MECHANIC AUTO ELECTRICAL & ELECTRONICS

NSQF LEVEL - 3

TRADE PRACTICAL

SECTOR: AUTOMOTIVE

(As per revised syllabus July 2022 - 1200Hrs)

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

Trades : Mechanic Auto Electrical & Electronics - Trade Practical - NSQF Level - 3 (Revised 2022)

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FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, by 2020 to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of 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 Auto Electrical & Electronics Trade Practical NSQF Level - 3 (Revised 2022) in Automotive Sector under Yearly 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

Addl.Secretary / Director General (Training)
Ministry of Skill Development & Entrepreneurship
Government of India.

New Delhi - 110 001

PREFACE

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

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

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

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

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

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

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

Chennai - 600 032 **EXECUTIVE DIRECTOR**

ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisation to bring out this IMP **(Trade Practical)** for the trade of **Mechanic Auto Electrical & Electronics** under the **Automotive** Sector for ITIs.

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

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

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

INTRODUCTION

TRADE PRACTICAL

The trade practical manual is intented to be used in workshop . It consists of a series of practical exercises to be completed by the trainees during the course of the **Mechanic Auto Electrical & Electronics** 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)

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

Module 1 - **Safety Workshop Practices**
Module 2 - **Measuring & Marking Practice**
Module 3 - **Fastening & Fitting**
Module 4 - **Basic Electrical & Electronics**
Module 5 - **Vehicle Specifications & Service Equipments**
Module 6 - **Electrical and electronic components**
Module 7 - **Starting and charging system**
Module 8 - **Electronic fuel and vehicle control system**
Module 9 - **Heating ventilation air conditioning (HVAC)**
Module 10 - **Trouble shooting in electrical system**

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 Auto Electrical & Electronics Trade. The contents are sequenced according to the practical exercise contained in the manual on Trade practical. Attempt has been made to relate the theortical aspects with the skill covered in each exercise to the extent possible. This co-relation is maintained to help the trainees to 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 indicating about the corresponding practical exercise are given in every sheet of this manual.

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

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

CONTENTS

LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

S.No	Learning Outcome	Lesson No
1	Use different types of tools and work shop equipment in the Auto work shop following safety precautions.	1.1.01 - 1.2.08
2	Perform precision measurements on the components and compare parameters with specifications used in automotive work shop practices.	1.2.09
3	Use different types of tools and work shop equipment in the Auto work shop following safety precautions.	1.3.10 - 1.3.13
4	Perform basic fitting operations used in the work shop practices and inspection of dimensions.	1.3.14 - 1.3.17
5	Construct electrical circuits and test its parameters by using electrical measuring instruments.	1.4.18 - 1.4.19
6	Perform basic electrical testing in a vehicle.	1.4.20
7	Perform battery testing and charging operations.	1.4.21 - 1.4.24
8	Construct basic electronic circuits and testing.	1.4.25 - 1.4.26
9	Check & Interpret Vehicle Specification data and VIN. Select & operate various Service Station Equipment's.	1.5.27 - 1.5.31
10	Identify the major components of LMV/HMV and dashboard gauges.	1.5.32 - 1.5.34
11	Identify and Check wiring circuits and the electrical components in the vehicle.	1.6.35 - 1.6.36
12	Trace /troubleshoot different wiring circuits in vehicle and prepare different electrical joints.	1.6.36
13	Check and overhaul the ignition system.	1.6.37 - 1.6.41
14	Apply appropriate rule and tools for starting and Charging system and diagnose & rectify faults.	1.7.42 - 1.10.51
15	Understand the constructional features and working principles of EDC/MPFI system.	1.10.52 - 1.10.60
16	Inspect power Steering control module and troubleshooting power steering.	1.9.61 - 1.10.65
17	Diagnosis for all comfort system.	1.10.66 - 1.10.69
18	Demonstrate the skill of automotive lighting system and their troubleshooting.	1.10.70 - 1.10.83
19	Trouble shoots in all electrical circuits.	1.10.84 - 1.10.89

SYLLABUS FOR MECHANIC AUTO ELECTRICAL & ELECTRONICS

Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With inidcative hour)	Professional Knowledge (Trade Theory)
Professional Skill 112Hrs; Professional Knowledge 25Hrs	Use different types of tools and work shop equipment in the Auto work shop following safety precautions.	1 Familiarization with institute, Job opportunities in the automobile sector, Machinery used in Trade. (10 hrs) 2 Types of work done by the students in the shop floor. (15 hrs) 3 Practical related to Safety and Health, Importance of maintenance and cleanliness of Workshop. (08 hrs) 4 Interaction with health centre and fire service station to provide demo on First aid and Fire safety, Use of fire extinguishers.(07 hrs) 5 Demonstration on safe handling and Periodic testing of lifting equipment, and Safety disposal of used engine oil. (08 hrs) 6 Energy saving Tips of ITI electricity Usage. (02 hrs) 7 Practice using all marking aids, like steel rule with spring calipers, dividers, scriber, punches, Chisel etc., Layout a work piece- for line, circle, arcs and circles.(40hrs) 8 Practice on removing and refitting of Dash Board. Front, Rear bumpers and other electrical components (22 Hrs)	Admission & introduction to the trade: Introduction to the Course duration, course content, study of the syllabus. General rule pertaining to the Institute, facilities available- Hostel, Recreation, Medical and Library working hours and time table. (07hrs) Occupational Safety & Health Importance of Safety and general Precautions to be observed in the shop. Basic first aid, safety signs - for Danger, Warning, caution & personal safety message. 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. Energy conservation-Definition, Energy Conservation Opportunities (ECOs)-Minor ECOs and Medium ECOs, Major ECOs), Safety disposal of Used engine oil, Electrical safety tips. (07hrs) 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, center punch, pin punch, hollow punch, number and letter punch. Chisel-flat, cross- cut. Hammer- ball pein, lump, mallet. Screw drivers-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 (11hrs)
Professional Skill 28 Hrs; Professional Knowledge 04 Hrs	Perform precision measurements on the components and compare parameters with specifications used in automotive work shop practices.	9 Practice on measuring the given component using precision measuring equipment like Vernier caliper, Micrometer (28 Hrs)	Systems of measurement, Description, care & use of - Micrometers- Outside and depth micrometer, Micrometer adjustments, Vernier calipers, Dial indicators, ,thread pitch gauge, (04hrs)

Professional Skill 56 Hrs; Profssional knowledge 10 Hrs	Use different types of tools and work shop equipment in the Auto work shop following safety precautions. Use of different type of fastening and locking devices in a vehicle.	10 Practice on General cleaning, checking and use of nut, bolts, & studs etc.(16 hrs) 11 Removal of stud/bolt from blind hole. (06 hrs) 12 Practice on cutting tools like Hacksaw, file, chisel, Sharpening of Chisels, center punch, safety precautions while grinding. (20 hrs) 13 Practice on Hacksawing and filing to given dimensions. (14 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. 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. (10 hrs)
Professional Skill 56 Hrs; Professional Knowledge 12 Hrs	Perform basic fitting operations used in the work shop practices and inspection of dimensions.	14 Practice on Marking and Drilling clear and Blind Holes, Sharpening of Twist Drills Safety precautions to be observed while using a drilling machine.(18 hrs) 15 Practice on Tapping a Clear and Blind Hole, Selection of tape drill Size, use of Lubrication, Use of stud extractor. (16 hrs) 16 Cutting Threads on a Bolt/ Stud. (10 hrs) 17 Adjustment of two piece Die, Reaming a hole/ Bush to suit the given pin/ shaft, scraping a given machined surface. (12 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. Screw extractors. Hand Reamers - Different Type of hand reamers, Drill size for reaming, Lapping, Lapping abrasives, type of Laps. (12 hrs)
Professional Skill 28 Hrs; Professional Knowledge 07 Hrs	Construct electrical circuits and test its parameters by using electrical measuring instruments.	18 Practice in joining wires using soldering Iron, Construction of simple electrical circuits.(16hrs) 19 Measuring of current, voltage and resistance using digital multimeter, practice continuity test for fuses, jumper wires, fusible links, circuit breakers.(12 hrs)	Basic electricity, Ground connections, Voltmeter, ammeter, Ohmmeter, Multimeter, Conductors & insulators, Wires, Shielding, Length vs. resistance, Resistor ratings. (07 hrs)
Professional Skill 28 Hrs; Professional Knowledge 05 Hrs	Perform basic electrical testing in a vehicle.	20 Diagnose series, parallel, series-parallel circuits using Ohm's law, 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. (28 hrs)	Fuses & circuit breakers, Ballast resistor, Stripping wire insulation, cable colour codes and sizes, Resistors in Series circuits , Parallel circuits and Series-parallel circuits, Capacitors and its applications, Capacitors in series and parallel.(05 hrs)
Professional Skill 28 Hrs; Professional Knowledge 04 Hrs	Perform battery testing and charging operations.	21 Cleaning and topping up of a lead acid battery, testing battery with hydrometer. (08 hrs) 22 Connecting battery to a charger for battery charging, Inspecting & testing a battery after charging.(08 hrs) 23 Measure and Diagnose the cause(s) of excessive Key-off battery drain	Batteries & cells, Lead acid batteries & Stay Maintenance Free (SMF) batteries, Thermisters, Thermo couples, Relays, Solenoids, Charging system circuit (04 hrs)

		(parasitic draw) and do corrective action. (07 hrs) 24 Testing of relay and solenoids and its circuit. (05 hrs)	
Professional Skill 28 Hrs; Professional Knowledge 07 Hrs	Construct basic electronic circuits and testing.	25 Identify and test power and signal connectors for continuity, Identify and test different type of Diodes, NPN & PNP Transistors for its functionality.(16 hrs) 26 Construct and test simple logic circuits OR, AND & NOT and Logic gates using switches. (12 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 28Hrs; Professional Knowledge 04 Hrs	Check & Interpret Vehicle Specification data and VIN. Select & operate various Service Station Equipment's.	27 Identification of different type of Vehicle. (04 hrs) 28 Demonstration of vehicle specification data.(06 hrs) 29 Identification of vehicle information Number (VIN). (04 hrs) 30 Demonstration of Garage, Service station equipments. (07 hrs) 31 Vehicle hoists - Two post and four post hoist, Engine hoists, Jacks, Stands.(07 hrs)	Auto Industry - History, leading manufacturers, development in automobile industry, trends, new product. Brief about Ministry of Road transport & Highways, 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 -Two post and four post hoist, Engine hoists, Jacks, Stands. (04 hrs)
Professional Skill 28Hrs; Professional Knowledge 07 Hrs	Identify the major components of LMV/ HMV and dashboard gauges.	32 Identification of parts in a diesel/ petrol engine of LMV/ HMV.(08 hrs) 33 Practice on starting and stopping of diesel/petrol engines. (12 hrs) 34 Observe and report the reading of Tachometer, Odometer, temp and Fuel gauge under ideal and on load condition. (08 hrs)	Introduction to Engine: Principle & working of 4-stroke diesel engine (Compression ignition Engine (C.I), Principle of Spark Ignition Engine (SI), difference between C.I. engine and S.I Engine, 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 gear shift position, Seat belt warning light, Parking-brake-engagement warning light and an Engine-malfunction light. Different type of starting and Stopping method of Petrol/Diesel Engine. (07 hrs)
Professional Skill 28Hrs; Professional Knowledge 07 Hrs	Identify and Check wiring circuits and the electrical components in the vehicle.	35 Practice to identify components and their locations indicated on the wiring diagram. (12 hrs) 36 Practice to identify the power source, ground connection, and controls for electrical circuits using a wiring diagram.(16 hrs)	Electrical and Electronic Components:- Switches-Description of Normally open, Normally closed, single pole single throw switch (SPST), ganged, and mercury switches used in Automobile circuit. Description of Relay, ISO Relays, Solenoids, Buzzers. Resistors- Description of different type of resistors and their color codes - Fixed, stepped, and variable resistors-Rheostat, Potentiometer. Description of Diodes, Diode identification and ratings, zener diodes, Avalanche diodes, Light emitting diodes, photo diodes and clamping diodes.

			Transistors- Description of NPN, PNP, field-effect transistor (FET), phototransistors. Description of Integrated circuits. Circuit protection devices- Description of fuses, different type of fuses- glass or ceramic, blade and bullet or cartridge fuses. Fusible links, maxi fuses, circuit breaker, Positive Temperature coefficient (PTC) resistor device. (07 hrs)
Professional Skill 28Hrs; Professional Knowledge 05 Hrs	Trace /troubleshoot different wiring circuits in vehicle and prepare different electrical joints.	36 A Diagnosis and remedy for- Speedometer shows no operation, fuel level meter shows no operation, coolant temp meter shows no operation, Oil pressure light shows no lighting. (28 hrs)	Wiring and circuit diagrams- Automotive wiring. Comparison between solid and stranded primary wire. Description of wire size- Metric and American wire gauge (AWG), Importance of ground straps used in automotive wiring. Description of different type of terminals and connectors- Molded, multiple-wire hard shell, bulkhead, weather-pack, metri-pack, heat-shrink covered butt connectors. Importance of printed circuit boards, wiring harnesses, wiring diagrams and color codes and circuit numbering. Study of common electrical and electronic symbols used in wiring diagrams. (05 hrs)
Professional Skill 28 Hrs; Professional Knowledge 04 Hrs	Check and overhaul the ignition system.	37 Check and replace ignition coil, Check ignition timing, Checking & changing a spark plug (04 hrs) 38 Diagnosis- Possible causes and remedy for Engine cranks, but will not or hard to start, Poor fuel economy or engine performance. (06 hrs) 39 Identification and testing of Hall effect sensor, Optical sensor. (08 hrs) 40 Tracing and testing of sensor circuits.(05 hrs) 41 Tracing of Distributor less ignition systems circuit. (05 hrs)	Ignition principles and Primary and secondary winding of Ignition components, Spark plugs, Spark plug components, ballast resistor coil, Dwell angle, Spark timing. Battery power source, Description and function of Capacitor/condenser, High-tension leads, Induction wiring, Hall effect sensors, Hall effect operation, Optical type sensors Distributor less ignition systems, Insulated coils, Distributor less ignition system timing. (14 hrs)
Professional Skill 56Hrs; Professional Knowledge 10Hrs	Apply appropriate rule and tools for starting and Charging system and diagnose & rectify faults.	42 Removing starter motor from v e - hicle, and Performance test for pull-in test, Hold-in test, pinion (plunger) return test, No- load performance test. (08 hrs) 43 Solenoid test for Hold in coil open circuit, Armature test - Ground test, Open circuit test, pull-in coil open circuit test, field coil test. (04hrs) 44 Inspections of brush length wear as per service manual. (02 hrs) 45 Trouble shooting, possible causes and remedy for starter motor not running, Starting motor running but too slow (small torque), staring motor running, but not cranking engine. Noise, starting motor does not stop	Starting system- purpose of starting system, Staring system components, Starter motor principles, study of starter control circuits. Starter motor construction, Starter magnet types, Starter motor engagement, Commutation, Switching, solenoid construction. (05 hrs)

		running. Growler testing for rotors.(08hrs) 46 Checking a starting system, Jump-starting a vehicle. (06 hrs)	
		47 Checking a charging system for the Cause of undercharge, No charge, and over charge conditions. (04 hrs) 48 Removing & replacing an alternator, Inspection of rotor for ground, open circuit - field coil resistance, slip ring surface, Fan, bearing. (06 hrs) 49 Inspection of stator for ground, open circuit, Inspection of Drive end bearing rotation, Rectifier, brush length compare with service manual. (06 hrs) 50 Slip ring surface. Inspecting & adjusting an engine drive belt, replacing an engine drive belt / pulleys / Tesnionsers and their alignments. (06 hrs) 51 Trouble shooting, possible causes and remedy for warning lamp does not glow when ignition switch is on, Warning lamp glows dim when ignition switch is on, warning lamp 'on' while the alternator is running, Warning lamp glows 'dim' while the alternator is running, warning lamp flickers considerably. (06 hrs)	Charging system- The purpose of Charging system, charging system components, charging system circuit, Alternator principles, Alternating current, Alternator components, Rectification, Phase winding connections, Rotor circuit, Voltage regulation, System operating voltage, High voltage charging systems, Rotor, Stator, Alternator end frames, Slip ring & brush assembly, Rectifier assembly, Alternator cooling fan. (05 hrs)
Professional Skill 84 Hrs; Professional Knowledge 12 Hrs	Understand the constructional features and working principles of EDC/MPFI system.	52 Identification of EDC components, sensors, testing of sensors and actuators. (14 hrs) 53 Identification of various components of MPFI system.(06hrs) 54 Testing of MPFI components and replacement if necessary. (04 hrs) 55 Check delivery from fuel Pump. Replacing a fuel filter. (02 hrs) 56 Identification of Electronic control Unit. (07hrs) 57 Set up for testing, Testing of Electronic Control Circuit. (08 hrs) 58 Fault finding in Electronic circuit and remedies using scan tool. (18hrs) 59 Identification of various sensors installed in engine & its mounting. (10 hrs) 60 Testing of Temperature sensor, Pressure senor, potentiometer, magnetic induction sensor, cam shaft sensor, crankshaft position sensor. (15 hrs)	Electronic Diesel control- Electronic Diesel control systems, Common Rail Diesel Injection (CRDI) system, Hydraulically actuated electronically controlled unit injector (HEUI) diesel injection system. Sensors, actuators and ECU (Electronic Control Unit) used in Diesel Engines. Introduction to Electronic fuel injection (EFI) fuel supply system, Multi-point injection systems (MPI/MPFI), EFI air cleaners, Electronic mufflers, EFI fuel supply system components- Description of Fuel pumps, EFI sensors, Potentiometer, Auxiliary air valves, Idle speed control devices, Inertia sensors. Introduction to EFI Engine Management - EFI operation Modes of EFI, Idle speed control systems, Feedback & looping, Cold start systems, Air measurement, Airflow monitoring, Variable intake manifold system, Electrical functions, EFI wiring diagram, Electronic control unit - ECU, EFI system ECU, Electronic control unit settings, Engine speed limiting, Malfunction indicator lamp. Importance of Diagnostic Trouble Code (DTC) & its general format. Use of scan tool and retrievals of codes. (07hrs)

			EFI sensors- Description, location and function of Intake Temperature sensor, Mass airflow sensor, Manifold absolute pressure sensor, Air vortex sensor, Fuel system sensor, Throttle position sensor, Exhaust gas oxygen sensor, Crank angle sensor, Hall effect voltage sensor. (05 hrs)
Professional Skill 28 Hrs; Professional Knowledge 07 Hrs	Inspect power Steering control module and troubleshooting power steering.	61 Inspection of power steering control module circuit. (04 hrs) 62 Trouble shooting and remedy for steering wheel feels heavy at low speed, poor recovery from turns, Vehicle pulls to one side during straight driving. (06 hrs) 63 Identification of ABS components, checking of ABS warning lamp. (04 hrs) 64 Identification of Automatic transmission components. (04 hrs) 65 Inspection of shift lever switch, throttle position sensor, speed sensor and automatic transmission wiring harness coupler.(10 hrs)	Steering, suspension and Brakes:- Description of Electric power assisted steering and it's wiring circuit. Basic electric power steering operation, Electronic adjustable-rate shock absorbers, Electric brakes, Electro hydraulic braking (EHB), ABS brake system, Antilock braking system operation, Principles of ABS braking, ABS master cylinder, Hydraulic control unit, Wheel speed sensors, ABS with Electronic Brake force Distribution (EBD) control unit. Electronic control transmission- Electronic control Unit, Fully hydraulically controlled transmission, Electronic shift programs, Manual selection. (07 hrs)
Professional Skill 56 Hrs; Professional Knowledge 10 Hrs	Diagnosis for all comfort system.	66 Identification of Air conditioning components, Performance test on A/c unit, Checking Charged state of refrigerant, Inspecting & adjusting an engine drive belt, replacing an engine drive belt. 67 Checking a heating system, Compressor rotation test, air Gap check, Refrigerant recovery - evacuating - charging of A/c system. 68 Replenishing compressor oil level Trouble diagnose and remedy for No cooling or warm air, Cool air comes out only intermittently, cool air comes out only at high, Insufficient cooling, Abnormal noise from compressor Magnetic clutch, condenser, evaporator, blower motor. 69 Diagnosis test for high pressure gauge pressure high low, pressure gauge for pressure high low.(56 hrs)	Heating Ventilation Air Conditioning (HVAC) legislation, Vehicle heating, ventilation & cooling systems, Basic air-conditioning principles, Air-conditioning capacity, Air-conditioning refrigerant, Humidity, Description and function of Fixed orifice, Control devices, Thermostatic expansion valve system, Thermal expansion valves, Air-conditioning compressors, Condensers & evaporators, Receiver drier, Lines & hoses, TX valve construction, Temperature monitoring thermostat, Refrigerants, Pressure switches, Heating elements. Air-conditioning ECU, Ambient air temperature sensor, Servo motors, Electric servo motors, Automatic climate control sensors, Evaporator temperature sensor, Blower speed control, Ventilation systems. (10 hrs)
Professional Skill 56 Hrs; Professional Knowledge 10 Hrs	Demonstrate the skill of automotive lighting system and their troubleshooting.	70. Trace the light circuit - test bulbs, align head lamps, aiming headlights. (02 hrs) 71 Changing a headlight bulb, checking of a head light switch and to replace if faulty. (02 hrs) 72 Trouble shooting and remedy for Headlight - headlight do not light up, only one headlight does not light up, Only one beam ("Hi" or "Lo") does not light.(04 hrs) 73 Trouble shooting and remedy for	Discharge (HID) headlights. Headlight & dimmer circuits, Park & tail light circuits, Brake light circuits, turn signal circuit, Cornering lights, Fog lights circuit, interior lights- courtesy, reading and instrument panel lights, Smart lighting , Reverse lights. (10 hrs)

		turn signal and hazard warning lights -Flash rate high or one side only flashes, No Flashing, flash rate low.(04 hrs) 74 Trouble shooting and remedy for clearance, tail and license plate lights -All lights do not light up, some lights do not light up.(02hrs) 75 Trouble shooting and remedy for Back-up light - Back-up lights do not light up. (03 hrs) 76 Trouble shooting and remedy for Brake lights - Brake lights do not light up, Brake light stay on.(03 hrs) 77 Trouble shooting and remedy for fuel meter and fuel gauge unit - Fuel meter shows no operation or incorrect operation. (03hrs) 78 Trouble shooting and remedy for Engine coolant Temp (ECT) meter and ECT Sensor - Engine coolant temp meter shows no operation or incorrect operation.(04 hrs) 79 Lighting system, Lamps/light bulbs, Lamp/light bulb information, LED lighting, Headlights-description of standard sealed beam, halogen sealed beam, composite and high intensity discharge (HID) headlights. (08 hrs) 80 Headlight & dimmer circuits, Park & tail light circuits, Brake light circuits, turn signal circuit, Cornering lights, Fog lights circuit, interior lights- courtesy, reading and Trouble shooting and remedy for oil pressure light - Oil pressure warning light does not light up when ignition switch is on at engine off.(08 hrs) 81 Trouble shooting and remedy for brake and parking brake warning light- Brake warning light does not light up when fluid flow level, Brake warning light does not light up when parking brake pull up, Brake warning lights stay on.(09 hrs) 82 Trouble shooting and remedy for interior light- Interior light do not light up.(02hrs) 83 Trace the wiring circuit of traffic signal flashers light circuit-tracing defects in the flasher circuits, replacing fuse bulb.(02hrs)	
Professional Skill 56 Hrs; Professional Knowledge 10 Hrs	Trouble shoots in all electrical circuits.	84 Trouble shooting and remedy for Horn- No horn operation, poor sound quality, horn sounds continuously and to replace the horn if faulty. (12 hrs)	Accessories: Horn circuit, wiper circuit, power window components and circuit. Power door lock circuit, automatic door lock circuit, remote keyless entry system circuit, antitheft system, immobilizer system. Navigation system, Car

		85 Remove and install wiper motors and wiper switches.(08 hrs) 86 Checking & replacing wiper blades.(08 hrs) 87 Trouble shooting and remedy for windshield wiper and washer - no operation, intermittent operation, continuous operation, and wipers will not park. (08 hrs) 88 Diagnose causes for improper operation of the windshield washer system and to replace the pump if faulty. (10 hrs) 89 Diagnose the power window system for - all power window motors do not operate, some switches do not operate. (10 hrs)	radio and cassette player, car videos. Description and function of Airbags, Seatbelt, Vehicle safety systems, Crash sensors, Seat belt pretensioners, Tire pressure monitoring systems Integrated communications, Proximity sensors, Reflective displays, Global positioning satellites, Triangulation/ trilateration, Telematics. Application of Automotive bus system- currently used in cars: CAN (Control Area Network) , LIN (Local Interconnect Network), FlexRay™ and MOST (Media Oriented Systems Transport)., Importance of E/E Architecture. (10 hrs)

Identify the machineries/equipments in mechanic auto electrical & electronics trade

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

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Test lamp - 1 No.
- Tester - 1 No.

Equipment / Machines

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

Materials

- Cotton waste - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Brief about the ITI and its functions**

1 Visit to all sections in the workshop.

2 Visit to ITI office and introduce to all sections and explain nature of work in the office.

3 Explain the organization structure of ITI through chart.

4 Explain the facilities provided by the ITI.

5 Give brief details to the students about the trade syllabus.

6 Give brief details about job opportunities in the automobile sector.

7 Ask the students to write the machineries and equipments available in the trade.

8 Ask the students to write the job opportunities in private and government sectors.

— — — — — —

TASK 2: **Introduction to the workshop machineries and equipments**

1 Take the trainees around the workshop.

2 Identify the major workshop machinery like compressor, drilling machines, spark plug tester

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

4 Explain the use of compressed air and its applications.

5 Explain bench drilling machine, pillar drilling machine.

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

Air compressor (Fig 1)

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

Jib crane (Fig 2)

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

Sensitive bench drilling machine (Fig 3)

Fig 1

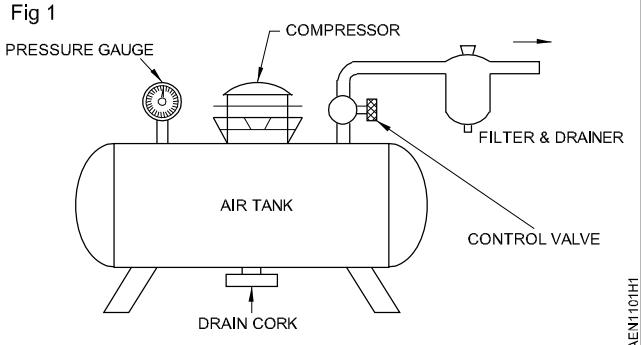
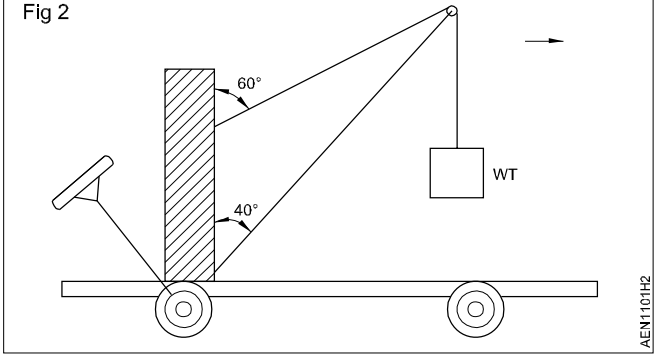


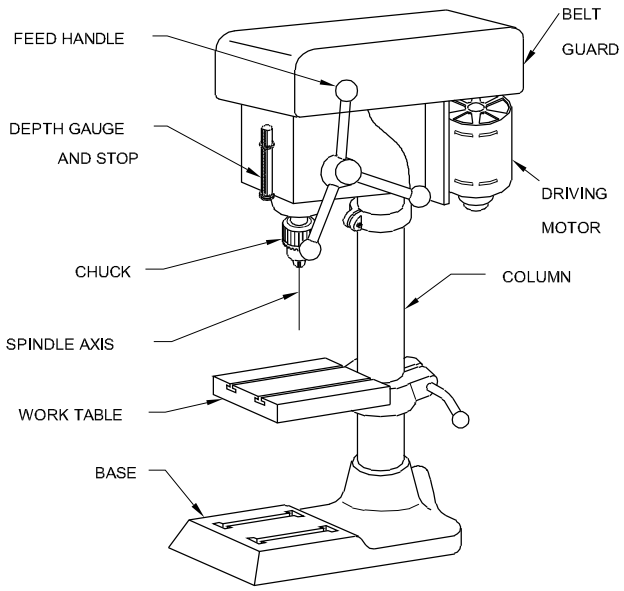
Fig 2



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 is used to clean the dirty spark plugs
- Spark plug tester is used for test the service ability of spark plug

Fig 4

Table 1

Ask the trainee's to write the workshop equipments name in table - 1

S.No	Equipment name	Use of the equipment	Remarks

Identify various work done in the shop floor

Objective: At the end of this exercise you shall be able to
- **identify various work done in the shop floor.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Test lamp - 1 No.
- Tester - 1 No.
- Multimeter - 1 No.

Equipment / Machines

- Vehicle - 1 No.
- Spark plug tester - 1 No.
- Armature tester - 1 No.
- Battery charger - 1 No.

Materials

- Cotton waste - As reqd.
- Wire (automobile circuit) - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK: **Identify the various works done in the shop floor**

Work done in the workshop:

1 Check the vehicle electrical circuits

2 Check the battery charge condition

3 Check the vehicle all lights

4 Replace the defective bulbs

5 Replace the defective fuses

6 Check and overhaul the alternator and replace the damaged parts

7 Check and overhaul the starter motor and replace the damaged parts

8 Check and repair the wiper motor and replace the wiper blade and damaged parts

9 Use the hydrometer to check battery charge condition

10 Check the circuit coupler connections

11 Check the circuit continuity by multimeter

12 Replace the damaged wires and circuit breakers

13 Replace the flasher unit

14 Check the panel board switches and replace the defective switches and gauge bulbs

15 Check the all sensors and replace defective sensors

16 Check the ECU wire connections

17 Check the ABS sensors and brake lights

18 Check distributor (or) distributor less ignition systems

19 Check spark plug with spark plug tester.

20 Check the diesel electronic fuel systems.

— — — — — —

Practice to maintain workshop tools and equipments

Objectives: At the end of this exercise you shall be able to
- **carryout the maintenance of equipment**
- **clean the tools and equipment**
- **perform practical related safety in work**
  - **workshop safety rules**
  - **personal protective equipments and its uses**
  - **identification of safety signs.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Safety wears - 1 set

Equipment / Machines

- Sign board - 1 No.
- Work equipments - 1 No.

Materials

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

PROCEDURE

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

1 Clean the tools and equipment for work more efficiently. At the end of each working day clean the used tools and equipment 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 the 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)

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

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.

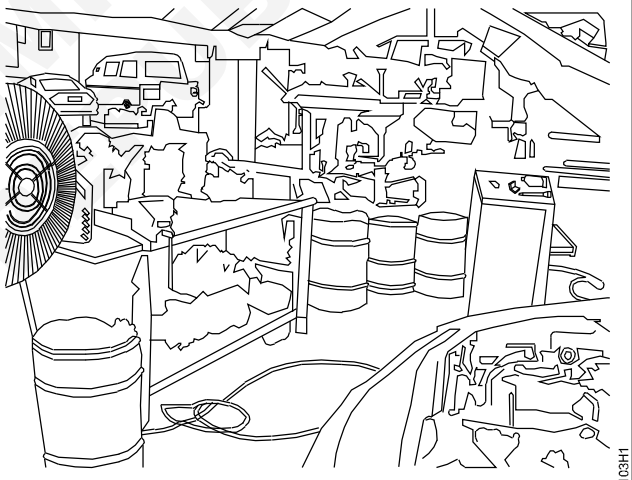
9 Do not pour solvents or other chemicals into the sewage system. This is both environmentally damaging and illegal.

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

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

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

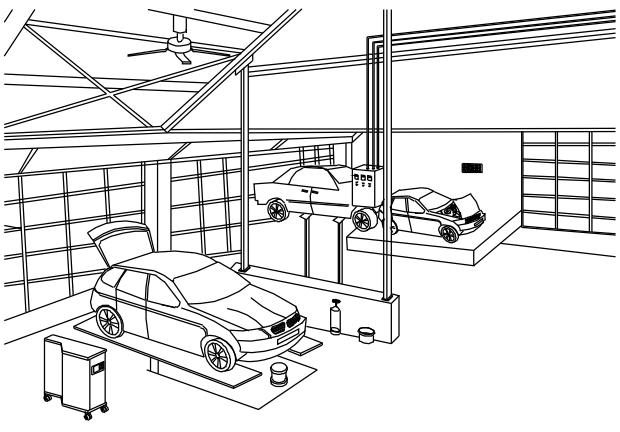
Fig 1



UNORGANIZED WORKSHOP

AEN1103H1

Fig 2



ORGANIZED WORKSHOP

AEN1103H2

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

1 Clean hand tools.

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

The other should be oily to prevent rust and corrosion.

2 Clean floor jacks.

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

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

3 Clean electrical power tools

Keep power tools clean by brushing off any dust and wiping off excess oil or grease with a clean rag. Inspect the electrical cables for dirt, oil or grease, and for any chafing or exposed wires.

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

4 Clean air powered tools

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

5 Clean hoists and heavy machinery.

Locate 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 handling.

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 clean cloth to wear in work place which is strong and fits well for easy to work.

8 Always use safety measure against injury or burns.

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

— — — — — —

TASK 4: **Safety workshop 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 designated containers in the work place.

3 Vehicle should be proper parked in designated place for repair work.

4 Use proper tools to check electrical circuits and components.

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

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

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

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

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

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

— — — — — —

TASK 5: **Safety Signs** (Fig 3)

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 and description of the safety sign in table1.

Fig 3

AEN1103H3

Table - 1

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

Get it checked by your instructor

TASK 6: **Personal protective equipments** (Fig 4)

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

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

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

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

Fig 4

Table - 2

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

Get it checked by your instructor

— — — — — —

TASK 7: **Various types of 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 Table 3.

Table 3

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

Fill up and get it checked by your instructor.

— — — — — —

TASK 8: **PPE Instruction and uses**

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

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

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

4 Always wear protective clothing and the appropriate safety equipment.

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

— — — — — —

Practice occupational safety and first aid

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

Requirements

Tools / Instruments

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

Equipment / Machines

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

Materials

- Old tyre - As reqd.
- Wood, Paper, Cloth & Grease - As reqd.
- Gas and 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 health center staff to give demo 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.

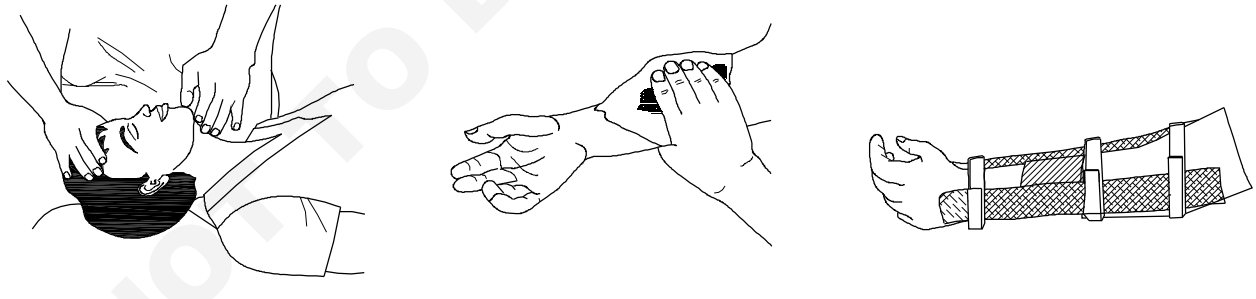
4 Bring the victim safely to the level ground, taking necessary safety measures. (Fig 1)

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 2).

2 Gently rock forward keeping your arms straight until they are nearly vertical, and steadily pressing the victim's back as shown in (Fig 3) to force the air out of the victim's lungs.

Fig 2

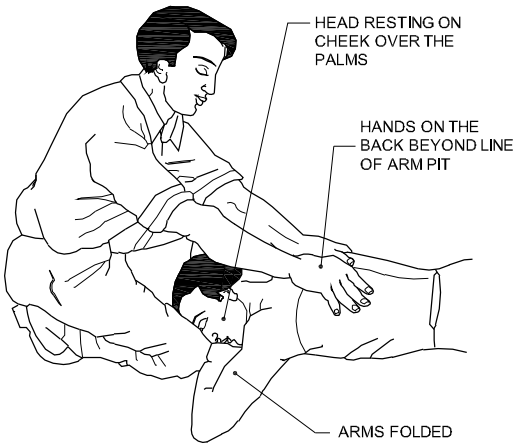
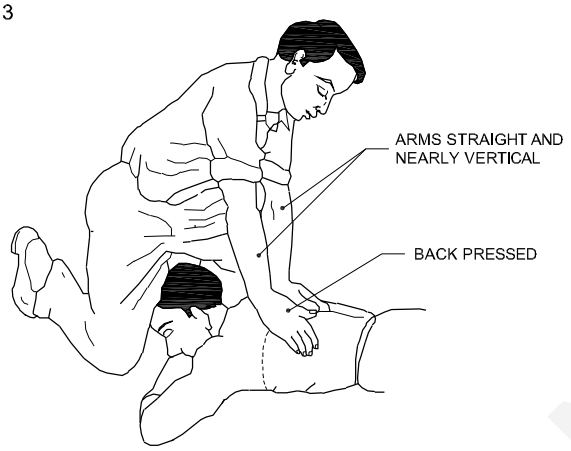


Fig 3



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 4). Continue to rock backwards.

4 As you rock back, gently raise and pull the victim's arms towards you as shown in (Fig 5) 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 4

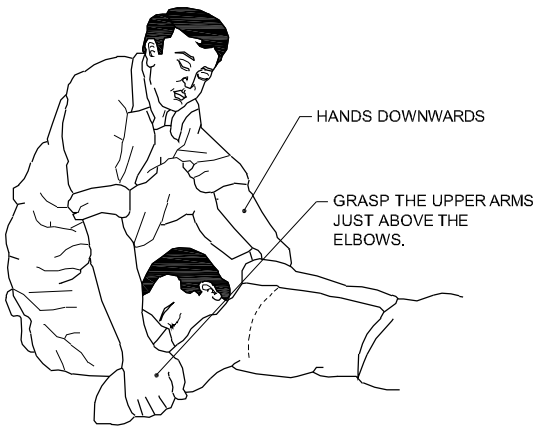
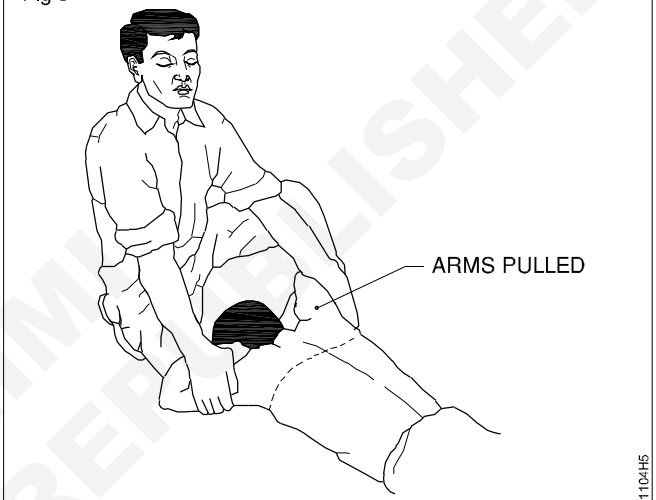


Fig 5



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 6).

2 Kneel astride the victim, so that his thighs are between your knees and with your fingers and thumbs positioned as in (Fig 6).

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 7).

Fig 6

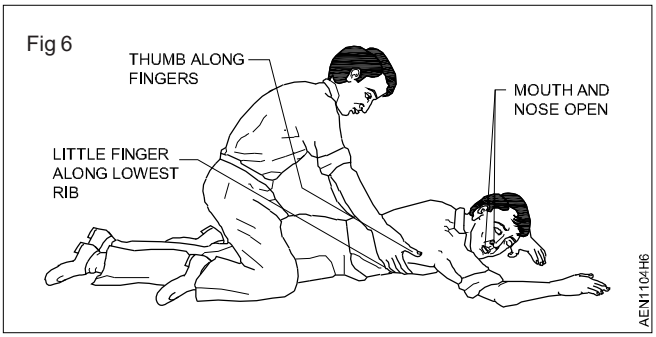
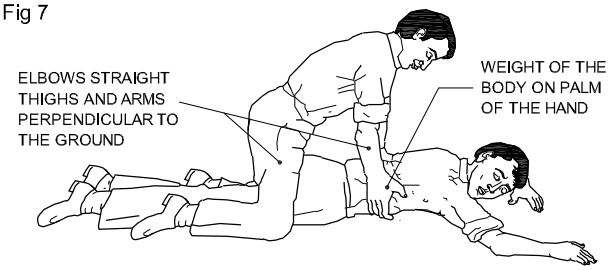


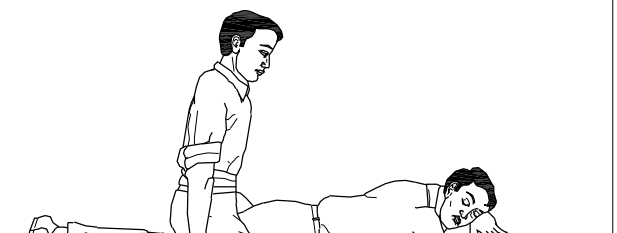
Fig 7



4 Now swing backward immediately removing all the pressure from the victim's body as shown in (Fig 8) 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 8



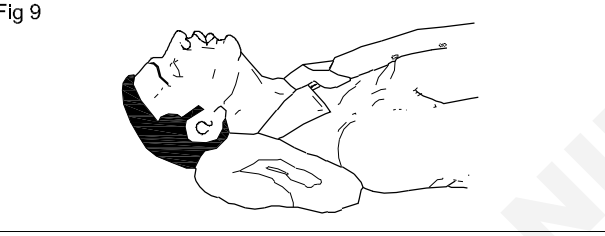
6 Continue artificial respiration till the victim begins to breathe naturally.

— — — — — —

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 9)

Fig 9



2 Tilt the victim's head back so that the chin points straight upward. (Fig 10)

Fig 10

3 Grasp the victim's jaw as shown in (Fig 11), 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 12) 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 12)

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).

Fig 11

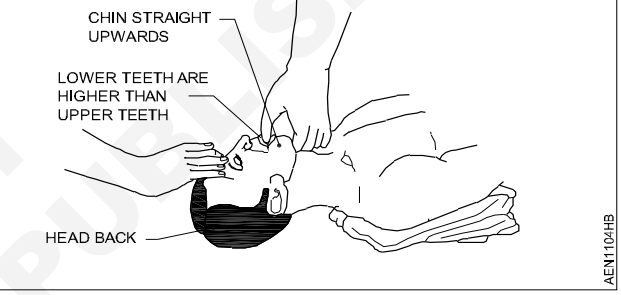
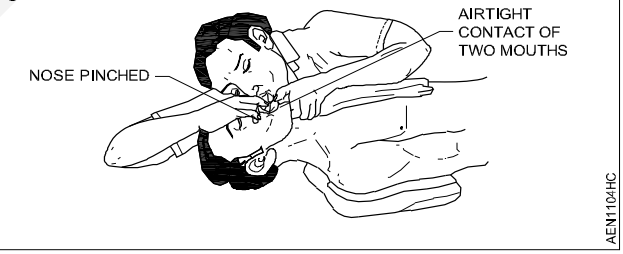


Fig 12



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 13)

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 13

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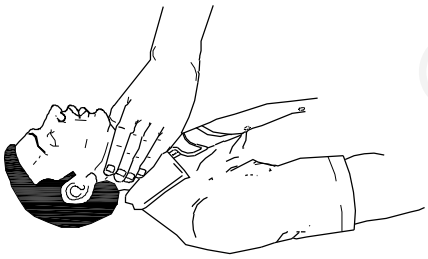
TASK 6: **Resuscitate a victim who is under cardiac arrest (CPR) cardio pulmonary.**

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

1 Check quickly whether the victim is under cardiac arrest. (Fig 14)

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 14



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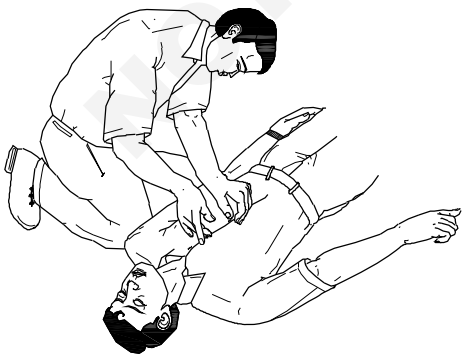
2 Lay the victim on his back on a firm surface.

3 Kneel alongside facing the chest and locate the lower part of the breastbone. (Fig 15)

Fig 15



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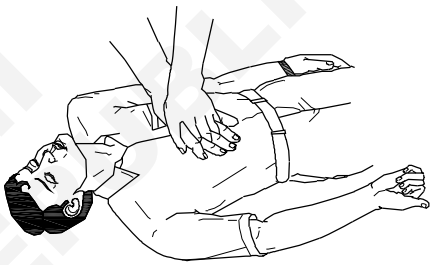
4 Place the palm of one hand on the center of the lower part of the breastbone, keeping your fingers off the ribs. Cover the palm with your other hand and lock your fingers together as shown in (Fig 16).

Fig 16



AEN1104HG

5 Keeping your arms straight, press sharply down on the lower part of the breast bone; then release the pressure. (Fig 17)

Fig 17

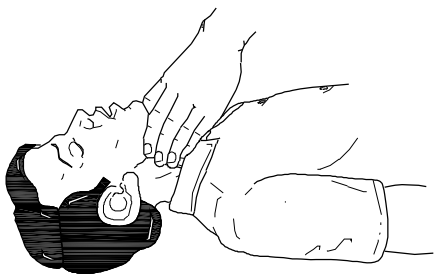
AEN1104HH

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

7 Check the cardiac pulse. (Fig 18)

8 Move back to the victim's mouth to give two breaths (mouth-to-mouth resuscitation) (Fig 19)

Fig 18



AEN1104HI

Fig 19

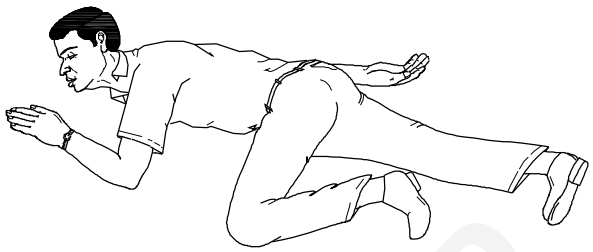
AEN1104HJ

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 20). Keep him warm and get medical help quickly.

Fig 20



AEN1104HK

Other steps

1 Send for a doctor immediately.

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

— — — — — —

TASK 7: **Perform procedure in the event of fire**

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.

TASK 8: **Perform fire extinguisher**

First extinguishers practice as demonstrate by fire service station.

1 Alert people surrounding by shouting fire, fire, fire when you observe fire. (Fig 21a)

2 Inform Fire Service or arrange to inform immediately. (Fig 21b)

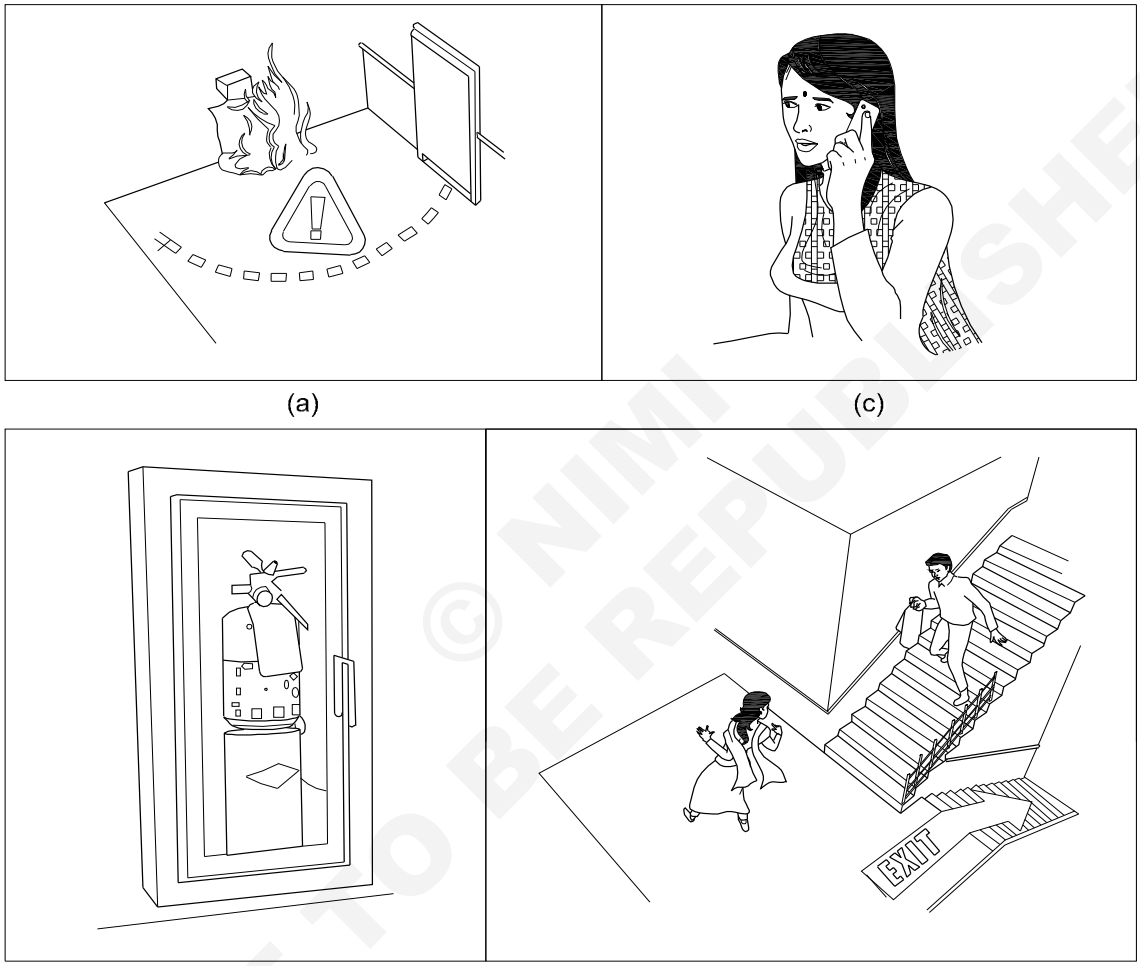
3 Open emergency exit and ask them to go away. (Fig 21c & 21d)

4 Put “Off” electrical power supply.

Do not allow people to go nearer to the fire

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

Fig 21



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 22)

9 Pull the safety pin from the handle. (pin located at the top of the fire extinguisher) (Fig 23)

10 Aim the extinguisher nozzle or hose at the base of the fire. (this will remove the source of fuel fire) (Fig 24)

Fig 22

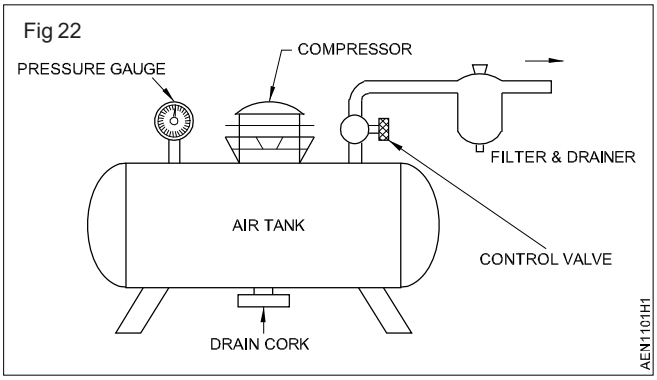


Table1

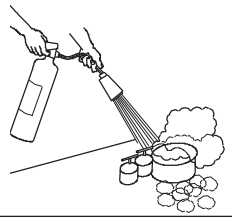
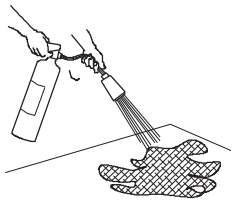
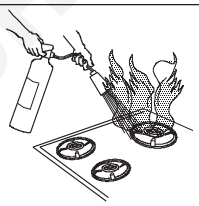
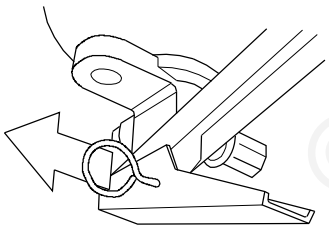
Class 'A'	Wood, paper, cloth, solid material	
Class 'B'	Oil based fire (grease, gasoline, oil) & liquefiable solids	
Class 'C'	Gas and liquefied gases	
Class 'D'	Metals and electrical equipment	

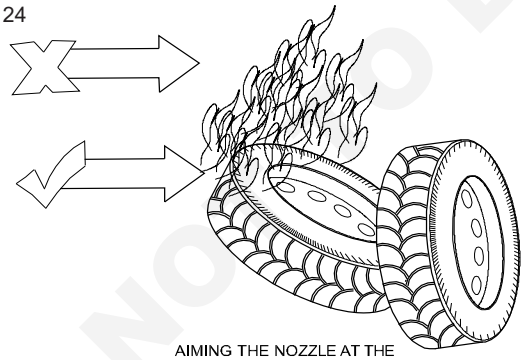
Fig 23



PULLING THE SAFETY PIN

AEN1104J3

Fig 24



AIMING THE NOZZLE AT THE BASE OF THE FIRE

AEN1104J4

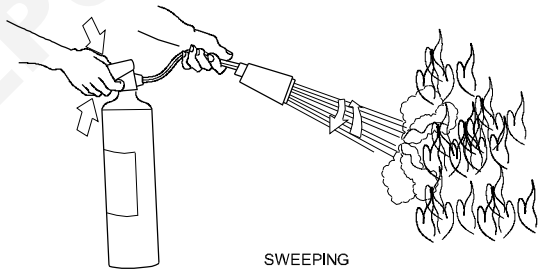
Keep your self low.

11 Squeeze the handle lever slowly to discharge the agent (Fig 25)

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

Fire extinguishers are manufactured for use from the distance.

Fig 25



SWEEPING

AEN1104J5

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.

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

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

In order to remember the simple operation of fire extinguisher.

Remember.

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

P for pull.

A for aim.

S for squeeze.

S for sweep.

Practice to handle and test lifting equipments and disposal of used engine oil

Objectives: At the end of this exercise you shall be able to
- **practice on 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.

Equipment / Machines

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

Materials

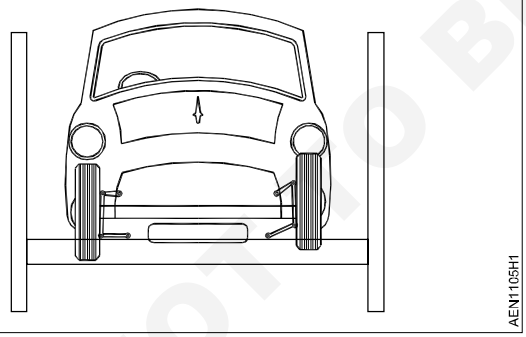
- Oil - As reqd.
- Water - As reqd.
- Kerosene - As reqd.
- Cotton waste - As reqd.
- Soap oil - As reqd.

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.

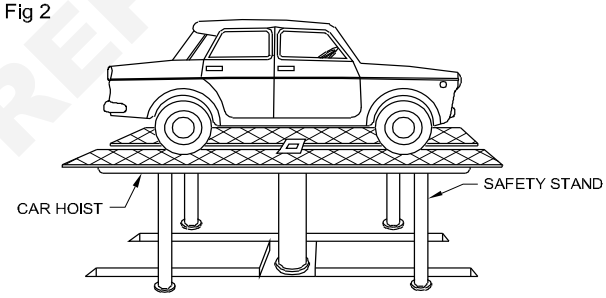
Date Serviced: 20/05/2018

Next Service: 19/05/2019

Check the equipment

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

Fig 2



HYDRAULIC CAR HOIST

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

3 Check whether the test equipment for its proper functioning.

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

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

6 Check whether it is lifting properly.

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

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

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

TASK 2: **Disposal of used engine oil**

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

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

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

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

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

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

6 While storing used oil, meant for disposal keep them in a separate place with proper identification mark in the container. (Fig 3)

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

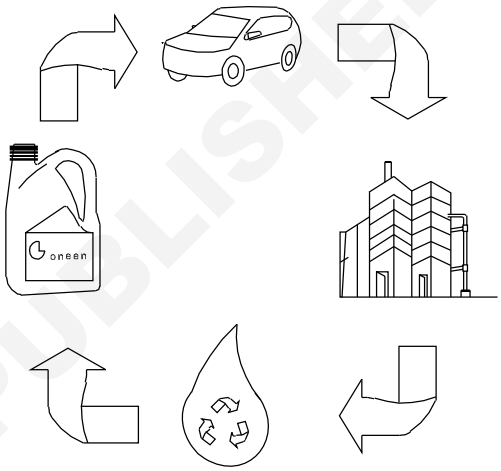
While transporting ensures that there is no spillage of oil. (Fig 4)

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

Fig 3

AEN1105J1

Fig 4



AEN1105J2

Table

Sl. No	Date	Qty per can (liter)	No of cans delivered	Total qty. disposed in liters	Remarks
1	Example 23 - 7 -19	20	05	100	
2	-	-	-	-	
3					
4					
5					

— — — — — —

Practice to save electrical energy

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

PROCEDURE

TASK 1: **Determine the energy conservation**

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 Lamp	5					
	8					
	11					
	15					
	20					
Regular lamp	25					
	40					
	60					
	100					
Tube lights	36					
	40					
Table fan /	60					
Ceiling fan	100					
Exhaust fan	150					
Air-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					

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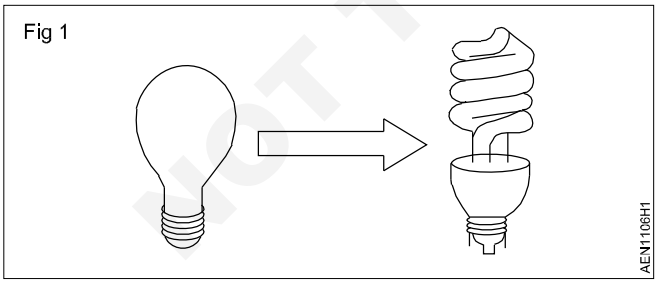
TASK 2: **Perform different way of energy conservation**

1 Make sure you are not still using tungsten bulbs. Replace them with CFL bulbs. CFLs reduce energy consumption by about 75% compared with tungsten bulbs, and their life is longer.

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

Fig 1

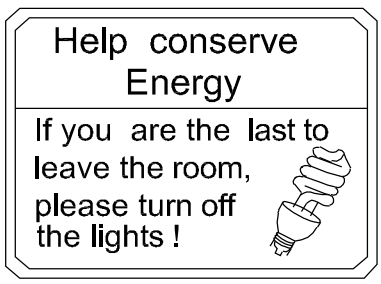


3 Post a friendly reminder in each room to prompt students and teachers to turn off lights when not in use. (Fig 2)

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.

Fig 2



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)

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.

Fig 3

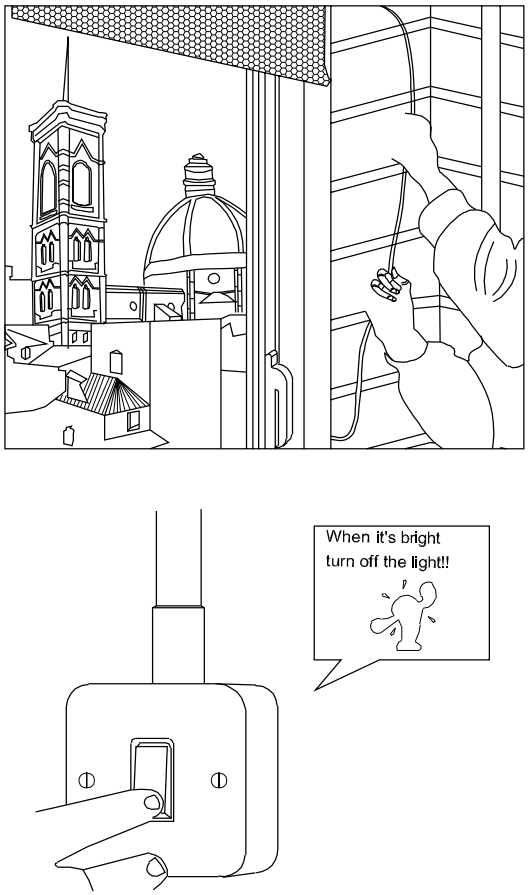
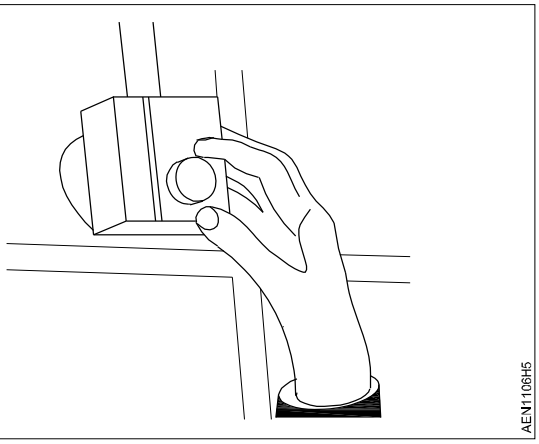


Fig 4

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

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

Fig 5



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

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

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

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

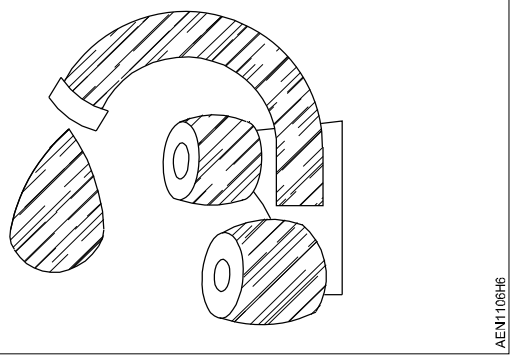
17 Water costs money, so savings it is a good idea.

18 Install water displacement devices in WC cisterns.

19 Turn off urinals during the holidays, or install 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.

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Practice to use various marking tools

Objectives: At the end of this exercise you shall be able to
- **draw the lines, parallel lines, angles, circles, and curves by suitable marking tools.**

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

- Chalk powder - As reqd.
- MS Plate - As reqd.

PROCEDURE

TASK: **Use various marking tools**

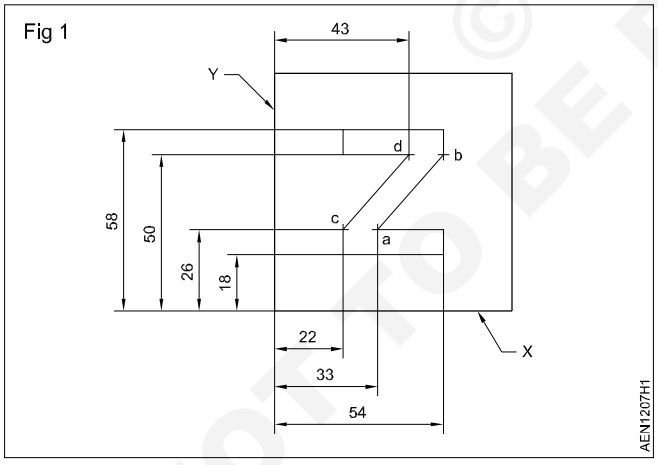
Marking 1

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

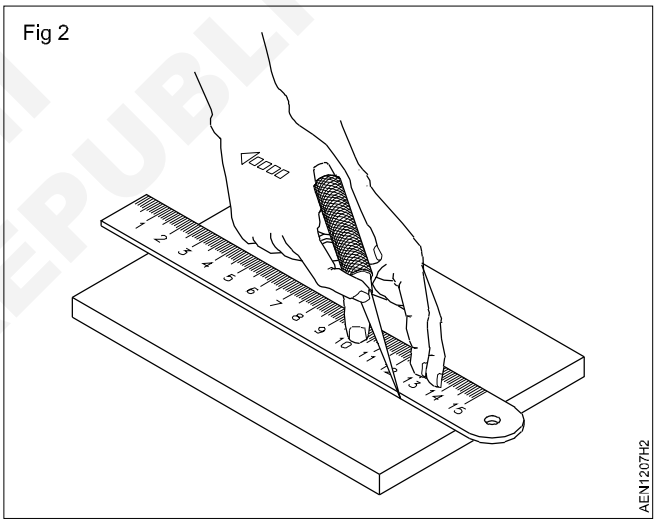


To avoid confusion, do not scribe the line longer than necessary.

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

5 Punch witness marks and complete 'Z' shape

Fig 2



Marking 2

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

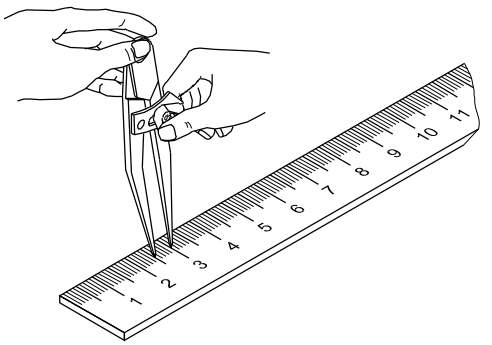
7 Mark the center lines of three circles and one semicircle using the jenny caliper.

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.

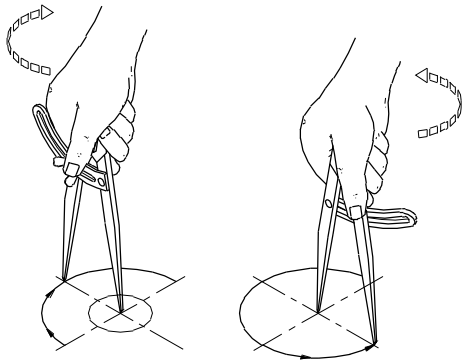
Fig 3



AEN1207H3

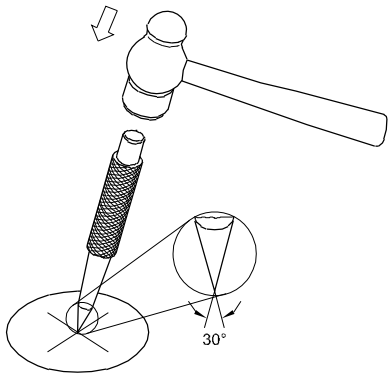
10 Draw two circles of ø10 using the divider. (Fig 4)

Fig 4



AEN1207H4

Fig 5



AEN1207H5

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

12 Punch witness marks on the circles and semicircles. (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.

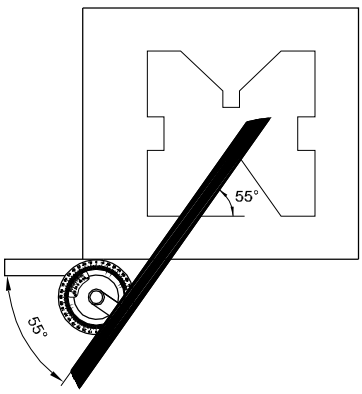
16 Mark all the parallel lines to the edges using the surface gauge.

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



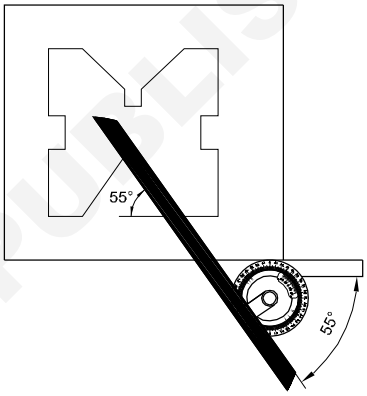
AEN1207H6

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)

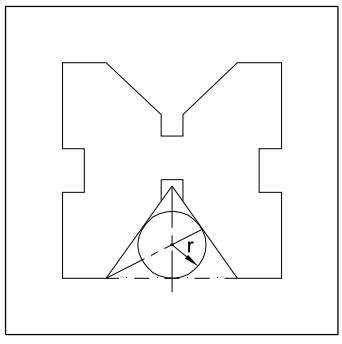
Fig 7



AEN1207H7

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

Fig 8



AEN1207H8

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

25 Punch witness marks.

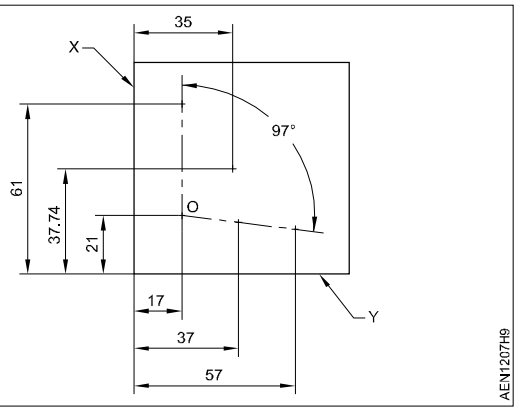
Marking 4

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.

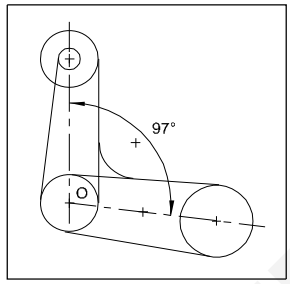
31 Draw all the four circles using a divider.

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



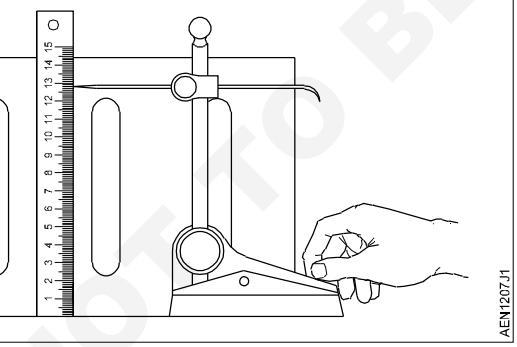
Skill sequence

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.**

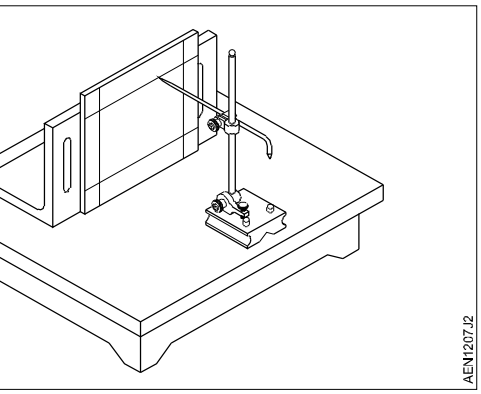
- Check the free movement of the scriber and other sliding units.
- Clean the base of the surface gauge.
- Keep the surface firmly on the surface plate.
- Reset the steel rule against the angle plate and set the scriber to the size to be marked. (Fig 1)

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)

Fig 2



Marking lines parallel to the edge of the job

Objectives: This shall help you to
- **mark parallel lines using a jenny caliper.**

Apply marking medium on the surface to be marked.

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

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

Incline slightly and move the jenny caliper with uniform speed and mark lines. (Fig 3)

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

Note to the instructor: Provide old exercise and models as much as possible to the trainees for acquiring measuring skills with simple measuring instruments. (Fig 4,5 and 6)

Fig 1

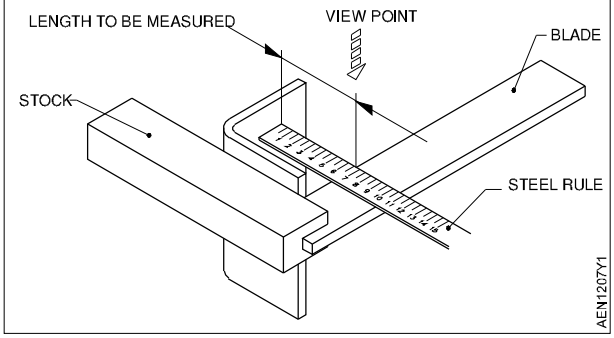


Fig 2

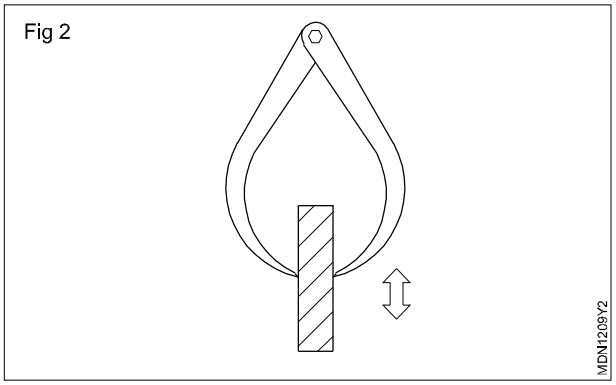


Fig 3

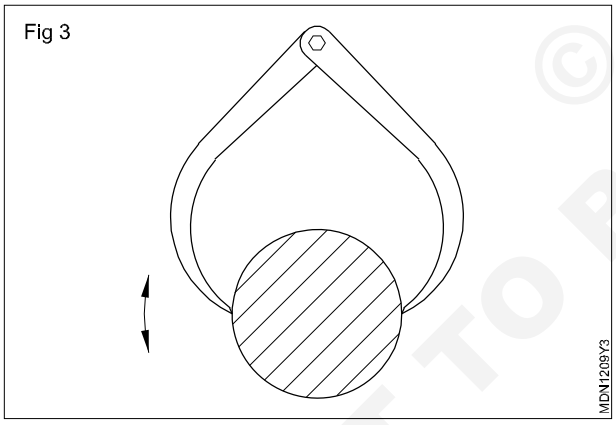


Fig 4

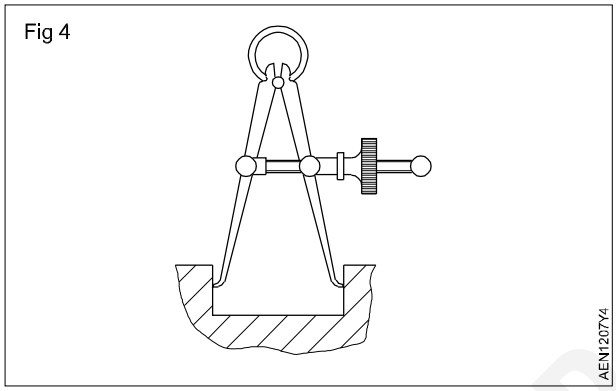


Fig 5

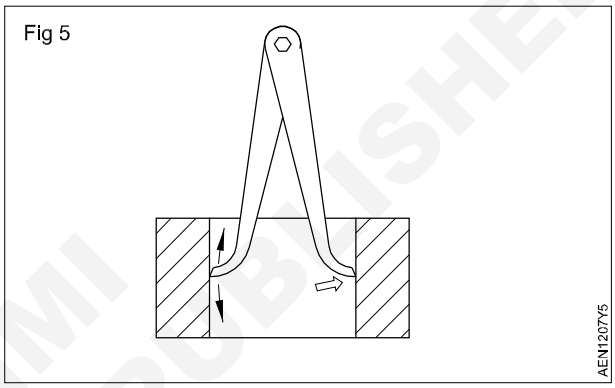
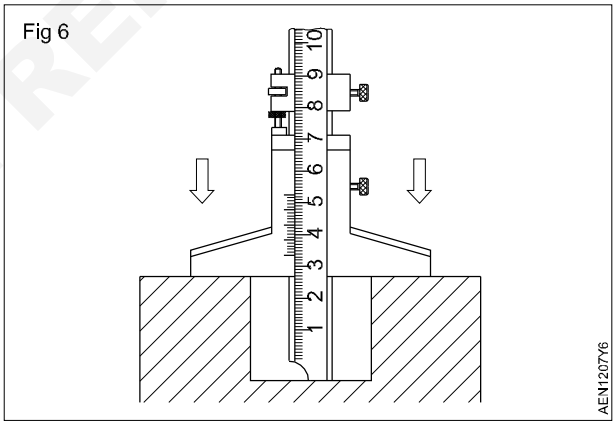


Fig 6



Practice to remove & refit the dashboard, bumpers and electrical components

Objectives: At the end of this exercise you shall be able to
- **remove the electrical component of dashboard and bumpers of vehicle**
- **inspect and replace the damaged electrical components**
- **refit the dashboard, bumper and all electrical components.**

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 No.
• Test lamp	- 1 No.
• Surface plate	- 1 No.

Equipments / Machines

• Vehicle	- 1 No.
• Work bench	- 1 No.

Materials

• Cotton waste	- As reqd.
• Soap oil	- As reqd.
• Bulbs	- As reqd.
• Bulb holders	- As reqd.
• Wires	- As reqd.
• Insulation tape	- As reqd.
• Wire clips	- As reqd.
• Emery sheet	- As reqd.

PROCEDURE

TASK 1: **Practice to remove the dash board electrical components**

1 Park the vehicle on level floor.

2 Apply hand brake and put chocks at wheels.

3 Find the location of dash board in vehicle.

4 Identify the dashboard mounting screws.

5 Before remove the dashboard mountings ensure the battery terminals disconnected.

6 Remove the dashboard mounting screws.

7 Remove the dashboard.

8 Check the dashboard electrical connections and bulbs.

9 Check the electrically operated gauges and electrical switches.

— — — — — —

TASK 2: **Refitting the dashboard assembly**

1 Replace the damaged electrical parts of the dash board assembly.

2 Refit the remove bulb, gauges, holders and switches of the dash board.

3 Refit the dash board assembly in vehicle.

4 Tighten the dash board electrical connections and mountings are properly fitted.

— — — — — —

TASK 3: **Remove the front and rear bumper assembly**

1 Find the location of front and rear bumpers of vehicle.

2 Identify the electrical connection of front and rear bumpers.

3 Identify the removes fitted location of the bumper

4 Identify the mounting bolts in bumpers

5 Disconnect the electrical wire connections of front and rear bumpers.

6 Remove the mounting bolts of front & rear bumper.

Note: Use proper tools to avoids the slippage and damage.

7 Remove the bumpers and place it on the work bench.

8 Remove the electrical fittings like light assemble and scanners.

9 Check the bulbs, holders, wires, wire clips and sensors under your instructors guide lines:

10 Replace the defective and damaged parts.

— — — — — —

TASK 4: **Refitting the bumper assembly**

1 Refit the bulb, holders and sensors to the front and rear bumpers.
2 Refit the front and rear bumpers.
3 Tighten the mounting screws of the bumpers.
4 Connect the electrical wires of bumper.
5 Refit the rear bumper to the vehicle.
6 Tighten the mounting screws of the bumper.
7 Connect the electrical wires of bumper.
8 Connect the battery terminals.
9 Check the function of bulbs and scanners
10 In case bumper lights are not glow check the faces of bumper electrical circuits.

— — — — — —

Practice to measure the electrical components by using vernier caliper and micrometer

Objectives: At the end of this exercise you shall be able to
- **measure the starter motor's armature / commutator diameter by vernier caliper**
- **measure the alternator's rotor slipping diameter by outside micrometer.**

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 No.
• Vernier caliper	- 1 No.
• Outside micrometer	- 1 No.
• Cleaning tool	- 1 No.

Equipments / Machines

• Work bench with vice	- 1 No.
• Micrometer stand	- 1 No.

Materials

• Cotton waste	- As reqd.
• Soap oil	- As reqd.
• Banyan cloth	- As reqd.
• Emery sheet	- As reqd.

PROCEDURE

TASK 1: **Practice to measure the starter motor's armature / commutator diameter by vernier caliper**

1 Select the measuring component.

2 Clean the component with cleaning tool by using recommended cleaning solvent.

3 Clean the measuring component with clean soft cloth.

4 Ensure the measuring component is properly cleaned.

5 Place the armature on the table vice at even level

6 Select the suitable vernier caliper.

7 Check the vernier caliper or error.

8 Measure the armature shaft with the help of vernier caliper under your guideline of instructor.

9 Note the readings in your note book.

10 Measure the rotary shaft at different location atleast two or three places and hole the reading.

11 Compare the noted readings with manufacturer's specified recommended limits.

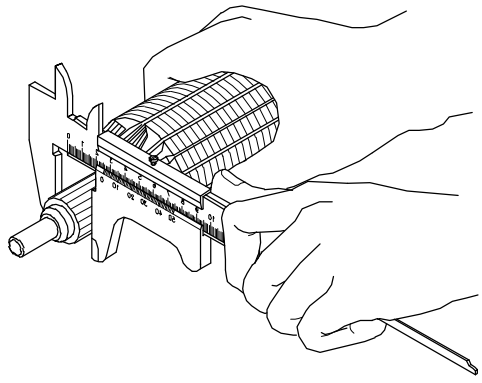
12 Place the outside micrometer in its box safely.

13 Remove the rotary from the table vice and keep safely.

Note:

Instructor should provide the starter motor's armature and alternator's rotor assembly to the trainees for measuring practice.

Fig 1



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TASK 2: **Check the rotor shaft (Fig 2)**

1 Check the rotor shaft visually for crabs

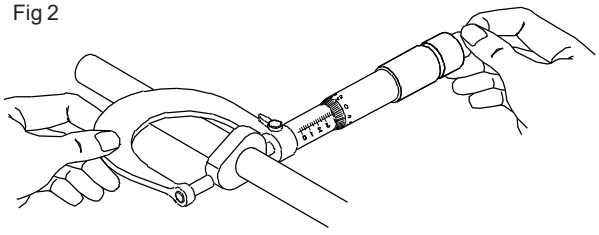
2 Clean the rotor shaft using a small brush with recommended cleaning solvent

3 Clear sludge and gum deposit

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

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

Fig 2



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6 Record the main scale reading and thimble reading

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

8 Use the micrometer to measure the rotor shaft height and record the results in a table 1.

Table 1

Component Name	Main scale Reading	Coinciding Thimble scale (div)	Least count	Result
	(a)	(b)	(c)	R = a + (b x c)
Rotor shaft slipping dia			0.01	

Check the cam armature diameter

1 Clean the armature before measuring camshaft-journal diameter

2 Inspect the journal diameter of the armature and record the results in a table 2.

Table 2

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

— — — — — —

Practice to clean and check the fasteners

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

• Trainee's tool kit	- 1 No.
• Spanner (DE & Ring)	- 1 set each
• Nose plier, copper drift	- 1 set each

Equipment / Machines

• Work bench & vice	- 1 No. each

Materials

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

PROCEDURE

TASK 1: **Fasten castle nut**

1 Clean the Axle Shaft threaded end.

2 Note down the thread size & type of thread.

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

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

5 Select proper spanner for tightening the castle nut.

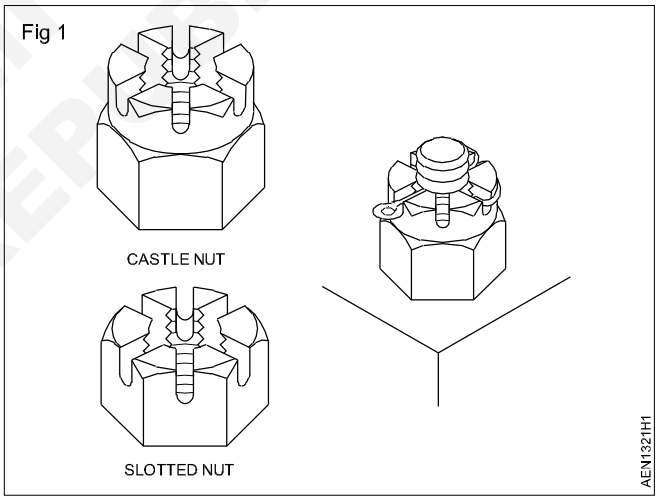
6 Tighten the castle nut.

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

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

9 Spread the split ends of the split pin.

Fig 1



TASK 2: **Fasten self-locking nut**

1 Clean the flange of the propeller shaft.

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

3 Insert the bolt into the slot of the flange.

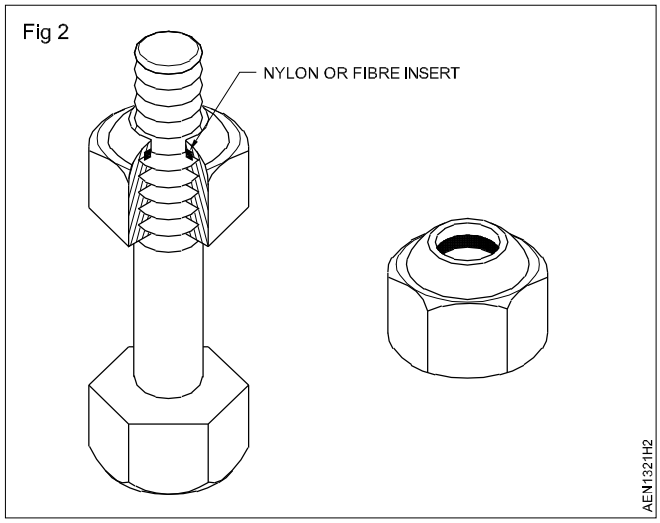
4 Tighten the self-locking nut by hand one or two threads only. (Fig 2)

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 2

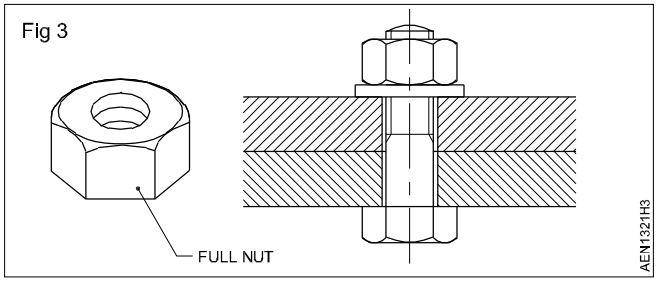


TASK 3: **Fasten hexagonal nut**

1 Select the two flat surface components to be fastened.

2 Select a proper size of hexagonal Nut & Bolt. (Fig 3)

Fig 3



3 Insert the Bolt in the hole of matching components.

4 Place a flat washer at the threaded end.

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

6 Tighten the hexagonal nut.

7 Select a same size of hexagonal lock nut.

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

Correct size of ring spanner should be used.

Nut & Spanner should be free of oil and dirt.

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

1 Clean the Bolts of Tappet cover.

2 Select proper size of hexagonal nut with caller. (Fig 4)

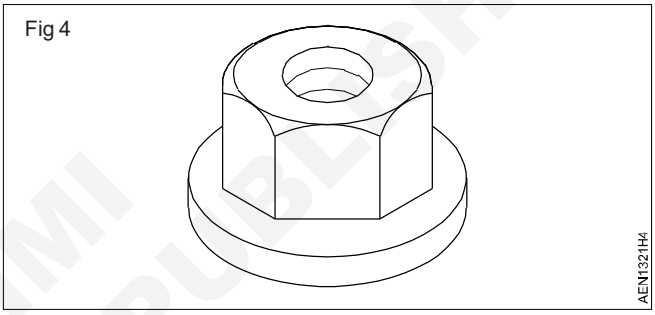
3 Tighten the hexagonal nut with collar by hand one or two threads only.

4 Select proper spanner for tightening the nut.

5 Tighten the nut with specified torque.

Do not overtighten.

Fig 4



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

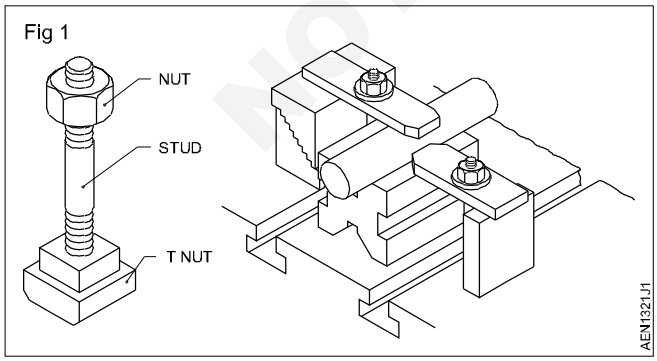
Skill sequence

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)

Fig 1



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

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

Tighten the stud with help of a proper spanner.

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

Use two spanners to remove the nuts from stud.

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

Safety precaution:

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

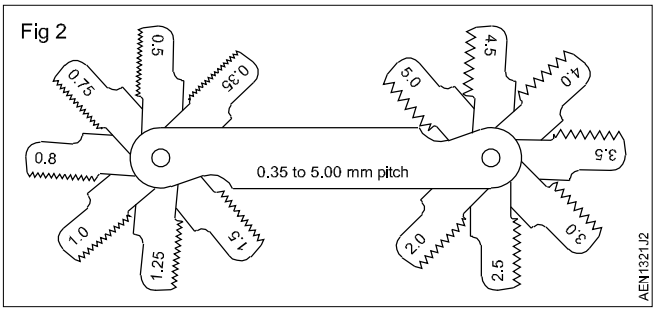
Measure the thread with the thread Pitch Gauge (Fig 2)

Select the stud of internal thread to be measured.

Clean the surface of the thread.

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

Fig 2



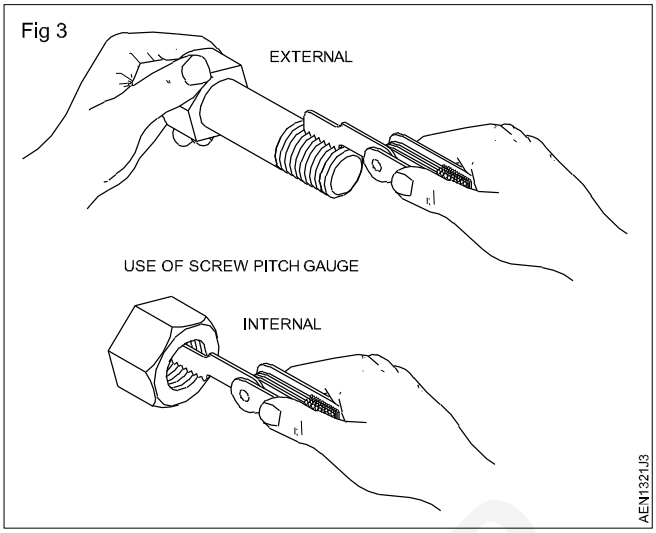
Place the blade on the thread to be measured. (Fig 3)

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

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

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

Fig 3



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

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Practice to remove broken stud/bolt

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

- Trainee's tool kit - 1 No.
- Tap wrench - 1 set
- Stud extractor - 1 set

Materials

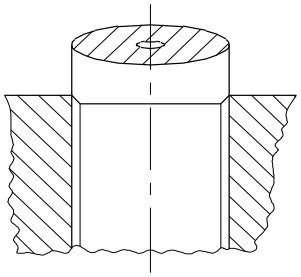
- Cylinder block with broken stud - As reqd.
- Cotton waste - As reqd.

PROCEDURE

TASK 1: **Remove broken stud/ bolt**

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

Fig 1

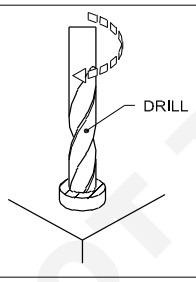


2 Locate the center and center punch it.

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

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

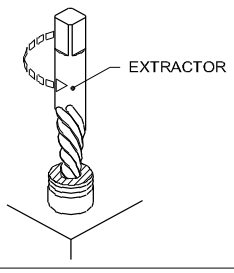
Fig 2



5 Check the hole is perpendicular.

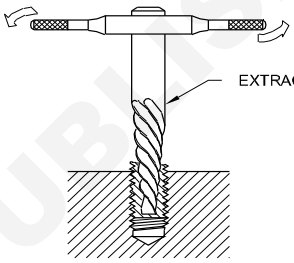
6 Set the ezy-out (stud extractor) on the drilled hole. (Fig 3)

Fig 3



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

Fig 4



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

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

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

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

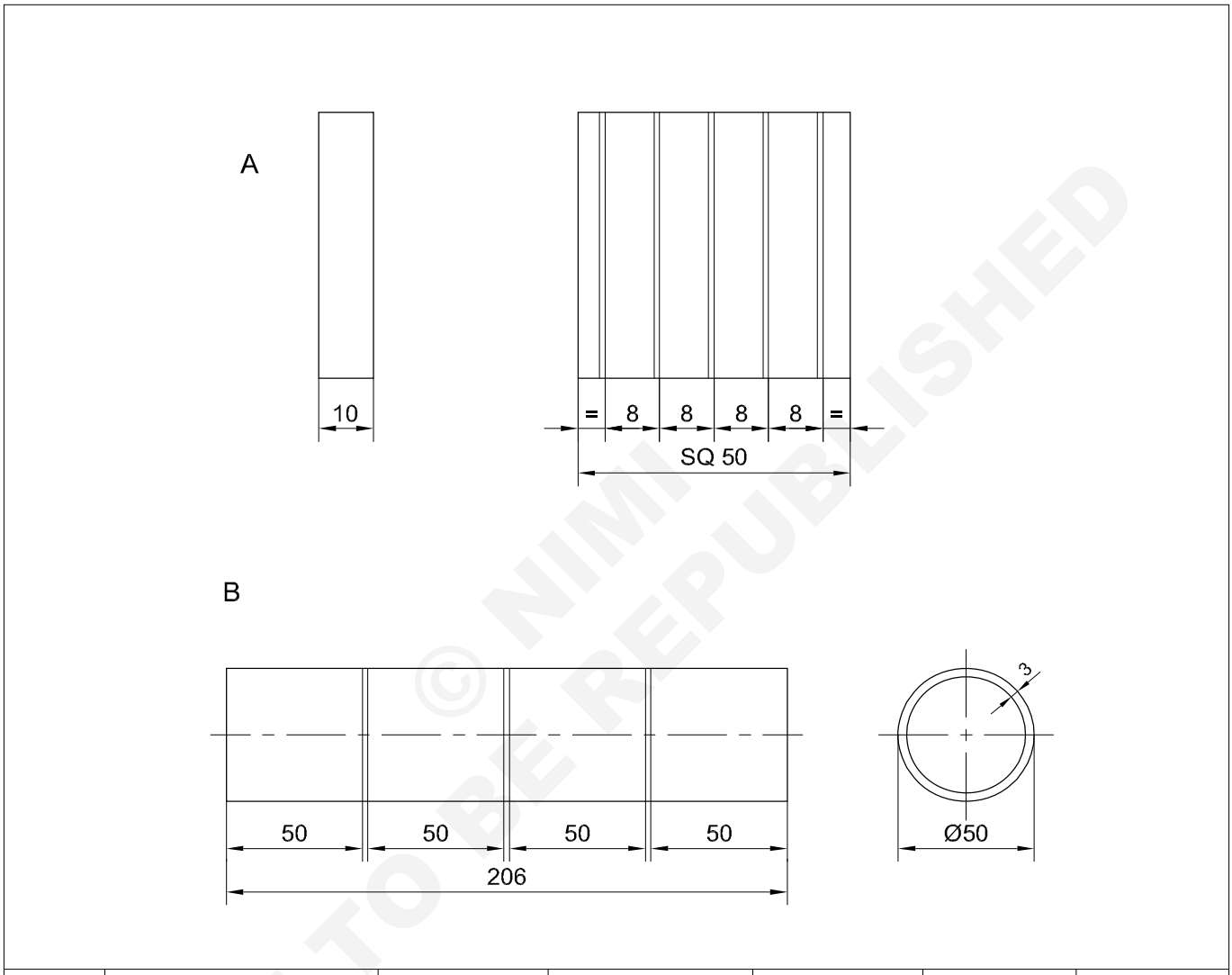
Table 1

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

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

Practice to use 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.**



1	Ø50 x 3 - 206		Fe 310		B	
1	50 ISF 10 - 50		Fe 310		A	1.03
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	HACK SAWING				TOLERANCE ±0.5	TIME 5h
					CODE NO. AEN1323E1	

PROCEDURE

TASK: **Marks lines as per drawing**

1 Check the size of the given M.S flat Job. (Fig 1A)

2 Apply copper sulphate solution and allow it to dry

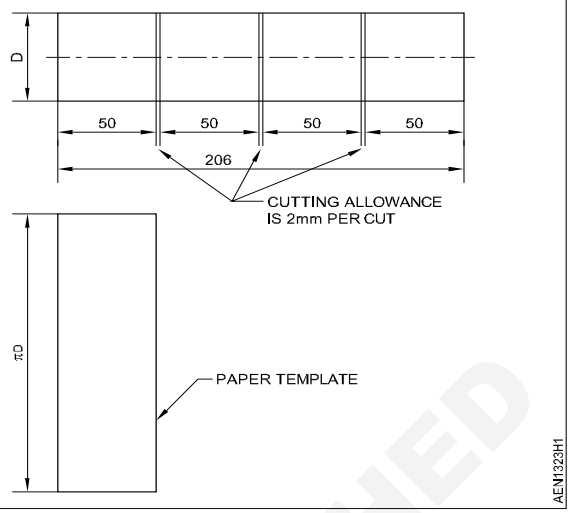
3 Layout lines as per drawing using a scriber taking measurement from the edge and punch mark the lines using a dot punch and hammer.

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 1B)

Fig 1



Skill Sequence

Practice to hold the work piece

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

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

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

Fig 1

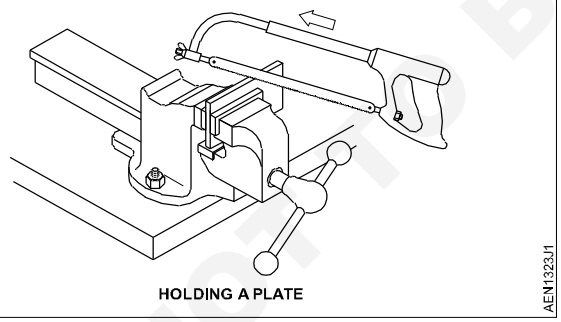


Fig 3

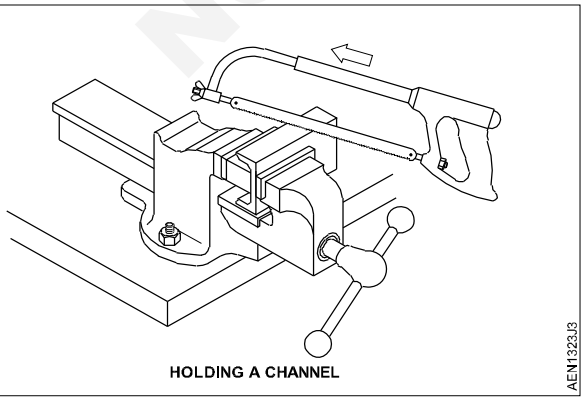
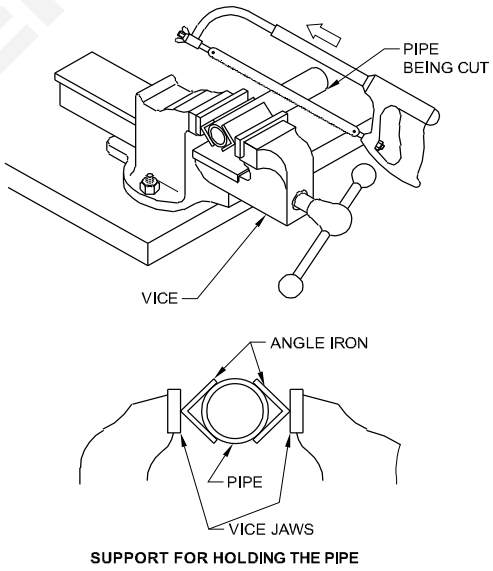


Fig 2



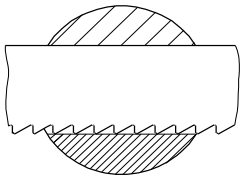
The selection of the blade depends on the shape and hardness of the material to be cut.

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

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

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

Fig 4



MORE CHIP CLEARANCE

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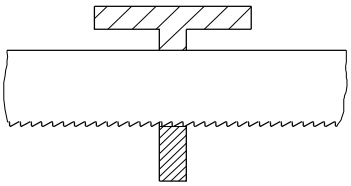
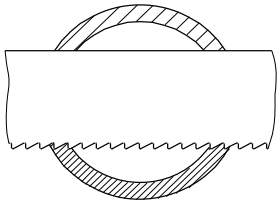
Fig 5



TWO OR MORE TEETH ON SECTION

AEN1323J5

Fig 6

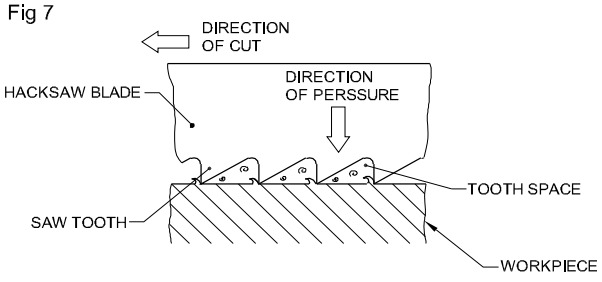


TWO OR MORE TEETH ON SECTION

AEN1323J6

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



AEN1323J7

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.

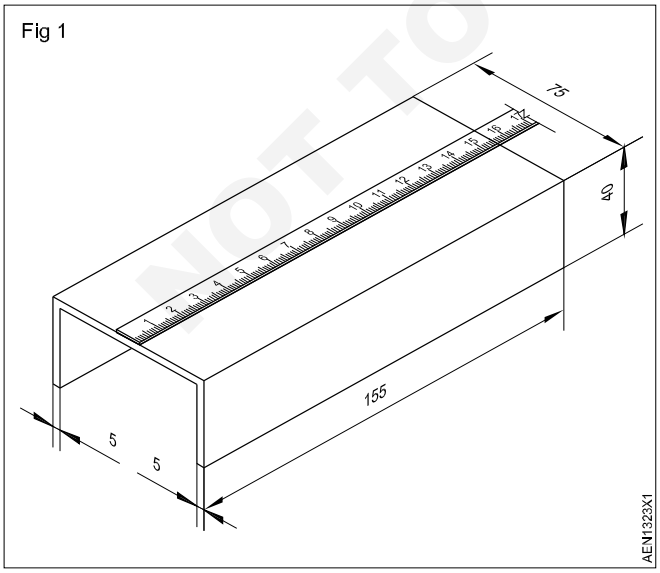
Practice to use file and hacksaw

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)

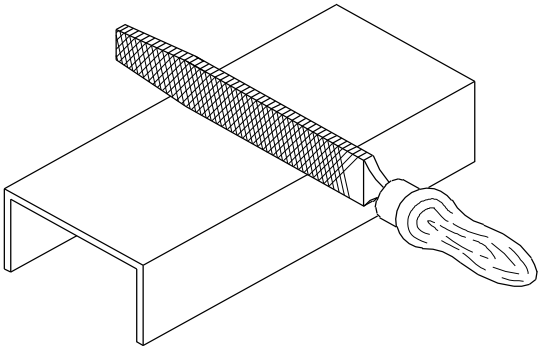
Fig 1



AEN1323X1

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

Fig 2



AEN1323X2

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

Fig 3

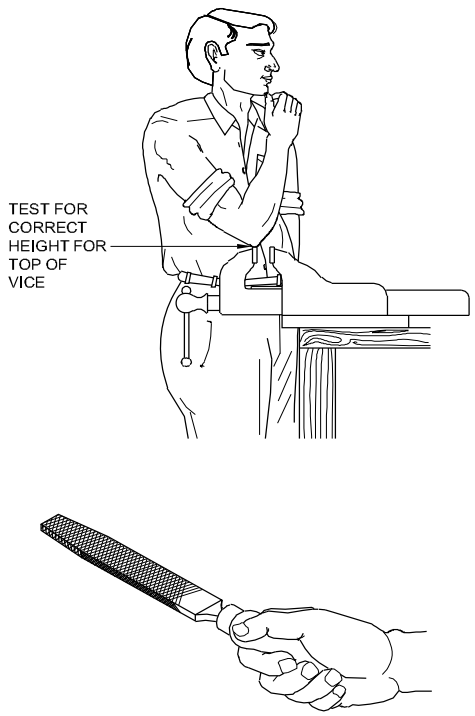
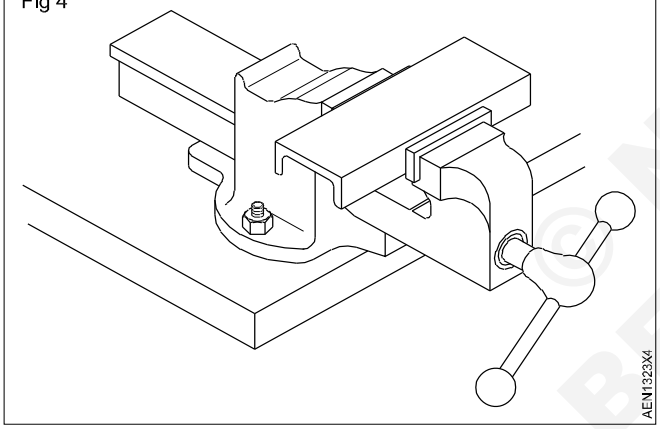
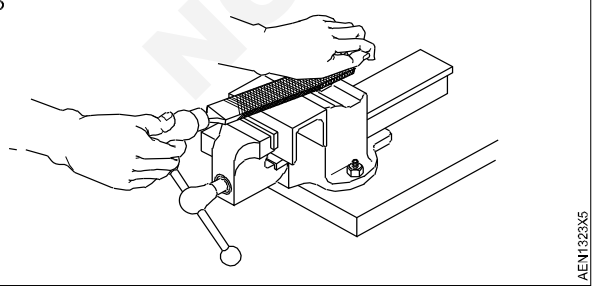


Fig 4



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

Fig 5



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

Fig 6

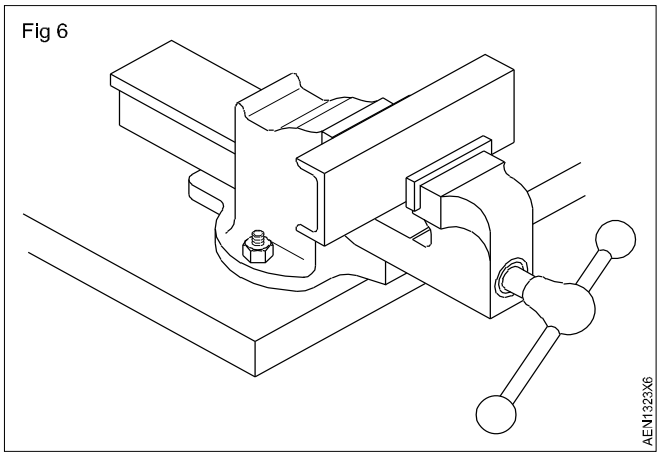
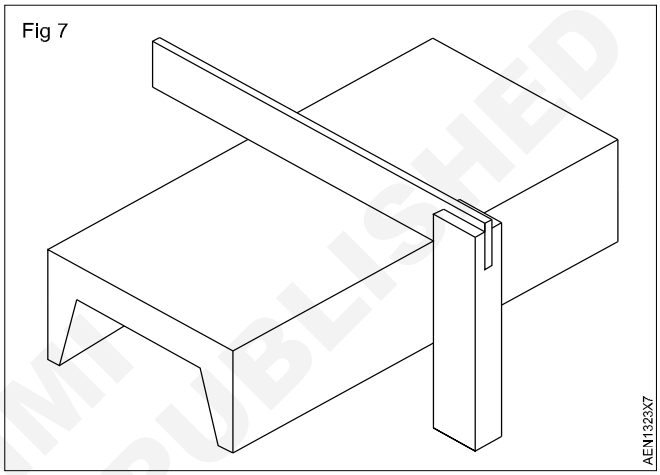
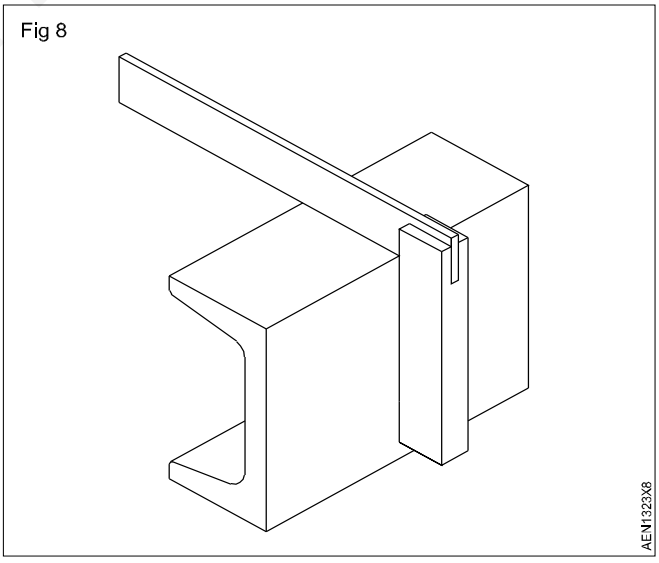


Fig 7



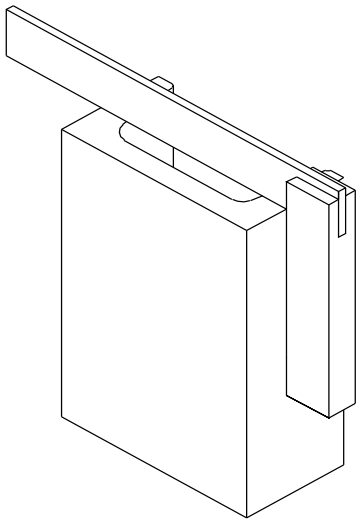
- Open the job and start on (D) (Fig 6) side filing as directed previously. Check the squareness along with (A). (Fig 8)

Fig 8



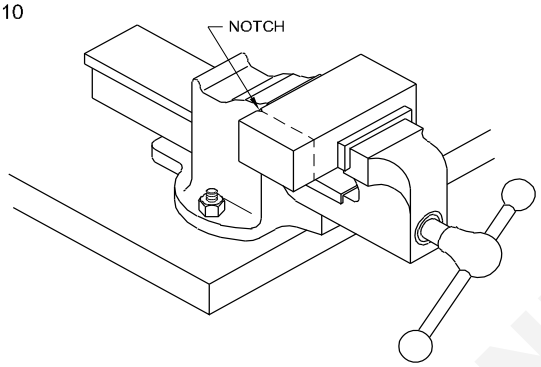
- Open the job and start on (C) side filing as directed previously. Check the squareness along with (A,B&D). (Fig 9)
- Open the job and start on (F) side filing as directed previously. Check the squareness along with (AB&D). (Fig 10)

Fig 9



AEN1323X9

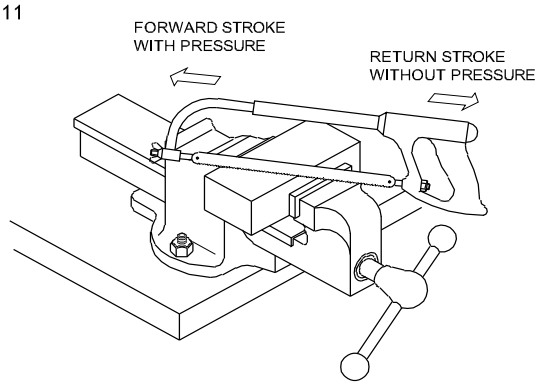
Fig 10



AEN1323XA

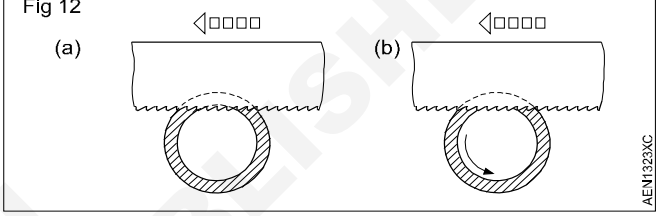
- Apply pressure only during the forward stroke. (Fig 11)
- At least two to three teeth should be in contact with the work while cutting. Select fine pitch blade i.e 0.8 or 1 mm pitch for thin work and for cutting pipes. (Fig 12a)
- Turn and change the position of the pipe while hacksawing (Fig 12b)

Fig 11



AEN1323X8

Fig 12



AEN1323XC

- 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.

Practice to Cut M.S. sheet by chisel

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

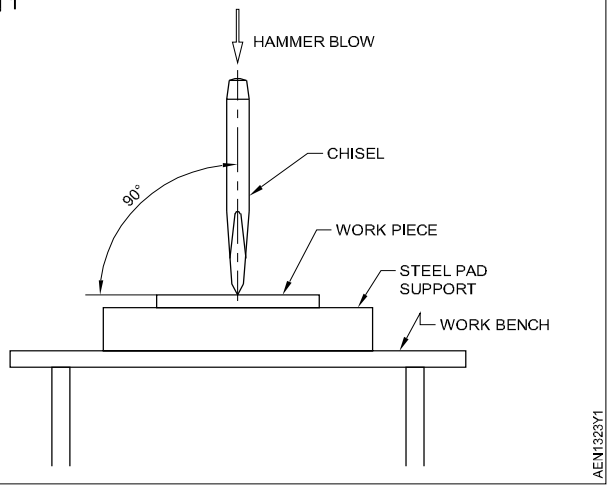
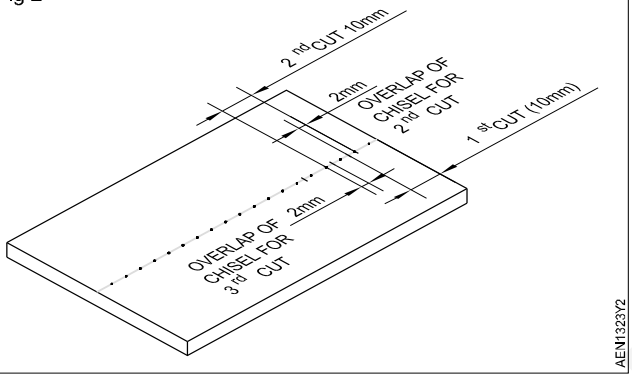


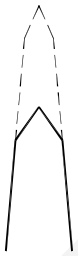
Fig 2



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.

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.

Fig 4

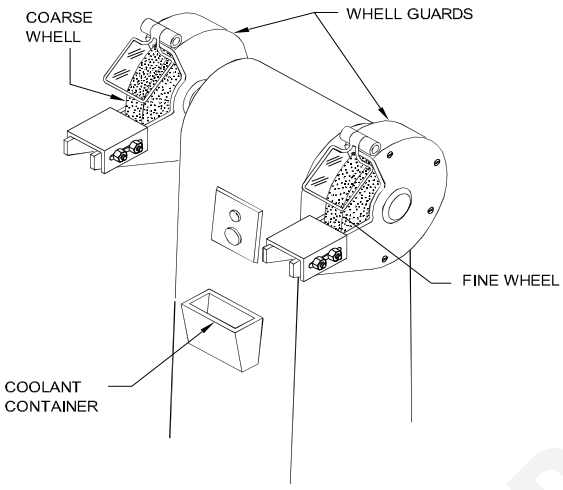
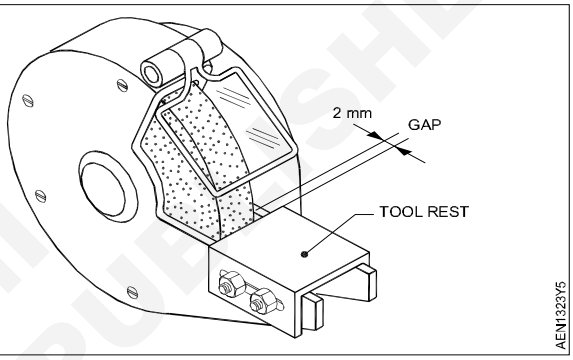
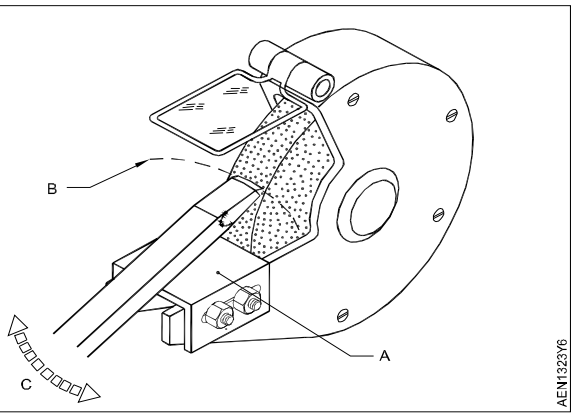


Fig 5



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

Fig 6



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

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

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

Wear safety goggles.

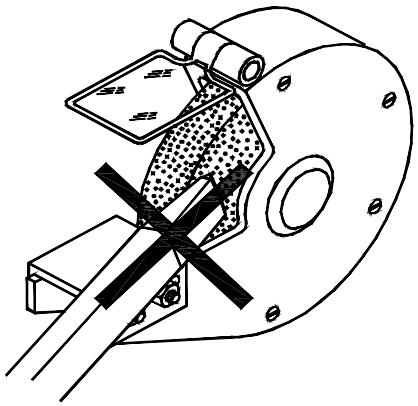
When switching on the grinding machine, stand aside until the wheel reaches the operating speed.

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

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

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

Fig 7



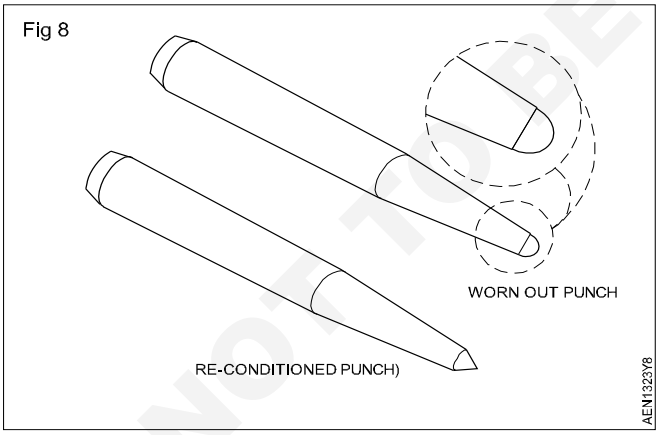
Report to instructor, if any damage to the grinding wheel is noticed.

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

Sharpen the center 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 work piece 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 arround its axis.

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

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

Grind the point - vertical position (Fig 9)

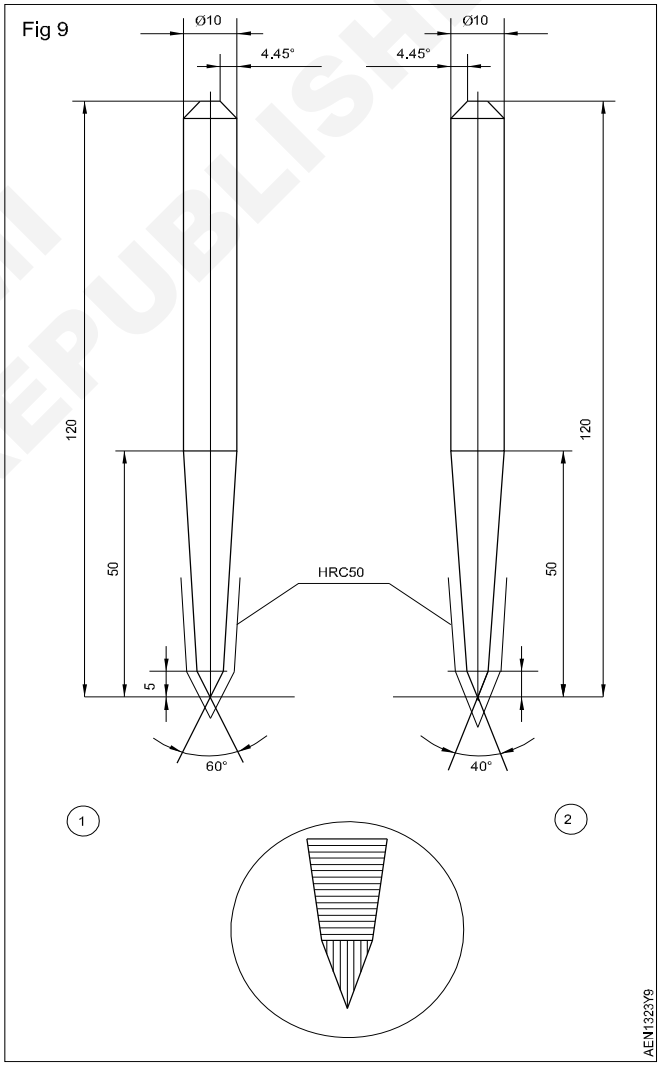
i Centre punch 60°

ii Scribing / Prick punch 40°

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

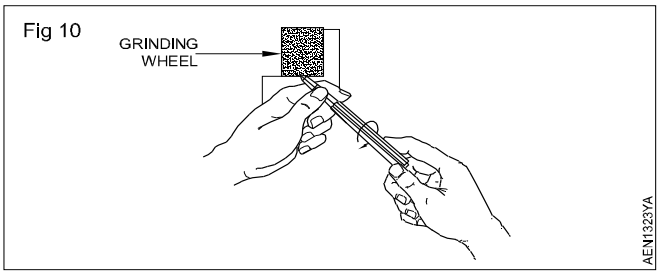
Check it finally for angle accuracy (as per drawing).

Fig 9



Check the center punch angle

Sharpen a center 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.



Move the punch into light contact with the rotating wheel or the grinder with the center 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 center punch.

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

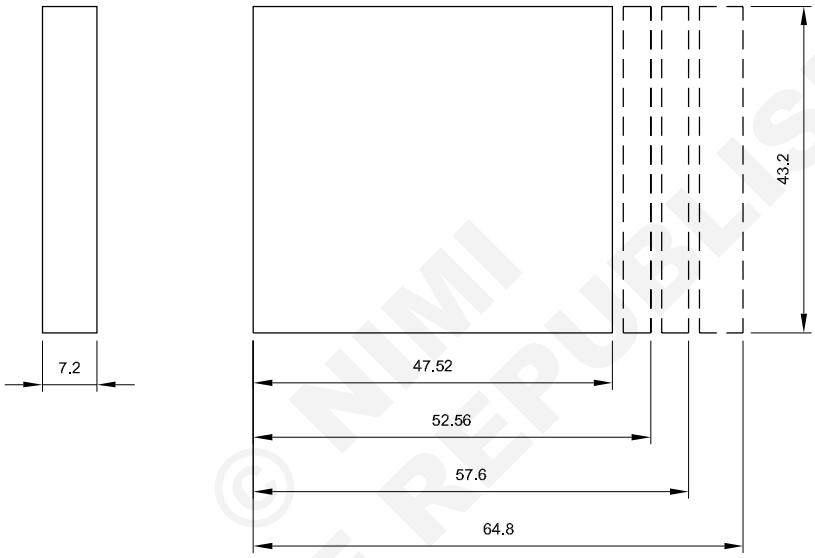
Keep the point cool by using only light pressure on the wheel and by frequently dipping the punch in a can of cooling water.

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 center of this punch and the wheel should be about 15°.

— — — — — —

Practice to use hacksaw and file to given dimensions

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			Fe 310			
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO1.3.24
SCALE NTS	HACK SAWING				TOLERANCE ±0.5	TIME 5h
					CODE NO. AEN1324E1	

PROCEDURE

TASK: **Hacksawing and filing on raw material**

1 Draw the markings to given diameter of the job.

2 Study the job drawing dimensions

3 Select the row material for the job

4 Mark dimensions on the selected raw material

5 Make a punch mark on the marked dimensions line.

6 Fix the raw material on the work bench vice

7 Select the hacksaw blade and hacksaw frame

8 Fix the hacksaw blade on frame at right direction

9 Take suitable position for cut the raw material piece

10 Cut the raw material and remove the work piece

11 Fix the work piece on the vice and file it to remove the excess metal

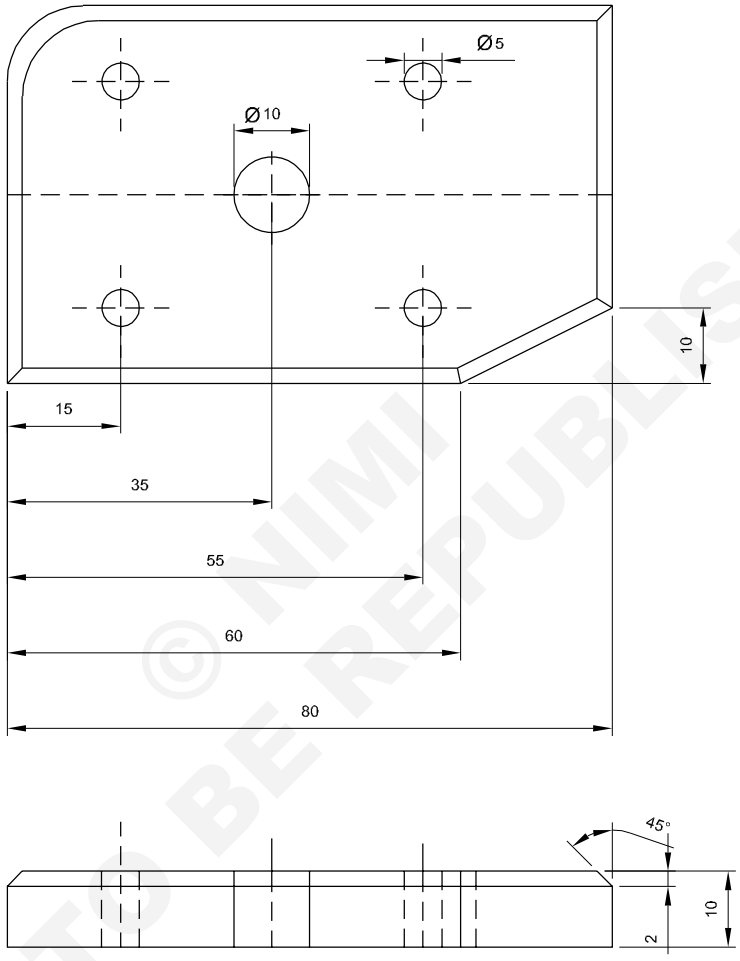
12 File with suitable flat file in both side of work piece for its correct dimensions

13 Ensure the work piece shape and diameter is a per given drawing.

— — — — — —

Practice to mark and drill to given dimensions

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**
- **drill through holes.**



1	65ISF12x85		Fe 310			
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	
SCALE NTS	DRILLING AND FILING RADIUS				DEVIATIONS ±0.1	
					CODE NO. AEN1325E1	

PROCEDURE

TASK: **Mark and drill to given dimensions**

1 Check the raw material for its size.

2 File flat the top face first.

3 File the two adjacent sides flat and square to each other as well as with top surface.

4 Mark the dimension as per the drawing file and finish the block.

5 Mark horizontal, vertical angular curved lines as per the drawing using scriber block and dividers.

6 Fix the M.S. plate in a vice.

7 File the radius and angle.

8 Locate the centers for holes to be drilled.

9 Drill ϕ 5mm and ϕ 10mm through holes as per drawing.

10 Remove the burrs from drill holes

11 File with knife edge file to finish the surface.

Skill sequence

Drill through hole

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

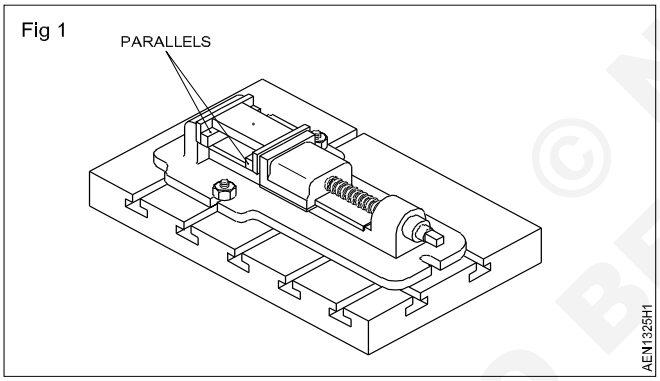
Method of Drilling

Check the given raw material for its size.

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

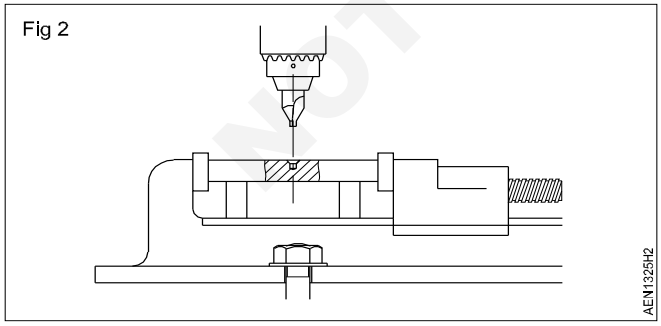
Mount the job in the machine vice on the parallel and clamp it securely to the drill-press-table. (Fig 1)

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

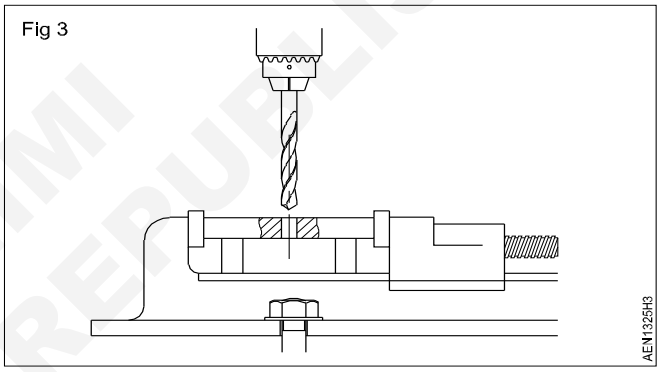
Spot the hole location with a center drill.

Remove the center 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.

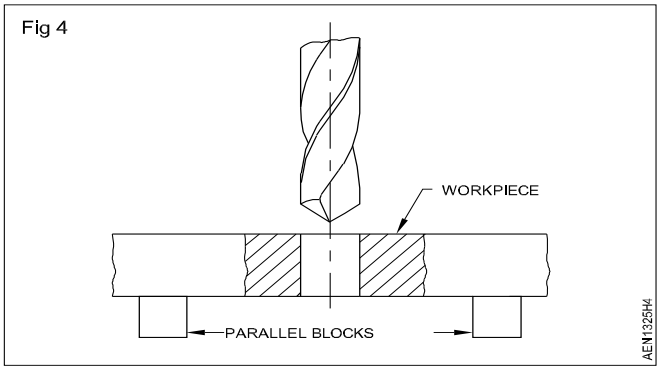
Fix 14.5 mm drill and drill through hole.

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



Drill blind holes

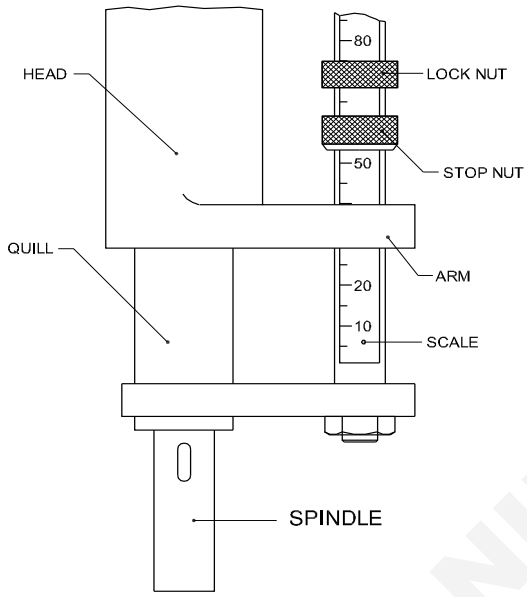
Objective: This shall help you to
- **drill blind holes to the required depth using the depth stops.**

Method of controlling depth of blind holes

While drilling blind holes, it is necessary to control the feed of the drill. Most machines are provided with a depth

stop arrangement by which the downward movement of the spindle can be controlled. (Fig 1)

Fig 1



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

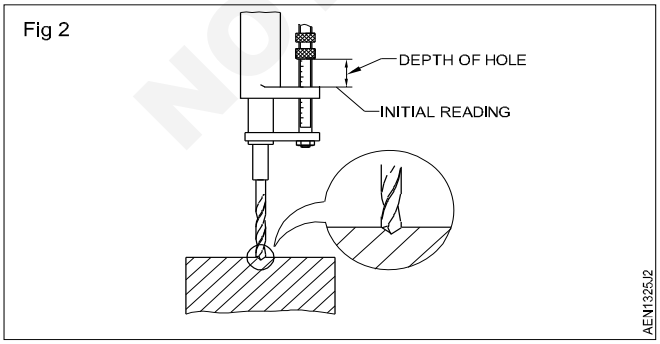
Generally, the blind hole depth tolerances are given up to 0.5 mm accuracy.

Setting for drilling blind holes

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

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

Fig 2



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

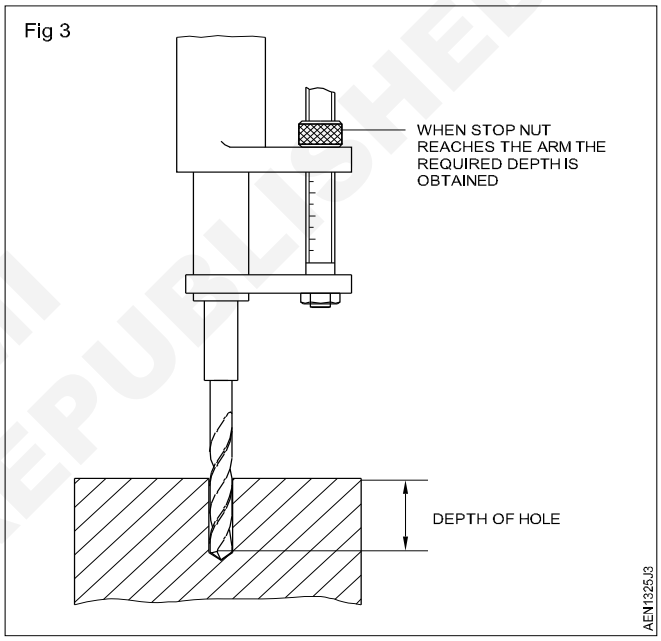
Initial Reading + Depth of Hole = Setting

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

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

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

Fig 3



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

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

Re-sharpen a twist drill

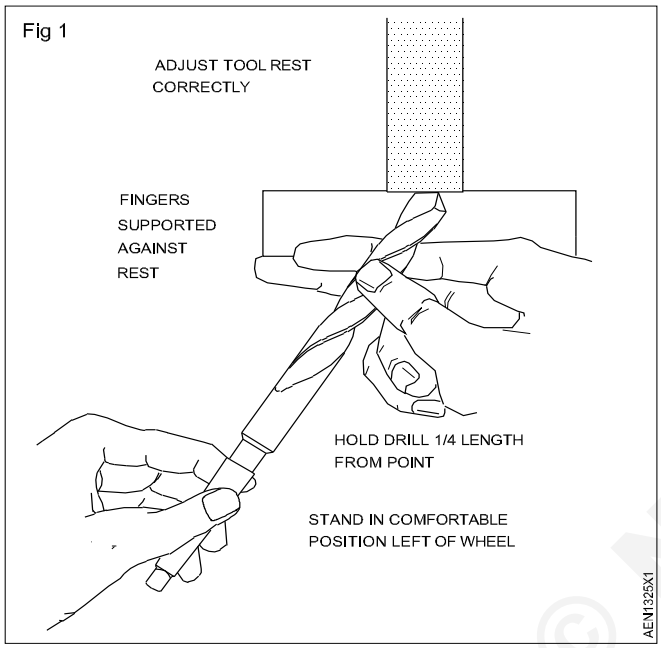
Objectives: This shall help you to
- **re-sharpen a twist drill**
- **test the drill that has been re-sharpened by drilling a through hole.**

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 an 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.

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

Fig 2

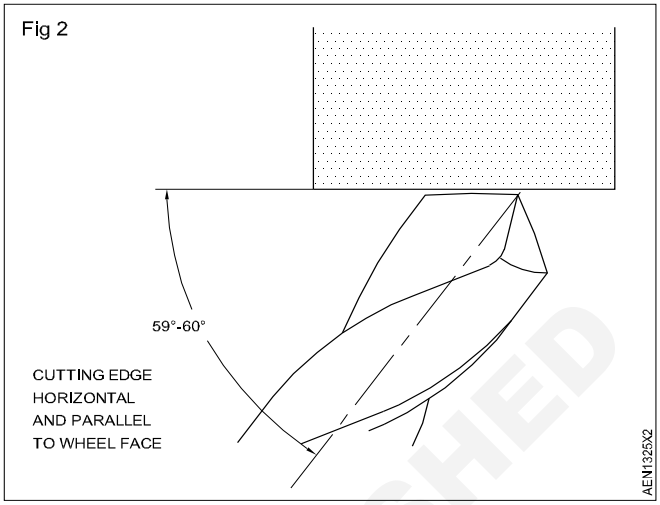


Fig 3

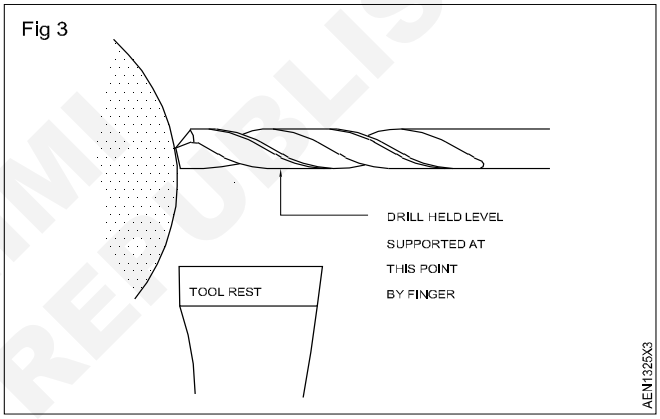
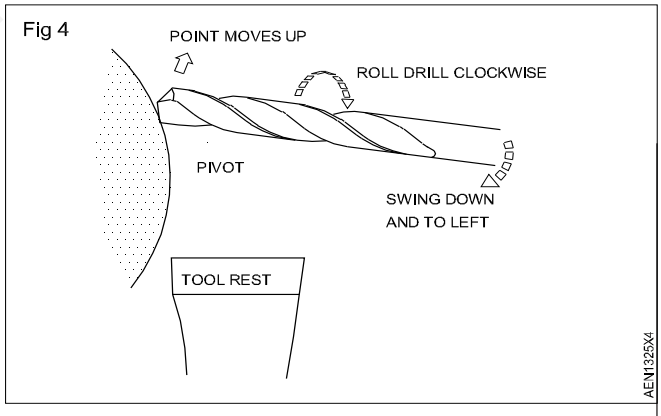
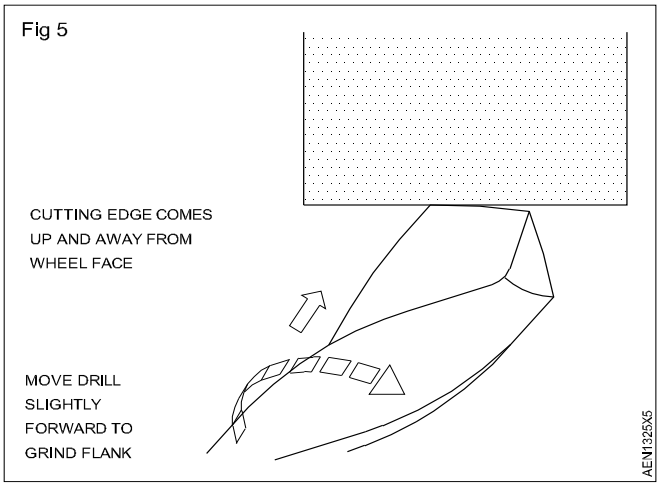


Fig 4



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.

Fig 5



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

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

Also not that, if the drill is twisted too far, the other cutting

edge will swing down to contact the wheel face.

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

Procedure to obtain equal angles

Move the drill back, clear of the wheel face.

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

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

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

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

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

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

Points to be considered when sharpening drills

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

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

Fig 6

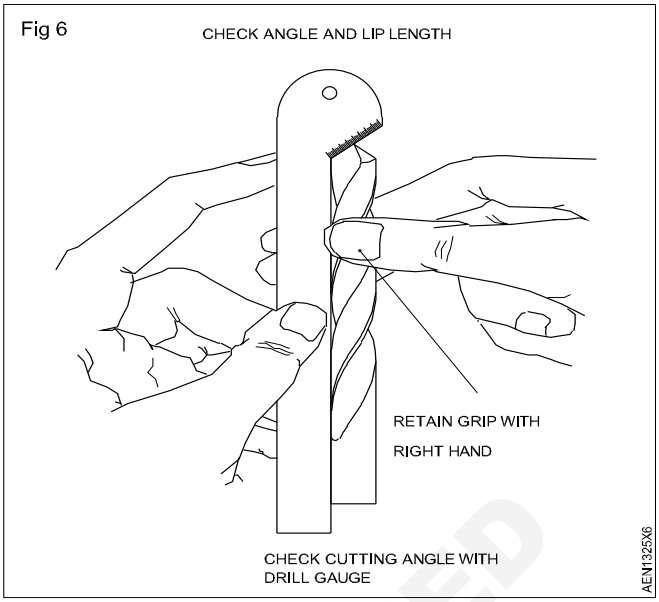
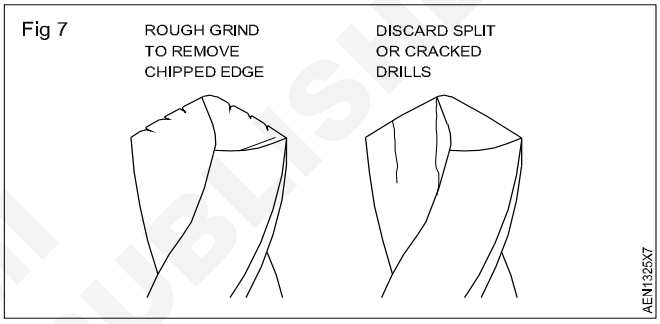


Fig 7

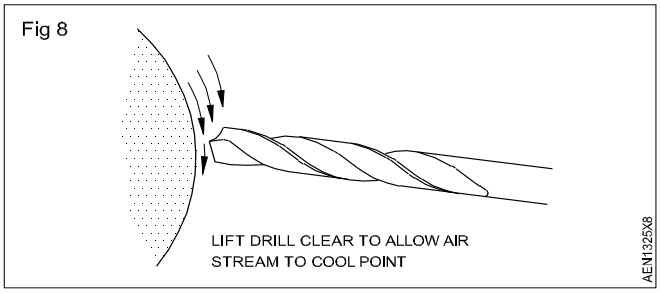


Never re-sharpen a cracked or split drill.

Avoid overheating the drill.

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

Fig 8

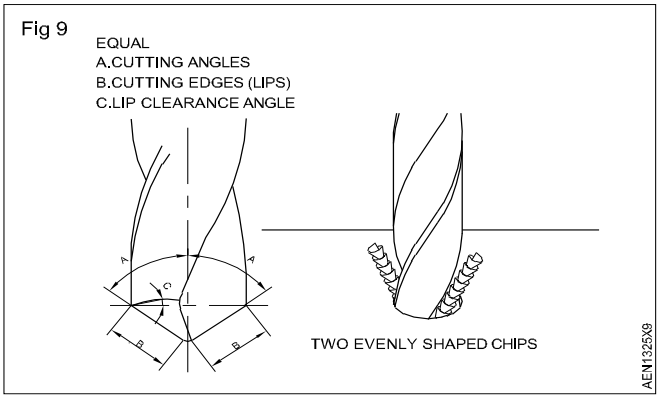


Cooling a drill rapidly by quenching in cold water may cause cracking of the cutting edge.

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

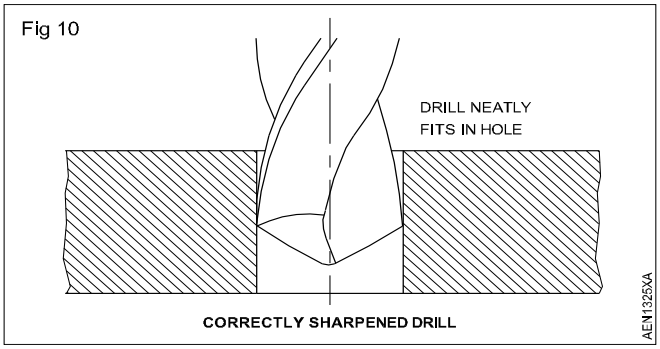
Set the spindle revolution of the drilling machine to give a cutting speed of 25 to 30 meters per minute. A drill that has been re-sharpened correctly will: (Fig 9)

Produce two evenly curled chips from its cutting edges.



Require only moderate pressure to feed it into the work.

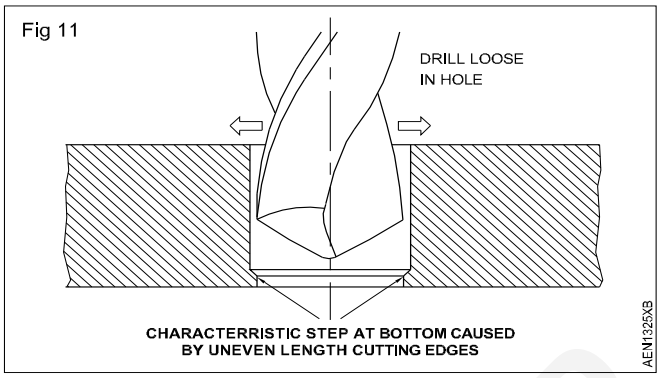
If the drill fits without any play it means that (Fig 10)



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)



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 procedure an out - of round hole.

Safety precautions while using drilling machine

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

Wear a dress suitable for work

Ensure that the spindle head and table is locked properly.

The work piece and the drill should be rigidly held.

Switch off power when not in use.

Clean and oil the machine after use.

Use a brush to clean the chips and sward.

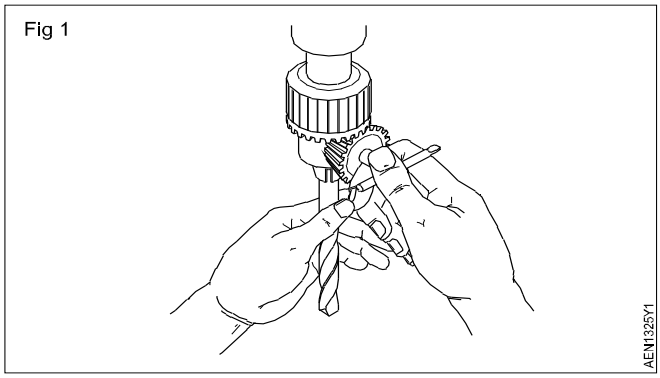
Select proper cutting speed according to material.

Select proper cutting fluid according to material.

Remove the work piece only after getting cooled or with a tong.

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

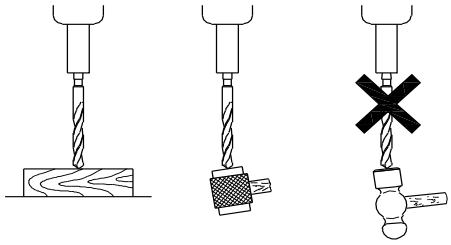
Ensure the belt safe Guard properly placed before drilling (Fig 3)



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

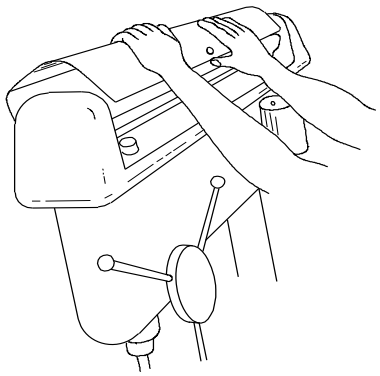
While removing the drill from the sockets/sleeves, don't allow it to fall on the table or jobs. (Fig 5)

Fig 2



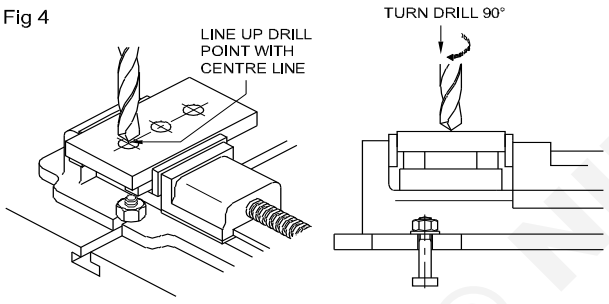
AEN1325Y2

Fig 3



AEN1325Y3

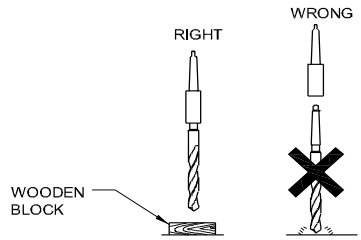
Fig 4



AEN1325Y4

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

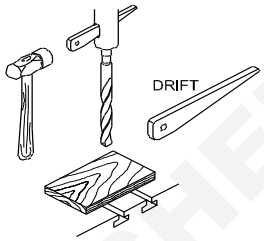
Fig 5



REMOVING A TAPER SHANK DRILL

AEN1325Y5

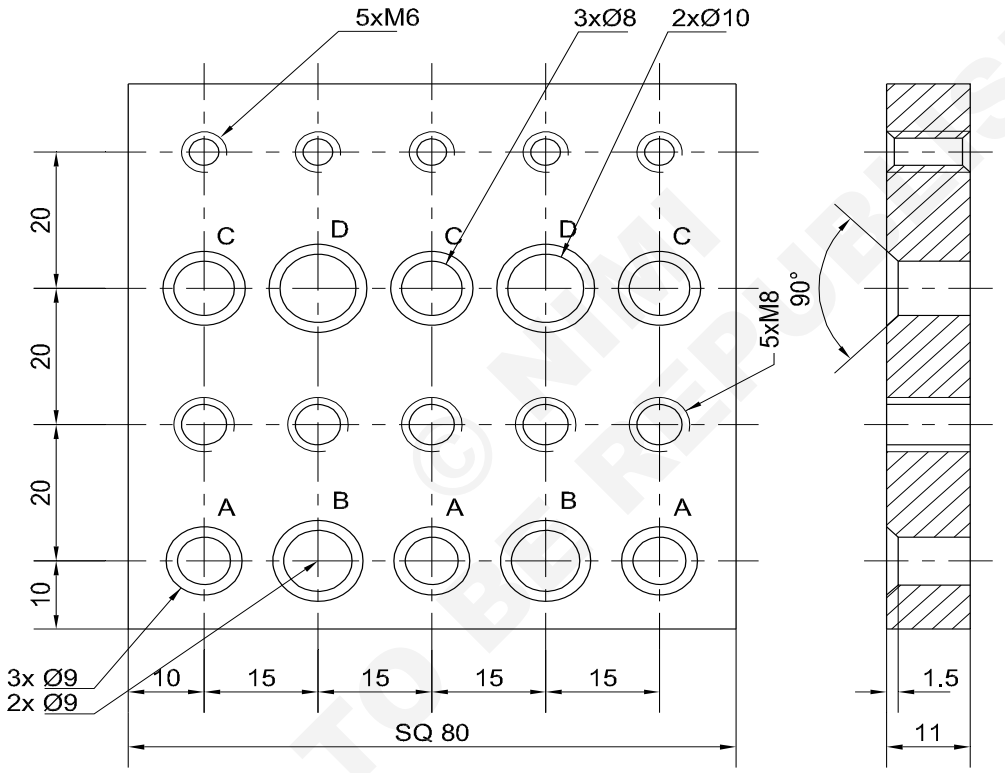
Fig 6



AEN1325Y6

Practice on tapping a clear and blind hole

Objective: At the end of this exercise you shall be able to
- **tap a clear drill hole.**



1	90ISF12x85	-	Fe310		2	1.3.26
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex.No.
SCALE 1:1	CUTTING INTERNAL THREADINGS				DEVIATIONS ±0.1	
					CODE NO. AEN1326E1	

PROCEDURE

TASK: **Drill various size holes in given job**

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 centers for holes to be drilled, tapped and countersunk.
4 Center punch the centres.
5 Drill five, ø 5 mm tapping drill size holes for M6 tapping.
6 Drill five, ø 6.8 mm tapping drill size holes for M8 tapping.
7 Drill four ø 8 mm through holes as per drawing. Enlarge by drilling ø 10 mm the 2nd and 4th hole of the second row.
8 Drill five ø 7 mm through holes as per drawing.
9 Enlarge the 2nd and 4th holes by drilling ø 9 mm on the 4th row
10 Countersink ø 8 and ø 10 holes with 90° countersink as per standard. (Refer to the table.)
11 Countersink ø 7 and ø 9 mm holes with 120° countersink as per5 standard. (Refer to the table.)
12 Cut M6 internal thread in the four ø 5 mm drilled holes.
13 Countersink 120° all the four ø 6.8 mm holes on both sides as per drawing.
14 Cut M8 internal threads in all the five ø 6.8 mm drilled holes with M8 taps.
15 Check M6 and M8 tapped holes with the supplied M6 and M8 screws, respectively.

— — — — — —

Skill sequence

Internal threading of through holes using hand taps

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

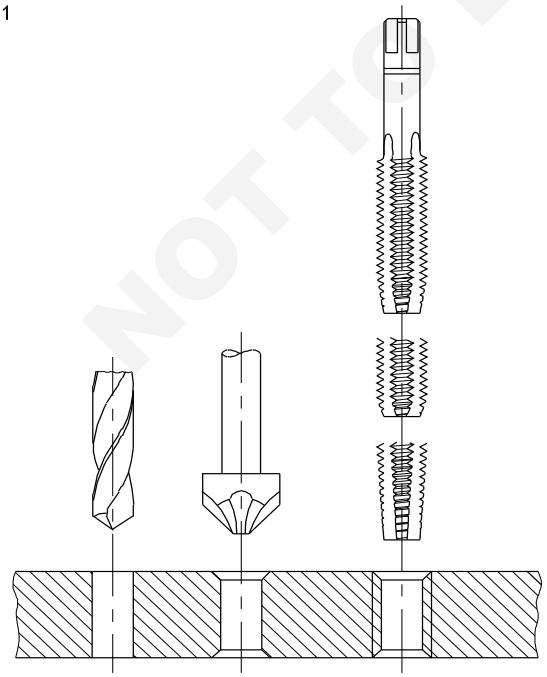
Determining the tap drill size

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

Drill the hole to the required tap drill size.

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

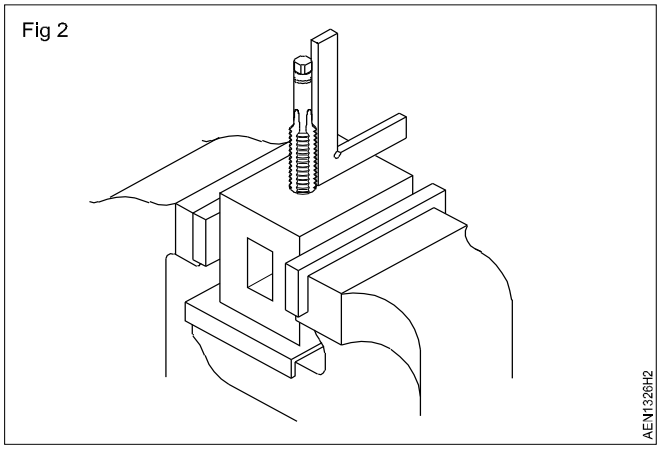
Fig 1



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

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

Fig 2



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

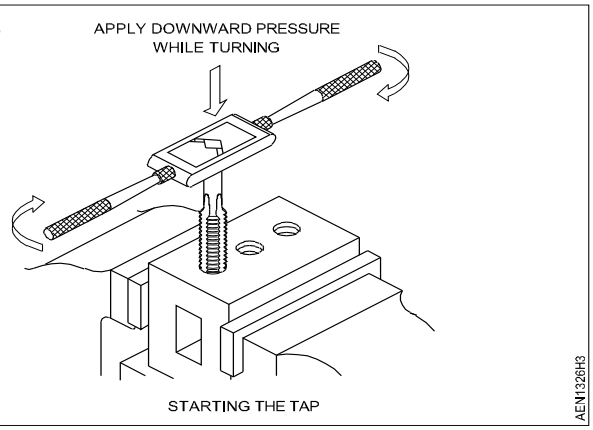
Fix the first tap (Taper tap) in the wrench.

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

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

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

Fig 3



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

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

Fig 4

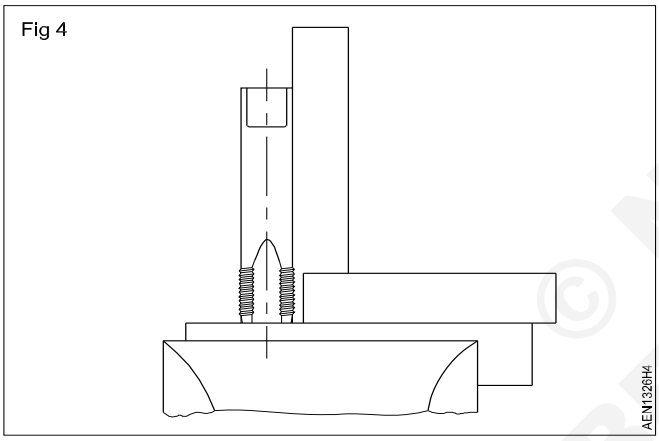
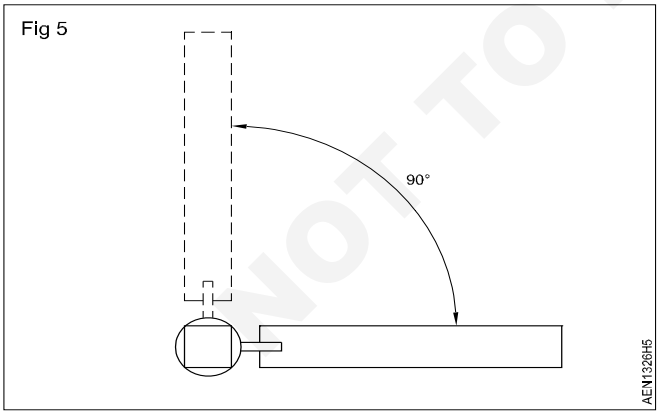


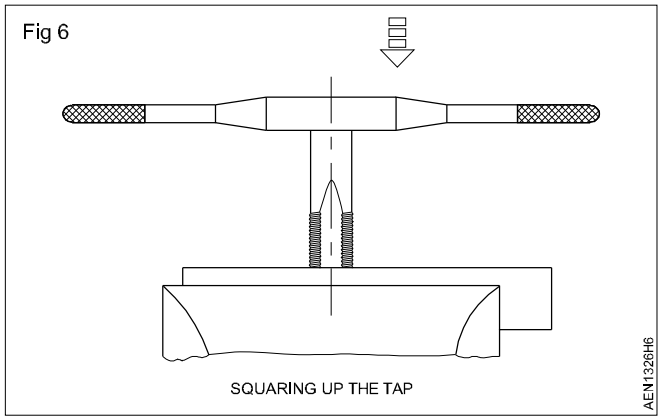
Fig 5



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

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

Fig 6



Check the tap alignment with a try square.

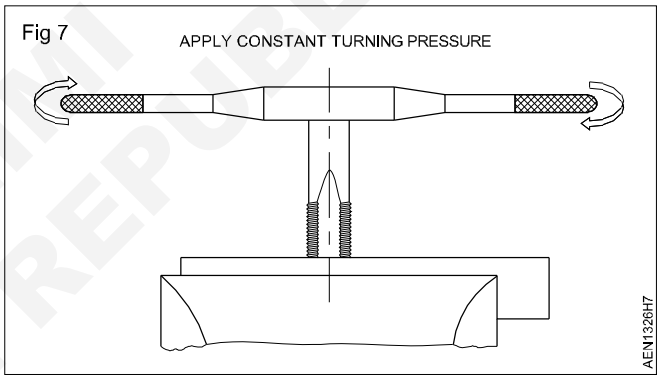
Fit the tap wrench, and tighten without disturbing the tap alignment.

Make one or two turns and check the alignment.

The tap alignment should be corrected within the first few turns.

After the tap is positioned vertically, turn the wrench lightly by holding the ends of the wrench handles without exerting any downward pressure. (Fig 7)

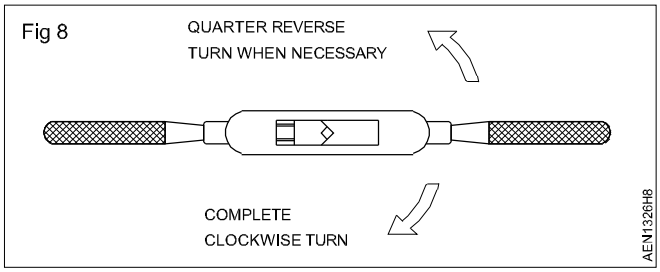
Fig 7



While turning the wrench, the movement should be well balanced. Any extra pressure on one side will spoil the tap alignment and can also cause breakage of the tap.

Continue cutting the thread. Turn backwards frequently, about quarter turn to break the chip. Stop and turn backward also when some obstruction to movement is felt. (Fig 8)

Fig 8



Use a cutting fluid while cutting the thread.

Cut the thread until the tap is fully inside the hole being threaded.

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

Remove chips from the work with a brush.

Check the threaded hole with a matching screw.

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

Internal threading blind holes using hand taps

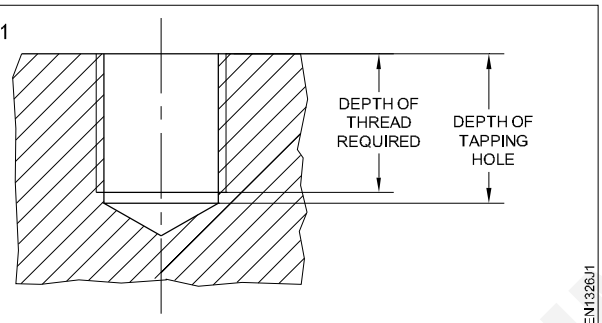
Objective: This shall help you to
- **cut internal threads in blind holes.**

Drilling a blind hole

Determine the tapping drill size using the table for tapping drill sizes.

Drill a blind hole (Fig 1) using the depth stop arrangement. The depth of the tapping hole should be slightly more than the depth of the required thread.

Fig 1



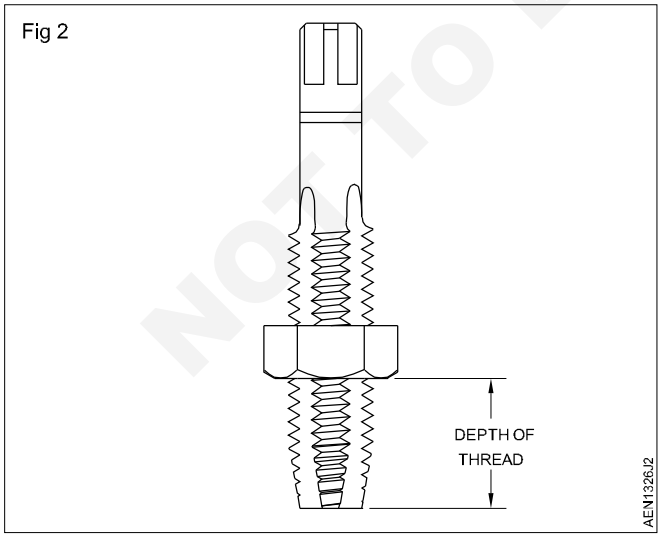
Procedure for threading

Remove metal chips, if any, from the blind hole by turning it upside down and slightly tapping it on a wooden surface.

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

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

Fig 2

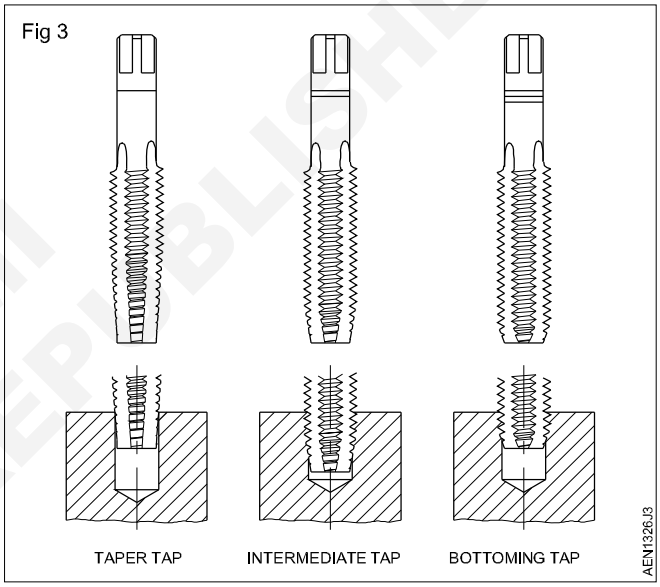


Thread the blind hole until the nut touches the plate surface.

Remove the chips from the hole frequently, using a flattened and bent wire.

Finish tapping the hole with intermediate and bottoming tap. Set nut to control the depth of thread. (Fig 3)

Fig 3



Practice to cut the External threads on a bolt/stud by using dies

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

PROCEDURE

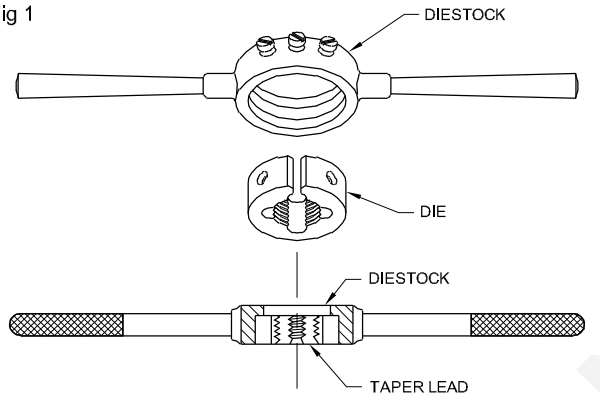
TASK: **External threading by using dies**

Check blank size

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

2 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.

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

Fig 2

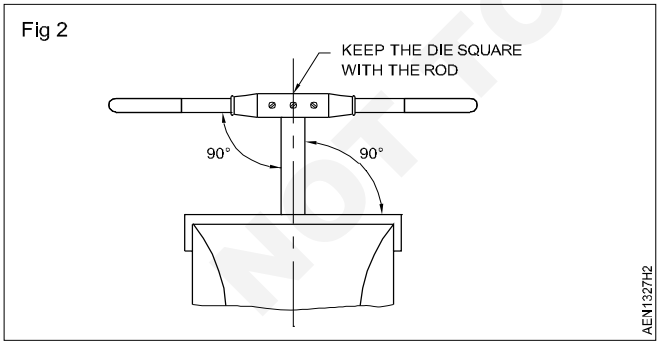
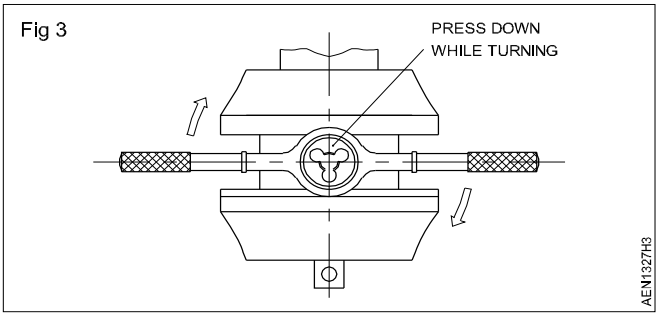


Fig 3



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

Fig 4

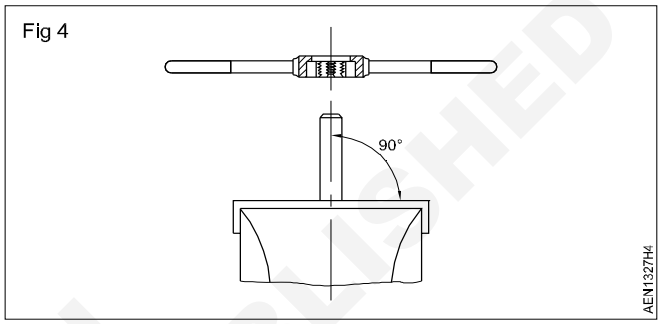
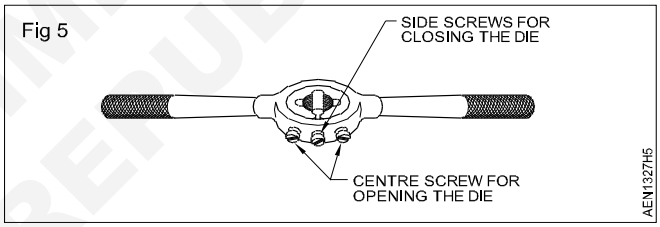


Fig 5



5 Start the die, square to the bolt center line.

6 Apply pressure on the die stock evenly and turn in the clockwise direction to advance the die on the bolt blank.

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

Use a cutting lubricant.

8 Increase the depth of the cut gradually by adjusting the outer screws.

9 Check the thread with a matching nut.

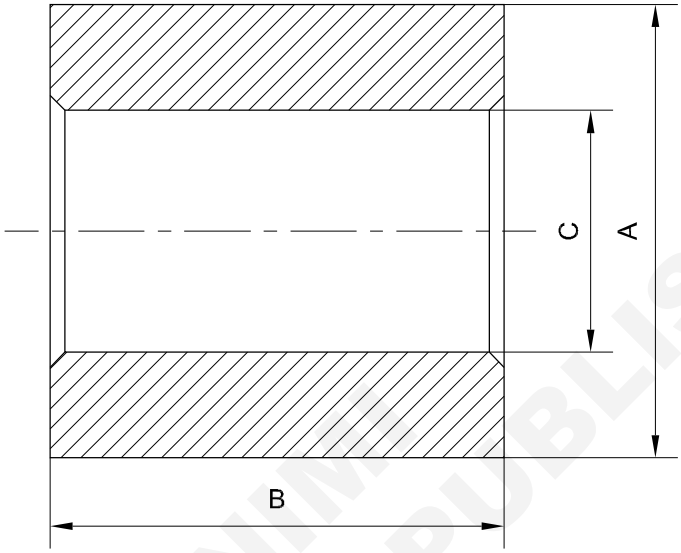
10 Repeat the cutting until the nut matches.

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

Clean the die frequently to prevent the chips from clogging and spoiling the thread.

Practice to ream a hole

Objectives: At the end of this exercise you shall be able to
- **ream through hole with a hand reamer**
- **check the reamed hole by using a plug gauge.**



A			
B			
C			

1	-	-	Fe310	-	-	1.3.28
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex No.
SCALE 1:1	REAMING				DEVIATIONS ±0.1	
					CODE NO. AEN1328E1	

PROCEDURE

TASK: **Ream a hole**

1 Hold the job in a vice.

2 Select the correct type and size of reamer

3 Hold the reamer in tap wrench

4 Ream the hole by using sufficient coolant.

5 Give uniform hand feed while reaming.

6 Check the hole with a ‘Go’ and ‘No-Go’ plug gauge.

— — — — — —

Skill sequence

Practice to ream 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,

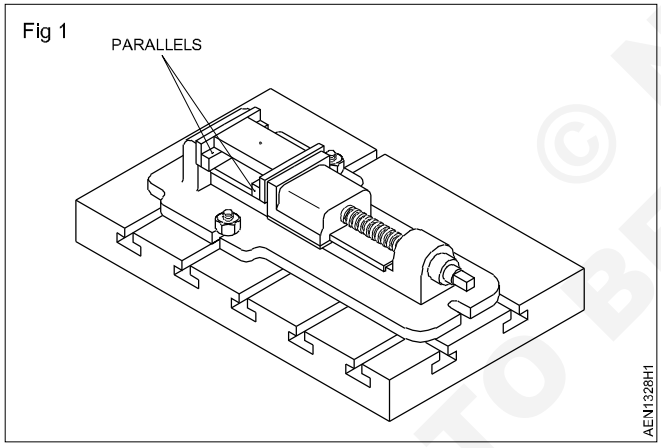
Drill diameter = reamed hole size. (undersize + oversize) [Refer to the table for the recommended under sizes in related theory on drill sizes for reaming].

Procedure for hand reaming

Drill holes for reaming as per the sizes determined.

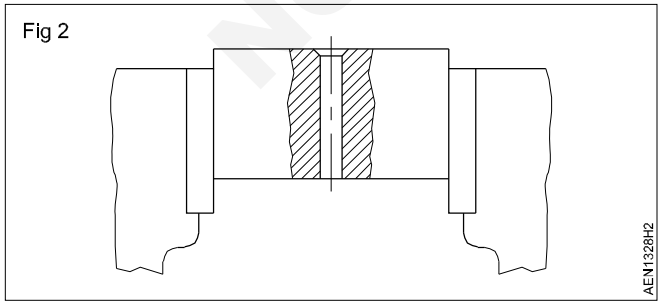
Place the work on parallels while setting on the machine vice. (Fig 1)

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

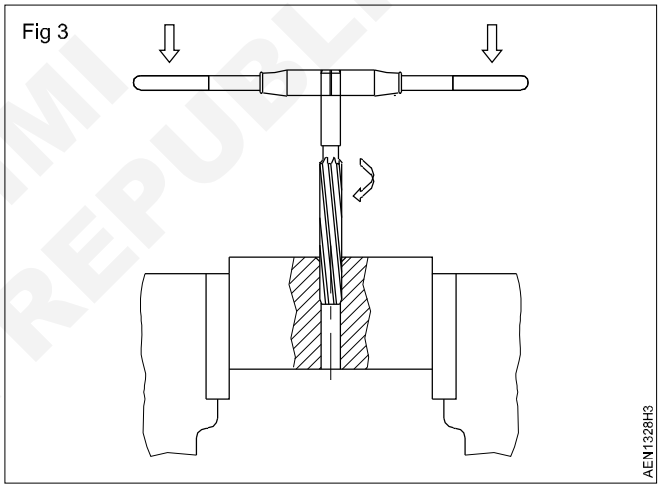


Fix the tap wrench on the square end and place the reamer vertically in the hole. Check the alignment with a try square. Make corrections, if necessary. Turn the tap wrench in a clockwise direction applying a slight downward pressure at the same time. Apply pressure evenly at both ends of the tap wrench.

Apply cutting fluid.

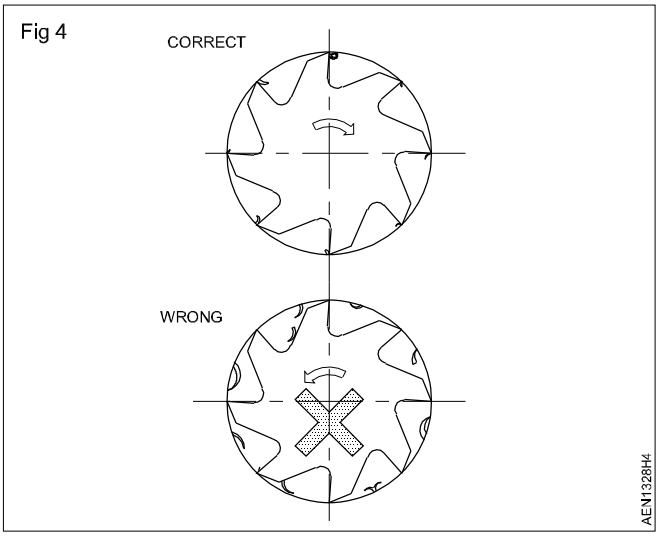
Turn the tap wrench steadily and slowly, maintaining the downward pressure. (Fig 3)

Fig 3



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

Fig 4



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

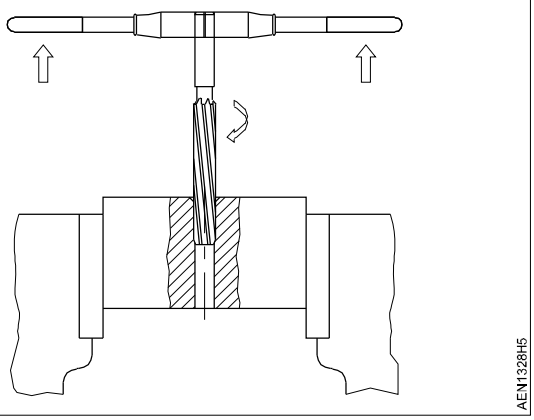
Do not allow the end of the reamer to the strike on the vice.

Remove the reamer with an upward pull until the reamer is clear of the hole. (Fig 5)

Remove the burrs from the bottom of the reamed hole.

Clean the hole. Check the accuracy with the cylindrical pins supplied.

Fig 5



Scraping curved surfaces

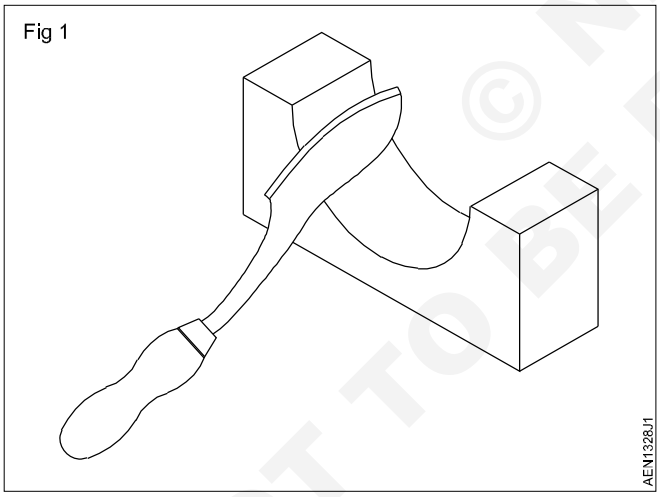
Objective: This shall help you to
- **scrape and test curved surfaces.**

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)

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 2

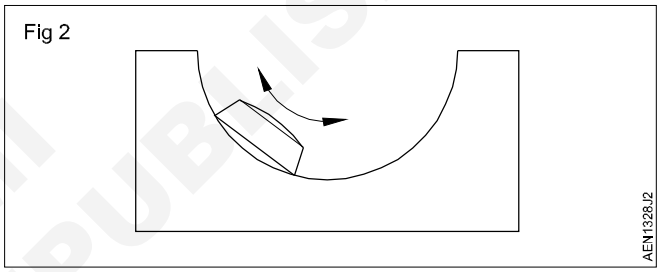


Fig 3

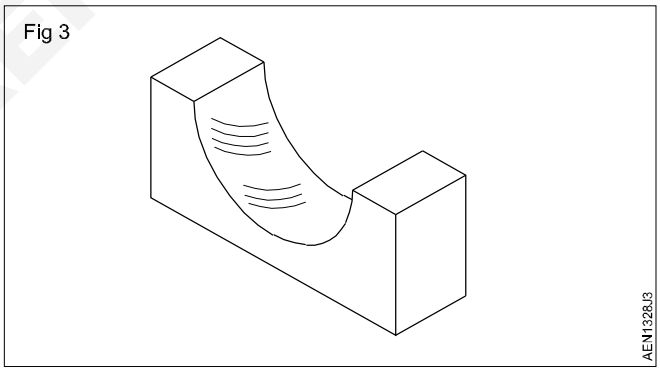
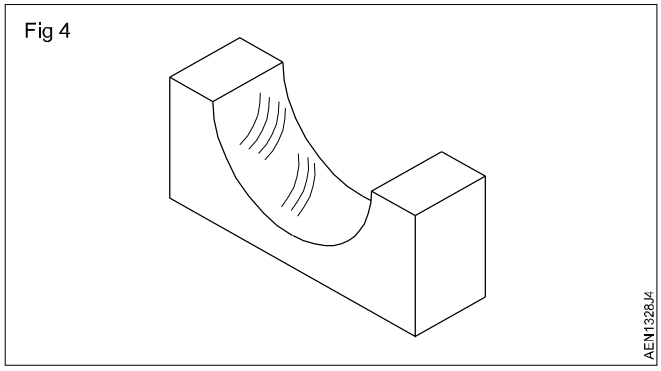


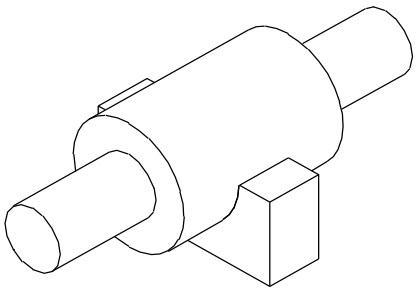
Fig 4



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

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

Fig 5



AEN1328J5

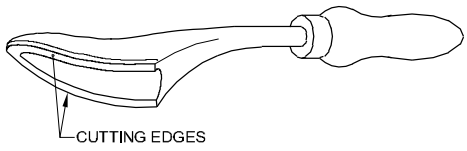
Sharpening scrapers

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.

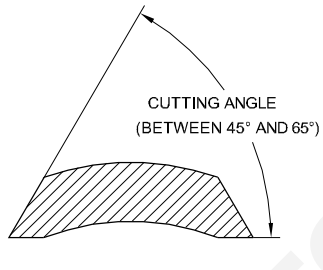
Fig 1



AEN1328X1

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)

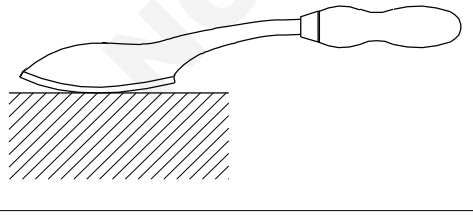
Fig 2



AEN1328X2

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

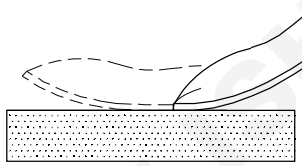
Fig 3



AEN1328X3

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

Fig 4



AEN1328X4

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.)

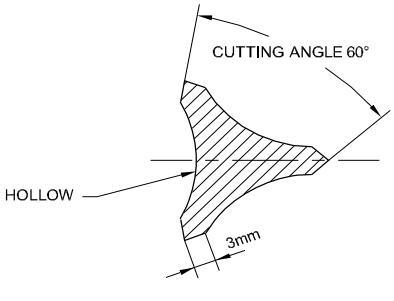
These scrapers have triangular cross-section which tapers to a point. (Fig 5)

Fig 5

AEN1328X5

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

Fig 6



AEN1328X6

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.

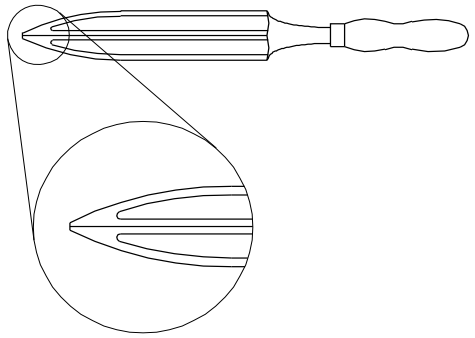
Apply only light pressure.

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 to crimp and solder wires

Objectives: At the end of this exercise you shall be able to
- **prepare the crimping joints with connector**
- **solder the cable using soldering iron.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Crimping plier - 1 No.
- Blow lamp - 1 No.
- Tong - 1 No.
- Combination plier - 1 No.

Materials

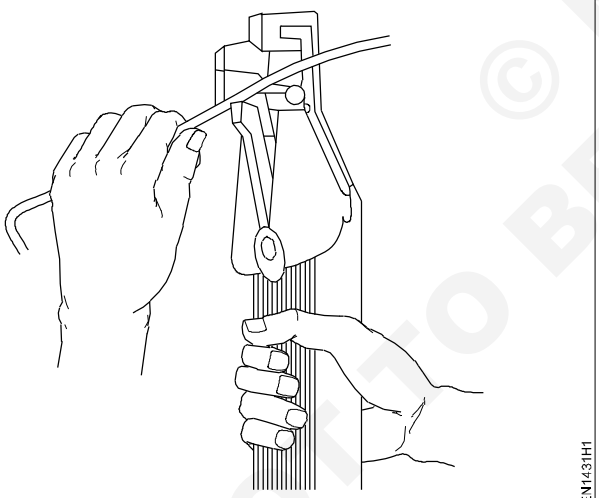
- Cotton waste - As reqd.
- Wooden plank - As reqd.
- Solder - As reqd.
- Brick - As reqd.
- Insulating sleeve - As reqd.
- Flux - As reqd.
- Lug socket - As reqd.
- Cloth/Cotton tape - As reqd.
- Grade sandpaper - As reqd.

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.

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

Fig 2

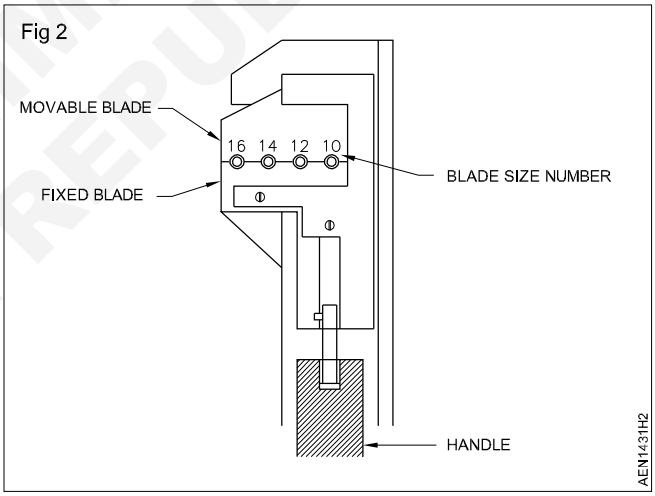
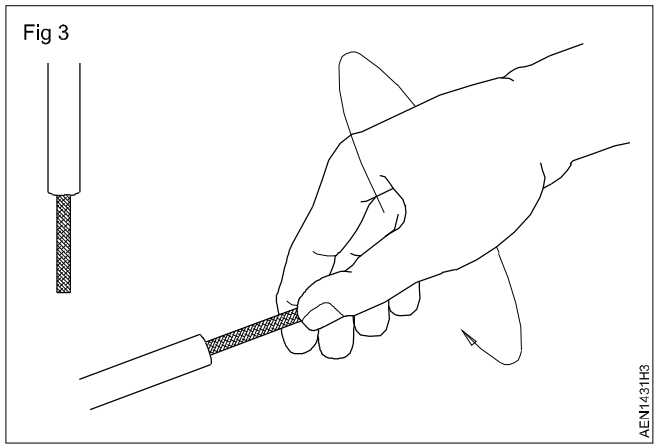
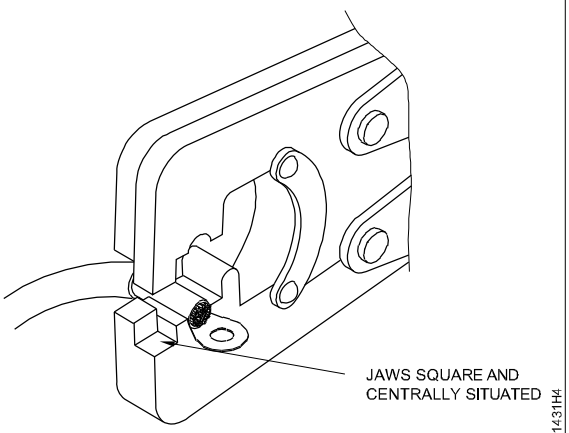


Fig 3



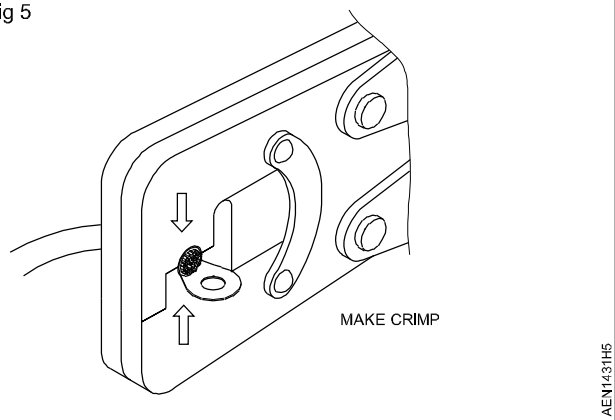
6 Check whether the connector is located in the middle of the band of the connector, and, if necessary, make final adjustments.

Fig 4



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 aluminum conductors of different lengths.

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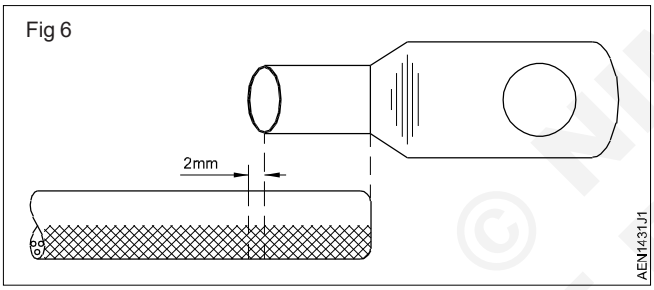
TASK 2: **Solder the cable lugs by using blow lamp**

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

Fig 6

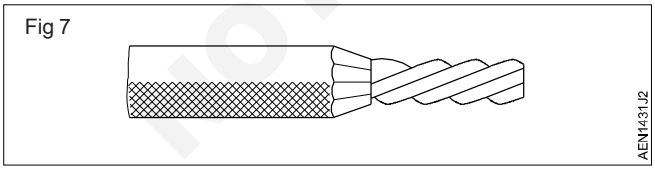


2 Clean the inner surface of the cable lug using 00 grade sandpaper.

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)

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

Fig 8

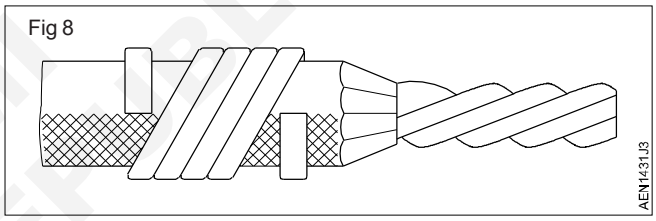
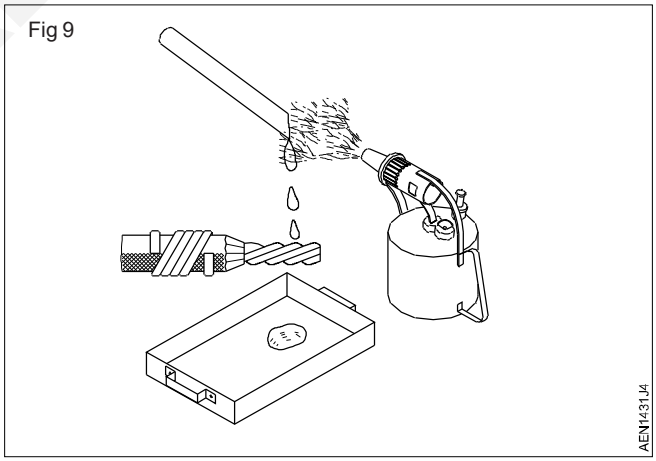


Fig 9



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)

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

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

Fig 10

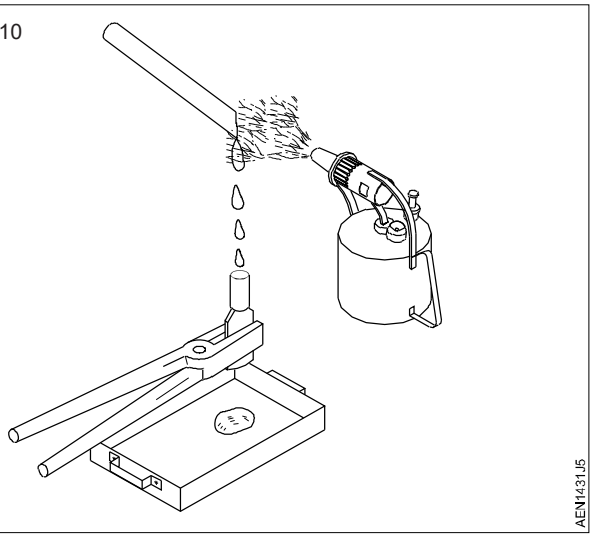
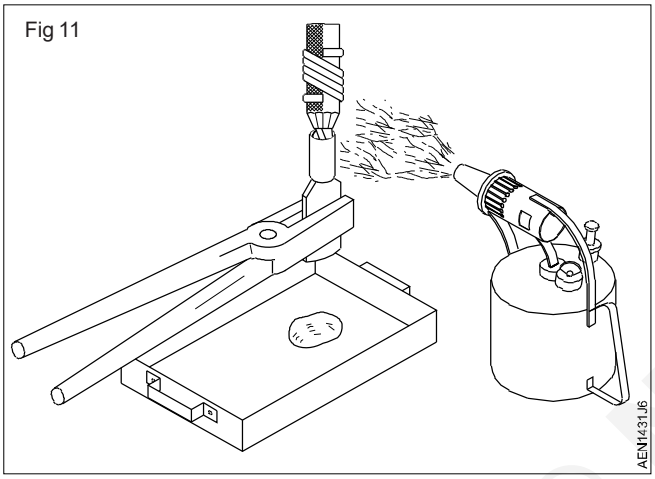


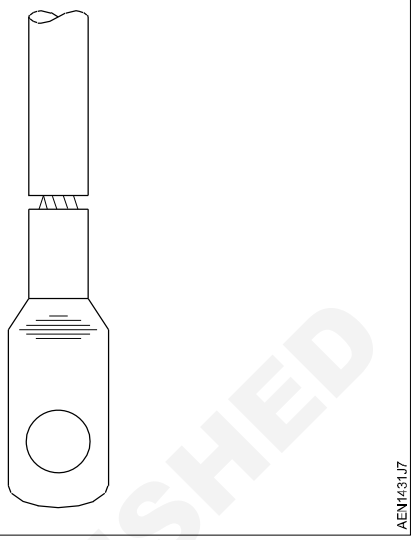
Fig 11



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.

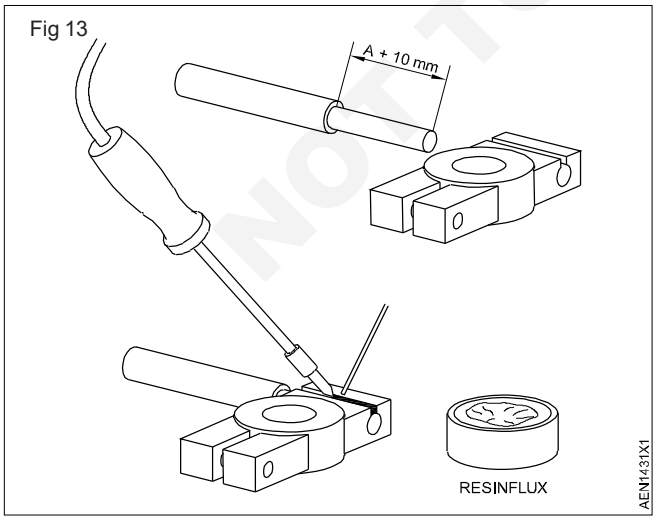
Do not use water to cool the lug.

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 13 and solder around the cable without melting the insulating sleeve.

Wound the insulation material with a wet cloth near the soldering end to prevent melting.

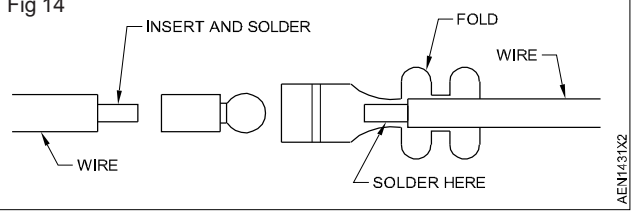
Soldering the circuit wire terminals

1 Remove the insulation as shown in the Fig 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.

Fig 14



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.

13 Construct a simple circuit by using wire and soldering iron. Solder the wires as given circuit diagram.

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Practice to measure electrical parameters in circuits & test for continuity

Objectives: At the end of this exercise you shall be able to
- **form DC series circuits and verify its characteristics**
- **form DC parallel circuits and verify its characteristics.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Ohmmeter/Multimeter - 1 No.
- Test lamp - 1 No.

Equipment / Machines

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

Materials

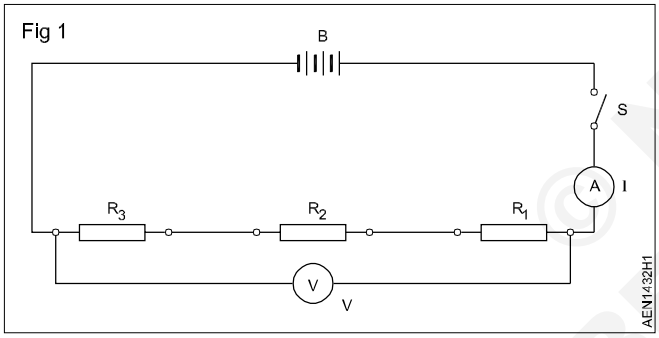
- Auto fuses - As reqd.
- Wires 4mm - As reqd.
- Insulation tape - As reqd.
- Fusible link connector - As reqd.
- Circuit breaker - As reqd.

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.

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.

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.

Fig 2

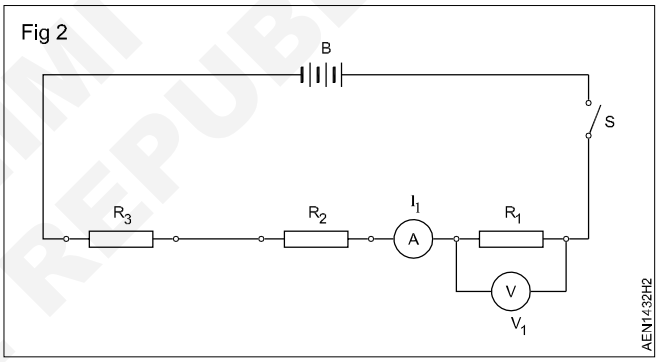
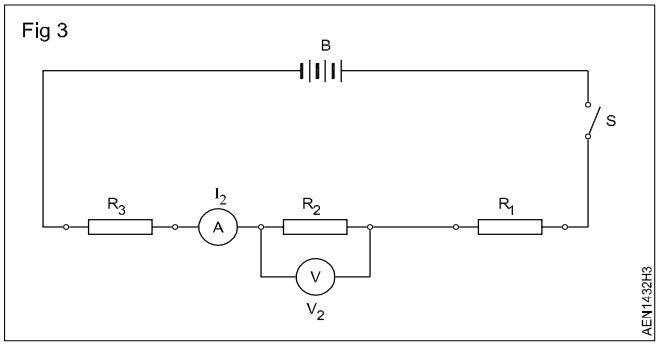


Fig 3



8 Enter the measured values in Table 1.

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

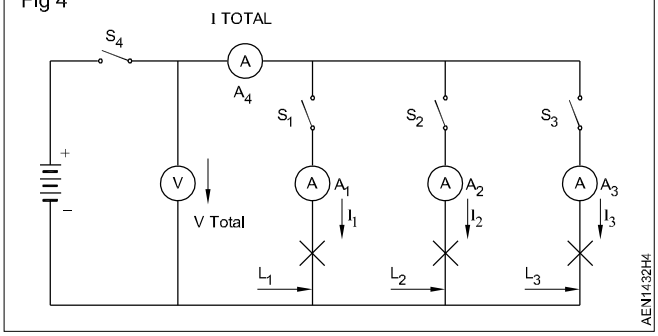
Table 1

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**

1 Form the branches 1, 2, 3 by connecting the torch lamps L1, L2, L3 (150 mA, 6v) with a holder, an ammeter A4 (500 mA) and switch 'S4' in series Fig 4.

Fig 4



2 Connect the lamp terminals of the three branches together.

3 Connect the leads of each branch together and also connect with the lead of the switch S4.

4 Form the circuit as shown in circuit diagrams with voltmeter (V), ammeter (A4), switch 'S4' and battery.

5 Close the switch 'S4' and switch 'S1' in branch 1.

6 Read the ammeters 'A4' and 'A1' and record the values in Table 2.

7 Close the switches 'S4' 'S1' and 'S2' in branch 2.

8 Read the ammeters 'A4' 'A1' and 'A2' and record the values in Table 2.

9 Close the switches 'S4' 'S1' and 'S2' in branch 3.

10 Read the ammeters 'A4' 'A1' 'A2' and 'A3' and record the values in Table 2.

11 Repeat the above steps after clamping the torch lamp in any one branch with 6v 300 mA lamp and record the results in Table 2.

12 Repeat the exercise by replacing all the three 'lamps with holder' by 'wire-wound resistors' (two numbers of 100 ohms and one of 150 ohms).

13 Verify the characteristics of current, voltage and resistance.

Table 2

Sl. No.	I_1	I_2	I_3	I_{Total}	Switches closed	Components in the branches
1					S_4, S_1	3 lamps of 150 mA.
2					S_4, S_1, S_2	,,
3					S_4, S_1, S_2, S_3	,,
4					S_4	,,
5					S_4, S_1	2 lamps of 150 m and one lamp 300 mA.
6					S_4, S_1, S_2	,,
7					S_4, S_1, S_2, S_3	,,
8						Resistors - two 100 ohms and one 50 ohms.
9					S_4, S_1, S_2	,,
10					S_4, S_1, S_2, S_3	,,

TASK 3: **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 5)

If the fuse is blown (2) due to overload the fuse wire is simply cut off. (Fig 6)

Fig 5

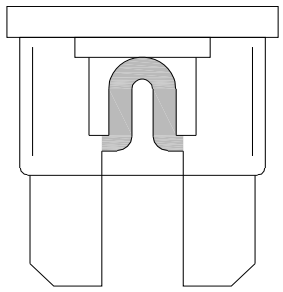
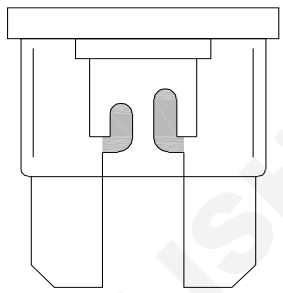


Fig 6



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TASK 4: **Check open and short circuit in the lighting circuit**

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

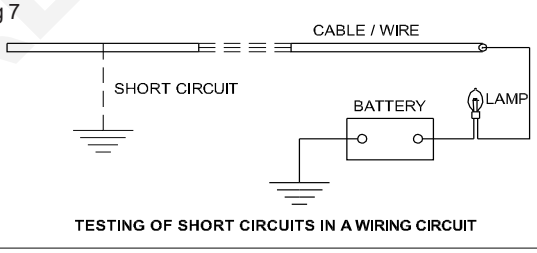
If there is an open circuit the ohmmeter reading will be more.

2 Trace the open circuit and rectify.

3 Check the wiring for short circuit with the test lamp. (Fig 7)

If there is a short circuit the test lamp will glow before the circuit is completed and also the fuse will be blown off.

Fig 7



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TASK 5: **Identify the fuse unit in the panel board (Fig 8)**

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.

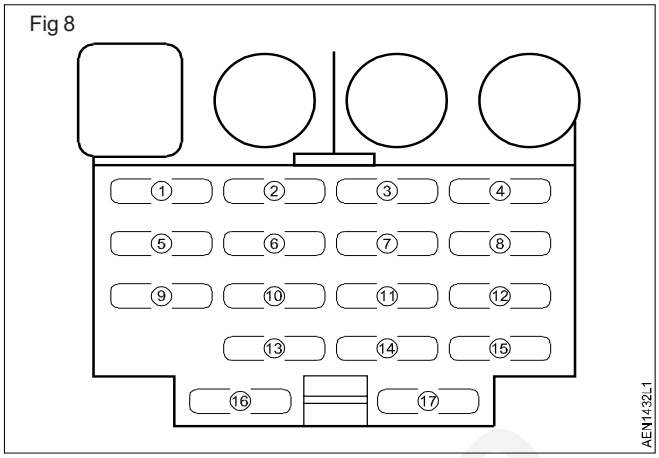
9 **CIG 15 A:** Cigarette lighter, clock digital type.

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 8



13 **Gauge 7.5 A:** Back-up lights, engine temperature gauge, fuel gauge, warning lights, warning buzzers.

14 **Dome 7.5 A:** Clock (digital type), interior light.

15 **16 7.5 A and 15 A:** Spare fuses

16 Write the name of the parts in the Table 1.

Table 1

Sl. No.	Lable No.	Name of the Parts and its rating
1	2	
2	5	
3	4	
4	1	
5	3	
6	11	
7	15	
8	12	
9	14	
10	6	
11	7	
12	9	
13	13	
14	16	
15	10	
16	8	

— — — — — —

TASK 6: **Connect jumper wire in battery**

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 9.

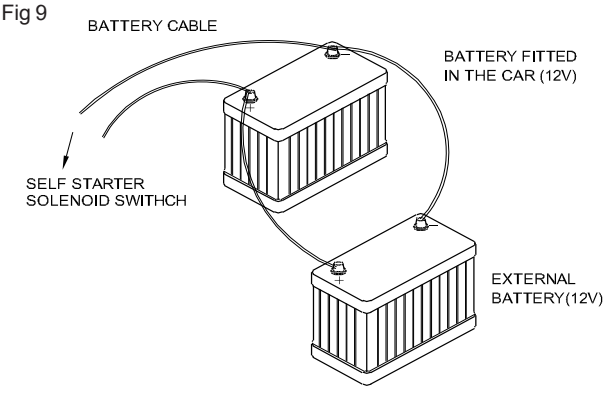
5 Start the vehicle run for some times.

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 9



JUMP STARTING OF AN ENGINE BY USING EXTERNAL BATTERY IN PARALLEL CONNECTION

— — — — — —

TASK 7: **Check of fusible link**

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

2 Check with the multimeter for continuity test.

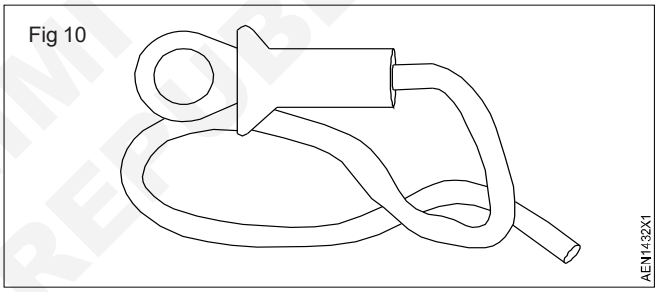
3 Replace the fusible link if damaged, burnout or disconnected

Replacing fusible links (Fig 10) 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.

And also it is very important to use the correct replacement of fusible link's size and length.

Fig 10



Never replace fusible link with normal electrical wire.

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TASK 8: **Check circuit breaker (Fig 11)**

1 Find the location of circuit breaker

2 Check the bimetallic strip (1)

3 Check the moving contact point (2)

4 Check the fixed contact point (3)

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

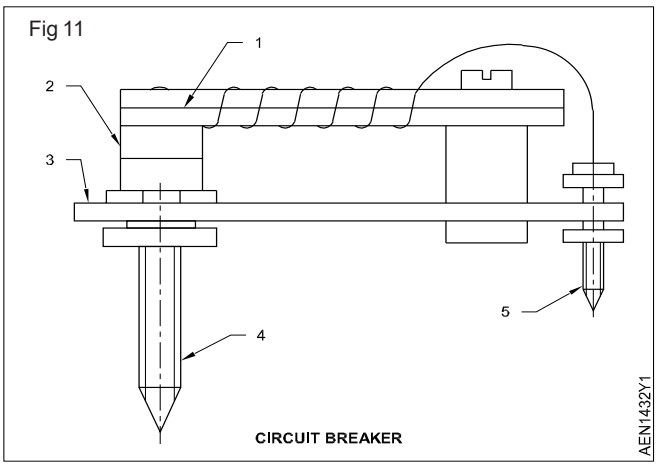
6 Identify the damaged parts during visual inspection of above mentioned parts

7 If find any damaged parts in circuit breaker, replace the part or replace the assembly

8 If contact point (2) & (3) pitted, file the surface and adjust it

10 Ensure the proper function of circuit breaker

Fig 11



CIRCUIT BREAKER

Practice to check the electrical circuits

Objectives: At the end of this exercise you shall be able to
- **check the DC series circuit joints**
- **check the DC parallel circuit joints**
- **check the DC series parallel circuit.**

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 No.
• Multimeter	- 1 No.
• Ohm meter	- 1 No.

Equipment / Machines

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

Materials

• 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.

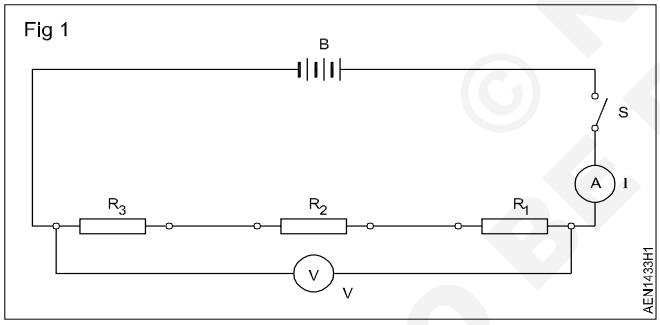
PROCEDURE

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

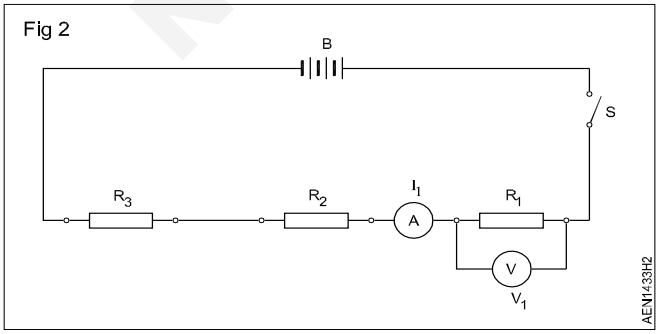


3 Close the switch 'S', measure the current 'I' and voltage 'V'.

4 Enter the measured values in Table 1.

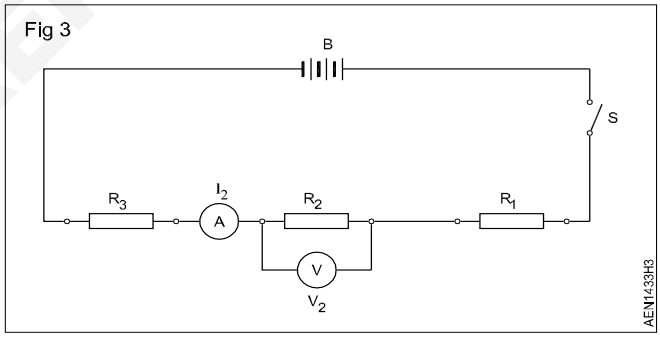
5 Switch off the supply, connect the ammeter and voltmeter as shown in the Fig 2. Switch on the supply and measure voltage V_1 and current I_1 through R_1.

Fig 2



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.

Fig 3



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=

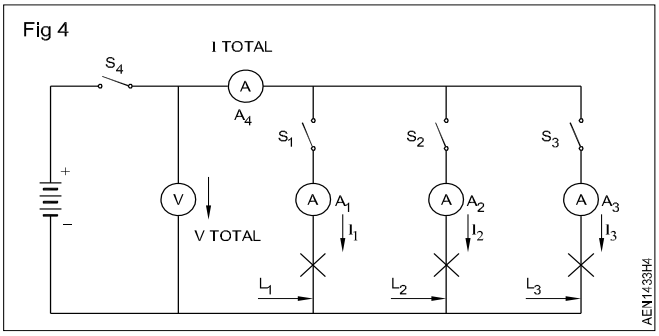
— — — — — —

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 4)

Fig 4



3 Connect the lamp terminals of the three branches connect with the lead of the switch S_4.

4 Form the circuit as shown in circuit diagrams with 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.**

Prepare the D.C series parallel circuit diagram

1 Calculate the voltage and currents for the series parallel circuit shown in Fig 5. Enter the values in Table 3.

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

3 Set the value of the rheostat resistances equal to the value given in Fig 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)

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

5 Calculate the value of R_T from V_s and I_s and record them in your note book and Compare with the value obtained in step 3.

Fig 5

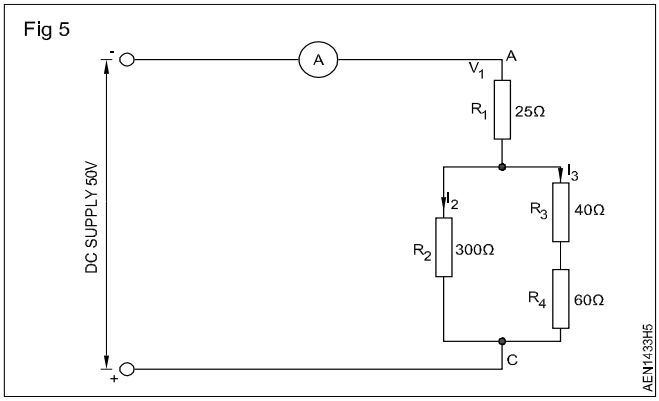


Table 3

		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 R_1 = 25W	Calculated 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	

— — — — — —

Practice to clean 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.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Hydrometer - 1 No.
- Multimeter - 1 No.
- Lead acid battery 6V or 12V 80AH - 1 No.

Equipment / Machines

- Vehicle - 1 No.
- Battery Charger - 1 No.

Materials

- Distilled water - As reqd.
- Vaseline - As reqd.
- Cotton rag - As reqd.
- Sand paper - As reqd.
- Soda bicarbonate - As reqd.
- Sulphuric acid - As reqd.

PROCEDURE

TASK 1: **Cleaning and Top-up of lead acid battery.**

1 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.

2 Unscrew all the vent plugs and check the level of the electrolyte.

Do not clean the battery top surface keeping the vent plugs open. The accumulated dirt may fall inside the cells and form sediments.

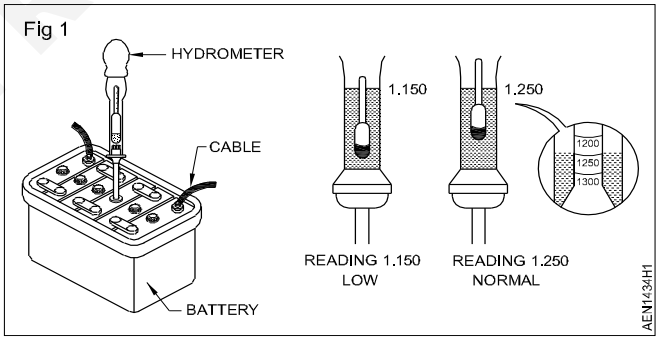
3 Top up the electrolyte to the marked level in all the cells with distilled water.

No electrolyte to be used to top up battery.

4 Open seal cap of battery and keep Hydrometer inside. suck electrolyte up to reference mark.

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

Fig 1



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TASK 2: **Check the specific gravity and open circuit voltage test**

1 Disconnect the negative cables first from the battery terminal.

2 Disconnect the positive cables from the battery terminal.

3 Remove the mounting clamp nuts.

4 Lift the battery from the vehicle.

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

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

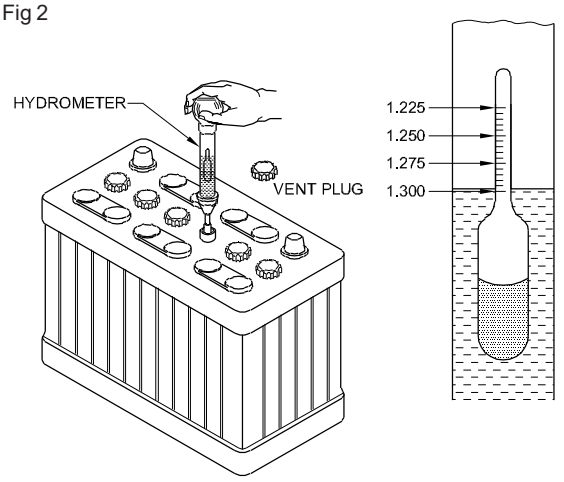
7 Check and top up the electrolyte level with distilled water. (if necessary)

8 Keep the battery on a leveled wooden workbench.

9 Remove all the vent plugs.

10 Hold the hydrometer vertically. (Fig 2)

Fig 2



TESTING SPECIFIC GRAVITY OF A BATTERY

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

12 Press the rubber bulb of the hydrometer.

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

14 Note the float level which is floating in the electrolyte.

15 Record the reading in Table 1.

Table 1

1	2	3	4	5	6

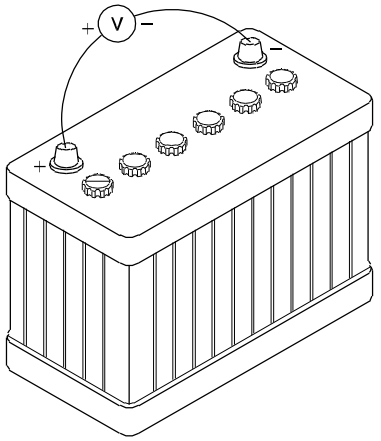
16 Repeat the same procedure for all the cells and record the readings.

The above reading should not vary more than 25 points between cells.

Protect your hands and clothes from the battery acid.

17 Connect the leads of the DC voltmeter (2) to the battery terminal (+ve to -ve). (Fig 3)

Fig 3



18 Take the reading from the voltmeter and record.

19 The voltmeter should read at least 13.2 volts per battery. After carrying out the above tests compare the readings with the manufacturer's specifications. Recharge/ replace the battery if it is in poor condition.

20 Clean the vent holes and tighten all the vent plugs.

21 Smear the battery terminals with Vaseline.

22 Place the battery in its position in the vehicle.

23 Tighten the battery mounting clamp nuts.

24 Clean the battery lugs with baking soda solution and water.

25 Connect the battery +ve cable first and tighten it.

26 Connect the battery -ve cable and tighten it.

27 Start the engine. Check whether the battery supplies sufficient current.

Disconnect the ground cable (-ve cable) first.

This will minimize the possibility of arcing and a resultant battery explosion.

— — — — — —

Practice to charge, inspect and test a battery

Objectives: At the end of this exercise you shall be able to
- **connect the battery to charger**
- **constant current method**
- **constant volt method.**

Requirements

Tools / Instruments

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

Equipment / Machines

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

Materials

• Vaseline	- As reqd.
• Battery acid	- As reqd.
• Cable/Wire	- As reqd.
• Distilled water	- As reqd.
• Cotton rag	- As reqd.
• Water emery	- As reqd.

PROCEDURE

TASK 1: **Charge the battery**

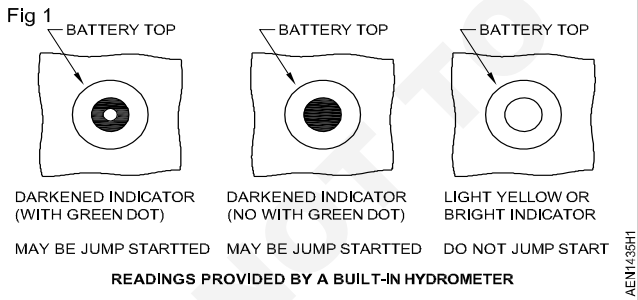
1 Place the battery on the charging table.

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.

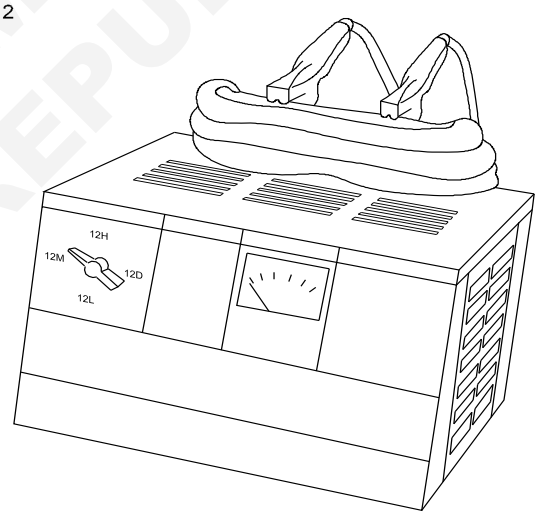
5 Consult an appropriate manual and determine the charging rate and time for the battery.

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.

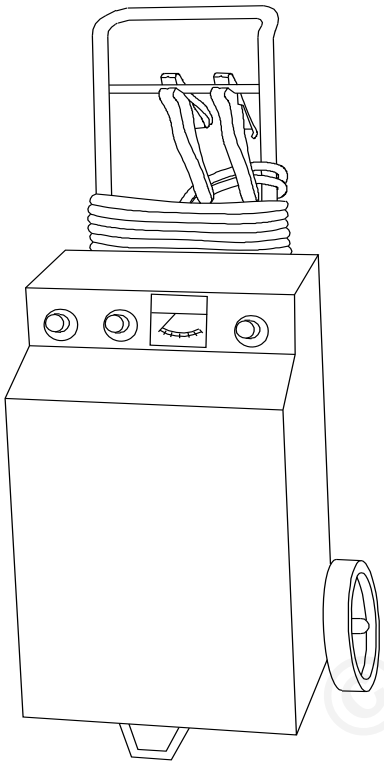
11 Continue charging until the allotted time or until the battery is fully charged.

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

AEN1435H3

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

Electrolyte temperature exceeds 125°F.

Violent gassing or spewing of electrolyte occurs.

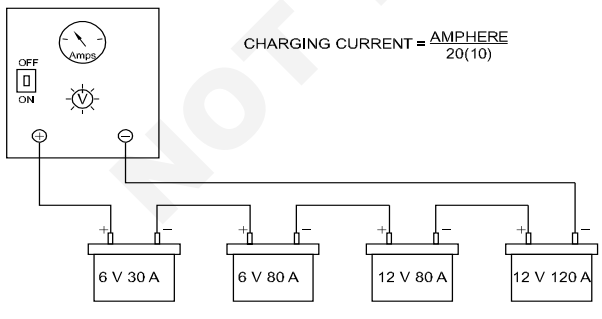
Battery is fully charged when over a two-hour period at a low charging rate in amperes all cells are gassing freely and no change in specific gravity occurs. For the most satisfactory charging, the lower charging rates in amperes are recommended.

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 4.

Fig 4



CONSTANT CURRENT METHOD

AEN1435J1

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

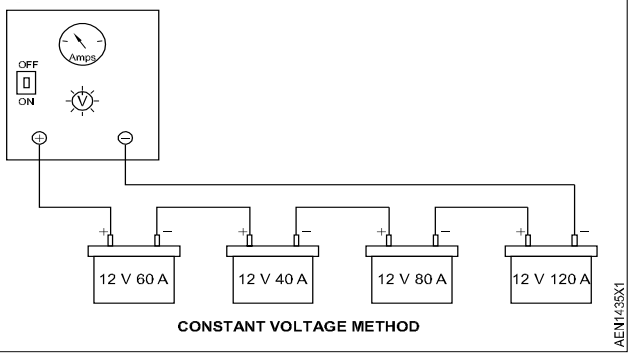
Table 1

Cell Battery	1	2	3	4	5	6
1						
2						
3						
4						

TASK 3: **Constant Voltage method (Fig 5)**

1 Connect all the batteries in parallel as shown in Fig 5

Fig 5



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.

Table 2

Cell Battery	1	2	3	4	5	6
1						
2						
3						
4						

7 Parasitic draw (Switch off) of battery

8 Check the battery for self-discharge by checking the battery charged condition periodically.

9 Check the battery, for discharge, externally as follows

10 Switch off the ignition switch

11 Check and clean the impurities and contaminated water layer on the top of the battery

12 Clean the top surface of the battery after topup the battery

13 Check any loose contact between battery post & terminals

14 Check any loose contact in the auto vehicle wiring circuit

15 Check and Replace the defective contact of all switches in the vehicle

16 Check and clean the sulphur formation of battery terminals.

— — — — — —

Practice to measure the voltage drop in a circuit

Objective: At the end of this exercise you shall be able to
- **test voltage drop in a circuit**
- **check the causes of parasitic draw of battery**
- **rectify the parasitic draw.**

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 No.
• Voltmeter MC 0 - 300 V	- 1 No.
• Multimeter	- 1 No.

Equipment / Machines

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

Materials

• Fuse	- As reqd.
• Switch	- As reqd.
• Cable/Wire	- As reqd.
• Sandpaper	- As reqd.
• Cleaning cloth	- As reqd.
• Baking soda	- As reqd.
• Petroleum jelly	- As reqd.
• Distilled water	- As reqd.
• Cleaning brush, 2 inch	- 1 No./batch.

PROCEDURE

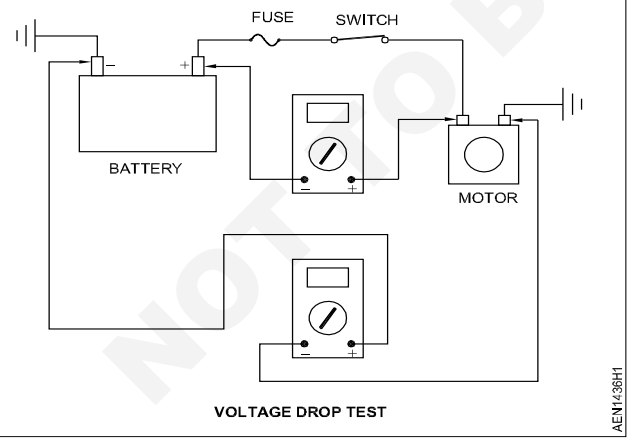
TASK 1: **Measure voltage drop in circuit**

1 Clean all the terminals, connectors in the auto electrical wiring circuits

2 Check, whether battery is fully charged condition.

3 Connect the multimeter at shown in Fig 1 in the auto electrical wiring circuit.

Fig 1



VOLTAGE DROP TEST

4 Connect (+)ve lead to the input terminal of the motor.

5 Connect (-)ve lead to the battery +ve terminal

6 Read the voltage in the multimeter.

7 Remove, clean and refit (or) Replace the terminal if voltage drop exceeds 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)

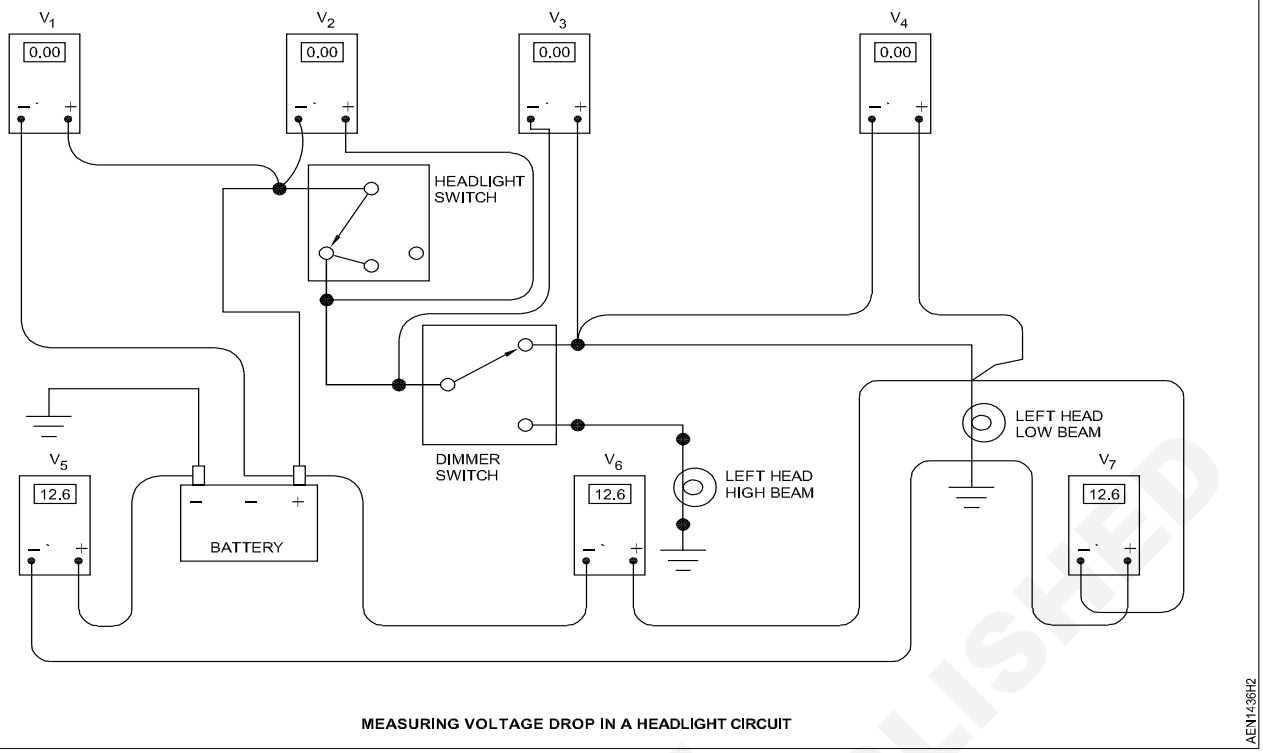
4 Measure the voltage drop shown in meter.

5 Compare the measured value with the rated value.

6 Replace, Clean and reconnect the lead if the voltage drops 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

— — — — — —

TASK 2: **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 color 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 3: **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 top up.
3 Check & tight the loose contact terminals
4 Replace the defective switches.
5 Keep the battery terminals free from sulphur formation.

If acceptable causes to discharge of battery is also causes to parasitic draw of battery

If the discharge rate of battery is more than 0.050 A at Ideal condition is said to be parasitic draw of battery.

— — — — — —

Check the relays, solenoid and electrical circuit using test lamp

Objectives: At the end of this exercise you shall be able to
- **check the condition of the solenoid switch in the starting system**
- **check the condition of the relay in the wiring circuit**
- **check the electrical circuits with the test lamp**
- **check the solenoid electrical circuit with a test lamp**
- **check the wiper motor electrical circuit.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Test lamp - 1 No.
- Multimeter - 1 No.

Equipment / Machines

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

Materials

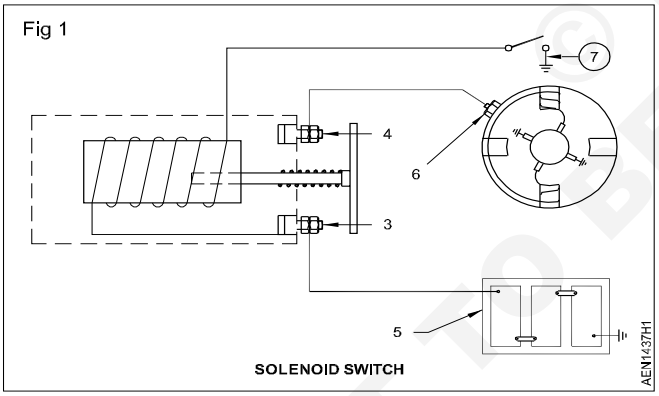
- Fuse - As reqd.
- Switch - As reqd.
- Cable/Wire - As reqd.
- Insulation tape - As reqd.

PROCEDURE

TASK 1: **Check the solenoid switch**

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

Fig 1



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

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

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

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

6 Disconnect the cable wires from the solenoid switch.

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

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

9 Connect one end of the test lamp with starter switch terminal and the other end to the earth with switch open. If the lamp burns bright, the solenoid is shorted. Replace the switch.

— — — — — —

TASK 2: **Check the relay in horn circuit**

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

2 Loosen the mounting nuts of the horn relay and remove it

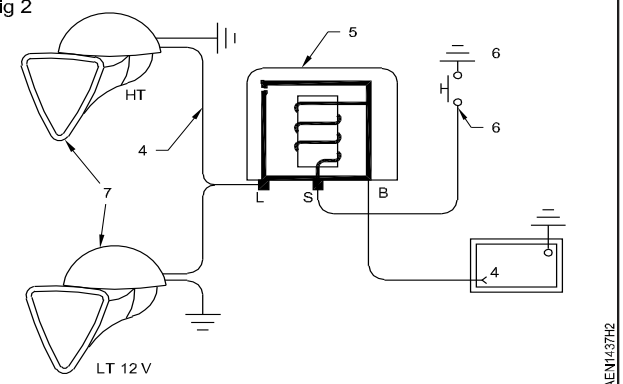
3 Check the condition of the horn relay using a rheostat and volt meter.

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

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

6 Start the full resistance in the circuit. Slide the knob to increase or decrease the voltage on the relay winding.

Fig 2



If there is an error when the relay point closes, adjust by bending the armature spring post

[Increasing the spring tension increases the closing voltage]

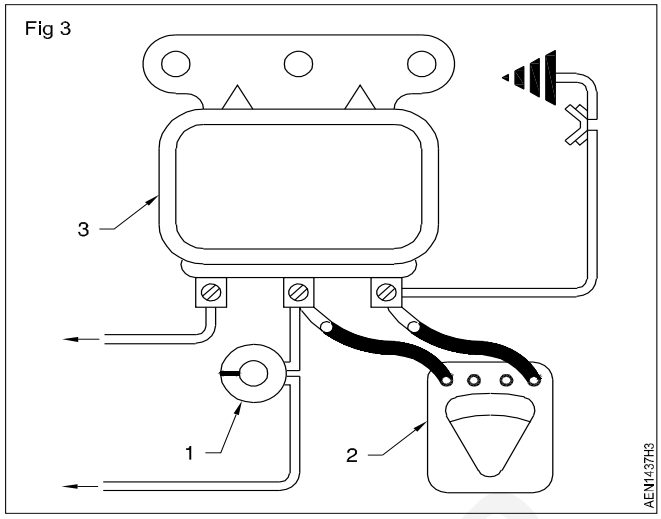
7 Replace the relay, if necessary.

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

9 Refit the spring and the horn switch.

10 Fit the retainer and press it.

Fig 3



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

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

Note:

Checking HL & Wiper motor relay.

Repeat the Task of checking the Relay.

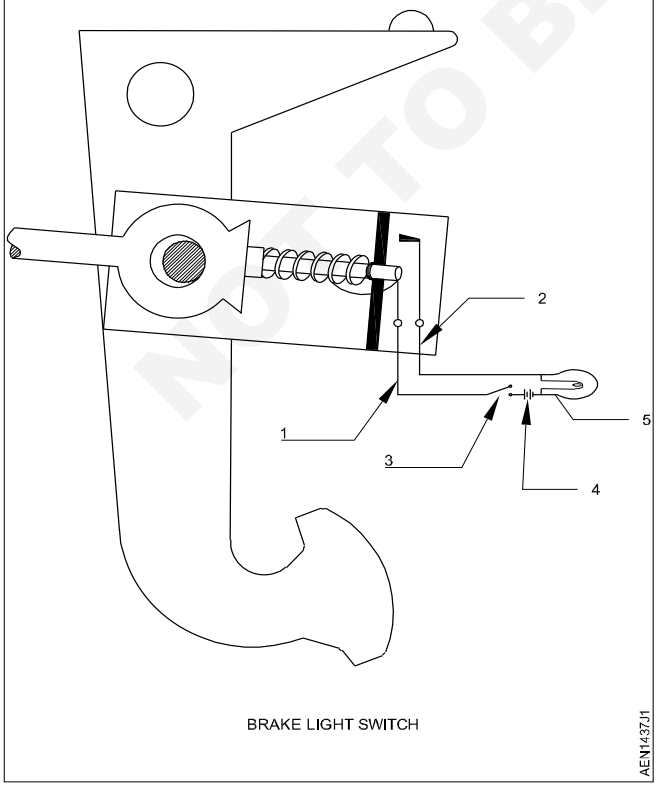
— — — — —

TASK 3: **Check solenoid circuit**

1 Check the brake light and solenoid switch visually. If there is any damage externally, replace.

2 Check the brake light switch terminal (1) & (2) and clean It. (Fig 4)

Fig 4

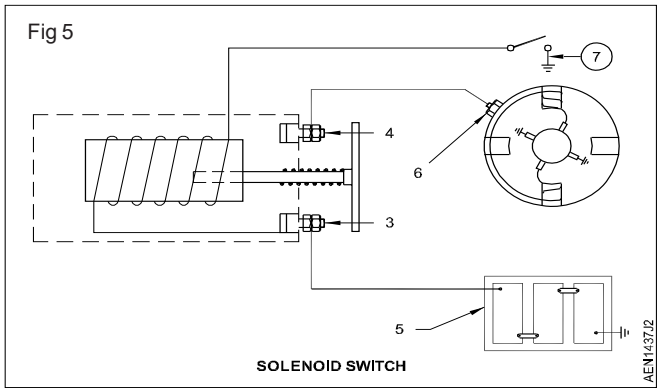


3 Check the wire connections from the brake light switch terminals (1 & 2) to the brake light lamp. Tighten, if they are found lose.

4 Check the battery cable connections from the battery (5) to the solenoid switch terminal (3). Tighten, if they are found losse.

5 Check the battery cable from the solenoid switch terminal (4) to the starting motor terminal (6). Tighten it if found lose. (Fig 5)

Fig 5



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

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

8 Disconnect the cable wires from the solenoid switch.

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

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

11 Connect one end of the test lamp with starter switch terminal and the other end to the earth with switch open. If the lamp burns bright, the solenoid is shorted. Replace the switch.

— — — — — —

TASK 4: **Check condenser**

1 Check the fiber head for wear; if necessary replace it. Connect the condenser as shown in the Fig 6. One side of the double pole, double throw switch (1) must be connected to the main, and the other side must be connected to the condenser (2) and test bulb (3) in series.

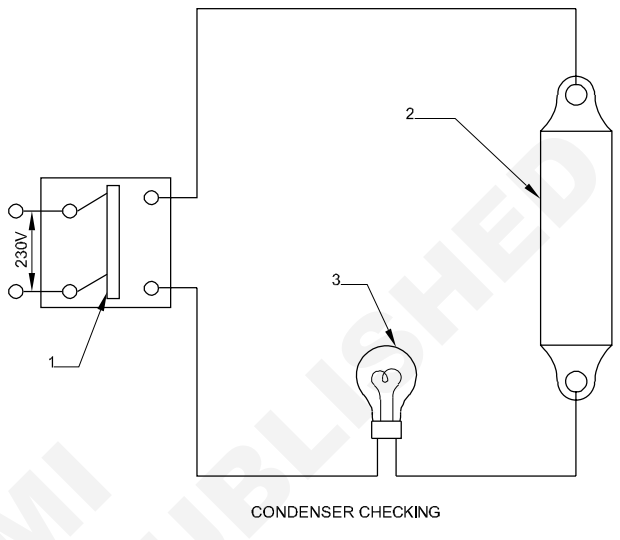
2 Put on the switch (1). If the bulb glows the condenser must be replaced by a new one.

3 If the bulb is not glowing, then the condenser is in proper condition.

4 Visually, check the cam, and replace, if required.

5 Check the magneto coils for open and short circuit with the help of an AVO meter. If found damaged replace the coil with a new one.

Fig 6



CONDENSER CHECKING

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TASK 5: **Test wiper motor circuit**

1 To measure the supply voltage, connect the wiper as shown in Fig 7. Switch on the motor and measure the voltage between the motor supply terminal (2) and the good earthing point with a voltmeter.

If the reading is low, check the battery cable connections and the panel switch (1).

2 Disconnect the cable rack and measure the no-load running circuit with an ammeter connected in the supply line. (2.5 A to 3.5 A)

No-load test

3 Connect the wires to the motor and effect supply check at what voltage the motor starts functioning in no-load.

For a 12-volt system the motor should start running from 4 volts.

Checking the cable rack

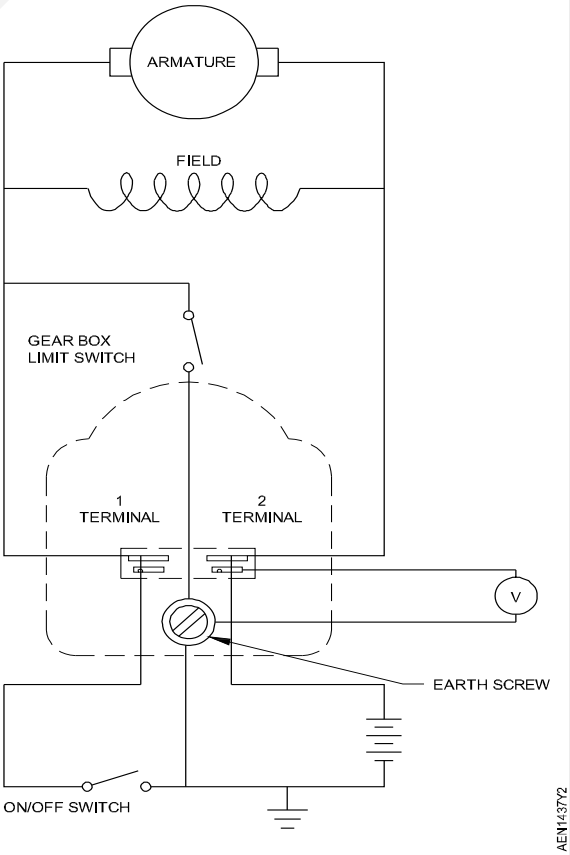
4 Check the maximum force to move the cable rack by hooking the spring balance.

The maximum permissible force is 2.7 kgs.

Final checking

5 Test the wiping speed of the motor. It should be between 45 and 50 cycles/minute.

Fig 7



Practice to identify and check the power & 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.
- Transistor - 1 No.
- Data book - 1 No.

Equipment / Machines

- CRDI - Engine - 1 No.

Materials

- Cotton waste - As reqd.
- Cable connector - As reqd.
- Sensors - As reqd.
- Insulation tap - As reqd.
- Cables - As reqd.
- Assorted types of diodes/Transistor - 20 No./ each.
- Blue, yellow, black Red color Red color sleeve wire - 10 cms each
- Patch cords - As reqd.

PROCEDURE

TASK 1: **Open circuit check**

1 Loose connection of connector

2 Poor contact of terminal (due to dirt, corrosion or rust on it, poor contact tension, entry of foreign object etc.

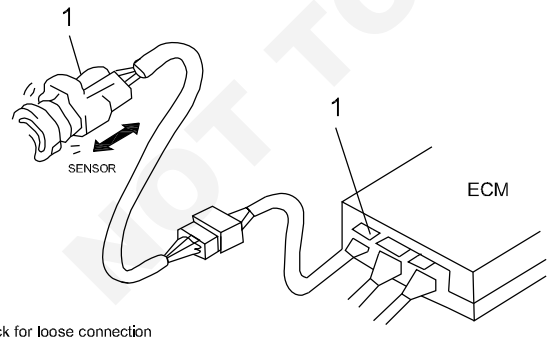
3 Wire harness being open power & signal connection for continuity

Check for cable loose connection (Fig 1)

1 Disconnect negative cable from battery.

2 Check each connector at both ends of the circuit being checked for loose connection (Fig 1). Also check lock condition of connector if equipped with connector lock.

Fig 1



1.Check for loose connection

3 Using a test male terminal, check both terminals of the circuit being checked for contact tension of its female terminal. by dirt, corrosion, rust entry of foreign object, etc) (Fig 2)

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

Fig 2

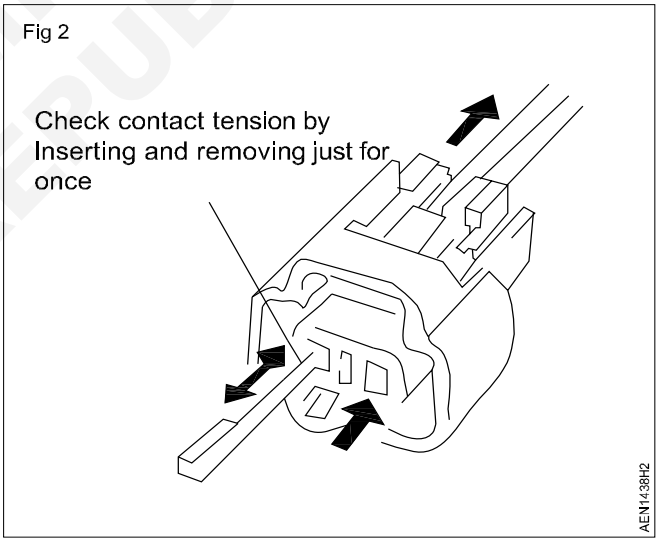
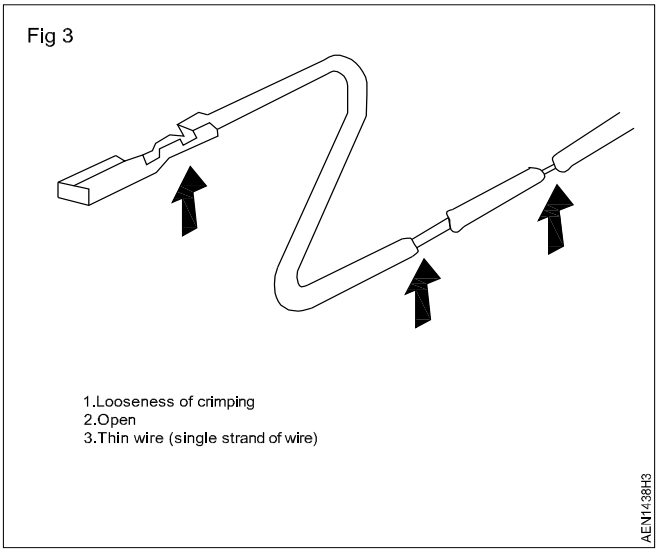
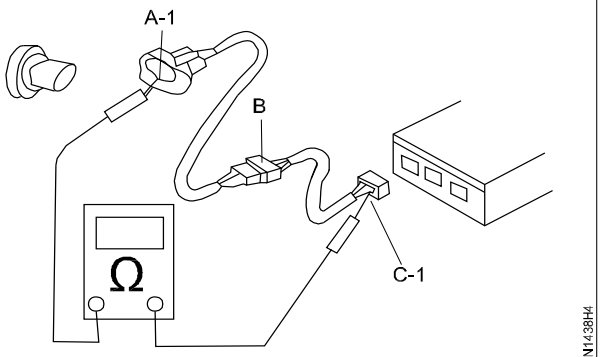


Fig 3



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

Fig 4

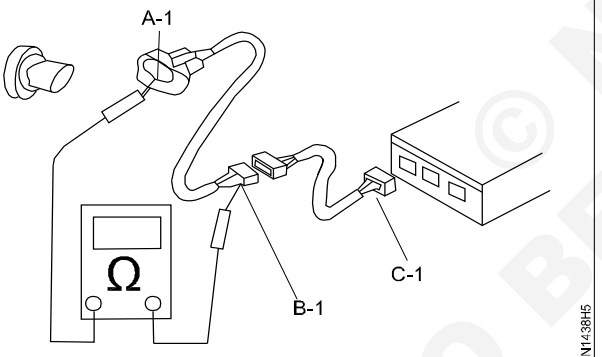


Continuity check

5 Measure resistance between connector terminals at both ends of the circuit being checked (between A-1 and C-1 in the figure).

If no continuity is indicated (infinity or over limit), that means that the circuit is open between terminals A-1 and C-1. (Fig 5)

Fig 5



6 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.

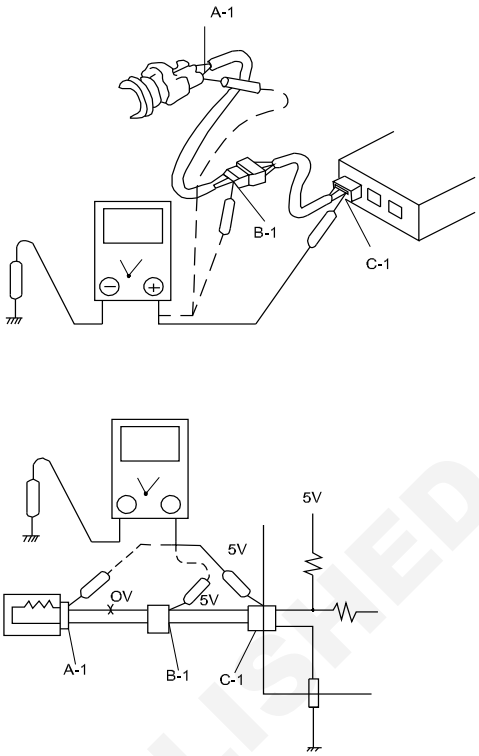
Voltage check (Fig 6)

If voltage is supplied to the circuit being checked, Voltage check can be used as circuit check.

7 With all connectors connected and voltage applied to the circuit being checked, measure voltage between each terminal and body ground.

If measurements were taken as shown in the figure at the left and results were as listed below, it means that the circuit is open between terminals B-1 and A-1.

Fig 6



Voltage Between:

C-1 and body ground: Approx. 5V
B-1 and body ground: Approx. 5V
A-1 and body ground: 0V

Also, if measured values were as listed below, it means that there is a resistance (abnormality) of such level that corresponds to the voltage drop in the circuit between terminals A-1 and B-1.

Voltage Between:

C-1 and body ground: Approx. 5V
B-1 and body ground: Approx. 5V 2V voltage drop
A-1 and body ground: Approx.3V

Short circuit check (Wire harness to ground) (Fig 7)

8 Disconnect negative cable from battery.

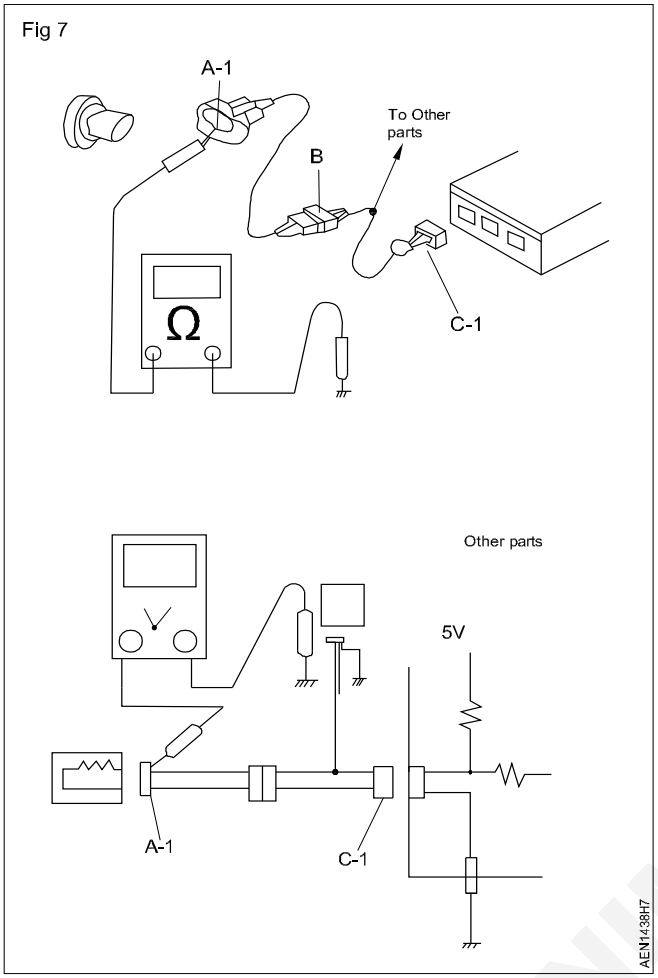
9 Disconnect connectors at both ends of the circuit to be checked.

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

10 Measure resistance between terminals at one end of circuit (A -1 terminal in figure) and body ground. If continuity is indicated, it means that there is a short to ground between terminals A-1 and C -1 of the circuit.

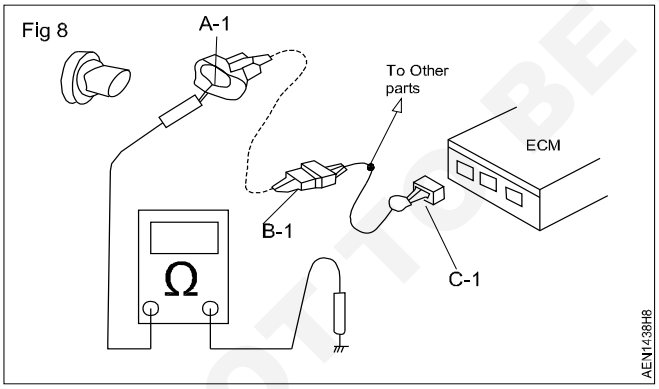
11 Disconnect the connector included in circuit (connector B) and measure resistance between A-1 and body ground. (Fig 7)

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



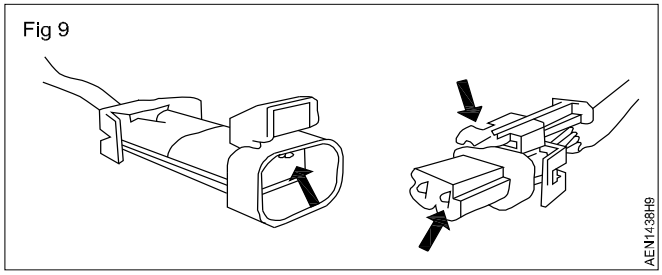
Intermittent and poor connection (Fig 9, 10)

Most intermittents are caused by faulty electrical connections or wiring, although a sticking relay or solenoid can occasionally be at fault. When checking it for proper connection, perform careful check of suspect circuits for:

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

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

Fig 9

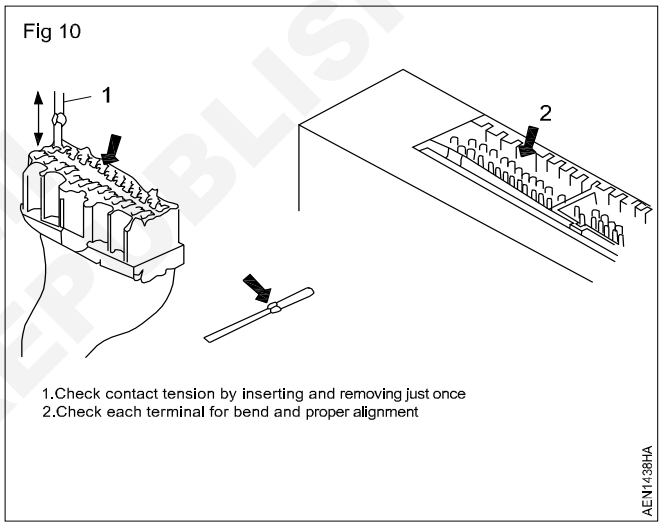


14 Damaged connector body, exposing the terminals to moisture and dirt, as well as not maintaining proper terminal orientation with the component or mating connector.

15 Improperly formed or damaged terminals.

Check each connector terminal in problem circuits carefully to ensure good contact tension by using the corresponding mating terminal. If contact tension is not enough, reform it to increase contact tension or replace.

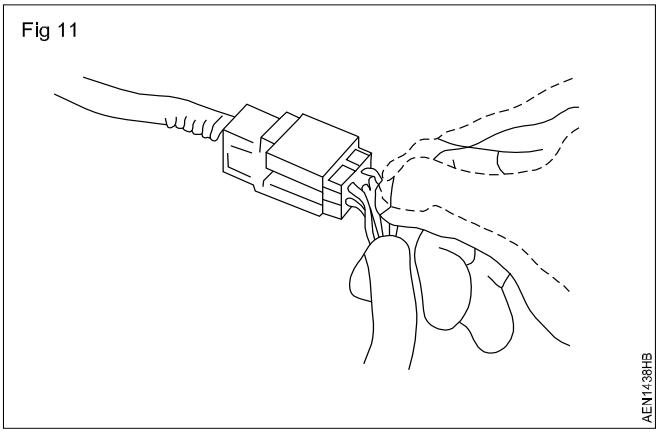
Fig 10



16 Poor terminal - to - wire connection. (Fig 11)

Check each wire harness in problem circuits for poor connection by shaking it by hand lightly. If any abnormal condition is found, repair or place.

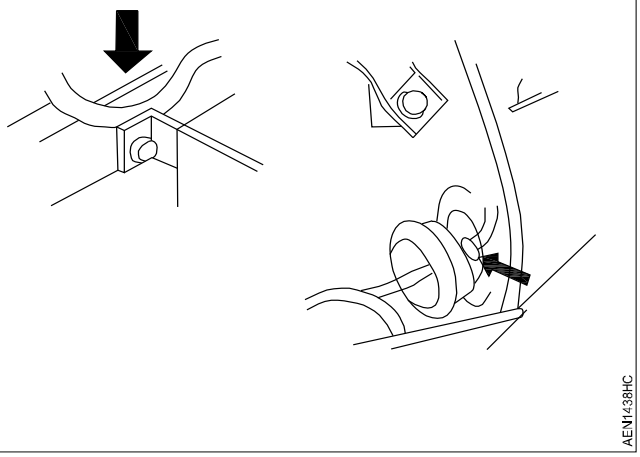
Fig 11



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

18 Wiring broken inside the insulation (Fig 12). This condition could cause continuity check to show a good circuit, but if only 1 or 2 strands of a multi-strand-type wire are intact, resistance could be far too high. If any abnormality is found, repair or replace.

Fig 12

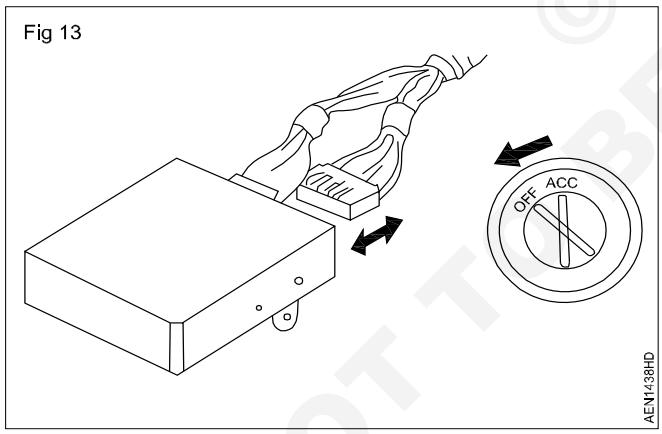


Precautions for electrical circuit service

19 When disconnecting and connecting coupler, make sure to turn ignition switch OFF, or electronic parts may get damaged.

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

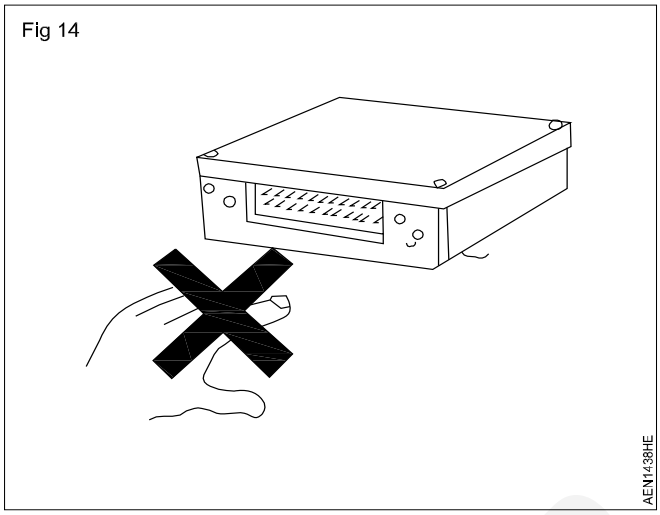
Fig 13



21 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.

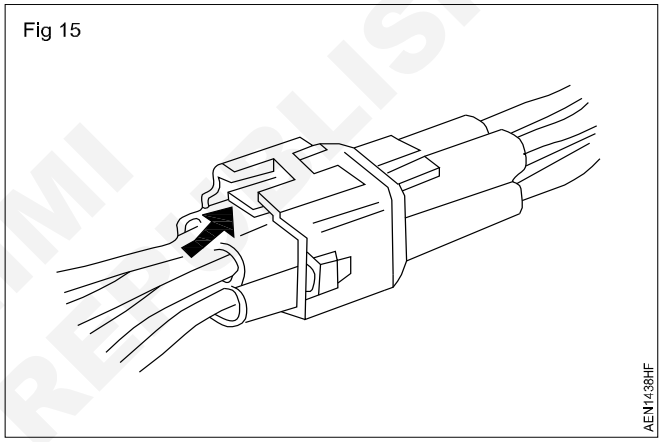
22 Never connect any tester (voltmeter, ohmmeter,) to electronic control unit when its coupler is disconnected. Attempt to do it may cause damage to it.(Fig 14)

Fig 14



23 Never connect an ohmmeter to electronic control unit with its coupler connected to it. Attempt to do it may cause damage to electronic control unit and sensors. (Fig 15)

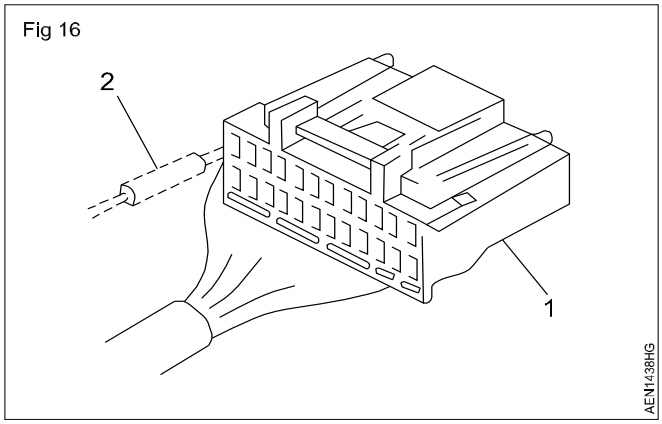
Fig 15



24 Be sure to use a specified voltmeter/ohmmeter. Otherwise, accurate measurements may not be obtained or personal injury may result. If not specified, use a voltmeter with high impedance (M /V minimum) or a digital type voltmeter.

25 When taking measurements at electrical connectors using a tester probe, be sure to insert the probe (2) from the wire harness side (backside) of the connector (1). (Fig 16)

Fig 16



Practice to test 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 transistor**
- **test transistor.**

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 color sleeve over the anode terminal of the diode.

4 Repeat step 1 to 3 for at least 5 diodes of different types and get your work checked by your instructor.

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TASK 2: **Check 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.

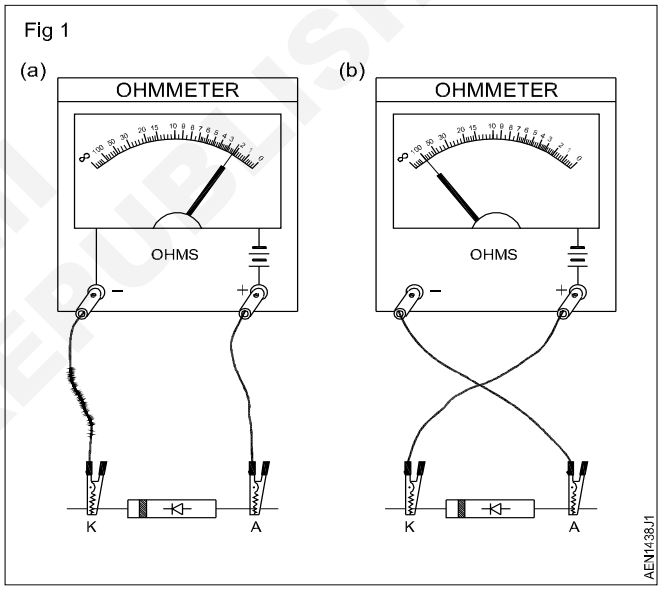
4 From the readings noted in steps 2 and 3, calculate and record the ratio between forward and reverse resistance.

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 at least ten more given diodes of different types.

7 Get the work checked by your instructor.

Observation & Tabulation Sheet

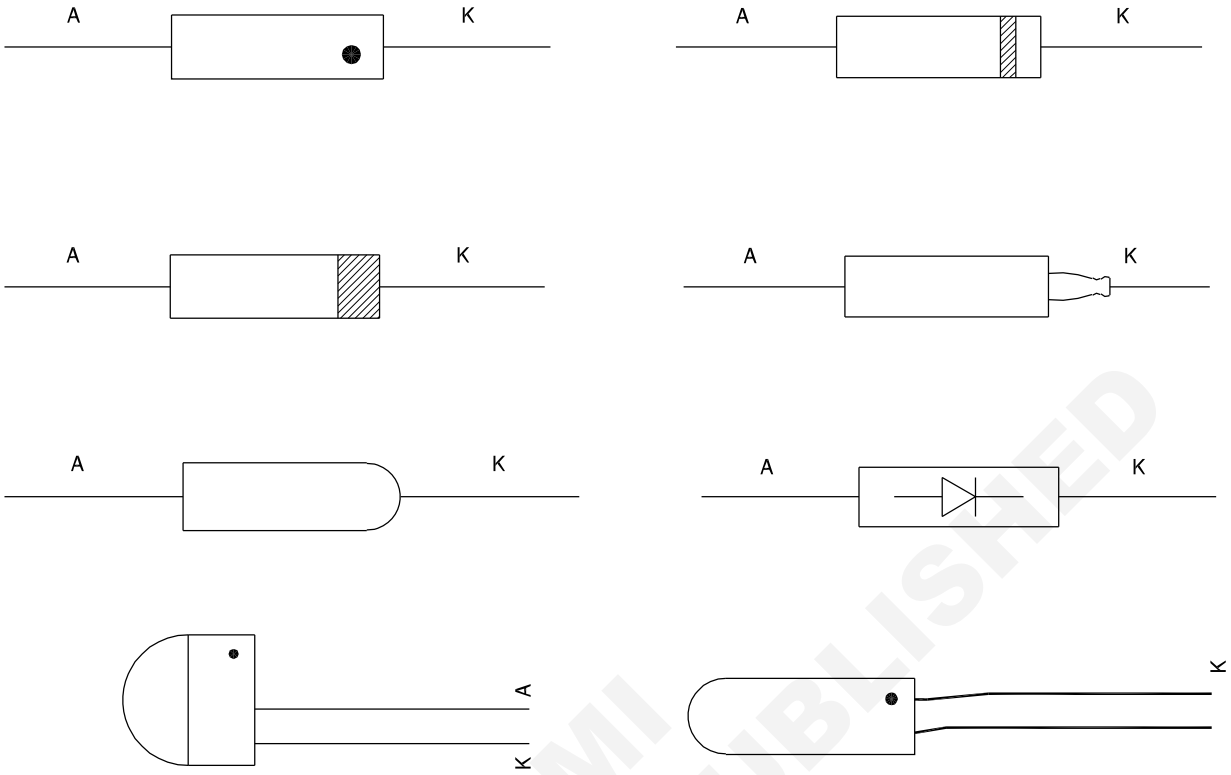
Table - 1

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

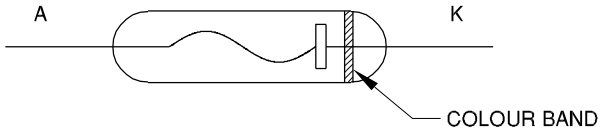
(Trainee) (Instructor)

Fig 1

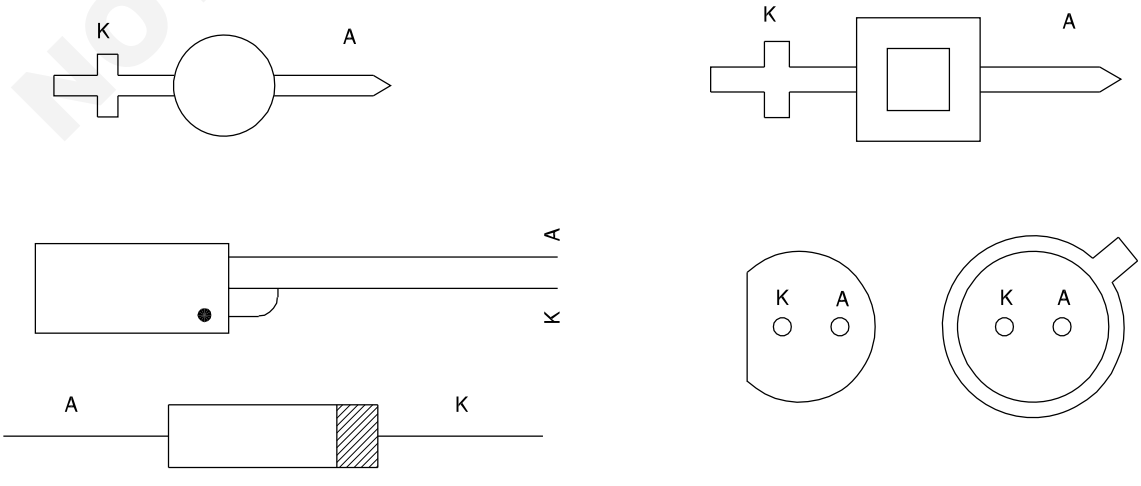
LOW POWER - PLASTIC PACKAGE DIODE



VERY LOW POWER - GLASS PACKAGE DIODE



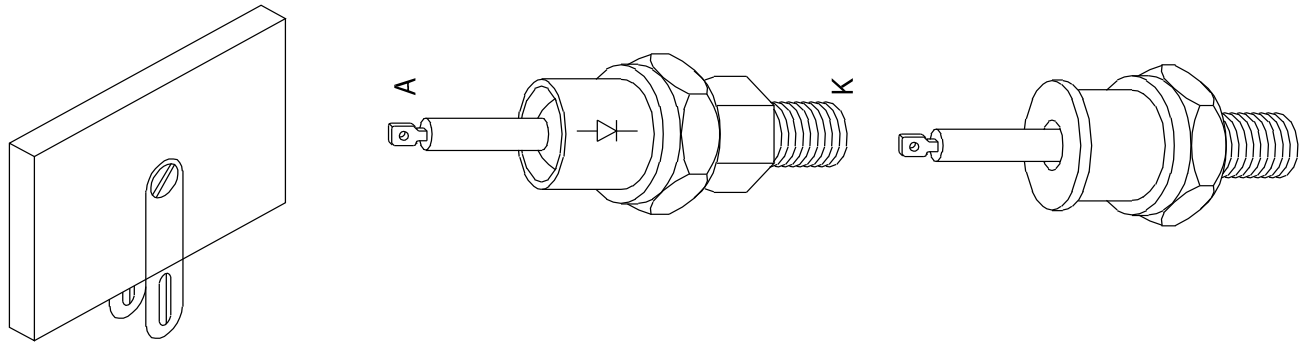
LOW POWER - METAL PACKAGE DIODE



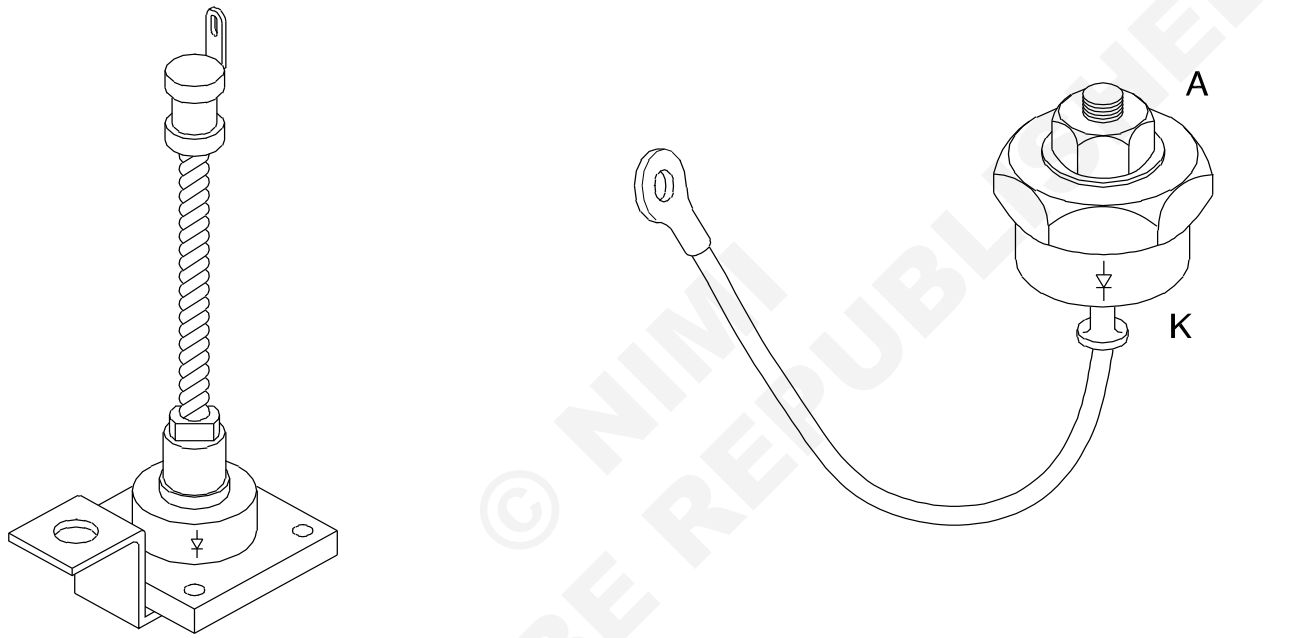
AEN1438C1

Fig 2

HIGH POWER - METAL PACKAGE DIODE



VERY LOW POWER - METAL PACKAGE DIODE



AEN14:38C2

TASK 3: **Identify 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.

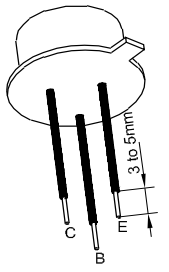
- Whether silicon or germanium
- Whether NPN or PNP
- Type of packaging or case outline (Example: TO5, TO7 etc.)

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 color scheme given below.

Base	-	Blue color sleeve
Emitter	-	Red color sleeve
Collector	-	Yellow color sleeve
Shield	-	Black color sleeve

Fig 1



AEN14:38X1

Note: In some power transistors, the metal body itself will be the collector. In such cases mark 'C' on the metal body using a pencil. All transistors will not have shield pin.

5 Repeat steps 1 to 4 for atleast five transistors of different types in the given lot and get your work checked by your instructor.

1 Identify which terminal of the ohmmeter being used is connected to the +ve terminal of the internal battery of the meter. Set the meter range to Rx100W.

Ohmmeters in very low or very high ohms range can produce excessive current/voltage and may damage low power transistors while testing.

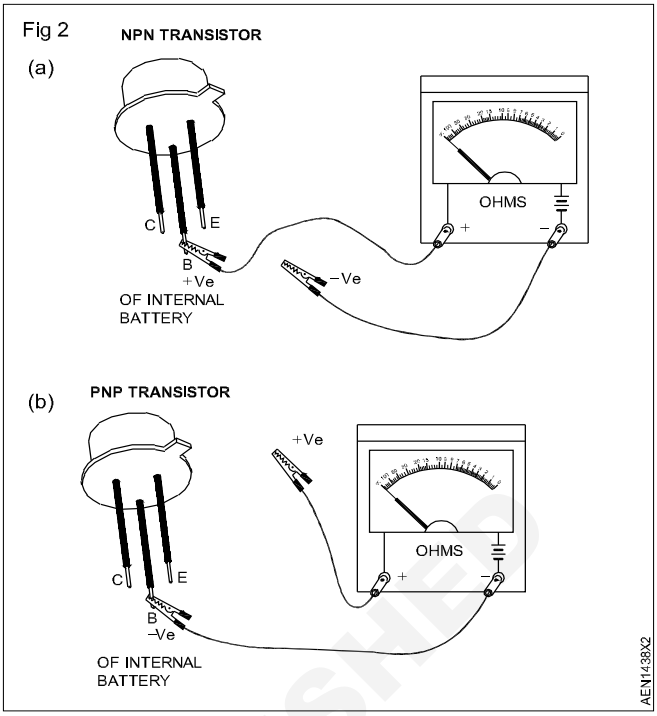
2 Take a transistor whose pins are identified and sleeved at Task 3. Depending on whether the chosen transistor is NPN or PNP, clip/hold the +ve or -ve of the meter prod to the base of the transistor as shown in Figs 2a and 2b.

3 Clip the other meter prod to the emitter. Check if the base-emitter junction diode of transistor shows low resistance (few tens of ohms) or very high resistance (few tens of 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.

Fig 2



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

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

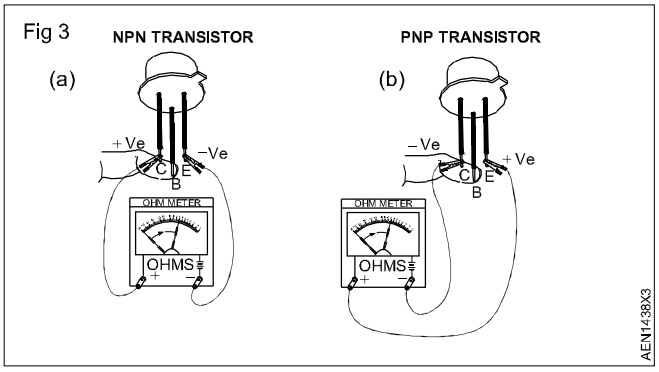
7 Measure the resistance across the emitter-collector and record the observation as V-HIGH (> 1MW) or LOW (< 500W).

Note: In a good transistor the resistance between the emitter and collector will be very high. A low resistance indicates that the transistor is leaky.

8 Clip the meter across the emitter-collector with correct polarity as shown in Fig 3. Touch the base-collector with moist fingers as shown in Fig 3 and check if the resistance shown by the meter decreases indicating that the transistor is turning ON. Record your observation as YES or NO in Table 1 of O&T sheet.

9 From the observations recorded at steps 5,6,7 and 8, give your conclusion on the overall condition of the transistor under test.

Fig 3



10 Repeat steps 1 to 9 for atleast five more transistors of different types.

11 Get your work checked by your instructor.

Practice to construct and test the logic gates

Objectives: At the end of this exercise you shall be able to
- **construct the logic gates & verify the truth table.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipment / Machines

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

Materials

- Relay 12V - As reqd.
- Lamp 12V, 10W - As reqd.
- Switches - As reqd.
- Resistors - As reqd.
- Transistor NPN 2A - As reqd.
- Wire - As reqd.

PROCEDURE

TASK 1: **Construct OR gate circuits and verify the truth table**

1 Connect the transistors as shown in Fig 1.

2 Connect the switches in parallel.

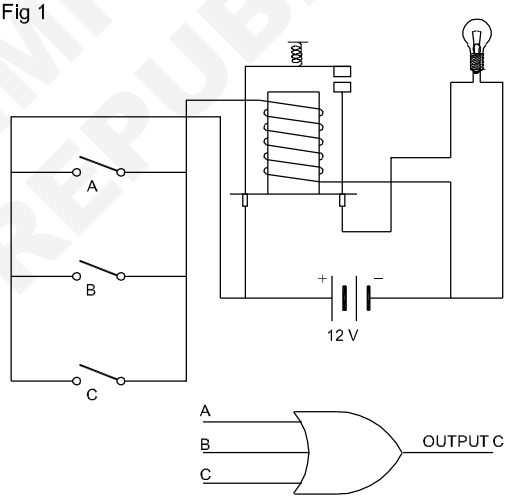
3 Connect the bulb at the output.

4 Connect battery.

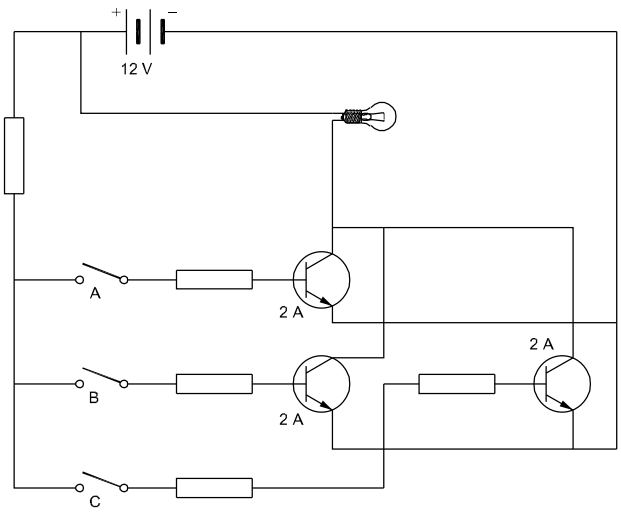
5 Operate the switches look at the bulb and make truth table 1.

6 Get the work checked by your instructor.

Fig 1



THREEE INPUT "OR" GATE ELECTRICAL



THREEE INPUT "OR" GATE ELECTRONIC

AEN1439H1

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	

TASK 2: **Construct an AND gate circuits and verify the truth table**

1 Connect two on-off switch.

2 Connect 21 W/12 V bulb as load.

3 Connect battery 12V.

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

5 3 NPN 2A transistors connected with suitable resistors.

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

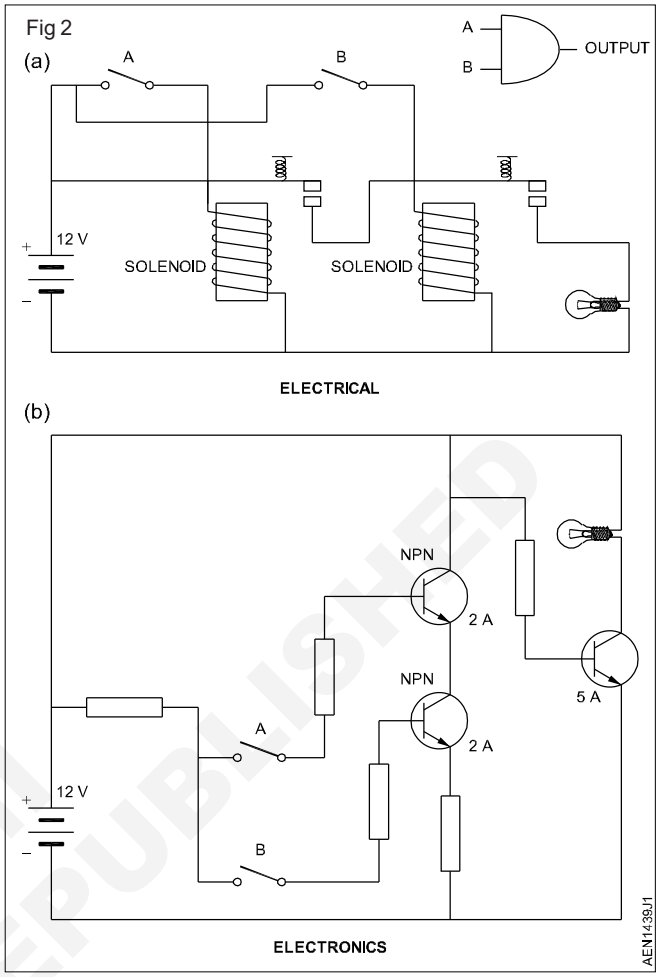
7 Prepare a truth table 1.

8 Get the work checked by your instructor.

Table 1

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

Fig 2



TASK 3: **Construct NOT gate and verify the truth table**

1 Use 1 mm wires and make the NOT gate electrical circuit (Figs 2 and 3)

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

2 Connect the 12V battery.

3 Connect the bulb at the output.

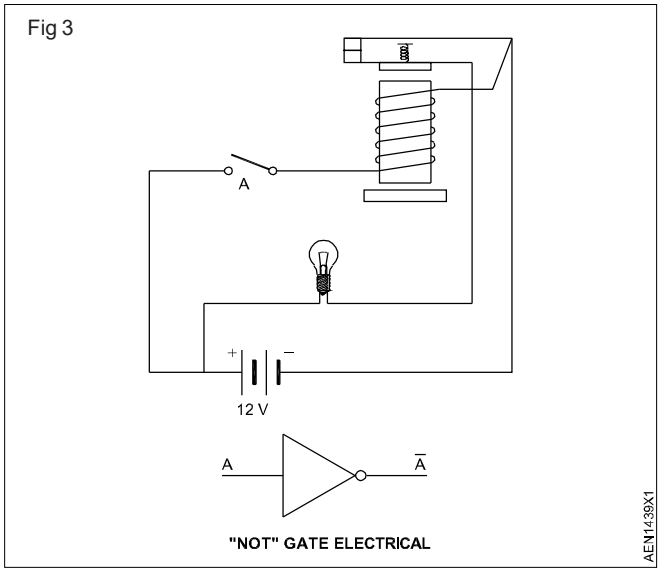
4 Operate the switches and look at the bulb for its function.

5 Get the work checked by your instructor.

Truth Table

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

Fig 3



Identify the different types of vehicles

Objective: At the end of this exercise you shall be able to
- **identify the different types of vehicle.**

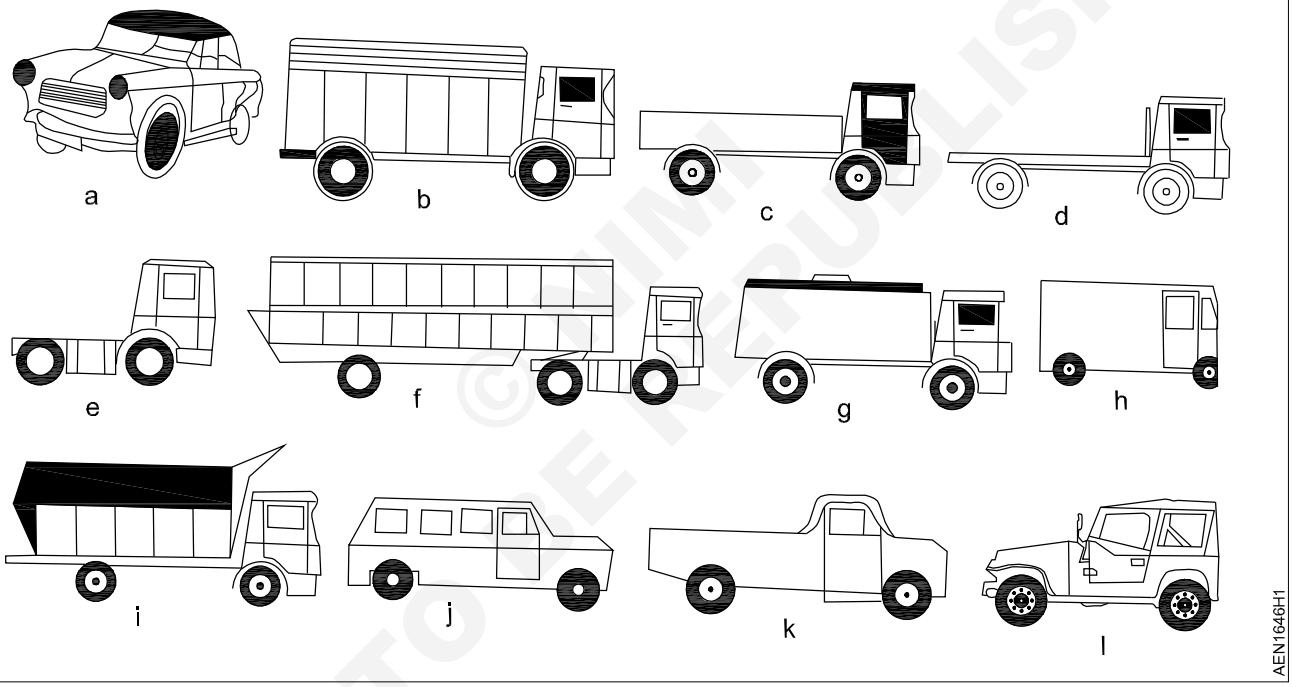
PROCEDURE

TASK 1: **Different types of vehicles**

1 Identify the type of vehicle (Fig 1)

a) Car b) Truck Punjab body or straight truck c) Truck half body d) Truck Flat form type e) Tractor f) Tractor with articulated trailer g) Tanker h) delivery van i) Dumper truck j) Station wagon k) Pick up l) jeep

Fig 1



2 Write the name of the parts in Table 1.

Table 1

Sl.No.	Match word	Vehicle name	Sl.No.	Match word	Vehicle name
1	b	7	7	h	
2	a	8	8	l	
3	e	9	9	k	
4	d	10	10	j	
5	c	11	11	i	
6	g	12	12	f	

— — — — — —

Demonstrate vehicle specification data

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

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 No.
• Compression gauge	- 1 No.
• Measuring tape	- 1 No.
• Vacuum gauge	- 1 No.
• Bore dial gauge	- 1 No.
• Hydro meter	- 1 No.
• Voltage tester	- 1 No.

Equipment / Machines

• Vehicle	- 1 No.
• Spark plug tester	- 1 No.

Materials

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

Note : Instructor demonstrate of vehicle specification

TASK: **Demonstrate various vehicle specification data**

Mahindra Bolero 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
	4WD : Semi-elliptical leaf type, stabilizer bar at front
Rear	Semi-elliptical leaf type
Frame	Rectangular tubular section 5 intermediate cross members (6 for IFS). Rear bumper
Steering	Power steering - worm & roller type with universal joints
Turning Radius	5.4 mts.
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 caliper 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 flatting 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 liters fitted with electrical float unit
Weights	
Kerb weight	1615 kg (2 WD) 1695 kg (4 WD)
G.V.W.	2200 kg (2 WD) 2280 kg (4 WD)

Identify the vehicle parts and check the specification of parts under guide line of instructor

Record vehicle identification number (VIN)

Objective: At the end of this exercise you shall be able to
- **identify the vehicle identification number & specification.**

Requirements

Tools / Instruments		Material	
• Measuring Tape	- 1 No.	• Cotton waste	- As reqd.
Equipment / Machines		• Paper	- As reqd.
		• Pencil	- 1 No.
• Car with vin	- 1 No.	• Eraser	- 1 No.

TASK: **Identify vehicle identification number & specification**

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
WMI	1	Geographic Zone		
	2	Manufacturer		
VDS	3	Vehicle Type		
	4	Series		
	5	Body Style and Version		
	6	Body Type		
	7	Restraint System	GVWR	Brake System
	8	Engine Type		
	9	Check Digit / Drive Side		
VIS	10	Model Year		
	11	Plant of product		
	12-17	Serial number		

- WMI: World Manufacturer Identifier
- VDS: Vehicle Descriptor Section
- VIS : Vehicle Indicator Section
- MPV: Multipurpose Passenger Vehicle (Ex : MPV, SUV, RV)
- GVWR : Gross Vehicle Weight Rating

Note: Vehicle code may be varying 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 informations

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Demonstrate garage and service station equipments

Objectives: At the end of this exercise you shall be able to
- **operate the air compressor**
- **operate the mechanical/hydraulic jack and jack stand**
- **operate a grease gun**
- **operate an oil spray gun**
- **operate the mechanical press**
- **operate the hydraulic press**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Measuring Tape - 1 No.

Equipments / Machines

- Car - 1 No.
- Air compressor - 1 No.

Material

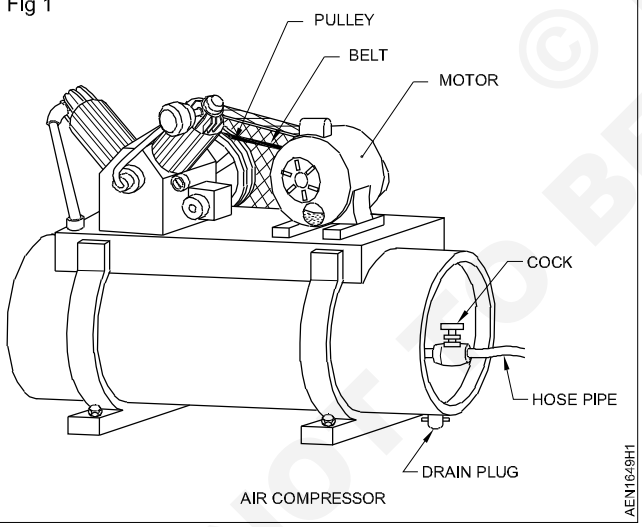
- Cotton waste - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Operate service station equipments**

Air compressor (Fig 1)

Fig 1



AIR COMPRESSOR

1 Check the oil level.

2 Check the belt's (1) tension connecting the motor (2) and the compressor's pulley (3).

3 Ensure that the belt guard is fixed in its position.

4 Drain the water through the drain plug (4) and tighten the drain plug.

5 Inspect the electrical connections visually for looseness, disconnections or cuts.

6 Switch 'on' the compressor

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

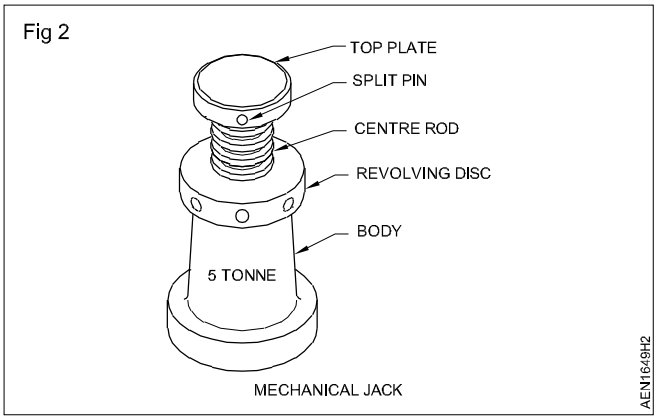
8 Switch 'off' the compressor.

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

10 Close the cock after using the compressed air.

Mechanical jack (Fig 2)/Hydraulic jack (Fig 3)

Fig 2



MECHANICAL JACK

1 Park the vehicle on level ground.

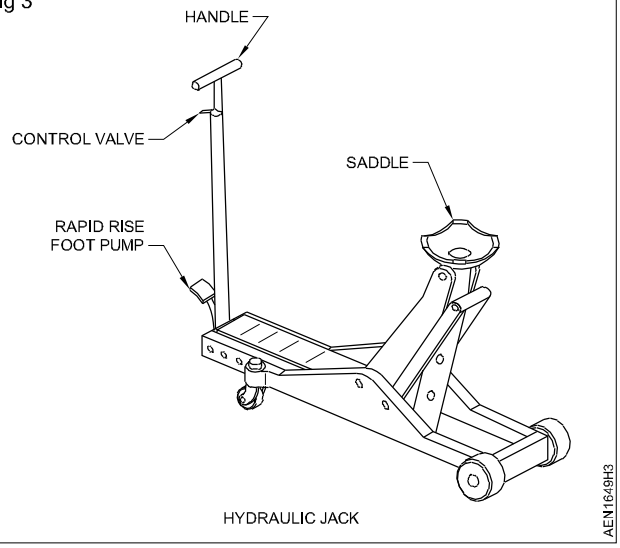
2 In case of jacking up the front axle, chock the rear wheels and vice versa.

3 Check the free movements of threads in a mechanical jack by hand and incase of hydraulic jack, Check the oil incase 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 lever slowly so that the axle jack up without any jerk.

Fig 3



HYDRAULIC JACK

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.

Grease gun (Fig 4)

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.

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

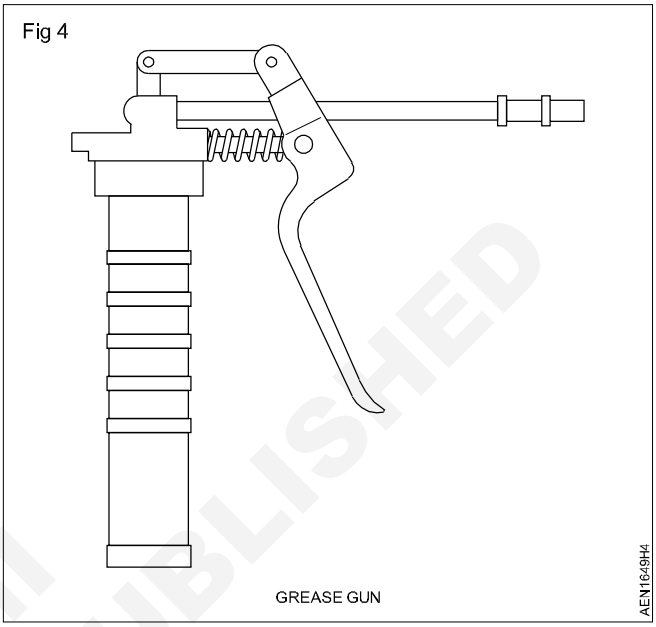
3 Connect the oil spray gun to the quick release coupler.

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.

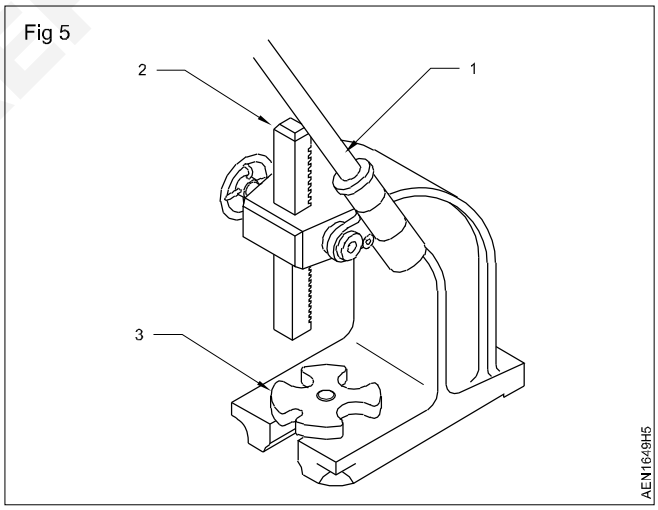
Fig 4



GREASE GUN

Arbor press (Fig 5)

Fig 5



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 6)

1 Clean the press.

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

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 Stop the pressing if the load exceeds more than the specified limit.

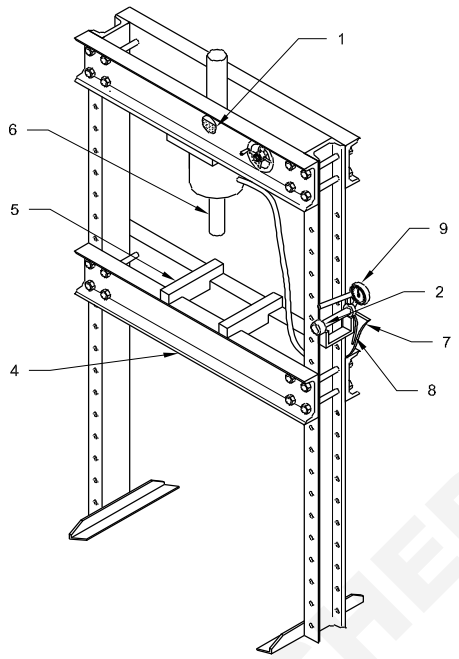
Safety

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.

Fig 6



HYDRAULIC PRESS

Practice to hoist a vehicle

Objectives: At the end of this exercise you shall be able to
- **operate the hydraulic car hoist**
- **operate a car washer**
- **hoist a vehicle using two post hoist**
- **hoist a vehicle using the four post host**
- **hoist a vehicle using engine hoist**
- **hoist a vehicle using jack stand.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipment / Machines

- Vehicle - 1 No.
- Two post hoist - 1 No.
- Four post hoist - 1 No.
- Single post hoist - 1 No.

Materials

- Cotton waste - As reqd.
- Soap oil - As reqd.

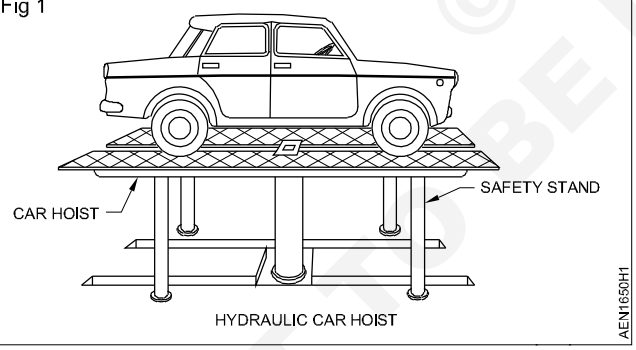
PROCEDURE

TASK 1: **Operate hydraulic car hoist** (Fig 1)

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

2 Clamp the front and rear axle or check wheels.

Fig 1



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.

— — — — — —

TASK 2: **Operate 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.

After completing the cleaning, stop the car washer.

Close the water intake cock (water supply).

Two post lift hoist (Fig 2)

1 Park the vehicle in the center of the electro mechanical part.

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

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

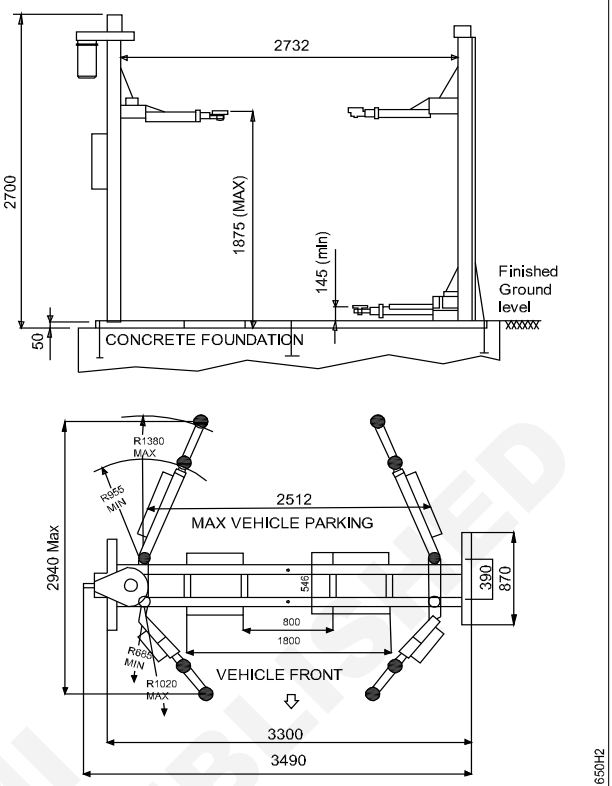
4 Set safety mechanism to prevent uneven lifting.

5 Use the extra safety nut.

6 Check the chain drive and operate the lifting switch.

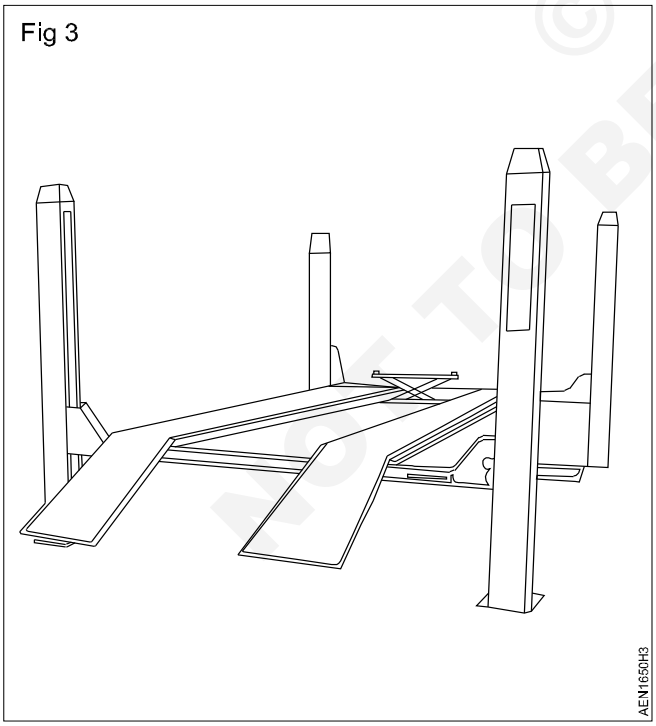
7 Use the anchoring bolts for safety. (Fig 2).

Fig 2



TASK 3: **Four post lift** (Fig 3)

Fig 3



1 Drive the vehicle on the levelled ramp of the four post lift.

2 Check the vehicle parked correctly are not on the ramp & 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.

TASK 4: **Operate 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.

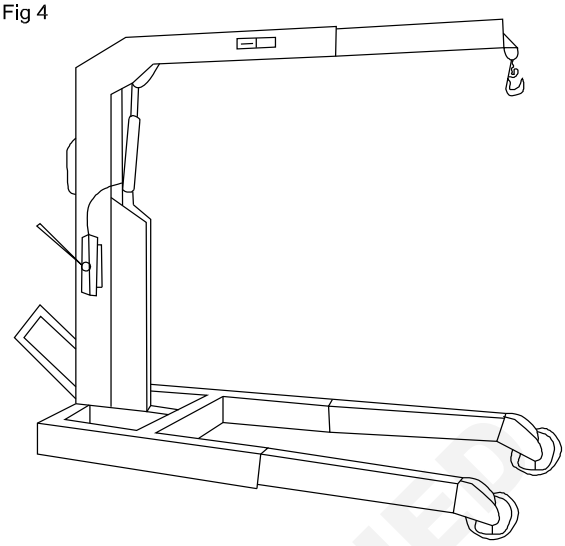
3 Pull up hand brake lever of vehicle.

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 4)

Fig 4



ENGINE HOST

AEN1650H4

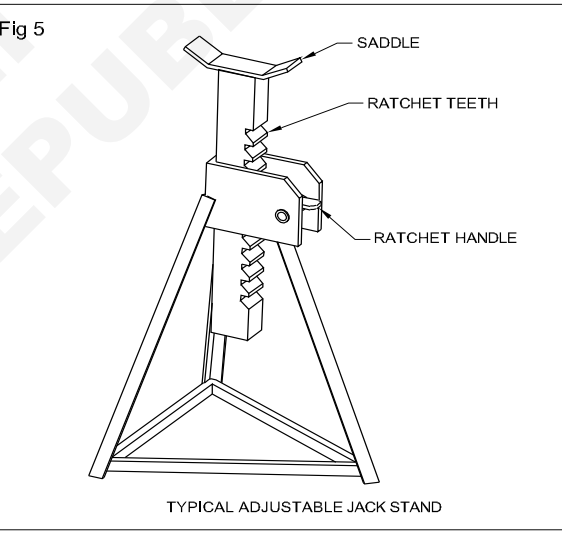
— — — — — —

TASK 5: **Jack stand (Fig 5)**

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

2 Stands must be properly and securely placed.

Fig 5



TYPICAL ADJUSTABLE JACK STAND

AEN1650H5

— — — — — —

Identify the different parts in a diesel engine of LMV/HMV

Objective: At the end of this exercise you shall be able to
- **identify diesel engine parts.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Box Spanner set - 1 No.
- Ring compressor piston ring expander, valve lifter - 1 No.

Equipment / Machines

- Multi cylinder diesel engine cut sectional model - 1 No.

Materials

- Tray - As reqd.
- Cotton cloth - As reqd.
- Kerosene - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK: **Identify diesel engine parts**

1 Place the cut - section model diesel engine on the work bench

2 Trace the radiator, FIP, injector air cleaner, fuel feed pump, fuel filter, alternator, self-starter, water pump, dipstick, inlet & Exhaust manifold, engine head & valve assembly, rocker arm, valve cover, piston, timing gear oil pump, fly wheel & housing, connecting rod, crankshaft and etc.

3 Identify the parts in the diesel engine cut-section model shown fig 1,2,3.

4 Write the name of the parts in the table 1.

Fig 1

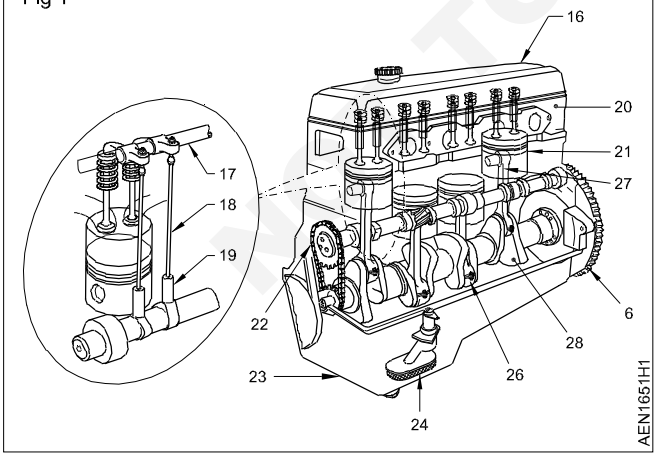


Fig 2

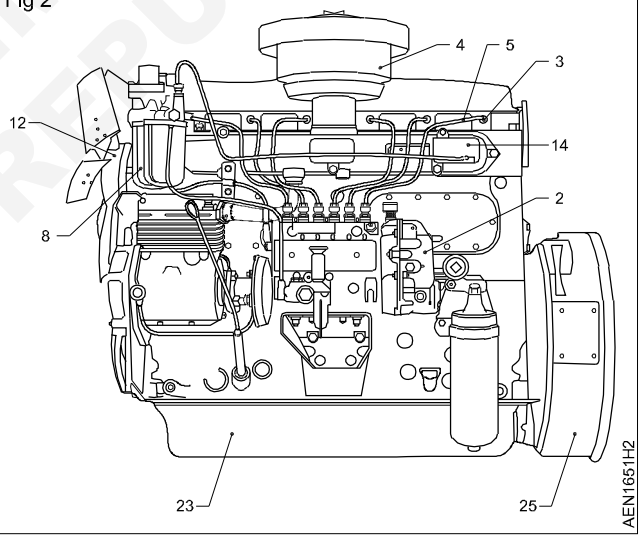


Fig 3

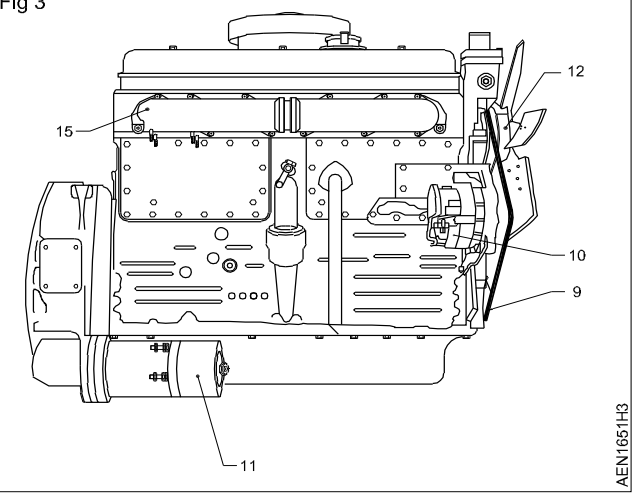


Table 1

S. No.	Name of Parts	Remarks
1		
2		
3		
4		
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Practice to start and stop diesel & petrol engine

Objectives: At the end of this exercise you shall be able to
- **prepare the engine for starting**
- **start the engine**
- **observe the dashboard meters and warning lights**
- **stop the engine.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Lead acid battery 12V with cables - 1 No.

Equipment / Machines

- Multicylinder four stroke diesel engine - 1 No.
- Running condition of diesel LMV vehicle - 1 No.

Materials

- Tray - As reqd.
- Cotton cloth - As reqd.
- Kerosene - As reqd.
- Diesel - As reqd.
- Soap oil - As reqd.
- Engine oil - As reqd.
- Coolant - As reqd.

PROCEDURE

TASK 1: **Prepare the engine for starting**

1 Check the water level in the radiator and top-up if needed.

2 Check the engine oil level and top-up if needed.

3 Check the electrolyte in the battery and top up with distilled water.

4 Insert the key in the main switch and turn the key to the 'ON' position.

Note down the warning lights in dashboard.

a Battery lights glows in red (i.e. battery discharging) (Fig 1A)

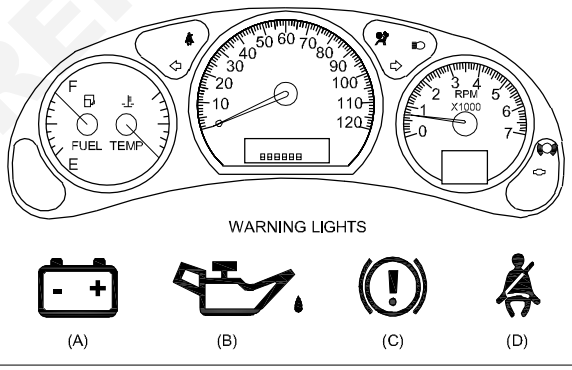
b Engine oil light glows in red (i.e. oil is low (or) nil) (Fig 1B)

c Parking brake light glows in red (i.e parking brake is applied) (Fig 1C)

d Seat belt light glows in red (i.e. driver not wear the seat belt) (Fig 1D)

5 Release the parking brake (now light not shown red)

Fig 1



6 Wear the seat belt properly (now light not shown red)

7 Shift the gear to neutral position.

8 Observe the fuel gauge reading it shows empty to full.

9 Observe the temperature gauge reading it shows minimum temperatures.

— — — — — —

TASK 2: **Start the engine (Fig.2)**

While starting don't press the accelerator pedal

1 Press the starter push button (Fig 2) or turn the ignition key further to start the engine.

2 Release the starter button / ignition key as soon as the engine has started.

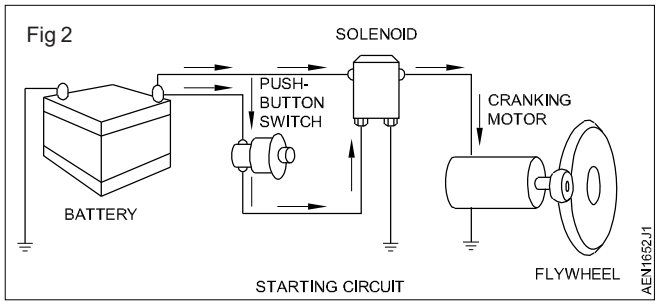
While engine running don't operate the starter button / key.

If the engine does not start immediately do not keep starter button (pressed (or) key turned) beyond 10 seconds.

This leads to the battery will get discharged and overheated.

3 Check the idling speed R.P.M in R.P.M meter.

4 Press the accelerator pedal to increase engine r.p.m steadily and allow the engine to warm up.



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TASK 3: **Stop the engine**

1 Remove the foot from accelerator pedal

2 Turn the ignition key to the OFF position to stop the engine.

— — — — — —

Check the performance of running engine by observing the dash board meters/warning lights

Objectives: At the end of this exercise you shall be able to
- **prepare the engine for starting**
- **start the engine**
- **observe the dashboard meters and warning lights.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Lead acid battery 12 V with cables - 1 No.

Equipment / Machines

- Multicylinder four stroke diesel engine - 1 No.
- Running condition of diesel LMV vehicle - 1 No.

Materials

- Cotton waste - As reqd.
- Tray - As reqd.
- Cotton cloth - As reqd.
- Kerosene - As reqd.
- Diesel - As reqd.
- Soap Oil - As reqd.
- Engine Oil - As reqd.
- Coolant - As reqd.

PROCEDURE

TASK 1: **Prepare the engine for starting**

1 Check the water level in the radiator and top-up if needed.

2 Check the engine oil level and top-up if needed.

3 Check the electrolyte in the battery and top up with distilled water.

4 Insert the key in the main switch and turn the key to the 'ON' position.

Note down the warning lights in dashboard.

a Battery lights glows in red (i.e. battery discharging) (Fig 1A)

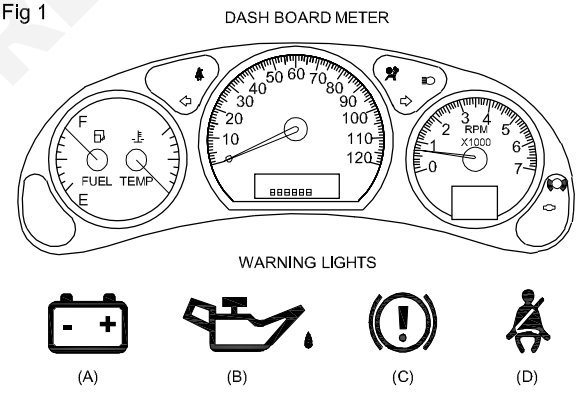
b Engine oil light glows in red (i.e. oil is low (or) nil) (Fig 1B)

c Parking brake light glows in red (i.e parking brake is applied) (Fig 1C)

d Seat belt light glows in red (i.e. driver not wear the seat belt) (Fig 1D)

5 Release the parking brake (now light not shown red)

Fig 1



6 Wear the seat belt properly (now light not shown red)

7 Shift the gear to neutral position.

8 Observe the fuel gauge reading it shows empty to full.

9 Observe the temperature gauge reading it shows minimum temperatures.

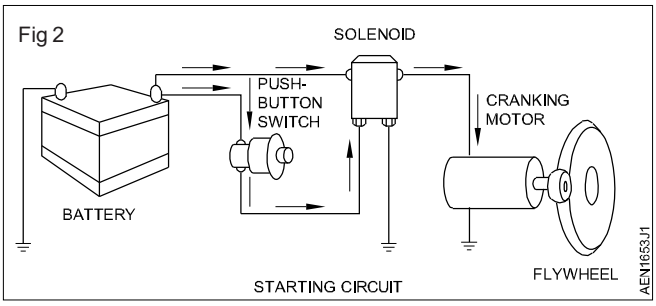
— — — — — —

TASK 2: **Start the engine (Fig 2)**

While starting don't press the accelerator pedal

1 Press the starter push button Fig.2 or turn the ignition key further to start the engine.

2 Release the starter button / ignition key as soon as the engine has started.



If the engine does not start immediately do not keep starter button (pressed (or) key turned) beyond 10 seconds.

This leads to the battery will get discharged and overheated.

3 Check the idling speed R.P.M in R.P.M meter.

4 Press the accelerator pedal to increase engine r.p.m steadily and allow the engine to warm up.

While engine running doesn't operate the starter button / key.

— — — — — —

TASK 3 : **Observe the dashboard meters / warning lights during engine run**

1 Observe the battery warning light it's not glow (ie. Battery is charging)

2 Observe the engine oil warning light it's not glow (i.e. oil pump is working)

3 Observe the oil pressure gauge.

4 Observe the water temperature in temperature gauge.

5 Observe the reading of tachometer

6 Observe the odometer reading during vehicle (moving) running

7 Observe the trip meter reading

— — — — — —

Practice to identify components and their locations indicated on the wiring diagram

Objective: At the end of this exercise you shall be able to
- **test the auto electrical components by using vehicle wiring circuits.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Test lamp - 1 No.
- Multimeter - 1 No.

Equipment / Machines

- Vehicle - 1 No.
- Vehicle electrical wiring diagram - 1 No.
- Battery - 1 No.

Materials

- Fuse - As reqd.
- Switch - As reqd.
- Cable/wire - As reqd.
- Vehicle wire horns - 1 No.

PROCEDURE

TASK: **Identify components and their locations indicated on the wiring diagram**

1 Identify the electrical (1-34) Components in the vehicle by using the automobile wiring circuits as shown in Fig. 1. Write the components name and serial number as the figure in Table - 1.

Table - 1

S. No.	Components Name	Figure S. No.	Remarks
1	Battery	1	Starting system
2	Starter motor	2	– do –
3			
4			
5			
6			
7			
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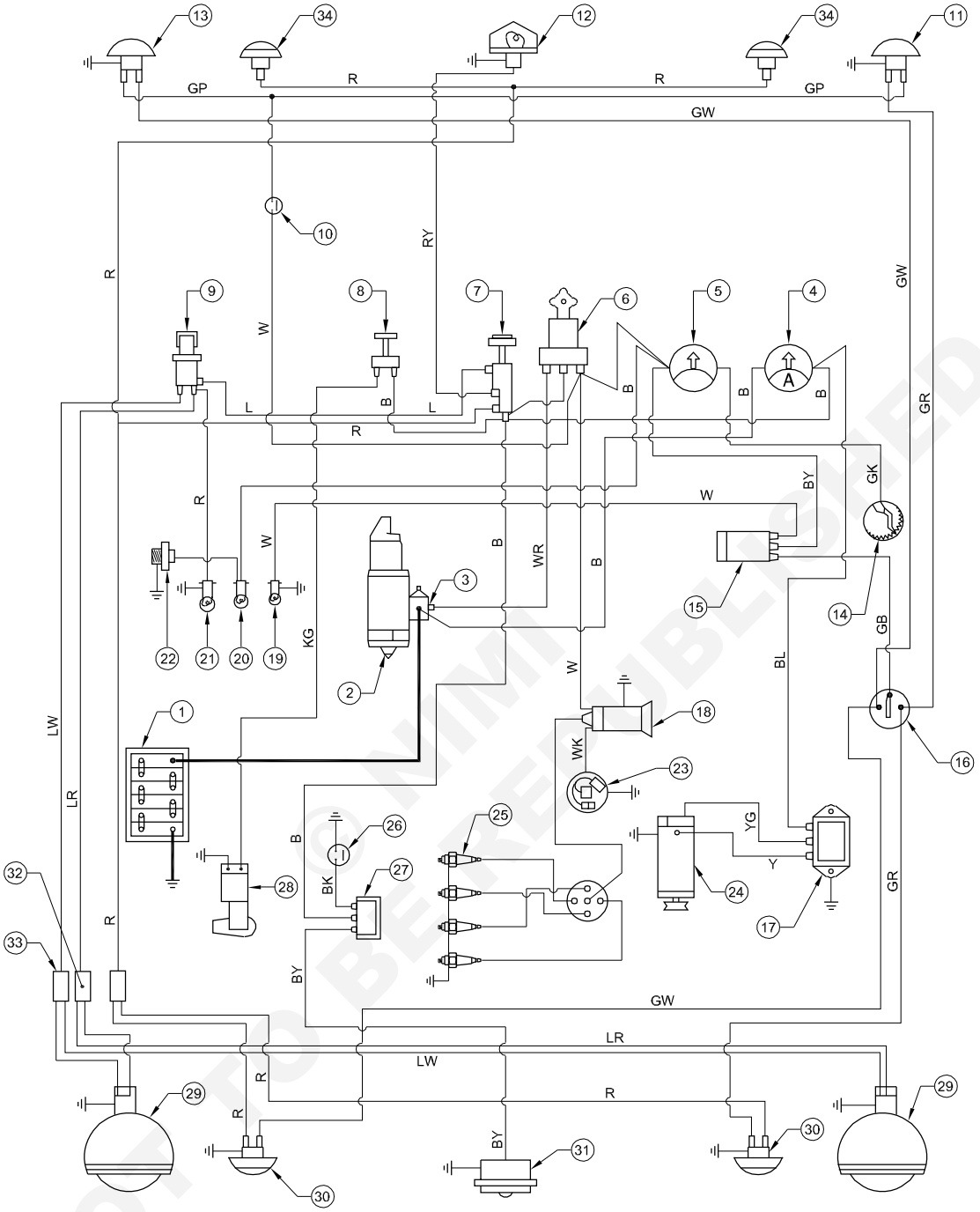
Fig 1



Practice to identify the power source, ground connection and controls for electrical circuits using a wiring diagram.

Objectives: At the end of this exercise you shall be able to
- **identify the power source for electrical wiring circuits**
- **identify the ground connections of automobile wiring circuit**
- **identify the controls for protective the wiring circuits.**

Requirements

Tools / Instruments
- Trainee's tool kit - 1 No.
- Test lamp - 1 No.
- Multimeter - 1 No.

Equipment / Machines
- Vehicle - 1 No.

Materials
- Cotton waste - As reqd.
- Circuit wire - As reqd.
- Insulation tape - As reqd.
- Wire clip - As reqd.
- Wire connectors - As reqd.
- Wire couplers - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Identify the power source for electrical wiring circuits**

1 Check the battery ground connection whether it is a +ve or -ve ground connection.

2 Take wiring diagram of any one vehicle.

3 Identify each lighting circuit and power source.

4 Identify the horn wiring diagram and relay connections and its power source.

5 Identify the wiper wiring circuit in wiring diagram.

6 Identify the power window circuit in wiring diagram.

7 Identify the wind shield sprayer wiring circuit and its power source.

8 Identify the interior light circuit and its power source.

9 Identify the audio or video circuit and its power source.

10 Identify the car A/c circuit and its power source.

11 Identify the starter motor wiring and its power source.

12 Identify the charging circuit and power source.

TASK 2: **Identify the ground connections of each wiring circuit**

1 Use the work shop manual for support to identify the wiring circuit and wire color code.

2 Check the all lighting circuits ground connections with your vehicle wiring diagram.

3 Mark the ground connection points of each circuits and note down the given table - 1 and check it with your instructor.

Table - 1

S. No.	Circuit Name	Wiring Ground connection marking number
1	Head light circuit	
2	Brake light circuit	
3	Side indicator circuit	
4	Wiper circuit	

5	Horn circuit	
6	Staring circuit	
7	Charging circuit	
8	EC 4 circuit	
9	Audio & video circuit	
10	Power window circuit	
11	Immobilizer circuit	

TASK 3: **Identify the controls for protective the wiring circuits**

1 Identify the fuse location of each wiring circuit.

2 Identify the power of each fuse in the circuit.

3 Identify the circuit breakers.

4 Identify the fusible link location of each circuit and mark on the given wiring diagram.

5 Write the fuse value of each circuit in Table - 2 and verify it with your instructor.

Table 2

S. No.	Name of the circuit	Fuse value
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
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19		
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Practice to trouble shoot panel board gauges

Objective: At the end of this exercise you shall be able to
- **cause and remedies for speedometer, fuel gauge, temperature and oil pressure gauge not work.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Test lamp - 1 No.
- Multimeter - 1 No.

Equipment / Machines

- Vehicle - 1 No.

Materials

- Cotton waste - As reqd.
- Circuit wire - As reqd.
- Insulation tape - As reqd.
- Wire clip - As reqd.
- Wire connectors - As reqd.
- Wire couplers - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Speedometer not working**

Repair Action	Causes	Remedies
Check the speedometer	Defective speedometer	
Check the cable	Speedometer cable broken	
Check the drive gear	Speedometer cable drive gear teeth damaged	
Check the speedometer cable-fitting	Speedometer cable improper fitting	
Check the speedometer drive gear teeth	Speedometer gear teeth damaged	
Check the speedo meter gear back lash	Speedo meter gear back lash excess	

TASK 2: **Fuel gauge not working**

Repair Action	Causes	Remedies
Check the fuel gauge wire connections	Wire connection disconnected or wire short circuited	
Check the fuel gauge	Defective fuel gauge	
Check the fuel tank float unit	Float unit damaged	

TASK 3: **Temperature gauge not working**

Repair action	Causes	Remedies
Check the temperature sending unit function	Temperature sensing unit defective	
Check the temperature gauge	Defective temperature gauge	
Check the wire connection or coupler connection	Wire short circuited or damaged or wire loose connection	
Check the temperature sensor	Defective sensors	

TASK 4: **Oil pressure gauge light / not working**

Repair action	Finding cause	Repair activities
Check the oil pressure indicating bulb	Bulb fuse	
Check the bulb wire connection	Loose wire connection	
Check the oil pressure sending unit	Defective sending unit/sensor	
Check the oil level	No oil	
Check the oil viscosity	Very low oil viscosity	
Check the oil pump function	Defective oil pump	

Note: The instructor has to train the trainees to fill up the remedies column

Practice to check and replace the ignition coil and spark plug

Objectives: At the end of this exercise you shall be able to
- **check the ignition coil function**
- **check and replace spark plug**
- **remove and refit the ignition coil.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multimeter - 1 No.
- Test lamp - 1 No.

Equipment / Machines

- Vehicle - 1 No.
- Test bench - 1 No.

Materials

- Cotton waste - As reqd.
- Ignition coil - As reqd.
- Distributor assembly - 1 No.
- Distributor accessories - As reqd.
- Soap oil - As reqd.
- Insulation tape - As reqd.
- Circuit wire - As reqd.
- Emery sheet - As reqd.

PROCEDURE

TASK 1: **Check the ignition coil**

1 Check the battery connection.

2 Check the battery charge condition.

3 Check the ignition switch wire connection.

4 Check the ignition coil wire connections.

5 Check the distributor mounting and wire connections.

6 Check the distributor cap and carbon rod spring sensor.

7 Check the high tension wire connections.

8 Check the spark plug.

9 Switch ON the ignition key.

10 Remove the HT lead

11 Crank the engine and check output current/voltage of the ignition coil.

12 The input voltage of the ignition coil is 12V its output should be 15,000 to 30,000 voltage at 5000 rpm to 30,000 rpm of the engine speed.

13 Check the voltage output by recommended testing instrument.

If recommended voltage output is not given at prescribed engine rpm, it means the ignition coil is defective. If the ignition coil is defective replace it.

— — — — — —

TASK 2: **Remove and replace the ignition coil**

1 Disconnect the battery terminals.

2 Disconnect the ignition coil terminal wire connection.

3 Remove the HT lead.

4 Unscrew the ignition coil mountings.

5 Remove the ignition coil assembly.

6 Select the appropriate new ignition coil assembly.

7 Test the ignition coil assembly under guideline of your instructor.

8 Fit the ignition coil on the vehicle.

9 Connect the ignition coil wire connection.

10 Switch on the ignition switch and start the engine and check the function of ignition coil.

Inspect distributor less ignition timing

1 Switch off the ignition.

2 Connect multi scan tool with the data link connector.

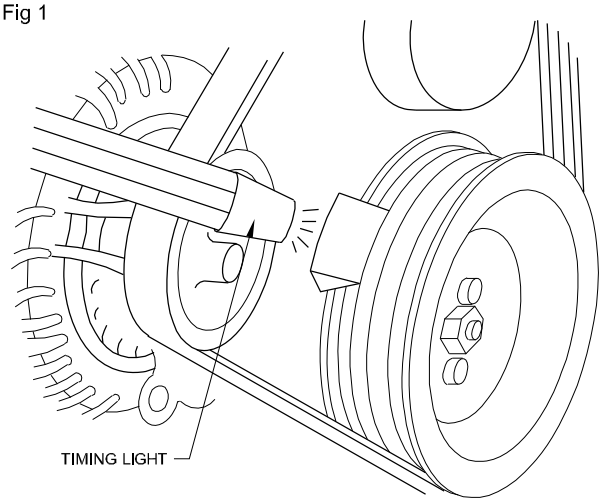
3 Start the engine and warm up to normal operating temperature.

4 Switch off all electrical connections except ignition.

5 Check the idle speed of the engine is within the specification.

6 For inspecting ignition timing, select the correct mode in the scan tool. For mode selection, collect the details from the shop manual.

Fig 1



STARTING MOTOR SWITCHED OFF ARMATURE STATIONARY

7 Connect timing light with the ignition coil no.1 and check the ignition timing (Fig 1). The timing advance differs from different vehicles. Confirm with the shop manual.

8 If the ignition timing is out of specification, check the crank shaft position sensor, cam shaft position sensor, throttle position sensor and knock sensor.

9 Replace the sensors if necessary.

10 Disconnect the multi scan tool.

Setting the ignition timing in electronic distributor ignition system

1 Remove spark plug from No. 1 cylinder

2 Place compression gauge hose fitting a spark plug hole.

3 Crank the engine by hand till the compression appears on the gauge align the timing marks.

4 Locate the No. 1 spark plug wire position in the distributor cap.

5 Loosen the clamp of the distributor body and positioned it by rotating distributor body slightly both directions until a high point of reflector is align with the head on the pickup coil.

6 Tighten the distributor body at the above position.

7 Clamp the distributor cap.

8 Connect high tension leads from distributor cap to all spark plugs as per firing order.

9 Start the engine and adjust if requires with the help of timing light.

— — — — —

TASK 3: **Remove 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 foreign particles entering into the cylinder.

6 Remove spark plug from the engine cylinders.

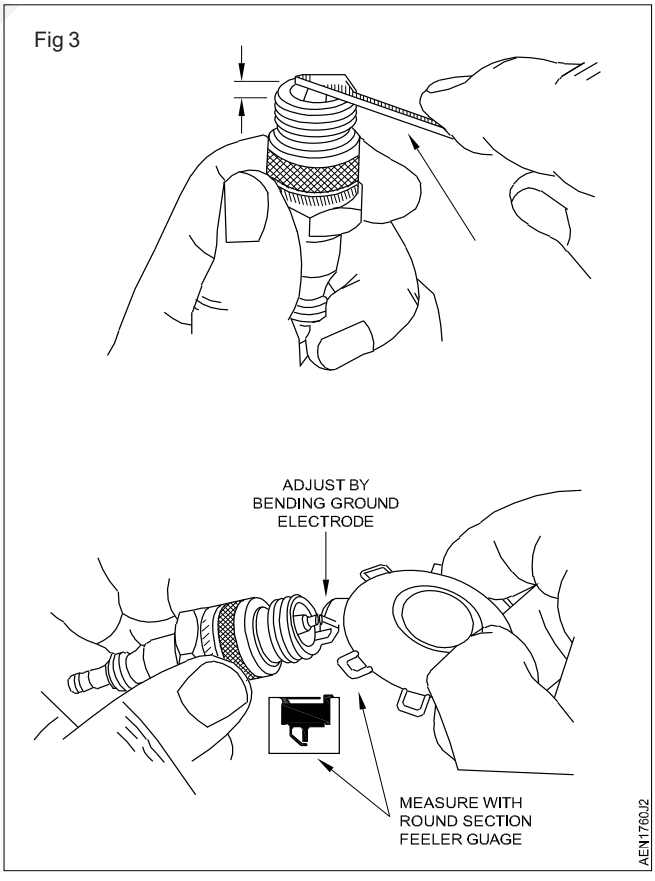
7 Check the spark plug in a standard spark plug tester shown in Fig 2

Fig 2

Clean and inspect spark plug

1 Check the spark plug for carbon deposition, cracks and damage.

Fig 3



2 Clean the spark plug with spark plug cleaning machine.

3 Check the spark plug for wear or insulator damage.

Adjust spark plug gap

1 Check the spark plug gap with the spark plug gauge. (Fig 3)

2 Adjust the gap as per the manufacturer's specification.

Check ignition spark

1 Mount ignition coil with the engine and connect the wires.

2 Connect the high tension leads with the spark plug.

3 Ground the plug.

4 Crank the engine and check ignition spark visually. If not, replace the spark plug or ignition coil.

Install spark plug

1 Install the spark plug to the engine.

2 Install the ignition coil.

3 Connect the high tension leads with the distributor to spark plug and as per the firing order.

4 Start the engine and check the performance of the engine.

Check and replace the spark plug

1 Remove the spark plug from the engine cylinders.

2 Check the spark plug normal conditions.

3 Check the deposits in the spark plug.

4 Check the breakage, abnormal corrosion, melting of the spark plug.

5 Clean the spark plug with help of spark plug tester.

After cleaning check the spark plug for clear cracks and damages. Cracks hidden by accumulated deposits sometimes after cleaning.

7 Clean the threads and metal shell with a brass wire brush and wipe the insulator at the top with clean and dry cloth.

8 If the counter electrode is worn out file the plug center electrode evenly to make a sharp edge. Be careful not to file too much off the center electrode.

9 Adjust the spark plug gap - 0.7 - 0.8 mm.

10 If defective / damaged spark plug replace it.

11 Install the spark plug - tighten the spark plug finger tight first kill the gasket reaches the cylinder head then use the spark plug spanner to tighten it.

— — — — — —

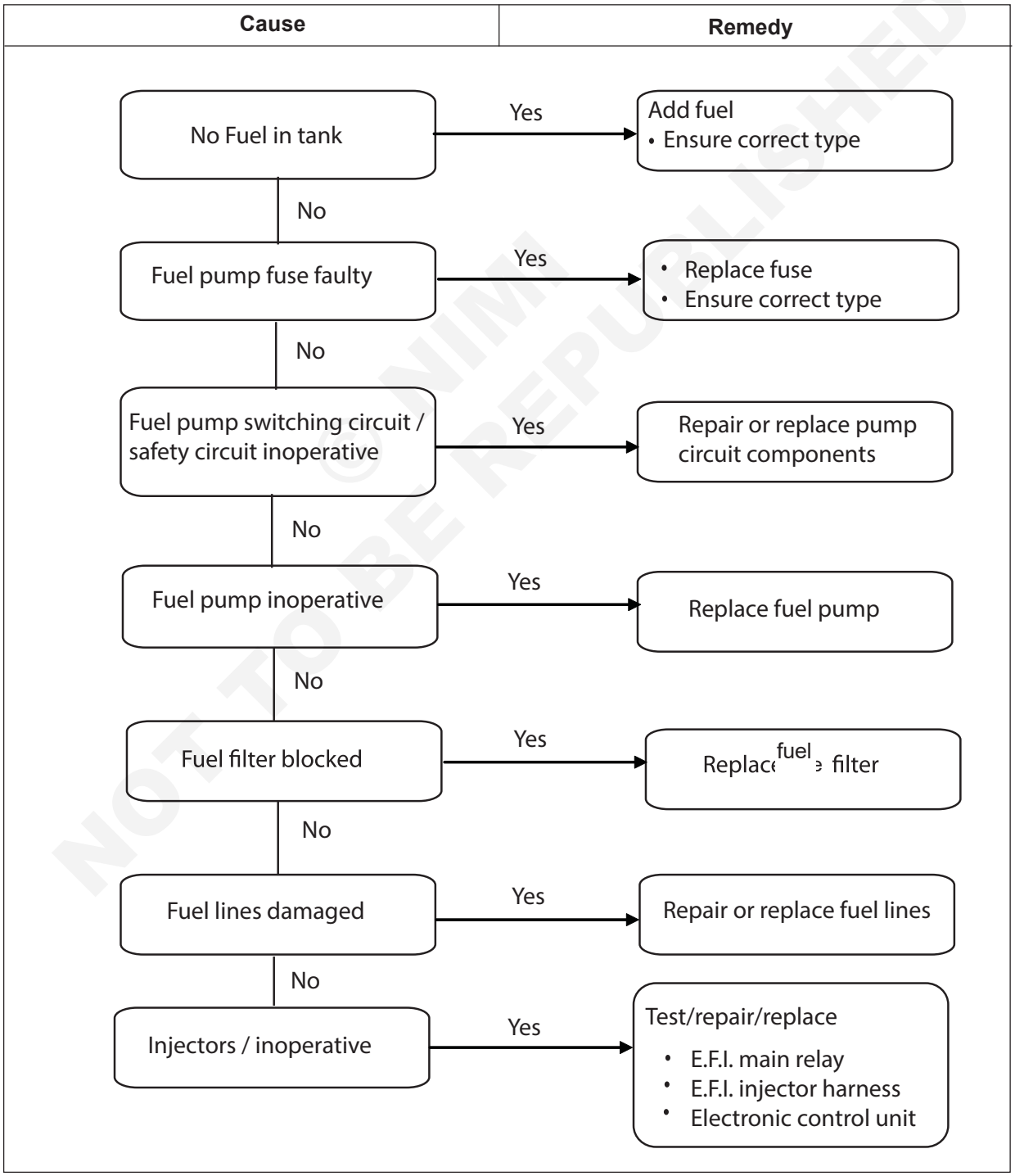
Practice to trouble shoot an engine

Objectives: At the end of this exercise you shall be able to
- **Identify the causes and remedies for engine does not start**
- **Identify the causes and remedies for poor engine performance.**

PROCEDURE

TASK 1: **Identify the causes and remedies for engine does not start**

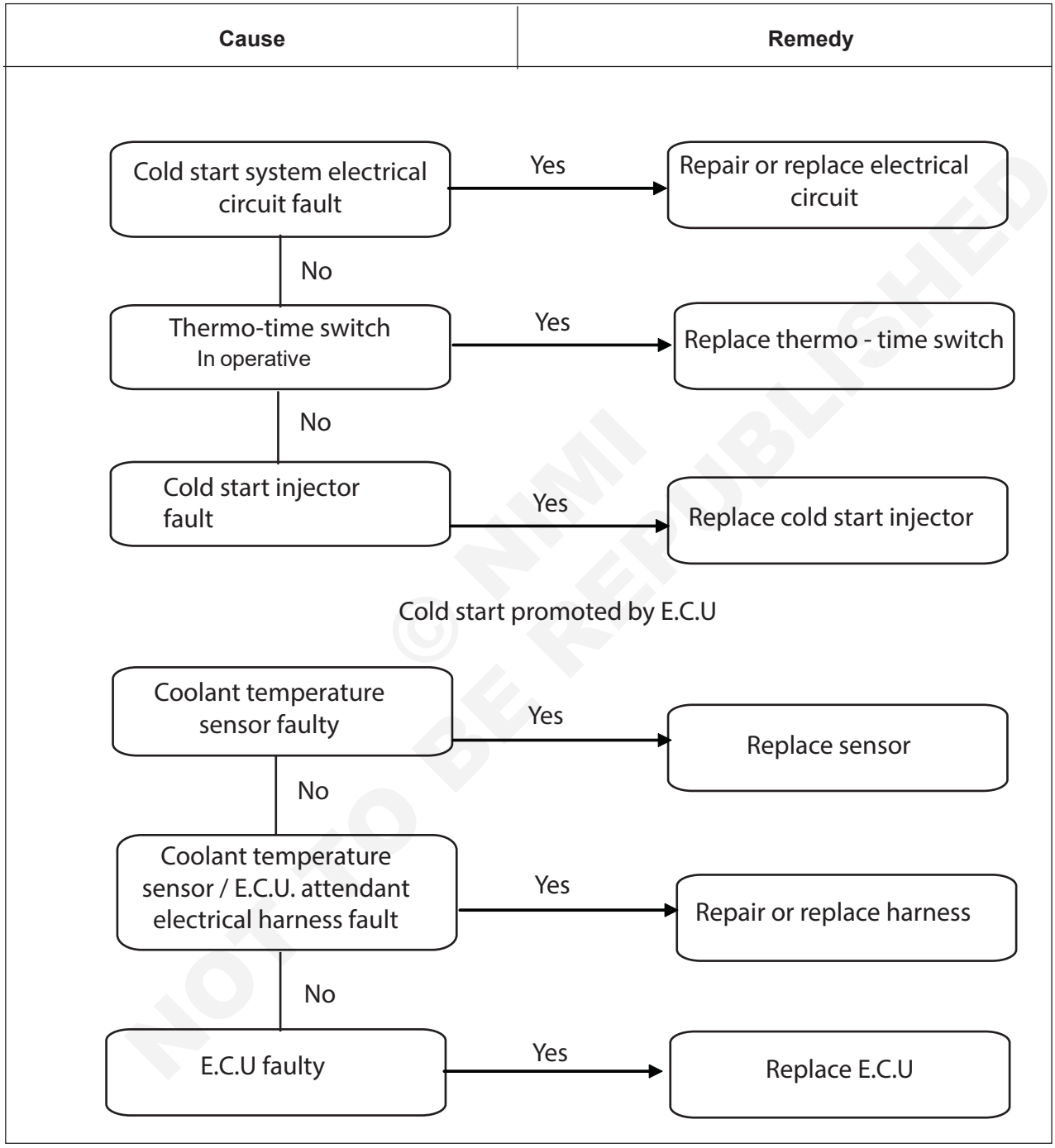
Chart 1 - Engine cranks but will not start



- Engines fitted with cold start injectors may start cold, run for a few seconds, then stop.
- The short run time is evidence that the fuel pump is operating satisfactorily.
- It is also evident that the main injectors or injector control circuits is fault.

Cold start via separate system

Chart 2 - Engine hard to start - cold



Electrical problems involving the system harness will most likely layering area of component/ harness coupling

Practice to trace and identify hall effect sensor

Objectives: At the end of this exercise you shall be able to
- **sensor testing**
- **sensor circuit tracing and testing.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multimeter - 1 No.

Equipment / Machines

- Petrol vehicle - 1 No.

Materials

- Insulation tape - As reqd.
- Cotton waste - As reqd.
- Hall effect sensor - As reqd.
- Wire - As reqd.
- Spark plug - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Sensor testing**

1 Park the vehicle on level surface and check the wheels

2 Visually check the hall effect (Fig 1) and optical sensors for harness loose connection or coupler disconnections, dust water formed between signal point

3 Connect the scanner tool to diagnostics coupler

4 Switch on scanner tool and turn on ignition key wait for scanner warm up and screen display.

5 Check the scanner display on the screen

6 Follow the instructions codes from display select the manufacturer of the vehicle

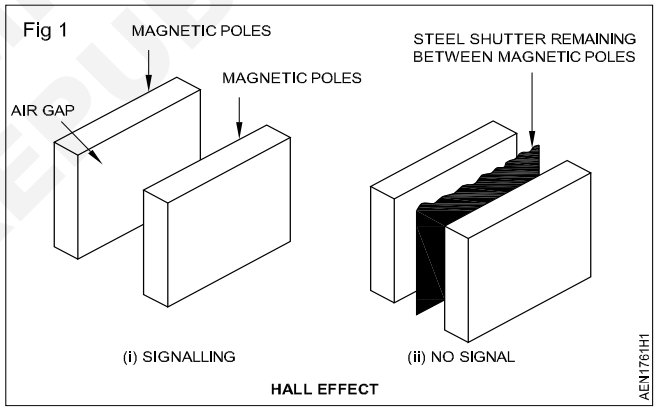
7 Select the model, make & manufacturing year.

8 Select the electrical ignition circuit and select auto defect in scanner.

After detecting check faulty memory

If any fault memory is present it will displayed

Fig 1



11 Read the system fault memory and rectify the loose connections or replace the defective sensors indicated in scan tool

12 Repeat the above steps for check the all sensor circuits and wire harness.

Tracing and practice to test the sensor circuit

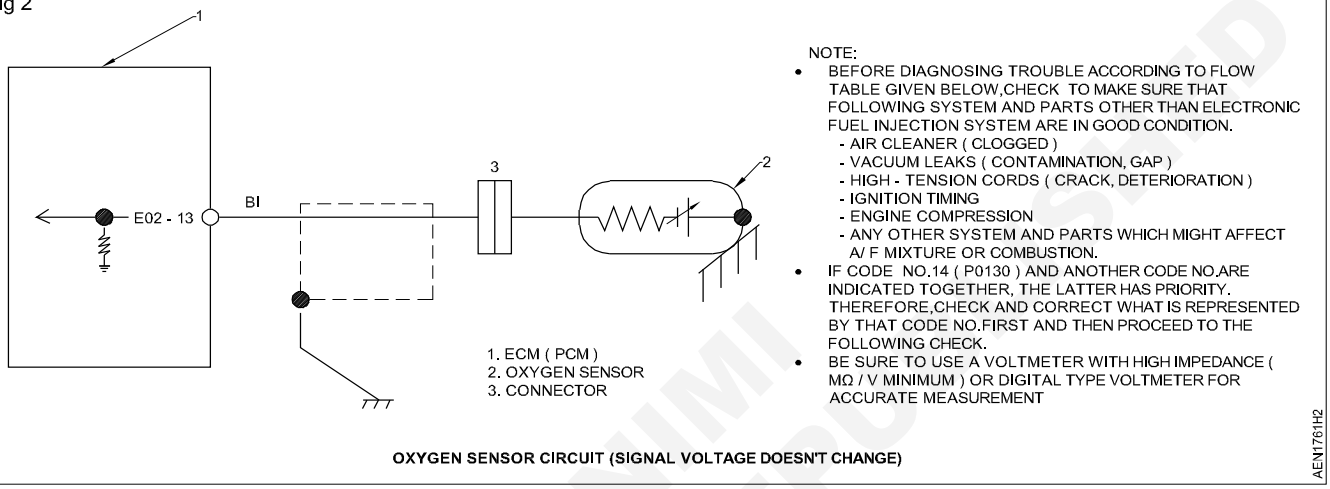
Objective: At the end of this exercise you shall be able to
- **sensor circuit tracing and testing.**

PROCEDURE

TASK: **Tracing and testing**

Oxygen sensor circuit (Signal voltage doesn't change) (Fig 1)

Fig 2



OXYGEN SENSOR CIRCUIT (SIGNAL VOLTAGE DOESN'T CHANGE)

Step	Action	Yes	No
1	1) Warm up engine to normal temperature. 2) Connect voltmeter between E02 - 13 terminal of ECM coupler and body ground. faulty ECM (PCM). 3) Maintain engine speed at 2000 rpm and after 60 seconds, check voltmeter Does the voltage deflect between above and below 0.45 V repeatedly ?	Oxygen sensor and (Closed loop system, A/F ratio feedback system) are in good condition. Intermittent trouble or	Go to Step 2.
2	Does the voltage remain unchanged at 0.45 V above ?	"BI" circuit shorted to power circuit or rich A/F Mixture. If circuit is OK, check MAP sensor, ECT sensor, fuel pressure, injectors and their circuit. If all above are OK, check ECM (PCM) and its circuit.	Go to Step 3
3	1) Maintain engine speed at 2000 rpm for 60 seconds 2) Check voltmeter while repeating 3) Does it indicate 0.45 V or more even once?	Poor E02 - 13 connection or lean A/F mixture open/short or If connection is OK, check MAP sensor, engine. ECT sensor, fuel pressure injectors and their circuit.	"BI" circuit oxygen sensor malfunction. If wire and connection are OK, replace oxygen sensor and recheck.

Practice to trace the distributor less ignition circuit

Objective: At the end of this exercise you shall be able to
- **trace the distributor less ignition circuit.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multimeter - 1 No.
- Wire cutter - 1 No.

Equipment / Machines

- Vehicle - 1 No.

Materials

- ECU - 1 No.
- Sensors - As reqd.
- Spark plug - As reqd.
- Cotton waste - As reqd.
- Wire - As reqd.
- Insulation tape - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Trace distributor less ignition circuit (Fig 1)**

1 Select the vehicle with distributor less ignition system.

2 Park the vehicle on the level ground.

3 Apply safety wooden block to front and rear wheel.

4 Disconnect the battery terminal before start to trace the circuit.

5 Use the vehicle wiring diagram to trace the ignition circuit.

6 Find the ECU location of the vehicle.

7 Trace the crankshaft and camshaft position sensors.

8 Trace the hall effect sensor or pair of ignition coil provided in the ignition circuit.

9 Trace the wire connections from ECU to spark plug.

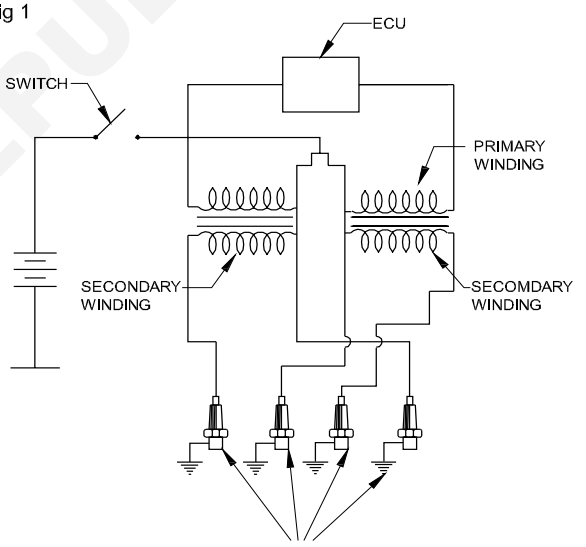
10 Trace the wire connections from CKP & CMP sensor to E.C.U.

11 Trace the hall effect sensor wire connection.

12 Connect the battery terminal.

13 Switch on the ignition key and crank the engine to measure the voltage in various points in the ignition circuit with help of multimeter.

Fig 1



DISTRIBUTOR LESS IGNITION SYSTEM FROM A FOUR CYLINDER ENGINE

Inspect the starter motor and test its performance

Objectives: At the end of this exercise you shall be able to
- **perform pull and hold test performance**
- **perform pinion return test**
- **perform no-load performance test**
- **fit the starter motor on the engine.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Box spanner set - 1 No.
- 10mm rod - 1 No.

Equipment / Machines

- Running vehicle - 1 No.

Materials

- Emery paper - As reqd.
- Hack saw blade - As reqd.
- Grease - As reqd.
- Cotton waste - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Test the starter motor for performance**

1 Remove starter motor assembly from vehicle

Pull in test

2 Connect the test leads as shown in the figure 1.

3 Check that the pinion (over- running clutch) jumps out; if it does not, replace it.

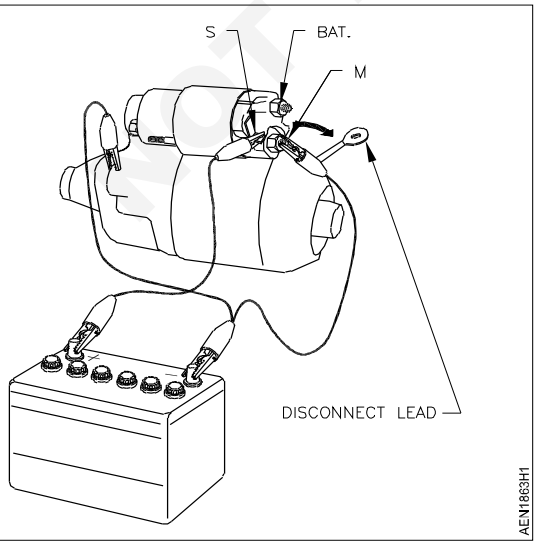
Before testing disconnect the field coil lead from the terminal.

Hold in test

4 While connecting as stated above with the pinion out, disconnect the negative lead from terminal 'C'

5 Check that the pinion remains out; if not, replace the magnetic switch.

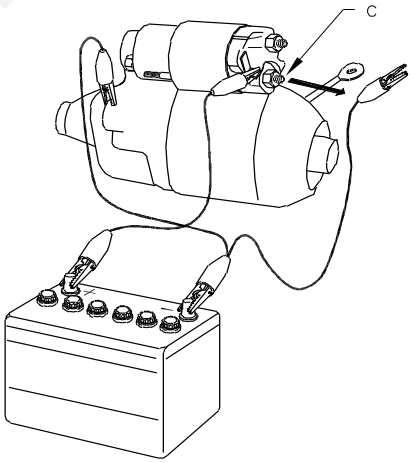
Fig 1



Pinion return test

6 Disconnect the negative lead. (Fig 2)

Fig 2



7 Check to make sure that the pinion returns inward quickly.

No-load performance test

8 Connect the test leads as shown in the figure. (Fig 3)

9 Check the motor runs without fail with the pinion moved out.

10 Check that the ammeter indicates the specified current. (No-load current - less than 53 A at 11.5 v) (Fig 3 & 4)

Fig 3

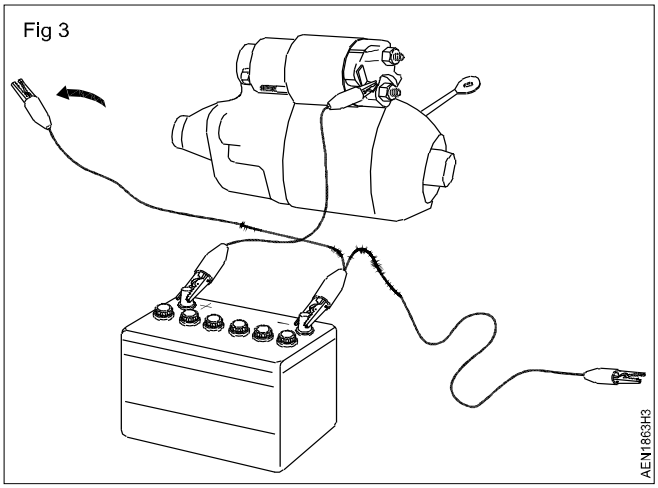
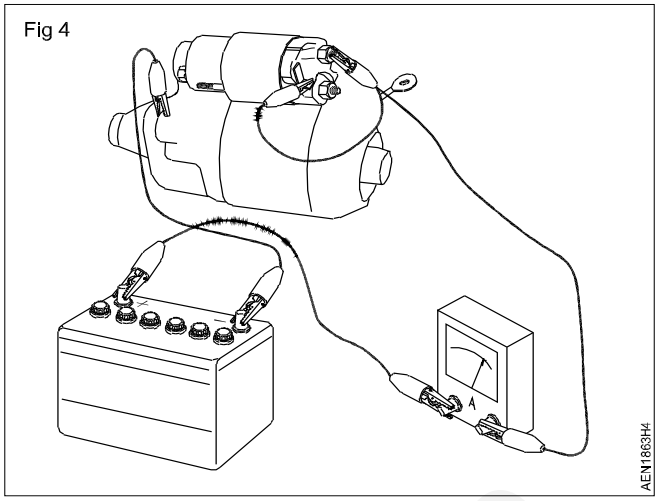


Fig 4



TASK 2: **Fit the starter motor on the engine**

1 Place the starter motor in its position.

2 Tighten the two mounting bolts.

3 Connect the battery cable and magnetic switch lead wires to the starter motor terminals.

4 Connect the negative lead to the battery.

Overhaul the starting motor (Hold in coil open circuit, Armature test - Ground test, Open circuit test, pull-in coil open circuit test, field coil test)

Objectives: At the end of this exercise you shall be able to
- **remove the starter motor**
- **dismantle the starter motor**
- **test magnetic switch**
- **test the armature and commutator**
- **check continuity of field coils**
- **check over-running clutch**
- **check end cover's shaft bushes**
- **assemble starter motor**
- **test the starter motor for performance**
- **fit the starter motor on the engine.**

Requirements

Tools / Instruments

• Trainees tool kit	- 1 Set
• Box spanner	- 1 No.
• Multimeter	- 1 No.
• Growler	- 1 No.
• V. Block	- 1 No.
• Dial test indicator with magnetic base	- 1 No.
• Vernier caliper	- 1 No.
• Tap set	- 1 No.
• Battery with terminal cable	- 1 No.

Equipment / Machines

• Vehicle	- 1 No.

Materials

• Cotton waste	- As reqd.
• Emery paper	- As reqd.
• Hacksaw blade	- 1 No.
• Knife	- 1 No.
• Grease	- As reqd.
• Bush bearing	- 1 Set.
• Magnetic switch	- 1 Set.
• Circlip	- 1 Set.
• Battery cable with clip	- 1 Set.

PROCEDURE

TASK 1: **Remove the starter motor**

1 Disconnect the negative (-) lead at the battery.

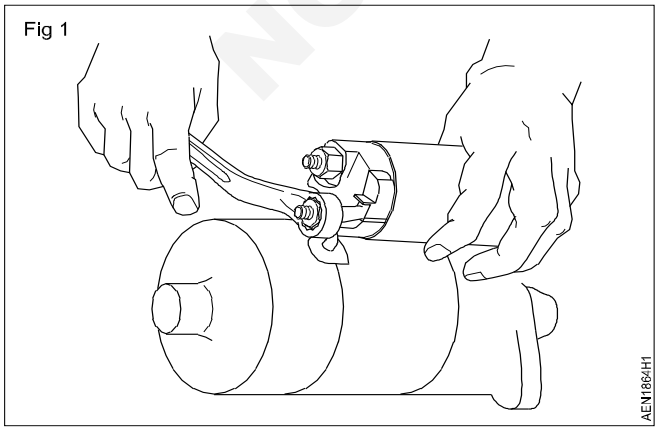
2 Disconnect the magnetic switch lead wires and the battery cable from the starting motor terminals.

3 Remove the two mounting bolts.

4 Remove the starter motor.

5 Remove the magnetic switch assembly (Fig 1)

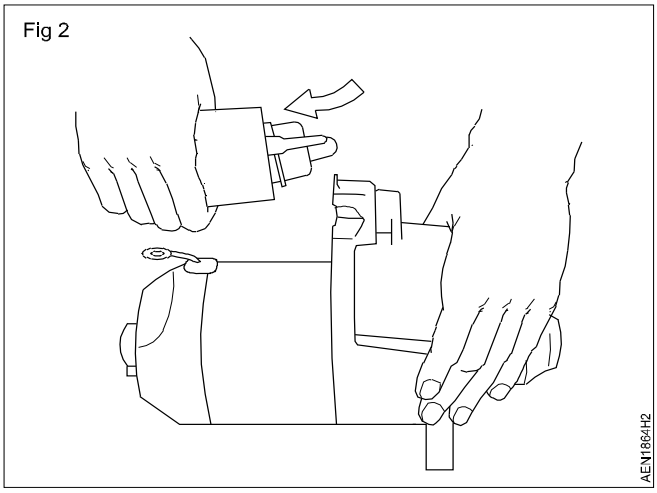
Fig 1



6 Remove the cable terminal nut and disconnect the lead wires from the magnetic switch.

7 Remove the two mounting nuts and then take out the magnetic switch by slight tilting as shown. (Fig 2)

Fig 2

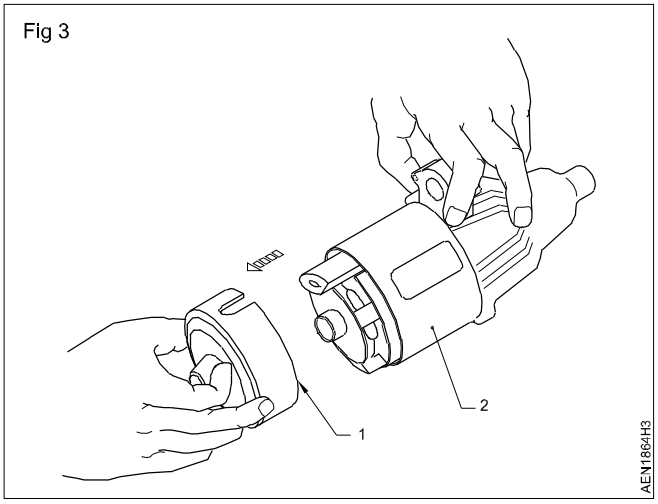


TASK 2: **Dismantle the starter motor**

1 Remove the through bolts.

2 Take off the commutator end housing (2) (Fig 3)

Fig 3



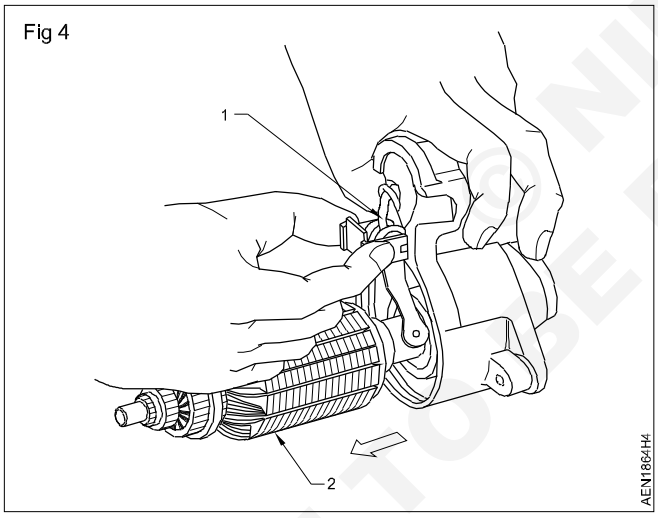
3 Remove the brush holder cover from the brush holder.

4 Take out the brush springs and brush.

5 Remove the yoke assembly.

6 Remove the armature (2) along with the pinion drive lever (1). (Fig 4)

Fig 4



7 Insert the screwdriver tip in the gap between the two stop collars (1) and (2). (Fig 5)

8 Push the front collar (1) outward.

9 Using a 14mm socket (3) push the rear stop collar (2) downwards. (Fig 6)

10 Remove the armature snap ring (4) by using a snap ring plier, and with the help of a screw driver. (Fig 7)

11 Pull out the rear pinion stop collar (2), and over-running clutch (5). (Fig 7)

Fig 5

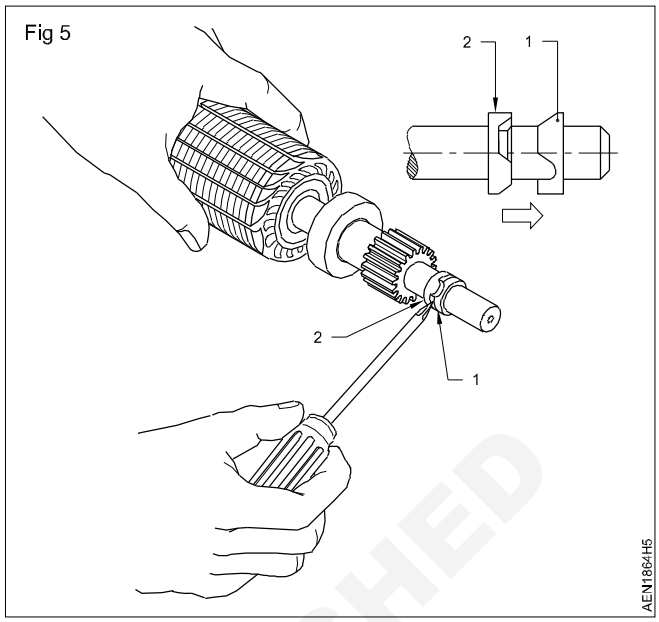


Fig 6

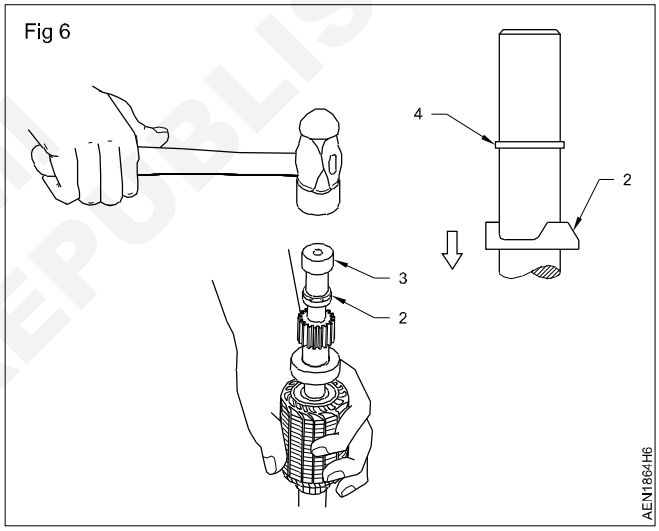
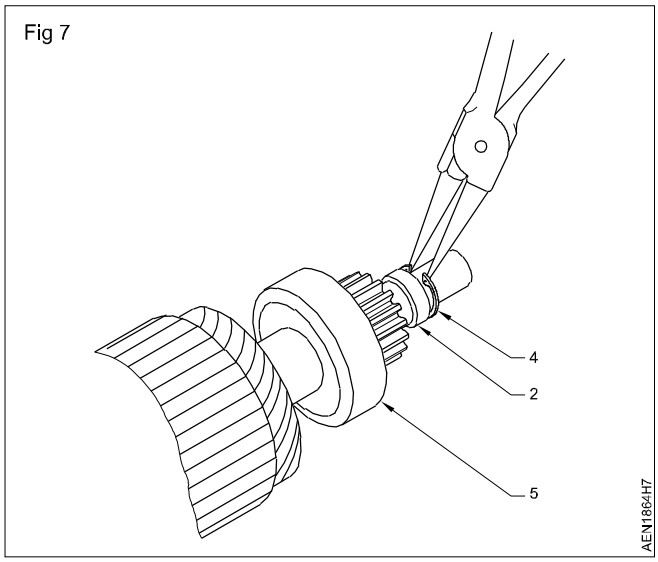


Fig 7

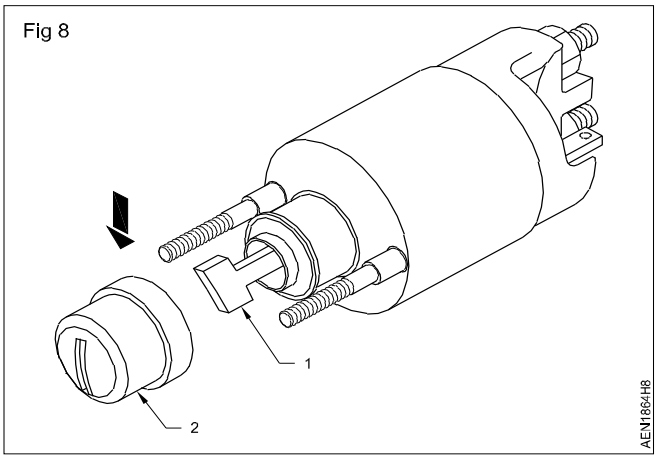


TASK 3: **Test magnetic switch**

1 Inspect the magnetic switch boot (2) for breakage. (Fig 8)

2 Inspect the plunger (1) for wear or damage. Replace if necessary. (Fig 8)

Fig 8



3 Push the plunger (1) in and release it. The plunger should return quickly to its original position. Replace if necessary. (Fig 9)

4 Check for continuity across the magnetic switch terminals (1) and coil case (2). If no continuity exists, the coil is open and should be replaced. (Fig 10)

5 Check for continuity across magnetic switch terminal (1) and terminals (3). If no continuity exists, the coil is open and should be replaced. (Fig 10)

Fig 9

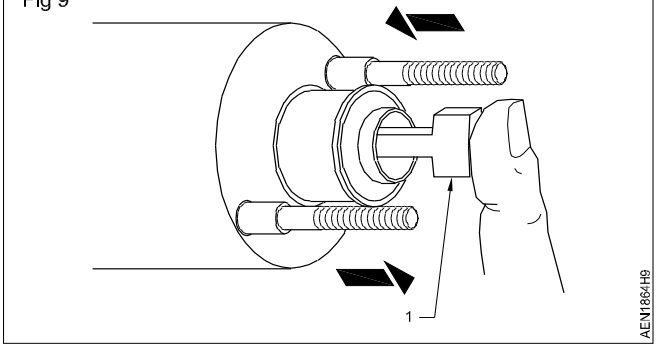
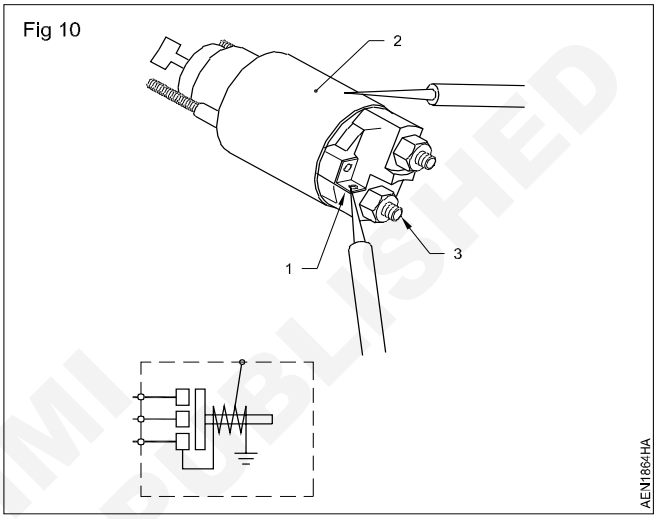


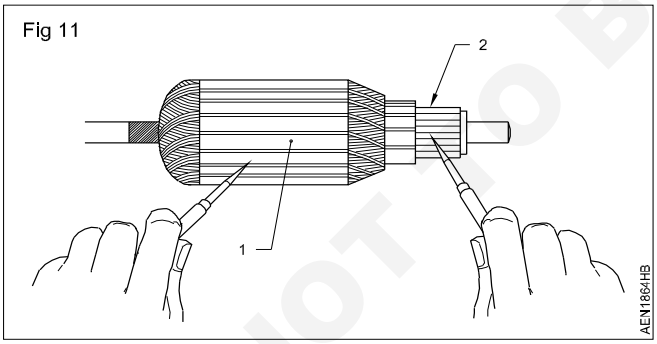
Fig 10



TASK 4: **Test the armature and commutator**

1 Test armature for ground (Fig 11)

Fig 11



2 Using an ohmmeter test for continuity between the commutator (2) and armature core (1). The ohmmeter will indicate infinite resistance if the insulation is in sound condition.

3 Test for open circuit (Fig 12)

4 Check for continuity between each pair of adjacent commutator segments, using an ohmmeter.

5 Replace the armature assembly if there is any discontinuity the ohmmeter needle will not deflect.

6 Check commutator run out (Fig 13)

Fig 12

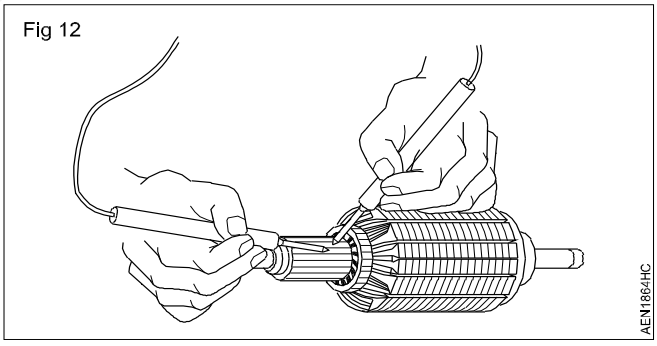
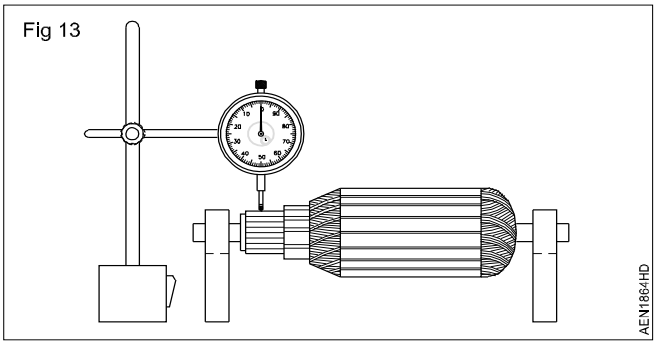


Fig 13



7 Place the armature between two 'V' blocks.

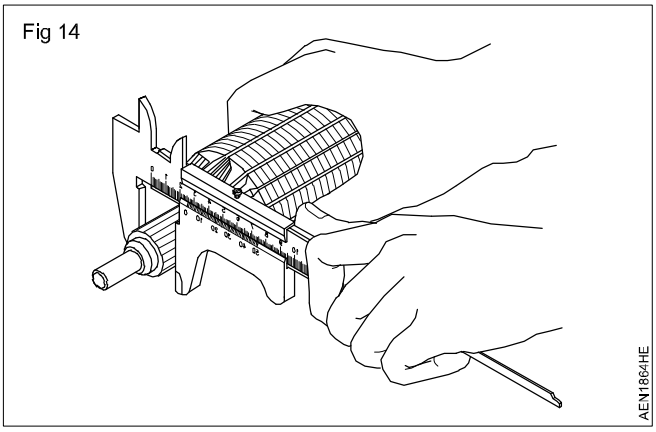
8 Using a dial gauge check the commutator for run out by slowly rotating it by hand.

9 Correct it on lathe if required.

10 Check commutator diameters

11 Check for wear and replace the armature if the diameter is below limit. (Fig 14)

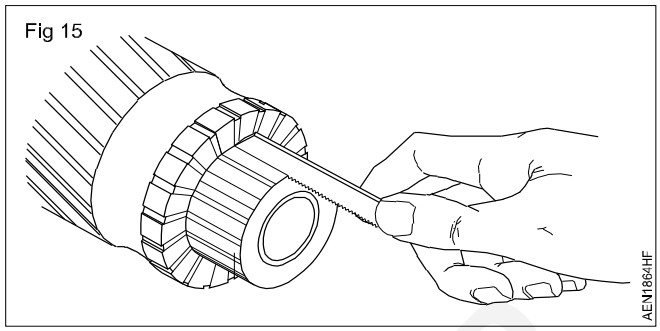
Fig 14



12 Clean the commutator surface by using 400 emery cloth.

13 Check the mica depth to a minimum of 0.2 mm and correct by using a hacksaw blade or knife, if required. (Fig 15)

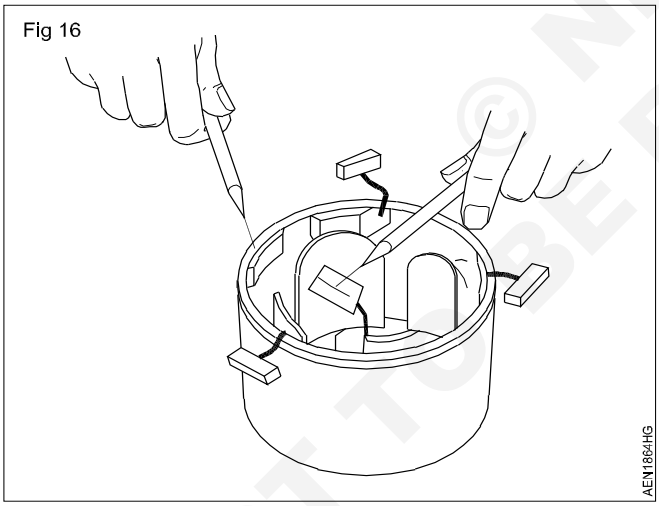
Fig 15



TASK 5: **Check continuity of field coils**

1 Using an ohmmeter, check for continuity between the field coil and the insulated brush. If continuity is not indicated, the insulation has failed. Replace the insulation between the brush and yoke. (Fig 16)

Fig 16



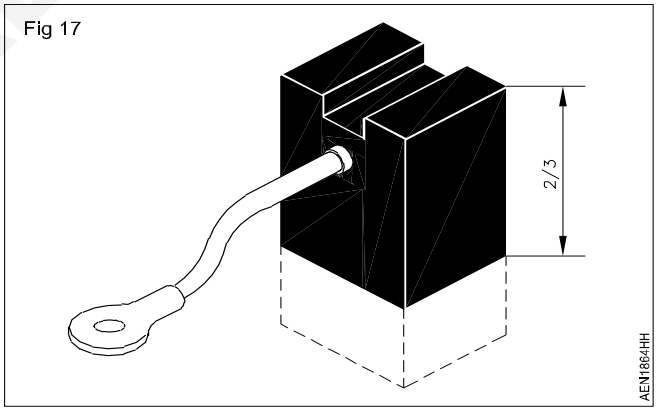
Brush

2 Measure the length of the brushes. If brushes are worn down to the service limit, replace them. (Fig 17)

Brush spring

3 Check the brush spring for tension, rust or breakage.

Fig 17

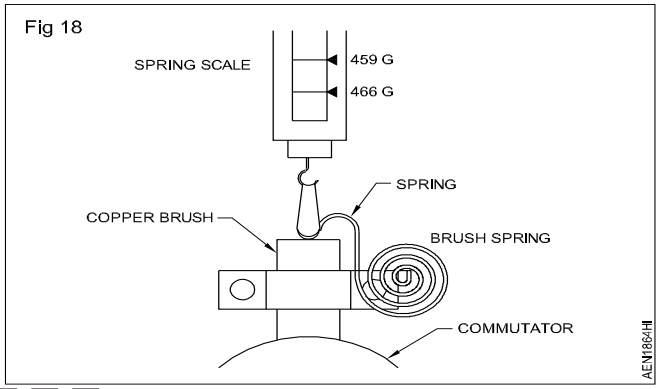


TASK 6: **Check over-running clutch**

1 Inspect the one-way clutch for free rotation in direction 'A', and locked up the other way round. (Fig 18)

2 Check the pinion for abnormal wear and replace it as assembly if required.

Fig 18



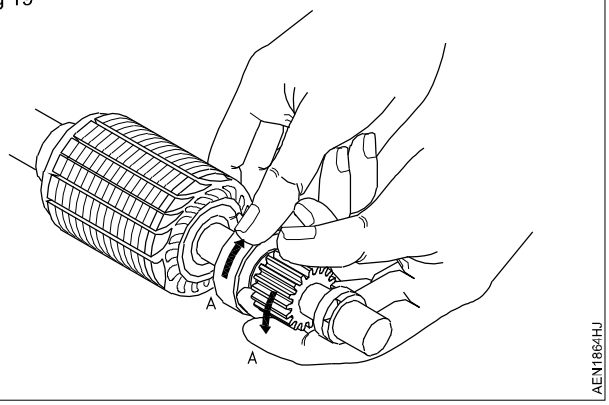
TASK 7: **Check end cover's shaft bushes**

1 Use a 10 mm rod, take out the bush cap.

2 Measure the internal diameter of the drive bush. (Fig 19)

3 Measure the outer diameter of the armature shaft at the drive end. (Fig 19)

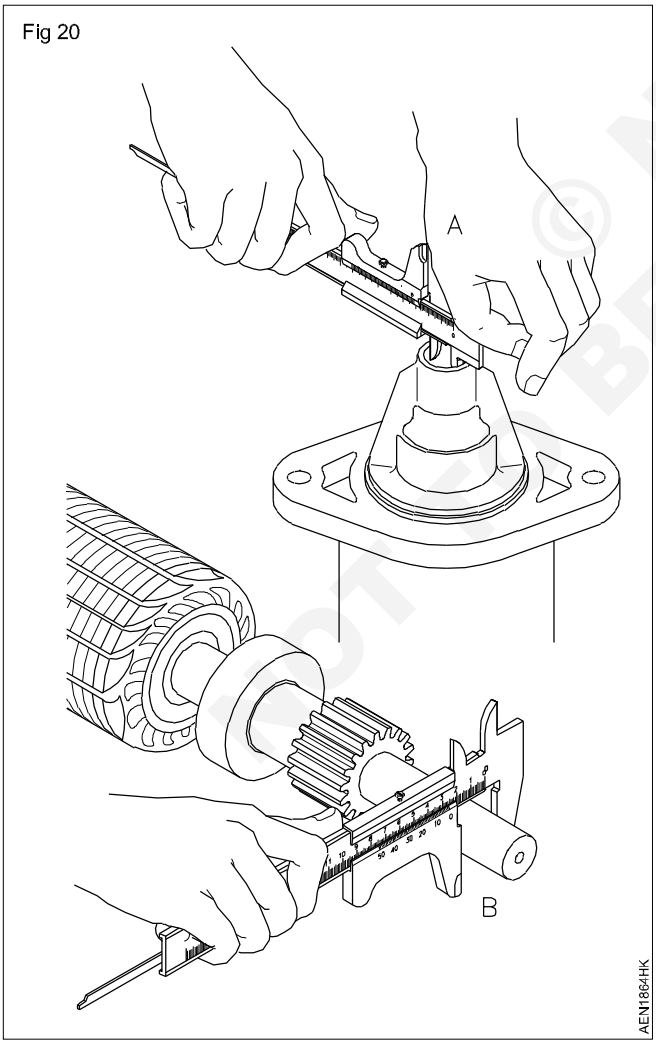
Fig 19



4 If clearance exceeds the limit, replace the bush.

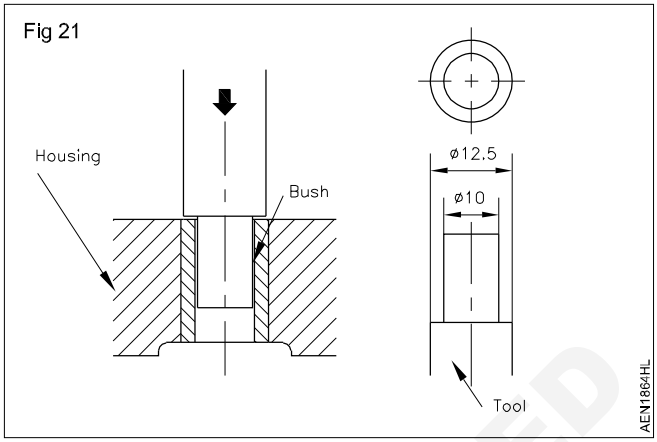
5 Use the tool as shown in the Fig 20, remove the bush from the drive housing on the arbor press.

Fig 20



6 Measure the internal diameter of the commutator end bush (2). (Fig 21)

Fig 21

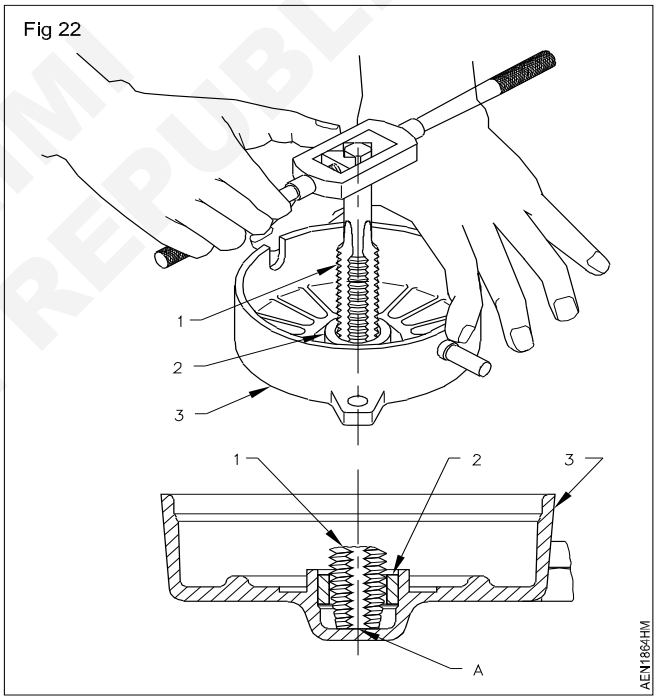


7 Measure the outer diameter of armature shaft at the commutator end.

8 If clearance exceeds the limits, replace the bush.

9 Thread in a 12 mm tap (1) in the bush. (Fig 22)

Fig 22



10 When the end of the tap reaches the bottom of the frame (3), tighten it further.

11 The bush will come out.

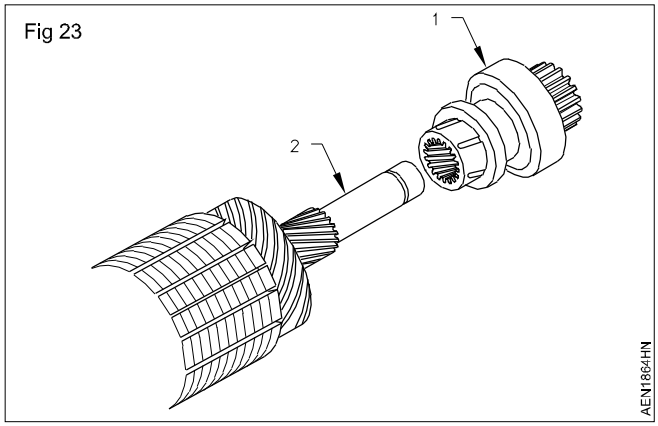
12 Fit new bushes as press fit on the arbor press.

13 Ream the inside surface of the bush to obtain oil clearance (0.05 mm) between the armature shaft and bush.

TASK 8: **Assemble starter motor**

1 Apply grease and install the over-running clutch (1) to the armature shaft (2) as shown in the Fig 23.

Fig 23



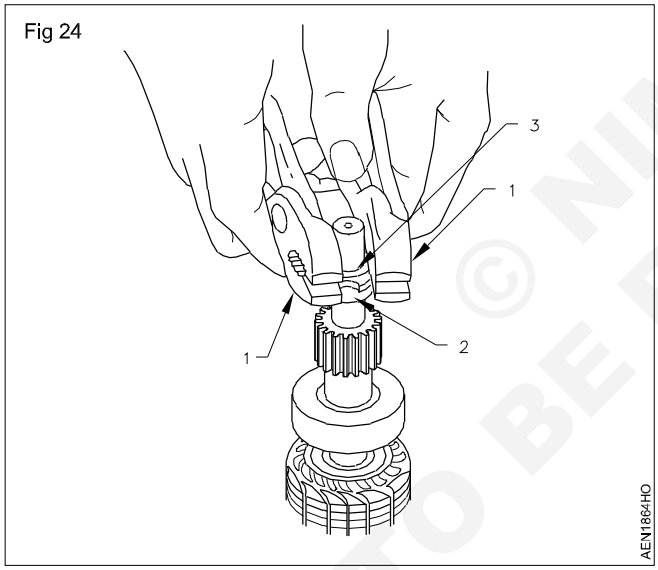
2 Insert the rear stop collar (2) in the armature shaft.

3 Insert a snap ring in the armature shaft.

4 Insert the front stop collar (3) in the armature shaft.

5 Press by two pliers (1) as shown in the Fig 24

Fig 24



6 Apply grease to the drive lever (1).

7 Combine it with the armature (2).

8 Assemble them with the drive housing (3). (Fig 25)

9 Install the yoke.

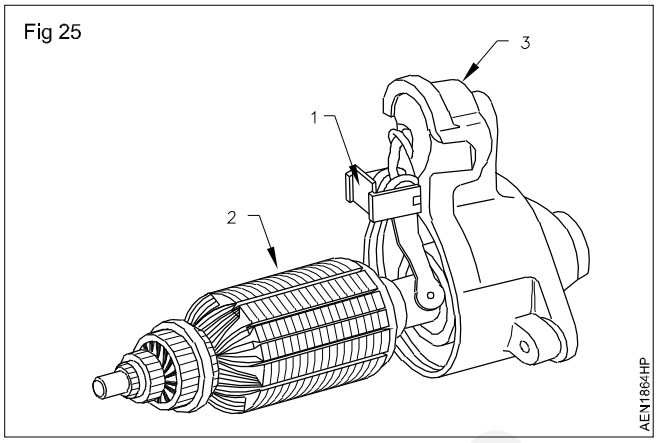
10 Install the brush holder.

11 Install 4 sets of brushes with the springs.

12 Install the brush holder cover.

13 Apply grease and install the commutator end housing as shown in the Fig 25

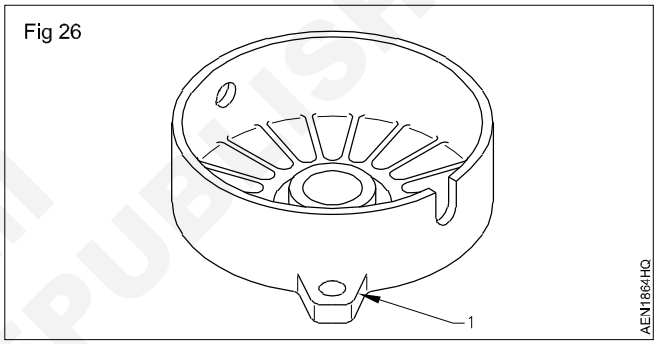
Fig 25



14 Replace the magnetic switch (3) and its boot (1) with a new one if required. (Fig 26)

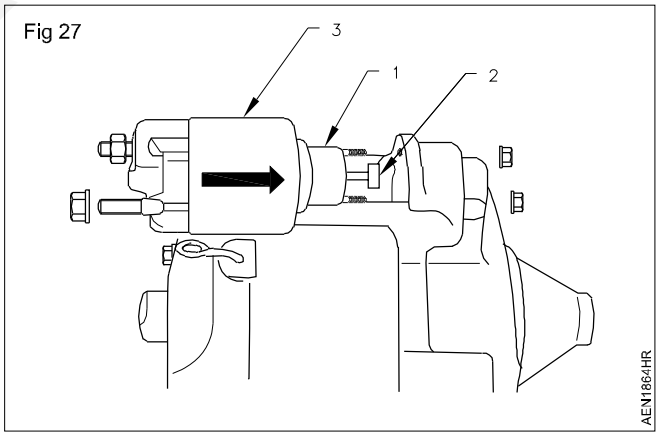
15 Apply grease to the plunger's (2) hook. (Fig 26)

Fig 26



16 Hook the switch plunger with the drive lever. (Fig 27)

Fig 27



17 Fasten the switch assembly with nuts.

18 Connect the lead wire.

— — — — — —

Inspect brush length and wear as per service manual

Objective: At the end of this exercise you shall be able to
- **Inspect the carbon brush length.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multimeter - 1 No.
- Test lamp - 1 No.

Equipment / Machines

- Vehicle - 1 No.
- Test bench - 1 No.
- Tray - 1 No.

Materials

- Cotton waste - As reqd.
- Carbon brush - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Inspect of starter motor carbon brush length and wear (Fig 1)**

1 Park the vehicle on the level ground.

2 Provide the safety measures to the vehicle.

3 Open the vehicle bonnet and disconnect the battery terminal.

4 Disconnect the all wire connections with self-starter.

5 Unscrew the self starter mounting screws.

6 Remove the starter motor from the vehicle.

7 Place the starter motor on the work bench.

8 Clean the starter motor with cleaning brush.

9 Dismantle the self-starter and place it on the tray.

10 Clean the all parts of starter motor.

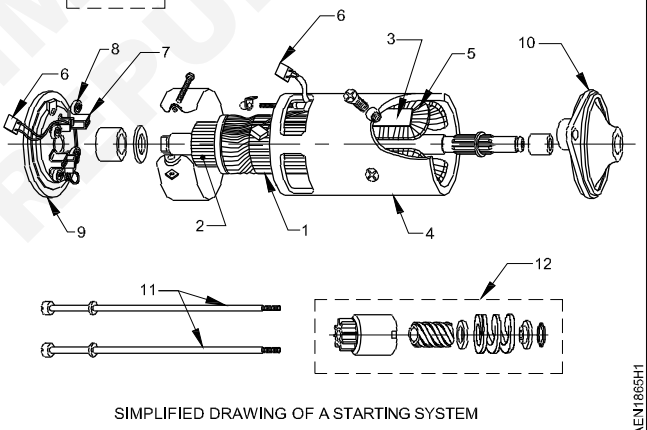
11 Unscrew the carbon brush with spring from the end plate.

12 Clean the carbon brush and visually inspect it.

13 Measure each brush length and compare with vehicle service manual.

14 If the brush length is less than as specified limit by the manufacture replace the brushes.

Fig 1



SIMPLIFIED DRAWING OF A STARTING SYSTEM

15 Fix the new brush with end plate.

16 Assemble the all dismantled parts of starter motor.

17 Test the starter motor for load tests, if it is in good performance, refit it on vehicle.

Inspect and troubleshoot the starter motor

Objectives: At the end of this exercise you shall be able to
- **rectify problem of engine not cranking**
- **rectify problem of engine crank too slowly to start**
- **rectify problem of starter spins but engine is not cracking**
- **rectify problem of starter not engaging or disengaging properly.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multi Meter - 1 No.

Equipment / Machines

- Vehicle - 1 No.

Materials

- Cotton waste - As reqd.
- Magnetic switch - As reqd.
- Petroleum jelly, brush - As reqd.

PROCEDURE

Refer to the chart below for the possible causes and needed actions, for each symptom and follow the action as per sequence, till the cause identified and do rectification.

Symptom (TASKS)	Possible cause	Action needed
Starter motor not running.	• Melting of magnetic switch points • loose connections • battery is dead • For faulty ignition switch • Faulty magnetic switch	
Engine cranks too slowly	• weak battery • loose or corroded • Check mechanical problems with engine or starter • Faulty starter motor	
Starter keeps running	• Binding ignition key • Faulty control components • Damaged pinion or ring gear • Faulty plunger in magnetic switch	
Starter spins, but engine not	• Faulty over-running clutch • Check for damaged or worn pinion gear or ring gear	
Starter does not engage/ disengage properly	• Faulty magnetic switch • Damaged or worn pinion gear or ring gear;	
Starter motor noise	• Pinion worn out • Bearing worn out • Mounting loose • Ring gear worn out	
Starter motor does not stop running	• Starter switch short circuited • Starter in relay contact • Binding ignition switch	

Practice to check the starting system

Objectives: At the end of this exercise you shall be able to
- **check the starting system**
- **perform joints starting a vehicle.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 Set
- Test lamp - 1 No.
- Multi Meter - 1 No.
- Jumper wire - 1 Set.

Equipment / Machines

- Running Vehicle - 1 No.
- 12V battery - 1 No.

Materials

- Cotton waste - As reqd.
- Emery sheet - As reqd.
- Wire with clip - As reqd.
- Battery - As reqd.
- Jumper cable - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK: **Check the starting system of the vehicle (Fig 1)**

1 Place the vehicle on surface floor.

2 Use wooden choke for front and rear wheels.

3 Check the battery terminal connections for sulphur deposit.

4 Remove the terminals and clean it with hot water If sulfur is deposited on battery terminals if sulfur is deposited on battery terminals.

5 Clean the battery post and cable connectivity by use the emery sheet.

6 Connect the battery terminals and ensure the proper tightness.

7 Check the battery charge condition with help of hydro meter and volt meter.

8 Check the starter motor battery cable connections and mountings.

9 Switch on the ignition key.

10 Turn on the glow plug and ensure the combustion chamber warmed up by glow plug light glow off.

11 Turn on the self-starter switch and carefully watch the pinion contact with engine flywheel ring gear.

12 Check the fly wheel rotation if fly wheel turning speed is slow that means battery low charge.

13 Take one full charge battery with jumper cable.

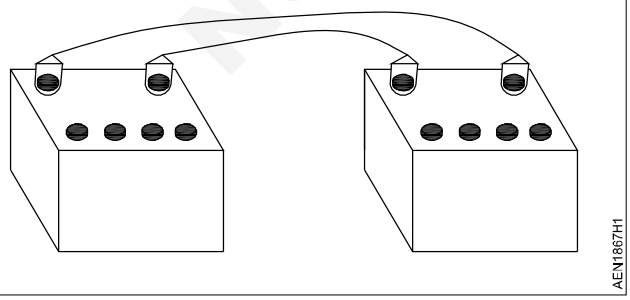
14 Place battery and connect by use of jumper cable in parallel connections to the vehicle battery.

15 Check the battery voltage by use of volt meter.

16 Turn on the starter motor switch and start the engine and check the battery charging system.

17 Disconnect the jumper cables and spare battery.

Fig 1



Practice to check the charging system

Objective : At the end of this exercise you shall be able to
- **identify and rectify trouble shoot in the charging system.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multimeter - 1 No.

Equipment / Machines

- Vehicle - 1 No.

Materials

- Gloves - 1 Set
- Cleaning cloth - As reqd.
- Emery sheet - As reqd.
- Cleaning solvent - As reqd.

PROCEDURE

TASK 1: **Trouble shoot the charging system (Fig 1)**

1 Switch on the ignition. Check the battery charging indicator lights ON.

2 Start the engine. Raise the engine to 2000 RPM and check the charging indicator light turns OFF.

3 If the charging indicator light does not ON 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 glow 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 fuse.

11 Connect the multimeter with the battery terminals.

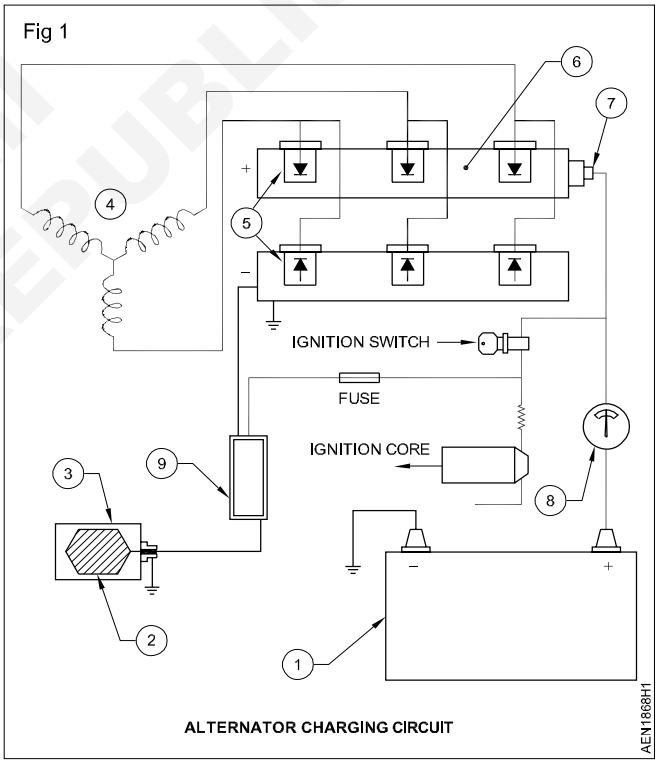
12 Set to measure voltage in the range of 6V to 60V.

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. (Fig 1)

Fig 1



ALTERNATOR CHARGING CIRCUIT

Trouble shooting in charging system

Problem	Causes	Remedies
Undercharge	- Improper adjustment of voltage regulator - improper conduct of carbon brushes - dirty slip ring	- Adjust the regulator - replace the tension spring of carbon brushes - Clean the slip ring of replace
No charge	- Defective diode rectifier - defective regulator - disconnected circuit wire - defective regulator	- replace - replace - connect wire - replace
Overcharge	- defective regulator	- replace

Overhaul and inspect an alternator

Objectives: At the end of this exercise you shall be able to
- **locate the circuit from the alternator to the battery**
- **remove the alternator**
- **dismantle the alternator**
- **check the rotor**
- **check the slip-rings.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Socket spanner set - 1 No.
- 12-volt lead acid battery - 1 No.
- Test lamp and cables - 1 No.

Equipment / Machines

- Vehicles - 1 No.

Materials

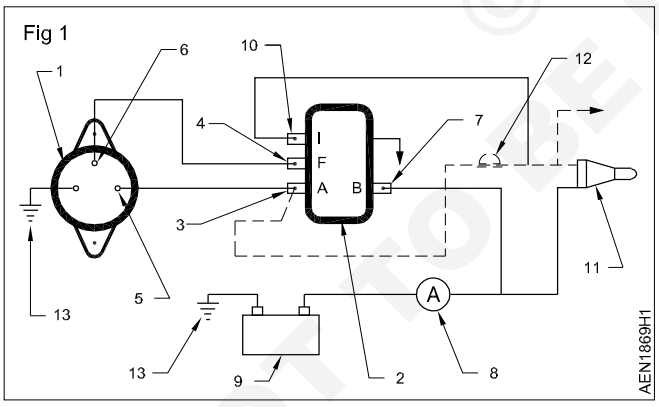
- Alternator - 1 No.
- Kerosene - As reqd.
- Emery paper - As reqd.
- Rotor - As reqd.
- Cleaning cloth - As reqd.
- Grease - As reqd.

PROCEDURE

TASK 1: **Identify the alternator circuit**

1 Locate the circuit from the alternator's (1) output terminal (5) to the voltage regulator's (2) terminal A (3). (Fig 1)

Fig 1



2 Locate the feedback circuit from the voltage regulator's (2) 'F' terminal (4) to the alternator's (1) field terminal (6).

3 Locate the circuit from the voltage regulator's (2) 'B' terminal (7) to the ammeter (8).

4 Locate the circuit from the ammeter (8) to the battery (9).

5 Locate the circuit from the voltage regulator's (2) 'A' terminal (3) to the indicator lamp (12).

6 Locate the circuit from the indicator lamp (12) to the ignition starting switch (11).

7 Locate the ground connection (13).

8 Locate the circuit from the ammeter (8) to the ignition starting switch (11).

— — — — — —

TASK 2: **Removing alternator**

1 Disconnect the earth cable of the battery.

2 Disconnect the wires from the alternator.

3 Dismount the bolts which secure the alternator with the bracket.

4 Take out the alternator.

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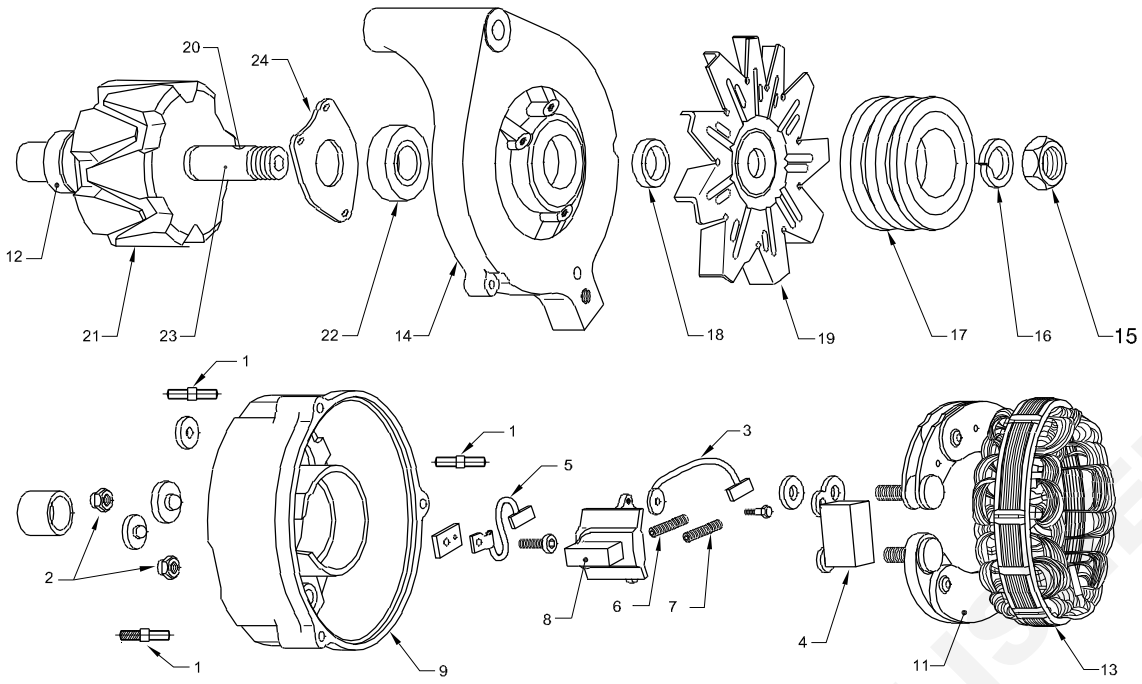
TASK 3: **Dismantling** (Fig 2)

Fig 2



1 Mark a line across both the end shields (14 & 9) and the stator to facilitate alignment during reassembling.

2 Remove the cover securing studs and nuts (1 & 2) and lift the cover. (Fig 2)

3 Disconnect the regulator leads (3) and (5) (+ve, -ve).

4 Remove the screw securing the regulator (4) to the brush box and remove the regulator (4).

5 Remove both the brushes (6) & (7). Note down the position of the sealing pad.

6 Remove the screws securing the brush-box (8) to the slipping end bracket (11) and lift out the brush-box (8).

7 Release the stator winding cable ends from the rectifier by applying a hot soldering iron to the terminal tags of the rectifier.

8 Gently pull out the cable end when the solder melts.

9 Remove the screws securing the rectifier assembly (11) to the slip-ring end bracket and lift out the rectifier assembly.

10 Remove the fixing bolts.

11 Take out the slip-ring end bracket (11).

12 Take out the stator assembly (13) from the drive end bracket (14).

13 Remove the shaft nut (15), washers (16) and take out the pulley (17), fan (19), woodruff key (20) and spacers (18).

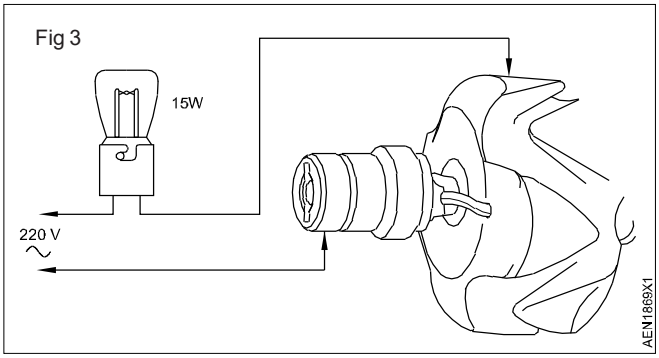
14 Push at the rotor shaft (23) end with your thumb to separate the drive end bearing (22) and rotor assembly (21).

— — — — — —

TASK 4: **Test for short circuit in rotor**

1 Check the rotor winding insulation by connecting to a 220 V AC mains with a 220 V 15 watt test lamp in circuit between either of the slip-rings and the rotor body. The lamp should not glow. If the lamp glows then the rotor winding is defective; rotor assembly need renewal (Fig 3).

Fig 3



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TASK 5: **Test for open circuit in Rotor winding**

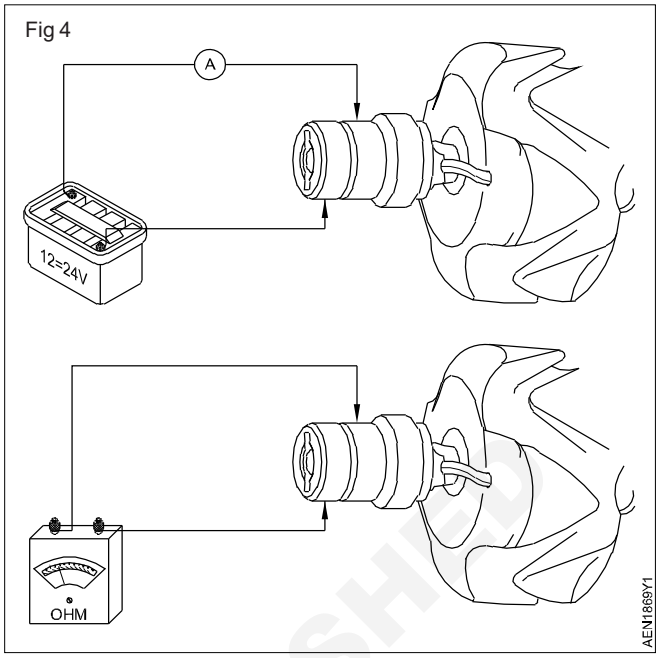
1 Check the motor winding continuity by connecting a 12 V/ 24 V battery and the moving coil ammeter between the slip-rings. (Fig 4)

The current should be 2 to 2.5 A approximately for 12 V. If it is not of the correct value then renew the rotor.

2 Check the resistance of the rotor winding with an ohmmeter.

3 The resistance should be 9.6 to +/- 1 ohms for a 24 V alternator and 3.2 +/- 0.5 ohms for a 12 V alternator. If the readings are not within the limit, renew the rotor assembly.

Fig 4



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TASK 6: **Check the slip rings**

1 Check the slip-rings (12) for their trueness in a lathe and with a dial test indicator. Check the surface of the slip-ring for burnt or dirt. Replace the slip-ring, if required.

While assembling ensure that the scribed reference lines are in alignment.

2 Assemble the rotor assembly (21) with the drive and bearing (22) to the drive end bracket (14) and fix the bearing retainer (24) with screws.

3 Assemble the spacer (18) woodruff key (20), fan (19) and pulley (17) on the rotor shaft (23).

4 Assemble the stator assembly (13) to the drive end bracket (14).

5 Place the rectifier assembly to the slip-ring end bracket and fix the screws.

6 Place the slip-ring end bracket (9) and fix the fixing bolt/stud.

7 Solder the stator winding cable ends to the rectifiers.

8 Place the brush-box on the slip-ring end bracket (9) and fix the screws.

9 Place the sealing pad and place both the brushes.

10 Place the delivery brush mounting plate in position and fix the screws.

11 Place the regulator (4) on the brush-box and connect the regulator leads (3) & (5) and fix the screws.

12 Place the cover and fix the cover securing studs (1) and washer (10) and tighten the nuts (2) firmly.

— — — — — —

Inspect and test starter components with service manual

Objective : At the end of this exercise you shall be able to
- **remove the alternator**
- **dismantle the alternator and cleaning the parts**
- **check the stator**
- **check the diodes**
- **assemble the alternator.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Socket spanner set - 1 No.
- 12 volt lead acid battery - 1 No.
- Test lamp and cables - 1 No.

Equipment / Machines

- Alternator - 1 No.
- Vehicles - 1 No.

Materials

- Alternator - 1 No.
- Kerosene - As reqd.
- Emery paper - As reqd.
- Stator - As reqd.
- Cleaning cloth - As reqd.
- Grease - As reqd.

TASK 1: **Remove alternator**

1 Disconnect the earth cable of the battery.

2 Disconnect the wires from the alternator.

3 Dismount the bolts which secure the alternator with the bracket.

4 Take out the alternator and place it on the work bench.

— — — — — —

TASK 2: **Clean and inspect of alternator dismantled parts**

1 Clean all the parts with kerosene and a nylon brush except the brushes.

2 Clean the brushes with petrol.

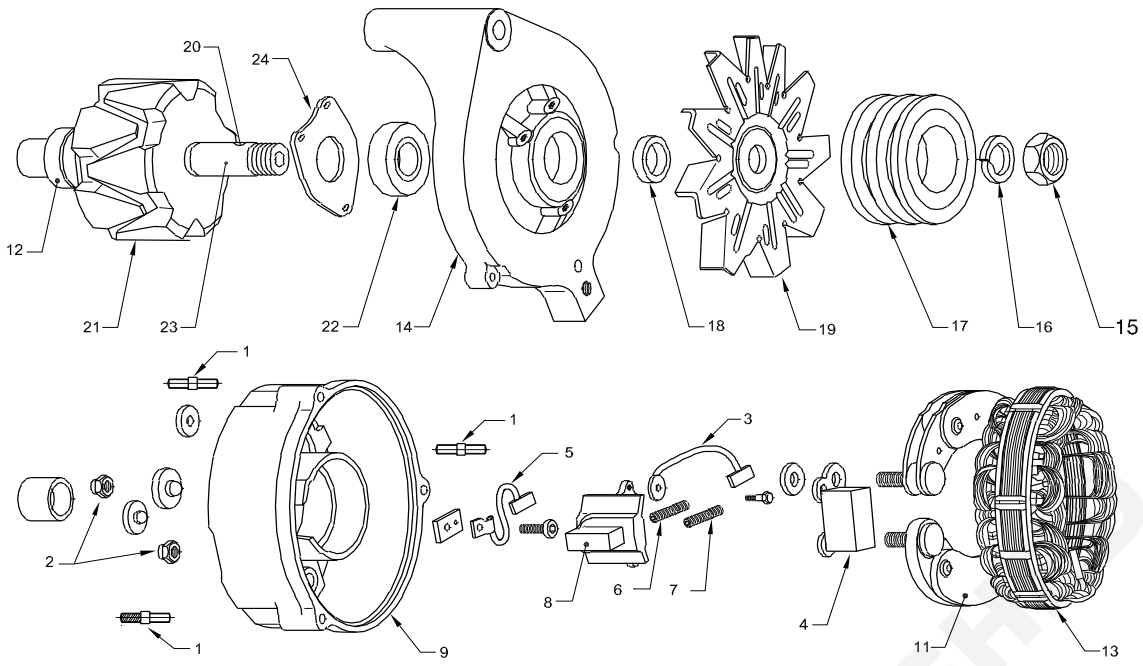
3 Check the bearings visually for any damage. If necessary, replace the bearing with a new one.

4 Check the brushes for correct dimension, according to the manufacturer's specification; replace, if required.

5 Check the brush spring tension; replace if required.

6 Check for the external crack on drive end bracket and slip end bracket.

Fig 1

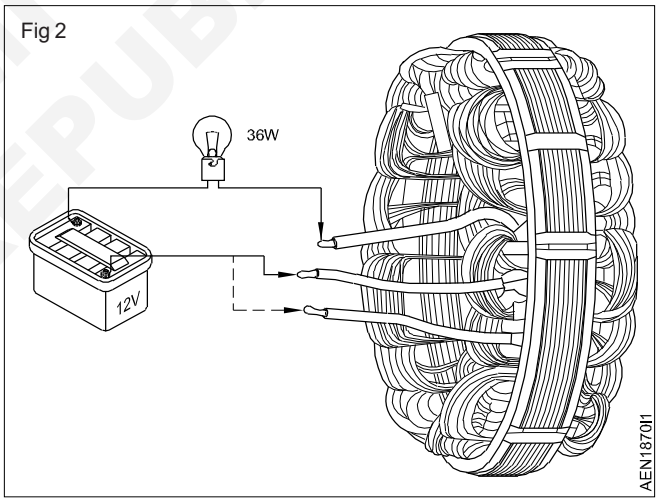


TASK 3: **Test for open circuit in the stator**

1 Check the continuity of the stator windings (Fig 2). First connect any two of the stator winding leads to a 12 V battery in series with a 36 W test lamp. The lamp should glow. Transfer one of the test lamp leads, to the third lead in the stator If the first part of the test is satisfactory.

2 The test lamp should glow. If there is any damage or burning or overheating of the winding, renew the stator assembly.

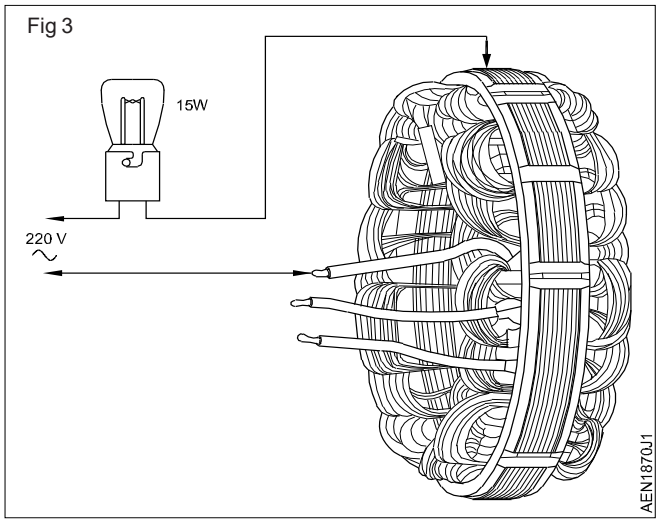
Fig 2



TASK 4: **Test for short circuit in stator**

1 Check the insulation of the stator windings by connecting a 220 V AC mains with a 220 Volt. 15 W test lamp in series between the stator laminators and each one of the three stator lead one by one. The lamp should not glow. It the test lamp glows then the stator winding is defective, renew the same (Fig 3).

Fig 3



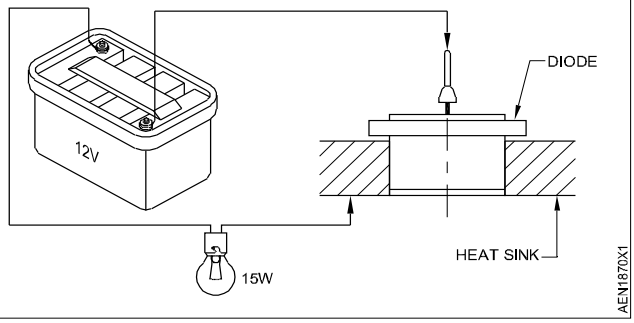
TASK 5: **Test the diodes**

1 Test each diode separately by connecting a 12 V battery and 12 V, 15 W bulb in series with the diode. Connect one test lead to the diode connecting pin and the other lead to the heat sink. (Fig 4)

2 Watch if the lamp glows. Then reverse the test lead connections. The lamp should glow during one direction of the test connection only.

3 Replace the diode if required.

Fig 4



Refitting alternator on the vehicle and testing

Objectives: This you shall be able to
- **refit an alternator to the diesel engine**
- **connect the battery to the circuit**
- **test the alternator's performance**
- **adjust the fan belt play.**

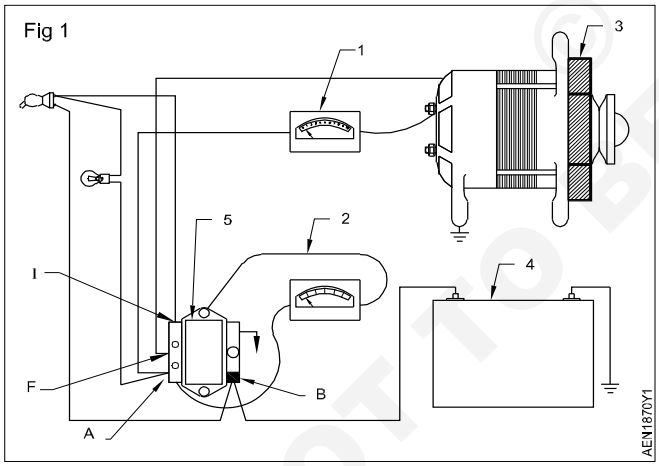
Refitting alternator to the vehicle

1 Place and secure the alternator in its bracket using bolts & nuts.

2 Connect all the wires of the alternator which you disconnected earlier. Connect the battery cables to the circuit. (Fig 1)

Testing alternator's performance

Fig 1



3 Check the fan belt for overstretched or damaged condition.

4 Check if all the ends of the battery cables are clean. check all the wire connections for loose, dirty or broken connections.

5 Disconnect the battery earth cable. Connect the ammeter (1) in series. Connect the voltmeter (2) parallel to the alternator terminal and earth. Connect a wire across the field output terminal in the alternator (3). Connect the battery cable and put on the starting switch. Note the ammeter reading.

The ammeter reading should be 2A approximately in the field current drawn from the battery (4).

The 'F' lead should be disconnected from the regulator, and the wire end should be insulated to avoid accidental earthing.

6 Run the engine at medium speed. Switch on the lights and other electrical appliances.

The voltmeter reading should be of 14.2 V approximately.

The ammeter reading should also be the maximum.

7 If the voltmeter (2) and ammeter (1) read low, the regulator (5) needs replacement.

Adjusting fan belt tension

8 Check the fan belt for proper tension.

9 If the fan belt tension is low/high adjust by removing the alternator to the appropriate side.

General maintenance of alternator.

– Clean the alternator periodically.
– Check the mounting bolts for tightness.
– Check the fan belt condition and tension to the recommended value.
– Check the specific gravity of the battery electrolyte.
– Check the battery terminals for tightness and cleanliness.
– Check the brush once in a year (1000 hours). If necessary, replace it.
– Check the bearings once in two years. renew, if worn out.
– Use fine emery-paper to clean the slip rings.

Inspect and rectify/replace alternator drive belt

Objectives: At the end of this exercise you shall be able to
- **remove the drive belt from the vehicle**
- **inspect the components**
- **replace the drive belt**
- **set alternator belt tension.**

Requirements

Tools / Instruments

- D.E. spanner set - 1 Set
- Ring spanner set - 1 No.
- Pry bar - 1 No.
- Socket spanner set - 1 No.
- Tension gauge - 1 No.

Equipment / Machines

- Motor vehicle running condition - 1 No.

Materials

- Drive belt - As reqd.
- Bolts/nuts - As reqd.

PROCEDURE

TASK 1: **Remove the drive belt from the vehicle (V belt type)**

1 Disconnect the negative terminal from the battery.

2 Remove the side engine cover if available.

3 Loosen the alternator mounting bolts.

4 Move the alternator towards the engine slightly.

5 Remove the drive belt from the vehicle.

Some manufacturers provide a belt tension scale. Replace the belt if the belt out of the range.

6 Inspect the belt for cracks, cuts, deformation and wear. Replace the belt if found defective.

Replace the belt if it completes its life time as per the manufacturer's specification.

7 Inspect the bracket and bolts / nuts for wear or damage. (v belt type)

8 Clean the belt before fitting on the vehicle.

9 Clean the pulley and tensioner.

10 Check the belt pulleys aligned properly.

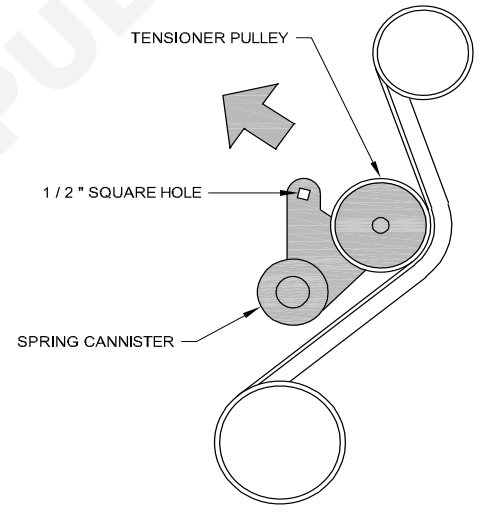
11 Insert the belt and check the belt seated properly.

Set alternator belt tension (Fig 1)

12 Pry against the alternator housing with a pry bar to tighten the alternator belt.

13 Check the belt tension with the tension gauge

Fig 1



A ONE - HALF INCH DRIVE OPENING IN THE TENSIONER PULLEY

The belt tension is normally 12-13mm in 30 cm length.

14 Adjust if necessary and tighten the alternator mounting bolts.

15 Connect the negative terminal of the battery.

Check the faults in alternator system

Objectives: At the end of this exercise you shall be able to
- **identify the cause of no charge**
- **identify the cause of low output voltage for alternator**
- **identify the cause of high charge/over charge**
- **identify the cause of alternator noisy.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 Set
- Multi Meter - 1 No.
- Battery 12V - 1 No.

Equipment / Machines

- Motor vehicle running condition - 1 No.

Materials

- Ignition switch - As reqd.
- Emery paper - As reqd.
- Cleaning solvent - As reqd.
- Cotton waste - As reqd.
- Soap oil - As reqd.
- Bulb - As reqd.
- Wire - As reqd.

PROCEDURE

TASK: **Check the faults in alternator system**

Note: The instructor should train the trainees to fill the remedies column

S. No.	Trouble (TASKS)	Causes	Remedy
1	Warning lamp does not glow when ignition switch on Dead battery	Blub fuse Loose connection	
2	No charge when engine running	Drive belt loose Broken drive belts Loose connections worn or dirty slip rings and brush Open field circuit Open charging circuit Open circuit in stator winding Open rectify circuit Defective diodes	
3	Low output voltage from alternator	loose connections on alternator slip rings dirty and worn out faulty regulator grounded stator low regulator setting shorted rectifiers	
4	High charging / over charging	Poor regulator ground connection Sticky regulator contacts improper Voltage regulators setting	
5	Alternator noisy	Loose mountings Loose drive pulley worn-out bearings brushes not seating properly	

Identify various electronic diesel control components

Objectives: At the end of this exercise you shall be able to
- **identify the components and sensors of EDC system**
- **test of sensors**
- **test of actuators.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multimeter - 1 No.
- Test lamp - 1 No.

Equipment / Machines

- Diesel vehicle - 1 No.
- Test bench - 1 No.

Materials

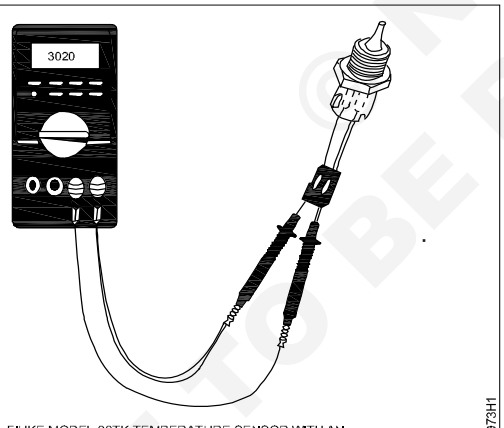
- Sensors - As reqd.
- Cotton waste - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Components & sensors of EDC system**

1 Identify the components and sensors of EDC system. (Fig 1)

Fig 1



FLUKE MODEL 80TK TEMPERATURE SENSOR WITH AN 80PK-6A PIERCING-TYPE PROBE

2 Read and use the CRDI fuel system circuit diagram in the user manual or workshop service manual.

3 Park the vehicle on the plain area.

4 Ensure the vehicle safety measures as per your instructor's guide line.

5 Open the vehicle bonnet cover.

6 Disconnect the battery terminals.

7 Identify the EDC components and sensors on the given diagram.

8 Match EDC diagram with your vehicle fuel system.

9 Identify the ECU location of the vehicle.

10 Identify the fuel tank.

11 Identify the low pressure fuel feed pump locating in the fuel tank.

12 Identify the wire connections and sensors of fuel pump.

13 Identify the high pressure fuel feed pump.

14 Identify the fuel pressure regulator and sensor.

15 Identify the common rail with high pressure fuel line.

16 Identify the injectors fitted on the cylinder head.

17 Identify the solenoid and sensors fitted with injectors.

18 Identify the overflow pipe connections.

19 Identify the pedal travel sensor.

20 Identify the air mass sensor.

21 Identify the common rail pressure sensor.

22 Identify the boost pressure sensor.

23 Identify the temperature sensor (intake air and coolant)

24 Identify the Lambda Oxygen Sensor.

25 Identify the wheel speed sensor (Crankshaft and camshaft).

26 Identify the brake switch sensor.

27 Identify the clutch switch sensor (automatic gear)

28 Identify the ignition switch wire connections.

29 Identify the glow plug control unit.

30 Identify the OBD connectors

31 Identify the actuators

32 Identify the throttle valve actuators.

33 Identify the boost pressure actuators.

34 Identify the induct switch off.

35 Identify the radiator fan switching sensor.

36 Identify the diagonal lamps.

— — — — — —

TASK 2: **Sensor and actuator testing: (Fig 2)**

1 Set the multimeter measurement valve

2 Identify the sensor to be testing.

3 Disconnect the wire connections of sensors.

4 Connect the sensor terminals with multimeter probe.

5 Check continuity of sensor.

6 If the sensor is in good working condition fix the sensor on its location and connect the wire one end of the sensor terminal and other wire connect with multimeter one side probe and other probe of multimeter should be connect with sensor's other one terminals.

7 Now connect the battery terminal and switch on the ignition key and test the sensor's function and voltage flow to the sensor.

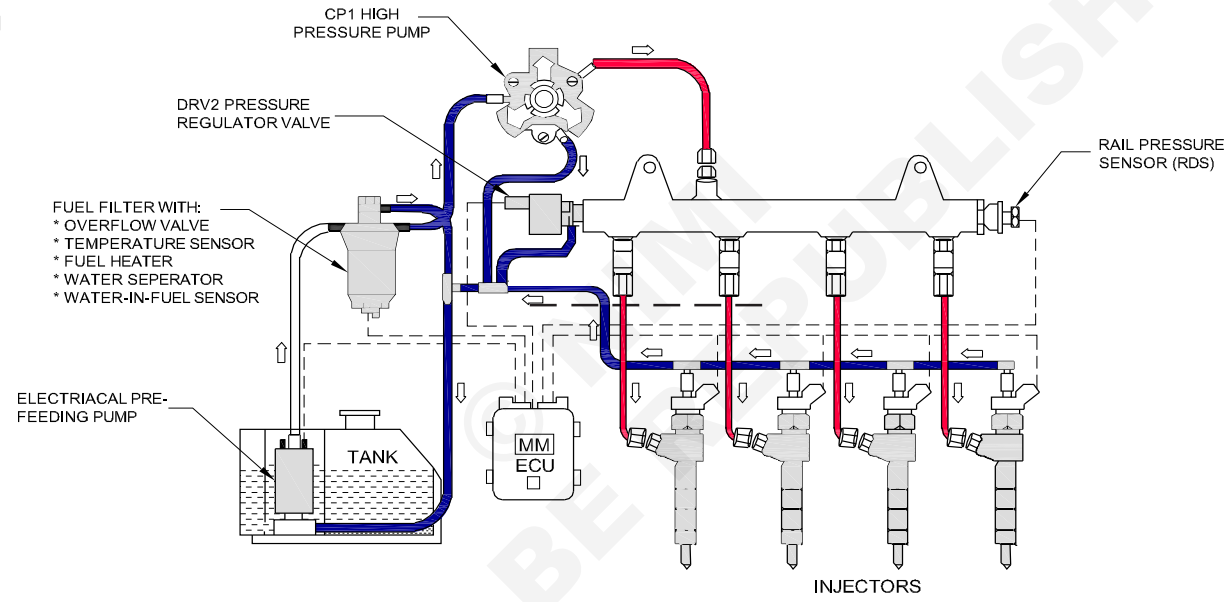
8 Check the A/C compressor if provided car A/C system in the vehicle.

9 As above test all sensors and actuators. (Fig 2)

10 Use the scan tool for find out or diagnose the fault big connect the scan tool with OBD connector.

11 Start the engine and check the engine performance.

Fig 1



DIESEL DIRECT INJECTION SUSTEM (DDIS) -- FUEL SYSTEM LAYOUT

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Identify the MPFI components and its sensors

Objective: At the end of this exercise you shall be able to
- **locate the various parts of MPFI and sensors.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipment / Machines

- Vehicle with MPFI - 1 No.

Materials

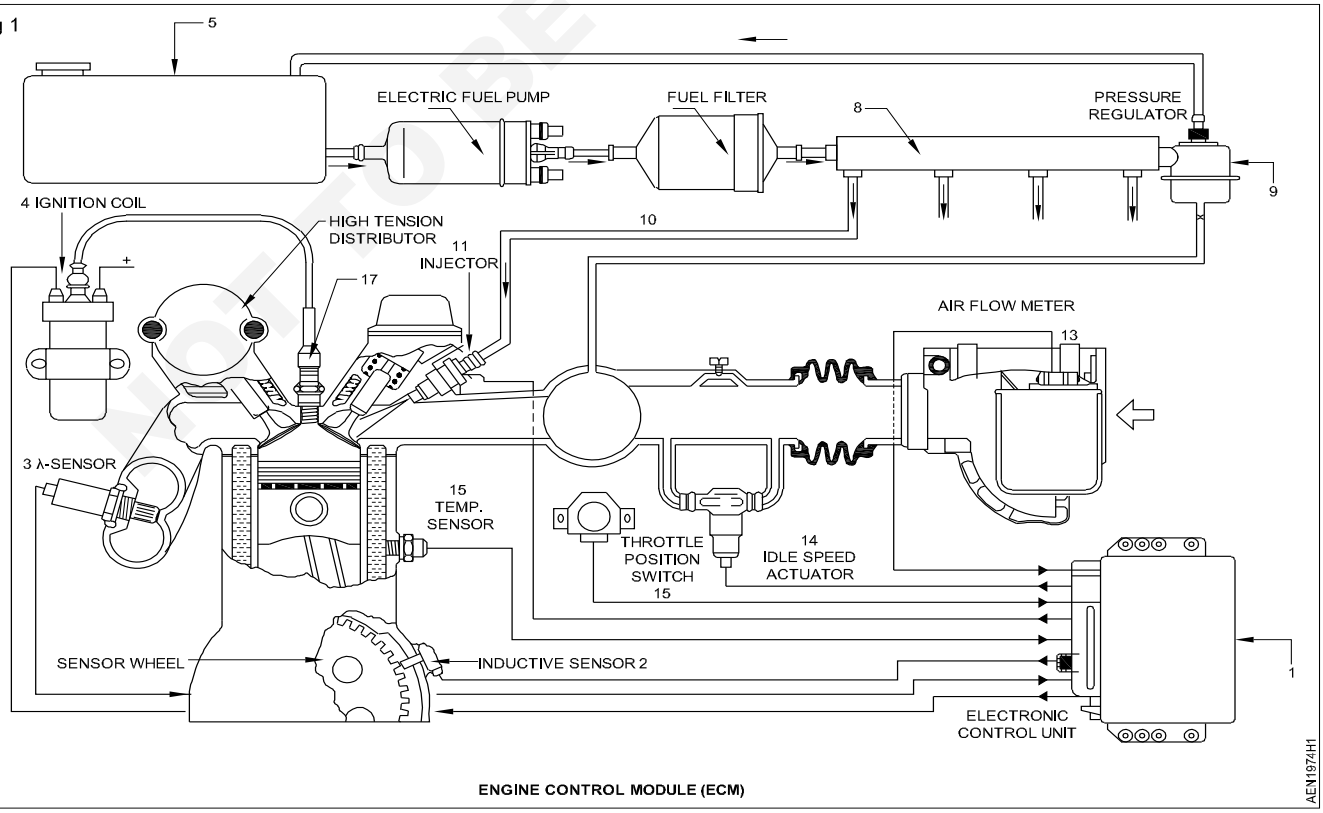
- Tray - 1 No.
- Cleaning cloth - As reqd.
- Soap oil - 1 No.

PROCEDURE

TASK 1: **Locate the various parts of MPFI and sensors (Fig 1)**

1 Locate the ECM (1)
2 Locate the fly wheel and the crank shaft position sensor (2)
3 Locate the oxygen sensor (3)
4 Locate the ignition coil (4)
5 Locate the fuel tank (5)
6 Locate electric fuel pump (6)
7 Locate the fuel filter (7)
8 Locate the common rail (8)
9 Locate the pressure regulator (9)
10 Locate fuel delivery line (10)
11 Locate the petrol injector (11)
12 Locate the accumulator (12)
13 Locate the intake air pressure sensor (13)
14 Locate the idle speed actuator (14)
15 Locate the throttle speed switch (15)
16 Locate the engine temperature sensor (16)
17 Locate the spark plug (17)

Fig 1



ENGINE CONTROL MODULE (ECM)

Test the MPFI components and its sensors

Objective: At the end of this exercise you shall be able to
- **locate the various parts of MPFI and sensors.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 Set
- Engine scan tool - 1 No.
- Tester - 1 No.

Equipment / Machines

- MPFI engine/ vehicle - 1 No.

Materials

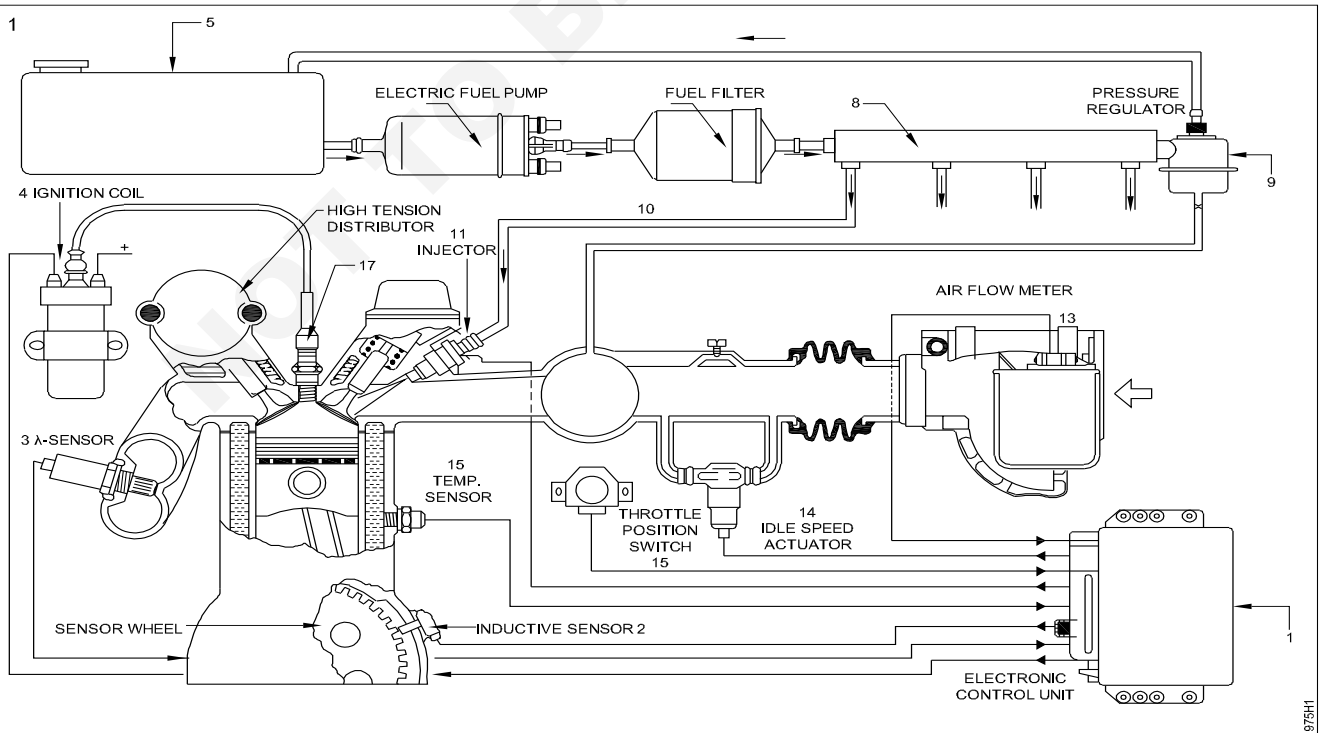
- Sensor - 1 No.
- Tray - 1 No.
- Cleaning cloth - 1 No.

PROCEDURE

TASK: **Locate the various parts of MPFI and sensors (Fig 1)**

1 Test the ECM(1)
2 Check the fly wheel and the crank shaft position sensor (2)
3 Test the oxygen / γ sensor (3)
4 Test the ignition coil (4)
5 Check the fuel tank (5)
6 Test the electric fuel pump (6)
7 Check the fuel filter (7)
8 Check the common rail (8)
9 Test the pressure regulator (9)
10 Check the fuel delivery line (10)
11 Test the petrol injector (11)
12 Test the accumulator (12)
13 Test the intake air pressure sensor (13)
14 Test idle speed actuator (14)
15 Test the throttle speed switch (15)
16 Test the engine temperature sensor (16)
17 Clean and test the spark plug (17)
18 If need replace the defective parts.

Fig 1



ENGINE CONTROL MODULE (ECM)

Overhaul the electrical fuel feed pump

Objectives: At the end of this exercise you shall be able to
- **overhaul the electrical fuel feed pump**
- **replace the fuel pump filter.**

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 No.
• Allen key set	- 1 No.
• Circlip plier	- 1 No.

Equipment / Machines

• Multicylinder diesel engine	- 1 No.
• Air compressor	- 1 No.
• Diesel vehicle	- 1 No.

Materials

• Kerosene	- As reqd.
• Diesel	- As reqd.
• Soap oil	- As reqd.
• Cotton cloth	- As reqd.
• New gasket	- As reqd.
• Cotton waste	- As reqd.
• Filter element	- As reqd.

PROCEDURE

TASK 1: **Overhauling electrical feed pump (Fig 1)**

1 Disconnect the +Ve and -Ve battery terminal.

2 Disconnect the wires connections of the electrical feed pump

3 Unscrew the mounting bolts & nuts

4 Remove the electrical feed pump

5 Place it on the work bench

6 Clean dust on the pump and dismantle it

7 Check the fixed contact point and movable point

8 Remove the pitting by fine emery paper

9 Check the fixed point body earth

10 Check the insulation and continuity of armature coil

11 Check the plunger movement

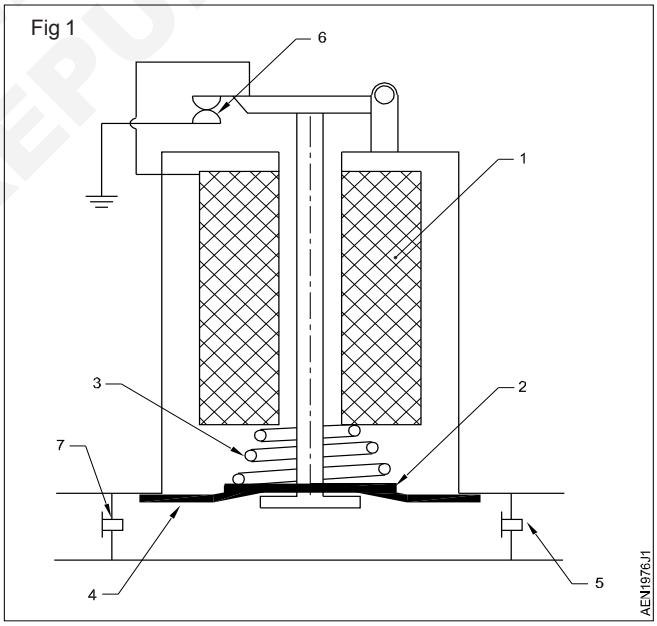
12 Inspect the inlet and outlet valve fitted below the diaphragm

13 Check the diaphragm, if damaged replace it

14 Assemble all the part of fuel pump and fit the fuel pump in the engine

15 Connect the wiring with insulation switch

Fig 1



16 Connect the battery terminal

17 Check its operation at high speed and idle speed.

18 Ensure no loose connection and leaky in fuel pump.

— — — — — —

TASK 2: **Replacing the fuel filter elements (Fig 2)**

1 Disconnect the fuel line from high pressure fuel pump

2 Disconnect the fuel line from the fuel tank

3 Loosen the center bolt of fuel filter

4 Remove the fuel filter with bowl

5 Remove the filter element from the bowl

6 Clean the bowl with diesel

— — — — — —

7 Clean the bowl with clean cloth

8 Remove the ‘o’ ring

9 Select the new fuel filter element

10 Fix the new ‘o’ ring in bowel top

11 Fill diesel in filter bowl

12 Insert the fuel filter in bowl

13 Fix the fuel filter bowl with it’s top

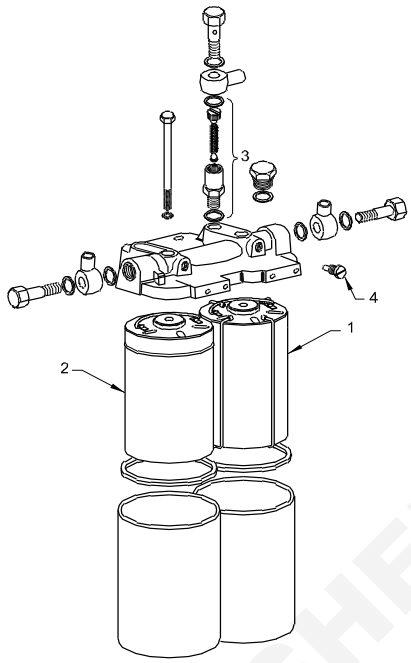
14 Fix the fuel filter bowl mounting center bolt

15 Tighten the center bolt and connect the bolt side fuel lines

16 Bleed the fuel line and start the engine

17 Check the engine running performance

Fig 1



Practice to Identify the electronic control unit

Objective: At the end of this exercise you shall be able to
- **Identify the location of ECU.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Test lamp - 1 No.

Equipment / Machines

- Latest Vehicle - 1 No.

Materials

- Cotton waste - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK: **Identification of ECU**

1 Select the latest vehicle

2 Park the vehicle and apply wooden chock for front and rear wheel

Every vehicle manufacturer sells specific ECU which belongs to that vehicle.

For example, lets look at the popular BMW x 3 driven 28 i sports utility vehicle

ECU have different part numbers with in the same make /model/year and within a particular modal there can also be multiple options available for

Example ECU stickers show the ECU exact part number. Arrow mark indicate the part number on the sticker.

37820 - POA - A51

351 - 197338

a 37820 - POA - A 51 is an ECM for a hard accord

b 15768288 is a term for a caroled truck

c F7uf - 12A650 - AFB- is an ECM for a fordan

3 Identify the diagnostic connector

4 Connect the OBD scan tool with connector

5 Switch on the ignition key

6 Read display on the scan tool it will indicate the ECU modal, serial number, make and fault diagnostic codes

7 Incase ECU number is unknown, switch of the ignition key and remove the battery terminals.

8 Disconnect the ECU wire connection and loose the mounting screw of ECU

9 Remove the ECU and clean it

10 Check the ECU sticker posted on the ECU and note the identification number.

Set up for testing, testing of electronic control circuit

Objectives: At the end of this exercise you shall be able to
- **Identify the E.C.U and engine scanner**
- **test the electronic control unit.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Engine scan tool - 1 No.

Equipment / Machines

- A running condition of E.F.I vehicle - 1 No.

Materials

- Cotton waste - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK: **Identify the E.C.U and engine scanner and test the electronic control unit**

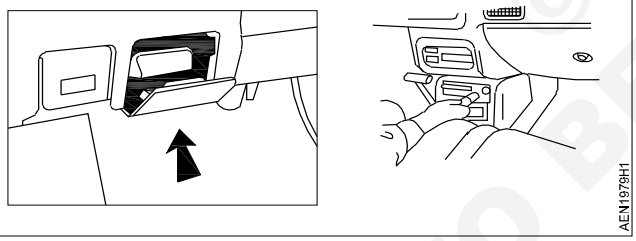
1 Select the scan tool related service manual for the vehicle.

2 Attach the proper test connector cable and power lead to the scan tool.

3 Ensure that the ignition switch is in the 'OFF' position.

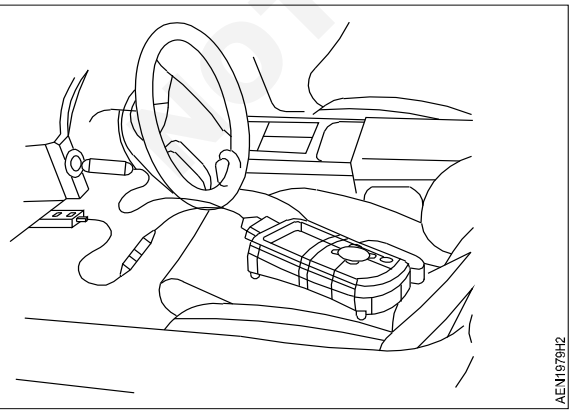
4 Attach the correct diagnostic connector. (Fig 1)

Fig 1



5 Attach the scan tool test connector cable to the diagnostic connector. If necessary, use the proper adapter to connect the scan tool. (Fig 2)

Fig 2



OBD II scan tools are powered from terminal 16 of the diagnostic connector, and no other power connection are needed.

6 Observe the scan tools screen to ensure that the scan tool is working properly. Most scan tools will complete an internal self check and notify the technician if there is a software (or) communication problem.

7 Enter vehicle information's needed to program the scan tool

- Most OBD II scan tools automatically read the vehicle identification number (VIN). When the ignition switch is turned to the 'ON' position. This gives the scan tool the information needed to check for codes and perform other operation.
- Older scan tools are programmed with the proper vehicle information by entering the vehicle year, engine type and other information. This information is usually contained in certain numbers and letters in the VIN.

8 Turn the ignition key to the 'ON' position.

9 Observe the scan tool to determine whether any trouble codes are present.

10 List all trouble codes as indicates in scan tool.

11 List all trouble codes as indicated in scan tool.

12 Use the scan tool literature (or) service manual to determine the meaning of the codes.

13 Erase the trouble codes shown in the scan tool.

14 Switch 'OFF' the 'ignition and switch on again.

15 Erase the trouble codes shown in the scan tool.

16 Switch 'OFF' the ignition and switch on again.

17 Check the engine indicator in OFF position. If not, some problems with the electronic management system (EMS.)

18 When the test is completed turn the ignition switch to the 'OFF' position.

19 Remove the scan tool test connection cable from the diagnostic connector.

Check electronic circuit for fault and verify using scan tool

Objectives: At the end of this exercise you shall be able to
- **identify fault by using scan tool**
- **rectification of fault in electronic circuit.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Scan tool - 1 No.
- Scan tool fault code manual book - 1 No.

Equipment / Machines

- Vehicle with ECU - 1 No.

Materials

- Wire - As reqd.
- Sensors - As reqd.
- Cotton waste - As reqd.
- Actuators - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Identify fault by using scan tool in Electronic Circuit (Fig 1 & 2)**

1 Park the vehicle on the plain ground.

2 Ensure the vehicle safety precautions.

3 Identify the ECU location of the vehicle.

4 Find the data link connector (DLC) female connector.

5 Select the OBD-II scan tool.

6 Connect the scan tool's DLC male connector with dash board female DLC connector.

7 Switch on the scan tool.

8 Select the vehicle and country.

9 Ensure scan tool connector is properly connected with panel board DLC female connector.

10 Start the engine and select the pin of trouble code of engine management system.

11 Systematically check the all systems electronic of vehicle like fuel system, control unit, ABS Brake system, Transmission system engine speed, actuators, delivered value generators and sensors.

12 Find the trouble through scan tool trouble code and reset the fault to rectify it, if it is not corrected do repair manually.

13 Before use the scan tool study the which trouble code indicate, what type of trouble and how to rectify it.

Note: Consult your instructor to connect and disconnect the scan tool with DTC connector, trouble code and rectification methods of your vehicle.

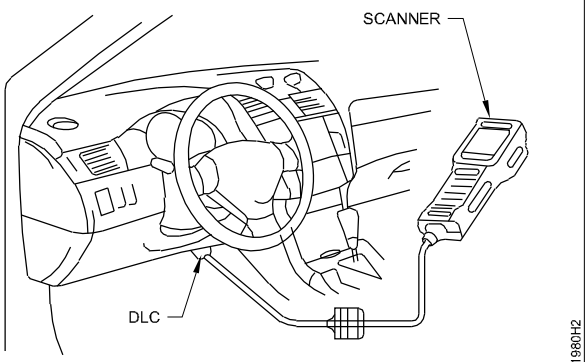
Fig 1

AEN1980H1

TASK 2: **Diagnosis Process**

Sensor → CAN network → ECU → DLC Female connector → DLC Male connector → Interface → Python

Fig 2



CHECKING AND REPLACING FUSES

When a MIL indicated on car dashboard then go to diagnosis process. This will help to defect and diagnosis the faults.

1 Check the battery is in good condition or not.

2 Ignition ON to prepare a diagnosis scan tools when DLC male connector connected to DLC female connector the entire vehicle information is available in DLC.

3 The ECU receives this information from the DLC to check either the sensor is properly working or not.

4 If any fault occurred in the components the sensors sends the signal to the ECU. It can also send this information to DLC with the help of electronic components. Through the python hardware scan tool can detect the DTC on your PC.

5 This DTC will help to better trouble shooting of the faults. These diagnostic tests can keep a vehicle in good condition. The diagnosis process requirements are computer, Python cables, interface, DLC connectors, ECU, sensors can network and diagnosis can tools.

(DLC = Data Link Connector)

(DTC - Diagnostic Trouble Code)

Write the Pin Number Trouble Code rectification method in given Table - 1

Table - 1

Pin No	Trouble Code No.	Diagnosis fault	Rectification Method
1	PO 302	Cylinder misfire detector	Repair
2	PO 194	Engine hesitation and surging	- Replace clogged fuel filter - Replace the fuel pressure sensor - Replace the corded wire connectors
3	PO 335	Crank shaft position sensor circuit malfunction	- Check the wire connections - Check the timing belt - Check the sensor or replace it
4	PO 341	Cam shaft signal error	- Check/replace the sensor - Check wire connection - Check timing
5			
6			
7			
8			
9			
10			

Identify various sensors installed in engine

Objective: At the end of this exercise you shall be able to
- **identify the various sensors fitted in engine.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Electronic wiring diagram manual - 1 No.

Equipment / Machines

- CRDI/MPFI Engine - 1 No.

Materials

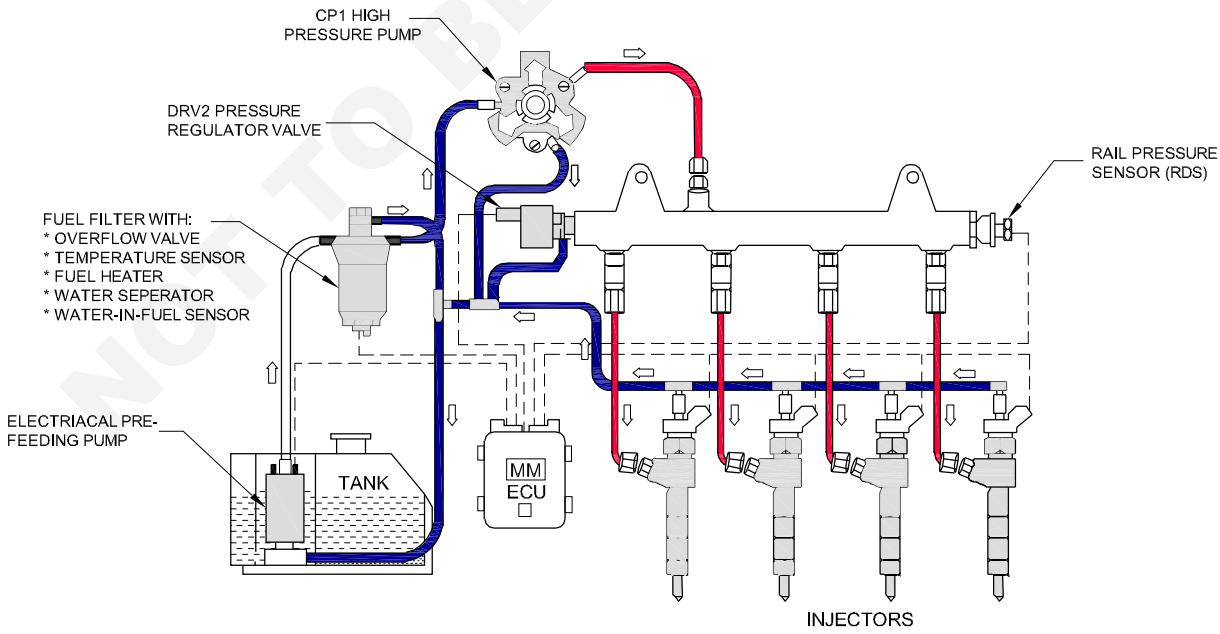
- Cotton waste - 1 No.
- Soap oil - 1 No.
- Wire - 1 No.
- Sensor - 1 No.

PROCEDURE

TASK 1: **Identify the sensors with engine (Fig 1)**

1 Identify the injection speed sensors
2 Identify the fuel rack position sensor
3 Identify the charge air pressure sensor
4 Identify the fuel pressure sensor
5 Identify the crank shaft position sensor
6 Identify the camshaft sensor
7 Identify the fuel crank level sensor
8 Identify the oxygen sensor fitted with exhaust system
9 Identify the temperature sensor
10 Identify the air flow sensor
11 Identify the fuel injector sensor
12 Identify no knock sensor
13 Identify the engine management sensor

Fig 1



DIESEL DIRECT INJECTION SUSTEM (DDIS) -- FUEL SYSTEM LAYOUT

Test various sensors

Objectives: At the end of this exercise you shall be able to
- **test the temperature sensor**
- **test the pressure sensor**
- **test the potentiometer**
- **crankshaft position sensor**
- **test the camshaft position sensor**
- **test the magnetic induction sensor.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multi Meter - 1 No.

Equipment / Machines

- Vehicle - 1 No.

Materials

- Tray - 1 No.
- Cleaning cloth - 1 No.

PROCEDURE

TASK 1: **Temperature sensor (Fig 1)**

1 Open the vehicle bonnet by removing the lock

2 Locate the temperature sensor, mostly it is located in the thermostat valve region.

3 Set the multi meter in the resistance measuring mode.

4 Ground the black terminal, connect the red terminal to the temperature sensor, measure the resistance.

5 Turn the engine on, run for two to three minutes to warm up the engine.

6 Now measure the resistance with the same procedure.

7 If the difference in resistance is more than 200 ohms the sensor is in good condition.

8 If the difference is not more than 200 ohms. Replace the temperature sensor.

Fig 1

FLUKE MODEL 80TK TEMPERATURE SENSOR WITH AN 80PK-6A PIERCING-TYPE PROBE

— — — — — —

TASK 2: **Pressure sensor (Fig 2)**

Air intake pressure, atmospheric pressure, vapor pressure in the fuel tank and fuel injection pressure sensors are used in the vehicle. But the testing procedure of the sensors used in the vehicle is same for all the sensors.

1 Identify the location of the sensor.

2 Use the multi meter, set in AC mV range.

3 Start the engine, keep it in running.

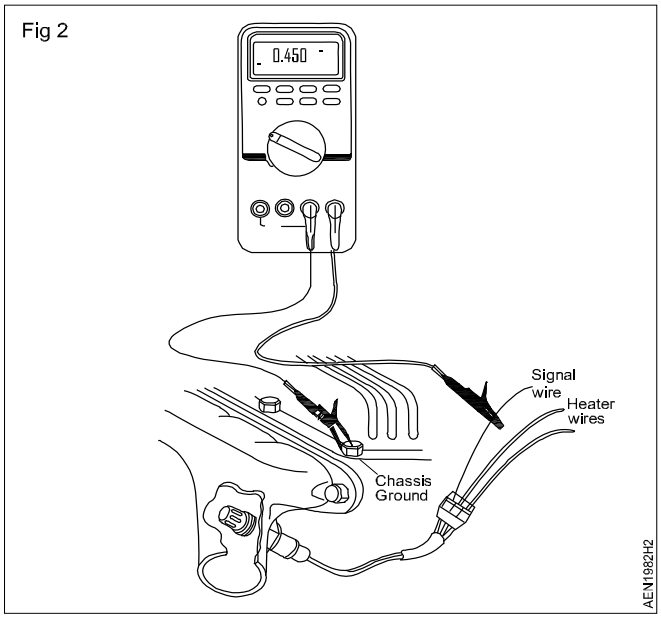
4 Ground the black terminal

5 Touch the red terminal

6 If voltage indicate at about 200 to 400mV then the sensor is functioning correctly.

7 If voltage is not developing then replace the sensor.

Fig 2



TASK 3: **Throttle position sensor (Potentiometer) test (Fig 3)**

1 Remove the air cleaner assembly

2 Turn off the ignition switch

3 Disconnect the connector from electric throttle body.

4 Check the TP sensor main and sub output voltage as follows.

5 Arrange 3 new 1.5 voltage batteries in series and check the voltage is 4.5 to 6.0 voltage. Connect the voltmeter and batteries to TP sensor as shown in the figure.

6 Connect the voltmeter and batteries to TP sensor as shown in the figure.

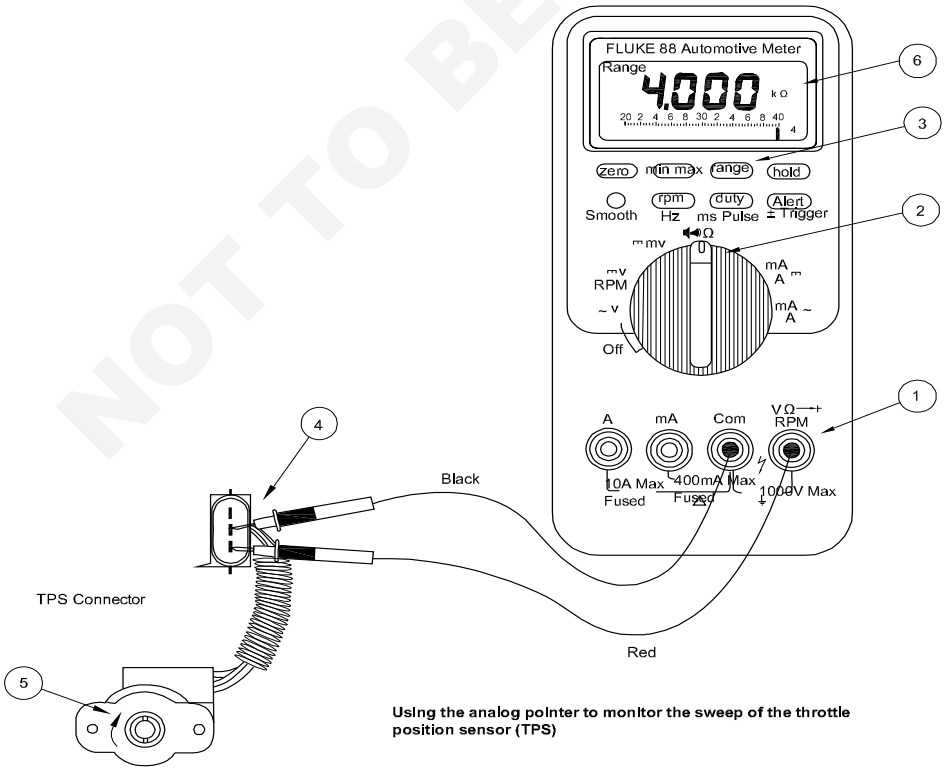
7 Check the voltage linearly varies depending on throttle opening angle as shown in the figure while throttle valve is opened and closed by finger.

While testing the following condition to be satisfied.

8 Ambient temperature should not exceed 5°C.

9 Accelerator pedal should be in idle position. i.e fully closed condition.

Fig 3



TASK 4: **Crank shaft position sensor (CKP) (Fig 4)**

These sensors are called by so many different names like: Hall effect sensor, CKP sensor, CMP sensor, pickup coil, Magnetic pulse generator, variable reflector and the list goes on with a few more names.

There are two types

Three pin type and two pin type.

If the car engine fails to start properly, there may a defect in crank shaft position sensor and cam shaft position sensor. This sensor measures the crank shaft position and speed. Both the sensor have the control injection and ignition timing.

1 It is comprising of very simple procedure.

2 Locate the sensor. Normally it is located either end of the crank shaft.

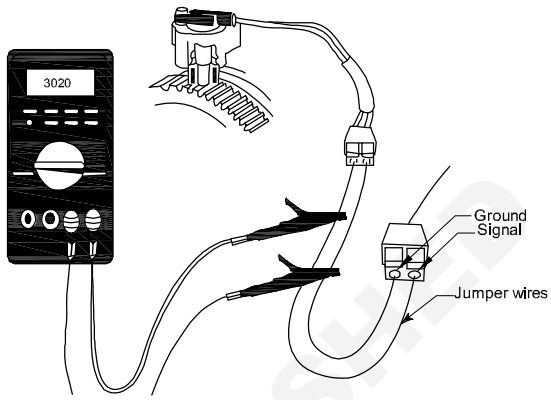
3 Run the engine and set the multi meter in the AC mille volt range.

4 Measure the voltage using the probes.

5 Normal range would be 200mV. Also refer the manufacturer's manual for the exact readings. It may vary manufacturer to manufacturer.

6 If not develops any voltage sensor may be opened. Replace it.

Fig 4



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TASK 5: **Cam shaft position sensor CMP**

1 It is also of very simple procedure like CKP.

2 Locate the sensor. Normally it is located either end of the head assembly.

3 Run the engine and set the multi meter in the AC millivolt range.

4 Measure the voltage using the probes.

5 Normal range would be 200 mV. Also refer the manufacturer's manual for the exact readings. It may vary manufacturer to manufacturer.

6 If not develops any voltage sensor may be opened. Replace it.

— — — — — —

TASK 6: **Magnetic induction sensor**

1 Locate the magnetic induction sensor normal it is used in electronic ignition system

2 Magnetic sensor is fitted in pulse generator

3 Magnetic sensor develops voltage and then passes signal to ECU.

4 Connect the multi meter between magnetic senior and ECU

5 Start the engine and check voltage reading in multi meter.

6 If voltage signal not found, check wire connections

7 If sensor is defective replace the sensor.

— — — — — —

Practice to inspect power steering circuits

Objective: At the end of this exercise you shall be able to
- **inspect of power steering control module circuit.**

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 No.
• Multimeter	- 1 No.

Equipment / Machines

• Vehicle (power steering)	- 1 No.

Materials

• Wire	- As reqd.
• Sensors	- As reqd.
• Wire connector	- As reqd.
• Soap oil	- As reqd.
• Insulation tape	- As reqd.

PROCEDURE

TASK 1: **Inspect power steering control module circuits.**

1 Park the vehicle on plain ground and ensure the safety precautions.

2 Identify parts of hydraulic pump electrical power steering system.

3 Check the tyre pressure for proper air pressure and size.

4 Verify the steering system components are genuine.

5 Check the steering column for loose mounting bolts.

6 Check the inner column sockets and outer sockets for gear or damage.

7 Verify the proper wheel alignment.

8 Check wheel proper height.

9 Check the battery proper voltage.

10 Verify that all power steering pump assembly connections are clean and fully seated.

11 Verify the proper fluid is used and power steering system for proper operation.

12 Check the steering noise during operation.

13 Check the power steering electrically controlled by the power steering control module.

14 Check the power steering control module harness connectors.

15 Check the power steering angle sensor.

16 Check the ECM transmits engine speed signal to the power steering control module via CAN communication.

17 Check the communication meter.

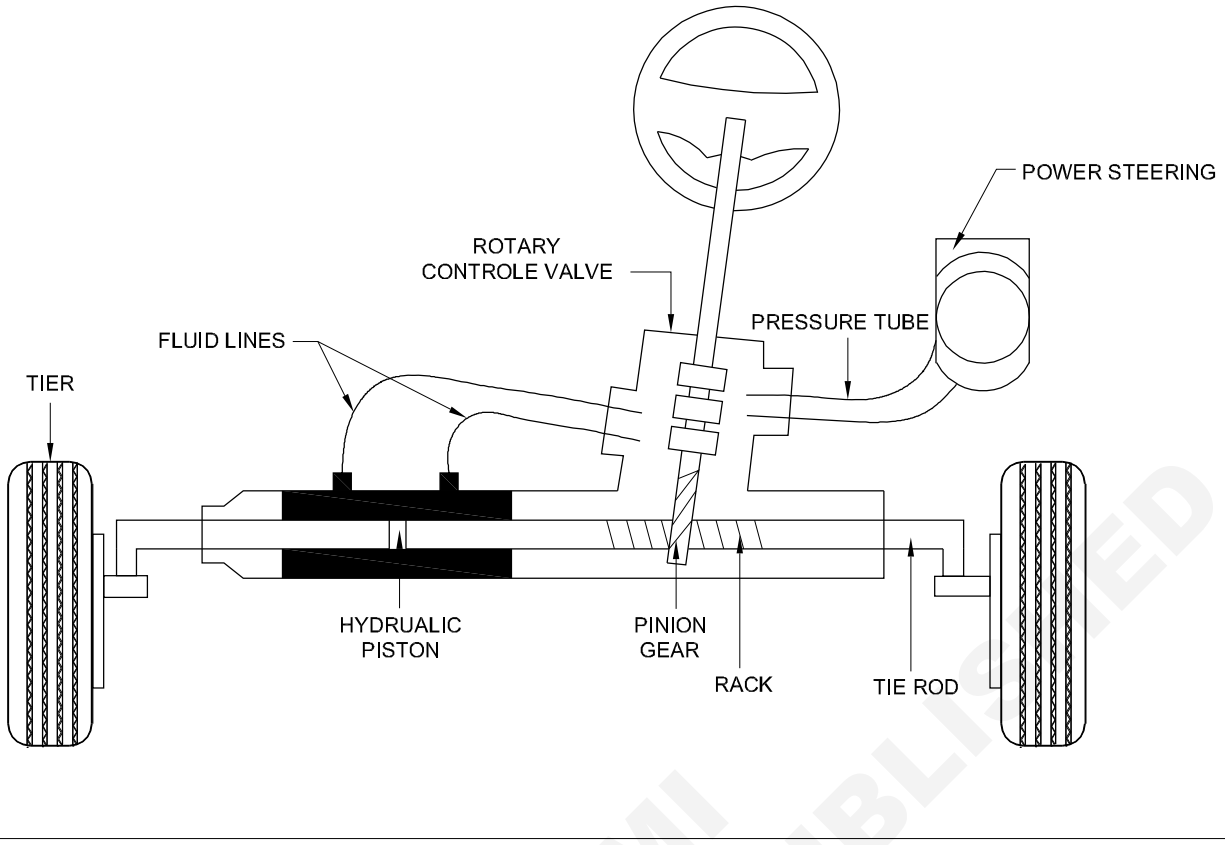
18 Check the power steering motor.

19 Check the combination meter.

20 Check the fusible link.

21 Check the continuity between power steering control module harness connector terminal and 1PDM E/R harness connector terminal.

Fig 1



Perform trouble shooting of hydraulic power steering system

Objectives: At the end of this exercise you shall be able to
- **rectify abnormal wear of tyre**
- **rectify wheel wobbling**
- **rectify poor self-cantering**
- **rectify hard steering**
- **rectify vehicle pulling to one side.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipment / Machines

- Vehicle with power steering - 1 No.

Materials

- Cotton clothes - as reqd.
- Soap oil - as reqd.
- Hydraulic oil - as reqd.
- Wheel bearing - as reqd.
- King pin - as reqd.
- Tie rod end - as reqd.

PROCEDURE

TASK: **Trouble shoot the hydraulic power steering system**

Trouble Shooting

Fault	Cause	Remedy
Abnormal wear of tyre	Low air pressure improper Toe-in toe-out Wheel Bearing worn out king pin Bush worn out, tie rod play Brake binding unbalanced Suspension	Maintain proper air pressure Adjust, toe-in, Toe-out Replace the bearing Replace the bush Adjust brake properly replace damaged suspension parts
Wheel wobbling	Loose wheel nut Wheel bearing worn out King pin worn out Improper air pressure Tie rod loose fitting	Tighten the nut Replace the bearing Replace the king pin Maintain proper air pressure Tighten the fittings
Poor self-cantering	Improper linkage adjustment Improper tyre pressure Improper wheel alignment Excess steering wheel pre load improper position of drop arm	Adjust steering linkage Maintain the tyre pressure Adjust wheel alignment Adjust the pre load Remove and refit in proper position
Hard Steering	Low tyre pressure Improper tyre size Dry king pin bearing Axle beam bend	Maintain proper air pressure Use correct size tyre Lubricate the bearing straighten or replace
Vehicle pulling to one side	One side low tyre pressure Improper size of tyre Improper brake adjustment Front road spring center bolt broken Disturbed front wheel alignment	Maintain correct air pressure Replace the tyre Adjust brake Replace the center bolt Adjust as prescribed

Perform maintenance of ABS brake system

Objectives: At the end of this exercise you shall be able to
- **handle the regular brake maintenance**
- **handle ABS maintenance.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 Set
- Steel rule - 1 No.

Equipment / Machines

- Vehicle - 1 No.

Materials

- Brake fluid - As reqd.
- Flexible tube - As reqd.
- Cleaning cloth waste - As reqd.

PROCEDURE

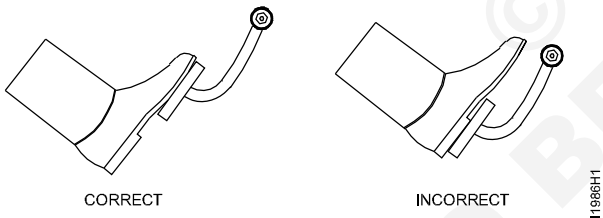
TASK 1: **Identify the ABS brake components and regular maintenance of brake**

1 Identify the master cylinder and check the brake fluid level in both sections of the master cylinder

2 Top - up brake fluid to the proper level with manufactures specified level

3 Identify the brake pedal and check it for proper free play (Fig 1)

Fig 1



4 Adjust the brake pedal free play to the manufacturers specified level.

5 Identify the brake lines and check all the brake lines and fittings for leaks

6 Inspect all the brake tubing for rust and corrosion leaks and damages

7 Check each wheel for free rotation. If the on the wheels is hard to rotate, the brakes are likely not releasing properly.

8 Conduct road test for checking efficient braking

9 Identify the brake pedal and operation during brake application.

10 Identify the hand brake and ensure proper spring action of hand lever of hand brake.

— — — — — —

TASK 2: **ABS brake warning light**

1 Check all the ABS wiring harness for damage, or worn insulation.

2 Inspect all the line and fittings for leaks

3 Start the engine and observe the ABS working light

4 The light should remain on for approximately 5 seconds and turn off

5 If the warning light switches ON continuously then it seems that same problem with the ABS.

6 The fault can be identified with the scan tool and then rectified as per the instructions given by the service manual.

Check the tooth ring

1 Check the toothed rings on the wheel for find out the damage.

2 If any damages in the toothed ring, replace the damaged toothed ring.

— — — — — —

Identify the automatic transmission components

Objectives: At the end of this exercise you shall be able to
- **identify the various parts of automatic transmission.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Ring spanner set - 1 Set
- Socket spanner set - 1 Set

Equipment / Machines

- Vehicle with automatic transmission - 1 No.

Materials

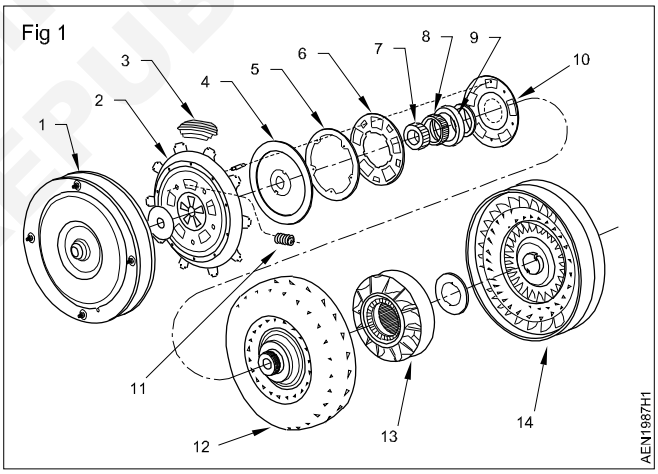
- Tray - 1 No.
- Cleaning cloth - As reqd.
- Transmission fluid - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK: **Identify the various parts of an automatic transmission system as shown in (Fig 1)**

1 Cover assembly
2 Clutch transfer ring
3 Shoe assembly
4 Washer
5 Pressure plate
6 Plate
7 Inner race
8 Roller assembly one way
9 Drive hub
10 End cover
11 Spring
12 Turbine assembly
13 Reactor and clutch assembly
14 Impeller assembly

Fig 1



Practice to adjust manual gear shift linkage

Objectives: At the end of this exercise you shall be able to
- **remove the gear shift mechanism**
- **adjust the shift linkage and test the gear shift mechanism**
- **test the throttle position and speed sensors**
- **test the transmission wiring harness**
- **Inspect the gear shift lever switch.**

Requirements

Tools / Instruments

- Trainees tool kit - 1 No.
- Box spanner set - 1 No.
- Allen key set - 1 Set
- Torque wrench - 1 No.
- Multi meter - 1 No.
- 1.5 V, 12 V Battery - 1 No.

Equipment / Machines

- Light motor vehicle - 1 No.

Materials

- Soap oil - 1 No.
- Tray - 1 No.
- Lubricant - As reqd.
- Cleaning cloth - As reqd.

PROCEDURE

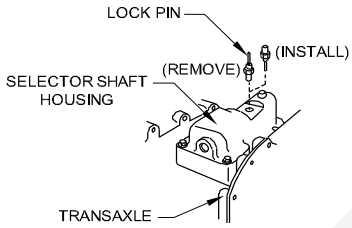
TASK 1: **Remove the gear shift mechanism**

1 Park the vehicle in a plain surface

2 Choke the vehicle with wooden blocks

3 Remove the lock pin from the trans axle selector housing Fig 1

Fig 1

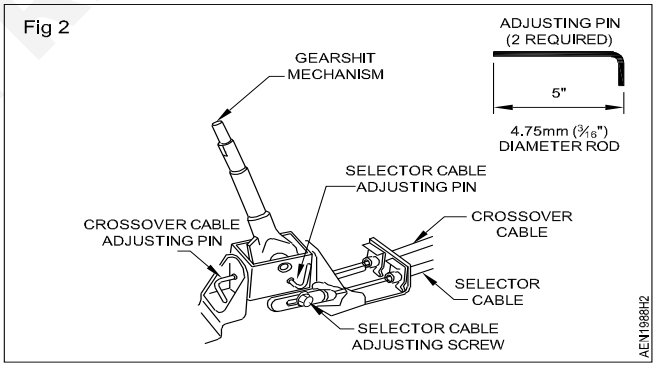


4 Reverse the lock pin and install it to lock the 1-2 shift fork shaft in the neutral position.

5 Remove the gear shift knob and cover.

6 Loosen the selector cable and cross cover cable adjusting bolt with the help of torque wrench. (Fig 2)

Fig 2



TASK 2: **Adjust the shift linkage**

1 Install the allen key to lock the gear shift rod in a required position.

2 Loosen the selector cable adjusting bolt and adjust the cable for the required position then tighten the bolt with torque wrench (Fig 3)

3 Remove the allen key from the slot after adjusting

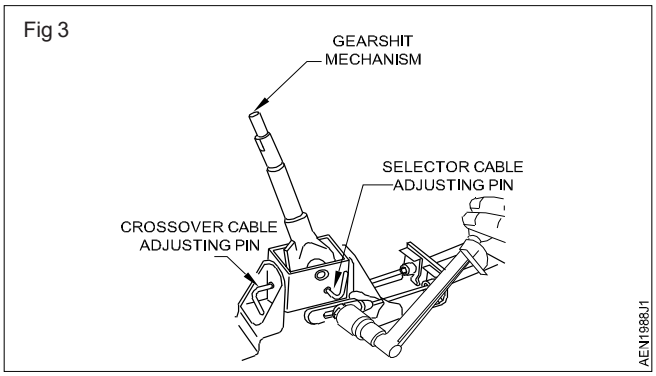
4 Fix the gear shifting lever and refix the lock pin in the original position.

5 Fix the cover and knob

6 Go for the test drive and confirm problem fixed.

The adjustment procedure slightly varies from vehicle to vehicle and model to model.

Fig 3



TASK 3: **Throttle position sensor check (Fig 4)**

1 Remove the air cleaner assembly

2 Turn off the ignition switch

3 Disconnect the connector from electric throttle body

4 Check the TP sensor main and sub output voltage as follows

5 Arrange 3 new 1.5 voltage

6 Connect the voltmeter (2) and battery (1) to TP sensor (3) as shown in Fig 1 (A & B).

7 Check the voltage linearly varies depending on throttle opening angle as shown in the Fig.1(C) while throttle valve is opened and closed by finger.

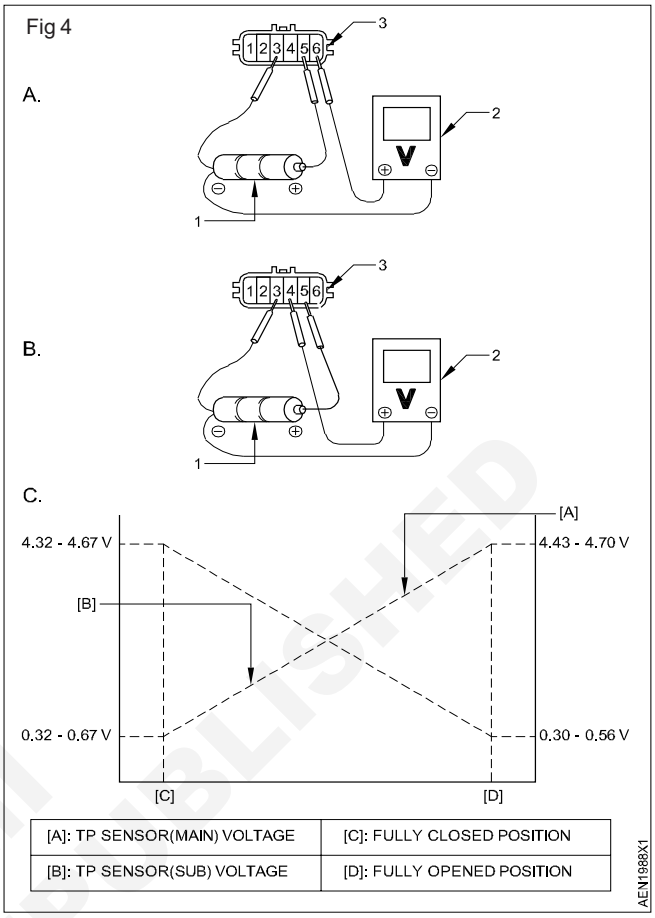
8 If no reading shown or ready varies abruptly sensor has to be changed.

While testing the following condition to be satisfied.

1 Ambient temperature should not exceed 5°C.

2 Accelerator pedal should be in idle position, throttle fully closed condition.

Fig 4



TASK 4: **Vehicle speed sensor (VSS) check (Fig 5)**

Visual check

1 Check the 'O' ring is free from damage

2 Check that end face of sensor and signal rotor tooth are free from any metal particles and damage.

Performance check

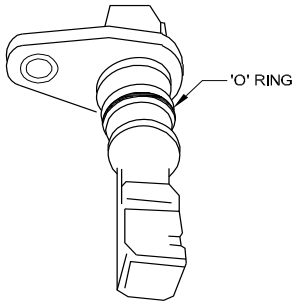
1 Remove the metal particles at the end face if any

2 Arrange 12V battery and connect its positive terminal to Voltage IN terminal and negative terminal to Ground terminal of the sensor. Then using Ohm meter measure resistance between Voltage Out terminal of sensor and negative terminal of battery by passing magnetic substance (iron) while keeping approximately 1mm gap with respect to end face of VSS.

3 If resistance does not vary as specified below replace the VSS.

VSS (Vehicle Speed Sensor) inspection (Non-ABS Model) Visual check (Fig 1)

Fig 5



Vss resistance

Resistance varies from less than 100Ω (ON) to infinity (OFF) or from infinity (OFF) to less than 100Ω (ON).

TASK 5: **Automatic transmission wiring harness coupler**

1 Check the wiring harness coupler continuity with multi meter.

2 Check, coupling points and automatic transmission control solenoid.

3 Check the following transmission wire harness connectivity functional part.

Automatic transmission safety switch

4 Automatic transmission safety switch gear selector switch.

5 Automatic transmission safety switch kicks down solenoid.

6 Automatic transmission safety switch speed sensor.

7 Automatic transmission safety switch E H gear box switch.

8 Automatic transmission safety switch gear position sensor.

9 Automatic transmission safety natural safety switch.

10 Automatic transmission safety over drive kick down switch.

11 Automatic transmission safety control solenoid module.

12 Automatic transmission safety position selector switch.

13 Automatic transmission safety pulse generator senior.

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TASK 6: **Inspection of gear shift lever switch.**

1 Check the position of power change mode lever for damage.

2 Check gear shift lever sensors wire connection.

3 Check gear lever movements in manual operation position.

4 Change lever position to automatic transmission and check the automatic speed of the vehicle.

5 Check panel board light signal of gear position.

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Identify the heating, ventilation & Air conditioning components

Objectives: At the end of this exercise you shall be able to
- **check the charged refrigerant**
- **check the engine drive belt**
- **replace the engine drive belt**
- **identify all HVAC components of a motor car.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Manifold gauge set - 1 No.

Equipment / Machines

- Vehicle with A/C - 1 No.

Materials

- Pointer - 1 No.
- Refrigerant - As reqd.
- Engine drive belt - As reqd.
- Compressor drive belt - As reqd.
- Cotton waste - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Identify all HVAC components of a motor car (Fig 1)**

1 Park the vehicle in plain area and apply the emergency brake.

2 Raise the hood and disconnect the negative battery cable.

3 Locate the compressor (1) and supporting device

4 Identify the compressor clutch (2)

5 Locate the expansion valve (3) and its supporting device.

6 Locate ventilation blower (4) and its support system.

7 Locate filter drier (6).

8 Locate high pressure service connections (7)

9 Locate the pressure switch (8)

10 Locate the condenser (9)

11 Locate the fan (10)

12 Locate the high pressure pipe in gaseous state (A)

13 Locate the high pressure pipe connection in liquid state (B)

14 Locate the low pressure pipe connections (7) in liquid state (C)

15 Locate the low pressure pipe in gaseous state (D)

— — — — — —

TASK 2: **Performance test on A/C unit**

1 Install manifold gauge set

a Close high pressure and low pressure valves

b Connect the high pressure hose to the discharge service valve of the compressor

c Connect the low pressure hose to the suction service valve of the compressor

d Run the engine and operate the car AC

e Set the blower switch at high speed in AC switch on temperature control at cool and air flow control at vent.

f Keep all window glasses open

g Position the thermometer bulb in cool air outlet (supply grill outlet)

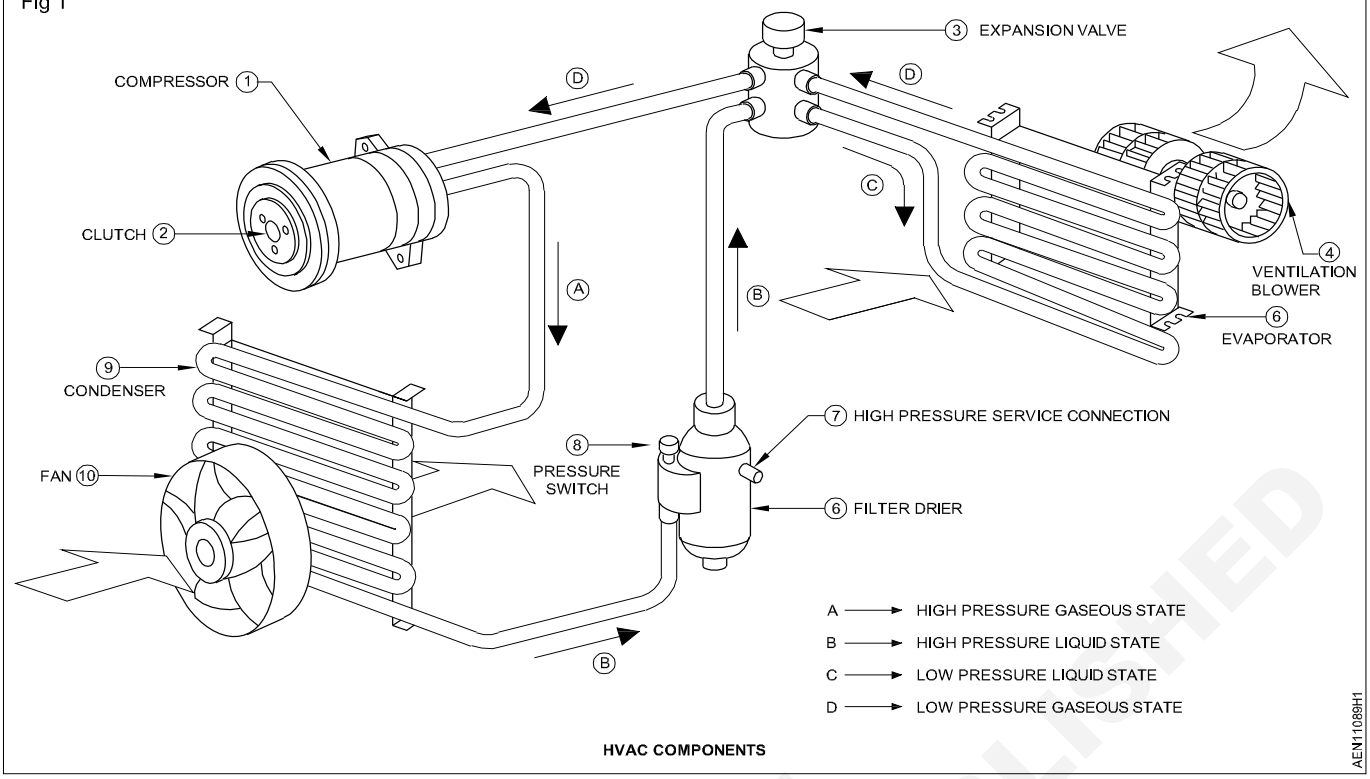
h Place psychomotor close to the inlet of the cooling unit (place the psychomotor near the cool air outlet)

2 Wait until A/C system stabilizes (for about 20 to 30 minutes)

a Check that the reading on high pressure gauge is 14.0 to 15.5 kg/cm$_2$ (200 to 230 PSI). If the reading is too high pour water on the condenser. If reading too low cover the front of the condenser.

b Check that the reading on the dry bulb thermometer at the air inlet is 25-35°C (77-95F)

Fig 1



HVAC COMPONENTS

3 Check the performance of the air conditioning system

a Compare the dry bulb and wet bulb temperature with psychomotor chart and dry bulb readings of the psychomotor at the air inlet.

After measuring the temperature of the wet and dry bulb thermometer at the evaporator air inlet relative humidity percentage can be obtained Ex;- supporting dry and wet bulb temperature at the evaporator air inlets are 25°C (77°F) and 19.5°C (67°F) respectively.

The point of inter section of the dotted lines in the graphic is 60%.

b Measure the dry bulb temperature at cool air out let and calculate the difference between inlet dry bulb and outlet bulb temperature.

c Check the intersection of the relative humidity and temperature difference between two hatched lines.

— — — — —

TASK 3: **Check refrigerant charge**

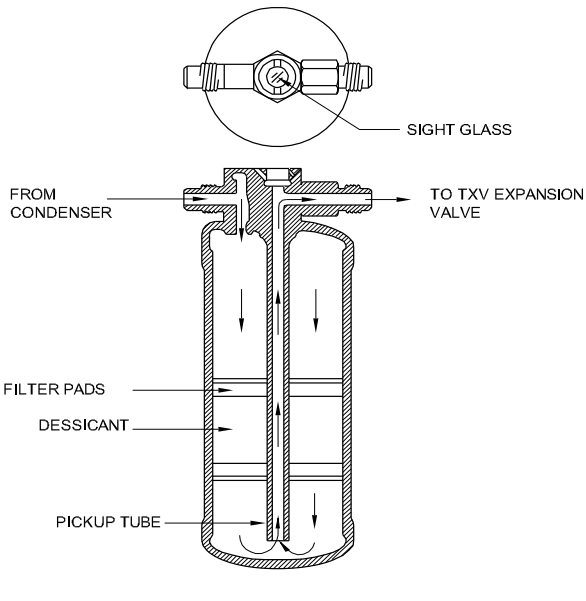
1 Run engine at fast idle

2 Operate air conditioner at maximum cooling for a few minutes.

3 Check amount of refrigerant.

Observe the sight glass on the receiver. (Fig 2)

Fig 2



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Item	Symptom	Amount of refrigerant	Remedy
1	Bubbles present in sight glass	Insufficient	Check for leak with gas leak test
2 3	No bubbles present in sight glass No temperature difference between compressor inlet and outlet	None, sufficient or too much Empty or nearly empty	Refer to items 3 and 4 evacuate and charge system. Then check for leak with gas leak tester.
4	Temperature between compressor inlet & outlet is noticeably different.	Proper or too much	Refer to items 5 and 6
5	Immediately after the air conditioner is turned off, refrigerant in sight glass stays clear.	Too much	Discharge the excess refrigerant to specified amount.
6	When the air conditioner is turned off, refrigerant foams and then stays clear.	Proper	

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TASK 4: **Visual inspection of engine drive belt**

1 **Check V-belt tension.** A slack V - belt slips, reducing compressor speed and limiting refrigerate capacity. To prevent such trouble, the following pre-inspection is recommended.

2 Push down on the center of the V - belt with a finger and check the distance it moves.

3 This distance varies between vehicles.

4 A worn V - belts must be replaced with a new one of appropriate size and model.

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TASK 5: **Check drive belt condition**

1 Visually check the condition of the drive belt.

2 If found damaged engine drive belt.

3 Fit the new fan belt and pull the belt and check the tension of the belt.

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TASK 6: **Check and adjust belt tension**

1 Check the tension of the belt in comparison with the recommended value given in service manual.

2 Measure the tension value using a tension gauge.

3 Normally the belt running time is about 600 kms but if the belt is in good condition just check the belt for any broken or torn cords/portions.

4 Some cars may have an idler pulley to adjust belt tension. Adjust the idler pulley and accordingly adjust belt tension.

— — — — — —

Check heating system, compressor rotation and air gap in air conditioning system

Objectives: At the end of this exercise you shall be able to
- **check the car AC heating system**
- **check the compressor rotation**
- **check the air gap.**
- **drain refrigerant in A/C system**
- **evacuate refrigerant in A/C system**
- **charge the system with refrigerant.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- High pressure gauge - 1 No.
- Low pressure gauge - 1 No.

Equipment / Machines

- Car with A/C - 1 No.

Materials

- Refrigerant - As reqd.
- Cotton waste - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Checking the AC heating system**

1 Check the fuse connection

2 Check the heater relay switch and wire connections

3 Check the hot water circulation coil and blower rotation

4 Check the blower motor mountings and wire connection

5 Check the blower switch

6 Check the heater coil and thermometer

7 Malfunction of this heating system should be checked according to this diagram.

Cause for blower motor does not turn on

1 Broken wiring between battery positive terminals and blower unit

2 Broken wire harness

3 Broken ignition switch circuit

4 Broken heater relay circuit

5 Loose or disconnected connectors

6 Blown out fuse

7 Broken thermo switch circuit

8 Broken heat mode switch circuit

9 Broken blower resistor

10 Broken power servo circuit

11 Broken blower switch circuit

12 Improper body grounding

13 Defection blower resistor

— — — — — —

TASK 2: **Check the compressor rotation test**

1 Check the compressor mountings

2 Check the compressor driven belt tension and condition.

3 Check the magnetic clutch operation.

4 Check the compressor oil level and vacuum creation in compressor.

5 Start the engine and check the compressor rotation

6 Check the noise from the compressor during compressor operation if found any noise rectify it.

7 Check the compressor inlet and outlet hose connections.

8 Check the compressor maximum refrigerant pressure at 100°C.

9 Check the compressor's rotation in idle and high speed of the engine.

10 Run the vehicle at 1500 RPM and record the cooling ratio

— — — — — —

TASK 3: **Check the air gap**

Clutch hub removal

- Remove magnetic clutch retaining ring or nut.
- Attach the tool to the end plate by threading the outer nut of the tool into the center hole of the clutch end plate.
- Tighten the inner tool arbor against the end of the compressor shaft to life the plate.

Tech Tip: Proper air gap between the clutch pulley and hub armature is critical to compressor overall performance failure to maintain the proper spacing as indicated in the service manual specification can lead to problems such as clutch burning or slippage.

Clutch hub installation

- Position the shaft key in place
- Slide the clutch hub on the shaft of the compressor. Be careful not to damage the components by using excess force.
- Thread the inner part of the tool onto the shaft. Tighten the outer nut of the tool to push the shaft key.
- Set the air by use of feeler gauge. Add or remove shims to obtain the manufacture's specification. Always set at the minimum number and measure at multiple points around the circumference.
- Reinstall the retaining or nut.
- Check oil level and rotate the hub with the hose of the compressor down to help lubricate check the case of the compressor rotation.

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Drain, evacuate and charge the refrigerant in air conditioning system

Objectives: This you shall be able to
- **drain refrigerant in A/C system**
- **evacuate refrigerant in A/C system**
- **charge the system with refrigerant.**

TASK 1: **Drain refrigerant in A/C system**

1 Park the vehicle in plain surface and apply the emergency brake set.

2 Raise the hood and disconnect the negative battery cable.

3 Place the recovery/recycle machine and plug it into a socket with machine off condition.

4 Hang a manifold gauges from the hood in plain view. (Fig 1)

5 Connect the high pressure side hose of manifold gauges (normally blue in color) to the low side on your A/C.

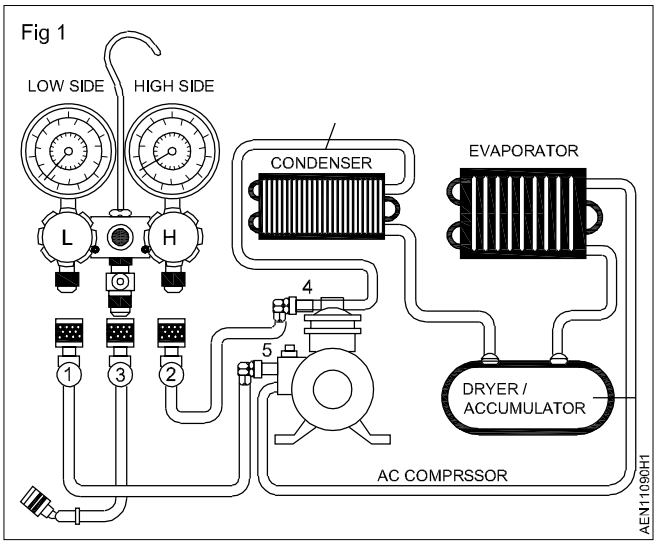
6 Connect the low pressure side hose of manifold gauge (normally red in color) to the low side on your A/C line.

While connecting the hoses you must unscrew a small dust cap from the low/high side nozzle and push hoses on to the quick - release nozzle. (Fig 1)

Refer to your owner's manual for the proper location of your low/high side nozzle fitting if you cannot find it. The cap has an "L"/ "H" stamped on it, which stands for low side/high side.

7 Connect the center hose of manifold gauge (normally yellow in color) to the proper fitting of machine. (as described by machine manufacturer). (Fig 1)

8 Turn on the recovery/recycling machine. (Fig 2)



9 Switch on the compressor on the recovery recycling machine.

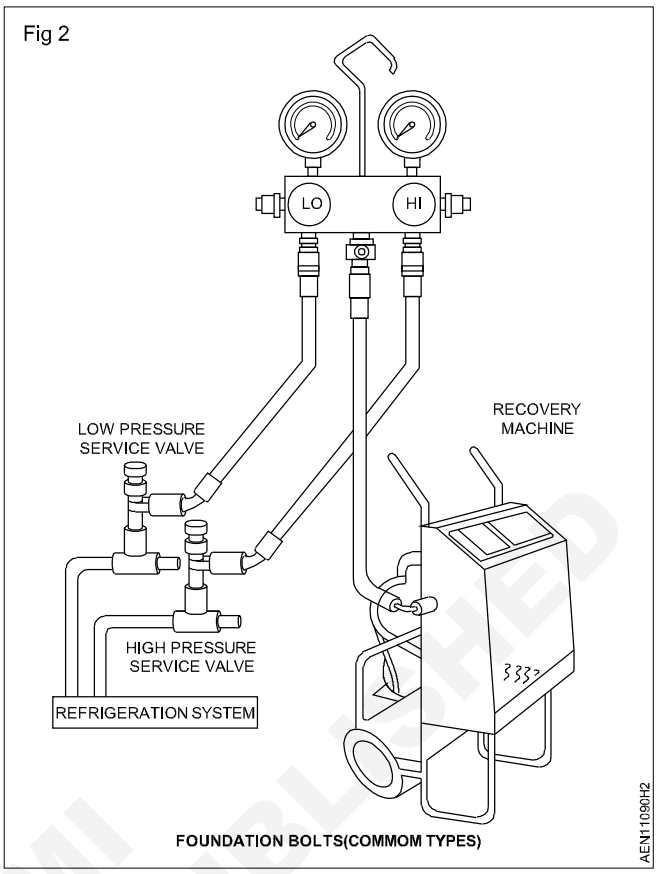
10 Operate the compressor until the vacuum as indicated on the gauge of recovery/recycling machine.

11 Compressor may shut off it have automatic shut off feature otherwise switch off compressor manually.

12 Observe the gauges on the machine for minimum of 5 min.

a If the vacuum rises but remains changes at 0 psi or below, the system is leaking, repair it after recovery process.

b If the vacuum reading changes to a pressure above 0 psi, the refrigerant was not completely removed from the system, then repeat steps above from 5 to 10.



c If the vacuum holds steady for a minimum 2 minutes, then the recovery is good.

13 close all the manifold gauge hand valves, service hose valves and recovery, system inlet valve.

14 Disconnect all the manifold gauge and cap all fittings.

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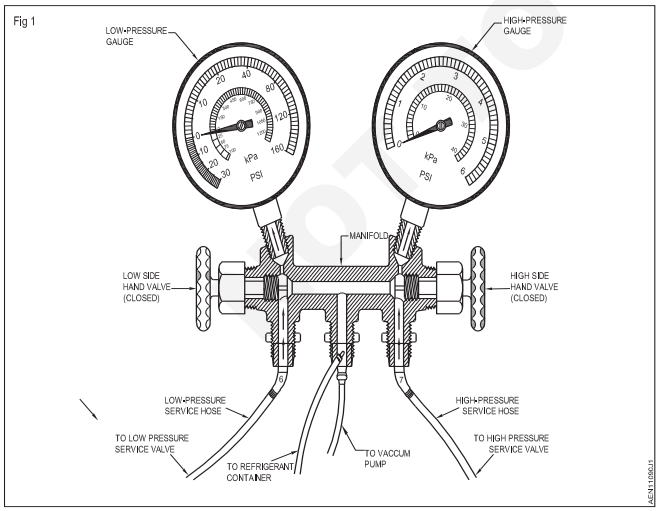
TASK 2: **Evacuate refrigerant in A/C system**

1 When the refrigerant in the system is discharged or recovered the system needs to be evacuated. Connect the vacuum pump to the system as shown in Fig 1.



2 Recommended refrigerant oil is to be added before evacuating the system (use mineral oil for R-12 and PAG oil for R-134 a system)

3 The oil circulates with the refrigerant through the system.

4 During discharge and recovery the refrigerant oil is trapped into oil separator during discharging.

5 Drain this oil into a measuring cup and add same amount of oil during evacuating.

6 Switch ON the vacuum pump. The vacuum pump pumps out air and creates vacuum thereby allowing moisture in the system to boil and vaporise.

7 Continued pumping action will remove moisture laden vapor.

8 The pump may also be attached to the manifold high pressure side fitting.

9 Close the center hose fitting to which refrigerator container is attached.

10 Switch ON the vacuum pump and follow the instructions given in service manual.

11 After the pump has run for about 10 minutes make a quick check for leakage.

12 Then close both manifold valves (low and high side) Check the vacuum in the gauges it should not drop more than 2 psi in 5 minutes.

13 If no leak is detected continue the vacuum pump operation until the entire refrigerant in the system is completely evacuated and the vacuum gauge reads a vacuum of 30" of mercury.

14 Evacuate the system for about 20 minutes after the maximum vacuum is reached. Close the valves and switch off the pump.

15 The system is now ready for charging the refrigerant. The unit tank must contain a sufficient amount of R-134 a refrigerant for charging. Check the amount of refrigerant in the tank. If there is less than 3.6 kg (8 pounds) of refrigerant, add new refrigerant to the tank. Refer to the manufacturer's instructions for adding refrigerant.

16 Verify that the high-side and the low-side hoses are connected to the A/C system. Open both the high side and the low-side valves on the unit's control panel.

17 Open both the gas and the liquid valves on the tank.

Refer to the manufacturer's instructions for the charging station in use. It is necessary to evacuate the system before recharging it with new or recycled refrigerant.

18 Start the vacuum pump and being the evocation process. Non-condensable gases (mostly air) are vented from the tank automatically during the recycling process. You may here the pressure being released.

19 Check for leaks in the system. Refer to the manufacturer's instructions for the charging station in use.

Change the vacuum pump oil frequently. Refer to the manufacturer's instructions for the charging station in use.

Once the system is evacuated, the system is ready for charging the refrigerant. Before charging pour recommended quantity of refrigerant oil through the suction port (refer service manual for quantity)

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TASK 3: **Charge the system with refrigerant**

The system can be charged in many ways.

- Using portable service/charging station.
- Using manifold gauge set and a charging cylinder

Using charging station

1 Connect the charging station vacuum pump to the middle service valve off the manifold gauge and switch on the pump.

2 The refrigerant from the cylinder will flow through the pump and into the compressor suction through the low pressure service valve in the manifold gauge set.

3 Before charging weigh the cylinder and switch OFF the charging station once the required quantity of refrigerant is charged. (refer service manual for proper quantity of refrigerant to be added).

4 Some charging station switch off automatically once the required amount of discharges done from the charging system.

Using manifold gauge set

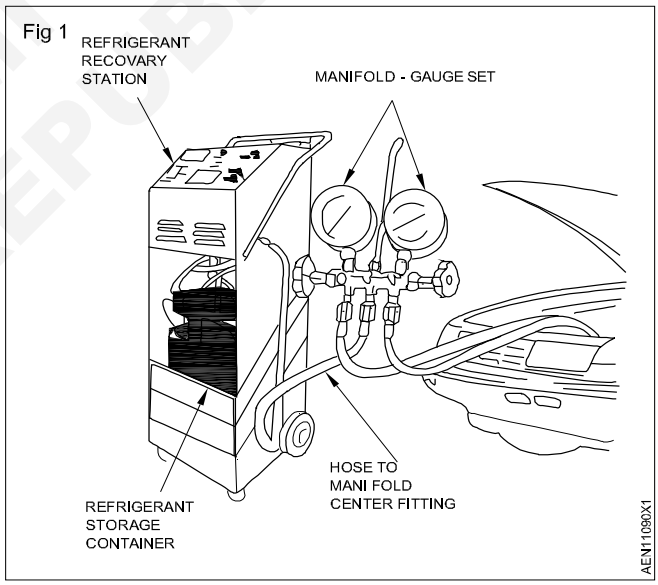
1 Connect the charging cylinder with the manifold gauge as shown in (Fig 1)

2 Open the valve from the charging cylinder and allow refrigerant to flow through the low pressure side of manifold gauge set.

3 The pressure gauge will show the rise in pressure once the refrigerant flows into the system.

4 The charging cylinder should be weighed before and after charging so that the net change in weight is equal to the quantity of refrigerant to be added.

Fig 1



5 Once charging is over close all the service valves with caps and disconnect the charging cylinder. The system is now charged with required quantity of refrigerant.

6 Start the vehicle and switch ON the A/C with blower speed minimum

7 Note down the temperature readings after about 10 minutes time.

8 Ensure that there is sufficient cooling in the cabin and that all the components are working properly.

9 Take suitable correction action if there is may leak or malfunctioning.

10 Check the compressor running and battery voltage check the watch glass of receiver and drier for proper refrigerant flow.

Trouble shoot air conditioning system

Objectives: At the end of this exercise you shall be able to
- **perform replenishing the A/C compressor oil**
- **perform the trouble shooting in car A/C system.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Owners repair manual - 1 No.
- Socket set - 1 No.
- Decibel meter - 1 No.

Equipment / Machines

- Vehicle with A/C system - 1 No.
- Recovery vacuum pump - 1 No.
- Recovery tank - 1 No.
- Manifold gauges - 1 No.

Materials

- Cotton waste - As reqd.
- Soap oil - As reqd.
- AC compressor drive bell - As reqd.
- Engine drive belt - As reqd.
- Refrigerant - As reqd.

PROCEDURE

TASK 1: **Any oil removed from the A/C system during the recovery process must be replenished at this time.**

1 Use the correct graduated bottle of PAG oil for the R- 134a system

Keep the oil bottles tightly capped at all times to protect the oil from moisture and contamination. You must have an accrued A/C vacuum for this operation. Never open the oil injection valve while there is positive pressure in the A/C system. This will result in oil blow back through the bottle vent. Never let the oil level drop below the pickup tube while charging or replenishing the system, as this will allow air into the A/C system.

2 Refer to the manufactures instructions for the charging station in use. Add the proper amount of PAG (polyalkyline glycol) oil to the system.

3 Close the valve when the required oil charge has been pulled into the system.

Charging

Evacuate the A/C system before charging

1 Close the low side valve on the control panel.

2 Open the high-side valve on the control panel.

3 Refer to the manufacturer's instruction for the charging station in use.

4 Enter the amount of refrigerant needed to charge the A/C, making sure to use the correct system of measurement, i.e kilogram (kg) or point (ib).

5 Begin the charging process.

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TASK 2: **Trouble shooting in car air conditioning system**

Trouble	Cause	Remedies
1. No cooling	- Air ducts clogged - Compressor drive belt loose fitting. - Low refrigerant level in compressor - Defective condenser - Condenser fins damaged. - Air filter clogged.	- Tighten the belt - Charge refrigerant - Replace - Clean it - Replace it
2. No warm air	- Defective blower - Heater coil burnt - No power supply to heater coil - Blower resistor defective	- Replace - Replace - Check wire connections - Replace
3. Cool air comes out only intermittently	- Slipping blower drive - Loose electrical connections to motor - Dust accumulated air filter	- Check the motor shaft - Check for loose wiring - Clean the air filter
4. Insufficient cooling	- Compressor drive belt slip - Blower motor not work - Window glass open - Low refrigerant level in compressor	- Replace - Repair/ Replace - Close the window glass - Charge refrigerant

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Check abnormal noise from air conditioning components

Objectives: This you shall be able to
- **check abnormal noise from compressor**
- **check abnormal noise from magnetic clutch**
- **check abnormal noise from condenser**
- **check abnormal noise from evaporator**
- **check abnormal noise from blower motor.**

Check abnormal noise from compressor

- Start the engine and switch on the AC
- Check the compressor mountings for noise
- Check the compressor drive belt tension for noise
- Check the compressor rotor bearing for noise
- Check the metallic sound from compressor Check oil level in compressor.

Check abnormal noise from magnetic clutch

- Check the magnetic clutch plate
- Check the magnetic clutch bearing
- Check the magnetic clutch mountings
- Check the magnetic coil power supply
- Check the puller
- Check the air gab between coil and pulley
- Check abnormal noise from condenser

Check abnormal noise from condenser

- Check the condenser fins for blockage or damage for noise
- Check the condenser mounting or lose fittings for noise
- Check the hose connection vibration and noise
- Check for bend/broken blades of fan.

Check the abnormal noise from evaporator

- Check the fins for damage and noise
- Check the mountings for lose fitting
- Check the hose vibration noise
- Check for tight fittings of blower coil unit
- Check for bend/loose end blower wheel from the shaft

Check the abnormal noise from blower

- Check the blower mountings
- Check the blower blade touch with body
- Check the blower (drive) motor mountings

Test for high and low pressure gauge in HVAC system

Objectives: At the end of this exercise you shall be able to
- **test the high pressure gauge performance**
- **test the low pressure gauge performance.**

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 No.
• Owners repair manual	- 1 No.
• Manifold gauges	- 1 Set

Equipment / Machines

• Recovery vacuum pump	- 1 No.
• Car with A/C	- 1 No.

Materials

• Cotton waste	- As reqd.
• Soap oil	- As reqd.
• Refrigerant	- As reqd.

PROCEDURE

TASK: **Test for high and low pressure gauge in HVAC system**

Checking of refrigeration system with manifold high / low pressure gauge.

Read the manifold gauge pressure with the following established conditions

a Temperature at the air inlet 30-35°C (86-95°F)

b Engine running at 2000 rpm.

c Blower speed set at high

d Temperature control lever set at cool.

Note: It should be noted that the gauge indications may very slightly due to ambient temperature conditions.

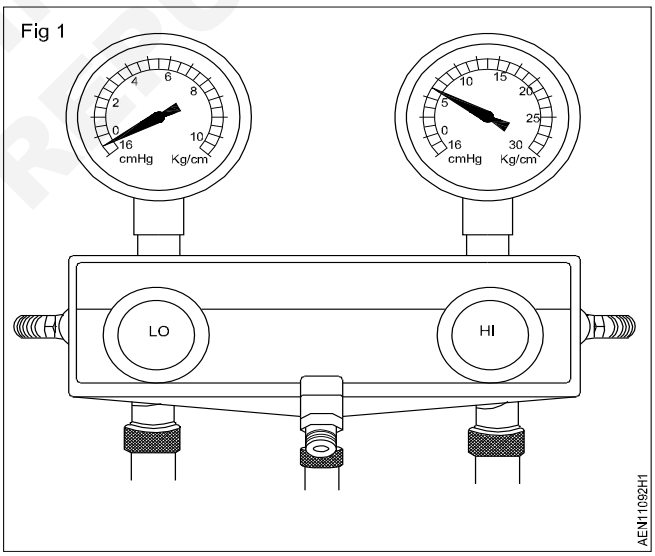
1 Normally functions refrigeration system (Fig 1)

Low pressure side: 1.5-2.0 kg/cm$_2$ (21-28 psi, 147-196 KPa)

High pressure side: 14.5-15.0 kg/cm$_2$ (206-213 psi, 1422-1471 KPa)

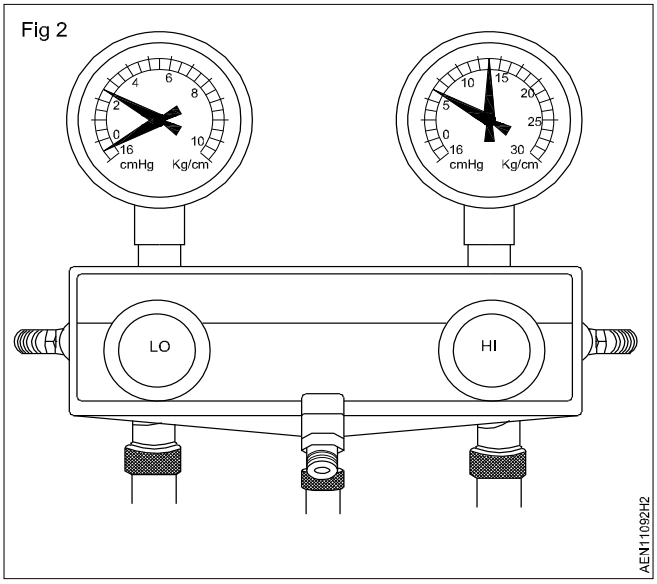
2 Moisture functions refrigeration system (Fig 2)

Fig 1



Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
During operation, pressure on low, pressure side sometimes becomes a vacuum and sometimes normal.	Moisture entered in refrigeration system freeze at expansion valve orifice and stops cycle, but normal state is restored after a time when the ice melts	Drier in oversaturated state Moisture in refrigeration system freezes at expansion valve orifice and blocks circulations of refrigerant	1. Replace receiver & drier 2. Remove moisture in cycle through repeated vacuum purging method. 3. Charge new refrigerant to proper amount.

Fig 2

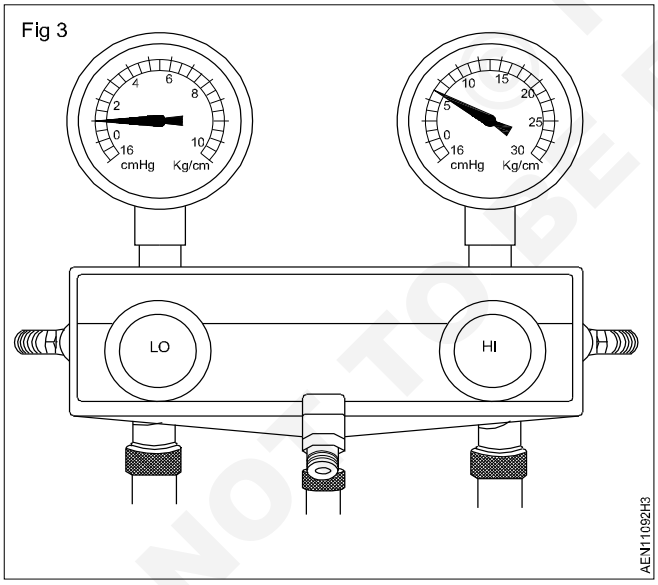


3 Insufficient refrigerant (Fig 3)

Condition, periodically cools and then fills to cool

Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Pressure low on both low and high pressure sides.	Gas leakage at some place in refrigeration system.	Insufficient refrigeration in system	Check with leak detector repair
Bubbles seen in sight glass insufficient cooling performance	Gas leaked from Refrigeration system	Refrigerant leaking	Charge refrigerant to proper amount.

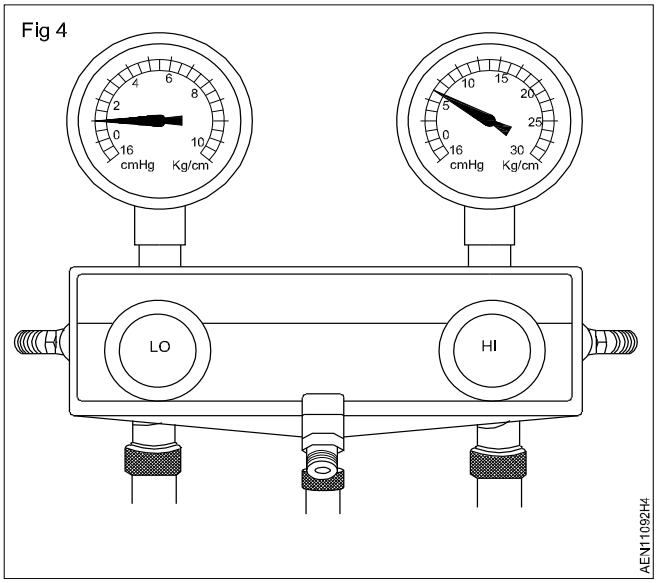
Fig 3



4 Poor circulation of refrigerant (Fig 4)

Condition: Insufficient cooling

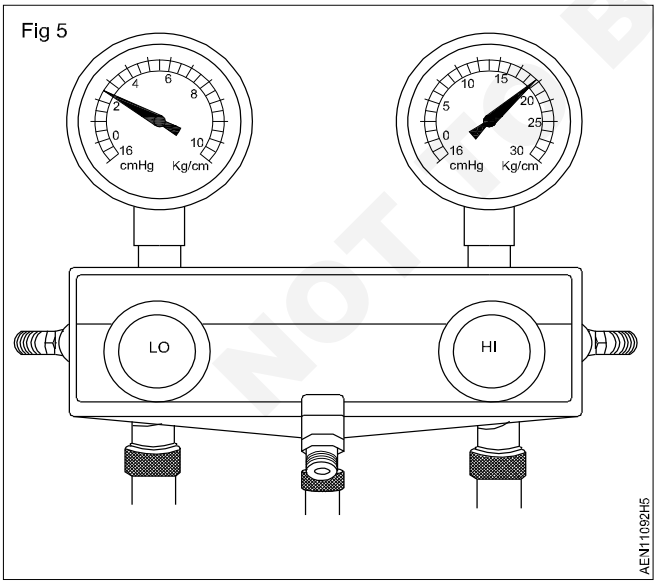
Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Pressure low on both low and high pressure sides. Frost on tubes from receiver to unit.	Refrigerant flow obstructed by dirt in receiver	Receiver clogged	Replace receiver



5 Refrigerant overcharge or insufficient cooling of condenser (Fig 5)

Condition: Does not cool sufficiently

Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Pressure too high on both low and high pressure sides.	Unable to develop sufficient performance due to excessive refrigerant in system condenser cooling insufficient	Excessive refrigerant in cycle refrigerant overcharged Condenser cooling in sufficient condenser fins clogged or fan motor faulty	1. Clean condenser 2. Check fan motor operation 3. If (1) and (2) are in normal state check amount of refrigerant. **Note.** Vent out refrigerant through gauge manifold low pressure side by gradually opening

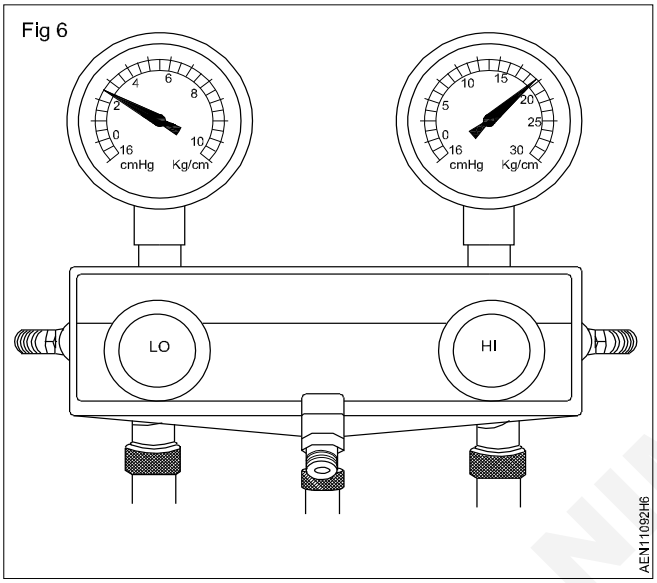


6 Expansion valve improperly mounted/Heat sensing tube defective (opens too wide) (Fig 6)

Condition: Insufficient cooling

Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Pressure too high or both low and high pressure sides.	Trouble in expansion valve or heat sensing tube not installed correctly. Refrigerant flow out of adjustment.	Excessive refrigerant in low pressure piping. Expansion valve opened too wide.	1.Check heat sensing tube installed condition. 2.If (1) is normal, test expansion valve is unit form. Replace if defective

Fig 6

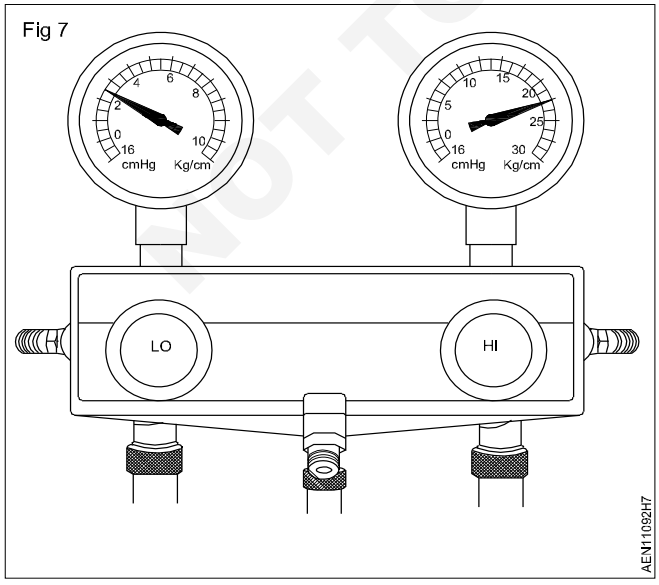


7 Air present in refrigeration system (Fig 7)

Condition: Does not cool down sufficiently

Note: These gauge indications are shown when the refrigeration system has been opened and the refrigerant charged without vacuum purging.

Fig 7



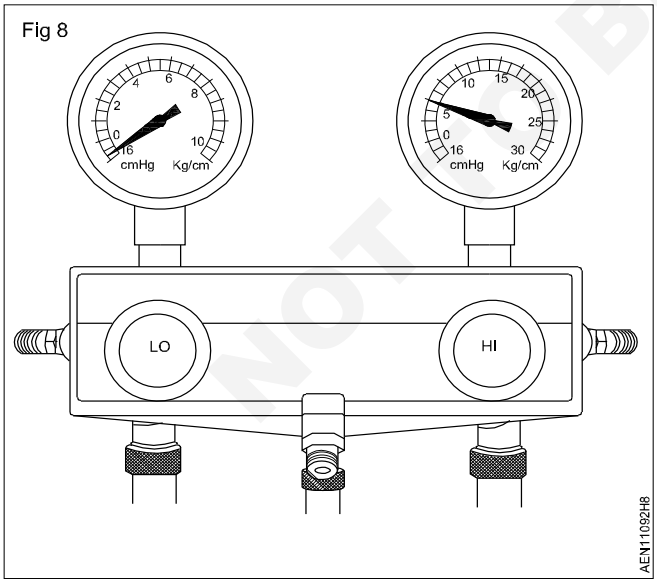
Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Pressure to high on both low and high pressure sides.	Air entered in refrigeration system	Air present refrigeration system. Insufficient vacuum purging.	1. Replace receiver & drier 2. Check compressor oil to see if dirty or insufficient. 3. Vacuum purge and charge new refrigerant.

8 Refrigerant does not circulate: (Fig 8)

Condition: Does not cool

Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Vacuum indicated on low pressure side, very low pressure indicated on high Frost or dew seen on piping before and after receiver and drier or expansion valve.	Refrigerant flow obstructed by moisture or dirt in refrigerant freezing or adhering to expansion valve orifice Refrigerant flow obstructed by gas, leakage from expansion valve heat sensing tube.	Expansion valve orifice clogged Refrigerant does not flow.	Allow to stand for some time and then restart operation to determine if trouble is caused by moisture or dirt. If caused by moisture refer to procedure step 2. If caused by dirt, remove expansion valve and clean off dirt by blowing with air. If unable If unable to remove dirt, replace valve. Vacuum purge and charge new refrigerant to proper amount. For gas leakage from heat sensing tube. Replace expansion valve.

Fig 8

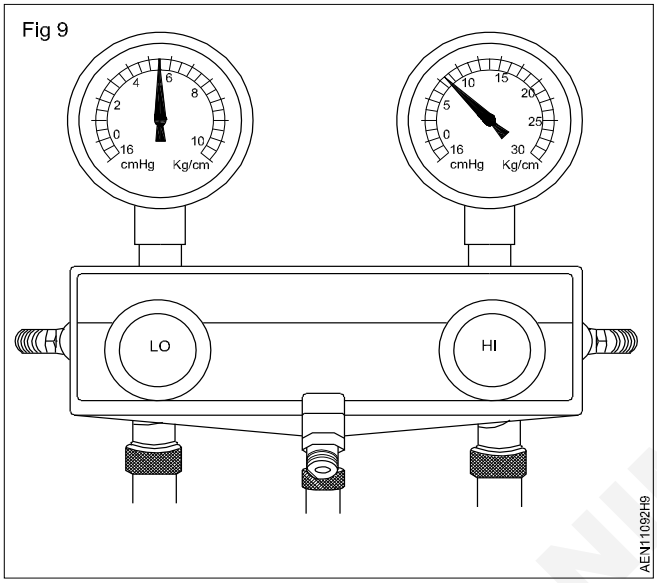


9 Defective compression compressor: (Fig 9)

Condition: Does not cool

Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Pressure too high or low pressure side. Pressure too low at high pressure side.	Internal leak in compressor.	Compression defective Valve leaking or broken. Sliding parts (piston, cylinder, gasket, connecting rod, etc,.)	Replace compressor

Fig 9



Diagnosis test for high pressure gauge-pressure high and low

Normal operating pressure ranges of car AC using HFC-134 a at an ambient conditions of 32°c to 35°c are

a Low pressure side: 1-3 kg/cm^2

b High pressure side 12-22 kg/cm^2

1 Clamp the gauge manifold of testing station to observe pressure conditions of car AC system.

2 Connect low side and high side hoses to service ports of car AC system.

3 Start the car and switch on AC, accelerate the engine shaft (Gear in Neutral) the RPM of the engine/ compressor shaft should be around 2600 RPM for about 15 to 20 minutes.

4 If the high side of car AC system is higher than normal, check for:-

A Dirty condenser

→ Clean the condenser

B Air in the system condenser

→ Recover and recharge the refrigerant

C Excess refrigerant charge.

→ Purge out and reduce the refrigerant and check for normal cabinet temperature conditions.

5 If high side of car AC system is lower than normal, check for

A Leakage of refrigerant

→ use soup solution to defect the leakage points of all fitting joints. If any leakage point is observed with soap bubbles, tighten the flare-fitting joint. If there is no leakage,

B Check for under charge of refrigerant in such case, the low pressure side gauge reads lower than normal.

→ Refrigerant may be charged if the system does not have leakage.

→ If there is leakage of refrigerant, arrest the leak, and reprocess the refrigerant charging.

6 If the low side of car AC system is lower than normal, check for

A Leakage points, arrest the leakage and reprocess the system for refrigerant charging.

B If the compressor has poor pumping, check the performance of compressor. The symptom in car cabinet is either poor or no cooling effect.

7 If the low side of car AC system is higher than normal, check for

A Over charge of refrigerant and the high side pressure also becomes higher than normal.

B If compressor has poor pumping, check the performance of compressor.

Practice to trace the lighting circuit in a vehicle

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

- **locate the circuit from**
  - **the battery to the junction box via the ammeter**
  - **the junction box to the headlamp switch**
  - **the switch to the fuse box**
  - **the fuse box to the headlamp**
  - **the fuse box to the parking lamp and the tail-lamp**
  - **the fuse box to the roof lamp**
  - **the fuse box to the mist lamp (fog lamp)**
  - **the circuit from the fuse box to the instrument panel lamps**
  - **the warning lamp circuit (brake light)**
- **align head lamps.**

Requirements

Tools / Instruments

• Trainee's tool kit	- 1 Set
• Soldering iron	- 1 No.

Equipment / Machines

• Running Vehicle	- 1 No.

Materials

• Auto electrical wire	- As reqd.
• Insulation tape	- As reqd.
• Cotton waste	- As reqd.
• Emery paper	- As reqd.
• Bulb	- As reqd.

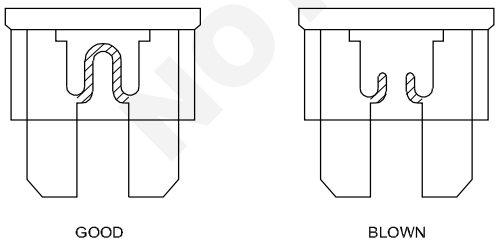
PROCEDURE

TASK 1: **Check the fuses of all the lighting units**

1 Check the battery charge.

2 Connect the test lamp clip to a good ground. 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 out 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.

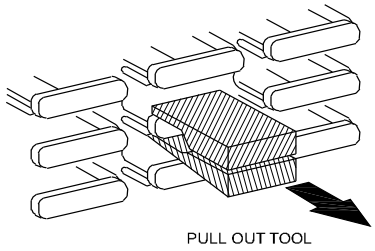
Fig 1



CHECKING AND REPLACING FUSES

3 Remove the fuse from its spring clip. Check whether it is blown or not. If blown, replace it using pull out tool. (Fig 1 & Fig 2)

Fig 2



CHECKING AND REPLACING FUSES

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

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

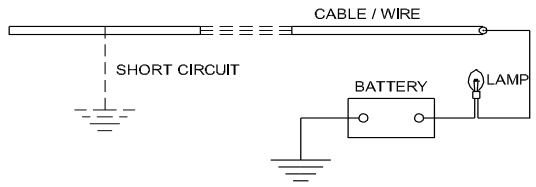
If there is an open circuit the ohmmeter reading will be more.

Trace the open circuit and rectify.

Check the wiring for short circuit with the test lamp. (Fig 3)

If there is a short circuit the test lamp will glow before the circuit is completed and also the fuse will be blown off.

Fig 3

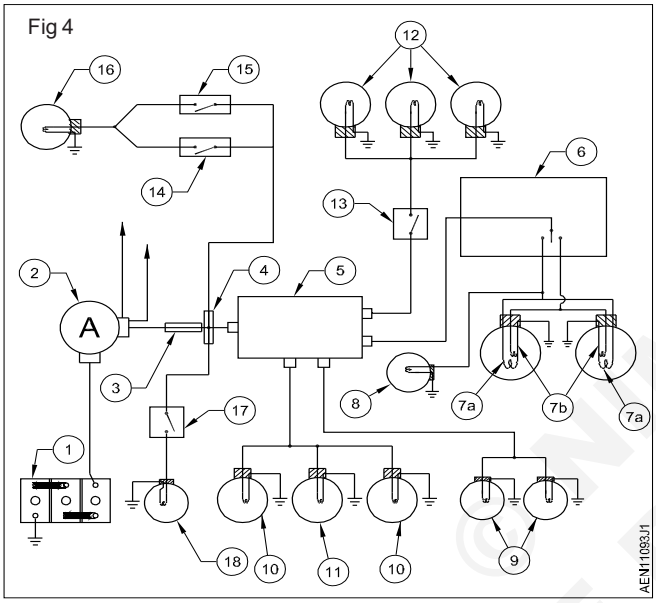


TESTING OF SHORT CIRCUITS IN A WIRING CIRCUIT

TASK 3: **Trace the lighting circuit**

1 Trace the battery cable from the battery (1) to the ammeter (2) and check for proper connections. (Fig 4)

Fig 4



2 Trace the wire from the ammeter (2) to the fuse unit (3) (or circuit breaker) and check for proper connections.

3 Trace the wire from the fuse unit (3) to the junction box (4) and check for proper connections.

4 Trace the wire from the fuse unit (4) to the headlamp switch (5) and check for proper connections.

5 Trace the wire from the headlamp switch (5) to the dipper switch (6) and check for proper connections.

6 Trace the wire from the dipper switch (6) to the connection of the headlamp's high beam (7a) and low beams (7b) and check for proper connections.

7 Trace the wire from the high beam (7a) circuit to the beam indicator lamp (8) in the instrument panel.

8 Trace the wire from the headlamp switch (5) to the parking lamp (9) and tail-lamp (10) and check for proper connections.

9 Trace the wire from the headlamp switch (5) to the number-plate lamp (11) and check for proper connections.

10 Trace the wire from the headlamp switch (5) to the instrument panel lamps (12) via the instrument panel switch (13) and check for proper connections.

11 Trace the wire from the junction box (4) to the dome light pillar switch (14) and automatic door switch (15) and to the roof light (16) and check for proper connections.

The roof light pillar switch and the automatic door switch are connected in pillar. Trace the wire from the junction box (4) to the stop light (warning light) switch (17) and to the stop-light (18) and check for proper connections.

12 Replace deflection bulbs, where they are fused.

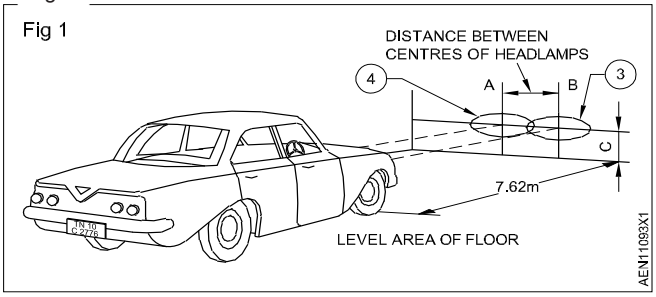
TASK 4: **Align and aiming head lights**

1 Check the air pressure in the tyres and inflate them to the correct pressure

2 Check the headlamp mountings. (Fig 5)

Fig 5

Fig 1



3 Position the car 7.62 meters away in front of a white screen or a plain wall.

4 Mark the distance between the centers (A & B) of the headlamps with respect to the axis of the car.

5 Ensure that the front of the car is square to the screen.

6 Load the car as it will be being driven for most of the time.

7 Cover up one lamp while aligning the other by a cloth or paper.

8 Mark the height (C) of the headlamps on the screen, two inches below the actual height of the headlamps.

9 Normal value of C (figure) is equal to the height from the floor to the center of headlamp minus 2” when headlamps are 25 ft. or 7.62 m apart from the screen.

— — — — — —

TASK 5: **Setting the beams (long and short) and test the beams**

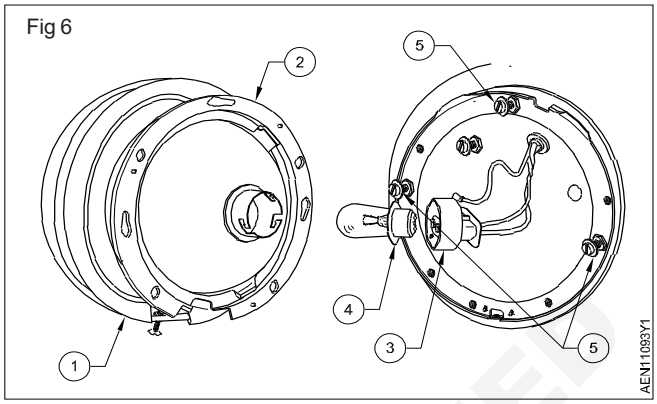
1 Adjust the headlamp beams by the vertical adjusting screw (1) or the horizontal adjusting screw (2).

2 Ensure that the main beam’s high intensity zone falls as shown (3) and (4). (Fig 6)

3 Ensure the upper beam is adjusted separately after throwing it separately on the white screen.

4 Observe the headlamp main beam directed straight ahead and parallel to the road when the vehicles is fully loaded. (Refer to the diagram)

Fig 6



Adjustment of headlamps

1 Adjust if required.

2 Operate the dip switch by foot. Observe the dipped beam dipping downwards and towards the kerb.

3. If head switch in defects and replace it.

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Practice to check the head light circuit

Objective: At the end of this exercise you shall be able to
- **remove the lighting units and check the bulb, holder and replace fused bulb**
- **assemble the light units and test for proper work**
- **replace the head light and clip switch.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 Set
- Test lamp - 1 No.
- Ohm meter/ multimeter - 1 No.
- Pull out tool - 1 No.

Equipment / Machines

- Running Vehicle - 1 No.

Materials

- Auto electrical wires - As reqd.
- Insulation tape - As reqd.
- Fuse - As reqd.
- Bulb - As reqd.
- Emery paper - As reqd.
- Cleaning solvent - As reqd.
- Cloth/Cotton waste - As reqd.

PROCEDURE

TASK 1: **Remove the lighting units and check the bulb and its holder and fused bulb**

a Headlamps

1 Unscrew the screw securing the rim.

2 Take out the rim along with the rubber dust excluder (1)

3 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.

4 Turn the bulb holder (3) in the anticlockwise direction to take it out.

5 Remove the bulb (4).

b All other lamps

6 Unscrew the screws.

7 Remove the lock - rings according to the model.

8 Remove the light lenses.

9 Remove the bulbs.

10 Check the bulbs

11 While removing the bulbs check for loose fitting.

12 Check the bulbs for fuse by connecting wires from the battery

13 If the bulb is fused replace it.

14 Check the clip switch if need replace it.

— — — — — —

TASK 2: **Assemble the light units and test for proper work**

1 Check the front lens and reflector and replace, if found damaged.

2 Position the new light unit on the rim.

3 Ensure that the locating tabs at the edge of the light unit fit into the slots in the rim.

4 Ensure that the unit retaining ring is correctly positioned.

5 Engage the projections on the bulb holder with the slots or flanges in the bulb sleeve.

6 Press and twist clockwise to fit the light assembly with the rim on the vehicle by the rim securing screws. Assemble all other light units by securing the screw/ lock-rings.

7 Test all the lights by operating all the switches, after completing all the checking, by connecting to a battery of proper voltage. If found any lighting switch is defective replace it. If found any lighting switch is defective replace it.

Practice to trouble shoot head light

Objective: At the end of this exercise you shall be able to
- **trouble shooting of head light.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 Set
- Test lamp - 1 No.
- Ohm meter/ multimeter - 1 No.
- Pull out tool - 1 No.

Equipment / Machines

- Running Vehicle - 1 No.

Materials

- Auto electrical wires - As reqd.
- Insulation tape - As reqd.
- Fuse - As reqd.
- Bulb - As reqd.
- Emery paper - As reqd.
- Cleaning solvent - As reqd.
- Cloth/Cotton waste - As reqd.

PROCEDURE

TASK: **Trouble shoot the head light defects**

Trouble shooting

Sl. No	Trouble	Causes	Remedies
1.	Head light do not glow	- Bulb fuse - Wire loose connection - Open circuit in wiring - Head light bulb fuse burned out - Head light switch defective	- Replace - Tighten it - Rack for the open circuit - Replace the bulb - Replace the switch
2.	One head light does not glow	- Loose wire connection - Bulb burned out - Open wire circuit - Defective wire - Rust formed in earth wire connection.	- Tighten the wire connection - Replace the bulb - Repair it. - Replace the wire junction box. - Clean it
3.	High or low beam does not work	- Head light bulb one filament burned out - Wire loose connections in bulb holder - Diamond bright switch defective - Defective head light bulb holder	- Replace the bulb - Tighten - Replace the switch - Replace the bulb holder

Trouble shoot in turn signal and warning lights

Objectives: At the end of this exercise you shall be able to
- **trace the turn signal light troubles**
- **identify the troubles in hazard warning light circuit.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multi meter - 1 No.

Equipment / Machines

- Running vehicle - 1 No.

Materials

- Cotton waste - As reqd.
- Soap oil - As reqd.
- Bulb - As reqd.
- Indicator light switch - 1 No.
- Hazard light switch - 1 No.

PROCEDURE

TASK: **Trouble shoot in turn signal and warning lights**

1 Check the battery connection for sulphur deposit on battery

2 Check the indicator turn switch wire connections

3 Check the Hazard switch wire connections

4 Start the engine and ensure the battery charging.

Sl. No	Trouble	Causes	Remedies
1.	Turn signal light not glowing	- Indicator switch defective - Flasher unit defective - Fuse blown out - Switch wire open circuit	- Replace - Replace - Replace - Connect wire and tighten the wire connection.
2.	No flashing the signal lights	- Flasher unit defective - Flasher unit loose wire connection	- Replace - Tighten the wire connection
3.	One side signal light only flashing	- One side bulb burned out - Wire connection disconnected - Indicator switch contact point burnt	- Replace the bulb - Connect the wire - Replace the switch
4.	Turn signal light flash rate low	- Indicator switch breaker breaker point dirty - Low power supply - Low power bulb used - Poor ground earth	- Clean the point - Check power supply - Replace the bulb - Correct the earthing point.
5.	Turn signal light flash rate high	- Bulb power high - Defective flasher unit	- Use correct power bulb - Replace.
6.	Hazard warning lights no flashing	- Flasher unit defective - Hazard warning switch defective - Bulb burned out - Wrong wire connection	- Replace - Replace - Replace - Correct the wire connection

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Perform trouble shoot in lighting circuit

Objectives: At the end of this exercise you shall be able to
- **check the clearance between bulb and license plate**
- **identify the causes for all lights not glowing**
- **replace the defective bulbs.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Test lamp - 1 No.

Equipment / Machines

- Running vehicle - 1 No.

Materials

- Cotton waste - As reqd.
- Soap oil - As reqd.
- Bulb - As reqd.
- Wire - As reqd.
- Insulation tape - As reqd.

PROCEDURE

TASK: **Trouble shoot the defects in lighting circuit**

1 Check the Clearance between license plate light bulb and number plate.

2 Check the causes for all lights not glowing

3 Check the light wiring circuit for the defects

4 Check the fuses in a lighting circuit

5 Check the bulb power values, if improper replace the bulb.

Sl. No	Trouble	Causes	Remedies
1.	All lights not glowing	- Switch defective - No power supply - Loose wire connections - Poor ground earthing - Light fuse burned out - Open wire circuit - All bulb are burned	- Replace - Provide proper power - Check and tighten wire connections - Clean and property connect the wires - Replace the fuse - Connect the wires - Replace the bulb.
2	Low clearance between bulb and license plate.	- Improper fitting the license plate. - Damaged number plate.	- Maintain the space between the number plate and bulb - Repair or replace the number plate.
3	One side frank and rear lights do not glowing	- Bulb fused - wire earthing disconnected	- Replace the bulb - Connect the wire property.

Practice to trouble shoot back up lighting system

Objectives: At the end of this exercise you shall be able to
- **trace out defects in back up lighting circuit**
- **identify the cause for the defects in back up lighting system.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Test lamp - 1 No.

Equipment / Machines

- Running Vehicle - 1 No.

Materials

- Bulb - As reqd.
- Insulation tape - As reqd.
- Cotton waste - As reqd.
- Soap oil - As reqd.
- Auto electrical wire - As reqd.

PROCEDURE

TASK: **Trace out the defects is backup lighting circuit**

1 Check the vehicle back up lights.

2 Switch on the headlight and check the back light.

3 Switch on the parking lights and check the lights brightness

4 If lights are not glowing visually check the bulb and wire connections.

Causes and Remedies

Sl. No	Trouble	Causes	Remedies
1.	Back up lights not glowing	- Wire short circuited - Back bulb fused - Fuse burned out - Loose wire connection - Poor ground earthing	- Replace the damaged wires. - Replace the bulb - Replace the fuse - Check and secure the wire connections - Check and repair.

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Practice to trouble shoot brake lighting system

Objectives: At the end of this exercise you shall be able to
- **trace out defects in brake lighting system**
- **trouble shoot defects in brake lighting system.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Test lamp - 1 No.
- Multi Meter - 1 No.

Equipment / Machines

- Running Vehicle - 1 No.

Materials

- Cotton waste - As reqd.
- Soap oil - As reqd.
- Bulb - As reqd.
- Wire - As reqd.
- Insulation tape - As reqd.
- Hydraulic - As reqd.

PROCEDURE

TASK: **Trouble shoot brake lighting system**

1 Check the vehicle back up lights.

2 Check the brake light.

3 Check the brake lighting wire circuit

4 Check the brake pedal operation.

5 Check the brake fluid in master cylinder.

6 Check the air pressure in air brake system.

7 Check the brake switch/sensor wire connections and power supply.

8 Check the battery power by use multi meter.

9 Check the battery charging systems in vehicle.

Trouble shooting

Sl. No	Trouble	Causes	Remedies
1	Brake light not glowing	- Bulb fused - Wire open circuit - Brake light switch defective - No power supply to bulbs - No brake oil in master cylinder	- Replace - Replace/connect the wires. - Replace the switch - Connect the power supply wire or clean the earthing wire connections. - Fill the brake oil
2	Brake light stay on	- Brake light switch defective - Wrong wire connection - Improper operation of - Master cylinder	- Replace the switch - Correct the wire connections - Overhaul the master cylinder

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Perform trouble shoot fuel gauge/meter unit in a vehicle

Objective: At the end of this exercise you shall be able to
- **trace out the defects in fuel meter/gauge circuit.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multi Meter - 1 No.

Equipment / Machines

- Running Vehicle - 1 No.

Materials

- Cotton waste - As reqd.
- Fuel gauge - As reqd.
- Wire - As reqd.
- Soap oil - As reqd.
- Fuel tank unit - As reqd.

PROCEDURE

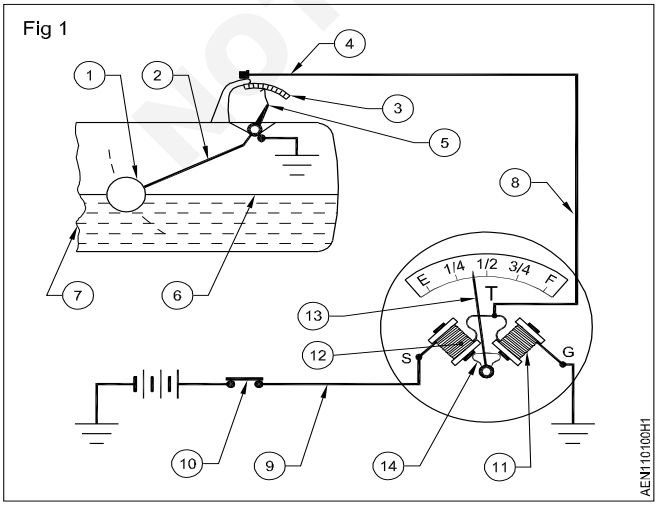
TASK: **Trouble shoot fuel gauge/ motor unit**

Troubles in fuel gauge unit (Fig 1 & 2) Causes and remedies of fuel gauge incorrect operation

Sl.No	Causes	Remedies
1	Float punctured	- Replace the float
2	Break up wire connection	- Check the wire connection
3	Empty fuel tank	- Fill up fuel in tank
4	Defective sending unit	- Change the sending unit
5	Damaged resistance	- Change the resistance
6	Fuel gauge defective	- Replace the gauge
7	Fuel gauge wire connection loose	- Tighten the wire connection
8	Sticky float unit	- Replace the float unit
9	Damaged ground wire in tank unit	- Check and correct it
10	Erratic float movement	- Repair or replace
11	Deformed bimetal element	- Replace
12	Open circuited heat wire	- Replace

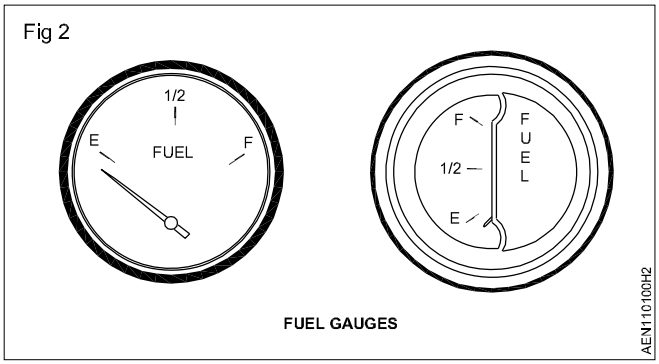
Tank unit (A)

Fig 1



Gauge unit (dash unit) (B)

Fig 2



FUEL GAUGES

Trouble shoot coolant temperature meter

Objectives: At the end of this exercise you shall be able to
- **identify the cause for engine coolant temperature meter not work**
- **replace the defective temperature sensors (ECT).**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multi meter - 1 No.
- Wire cutter - 1 No.
- Battery - 1 No.

Equipment / Machines

- Vehicle with ECU - 1 No.

Materials

- Emery sheet - As reqd.
- Insulation tape - As reqd.
- Bulb - As reqd.
- ECT sensor - As reqd.
- Thermostat - As reqd.
- Wire 3 mm, 4 mm - As reqd.
- Cotton waste - As reqd.
- Cleaning solvent - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK: **Trouble shoot coolant temperature meter**

1 Check the coolant level in radiator before start the engine.

2 Check the sensor wire connections

3 Check the power supply to sensor with help of multi meter

4 Check the engine working temperature (thermostat valve) during engine.

5 Check wire connection of temperature gauge before start (Fig 1 & 2)

6 Check temperature meter operation in running engine

Fig 1

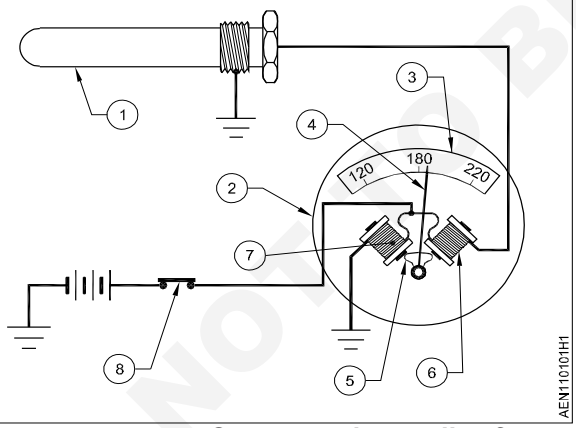
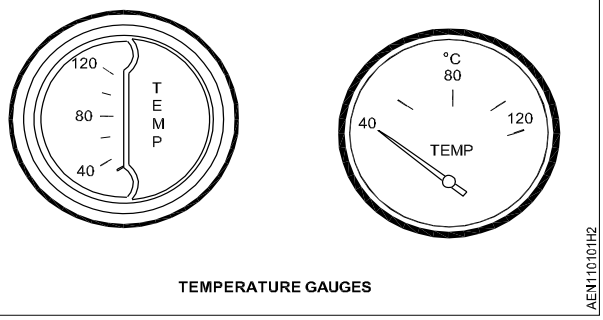


Fig 2



TEMPERATURE GAUGES

Causes and remedies for coolant temperature meter not work

Sl.No	Causes	Remedies
1	Defective temperature gauge	- Replace
2	Wire short circuit	- Tighten the wire connection
3	Defective coolant sensor	- Replace
4	Low water level in radiator	- Top up coolant
5	No wire connection	- Connect the wire with temperature gauge
6	No power supply	- Connect the power

Practice to trace the sealed beam, halogen sealed beam composite, HID and LED lights

Objective: At the end of this exercise you shall be able to
- **identify and trace the different types of lighting arrangements.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Test lamp - 1 No.
- Multimeter - 1 No.
- Lighting circuit diagram - 1 No.

Equipment / Machines

- Vehicle - 1 No.

Materials

- Bulb - As reqd.
- Halogen sealed beam - As reqd.
- LED lights - As reqd.
- Cotton waste - As reqd.
- Insulation tape - As reqd.
- Soap oil - As reqd.
- Wire - As reqd.
- Wire clip - As reqd.

PROCEDURE

TASK: **Trace the LED and halogen sealed beam and high intensity discharge head lights.**

1 Park the vehicle on the plain ground and ensure the vehicle and personal safety.

2 Study the lighting circuit diagram.

3 Trace the head light circuit.

4 Check the battery charge and its cable connection.

5 Check the head lights construction method.

6 If the head light is LED bulbs provided check the bulbs voltage value.

7 Check the standard bulb data.

8 Check the sealed beam mountings and alignments.

9 Check the halogen sealed beam composite constructions and mountings of sealed beam.

10 Check halogen sealed beam diodes and HID lights.

11 Study the HID head light and sealed beam head lights lens reflector and light source and its body construction.

12 Study the different type of head light assembly designs.

13 Compare the light source and power difference between different modules.

14 Note down the different type vehicle's head light type and bulb used.

Table - 1

S. No.	Vehicle Type	Head light type	Bulb used
1	TATA INDICA	LED	
2		Sealed beam	
3		Halogen sealed beam	
4		High intensity discharge	
5		Sealed beam	
6			
7			

— — — — — —

Practice to trouble shoot oil pressure warning light

Objectives: At the end of this exercise you shall be able to
- **identify the cause for oil pressure warning light dose not glow**
- **rectify the defects in oil pressure warning light.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multi Meter - 1 No.
- Wire cutter - 1 No.
- Battery - 1 No.

Equipment / Machines

- Running Vehicle - 1 No.

Materials

- Insulation tape - As reqd.
- Bulb - As reqd.
- Socket - As reqd.
- Sensor - As reqd.
- Wire - As reqd.
- Cotton waste - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK: **Trouble shoot oil pressure warning light**

1 Check the all lightening circuits for its proper function
2 Check the oil pressure switch wire connections
3 Check the oil pressure warning light bulb
4 Check the engine oil viscosity and oil level
5 Check the oil pressure sensor connections
6 Check the sensor wire short circuits
7 Check the oil pump and filter.

Oil pressure warning light does not light up when ignition switch is on at engine off.

Causes and remedies of oil pressure warming light does not light up

Sl No	Causes	Remedies
1	Lubrications system not working properly	- Over haul the lubrication system
2	Oil level is low	- Top up oil
3	Defective oil pressure gauge	- Change the gauge
4	Oil pressure relief valve defective	- Replace the valve
5	Clogged oil filter	- Change the filter
6	Defective, sensor oil pressure	- Replace
7	Warning light bulb fuse	- Replace
8	Oil pressure switch defective	- Replace
9	Oil pressure warning light wire short circuited	- Repair/Rectify
10	Oil pressure sensor wire loose connection	- Tight it.

— — — — — —

Practice to trouble shoot brake and parking warning light

Objectives: At the end of this exercise you shall be able to
- **identify the cause for brake and parking warning light**
- **rectify the defects in brake warning light.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multi Meter - 1 No.
- Wire cutter - 1 No.
- Battery - 1 No.

Equipment / Machines

- Running Vehicle - 1 No.

Materials

- Bulb - As reqd.
- Cotton waste - As reqd.
- Wire - As reqd.
- Soap oil - As reqd.
- Brake fluid - As reqd.

PROCEDURE

TASK: **Trouble shoot brake & parking warning light**

Brake warning light does light up

1 Check the brake fluid level in master cylinder
2 Check the brake light switch wire connections
3 Check the master cylinder operation
4 Check the brake light wire connections
5 Check the brake and parking light bulb.
6 Check the brake light wire continuity by multi meter
7 Check the parking brake mechanical linkage operation
8 Check the brake light wire ear thing
9 Check the brake light wire short circuit
10 If brake light stay on, check brake light switch and wire connection short circuited.

Note: Study the light wiring diagram for trace the fault easily

Causes and remedies for brake light does not glow

Sl No	Causes	Remedies
1	Wear and rust in linkage	- Change the linkage
2	Corrosion in joints	- Clean and lubricate
3	Defective switch	- Replace
4	Hand brake lever not fully release	- Replace or adjust
5	Brake light wire connection loose	- Tighten
6	Brake light bulb fuse	- Replace
7	Poor earthing in brake light	- Clean and refit the earthing wire
8	Brake fluid level low in master of cylinder	- Top-up
9	Defective brake light bulb holder	- Replace the holder
10	Improper power supply to brake light	- Rectify
11	Brake hand linkage disconnected	- Connect the linkage
12	Brake light switch short circuited	- Rectify

Practice to trouble shoot interior lights

Objectives: At the end of this exercise you shall be able to
- **identify the cause for interior light do not light up.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multi Meter - 1 No.
- Test lamp - 1 No.
- Wire cutter - 1 No.
- Battery - 1 No.

Materials

- Switch - As reqd.
- Bulb - As reqd.
- Cotton waste - As reqd.
- Wire - As reqd.
- Soap oil - As reqd.

Equipment / Machines

- Running Vehicle - 1 No.

PROCEDURE

TASK: **Trouble shoot interior lights**

1 Check interior light switches
2 Check interior light bulb
3 Check bulb voltage power
4 Check bulb holder
5 Check wire short circuits
6 Check bulb wire earth connections
7 Check wire continuity by multi meter Interior light does not glow.

Cause and remedies for interior light not lighting up

Sl No	Causes	Remedies
1	Light switch defective	- Replace
2	Interior light wire short circuited	- Rectify
3	Light sensor defective	- Replace
4	Bulb fuse	- Replace
5	Improper light connection	- Correct the connection
6	Bulb improperly seated	- Correct it.
7	Moisture in the bulb holder	- Clean and refit
8	Rusty in the earthing point	- Clean
9	No power supply to the bulb	- Check wire correction.

— — — — — —

Practice to check the flasher circuit

Objective: At the end of this exercise you shall be able to
- **identify the flasher light do not light up.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Multimeter - 1 No.

Equipment / Machines

- Running Vehicle - 1 No.

Materials

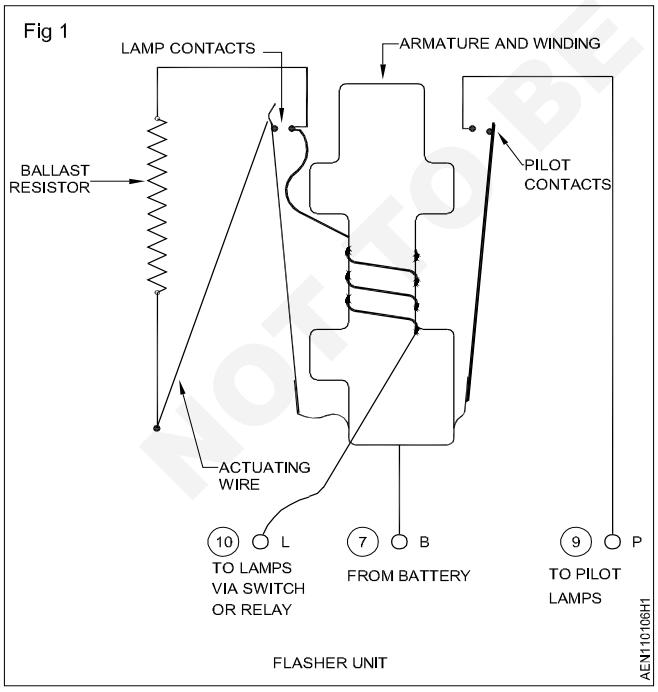
- Fuse - As reqd.
- Relay - As reqd.
- Cotton waste - As reqd.
- Soap oil - As reqd.
- Flasher unit - As reqd.

PROCEDURE

TASK 1: **Check the flasher unit circuit**

- Check the battery voltage with high rate discharge tester for its correct voltage.
- Check the specific gravity of the battery with the aid of a hydrometer.
- Check the fuse for proper condition.
- Check the bulbs if found fused replace the bulb
- Refer to the vehicle wiring diagram and check all the flasher circuit connections. (Fig 1)

Fig 1



- Check with a voltmeter and ensure that the flasher unit terminal B is at battery voltage with respect to earth.
- Connect the flasher unit terminal 'B' and 'L' together, and operate the direction indicator switch. If the flasher lamp glow, then the flasher unit is defective and must be replaced. Note the flasher unit cannot be repaired.

While replacing a flasher unit or when installing a flashing light system, test the circuits before connections to the flasher terminals 'L' 'B' and 'P' are made.

While testing, join the cables normally connected to these terminals together and operate the indicator switch. If the connections are wrong, the ignition auxiliaries fuse will blow but no damage will be done to the flasher unit.

TASK 2: **Check the flasher switch**

1 Check the wire connections to the flasher switch terminals for proper tightness.

2 Replace the switch, if found defective.

3 Check the bulbs for fused filaments.

4 Check the bulbs for any damage to the cap or contact point.

5 Replace the bulbs if found fused or damaged.

6 Trace the wiring from the battery (1) to the fuse (2). (Fig 2)

7 Trace the wiring from the fuse (2) to the flasher unit 'B's terminals (3).

8 Trace the wiring from the flasher unit "L's terminal (4) and to the two-way switch (5).

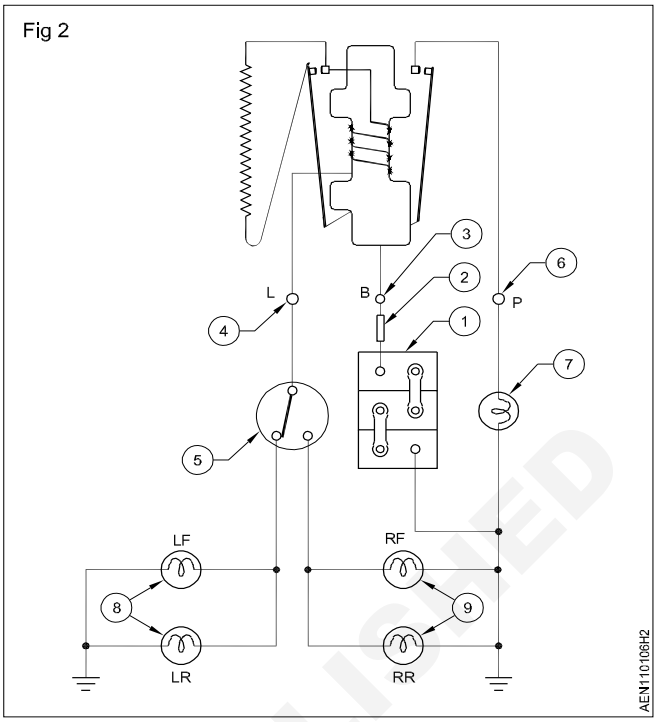
9 Trace the wiring from the flasher unit 'P's terminal (6) to the pilot lamp (7) in the dashboard.

10 Trace the wiring from the switch (5) to the left front lamp (8).

11 Trace the wiring from the switch (5) to the right rear lamp (9).

12 Trace the wiring from the switch (5) to the right rear lamp (9).

Fig 2



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Perform trouble shooting in horn assembly

Objectives: At the end of this exercise you shall be able to
- **identify fault in horn circuit**
- **trouble shoot fault rectification in horn circuit.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Test lamp - 1 No.

Equipment / Machines

- Running car - 1 No.

Materials

- Cotton waste - As reqd.
- Soap oil - As reqd.
- Insulation tape - As reqd.
- Wire - As reqd.
- Fuse - As reqd.

PROCEDURE

TASK: **Identify fault in horn circuit**

1 Locate the horn assembly.

2 Check the horn connections.

3 Check the function of the horn assembly.

4 If found defective horn, remove the horn electrical connections.

5 Dismount the horn mounting bolts.

6 Remove the horn assembly from the vehicle.

7 Select the suitable horn assembly.

8 Mount the horn assembly on the vehicle and connect horn wires and test and tune up the horn.

Horn trouble shooting

Horn not operate		
Sl No	**Causes**	**Remedies**
1	Horn push button defective	- Replace
2	Horn contact point burnt	- Replace
3	More gap between horn point	- Adjust
4	Wire disconnected	- Connect wire
5	Loose earthing contact	- Tighten the earth wire
6	Damaged diaphragm	- Replace

Poor sound quality		
Sl No	**Causes**	**Remedies**
1	Low voltage supply	- Check battery, charging system
2	Improper horn tone adjustment	- Adjust for proper turning
3	Wire loose connection	- Tighten the wire connection
4	Improper contact of horn switch	- Replace
5	Horn diaphragm assembly defective	- Replace

Horn sounds continuously		
Sl No	**Causes**	**Remedies**
1	Horn switch defective	- Replace
2	Horn magnetic switch defective	- Replace
3	Power continues supply	- Disconnect the power

Overhaul the wiper motor assembly

Objectives: At the end of this exercise you shall be able to
- **remove the wiper blades and wiper motor assembly from the vehicle**
- **dismantle the wiper motor assembly, clean and inspect parts**
- **assemble the wiper motor and test**
- **refit wiper motor assembly and blades on vehicle.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 Set
- Multimeter - 1 No.

Equipment / Machines

- Running car - 1 No.

Materials

- Wiper blade - As reqd.
- Emery sheet - As reqd.
- Cotton waste - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK 1: **Remove the wiper blades and wiper motor assembly from the vehicle**

- Loosen the wiper blades fixing bolt/screw.
- Pull out the blade assembly from the milling
- Disconnect the wires from the wiper motor.
- Disconnect the operating lever/cables.
- Loosen the mounting bolts and nuts.
- Remove the motor with the extending arm.

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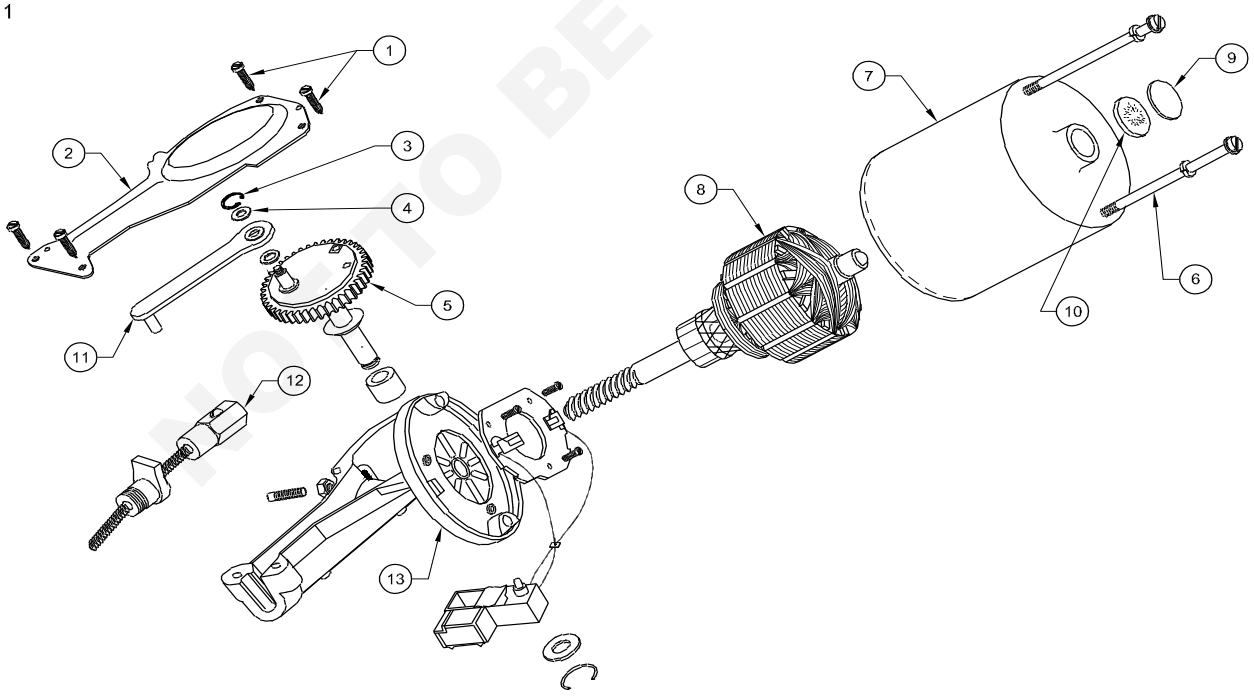
TASK 2: **Dismantle the wiper motor assembly, clean and inspect parts (Fig 1)**

Fig 1



EXPLODED VIEW OF 14W WIPER MOTOR

AEN110108H1

1 Remove the gearbox's cover fixing screws (1) and lift the cover (2). Remove the circlip (3) and the flat washer (4).

2 Remove the gear (5) assembly and connecting rod (11)

3 Remove the through bolts (6) from the motor housing (7)

4 Remove the housing carefully and place it vertically.

5 Remove the armature (8) from the gearbox housing.

6 Clean the dust and dirt from all the parts by using a nylon brush and cloth.

7 Testing motor field winding armature brush and brush tension spring.

8 Visually check the gear wheel teeth for damage or wear. Replace, if necessary.

— — — — — —

TASK 3: **Assemble the wiper motor and test**

1 Before assembling lubricate the - gear worm gear - wheel and worm with grease, and the armature shaft bearing surface, bearing bushes, gearwheel shaft and crankpin with SAE-40 oil.

2 Refit the armature to the housing, ensure that the thrust disc (9) and the felt washer (10) are in place. Place the armature through the housing (7) and tighten the through bolts (6) with the gearbox mounting cover (13).

3 Fit the gear and plate assembly (5) with the bush.

4 Fit the connecting rod (11) with a flat washer (4) and circuit (3).

5 Check the connecting rod and pin, fixed in the cable rack assembly (12).

6 Fit the gearbox cover (2) in its position and tighten the fixing screws (1).

Testing (Fig 2)

7 Measure the supply voltage, by connecting the wiper as shown in Fig 2.Switch on the motor and measure the voltage between the motor supply terminal (2) and the good earthing point with a voltmeter.

8 If the reading is low, check the battery cable connections and the panel switch (1) .

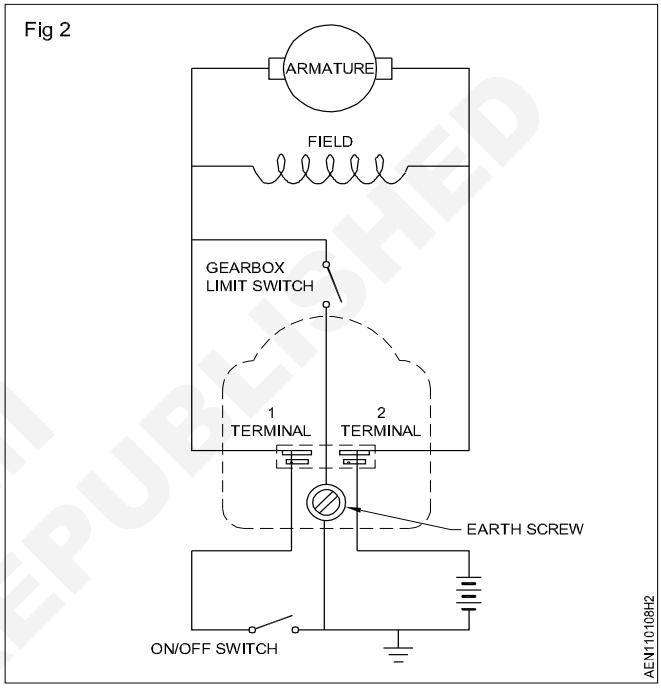
9 Disconnect the cable rack and measure the no-load running current with an ammeter connected in the supply line. (2.5 A to 3.5 A)

10 Carry out no-load test

11 Connect the wires to the motor and effect supply. Check at what voltage the motor starts functioning at no-load.

12 For a 12 volt system the motor should start running from 4 volts.

Fig 2



13 Check the cable rack.

14 Check the maximum force to move the cable rack by hooking the spring balance.

The maximum permissible force is 2.7 kgs.

15 Check out final checking.

16 Test the wiping speed of the motor. It should be between 45 and 50 cycles/ minute.

— — — — — —

TASK 4: **Refit wiper motor assembly and blades on the vehicle and check for its operation**

1 Place the motor in its place.

2 Tighten the mounting bolts and nuts.

3 Connect the wires to the motor.

4 Ensure that the gearbox spindles are in the correct position by switching on and switching off and allowing them to come to rest at the end of the cycle.

5 Fit the arms and blades to the splinted driving drums on the gearbox spindle at the correct parking angle.

6 Press the headpiece until the retaining clip sound is heard to snap over the end of the drum.

7 Switch on and note the wiped areas. If necessary, change the position of the arms by removing and refitting them in the appropriate position.

8 Do not attempt to turn the spindle by hand force.

— — — — — —

Check and replace the wiper blade

Objectives: At the end of this exercise you shall be able to
- **check the wiper blade**
- **replace the wiper blade.**

Requirements

Tools / Instruments		Materials	
• Trainee's tool kit	- 1 Set	• Wiper blade	- As reqd.
Equipment / Machines		• Wiper motor	- As reqd.
		• Wiper blade mounting net	- As reqd.
• Running car	- 1 No.	• Cotton waste	- As reqd.
		• Soap oil	- As reqd.

PROCEDURE

TASK 1: **Check and replace wiper blade**

1 Identify the wind shield wiper blade
2 Lift the wiper blade arm away from the wind shield
3 Look for damage or loss of resistance in the material
4 If found wiper blade is damaged loose the mounting of wiper arm
5 Remove the wiper blade assembly from mountings
6 Select the new wiper blade assembly
7 Measure the wiper blade with steel rules
8 Ensure the new blade is as same the old wiper blade
9 Install the new wiper blade and tight the mounting nut
10 Test the wiper operation with wind shield, if need realign the wiper blade
11 Operate the wipers to check their performance
12 Make sure wiper blade removes the water evenly

Note: Never operate the wiper on dry wind shield glass that will damage blade and make a scratches on wind shield glass

Perform trouble shoot in wind shield wiper

Objective: At the end of this exercise you shall be able to
- **identify defects in wiper motor and blades.**

Requirements

Tools / Instruments
- Trainee's tool kit - 1 No.

Equipment / Machines
- Running car - 1 No.

Materials
- Wiper motor - 1 No.
- Wiper blade - 1 No.
- Wiper nozzle - 1 No.
- Washer - 1 No.
- Washer container - 1 No.

PROCEDURE

TASK: **Identify fault is wind shield wiper**

1 Check the wiper switch and blade
2 Check the wind shield water sprayer
3 Check the electrical wire connections
4 Check the wiper blade movements.

Trouble shooting

Wind shield wiper not work		
Sl No	**Causes**	**Remedies**
1	Wiper blade unserviceable	- Replace
2	Wiper motor not work	- Repair / replace
3	Wiper blade loose mounting	- Tighten the mounting
4	Wiper motor loose fitting	- Tighten the loose fitting
5	Wiper motor gear teeth worn out	- Replace the gears
6	Wiper connecting rod bend	- Replace
7	Wiper motor noise	- Repair / Lubricate
8	Wiper motor armature short circuit	- Replace armature
9	Wiper switch defective	- Replace
10	Wiper blade misalignment	- Adjust the wiper blade

Trouble shooting in wind shield water sprayer		
Sl No	**Causes**	**Remedies**
1	No water in washer container	- Fill water
2	Washer operating switch defective	- Replace
3	Washer spray jet nozzles defective	- Replace
4	Water leak in jet nozzle connection	- Rectify
5	Washer water pumping motor defective	- Repair / replace
6	Wire loose connection	- Tighten the water connection

Check and replace wind shield washer

Objectives: At the end of this exercise you shall be able to
- **diagnose causes for improper operation of wind shield washer**
- **replace the wind shield washer pump.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipment / Machines

- Running car - 1 No.

Materials

- Water spray jet - 2 Nos.
- Pump for wing shield washer - 1 No.
- Cotton waste - As reqd.
- Soap oil - As reqd.
- Rubber tube - As reqd.

PROCEDURE

TASK: **Check and replace the wind shield washer pump**

1 Switch on the ignition key

2 Check water level in wind shield washer bowel

3 Check the wire connections and switches, if defective switch replace it

4 Check the water spray jets for jet holes and water tube connection

5 Operate the wind shield washer pump and check the function of it

6 If found pump is defective, replace the pump

7 Check the jet spray if improper spray clean the hole or replace the spray jets

8 If found clogged water tube, replace water tube (Pump to jet)

9 If found water spray in low pressure, means Low power supply to the pump, provide proper power to the motor

10 If found dirty water replace the water.

— — — — — —

Check and replace power window

Objectives: At the end of this exercise you shall be able to
- **diagnose the fault in power window**
- **rectify the fault of power window.**

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.

Equipment / Machines

- Running car - 1 No.

Materials

- Power window - As reqd.
- Mounting bolts - As reqd.
- Washers - As reqd.
- Cotton waste - As reqd.
- Soap oil - As reqd.

PROCEDURE

TASK: **Diagnose the fault of power window**

1 Switch on the ignition Key

2 Locate the power window switches

3 Check the all power window operating switches function

4 Operate the power window switches one by one

5 If found switch is defective replace it

6 Check the window glass movements/operation, if found the improper operation of power window glass then check the door glass channels and power window motor

7 If window glass door channels are unserviceable, replace it

8 When power window glass operating switch is on but there is no window glass movement, means motor is defective, replace the motor

9 If motor is running properly but glass is not lifting means window glass lifting regulator is defective, replace it.

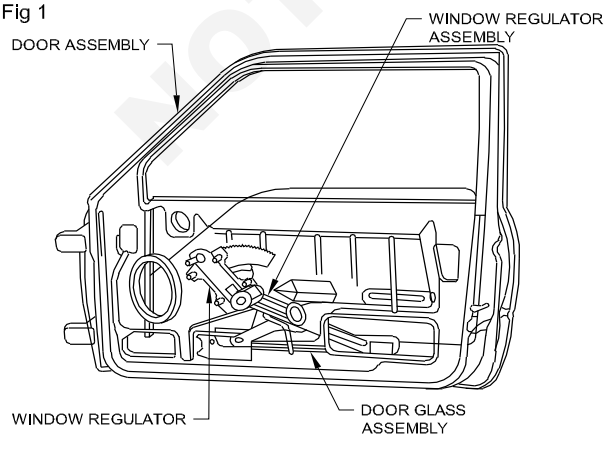
10 Check the power window for external and internal damages, if any major damage in door, replace the door with new one

Check the door lock mechanism and rectify the defects

Objective: This you shall be able to
- **diagnose and service power door lock problems.**

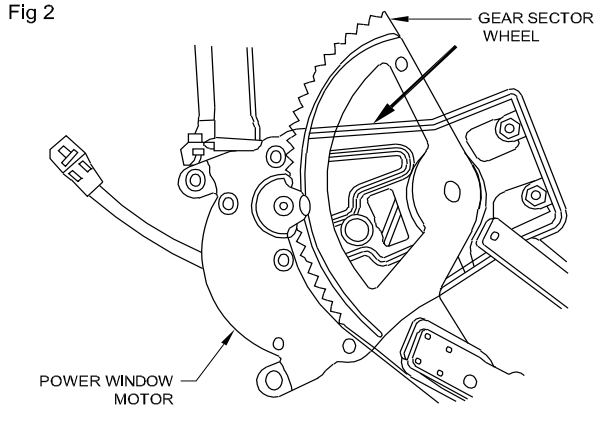
TASK: **Power door lock problem (Fig 1 & 2)**

Fig 1



STARTING MOTOR SWITCHED OFF ARMATURE STATIONARY

Fig 2



STARTING MOTOR SWITCHED OFF ARMATURE STATIONARY

1 Remove the door lock control switch

2 Disconnect the probes

3 Check power is available at the probes

4 If the power is not available with the probes, trace the circuit till the problem is located (Fig 3 & 4)

5 Check the switch for continuity. If there is no continuity, switch faulty. replace the switch.

6 Remove the door panel. check the continuity in the door lock solenoid.

7 If there is no continuity, check the wiring between the switch and solenoid.

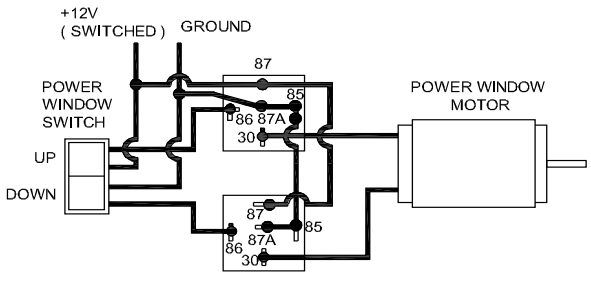
8 Check the lock mechanism and the linkage for sticking, misaligned or bent linkage.

9 Check the solenoid is properly earthed.

10 Reassemble the solenoid, locks and door panel.

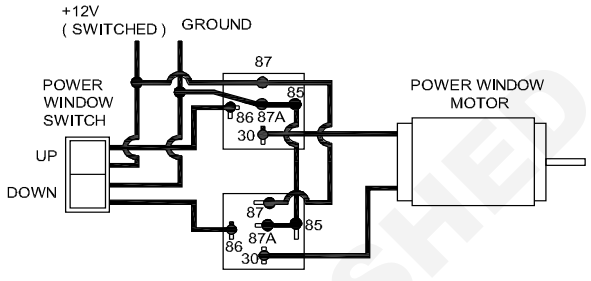
11 Check the door lock operation and ensure the proper performance of door lock.

Fig 3



POWER WINDOW (DRIVER'S) CIRCUIT

Fig 4



POWER WINDOW (PASSENGER'S) CIRCUIT