnet.

20 Replace the damaged/parts.

— — — — — — — —

Practice on reassembling the two wheeler engine

Objectives: At the end of this exercise you shall be able to
- **reassemble engine components**
- **refit engine on the vehicle**
- **set valve timing**
- **set valve clearance**
- **adjust spark plug gap.**

Requirements

Tools/Instruments

- Trainers Tool Kit - 1 No.
- Box Spanner Set - 1 No.
- Circlip Plier - 1 No.
- Feeler Gauge - 1 No.

Equipment / Machinery

- Engine stand - 1 No.
- Spark plug cleaner of tester - 1 No.

Materials/components

- Cotton waste - as reqd.
- Bamion cloth - as reqd.
- Engine bearings - as reqd.
- Engine oil- 4f - as reqd.
- Oil seal - as reqd.
- Three band / Anaband - as reqd.
- Head gasket - as reqd.

PROCEDURE

TASK 1: **Engine bearings and oil seals fitting**

1 Clean the bearing surfaces thoroughly before assembling.

2 Replace the bearings in the crank case cover.

if any one of the bearing is not good, change both the bearings by new.

3 Apply oil in the lip of the oil seal.

4 Replace the new oil seals in their places by using special tool

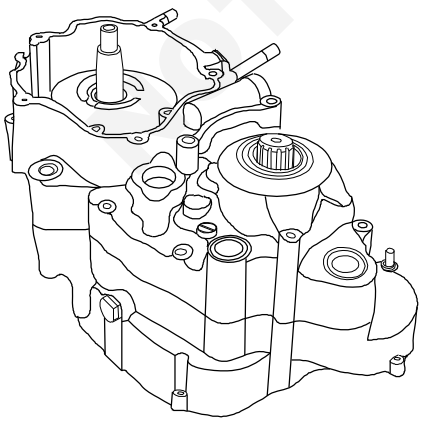
— — — — — — — —

TASK 2 : **Assembling crank case**

1 Clean the mating surfaces of the crank case.

2 Assemble the crank shaft on the left side crank case as shown in Fig 1.

Fig 1



3 Assemble the kick starter shaft, guide and return spring.

check the markings if available.

4 After assembling, rotate the kick start shaft and lock it with the guide.

5 Assemble the drive and counter shaft set in the crank case.

6 Assemble gear fork set.

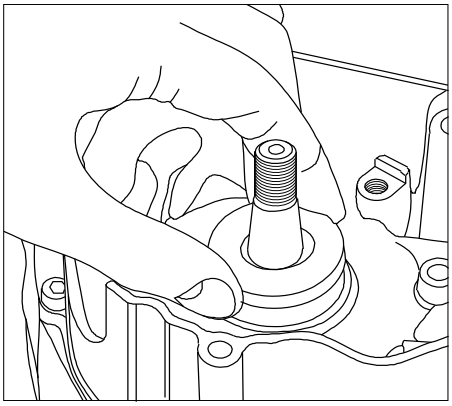
7 Fix gasket or apply liquid gasket and Fit the crank case right side on the left side crank case.

8 Tighten the crank case bolts and check the free rotation of shafts.

9 Fix the timing chain on the crank shaft gear

10 Assemble the starter assembly.

Fig 2



TASK 3 : **Assembling clutch**

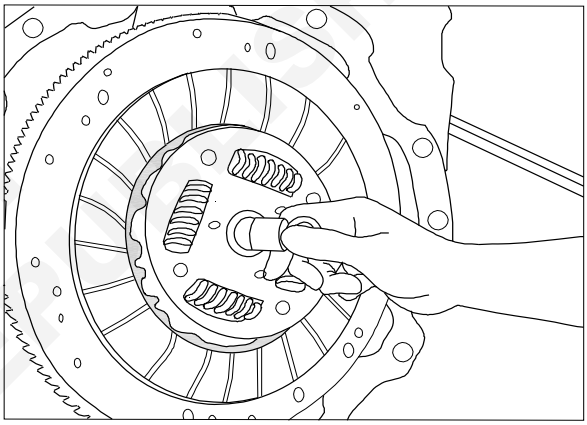
1 Assemble the bell housing, clutch and pressure plates.

2 Assemble the clutch cover after installing adopter. (Fig 1)

3 Connect the clutch cable with clutch operating linkage.

4 Adjust the clutch free play as manufactures specified limit.

Fig 1



TASK 4 : **Assemble the piston and cylinder block**

1 Fix the piston on the connecting rod.

2 Insert the circlips on both the sides of piston pin.

3 Fit the connecting rod with crank shaft

check the circlips seated properly in its seat.

4 Insert the cylinder block and bolted it with the crank case.

TASK 5: **Assembling cylinder head**

1 Place the gasket on the top of the block.

2 Assemble the cylinder head assembly on the cylinder block.

3 Fill the engine oil upto level.

4 Ensure engine oil level upto recommended level.

TASK 6 : **Setting valve timing**

1 Rotate the magneto assembly until the TDC mark coincides with the mark on the cark case.

2 Ensure the mark on the cam shaft sprocket matches with the mark on the cylinder head.

3 At this position, fix the timing chain on the cam shaft sprocket.

TASK 7 : **Setting valve clearance**

1 Align the TDC mark on the rotor assembly with the turning mark on the crank case.

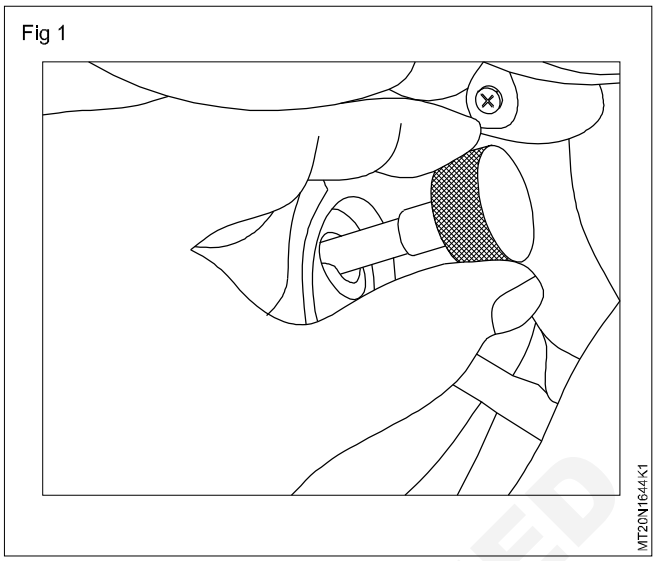
2 Check the freeness of the rocker. If rocker is not free, then rotate the magneto another 360?.

3 Set the valve clearance as per the manufacturer's specification by feeler gauge.

4 Adjust the clearance by loosening the lock nut which is at the top of the rocker and rotate the screw either clockwise or anti-clock wise to get correct valve clearance.

5 Then finally lock the lock nut.

Fig 1



— — — — — — — —

TASK 8 : **Cleaning spark plug**

1 Clean the spark plug by sand blasting and check and adjust the gap by feeler gauge as per the manufacturer's specification.

2 Refit spark plug on the engine.

3 Connect the H.T cable with spark plug.

4 Start the engine and check the engine performance.

— — — — — — — —

Practice on adjust drive chain tension of to wheeler

Objectives: At the end of this exercise you shall be able to
- **remove drive chain from the vehicle**
- **check the performance of electrical system**
- **clean drive chain**
- **measure chain wear**
- **lubricate drive chain**
- **reassemble drive chain**
- **check slackness of the drive chain.**

Requirements

Tools/Instruments

• Trainee's tool kit	- 1 No.
• DE Spanner set	- 1 No.
• Ring spanner set	- 1 No.
• Tublar spanner	- 1 No.
• Combination plier	- 1 No.
• Stove and pan	- 1 No.
• Vernier caliper	- 1 No.

Equipments/Machinery

• Motor cycle	- 1 No
• Two wheeler lift	- 1 No
• Air compressor	- 1 No

Materials/Components

• Kerosene	- as reqd.
• MP3 Grease	- as reqd.
• Brush, Soap oil	- as reqd.
• Banyan Waste	- as reqd.

PROCEDURE

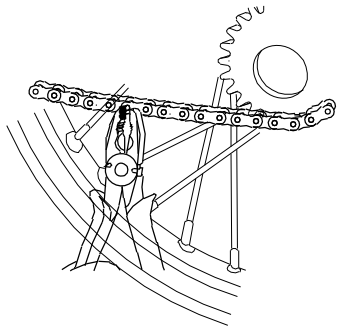
TASK 1: **Removing drive chain assembly from the vehicle**

1 Place the vehicle on the two wheeler lifter lift.
2 Lift the vehicle.
3 Remove the dust rubber seal from the chain cover.
4 Loosen the bolts and remove the upper and lower chain cover from the vehicle.
5 Unlock the chain link and remove it (Fig 1)

During this, hold the chain properly. The chain should not fall.

6 Slowly remove chain from the sprocket.
7 Place the chain on the tray

Fig 1



— — — — — — — —

TASK 2 : **Cleaning the drive chain**

1 Dip the chain in the kerosene.
2 Clean the chain with the brush till all the dirt and sticky lubricant to remove.
3 Place the chain in a tray and allow it to dry.
4 Clean the big and small sprocket with cleaning solvent and clean it thoroughly with dry cloth.

— — — — — — — —

TASK 3 : **Measuring chain wear**

Refer the service manual for this case

1 Count the number of pins of the chain assembly as given by the manufacturer. For example, say 21 pins.
2 Measure the distance of the said pins and note down it.

Measure the distance between the chain link pins = in mm.

Permissible service limit = in mm.

Check the condition of the chain sprocket and chain of the wearness of chain and sprocket is exceed than permissible wear replace it.

TASK 4 : **Lubricating the chain**

1 Take the MP3 grease in the pan and heat the grease with the help of stove.

2 Dip the chain into the molten grease and allow it to cool.

— — — — — — — —

TASK 5 : **Reassembling the drive chain**

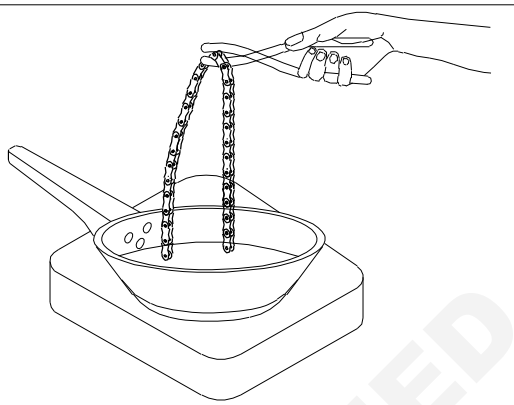
1 Place the drive chain on the big sprocket and move the chain slowly towards the small sprocket.

2 After placing the drive chain on the sprockets connect both the ends with the chain link.

During assembling the link with the chain, the open side of the link should face the opposite direction of the chain rotation.

3 Place the upper and lower chain covers and bolt it.

Fig 1



— — — — — — — —

TASK 6 : **Checking the slackness of the drive chain**

1 Insert the index finger in to the inspection window of chain cover.

2 Check the slackness of the chain by moving the chain up and down.

The slackness should be 20 - 25 mm.

Mention the slackness of the chain = 18mm.

If the slackness is more or less, adjust the chain as follows.

3 Loosen the rear wheel nut which is at silencer side.

4 Loosen the sprocket nut.

5 Loosen the lock nut of the chain adjuster both sides.

6 Turn the adjusting nut one or two turns at a time on both sides and check the slackness.

7 Continue this till the correct chain tension is obtained.

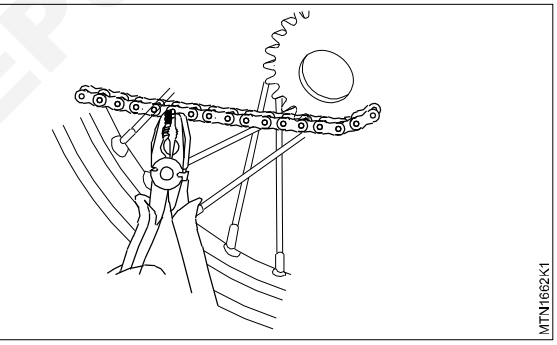
8 Tighten the sprocket nut.

9 Tighten the wheel nut.

10 Rotate the wheel by hand and check the performance of the chain.

11 Down the lift and take out the vehicle from the lift.

Fig 1



— — — — — — — —

TASK 7 : **Check the performance of electrical system**

1 Check the battery condition

2 Check the switches

3 Check the electrical wire connections

4 Start the engine and check the engine performance

5 Check the alternator's out put current by multimeter

6 Check the sensors working performance

7 Check the ECU function

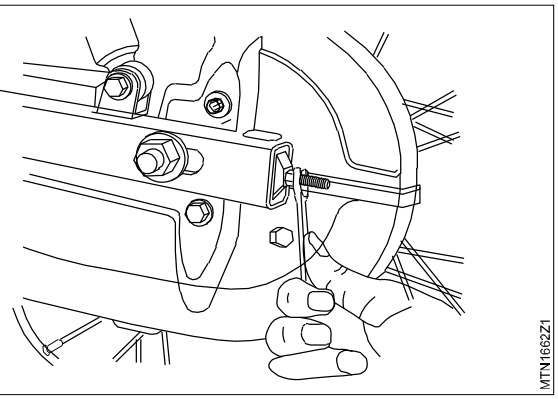
8 Check the transformer is input and out put current

9 Check the lighting system

10 Check the electrical systems performance during engine run

- If found any malfunctioning rectify the fault or replace the defective parts.

Fig 1



— — — — — — — —

Practice on dismantling and inspection of three wheeler engine

Objectives: At the end of this exercise you shall be able to
- **identify various parts of engine**
- **dismantle the engine components**
- **clean the engine parts**
- **check engine parts using instruments / gauges.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Feeler gauge - 1 No.
- Micrometer - 1 No.

Equipments / Machinery

- Engine - 1 No.
- Work table - 1 No

Materials / components

- Piston - as reqd.
- Piston rings - as reqd.
- Engine block with liner - as reqd.
- Banian cloth - as reqd.
- Cotton waste - as reqd.

PROCEDURE

TASK 1 : **Dismantling the engine**

1 Part the vehicle on a flat surface rigidly by keeping the vehicle on the centre stand.

2 Close the fuel tap, also remove the battery and its connections from the battery holder using suitable DE spanner.

3 Remove the carburettor by loosening the air filter by using suitable screw driver and inlet manifold connection using suitable DE spanner.

4 Dismantle the chain from the sprocket using suitable plier / snip tool.

5 Also remove the clutch cable by loosening the lock nut.

6 Drain the engine oil by loosening the drain nut/plug.

7 Clean the cylinder block with a clean cloth

8 Remove the spark plug from the cylinder head using a plug spanner

9 Dismantle the cylinder head from the crankcase by loosening the bolts provided on the cylinder head

10 Remove the cylinder head gaskets and bushes and keep it in a safe clean place

11 Take out the cotters/locks/collets using the special tool

12 Remove the intake and exhaust valve along with the valve seating and spring.

13 Dismantle the Camshaft by removing the timing gear from the crankshaft. (Care should be taken not to change the timing identification marks

14 Remove the intake and exhaust valve along with the valve seating and spring

15 Loosen the connecting rod bolts from the big end of the crankshaft using suitable DE spanner.

16 Remove the brass bushes from the connecting rod by loosening the dowel pins

17 Using a wooden mallet remove the piston pin by gently tapping on the pin and dismantle piston from the connecting rod.

18 Remove the piston ring from the piston using a circlip plier.

19 Separate the crankshaft gear from the counter shaft gear (Dismantle, clean and check the transmission separately).

20 Remove the crankshaft using suitable DE spanner and also the bearings using suitable pullers.

21 Remove the flywheel securing bolts from the crankshaft using suitable DE spanner and dismantle the flywheel.

22 Remove the lube oil pump and clean it separately.

TASK 2 : **Cleaning**

1 Clean the piston, piston pins with kerosene. Clean the piston head thoroughly removing the carbon and other deposits formed on it.

2 Clean the inlet and exhaust valves, also clean the valve springs and seating

3 Clean the big and small ends of the connecting rod with kerosene

4 Clean the crankshaft thoroughly with recommended solvent, removes the any carbon, oil deposits with a wire brush.

5 Clean the bolt and nuts fitted on the cylinder head and crankcase thoroughly.

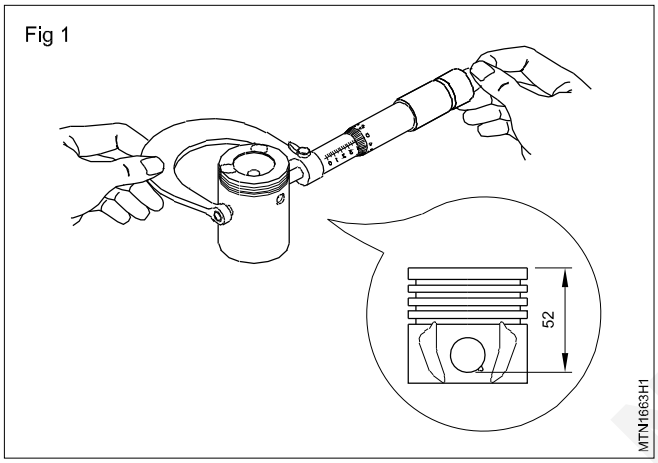
6 Clean the cylinder walls thoroughly.

— — — — — — — —

TASK 3: **Check the piston diameter**

1 Using a micrometer, measure the piston diameter at right angles to the piston pin center line, and at a position 52 mm (2.05 in.) from the top of the piston head and record the results in a Table 5 (Fig 1).

Fig 1



2 Using a micrometer, measure the external diameter of the piston pin and record the results in Table 6 (Fig 2).

Fig 2

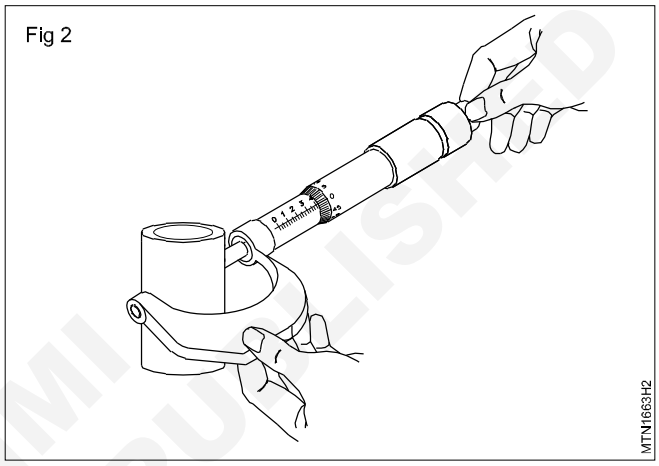


Table 5

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

Table 6

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

— — — — — — — —

TASK 4: **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 allow 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.

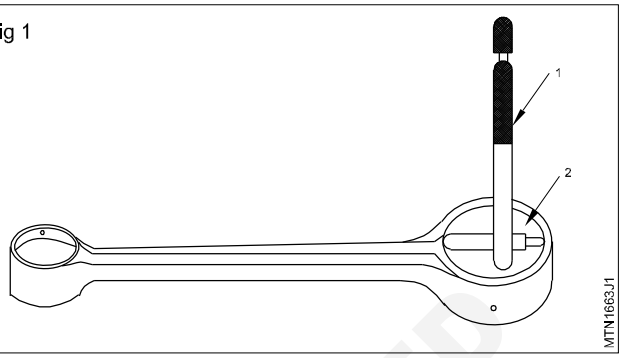
6 Move the gauge slightly inside the connecting rod bore and get the correct feel.

7 Lock the telescopic gauge (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 5: **Inspection of cylinder head**

1 Clean the cylinder head carbon deposit on the combustion chain bear.

2 Clean the air flow dusts on the cylinder head.

3 Inspect the cylinder head fins.

4 Visually inspect the cylinder head surface, if found any damage or crack, bent replace the cylinder head.

5 Check the valve and valve seat.

6 Check the valve operating mechanism and timing chain drive sprocket (can shaft) replace the damaged part.

— — — — — — — —

TASK 6 : **Inspection of piston ring**

1 Remove the piston rings from the piston.

2 Clean the piston rings

3 Measure the piston ring gap and thickness of piston ring as per manufactures guide line.

4 If found damaged/wornout piston rings replace the piston rings.

— — — — — — — —

Performing measurement of piston ring gap

Objectives: At the end of this exercise you shall be able to
- **measure the piston ring gap**
- **measure the piston ring to groove clearance**
- **measure the cylinder to piston clearance**
- **measure the piston pin to connecting rod clearance.**

Requirements

Tools / Instruments

• Trainee Tool Kit	- 1 No.
• Circlip remover	- 1 No.
• Hand wire	- 1 No.
• Pinton ring expander	- 1 No.
• Feeler Gauge	- 1 No.
• Ring groove clearance	- 1 No.

Equipment / Machinery

• Two wheeler engine	- 1 No.

Materials / components

• Cleaning agent	- as reqd.
• Cotton waste	- as reqd.
• Carbon tetra chloride	- as reqd.
• Soap oil	- as reqd.
• Piston	- as reqd.
• Piston ring	- as reqd.

PROCEDURE

TASK 1: **Measure the piston ring close gap (Fig 1)**

1 Clean the cylinder bore with baniyan cloth

2 Clean the selected piston ring for measure

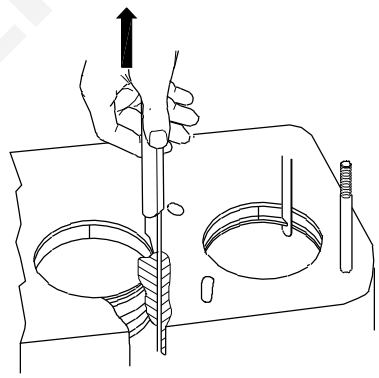
3 Insert the piston ring inside of the cylinder bore

4 Ensure the piston ring placed in specified level in side of cylinder bore (push the ring in the cylinder by piston head without rings)

5 Measure the piston ring, close gap by feeler gauge

6 Note the feeler gauge leaf reading and compare with service manual specification.

Fig 1



— — — — — — — —

TASK 2: **Measure the clearance between the liner and piston**

1 Clean the oil and dust of the piston with kerosene

2 Clean the piston with compressed air and baniyan cloth.

3 Clean the cylinder bore with baniyan cloth

4 Insert the piston (without ring) inside of the cylinder bore/ liner

5 Measure the clearance between the liner and the piston below the gudgeon pin by the feeler gauge

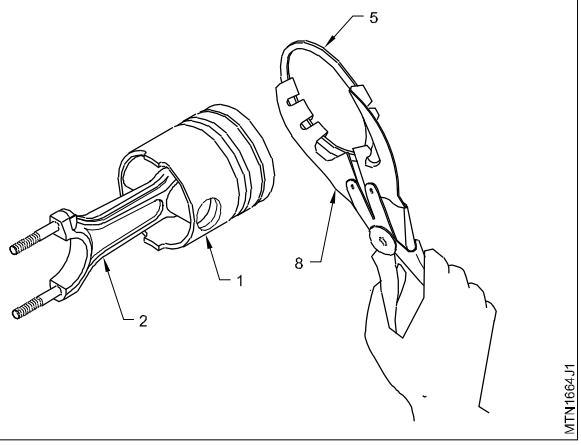
6 Note the reading of feeler gauge leaves and compare with service manual specification.

— — — — — — — —

TASK 3: **Measure the piston ring groove clearance**

1 Remove the piston ring (5) with help of piston ring (8) expander as shown in (Fig 1).

Fig 1



2 Remove the circlip (9) of the piston pin (10), using a circlip plier.

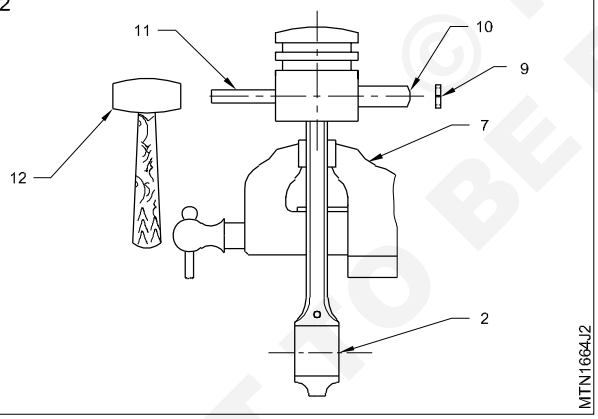
3 Remove the piston pin (10) with the help of a drift (11) and hammer(12). Repeat the steps to all the pistons. (Fig 2)

4 Remove connecting rod from piston.

5 Clean the piston, piston pin, piston rings grooves, oil ring holes.

6 Remove the carbon deposits from the piston ring grooves.

Fig 2



7 Clean the piston rings and the connecting rod by using kerosene.

8 Check the piston skirt and crown for scuffing, crack, scoring etc.

9 Check the piston pin circlip grooves in the piston for damage.

10 Check piston ring side clearance (A) (Fig 3) in the piston's (2) groove with a feeler gauge (3).

11 Check the wear of piston (Fig 4) diameter at different point

12 Check the wear of piston ring grooves and land.

13 Measure the piston diameter at different points.(Fig 4)

14 Compare the dimension with service mannual.

Fig 3

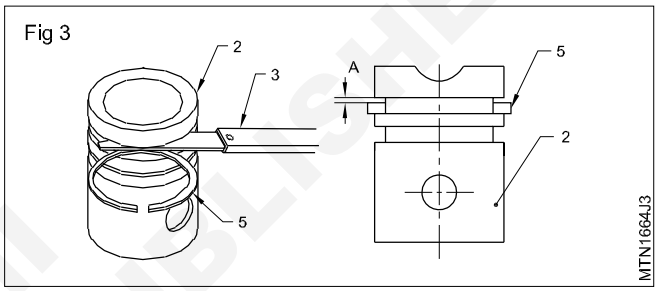
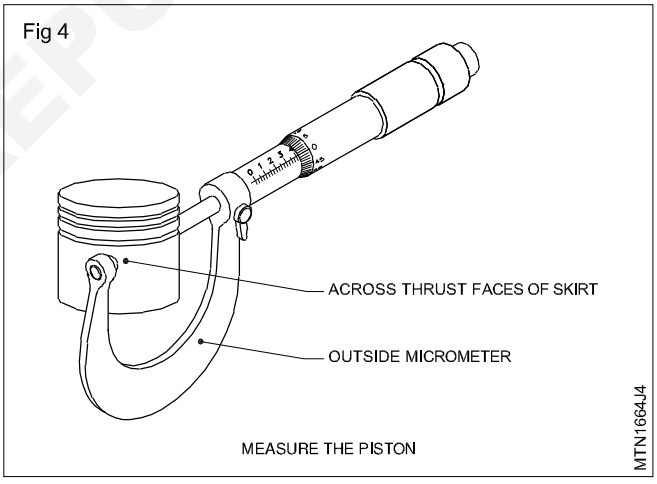


Fig 4



Practice on trouble shooting in engine

Objectives: At the end of this exercise you shall be able to
- **trouble shooting of poor idling**
- **trouble shooting of low compression**
- **trouble shooting of high compression**
- **trouble shooting of engine excessive noise.**

Requirements

Tools/Instruments

- Trainee Tool Kit - 1 No.

Equipment / Machinery

- Two wheeler engine - 1 No.

Materials/components

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

Trouble shooting

S.No	Defect		Remedies
1	Low compression	- Piston ring worn out - Piston worn out - Cylinder head gasket leak - Valve seat worn out - Valve improper seaking - Cylinder bore worn out	- Replace - Replace - Replace - Set valve seat - Grind valve seat - Restore / Replace
2	High compression	- Low clearance volume - Low exhaust valve clearance	- Increase the volume - Adjust valve clearance
3	Engine excessive noise	- Low oil level - Big end bearing worn out - Piston and piston ring worn out - Piston pin worn ou - Excessive valve clearance - Timing chain loose fitting - Crank shaft bearing worn out	- Top up oil - Replace - Replace - Replace - Adjust - Adjust - Replace
4	Engine poor idling Cause	- Carburettor improper adjust - Dirty spark plug - Air cleaner dirty air filter - Improve for valve adjustment - H.T load current leak - Weak current supply - Piston ring worn out - Compressing weak	- Adjust idling speed - Clean / replace - Clean / replace - Adjust - Replace H.T lead - Check ignition system - replace - Check the piston ring or rebore the engine

Practice to identify valves and condition of valve seat

Objectives: At the end of this exercise you shall be able to
- **identify the valves and its condition**
- **identify the condition of valve seat**
- **inspection of rocker arm and cam shaft**
- **inspection of valve seat and replacing valve guide.**

Requirements

Tools / Instruments

- Trainee Tool Kit - 1 No
- Valve grinding stick - 1 No
- 'C' clam P - 1 No
- Tray - 1 No

Equipment / Machinery

- Motor cycle - 1 No

Materials / components

- Cotton waste - as reqd.
- Soap oil - as reqd.
- Valve spring - as reqd.
- Valve - as reqd.
- Valve guide - as reqd.
- Valve oil seal - as reqd.
- Cylinder head gasket - as reqd.
- Lapping abrasive - as reqd.

PROCEDURE

TASK 1: **Identify the valve and it's condition**

1 Remove the cylinder head inlet and exhaust connections

2 Loosen the cylinder head mounting bolts and cylinder head cover

3 Remove the mounting bolts of cylinder hear

4 Remove the timing chain and chain adjusts and cam shaft sprocket

5 Remove the rocker arm pull out the rocker shaft

6 Remove the cylinder head from the engine block

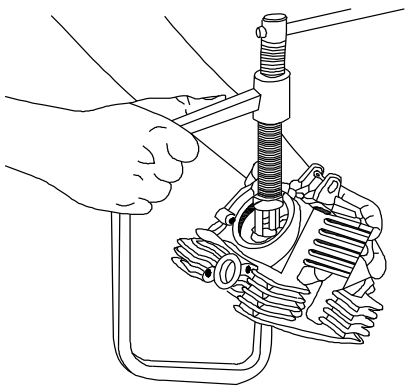
7 Clean the cylinder head

8 Remove the valve spring cotters by using 'C' clamp (Fig 1)

9 Remove the valve spring retains, spring cuter and inner stem seal and spring seat

- Bring out the both valve from the cylinder head

Fig 1



MTN1666H1

TASK 2: **Inspecting valves**

1 Visually inspect the valve stem for bend or pitting.

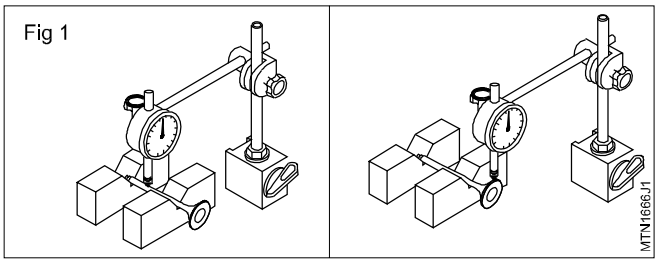
2 Replace the valve if valve is burnt.

3 Inspect the valve stem for run out.

4 Measure the free length of the valve spring.

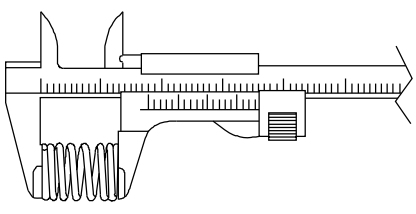
5 Replace the defective valve springs and valve.

Fig 1



MTN1666J1

Fig 2



MTN1666J2

TASK 3: **Inspection of can shaft**

1 Inspect the cam lobes for wear, pitting or damages.

2 Measure the cam lobe height.

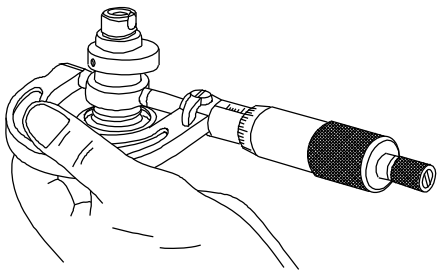
Height of the cam lobe (inlet valve)

Height of the cam lobe (exhaust valve)

3 Inspect on condition of the cam shaft.

4 If found any wearness or damage replace the parts.

Fig 1



MTN1666K1

— — — — — — — —

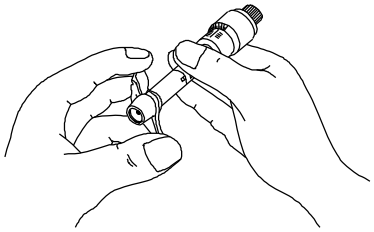
TASK 4: **Inspection of rocker arm /shaft / cam chain tensioner**

1 Inspect the rocker arm sliding surface for wear.

Measure the rocker arm bore and compare with service limit.

Check the condition of the rocker arm

Fig 1



MTN1666Y1

2 Inspect the rocker arm shaft

Measure the rocker arm shaft dia and compare with service limit

Check condition of the rocker shaft if any damage replace it

3 Inspect the cam chain tensioner

Inspect the cam chain tensioner for damage, cuts, cracks.

— — — — — — —

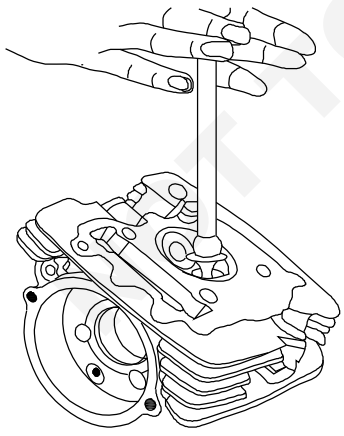
TASK 5 **: Lapping the valves**

1 Dismantle the valve assembly.

2 Apply the valve lapping compound (course) uniformly around the valve face.

3 Hold the valve with the stick in its place; rub the valve against seating with light pressure till the perfect surface is obtained.

Fig 1



MTN1666Z1

At the time of lapping, rotate the valve ¾ rotations in clockwise direction and ¼ rotation in anticlockwise direction.While rotating, the valve face should rub on the valve seat during clockwise movement and lift the valve slightly during anticlockwise movement.

4 Thoroughly clean the valve and the valve seat to remove the lapping compound.

5 Apply fine compound and do the same as above mentioned.

6 Check the valve guide if need replace it.

7 Assemble the valve components in the cylinder head.

— — — — — — — —

Servicing of cylinder head assembly

Objectives: At the end of this exercise you shall be able to
- **remove the cylinder head assembly**
- **disassembly the cylinder head components**
- **inspect the cylinder head components**
- **decarbonizing the cylinder head**
- **reassembly the cylinder head components.**

Requirements

Tools / Instruments

• Trainee Tool Kit	- 1 No.
• Value spring compressor, Hammer	- 1 No.
• Vernier Caliper	- 1 No.
• o/s micrometer - (0-25) (25-50)	- 1 No.
• Dial gauge with magnetic stand	- 1 No.
• V-Block	- 1 No.
• Inside micrometer	- 1 No.
• Feeler Gauge	- 1 No.
• Tarque wrench	- 1 No.

Equipment / Machinery

• Two wheeler engine	- 1 No.

Materials / components

• Valve seal	- as reqd.
• Gasket	- as reqd.
• Cotton waste	- as reqd.
• Kerosene	- as reqd.
• Valve key Inserter	- as reqd.
• Wire to tie cam chain	- as reqd.

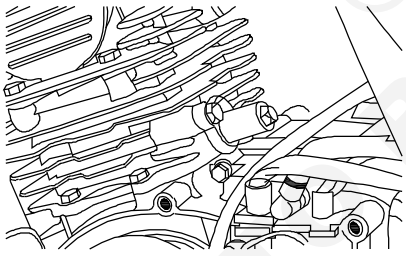
PROCEDURE

TASK 1: **Removing the cylinder head assembly**

1 Loosen the chain tensioner plug and release the plunger spring.

2 Loosen the bolts and remove the chain tensioner body.

Fig 1



3 Align the TDC mark on rotor assembly with the crank case mark by rotating the rotor assembly.

Check the valve rockers are free if at rotate another one full rotation to make it free.

4 Remove cylinder head cover.

5 Loosen the bolts and remove the sprocket from the cam shaft.

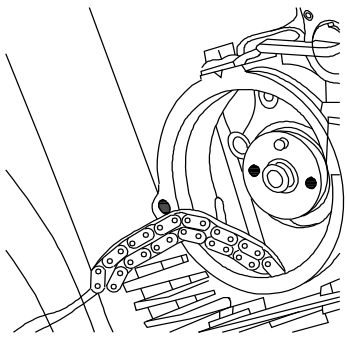
6 Take out the sprocket and release the cam chain

7 Leave the cam chain (2) on the cylinder head and tie it with a wire.

If it is not tied properly, possibility of timing chain to fell down in to the crank case.

8 Remove the inspection cap.

Fig 2



9 Remove the rocker arm stopper and pull out the rocker shaft.

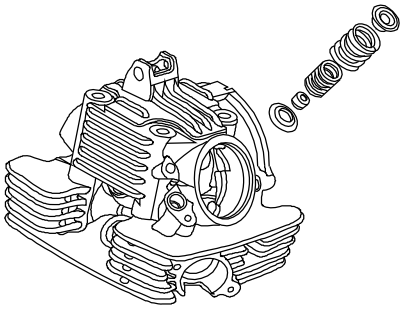
10 Take out the rocker arms.

11 Remove the cam shaft from the assembly.

12 Loosen the cylinder head bolts.

13 Take out the cylinder head from the assembly.

Fig 3



TASK 2 **: Dismantling the cylinder head components**

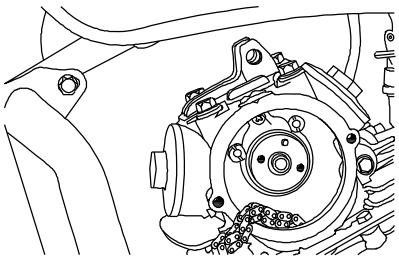
1 Remove the cam chain tensioner.

2 Remove valve spring cotters by using valve spring com presser and nose plier.

3 Remove the spring retainer, spring outer and inner, valve stem seal and spring seat.

4 Take out both the valves from the bottom side of the cylinder head.

Fig 1



MTN1667J1

— — — — — — — —

TASK 3 **: Inspecting cylinder head components**

1 Inspect the cylinder head surfaces for warpage with the help of surface plate and feeler gauge.

2. Measure the warpage in many places

— — — — — — — —

TASK 4 **: Decarbonizing the cylinder head**

1 Remove carbon deposits from the cylinder head. Use carbon tetra chloride (Ccl4).

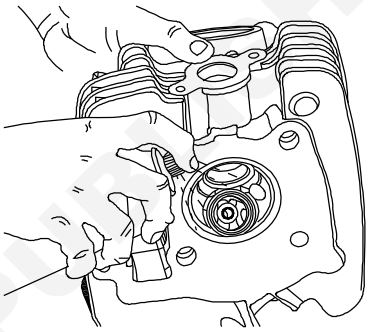
2 Remove carbon from the valve.

3 Remove carbon from the top of the piston which is in the cylinder block.

Do not use emery or sand paper for removing carbon.

A fine scrapper may use if the carbon layer is very thick.

Fig 1



MTN1667K1

— — — — — — — —

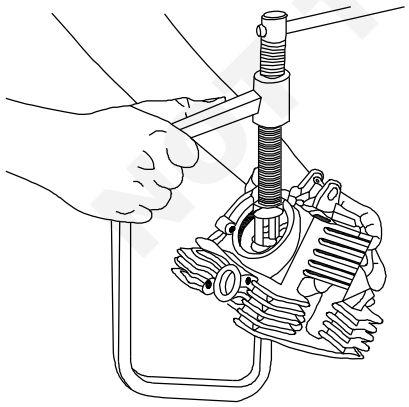
TASK 5 : **Reassembly of cylinder head**

1 Assemble the valve assembly with new valve seal.

2 After assembling, tap slightly on valve tip to ensure the cotters placed properly.

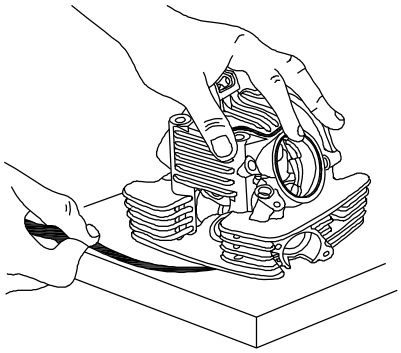
3 Check valve leak by pouring petrol around the valve seating. if leakage is found the lap the valves again.

Fig 1



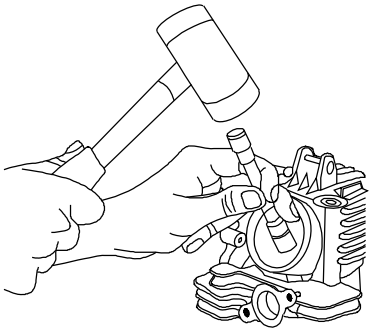
MTN1667Z1

Fig 2



MTN1667Z2

Fig 3



MTN1667Z3

— — — — — — — —

Check the valve clearance and setting ignition timing

Objectives: At the end of this exercise you will be able to
- **inspection valve clearance**
- **ignition timing set method.**

Requirements

Tools / Instruments

- Trainee Tool Kit - 1 No.
- Value spring compressor, Hammer - 1 No.
- Vernier Caliper - 1 No.
- Feeler Gauge - 1 No.
- Tarque wrench - 1 No.

Equipment / Machinery

- Running motor gale - 1 No.

Materials / components

- Cotton waste - as reqd.
- Kerosene - as reqd.

PROCEDURE

TASK 1: **Inspection valve clearance**

1 Ensure the engine is stone cold.

2 Strip the bike down.

3 Remove the cylinder head cover.

4 Take care of the cam shaft holder.

5 Make a chart - record the all measurement you make so draw the layout on a piece of paper.

6 Position the crank shaft.

7 measure the first set of clearance use your feeler gauge to check the gaps measure the space between the cam and the bucket making sure it corresponds to the correct valve.

8 Measure the second set of clearance.

9 Ensure all of the clearance will be within the specified to clearances.

10 In case bucket and shrin valve clearance rotate the cam shaft still aligned with the engine mating surface.

11 Make sure you rotate the cam shafts before removing the holder and ensure align the timing mark.

12 Remove the cam chain tensions.

13 Remove the cam shaft holder and check the bearings surface for wear or damage.

14 Remove the cam and check the surface of bearing and cam lobes for any signs of wear or damage.

15 Remove the shrins from the valves that have incorrect clearances and measure the shein and place the correct size of shims.

16 Refit the buckets and shrin and fit the cam, bolt the cam shaft holder back on and refit cam chain tensions and measure the valve clearance again and engine the valve clearance as specified limit. Refit the cylinder head.

— — — — — — — —

TASK 2: **Ignition timing setting method**

1 Before set ignition timing be sure to read the shop manuel and take notes and pictures of how the cam shaft is installed and aligned. Set the engine to TDC.

2 Remove the cam chain tensioner.

3 Slide the cam shaft through the cam chain.

4 Align the timing marks on the cam with the sprocket and cylinder head.

5 Tighten the cam chain tensioner.

6 Confirm the cam marks are properly aligned.

7 For double overhead cam engines make sure to count the number of cam chain links between each cam shaft sprocket. There is a specific number of links that should be between the two cam shaft. Ensure both sprockets line up with the correct engine markings.

8 Install the cam chain adjuster *** loosest position and back it onto the engine cylinder block. Set the adjustment by loosening and retightening the bolt and lock nut.

9 If your engine has lot of noise, it could be due to a worn cam chain, you may be able to reset the cam chain adjuster to take the excess slack out if not replace the cam chain as soon as possible.

— — — — — — — —

Practice on engine trouble shooting

Objectives: At the end of this exercise you will be able to
- **trouble shooting of engine excessive smoke**
- **trouble shooting of engine over heating**
- **trouble shooting of engine abnormal noise**
- **trouble shooting of cam chain noise**
- **trouble shooting of cam chain slack excessively.**

Sl.No	Trouble	Causes for trouble	Remedies
1	**Excessive smoke**	- Cylinder bore wornout - Piston ring wornout - Piston wornout - Valve seal damaged - Incorrect ignition timing - Dirty spark plug - Valve guide wornout - Air cleaner clogged - Starter plunger stick open - Engine oil too high - Carburettor over flow	- Replace/rebour - Replace - Replace - Replace - Set properly - Replace/clean - Replace - Repair - Drain excess oil - Repair
2	**Engine over heating**	- Incorrect firing order - Dirty spark plug - Carbon deposit on piston head - Over load - Exhaust back pressure - Improper fuel quality - Pre ignition - Uneven fuel burn - Clogged air filter - Dirty air filter - Excessive valve clearance - Ignition retarded	- Set the proper firing order - Replace - Clean the carbon - Use load as specified - Repair - Replace the fuel - Set the ignition timing - Over the carburettor - Replace - Clean/replace - Adjust the clearance - Set proper timing
3	**Engine abnormal noise**	- Valve spring broken - Ignite trouble - Incorrect grade of fuel - Incorrect spark plug gap - Incorrect valve clearance - Cam shaft bearing w/o - Piston pin w/o - Cylinder head gasket leaking - Engine mounting loose - Crank shaft bearing worn out - Cam shaft chaw loose - Cam shaft sprocket worn out - Cam shaft valve guide wornout - Drive chain inproper tension - Drive chain inproper lubricate	- Replace - Replace - Replace the fuel - Adjust spark plug gap - Adjust - Replace - Replace - Replace - Replace - Tighten it - Replace - Adjust - Replace - Replace - Adjust - Lubricate

4	**Cam shaft drive chain noise**	- Improper adjustment -Chain wornout - Engine/camshaft sprocket wornout - Insufficient lubrication - Timing chain adjuster defective	- Adjust - Replace - Replace - Top up oil in oil lamp - Replace
5	**Cam shaft drive chain slack excessively**	- Slack adjuster defective - Improper adjustment - Engine and cam shaft - Sprocket teeth damaged - Timing chain wornout	- Replace - Adjust properly - Replace - Replace

— — — — — — — —

Practice on checking the throttle cable and throttle grip free plug

Objectives: At the end of this exercise you will be able to
- **check the throttle cable**
- **measure the throttle grip free play**
- **check the engine idle speed.**

Requirements

Tools / Instruments

- Trainee Tool Kit - 1 No.

Equipment / Machinery

- Running motor cycle - 1 No.

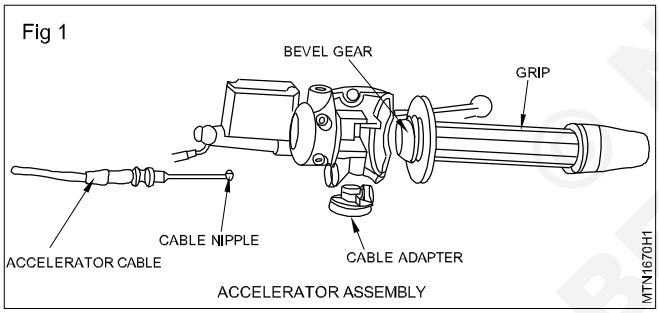
Materials / components

- Carburettor clearing kit - as reqd.
- Brush - as reqd.
- Throttle cable - as reqd.
- kerosene - as reqd.
- lub - as reqd.
- cotton waste - as reqd.
- soap oil - as reqd.

PROCEDURE

1 Visually inspect the throttle cable for crakes deterioration and severely worn out due to rubbing / crushing.

Fig 1



ACCELERATOR ASSEMBLY

2 Inspect the cable from throttle grip to throttle body.

3 Check the throttle grip movement (2-3mm) free play.

4 Check throttle opening and closing position.

5 Measure the amount of motion relative to the housing. with a ruler scale or caliper.

6 Confirm throttle quick return position.

7 If the throttle does not completely return the cable may be binding incorrectly routed frayed or corroded.

8 Remove the old cables and route the new cable in a similar fashion (Prescribed in service manual).

9 Install the cable ends into the throttle body and throttle cable housing

10 Remove the cable adjuster and loose the lock nut

11 Adjust cable adjuster up to 2-3 mm free play (throttle grip correct amount free play)

12 Tight the lock nut and install dust cover

13 Start the engine check and adjust the idling speed

14 Rotate the handle bar end to end and lighter any change in ideal behaviour.

— — — — — — — —

Checking engine compression

Objectives: At the end of this exercise you will be able to
- **prepare the engine for testing compression test**
- **remove the throttle valve**
- **check the throttle valve**
- **assemble throttle valve**
- **install compression gauge**
- **check engine compression**
- **interpret the results.**

Requirements

Tools / Instruments

- Trainee Tool Kit - 1 No.
- Spark plug spanner - 1 No.
- Compression gauge set - 1 No.

Equipment / Machinery

- Motor cycle - 1 No.

Materials / components

- Banyan cloth - as reqd.
- Lub oil - as reqd.
- Soap oil - as reqd.
- Cotton work - as reqd.

PROCEDURE

TASK 1 : **Preparing the engine for testing**

1 Insert the ignition key on the ignition switch and turn on.

2 Start the engine.

3 Run the engine at idle speed for at least 10 minutes to bring its normal operating temperature.

4 Switch off the engine.

5 Disconnect the HT lead from the spark plug.

6 Remove the spark plug.

7 Turn the fuel cock knob in to OFF position.

8 Installing the compression gauge

9 Select the proper adopter from the compression gauge set.

10 Connect the selected adopter in the compression gauge.

11 Connect the other end of the adopter at the spark plug hole.

12 Press the gas release knob in the gauge and check the pointer shows zero.

13 Checking engine compression

Dry test

14 Hold the compression gauge firmly.

15 Open the throttle valve fully by operating the accelerator lever.

16 Kick start or self stark the engine for eight to ten times rotation of engine.

17 Note the highest reading showed in the gauge.

Wet test

18 Set the gauge reading in to zero.

19 Unscrew the gauge adopter from the spark plug hole.

20 Apply few drops of oil in to the cylinder through the spark plug hole.

21 Install the compression gauge and recheck the engine compression and note down the reading.

Interpreting the results

22 The standard compression value is 10-13 kg/cm2.

23 Compare the dry test values with the manufacturer's specification.

24 If it is matches with the specification, then the engine compression is correct.

25 If the values are more than the specified value, indicates more carbon deposits in the combustion chamber.

26 If the dry test value is less than the specified value and wet test value shows higher than the dry test value and within the limit, then the problem with the piston ring or cylinder wear.

25 If both dry and wet test values are less than the specified value and not shown any difference, then the problem with the valves or engine gasket.

TASK 2: **Removing throttle valve**

1 Disconnect the negative terminal of battery.

2 Loosen the adjuster nut of the throttle cable and disconnect the cable from the throttle valve

3 Disconnect the throttle position sensor coupler.

4 Unlock and remove the throttle position sensor.

5 Loosen the clamps and disconnect the air filter hose.

6 Loosen the screws and remove it from the intake pipe.

7 Take out the throttle valve assembly.

— — — — — — — —

TASK 3: **Cleaning the throttle valve**

1 Spray the carburettor cleaner in the passage of throttle body.

2 Gently brush inside the passage.

3 Clean the dirt and gum deposited in the passages the with the brush or clean cloth.

Reassembling the throttle valve

4 Place the throttle valve and screw it with the intake port.

5 Fix and clamp the air fitter assembly

6 Screw the throttle position sensor and connect the accelerator cable

7 Adjust the free play of throttle cable and lock nut.

8 Connect the battery terminals.

9 Ensure throttle cable and throttle body valve is properly fitted.

10 Start the engine and check the engine performance.

— — — — — — — —

Practice on over hauling of carburetor

Objectives: At the end of this exercise you will be able to
- **remove the carburettor from the vehicle**
- **dismantle the carburettor**
- **clean the carburettor parts**
- **inspect the carburettor parts**
- **reassemble the carburettor**
- **refit carburettor on the vehicle**
- **tuning up the carburettor.**

Requirements

Tools / Instruments

- Trainee Tool Kit - 1 No.
- Nose plier - 1 No.

Equipment / Machinery

- Motor cycle - 1 No.
- Pollution testing equipment - 1 No.
- Air compressor - 1 No.

Materials / components

- Throttle cap ring - 1 No.
- Carburettor cleaner - 1 No.
- Baniyan cloth - as reqd.
- Soap oil - as reqd.
- Cotton waste - as reqd.

PROCEDURE

TASK 1: **Removing the carburettor from the vehicle**

1 Turn off fuel cock knob.

2 Disconnect the fuel supply hose from the carburettor.

3 Unscrew the throttle cap and remove the piston valve and spring Refer Fig 1.

4 Press the spring and disconnect the piston valve from the throttle cable by dislocating the cable from the piston groove.

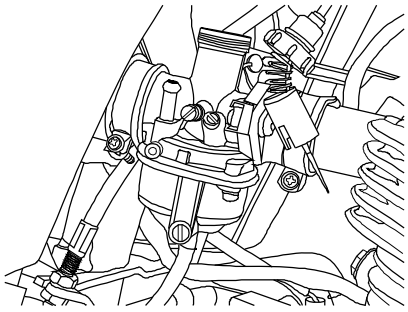
5 Take away the piston, spring and throttle cap.

6 Unscrew the hose clamps from both sides of the carburettor.

7 Remove the adaptor.

8 Take out the carburettor from the vehicle.

Fig 1



— — — — — — — —

TASK 2 : **Disassemble the carburettor**

1 Remove the O ring from the flange.

2 Remove the hoses connected with the carburettor.

3 Loosen the screws and remove the float body assembly.

4 Remove the float assembly by removing the pin. (Fig 1)

5 Remove the needle valve assembly.

6 Remove the main jet and the jet holder.

7 Take out the jet holder.

8 Remove the pilot jet.

9 Remove the air screw along with the spring, washer and O ring.

10 Remove the idle screw adjuster along with spring, washer and O ring. (Fig 2)

11 Remove the choke lever.

12 Remove the choke assembly and dismantle the plunger and spring from the assembly.

13 Remove the jet needle from the piston valve. (Fig 3)

Fig 1

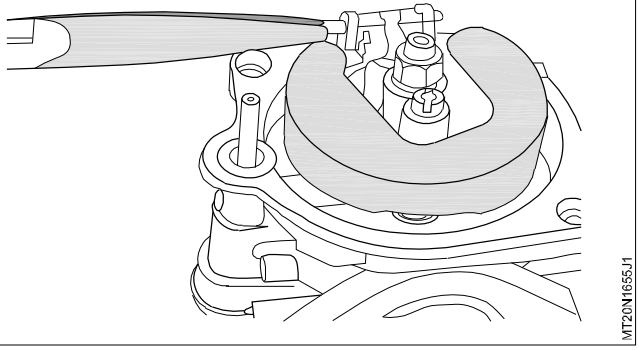


Fig 2

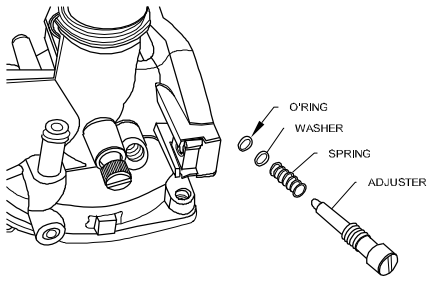
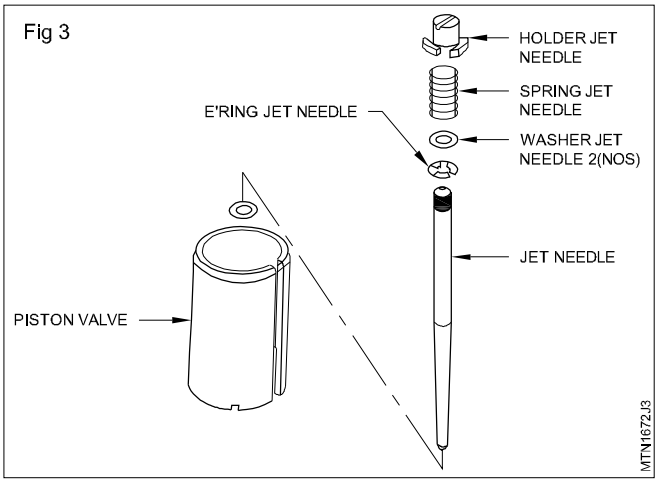


Fig 3



— — — — — — — —

TASK 3 : **Cleaning the carburettor (Fig 1)**

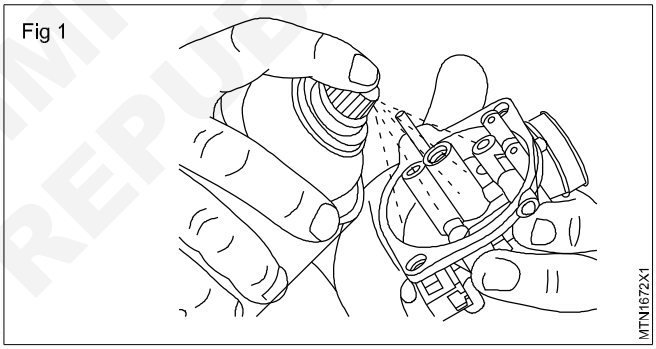
1 Clean all the passages by recommended.

2 Blow compressed air to clean the passages free from blockages.

Never use wire or needle to clean carburettor passages.

Do not use petrol for cleaning which does not remove gum deposits.

Fig 1



— — — — — — — —

TASK 4 : **Inspecting the carburettor parts (Fig 1)**

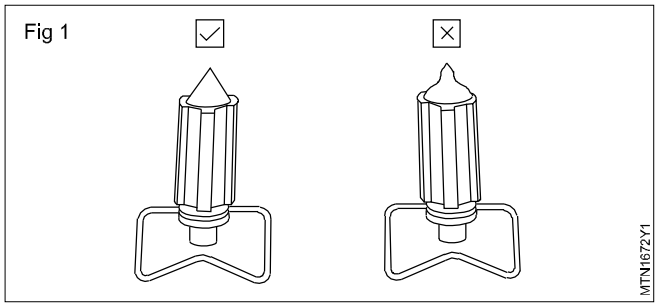
1 Inspect the float for damage.

2 Inspect the needle valve assembly for wear.

3 Inspect piston valve, needle, and jet for wear or damage.

Replace these parts by new ones if found damage

Fig 1



— — — — — — — —

TASK 5 : **Reassembling the carburettor**

1 Assemble the chock assembly.

Care to be taken to place the spring plate properly in the choke assembly.

2 Assemble the piston valve assembly.

While reassembling the needle assembly, confirm the ring is placed as before it dismantled.

3 Assemble the idle and air adjusting screws.

4 Assemble the main and pilot jets.

5 Assemble the float.

6 Assemble the float body with the carburettor.

Replace the gasket of float body by a new one.

— — — — — — — —

TASK 6 : **Refitting carburettor**

1 Fit the carburettor and tighten the clamps which connect the adopter in the engine side and air cleaner outlet.

2 Connect the piston valve and cap with the throttle cable.

Replace the ring of throttle cap by new one.

3 Insert the piston valve in the carburettor body in such a way that the groove in the valve slides on the projection in the body.

4 Connect the hoses.

— — — — — — — —

TASK 7 : **Tuning carburettor (Fig 1)**

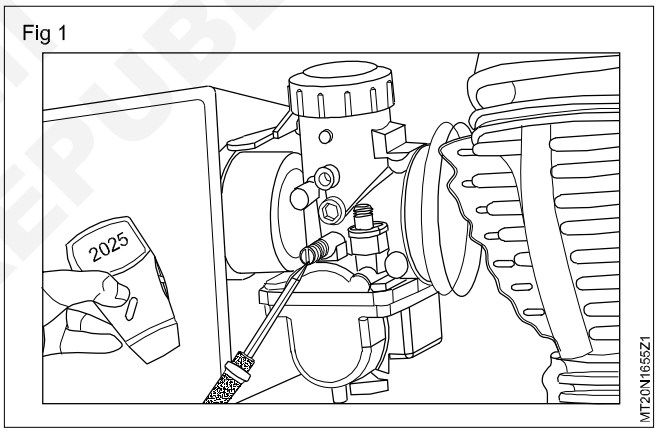
1 Tighten the air screw fully and then loose it 1¼ turns to 1½ turns.

2 Start the engine and run the engine till it reaches to normal operating temperature.

3 Turn the idle screw and fix the idle in between approximately 1500 RPM with the help of tachometer.

4 Check the CO% and readjust if necessary. Use pollution testing equipment.

Fig 1



— — — — — — — —

Adjust the throttle grip free play

Objectives: At the end of this exercise you shall be able to
- **adjust the throttle grip free play.**

PROCEDURE

TASK 1: **Cable adjustment**

1 Remove dust cover and identify the accelerator cable
2 Loose the lock nut for slacker the cable adjuster
3 Adjust the paly of throttle grip as per carburettor manual
4 Check the free play of hand grip
5 If the hand grip free play is as per throttle cable
6 Specified limit tighter the lock nut
7 Slide the dust cover over the adjusters

— — — — — — — —

TASK 2 : **Check after adjustment**

1 Check and confirm the throttle return function in all handle bar positions
2 Start and run the engine upto warm-up period
3 Adjust the idling speed with help of throttle and air screw
4 Check the free paly of throttle grip by rotate the handle bar end to end and sure better performance in idle speed of an engine operation.
5 Ensure throttle grip free play is as per manufactures specified manual limit.

— — — — — — — —

Practice on removing and cleaning of air cleaner, oil filter, fuel line and spark plug

Objectives: At the end of this exercise you shall be able to
- **inspection of fuel line**
- **dismantle the air filter assembly**
- **clean the air filter element**
- **reassemble the air filter assembly**
- **check engine oil level clean filter**
- **remove the spark plug, clean and refit.**

Requirements

Tools / Instruments

• Trainee Tool Kit	- 1 No.
• Feeler gauge	- 1 No.

Equipment / Machinery

• Two wheeler Vehicle	- 1 No.
• Spark plug testing machine	- 1 No.

Materials / components

• Kerosene	- as reqd.
• Tray	- as reqd.
• 4T Engine oil	- as reqd.
• Air filter element	- as reqd.
• Gasket	- as reqd.
• Cotton cloth	- as reqd.
• cab oil	- as reqd.
• Oil Filter	- as reqd.
• Emery paper	- as reqd.

PROCEDURE

TASK 1: **Removing and cleaning of air cleaner (Fig 1)**

1 Park the vehicle on shop floor.

2 Clean the vehicle with dry compressed air.

3 Identify the tub wheeler's air cleaner and it's connections.

4 Disconnect the air hose between carburettor and air cleaner.

5 Remove the hose.

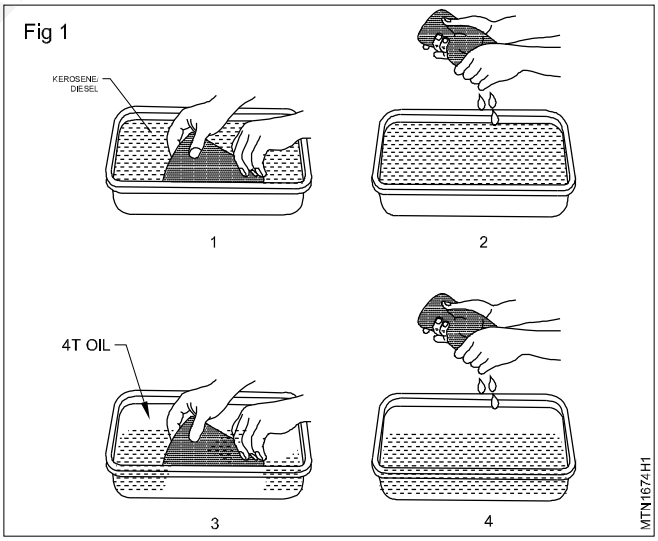
6 Dismount the air cleaner mounting bolts and remove the air cleaner and place it on the work bench.

7 Remove the air filter from bowel.

8 Clean the air filter by compressed air.

9 Inspect the air filter element if it is found unserviceable raplace the fitter element.

Fig 1



— — — — — — — — —

TASK 2: **Assemble the air cleaner**

1 Place the air filter element in the bowel at proper position

2 Ensure filter element is properly placed in it's position

3 Fit the air cleaner on the vehicle

4 Connect the air hose between carburettor and air cleaner

5 Fix the hose clamp and tighten it

6 Ensure air cleaner and air hose is properly fitted as per service manual

— — — — — — — — —

TASK 3 : **Inspection of fuel lines**

1 Check he fuel tank for leakage or any damage.

2 Check the fuel coat ON/OFF.

3 Check the fuel rubber hose for damage.

4 Check the fuel hose connection.

5 Check the accelerator and chock cable connections and its function if found any damage replace the cabel

6 Check the function of carburettor.

7 Start the engine and check the fuel flow and engine performance.

— — — — — — — — —

TASK 4 : **Checking of engine oil level and cleaning oil filter element**

1 Place the oil tray under the two wheeler engine

2 Remove the oil filter cap and oil drain plug

3 Remove the from the engine

4 Unscrew the oil filter mounting screw

5 Remove the oil filter and clean it with cleaning solvent

6 Let allow to dry the filter

7 Inspect the oil filter if it is found damaged, replace it

8 Fix the oil filter and tighten the mounting screw bolt

9 Fix the oil drain plug

10 Check the drain plug gasket washer and replace it. If found damaged.

11 Refil the engine oil with the correct grade of oil as recommended by the manufacturer.

12 While refilling check intermittently the oil level bby the dip stick till the oil level reaches the full level mark.

13 Refit the oil filling cap.

14 Start the engine and warm up.

15 Check the oil leak through the drain plug and filter. If a leak is found rectify the leakage.

16 Stop the engine and check the oil level with the dip stick. If required add till the oil level reaches the maximum mark on the dip stick.

17 Start the engine and observe the oil pressure at the idling speed of 600 to 700 r.p.m. 1000 r.p.m. 1500 r.p.m and 2500 r.p.m. Observe the engine speed with the help of a tachometer and note down all the readings and compare them with the manufacture's specifications.

— — — — — — — —

TASK 5 : **Checking spark plug**

1 Remove air cleaner assembly

2 Disconnect high tension lead from the spark plug.

3 Remove ignition coil assembly if required.

4 Loosen the spark plugs.

5 Apply air blow around the spark plug to avoid fording particles entering into the cylinder.

6 Remove spark plug from the engine cylinders.

7 Check the spark plug in a standard spark plug tester shown in Fig 1.

8 Check the spark plug for carbon deposition, cracks and damage.

9 Clean the spark plug with spark plug cleaning machine. (Fig 1)

10 Check the spark plug for wear or insulator damage.

11 Check the spark plug gap with the spark plug gauge. (Fig 2)

12 Adjust the gap as per the manufacturer's specification.

13 Connect the high tension lead with spark plug.

14 Ground the plug and crank the engine and check ignition spark visually, if spark not found in spark plug replace the spark plug.

15 Install the spark plug to the engine and connect the high tension lead with the spark plug.

16 Start the engine and check the performance of the engine.

Fig 1

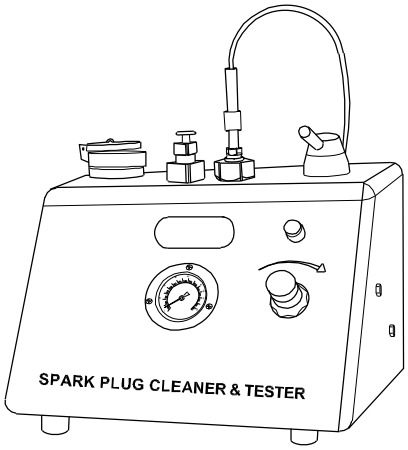
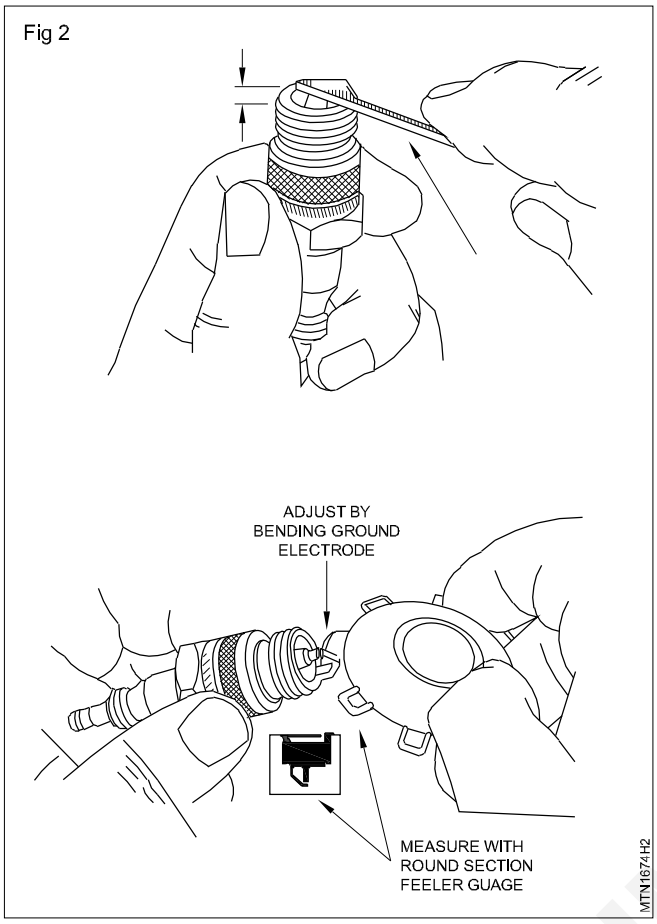


Fig 2



Practice on servicing of fuel tank and petrol tap

Objectives: At the end of this exercise you will be able to
- **remove fuel tank from the vehicle**
- **clean the fuel tank**
- **reassemble the fuel tank.**

Scan the QR code to view the video for this exercise

Requirements

Tools / Instruments

- Trainee Tool Kit 1 No.

Equipment/Machinery

- Two wheeler m/c 1 No.

PROCEDURE

TASK 1: **Removing fuel tank**

1 Remove the seat by loosening the nut fitted with the seat and frame / unlock the seat.

2 Remove the fuel hose connection from the fuel filter.

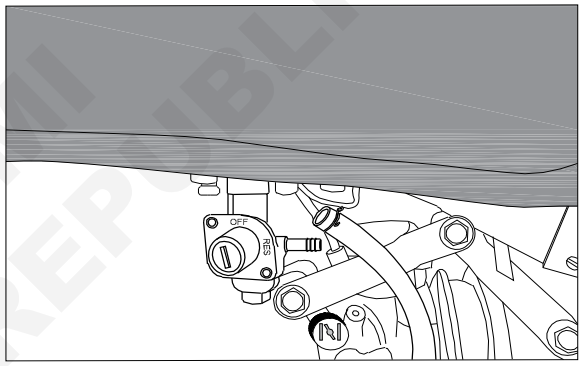
3 Drain the fuel from the tank and collect it in a container.

4 Remove the fuel tank by removing the bolts with spacer and cushion.

5 Take out the embly (Fig 1) fuel the tank with O ring.

6 Remove the fuel gauge wire connection from the bottom of the tank.

Fig 1



TASK 2 : **Cleaning the fuel tank**

1 Clean the fuel tank with the cleaning solvent and remove the gums and dusts available in the tank.

2 Clean the tank by water.

3 Blow air to dry the tank and allow it to dry in the sunlight.

4 After cleaning, apply anti-rust solution to the inner walls of the fuel tank.

TASK 3 : **Inspecting the fuel tank**

1 Inspect the fuel tank thoroughly on the welded areas and corners for any leakage.

TASK 4 : **Reassembling the fuel tank (Fig 1)**

1 After dry, mount the fuel cock with the tank.

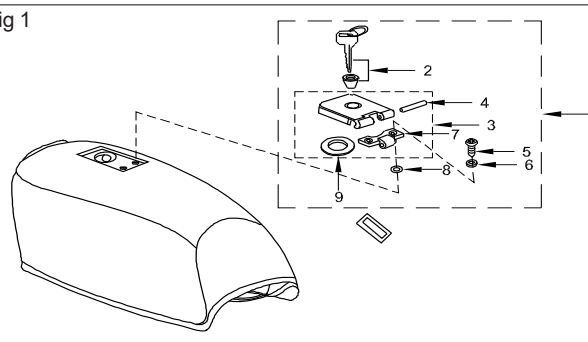
2 Fix the tank with cushion and bolt it with the frame.

3 Connect the fuel hose with the fuel filter.

4 Refill the petrol and check for any leakages.

5 Open the fuel tap and ensure the fuel free flow to carburettor.

Fig 1



Practice on servicing of petrol tap and strainer

Objectives: At the end of this exercise you shall be able to
- **remove the petrol tap and strainer**
- **clean, inspect and assemble the petrol tap and strainer**

Requirements

Tools /Instruments

• Trainee Tool Kit	1 No.
• Cleaning tray	1 No.

Equipment/Machinery

• Two wheeler m/c	1 No.
• Air compressor	1 No.
• Work bench	1 No.

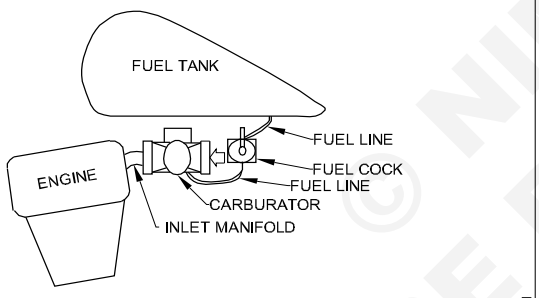
Materials/components

• Cotton waste	- as reqd.
• Soap oil	- as reqd.
• Fuel cock unit	- as reqd.
• Cleaning solvent	- as reqd.

PROCEDURE

1 Remove the fuel tank after disconnect the electrical connection and fuel pipe line. (Fig 1)

Fig 1



LAYOUT OF CABURATOR FUEL SYSTEM

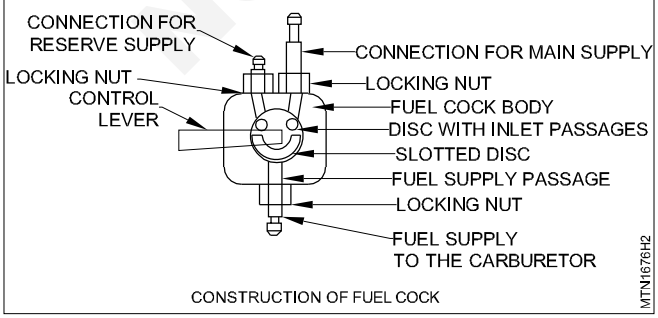
2 Remove the fuel tap and bowl from the fuel tank

3 Remove the sediment from the fuel tank

4 Use soft brush with oil free petrol, clean the dust from tap and filter unit.

5 Dismantle the fuel cock unit (Fig 2)

Fig 2



CONSTRUCTION OF FUEL COCK

6 Clean the fuel cock dismantled parts as shown in figure.

7 Clean the fuel cock body

8 Clean the strainer and fuel cock passage

9 Inspect the slotted disc and control lever

10 If found any damage replace the parts or replace the fuel cock unit

11 Assemble the dismantled parts as reverse in dismantling operator.

12 Clean circular spring steel washer and retaining screws

13 Apply oil free shellac on the washer

14 Place the washers between tank and tap

15 Screw the tap unit and strainer to the tank up to air tighter

16 Fix the three way circular line and tight by retaining screw

If screw over tight the tap will not turn ON if too loose then the petrol leaks between the line

17 Fix the tap in the valve closed position of petrol flow

18 Check the tap valve resistance during opening and closing position

This tap allow three position as off – main-reserve)

Perform engine tune up

Objectives: At the end of this exercise you shall be able to
- **trouble shooting of an engine**
- **tuning the motor vehicle.**

Requirements

Tools / Instruments

- Spanner set complete - 1 No.
- Screw driver (Philips) - 1 No.
- Screw driver set - 1 No.
- Nose plier - 1 No.
- Combination plier - 1 No.
- Compression gauge - 1 No.
- Valve clearance adjusting tool - 1 No.
- Spark plug gauge - 1 No.

Equipment / Machinery

- Pollution testing equipment - 1 No.
- Spark plug cleaning and testing m/c - 1 No.

Materials / components

- Engine oil - as reqd.
- Air filter - as reqd.
- Brake oil - as reqd.
- Fork oil - as reqd.

PROCEDURE

TASK 1 : **Perform trouble Shooting**

Trouble Shooting of engine

S.No.	Defects	Causes for trouble	Remedies
1	Engine does not start	- Defective starter motor	- Repair
		- Battery voltage low	- Recharge
		- Starter switch defective	- Replace
		- Spark plug defective	- Replace
		- No fuel supply	- Top-up fuel
		- No power supply	- Connect the power
		- Engine seizure	- Repair or replace
		- Stouter motor pinion gear teeth broken	- Replace
		- Engine fly wheel teeth wornout	- Replace
		- Piston ring wornout	- Repair / Replace
		- Engine inlet and exhaust value sticky	- Repair
		- Ignition coil defective	- Replace
		- Alternator defective	- Repair
2	High fuel consumption	- Fuel line leak	- Repair
		- Piston ring wornout	- Repair / Replace
		- Improper carburettor adjustment	- Adjust
		- Dirty spark plug	- Clean / Replace
		- Dirty air filter	-Clean the air filter
		- Clogged air filter	- Replace
		- Chock applied position	- Replace the chock
		- Low gear drive and high acceleration	- Use proper gear as need
		- Fuel over flow	- Repair / Replace the needle valve
		- Improper ignition timing	- Set proper timing

TASK 2 : **Perform engine tune up**

1 Clean the carburattor
2 Clean the spark plug and adjust the spark plug gap
3 Adjust the tapper clearance
4 Change the engine oil
5 Top-up the fuel
6 Adjust the carburattor air and throttle screw
7 Check the ignition circuit
8 Check the start or motor operation
9 Adjust the clutch cable free play
10 Adjust the brake cable free play
11 Adjust the slackness of the chain
12 Check the engine oil flow
13 Start the engine and check engine performance

— — — — — — — — —

Identify the steering system components

Objectives: At the end of this exercise you will be able to
- **identify the steering parts of two and three wheeler.**

Requirements

Tools /Instruments

• Trainee tool kit	- 1 No.
• Service manual	- 1 No.

Materials /components

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

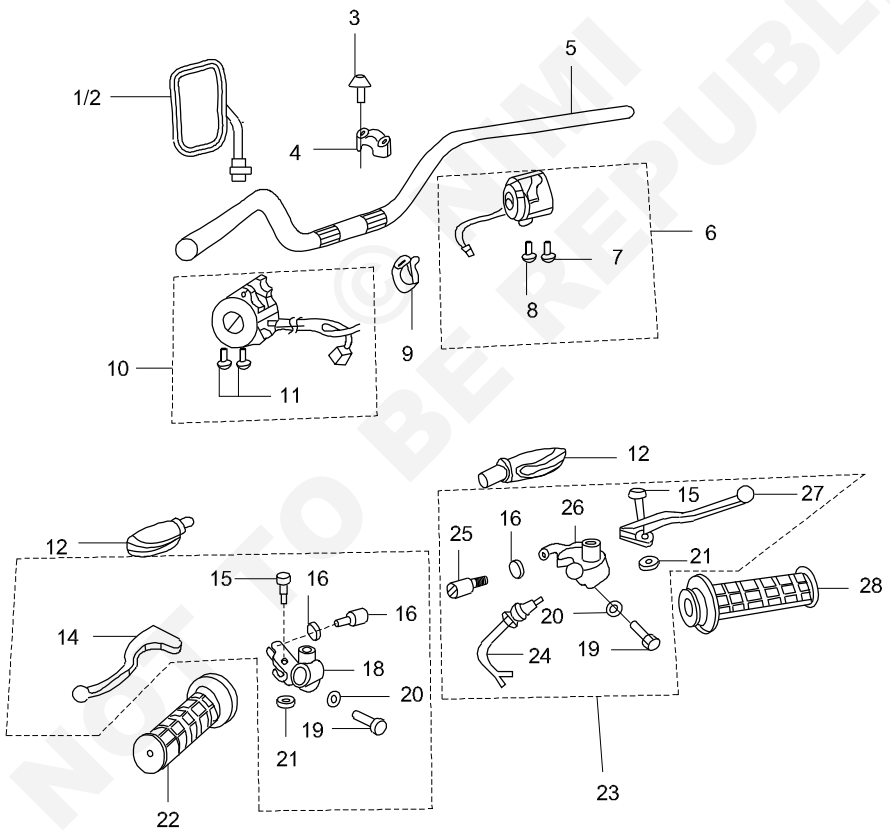
Equipment / Machinery

• Vehicle 2 wheeler	- 1 No.
• Vehicle 3 wheeler	- 1 No.

PROCEDURE

1 Identify the parts of two wheeler staring system (Fig 1)

Fig 1



Identify the part of steering (Fig 1)

S.No	Parts No.	Name of the parts
1	1/2	Rear view mirror
2	5	Handle bar

3	6	
4	9	
5	12	
6	13	
7	14	
8	18	
9	21	
10	22	
11	23	
12	27	
13	28	

Practice on removal inspection and assembling of handle bar

Objectives: At the end of this exercise you will be able to
- **remove the accessories of handle bar**
- **dismantle the steering assembly**
- **inspect the steering assembly parts**
- **reassemble the steering assembly**
- **adjust the steering play.**

Requirements

Tools / Instruments

- Box spanner - 1 No.
- D.E. Spanner set - 1 No.
- Screw driver set - 1 No.
- Wrench for steering nut - 1 No.
- Chisel - 1 No.
- Hammer - 1 No.
- Ring spanner set - 1 No.

Equipment / Machinery

- Two wheeler - 1 No.

Materials / components

- Grease - as reqd.
- Cleaning solvent - as reqd.
- Cotton waste - as reqd.
- Soap oil - as reqd.

PROCEDURE

TASK 1 : **Removing the accessories**

1 Remove the head light assembly.

2 Disconnect the wiring sockets.

3 Remove the cables. (brake, clutch accelerator)

4 Remove the front fork.(Fig 1)

5 Remove the speedometer assembly.

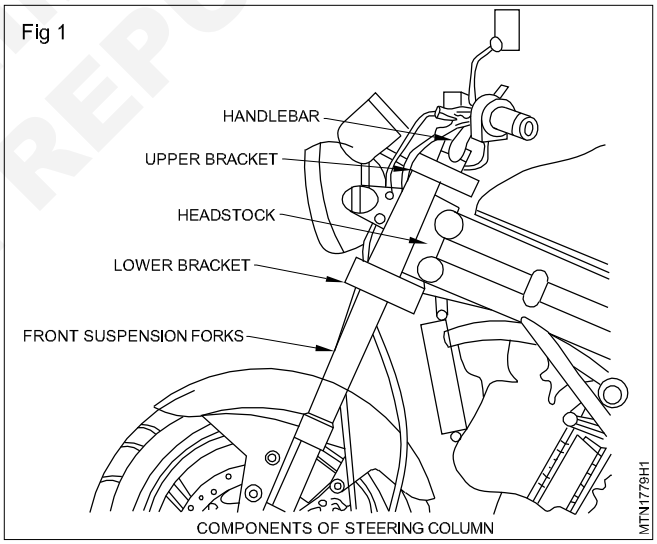
6 Remove the rear view mirror

7 Remove the clutch and brake lever

8 Disconnect the front brake fluid connection

9 Remove the master cylinder

Fig 1



COMPONENTS OF STEERING COLUMN

TASK 2 : **Dismantling the steering assembly**

1 Remove the lock nut with washer from the top of the steering. (Fig 2)

2 Lift and support the handle bar assembly.

3 Loosen the steering gut (1) with the special tool.

4 Remove the dust seal.

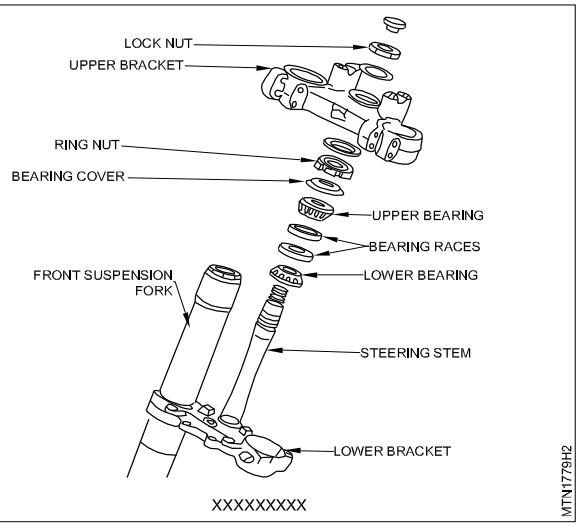
5 Remove the outer race from the top.

6 Gently pull out the steering from the housing.

7 Collect all the steel balls from the upper and lower portions.

8 Remove the inner races from the top and bottom portions of the housing.

Fig 2



XXXXXXXXX

— — — — — — — — —

TASK 3 : **Inspecting the steering assembly parts**

1 Before inspection, clean all the parts by cleaning solvent.

2 Visually inspect the handle bar for straightness.

3 Visually inspect the races for wear and pittings.

4 Visually inspect the balls for wear or damage.

5 Visually inspect the steering stem.

6 Visually inspect the front fork.

7 If found any parts damaged replace it.

— — — — — — — — —

TASK 4 : **Reassembling the steering**

1 Assemble the inner races at the top and bottom of the housing.

2 Assemble the outer race in the bottom of the steering.

3 Insert the steering in the housing.

4 Place the dust cover.

5 Place the steering nut (4) and tighten it with the special tool.

6 Place the handle bar assembly with the bracket.

7 Place the washer and tighten the lock nut.

8 Refit the fork assemblies.

9 Refit the speedometer assembly and head lamp assembly.

10 Reconnect the cables and wiring sockets.

11 Ensure all parts are fitted as per service manual layout.

— — — — — — — — —

Practice on of front fork assembly

Objectives: At the end of this exercise you will be able to
- **remove the front fork assembly**
- **dismantle the front fork assembly**
- **inspect the front fork assembly parts**
- **reassemble the front fork assembly.**

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 No.
• Allen key set	- 1 No.
• fork piston holder special tool	- 1 No.
• oil seal remover	- 1 No.

Equipment / Machinery

• Two wheeler	- 1 No.

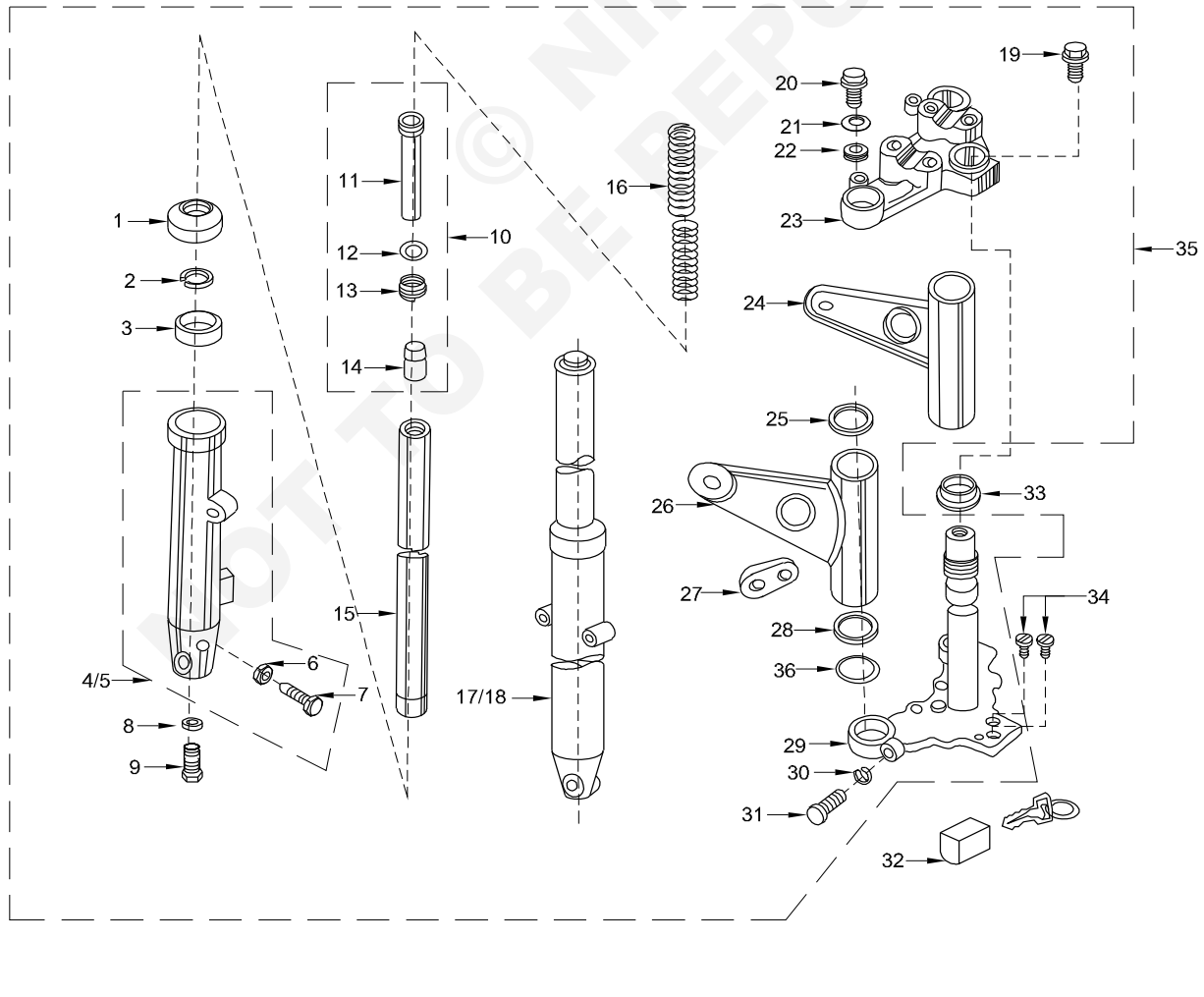
Materials / components

• Fork oil as required	- as reqd.
• Cleaning solvent	- as reqd.
• Soap oil	- as reqd.
• Cotton waste	- as reqd.
• Front fork any	- as reqd.

PROCEDURE

TASK 1 : **Removing front fork assembly (Fig 1)**

Fig 1



1 Remove the bolt with washer from both front fork assemblies.

2 Loosen the bolts from the lower bracket and remove it.

3 Pull out both the fork assemblies.

4 Loosen and remove the nut from the top of the fork assembly.

5 Take out spacer, washer and spring from the fork tube (Fig 2).

6 Drain the fork oil completely. (While draining, pump the fork assembly in and out to drain completely.)

— — — — — — — — —

TASK 2 : **Dismantling the fork assembly (Fig 2)**

1 Hold the piston by a special tool.

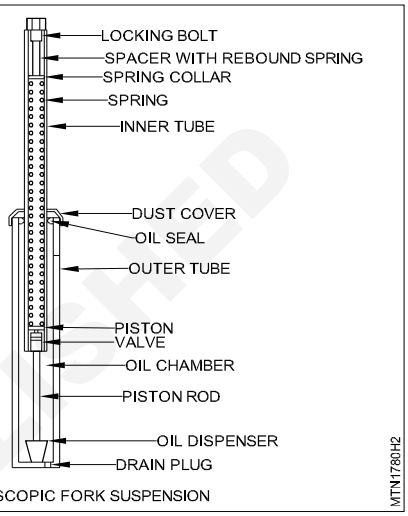
2 Loosen and remove the allen screw which holds the piston.

3 Pull out the inner tube assembly.

4 Remove the oil lock, piston, spring and dust seal.

5 Remove the oil seal by using oil seal remover.

Fig 2



TELESCOPIC FORK SUSPENSION

— — — — — — — — —

TASK 3 : **Inspecting the fork assembly parts**

1 Clean all the parts by cleaning solvent.

2 Visually inspect the piston for wear or damage.

3 Visually inspect the outer and inner tubes for scoring marks or scuffing.

4 Measuring the free length of the spring and compare with manufactures specified limit.

5 If the value exceeds the manufacturer's specification, replace the spring.

— — — — — — — — —

TASK 4 : **Reassembling the front fork**

1 Fit the oil seal valve, drain plug and oil disa.

2 Assemble the piston and spring on the inner tube.

3 Fit the inner tube in the housing with locking bolt and lock it with the allen screw.

(While locking, hold the inner housing with the special tool)

4 First the inner tube with outer tube

5 Place the spring, washer and spacer on the tube.

6 Fill the fork oil in oil chamber.

7 Tighten the fork with allen bolt.

8 Fix the dust cover.

9 Assemble the fork assembly on the vehicle.

10 Tighten the lower bracket screws.

11 Tighten the top mounting bolts.

12 Bleed the air from front fork by pumping the fork.

13 Ensure complete air is removed from front fork.

14 Ride the vehicle on the road and check the performance of front fork.

— — — — — — — — —

Practice on steering stem adjustment

Objective: At the end of this exercise you will be able to
- **remove and adjust the steering system.**

Requirements

Tools / Instruments

- Trainee's Tool - 1 No.
- Allen key set - 1 No.
- fork piston holder special tool - 1 No.
- Oil seal remover - 1 No.

Equipment / Machinery

- Two wheeler - 1 No.

Materials / components

- Fork oil - as reqd.
- Cleaning solvent - as reqd.
- Soap oil - as reqd.
- Cotton waste - as reqd.

PROCEDURE

1 Remove the accessory of handle bar

2 Dismantle the steering stem and clean the dismantled parts

3 Inspect the steering stem parts.

4 Replace the damaged or wornout parts

5 Assemble the inner races at the top and bottom of the steering

6 Apply grease and place the steering balls in the with top and bottom of the stem

(Before placing the balls, confirm the number of balls from the service manual)

7 Insert the stem in the housing

8 Place the duster cover

9 Place the steering nut and tighten it with the special tool

10 Place the handle bar assembly with the bracket

11 Place the washer and lighten the lock nut

12 Refit the fork assemblies

13 Grip the front fork with the hands to check the paly.

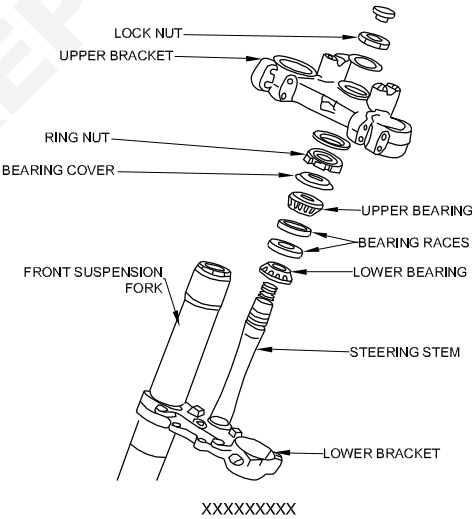
14 If paly is found then loose & slightly the lock nut.

15 Turn the steering nut clock wise or anti-clock wise till the play is zero.

16 Tighten the lock nut and check the steering play.

17 Ensure there is no play in steering stem. (Fig 1)

Fig 1



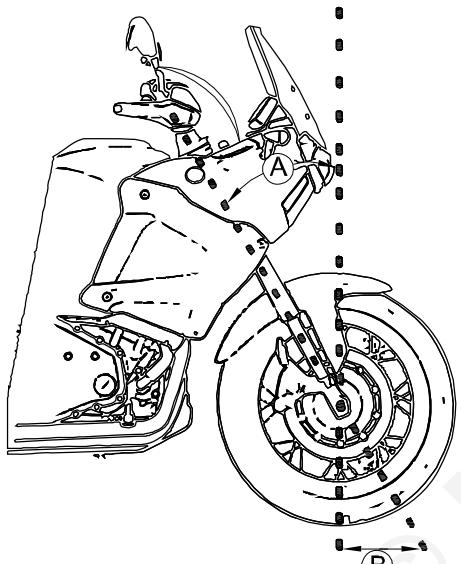
Practice on inspect the condition of fork

Objective: At the end of this exercise you will be able to
- **check inspect and adjust the rake any paly.**

PROCEDURE

1 Raise the front wheel of two wheeler

Fig 1



MTN17821H1

2 Grip the front fork with the hands and jiggle it check the rack angle paly

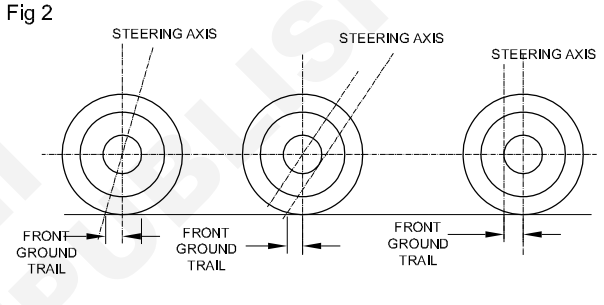
3 If the play is more or less play

4 Loosen the slotted nut by special spanners

5 Set the recommended play and tighten the slotted nut

6 Recheck the rack angle play (Fig 1 & Fig 2)

Fig 2



MTN1782H2

Identify the suspension components

Objective: At the end of this exercise you will be able to
- **identify the suspension components.**

Requirements

Tools / Instruments

- Trainee tool kit - 1 No.

Equipment / Machinery

- Two and Three Wheeler - 1 No.

Materials / components

- Cotton waste - as reqd.
- Chalk piece - as reqd.
- Pencil & Paper - as reqd.

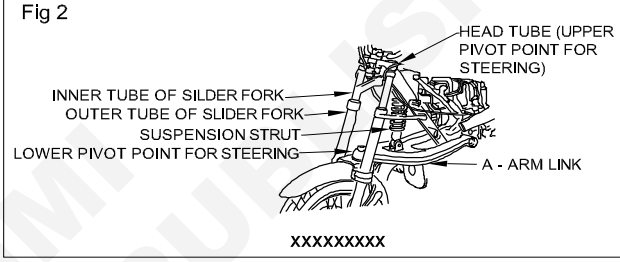
PROCEDURE

1 Park the vehicle on shop floor and refer the service manual to identify the suspension parts.

2 Identify the rear suspension part as shown in Fig 1

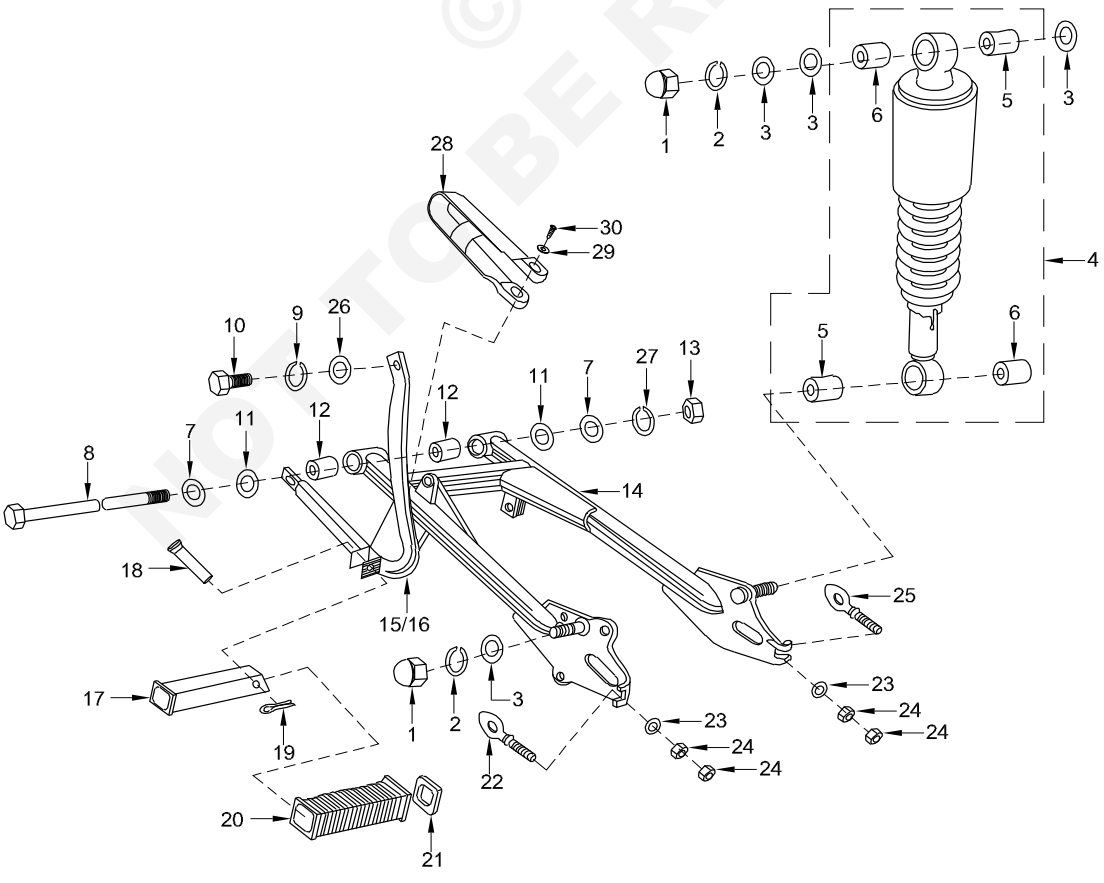
3 Identify the front suspension on parts as shown in Fig 2

Fig 2



Identify the suspension parts

Fig 1



Identify the part manue from Fig 1

Sl.No	Parts Name	Sl.No	Parts name
1	Domed Cap Nut	16	Holder Step (RH)
2	Washer Spring		Holder Step (RH) (for M8 bolt)
3	Washer Plain		Holder Step (RH) (for M 10 bolt)
4	Rest Shock Absorber (MSL)	17	Step RR
	Rest shock absorber (Gabriel)		Step RR
	Rest shock Absorber (Endurance)	18	Pin
5	Rubber Bush	19	Pin Cotter
6	Inner Bush	20	Step RR Rubber
7	Palin Washer		Step RR Rubber
8	Shaft Swing Arm	21	Washer, Step Fitting
9	Washer Spring	22	Adjuster Chain (RH)
10	Bolt		Adjuster Chain (RH)
11	Palin Washer	23	Washer Plain
12	Bushing Rubber	24	Hex Nut
13	Nut Hex	25	Adjuster Chain (LH)
14	Arm Comp. Swing / Bush		Adjuster Chain (LH)
15	Holder Step (LH)	26	Plain Washer
	Holder Step (LH) (for M8 Bolt)	27	Spring Washer
	Holder step (LH) (for M 10 Bolt)	28	Damper for Swing arm
		29	Plain washer
		30	Self tapping Screw

— — — — — — — —

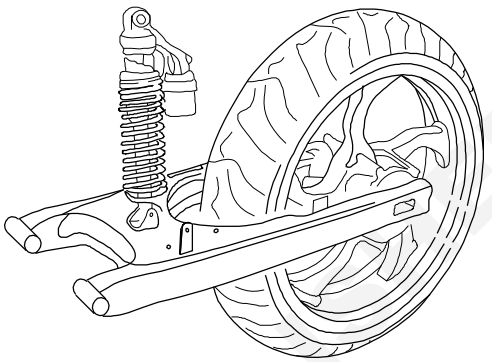
Practice on remove and re-assemble the rear shock absorber

Objective: At the end of this exercise you will be able to
- **remove inspect and assemble the shock absorber.**

PROCEDURE

1 Remove the pillion seat and rider seat
2 Disconnect battery cables
3 Remove battery and bracket
4 Loosen the upper mounting bolt of shock absorber
5 Remove bottom mounting bolt of shock absorber
6 Remove the rear shock absorber
7 Inspect the shock absorber spring visually
8 Check the spring tension
9 If found damage replace the shock absorber spring.
10 Check the shock absorber function.
11 If found oil leak in shock absorber or unserviceable, replace the shock absorber.
12 Check the shock absorber rubber bushes if found damage replace it.
13 Refit the shock absorber.
14 Tighten the mounting bolts of shock absorber.
15 Connect battery joint.
16 Refit the billion seat and rider seat.
17 Check the suspension action of vehicle.

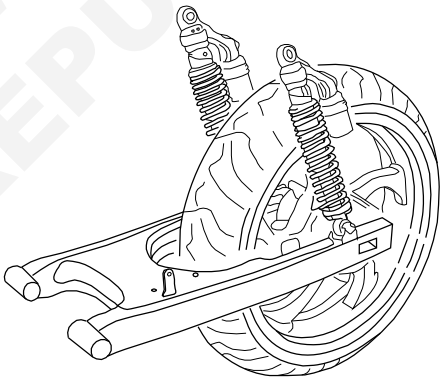
Fig 1



MONO SHOCK REGULAR SWINNG ARM

MTN1784H1

Fig 2



TWIN - SHOCK REGULAR SWING ARM

MTN1784H2

Practice on servicing swing arm of two wheeler

Objectives: At the end of this exercise you will be able to
- **remove swing arm assembly**
- **inspect the swing arm assembly parts**
- **reassemble swing arm assembly.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Spanner set - 1 No.
- Nose plier - 1 No.
- dial gauge - 1 No.
- Magnetic base - 1 No.
- V-block - 1 No.

Equipment / Machinery

- Two wheeler - 1 No.

Materials / components

- Wooden blocks - as reqd.
- Grease - as reqd.
- Cleaning solvent - as reqd.

PROCEDURE

TASK 1 : **Removing the swing arm (Fig 1)**

1 Remove the seat.

2 Remove the rear wheel assembly complete

3 Remove the drive chain assembly with sprocket.

4 Remove the rear shock absorbers by loosening the bolts.

5 Remove the foot rest.

- Remove the rear wheel

- Remove the swing arm mounting bolts

6 Remove the engine and place it on work bench

7 Loosen and pull out the swing arm shaft (1) from the vehicle.

8 Take out swing arm (2) complete from the frame.

9 Pull out the bushes (3) from the swing arm.

— — — — — — — — —

TASK 2 : **Inspecting the swing arm**

1 Clean the swing arm parts with cleaning solvent.

2 Check the run out of the swing arm shaft and compare the run out of swing arm shaft with manufactures specified limit.

3 If found any damage swing arm replace it.

4 Check the condition of swing arm.

5 Visually inspect the swing arm from any distortion or damage.

— — — — — — — — —

TASK 3 : **Reassembling the swing arm**

1 Replace the bushes and refit it in the swing arm.

2 Replace the swing arm, insert th swing arm shaft and tighten it.

3 Replace the foot rest and tighten it with the bolt.

4 Replace the shock absorbers.

5 Refit the drive chain assembly.

6 Refit the rear wheel assembly.

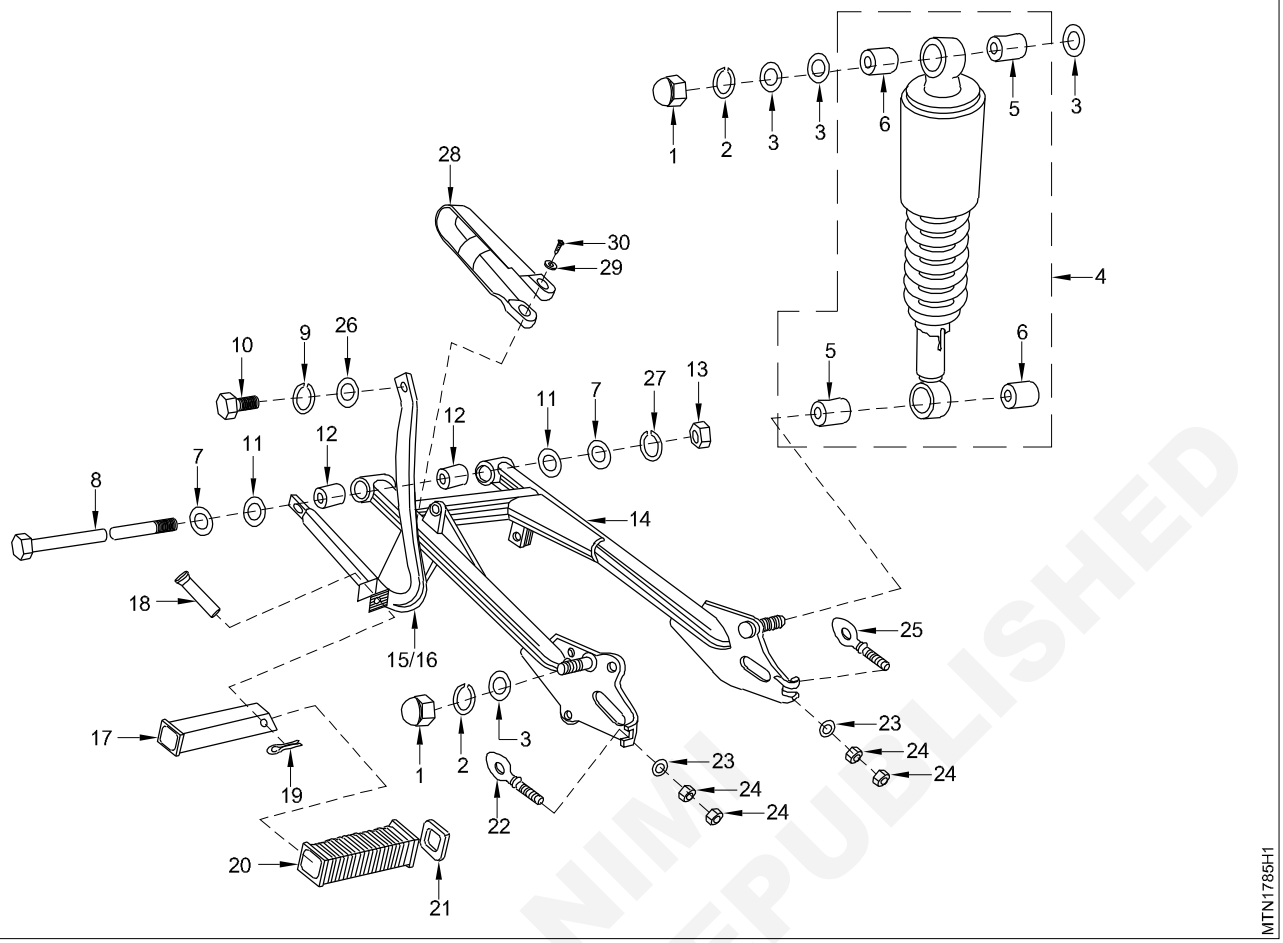
7 Refit the seat.

8 Refit the engine assembly.

9 Adjust the drive chain tension.

— — — — — — — — —

Fig 1



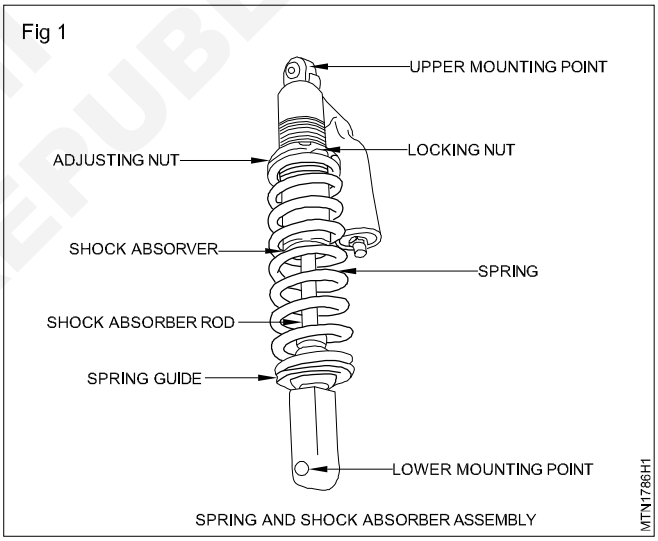
Practice on servicing of two wheeler's shock absorber suspension system

Objective: At the end of this exercise you will be able to
- **Check the suspension and replace the bushes.**

PROCEDURE

1 Inspect the condition of shock absorbers
2 Remove the rider seat
3 Loosen the rear shock absorber bolt and remove the shock absorber.
4 Check shock absorber spring tension.
5 Check spring washer, plain washer, rubber bush, inner bush.
6 Check shock absorbers suspension action.
7 Check the damper cap nut
8 Check the washer spring
9 Check the shock absorber rod
10 Check the lock nut
11 Check the adjusting nut
12 Check the upper and lower
13 Mounting point
14 Check the spring guide
15 Check the plain washer
16 Check the rear shock absorber
17 Check the rubber bush
18 Check the inner bush
19 Replace the damaged parts
20 Replace the damaged and low tension coil spring
21 Replace the low suspension action shock absorber
22 Fix the new bushes and washers
23 Refit the shock absorber
24 Tighten the shock absorber mounting bolts
25 Check the shock absorbers suspension action
26 Ensure after repair the shock absorber function as satisfied. (Fig 1)

Fig 1



SPRING AND SHOCK ABSORBER ASSEMBLY

Perform removal of front wheel assembly

Objectives: At the end of this exercise you will be able to
- **remove front wheel assembly**
- **check wheel rim runout**
- **check brake drum.**

Requirements

Tools / Instruments

• Steel rule	- 1 No.
• D.E. spanner set	- 1 No.
• Ring spanner set	- 1 No.
• Tubular spanner set	- 1 No.
• Nose plier	- 1 No.
• Hot plate	- 1 No.
• Bearing puller	- 1 No.
• Oil seal remover	- 1 No.
• Vernier caliper	- 1 No.
• Dial gauge with magnetic base	- 1 No.
• V block	- 2 nos.
• Vacuum cleaner	- 1 No.
• spokes nipple wrench	- 1 No.
• Tyre wear indicator	- 1 No.
• Tyre pressure gauge	- 1 No.

Equipment / Machinery

• Motor cycle	- 1 No.
• Two wheeler lift	- 1 No.

Materials / components

• Cotton waster	- as reqd.
• Cleaning solvent	- as reqd.
• Soap oil	- as reqd.

PROCEDURE

TASK 1 : **Remove the wheel assembly (Fig 1 & 2)**

1 Place the vehicle on stand.

2 Unscrew the speedometer cable and remove it.

3 Loosen and remove the brake assembly adjuster nut.

4 Remove the dust cap, washers and spring.

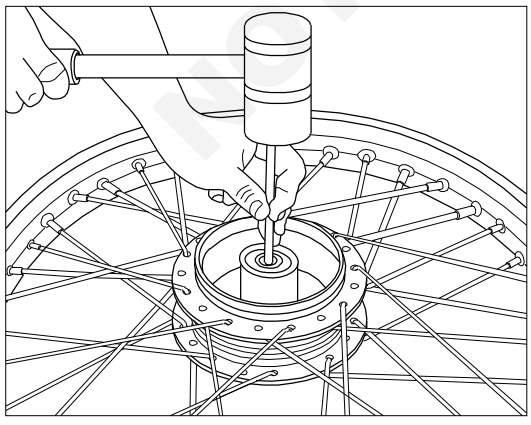
5 Pull out the front brake cable from the brake cam lever.

6 Hold the front axle head with a spanner and loosen and remove the axle nut which is in another side.

7 Remove the front axle.

8 Remove the spacers with washers.

Fig 1



MT20N1770H1

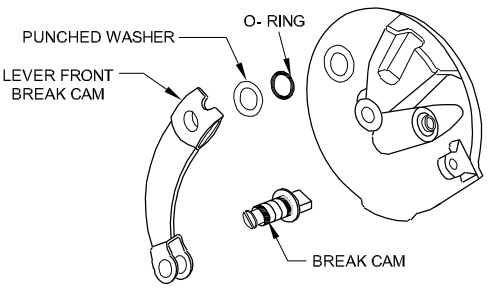
During this operation, hold the front wheel firmly.

9 Remove the front wheel assembly with brake panel assembly.

10 Separate the brake panel assembly from the front wheel.

11 Heat the hub for few minutes.

Fig 2



MT20N1770H2

12 Remove the bearings from both the sides of the wheel by a bearing puller. (Fig 3)

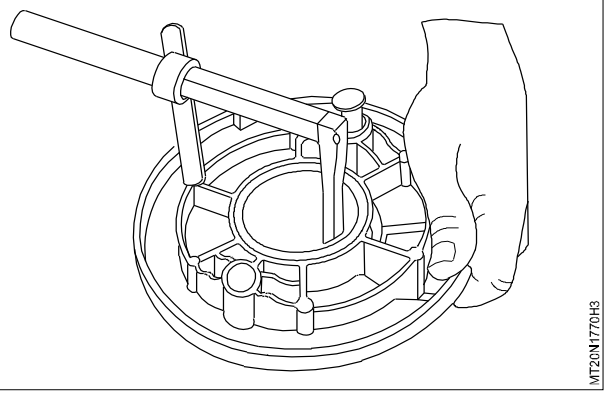
13 Flip the shoes inwards and remove the brake shoe set from the brake panel.

14 Loosen and remove the bolt and nut from the cam lever.

15 Separate the cam lever, washer, O ring and cam.

16 Remove the oil seal from the brake panel.

Fig 3



MT20N1770H3

17 Remove the screw from the speedometer gear assembly and take out the speedometer gear, pinion and washers.

TASK 2 : **Inspecting The Front Wheel Assembly (Fig 1)**

1 Clean all the front wheel assembly components with cleaning solvent, dry it and lubricate the parts where ever necessary.

2 Inspect visually the brake shoe for glaze.

3 Remove the glaze from the shoe.

4 Place the emery paper on the table and hold it firmly with one hand.

5 Take the shoe and rub it against the emery paper without affecting its curvature.

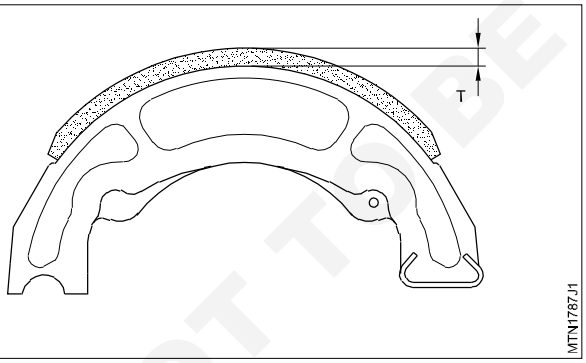
6 Measure the thickness of the brake lining.

Thickness of the brake lining: 15 mm.

Service limit: 17 mm.

Condition of the brake lining: not OK.

Fig 1



MTN1787J1

7 Replace the brake shoe if it is not with in the limit.

8 Inspect visually the brake drum for scratches or scoring.

Heavily scored brake drum should be replaced.

9 Polish the drum with emery paper.

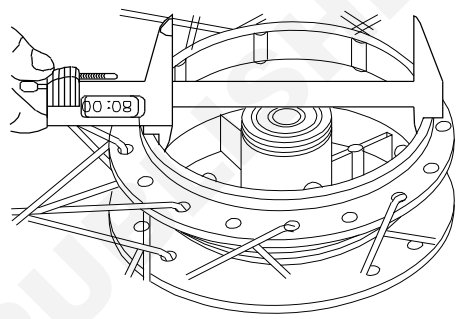
10 Measure the diameter of the brake drum. (Fig 2)

Condition of the brake drum: not OK.

Replace the brake drum if found not OK.

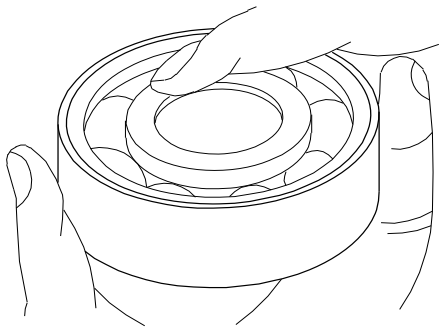
11 Inspect the play of the bearings. (Fig 3)

Fig 2



MTN1787J2

Fig 3



MTN1787J3

12 Check the bearings for abnormal noise or sticky rotation if need replace the bearings

13 Check the run out of the axle shaft (Fig 4)

Condition of the axle shaft: OK/not OK.

14 Replace if necessary.

15 Check the run out of the wheel rim.

If run out is more than the limit, tighten the spokes.

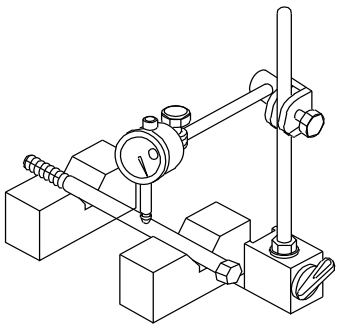
16 Check the tyre tread depth.

Condition of the tyre: OK/not OK.

Replace the tyre if found not OK.

17 Inflate the tyre to correct pressure.

Fig 4



MTN1787.J4

TASK 3 : **Reassembling the front wheel assembly (Fig 1)**

1 Assemble the speedometer gear and pinion and lock it with a screw.

2 Assemble the brake panel assembly.

3 Install the bearings and oil seals.

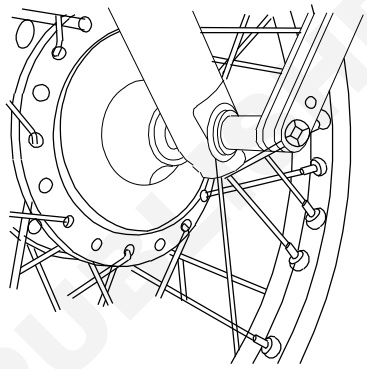
Before assembling, apply grease on the bearings.

4 Place the front wheel and insert the axle with spacers and washers.

5 Tighten the axle shaft nut with torque wrench. (Fig 1)

6 Rotate the wheel and check its performance.

Fig 1



MTN1787.J5

Practice on servicing of rear wheel assembly

Objectives: At the end of this exercise you will be able to
- **remove the rear wheel assembly**
- **inspect the rear wheel assembly**
- **reassemble rear wheel assembly**
- **adjust the free play of brake pedal**
- **check brake wear.**

Requirements

Tools / Instruments

• Tacho meter	- 1 No.
• Steel rule	- 1 No.
• D.E. spanner set	- 1 No.
• Ring spanner set	- 1 No.
• Tubular spanner set	- 1 No.
• Nose plier	- 1 No.
• Hot plate	- 1 No.
• Bearing puller	- 1 No.
• Oil seal remover	- 1 No.
• Vernier caliper	- 1 No.
• Dial gauge with magnetic base	- 1 No.
• V block	- 1 No
• Vacuum cleaner	- 1 No
• Spokes nipple wrench if necessary	- 1 No
• Tyre wear indicator	- 1 No
• Tyre pressure gauge	- 1 No

Equipment / Machinery

• Motor cycle	- 1 No
• Two wheeler lift	- 1 No

Materials / components

• Cleaning solvent	- as reqd.
• Soap oil	- as reqd.
• Cotton waste	- as reqd

TASK 1 : **Removing wheel assembly (Fig 1 to 3)**

1 Place the vehicle on lift.

2 Remove the rear wheel mounting nut

3 Loosen the brake adjusting nut and remove it.

4 Remove the brake rod/cable from the brake cam lever.

5 Takeaway the brake adjuster and washer from the brake rod.

6 Loosen the stay rod bolt; remove the stay rod from the brake panel (rear wheel).

7 Hang the stay rod with the swing arm by a rope (rear wheel)

Do not leave the stay rod free. Sometimes the stay rod will bend while contacting with the ground

8 Hold the wheel centre bolt head by a spanner or screw driver and loosen the wheel nut.

9 Remove the wheel nut and pullout the centre bolt.

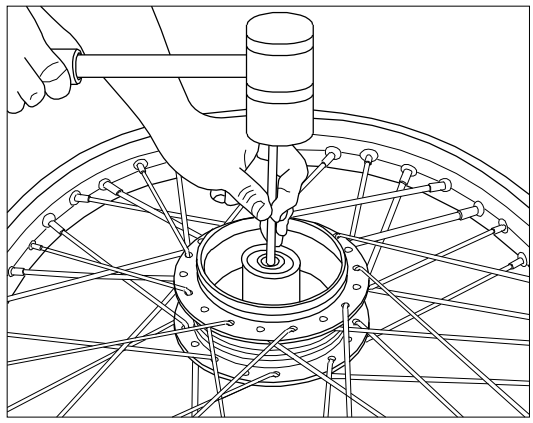
10 Remove the spacer.

11 Slightly tilt the vehicle and remove the wheel assembly from the vehicle.

12 Remove the panel assembly from the wheel.

13 Remove the cushioning rubber (rear wheel)

Fig 1



MT20N1771H1

14 Remove the brake shoe assembly from the brake panel.

15 Loosen and remove the bolt and nut from the cam lever.

16 Remove the oil seal from the brake panel.Remove the bearings from both the sides of the wheel by a bearing puller.

17 Flip the shoes inwards and remove the brake shoe set from the brake panel.

18 Loosen and remove the bolt and nut from the cam lever.

19 Separate the cam lever, washer, O ring and cam.

20 Remove the oil seal from the brake panel.

Fig 2

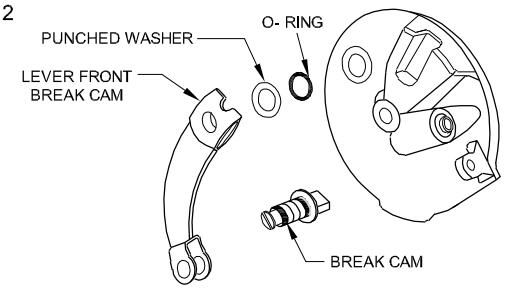
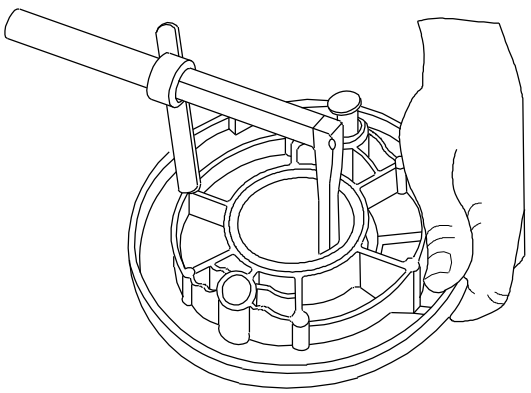


Fig 3



TASK 2 : **Inspecting wheel assembly (Fig 1 to 4)**

1 Clean all the rear wheel assembly components with cleaning solvent, dry it and lubricate the parts where ever necessary.

2 Inspect visually the brake shoe for glaze.

3 Remove the glaze of the shoe by engine paper

4 rub the brake shoe against the emery paper without affecting its curvature.

6 Measure the thickness of the brake lining.

8 Replace the brake shoe if it is not with in the limit.

9 Visually Inspect the brake drum for scratches or scoring. Heavily scored brake drum should be replaced.

10 Polish the drum with emery paper.

11 Measure the diameter of the brake drum.

12 Replace the brake drum if found not OK.

Inspect the play of the bearings.

13 Check the bearings for abnormal noise or sticky rotation.

14 Check the run out of the axle shaft if need replace it.

15 Replace the wheel bearing if necessary.

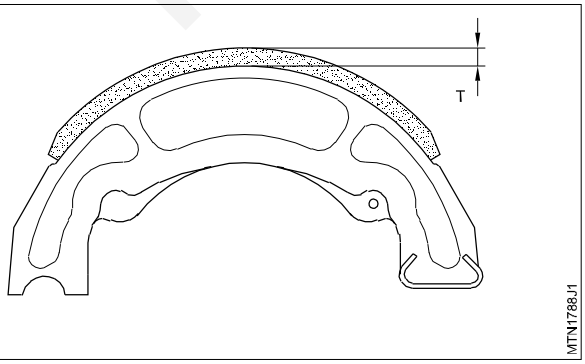
16 Check the run out of the rear wheel rim.

17 If run out is more than the limit, tighten the spokes.

18 Check the tyre tread depth.

19 Replace the tyre if found tyre wornout.

Fig 1



20 Inflate the tyre to correct pressure.

21 Check the hub cushioning rubber for wear (rear wheel).

Fig 2

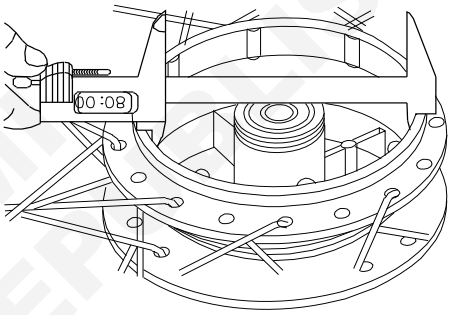


Fig 3

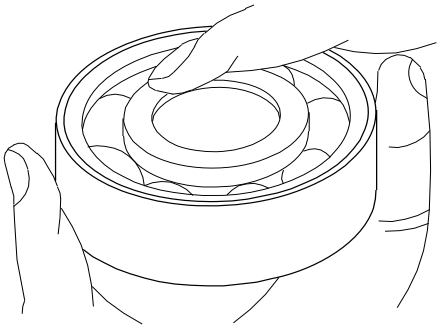
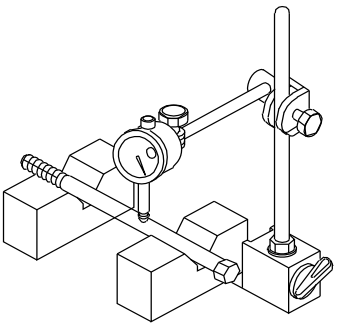


Fig 4



TASK 3: **Reassembling the wheel assembly**

1 Place the brake panel on the table.

2 Lubricate the brake cam lever with the grease and position it into the brake panel.

3 Connect the springs on the brake shoes and fix the brake shoes in the brake panel.

4 Place the o ring in the rear side the brake cam lever on the brake panel.

5 Fix the bearings in the wheel.

6 Place the cushioning rubber.

7 Place the brake panel assembly on the rear wheel.

8 Assemble the rear wheel assembly on the vehicle.

9 Place the spacer correctly.

10 Insert the centre bolt and tighten it with the specified torque.

11 Position the stay rod and bolt it (rear wheel).

12 Rearrange the spring and washer on the brake rod and fix it with the brake adjuster on the cam lever.

13 Adjust the brake pedal free play as per specified.

14 Adjust the rear wheel drive chain.

15 Ensure all parts are properly manual.

— — — — — — — — — —

Practice on dismantling and repairing of tube and tyre

Objectives: At the end of this exercise you will be able to
- **remove the tyre and tube for checking annexure.**
- **check puncture tyre.**
- **repair puncture tyre.**
- **reassemble tyre.**

Requirements

Tools/Instruments

• Trainee's tool kit	- 1 No.
• Spanner set	- 1 No.
• Scraper	- 1 No.
• Stitching tool	- 1 No.

Equipment / Machinery

• Air Compressor	- 1 No.
• Tyre changer	- 1 No.
• Two wheeler	- 1 No.

Materials/components

• Soap water mixture	- as reqd.
• Vulgarising paste	- as reqd.
• Mushroom patch	- as reqd.
• Tyre beading paste	- as reqd.
• Soap oil	- as reqd.
• Cotton waste	- as reqd.

PROCEDURE

TASK 1 : **Checking puncture of tubeless tyre**

1 Remove the tyre from the vehicle.

2 Check and remove any nail present in the tyre.

3 Inflate air up to recommended pressure.

4 Pour soap-water mixture on the tyre and check any leakages in the tyre.

5 Mark the punctured surface with chalk piece.

6 Confirm again any leakages present in the tyre.

7 Remove air from the tyre.

8 Remove the tyre from the rim.

— — — — — — — — —

TASK 2 : **Repairing the puncture tyre**

1 Clean the inner surface of the tyre.

2 Check and remove any nail present in the inner portion of the tyre.

3 Drill the punctured hole with 6 mm drill bit.

4 Rub the inner side of the punctured portion with scarper.

5 Apply paste on the inner portion of the tyre punctured hole and the surface of the mushroom head.

6 Wait for few minutes and place the mushroom head from the inner side of the tyre.

7 Confirm the needle portion of the mushroom ejects on the tye outside.

8 Pull the needle portion of the mushroom with combination plier fully and cut the extended portion.

9 Roll the mushroom with the stitching tool.

— — — — — — — — —

TASK 3 : **Reassembling the tyre**

1 Place the rim on the tyre changer

2 Apply tyre beading paste on the rim.

3 Fix the tyre on the rim.

4 Fix the air valve.

5 Remove the tyre from the tyre changer.

6 Inflate the air as per the standard.

— — — — — — — — —

TASK 4 : **Remove the tyre and tube for checking puncture**

1 Park the vehicle on the shop floor

2 Dismount the brakes linkages and other connections with wheel

3 Loosen the wheel axle shaft mounting nut

4 Remove the axle shaft and remove the brake shred back

5 Tilt the vehicle and remove the wheel from the vehicle

6 Place the wheel on punctured area

7 Remove the value from the tube

8 Remove the tyre and tube with help of tyre changer or tyre lover

9 Chock the tyre inside nail or any other sharp itemd tail with tyre.

10 Remove the nails with tyre.

11 Remove the tube and fix the valve tube.

12 Inflate the tube with compressed air.

13 Apply soap water on the tube and find the location of puncture on the tube.

14 Mark the puncture spot by marker

15 Rub the punctured spot by emery sheet and clean it.

16 Apply the rubber solution on the tube and allow it dry for few minutes

17 Fix the puncture patch on the punctured spot

18 Hit the patch by soft hammer

19 In flake the tube and again check the air leaks from tube

20 If there is no air leak, remove the air and clean the tube outside.

21 Apply branch chalk powder inside of the type and fix the tube inside of the tyre.

— — — — — — — — —

Check and analyze the tyre wear pattern

Objective: At the end of this exercise you will be able to
- **check the tyre wear and its causes.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Tyre changer - 1 No.
- Bearing puller - 1 No.

Equipment / Machinery

- Two wheeler - 1 No.

Materials / components

- Hub greases - as reqd.
- Cotton waste - as reqd.
- Soap oil - as reqd.
- Wheel bearing - as reqd.
- Oil seal - as reqd.
- Wheel nut - as reqd.

PROCEDURE

1 Check air pressure in the tyre.

2 Inspect Tyre Wear (Fig 1) shows the various types of tyre wear in a vehicle.

3 Tool wear - a feathered wear pattern across both front tyres. and sometimes shoulder wear on the inner or outer edge of both tyres.

4 Camber wear - uneven wear on one side of a tyre may show up when control arm bushings have collapsed.

5 Cupped wear - This may be the result of bodly worn shocks or struts, or wheel and tyre imbalance

6 Unbalanced right and left tyre wear, size difference.

7 Tyres with low pressure will wear both outer edges. Over inflation will wear the center of the tyres.

8 Tyre size and make, if different can cause a vehicle with accurate wheel alignment to have a directional pull or non - centered steering wheel. If tyre sizes match but brands and tread design differ, measure each tyre individually.

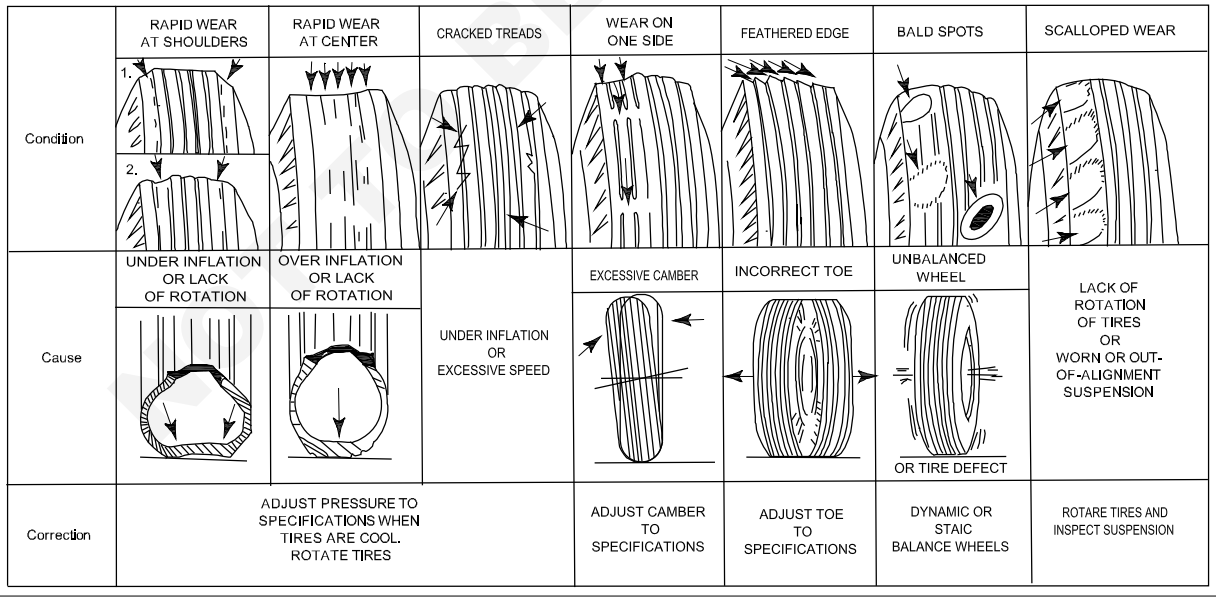
9 Tyre run - out.

10 Check the wheel bearings if need replace the bearings

11 Check the all wheel hub greater if need replace it.

12 Replace the damaged tyre's with new one.

Fig 1



Adjust front and rear brake lever free play

Objective: At the end of this exercise you will be able to
- **adjust brake lever free play.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Steel rule - 1 No.
- Tubular spanner set - 1 No.
- Nose plier - 1 No.
- Hot plate - 1 No.
- Vacuum cleaner - 1 No.
- Spokes nipple wrench - 1 No.
- Tyre wear indicator - 1 No.
- Tyre pressure gauge - 1 No.

Equipment / Machinery

- Motor cycle - 1 No.
- Two wheeler lift - 1 No.

Materials / components

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

Clean the hub thoroughly to avoid the dust entering in to the bearing.
Rotate the wheel by hand and check the free rotation of the wheel and for any bearing noise.

PROCEDURE

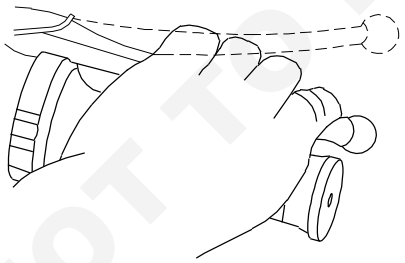
TASK 1: **Adjusting Brake Lever Free Play (Fig 1 to 4)**

1 Before applying the brake, rotate the wheel by hand and check the free rotation of the wheel.

2 Rotate the wheel and apply the brake simultaneously and find when the wheel stops.

3 Measure the distance between the original position of the lever and the position where the wheel stops.

Fig 1

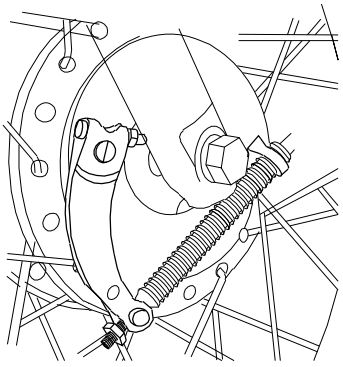


4 If the free play of the lever is not matches with the specified limit given by the manufacturer, then adjust.

5 Turn the brake cable adjuster nut inwards or out wards till correct level is obtained.

6 After adjusting the free play, check the wear of the brake shoe.

Fig 2

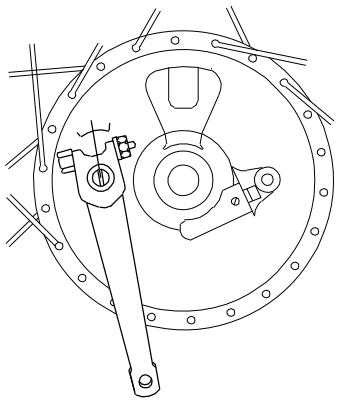


Wear indicator mark is provided in the wheel assembly to identify the wear level of brake shoe

7 Brake wear indicator has provided in the brake panel. (Fig 3)

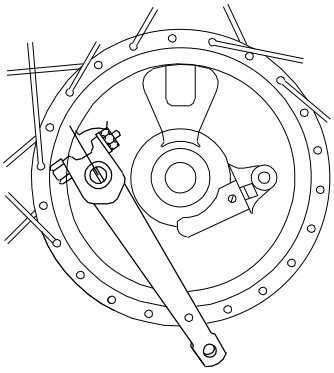
8 Apply brake and check the wear indicator mark shows within the specified limit or not. If not brake shoe and brake drum has to be checked and if need replace the brake shoe and drum.

Fig 3



MTN1791H3

Fig 4



MTN1791H4

Servicing of disc brake assembly

Objectives: At the end of this exercise you will be able to
- **remove the disc brake parts.**
- **inspect the disc brake parts.**
- **reassemble the disc brake parts.**
- **bleed the brake system.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Flat head screw driver - 1 No.
- Out side Micrometer - 1 No.

Equipment / Machinery

- Air compressor - 1 No.
- Two wheeler - 1 No.

Materials / components

- Brake fluid - as reqd.
- Soap oil - as reqd.
- Brake pod - as reqd.
- Caliper unit - as reqd.
- Cotton waste - as reqd.

PROCEDURE

TASK 1: **Removing disc brake parts (Fig 1 to 3)**

A Caliper assembly

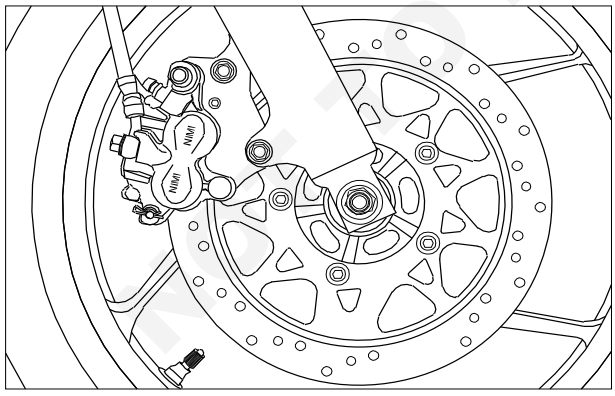
1 Unscrew the bleeder screw and bleed the brake oil in the system.

2 Remove the banjo bolt and take out the brake pipeline from the caliper assembly.

3 Loosen and remove the mounting bolts from the caliper assembly and take out the caliper assembly.

4 Remove the plug pin from the caliper body.

Fig 1



5 Remove the pin hangers.

6 Remove the inner and outer pad from the caliper body.

7 Remove the spring pad and bracket.

8 Remove the boots from the assembly.

9 Remove the pistons by apply compressed air and take it out.

10 Remove seals from the assembly.

11 Remove the bleeder screw.

Fig 2

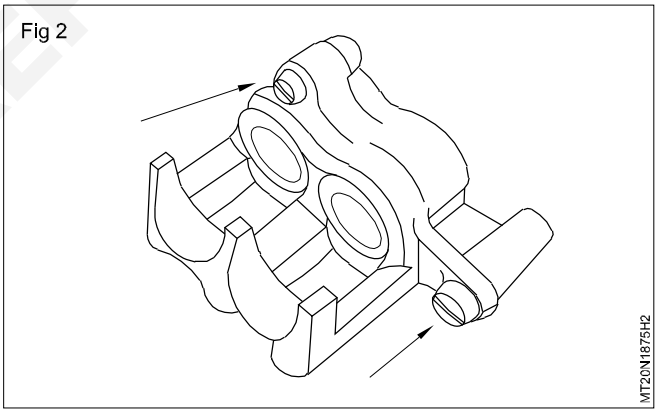
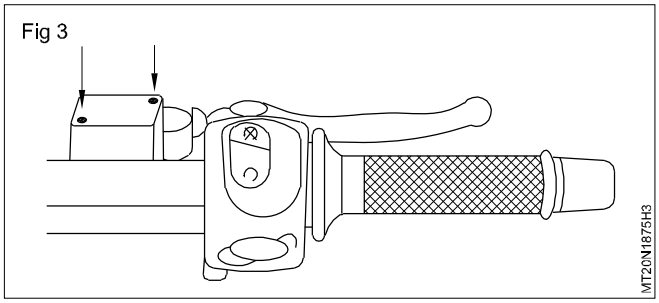


Fig 3



B Master cylinder

12 Loosen and remove the banjo bolts and remove the brake pipeline from the master cylinder.

13 Unscrew and remove the reservoir cap.

14 Take out the diaphragm.

15 Remove the brake lever.

16 Loosen and remove the blots and take out the master cylinder.

17 Remove the stop light switch from the brake lever.

18 Remove the boot from the master cylinder.

19 Remove the circlip.

20 Press the piston out slowly.

— — — — — — — —

TASK 2 : **Inspecting the disc brake assembly parts (Fig 1 & 2)**

1 Clean all the parts before inspection.

2 Visually inspect the caliper parts for

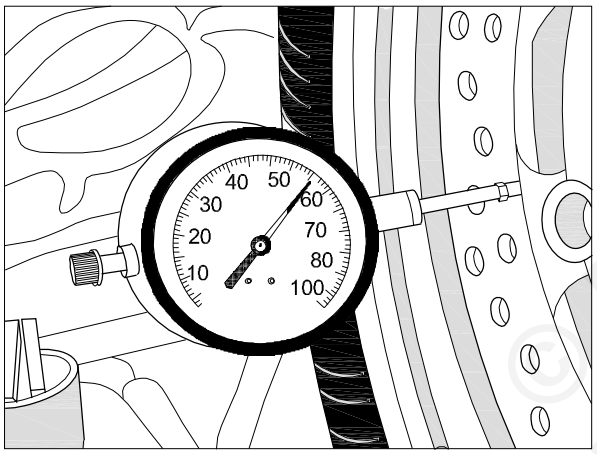
- Caliper bore for scratches.
- Piston for scratches.
- Pin for bend.

A Disc plate

3 Measure the disc surface flatness with dial gauge.

4 Measure the thickness of the disc.

Fig 1



B Master cylinder

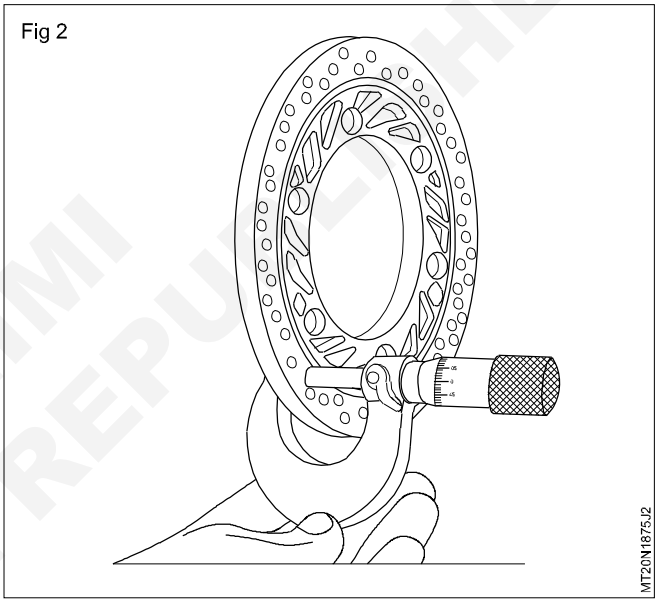
5 Clean the master cylinder with compressed air to remove blockages.

Clean with brake fluid only.

6 Visually inspect the master cylinder parts for

- Master cylinder bore for scratches.
- Pistin and cup for scratches.

Fig 2



— — — — — — — —

TASK 3 : **Reassembling the disc brake parts**

a Master cylinder

1 Assemble the piston and cap in the master cylinder and place the circlip to lock.

2 Fix the diaphragm on the reservoir.

3 Fix the stop light switch in the reservoir.

4 Remount the master cylinder.

5 Fix the brake pipeline on the master cylinder and tighten the banjo bolt.

b Caliper

1 Install the pistons on the caliper assembly.

2 Fix the bracket and place the pads.

3 Insert the plug pins.

4 Mount the caliper on its place and blot it,

5 Connect the brake pipeline with the caliper assembly.

— — — — — — — —

TASK 4 : **Bleeding the brake system (Fig 1)**

1 Remove the bleeder cap and attach the bleeder tube.

2 Submerge the other end of the tube in the container filled with brake fluid.

3 Operate the front brake lever for pumping fluid

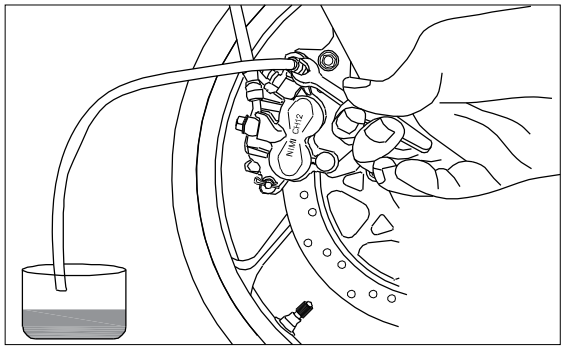
4 Ensure complete air is removed from the brake system

5 Lock and tighten the bleeding nipple and remove the fluid hose with container

6 Top-up fluid in master cylinder

7 Adjust the brake free play and check the brake efficiency.

Fig 1



Practice on inspection of brake shoe and wheel drum

Objectives: At the end of this exercise you will be able to
- **remove the replace new lining**
- **replace the brake linings.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Flat head drift - 1 No.
- Feeler gauge - 1 No.
- C-clamp - 1 No.
- Flat file - 1 No.

Equipment / Machinery

- Bench vice - 1 No.
- Two wheeler - 1 No.

Materials / components

- Brake liner (As per specification) - as reqd.
- Emery paper - as reqd.
- Rivets - as reqd.
- Cotton waste - as reqd.

PROCEDURE

1 Park the vehicle on the shop floor

2 Remove the wheel and brake shoe

3 Inspect the brake shoe and lining for wear.

4 Drill the old rivets

5 File off burrs and high spots

6 Remove the old lining

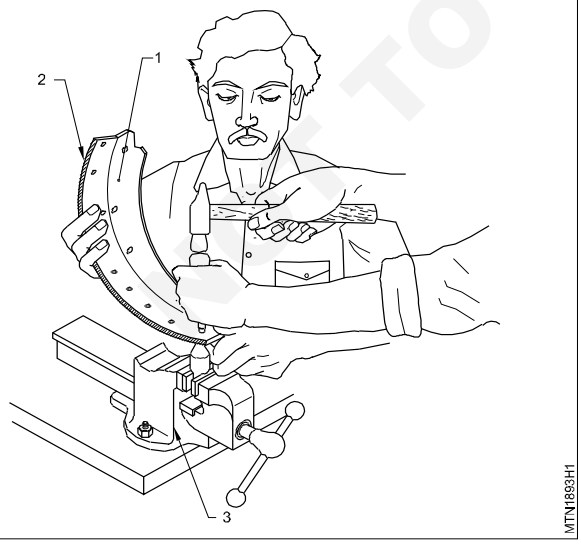
7 Select the correct size of the brake lining according to the size of the drum.

8 Select rivets according to the hole size.

9 Clean the contact surfaces of the shoe and lining

10 Align the rivet holes on the brake lining with the brake shoe

Fig 1

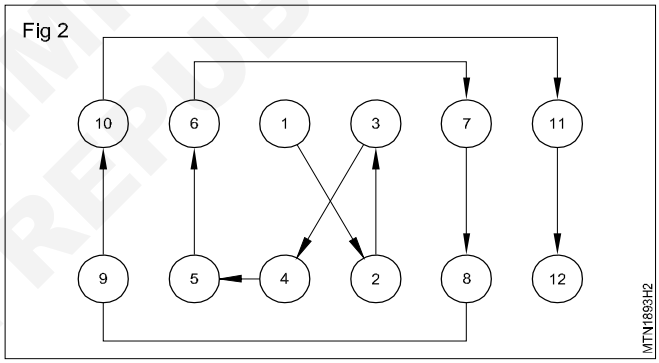


11 Clamp the linings (2) to the brake shoe (1) with 'C' clamps in the vice (3). (Fig 1)

12 Adjust the 'C' clamps as close as possible to the rivet holes.

13 Start riveting from the center towards the ends (or as per manufacturer's specification. (Fig 2)

Fig 2

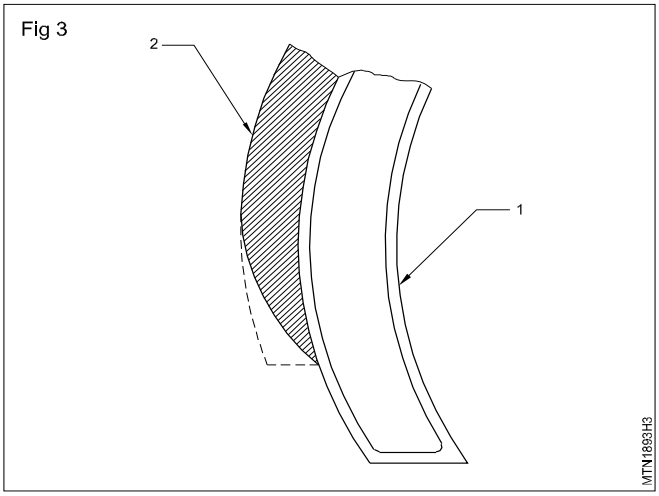


14 Drive the rivets squarely into the holes with a flat head drift

15 After riveting check the clearance between the lining and the shoe with a feeler gauge. Measure the clearance in between the rivets.

16 File the lining (2) at both ends to have smooth curve ends. (Fig 3)

Fig 3



Adjust clutch lever free play

Objective: At the end of this exercise you shall be able to
- **adjust clutch lever free play.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Nose plier - 1 No.
- Vernier caliper - 1 No.

Equipment / Machinery

- Running motor cycle - 1 No.

Materials / components

- Petrol - as reqd.
- Cotton waste - as reqd.
- Soap oil - as reqd.
- Clutch pate - as reqd.

PROCEDURE

1 Measure the free play at the clutch lever end before the clutch begins to disengage.

- The free play should be 10-15mm.

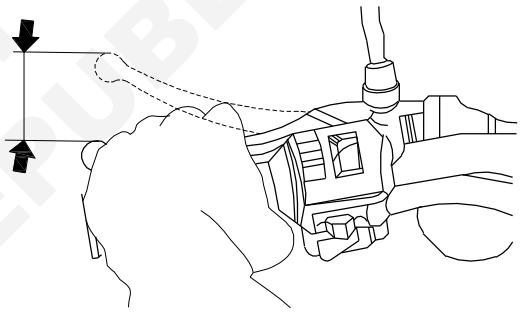
2 Loosen the lock nut near the clutch housing and turn the adjusting nut till the specified play is obtained.After adjustment, lock the lock nut.

3 After the clutch cable free play adjustment gear is not properly engaged means clutch plate is wornout

4 Disconnect the clutch cable

5 Drain the engine oil. (Fig 1)

Fig 1



Check clutch cable for correct routing. If Clutch cable in damaged replace it

Practice on replacing the defective parts of two wheeler clutch assembly

Objectives: At the end of this exercise you shall be able to
- **dismantle multi plate clutch assembly**
- **inspect multi plate clutch assembly**
- **reassemble multi plate clutch assembly**
- **adjust clutch lever free play.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Nose plier - 1 No.
- Vernier Caliper - 1 No.
- Feeler gauge - 1 No.
- puller - 1 No.

Equipment / Machinery

- Two wheeler - 1 No.
- Valve spring tester - 1 No.
- Compressor - 1 No.

Materials / components

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

PROCEDURE

TASK 1: **Dismantle multi plate clutch assembly (Fig 1)**

1 Drain oil from the engine.

2 Disconnect the clutch cable from the clutch housing by lifting the clutch arm.

3 Remove the kick starter lever from the housing.

4 Remove the clutch cover mounting bolts.

5 Remove the clutch cover and take out.

Place the oil pan under the clutch cover to collect the oil in the clutch assembly. Because oil in the clutch assembly will come out. This quantity of oil is also being considered while measuring the drained oil.

6 Collect the clutch release adaptor and ball if available from the cover assembly.

7 Remove the bolts from the clutch release plate by uniform loosening and tightening to avoid uneven loading of plates.

8 Take out the clutch springs.

9 Remove the clutch shaft nut with the clutch holding and nut tightening tool.

10 Take out the spring disc.

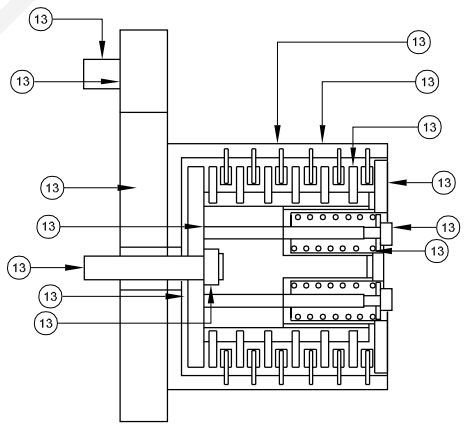
11 Pull out the pressure and clutch plates. (Fig 3)

12 Separate the clutch hub, discs and plates and place it in a sequence as shown in Fig 2.

13 Remove the cup, split washers and shim from the shaft.

14 Take out the primary gear driven component.

Fig 1



1. CRANKSHAFT
2.PRIMARY DRIVER GEAR
3.PRIMARY DRIVEN GEAR
4.CLUTCH HOUSING
5.FRICTION PLATE
6.CLUTCH PLATE
7.CLUTCH BOSS
8.PRESSURE PLATE
9.CLUTCH SPRING
10.LOCKING BOLT AND WASHER
11.OUTPUT SHAFT
12.THRUST WASHER
13.LOCKING NUT

CONSTRUCTION OF MULTIPLATE CLUTCH

MTN1995H1

Fig 3

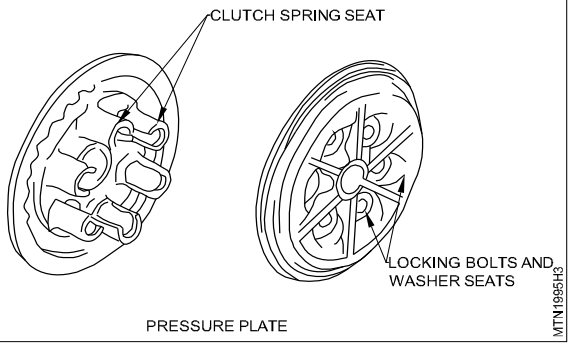
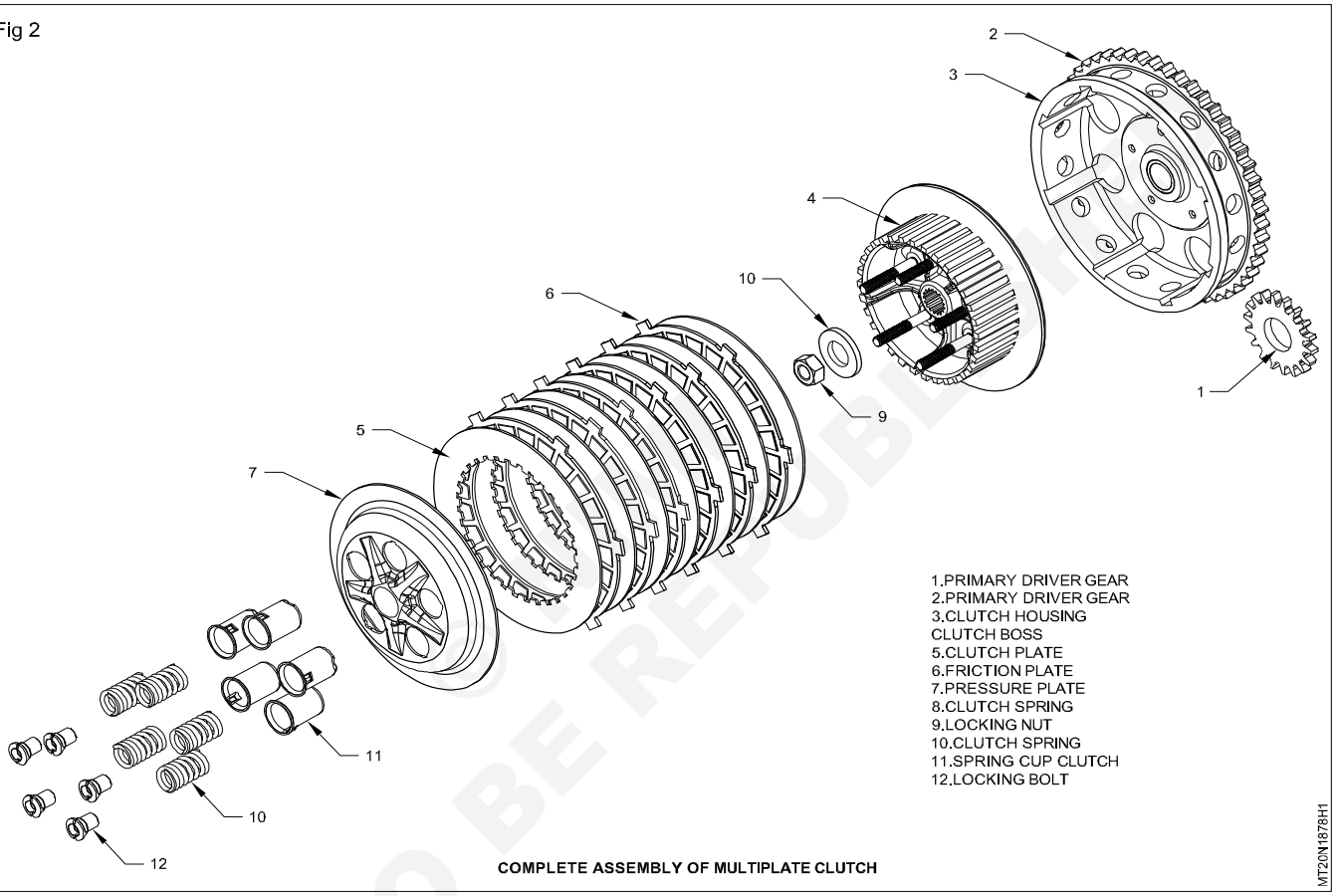


Fig 2



— — — — — — — — —

TASK 2 : **Inspect multi plate clutch assembly**

A Visual inspection

1 Check the clutch plates for burning due to low oil level, contaminated oil and excessive friction.

2 Inspect the primary gear driven for cuts. If found, replace it.

3 Inspect the clutch hub for wear, ridges or cuts. If found, replace it.

B Inspection by measuring (Fig 1)

1 Measure the clutch plate thickness and width by Vernier caliper.

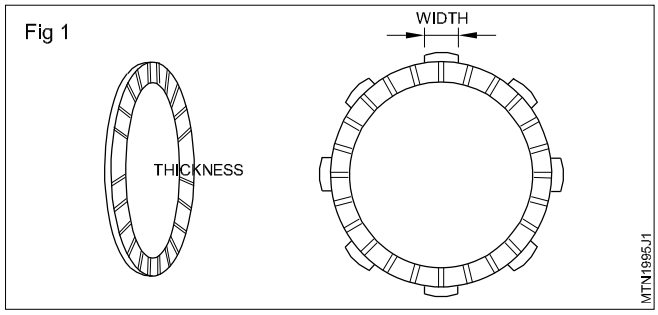
Thickness of the clutch plates: ___mm

Width of the clutch plates: ___mm

Service limit (by the manufacturer): thickness___mm, width___mm.

Condition of the clutch plates: OK/not OK.

Fig 1



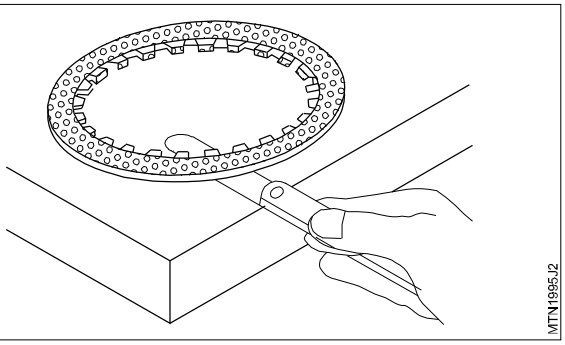
2 Measure the pressure plate for distortion (use feeler gauge):

Distortion level of pressure plates: ___mm, ___mm, ___mm, ___mm, ___mm

Service limit (by the manufacturers): ___mm.

Condition of the pressure plate: OK/not OK. (Fig 2)

Fig 2



3 Measure the free length of the spring by

Vernier caliper as in Fig.

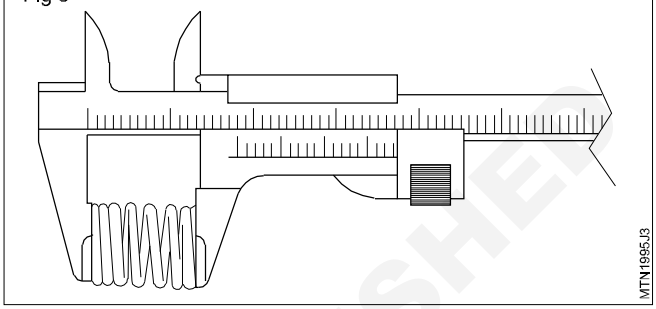
The free length of the spring: ___mm

Service limit: ___mm

Condition of the spring: OK/ not OK. (Fig 3)

Some of the manufacturer use springs with different grading colours. While replacing use the same colour.

Fig 3



— — — — — — — —

TASK 3 : **Replace the defective parts of clutch**

1 Check primary gear if need replace it.

2 Check the clutch hausing for damage, if found any damage replace it.

3 Check the clutch for damage, if need replace it.

4 Check the clutch and friction plate for wear if need replace it.

5 Check the pressure plate for damage, if need replace it.

6 Check the locking bolt and washer, locking nut, if found any damage on it replace it.

7 Check the out put shaft for damage if need replace it.

— — — — — — —

TASK 4 : **Assemble the clutch**

1 Fit the clutch boss and tighten by lock nut.

2 Fix the clutch plates and friction plates.

3 Fix the pressure plate and clutch spring, lock washer and tighten the lock nut.

4 Before fit the clutch assembly check condition of crank shaft and primary drive gear.

5 Fix the clutch hausing and fill the oil.

6 Connect the clutch cable and adjust clutch free play as you need.

7 Inspect the clutch cable and clutch lever if found any damage replace it.

— — — — — — — —

Inspect and repair work of two and three wheeler automatic transmission system

Objectives: At the end of this exercise you will be able to
- **remove variable transmission assembly**
- **disassembly of clutch**
- **inspect variable transmission parts**
- **reassemble the variable transmission.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- D.E. spanner set - 1 No.
- Ring spanner set - 1 No.
- Philips head screw driver - 1 No.
- Fixed drive holder - 1 No.
- Magneto assembly holder - 1 No.
- Clutch holder - 1 No.
- Clutch tool assembly - 1 No.
- Vernier caliper - 1 No.

Equipment / Machinery

- Two wheeler with variable transmission - 1 No.
- Two wheeler lift - 1 No.

Materials / components

- Banyan waste - as reqd.
- Soap oil - as reqd.
- Engine oil - as reqd.
- Drive belt - as reqd.

PROCEDURE

TASK 1: **Removing variable transmission assembly of two wheeler (Figs 1 to 3)**

1 Part the two wheeler on the shop floor.

2 Lift the two wheeler by two wheeler lift.

3 Refer the two wheeler service manual for removing and refitting the automatic transmission system.

4 Remove the clutch cover.

5 Remove the driving pulley lock nut.

6 Remove the fix sheave.

7 Remove the trape zoidal belt.

8 Remove the sliding sleeve.

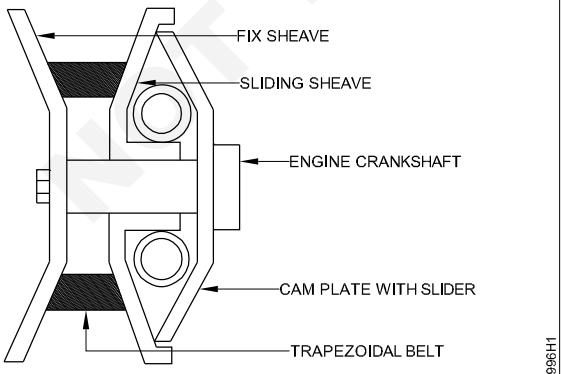
9 Remove the roller.

10 Remove the camplate with slider.

11 Remove thecompassion spring.

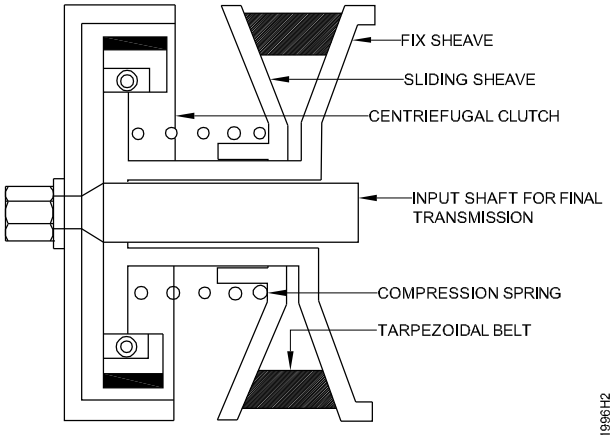
12 Remove the driver pulley and driven pulley.

Fig 1



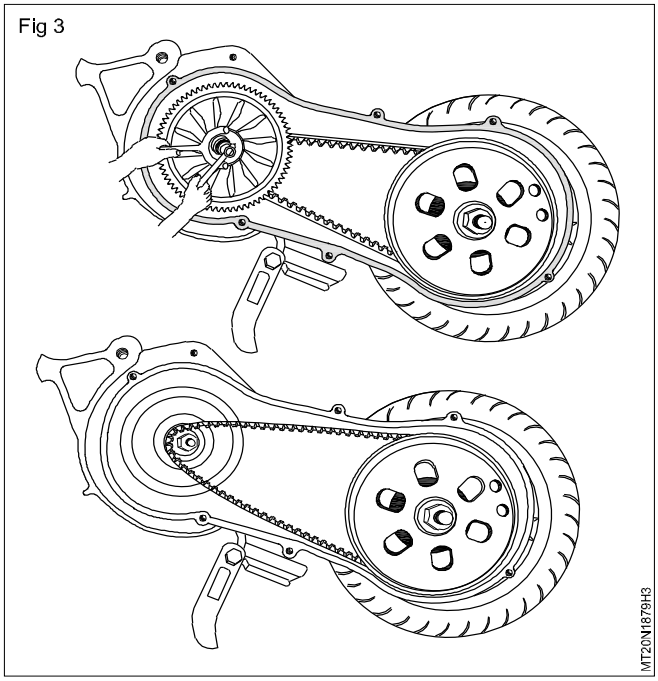
DRIVING PULLEY OF CVT

Fig 2



DRIVEN PULLEY OF CVT

Fig 3



TASK 2 : **Disassembly of clutch (Fig 1)**

1 Loosen the clutch shoe nut with the help of clutch holder.

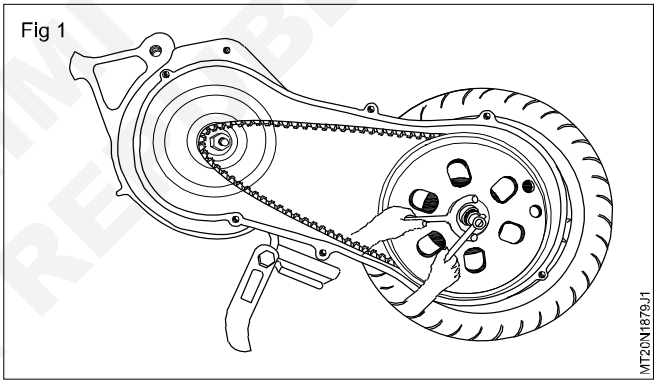
2 Place the clutch tool assembly on the clutch.

3 Remove the clutch shoe nut.

4 Take out the clutch with spring.

5 Take out the movable and fixed drive in the rear side.

Fig 1



TASK 3 : **Inspecting variable transmission parts (Fig 1)**

1 Measure the roller diameter.

Size of roller = ___mm

Service limit = ___mm

2 Check the flattening of roller.

Condition of the roller =___mm

3 Inspect the movable face for wear or damage.

4 Inspect the drive belt for cracks, wear or cuts.

5 Measure the width of the drive belt.

Width of the belt = ___mm

Service limit = ___mm

Condition of the belt =OK/not OK.

6 Inspect the clutch shoe for wear or damage.

Fig 1

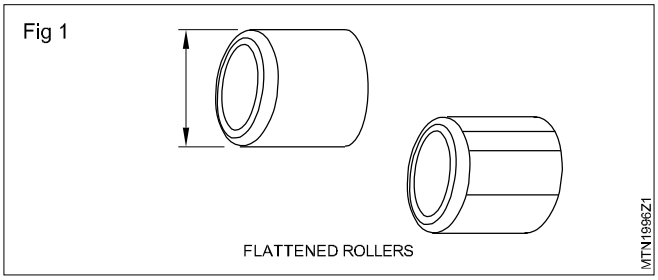
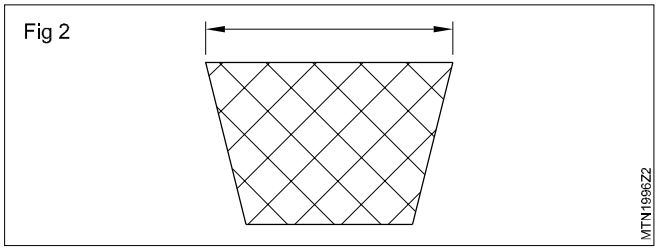


Fig 2



7 Measure the shoe thickness.

Thickness of the shoe =___mm

Service limit =___mm

Condition of the shoe = ___mm.

8 Inspect the clutch housing for wear or damage.

9 Measure the clutch housing.

Inner dia of the clutch housing = ___mm

Service limit =___mm

Condition of the clutch housing = OK / not OK.

— — — — — — — —

TASK 4 : **Reassembling the variable transmission**

1 Before assembling clean the movable and fixed face thoroughly.

2 Assemble the clutch assembly.

3 Place the v belt on the faces.

4 Place the rollers in the moving plate (front)with little grease and fix it.

5 Assemble fixed plate

6 Place the v belt properly on the two faces.

7 Fix the variator cover.

8 Fix the kick starter.

9 Assemble the starter on the crank case

— — — — — — — —

Practice on removal of crank shaft and replacing timing sprocket

Objectives: At the end of this exercise you will be able to
- **remove the crank shaft**
- **replace the timing sprocket.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Dial gauge/ feeler gauge - 1 No.
- Crank case split tool - 1 No.

Equipment / Machinery

- V - Block - 2 No.
- Crank shaft centring equipment - 1 No.
- Motor cycle engine - 1 No.

Materials / components

- Cotton - as reqd.
- Engine oil - as reqd.
- Kerosene - as reqd.
- Crank shaft - as reqd.

PROCEDURE

TASK 1: **Remove crank shaft assembly and timing sprocket**

1 Park the vehicle on repair shop.

2 Disconnect all the connections with engine.

3 Remove the rear wheel drive chain cover and chain.

4 Remove the engine mounting bolts.

5 Remove the engine from the vehicle.

6 Place the engine on work bench.

7 Drain the engine and gear oil.

8 Remove the tappet cover.

9 Remove the timing chain and timing sprocket.

10 Remove the cylinder head and cylinder bore.

11 Remove engine housing bolts.

12 Remove the clutch assembly.

13 Remove the magnets and coil assembly.

14 Remove the crank shaft from the engine housing.

15 Remove the piston and connecting rod.

16 Remove the crank shaft and timing sprocket.

17 Measure the connecting rod big end side play as shown in Fig 2.

18 Measure the connecting rod axial play.

19 Inspect the crank shaft crank pin and main journal of found any damage repair or replace the crank shaft. (Fig 3)

20 Inspect the timing chain, timing sprocket and crank web.

21 If found any damage or wearness replace parts.

Fig 1

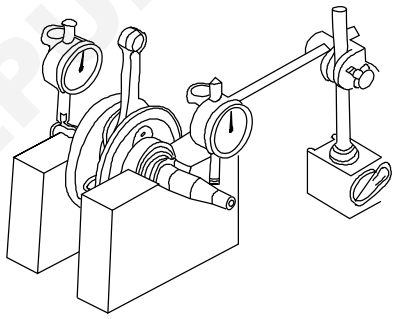


Fig 2

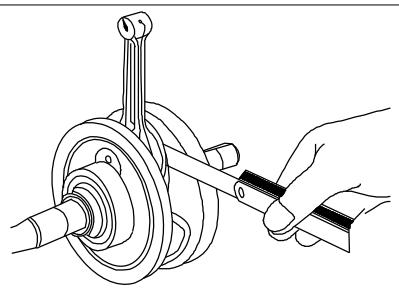
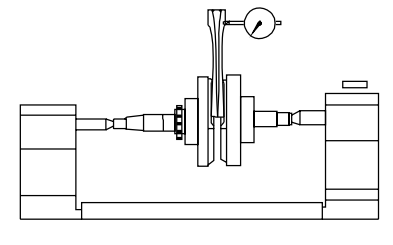


Fig 3



TASK 2 : **Assembling the crank shaft and timing sprocket**

1 Clean the all dismantled parts with clean cloth.

2 Fix the crank shaft bearing on engine housing.

3 Fix the piston and connecting rod on the crank shaft.

4 Fix the timing chain and fix the engine housing with crank shaft.

5 Tighten the bolts of engine bousing.

6 Ensure crank shaft and connecting rod rotate freely.

7 Fix the clutch housing and clutch assembly.

8 Fit the engine sprocket, cylinder bore, cylinder head.

9 Fit the timing sprocket and set the timing by connect the timing chaim.

10 Fix the cylinder head cover and set the timing by connect the timing chain.

11 Fix the engine on the vehicle and tighten the engine mounting bolts.

12 Fix the magnet assembly.

13 Fix the rear wheel drive chain and adjust the chain tension.

14 Fix the chain cover and connect the all engine connection.

15 Start the engine and check the engine performance.

— — — — — — — —

Practice on removing and refitting of kick starter assembly

Remove the kick starter inspect and assemble

Objectives: At the end of this exercise you shall be able to
- **dismantle the kick starter**
- **assembling the kick starter.**

Requirements

Tools / Instruments

• Trainees tool kit	- 1 No.
• Feeler gauge	- 1 No.

Equipment / Machinery

• Two wheeler	- 1 No.
• Motor gauge	- 1 No.
• Special puller	- 1 No.
• Two wheeler hoist/stand	- 1 No.
• Air compressor	- 1 No.

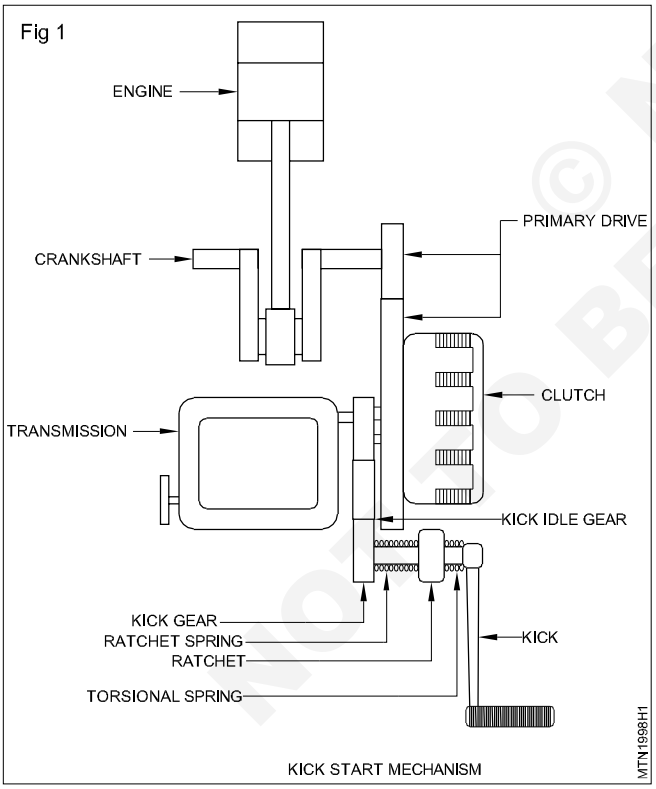
Materials / components

• Cotton waste	- as reqd.
• Engine oil	- as reqd.
• Kerosene	- as reqd.
• Oil seal	- as reqd.
• Bearings	- as reqd.
• packing	- as reqd.
• gasket	- as reqd.

PROCEDURE

TASK 1: **Removing the kick starter mechanism of two wheeler (Fig 1)**

Fig 1



KICK START MECHANISM

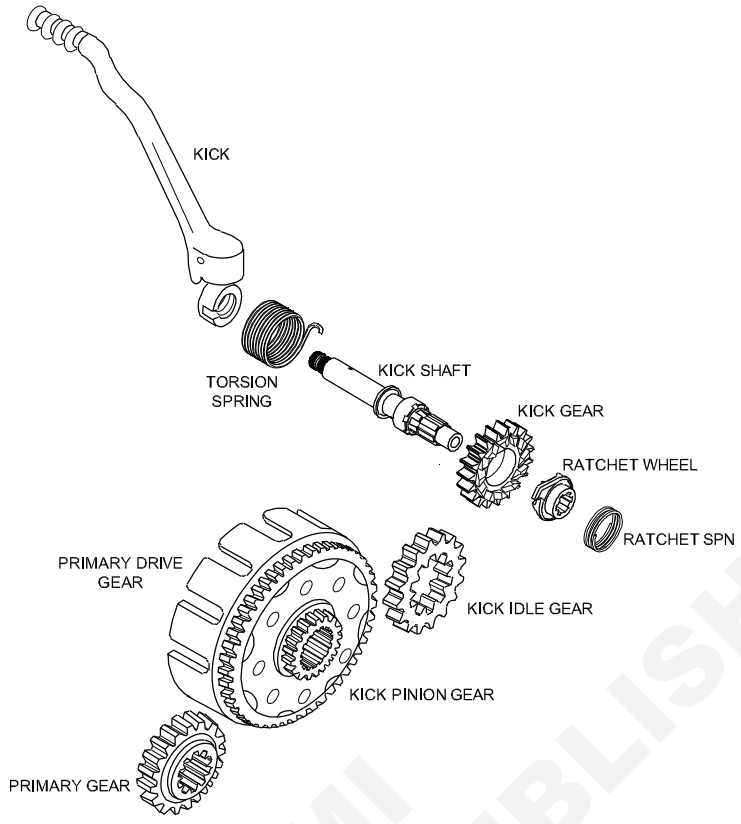
1 Loosen the kick liver mounting screw.
2 Remove the kick lever.
3 Remove the clutch assembly.
4 Remove the torsional spring.
5 Remove the ratchet.
6 Remove the ratchet spring.
7 Remove the kick gear.
8 Remove the kick idle gear.
9 Remove the kick.
10 Remove the primary drive and driven gear.

— — — — — — — —

TASK 2: **Cleaning and inspection of dismantled parts (Fig 1)**

1 Clean the all dismantled parts with cleaning solvent.
2 Inspect the all parts for damage or worn out.
3 Replace the damaged parts.

Fig 1



— — — — — — —

TASK 2: **Assembling the kick start mechanism**

1 Fix the primary drive and driven gear.

2 Fix the kick pinion gear.

3 Fix the kick idle gear.

4 Fix the kick gear.

5 Fix the ratchet spring.

6 Fix the ratchet.

7 Fix the torsional spring.

8 Fix the clutch assembly.

9 Fix the clutch cover assembly.

10 Fix the kick start lever and its lock nut.

— — — — — — — —

Servicing of gear box assembly

Objectives: At the end of this exercise you shall be able to
- **remove and dismantle the gear box**
- **inspect the gear box parts**
- **reassemble the gear box.**

Requirements

Tools / Instruments

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

Equipment / Machinery

- Two wheeler vehicle (motor cycle) - 1 No.
- Special puller - 1 No.
- Two wheeler hoist / Stand - 1 No.
- Air compressor - 1 No.

Materials / components

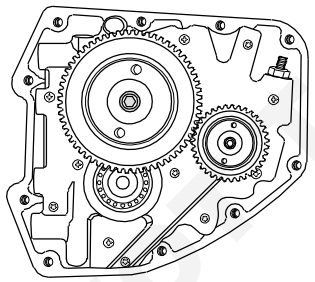
- Cotton waste - as reqd.
- Oil seal - as reqd.
- Kerosene - as reqd.
- Engine oil - 4T - as reqd.
- Bearings - as reqd.
- Packing - as reqd.
- Gasket - as reqd.

PROCEDURE

TASK 1: **Removing and dismantling the gear box parts (Fig 1)**

1 Remove the kick start lever
2 Housing & clutch bolts
3 Remove crank shaft sprocket
4 Remove primary drive gear
5 Remove crankshaft spacer
6 Remove gear shift mechanism
7 Remove the gear shift switch.
8 Remove the starter from the engine.
9 Remove the gear linkages which are in the right side of the crank case.
10 Remove the gear shift oil pump drive.
11 Loosen the screws and separate the crank case by using a special puller.
12 Take out the kick starter shaft and drive.
13 Remove the shift fork shaft.
14 Take out main gear shift forks.
15 Remove drive and counter shaft gear assembly.
16 Dismantle the gear parts from the shafts.
17 Pull out crank shaft assembly.
18 Remove the bearings from the crank case.
19 Remove the oil seals.

Fig 1



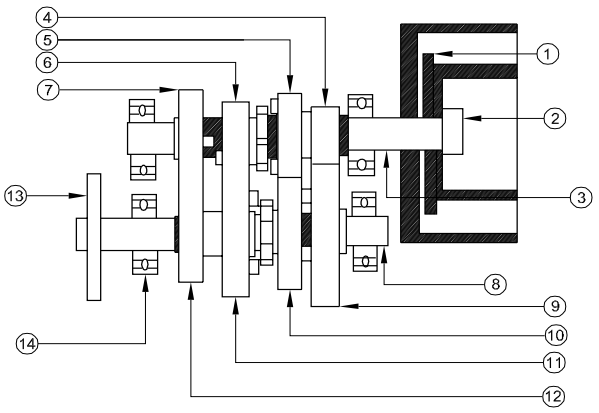
— — — — — — — —

TASK 2 : **Inspecting Gear Parts (Fig 2)**

A Visual Inspection

1 Clean all the dismantled parts
2 Inspect the gears for crack or breakage.
3 Inspect the shafts.
4 Inspect the gear changing dogs.
5 Inspect the kick starter parts.
6 Inspect the bearing washers, gr clips.
7 Inspect the fual drive sprocket.
8 Check clutch boss and locking nut.

Fig 1



1. CLUTCH BOSS
2. LOCKING NUT
3. MAIN SHAFT
4. 1ST GEAR - DRIVE (FIX)
5. 3RD GEAR - DRIVE (FREE)
6. 2ND GEAR - DRIVE WITH DOG (FIX)
7. 4TH GEAR - DRIVE (FREE)
8. COUNTER SHAFT
9. 1ST GEAR - DRIVEN (FREE)
10. 3RD GEAR - DRIVEN WITH DOG(FIX)
11. 2ND GEAR - DRIVEN (FREE)
12. 4TH GEAR - DRIVEN (FIX)
13. FINAL DRIVE SPROCKET
14. BEARINGS

MTN1999H1

SEQUENTIAL GEARBOX

b Measurement

Measure the clearances between fork and groove.

Clearance between fork and groove = ___mm

Service limit =___mm

Condition of the fork =OK/ not OK.

— — — — — — — —

TASK 3 : **Reassembling the gear box (Figs 1 & 2)**

1 Fit the oil seals and bearing on the crank case.

2 Fit the crank shaft on crank case.

3 Fit the crank case and tighten the crank case bolts.

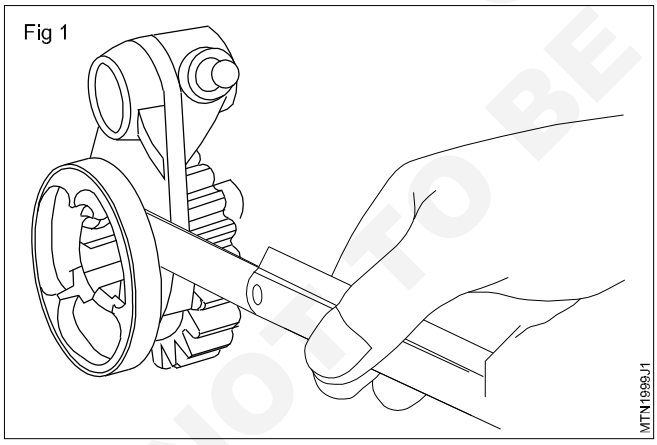
4 Ensure crank shaft is rotate freely.

5 Fit the clutch boss and its lock nuts.

6 Fit the gears on the main shaft and counter shaft.

7 Ensure gears are fixed properly.

Fig 1



MTN1999J1

8 Fit forks and gear shift mechanism.

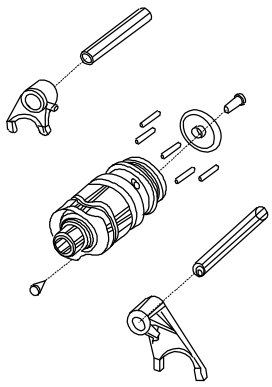
Before assembling, check the bolts are placed in the correct place.

9 Fit the clutch plates, pressure plate and clutch housing.

10 Fit the gear shift lever and clutch cable connection.

11 Operate the vehicle and ensure gears on functioning properly.

Fig 1



MTM199921

— — — — — — — —

Practice on dismantling and assembling of oil pump

Objectives: At the end of this exercise you will be able to
- **remove oil pump**
- **Clean and inspect the dismantled parts**
- **assemble the oil pump.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Fixed drive holder - 1 No.
- pump assembly tool - 1 No.

Equipment / Machinery

- Running motor cycle - 1 No.

Materials / components

- Cotton waste - as reqd.
- Oil - as reqd.
- Filter - as reqd.
- Casket set - as reqd.
- 'O' ring - as reqd.

PROCEDURE

1 Remove oil pump mounting pan screws.

2 Remove the dummy shaft.

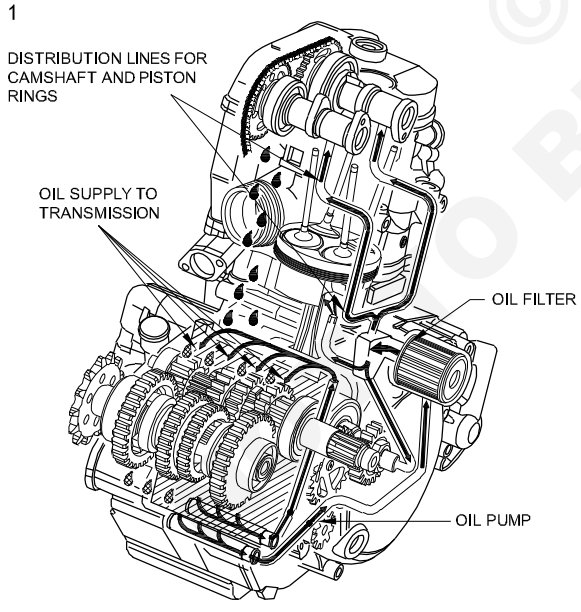
3 Remove the pump cover assembly.

4 Remove the washer and strainer.

5 Remove the rotary pump shaft.

6 Clean all the parts with kerosine.

Fig 1



7 Inspect the parts if damage replace.

8 Check the oil inner holes and clean with compressed air.

9 Refit the pump shaft.

10 Set the pump gears with marking and inset it.

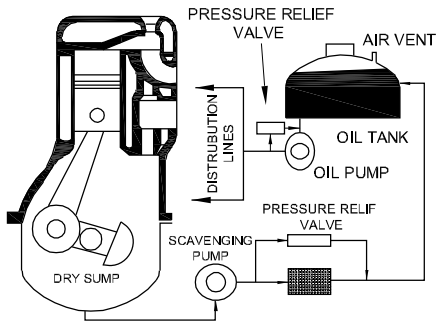
11 Rift the cover assembly, and fill the oil upto level mark.

12 (Use torque wrench with specified torque as per manual recommendation).

13 Start the engine and check the oil circulations and leakages from engine.

14 Ensure oil pump is working properly. (Fig 1 & 2)

Fig 2



DRY SUMP LUBRICATING SYSTEM

Practice on dismantling and assembling of gear shift linkage

Objectives: At the end of this exercise you will be able to
- **remove the gear shift linkage**
- **cleaning and inspect the gear shift linkage**
- **assembling the gear shift linkage.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Nose plier - 1 No.
- Circlip remover - 1 No.

Equipment / Machinery

- Two and three wheeler - 1 No.
- Special puller - 1 No.
- Two wheeler, stand - 1 No.
- Air compressor - 1 No.

Materials / components

- Gear shift lever - 1 No.
- Cotton waste - as reqd.
- Oil seal - as reqd.
- Kerosene - as reqd.
- Packing - as reqd.
- Soap oil - as reqd.

PROCEDURE

1 Removing and refitting of gear shift linkages.

2 Remove the gear shift lever.

3 Remove gear change shaft lever.

4 Remove the gear shift lever spring.

5 Remove washer (bit) and shaft collar and spring.

6 Remove gear shift lever in Lipitor.

7 Remove lever mounting screw.

8 Remove drum stopper lever

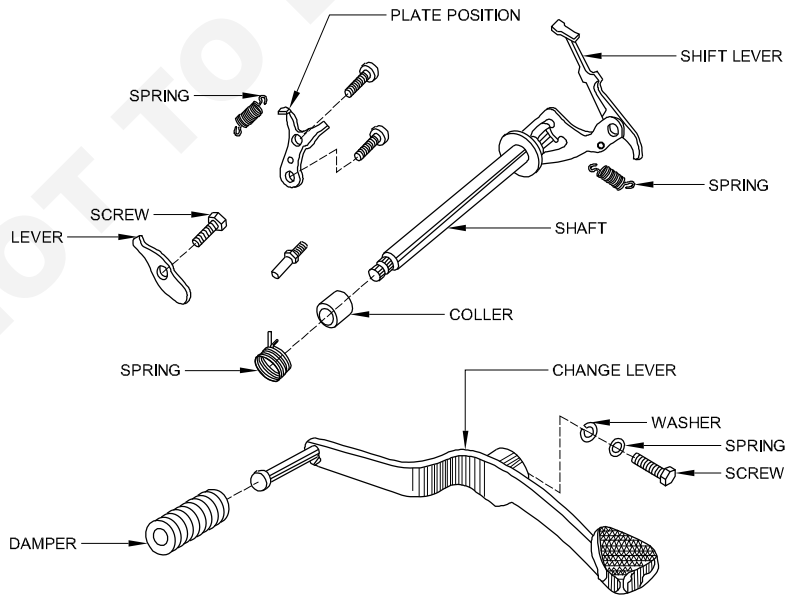
9 Remove all bolt and replay gear shift guide and spacer

10 Clean and inspect the parts (if warrant replace)

11 Assemble the parts in reverse of dismantling the gear shift lever.

12 Ensure gear shift lever is functioning properly.

Fig 1



Practice on A.C generator removing and refitting in two wheeler

Objective: At the end of this exercise you shall be able to
- **removing, cleaning and refitting of A.C generator.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.

Equipment / Machinery

- Two and three wheeler - 1 No.
- Rotor holder - 1 No.

Materials / components

- Cotton waste - as reqd.
- Cap Oil - as reqd.
- Emery paper - as reqd.
- grease - as reqd.
- Washers - as reqd.

PROCEDURE

TASK 1: **A.C generator removing method**

1 Remove A.C generator cover bolts.

2 Remove cover bolt by crisscross method.

3 Remove rotor by rotor holder.

4 Remove flange bolt.

5 Remove washers.

6 Remove the regulator and rectifier.

7 Remove the stator assembly.

8 Remove rotor and key.

9 Hold the magneto assembly by using a magneto assembly holder.

10 Loosen and remove the magneto nut.

11 Remove the magneto assembly by using magneto assembly puller.

12 Disconnect the wiring sockets of the stator assembly.

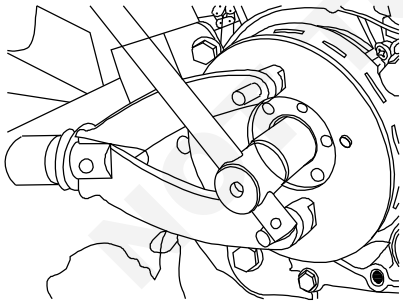
13 Loosen the screws and remove the stator assembly.

14 Loosen the screws and remove the stator assembly.

15 Remove the 'O' rings available at the crank case.

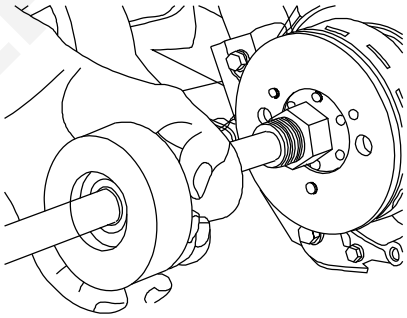
16 Take out the cam chain.

Fig 1



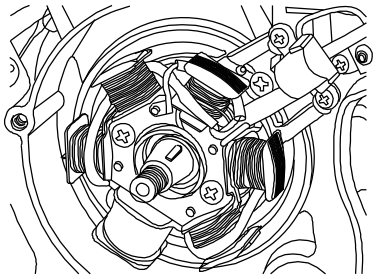
MTN19102H1

Fig 2



MTN19102H2

Fig 3



MTN19102H3

TASK 2: **Cleaning and refitting of A.C generator (Fig 1)**

1 Clean the all dismantled parts of A.C generator.

2 Visually inspect the parts.

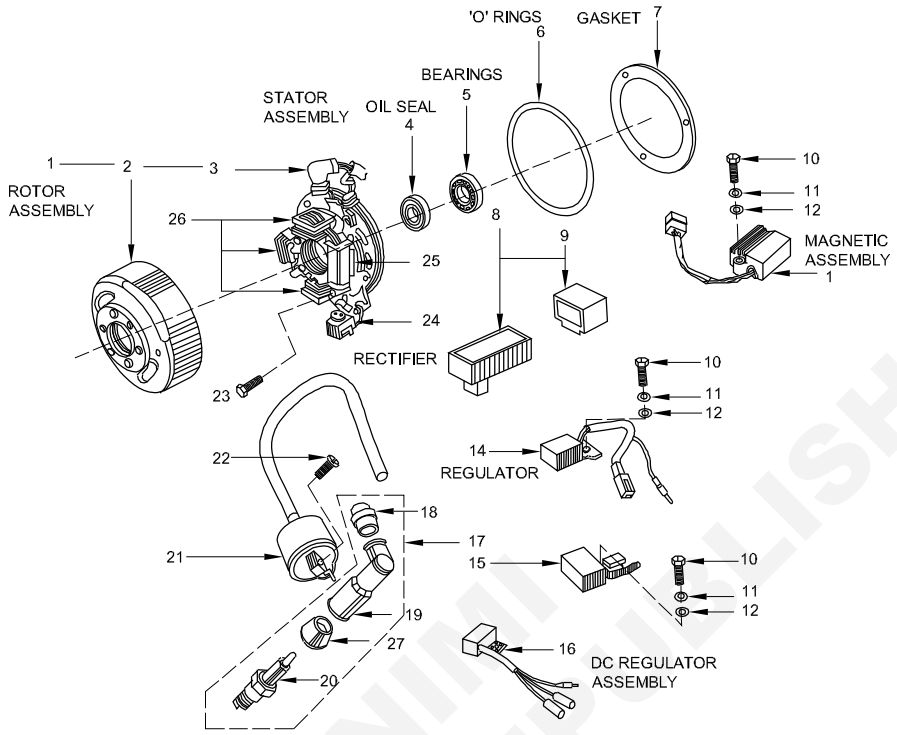
3 Check the coil continuity with help of multimeter.

4 Check the stator and rotor assembly and wires.

5 Assembly the stator and rotor assembly.

6 Fit the rectifier and regulator and generator cover assembly.

Fig 1



Practice on removing and reinstallation of cam chain tensioning

Objectives: At the end of this exercise you will be able to
- **remove the push rod**
- **remove the chain tensioner**
- **reinstallation of chain tensioner.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.

Equipment / Machinery

- Two and three wheeler - 1 No.
- Cam sprocket remove - 1 No.
- Compressor - 1 No.

Materials / components

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

PROCEDURE

TASK 1: **Removing the cam chain tensioner (Fig 1)**

1 Remove the cylinder head with gasket.

2 Bring the pisto to T.D.C position.

3 Align the rotor mark with crankcase strait line mark.

4 Check on R.H cam sprocket arrow.

5 Remove cam sprocket bolt and 'O' ring (10mm).

6 Loosen the chain tensioner screw on R.H.S chain tensioner mounting.

7 Remove the bolt (6m.m).

8 Remove the tensioner along with gasket.

9 Use special tool and remove cam sprocket holder.

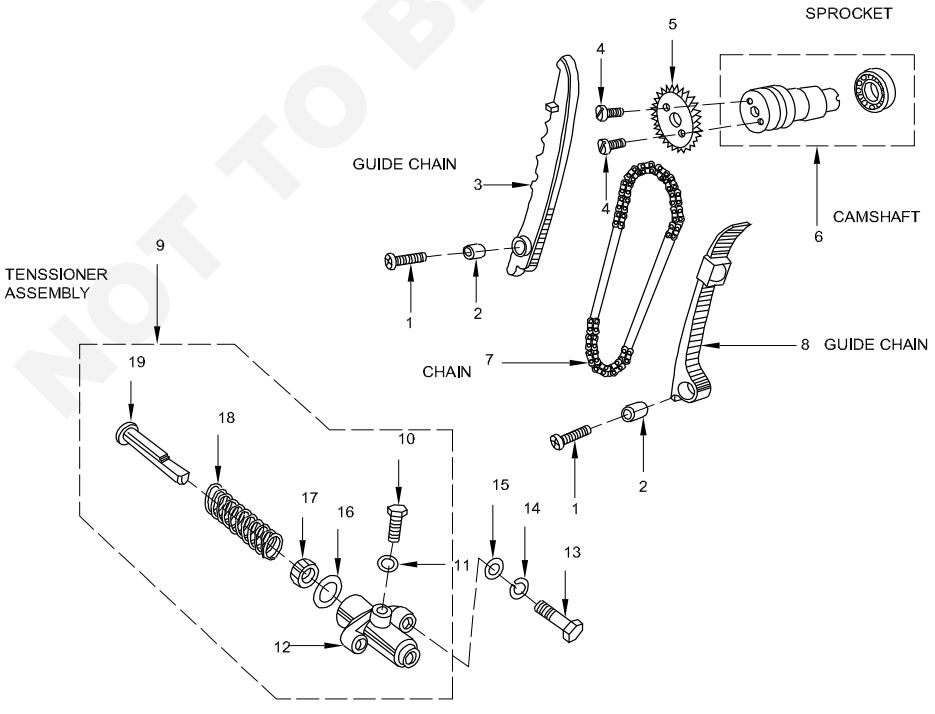
10 Remove the flange.

11 Remove cam sprocket.

12 Remove the cam shaft spacer.

13 Tie the timing chain with soft copper wire with bolt.

Fig 1



14 Clean all the parts and inspect if need replace the parts.

15 Remove the push rod.

16 Replace worn out parts.

— — — — — — — —

TASK 2: **Reinstallation of cam chain tensioner and push rod**

1 Clean the parts before reinstallation.

2 Fit the push rod and cam shaft with sprocket.

3 Align the timing mark.

4 Fit the timing chain on the cam shaft sprocket.

5 Fit the cam chain guide.

6 Adjust the cam chain tension.

7 Fit cylinder head cover and start the engine.

8 Check the engine performance

— — — — — — — —

Practice on trace the electrical circuit of two and three wheeler

Objectives: At the end of this exercise you shall be able to
- **use multimeter for testing continuity in circuit**
- **use ohmmeter to find resistance in a circuit**
- **use ammeter and AVO meter to measure current, voltage and resistance in a circuit**
- **detect fault in electrical circuits and rectify them.**

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 No.
• Test lamp	- 1 No.
• Multi meter	- 1 No.
• Soldering iron	- 1 No.
• Service manual	- 1 No.

Equipment / Machinery

• Two and three wheeler	- 1 No.

Materials / components

• Cotton waste	- as reqd.
• Flux	- as reqd.
• Solder	- as reqd.
• Soap oil	- as reqd.

PROCEDURE

1 Check the battery terminals and tighten them if they are loose.

2 Using a AVO meter (multimeter) in 12 V range connect the +ve terminals of the battery and ammeter input lead to check continuity.

3 Check continuity between.
- Am meter and ignition key
- Ignition key and ignition coil (magneto coil)
- Ignition coil and distribution cap motor
- Distributor outer terminal (7) and each spark plug (8) (There will be no distributor in motor cycles/ mopeds. The spark plug will be directly connected to the HT lead to the secondary coil)

4 If there is any discontinuity between any of the above circuit the multimeter will show very high (infinite) resistance indicating broken/loose connection between points.

5 Sometimes the wires may be broken or torn which may lead to discontinuity. If there is any open circuit replace the defective leads. Also tighten any loose connections. Checking voltage in the coil ignition circuit (Magneto assembly)

6 Check the connectivity between battery and CDI (Capacitor ignition circuit) unit using a multimeter and check for any faults like discontinuity/open connections.

7 Check the connectivity between voltage regulator (charging rectifier and diode system) and the battery. Ensure that the battery is not overcharged or undercharged.

8 Check the resistance between voltage regulator and magneto assembly using a correct range of ohmmeter. If the test lamp lights or ohmmeter reading is almost zero then the circuit is grounded. Rectify it.

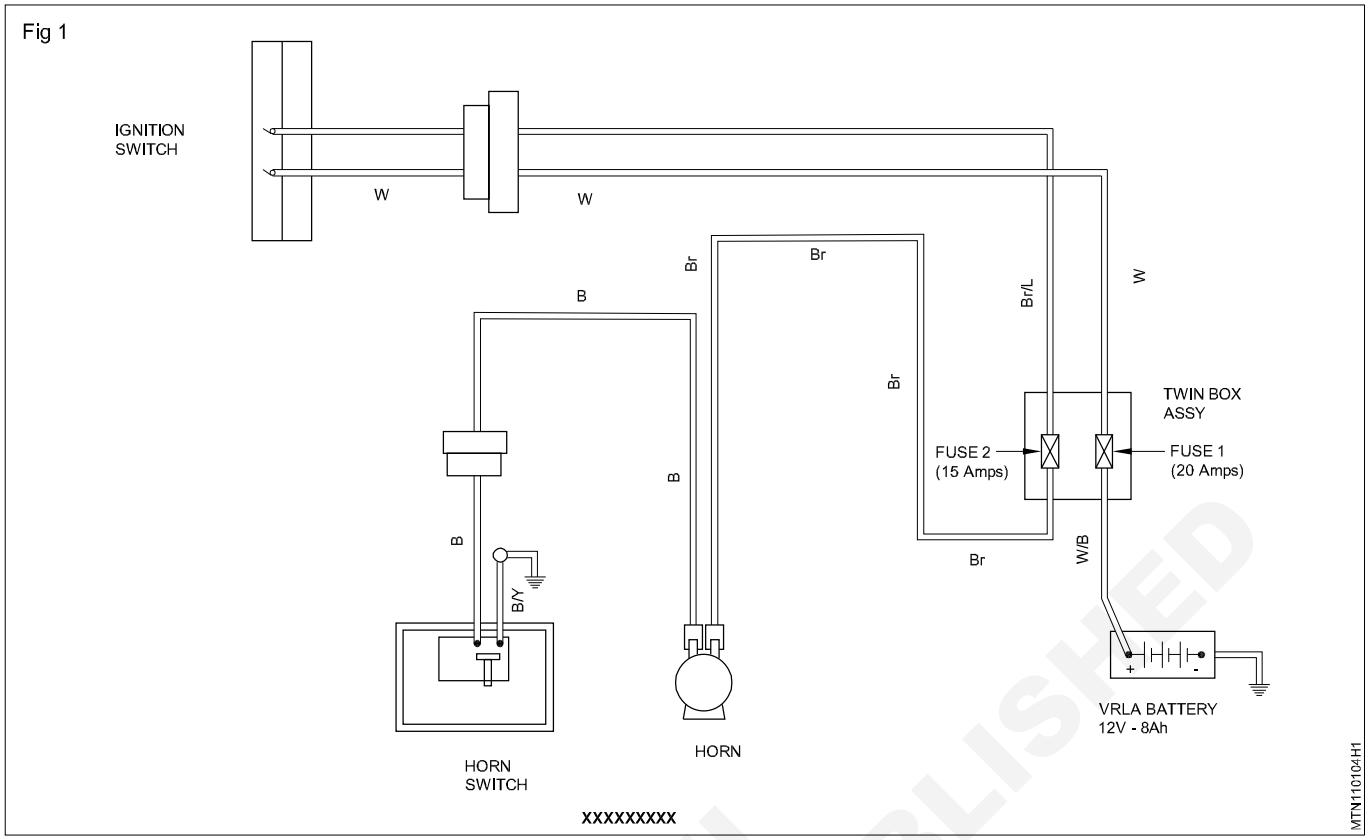
9 Using a DMM (Digital Multi Meter) check the continuity for each wiring circuit like horn, headlight, tail lamp, brake light switch/circuit etc., and take suitable corrective action. If the bulb filament is worn out replace the bulb in the respective circuit.

10 If the bulb is working well, then check for any discontinuity or short in the circuit and rectify it.

11 Owner's manual/service manual of any two wheelers will contain the detailed wiring circuit/diagram. Refer the diagram and carryout the electrical checks.

12 The wiring diagram for VESPA scooter is given below for reference (Fig 1).

Fig 1



Practice on measure the resistance of ignition coil DC voltage and DC current

Objective: At the end of this exercise you will be able to
- **check the ignition coil voltage and DC current resistance.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Digital multimeter - 1 No.
- Ohmmeter - 1 No.

Equipment / Machinery

- Two and three wheeler - 1 No.
- H.T current tester - 1 No.

Materials / components

- Cotton waste - as reqd.
- Clip with holder - as reqd.

PROCEDURE

1 Check battery state of charge (at least 70 %).

2 Hand and eye checks (all connections secure and clean).

3 Check supply to ignition coil (within 0.5 V of battery) through a multimeter.

4 Spart from coil via known good HT lead will jump to about 10mm. (Fig 1).

5 Check HT system for tracking and open circuits. Check plugs condition (leads should be a maximum resistance of about 30k?/m and per lead).

6 Check continuity of coil windings (primary 0.5 to 3 ohm, secondary several k ohm, secondary several k ohm).

7 Supply an earth to module (12 V minimum supply, earth drop 0.5 V maximum).

8 Check the voltage in primary and corresponding voltage in secondary (should vary between 12 V in primary to 35 kV in secondary).

9 Check the driver circuit for proper resistance. If the resistance is too high check for any open circuit.

10 As the E-DIS coil comes as a seated unit, it is very difficult to detect any major faults and such cases the usual practice is to change the coil pack.

Checking the ignition coil

1 Insert the test leads into the V W and COM input terminals.

2 Set the DMM's selector rotary switch to W.

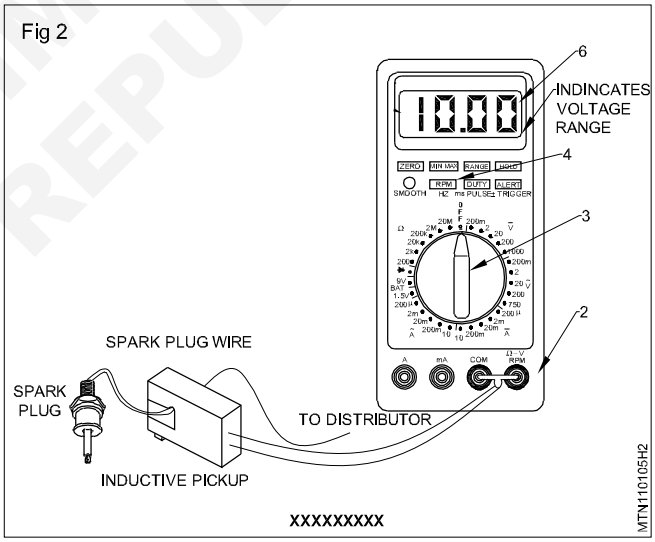
3 Touch the probes as shown in the figure to measure resistance in primary winding.

4 Observe the display. Resistance should be less that a few ohms.

5 Touch probes as shown in the figure to measure resistance in secondary windings.

6 Observe the display resistance should typically be in the 10 k ohm range (Fig 2).

Fig 2



1 dis coil checks

1 The coils in DIS ignition systems function the same as those in ordinary ignition systems, so testing is essentially the same.

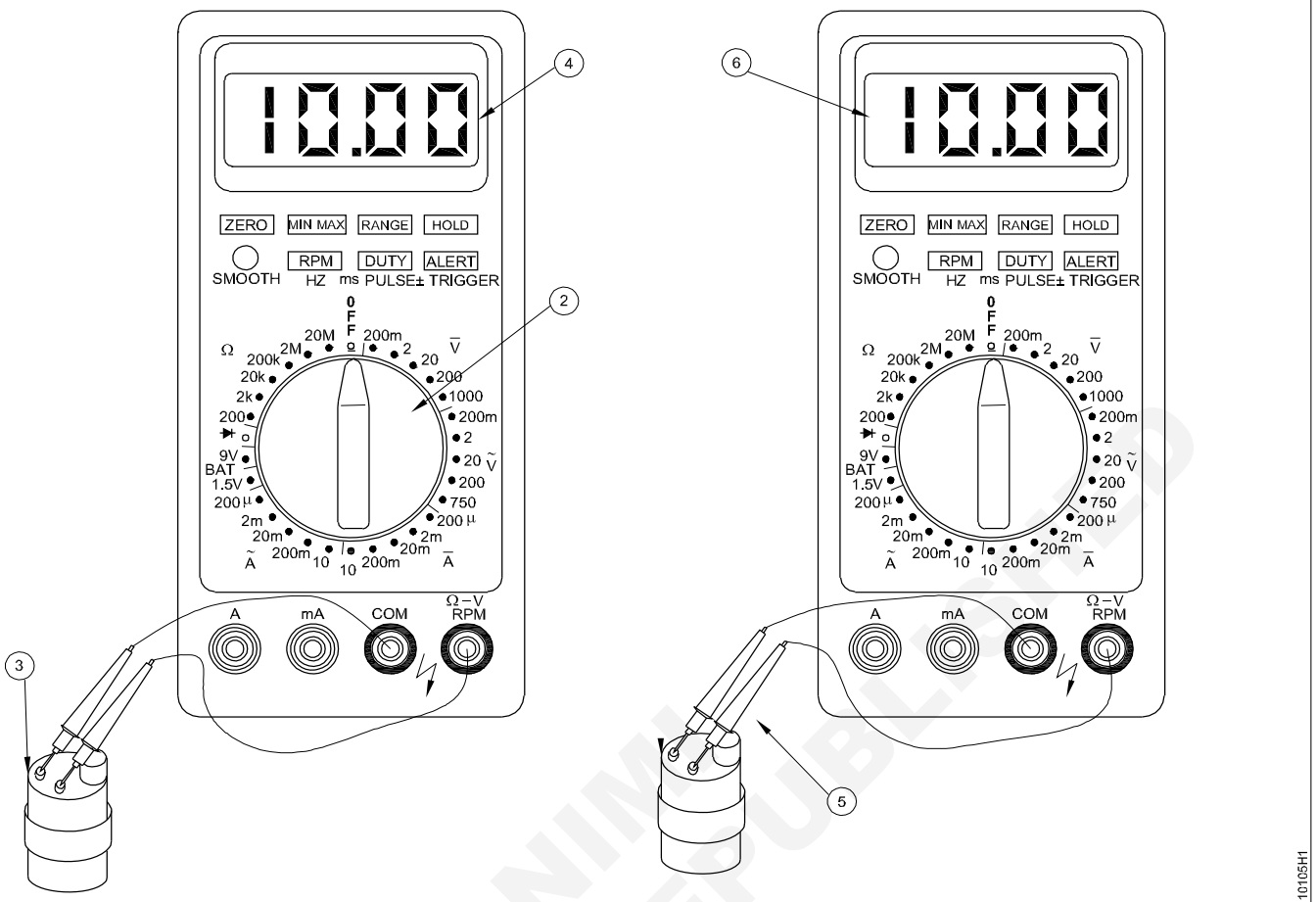
2 But the driveability symptoms caused by a weak coil or dead coil will be limited to one or two cylinders rather than all the cylinders.

3 Many DIS systems use the 'waste spark' setup where one coil fires a pair of spark plugs that are opposite one another in the firing order.

4 Others, including the newer coil-over-plug systems, have a separate coil for each spark plug.

5 Individual DIS coils are tested in essentially the same way as epoxy-filled (square-type) ignition coils.

Fig 1



TESTING THE INDUCTIVE PICK UP AND SPARK PLUG

MTN110105H1

6 First, isolate the coil pack by disconnecting all the leads.

7 Set the ohmmeter in the low range, and recalibrate if necessary

8 Connect the ohmmeter leads across the ignition coil primary terminals, and compare the primary resistance reading to specification (typically less than 2 ohms).

9 Then connect the ohmmeter leads across the coil secondary terminals and compare the secondary resistance reading to specifications (typically 6,000-30,000 ohms).

10 If readings are outside the specified range, the coil is defective and needs to be replaced.

11 If measuring the secondary resistance of a DIS coil is difficult because of the coils location, try removing the wires from the spark plugs and measure secondary resistance through the plug wires rather than at the secondary terminals on the coils.

12 Just remember to add in a maximum of 8,000 ohms of resistance per foot for the plug wires.

Dis module & sensor checks

1 Connect a halogen headlamp to the spade terminals that mate the DIS module to the coils.

2 A headlamp is recommended here because it puts more of a load on the module than a test lamp.

3 If the headlamp flashes when the engine is cranked, the DIS module and crank shaft position sensor circuit are functioning.

4 Therefore, the problem is in the coils.

5 If the headlamp does not flash, or there is no voltage to the module or coil pack when the engine is cranked, the problem is most likely in the crankshaft sensor circuit.

6 On most vehicles, a bad crank position sensor will usually set a fault code.

7 So use a scan tool to check for a code. Or, check the crank sensor itself.

8 Magnetic crank sensors can be tested by unplugging the electrical connector and checking resistance between the appropriate terminals.

9 If resistance is not within space, the sensor is bad and needs to be replaced.

10 Magnetic crank position sensors produce an alternating current when the engine is cranked so a voltage output check is another test that can be performed.

11 With the sensor connected, read the output voltage across the appropriate module terminals while cranking the engine.

12 If you see at least 20mV on the AC scale, the sensor is good, meaning the fault is probably in the module.

13 If the output voltage is low, remove the sensor and inspect the end of it for rust or debris (magnetic sensors will attract iron and steel particles).

14 Clean the sensor, reinstall it and test again.

15 Make sure it has the proper air gap (if adjustable) because the spacing between the end of the sensor and the relutor wheel or notches in the crankshaft will affect sensor output voltage.

16 If the air gap is correct and output is still low, replace the sensor.

17 Half effect crankshaft position sensor typically have three terminals; one for current feed, one for ground and one for the output signal.

18 The sensor must have voltage and ground to produce a signal, so check these terminals first with an analog voltmeter.

19 Sensor output can be checked by unplugging the DIS module and cranking the engine to see if the sensor produces a voltage signal.

20 The voltmeter needle should jump each a shutter blade passes through the hall effect switch.

21 If observed on an oscilloscope, you should see a square waveform. No signal would tell you the sensor has failed.

— — — — — — — —

Practice on measurement of charging voltage and leakage current

Objective: At the end of this exercise you shall be able to
- **trouble shoot the charging system.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Multimeter - 1 No.

Equipment / Machinery

- Two wheeler - 1 No.

Materials / components

- Gloves - as reqd.
- Banian cloth - as reqd.
- Emery sheet - as reqd.
- Cleaning solvent - as reqd.
- Cotton waste - as reqd.
- Soap oil - as reqd.

PROCEDURE

TASK 1: **Trouble shoot the charging system**

1 Switch on the ignition. Check the battery charging indicator lights On.

2 Start the engine. Raise the engine speed up to 2000 RPM and check the charging indicator light turn ON OFF.

3 If the charging indicator light does not No during ignition On, then follow the steps

4 Check charging circuit fuse.

5 If fuse is good, then check the condition of the charging indicator bulb replace bulb if necessary.

6 Check and tighten the connections check the wirings for frayed insulation and other physical damage.

7 If charging indicator light does not go out with the engine running, then follow the steps.

8 Check drive belt for its correct tension

9 Check battery and its connection

10 Check the fuse

11 Connect the multimeter with the battery terminals.

12 Set to measure voltage in the range of 6V to 60V

13 Start the engine and check the battery voltage

14 If the battery shows 14.2V to 14.8V then charging system is in good condition. Otherwise decide the problem with the alternator or charging circuit.

15 Run the engine and check and squealing noise this may be because of bearing problem or improperly adjusted drive belt.

Note: Cable colour

Green	-	Main power
Red	-	Open circuit
Red	-	Damaged battery
Red	-	Reverse polarity
White	-	Boost indicator light
Yellow	-	New battery
Green	-	Changed battery
Black	-	- Ve Terminal
Red	-	+ Terminal

16 Checking the leakage current

17 Check drive belt loose

18 Check loose connection

19 Check worn or dirty slip ring

20 Brake light wrong adjustment

21 Rectifier short circuit

22 Defective rectifier circuit

23 Defective diodes

24 Worn out or sticky brush

25 Light switch short circuit

26 Short circuit due it over sediment

27 Damaged separator in the battery

28 Oiling on the top of battery terminals

29 Wiring harness damages

Practice on headlight removing and reinstallation

Objectives: At the end of this exercise you shall be able to
- **Remove head light assembly**
- **replace the head light bulb**
- **install the head light assembly.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Allen key - 1 No.
- Test lamp - 1 No.

Equipment / Machinery

- Running two wheeler - 1 No.

Materials / components

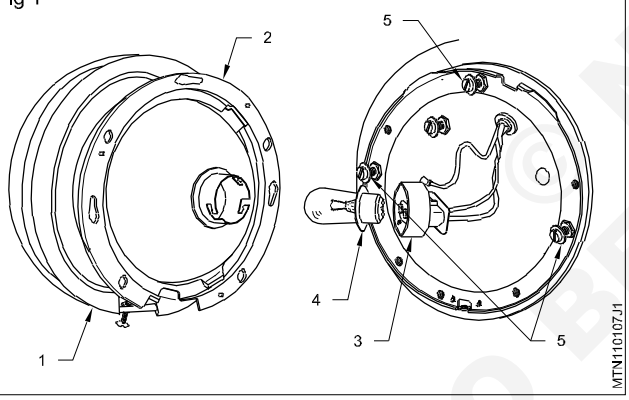
- Gloves - 1 No.
- Head light bulb - as reqd.
- Screws - as reqd.
- Cotton waste - as reqd.
- Insulation tape - as reqd.
- Soap oil - as reqd.

PROCEDURE

1 Remove, check assemble the head light

2 Unscrew the screws securing the rim (Fig 1).

Fig 1



3 Take out the rim along with the rubber dust excluder (1).

4 Press the light unit and turn it in the anticlockwise direction so that the light unit (2) will come out.

While removing the light unit ensure that the adjusting screws (5) are not disturbed.

5 Turn the bulb holder (3) in the anticlockwise direction to take it out.

6 Remove the bulb (4).

7 Unscrew the screws.

8 Remove the lock-rings according to the model.

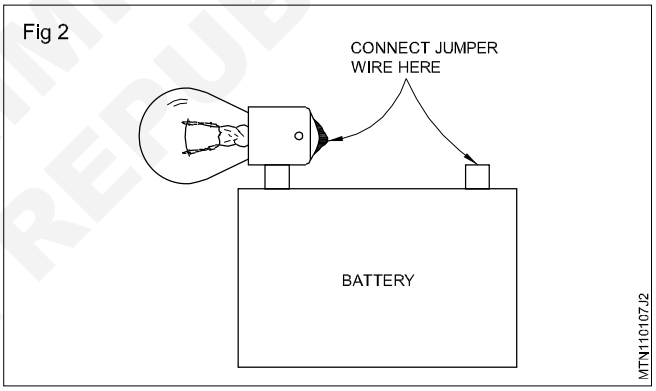
9 Remove the light lenses.

10 Remove the bulbs.

11 Removing the bulbs check for loose fitting.

12 Check the bulbs for fuse by connecting wires from the battery as shown in the Fig 2.

Fig 2



13 If the bulb is fused replace it.

14 Check the front lens and reflector and replace, if found damaged.

15 Position the new light unit on the rim.

Ensure that the locating tabs at the edge of the light unit fit into the slots in the rim.

Ensure that the unit retaining ring is correctly positioned.

16 Engage the projections on the bulb holder with the slots or flanges in the bulb sleeve.

17 Press and twist clockwise to fit the light assembly with the fim on the vehicle by the rim securing screws. Assemble all other light units by securing the screws/ lock-ring.

Testing lights by operating all the switches, after completing all the checking, by connecting to a battery of proper voltage.

Remove speedometer and refit

Objective: At the end of this exercise you will be able to
- **Remove head light and refit**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Allen tool - 1 No.
- Multi meter - 1 No.

Equipment / Machinery

- Two and three wheeler - 1 No.
- Battery - 1 No.

Materials / components

- Cotton waste - as reqd.
- Bulbs - as reqd.
- Speedometer - as reqd.

PROCEDURE

TASK 1: **Removal of speedometer from two wheeler (Fig 1& 2)**

1 Park the vehicle on shop floor.

2 Identify the speedometer on the vehicle.

3 Refer the service manual to removing and refitting the speedometer.

4 Unscrew the head light dome.

5 Remove the head light dome and disconnect the wire connected with head light.

6 Unscrew the speed meter mounting screw.

7 Disconnect the wire or cable connections with speedometer.

8 Remove the speedometer cover.

9 Remove the speedometer from meter case.

10 Check speedometer grass and nedle and numbers.

11 Incase combination meter check the mother board with electronic tester.

12 Check the speedometer, oil level indicator, Eco indicator multi function, display, coolant indicator, engine warning light, RPM gear display, high beam indicator, tachometer, turn signal indicator neutral indicator, fuel level indicator.

13 If found any defective replace the defective parts.

14 Assemble the speedometer and test the meter on test bench.

15 If meter is working properly, fit the speedometer on the vehicle and connect the cable or wire connections.

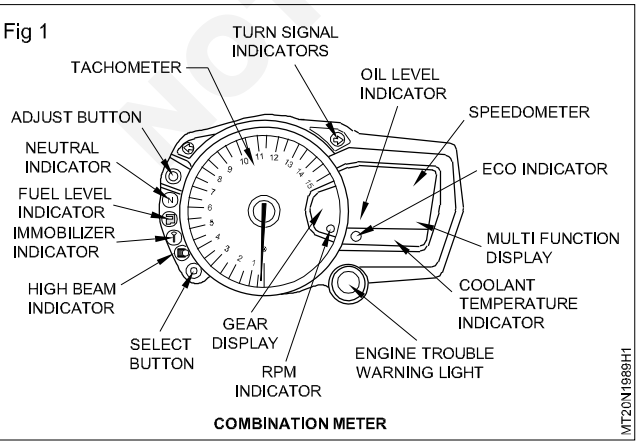
16 Fit the gauge light.

17 Fit the head light dome.

18 Ensure speedometer and head light wire connections are properly connected.

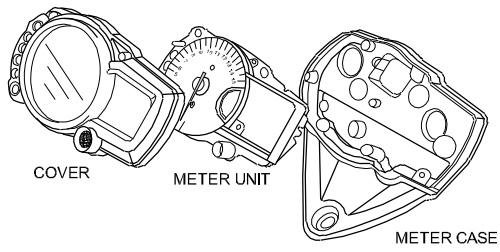
19 Start and run the vehicle for check the function of speedometer.

Fig 1



COMBINATION METER

Fig 2



CONSTRUCTION DETAILS OF COMBINATION METER

TASK 2: **Removal of indicator lamp (Fig 1)**

1 Identify the indicator light switch and lights location.

2 Trace the turn indicator wiring circuit.

3 Check the wiring connectivity.

4 Find the wire short circuit and rectify it.

5 Check the function, of turn indicator switch.

6 Check the neutral indicator lamp if need replace the bulb.

7 Check the high beam indicator lamp if need replace the bulb.

8 Check the ignition 'ON' indicator lamp if need replace the bulb.

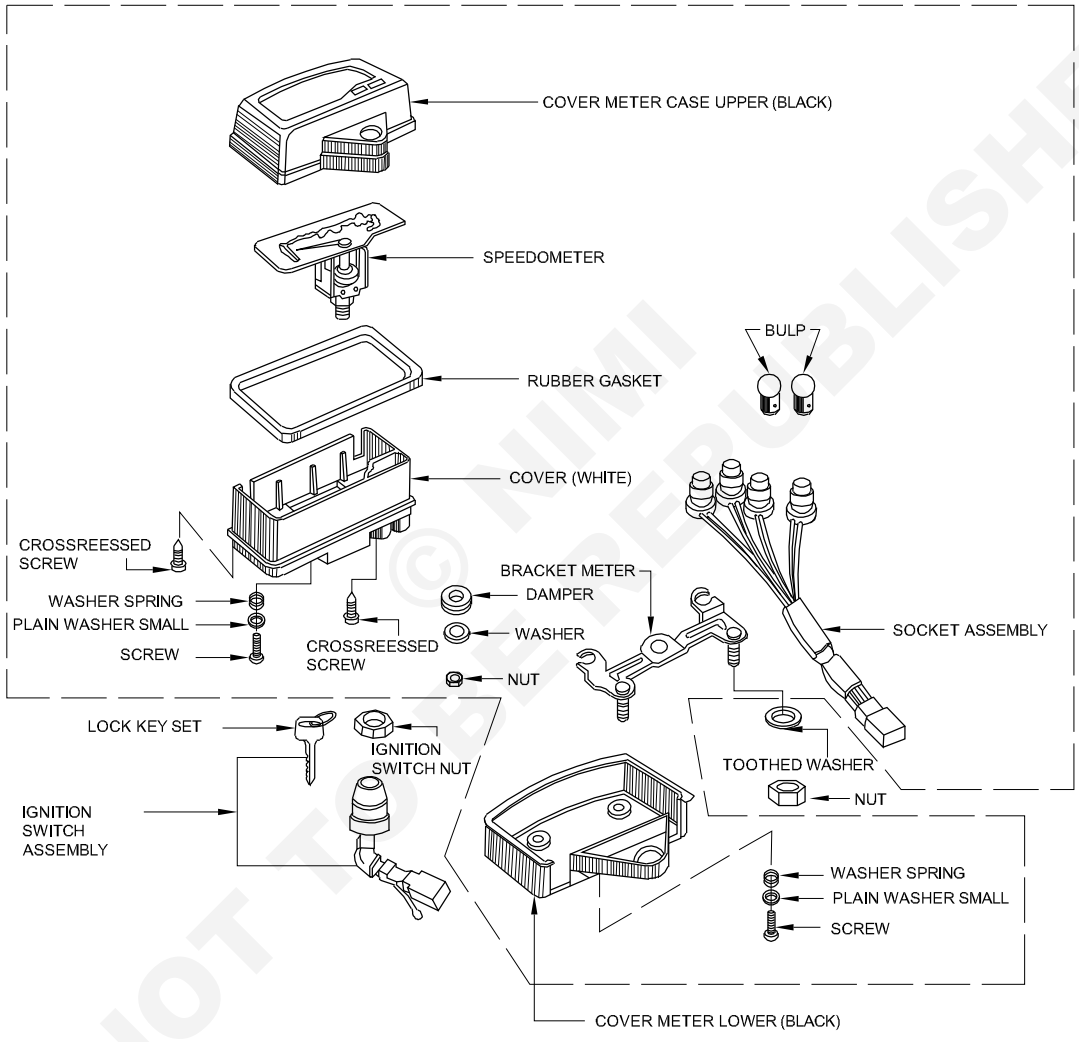
9 Check the engine malfunctioning indicator lamp, if need replace.

10 Check the high RPM indicator lamp if need replace he bulb.

11 Check the side indicator lamp if need the bulb.

12 Check the low fuel indicator if found any fault repalace it.

Fig 1



Practice to check the horn, head light, and indicator circuits

Objectives: At the end of this exercise you shall be able to
- **check electrical horn circuits**
- **check the indicator circuits**
- **check the head light circuits.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Nose Plier - 1 No.
- Multi meter - 1 No.
- Test lamp - 1 No.

Equipment / Machinery

- Two wheeler - 1 No.

Materials / components

- Cotton waste - as reqd.
- Soap oil - as reqd.
- Wire - as reqd.
- Insulation taps - as reqd.

PROCEDURE

TASK 1 : **Check the horn circuit**

1 Check the horn switch of need replace it.

2 Check the horn switch wire connection.

3 Check the horn circuit wire continuity with test lamp or multimeter, if found short circuit rectify it.

4 Check the horn mountings and wire connections and its function.

5 If the horn is defective, repair or replace the horn.

6 If horn tone is low, tune up the horn.

7 If the twin horn do the tuning procedure first for one horn by disconnecting the other and vice verse.

8 Ensure there no defects or short circuits in horn circuit.

— — — — — — — —

TASK 2 : **Check the head light circuit**

1 Check the battery charge condition, if need recharge the battery or replace.

2 Check the battery connections, if need clean the battery terminals.

3 Check the head light switch, if found defective replace it.

4 Check the head light wire connection, if found any short circuit rectify the defects.

5 Check the head bulb, if fuse, replace it.

6 Check the head light wiring circuit by test lamp.

7 Ensure head light electrical circuit is up-date condition.

— — — — — — — —

TASK 3 : **Checking of indicator wiring circuit**

1 Identify the indicator switch location.

2 Identify the flasher unit location.

3 Identify front and rear indicator lights (left and right side).

4 Check the indicator switch function, if found defective replace it.

5 Check the flasher unit function if found defective replace it.

6 Check the flasher unit connections, if found loose connection tighten it.

— — — — — — — —

Practice on adjusting head lights focus

Objectives: At the end of this exercise you shall be able to
- **aligning the head light**
- **replacing the head lamp.**

Requirements

Tools / Instruments

- Screw driver set - 1 No.

Materials / components

- Head lamp - 1 No.

PROCEDURE

TASK 1: **Aligning the head light focus**

1 Check the head light wire harness if found short circuit rectify it.

2 Check the air pressure in the types and inflate them to the correct pressure.

3 Check the headlamp mountings.

4 Position the two wheeler 7.62 metres away in front of a white screen or a plan wall.

5 Mark the distance between the centres (A & B) of the headlamps with respect to the axis of the two wheeler.

6 Ensure that the front of the two wheeler is square to the screen.

7 Load the two wheeler as it will be while being driven for most of the time.

8 Mark the height of the headlamps on the screen, two inches below the actual height of the headlamps.

9 Normal value is equal to the height from the floor to the centre of headlamp minus 2" when headlamps are 25ft. or 7.62m apart from the screen.

— — — — — — — — —

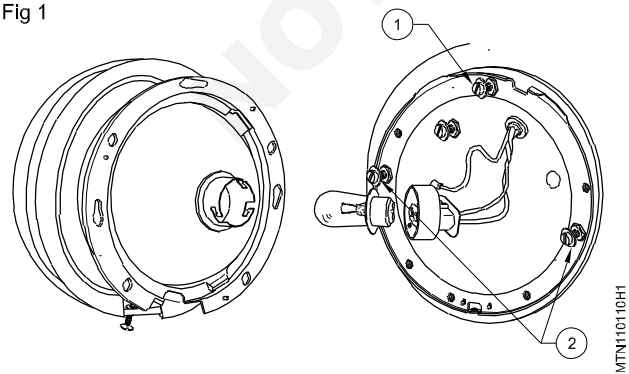
TASK 2: **Setting the beams (long and short) and test the beams (Fig 1 & 2)**

1 Adjust the headlamp beams by the vertical adjusting screw (1) or the horizontal adjusting screw (2).

2 Ensure that the main beam's high intensity zone falls.

3 Ensure the upper beam is adjusted separately after throwing it separately on the white screen.

Fig 1



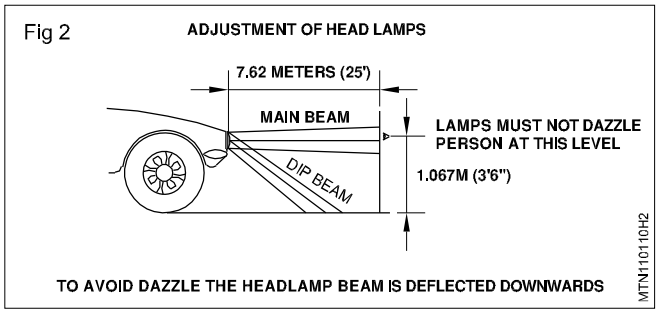
4 Observe the headlamp main beam directed straight ahead and parallel to the road when the vehicle is fully located. (Refer to the diagram).

Adjustment of headlamps

1 Adjust if required.

2 Operate the dip switch by hand observe the dipped beam dipping downwards and towards the kerb.

Fig 2



— — — — — — — — —

Practice on spark plug cleaning and gap adjustment

Objectives: At the end of this exercise you shall be able to
- **remove the spark plug**
- **clean and inspect the spark plug**
- **adjust spark plug gap**
- **check and install spark plug.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Spark plug spanner - 1 No.
- Feeler gauge - 1 No.

Equipment / Machinery

- Air compressor - 1 No.
- Two and three wheeler - 1 No.
- Spark plug cleaner - 1 No.

Materials / components

- Kerosene - as reqd.
- Emery paper - as reqd.
- Cotton waste - as reqd.
- Spark plug - as reqd.
- Soap oil - as reqd.

PROCEDURE

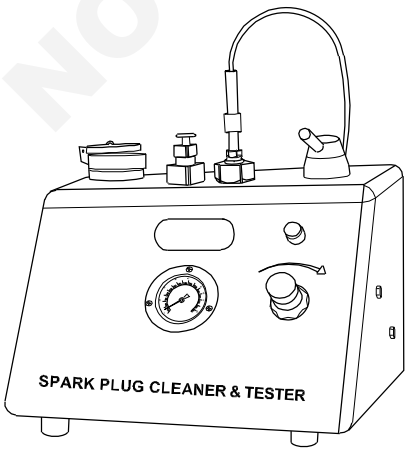
1 Remove spark plug

- Disconnect high tension lead from the spark plug
- Remove ignition coil assembly if required
- Loosen the spark plugs.
- Apply air blow around the spark plug to avoid foreign particles entering into the cylinder
- Remove spark plug from the engine cylinders.
- Check the spark plug in a standard spark plug teser shown in Fig 1

2 Clean and inspect spark plug

- Check the spark plug for carbon deposition, crack and damage.
- Clean the spark plug with spark plug cleaning machine
- Check the spark plug for wear or insulator damage.

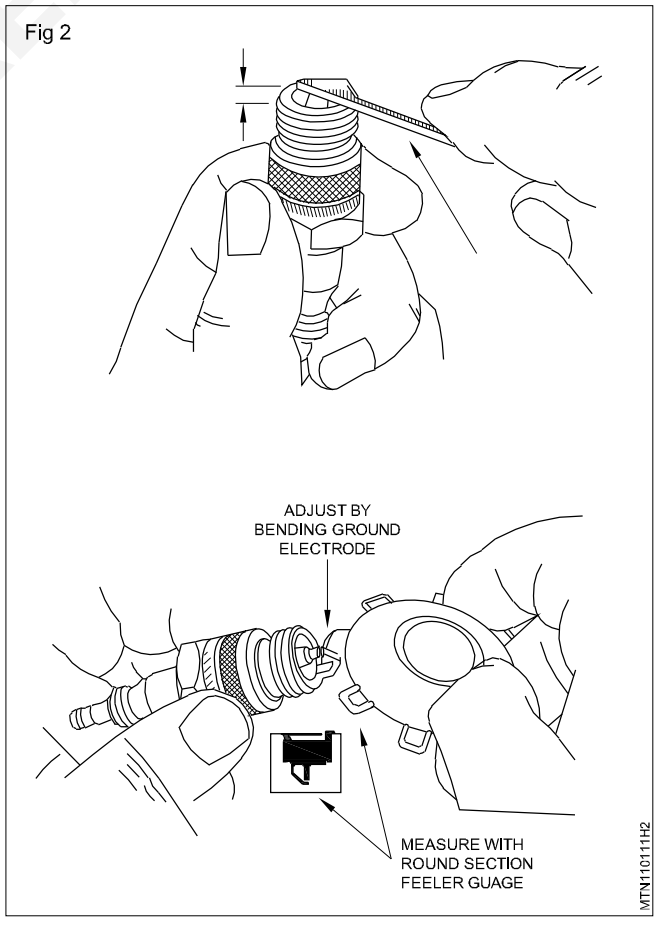
Fig 1



3 Adjust spark plug gap

- Check the spark plug gap with the spark plug gauge (Fig 2)
- Adjust the gap as per the manufacturer's

Fig 2



4 Check ignition spark

1 Connect ignition coil with the engine.

2 Connect the high tension leads with the spark plug.

3 Ground plug.

4 Crank the engine and check ignition spark visually, if not, replace the spark plug.

5 Install spark plug

1 Install the spark plug to the engine.

2 Install the ignition coil.

3 Connect the high tension leads with the spark plugs.

4 Start the engine and check the performance of the engine.

— — — — — — — —

Practice on measure the resistance of ignition coil windings

Objectives: At the end of this exercise you will be able to
- **check continuity in ignition circuit**
- **check open circuits in ignition circuit**
- **check short circuits in ignition circuit.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multi meter - 1 No.
- Spark plug spanner - 1 No.
- Spark plug gauge - 1 No.

Equipment / Machinery

- Spark plug cleaning machine - 1 No.
- Two wheeler - 1 No.

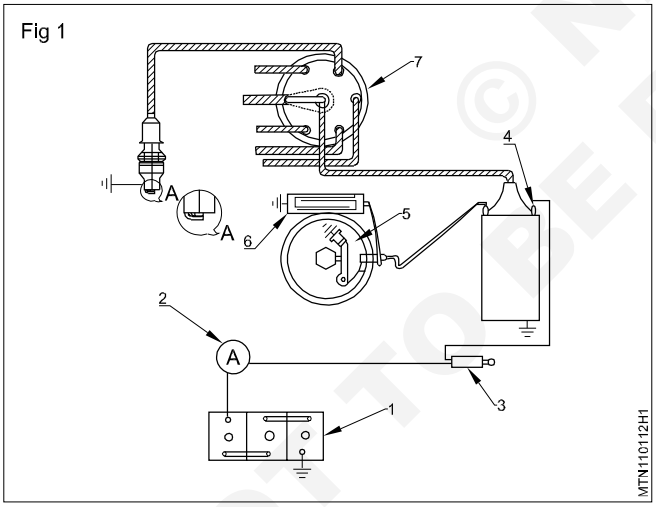
PROCEDURE

1 Measure the resistance of ignition coil windings

2 Check the battery terminals and tighten them if found loose.

3 Using a A.V.O. meter (multimeter) in 12 volts range, connect the leads on both the +ve terminals of the battery (1) and the ammeter (2) input lead to check continuity. (Fig 1)

Fig 1



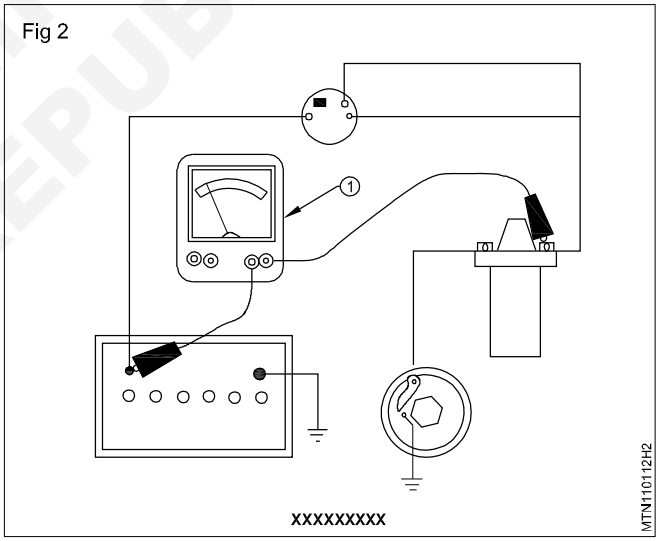
4 Check the continuity between:

- Ammeter (2) and the ignition key (3).
- Ignition key (3) and ignition coil (4).
- Ignition coil (4), ignition point (5) and condenser (6).
- Ignition coil (4) and the distributor cap (7) motor.
- Distributor outer terminal (7) and each spark plug (8).

5 If there is any open circuit replace the defective leads. If any loose connections are found in the above circuit, tighten them.

6 Check the ignition coil primary and secondary winding resistance multimeter and (1) in parallel with the circuit and switch on. Note the reading of resistance of primary winding and secondary winding. (Fig 2)

Fig 2



7 Set the multi meter (1) in to 20 ohm range.

8 Test the primary winding resistance. (2)

(Normally the secondary winding resistance will be approximately 3-3.5 ohm)

9 Set the multimeter in to 20000 ohm range.

10 Test the secondary windin gresistance.

(Normally the secondary winding resistance will be approximately 15000 ohm)

11 If the values are not matching with the manufacturer's specification, then replace the ignition coil assembly.

— — — — — — — —

Practice to check the performance of ignition coil

Objectives: At the end of this exercise you shall be able to
- **check ignition coil**
- **check pulsar coil.**

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 No.
• Screw driver set	- 1 No.
• Multi meter	- 1 No.
• Spark plug spanner	- 1 No.

Equipment / Machinery

• Two wheeler	- 1 No.

Materials / components

• Cotton waste	- as reqd.
• Soap oil	- as reqd.
• Ignition coil	- as reqd.

PROCEDURE

TASK 1 : **Checking ignition coil performance (Fig 1 & 2)**

1 Remove the fuel tank after draining the fuel.

2 Disconnect the wiring socket from the ignition coil.

3 Disconnect the high tension wire.

4 Remove the ignition coil assembly.

5 Place the ignition coil on test bench.

6 Set the multi meter (1) in to 20 ohm range.

7 Test the primary winding resistance. (2)

(Normally the secondary winding resistance will be approximately 3-3.5 ohm)

To check the primary coil connect the ohmmeter, two leads to the coils primary terminal (+ and -).

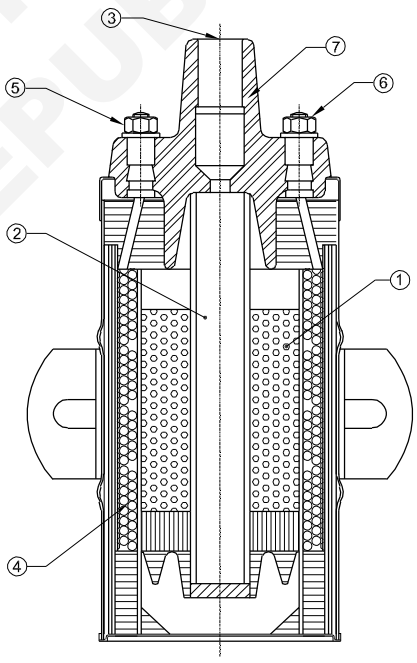
Note the reading between 0.4 and 2 ohms. If it is how zero resistance it mean coil winding short circulate.

8 Test the secondary winding resistance.

(Normally the secondary winding resistance will be approximately 15000 ohm)

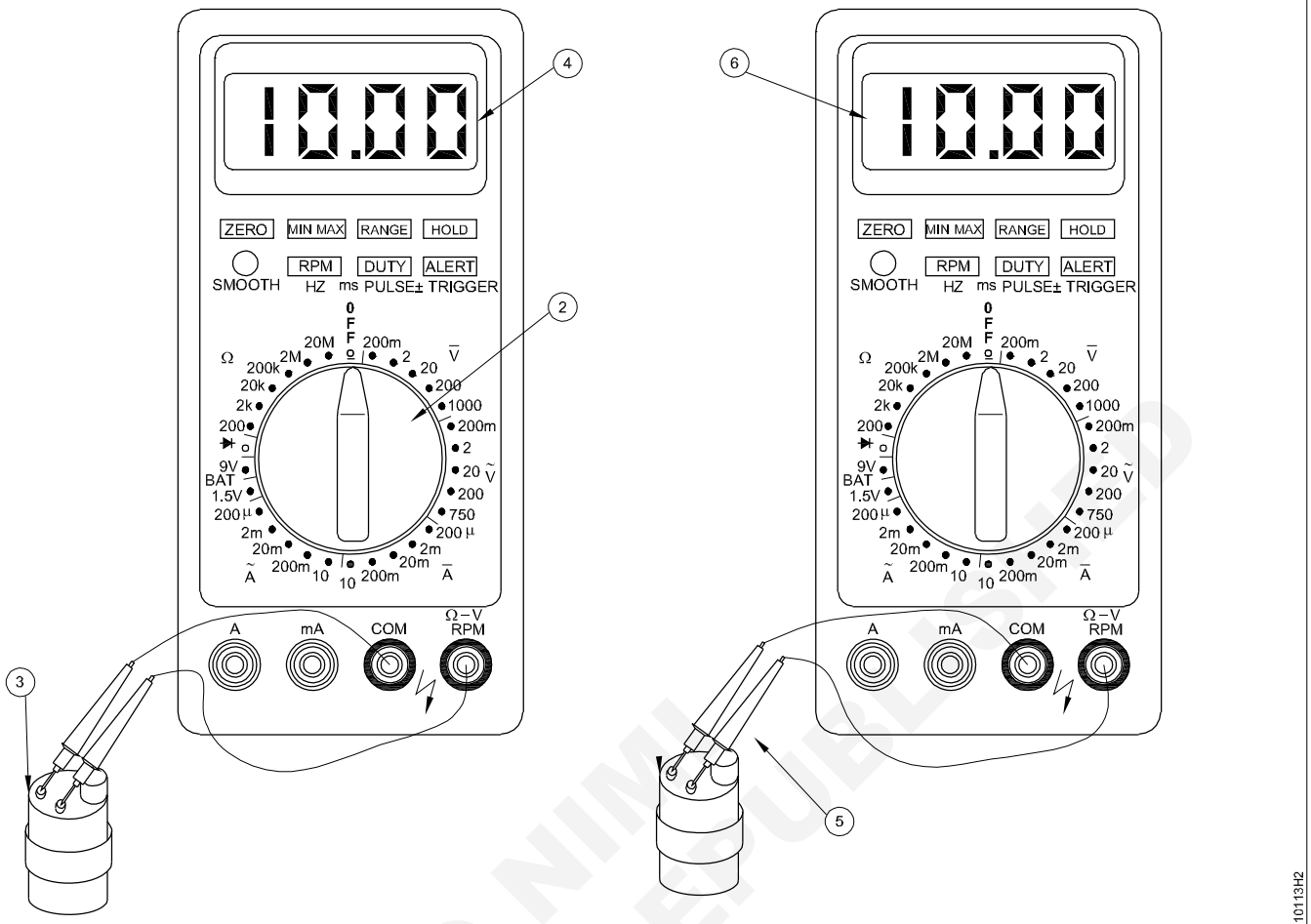
Secondary resistance measured between the positive (+) terminal and high voltage out put terminal. It read 6000 to 8000 ohms.

Fig 1



IGNITION COIL

Fig 2



TESTING THE INDUCTIVE PICK UP AND SPARK PLUG

MTN110113H2

TASK 2 : **Checking the pulser coil assembly (Fig 1)**

1 Remove the magneto cover.

2 Disconnect the wiring socket from the pulser coil.

3 Remove the pulser coil (3).

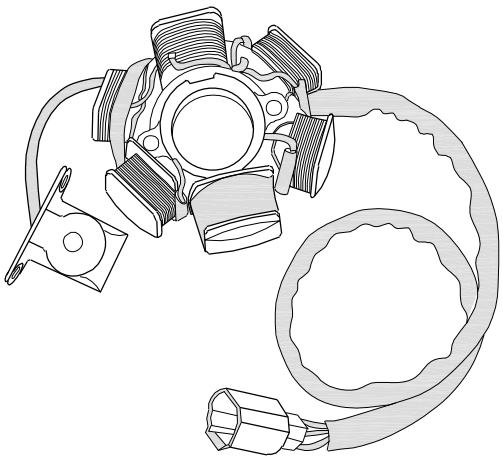
4 Set the multi meter in to 2000 ohm range.

5 Test the resistance of the pulser coil.

6 The vaue will be approximately 220 - 300 ohms.

7 If the value is not within the limit, then replace by a new one.

Fig 1



MT20N1991J1

Practice on inspect the AC generator and C.D.I unit

Objective: At the end of this exercise you shall be able to
- **test the A.C generator and C.D.I unit.**

Requirements

Tools / Instruments

• Trainees tool kit	- 1 No.	• Battery	- 1 No.
• Digital multimeter	- 1 No.	• Two wheeler	- 1 No.

Equipment / Machinery

• Two and three wheeler	- 1 No.	• Cotton waste	- as reqd.
• capacitance meter	- 1 No.	• Soap oil	- as reqd.
		• Capacitor	- as reqd.

PROCEDURE

TASK 1 : **Inspection of two wheeler's AC generator (Fig 1)**

1 Park the two wheeler on shop floor.

2 Lift the vehicle on two wheeler lift.

3 Drain the engine oil.

4 Remove the chain cover.

5 Loosen the drive chain.

6 Remove the wheel drive chain.

7 Remove the crank case cover by loosen the mounting nut.

8 Remove the permanent magnet.

9 Remove the stator wire connections and rectifiers and chain sprocket.

10 Clean the dismantled parts

11 After cleaning visually inspect the dismantled parts.

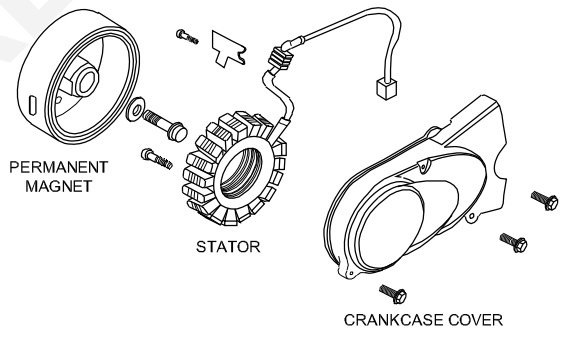
12 Choose the stator's coil continuity if found any short circuit replace.

13 Check the permanent magnet quality

14 After testing every thing is in good condition assemble the parts in reverse of dismantling process

15 After assembly start the vehicle and the A.C generator's out put by multimeters.

Fig 1



ALTERNATOR ASSEMBLY

— — — — — — — —

TASK 2 : **Removal of C.D.I unit (Fig 1)**

1 Park the two wheeler on shop floor.

2 Remove the seat and battery connections.

3 Dismount the mounting bolt of C.D.I unit.

4 Disconnect the wire connection of C.D.I unit.

5 Remove the C.D.I unit and clean it.

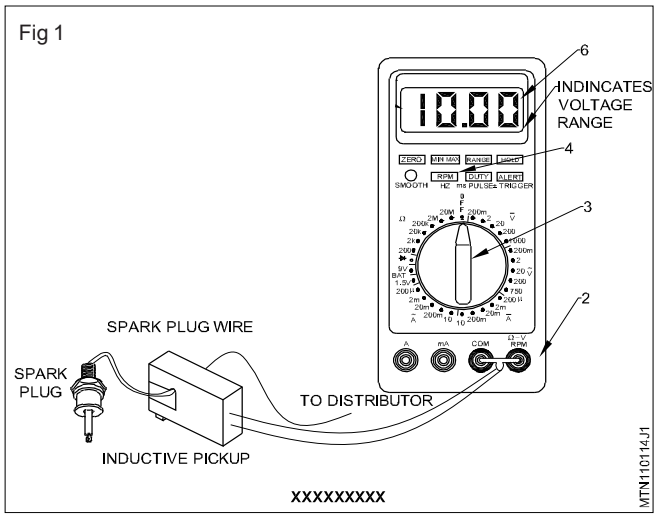
6 Use the multimeter to test the C.D.I unit.

7 Check the resistance and voltage output as per guide line by manufactures.

8 If found defects replace the C.D.I unit.

9 Assemble the C.D.I unit as in reverse of remounting process.

10 After assembling the count start the engine and check the performance.



Adjust the ignition timing in electronic ignition system

Objectives: At the end of this exercise you will be able to
- **servicing of electronic ignition system**
- **set the ignition timing**
- **identify the parts of ignition system**
- **check the ignition system for faults**
- **check continuity between various parts using AVO/DMM.**

PROCEDURE

TASK 1 : **Servicing of electronic ignition system (Fig 1)**

1 Park the vehicle on the shop floor.

2 Jack up the vehicle on the two wheeler lift.

3 Refer the manufactures service manual of the vehicle.

4 Trace the electronic ignition system electrical circuit.

5 Identify the parts of electronic ignition system.

6 Switch on the ignition key and start the engine and check the performance of engine if found any malfunctioning find the defects.

7 Switch off the engine.

8 Disconnect the battery terminal.

9 Disconnect the wire from ECU ignition coil spark plug, ignition key and battery.

10 Remove the ignition coil, ECU, spark plug, crank sensor.

11 Clean the spark plug and adjust the gap.

12 Check sensor with help of multimeter.

13 Check the ignition coil as shown figure in exercise No. 113.

14 Check the ECU with help of multimeter and electronic tester.

15 If found defective parts during testing replace the parts.

16 Rotate the engine and set the crank shaft trigger point coin side with timing mark.

17 Connect wire between crank sensor and ECU.

18 Fit the ignition coil and spark plug.

19 Connect the wire connection between ECU and ignition coil.

20 Connect the wire (HT cable) between ignition coil and spark plug.

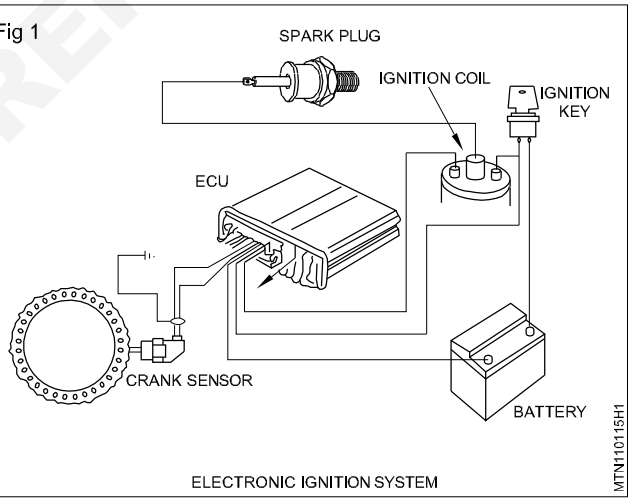
21 Connect the wire between ignition switch and ignition key.

22 Connect the battery terminal.

23 Switch on the ignition key start the vehicle.

24 Check the performance of vehicle.

Fig 1



ELECTRONIC IGNITION SYSTEM

— — — — — — — —

TASK 2 : **Set ignition Timing**

1 Ignition timing is very essential for proper engine firing. The CDI (Capacitor Discharge Ignition system is the commonly found system in scooters nowadays.

2 Ignition timing is usually set at idling speed.

3 Remove the magneto cover and see that the magneto timing mark is visible to the naked eye.

4 Initially note down the timing mark in the magneto

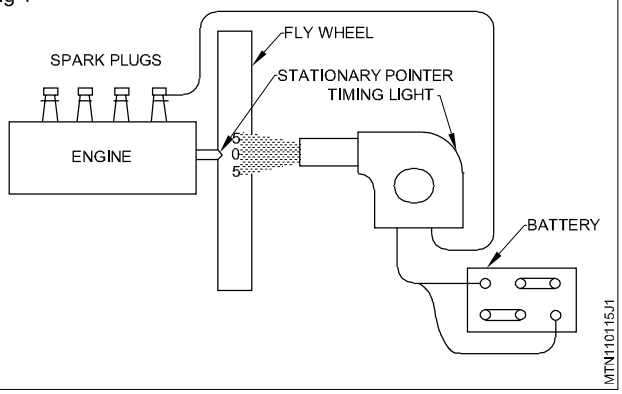
5 Crank the engine check where spark plug is fired by the trigger unit.

6 Use the stroboscopic light for setting an accurate timing (Fig 1)

7 Suitably rotate the armature either forward or backward to vary the timing.

8 Locate the exact instant when the spark is to be fired and accordingly adjust the timing mark on the magneto.

Fig 1



9 Recheck the timing and close the magneto cover.

Checking the Ignition system

1 Check the battery terminals and tighten them if they are loose

2 Using a AVO meter (Multimeter) in 12 V range connect the +ve terminals of the battery and ammeter input lead to check continuity.

3 Check continuity between.

- Ammeter and ignition key.
- Ignition Key and ignition coil (magneto coil)
- Ignition coil and distributor cap (HT lead cap)
- Distributor outer terminal and each spark plug (There will be no distributor in scooters / mopeds. The spark plug will be directly connected to the HT lead from the secondary coil)

4 If there is any discontinuity between any of the above circuit the multimeter will show very high (infinite) resistance indicating broken/loose connection between points.

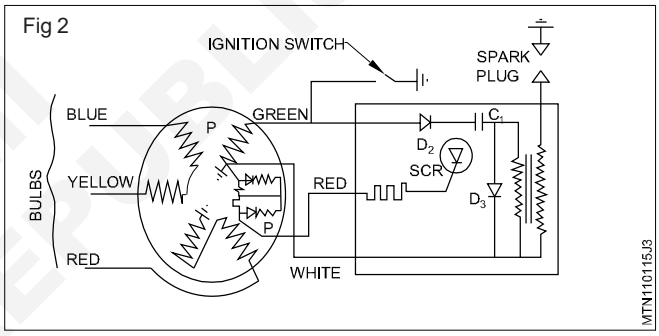
5 Sometimes the wires may be broken or torn which may lead to discontinuity. If there is any open circuit replace the defective leads. Also tighten any loose connections. Checking voltage in the coil ignition circuit (Magneto assembly((Fig 2)

6 Check the connectivity between battery and CDI (Capacitor ignitiion circuit) unit using a multimeter and check for any faults like discontinuity / open connections. (refer Fig 2)

7 Check the connectivity between voltage regulator (charging rectifier and diode system) and the battery. Ensure that the battery is not overcharged or undercharged.

8 Check the resistance between voltage regulator and magneto assembly using a correct range of ohmmeter. If the test lamp lights or ohmmeter reading is almost zero then the circuit is grounded rectify it.

Fig 2



Check handle bar switches and front and rear brake light switches

Objectives: At the end of this exercise you shall be able to
- **check the handle bar switches**
- **check front and rear brake light switches.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Multimeter - 1 No.

Equipment / Machinery

- Two and three wheeler - 1 No.
- Battery - 1 No.

Materials / components

- LED bulbs - as reqd.
- Switches - as reqd.
- Wire - as reqd.
- Insulation tape - as reqd.
- Soap oil - as reqd.
- Cotton waste - as reqd.

PROCEDURE

1 Check the handle bar switches (Fig 1, 2 & 3)

2 Part the vehicle on repair shop.

3 Check the battery charge condition with help of multimeter.

4 If need replace or recharge the battery.

5 Switch on the ignition key.

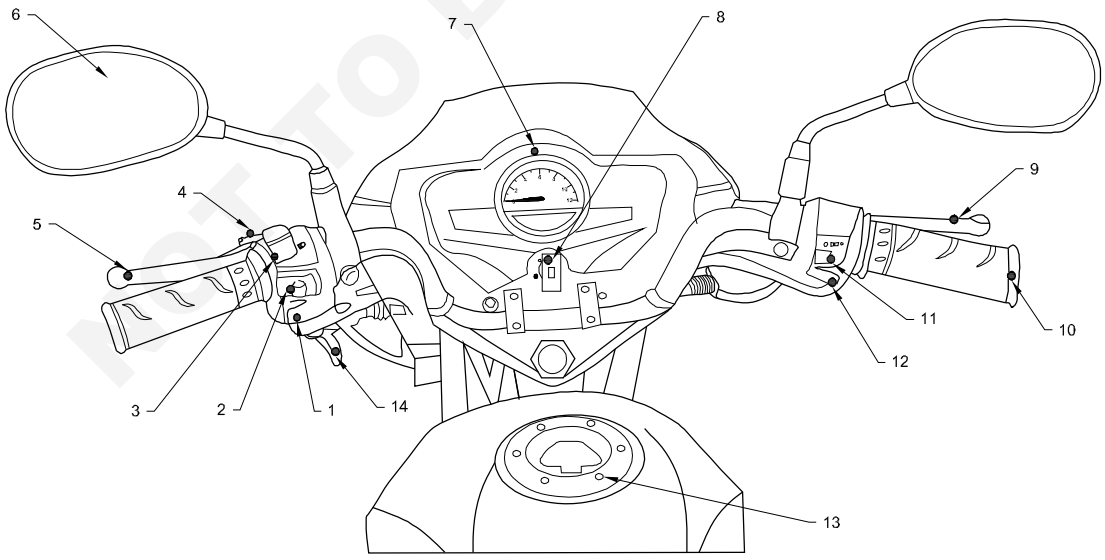
6 Start the engine with start switch locating on right handle bar if found defective replace the switch.

7 When engine is running apply the engine stop switch locating on in good condition if engine is not stopped, replace the stop switch.

8 Press the horn switch locating on lift handle bar, if horn is not functioning replace the horn switch before replace check the horn wire connecting and relay.

9 Operate the side light switch if found defective replace it before replacing check the side light wire connections and bulbs.

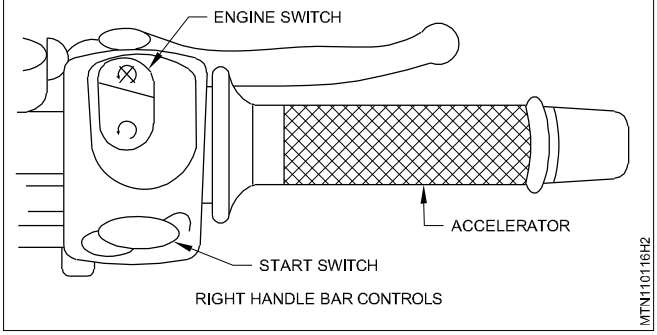
Fig 1



10 Press the passing light, if found defective replace it before replace the switch check the head bulb and wire connection.

11 Check the brake light bulbs, if found fuse replace the bulb.

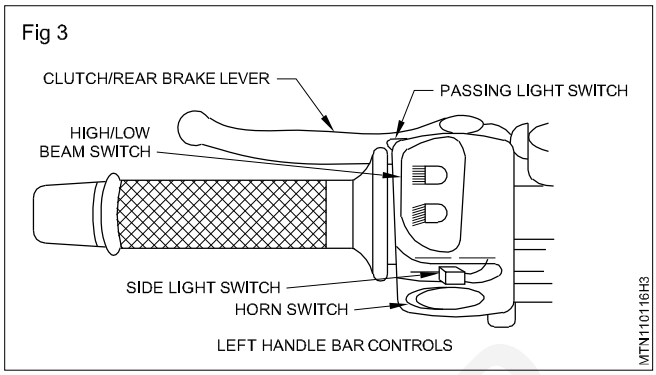
Fig 2



12 Apply front brake lever and check the brake light glowing, if not glowing replace the brake light switch.

13 Apply foot brake and check the brake light if not glowing replace the brake light switch.

Fig 3



Identify the various parts of LPG/CNG kit

Objectives: At the end of this exercise you shall be able to
- **identify the parts of LPG fuel system**
- **identify the parts of CNG fuel system.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Service manual - 1 No.

Equipment / Machinery

- LPG. Kit fitted two wheeler - 1 No.
- CNG. Kit fitted two wheeler - 1 No.

Materials / Components

- Cotton waste - as reqd.
- LPG kit - 1 No.
- CNG kit - 1 No.
- Soap oil - as reqd.

PROCEDURE

TASK 1 : **Identify the parts of LPG kit and trouble shooting (Fig 1 to 6)**

1 Place the vehicle on work shop.

2 Refer the vehicle service manual and LPG kit guide book.

3 Identify the air gas valve.

4 Identify the LPG cylinder.

5 Identify the multifunction valve.

6 Identify the shut off valve.

7 Identify the excess flow valve.

8 Identify the gas level indicator.

9 Identify the automatic fill limiter.

10 Identify the LPG solenoid valve (E)

11 Identify the refilling unit (F)

12 Identify the vapour box (G)

13 Identify the petrol solenoid valve

14 Identify the pipe assembly.

15 Identify the flexible hose assembly

16 Identify the inline regulator.

17 Identify the gas control switch.

18 Identify the gas and petrol OFF switch.

19 Identify the gaseous fuel mixer unit.

Fig 1

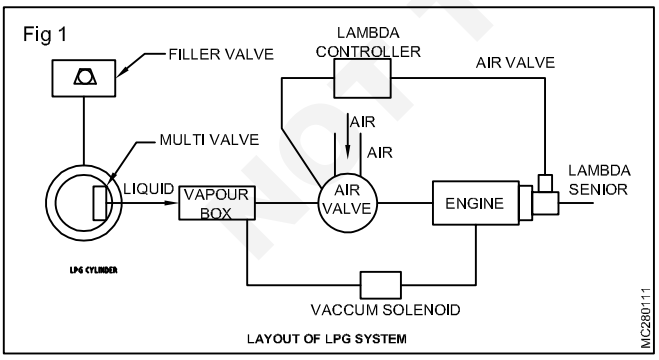


Fig 1

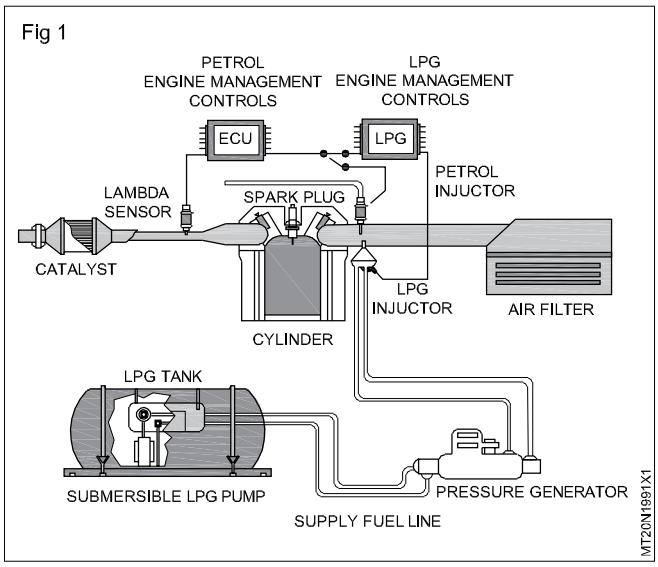
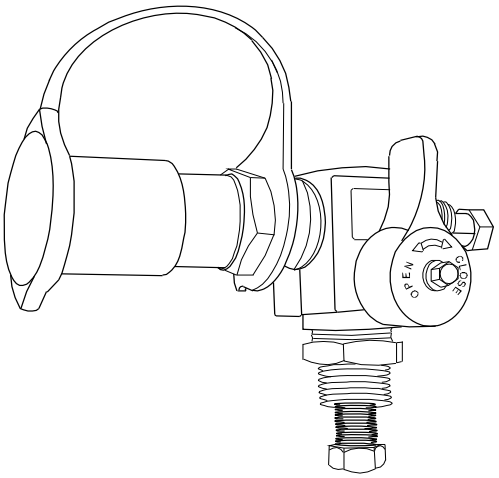
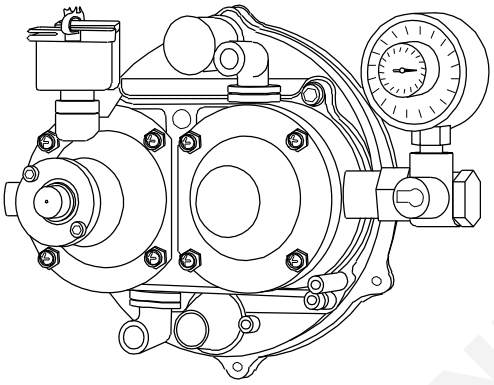


Fig 2



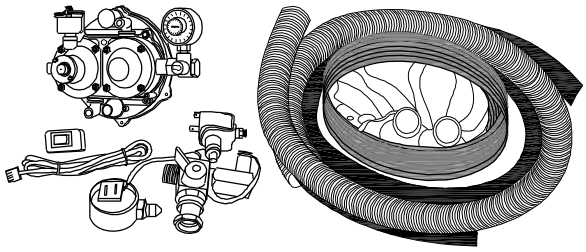
MT20N1991X2

Fig 3



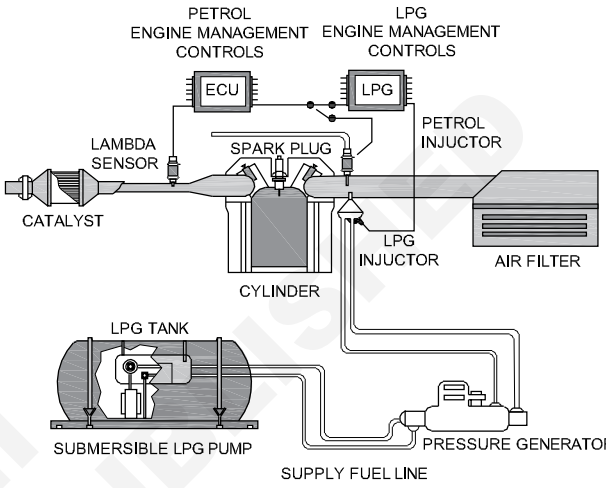
MT20N1991X3

Fig 4



MT20N1991X4

Fig 5



MT20N1991X5

Trouble shooting of LPG kit	
Trouble	**Remedies**
Air gas valve leak	Replace valve
AG gas valve pipe joint leaks	Tighten it
Empty gas cylinder	Fill the gas
Multifunction valve defective	Replace
Shut off valve defective	Replace
Excess slow valve defective	Replace
Gas indicator defective	Replace
Solenoid valve defective	Replace
Petrol solenoid valve defective	Replace
Gas pipe leak / crack	Replace
Gas flexible hose damaged	Replace
Gas control switch and regulator defective	Replace

— — — — — — — —

TASK 2 : **Identify the parts of CNG kit and trouble shooting (Fig 1)**

1 Park on the shop floor

2 Identify CNG storage tank

3 Identify the pressure regulator

4 Identify the fuel shut OFF valve

5 Identify the high pressure line

6 Identify the gas reducing valve

7 Identify the fuel gallery

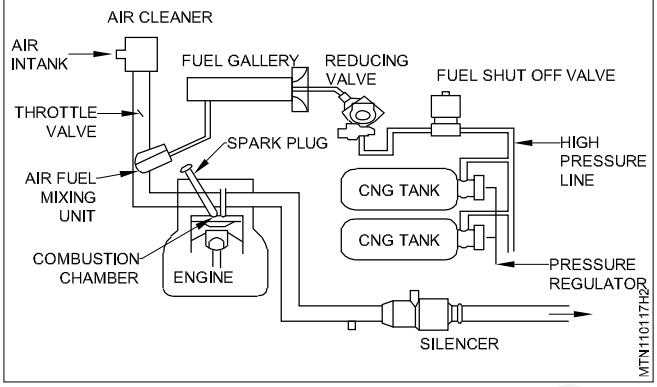
8 Identify the throttle body

9 Identify the air fuel mixing unit

10 Identify the gas filter and air filter

11 Identify the spray bar

Fig 1



Trouble shooting of CNG kit	
Trouble	**Remedies**
Empty CNG tank	Fill the gas
Pressure regulator defective	Replace
Fuel shut OFF valve leak	Replace
High pressure line damage	Replace
Gas reducing valve not work	Replace
Air fuel mixer unit damaged	Replace
Air filter dirty	Clean/replace
Gas filter dirty	Replace
Spray bar holes blocked	Clean

Practice on engine tune up and smoke testing

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

- **adjust the carburettor for optimum engine performance**
- **set /correct the ignition timing**
- **clean spark plug and reset the gap**
- **check the brake and clutch optimum engine**
- **check the battery**
- **adjust /correct the settings for performance**
- **set /correct the ignition timing**
- **identify engine problems and their remedy.**

Requirements

Tools / Instruments

- Tacho meter - 1 No.

Equipment / Machinery

- Exhaust Gas analyzer - 1 No.

Materials / components

- Baniyan waste - 1 No.

PROCEDURE

TASK 1: **Engine tune up and setting**

1 Take a road test of the vehicle (for about 2 kms)

2 Ensure the acceleration is good and smooth

3 Ensure that the firing is smooth (timing to bt checked if engine misfires)

4 Check the brake and the suspension are functioning properly

5 Adjust the brake pedal free play to required level

6 Adjust the clutch lever free play that the engage and disengage is smooth.

7 Check whether all the instruments in the console are functioning properly, headlight, tail tamp, lamp, and brake light, left and right blinkers.

8 Adjust the chain tension (if the ply is large and adjustment is necessary)

9 Tune up the carburettor for correct idling condition.

10 Check the ignition timing and take corrective action if necessary.

11 Ensure that all the engine bolts are tightened to required torque using torque wrench (if there are any over / under tightened bolts it may lead to vibration and stress and the bolt may fail prematurely)

12 Properly inflate the tyres - 25 psi for the front and 29 psi for the rear (Solo) and 27 psi and 32 psi with pillion rider (refer to service manual for recommended tyre pressure for each vehicle)

13 Check the battery for electrolyte level and proper current rating. Also check the sp. gravity of the battery and ensure it is satisfactory.

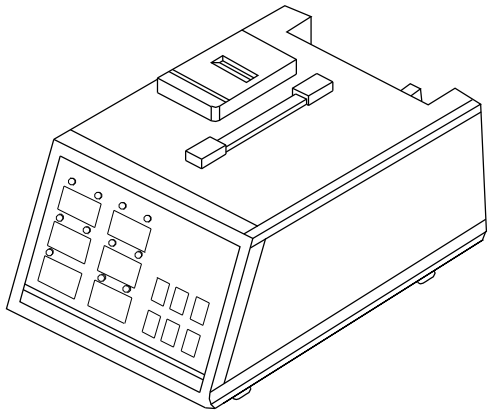
14 Chuck cam shaft sprocket and timing chain if need replace it.

15 Check the valve if need adjust the valve clearance.

16 Clean the spark plug and adjust the spark plug gap.

17 Start the engine and check the performance of engine.

Fig 1



MTN110118H1

TASK 2: **Preparing the engine for testing**

1 Insert the ignition key on the ignition switch and turn on.

2 Start the engine.

3 Run the engine at idle speed for at least 10 minutes to bring its normal operating temperature.

4 Switch off the engine.

5 Check the engine idling RPM with tachometer.

6 Set the proper idling if necessary.

— — — — — — — —

TASK 3: **Checking engine emission**

1 Switch on the gas analyzer.

2 Insert the probe of exhaust gas analyzer in to the silencer.

3 Start the engine and run the engine at idle speed.

4 Wait for few seconds till the reading is obtained on the screen.

5 Compare the values obtained with the actual values.

6 Tune the engine if necessary and check the CO again.

— — — — — — — —

Practice on servicing electrical vehicle

Objectives: At the end of this exercise you shall be able to
- **operate the equipment according to safety protocols**
- **identify the test equipment**
- **servicing the electric two & three wheeler.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Multimeter - 1 No.
- Tester - 1 No.

Equipments / Machinery

- Electric vehicle - 1 No.
- Test bench - 1 No.

Materials / Components

- Cotton waste - as reqd.
- Soap oil - as reqd.
- wire - as reqd.
- ECU - as reqd.
- Motor - as reqd.
- Chain/belt - as reqd.
- Switches - as reqd.

PROCEDURE

TASK 1: **Servicing procedure of electric vehicle**

1 Check the tyre air pressure and adjust as necessary.

2 Check the tyre wear and replace the damaged tyre

3 Check the brake oil and top up if required

4 Rotate the tyre every 7500 km or every six month

5 Check the power accessories, if damaged or short circulated replace it.

6 Check the battery charging module

7 Check the chassis and steering

8 Lubricate the body components

9 Check the suspension parts wear, cracks or damage

10 Check the drive chain / belt damage

11 Check the sprockets teeth w/o

12 Visually inspect the suspension gas strut damages

13 Check the functions of switches

14 Flush corrosive materials from the body using plain water

15 Replace the windshield wiper blade in three wheeler

16 Check the battery condition

17 Check the drive motor

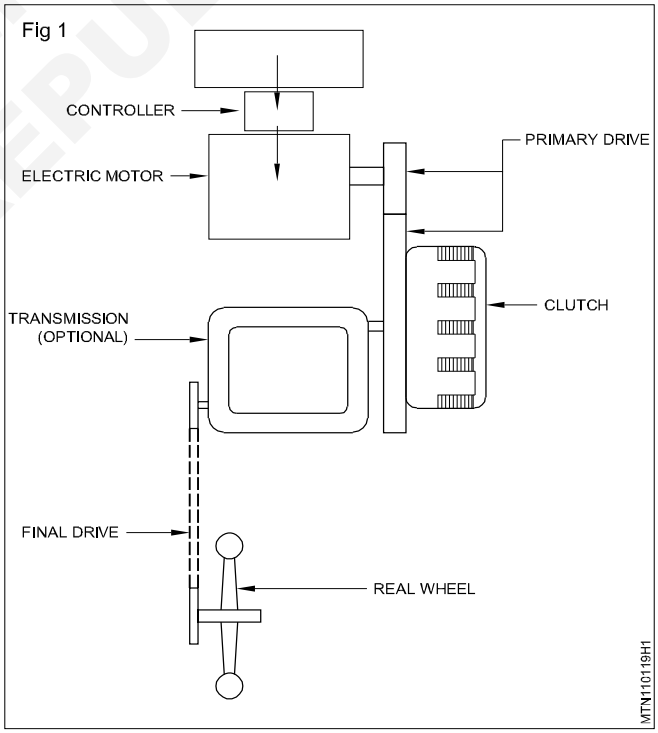
18 Check the lights and its switches

19 Check the transmission output

20 Check the rear wheel

21 Remove the battery connection before check the any EV circuits continuously

Fig 1



22 Use the electrical diagnostic equipment appropriate to EV being diagnosed and repaired including the

Insulation tester

Scam tool

Residual voltage tester

Digital multimeter cat III 1000 volt rating

Insulation tester

Oscilloscope

Identify the basic propulsion system of electrical vehicle

Objectives: At the end of this exercise you shall be able to
- **identify the parts of Electric Vehicle propulsion parts**
- **identify the power transfer systems in Electric vehicle.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- User Manual - 1 No.

Equipments / Machinery

- Electric Two wheeler - 1 No.
- Electric Three wheeler - 1 No.

Materials / Components

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

PROCEDURE

1 Identification of electric vehicle basic propulsion system

2 Park the electric vehicle on the plain ground of workplace.

3 Jack up the drive wheel of (EV) Electric vehicle.

4 Refer the user hand book for EV operating system.

5 Identify parts of EV propulsion system in manual diagnose.

6 Refer the parts of the diagram with EV. (Refer exercise)

7 Check the vehicle power transmission system whether direct drive or indirective are provided on the vehicle.

8 Identify the battery location

9 Identify the control unit

10 Identify the starting switch

11 Identify the drive mode switch

12 Trace the wire harness

13 Identify the Electric motor (front / rear wheel drive)

14 Identify the Electric motor primary drive

15 Identify the clutch, transmission if provided

16 Identify the chain/ belt (if provided). connect the motor to the drive wheel

17 Identify the drive motor technology (AC/DC drive)

— — — — — — — —

Practice on diagnose, repair and test power electric circuit of electric vehicle

Objectives: At the end of this exercise you shall be able to
- **Diagnose the repair of Electric drive system**
- **Diagnose the repair of electric circuit of Electric drive system**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Multimeter - 1 No.
- Tester - 1 No.

Equipments / Machinery

- Electric vehicle - 1 No.
- Work bench - 1 No.
- Battery charger - 1 No.

Materials / Components

- Cotton waste - as reqd.
- Soap oil - as reqd.
- Wire - as reqd.
- Wire harness - as reqd.
- Control unit - as reqd.
- Drive Motor - as reqd.
- Switches - as reqd.

PROCEDURE

1 Diagnose the repair in electric circuit of electric drive system

2 Check the battery for over heating, physical impact damage, Chemical leakage, smoke or water damage.

3 Test the battery sealing and electric test.

4 Use the isolated tools during diagnose the fault in electronic circuit

5 Check electrical drive trains system

6 Check the battery grounding connections

7 Check the fuses if power is not supply to the drive system

8 Check the ignition switch and drive mode switches if power is not flow through switch replace the switch

9 Check the electronic circuit wire connections if lose or damaged replace, tighten or replace it.

10 Check the drive motor drive condition and speed if found any fault like not run, very slow speed and internal noise, replace the drive motor

11 Check the motor wire connections if loose connection correct it

12 Check the control unit wire connections

13 Check the sensors function if not work replace the sensors

14 Check the wire continuity with multimeter if any damage, is correct short circuit, disconnect found rectify the fault, after repair again recheck and ensure the circuit continuity is correct.

— — — — — — — —

Practice on diagnose, repair and test motor controls

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

- **Diagnose the repair and test the drive motor control system**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Multimeter - 1 No.
- Test lamp - 1 No.
- Continuity Tester - 1 No.

Equipments / Machinery

- Electric vehicle - 1 No.
- Test bench - 1 No.

Materials / Components

- Cotton waste - as reqd.
- Soap oil - as reqd.
- Control unit - as reqd.
- Drive Motor - as reqd.

PROCEDURE

1 Preparing the engine for testing

2 Check the controller inputs

3 Check the controller outputs

4 Check the controller resolves

5 Check the battery interface

6 Use the seam tool to diagnose the fault in control unit

7 Diagnostic the trouble code and repair the fault

8 Check the fuse connection and rectify the fault

9 Check the controller input and output signal and wave forms

10 Tighten the loose connection and loose momenting of control unit and rectify the fault

11 Replace the faulty or damaged cable connections

12 Replace the faulty and damaged parts of control unit

13 Removing and replacing motor speed controller

14 Check the electrical connectors mating

15 Check the sensors and replace the defective sensors

— — — — — — —

Practice on Diagnose, repair and test high voltage battery

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

- **Diagnose the repair and test the high voltage battery.**

Requirements

Tools/Instruments

- Trainees tool kit - 1 No.
- Multimeter - 1 No.
- Voltmeter - 1 No.
- Ampire meter - 1 No.
- Insulated Tester - 1 No.

Equipment and machineries

- Electric vehicle with high voltage battery - 1 No.
- Test bench - 1 No.
- Battery charger - 1 No.

Materials

- Battery - 1 No.
- Cotton waste - 1 No.
- Soap oil - 1 No.
- Wire - 1 No.

PROCEDURE

1 Diagnose, repair and repairing damaged batteries

2 Observe safety information prior to commencing work on the high voltage battery

3 Carry out a dynamic risk assessment of the vehicle and work to be carried out.

4 Select and wear correct and appropriate personal protection clothing and equipment as advised by the manufacturer.

5 Inspect the external and visible parts of the high voltage battery for signs of damage

6 Check the battery cable connections.

7 Follow the battery manufacturer's instructions, if damage to the high voltage components has been found replace the damaged parts.

8 Use the diagnostic and test equipment for battery testing

9 Interpret the results obtained from the diagnostic test equipment.

10 Ensure all work carried out takes place immediately following inspection as possible.

11 Isolate the high voltage system as per manufacturer's guidelines.

12 Select the appropriate tools as per guidelines and specifications.

13 Carry out visual inspection of battery.

14 Remove the high voltage battery and place it in a suitable, isolated area with restricted access.

15 Remove the battery housing to carry out a visual inspection.

16 Ensure the high voltage battery is made safe and access to the storage area restricted if the battery is left unattended.

17 Reduce the battery voltage to a safe working limit in line as per guide line.

18 Select the new components for damaged prior to installation using visual inspection method.

19 Inspect all new components by using visual inspection methods.

20 Ensure the integrity of repair prior to reestablishing the normal operating battery system voltage.

21 Re-establish the normal operating battery voltage in line with manufacturer's guidelines.

22 Reassemble the battery housing.

23 Recommission the battery in line with recommended guideline using specialist high voltage test equipment.

24 Re- install the battery following manufacturer's recommend guidelines with particular attention to any potential equalisation connections.

25 Reinstable the vehicle following manufacturer's guidelines

26 Carryout diagnostic test prior the hand over of the vehicle.

27 Ensure records of work are accurate complete and passed to the relevant person in the formats required.

Practice on storage, dispose the high voltage battery

Objectives: At the end of this exercise you shall be able to
- **storage, dispose the high voltage battery**
- **check the inverter assembly.**

Requirements

Tools/Instruments

- Trainees tool kit - 1 No.
- Multimeter - 1 No.

Equipment and machineries

- Electric vehicle - 1 No.
- High voltage battery - 1 No.

Materials

- Inverter - 1 No.
- Cotton waste - 1 No.
- Soap oil - 1 No.

PROCEDURE

TASK 1: **Storage the high voltage battery**

1 Disconnect the battery terminals
2 Remove the battery mounting bolts
3 Removing the battery housing
4 Clean the battery and visually inspect the battery
5 Carry the battery to charging station
6 After charging check the battery voltage
7 Carry the battery to battery storage ventilated room
8 Place the battery on the storage racks
9 Ensure battery storage room is very safe as per battery manufacturer's guidelines.

— — — — — — — —

TASK 2: **Handle and dispose of high voltage battery system**

1 Check the high voltage battery damage by visual inspection.
2 If found battery is damaged and then carry the battery with safe to battery dispose spot.
3 Dispose the battery carefully where it is not effect on human health and others.
4 Otherwise send the battery to recycling spot.

— — — — — — — — —

TASK 3: **Check the inverter assembly of Electric vehicle**

1 Park the vehicle on surface work floor.
2 Check the battery charge conditions by specified tools.
3 Check the battery connection with inverter
4 Check the inverter's input voltage.
5 Check the inverter's output voltage.
6 Check the AC voltage input of drive motor.

— — — — — — — —