

MECHANIC AUTO BODY REPAIR

NSQF LEVEL - 3

TRADE PRACTICAL

SECTOR: AUTOMOTIVE

(As per revised syllabus July 2022 - 1200 Hrs)



Directorate General of Training

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



**NATIONAL INSTRUCTIONAL
MEDIA INSTITUTE, CHENNAI**

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

Sector : Automotive

Duration : 1 Year

**Trade : Mechanic Auto Body Repair - Trade Practical - NSQF Level - 3
(Revised 2022)**

Developed & Published by



National Instructional Media Institute

Post Box No.3142

Guindy, Chennai - 32

INDIA

Email: chennai-nimi@nic.in

Website: www.nimi.gov.in

Copyright © 2022 National Instructional Media Institute, Chennai

First Edition : October 2022

Copies: 250

RS.285/-

All rights reserved.

No part of this publication can be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording or any information storage and retrieval system, without permission in writing from the National Instructional Media Institute, Chennai.

FOREWORD

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

The National Instructional Media Institute (NIMI), Chennai has now come up with instructional material to suit the revised curriculum for **Mechanic Auto Body Repair- 1 Year - Trade Practical - NSQF Level - 3 (Revised 2022) in Automotive Sector under Annual Pattern**. The NSQF Level - 3 (Revised 2022) Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 3 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 3 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these 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 the Federal Republic of Germany. The prime objective of this institute is to develop and provide instructional materials for various trades as per the prescribed syllabi under the Craftsman and Apprenticeship Training Schemes.

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

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

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

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

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

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

Chennai - 600 032

EXECUTIVE DIRECTOR

ACKNOWLEDGEMENT

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

MEDIA DEVELOPMENT COMMITTEE MEMBERS

- | | | |
|--------------------------|---|--|
| Shri. P.N. Sivakumar Rao | - | Asst. Training Officer,
Govt. I.T.I, Chengalpattu. |
| Shri. A. Muthuvel | - | Junior Training Officer,
Govt. I.T.I, Nagapattinam. |
| Shri. N. Bharath Kumar | - | Junior Training Officer,
Govt. I.T.I, Ulundurpet. |
| Ms. G. Pavithra | - | Junior Training Officer,
Govt. I.T.I, Sankarapuram. |
| Shri. A. Thangavelu | - | Asst. Training Officer (Retd.),
Govt. I.T.I, Chennai. |

NIMI CO-ORDINATORS

- | | | |
|-------------------------|---|---|
| Shri. Nirmalya Nath | - | Deputy Director of Training,
NIMI, Chennai - 32. |
| Shri. S. Gopalakrishnan | - | Assistant Manager,
NIMI, Chennai - 32. |

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

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

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

INTRODUCTION

TRADE PRACTICAL

The trade practical manual is intended to be used in practical workshop. It consists of a series of practical exercises to be completed by the trainees during the Course of the **Mechanic Auto Body Repair** Trade supplemented and supported by instructions/ informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in compliance with NSQF LEVEL - 3 (Revised 2022) syllabus are covered.

Module 1	Workshop safety practices
Module 2	Hand and power tools
Module 3	Basic electricity
Module 4	Hydraulics, pneumatics and auto industry development
Module 5	Vehicle construction technology and compressor air system
Module 6	Welding technology
Module 7	Auto body sheet metal repair
Module 8	Auto body paint technology
Module 9	Auto body plastic repair technology
Module 10	Auto body parts and unibody/frame alignment

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 Diesel Trade. The contents are sequenced according to the practical exercise contained in NSQF LEVEL - 3 (Revised 2022) syllabus on Trade practical. Attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This correlation is maintained to help the trainees to develop the perceptual capabilities for performing the skills.

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

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

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

CONTENTS

Exercise No.	Title of the Exercise	Leaning Outcome	Page. No.
Module 1 : Workshop Safety Practice			
1.1.01	Practice on visit all sections of institute and importance of the trade	1	1
1.1.02	Practice on identify the machinery used in autobody repair shop		2
1.1.03	Identify the work done by the trainee's in auto body repair shop floor		4
1.1.04	Practice on use the practical related safety and health		6
1.1.05	Practice on work shop maintenance		9
1.1.06	Practice on fire extinguishers		11
1.1.07	Handling and testing of workshop equipments		14
1.1.08	Practice on saving electrical energy and safety disposable of used engine oil		15
Module 2 : Hand and Power Tools			
1.2.09	Marking practice on the given job		19
1.2.10	Layout and marking		23
1.2.11	Practice on measure the wheel base of a vehicle		27
1.2.12	Practice on removing wheel lug nuts		29
1.2.13	Practice on handling hand tools and power tools	1	30
1.2.14	Handling of pipe flaring & cutting tools	2	36
1.2.15	Practice on visual identification of materials used in autobody repair shop		42
1.2.16	Practice on trouble shooting of air drills		43
1.2.17	Practice on trouble shooting in air ratchets and air wrenches		45
1.2.18	Practice on trouble shooting in hydraulic tool leaks under pressure		46
1.2.19	Practice on trouble shooting of hydraulic tool handle kick back		47
1.2.20	Measuring practice on engine components	3	48
1.2.21	Practice on use of nuts, bolts & studs	4	50
1.2.22	Removing broken stud/bolt from blind hole		54
1.2.23	Practice on using various cutting tools		56
1.2.24	Practice on hacksaw - cutting and filling		63
1.2.25	Practice on drilling clear and blind hole and sharpening of drills		64
1.2.26	Safety precautions while using drilling machine		69
1.2.27	Practice on tapping a clear and blind hole		70
1.2.28	Practice on use of tap extractor cutting threads on a bolt/stud		74
1.2.29	Practice on making rectangular tray		76
1.2.30	Practice on soldering & brazing of pipes		79
Module 3 : Basic Electricity			
1.3.31	Practice on soldering wires	5	81
1.3.32	Practice on measuring electrical parameters in circuits		85
1.3.33	Practice on continuity test of electrical circuit		87
1.3.34	Test voltage drop in a circuit		90

Exercise No.	Title of the Exercise	Leaning Outcome	Page. No.	
Module 4 : Hydraulics, Pneumatics & Auto Industry Development				
1.4.35	Identification of Hydraulics and pneumatic components of vehicle	6	92	
1.4.36	Identify the different types of vehicle		94	
1.4.37	Studying vehicle specification data		95	
1.4.38	Identification of Vehicle Information Number (VIN)		97	
1.4.39	Practice on garage service station equipments		98	
1.4.40	Practice on garage equipments		101	
Module 5 : Vehicle Construction Technology and Compressor Air System				
1.5.41	Practice on preparation of vehicle accident report	7	103	
1.5.42	Practice on prepare the body shop repair sequence of a vehicle		104	
1.5.43	Identification of different type of body chassis and drive lines		105	
1.5.44	Practice on identify the location of vehicle parts and panels		108	
1.5.45	Practice on identify the parts of unibody design vehicle		110	
1.5.46	Practice on identify the front and rear body structural components of unibody sedan		111	
1.5.47	Practice on identify the under body front and rear section structural components of unibody sedan		113	
1.5.48	Practice on identify the front and rear body structural components of mid engine vehicle		114	
1.5.49	Practice on identify the parts of a full frame of pick up truck and sport utility vehicle		116	
1.5.50	Practice on use of computer - based service information		118	
1.5.51	Practice on identify the parts of stationary air compressor		8	119
1.5.52	Practice on check the air compressor air filter, head fins and air inter cooler			121
1.5.53	Practice on check the air filter element and adjust the pressure switch cut in and cut out			122
1.5.54	Practice on align a loose air compressor drive motor pulley	123		
1.5.55	Practice on check the air leaks of air compressor out fit air piping system	124		
Module 6 : Welding Technology				
1.6.56	Practice on identify the parts of oxy-acetylene welding equipments	9	126	
1.6.57	Practice on oxy-acetylene gas welding, brazing and soldering process		127	
1.6.58	Practice on torch flame adjustment		134	
1.6.59	Practice on identify the different parts of MIG welding machine		135	
1.6.60	Practice on surface preparation and setting of MIG and plug welding parameters		137	
1.6.61	Practice on spraying antispatter compound into a MIG nozzle		139	
1.6.62	Practice on basic welding techniques and identify the parts of spot welding machine		141	
1.6.63	Practice on resistance spot welding process		144	

Exercise No.	Title of the Exercise	Leaning Outcome	Page. No.
1.6.64	Practice on tip dressing, tip changing, weld test and check the spot weld quality		146
1.6.65	Practice on plasma cutting operation		148
	Module 7 : Auto body Sheet metal Repair		
1.7.66	Practice on minor repair of damaged car	10	150
1.7.67	Practice on using a hammer and dolly for straighten the damaged door		151
1.7.68	Practice on a long spoon to pryout a fender		152
1.7.69	Practice on using pry picks to remove small dents		153
1.7.70	Practice on using dent puller to pull out minor damage		154
1.7.71	Practice on using a spot weld dent puller to remove dents		155
	Module 8 : Auto body Paint Technology		
1.8.72	Practice on paint stripping by using single action sander		157
1.8.73	Practice on maintenance of single action sander		159
1.8.74	Practice on Auto Body filler application and quality sanding		160
	Module 9 : Auto body Plastic Repair Technology		
1.9.75	Practice on identify the thermoplastics and thermosetting of plastics	11	162
1.9.76	Practice on identify the common automotive plastic parts		165
1.9.77	Practice on using chemical adhesive bonding techniques to plastic repair		167
1.9.78	Practice on using heat to reshape the plastics		168
1.9.79	Practice on hood removal as per procedure	12	170
1.9.80	Practice on vehicle hood adjustment		171
1.9.81	Practice on removal and installing the fenders		176
	Module 10 : Auto Body Parts and Unibody/Frame Alignment		
1.10.82	Practice on removing wind shield and rubber gasket service		179
1.10.83	Practice on aligning wind shield into position		181
1.10.84	Practice on using a adhesive sealer gun		183
1.10.85	Practice on identify the basic parts of a door assembly		184
1.10.86	Practice on power window servicing		185
1.10.87	Practice on door glass adjustment and roof panel service		189
1.10.88	Practice on identification the parts of passenger compartment		193
1.10.89	Practice on passenger seat and dash panel service		195
1.10.90	Practice on instrument cluster & head liner service		199
1.10.91	Practice on checking drain hoses, wind noise, repairing leaks and rattle elimination of unibody		201
1.10.92	Practice on use of trame gauge for upper body damage measurement	13	203
1.10.93	Practice on measurement of front and rear body damage		205
1.10.94	Practice on identify the impact damage of vehicle body		208
1.10.95	Practice on universal measuring and computerized measuring system		210
1.10.96	Practice on analyzing the length, width and height of damaged parts	14	212
1.10.97	Practice on repair the damaged parts of Unibody vehicle		215

LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

S.No.	Learning Outcome	Ref. Ex.No.
1	Check & perform Measuring & marking by using various Measuring & Marking tools following safety precaution (Vernier Caliper, Micrometer, Telescope gauges, Dial bore gauges, Dial indicators, straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.)	1.1.01 - 1.2.13
2	Plan & perform basic fastening & fitting operation by using correct hand tools, Machine tools & equipments.	1.2.14 - 1.2.19
3	Check & perform Measuring & marking by using various Measuring & Marking tools following safety precaution (Vernier Calliper, Micrometer, Telescope gauges, Dial bore gauges, Dial indicators, straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.)	1.2.20
4	Plan & perform basic fastening & fitting operation by using correct hand tools, Machine tools & equipments	1.2.21 - 1.2.30
5	Trace and Test all Electrical & Electronic components & circuits and assemble circuit to ensure functionality of system.	1.3.31 - 1.4.35
6	Check & Interpret Vehicle Specification data and VIN Select & operate various Service Station Equipments.	1.4.36 - 1.4.40
7	Assess damage to Vehicle and identify repair and replacement needs	1.5.41 - 1.5.50
8	Identify various vehicle parts and Service, Repair and Maintenance of Air compressor and Air Lines.	1.5.51 - 1.5.55
9	Demonstrate the proper operation and methods of welding and cutting equipment including plasma arc cutting processes	1.6.56 - 1.6.65
10	Analyze minor body damage and perform repair following sequential procedures involved in metal damage repair.	1.7.66 - 1.8.74
11	Evaluate and repair damage plastic part.	1.9.75 - 1.9.78
12	Demonstrate glasses, body parts and door fitting and repairing process	1.9.79 - 1.10.91
13	Demonstrate knowledge of the procedures for diagnosing structural collision damage and measuring systems to identify location and extent of damage	1.10.92 - 1.10.95
14	Demonstrate how to use frame straightening equipment and re-alignment procedures along with various anchoring methods and ensuring the structural integrity of the vehicle and occupant safety.	1.10.96 & 1.10.97

SYLLABUS

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
Professional Skill 86 Hrs; Professional Knowledge 13 Hrs	Check & perform Measuring & marking by using various Measuring & Marking tools following safety precaution (Vernier Caliper, Micrometer, Telescope gauges, Dial bore gauges, Dial indicators, straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.)	<ol style="list-style-type: none"> 1. Familiarization with institute, Job opportunities in the automobile sector.(04 hrs) 2. Machinery used in Trade. (08 hrs) 3. Types of work done by the students in the shop floor. (10hrs) 	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. (03 hrs)
		<ol style="list-style-type: none"> 4. Practical related to Safety and Health.(5 hrs) 5. Importance of maintenance and cleanliness of Workshop. (2 hrs) 6. Use of fire extinguishers. (5 hrs) 7. Demonstration on safe handling and Periodic testing of lifting equipment. (5 hrs) 8. Safety disposal of used engine oil. Energy saving Tips/Audit of ITI electricity Usage.(5 hrs) 	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, Safety disposal of Used engine oil, Electrical safety tips. Hazard identification, spatter hazard etc and countermeasure to eliminate them & importance of usage of PPEs.(03 hrs)
		<ol style="list-style-type: none"> 9. Practice using all marking aids, like steel rule with spring calipers, dividers, scribe, punches, Chisel etc.(12 hrs) 10. Layout a work piece- for line, circle, arcs and circles.(10 hrs) 11. Practice to measure a wheel base of a vehicle with measuring tape.(5 hrs) 12. Practice to remove wheel lug nuts with use of an air impact wrench. (05 hrs) 13. Practice on General workshop tools & power tools and equipments.(10hrs) 	Hand 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, scribe, punches-prick punch, center punch, pin punch, hollow punch, number and letter punch. Chisel-flat, cross-cut. Hammer-ball pein, lump, mallet. , Different type of -body hammers, pick hammers, , Bumping hammers, finishing hammers, dolly block, and body spoon, body picks, body pullers and pull rods, suction cup, scratch awl,

			<p>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, Nippers or pincer pliers, Metal cutting shears- Tin snips, sheet metal cutting pliers, (Aviation snips), panel cutters, trim and upholstery tools, Door handle tool (clip pullers), Metal files-reveal file, surform file, sanding board, sanding block, spreaders and squeegees. (07 hrs)</p>
<p>Professional Skill 46 Hrs; Professional Knowledge 10 Hrs</p>	<p>Plan & perform basic fastening & fitting operation by using correct hand tools, Machine tools & equipments</p>	<p>14. Practice on General workshop tools & power tools and equipments. (05 hrs) 15. Practice on visual Identification of materials used in workshop.(08 hrs) 16. Trouble shooting for Air drills- Tool will not run, Tool locked up, spindle will not run, tool will not shutoff, Trouble shooting for Air hammers-tool will not run, chisel stuck in nozzle.(10hrs) 17. Trouble shooting for Air ratchet-Motor runs, spindle does not turn or turns erratically, motor will not run, Trouble shooting for Air Wrenches-Tools run slowly & not at all.(10hrs) 18. Tool will not retract tool leaks under pressure. (08 hrs) 19. Handle kickback, works properly onetime but not the next.(5 hrs)</p>	<p>Power Tools:- Air powered tools - Advantage over electrical powered tools, Construction and its parts of air spray gun, Air drill, air screw drivers, air sanders-disc type and dual action(finishing) sander, Different type of air grinders, air saw, air scraper, air shear, air nibblers, air chuck, air polishers/buffers, media blasting (sand blasting), plastic media blasting, soda blasters, maintenance of pneumatic tools. air impact wrench, air ratchet, air drill, spot weld remover air drill, spot weld cutter-drill type & Hole saw type, air chisel, air blowgun, Spray guns, wrenches- Torque wrenches, pipe wrenches, car jet washers Pipe flaring & cutting tool. Vacuum cleaner, power washers, Heat gun, Hydraulically powered shop equipment- Hand or bottle jacks, Transmission jack, service jack, Frame rack, Maintenance of hydraulic tools, hydraulic lifts. Engine crane. (10 hrs)</p>

<p>Professional Skill 20 Hrs;</p> <p>Professional Knowledge 04 Hrs.</p>	<p>Check & perform Measuring & marking by using various Measuring & Marking tools following safety precaution (Vernier Calliper, Micrometer, Telescope gauges, Dial bore gauges, Dial indicators, straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.)</p>	<p>20. Measuring practice on different components.(20 hrs)</p>	<p>Systems of measurement:</p> <p>Description, care & use of Micrometers - Outside and depth micrometer, Micrometer adjustments, Vernier calipers. (04 hrs)</p>
<p>Professional Skill 98 Hrs;</p> <p>Professional Knowledge 15 Hrs</p>	<p>Plan & perform basic fastening & fitting operation by using correct hand tools, Machine tools & equipments.</p>	<p>21. Practice on General cleaning, checking and use of nut , bolts, & studs etc.(12 hrs)</p> <p>22. Removal of stud/bolt from blind hole.(08 hrs)</p>	<p>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. Description of Riveting tools. (03 hrs)</p>
		<p>23. Practice on cutting tools like Hacksaw, file, chisel, OFF-hand grinding with sander, bench and pedestal grinders, safety precautions while grinding.(15 hrs)</p> <p>24. Practice on Hacksawing and filing to given dimensions. (10 hrs)</p>	<p>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., chisel, OFF-hand grinding with sander, bench and pedestal grinders, safety precautions while grinding. (03 hrs)</p>
		<p>25. Practice on Marking and Drilling clear and Blind Holes, Sharpening of Twist Drill.(10hrs)</p> <p>26. Safety precautions to be observed while using a drilling machine. (08 hrs)</p> <p>27. Practice on Tapping a Clear and Blind Hole, Selection of tape drill Size, use of Lubrication.(10hrs)</p> <p>28. Use of tap extractor, Cutting Threads on a Bolt/ Stud.(10hrs)</p> <p>29. Practice on making Rectangular Tray. (05 hrs)</p> <p>30. Soldering and Brazing of Pipes. (10 hrs)</p>	<p>Drilling machine -Description and study of Bench type Drilling machine, Portable electrical Drilling machine, drill holding devices, Drill bits.</p> <p>Taps and Dies: Hand Taps and wrenches, Different type of Die and Die stock. Screw extractors.</p> <p>Hand Reamers - Different Type of hand reamers.(05 hrs)</p> <p>Sheet metal - State the various common metal Sheets used in Sheet Metal shop. Sheet metal operations - Shearing, bending, Drawing, Squeezing.</p> <p>Sheet metal joints - Hem & Seam Joints Fastening Methods - Riveting, soldering, Brazing. fluxes used on common joints. Sheet and wire-gauges. The blow lamp- its uses and pipe fittings. (04 hrs)</p>

Professional Skill 38 Hrs; Professional Knowledge 05 Hrs	Trace and Test all Electrical & Electronic components & circuits and assemble circuit to ensure functionality of system.	31.Practice in joining wires using soldering Iron. (4 hrs) 32.Measuring of current, voltage and resistance. (03 hrs) 33.Using digital multimeter, practice continuity test for fuses, jumper wires, fusible links, circuit breakers. (6 hrs)	Basic electricity, Electricity principles, Ohm's law, Voltage, Current, Resistance, Power, Energy. Voltmeter, ammeter, Ohmmeter Multimeter, Conductors & insulators, Wires.(03 hrs)
		34.Perform voltage drop test in circuits using multimeter, measure current flow using multimeter /ammeter. (10hrs) 35.Identification of Hydraulic and pneumatic components used in vehicle. (15hrs)	Introduction to Hydraulics & Pneumatics: - Definition of Pascal law, pressure, Force, viscosity. Pneumatic Symbols. (02 hrs)
Professional Skill 25 Hrs; Professional Knowledge 03 Hrs	Check & Interpret Vehicle Specification data and VIN Select & operate various Service Station Equipments.	36.Identification of different type of Vehicle. (5 hrs) 37.Demonstration of vehicle specification data. (5 hrs) 38.Identification of vehicle information Number (VIN). (5 hrs) 39.Demonstration of Garage, Service station equipments.(5 hrs) 40.Vehicle hoists - Two post and four post hoist, Engine hoists, Jacks, Stands. (5 hrs)	Auto Industry - History, leading manufacturers, development in automobile industry, trends, new product. Brief about Ministry of Road transport & Highways, The Automotive Research Association of India (ARAI), National Automotive Testing and R&D Infrastructure Project (NATRIP), & Automobile Association. Definition: - Classification of vehicles on the basis of load as per central motor vehicle rule, wheels, final drive, and fuel used, axles, position of engine and steering transmission, body and load. Brief description and uses of Vehicle hoists - Two post and four post hoist, Engine hoists, Jacks, Stands. (03 hrs)
Professional Skill 75 Hrs; Professional Knowledge 14 Hrs	Assess damage to Vehicle and identify repair and replacement needs	41.Practice on preparation of accident report. (15hrs) 42.Preparation of Body shop repair sequence procedures. Washing of vehicle.(5 hrs) 43.Identification of different type body, chassis, Drive lines.(05 hrs) 44.Identify the location of parts and panels. (5 hrs) 45.Identify the parts of unibody design vehicle. (5 hrs) 46.Identify the front body structural components of a transverse-mounted engine of FWD vehicle. Identify the rear body structural components of a unibody sedan. (5 hrs)	Introduction to Engine: Description of internal & external combustion engines, Classification of IC engines, Principle & working of 2&4-stroke diesel engine (Compression ignition Engine (C.I)), Principle of Spark Ignition Engine(SI), differentiate between 2-stroke and 4 stroke, C.I engine and S.I Engine, Technical terms used in engine, Engine specification.. Vehicle construction Technology: Definition of collision repair, body shop, classification of body shop-Independent body shop, dealership body shop, specialty

		<p>47. Identify the under body front and rear section structural components of a unibody sedan. (5 hrs)</p> <p>48. Identify the front, rear body structural components of mid-engine vehicle. (5 hrs)</p> <p>49. Identify the parts of a full frame of pickup truck and Sports utility vehicle (SUV). (10 hrs)</p> <p>50. Practice on use of computer-based service information, service manuals, collision repair guides, refinishing guides, vehicle dimension manual, color matching guides, parts interchange guides. (15 hrs)</p>	<p>body shop. Description of Repair order(RO) Description of vehicle Body and Chassis, Vehicle Frame- definition, Body- over-frame (Independent frame) construction, Hydro formed frame, Unibody construction; Major Body Sections-Front, Center, rear section, and vehicle left and right sides; Drive line configuration- Transverse engine, longitudinal engine, front-engine front wheel drive (FWD), front-engine rear wheel drive (RWD), Rear-engine rear wheel drive (RRD), Mid-engine rear wheel drive (MRD), Four-wheel drive (4WD); Body Classifications- Based on Car size, Roof designs; Body panels, Description of Unibody Panels and their parts, Unibody Design Factors, Advantage of Aerodynamic design, General unibody characteristics, Plastic parts and panels, composite unibody frame, Aluminium vehicle construction, , Body-Over-Frame Considerations -characteristics of body-over-frame vehicles, Full frame designs- Ladder frame, Perimeter frame, X-frame (or backbone frame), Crash Testing-Types of crash tests. Service information, Specifications, and Measurements - Study of Service Information, basic steps to using refinishing materials information, Vehicle paint code, study of service symbols, diagnosis charts, wiring diagram, Collision Repair Measurements. (14 hrs)</p>
<p>Professional Skill 41 Hrs; Professional Knowledge 06 Hrs</p>	<p>Identify various vehicle parts and Service, Repair and Maintenance of Air compressor and Air Lines.</p>	<p>51. Identify the parts of a piston type stationary compressor, Overhauling of Air compressor, Overhauling of service (FRL) unit, Drain the air receiver and the moisture separator/ regulator or air transformer. (10 hrs)</p> <p>52. Check the level of the oil in the crankcase, clean air filters, Clean or blow off fins on cylinders, heads, intercoolers, After coolers. (08 hrs)</p> <p>53. Check the oil filter in the air line and change the filter element if necessary, Adjust the</p>	<p>Compressor Air system :</p> <p>Basic requirement for compressed air systems, Type of Compressor- Description and construction of Diaphragm compressor, piston type compressor-single stage and two stage, rotary screw air compressor, Performance of air compressor- Description of Horse power, delivery volume, displacement, Free air delivery, compressor volumetric efficiency, tank size,</p>

		<p>pressure switch cut-in and cut-out settings if Needed, Check the relief valve for exhausting of head pressure each time the motor stops. Tighten belts to prevent slippage. (12 hrs)</p> <p>54. Check and align a loose motor pulley or compressor. (03 hrs)</p> <p>55. Check for air leaks on the compressor outfit and air piping system. (08 hrs)</p>	<p>Air and Fluid Control Equipment - In take air filter, Distribution system, regulator, lubricator, different type air purification method, Compressor Accessories -Hose type, hose size, maintenance of hose, connectors, adapters and couplings, Air System Maintenance. Study the typical piping arrangement found in a body shop, colour coding of airline, water line and fuel line. (06 hrs)</p>
<p>Professional Skill 102 Hrs; Professional Knowledge 25 Hrs</p>	<p>Demonstrate the proper operation and methods of welding and cutting equipment including plasma arc cutting processes</p>	<p>56. Identify the parts of an oxyacetylene welding and cutting outfit. (08 hrs)</p> <p>57. Practice on Oxyacetylene welding process, Practice on Soldering and brazing. (10 hrs).</p> <p>58. Practice on torch flame adjustment. (02 hrs)</p> <p>59. Identify the different parts on MIG welding machine, Selection of weld specification as per manual, selection of MIG wire size. (5 hrs)</p> <p>60. Compare the welding methods used in vehicle production, practice on surface preparation and setting of welding parameter, use of clamping and MIG welding of sample panel, practice on plug weld hole for body panel replacement. (10 hrs)</p> <p>61. Practice on Spraying antispatter compound into a MIG nozzle will help protect the tip and prevent the wire from sticking in the gun, Practice on Flat, Horizontal, vertical and overhead welding position. (10 hrs)</p> <p>62. Practice on continuous, plug, stitch, MIG spot, lap, tack welding techniques, Identify the different parts on SPOT welding machine. (20 hrs)</p> <p>63. Practice on resistance spot welding process on different thickness materials. (10 hrs)</p> <p>64. Practice tip dressing, tip change, chisel test nugget test for spot welding to ensure the spot weld quality. (15 hrs)</p> <p>65. Practice on plasma cutting operation. (12 hrs)</p>	<p>Welding:</p> <p>Introduction to joining of metals, Welding characteristics, weld terminology, weld symbols, Common Auto body welding techniques- MIG, TIG, Soft brazing, Factory weld specification, Typical Auto body MIG wire sizes, Typical Auto body shielding gases, Heat affected Zone (HAZ), Auto body MIG welding -Principles & characteristics, MIG welding equipments, Welding lens, MIG operation methods, MIG welding equipment, MIG welding current, MIG Arc voltage, MIG Tip to base metal distance, MIG gun angle and welding direction, MIG shield gas flow volume, MIG welding speed, MIG wire speed, MIG gun nozzle adjustment, Heat buildup penetration, clamping tools for welding, Welding position. welding Technique- Tack weld, Continuous weld, plug weld, spot weld, lap weld, stitch weld, intermittent weld, Base welding method-Butt welds lap & flange welding, plug weld, stitch weld, MIG welding of Galvanized metals & Aluminum, Welding Aluminum, MIG weld defects, Testing the MIG weld. FCAW (Flux cored Arc welding) , TIG Welding, Resistance spot welding, Resistance spot welding components, Spot welder adjustments, Operating a squeeze-type resistance spot welder, Other spot welding functions, stud spot welds for dent removal, Oxyacetylene welding, welding & cutting equipment, types of flame and</p>

			<p>adjustment, welding torch flame adjustment, gas cutting torch flame adjustment, cutting HSS for salvage purposes, Heat crayons, Cleaning with a torch, Probable causes and remedies for flame abnormalities, Brazing, interaction of flux and brazing rods, Brazing joint strength, Brazing operations, Treatment after brazing, Soldering (soft brazing) soldering procedure, plasma arc cutting, operating a plasma arc cutter. Advantage and disadvantage over different type of welding methods. (25 hrs)</p>
<p>Professional Skill 66 Hrs; Professional Knowledge 15 Hrs</p>	<p>Analyze minor body damage and perform repair following sequential procedures involved in metal damage repair.</p>	<p>66. Practice on minor repair of damaged car. (5 hrs) 67. Practice on using a hammer and dolly straighten damage on a door. (8 hrs) 68. Using long spoon to pry out a fender to allow for hammer straightening. (8 hrs) 69. Using Pry picks remove small dents in hard-to-reach areas. (09 hrs) 70. Practice on Using dent puller to pull out minor damage along a lip in the fender. (8 hrs) 71. Using a spot weld dent puller remove dents in steel Panels. (8 hrs) 72. Perform Paint Stripping using single action sander, Abrasive selection. (05 hrs) 73. Carry out maintenance of single action sander. (05 hrs) 74. Perform Body Filler application & Sanding to ensure body repair quality. (10 hrs)</p>	<p>Sheet metal repair. Automotive sheet metal, basic steps for correcting minor sheet metal damage, Low carbon steel, high strength steels (HSS)- Type of HSS- High tensile strength steel (HTSS), Type of loading- Tensile, compress, shear, cleavage, peel, Properties of sheet metal- Yield strength, Compressive strength, shear strength, torsional strength, effect of impact forces (Yield point), elastic deformation, plastic deformation, work hardening, Classifying body damage- direct damage, indirect damage, work hardening, analyzing sheet metal damage, Buckles- simple hinge buckles, pressure forces, single crown panels-door dings, Determining the direction of damage - metal straightening technique- using body hammer, Bumping dent with dollies, Hammer-on-dolly method, Hammer-off-dolly method, picking dents, unlocking on a hammer & dolly, straightening with body spoons, other metal straightening method-paint removal, pulling dents, spot-weld dent pullers, metal shrinking, stress reliving, stretched metal, Principle of shrinking , shrinking steel panel with heat, Kinking, shrinking a gouge, filling the repair area, working Aluminum panels, working Aluminum with hammer and dolly, straightening aluminum with hammer, filling and grinding aluminum, straightening aluminum by heat shrinkage, Paint less dent removal method.</p> <p>Introduction to Paint: Primer-sealer, top coats, paint material types- Lacquer, enamel, water base, Content</p>

			of paint-pain pigments, paint binders, paint solvents, Paint additives, Definition of Drying, curing, flash, retarder, accelerator, catalyst, adhesion promoter, blending solvent, Toners, Primers & sealers- self-etching primer, UV primer Requirement of body filler, components of body filler (filler & hardener), mixing ratio of filler and hardener, tools used for mixing and application - Spatula, Board, application process, drying of body filler using conventional procedure and infrared drier, scuffing, sanding of body filler, defects in body filler application, final finishing of body panel. (15 hrs)
Professional Skill 23 Hrs; Professional Knowledge 07 Hrs	Evaluate and repair damage plastic part.	75. Identify the thermoplastics, thermosetting plastics. (5 hrs) 76. Identify common automotive plastics used in the industry. (5 hrs) 77. Practice on using chemical adhesive bonding techniques to repair of minor cuts and cracks. (5 hrs) 78. Practice on using heat to reshape plastics, (08 hrs)	Repairing Plastics Introduction to plastics, Types of Plastics- Thermoplastics, thermosetting plastics, safety points observed while working with plastic repair, common automotive plastics identification, plastic repair, chemical adhesive bonding techniques- repair of minor cuts and cracks, repair of tears, and punctures, using the right adhesive, Flexible part repair- Plastic welding, Hot air plastic welding, High speed plastic welds, plastic welder setup shutdown, and servicing, Airless plastic welding, ultrasonic plastic welding, plastic welding procedures, general plastic welding, techniques, Plastic tack welding, plastic welding procedures, airless melt-flow plastic welding, plastic stitch-tamp welding, single-sided plastic welds, two sided plastic welds, repairing vinyl, using heat to reshape plastics, ultrasonic stud welding, reinforced plastic repairs. (07 hrs)
Professional Skill 100 Hrs; Professional Knowledge 20 Hrs	Demonstrate glasses, body parts and door fitting and repairing process	79. Practice on Hood removal as per procedure. (5 hrs). 80. Practice on Hood adjustment, Hood-to-hinge adjustment, hood height adjustment, hood latch mechanism, hood latch adjustments, and Bumper replacements. (10 hrs)	Hood, Bumper, Fender, Lid, And Trim Service Part removal Sequence, Hood service- Hood removal, Hood adjustment, Hood-to-hinge adjustment, hood height adjustment, hood latch mechanism, hood latch adjustments, Bumper replacements, Fender service-

		<p>81.Practice on Fender removal, installing fenders, fender adjustments, grille service, Trunk lid adjustments, panel alignment, Truck bed service. (20 hrs)</p>	<p>Fender removal, installing fenders, fender adjustments, grille service, Trunk lid adjustments, panel alignment, Truck bed service, sound-Deadening pads, custom body panels, installing body trim and moldings, removing adhesive held moldings, installing adhesive body sine moldings. (07 hrs)</p>
		<p>82.Practice on removing windshield, Practice on windshield rubber gasket service. (5 hrs)</p> <p>83.Practice to align windshield into position during Installation(5 hrs)</p> <p>84.Practice on using a sealer gun to apply adhesive to windshield glass. (08 hrs)</p> <p>85.Identify the basic parts of a door assembly. (5 hrs)</p> <p>86.Practice on door removal. Practice on repair of modern power window regulator, door lock & latch, Door & Door glass adjustments, servicing welded door hinges, bolted door hinge adjustment. (10hrs)</p> <p>87.Practice on Door glass adjustment, door trim panel installation tailgate glass service, station wagon tailgate adjustment, rear view mirror service, roof panel service. (12 hrs)</p>	<p>Door, roof, and glass Service</p> <p>Vehicle Glass Technology-Introduction, type of glass-laminated, plate glass, tempered glass, glass service- removing windshield molding, windshield rubber gasket service, Glass adhesive-full cut-out method, glass adhesive, partial cutout method, windshield wiper service, rear and quarter window service, service doors-door construction, manual & power regulators, checking door operation, door removal, door weather strip service, Door inner trim panel Door window regulator service, door lock & latch service, Door reinforcements, panel adhesive technology, Replacing bonded door skins, replacing SMC(Sheet molded compound) Door skins, Door & Door glass adjustments, servicing welded door hinges, bolted door hinge adjustment, Door glass service- Door glass adjustment, door trim panel installation tailgate glass service, station wagon tailgate adjustment, Glass element repairs, rear view mirror service, roof panel service, fastened roof panel service, convertible top service, Sun roof service. (8 hrs)</p>
		<p>88.Identify the different parts of Passenger Compartment, practice on seat service. (5 hrs)</p> <p>89.Front seat service, Rear bench seat service, seat cover service, carpeting service, dash panel service, console service. (5 hrs)</p> <p>90.Instrument cluster service, Headliner service, locating air and water leaks(5 hrs)</p>	<p>Passenger compartment Service</p> <p>Major parts of Passenger Compartment - dash assembly, instrument cluster, seat assemblies, interior trim, steering column assembly, headliner assembly, carpeting, weather stripping, Interior trim-pillar trim panels, dash panel, door trim panels, Glass trim panels, sill plates,</p>

		91. Checking drain hoses, wind noise, repairing leaks, Rattle elimination, Fixing rattle. (05 hrs)	interior trim service- procedure, roll bars, seat service- Front seat service, Rear bench seat service, seat cover service, carpeting service, dash panel service, console service, Instrument cluster service, Headliner service, locating air and water leaks- checking drain hoses, wind noise. (05 hrs)
Professional Skill 70 Hrs; Professional Knowledge 13 Hrs	Demonstrate knowledge of the procedures for diagnosing structural collision damage and measuring systems to identify location and extent of damage	92. Practice on use of frame gauge, upper body dimensioning. (25hrs) 93. Measurement of the front body, measurement of the body side panel, measurement of the rear body Damage Using Gauge Measuring Systems, Strut Centerline Gauge. (15 hrs) 94. Identify the condition of collision, influence of impact on a body-over-frame vehicle, visually determine the extent of impact damage. (15hrs) 95. Inspecting for damage from passengers & luggage, Universal Measuring Systems, Computerized Measuring Systems. (15hrs)	Major Body/ frame damage Measurement Vehicle measurement-collision repair process, diagnostic procedure for collision damage, impact and its effects on a vehicle- Determining the condition of collision, influence of impact on a body-over-frame vehicle, Frame deformation- sideways damage, sag damage, mash damage, diamond damage, twist damage, impact effect on unibody vehicles- primary damage area, secondary damage area, collision damage sequence, visually determine the extent of impact damage, inspecting for damage from passengers & luggage, body dimensions- body dimension charts, vehicle measuring basics, measurement importance, Gauge measuring system- frame gauge, upper body dimensioning, measurement of the front body, measurement of the body side panel, measurement of the rear body, digital tram gauges, dimensional references, the centre panel, zero planes, diagnosing damage, measuring Vehicle Impact and Its Effects on a vehicle, Visually Determining the Extent of Impact Damage, Measurement of Body Dimensions, Gauge Measuring System, Tram Gauges, Digital Tram Gauges, Centering Gauges. (13 hrs)

<p>Professional Skill 50 Hrs;</p> <p>Professional Knowledge 10 Hrs</p>	<p>Demonstrate how to use frame straightening equipment and re-alignment procedures along with various anchoring methods and ensuring the structural integrity of the vehicle and occupant safety</p>	<p>96. Practice on analyzing damage- Length damage, Width damage, Height damage. (20 hrs)</p> <p>97. Practice on repair method for front-end damage, rear damage, side damage, sag damage, twist damage, diamond damage, straightening strut, tower damage, stress relieving, straightening strut tower damage, stress relieving with heat, stress concentrators, Frame Straightening Equipment, anchoring the vehicle using pulling clamps and chains. (30 hrs)</p>	<p>Unibody/ frame alignment</p> <p>Realignment basics-vehicle anchoring and pulling, pulling direction, single-pull method, multiple-pull Method, visualizing front-end Collisions, rear-end collisions, side collision, rollover damage, angled impacts, unibody / Frame Straightening Equipment, in-floor straightening equipment-anchor-pot system and the modular rail frame system. portable body and frame pullers, rack (floor) straightening systems, bench straightening systems, anchoring the vehicle using pulling clamps and chains, other straightening accessories-restraint bar, door aligner, engine holder, portable hydraulic rams, strut plate, straightening and realigning techniques-sequence for a total structure realignment procedure, unibody / frame realignment safety, measuring when pulling, computerized measuring systems, procedure for planning the pull, making pulls-single-pull setup, multiple-pull setups, executing a pulling sequence, purpose of overpulling. (10 hrs)</p>
--	---	--	---

Practice on visit all sections of institute and importance of the trade

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

- **familiarization with institute**
- **job opportunities in the automotive sector.**

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Chalk piece	- as reqd.
• Organisation chart	- 1 No.	• Soap oil	- as reqd.
• LCD projector	- 1 No.	• Cotton waste	- as reqd.
Equipments/ Machines		• Note book	- as reqd.
• Computer with projector	- 1 No.	• Pen/pencil	- as reqd.
• Video screen	- 1 No.		
• Smart class room	- 1 No.		

PROCEDURE

Task 1: Familiarisation with institute

- | | |
|--|--|
| <ol style="list-style-type: none"> 1 Prepare the smart class room. 2 Check the computer functions. 3 Give introduction to the trainee's about institute's function. 4 Explain the importance of institute. 5 Explain the importance of autobody repair trade. 6 Brief about institute organisation section and their importance through organisation chart. 7 Explain about the institute's functions by video. | <ol style="list-style-type: none"> 8 Visit to all workshop trade sections and office. 9 Explain about duties of each person in the organisation. 10 Ask the trainee's to write the name of sections and incharge of the section in the organization. 11 Collect the telephone numbers of ITI office, nearest hospital, police station and fire station. 12 Ask the trainee to draw the layout of institute. |
|--|--|

Task 2: Autobody repair technician job opportunities in the automotive sector

- | | |
|---|---|
| <ol style="list-style-type: none"> 1 Auto body repair trainee's can get number of job opportunities in the automobile sector with the name of the organisations can be get jobs. | <ol style="list-style-type: none"> 2 Ask the trainee's to write job opportunities in table 1 and check it with instructor. |
|---|---|

Table 1

S.No	Name of the organization	Nature of job	Remedies
1	Table vehicle autobody shop	Auto body filter	
2			
3			
4			

Practice on identify the machinery used in autobody repair shop

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

- identify the machineries in the autobody repair shop
- state the function of machineries in the autobody repair shop.

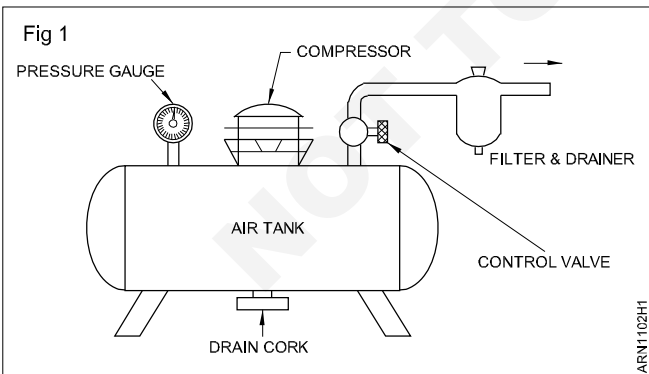
Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Gas welding machine	- 1 No.
• Machineries chart	- 1 No.	Materials	
Equipments/ Machines			
• Jib crane, drilling machine	- 1 No each.	• Welding rod	- as reqd.
• Air compressor	- 1 No.	• Cotton waste	- as reqd.
• Arc welding machine	- 1 No.	• Soap oil	- as reqd.

PROCEDURE

- 1 Take the participants around the workshop.
- 2 Identify the major workshop machinery like compressor, drilling machines, jib crane, welding machine, grinder.
- 3 Explain the constructional features and the use of the machineries in the shop.
- 4 Explain the use of equipments and its applications.
- 5 Explain equipments maintenance and its importance.
- 6 Explain through display charts, the features of all equipments in an autobody repair shop.

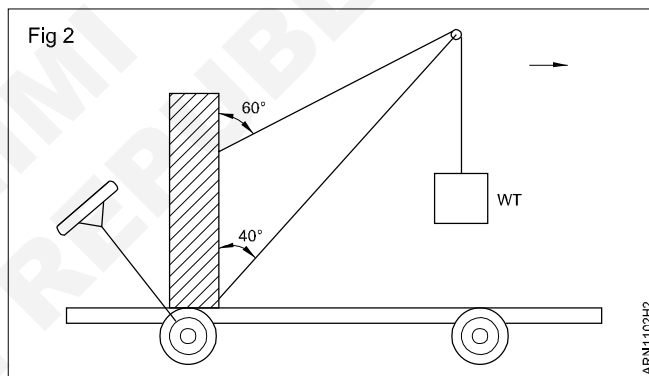
Air compressor (Fig 1)

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

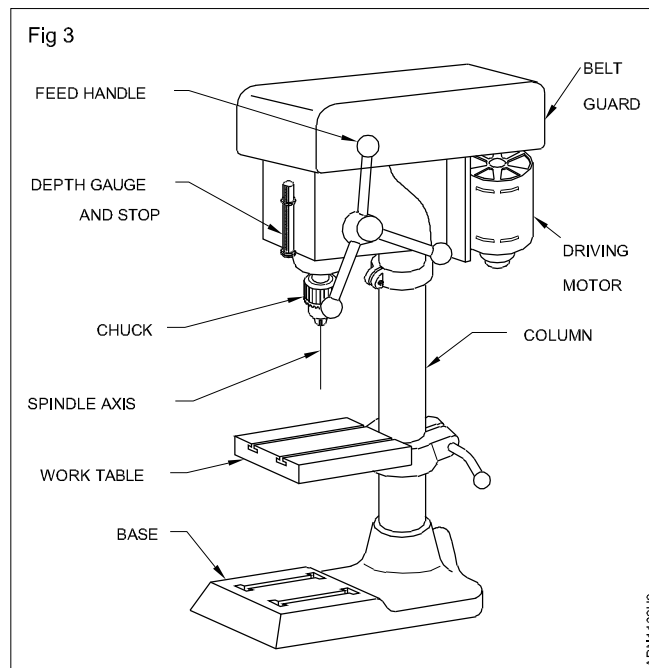


Jib crane (Fig 2)

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



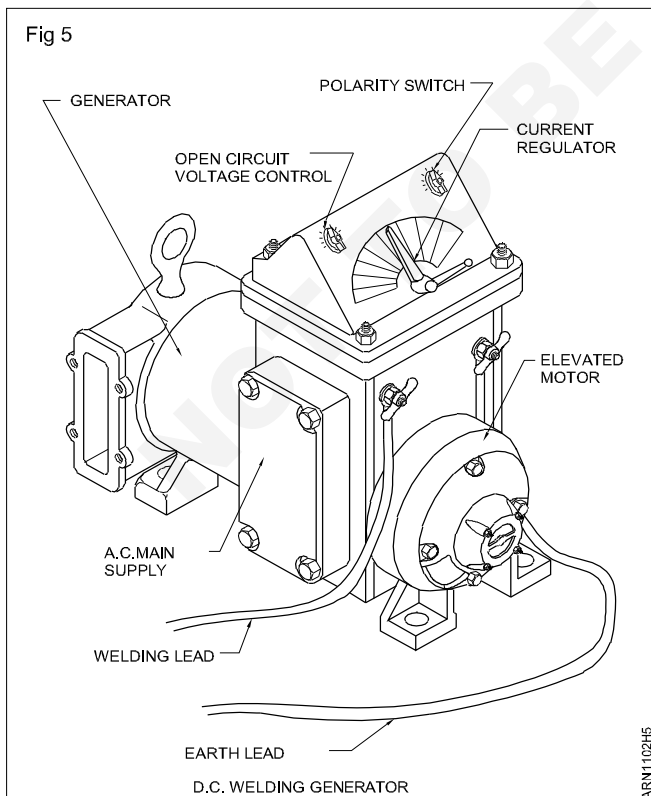
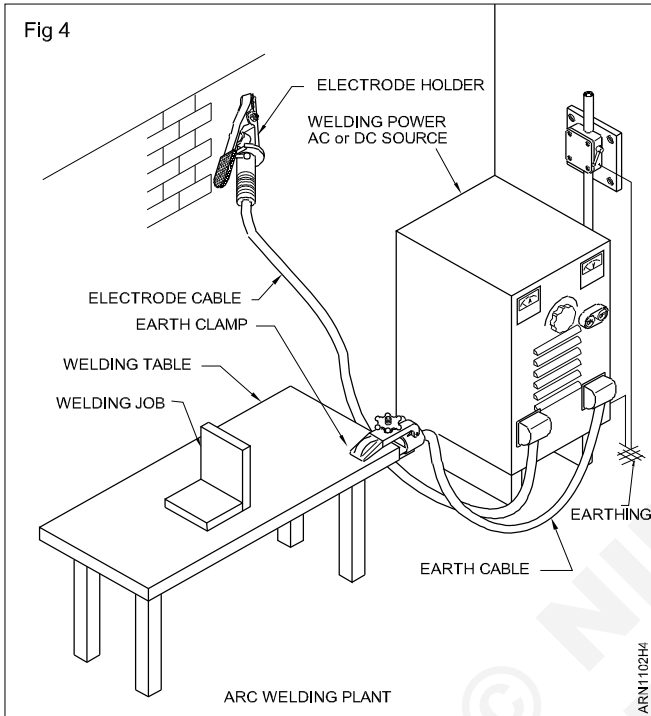
Sensitive bench drilling machine (Fig 3).



Drilling machine

- 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.

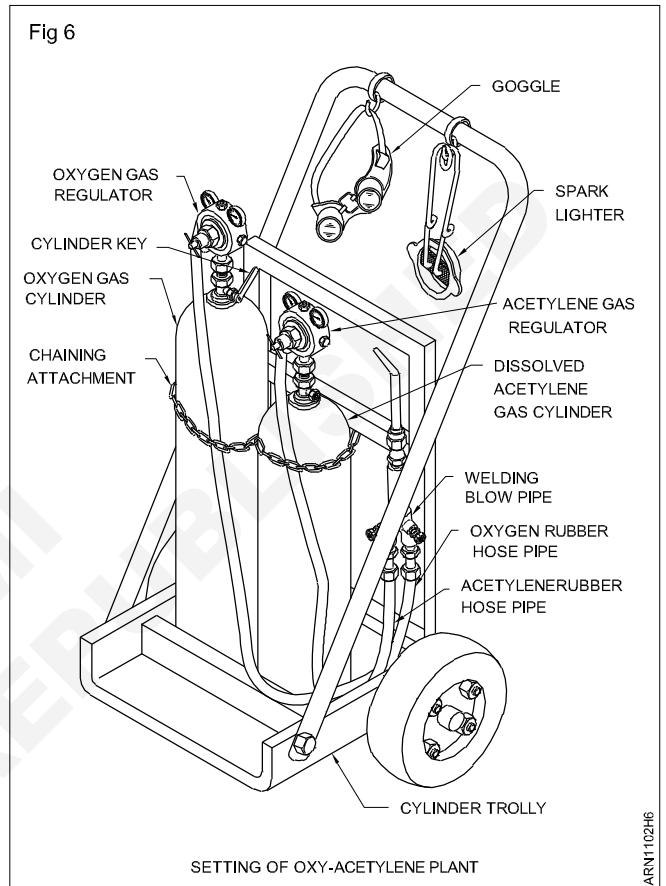
Arc welding machine (Fig 4&5)



- Arc welding and DC welding machines are used to get suitable current for welding process.
- It is used to joining two metals pieces, by melting the electrodes at an angle of 70° to 80° with weld line.

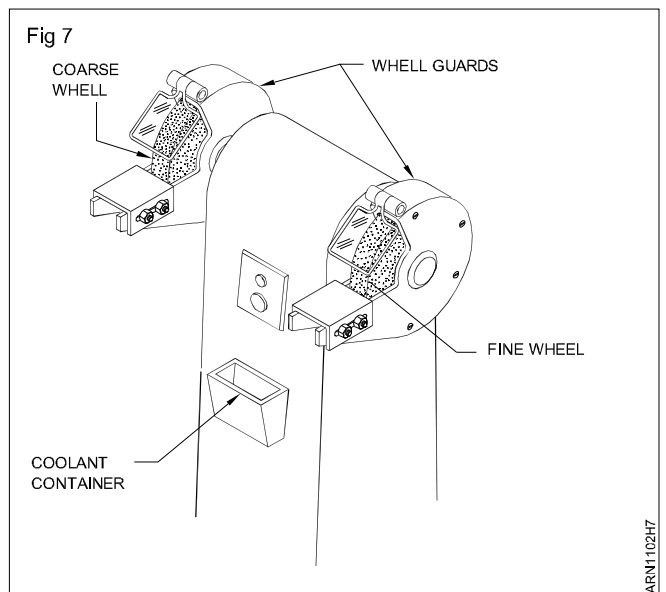
Oxy-acetylene gas welding plant (Fig 6)

- Oxy-acetylene welding equipment and accessories are used to joining metals by heating to melting point using mixture of oxygen and acetylene gases.



Grinding machine (Fig 7)

- It is used to grind and sharpening the tools.



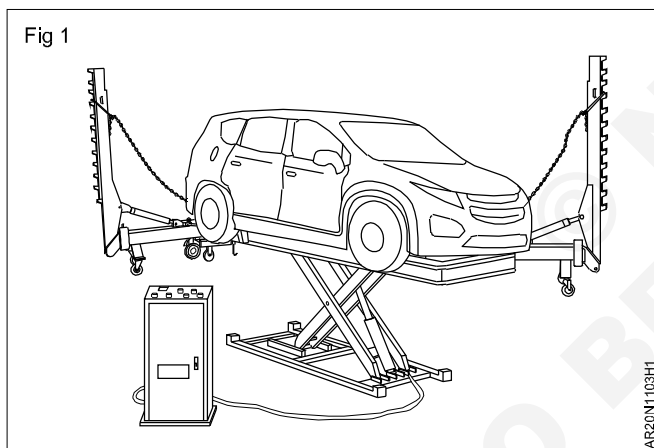
Identify the work done by the trainee's in auto body repair shop floor

Objective: At the end of this exercise you shall be able to
 • identify the nature of work in auto body shop floor.

Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Car washer	- 1 No.
• Different type of hammers	- 1 No each.	• Air compressor	- 1 No.
• Tinkering tool kit	- 1 No.		
Equipments/ Machines			
• Vehicle	- 1 No.	Materials	
• Welding machine (Arc of gas)	- 1 No each.	• Cotton waste	- as reqd.
• Surface grinder	- 1 No.	• Soap oil	- as reqd.
		• Welding rod	- as reqd.
		• Flux	- as reqd.

PROCEDURE

1 Clean vehicle before moving it into repair area (Fig1).



- 2 Study repair order and vehicle damage to determine repair procedure.
- 3 Remove badly damaged bolt on parts.
- 4 Measure the damage.
- 5 Straighten frame/unibody damage on frame rack.
- 6 Replace badly damaged welded-on parts.
- 7 Straighten minor body damage (Fig 2).

8 Apply body filler and coarse sand repair area.

9 Apply a primer-filler around body filled area (Fig 3).

10 Fine sand repair area and all parts to be refinished.

11 Mask the areas not to be painted.

12 Clean surface to be painted (Fig 4).

13 Refinish (prime, seal, paint) damaged body parts.

14 Detail vehicle (unmask, clean and polish) as needed.

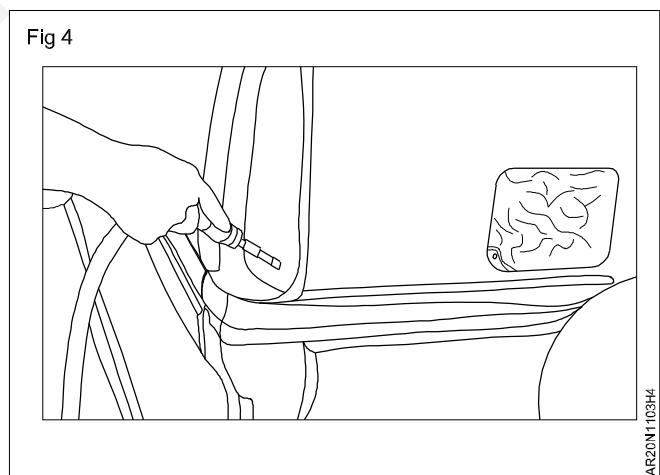
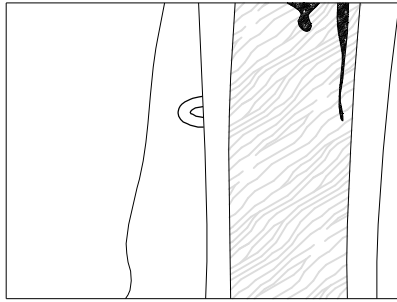
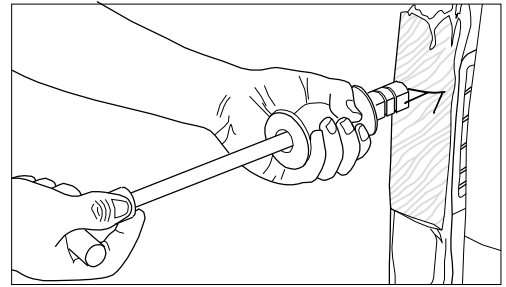


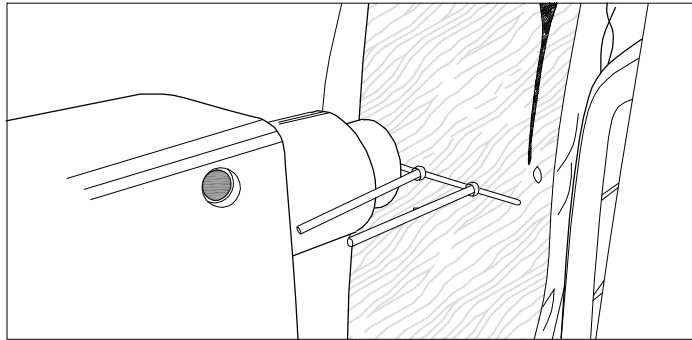
Fig 2



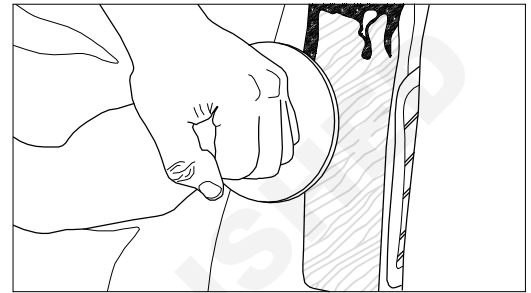
A PANEL MINIOR DAMAGED



PULL THA WELDED PINS BY CHANGING PULLER



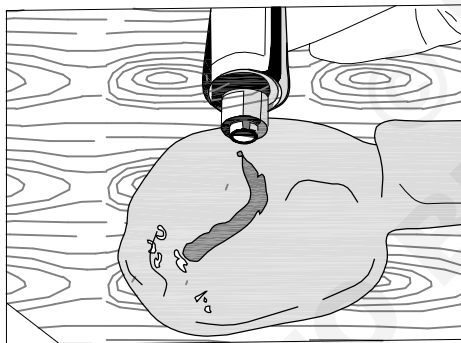
NAIL WELD GUN USED TO PULL THE DAMAGED PANEL



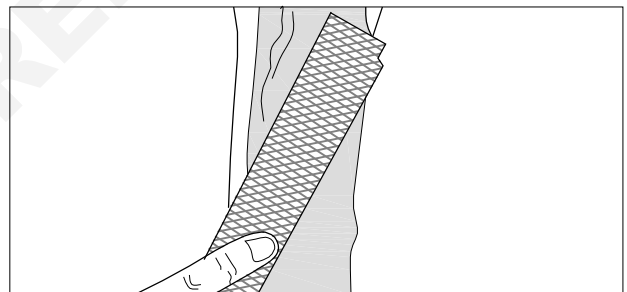
CUT AND GRIND OFF THE PINS

AR20N1103H2

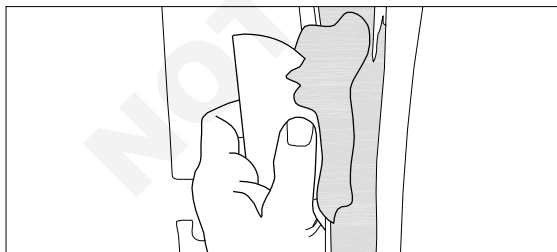
Fig 3



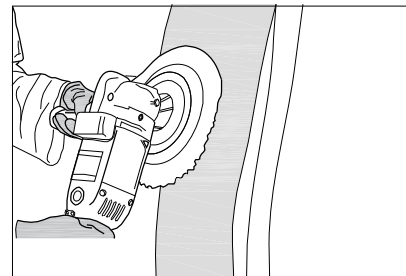
A. MIXING BODY FILLER AND HANDENER



C. FILE TO ROUGHOUT THE SHAPE IN MULTIPLE DIRECTION



B. APPLY BODYH FILLER TO CLEAN BODY SURFACE



D. FEATHER EDGE THA FILLER AND OLD PAINT

AR20N1103H3

Practice on use the practical related safety and health

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

- select the correct personal safety working procedure
- select the correct safety equipment.

Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Weld shield glass	- 1 No.
• Respirator	- 1 No.	Materials	
• Hand gloves	- 1 Set.	• Cotton waste	- as reqd.
Equipments/ Machines		• Soap oil	- as reqd.
• Vehicle	- 1 No.	• Sand paper	- as reqd.
• Grinding machine	- 1 No.	• Welding rod	- as reqd.
• Welding machine	- 1 No.	• Flux	- as reqd.

PROCEDURE

Task 1: Safety and health practice

- | | |
|--|---|
| <ol style="list-style-type: none"> 1 Select and follow the important personal safety rules that must be headed while working. 2 Remove rings, bracelets, neck laces, watches and other jewellery. 3 Role up long sleeves and secure long hair. 4 Follow the repair procedure and safety rules of working environment. 5 Always use right tools for the job 6 Don't allow the non employees and customers in the shop work area. 7 Wear dust respirator during auto body repair work in the shop floor. 8 Wear welding respirator during auto body welding work. 9 Wear the air supplied respirator while painting a car. 10 Consider wearing a padded bump cap or welder cap when working beneath hoods under cars or on a frame rack. | <ol style="list-style-type: none"> 11 Use safety glasses, goggles, face shields, helmet to protect your eye, face and head. 12 Use ear plugs in autobody shop to protect your ear, when using air powered cutting tools. 13 Hand tools should be kept clean and in proper working condition. 14 Keep clothing away from moving parts when machine is running. 15 Your pants should be always be long enough to cover the top of your shoes, when welding the autobody parts. 16 Use hand gloves when working with any chemical to prevent chemical burns, cuts or abrasions. 17 Use shop tools or perform repair operation only after receiving proper instruction 18 Don't attempt to use a power tool beyond its stated capacity. |
|--|---|

Task 2: Personal protective equipments

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.

- 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 1.



Table 1

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

Get it checked by your instructor.

Task 3 : Identify the occupational hazard

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 2.
- 2 Ask the trainee's to write the potential harm and occupied hazards in table 2.

Table 2

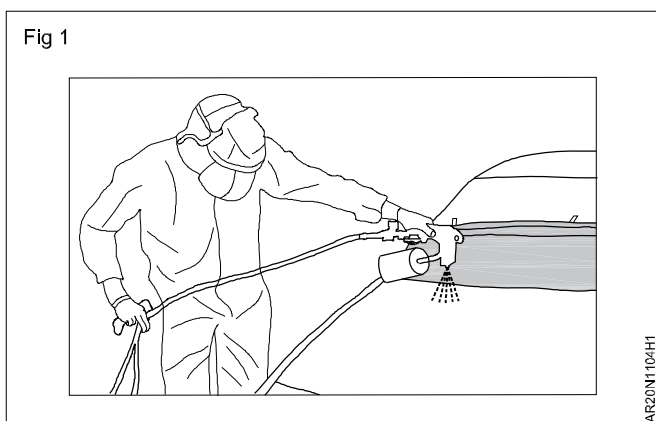
S.No	Source or potential harm	Type of occupational hazards
1	Noise	
2	Explosive	
3	Virus	
4	Sickness	
5	Smoking	
6	Non control device	
7	No earthing	
8	Poor house keeping	

Fill up and get it checked by your instructor.

Task 4: PPE Instruction and uses

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

- 2 Do not use flammable cleaners or water on electrical equipment.
- 3 Make sure designated walkways are kept clear of any obstructions.
- 4 Always wear protective clothing and the appropriate safety equipment.
- 5 Make sure that you understand and observe all legislative and personal safety procedures when carrying out the following tasks. If you are unsure of what these procedures are, ask your instructor.



Practice on work shop maintenance

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

- carryout the maintenance of equipment
- clean the tools and equipment.

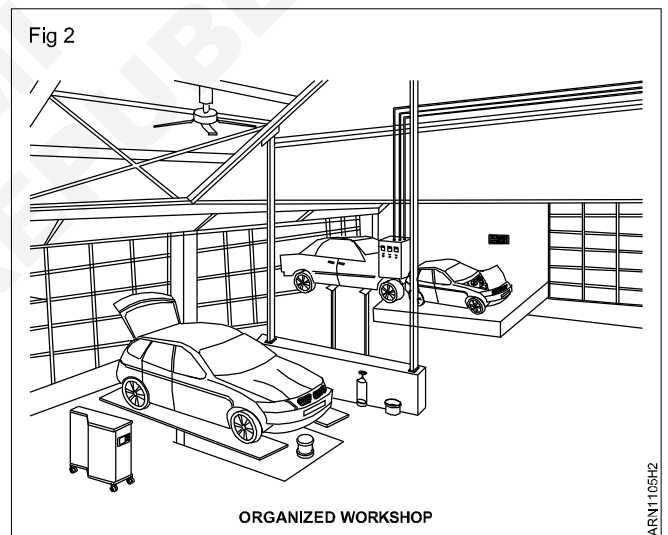
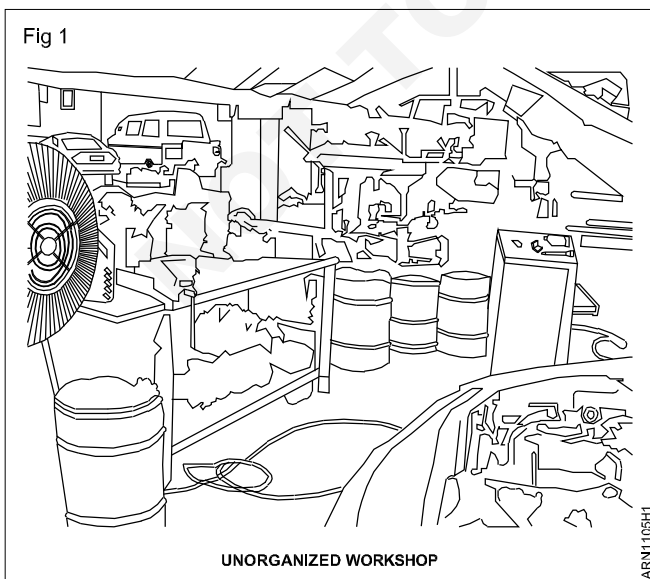
Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cleaning solvent	- as reqd.
Equipments/ Machines		• Washing powder	- as reqd.
• Vehicle	- 1 No.	• Cotton waste	- as reqd.
		• Brush	- as reqd.

PROCEDURE

Task 1: Maintenance of tools and equipment

- 1 Clean tools and equipment and work more efficiently. At the end of each working day clean the tools and equipment used and check them for any damage. If you note any damage, tag the tool as faulty.
- 2 Electrical current can travel over oily or greasy surfaces. Keep electrical power tools free from dust and dirt and make sure they are free of oil and grease.
- 3 All workshop equipment should have a maintenance schedule. Always complete the tasks described on the schedule at the required time. This will help to keep the equipment in safe working order.
- 4 Store commonly used tools in an easy-to-reach location.
- 5 If a tool, or piece of equipment, is too difficult to be returned, it could be left on a workbench or on the floor where it will become a safety hazard (Fig 1).

- 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 chemical gloves when using any cleaning material because excessive exposure to cleaning materials can damage skin.
- 10 Some solvents are flammable. Never use cleaning materials near an open flame or cigarette.
- 11 The fumes from cleaning chemicals can be toxic, so wear appropriate respirator and eye protection wherever you are using these products.

Task 2 : Cleaning hand tools, jack, power tool and machinery

1 Clean hand tools

- Keep your hand tools in, clean condition with two sets of cabinet. One cabinet should be lint-free to handle precision instruments or components.
- The other should be oily to prevent rust and corrosion.

2 Clean floor jacks

- Wipe off any oil or grease on the floor jack and check for fluid leaks. If you find any leaks, rectify the leaks and top up the hydraulic fluid.
- Occasionally, apply a few drops of lubricating oil to the wheels and a few drops to the posts of the safety stands.

3 Clean electrical power tools

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

- Inspect any electrical cables for dirt, oil or grease, and for any chafing or exposed wires.
- With drills, inspect the chuck and lubricate it occasionally with machine oil.

4 Clean air powered tools

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

5 Clean hoists and heavy machinery

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

Clean operating mechanisms and attachments of excess oil or grease.

Practice on fire extinguishers

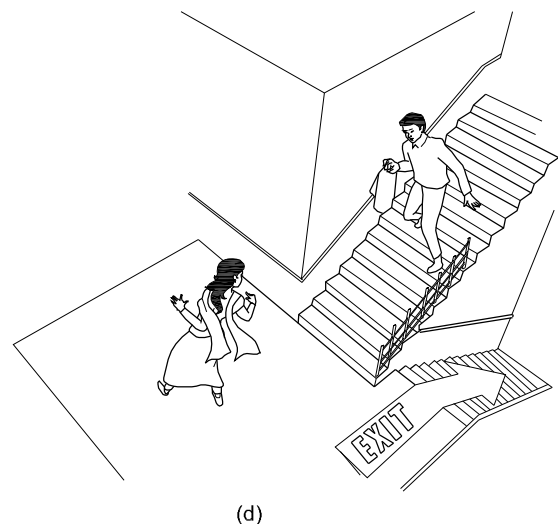
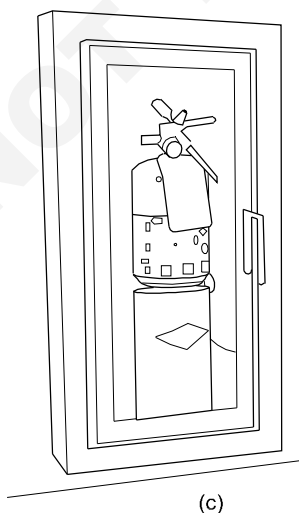
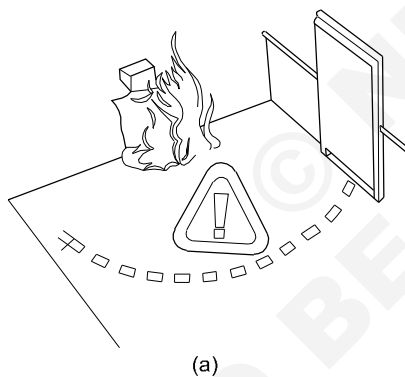
- Objectives:** At the end of this exercise you shall be able to
- select the fire extinguisher according to the type of fire
 - operate the fire extinguisher
 - extinguish the fire.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Old tyre	- as reqd.
Equipments		• Wood, Paper, Cloth & Grease	- as reqd.
• Fire extinguisher	- as reqd.	• Gas and Liquefied gas	- as reqd.
• Fire extinguisher (different type)	- as reqd.	• Metal and Electrical equipment	- as reqd.

PROCEDURE

- 1 Alert people surrounding by shouting fire, fire, fire when you observe fire (Fig 1a).
- 2 Inform Fire Service or arrange to inform immediately (Fig 1b).

Fig 1



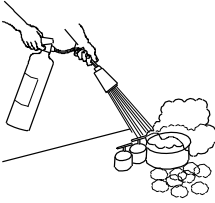
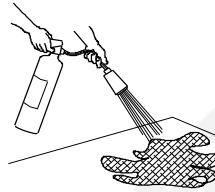

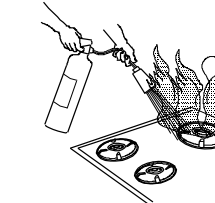
3 Open emergency exit and ask them to go away.
(Fig 1c & 1d)

4 Put "Off" electrical power supply.

Do not allow people to go nearer to the fire

5 Analyze and identify the type of fire. Refer Table 1.

Table 1

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

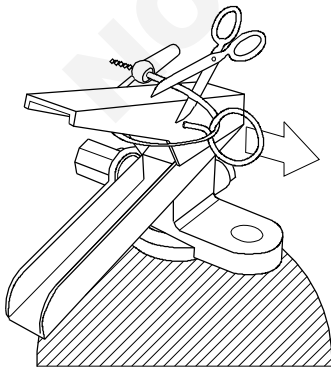
Assume the fire is 'B' type (flammable liquefiable solids)

6 Select CO₂ (carbon dioxide) fire extinguisher

7 Locate and pick up CO₂ fire extinguisher. Check for its expiry date.

8 Break the seal (Fig 2).

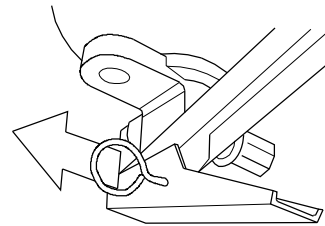
Fig 2



ARN1107H2

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

Fig 3



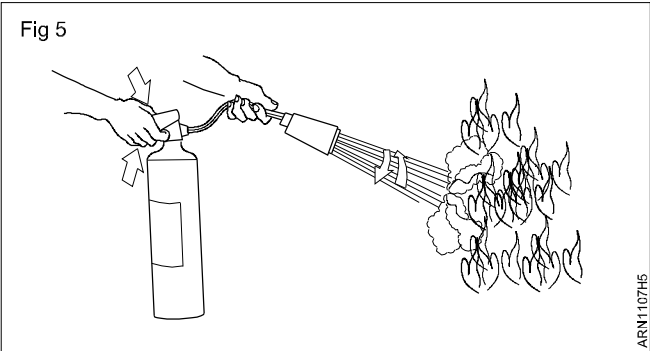
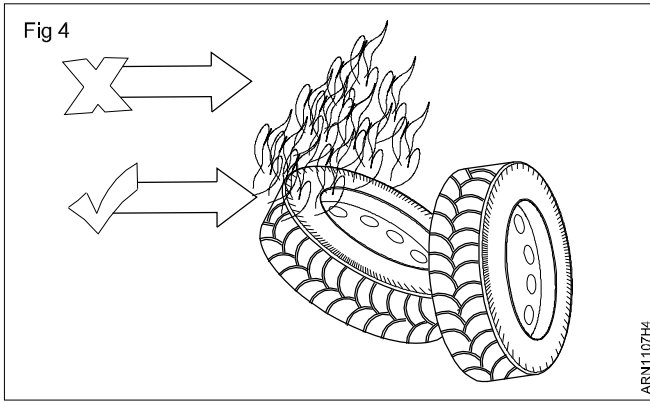
ARN1107H3

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

Keep your self low.

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

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



Fire extinguishers are manufactured for use from the distance.

Caution

- 1 While putting off fire, the fire may flare up.
- 2 Do not be panic so long as it put off promptly
- 3 If the fire doesn't respond well after you have used up the fire extinguisher move away your self away from the fire point.
- 4 Do not attempt to put out a fire where it is emitting toxic smoke, leave it to the professionals.
- 5 Remember that your life is more important than properly. So don't place yourself or others at risk.

In order to remember the simple operation of fire extinguisher.

Remember.

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

P for pull.

A for aim.

S for squeeze.

S for sweep.

Handling and testing of workshop equipments

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

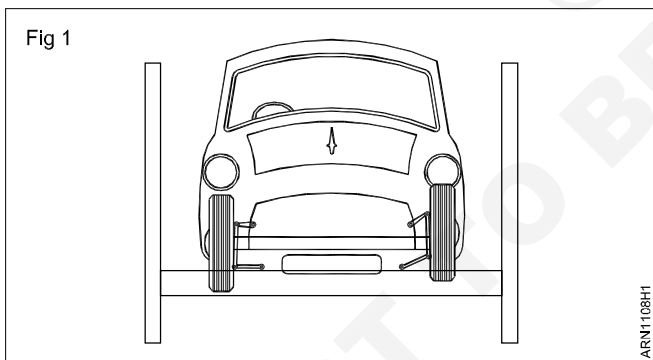
- demonstrate safe handling of lifting equipments
- do the periodic testing of lifting equipments.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Oil	- as reqd.
Equipments		• Water	- as reqd.
• Hoist	- 1 No.	• Kerosene	- as reqd.
• Air compressor	- 1 No.	• Cotton waste	- as reqd.
• Vehicle	- 1 No.		

PROCEDURE

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.



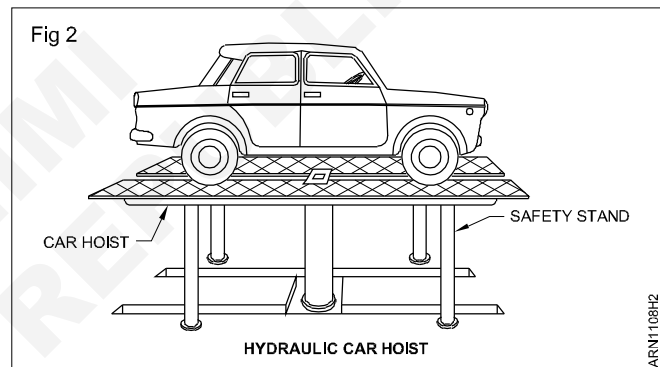
M/s. ABCD,
Vehicle Hoist Service,
044-12345678,
Chennai - 78.
SERVICE

Date Serviced: 20/05/2021

Next Service : 19/05/2022

Check the equipment

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



- 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 is no leakage in the hose, control valves and oil pump
- 5 Before operating the lift, ensure that the car is correctly placed in the platform.
- 6 Check whether it is lifting properly.
- 7 And also check whether it is holds the oil or not.

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

- 8 After the completion of the work, lower the ram to its normal position.
- 9 If you use the crane, ensure the proper function of it before use to avoid the accident occur during work.

Practice on saving electrical energy and safety disposal of used engine oil

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
- safety disposal of engine oil.

PROCEDURE

Task 1 : **Determine the energy conservation**

- 1 Survey the ITI building premises for lights, fans and other appliances.
- 2 Use the table- 1 below for listing the devices with their actual energy ratings (wattage) and hours of use.

Table 1

Applications	Approximate Load (watts)	No of equipment	Total load (watts)	Average hours / day	No. of days in a month	Approximate units / months
	A	B	$C = A \times B$	D	E	Unit= $C \times D \times E / 1000$
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 condition	1000					
	1500					
Refrigerator (165 liters)	150					
Refrigerator (210 liters)	270					
Computer						
Other	200					

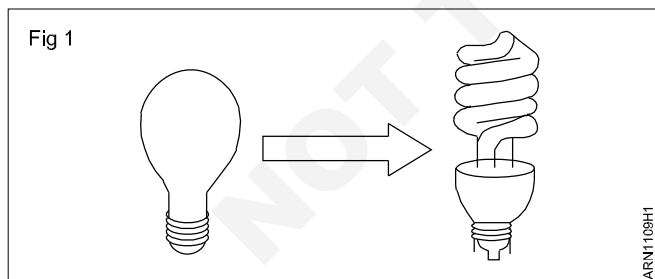
- 3 Record and compare the current year consumption with last year consumption and determine the saved energy in Table 2.

Table 2

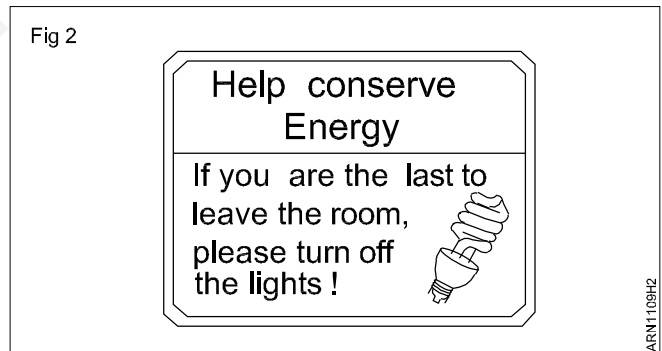
Month	Last year (A)		Current Year (B)		Units saved / Excess (B-A)
	No. of Units	Bill Amount (Rs.)	No. of Units	Bill Amount (Rs.)	Amount Saved / Excess (Rs) (B-A)
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					

Task 2 : Perform different way of energy conservation

- 1 Make sure you are not still using tungsten light bulbs. Replace them with CFL bulbs. CFLs reduce energy consumption by about 75% compared with tungsten bulbs, and they last longer.
- 2 Upgrade older fluorescent light fittings with modern high frequency fluorescent fittings (Fig 1).

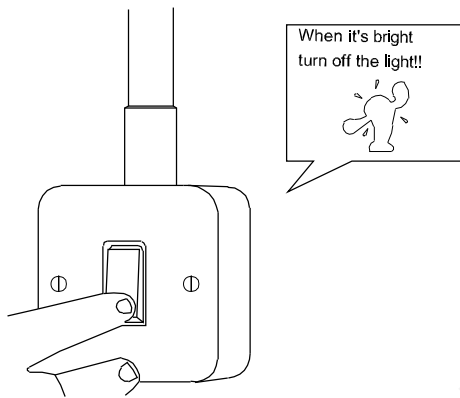
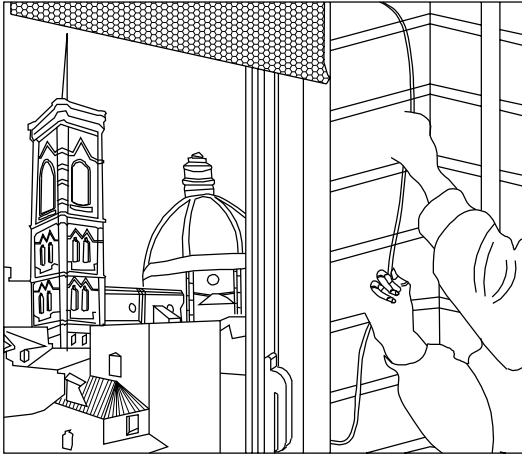


- 3 Post a friendly reminder in each room to prompt students and teachers to turn off lights when not in use (Fig 2).
- 4 Lighting in class rooms can use a lot of electricity, which costs money. Classrooms can often be lit with daylight instead (Fig 3).
- 5 It is best to open the blinds when possible, and switch off the lights whenever there is enough daylight.



- 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



ARN1109H3

Fig 4

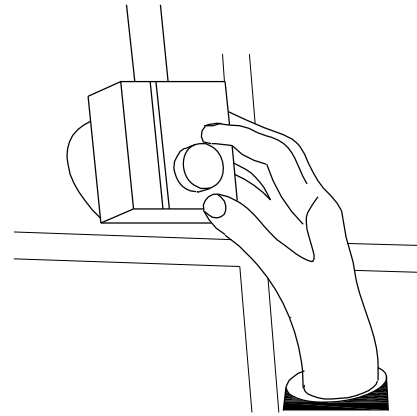


ARN1109H4

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



ARN1109H5

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.

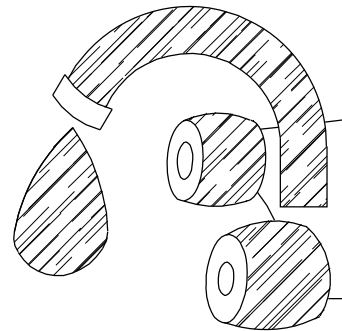
17 Water costs money, so savings it is a good idea.

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



ARN1109H6

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.

Task 3 : Safety disposal of used engine oil

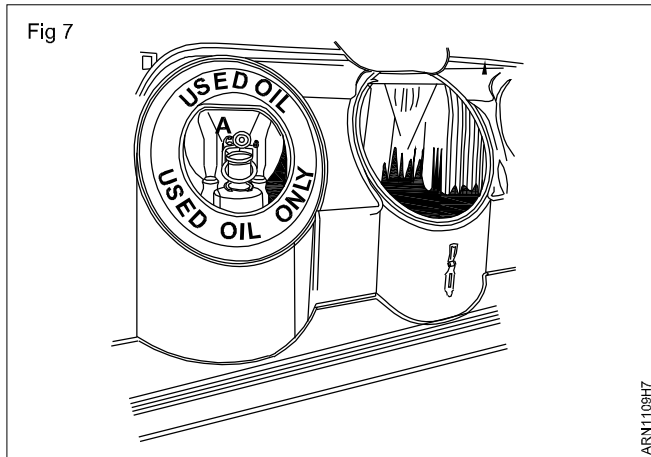
- 1 Wear protective clothing, such as gloves, mask, shoes, apron etc.,
- 2 Do not spill any oil or grease on the ground.

- 3 Put your used motor oil in a clean plastic container with a tight lid. Never store 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 7).



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

While transporting ensure that there is no spillage of oil (Fig 8).

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

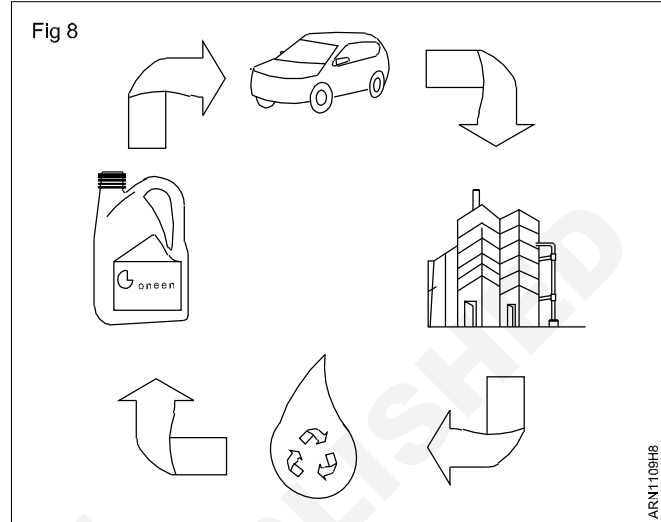


Table 1

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

Marking practice on the given job

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

- draw lines on metallic surfaces by scribers
- draw parallel lines on metallic surfaces by jenny calipers
- draw parallel lines with a surface gauge supporting the job against the angle plate
- draw angles with a simple protractor and scriber
- bisect the angles with a divider
- draw circles with a divider
- draw curves and tangents with dividers steel rule and scribers
- register the profile by dot punching
- punch the centre of the circle with a centre punch and ball-peen hammer.

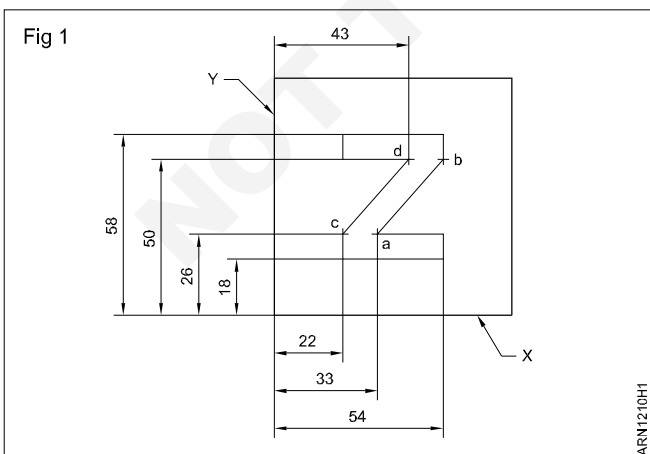
Requirements			
Tools/Instruments		Equipments	
• Trainee's tool kit	- 1 No.	• Surface plate	- 1 No.
• Scriber, Divider, 'V' groove	- 1 No each.	Materials	
• Bevel Protractor	- 1 No.	• Chalk powder	- as reqd.
• Centre punch & Angle plate	- 1 No each.	• MS Plate	- as reqd.
• Surface gauge & Depth gauge	- 1 No each.		
• Outside, Inside & Jenny caliper	- 1 No each.		

PROCEDURE

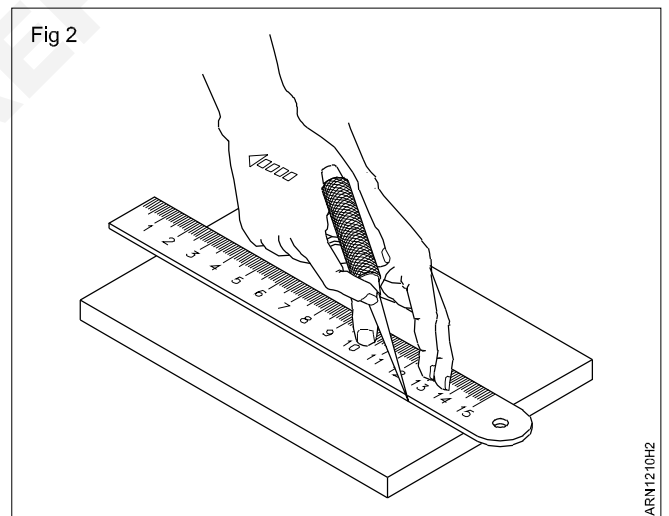
Marking 1

- 1 Check the raw material for its size and its squareness.
- 2 Apply copper sulphate solution on one side of the job and allow it to dry.
- 3 Scribe parallel lines to the edges 'x' and 'y' using a surface gauge (Fig 1).

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



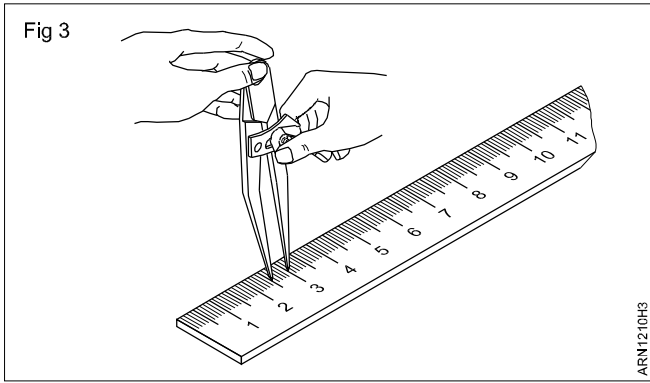
- 4 Scribe two lines by joining points ab and cd, using a steel rule and scriber (Fig 2).
- 5 Punch witness marks and complete 'Z' shape



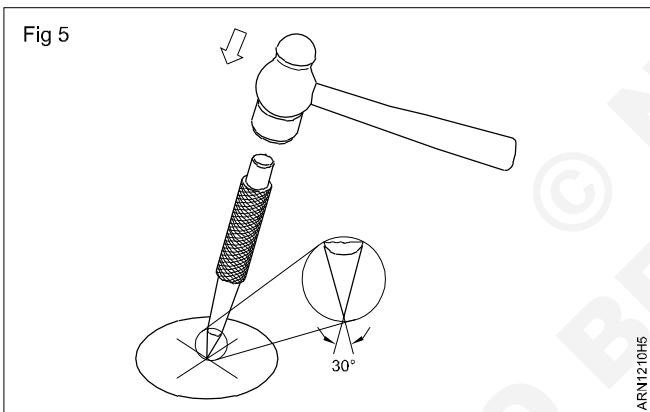
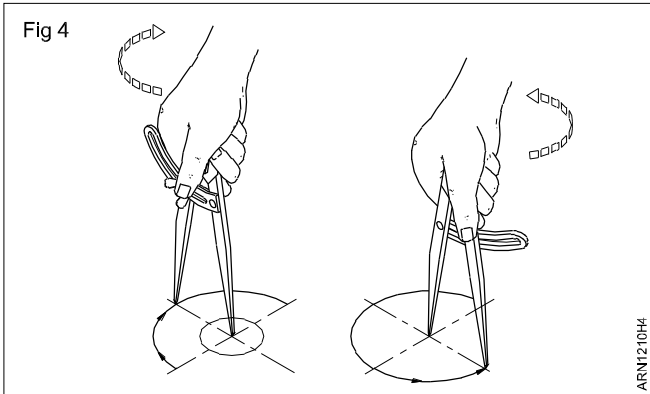
Marking 2

- 6 Apply the marking medium on the other side of the job and allow it to dry.
- 7 Mark the centre lines of three circles and one semicircle using the jenny caliper.
- 8 Punch all the four centres using a 30° prick punch. (Fig 5)
- 9 Open and set the divider to 5 mm. (Fig 3)

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



10 Draw two circles of $\phi 10$ using the divider (Fig 4).



11 Set the divider and draw $\phi 12$ circle and R35 semicircle.

12 Punch witness marks on the circles and semicircles.

Reuse the same material for marking 3 and 4

Marking 3

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

14 Apply copper sulphate solution on the finished side.

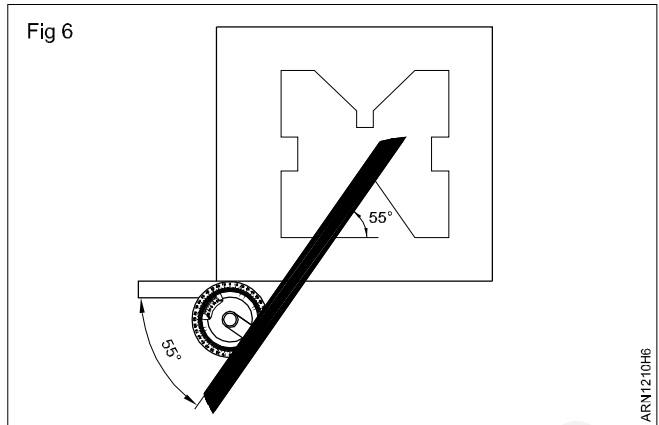
15 Butt the job against the angle plate.

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

17 Also mark the starting points of the Vee groove.

18 Set and lock the bevel protractor at 55° .

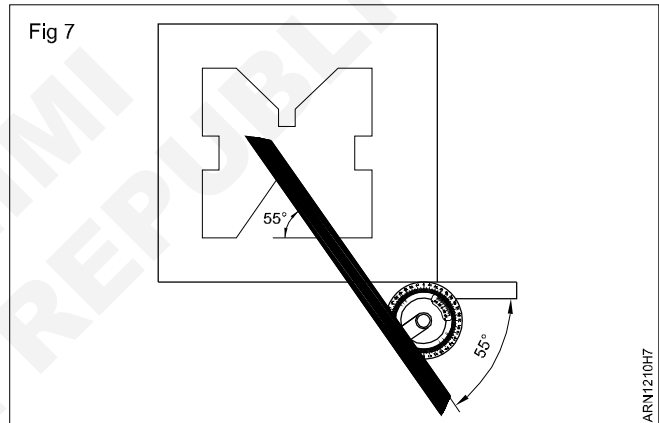
19 Butt the bevel protractor on to the edge of the job and mark one side of the Vee groove. (Fig 6)



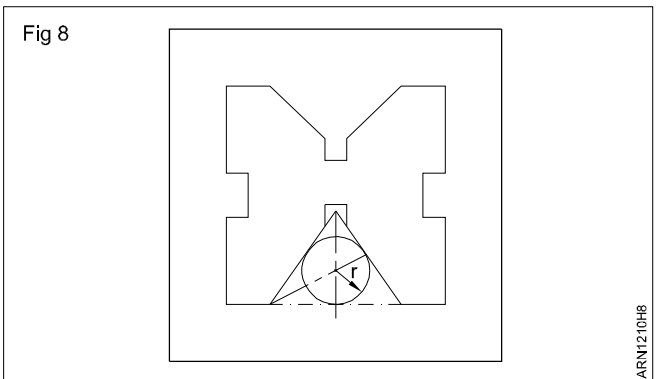
20 Continue the same procedure and complete the 44° Vee groove.

21 Complete the Vee block marking.

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



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



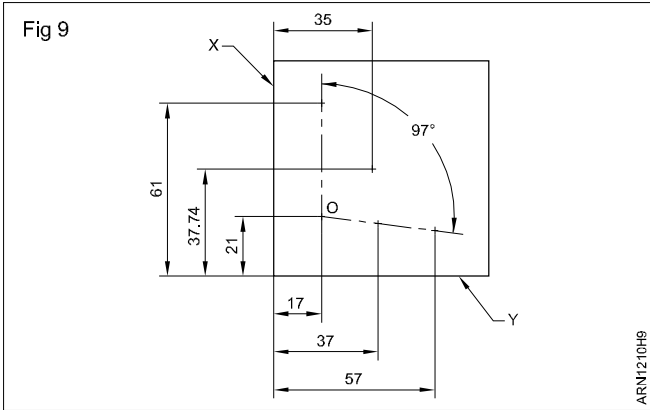
24 Similarly draw the circle on the 44° Vee groove.

25 Punch witness marks.

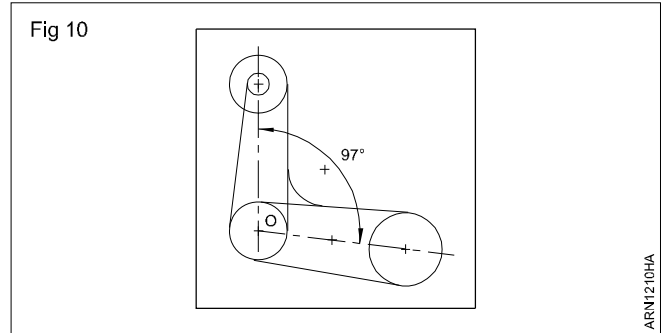
Marking 4

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

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



- 28 Set 97° on the bevel protractor.
- 29 Mark 97° line through point 'O' and get the centres of the other two circles (Fig 10).
- 30 Punch centre 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 scribe (Fig 10) and complete the marking as per shape given.
- 34 Punch witness marks.

Skill sequence

Marking parallel lines using surface gauge

Objectives: This shall help you to

- mark parallel lines using a surface gauge
- set the surface gauge to any height dimension.

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

Clean the base of the surface gauge.

Keep the surface firmly on the surface plate.

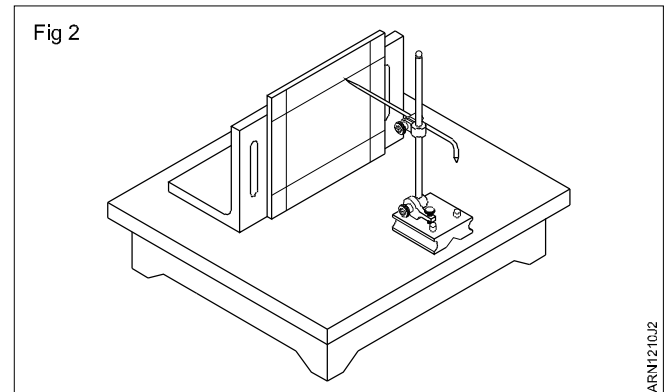
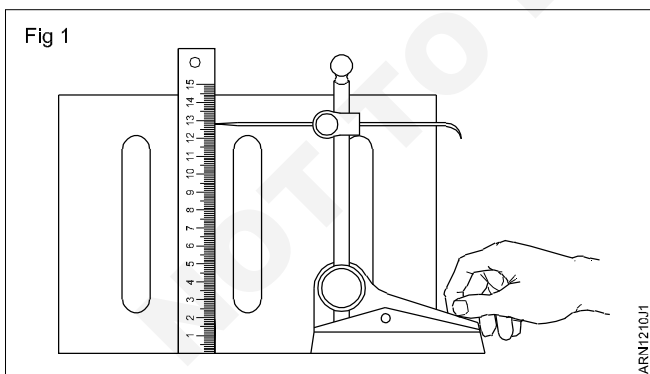
Rest the steel rule against the angle plate and set the scribe to the size to be marked (Fig 1).

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

Apply a thin and even coating of the marking media.

Butt the job against the angle plate.

Hold the job in one hand and move the scribe point touching the surface across the work and mark (Fig 2).



Marking lines parallel to the edge of the job

Objective: This shall help you to

- mark parallel lines using a jenny caliper.

Apply marking medium on the surface to be marked.

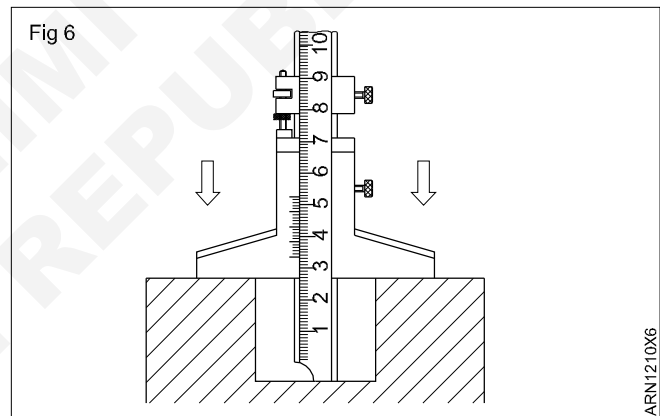
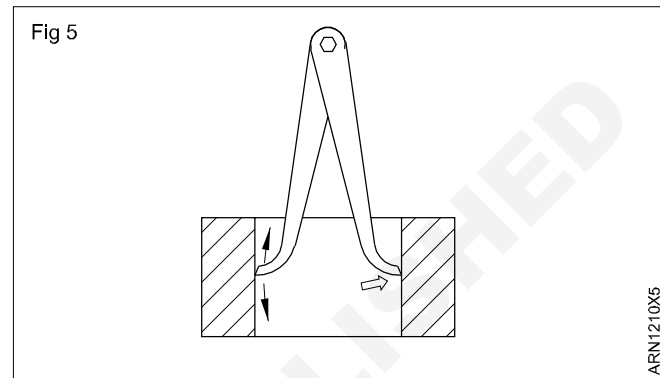
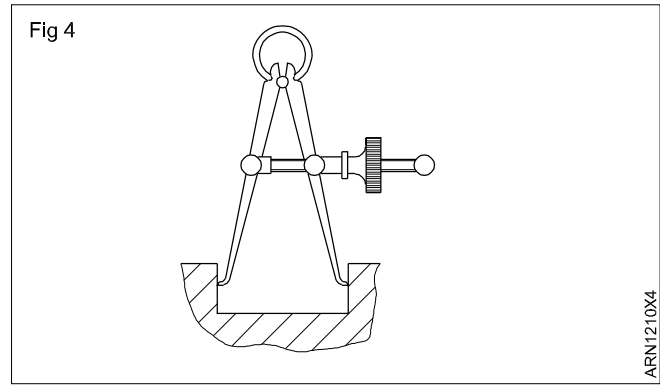
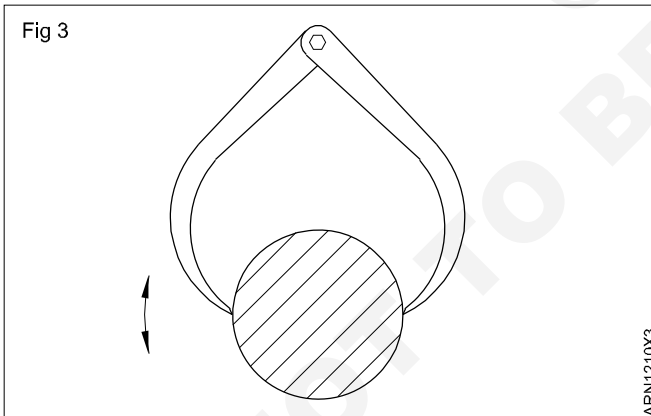
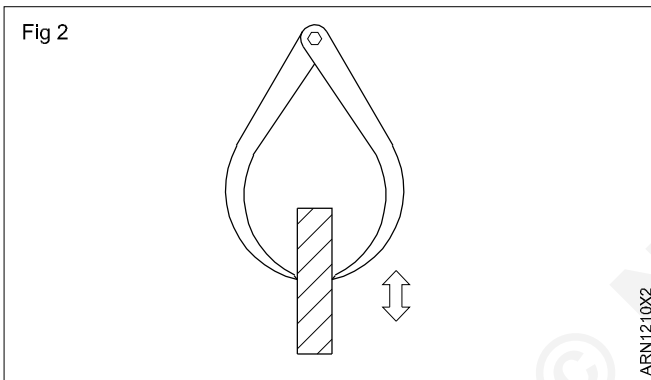
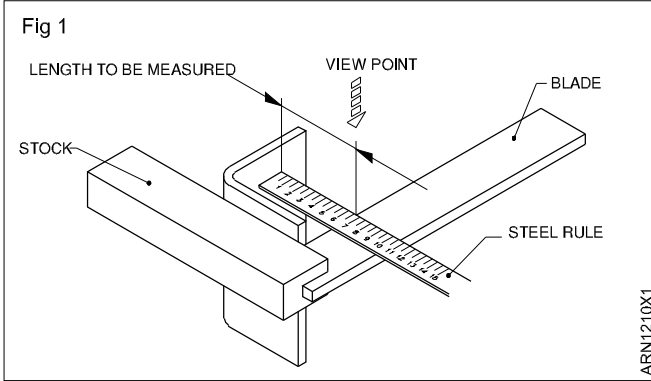
Set the jenny caliper to the size to be marked (i.e. dimension) with the help of a steel rule (Fig 1).

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

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

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

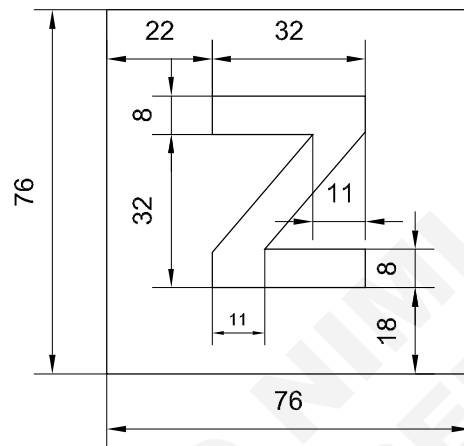
Note to the instructor : Provide old exercise and models as much as possible to the trainees for acquiring measuring skills with simple measuring instruments.



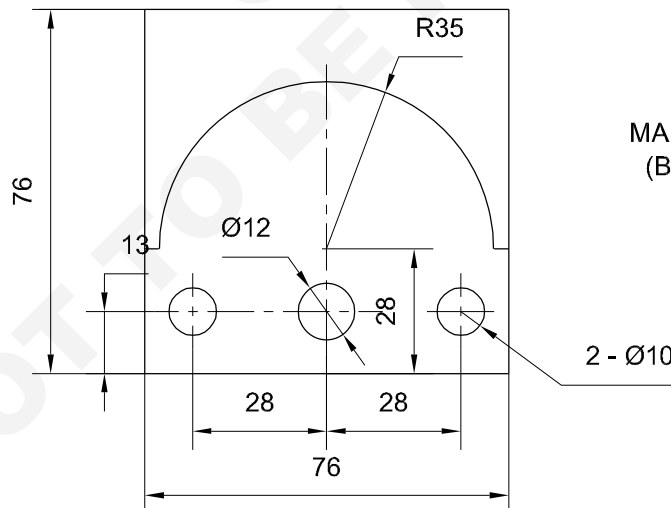
Layout and marking

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

- draw lines on metallic surfaces by scribers
- draw parallel lines on metallic surfaces by jenny calipers
- draw parallel lines with a surface gauge supporting the job against the angle plate
- draw angles with a simple protractor and scriber
- bisect the angles with a divider
- draw circles with a divider
- draw curves and tangents with dividers steel rule and scribers
- register the profile by dot punching
- punch the centre of the circle with a centre punch and ball-peen hammer.

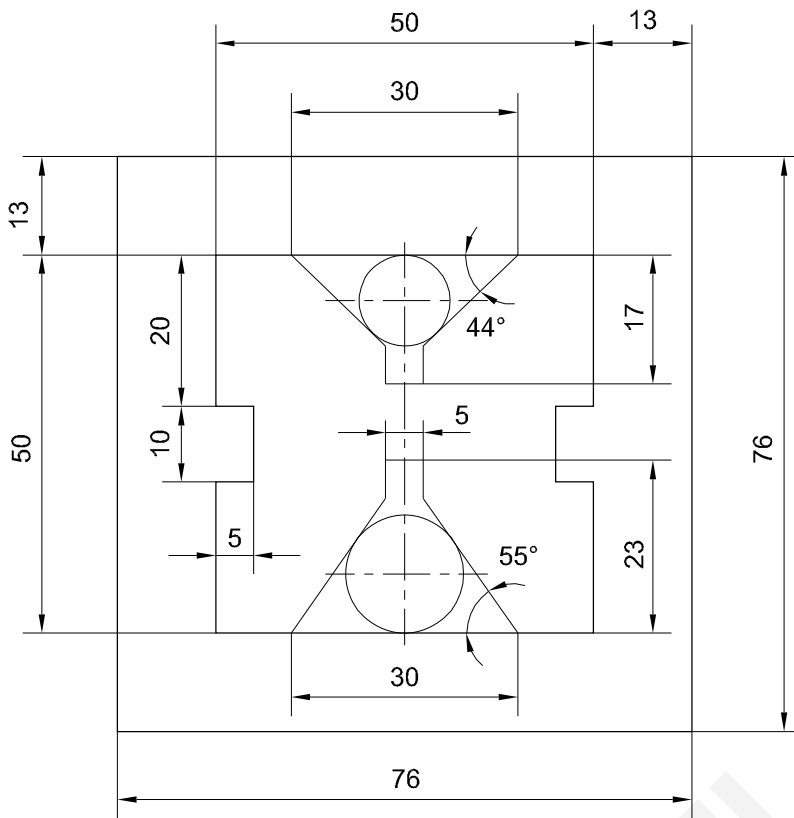


MARKING PARALLEL LINE
(By jenny caliper and scriber)
Fig 1

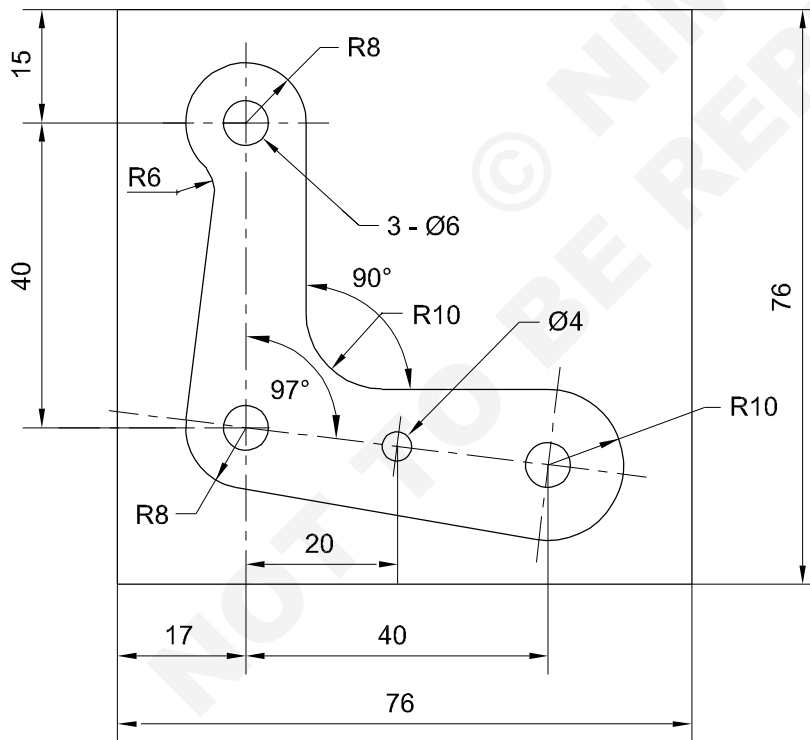


MARKING CURVES & CIRCLES
(By jenny caliper and divider)
Fig 2

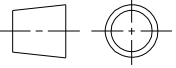
1	-	→ 1 - 05	Fe310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	
SCALE 1:1	LAYOUT & MARKING				DEVIATIONS ±0.1	
					CODE NO. ARN1211E1	



MARKING ANGLES & CIRCLES
Fig 3



MARKING TANGENTS & ARCS
Fig 4

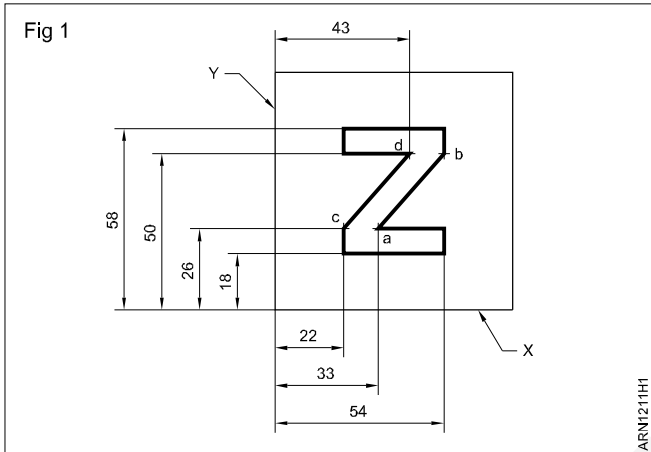
1	-	-	Fe310	-	-	
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	
SCALE 1:1					DEVIATIONS ±0.1	
					<p>LAYOUT & MARKING</p> <p>CODE NO. ARN1211E2</p>	

PROCEDURE

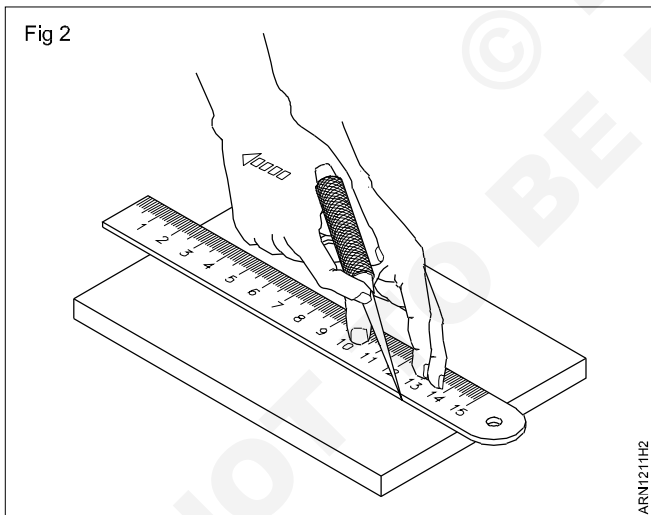
Marking 1

- 1 Check the raw material for its size and its squareness.
- 2 Apply copper sulphate solution on one side of the job and allow it to dry.
- 3 Scribe parallel lines to the edges 'x' and 'y' using a surface gauge (Fig 1).

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

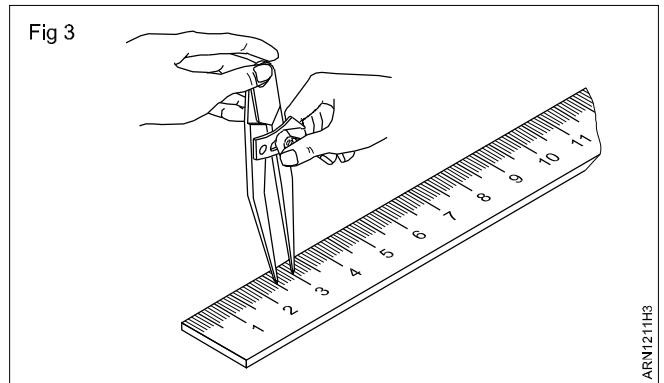


- 4 Scribe two lines by joining points ab and cd, using a steel rule and scriber (Fig 2).
- 5 Punch witness marks and complete 'Z' shape



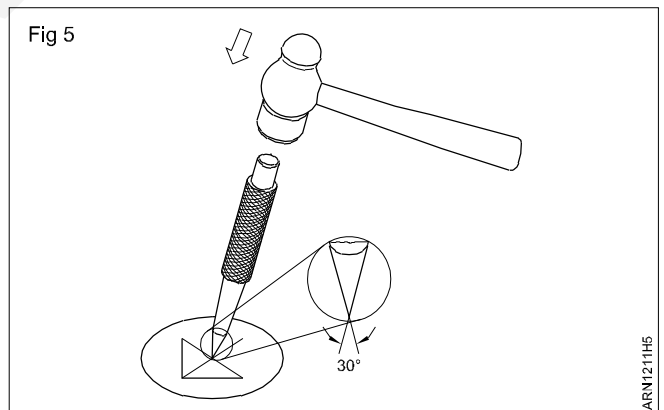
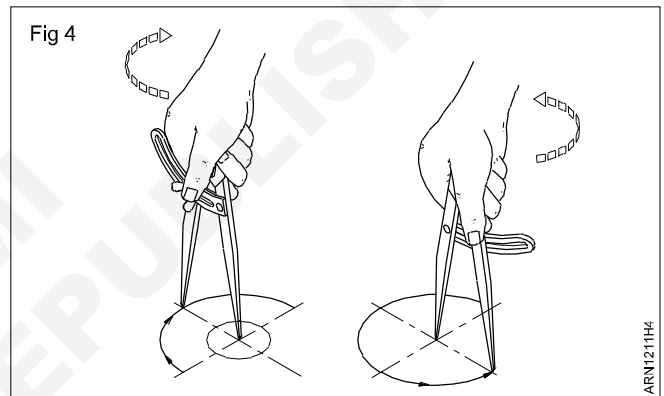
Marking 2

- 1 Apply the marking medium on the other side of the job and allow it to dry.
- 2 Mark the centre lines of three circles and one semicircle using the jenny caliper.
- 3 Punch all the four centres using a 30° prick punch. (Fig 5)
- 4 Open and set the divider to 5 mm (Fig 3).



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

- 5 Draw two circles of $\varnothing 10$ using the divider (Fig 4).



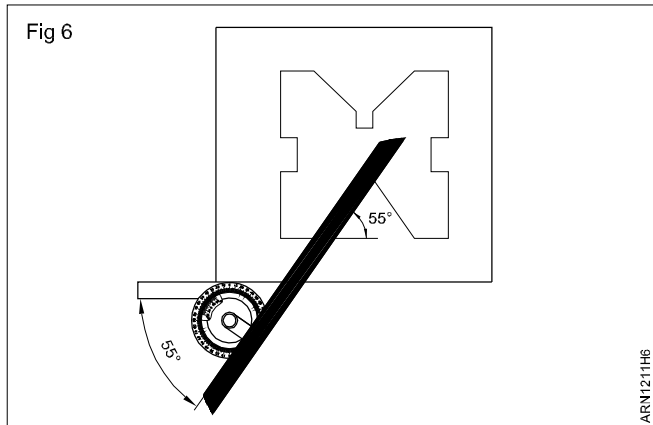
- 6 Set the divider and draw $\varnothing 12$ circle and R35 semicircle.
- 7 Punch witness marks on the circles and semicircles.

Reuse the same material for marking 3 and 4

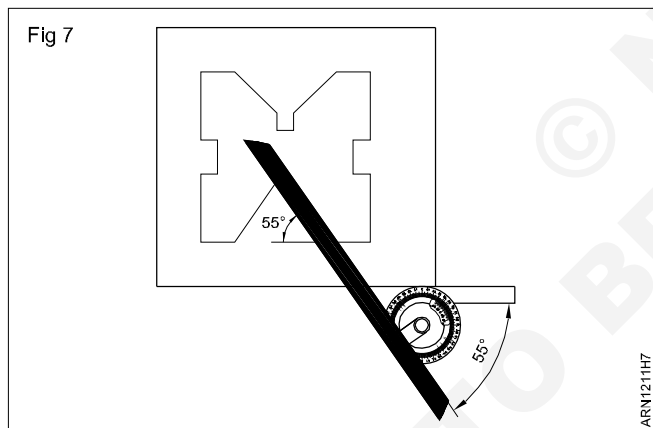
Marking 3

- 1 File and finish one of the marked surfaces flat and deburr.
- 2 Apply copper sulphate solution on the finished side.
- 3 Butt the job against the angle plate.

- 4 Mark all the parallel lines to the edges using the surface gauge.
- 5 Also mark the starting points of the Vee groove.
- 6 Set and lock the bevel protractor at 55° .
- 7 Butt the bevel protractor on to the edge of the job and mark one side of the Vee groove (Fig 6).



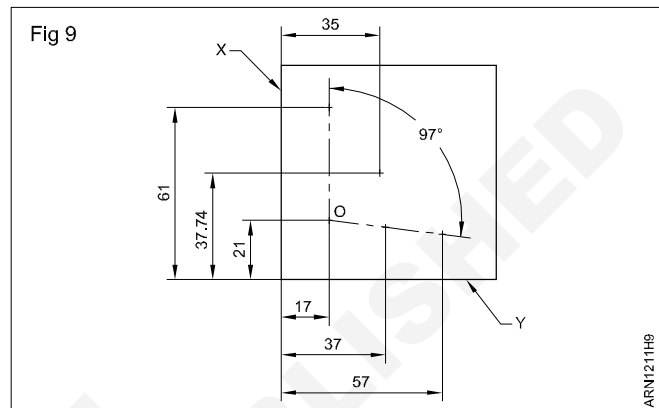
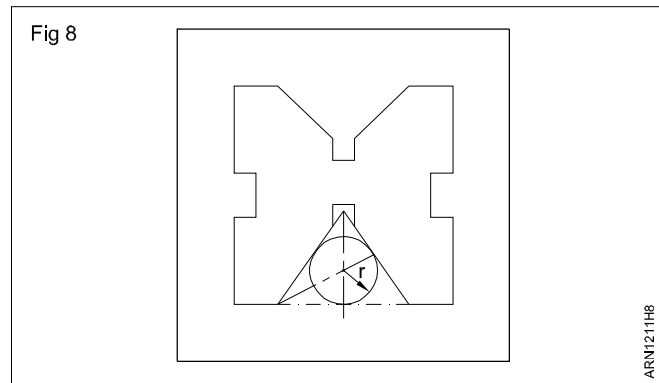
- 8 Continue the same procedure and complete the 44° Vee groove.
- 9 Complete the Vee block marking.
- 10 Bisect any two sides of the triangle formed by the 55° Vee groove, and get the centre and radius of the circle (Fig 7).



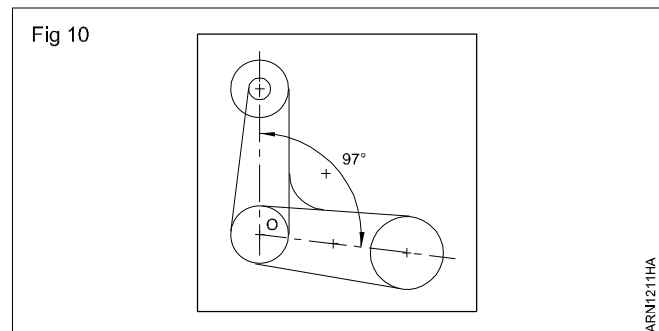
- 11 Draw the circle on the 55° Vee groove (Fig 8).
- 12 Similarly draw the circle on the 44° Vee groove.
- 13 Punch witness marks.

Marking 4

- 1 File and finish the other surface flat, deburr and apply the marking medium.
- 2 Scribe the centre lines and parallel lines to the edges 'x' and 'y' (Fig 9).



- 3 Set 97° on the bevel protractor.
- 4 Mark 97° line through point 'O' and get the centres of the other two circles (Fig 10).
- 5 Punch centre marks on all the four circles.
- 6 Draw all the four circles using a divider.
- 7 Draw R8, R8 and R10 curves a little more than the length required.
- 8 Draw two tangents close to the edges of the 'x' and 'y' circles using a steel rule and scribe (Fig 10) and complete the marking as per shape given.
- 9 Punch witness marks.



Practice on measure the wheel base of a vehicle

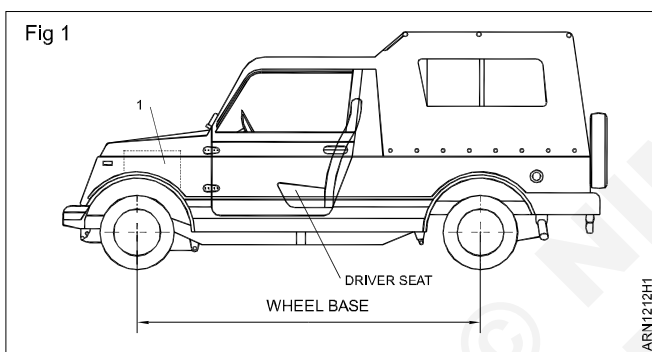
Objective: At the end of this exercise you shall be able to

- **measure the wheel base of a vehicle.**

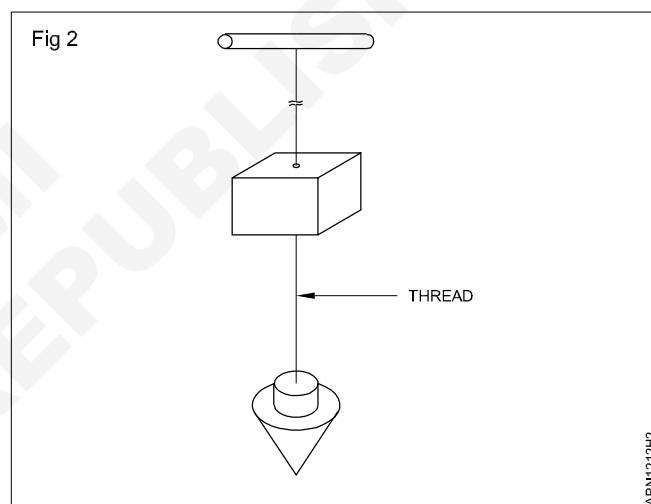
Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Measuring tape and Plumb bob	- 1 No each.	• Soap oil	- as reqd.
Equipments			
• Vehicle	- 1 No.		

PROCEDURE

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



- 2 Make the wheels straight ahead
- 3 Apply the vehicle hand brake
- 4 Apply wheel chokes on front and rear wheels
- 5 Close all the doors
- 6 Use the plumb bob and mark the vehicle front wheel centre (from the side view of vehicle) on the ground. (Fig 2).



- 7 Similarly mark the vehicle rear wheel centre (from the same side view of the vehicle) on the ground
- 8 Measure the wheel base using measuring tape between the two markings

Skill sequence

Practice on use of tape and plumb bob

Objective: This shall help you to

- **measure wheel base front overhang and rear overhang.**

- Select the correct measurement tape (Fig 2)
- Select the proper length of measuring tape
- Release the lock of the tape & pull it out for measurement
- Front end of the tape should be coincide with the centre mark line on the ground
- Keep the tape straight till the other end of the marked line

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

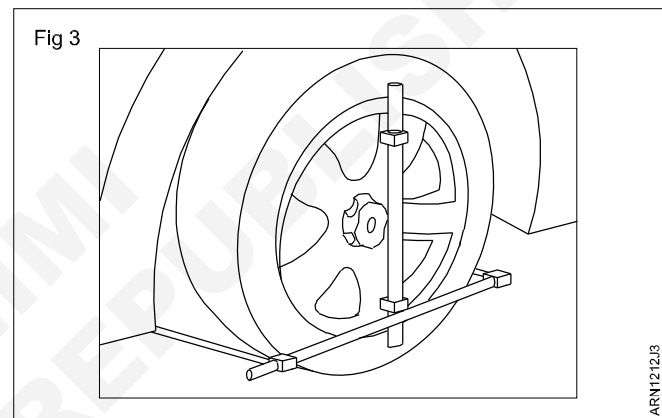
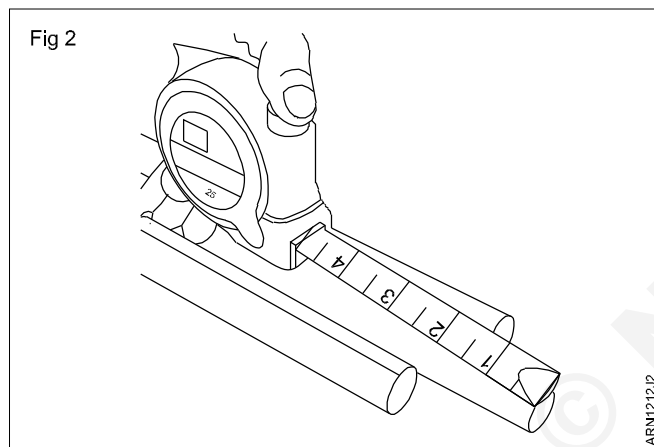
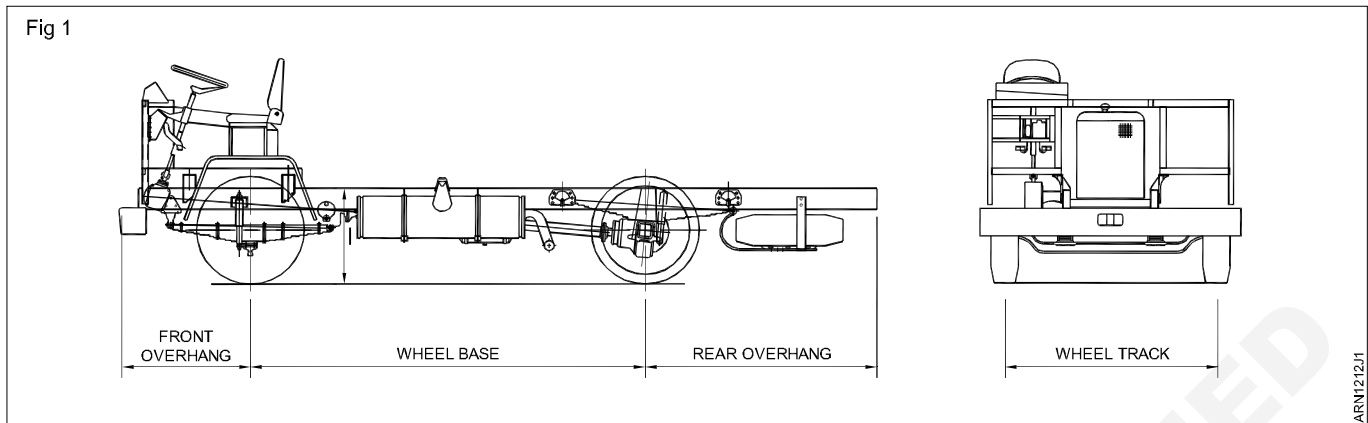
Take the measurement & check with the manufacturer's specified wheel base data. (Fig 3)

Measure the distance between centre of front wheel so center of rear wheel, which wheels are in straight ahead position. This is wheel base. (Fig 1)

Measure the distance between center of front LH tyre to center of front RH tyre. This is wheel track. (Fig 1)

Measure the distance between center of front wheel to the farthest point of the vehicle in front direction. This is front overhang.

Measure the distance between center of rear wheel to the farthest point in the rear (normally rear bumper). This is rear overhang. (Fig 1)



Practice on removing wheel lug nuts

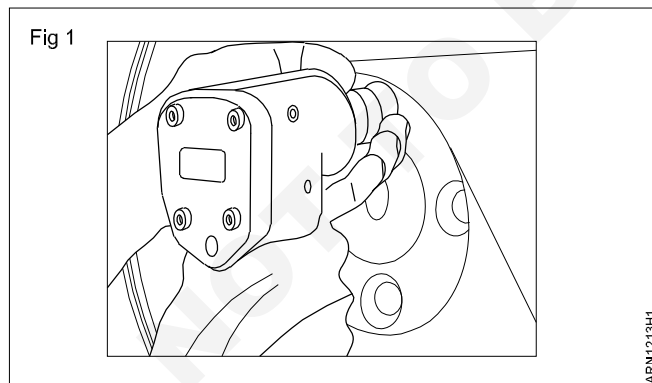
Objectives: At the end of this exercise you shall be able to

- handle an air impact wrench
- loosen and tighten wheel nuts
- set the required torque.

Requirements			
Tools / Instruments			
• Trainee's tool kit	- 1 No.	• Air Compressor unit	- 1 No.
• Air impact wrench	- 1 set.	Materials	
Equipments			
• Vehicle	- 1 No.	• Cotton waste	- as reqd.
		• Wheel nut	- as reqd.

PROCEDURE

- 1 Park the vehicle on level ground.
- 2 Apply Hand Brake.
- 3 Close all the doors.
- 4 Put wheel chocks to all the wheels.
- 5 Remove the wheel cap.
- 6 Check the Air impact wrench is connected to the Air lines.
- 7 Select correct size of socket/special socket for wheel lug nut which can with-stand sudden impact force (six point Impact Socket).
- 8 Fit the socket on the Air-impact wrench (Fig 1).
- 9 Set the direction of spin forward or backward with the help of wrench lever.
- 10 Set the torque by turning the valve to increase or decrease.
- 11 Insert impact socket on the wheel lug nut.
- 12 Trigger the switch of the impact wrench to loosen and remove the wheel lug nuts.
- 13 After removing all wheel nuts, place one or two nuts on the wheel bolt to avoid slipping of the wheel while jack up the vehicle for wheel removing.



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

Wear ear protection device such as ear muffs and ear plugs

Wear safety glasses for eye protection

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

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

Practice on handling hand tools and power tools

- Objectives:** At the end of this exercise you shall be able to
- identify screw driver for specific purpose and handle it
 - identify spanner & wrenches for specific purpose and handle it
 - identify pliers for specific purpose and handle it
 - tighten the lock devices.

Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Jack mechanical and hydraulic	- 1 No.
• Screw driver	- 1 Set.	• Hydraulic press	- 1 No.
• Ring and D/E spanners	- 1 Set.	• Flaring equipments	- 1 No.
• Pliers	- 1 Set.		
Equipments			
• Pullers	- 1 No.	• Kerosene	- as reqd.
• Air compressor	- 1 No.	• Cotton waste	- as reqd.
• Car washer	- 1 No.	• Pipe	- as reqd.
		• Steel wire	- as reqd.

PROCEDURE

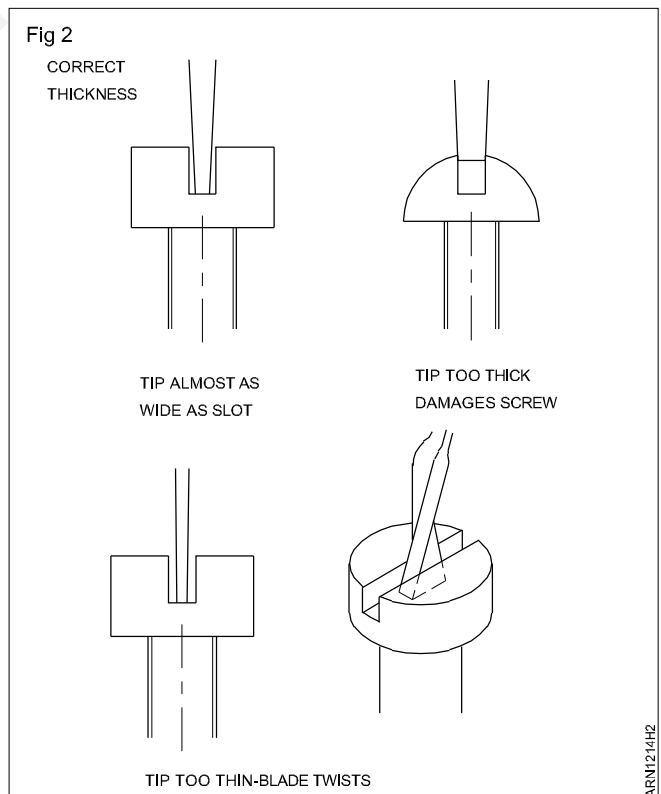
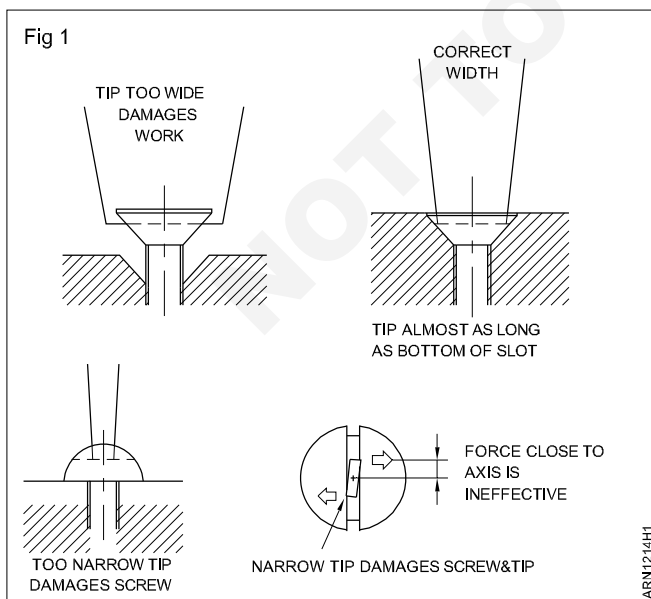
Task 1: Identify the screw driver for specific purpose

Checking the condition of the fastener to be removed

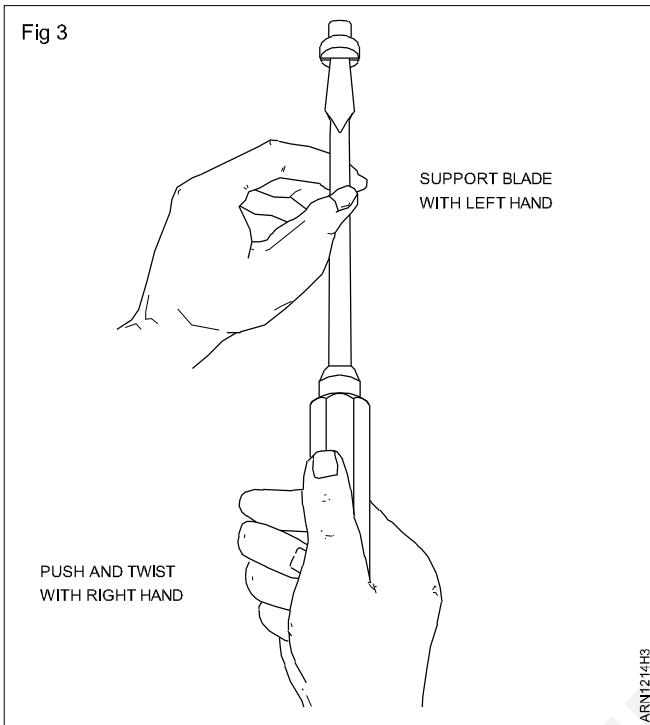
- 1 Clean the surface of the fastener to be removed by using kerosene, of banian cloth.
- 2 Check the cornering faces of the fastener for any wear or damage.
- 3 If it is found good, then proceed as follows
- 4 Select the correct size screwdriver to suit the screw slot (Fig 1).

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

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



- 6 Hold the screwdriver with its axis in line with the axis of the screw.
- 7 Guide the blade with the left hand. Apply a little pressure with the right hand to keep the tip in the slot (Fig 3).



- 8 Twist firmly and steadily.

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

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

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

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

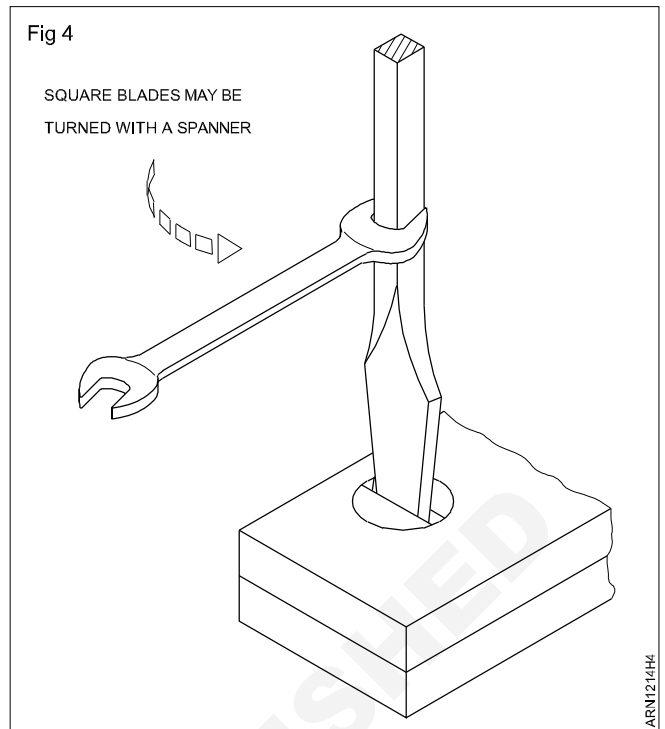
Never use pliers or toothed wrenches to apply twisting force to a screwdriver.

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

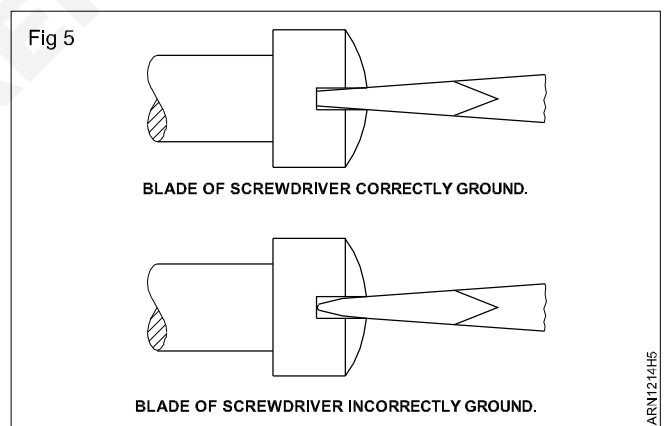
Do not grind the blade to a chisel point, as it has a tendency to slip out of the screw slot.

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

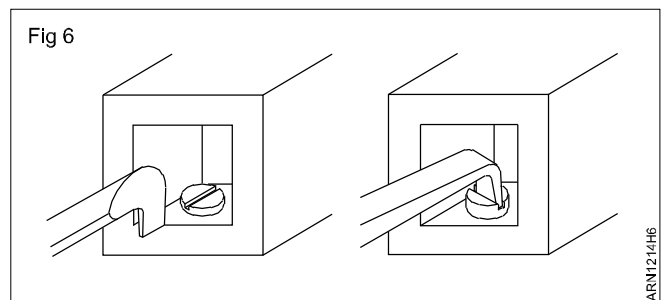
Never grind screwdrivers on a silicon carbide grinding wheel.



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



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



- 13 Reverse the screwdriver after one end to get on quarter turn on .
- 14 Use the other end to get the next quarter turn and so on.

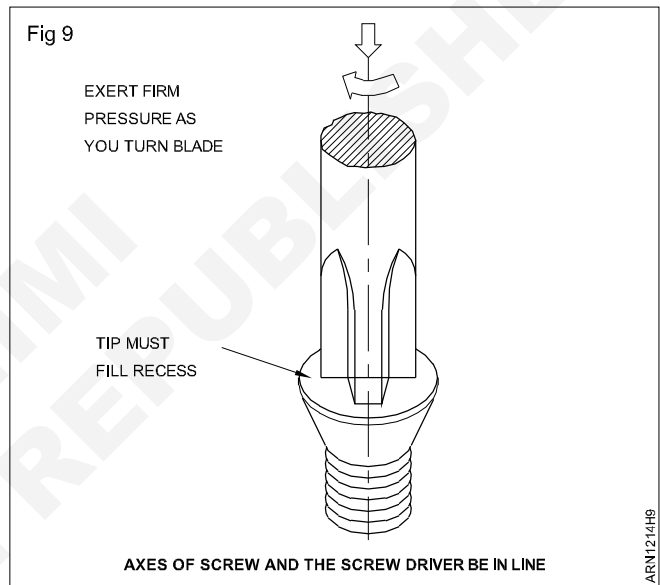
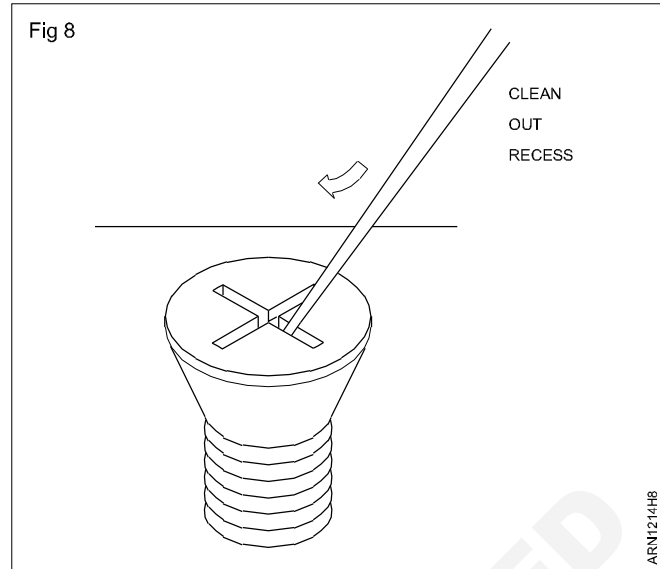
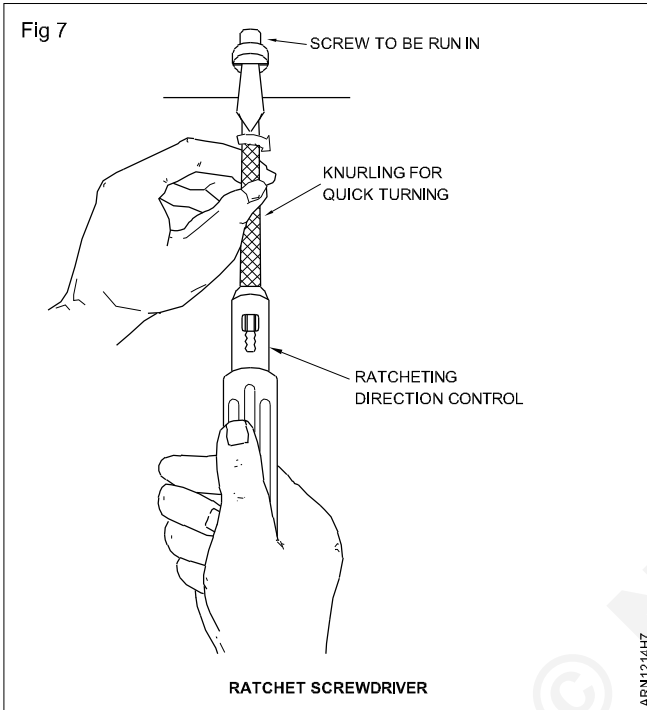
Keep pressing the tip into the slot as you turn.

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

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

Change the direction of control depending on your movement.

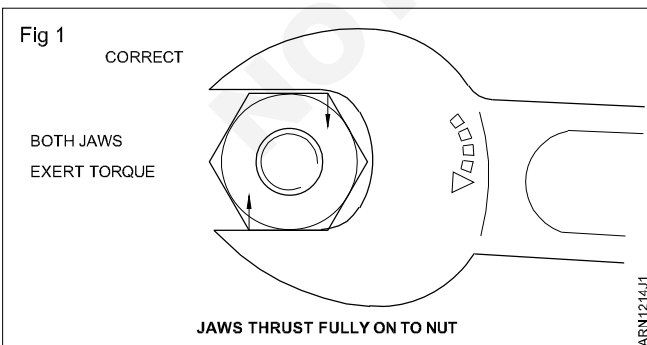
Phillips (cross-recess) screwdrivers (Fig 8 & 9)



Task 2: Identify spanner & wrenches for specific purpose

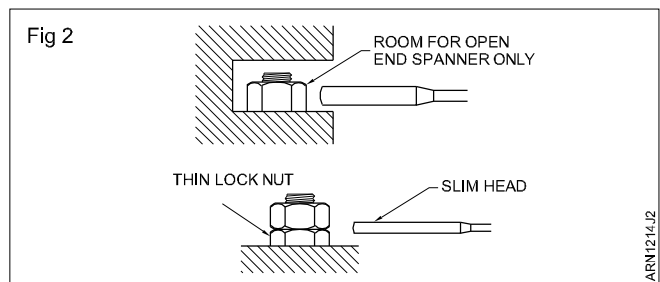
Identifying the correct size of the tool

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



2 Decide the size of the spanner.

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

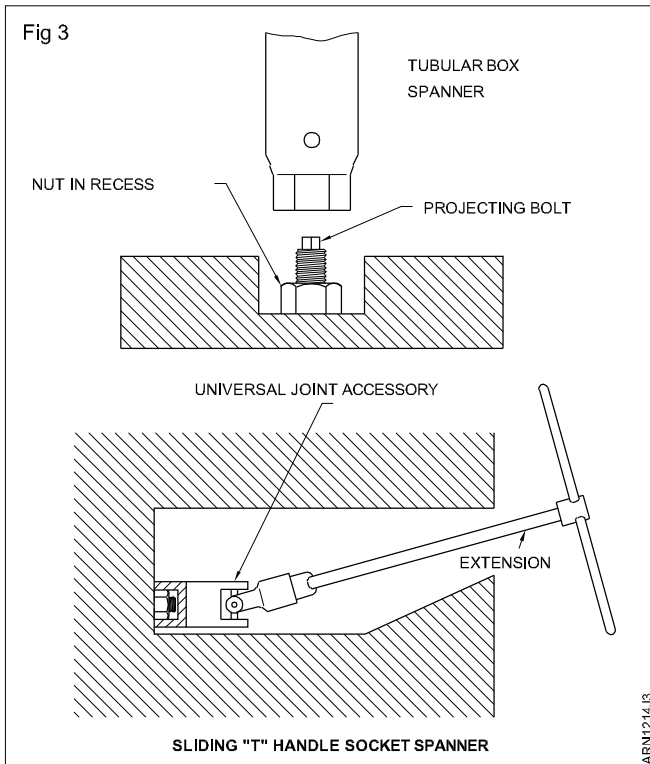


Handling the Tool excess clearance will cause slipping of spanner & fasteners corners gets damaged.

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

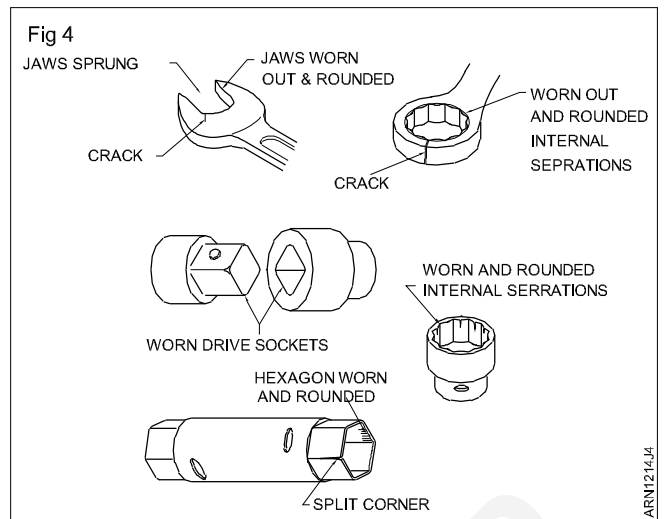
5 Take a sliding offset handle and insert the drive attachment with square driving ends of a socket.

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



- 7 Keep the position of the handle perpendicular to your forearm which enables you maximum leverage.
- 8 Pull the socket handle and drive out the nut/bolt head.

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



- 9 Insert the ring spanner on the bolt or nut.
- 10 Keep the position of the shank perpendicular to your forearms which enables you maximum leverage.
- 11 Use D.E spanner where ring spanner is not suitable.

Always try to pull the spanner.

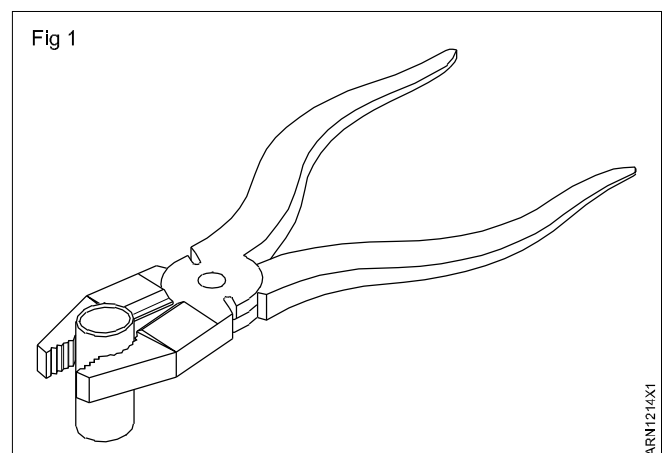
If you are forced to push the spanner, use the base of your hand and keep your hand open.

Use both hands for large spanner.

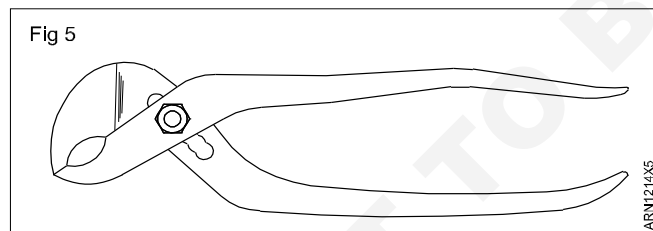
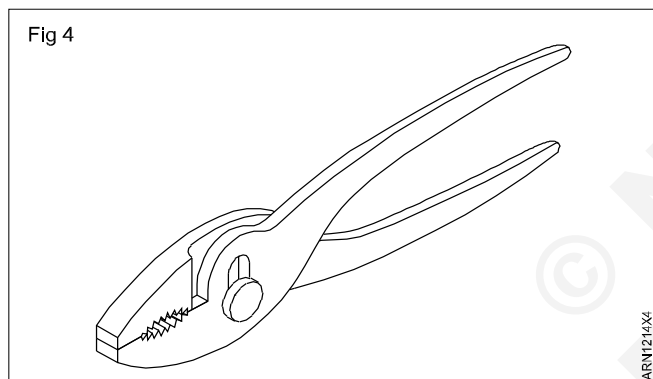
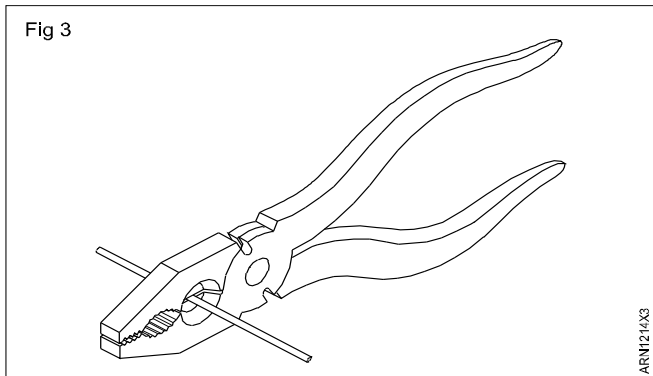
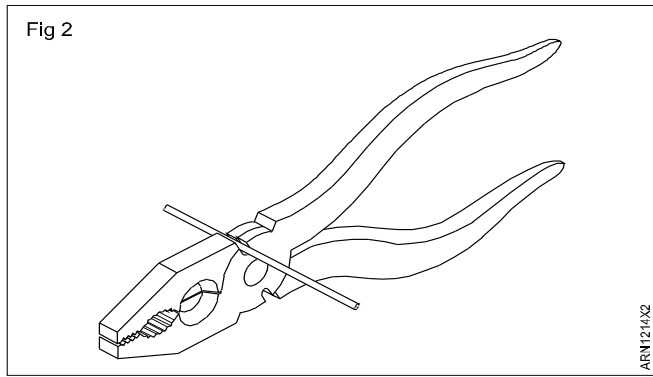
Keep yourself balanced and firm to avoid slipping.

Task 3: Handling of Plier

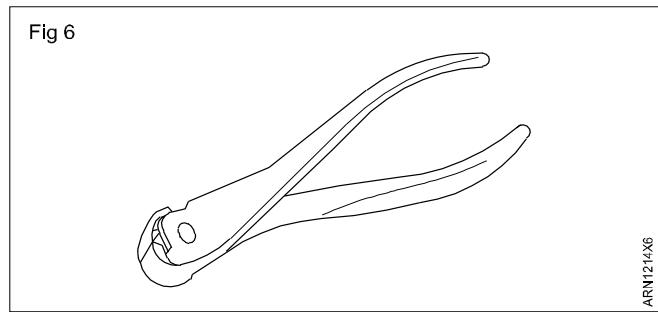
- 1 Select a component with lock wire to nut, which is to be removed.
- 2 Use the combination plier flat grip for untwist the lock wire.
- 3 After untwisting, pull the lock wire from the nut.
- 4 Remove the nut with proper spanner.
- 5 Select a brake pipe line to be removed from a junction.
- 6 Hold the brake pipe line with serrated pipe grip portion at combination pliers (Fig 1).
- 7 Select proper size of proper double open end spanner & remove the union nut.
- 8 Select a 3 mm electrical wire to be cut.
- 9 Place the wire between joint cutters at the point which is to be cut (Fig 2).
- 10 Press the handle to cut the wires.
- 11 Select a steel wire to be cut (Fig 3).
- 12 Place the steel wire in between side cutter.
- 13 Press the handle to cut the wire.



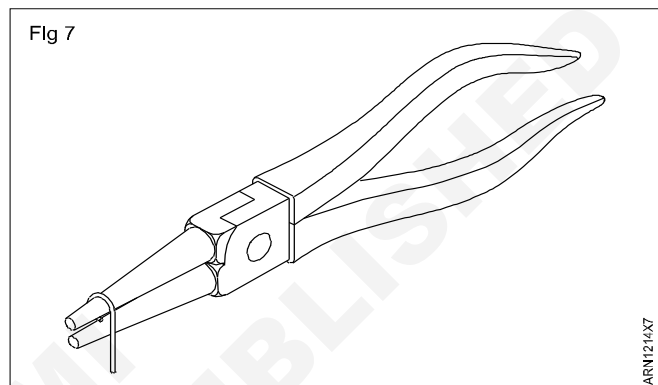
- 14 Select a nut with tab washer to be removed.
- 15 Unfold the tab washer with help of flat nose pliers (Fig 4).
- 16 Use a proper spanner to remove the nut.
- 17 Select a cylindrical component with nut.
- 18 Hold the cylindrical shaft with help of slip joint pliers jaws (Fig 5).



- 19 Remove the nut with proper spanner.
- 20 Select a wire to be trimmed.
- 21 Place the end of the wire to be trimmed by end cutting plier in between the cutting end (Fig 6).
- 22 Apply pressure on handles to cut the wire.
- 23 Select the steel wire to be cut close to the component surface.
- 24 Cut the steel wire by slip joint multi grip plier applying pressure on the handles.
- 25 Use the cutting pliers to spread the cotter pin.
- 26 Select a stead with lock nut, from which lock nut has to be removed.
- 27 Hold the stead by locking pliers adjusting the screw in the handle lock with lever.

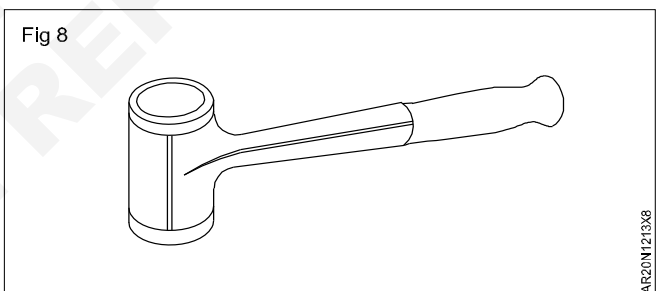


- 28 Use a proper spanner to remove the locking nut.
- 29 Select a wire which has to be converted into loop.
- 30 Hold the wire between the jaws (Fig 7).
- 31 Form a loop by tuning the round nose pliers.



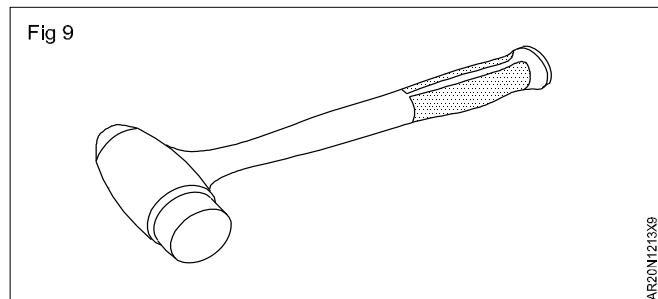
Plastic faced dead below hammer

- It is used to re-shapening the panel (Fig 8).



Dead below hammer

- This hammer has metal head is filled lead shot. It is used to autobody repair work (Fig 9).

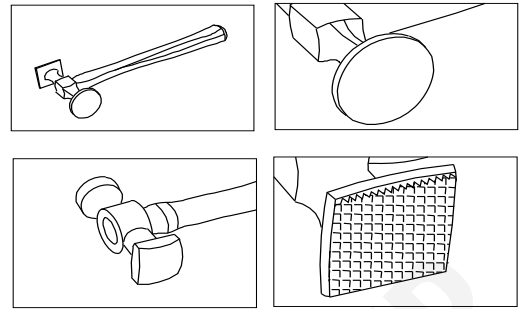


- The following body hammer and dollies are often needed to take minor dents out of sheet metal.
- Body hammers have specially shaped heads for working sheet metal. Dollies are specially shaped blocks of steel for straightening sheet metal.
- Body hammers are the primary striking tools used in collision repair.

- A body hammer has the head shaped for working sheet metal. This one has large flat heads flattening sheet metal.
- This body hammer has rounded heads for forcing a curve into sheet metal.
- This body hammer head is flat and smooth for working damage out of sheet metal.
- The serrated body hammer head will shrink metal after it has been stretched from collision damage (Fig 10).
- The dolly and spoons are used to straighten the autobody panels. (Fig 11)
- An interchangeable driver set is handy because you can match the shape of the drive to the desired contour of the sheet metal panel being straightened.

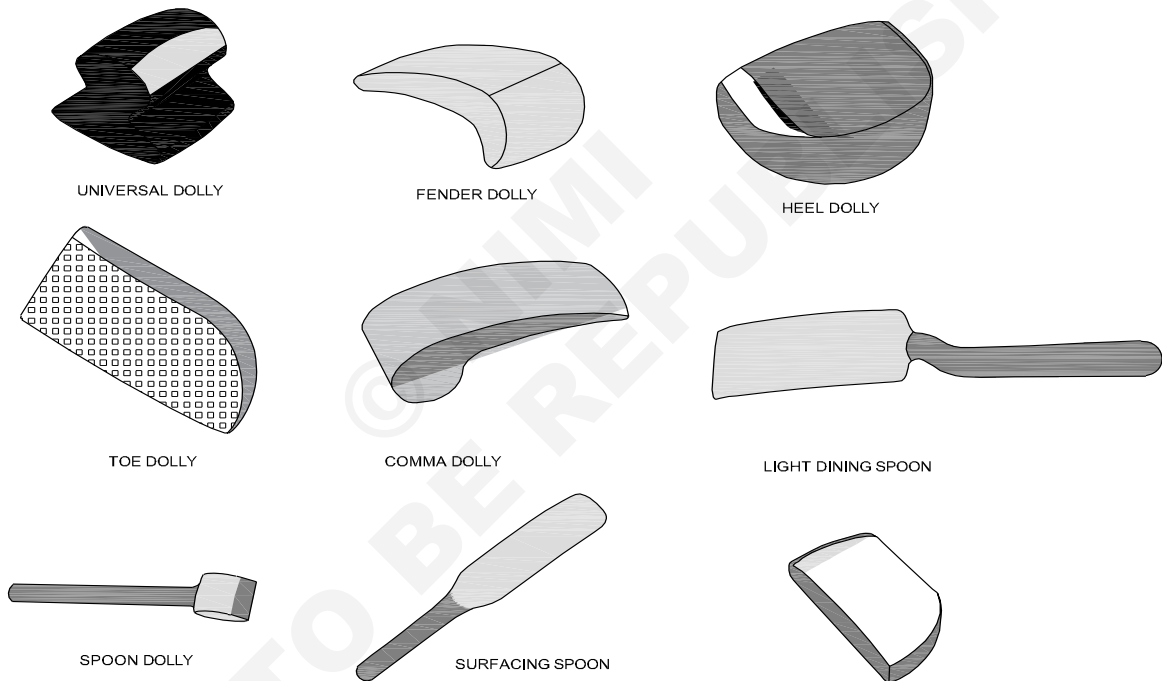
- The different driver heads that can be used to reshape and fix damaged sheet metal (Fig 12A).
- A small driver head can be placed into a dented body line to hammer it straight quickly. (Courtesy of SPX/OTC service solutions.) (Fig 12B)

Fig 10



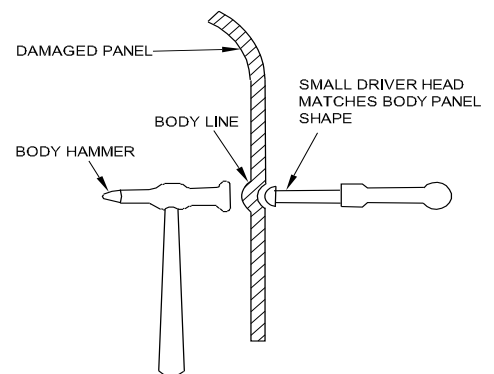
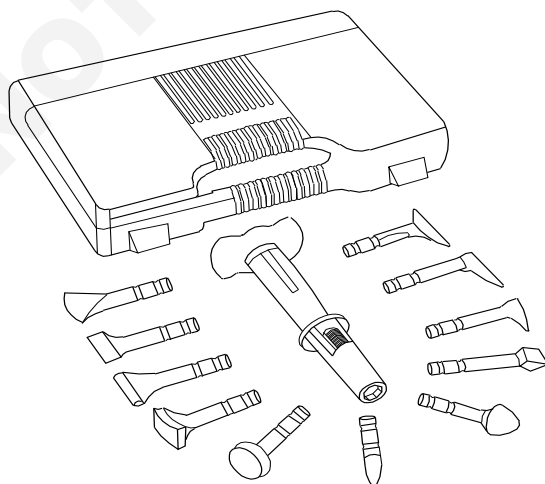
AR20N1213XA

Fig 11



AR20N1213XB

Fig 12



AR20N1213XC

Handling of pipe flaring & cutting tools

Objective: At the end of this exercise you shall be able to
 • cut a G.I pipe using a pipe cutter.

Requirements

Tools / Instruments

- Trainee's tool kit - 1 No.
- Pipe flaring and cutting tool - 1 No.
- Pipe cutter - 1 No.
- Try square - 1 No.
- Impact wrench - 1 No.
- Air drill - 1 No.
- Heat gun - 1 No.
- Air chisel - 1 No.
- Puller - 1 No.

- Air sander - 1 No.

Equipments

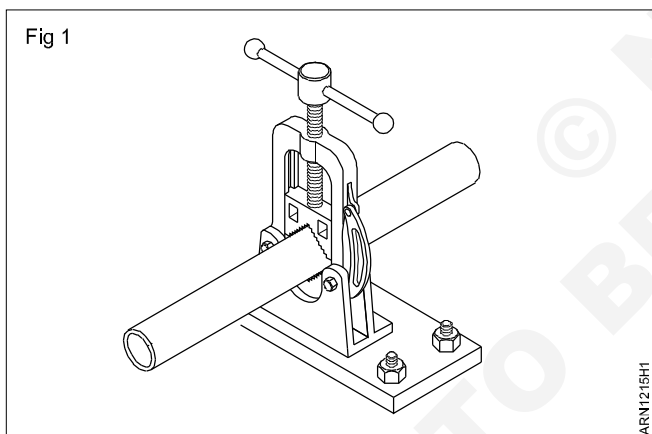
- Vehicle - 1 No.

Materials

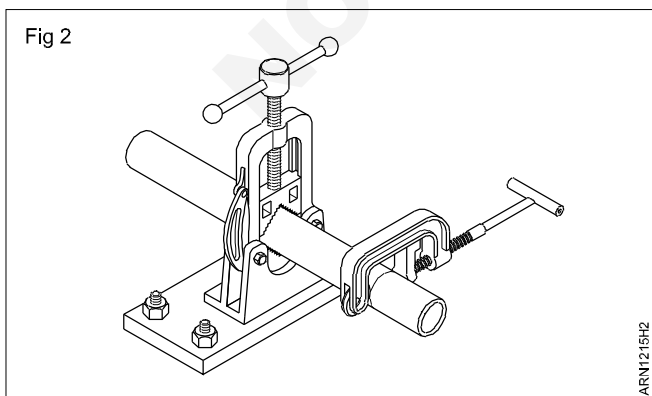
- Cotton waste - as reqd.
- Abrasive - as reqd.
- Soap oil - as reqd.

PROCEDURE

- 1 Measure the required length of pipe and mark it with chalk.
- 2 Keep the pipe in the pipe vice and tighten it (Fig 1).

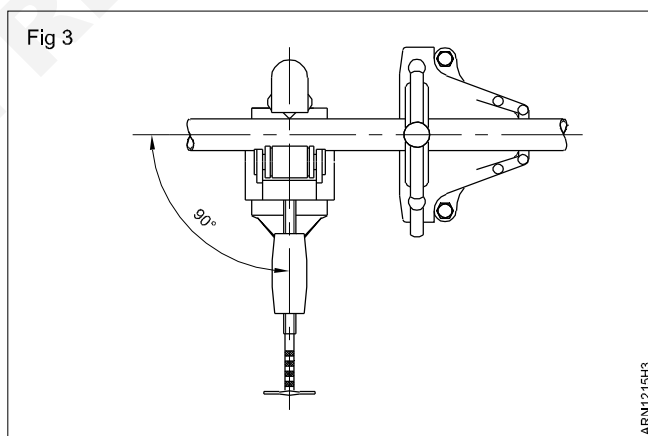


- 3 Fit the pipe cutter on the G.I pipe (on the scribed line) and tighten the jacking screw so that the cutting wheel is touching the pipe (Fig 2).

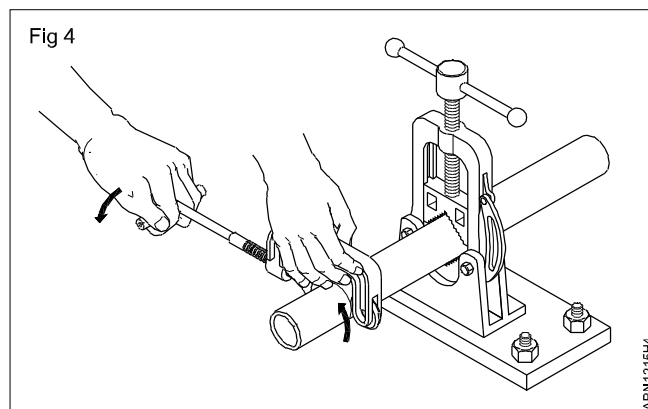


Ensure that the pipe is kept horizontal and parallel to the serrations such that the marking is visible at the top.

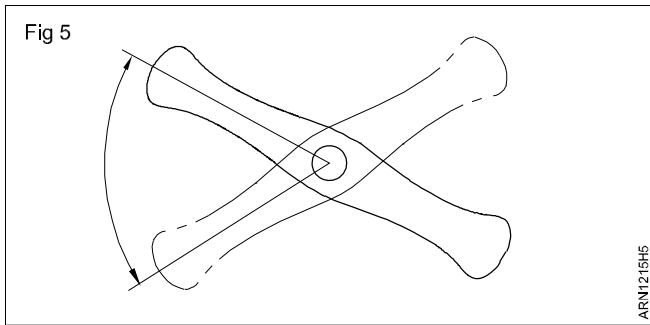
- 4 Rotate one or two turns to ensure that the cutting wheel is sitting exactly on the scribed line at 90° to the pipe (Fig 3).



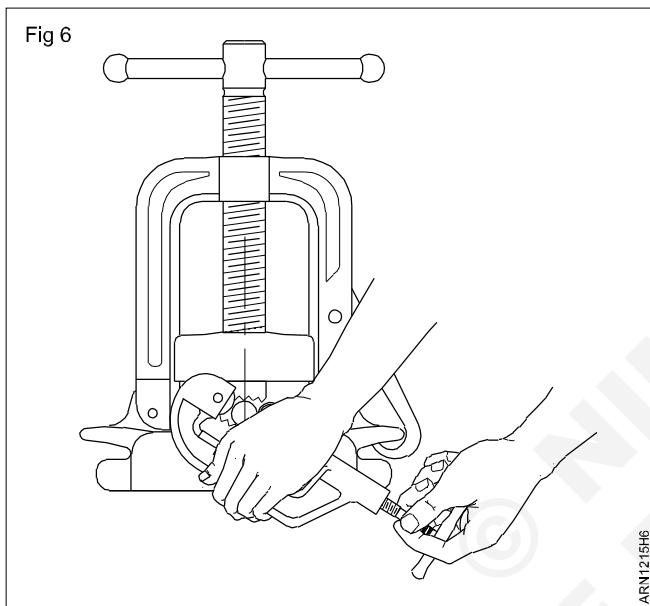
- 5 Rotate the pipe cutter around the pipe (Fig 4).



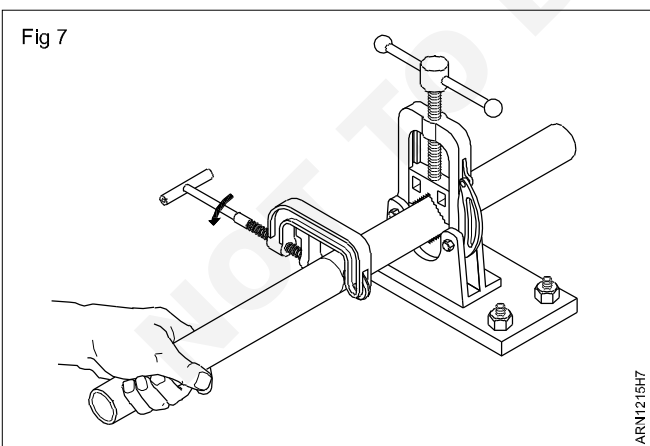
6 After two or three turns use the jacking screw to apply pressure on the cutting wheel (Fig 5).



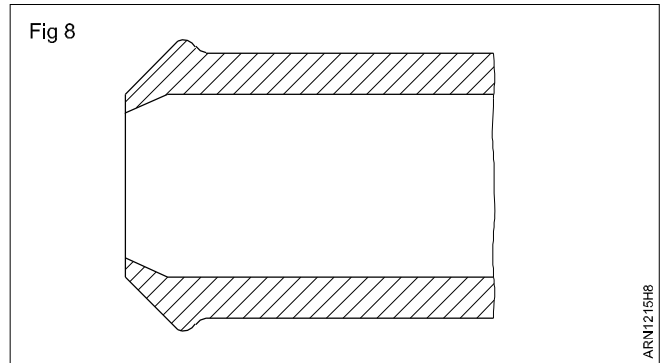
7 Keep rotating the pipe cutter around the pipe. Increase the pressure to the cutter by repeating the cycle until the pipe is cut through (Fig 6).



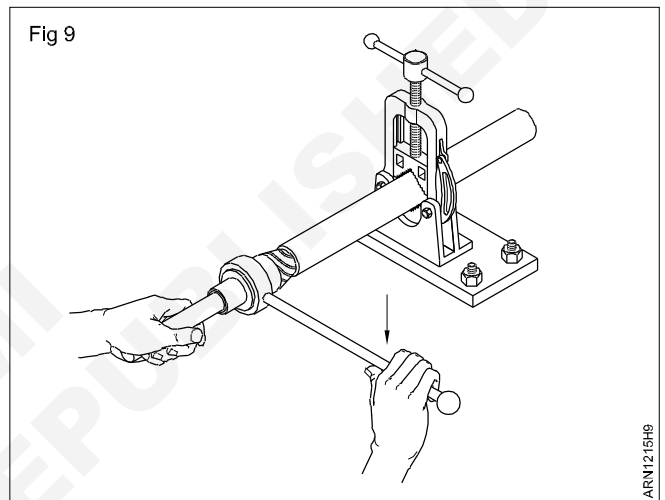
8 Support the pipe with your left hand so that the free end of the pipe does not fall (Fig 7).



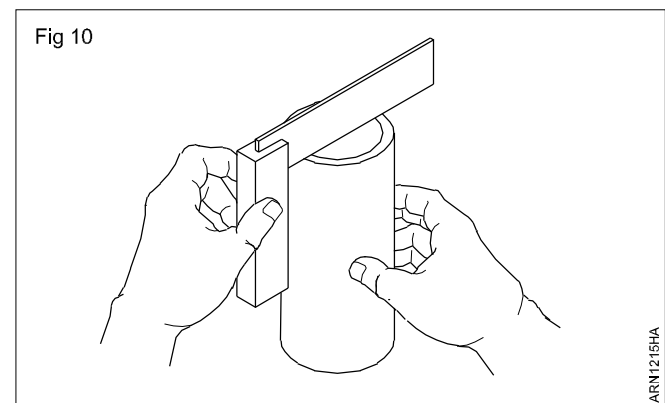
The cut portion of the pipe will appear as shown in Fig 8.



9 Remove burrs using a pipe reamer (Fig 9).



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



Skill sequence

Make flare joints and test them with flare fittings

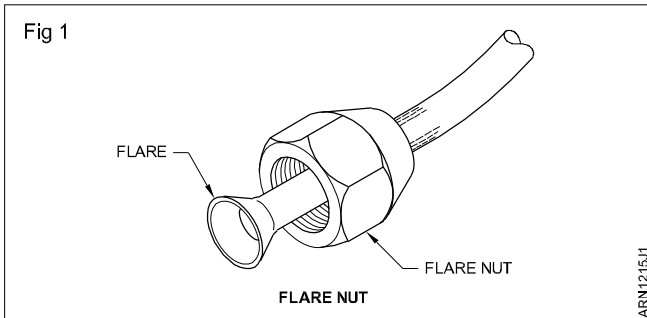
Objectives: This shall help you to

- flare the end pipe
- joint flare nut with flare fitting and test it.

Flaring

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

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



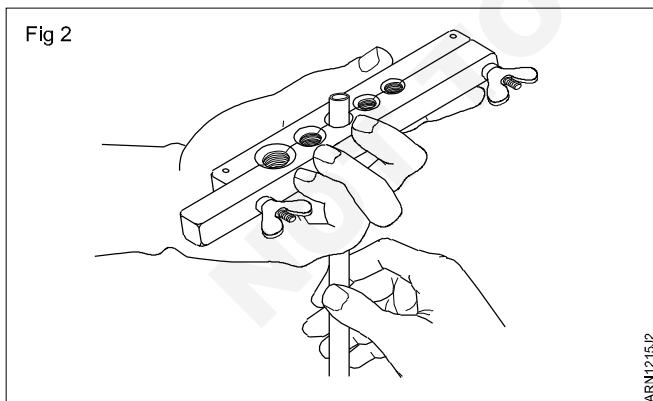
Always place the special flare nut on the pipe first before flaring.

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

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

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

- Place the flare nut on the pipe
- Choose the correct size hole in the flaring tool to fit the pipe; (there are 5 holes to fit different sizes of pipe.)



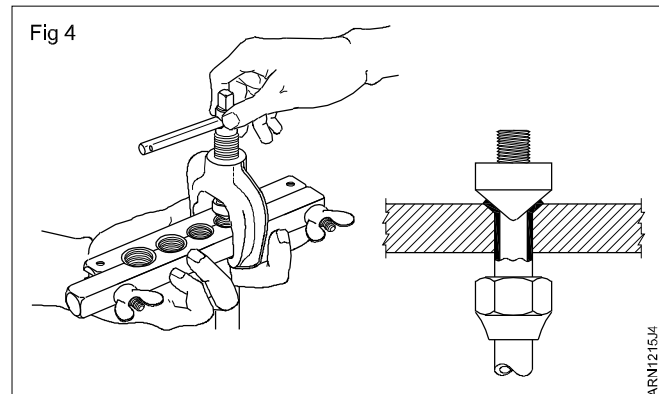
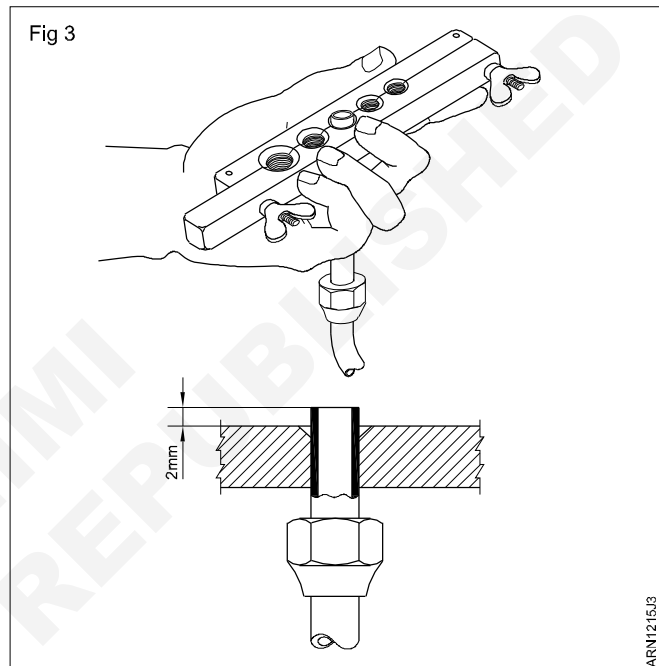
If the pipe is 1/4 inch (6mm) in diameter, position the pipe so that the end is at least 2 mm above the top of the flaring block (Fig 3). (This distance is calculated as "pipe diameter divided by 3"; in this case, 6mm divided by 3 = 2 mm).

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

Fit the yoke to the flaring block (Fig 3)

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

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



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

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

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

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

Observation Table 1

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

Joining with flare fittings

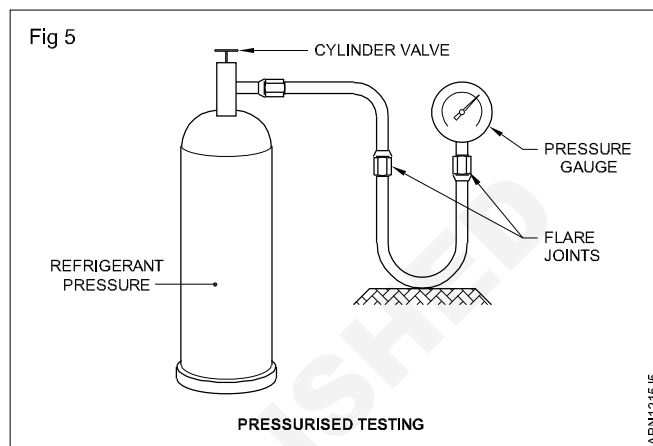
Put thread seal tape on the thread

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

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

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

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



Observation Table 2

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

The pressure will be shown in the pressure gauge.

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

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

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

Observation Table 3

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

Air powered wrench (Fig 6&7)

Air impact wrench and air ratchet has involves threaded fasteners can be done faster and easier.

Spot weld drill (Fig 8)

Spot weld drill is used to removing welded spots on panel.

Electric drill (Fig 9)

Electric drill used to tighten and opening the small screws and drill the small holes on metal and wood parts.

Air sanders (Fig 10)

Disc and orbital air sanders are used an abrasive action to smooth and shape body surface.

Air scraper (Fig 11)

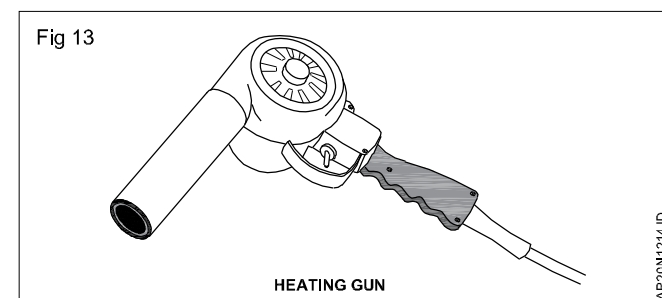
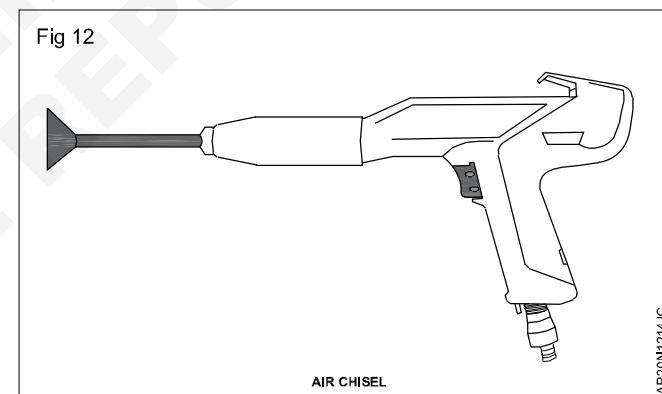
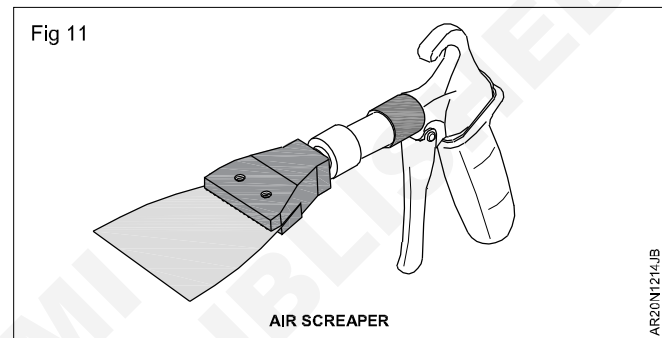
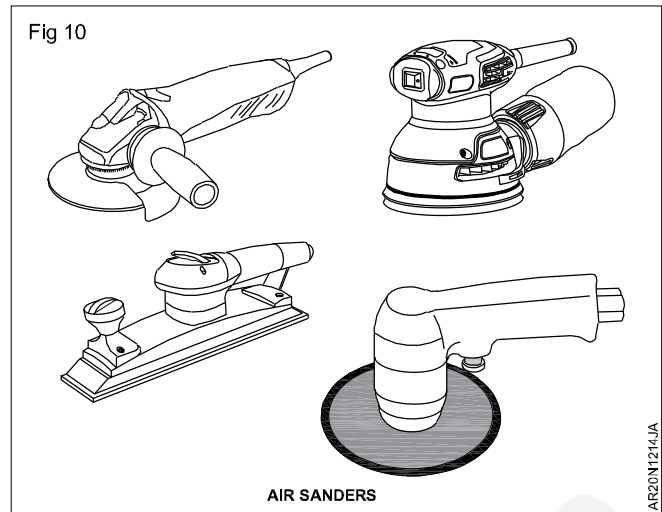
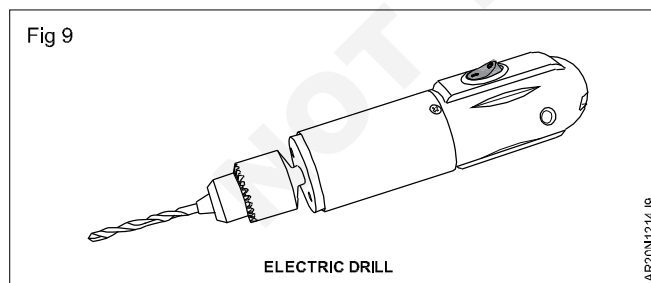
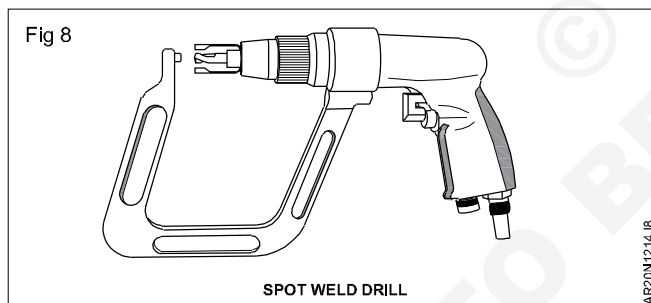
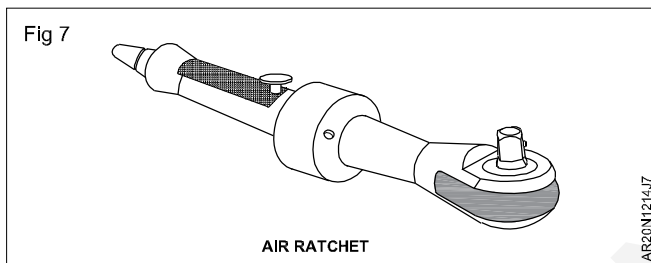
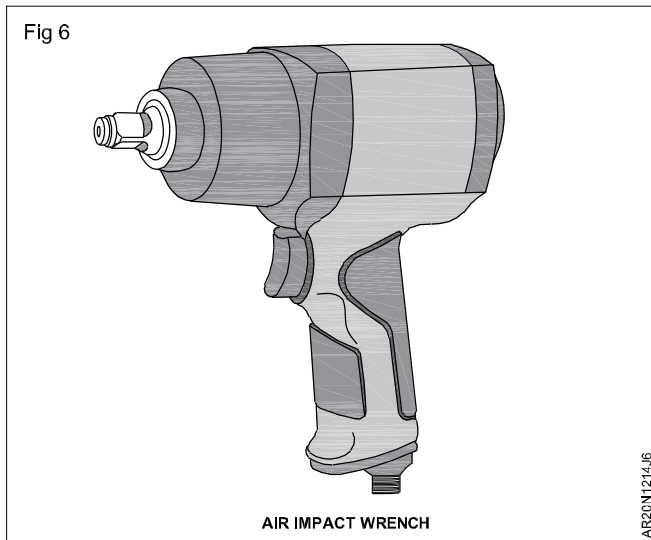
Air scraper used to remove the old paints on panel during major/minor repair.

Air chisel (Fig 12)

Air chisel used to make rough cuts in metal quickly.

Heat gun (Fig 13)

Heat gun used to apply controlled heat to removing stick - on decals and pin strips on body panel.

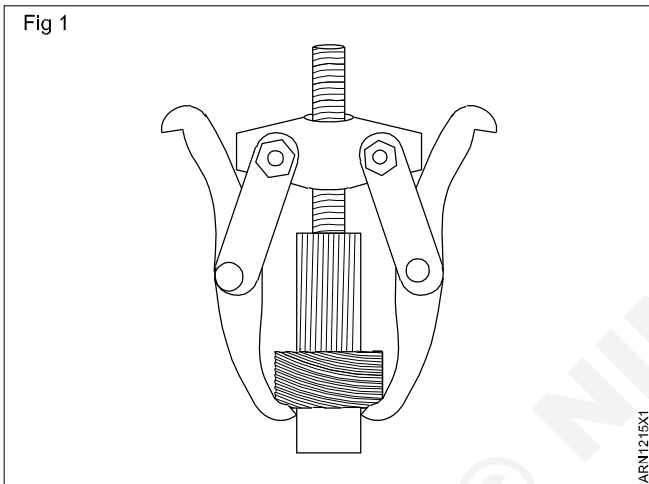


Handling of puller, gear & bearing

Objectives: This shall help you to

- select, install to use a puller for removing gear from shaft
- select install to use of puller for removing bearing from shaft.

Identify the object to be removed, i.e. Gear / Bearing.
Determine the size of the Gear / Bearing to be removed.
Choose a puller according to Gear / Bearing i.e, 2 or 3 Jaw & External or Internal Jaw puller.
Unscrew the forcing screw of the puller to the optimum length.
Split open the jaw of the puller.
Position the jaws of the puller over gear as shown in the diagram (Fig 1).



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

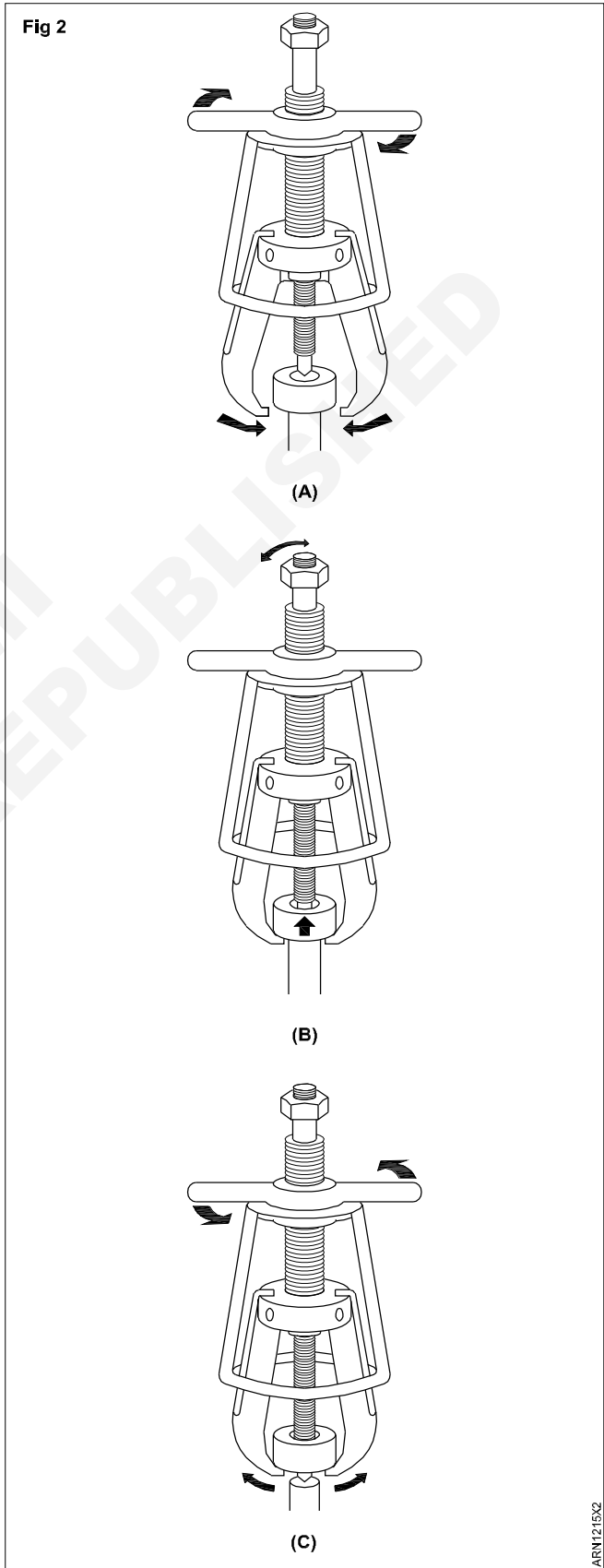
Tighten the forcing screw till the forcing screw end touches the shaft.

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

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

Warnings

- Always wear proper personal protective gear (i.e gloves, safety glasses)**
- Never use a tool to strike the puller. Hitting the puller may cause it to break.**
- Applying heat to the puller may damage it.**



Practice on visual identification of materials used in autobody repair shop

Objective: At the end of this exercise you shall be able to
 • **identification of various materials used in autobody shop.**

Requirements			
Tools / Instruments			
• Trainee's tool kit	- 1 No.	• Soap oil	- as reqd.
Equipments			
• Vehicle	- 1 No.	• Metal sheet (MS)	- as reqd.
Materials			
• Cotton waste	- as reqd.	• Aluminium sheet	- as reqd.
		• Copper pipe (car AC)	- as reqd.
		• Plastic sheet	- as reqd.
		• Rubber sheet	- as reqd.

PROCEDURE

Identification of autobody shop materials

- 1 Clean the workshop.
- 2 Clean the materials available in the autobody shop.
- 3 Layout the material on the shop floor.
- 4 Refer the autobody manual and separate the materials type wise.
- 5 Inspect the each materials laid on the floor.
- 6 Compare the materials with manual information.
- 7 Identify and select any one material and pick up it from laying on the floor.
- 8 Layout the low carbon steel materials and inspect it.
- 9 layout the high strength steels and visually inspect the quality of materials.
- 10 Layout the aluminium materials in the body shop and visually inspect the quality of the materials.
- 11 Layout the plastic materials and visually inspect it.
- 12 layout the materials and inspect it.
- 13 Layout the upholstery materials and inspect it.
- 14 Layout the paint materials in auto body repair shop and inspect materials quality.
- 15 Layout the abrasive materials and inspect the quality and serviceability.
- 16 Consolidate the damaged and defective materials and listout the unsuitable materials which is not in use in the autobody repair work.

Practice on trouble shooting of air drills

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

- identify the troubles in air drills
- rectify the troubles of air drills
- check the serviceability of air drills.

Requirements		
Tools/Instruments		Materials
<ul style="list-style-type: none"> • Trainee's tool kit 	- 1 No.	<ul style="list-style-type: none"> • Cotton waste • Soap oil • Air drill repair kit
Equipments		
<ul style="list-style-type: none"> • Air compressor • Air drill machine • Vehicle 	<ul style="list-style-type: none"> - 1 No. - 1 No. - 1 No. 	<ul style="list-style-type: none"> - as reqd. - as reqd. - as reqd.

PROCEDURE

Trouble shooting for air drills

Problem	Probable cause	Recommended action
Tool will not run or runs slowly; air flows slightly from exhaust; spindle turns freely	Motor or throttle plugged with dirt	<ol style="list-style-type: none"> 1 Check for dirt in air inlet. 2 Pour liberal amount of air tool oil in air inlet 3 Operate trigger in short bursts. 4 Disconnect air supply, then turn empty and closed drill. Check by hand, reconnect air supply 5 If still not functional, tool should be checked by an authorized service center.
Tool will not run; air flows freely from exhaust; spindle turns freely.	Rotor vanes stuck with dirt or varnish	<ol style="list-style-type: none"> 1 Pour liberal amount of air tool oil in air inlet. 2 Operate trigger in short bursts. 3 Disconnect air supply, then turn empty and closed drill chuck by hand. Reconnect air supply. 4 If still not functional, tool should be checked by an authorized service center.
Tool locked up; spindle will not turn.	Broken motor vane Gear broken or jammed by foreign object	Tool should be checked by an authorized service center.
Tool will not shut off	Throttle valve o-ring blown off seat	See parts list for part number and replace o-ring or send tool to an authorized service center.

Trouble shooting of Air Hammers

Problem	Probable cause	Recommended action
Tool will not run	<p>Cycling valve or throttle valve clogged with dirt or sludge</p> <p>Piston stuck in cylinder bore by rust or dirt</p>	<ol style="list-style-type: none"> 1 Pour liberal amount of air tool oil in air inlet (check for dirt) 2 Operate trigger in short bursts (chisel in place against solid surface) 3 If not free, first disconnect air supply, then tap nose or barrel lightly with plastic mallet, reconnect air supply. 4 If still not free, disconnect air supply, insert a 6-inch piece of 3/8-inch diameter rod in nozzle and lightly tap to loosen piston in rearward direction. Reconnect air supply, and repeat steps 1 and 2.
Chisel stuck in nozzle	End of shank peened over	Tool should be sent to an authorized service center.

© NIMI
 NOT TO BE REPUBLISHED

Practice on trouble shooting in air ratchets and air wrenches

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

- identify defects in air ratchet and air wrenches
- rectify the defects in air ratchet and air wrenches.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Soap oil	- as reqd.
• Air ratchet	- 1 No.	• Air ratchet repair kit	- as reqd.
• Air wrenches	- 1 No.	• Air wrenches repair kit	- as reqd.
• Air compressor	- 1 No.		

PROCEDURE

Task 1: Trouble shooting for air ratchets

Problem	Cause	Remedies
Motor runs; spindle does not turn or turns erratically	Worn teeth on ratchet or pawl Weak or broken pawl pressure spring. Weak drag springs fail to hold spindle while pawl advances for "another bite"	Replacement parts should be installed by an authorized service center only.
Motor will not run; ratchet head indexes crisply by hand	Dirt or sludge in motor parts	<ol style="list-style-type: none"> 1 Pour liberal amount of air tool oil into air inlet. 2 Operate throttle in short bursts. 3 With socket engaged on bolt, alternately tighten and loosen bolt by hand. 4 If motor remains jammed, tool should be checked by an authorized service center.

Task 2: Trouble shooting for air wrenches

Problem	Probable cause	Recommended action
Tools runs slowly or not at all; air flows only slightly from exhaust	Air flow blocked by accumulation of dirt Motor parts jammed with dirt particles Power regulator might have simply vibrated to closed position	<ol style="list-style-type: none"> 1 Check air inlet strainer for blockage. 2 Pour liberal amount of air tool oil into air intel. 3 Operate tool in short bursts, quickly reversing rotation back and forth. 4 Repeat as needed 5 If this fails to improve performance, tool should be serviced at an authorized service center.

Practice on trouble shooting in hydraulic tool leaks under pressure

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

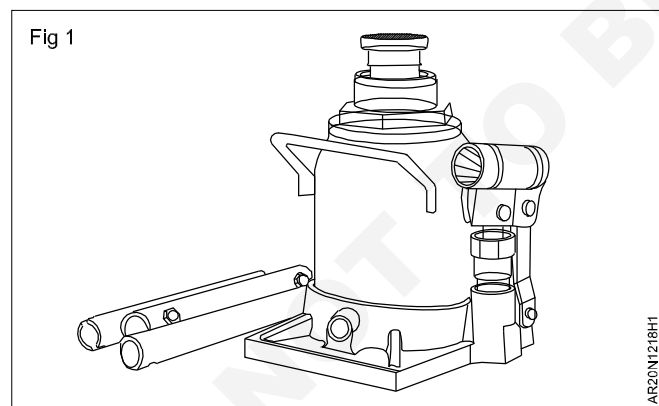
- identify the defect in hydraulic tool
- rectify the defects in hydraulic tool.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Bleeding kit	- 1 No.	• Soap oil	- as reqd.
Equipments		• Hydraulic oil	- as reqd.
• Hydraulic tool	- 1 No.		
• Vehicle	- 1 No.		

PROCEDURE

Trouble shooting for air ratchets

Problem	Probable cause	Remedies action
Tool will not retract	Fluid reservoir too full Bent plunger Damaged quick coupler	Remove the extra oil Replace the plunger Replace
Tool leaks under pressure	Release valve not fully closed Dirt in release valve	Close the valve Replace the fluid/Clean the valve



Practice on trouble shooting of hydraulic tool handle kick back

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

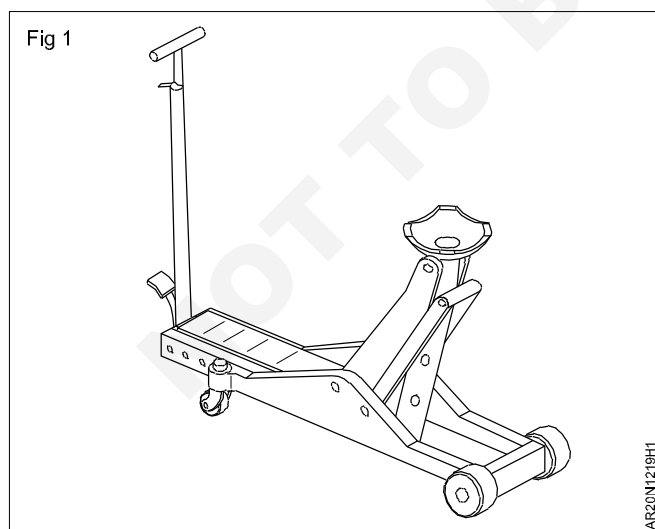
- identify the hydraulic tool handle kick back
- identify cause for hydraulic tool works properly one time only
- rectify the defects in hydraulic tool.

Requirements		
Tools/Instruments		Materials
<ul style="list-style-type: none"> • Trainee's tool kit • Air bleeding kit 	<ul style="list-style-type: none"> - 1 No. - 1 No. 	<ul style="list-style-type: none"> • Cotton waste • Soap oil • Hydraulic oil
Equipments		
<ul style="list-style-type: none"> • Hydraulic tool • Vehicle 	<ul style="list-style-type: none"> - 1 No. - 1 No. 	<ul style="list-style-type: none"> - as reqd. - as reqd. - as reqd.

PROCEDURE

Trouble shooting for air ratchets

Problem	Probable cause	Remedies action
Hydraulic tool handle kick back	<ul style="list-style-type: none"> Dirt in check valve Damaged check valve 	<ul style="list-style-type: none"> Clean or Replace Replace the valve
Hydraulic tool properly works in one time only	<ul style="list-style-type: none"> Loose valve fitting Dirt in valve systems Air bubbles in valve system 	<ul style="list-style-type: none"> Tighten the valve Clean or Replace the valve Bleed the fluid system



Measuring practice on engine components

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

- check warpage and runout of flywheel
- check the crankshaft for fillet radii and bend
- check the camshaft journal, cam lobe surface wear and end play.

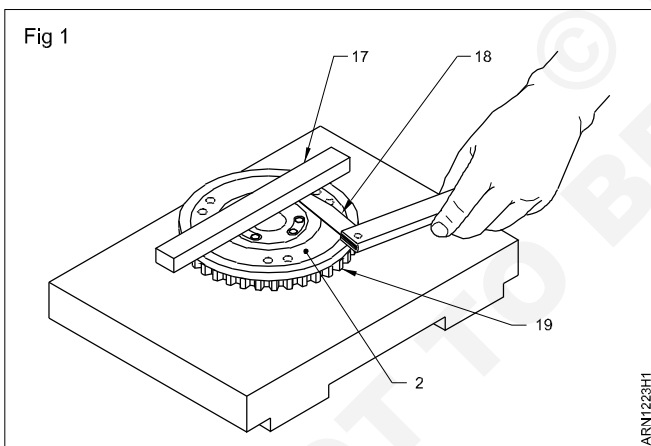
Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Work table	- 1 No.
• Dial indicator with magnetic base	- 1 No.	Materials	
• Outside micrometer	- 1 No.	• Cotton waste	- 1 No.
• Straight edge and feeler gauge	- 1 No.	• Serviceable crankshaft, camshaft, flywheel	- 1 No each.
Equipments			
• Vehicle	- 1 No.		

PROCEDURE

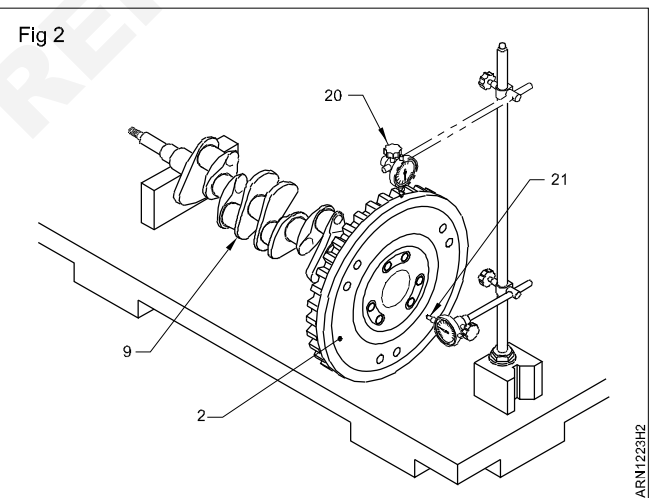
Task 1: Check warpage and runout of flywheel

- 1 Check for warpage of the flywheel (2) friction surface by using a straight edge (17) and feeler gauge (18). If the warpage is more than the minimum limit specified by the manufacturer, then the flywheel should be reground. (Fig 1)

Ensure that, after grinding, the thickness of the flywheel remains within the limit specified by the manufacturer.



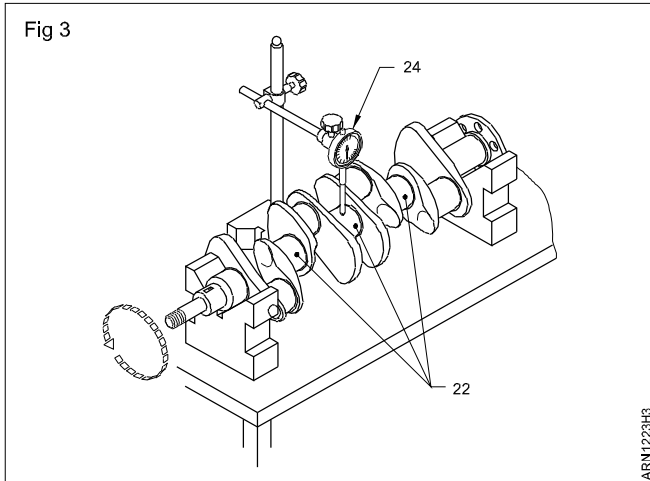
- 2 Check ring gear (19) of flywheel for wear/damage. If found, replace.
- 3 Check faceout & run out of flywheel: Mount the flywheel (2) on the crankshaft (9) and keep it on the inspection table (Fig 2).
- 4 Note down the face out of the flywheel with the help of a dial indicator (20).



- 5 Place dial indicators plunger (21) on periphery of flywheel. Rotate flywheel and check run out. If run out is more than the specified limit replace the flywheel.
- 6 Check the runout of journals (22) with a dial indicator (24) (Fig 3).

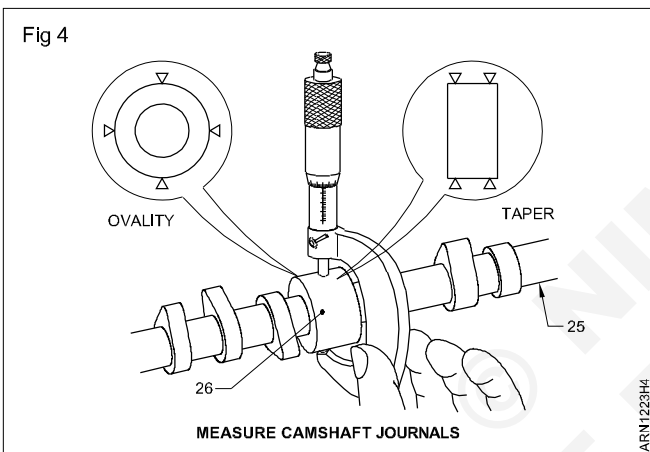
If runout exceeds the given limit then the crankshaft should be recommended for regrounding.

If the face out of the flywheel is more than the maximum limit specified by the manufacturer then the flywheel should be reground.



Task 2: Check the camshaft journal, cam lobe surface wear and end play

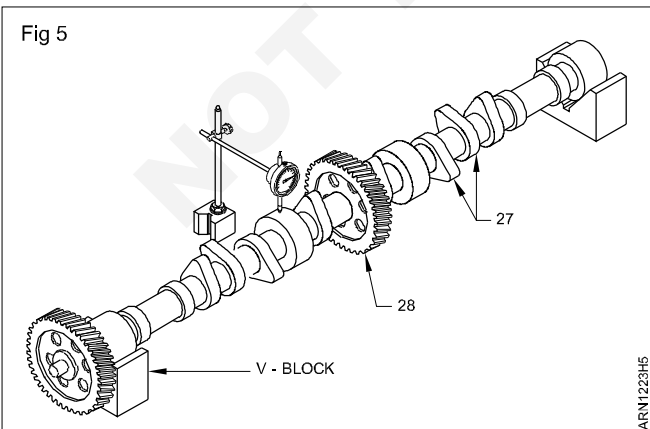
1 Inspect the camshaft (25) journals for scratches, grooves and tipping marks (Fig 4).



2 Check camshaft journals (26) for taper ovality and wear using micrometer.

3 Check the camshaft for bend and concentricity using dial indicator. If found more than specified limit, replace it.

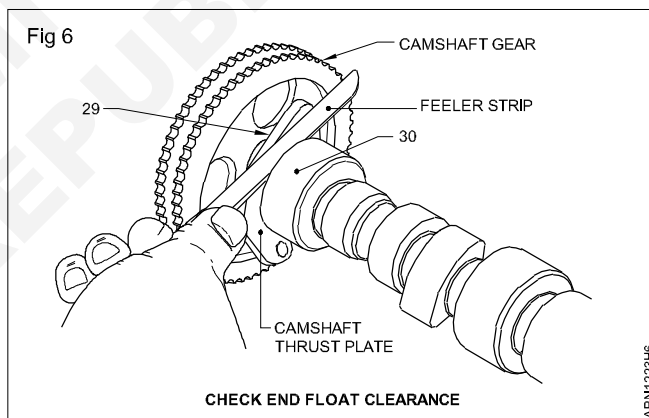
4 Check the cam lobe (27) surface for wear (Fig 5).



5 Measure the basic circle diameter of the cam lobe and the lobe height by a micrometer. The difference between the lobe height and the basic circle dia. Is

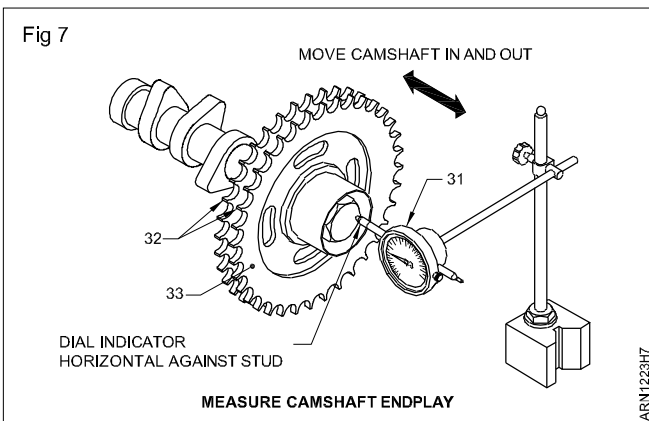
the cam lift. Replace the camshaft if the cam lift is found to be less than the specified limit.

6 Check the oil pump drive gear (28) for pittings, wear and damages. If any replace camshaft. Measure the clearance between thrust washer (29) and the camshaft 1st journal (30) using feeler strip (Fig 6).



7 Measure the end play of camshaft with the help of dial indicator (31) (Fig 7).

8 Change the thrust washer if the end play is not as per the manufacturer recommendation. Inspect the teeth (32) of sprocket (33) (for chain drive). Check the chain for elongation (for chain drive)



Practice on use of nuts, bolts & studs

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

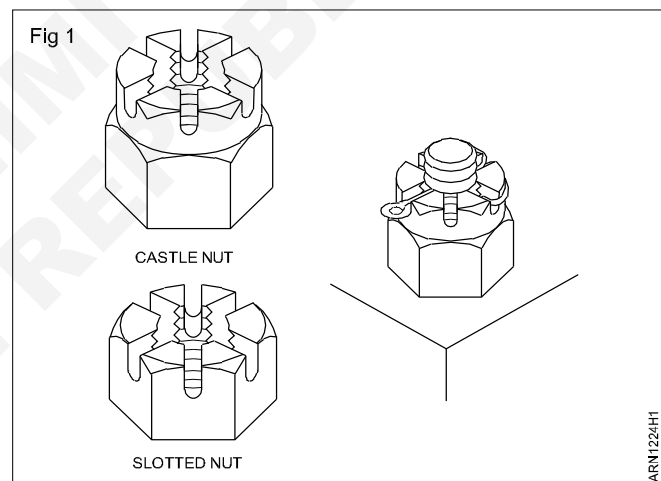
- fasten castle nut on axle shaft.
- fasten self locking nut on propeller shaft.
- fasten hexagonal nut on two flat surfaces.
- fasten hexagonal nut with collar on tappet cover.

Requirements	
<p>Tools/Instruments</p> <ul style="list-style-type: none"> • Spanner (DE & Ring) - 1 Set each. • Nose plier, copper drift - 1 Set each. <p>Equipments</p> <ul style="list-style-type: none"> • Work bench & vice - 1 No. 	<p>Materials</p> <ul style="list-style-type: none"> • Kerosene, Cotton waste, Banion cloth - as reqd. • Axle shaft and castle nuts - as reqd. • Propeller shaft and self locking bolt - as reqd. • Hexagonal nut with washers - as reqd.

PROCEDURE

Task 1: Fasten castle Nut

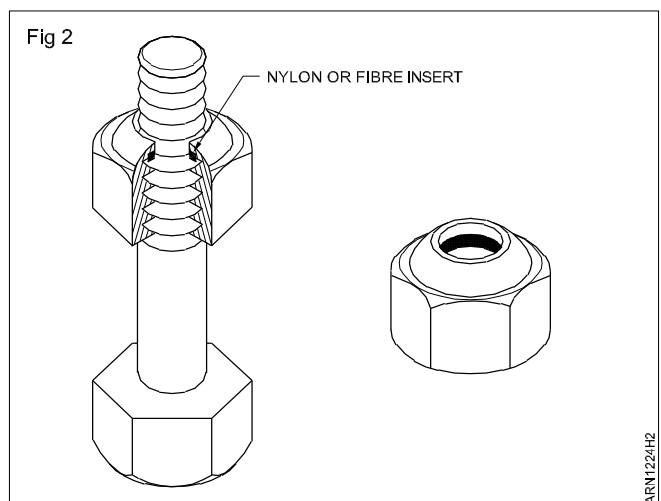
- 1 Clean the axle shaft threaded end.
- 2 Note down the thread size & type of thread.
- 3 Select the proper size of castle nut. (Fig 1)
- 4 Tighten the castle nut by hand, one or two threads only.
- 5 Select proper spanner for tightening the castle nut.
- 6 Tighten the castle nut.
- 7 Align the axle shaft hole and slot of the castle nut.
- 8 Insert a split pin through the axle shaft hole & slots of castle nut.
- 9 Spread the split ends of the split pin.



Task 2: Fasten self locking nut

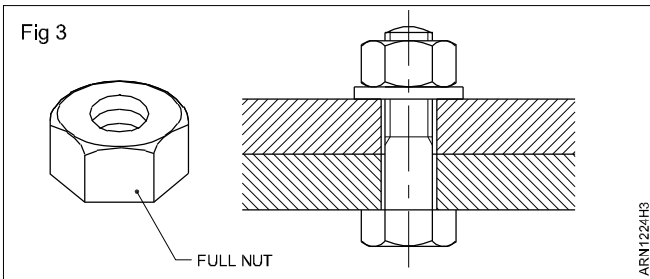
- 1 Clean the flange of the propeller shaft.
- 2 Select the proper size of nut & bolt to be fitted.
- 3 Insert the bolt into the slot of the flange.
- 4 Tighten the self locking nut (Fig 2) by hand one or two threads only.
- 5 Select proper spanner for tightening the self locking nut.
- 6 Tighten the self locking nut.

Do not overtight on the self locking nut.



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).
- 3 Insert the Bolt in the hole of matching components.

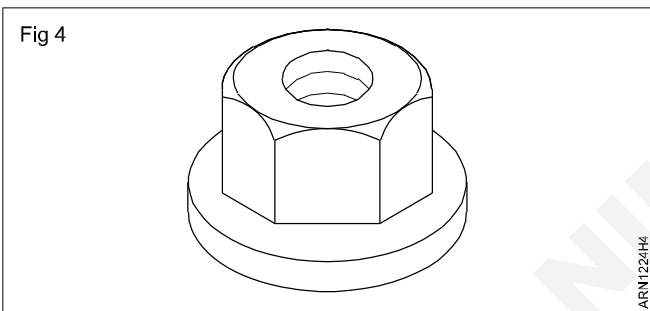


- 4 Place a flat washer at the threaded end.
- 5 Select the correct spanner to tighten the particular size of that nut.
- 6 Tighten the hexagonal nut.
- 7 Select a same size of hexagonal lock nut.
- 8 Tighten the lock nut by holding the earlier tighten nut with spanner.

**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.

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

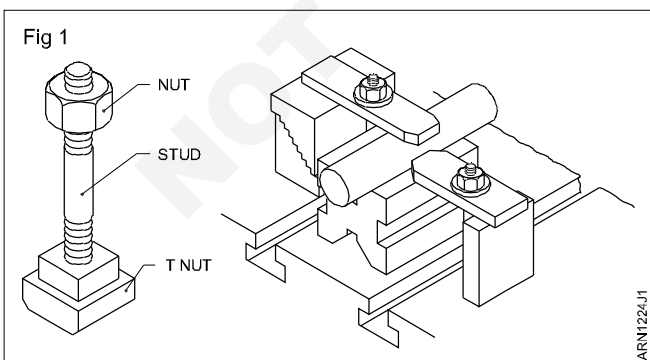
Skill sequence

Fastening of stud

Objectives: This shall help you to

- measures the pitch of the thread
- select the correct size of stud
- fasten the given jobs with stud.

Select the components to be joined (Fig 1).



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.

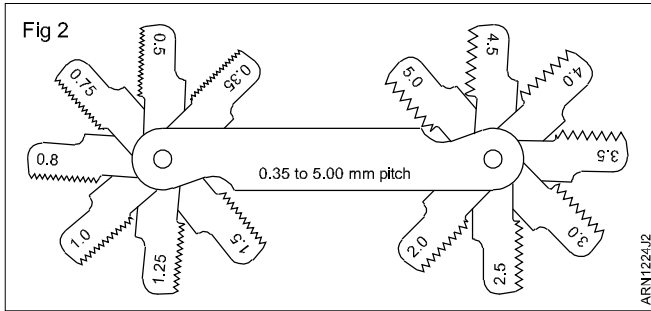
Safety precaution

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.



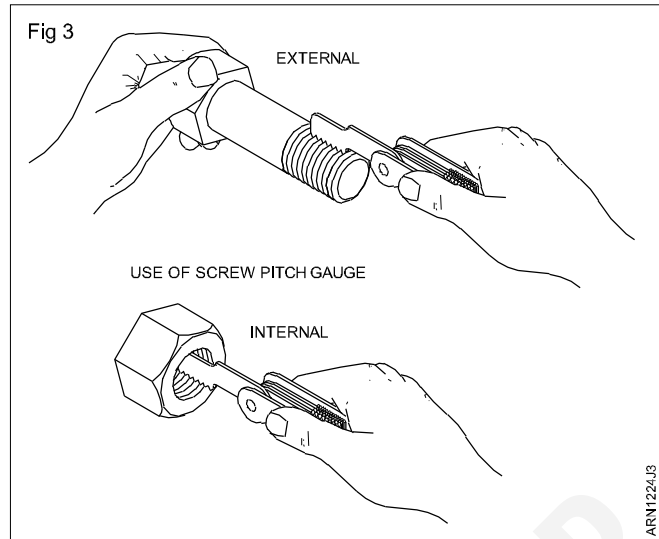
Select any one the blade from the screw pitch gauge.

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

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

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

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



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

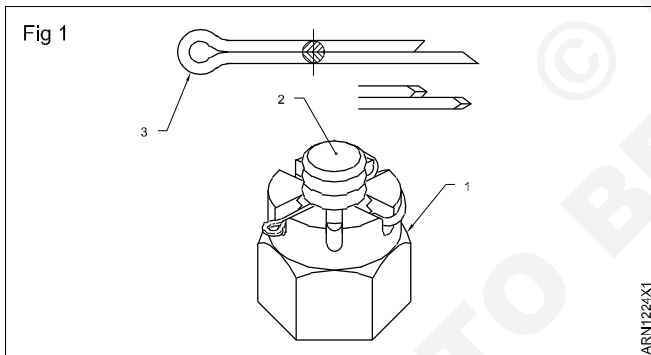
Tightening locking devices

Objective: This shall help you to

- use different types of locking devices correctly.

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

Insert a new suitable split pin (3) in the slot and hole. (Fig 1)



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

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

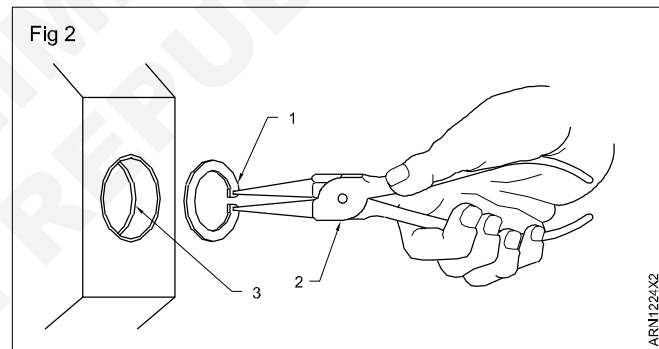
Tighten the nut (1) at the specified torque.

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

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

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

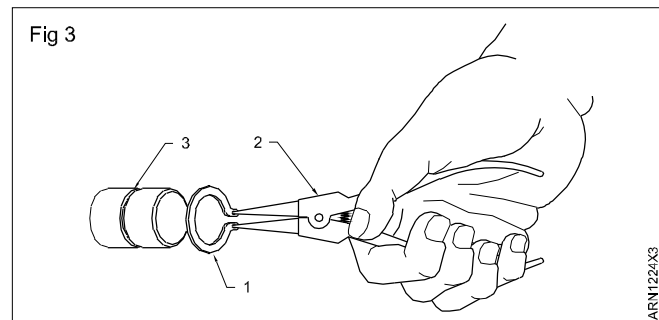
Take out the plier (2).



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

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

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



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

Take out the plier (2).

Wire ring hose clamp (Fig 4)

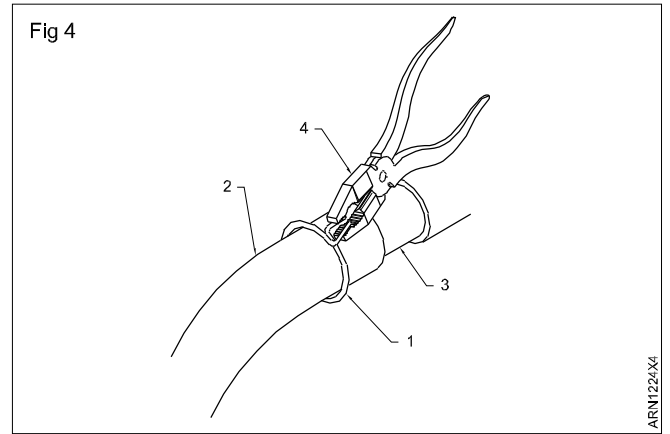
Clean the outside surface where the hose-pipe is to be set.

Apply grease inside the starting end surface for easy insertion.

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

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

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



© NIMI
NOT TO BE REPUBLISHED

Removing broken stud/bolt from blind hole

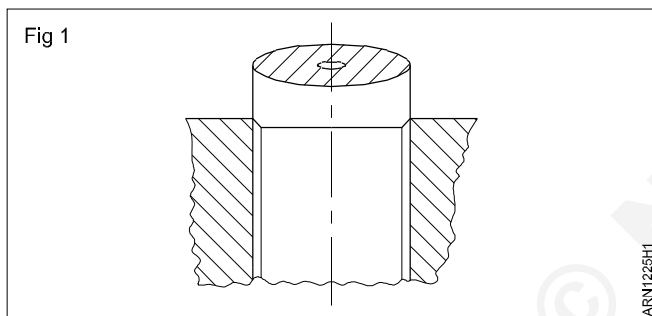
Objective: At the end of this exercise you shall be able to

- remove the broken stud below the surface using the Ezy-out (stud extractor).

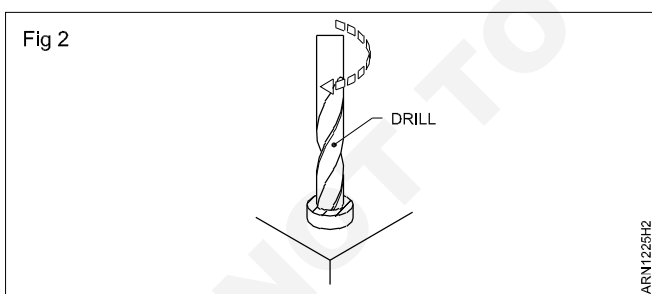
Requirements			
Tools/Instruments			
• Trainees tool kit	- 1 No.	• Cylinder block with broken stud	- 1 No.
• Tap wrench	- 1 Set.	• Cotton waste	- as reqd.
• Stud extractor	- 1 Set.	• Stud	- as reqd.
Materials		• Soap oil	- as reqd.
• Oil	- as reqd.		

PROCEDURE

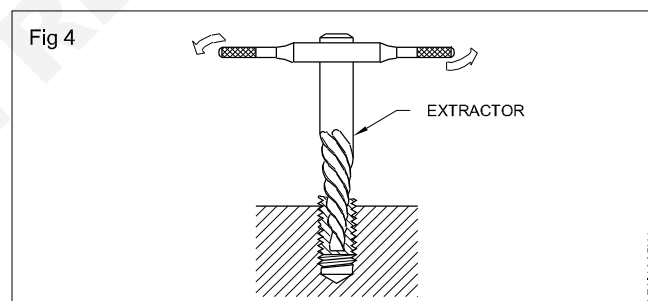
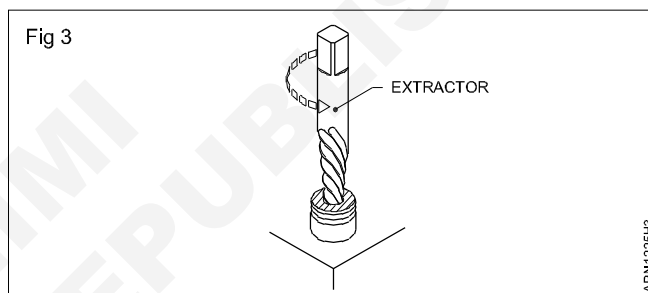
- 1 File flat on the top surface of the stud (Fig 1).



- 2 Locate the centre and centre punch it.
- 3 Select the Ezy-out and the recommended drill size from Table 1.
- 4 Drill a hole on the centre punch mark (Fig 2).



- 5 Check the hole is perpendicular.
- 6 Set the Ezy-out (stud extractor) on the drilled hole (Fig 3).
- 7 Turn it anticlockwise by a tap wrench (Fig 4).



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

- 8 Replace a new stud in position after lubricating the threads.
- 9 File two sides of the studs flat above the surface.
- 10 Use a wrench and unscrew to remove the broken stud out.

Table 1

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

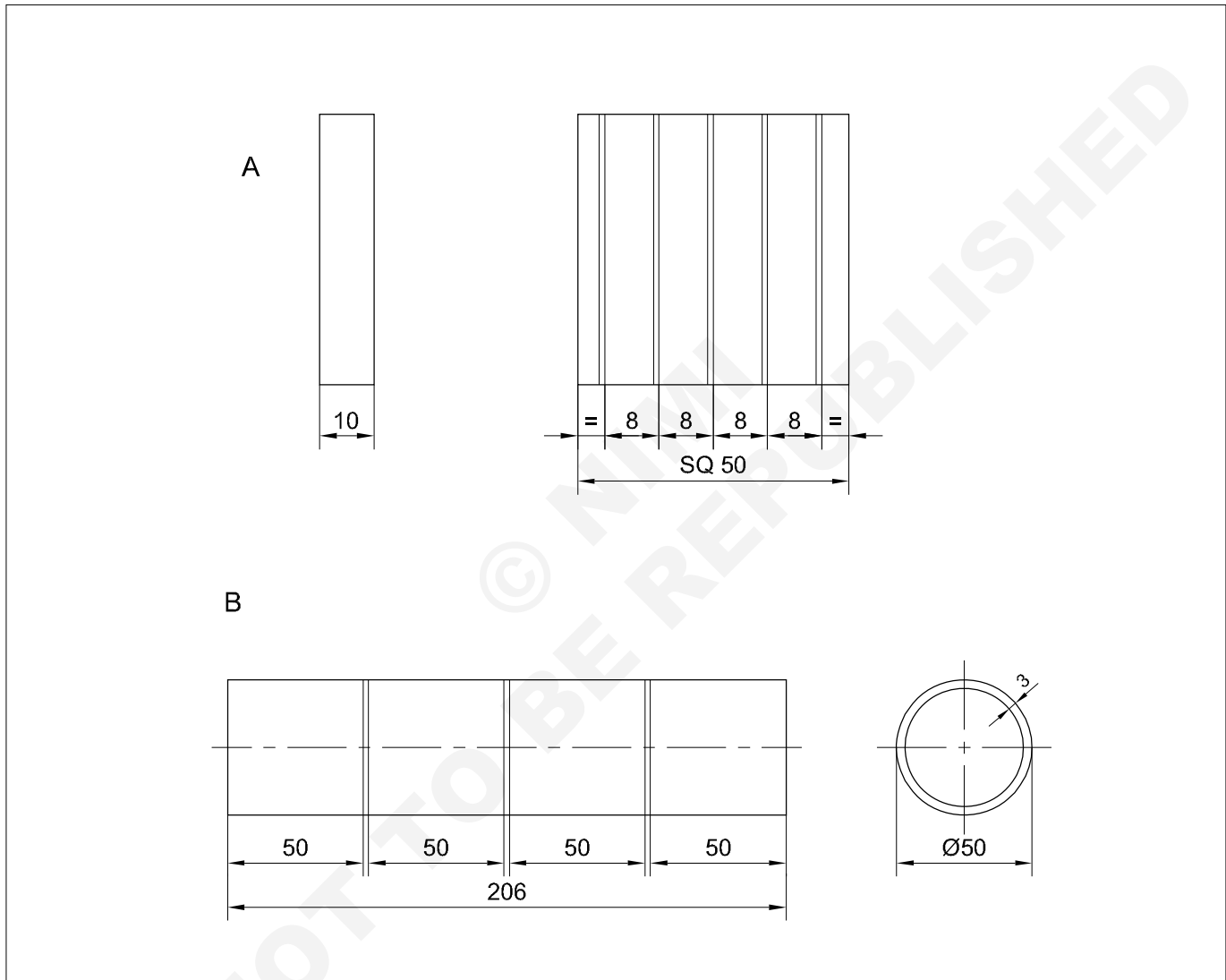
Suitable for screw size	Drill size to be used	Ezy-out No. to be used
1/8" to 1/4" (3 to 6 mm)	5/64" (2 mm)	1
Over 1/4" to 5/16" (6 to 8 mm)	7/64" (2.8 mm)	2
Over 5/16" to 7/16" (8 to 11 mm)	5/32" (4 mm)	3
Over 7/16" to 9/16" (11 to 14 mm)	1/4" (6.3 mm)	4
Over 9/16" to 3/4" (14 to 19 mm)	17/64" (6.7mm)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

© NIMI
NOT TO BE REPUBLISHED

Practice on using various cutting tools

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

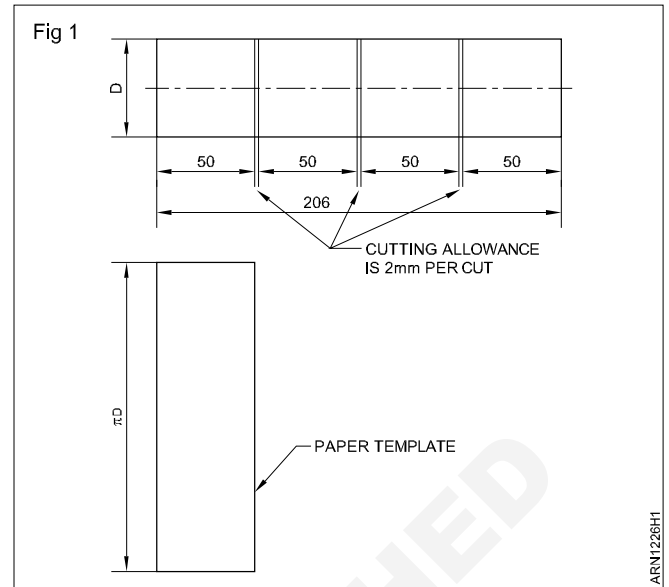
- cut a mild steel flat along a straight line using a hack saw
- flat filing practice along with flatness checking
- cut the given MS sheet in to two pieces along its length using chisel
- sharpening of chisel and center punch in grinder
- safety precaution in grinding tools.



1	Ø50 x 3 - 206		Fe 310		B	
1	50 ISF 10 - 50		Fe 310		A	1.2.26
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	HACK SAWING				TOLERANCE ±0.5	TIME 5h
					CODE NO. ARN1226E1	

PROCEDURE

- 1 Check the size of the given M.S flat Job.
- 2 Apply copper sulphate solution and allow it to dry
- 3 Layout lines as per drawing using a scribe 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 filing.
- 6 Mark lines as per drawing using a paper template and punch mark the line. (Fig 1)



Skill Sequence

Holding the workpiece

Objectives: This shall help you to

- holding the work piece
- fixing of hacksaw blades.

Holding the workpiece

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

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

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)

Fixing of Hacksaw Blades

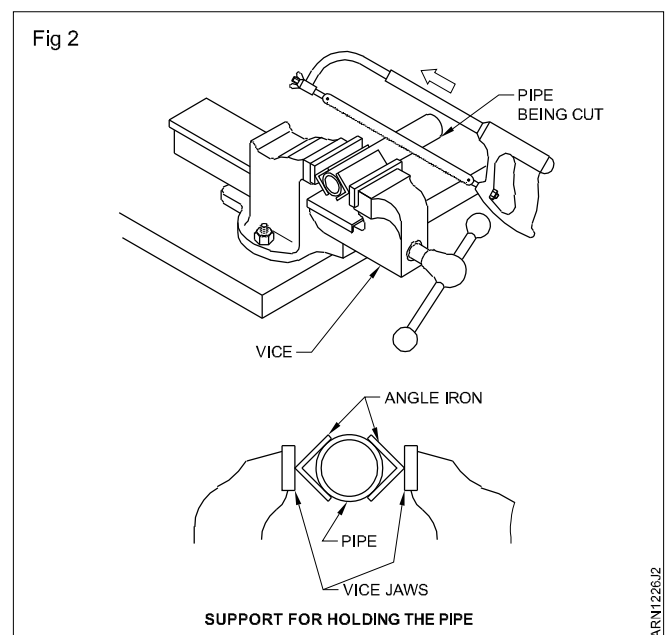
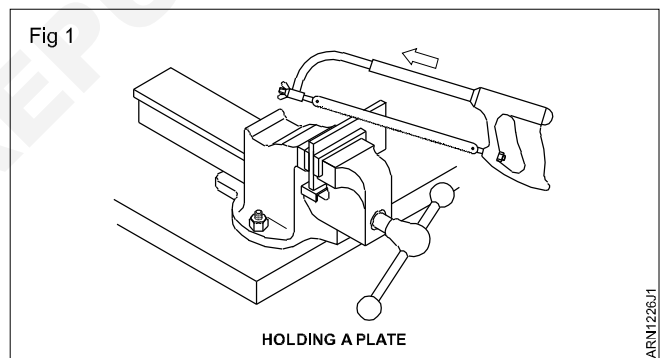
The teeth of the hacksaw blade should point in the direction of the cut and away from the handle. (Fig 7)

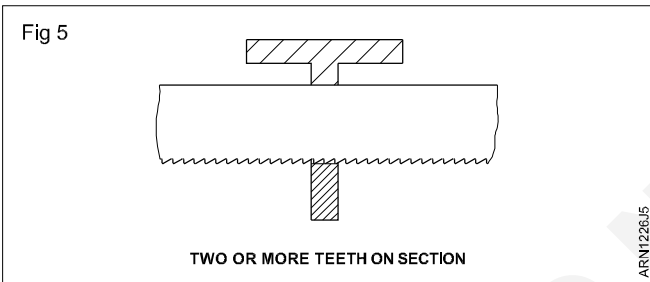
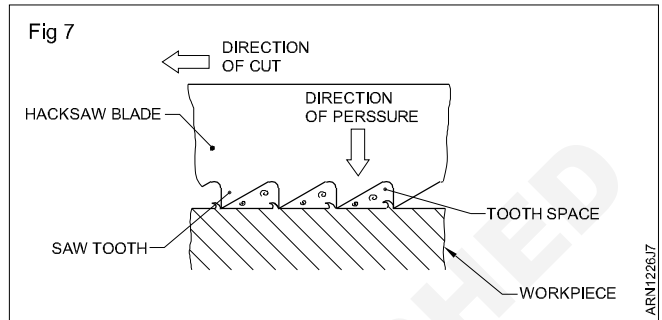
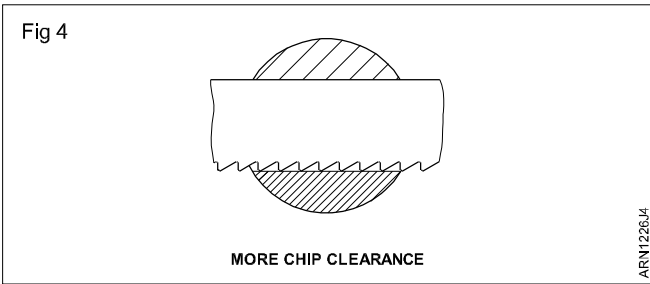
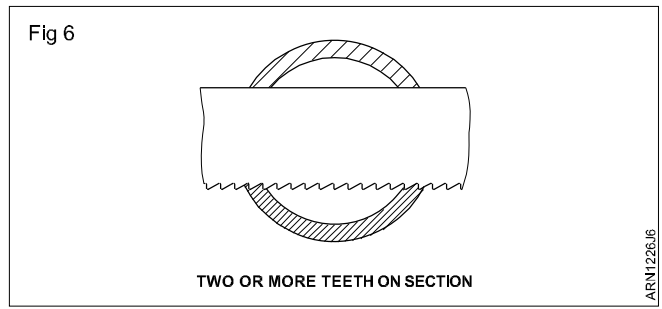
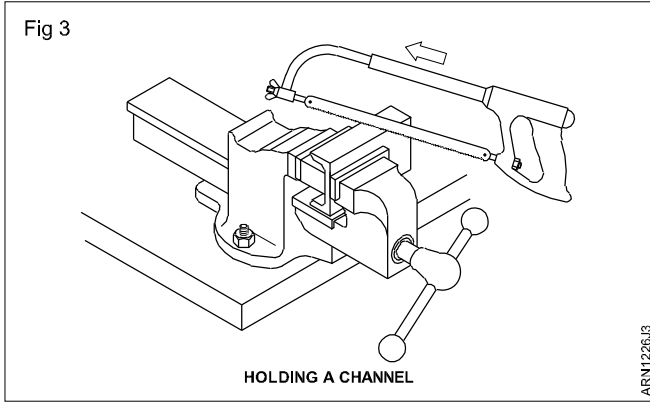
The blade should be held straight, and correctly tightened before starting.

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

Notch means a small groove on the job surface.

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



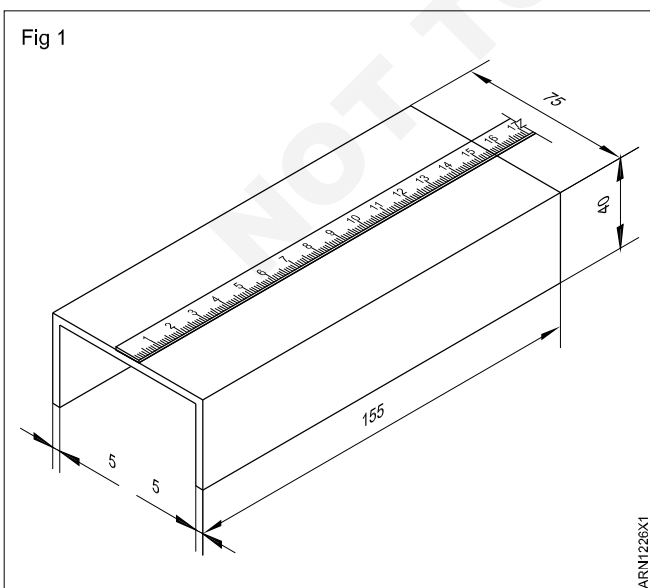


Filing and hacksawing

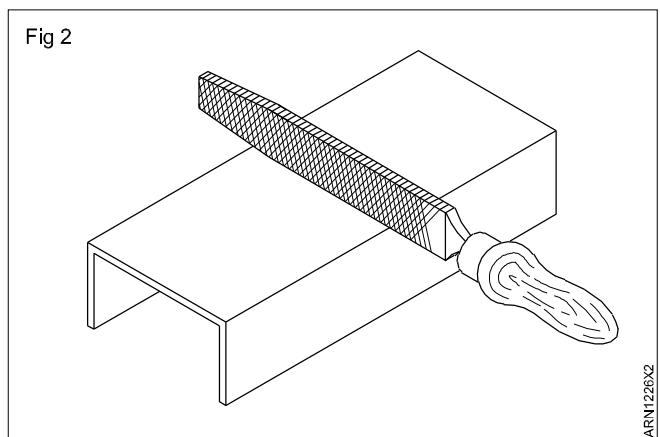
Objectives: This shall help you to

- file M.S channel
- cutting pipe by hacksaw.

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

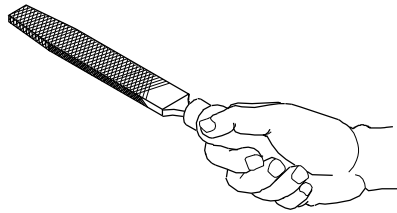
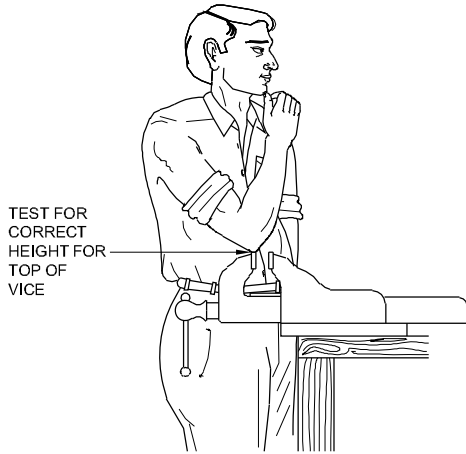


Remove all the rust from all the surfaces by the edge of file, clean by cotton waste (Fig 2).



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.

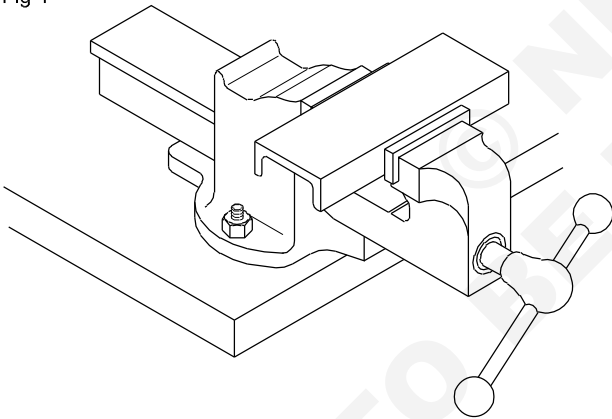
Fig 3



ARN1226X3

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

Fig 4

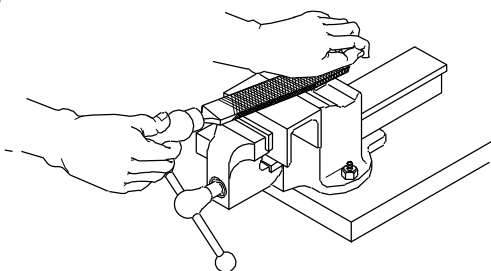


ARN1226X4

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).

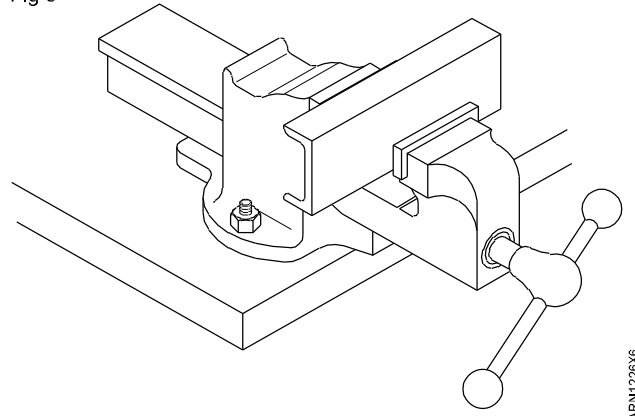
The pressure and changes the place file and go for next area (Fig 6). Like that complete operation and check flatness with the help of try square blade.

Fig 5



ARN1226X5

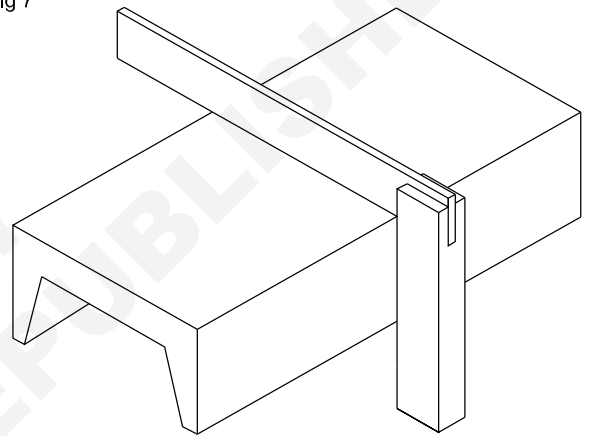
Fig 6



ARN1226X6

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

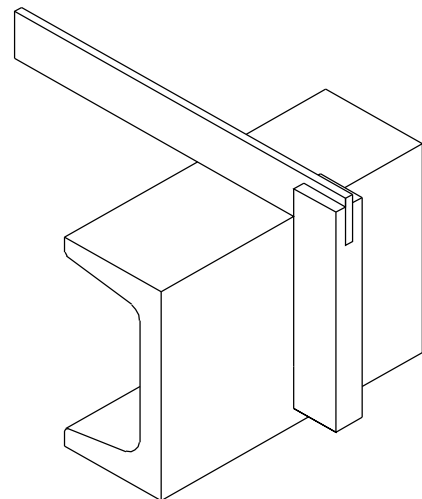
Fig 7



ARN1226X7

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

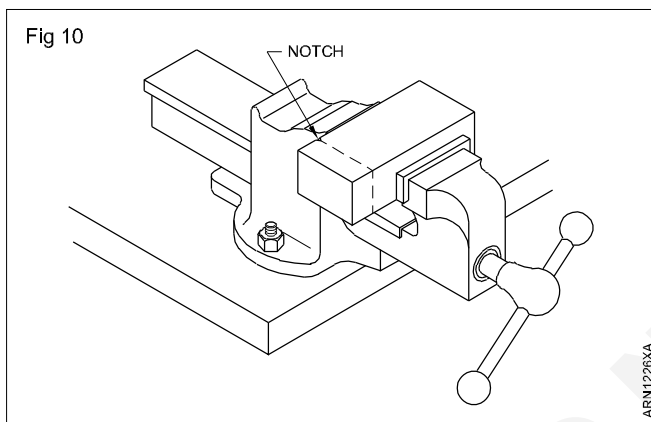
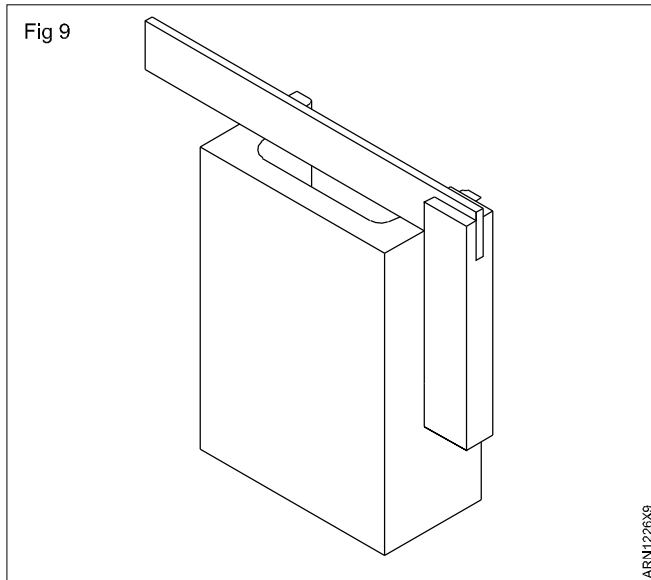
Fig 8



ARN1226X8

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)



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)

Cutting M.S sheet by chisel

Objectives: This shall help you to

- cut the M.S sheet by chisel
- sharpen the chisel
- sharpen the centre punch
- check the centre punch angle.

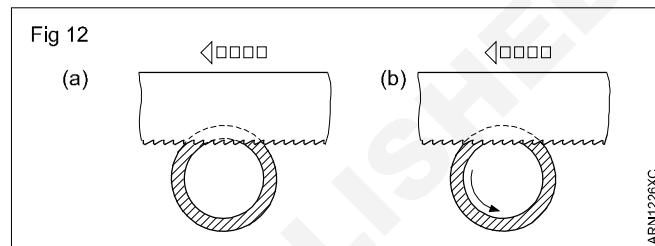
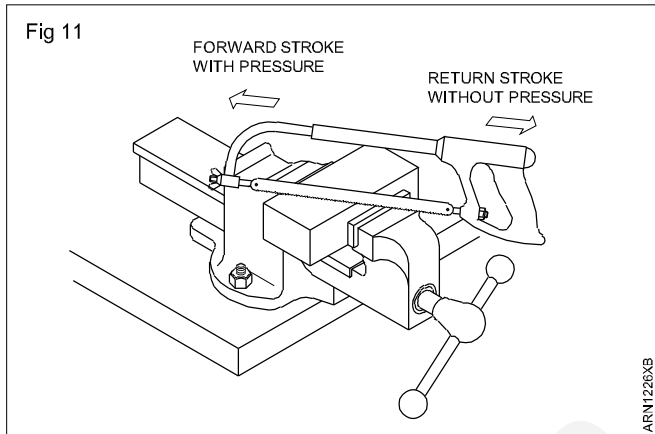
Cutting M.S sheet by chisel

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

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

Sometimes the job is clamped to the work bench or to the steel pad by "C" clamps so that the job will not slip while chiseling. After making cut on the marked line, move the chisel approximately for 80% of the length of the first cut and again make a cut.

Turn and change the position of the pipe while hacksawing (Fig 12b)



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.

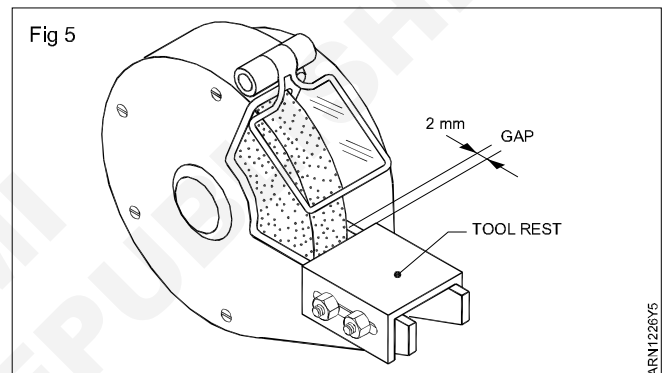
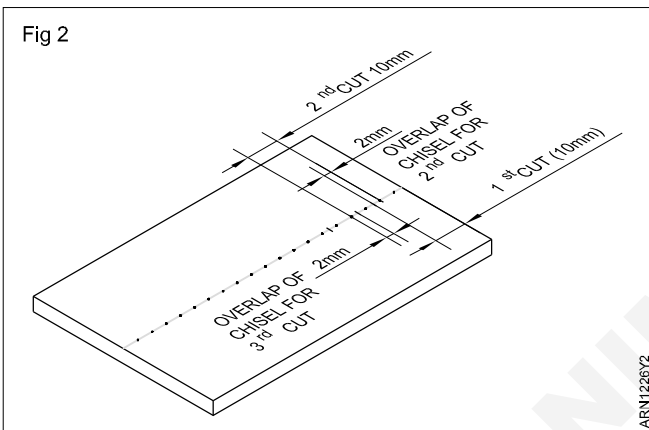
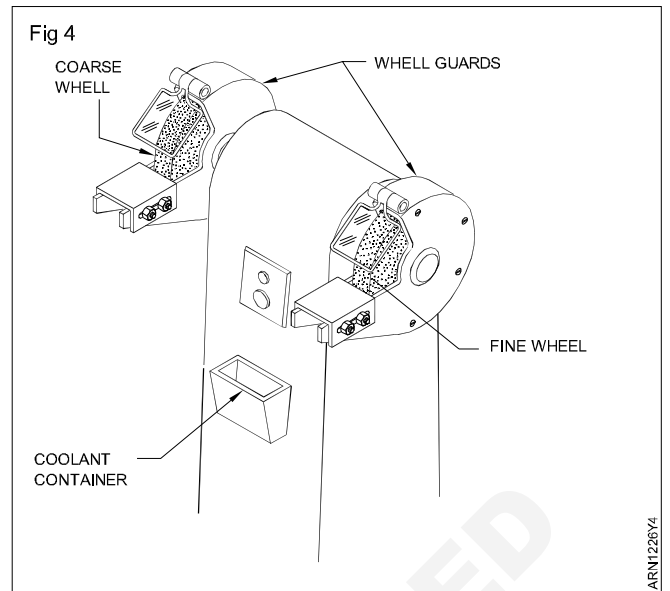
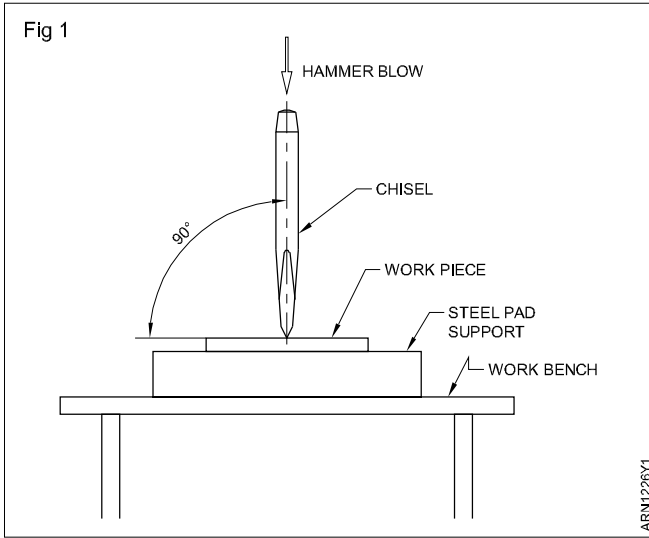
Normally, a coolant is not necessary while hacksawing.

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.

This is done to ensure that the cutting action continues progressively along the marked line and no portion of metal will be left uncut.

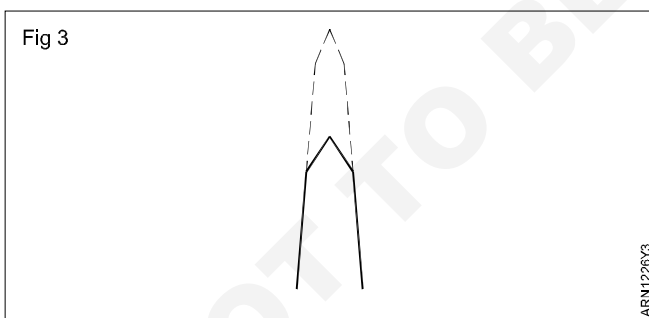
In addition the cutting edge of the chisel can be positioned properly along the line of cut which will avoid a zig zag cutting (Fig 2).

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.



Sharpening the chisel

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



Chisels are sharpened on grinding machines. (Fig 4)

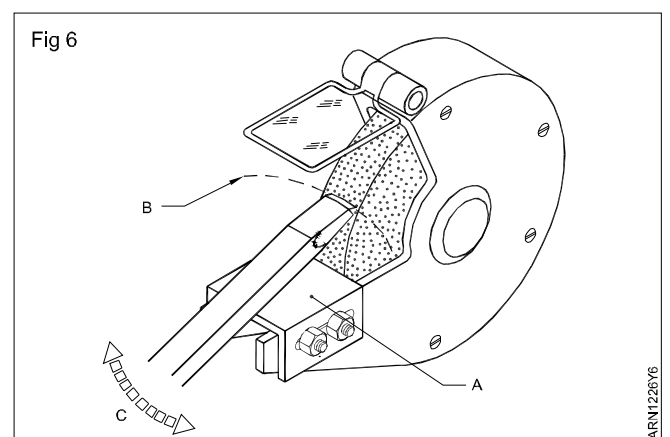
Inspect the tool-rest. If there is too much of a gap between the tool-rest and the wheel, adjust it, and position it as close to the wheel as possible. (Fig 5)

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.

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



After re-grinding many times, the cutting edges become too thick. Such chisels are unsuitable for reshaping. 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.

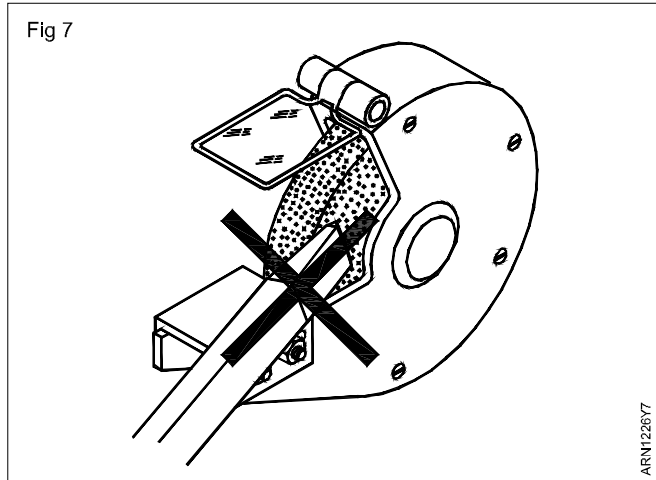
Clean by grinding. If the chisel-head is mushroomed.

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

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.

Fig 7

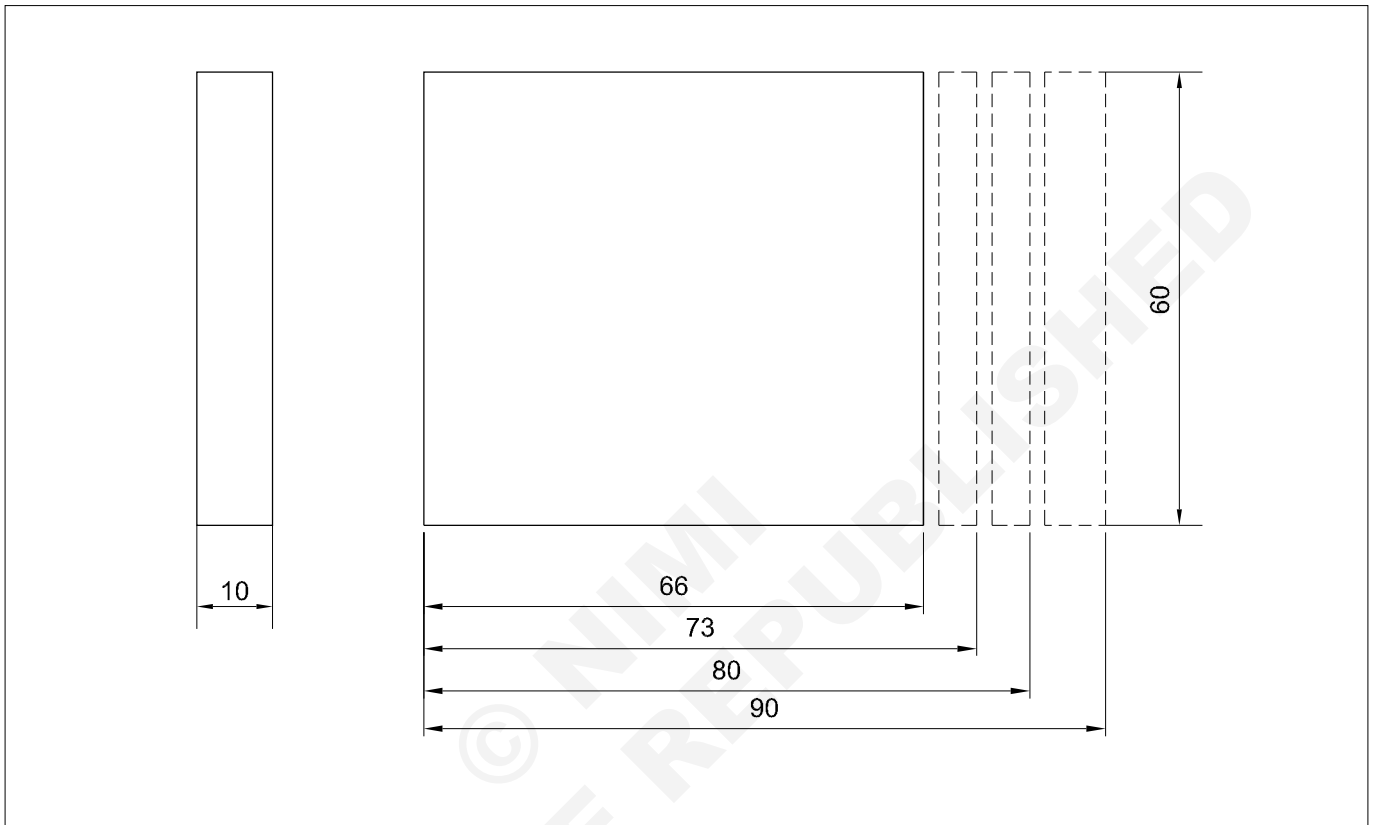


© NIMI
NOT TO BE REPUBLISHED

Practice on hacksaw - cutting and filling

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

- mark straight lines using a scribing block
- cut on marked lines using a hacksaw blade.



1		FROM EXERCISE 2	Fe 310			1.2.27
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	HACK SAWING				TOLERANCE ±0.5	TIME 10HRS.
					CODE NO. ARN1227E1	

PROCEDURE

- 1 Mark off lines for hacksawing using a scribing block.
- 2 Fix hacksaw blade on frame.
- 3 Select the correct pitch blade.
- 4 Fix job on the vice and make a notch on the line to start the cut.
- 5 Hacksaw along line.
- 6 Use the full length of the blade while sawing.
- 7 Apply pressure only on the forward stroke.
- 8 Reduce speed and pressure during completion stage of the cut, just before the pieces separate.
- 9 Repeat the same procedure for the other two cuts.
- 10 Ensure the sawing is not getting staggered.
- 11 Do not allow the saw to slip off to the side during commencement of the cut.
- 12 Saw cut to remove the excess metal for the given size of job.
- 13 File the two side of the given job with flat file.
- 14 Ensure the size of job after filling.

Avoid sawing very fast and giving too much pressure which may tend to break the blades.

Practice on drilling clear and blind hole and sharpening of drills

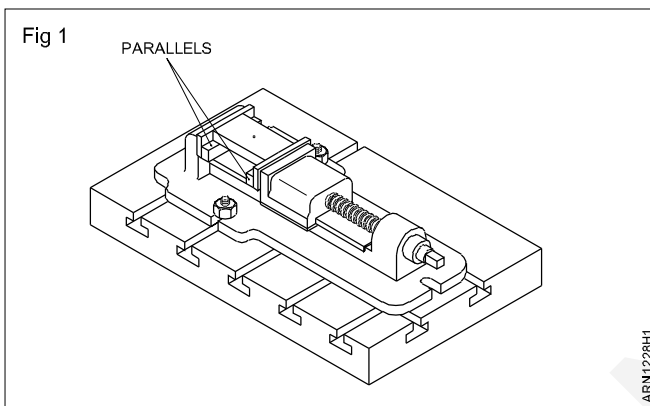
Objective : At the end of this exercise you shall be able to

- drill through hole to the required size
- sharpening of twist drill.

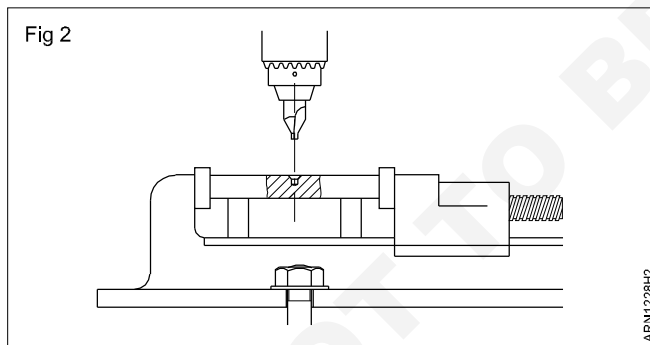
PROCEDURE

Task 1: Method of drilling hole

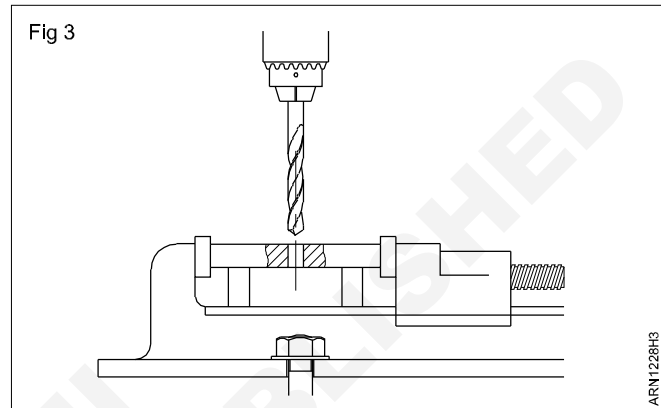
- 1 Check the given raw material for its size.
- 2 Mark and locate the centres for the hole to be drilled.
- 3 Mount the job in the machine vice on the parallels and clamp it securely to the drill-press-table (Fig 1).



- 4 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.



- 5 Fix the centre drill on the drilling machine spindle and align with the centre mark on the job.
- 6 Spot the hole location with a centre drill.
- 7 Remove the centre drill and fix 8 mm drill for pilot hole.
- 8 Start the drilling machine.
- 9 Feed the drill and drill through hole. (Fig 3)



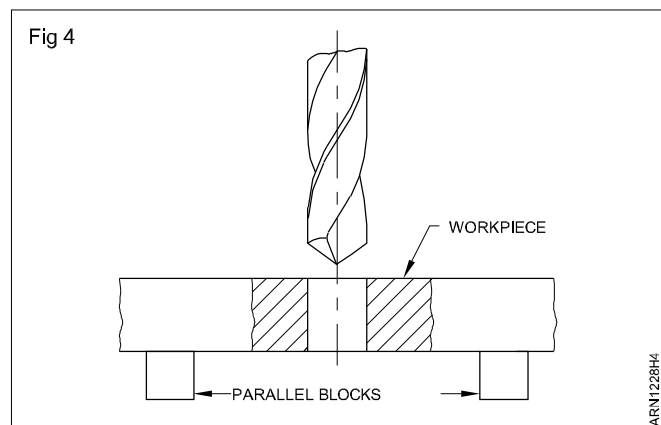
- 10 Set the spindle speed of the drilling machine to the nearest calculating r.p.m.

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

- 11 Remove drill from the machine without disturbing the set up.
- 12 Fix 14.5 mm drill and drill through hole.

While drilling use cutting fluid.

- 13 Release the drill frequently from the hole for the chips to be flushed out by the cutting fluid.
- 14 Remove the drill and job from the machine (Fig 4).



Skill sequence

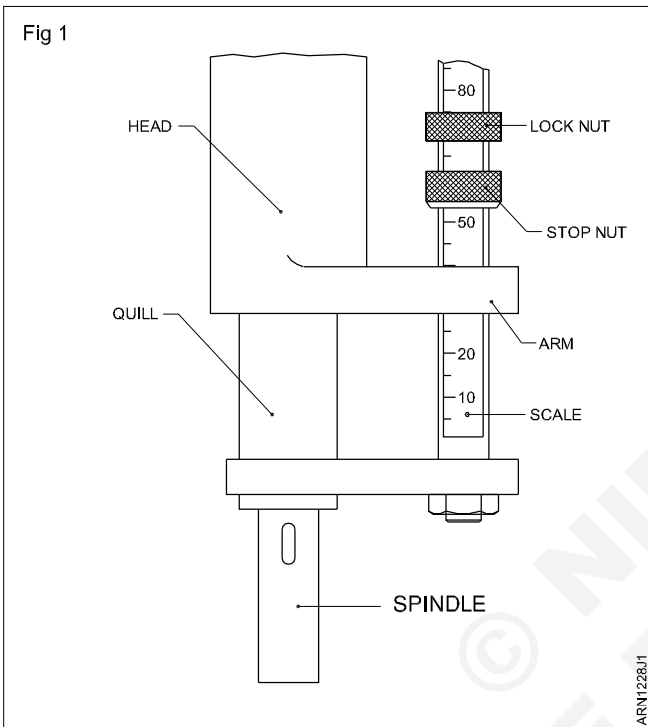
Drilling blind holes

Objective : This shall help you to

- **drill blind holes to the required depth using the depth stops.**

Method of controlling depth of blind holes

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



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

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

Setting for drilling blind holes

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

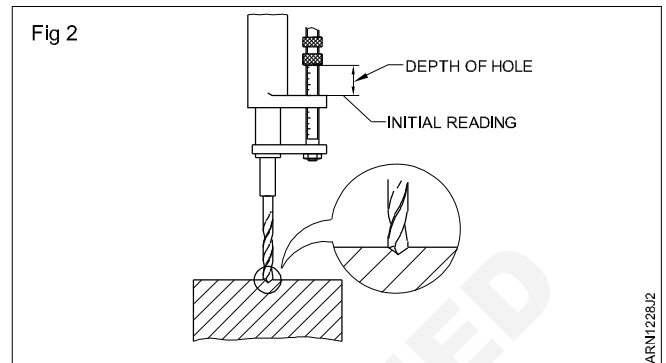
The drill is started, and it drills until the full diameter is formed. Note down the initial reading at this point (Fig 2)

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

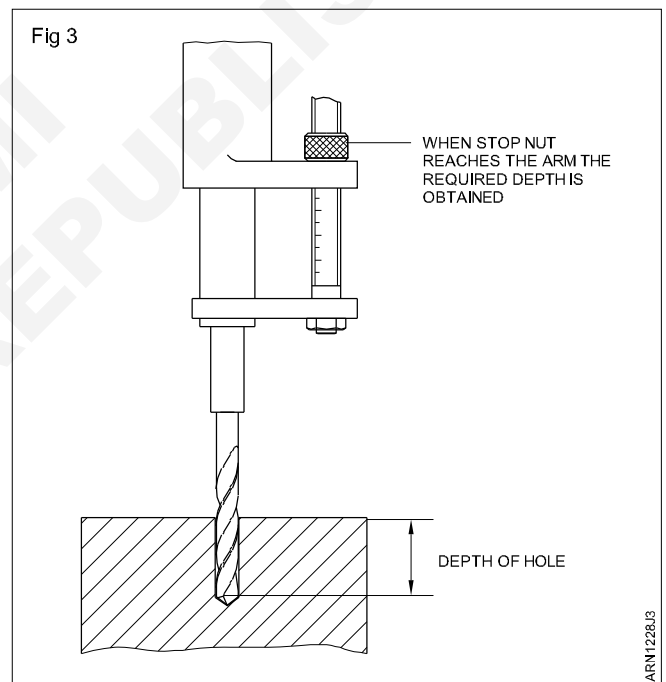
Initial Reading + Depth of Hole = Setting

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

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)



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

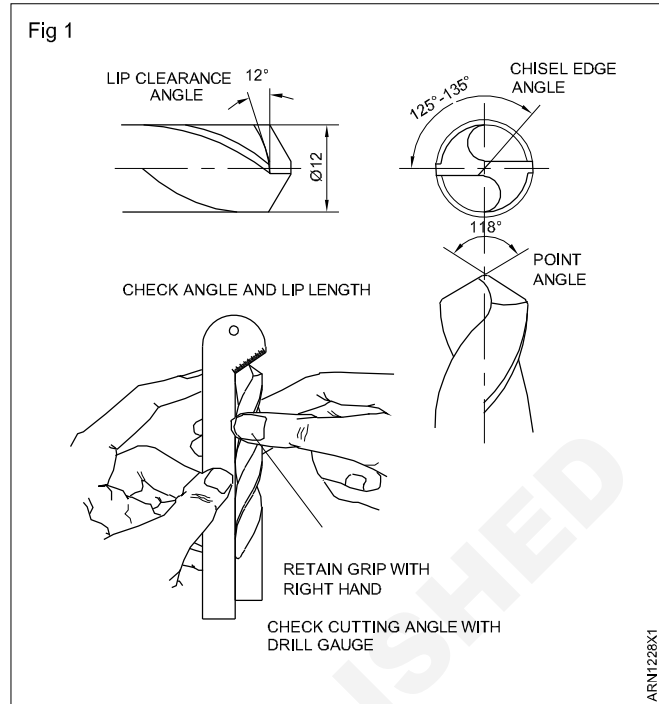
Do not drill on a light component without clamping. If not clamped, the job will rotate along with drill.

Task 2: Sharpening of twist drill

- 1 Check the working condition of the grinding machine and its wheels.

The drill bit is held behind the point with the thumb and index finger of the left hand, shank with the thumb and index finger of the right hand.

- 2 Lightly press the drill with angle of 59° against the grinding wheel, and at the same time, the drill shank is moved up and down to get the lip clearance angle of 8° to 12° .
- 3 Repeat the operation 1 and 2 for the other lip.
- 4 Dip the tool in a coolant frequently.
- 5 Finish the clearance angle from 9° to 12° and check the angle with a drill gauge.
- 6 Check the lip length and maintain both sides equal.
- 7 Reduce the web thickness at dead centre.
- 8 Deburr the cutting edge by an oilstone.



Re-sharpening a twist drill

Objectives : This shall help you to

- re-sharpen a twist drill
- test the drill that has been re-sharpened by drilling a through hole.

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

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

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

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)

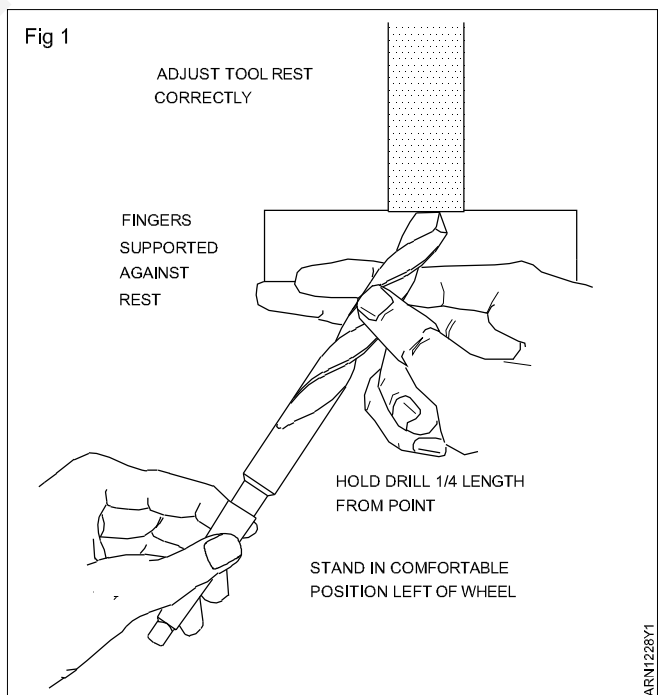
Hold the drill level. Twist it until one cutting edge is horizontal and parallel to the wheel face. (Fig 3)

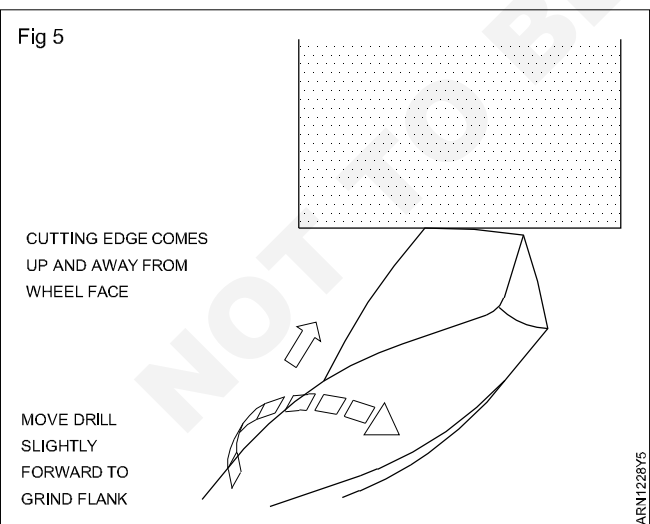
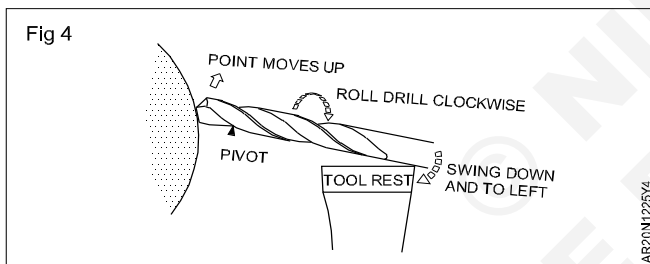
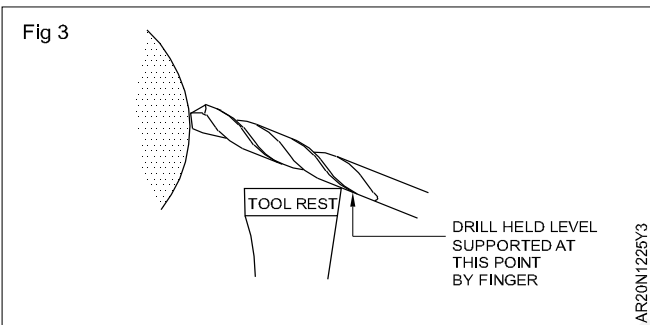
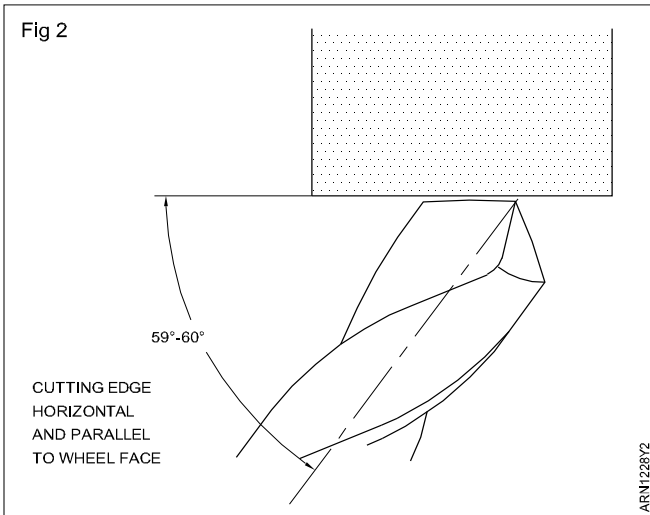
Swing the shank of the drill slightly downwards and to the left with the left hand. The right hand is on the tool-rest.

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&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.





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

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

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

Also note that, if the drill is twisted too far, the other cutting edge will swing down to contact the wheel face.

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

Procedure to obtain equal angles

Move the drill back, clear of the wheel face.

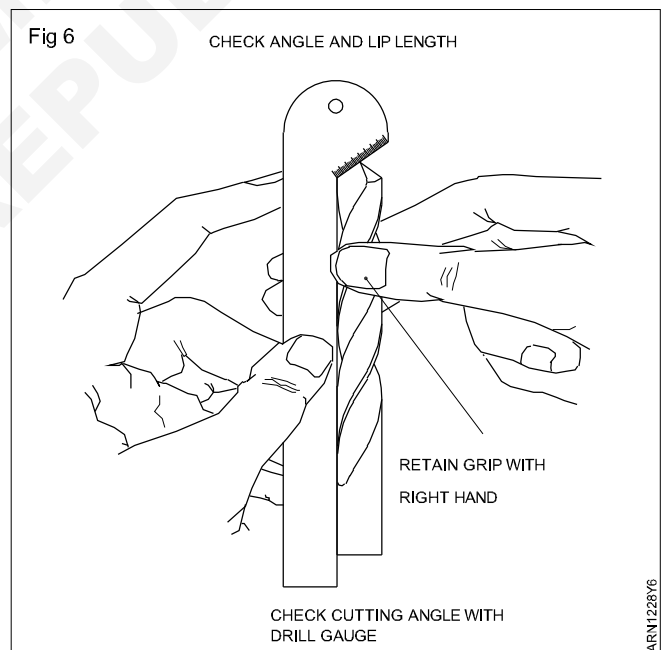
Turn the drill over without moving the position. This presents the second edge to the wheel face at the same angle as the first cutting edge.

Proceed to sharpen the second cutting edge, using the same amount of drill movement as before.

When these actions are carried out carefully, the drill will be sharpened with equal cutting angles.

The lip clearance will be correct and equal.

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



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

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

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

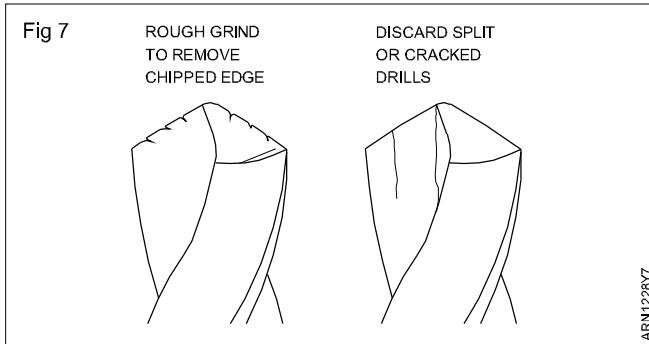
Points to be considered when sharpening drills

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

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

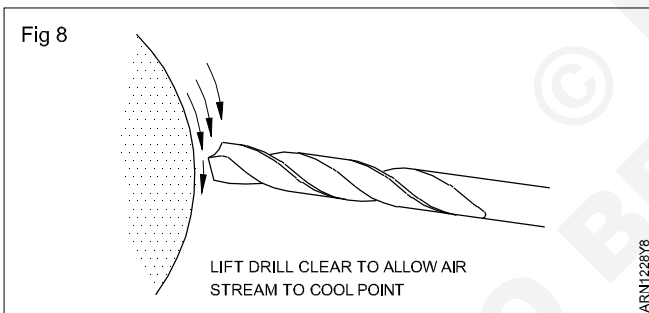
Never re-sharpen a cracked or split drill.

Avoid overheating the drill.



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

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



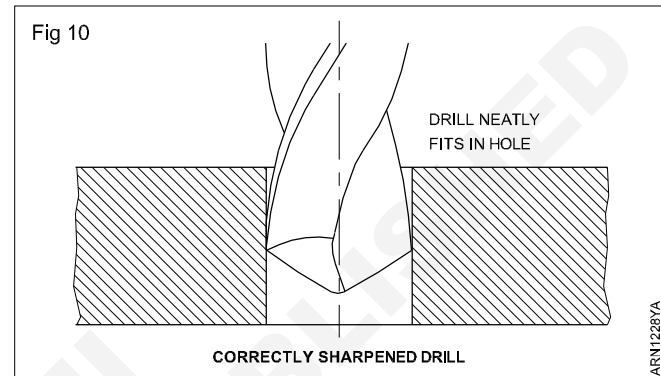
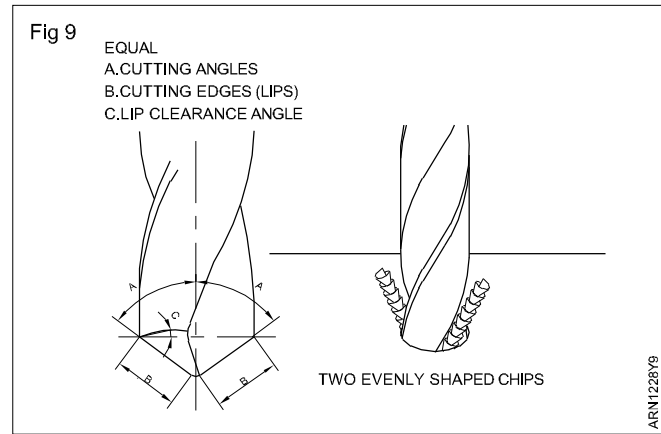
Re-sharpening of very small drills required great skill. They require proportionally less movement to produce the cutting angles.

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)

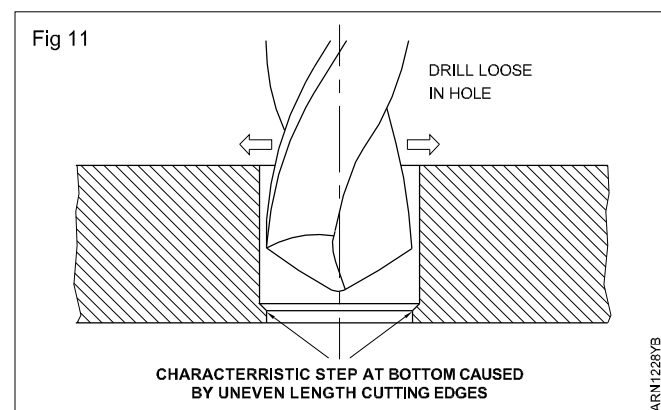
The cutting edges are of uneven length

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

Produce an out-of round hole.



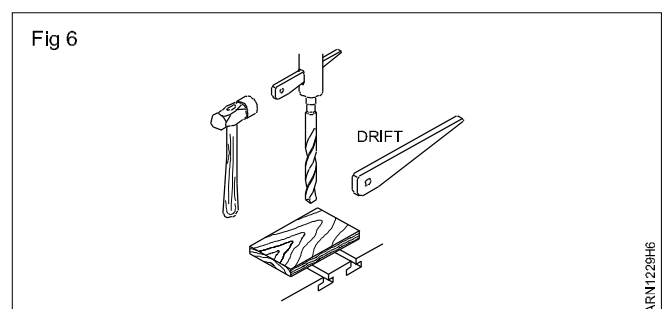
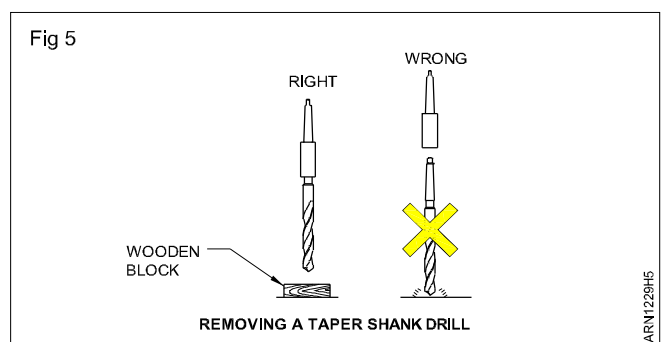
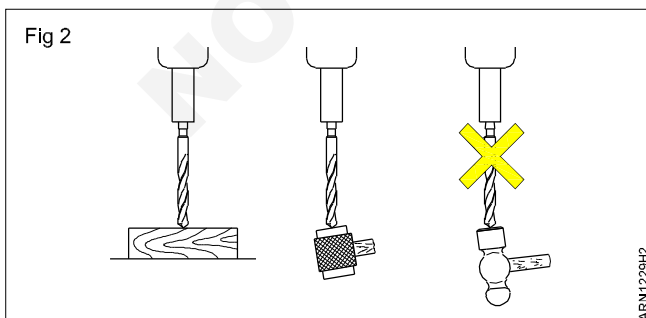
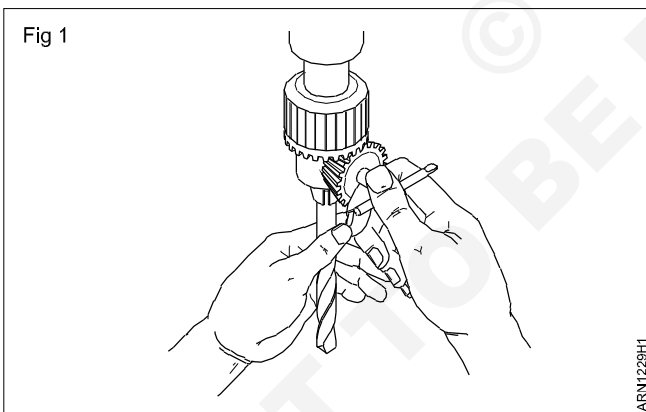
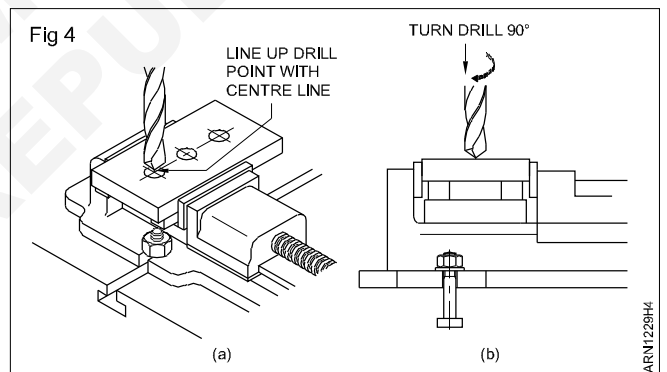
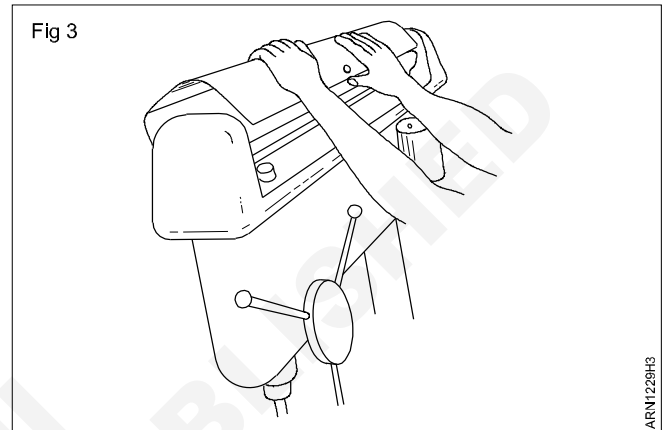
Safety precautions while using drilling machine

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

- follow personal safety
- follow drilling machine safety
- follow job safety
- follow drill bit safety.

PROCEDURE

- 1 Wear a dress suitable for work
- 2 Ensure that the spindle head and table is locked properly.
- 3 The workpiece and the drill should be rigidly held.
- 4 Switch off power when not in use.
- 5 Clean and oil the machine after use.
- 6 Use a brush to clean the chips and swarf.
- 7 Select proper cutting speed according to material.
- 8 Select proper cutting fluid according to material.
- 9 Remove the workpiece only after getting cooled or with a tong.
- 10 While fixing the drill in a socket or sleeve, the tang portion should align in the slot. (Fig 1&2) This will facilitate the removal of drill or sleeve from the machine spindle.

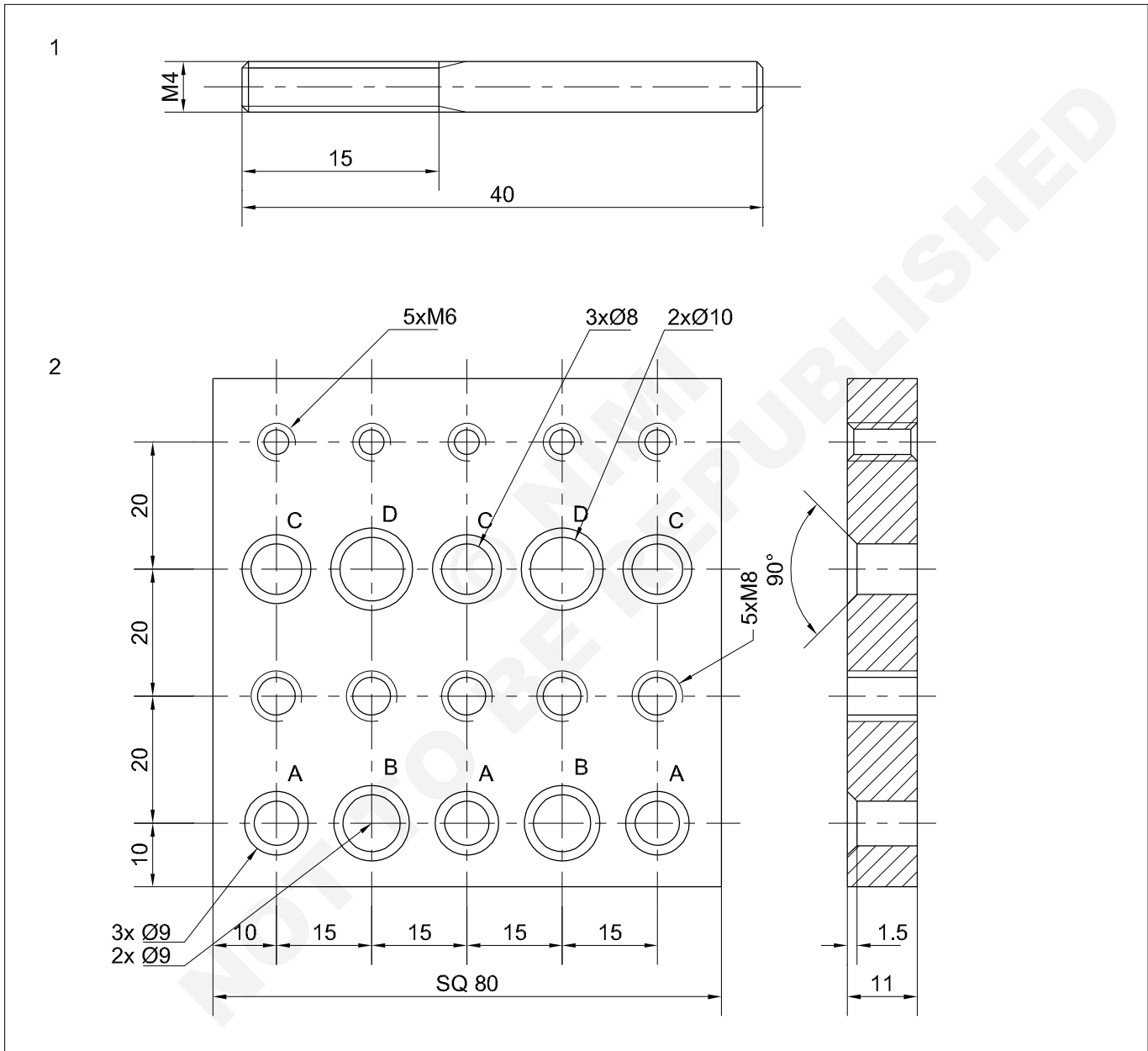


- 11 Use a drift to remove drills and sockets from the machine spindle. (Fig 3)
- 12 While removing the drill from the sockets/sleeves, don't allow it to fall on the table or jobs. (Fig 5&6)

Practice on tapping a clear and blind hole

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

- file surfaces flat and parallel within ± 2 mm
- drill through holes
- countersink holes to fit standard screw heads
- cut internal threads using hand taps.



1	5x45		Fe310		1	1.2.30
1	90ISF12x85	-	Fe310		2	1.2.30
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex.No.
SCALE 1:1	CUTTING INTERNAL THREADINGS				DEVIATIONS ± 0.1	
					CODE NO. ARN1230E1	

PROCEDURE

- 1 Check the raw material for its size.
- 2 File and finish the plate 80 x 11 x 80 within ± 0.2 mm.
- 3 Locate centres for holes to be drilled, tapped and countersunk.
- 4 Centre punch the centres.
- 5 Drill five, $\varnothing 5$ mm tapping drill size holes for M6 tapping.
- 6 Drill five, $\varnothing 6.8$ mm tapping drill size holes for M8 tapping.
- 7 Drill four $\varnothing 8$ mm through holes as per drawing. Enlarge by drilling $\varnothing 10$ mm the 2nd and 4th hole of the second row.
- 8 Drill five $\varnothing 7$ mm through holes as per drawing.
- 9 Enlarge the 2nd and 4th holes by drilling $\varnothing 9$ mm on the 4th row
- 10 Countersink $\varnothing 8$ and $\varnothing 10$ holes with 90° countersink as per standard. (Refer to the table.)
- 11 Countersink $\varnothing 7$ and $\varnothing 9$ mm holes with 120° countersink as per standard. (Refer to the table.)
- 12 Cut M6 internal thread in the four $\varnothing 5$ mm drilled holes.
- 13 Countersink 120° all the four $\varnothing 6.8$ mm holes on both sides as per drawing.
- 14 Cut M8 internal threads in all the five $\varnothing 6.8$ mm drilled holes with M8 taps.
- 15 Check M6 and M8 tapped holes with the supplied M6 and M8 screws, respectively.
- 16 Hold cylindrical blank on vice.
- 17 Cut M4 external thread using M4 dies on part 2.

Skill sequence

Internal threading of through holes using hand taps

Objectives: This shall help you to

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

Determining the tap drill size

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

Drill the hole to the required tap drill size.

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

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

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

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

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

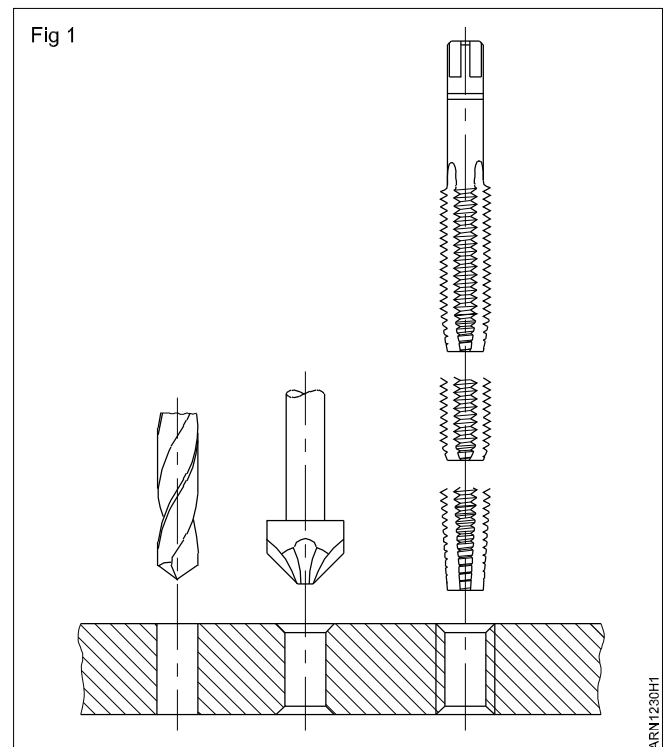
Too small a wrench will need a greater force to turn the tap. Very large and heavy tap wrenches will not give the feel required to turn the tap slowly as it cuts.

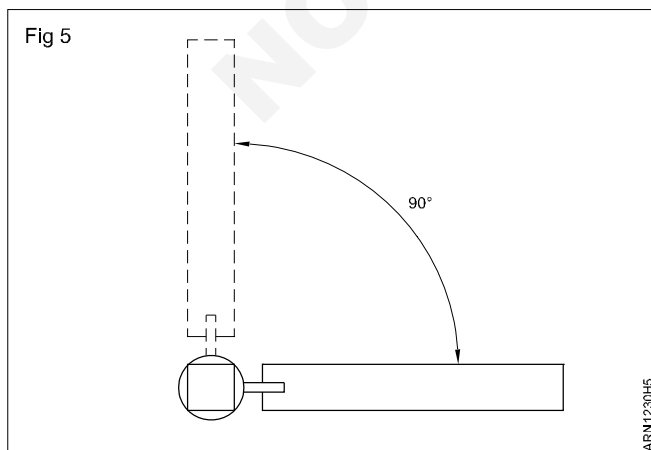
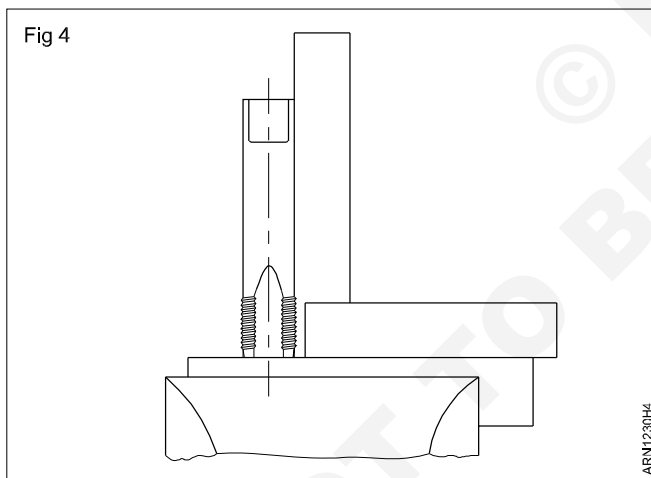
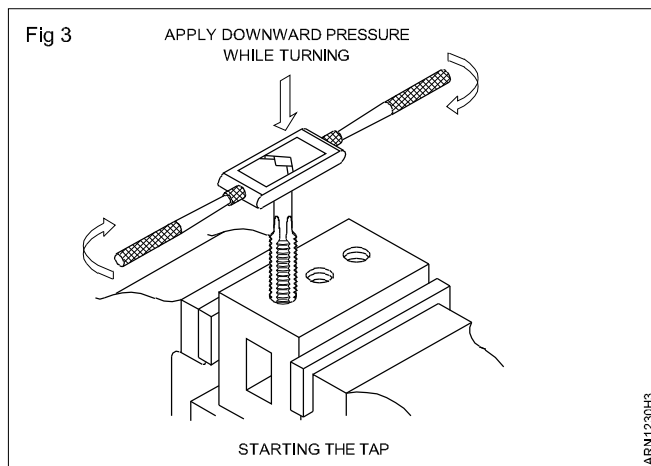
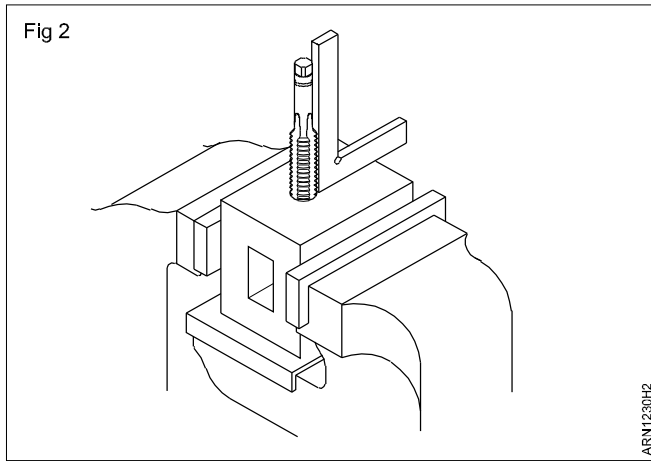
Position the tap in the chamfered hole vertically by ensuring the wrench is in the horizontal plane.

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

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

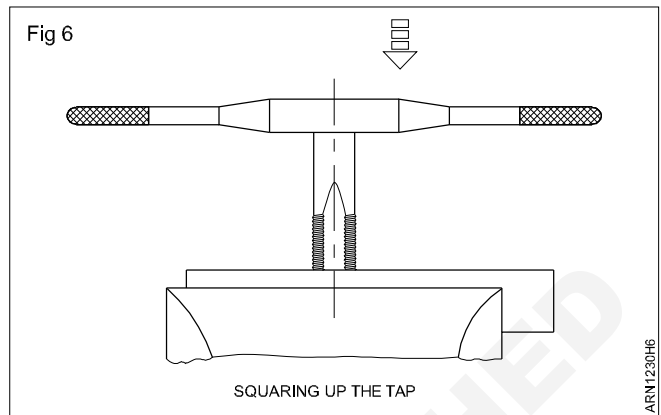
Check and make sure the tap is vertical, use a small try square for help. Place the try square in two positions, 90° to each other (Fig 4 & Fig 5).





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.



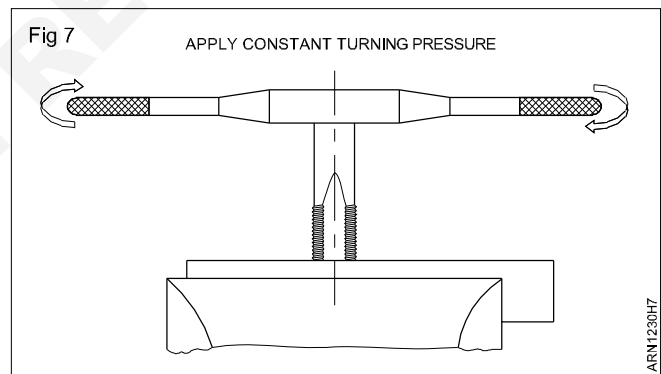
Check the tap alignment again with a try square.

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

Make one or two turns and check the alignment.

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

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



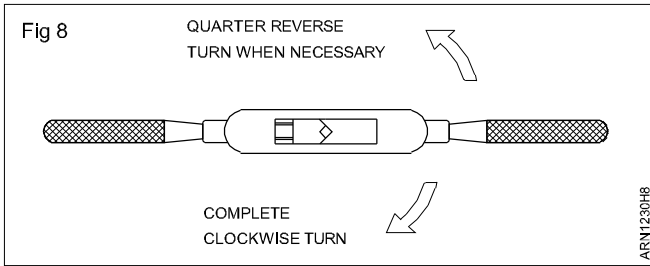
While turning the wrench, the movement should be well balanced. Any extra pressure on one side will spoil the tap alignment and can also cause breakage of the tap.

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

Use a cutting fluid while cutting the thread.

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

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



Remove chips from the work with a brush.

Check the threaded hole with a matching screw.

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

Internal threading blind holes using hand taps

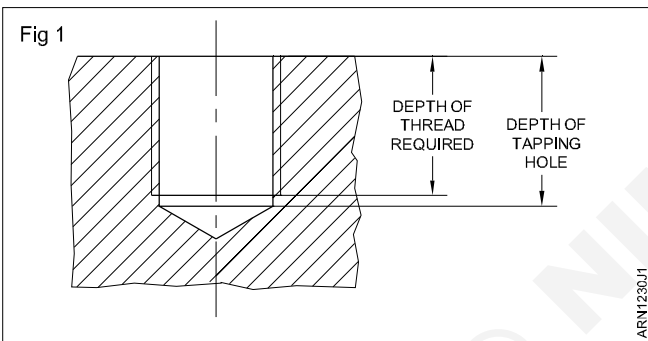
Objective: This shall help you to

- cut internal threads in blind holes.

Drilling a blind hole

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

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

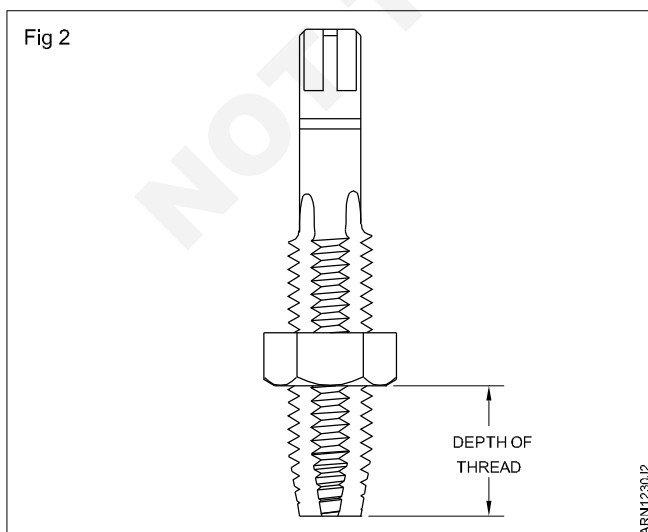


Procedure for threading

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

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

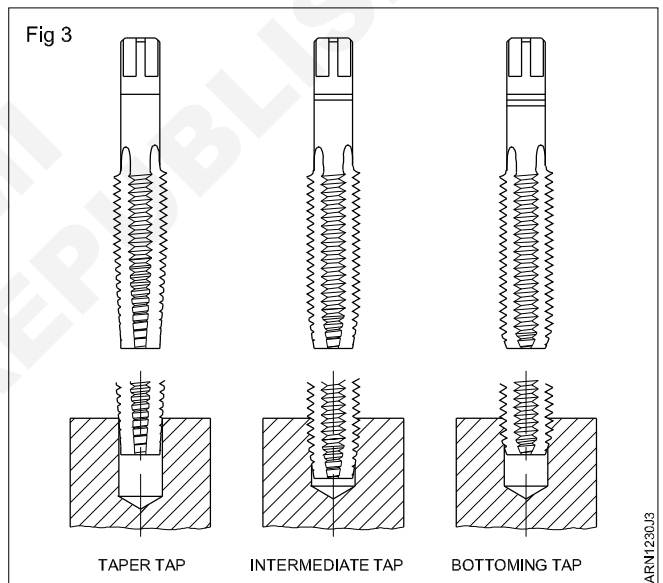
Screw a matching nut on the first tap to act as a depth stop. (Fig 2)



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

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

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



use a cutting lubricant

Increase the depth of the cut gradually.

Check the threads with a matching stud/bolt.

Repeat the cutting until the bolt matches.

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

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

Practice on use of tap extractor cutting threads on a bolt/stud

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

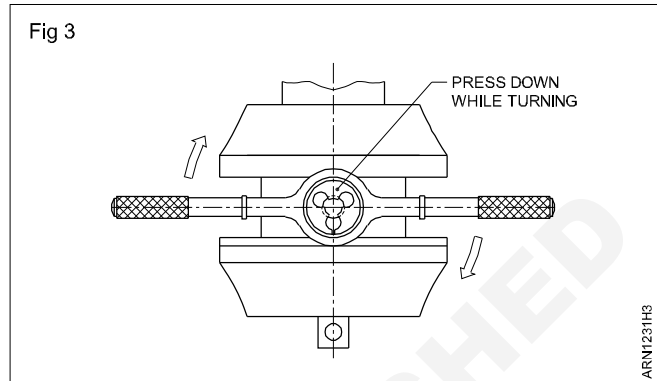
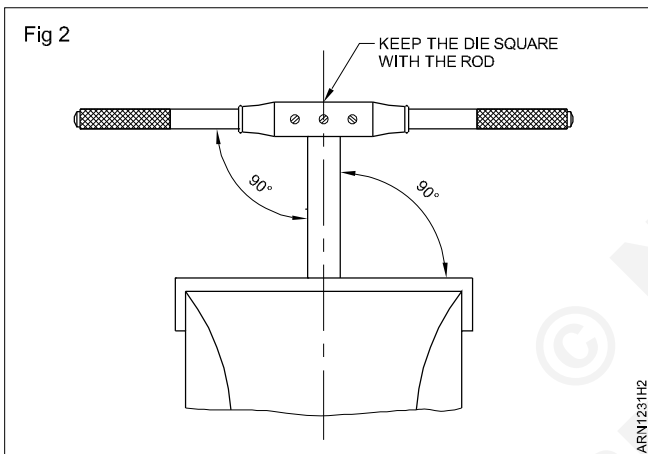
Check blank size

- 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)

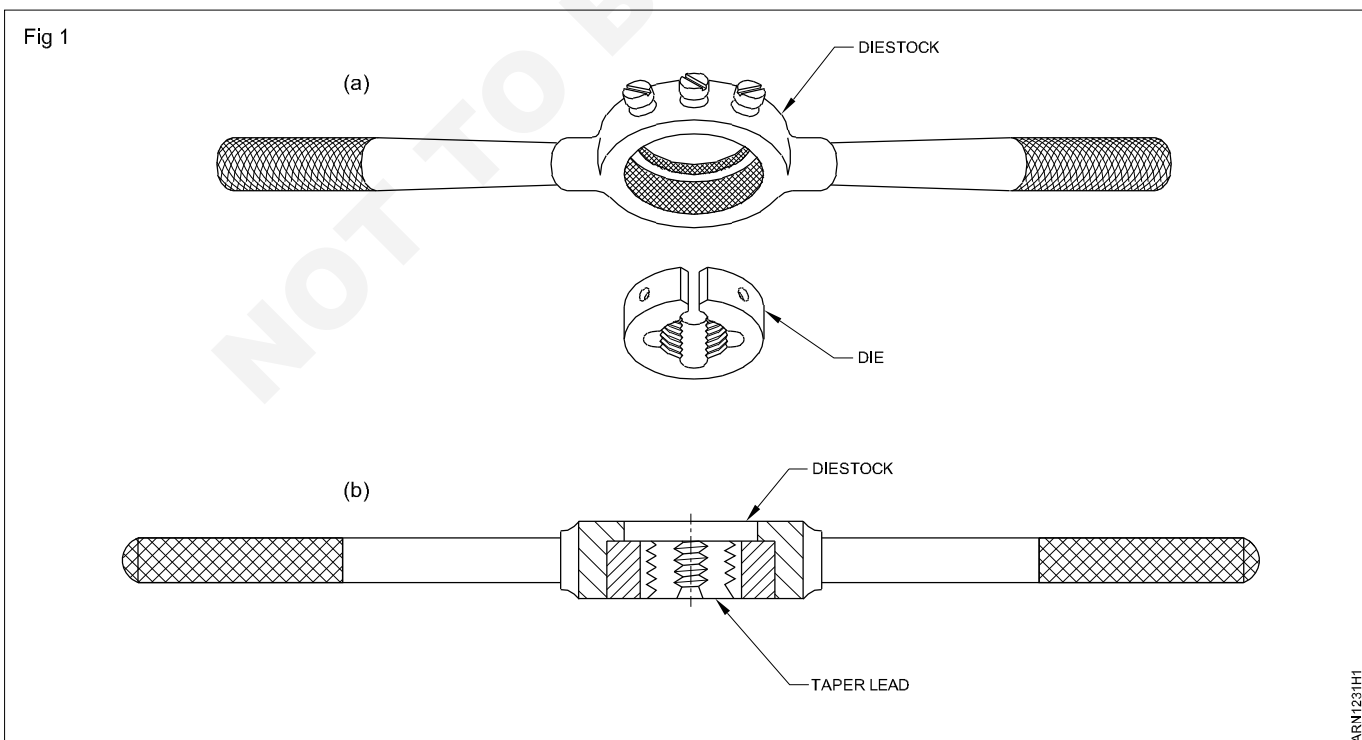
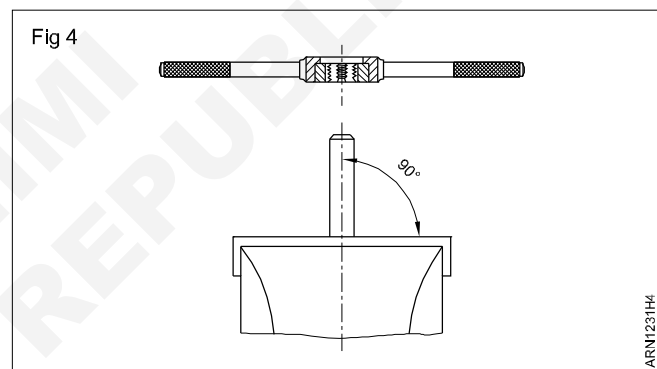
Use false jaws for ensuring a good grip in the vice.

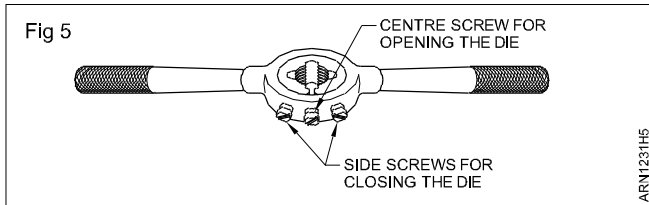
Project the blank above the vice-just the required thread length only.

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



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





- 5 Start the die, square to the bolt centre 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.

- 8 Increase the depth of the cut gradually by adjusting the other screws.
- 9 Check the threads with matching nut.
- 10 Repeat the thread cutting until the nut matches.

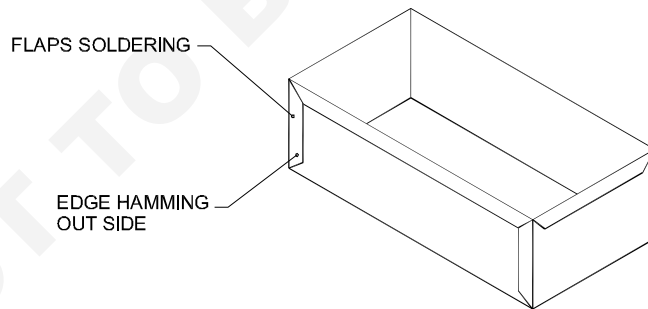
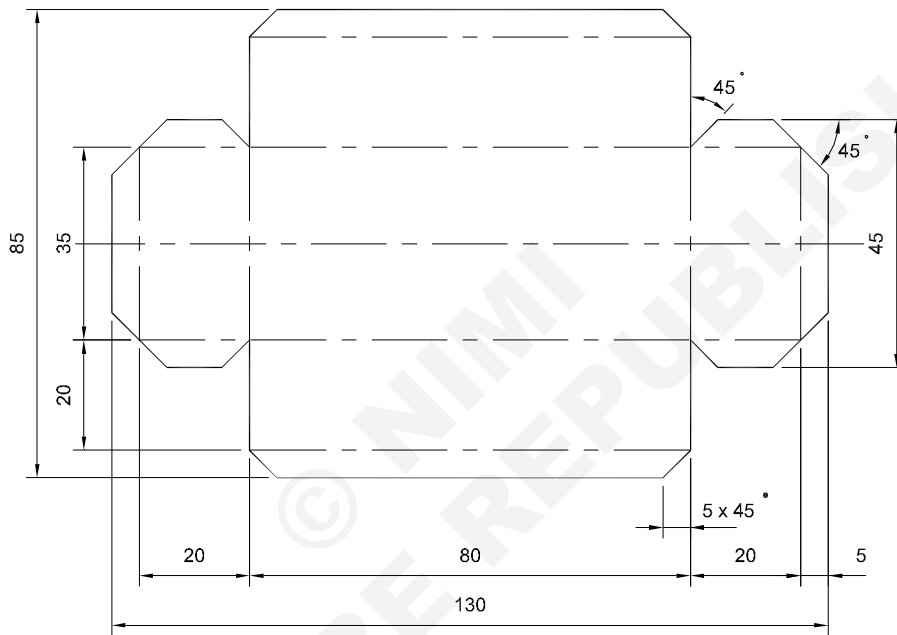
Note

- **Too much depth of thread cut at one time will spoil the threads, it can also spoil the die.**
- **Clean the die frequently to prevent the chips from clogging and spoiling the threads.**

Practice on making rectangular tray

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

- develop a rectangular tray by the parallel line method
- shape and size the sheet metal using straight snips
- make single hemming using a man's anvil
- bend the sheet to 90° using a Tin man's anvil
- solder lap joint maintaining uniform flow of solder and penetration

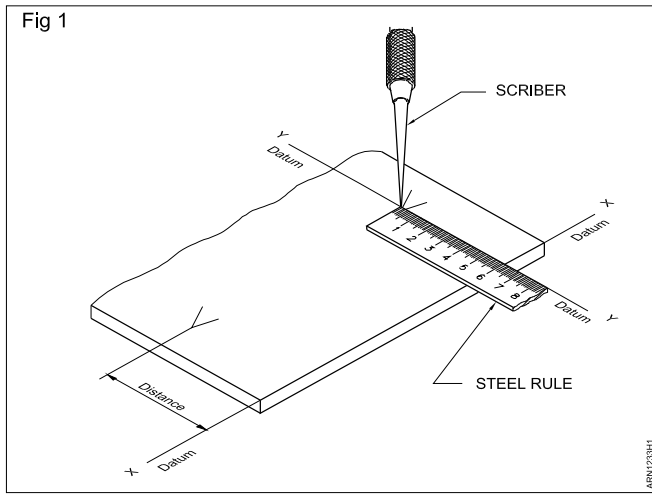


1	ISSH 135 x 90 x 0.5		G.I. SHEET	1		1.2.33
No. OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	TITLE				TOLERANCE ±0.5	TIME 5 hrs
		MARKING RECTANGULAR TRAY WITH FLAPS SOLDERING			CODE No. ARN1233E1	

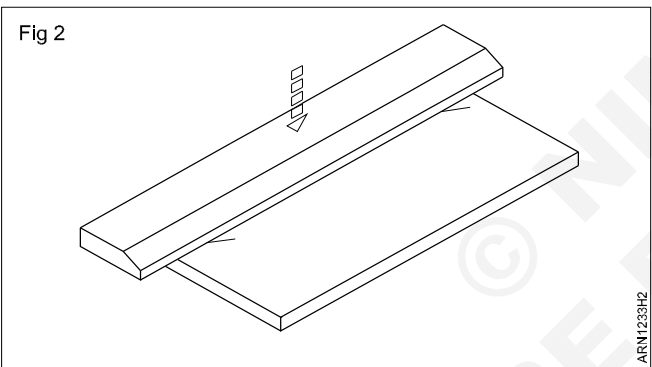
PROCEDURE

Task 1: Mark line parallel to an edge

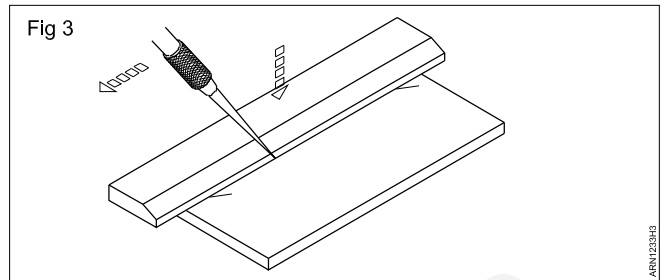
1 Mark off two 'V' marks from the datum xx at a distance as required by measurement, using a steel rule and a scriber. Datum xx is at right angle to datum yy (Fig 1).



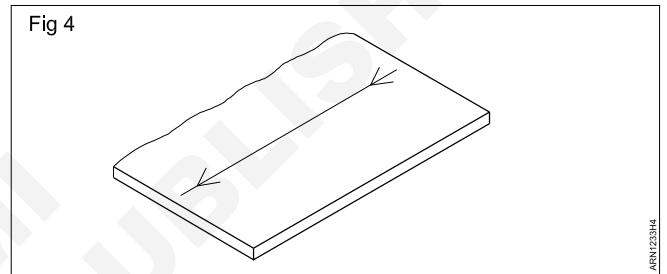
2 Set the straight edge in between the 'V' marks and press with your fingers. (Fig 2)



3 Scribe the line towards you with a proper inclination of the scriber on the level edge of the straight edge. (Fig 3)



4 The line AB is the parallel line to the datum xx. (Fig 4)
5 Draw parallel lines as per dimensions following the above procedure.

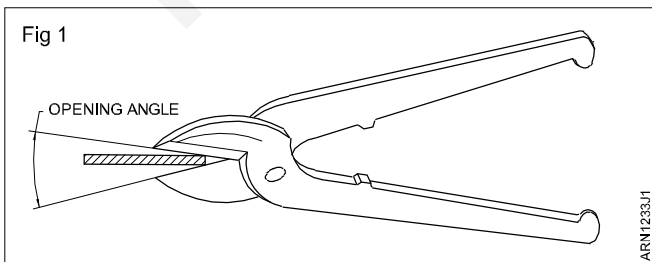


Skill Sequence

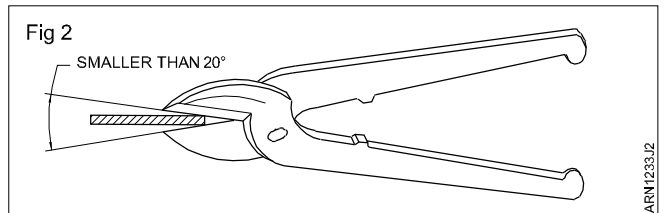
Cutting sheet by snips

Objective : This shall help you to
• cut sheet metal by a straight snip.

Hold the sheet by one hand, and with the other hand, hold the snip handle at the end, and place the upper blade of the snip on line by keeping a smaller opening angle. (Fig 1)



Maintain the gap in between the blades, less than 20°. (Fig 2)

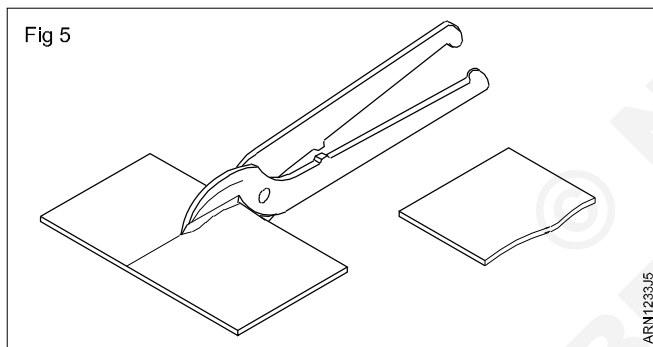
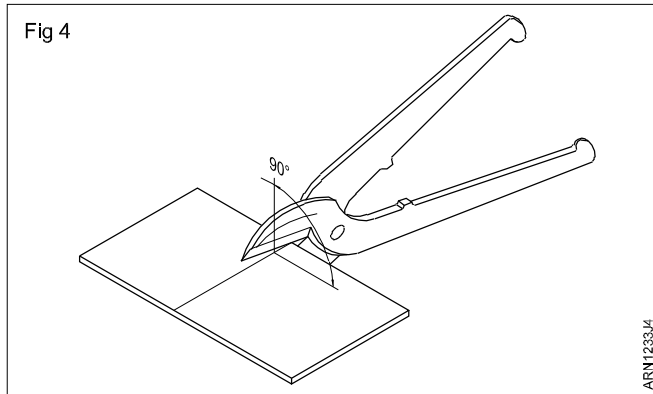
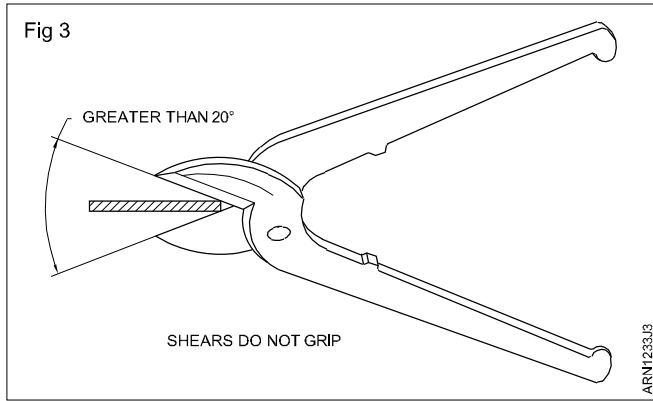


If the blade gap is more than 20°, shears cannot be gripped properly. (Fig 3)

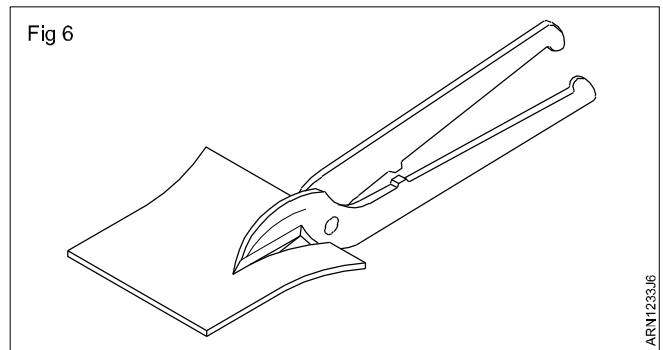
Keep the blade perpendicular to the surface of the sheet metal. Hold the snips straight. (Fig 4)

Caution

Do not use the full length of the blade by a single stroke. (Fig 5)

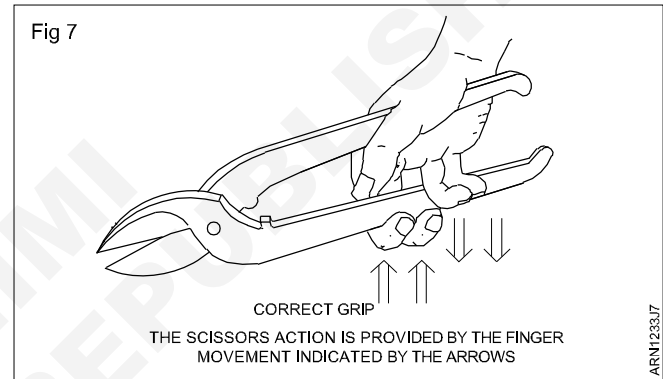


If you use the full length of the blade by a single stroke, then the cutting or shearing line will not be straight. (Fig 6)



Keep less metal (sheet) as far as possible on the left hand side at the time of-cutting the sheet. (Fig 7)

Where stops are not fitted, care should be taken not to pinch the palm of the hand between the turned-in ends of the handles when closing the cutting blades.



After cutting the metal sheet as per measurement bolt it in the shape of rectangular tray.

Joint the tray joints by soldering or riveting or brazing.

Practice on soldering & brazing of pipes

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

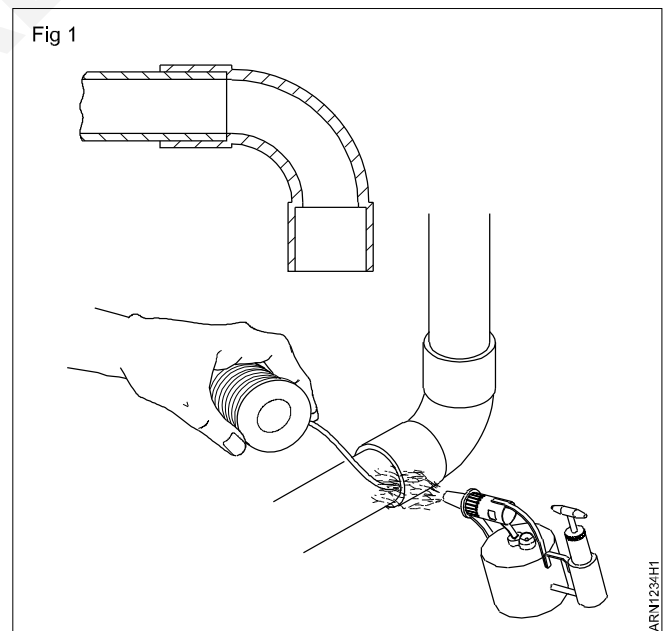
- lay copper pipes using different jointing methods
- capillary joint of end feed capillary fittings
- capillary joint of internal solder ring fittings
- braze copper with M.S tube.

Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 Set.	• Solder	- as reqd.
• Soldering Iron	- 1 No.	• Brazing rod	- as reqd.
• Blow lamp	- 1 No.	• Flux	- as reqd.
• Tong	- 1 No.	• Water	- as reqd.
Equipments		• Bucket	- as reqd.
• Work bench	- 1 No.	• Sand paper	- as reqd.
• Anvil	- 1 No.	• Silver bragging flex	- as reqd.
• Oxy - acetylene gas welding set	- 1 No.	• Silver bragging rod	- as reqd.
Materials		• Copper tube	- as reqd.
• M.S Tube	- as reqd.	• M-3 tube	- as reqd.
		• Clean cloth	- as reqd.

PROCEDURE

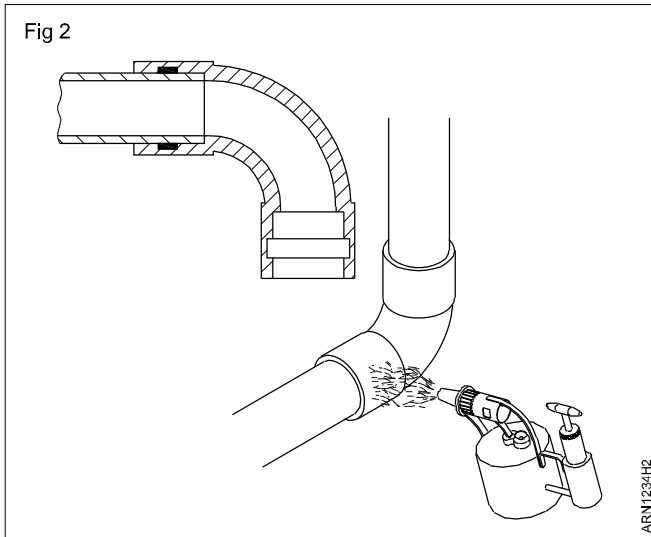
Task 1: Capillary fitting

- 1 Cut the pipe end. Square with a pipe cutter.
- 2 Remove the burr from inside and outside of the pipe with a reamer.
- 3 Clean the outside of pipe and inside of the fitting with sand paper.
- 4 Apply a thin film of flux to the outside of pipe and inside of fittings with brush.
- 5 Insert the pipe into the fitting cup till the pipe end touches the base of the fitting cup.
- 6 Apply heat to the pipe and fitting.
- 7 Add the solder to the side which is opposite to the heat when the flux begins to boil. (Fig 1)
- 8 Wipe of excess solder.



Task 2: Using capillary joint (Integral solder ring fitting) (Fig 2)

- 1 Cut the pipe with a cutter.
- 2 Remove the burr from inside the pipe with a reamer.
- 3 Clean the outside of the pipe and inside of the fittings with sand paper.
- 4 Apply flux on outside surface of pipe and inside of fittings.
- 5 Heat the fittings and pipe until a complete ring of solder appears at the mouth of the fittings (Fig 2).



6 Allow the joint to cool without disturbance.

Non manipulate compression fittings

1 Cut the tube to correct length.

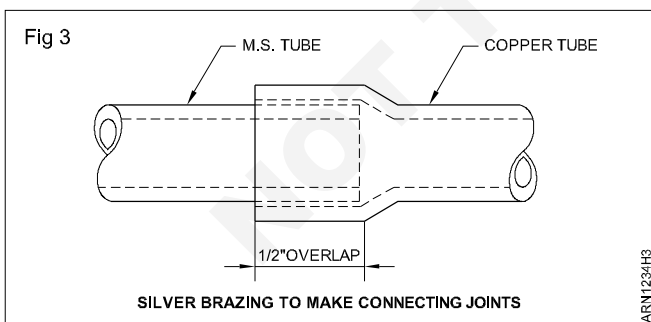
- 2 Remove burrs from pipe and fittings.
- 3 Insert tube into fittings until it makes contact with the tube stop.
- 4 Choose the correct size grip jaw.
- 5 Compress the fitting until the grip jaw stops.
- 6 Check the joints by pulling them apart with the hands.

Manipulate compression fittings

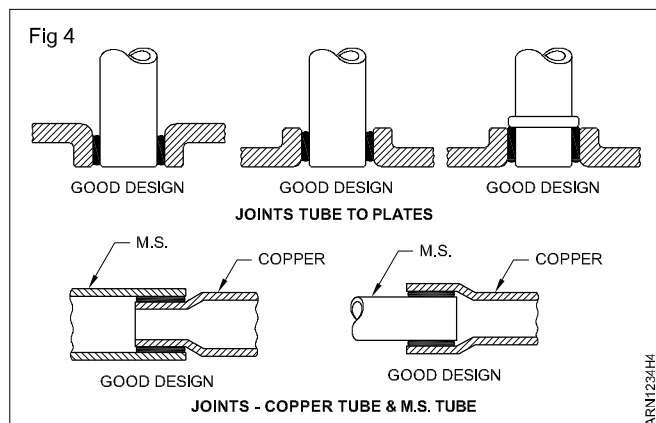
- 1 Slip the compression fitting nut and compression ring over the tube.
- 2 Flare the end of the pipe.
- 3 Place the cone end of adapter piece on the flared pipe end.
- 4 Engage the compression nut onto the body thread.
- 5 Tighten the nut with spanner.

Task 3: Brazing

- 1 Place the tube in V- guide of cutter
- 2 Tighten the thumb screw until considerable pressure is applied
- 3 Revolve the cutter slowly around the tube so that the sharp cutting wheel feeds gradually on the tubings to apply pressure thumb screw till tube is completely cut
- 4 Ream and file the edges of the tubing
- 5 Use sand paper to clean the outer surface of the tube and clean inside by wire brush
- 6 Make a paste of silver brazing flux by mixing it with little bit of water and apply a thin coat of flux to outside of the fitting
- 7 Insert the pipe into MS pipe and see that the fit is not too easy (Fig 3)



- 8 Clamp the pipe in the flaring block and mount the block in the vice
- 9 Light the oxy - acetylene torch using the spark lighter
- 10 Heat the connection at safe distance from the joint until the water vapourizes
- 11 Continue heating until the flux turns milky and finally turns clean (Fig 4)
- 12 Apply the silver solder to both edges of the MS tube until the solder flows on both pipes
- 13 Remove silver solder rod and allow the joint to cool
- 14 After cool the assembly and test the connector to 10.5 kg/cm² pressure.



Practice on soldering wires

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

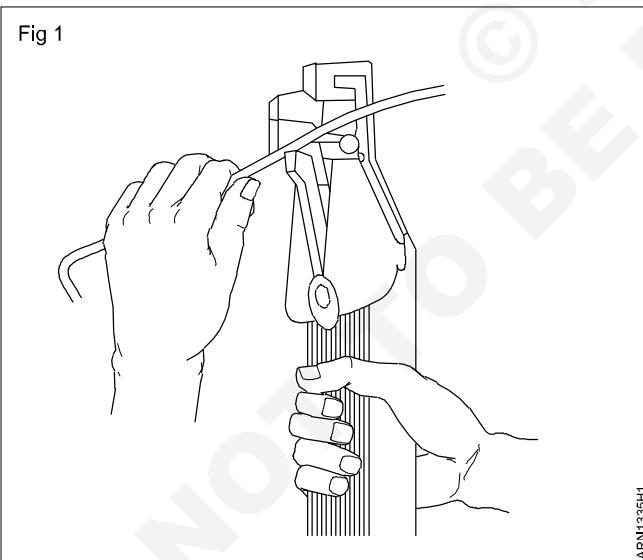
- **prepare crimping joints on the connectors**
- **solder the cables by using blow lamp**
- **solder the wires by using electric soldering iron.**

Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Solder	- as reqd.
• Crimping plier	- 1 No.	• Brick	- as reqd.
• Blow lamp	- 1 No.	• Insulating sleeve	- as reqd.
• Tong	- 1 No.	• Flux	- as reqd.
• Combination plier	- 1 No.	• Lug socket	- as reqd.
Materials		• Cloth/Cotton tape	- as reqd.
• Cotton waste	- as reqd.	• Grade sandpaper	- as reqd.
• Wooden plank	- as reqd.	• Copper and aluminium conductors	- as reqd.

PROCEDURE

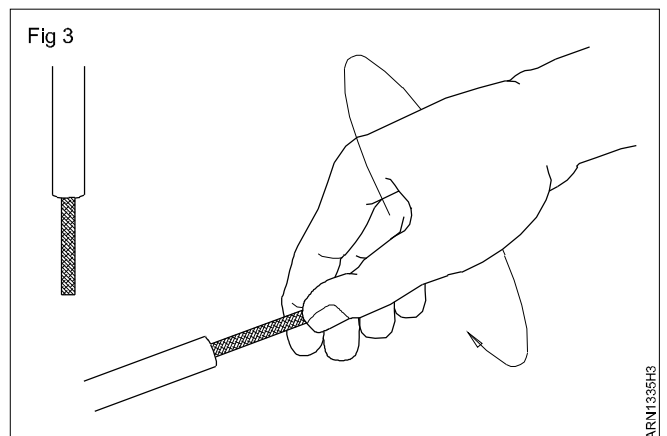
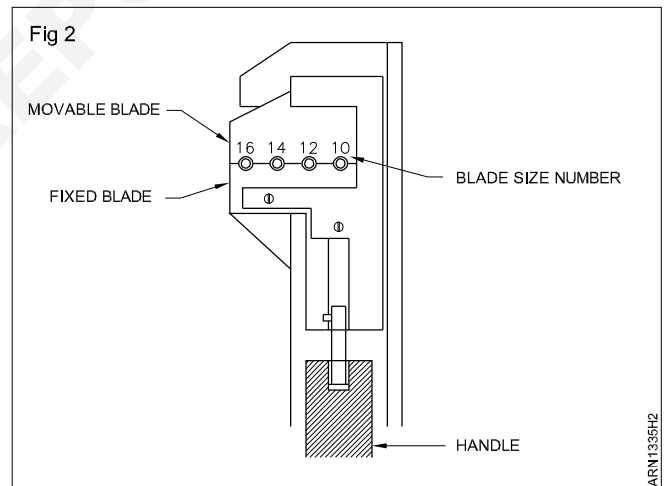
Task 1: Prepare the crimping joints with connector

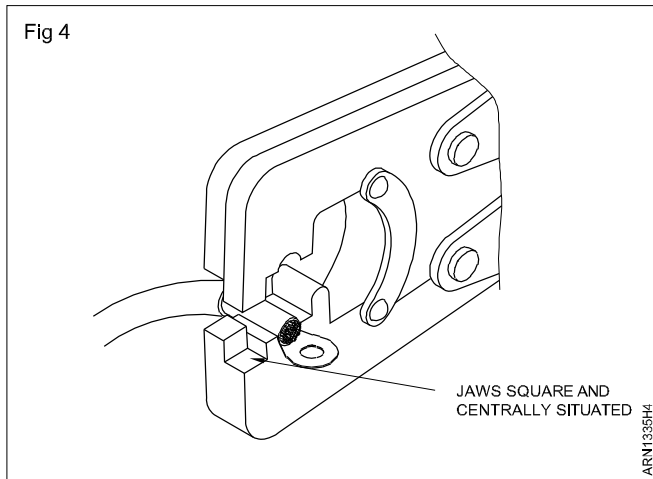
- 1 Strip off the required length of insulation from the cable that suits the terminal size. (Fig 1)



Be sure not to cut or damage the wire core, and use correct size wire stripper blade. (Fig 2)

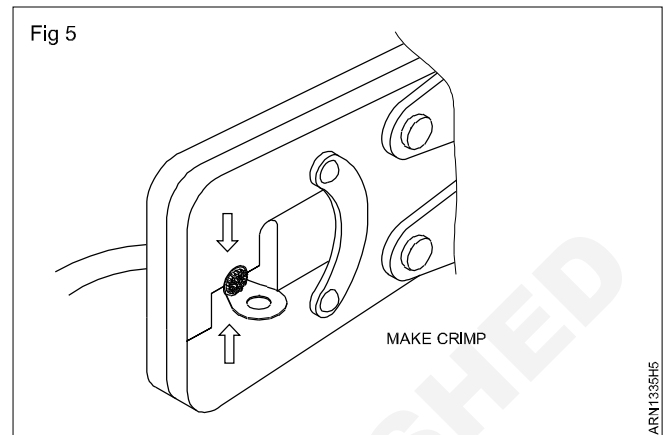
- 2 Twist the strands of the wire slightly clockwise. (Fig 3)
- 3 Clamp the spade connector with the crimping pliers in the matching position of the jaws. (Use a suitable spade connector and crimping plier.) (Fig 4)
- 4 Insert the wire far enough in the connector.





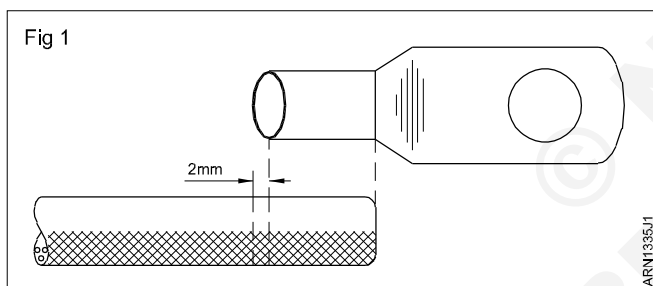
- 5 Apply slight pressure to create a light impression on the connector.
- 6 Check the connector is located in the middle of the band of the connector, and, if necessary, make final adjustments.

- 7 Apply sufficient pressure in the handle to press the connector fully. (Fig 5)
- 8 Check whether the prepared crimping joint is firm by pulling the cable and connector.
- 9 Repeat the crimping of connectors for various sizes of copper and aluminium conductors of different lengths.

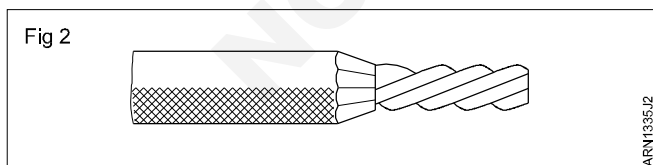


Task 2: Solder the cable lugs by using blow lamp

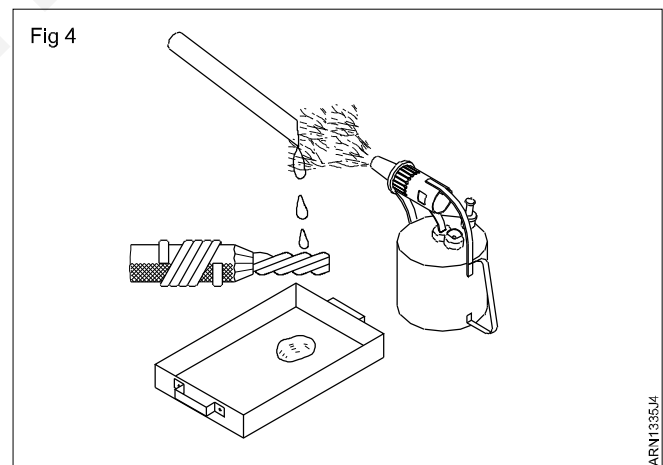
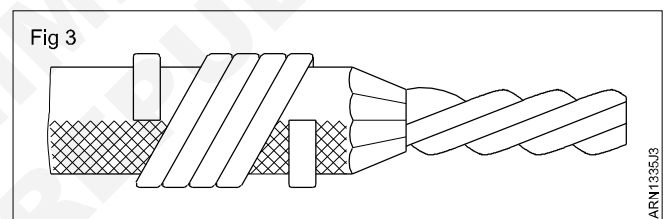
- 1 Solder a lug to a copper conductor (Fig 1).



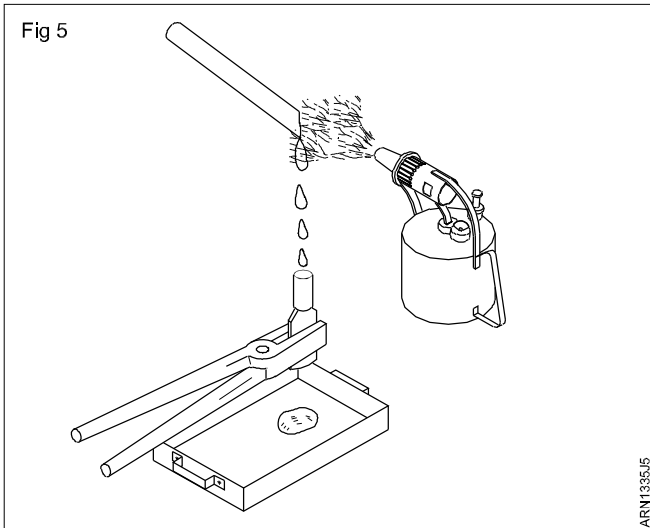
- 2 Clean the inner surface of the cable lug using 00 grade sandpaper.
- 3 Put the cable lug to one end of the cable and mark the cable according to the depth of the cable lug. Add about 2 mm to the marking.
- 4 Remove the insulation from the cable and clean the strands. (Avoid damage to the strands of the cable while skinning.) (Fig 2)



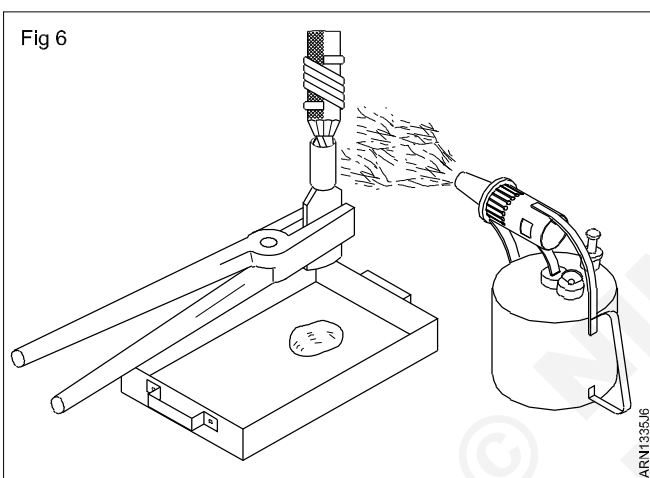
- 5 Wrap a cloth/cotton tape on the insulation of the cable to a length of 30 mm and wet it with water. (Use minimum water to wet the cloth/tape. Do not allow water to drip.) (Fig 3)
- 6 Light the blowlamp and let it emit a blue flame (Fig 4).
- 7 Apply a thin coat of flux to the cable end.



- 8 Tin the cable end by monitoring the blowlamp on the solder stick and by allowing the molten solder to fall on the bar stranded cable end. Place a clean tray below the cable end to collect the excess solder.
- 9 Apply a small quantity of flux inside the lug socket. Tin the lug by melting the solder stick to fill the socket and collect the excess molten solder in the tray. (Fig 5)



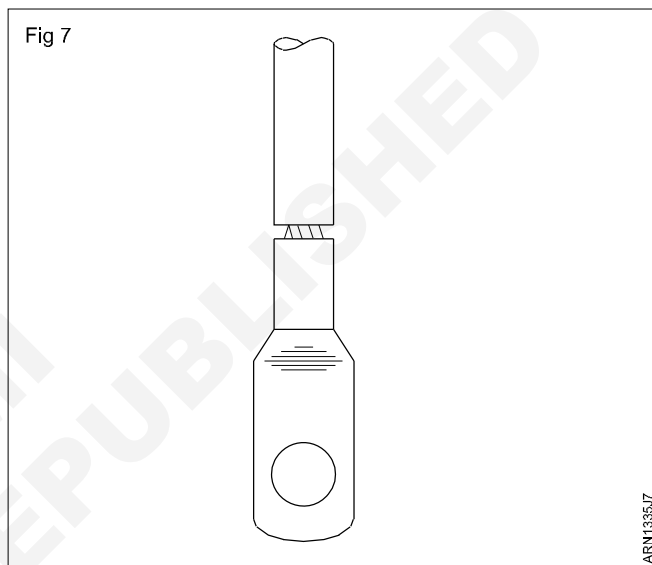
10 Apply some flux to the cable end and socket interior. (Fig 6)



- 11 Fill up the socket of the lug with the molten solder.
- 12 Monitor the blowlamp flame on the socket; insert the cable in the socket and hold the cable vertically.
- 13 Remove the blowlamp and hold the cable and socket without shaking. (Fig 7)
- 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.

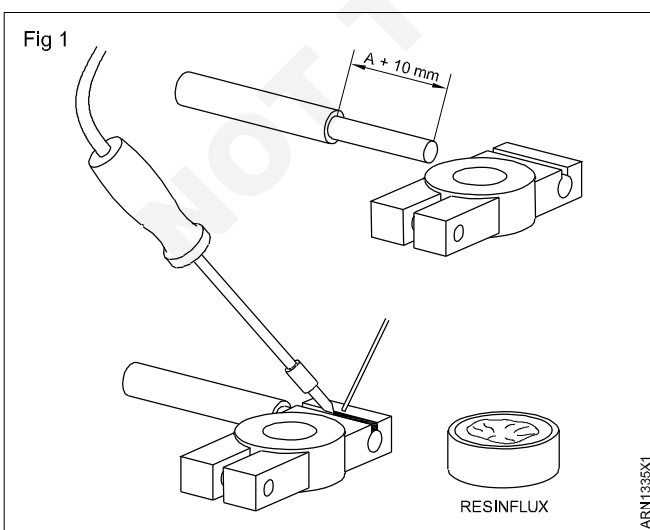
Do not use water to cool the lug.

Fig 7



Task 3: Solder the cable using soldering iron

- 1 Clean the strands and get a copper face free from sulphate.
- 2 Insert the wire end as shown in the Fig 1.



- 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.

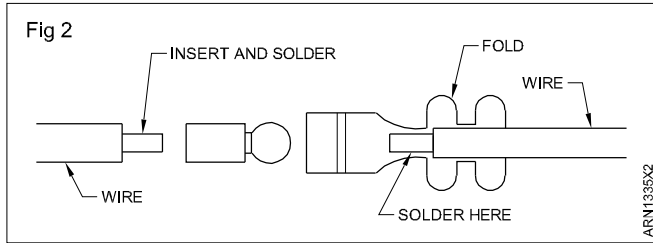
Do not over heat the iron. Overheating would impair wetting of iron. Wetting means coating soldering iron with solder.

- 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 1 and solder around the cable without melting the insulating sleeve.

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

Soldering the circuit wire terminals

- 1 Remove the insulation as shown in the Fig 2 without cutting conductor strands.
- 2 Connect a soldering iron of 300w/220v to an AC supply and keep the iron on a brick.



- 3 Clean the copper strands with emery paper.
- 4 Twist the end neatly.
- 5 Keep the end on a wooden plank.
- 6 Wet the iron with soft solder.

Do not over heat the iron

- 7 Coat the end with solder.

- 8 Insert the end into the small loop on the eyelet terminal.
- 9 Fold the terminal tabs one by one and crimp with a tool.
- 10 Now keep the clamp on wooden plank.
- 11 Keep the iron so that a wide area of contact is achieved for better heat transfer to obtain a molten flow of soft solder.
- 12 Wait for solidification of solder and inspect the result. Repeat the same operation for other terminal soldering.

Insulating 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.

Practice on measuring electrical parameters in circuits

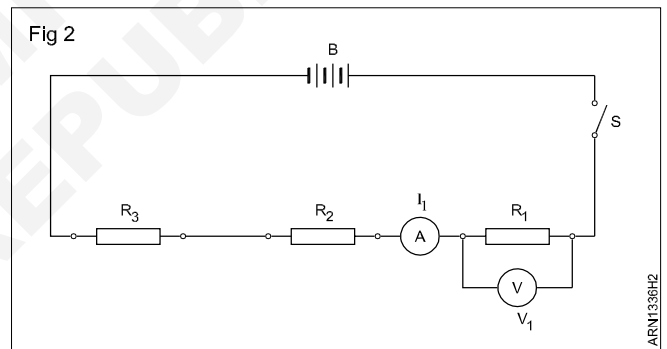
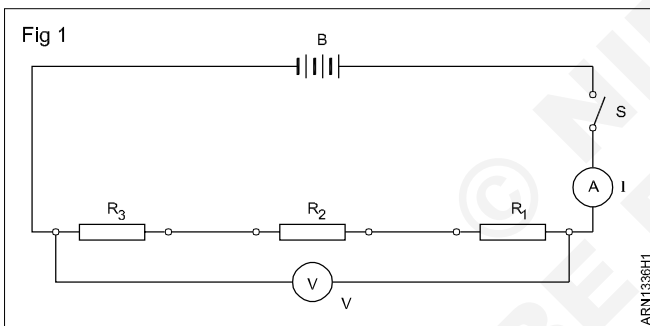
- Objectives :** At the end of this exercise you shall be able to
- construct DC series circuits and verify its characteristics
 - construct DC parallel circuits and verify its characteristics.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Wires 4mm	- as reqd.
• Ohmmeter/Multimeter	- 1 No.	• Insulation tape	- as reqd.
• Soldering iron	- 1 No.	• Soldering wire	- as reqd.
Equipments		• Flux	- as reqd.
• Circuit board	- 1 No.		
• Battery 12V, 6V	- 1 No.		

PROCEDURE

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

1 Form a circuit as shown in the 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 .

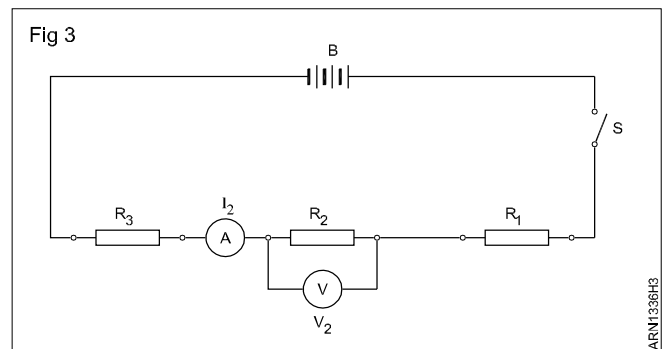


Table 1

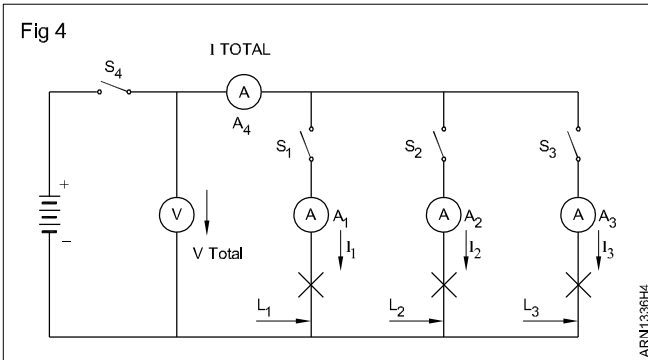
Values	Total circuit	$R_1=10$	$R_2=20$	$R_3=10$
Current	$I =$	$I_1 =$	$I_2 =$	$I_3 =$
Voltage	$V =$	$V_1 =$	$V_2 =$	$V_3 =$
Res. R=	$R = \text{_____} =$	$R_1 = \text{_____} =$	$R_2 = \text{_____} =$	$R_3 = \text{_____} =$

- Connect and measure I_3 and V_3 across R_3 .
- Enter the measured values in Table 1.

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

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

- Form the branches 1, 2, 3 by connecting the torch lamps L_1 , L_2 , L_3 (150 mA, 6v) with a holder, an ammeter A_4 (500 mA) and switch ' S_4 ' in series Fig 4.



- Connect the lamp terminals of the three branches together.
- Connect the leads of each branch together and also connect with the lead of the switch S_4 .
- Form the circuit as shown in circuit diagrams with voltmeter (V), ammeter (A_4), switch ' S_4 ' and battery.

- Close the switch ' S_4 ' and switch ' S_1 ' in branch 1.
- Read the ammeters ' A_4 ' and ' A_1 ' and record the values in Table 2.
- Close the switches ' S_4 ' ' S_1 ' and ' S_2 ' in branch 2.
- Read the ammeters ' A_4 ' ' A_1 ' and ' A_2 ' and record the values in Table 2.
- Close the switches ' S_4 ' ' S_1 ' and ' S_2 ' in branch 3.
- Read the ammeters ' A_4 ' ' A_1 ' ' A_2 ' and ' A_3 ' and record the values in Table 2.
- 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.
- 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).
- Verify the characteristics of current, voltage and resistance.

Table 2

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

Practice on continuity test of electrical circuit

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

- check the fuses of all the lighting units
- find out the open and short circuits in the lighting circuit
- use of jumper wire
- check the fusible links
- check the circuit breakers.

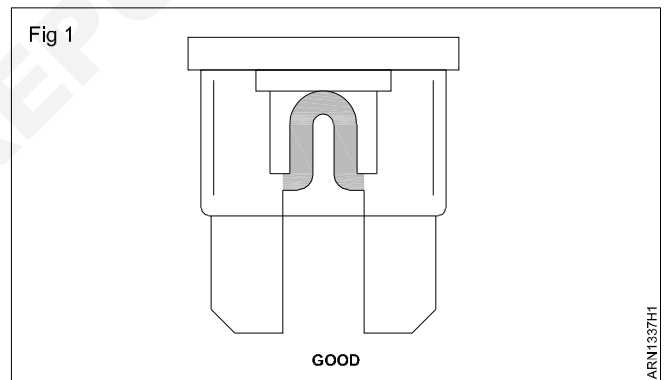
Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Auto fuses	- as reqd.
• Multimeter	- 1 No.	• Test lamp	- 1 No.
• Wire cutter	- 1 No.	• Cable/Wire	- as reqd.
Equipments		• Fusible links	- as reqd.
• Battery 12V	- 1 No.	• Circuit breaker	- as reqd.
• Vehicle	- 1 No.	• Insulation tape	- as reqd.
		• Fuse	- as reqd.

PROCEDURE

Task 1: Check the fuses of all the lighting circuits

- 1 Check the battery for its charge.
- 2 Connect the test lamp clip to a good ground.
- 3 Touch the probe of the test lamp on either end of the fuse. If the test lamp lights, the fuse is in good condition.

If the test lamp lights only while touching one side that means the fuse is defective. If the test lamp does not light even on touching both the sides that means the power source is not on or the ground connection is bad.

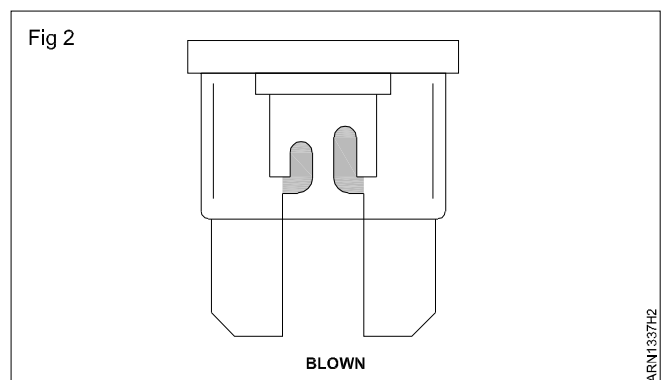


- 4 Remove the fuse from its spring clip. Check whether it is blown or not.

If it is blown we can see through the glass tube.

If the fuse is blown due to short circuit the colour of glass tube becomes black (1) and the fuse wire melts like small balls. (Fig 1)

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



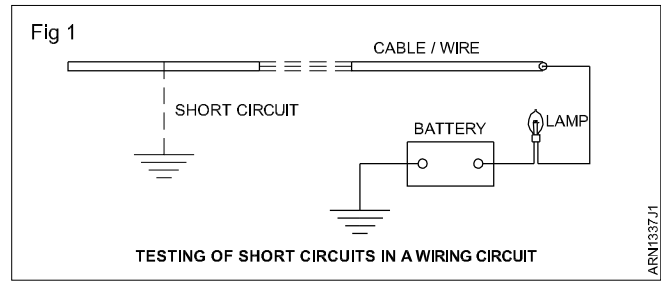
Task 2: Fine out open and short circuit in the lighting circuit

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

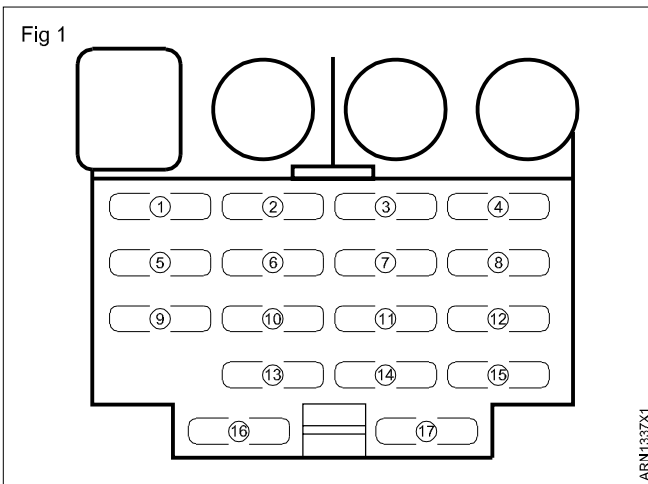
If there is an open circuit the ohmmeter reading will be more.

- 2 Trace the open circuit and rectify.
- 3 Check the wiring for short circuit with the test lamp. (Fig 1)

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



Task 3 : Identify the fuse unit in the panel board (Fig 1)



- 1 **Engine 7.5 A** : Alternator voltage regulator (IG terminal), fuel cut solenoid, intake shutter, indicator light.
- 2 **Heater 20 A** : Heater blower motor, air conditioner.
- 3 **Tail 15 A** : Instrument panel lights, license plate lights, parking lights, tail lights.
- 4 **Head (RH) 15 A** : High beam indicator light, right hand headlights.

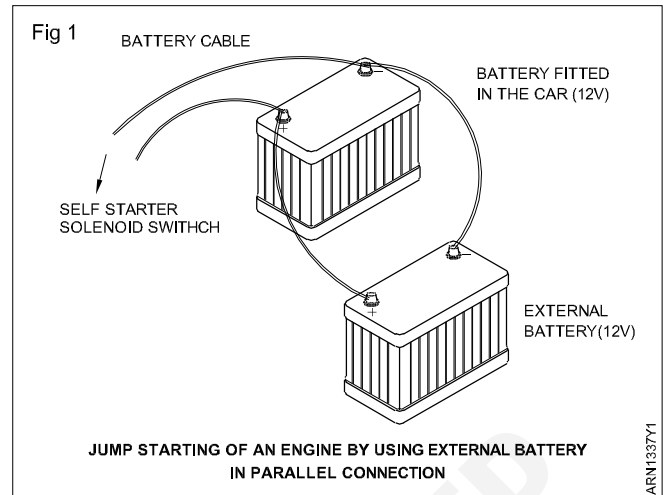
- 5 **Charge 7.5 A** : Alternator voltage regulator, (L terminal), discharge warning light.
- 6 **AC 20 A** : Air conditioner.
- 7 **HAZ-HORN 15 A** : Emergency flashers, emergency flasher indicator lights, horn, turn signal indicator lights, turn signal lights.
- 8 **Head (LH) 15 A** : High beam indicator light, left hand head lights.
- 9 **CIG 15 A** : Cigarette lighter, clock digital type.
- 10 **Wiper 15 A** : Windshield wipers and washer.
- 11 **Stop 15 A** : Stop light
- 12 **Radio 7.5 A** : Radio, stereo cassette tape player
- 13 **Gauge 7.5 A** : Back-up lights, engine temperature gauge, fuel gauge, warning lights, warning buzzers.
- 14 **Dome 7.5 A** : Clock (digital type), interior light.
- 15 **16 7.5 A and 15 A** : Spare fuses
- 16 Write the name of the parts in the Table 1.

Table 1

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

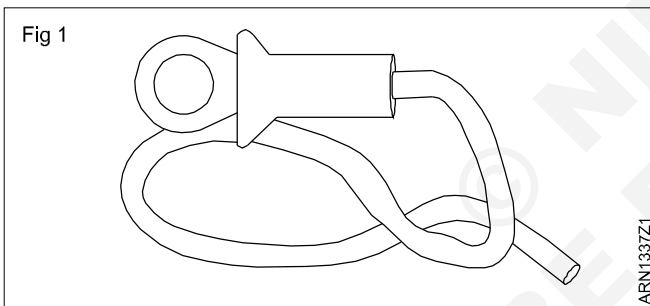
Task 4 : Jumper Wire

- 1 Park the vehicle, on level ground and apply hand brake.
- 2 Open the bonnet and secure with the holding lever.
- 3 Place the fully charged battery adjacent to the vehicle discharge battery.
- 4 Connect the two battery terminal in parallel by using jumper wire cables as shown in Fig 1.
- 5 Start the vehicle run for some times.
- 6 Disconnect the jumper cables from the vehicle battery terminal.
- 7 Now the vehicle will run with its own battery.
- 8 Close the bonnet, securely.



Task 5: Checking of fusible link

- 1 Visually inspect the fusible link for burnout, disconnect, and damaged.
- 2 Check with the multimeter for continuity test.
- 3 Replace the fusible link if damaged, burnout or disconnected.



Replacing fusible links (Fig 1) is little bit complex than simply pulling a fuse, since they are bolted in place and are sometimes difficult to reach.

Using the right tools and finding the blown fusible link location is important.

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

Never replace fusible link with normal electrical wire.

Test voltage drop in a circuit

Objective: At the end of this exercise you shall be able to
 • test voltage drop in a circuit.

Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Battery	- 1 No.
• Voltmeter MC 0 - 300 V	- 1 No.	Materials	
• Multimeter	- 1 No.	• Fuse	- as reqd.
Equipments		• Switch	- as reqd.
• Vehicle	- 1 No.	• Cable/Wire	- as reqd.
• Auto electrical wiring circuit board	- 1 No.		

PROCEDURE

Voltage Drop Test in Head light circuit

- 1 Clean all the terminals, connectors in the auto electrical wiring circuits
- 2 Check, whether battery is fully charged condition.
- 3 Connect the multimeter at shown in Fig 1 in the auto electrical wiring circuit.
- 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 exceed 0.2 V.
- 8 Select a low scale on the voltmeter.

Measuring voltage drop in head light circuit

- 1 Connect the voltmeter across the part of the circuit in which high resistance is suspected.
- 2 Measure the voltage drop across the HL ground.
- 3 Connect the voltmeter positive lead to the HL ground and Negative lead to the -ve terminal of battery. (Fig 2)
- 4 Measure the voltage drop shown in meter.
- 5 Compare the measured value with the rated value.
- 6 Replace, Clean and reconnect the lead if the voltage drop excel W o.2 Volt.
- 7 Repeat the same volt drop test task to check the voltage drop in all the other Electrical accessories.

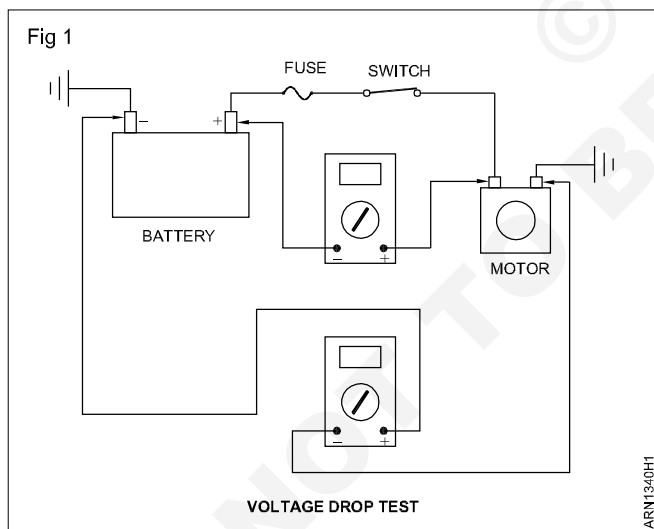
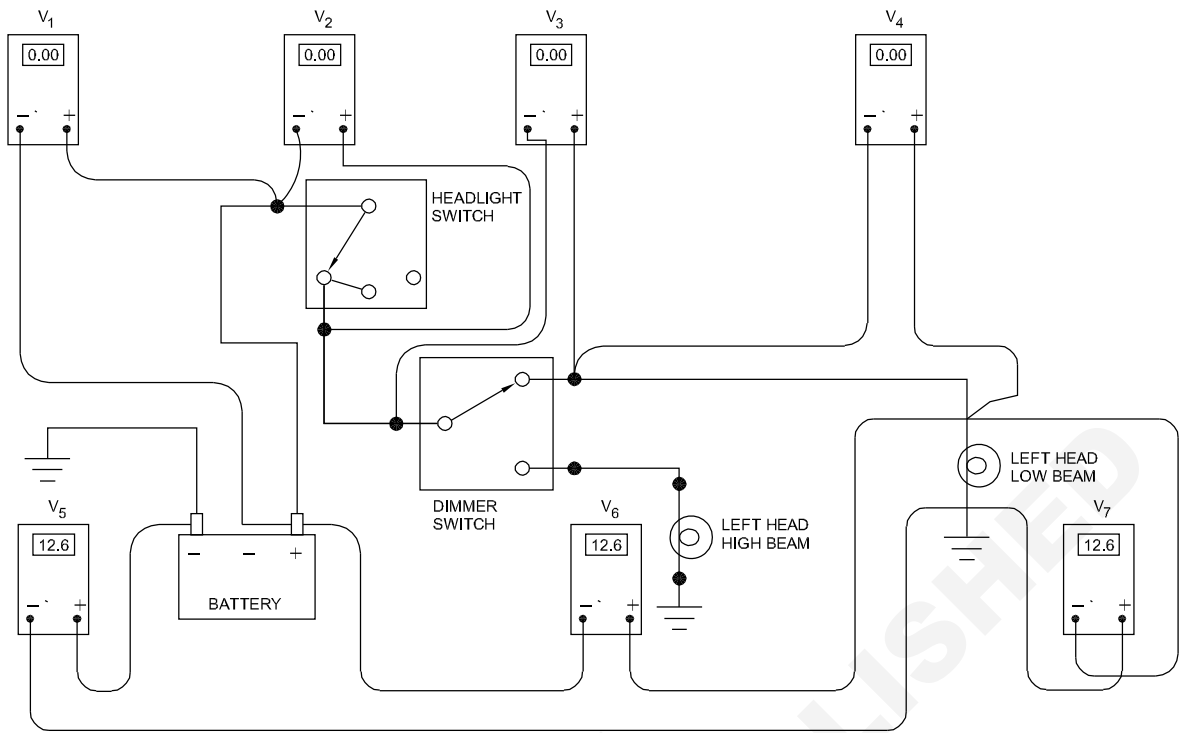


Fig 2



MEASURING VOLTAGE DROP IN A HEADLIGHT CIRCUIT

ARN13/0H2

Identification of Hydraulics and pneumatic components of vehicle

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

- identify the hydraulic clutch components in a vehicle
- identify the components of pneumatic brake system in a vehicle.

Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Pneumatic brake	- 1 No.
Equipments		Materials	
• Vehicle	- 1 No.	• Hydraulic oil	- as reqd.
• Hydraulic clutch vehicle	- 1 No.	• Cotton waste	- as reqd.
		• Soap oil	- as reqd.

PROCEDURE

Task 1 : Identify the hydraulic clutch components on a vehicle

- 1 Place the vehicle on the level ground.
- 2 Support the vehicle tyre with stoppers (wooden block)
- 3 Apply hand brake.
- 4 Open the bonnet.
- 5 Remove the negative battery cable.
- 6 Trace the hydraulic clutch system and locate the components i.e. Master cylinder reservoir, Master cylinder, Slave cylinder, Hydraulic lines and Throw-cut lever.
- 7 Identify the parts in the system as shown in Fig 1.
- 8 Write the name of the parts in the Table 1.

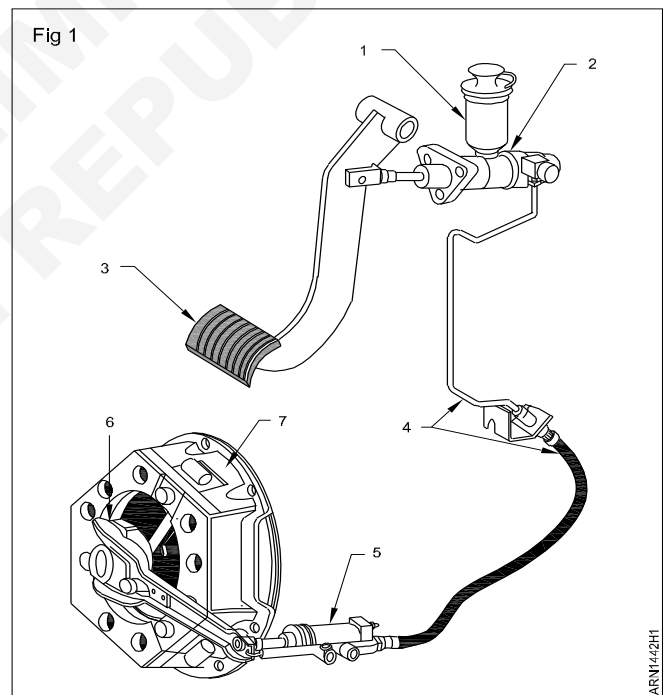


Table 1

Sl. No	Label No	Name of the Parts
1	2	
2	5	
3	4	
4	1	
5	3	

Task 2 : Tracing the pneumatic components of a vehicle

- 1 Identify the air compressor in the Fig 1 which provide compressed air.
- 2 Locate air tank , which receives the compressed air from air compressor.
- 3 Locate unloader valve which unloads the excess air, as air pressure setting is reached in air tank.
- 4 Identify the brake valve which permits air flow, setting to front and rear brake chambers when brake pedal is pressed.
- 5 Locate 2 front brake chambers and 2 rear brake chambers which pushes slack adjuster for application of front & rear brake.
- 6 Locate the slack adjusters, for front & rear breaker.
- 7 Layout diagram of air brake system.
- 8 Identify air pressure gauge, which is indicate the pressure of air, in the air tank.
- 9 Write the parts name of pneumatic brake system in the Table 2

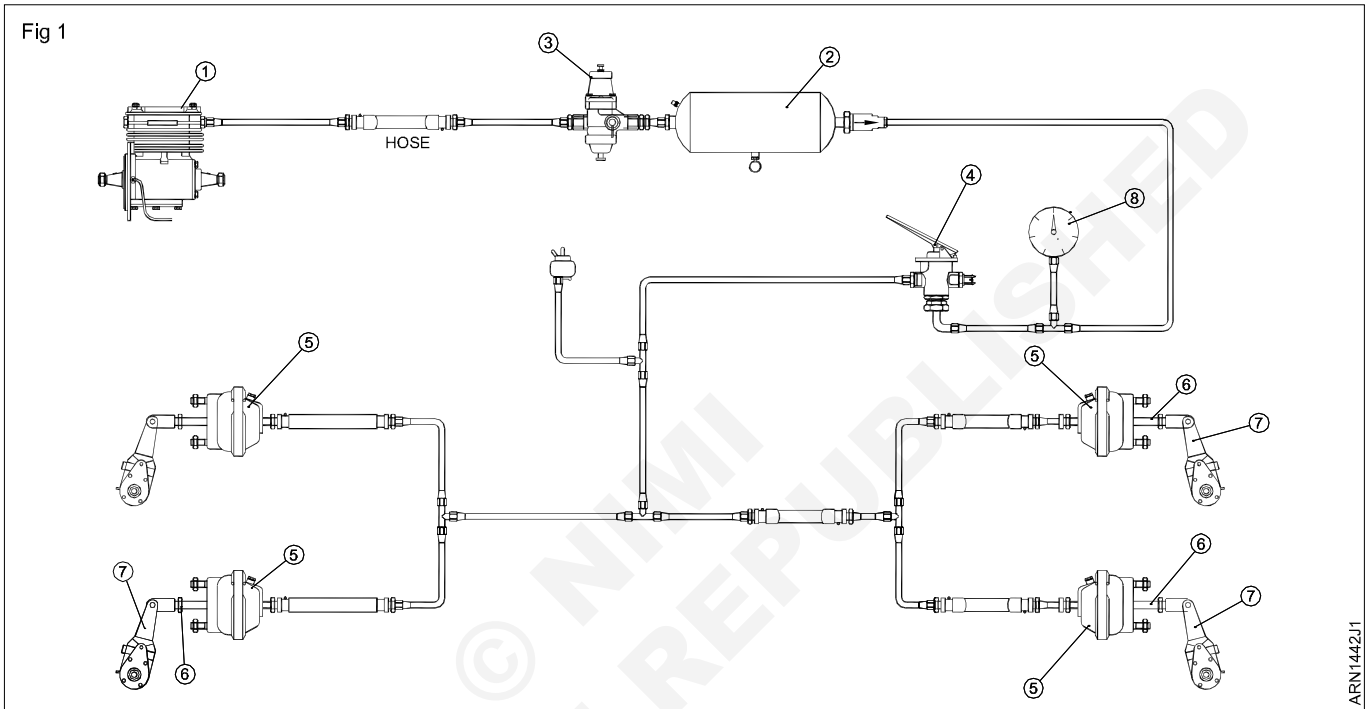


Table 2

SI. No.	Name of the Parts	Location
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Identify the different types of vehicle

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

PROCEDURE

1 Identify the following vehicle (Fig 1).

- a Car
- b Truck punjab body or straight truck
- c Truck half body
- d Truck Flatform type
- e Tractor
- f Tractor with articulated trailer

- g Tanker
- h delivery van
- i Dipper truck
- j Station wagon
- k Pick up
- l jeep

2 Write the name of the vehicle in Table 1.

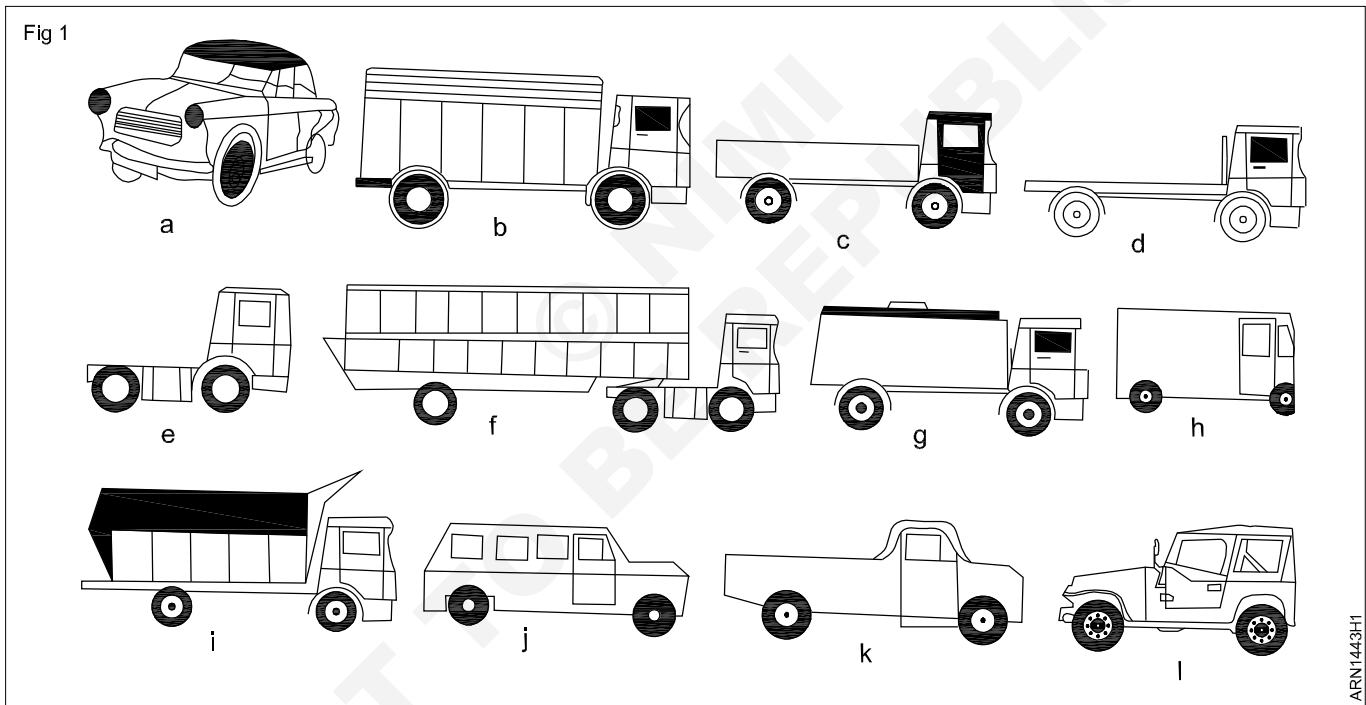


Table 1

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

Mechanic Auto Body Repair - Hydraulics, Pneumatics and Auto Industry Development

Studying vehicle specification data

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

- identify the parts of the vehicle
- check the specification of the parts as per vehicle specification data.

Requirements			
Tools/Instruments		Equipment	
• Trainee's tool kit	- 1 No.	• Vehicle	- 1 No.
• Compression gauge	- 1 No.	Materials	
• Measuring tape	- 1 No.	• Cotton waste	- as reqd.
• Vacuum gauge	- 1 No.	• Engine oil	- as reqd.
• Bore dial gauge	- 1 No.	• Hydraulic fluid	- as reqd.
• Hydro meter	- 1 No.	• Soap oil	- as reqd.
• Voltage tester	- 1 No.		

Note : Instructor demonstrate of vehicle specification

Mahindra Balero GLX

Engine	XD-3PFI Diesel		
Type	4-stroke oversquare, 4-cylinder, in line		acting telescopic shock absorber and anti roll bar
Bore	94.0 mm		4WD : Semi-elliptical leaf type, stabilizer bar at front
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)	Rear	Semi-elliptical leaf type
Max. Gross Torque	15.3 kg-m at 2000 R.P.M	Frame	Rectangular tubular section 5 intermediate cross members (6 for IFS). Rear bumper
Fuel Injection System	Distributor pump	Steering	Power steering - worm & roller type with universal joints.
Weight of Engine (dry)	200 kg with flywheel and starter	Turning Radius	5.4 mts.
Cooling System	By Belt driven pump on cylinder head, thermostat controlled	Clutch	Hydraulic, single dry plate 235mm (9.25" dia)
Transmission	5-speed, All synchromesh	Brakes	
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	Type	Hydraulic with tandem master cylinder with vacuum assisted servo
Transfer Case	For 4WD only	Front	13 mm disc and calliper type
Ratios	High - 1 : 1, Low - 2.48 :1	Rear	Drum : 27.4 x 50.8 mm (11" x 2")
Suspension		Parking	Internal expanding type on rear wheels. Hand lever and cable type.
Front	2WD : Independent, Coil Spring, Double		

Axle		Wheels and Tyres	
Front	IFS-2WD: Stub Axle 4WD : Full flating hypoid type	Wheels	Rim size 6J x 15
Capacity/Ratio	1000 kg / 4.88 : 1	Tyre	P215 / 75 R 15 radial
Rear	Full floating hypoid type	Fuel System	
Capacity/Ratio	1700 kg / 4.88 : 1	Capacity	60 litres fitted with electrical float unit
Electricals		Weights	
Battery	12 volts, negative earth	Kerb weight	1615 kg (2 WD) 1695 kg (4 WD)
Capacity	70 amp. hr	G.V.W.	2200 kg (2 WD) 2280 kg (4 WD)
Alternator	65 amp. with built-in regulator and vacuum pump		
Drive	Belt drive		
		Identify the vehicle parts and check the specification of parts under guide line of instructor.	

- 1 Part the vehicle on the shop floor.
- 2 Identify the engine type and compare with vehicle specification data.
- 3 Count the engine cylinder of the vehicle.
- 4 Identify the chassis type of the vehicle.
- 5 Identify the vehicle drive type of the vehicle.
- 6 Identify the vehicle brake type of the vehicle.
- 7 Identify the steering type of the vehicle.
- 8 Identify the fuel system of the vehicle.
- 9 Identify the vehicle transmission type.
- 10 Identify the vehicle body type.
- 11 Identify the vehicle body paint type.
- 12 Identify the suspension type of the vehicle.

Mechanic Auto Body Repair - Hydraulics, Pneumatics and Auto Industry Development

Identification of Vehicle Information Number (VIN)

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

- identify the vehicle of identification number specification.

Requirements			
Tools/Instruments		Materials	
• Measuring Tape	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Paper	- as reqd.
• Car	- 1 No.	• Pencil	- 1 No.
		• Eraser	- 1 No.

General information for VIN

Vehicle Identification Number (VIN) is composed of 17 digits and classified into three large groups such as WMI, VDS and VIS. Example:- MALBB5 IBC AMI 73752.

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

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

Note: Vehicle code may be vary depend upon manufacturer

- Check the VIN number in your institute vehicle under guide line of your 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

Practice on garage service station equipments

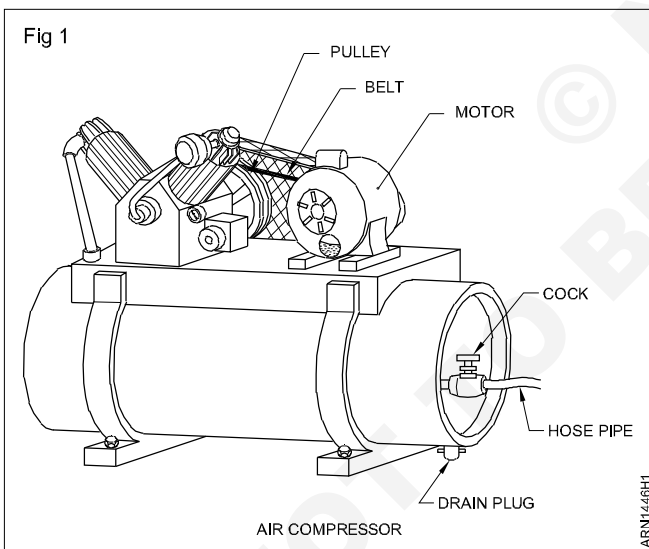
Objectives : At the end of this exercise you shall be able to

- operate the air compressor
- operate the hydraulic car hoist
- operate a car washer
- operate a grease gun and an oil spray gun
- operate the mechanical press and hydraulic press.

Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Air compressor	- 1 No.
• Measuring Tape	- 1 No.	• Grease gun	- 1 No.
Equipments			
• Car	- 1 No.	• Cotton waste	- as reqd.
• Hydraulic car hoist	- 1 No.	• Soap oil	- as reqd.
• Arbor press	- 1 No.		

PROCEDURE

Air compressor (Fig 1)



- 1 Check the oil level.
- 2 Check the belt's (1) tension connecting the motor (2) and the compressor's pulley (3).
- 3 Ensure that the belt guard is fixed in its position.
- 4 Drain the water through the drain plug (4) and tighten the drain plug.
- 5 Inspect the electrical connections visually for looseness, disconnections or cuts.
- 6 Switch 'on' the compressor
- 7 Observe the sound of the compressor. If any abnormal sound is found, stop the compressor immediately. (Consult your instructor)
- 8 Switch 'off' the compressor.
- 9 Hold the hose-pipe (5) and open the cock (6). Use compressed air wherever needed.
- 10 Close the cock after using the compressed air.

Skill Sequence

Hydraulics car hoist

Objectives: This shall help you to

- operate service station equipments.

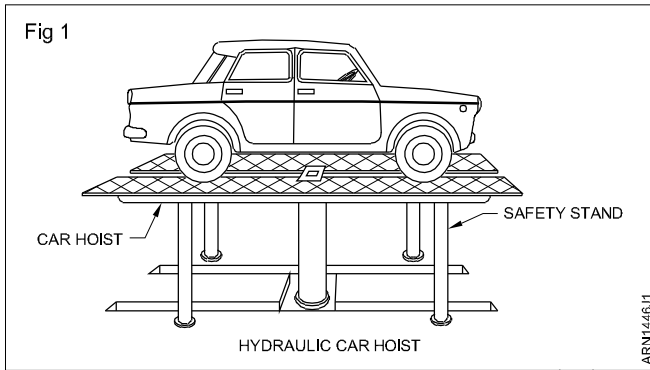
Hydraulic car hoist (Fig 1)

Park the vehicle in the centre of the car hoist.

Clamp the front and rear axle or check wheels.

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

Close the cock when it reaches the required height.



Provide safety stands (2) underneath the hoist. Open the outlet cock slowly so that the vehicle moves down without jerk. Ensure that the hoist side rail sits firmly on the stand.

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

Remove the safety stands.

Ensure that nobody is present underneath the vehicle.

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

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

Car washer

Check the oil level.

Check the belt tension.

Check the belt guard for its position.

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

Open the water tank.

Check the water level.

Hold the gun before starting the car washer.

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

Open the water gun.

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

After completing the cleaning, stop the car washer.

Close the water intake cock (water supply).

Grease gun (Fig 2)

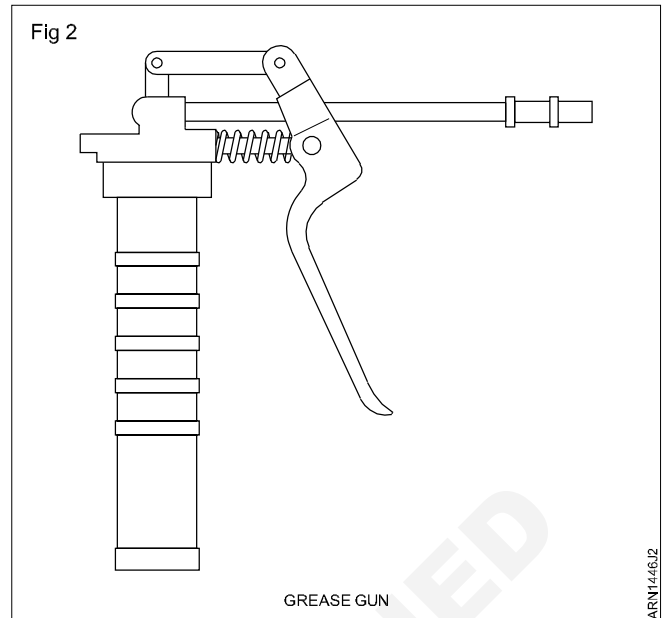
Select the grease gun nipple according to the vehicle. (Consult your instructor)

Check visually, the grease nipple holder for any damage.

Fill up the gun with the specified grease.

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

Use the gun for the required purpose.



Oil spray gun

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

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

Connect the oil spray gun to the quick release coupler.

Operate the oil spray gun.

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

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

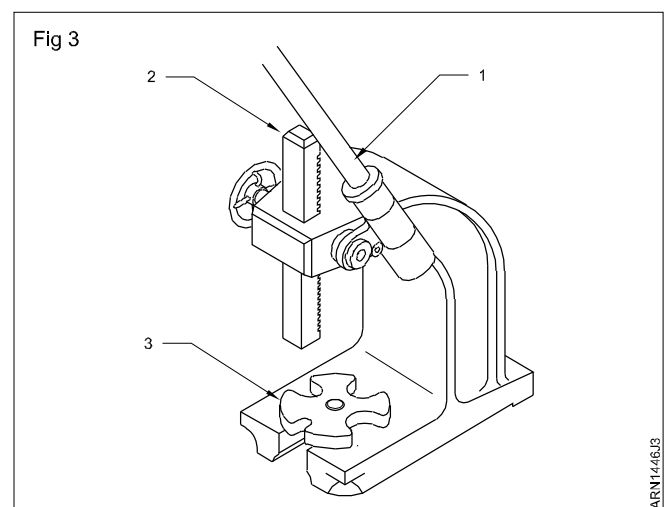
Arbor press (Fig 3)

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

Select the plate (3) according to the work.

Place the component on the plate.

Press the work slowly and listen for abnormal noise.

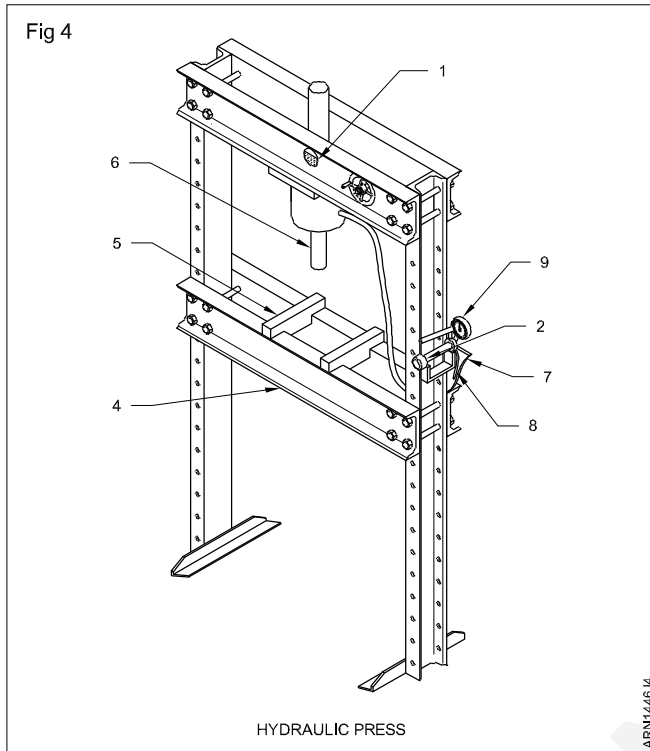


Hydraulic press (Fig 4)

Clean the press.

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

Check the hydraulic press for its free function and leakage.



Lock the cylinder plunger releasing knob (2).

Adjust the bed (4) to the required height so that, after placing the job, there will be 100mm clearance between the plunger (6) and the bed (4).

Align the anvil (5) according to the job.

Place the job on the anvil (5).

Select the distance piece in such a way that while pressing the shaft/bush, it does not touch the body (minimum 10mm gap to be given between the plunger (6) and the distance piece)

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

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

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

If the load exceeds more than the specified limit, stop the pressing.

Safety

- Shield brittle parts such as bearings to protect against flying parts.
- After finishing the work loosen the plunger releasing knob (2).
- Remove the job and clean.

Practice on garage equipments

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

- operate the two post hoist
- operate the four post hoist
- operate the engine hoist
- operate the mechanical and hydraulic jacks
- operate the stands.

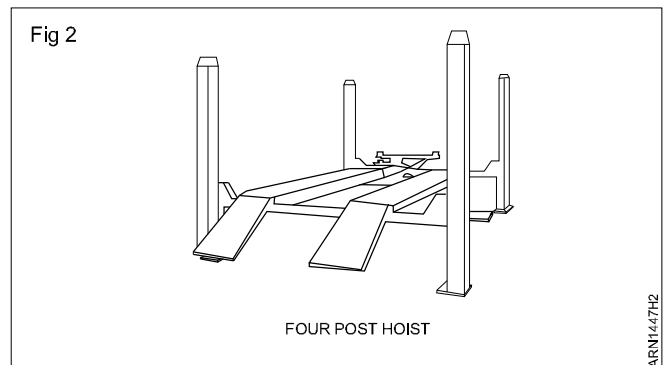
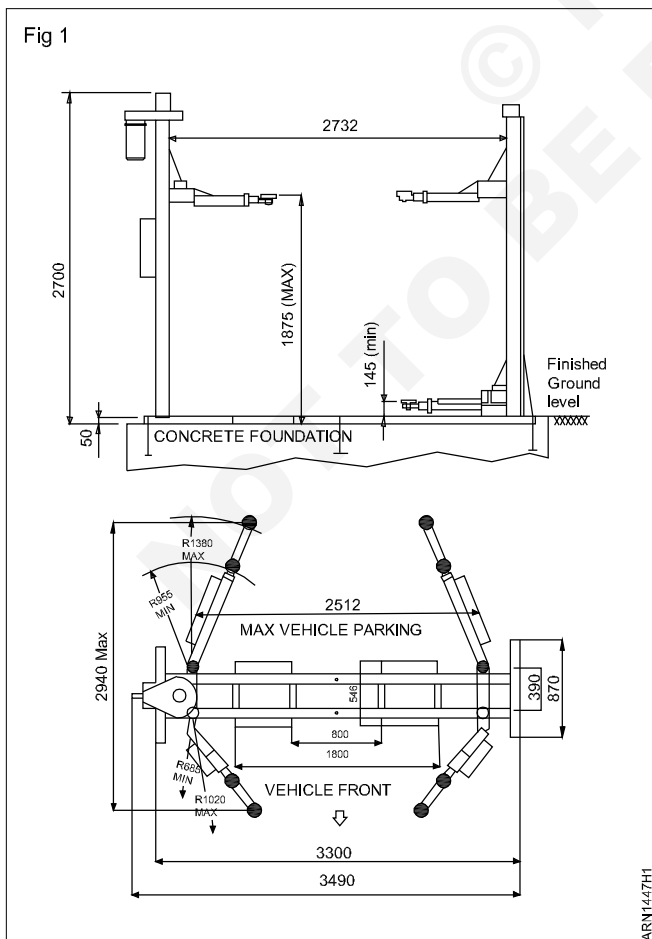
Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Stand	- 1 No.
Equipments			
• Two post hoist	- 1 No.	• Cotton waste	- as reqd.
• Four post hoist	- 1 No.	• Hydraulic oil	- as reqd.
• Jack	- 1 No.	• Soap oil	- as reqd.

PROCEDURE

Two post lift hoist (Fig 1)

1 Park the vehicle in the centre of the electro mechanical hoist.

- 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).



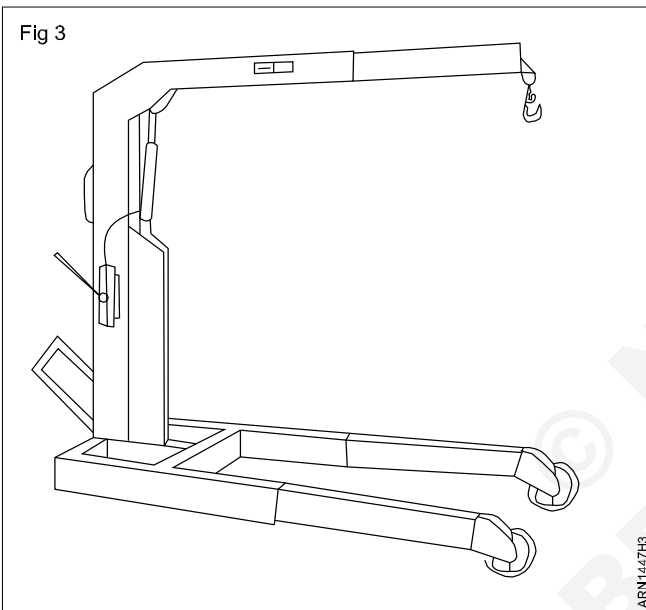
Four post lift

- 1 Drive the vehicle on the leveled ramp of the four post lift.
- 2 Check the vehicle parked correctly are not on the 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.

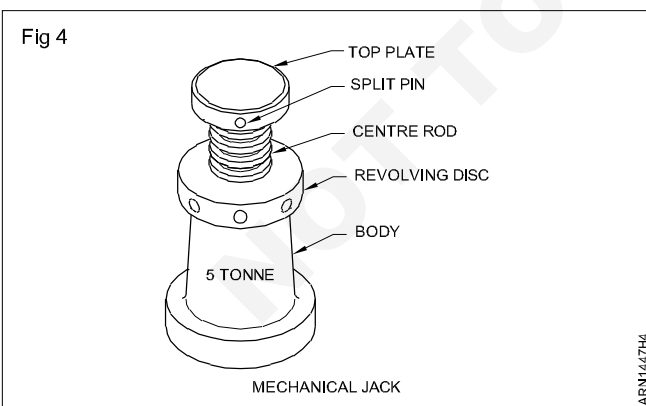
- 5 Offering pull range mechanical protection by using safety block
- 6 Connected by using steel cables, Forced synchronized movement of the lift in order to effectively prevent the sloping of the vehicle
- 7 4 Ton with extended run way length for LCV & Bigger vehicle.

Engine hoist (Fig 3)

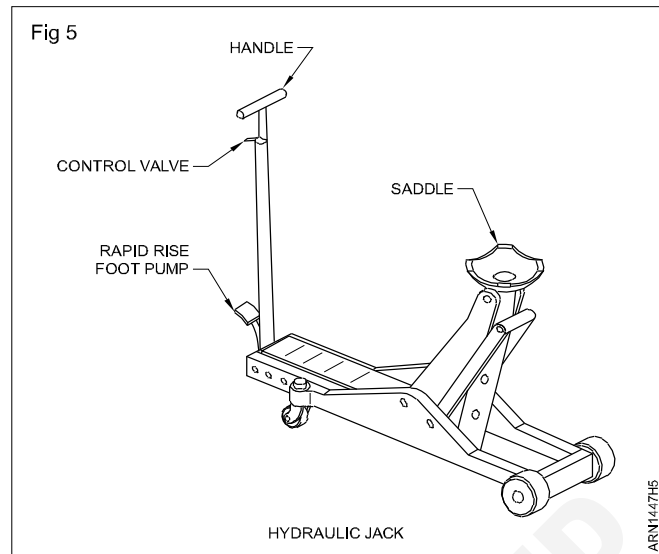
- 1 Keep the vehicle on level ground.
- 2 If firm ground is not there use big wooden block under the base of hoist.
- 3 Pull up hand brake lever of vehicle.
- 4 Place the hoist on firm ground & fix a rope to such part of engine.
- 5 Lift the hoist slowly till free from the vehicle.
- 6 Slowly role the wheel hoist and lake hoist to work shop. (Fig 3)



Mechanical jack (Fig 4)/Hydraulic jack (Fig 5)



- 1 Park the vehicle on level ground.
- 2 In case of jacking up the front axle, chock the rear wheels and vice versa.
- 3 Check the free movements of threads in a mechanical jack by hand and in the hydraulic jack. Check the oil level and its operations.



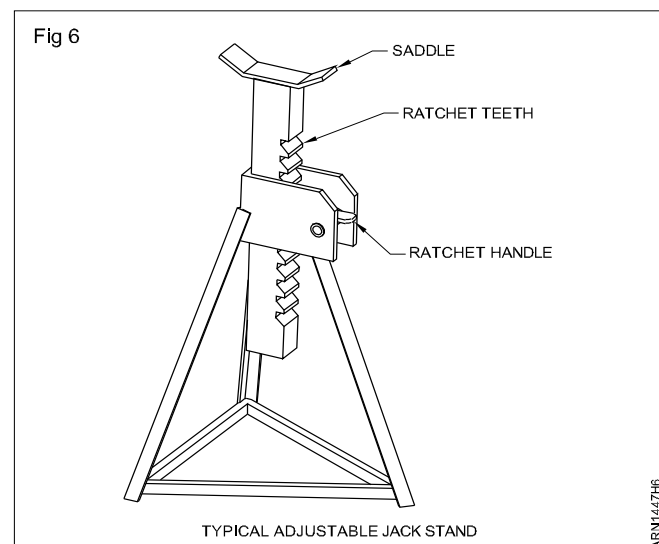
- 4 Place the jack under the vehicle in specified place.
- 5 Rotate the screw gradually with the jack lever and lift the vehicle and in the case of hydraulic jack move the jack's lever slowly so that the axle jacks up without any jerk.
- 6 Place the support/horses below the chassis frame/ axle.
- 7 Lower down the jack and remove it.
- 8 After completing the specific job jack up again.
- 9 Remove the support/horses.
- 10 Lower down the jack and remove it.

Safety

- Never work under a vehicle supported by a floor jack only .
- Lift saddles must be properly located and in secured contact.
- Always check for equipments, parts or personnel beneath the car before lowering.

Jack stand (Fig 6)

- 1 The height of the jack stand is adjusted by the ratchet adjustment.
- 2 Stands must be properly and securely placed.



Practice on preparation of vehicle accident report

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

- preparation of accident report.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Soap oil	- as reqd.
• Vehicle	- 1 No.	• Paper A4 sheet	- as reqd.
		• Pen/Pencil	- as reqd.

PROCEDURE**Preparation of vehicle accident report**

- 1 Prepare the accident report forms as per given format.
- 2 Visually inspect the accident spot.
- 3 Find the cause for an accident.
- 4 Find the type of accident.
- 5 List out the damaged and injured parts of person and vehicle.
- 6 List out the damaged tools and machineries parts.
- 7 Note the time of accident and collect details of accident.
- 8 Check the first aid kit is available in that section.
- 9 Fill the accident form.
- 10 Once again go through the accident form whether complete details are filled in an accident report form.
- 11 Submit the accident report to higher official to take necessary action.

Mechanic Auto Body Repair - Vehicle Construction Technology and Compressor Air System

Practice on prepare the body shop repair sequence of a vehicle

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

- prepare the vehicle
- prepare the body shop
- repair the vehicle in sequence procedure
- wash the vehicle.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Soap oil	- as reqd.
• Vehicle	- 1 No.		

PROCEDURE

Task 1: Washing of vehicle

- 1 Brought up the vehicle to the repair shop.
- 2 Place the vehicle on wash up area.
- 3 Clean the vehicle with soap and water.
- 4 Wiping the body down with wax and grease remover.
- 5 Remove mud, wax and water soluble contaminants.
- 6 Remove unwanted substances.
- 7 Remove the paint on damaged area.
- 8 Vehicle should be dry before being moved to the vehicle repair area.

Task 2: Body shop basic repair sequence of a vehicle

- 1 Clean the vehicle before moving it into repair area.
- 2 Study the repair order and vehicle damage to determine repair procedure.
- 3 Remove the damaged nut, bolt of a vehicle body.
- 4 Measure the damaged area and mark it on the vehicle body.
- 5 Straighten frame/ unibody damage on frame rack.
- 6 Replace the damage welded parts of frame.
- 7 Straighten the minor body damage with help of special tools recommended by manufacturers.
- 8 Sanding the damage marked area and apply body filler coarse the repair area.
- 9 Apply the primer filler around body damaged area.
- 10 Fine sanding the repair area and all parts to be refinished.
- 11 Mask the areas not to be painted.
- 12 Clean surfaces to be painted.
- 13 Refinish (primer, sealer, paint) the damaged body parts.
- 14 Detail the vehicle (unmask, clean and polish) as needed.

Identification of different type of body chassis and drive lines

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

- identify the different type of vehicle body
- identify the different types of chassis and drive lines.

Requirements	
Tools/Instruments	
• Trainee's tool kit	- 1 No.
• Vehicle chart	- 1 No.
Equipments	
• Vehicle body different type (each)	- 1 No.
• Vehicle chassis different type (each)	- 1 No.
• Vehicle drive line different type	- 1 No.
Materials	
• Cotton waste	- as reqd.
• Soap oil	- as reqd.

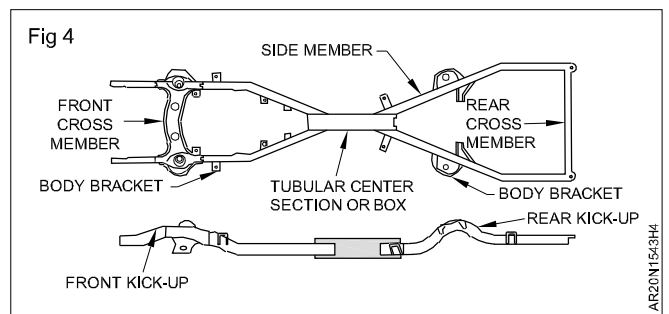
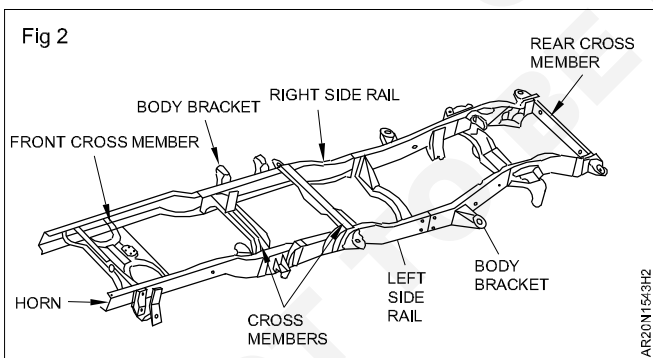
PROCEDURE

Task 1: Identification of different type of vehicle body

- 1 Layout the different type of vehicle body
- 2 Compare the vehicle bodies with vehicle body chart.
- 3 Identify the vehicle bodies as per sequence of chart. (Fig 1)

Task 2: Identify the different type of vehicle chassis

- 1 Identify the truck chassis (Fig 2).
- 3 Identify the 'X' frame chassis (Fig 4).



- 2 Identify the torque box type chassis (Fig 3).

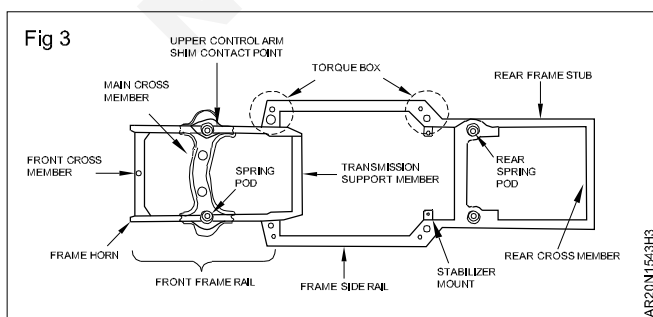
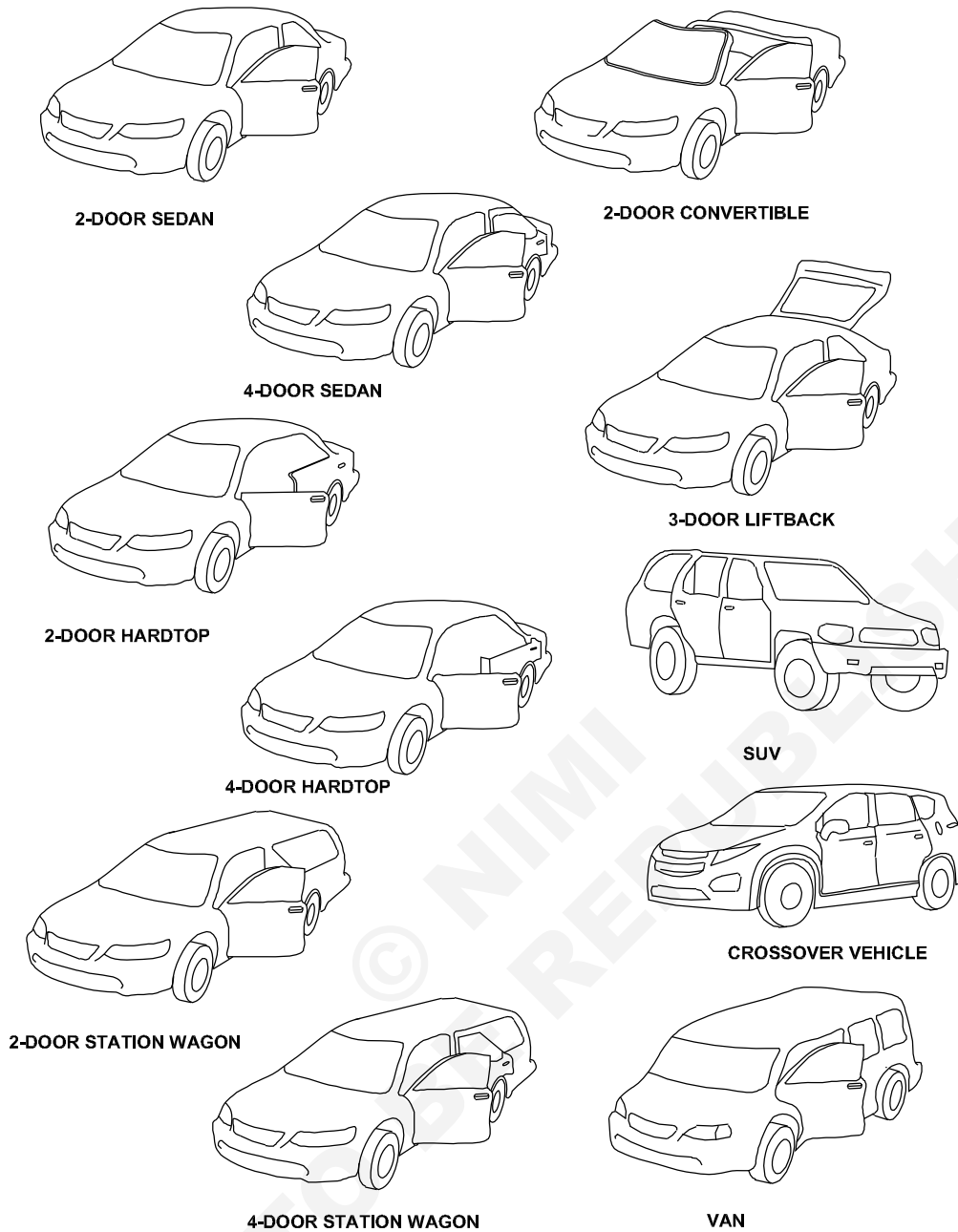


Fig 1

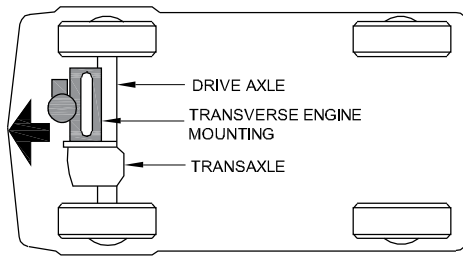


AR20N15/3H1

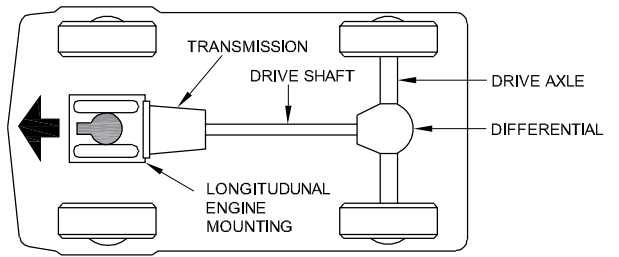
Task 3: **Identify the different type of drive line (Fig 1)**

- 1 Identify the front engine front wheel drive (transverse engine)
- 2 Identify the front engine front wheel drive (longitudinal engine)
- 3 Identify the rear wheel drive
- 4 Identify the mid-engine rear wheel drive

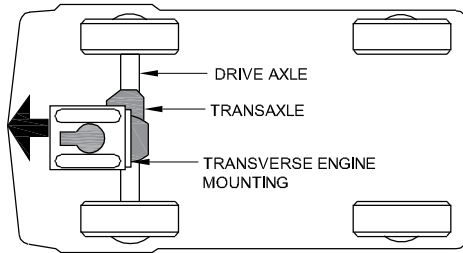
Fig 1



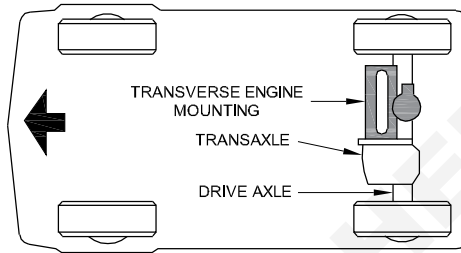
(a) FRONT-ENGINE,FRONT-WHEEL DRIVE
(TRANSVERSE ENGINE)



(c) FRONT-ENGINE,REAR-WHEEL DRIVE



(b) FRONT-ENGINE,FRONT-WHEEL DRIVE
(LONGITUDINAL ENGINE)



(d) MID-ENGINE,REAR-WHEEL DRIVE

AR201543J1

Practice on identify the location of vehicle parts and panels

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

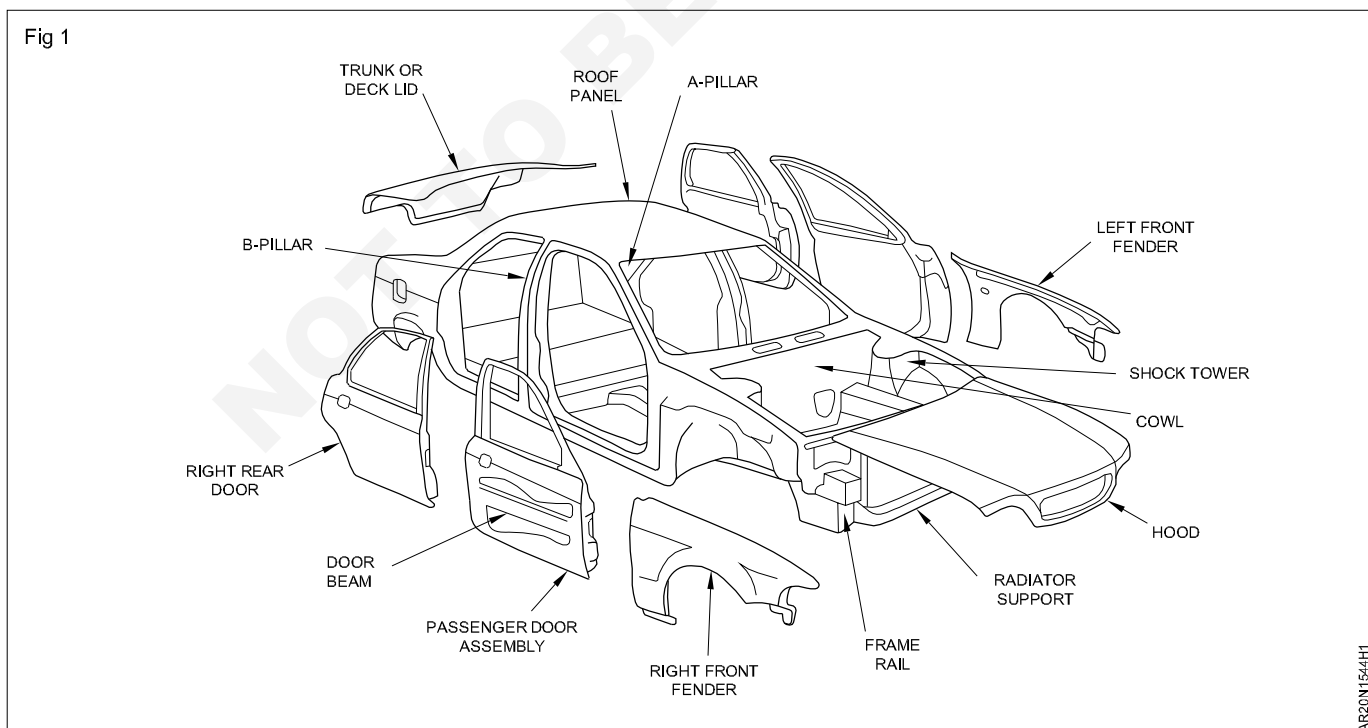
- identify the vehicle unibody parts
- identify the vehicle unibody panels.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Vehicle chart	- 1 No.	• Soap oil	- as reqd.
Equipments			
• Vehicle	- 1 No.		

PROCEDURE

Task 1: Identify the vehicle parts (Fig 1)

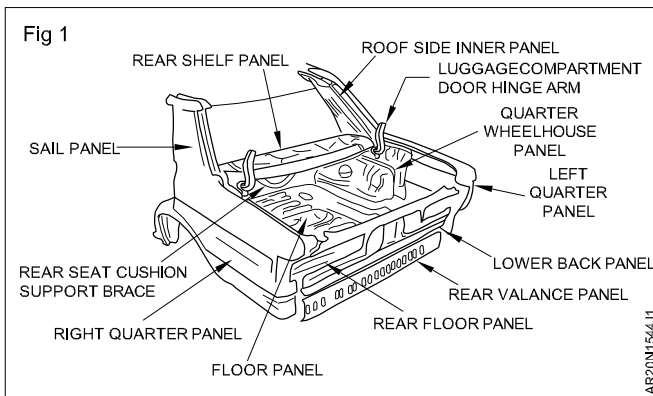
- 1 Identify and locate the hood.
- 2 Identify and locate the cowl
- 3 Identify and locate the shock tower
- 4 Identify and locate the left front fender
- 5 Identify and locate the A-pillar
- 6 Identify and locate the deck lid.
- 7 Identify and locate the B-pillar.
- 8 Identify and locate the right rear box.
- 9 Identify and locate the door beam
- 10 Identify and locate the passenger door assembly.
- 11 Identify and locate the right front fender
- 12 Identify and locate the frame rail.
- 13 Identify the radiator support.
- 14 Identify the roof panel.



Task 2: Identify and locate the vehicle panels (Fig 2)

- 1 Locate the roof panel.
- 2 Locate the cowl top panel.
- 3 Locate the rear quarter panel.

- 4 Locate the dash panel
- 5 Locate the rear valance panel
- 6 Locate the lower back panel
- 7 Locate the left quarter panel
- 8 Locate the quarter wheel house panel
- 9 Locate the roof side panel
- 10 Locate the rear shelf panel.
- 11 Locate the sail panel
- 12 Locate the right quarter panel.
- 13 Locate the rear floor pan.



© NIMI
NOT TO BE REPUBLISHED

Practice on identify the parts of unibody design vehicle

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

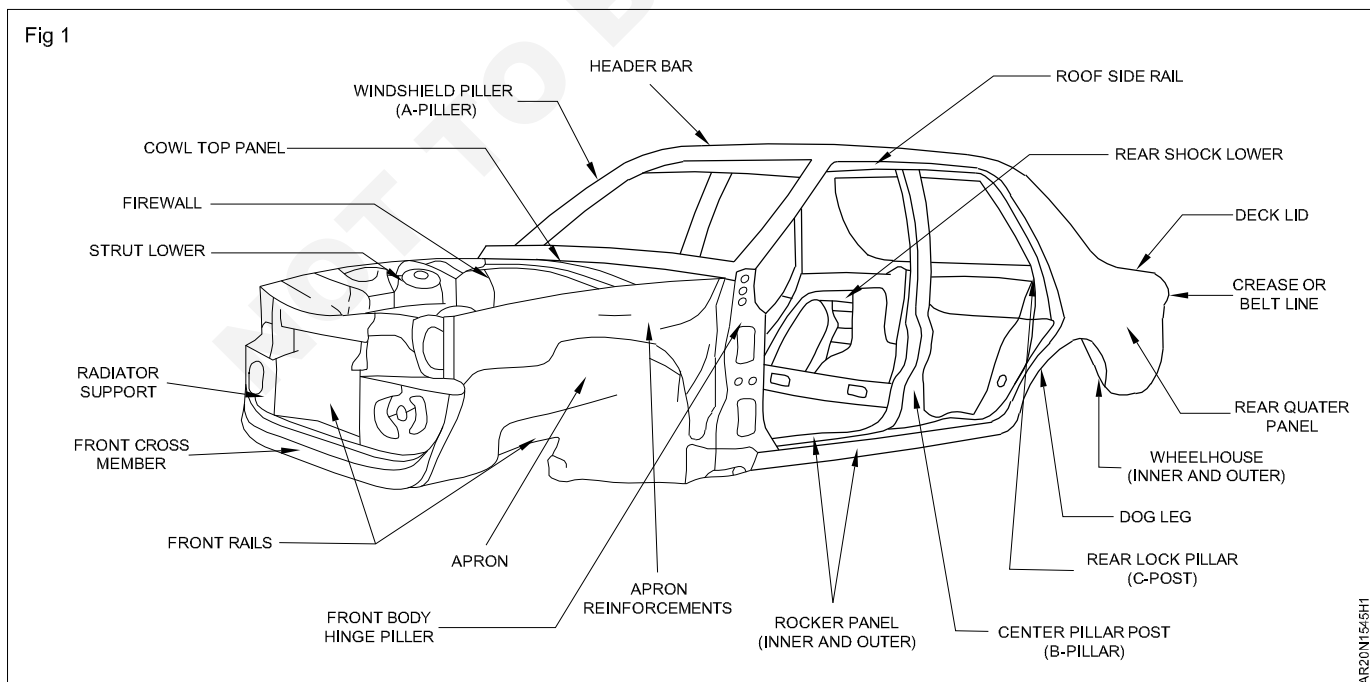
- identify the parts of unibody vehicle.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Vehicle chart	- 1 No.	• Soap oil	- as reqd.
Equipments			
• Vehicle	- 1 No.		

PROCEDURE

Identify and locate the unibody vehicle parts (Fig 1)

- | | |
|---------------------------------------|--|
| 1 Locate the roof side rail | 12 Locate the apron reinforcements |
| 2 Locate the header bar | 13 Locate the rocker panel. |
| 3 Locate the wind shield pillar | 14 Locate the center pillar post. |
| 4 Locate the top panel | 15 Locate the rear lock pillar |
| 5 Locate the fire wall | 16 Locate the dog leg. |
| 6 Locate the strut tower | 17 Locate the wheel house inner and outer. |
| 7 Locate the radiator support | 18 Locate the rear quarter panel |
| 8 Locate the front cross member | 19 Locate the crease or belt line |
| 9 Locate the front rails | 20 Locate the deck lid |
| 10 Locate the apron | 21 Locate the shock tower. |
| 11 Locate the front body hinge pillar | |



Mechanic Auto Body Repair - Vehicle Construction Technology and Compressor Air System

Practice on identify the front and rear body structural components of unibody sedan

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

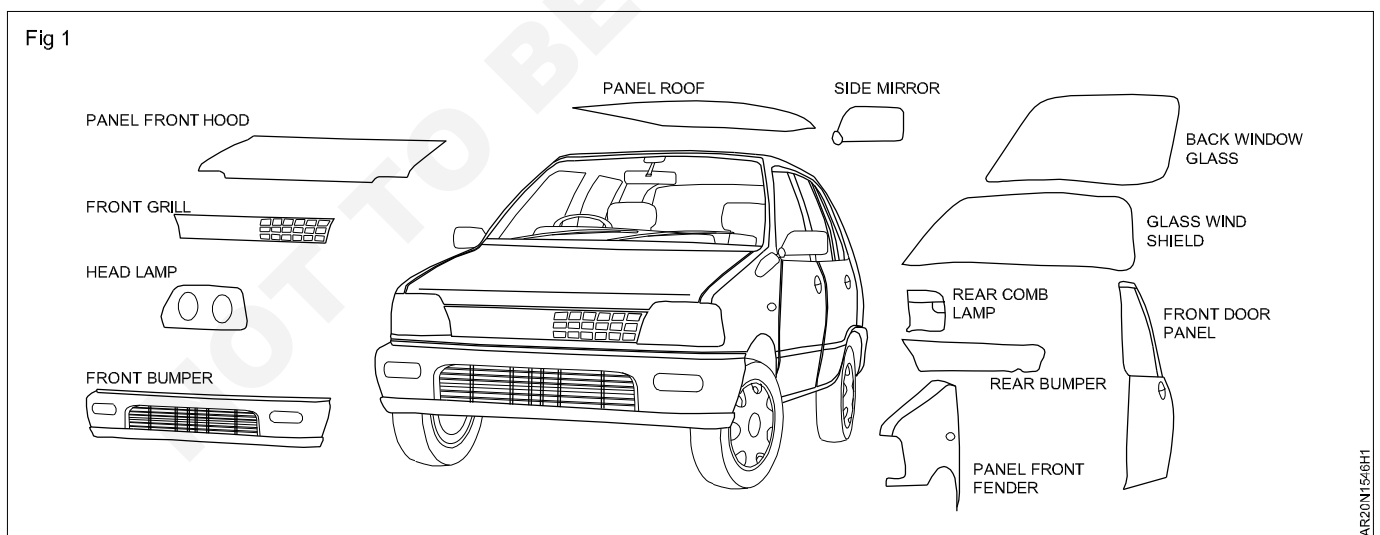
- identify the front body structural components of unibody vehicle.

Requirements		
Tools/Instruments		Materials
<ul style="list-style-type: none"> • Trainee's tool kit • Service manual 	<ul style="list-style-type: none"> - 1 No. - 1 No. 	<ul style="list-style-type: none"> • Cotton waste - as reqd. • Soap oil - as reqd.
Equipments		
<ul style="list-style-type: none"> • Unibody vehicle 	<ul style="list-style-type: none"> - 1 No. 	

PROCEDURE

Task 1: Identify and locate the structural components of unibody sedan (Fig 1)

- | | |
|--|---|
| 1 Locate the hood hinge. | 7 Locate the front suspension cross member. |
| 2 Locate the cowl panel | 8 Locate the front cross member. |
| 3 Locate the front fender apron to cowl side lower member. | 9 Locate the hook lock brace. |
| 4 Locate the dash panel. | 10 Locate the radiator side support. |
| 5 Locate the front fender apron | 11 Locate the radiator upper support. |
| 6 Locate the front side member. | 12 Locate the shock tower. |



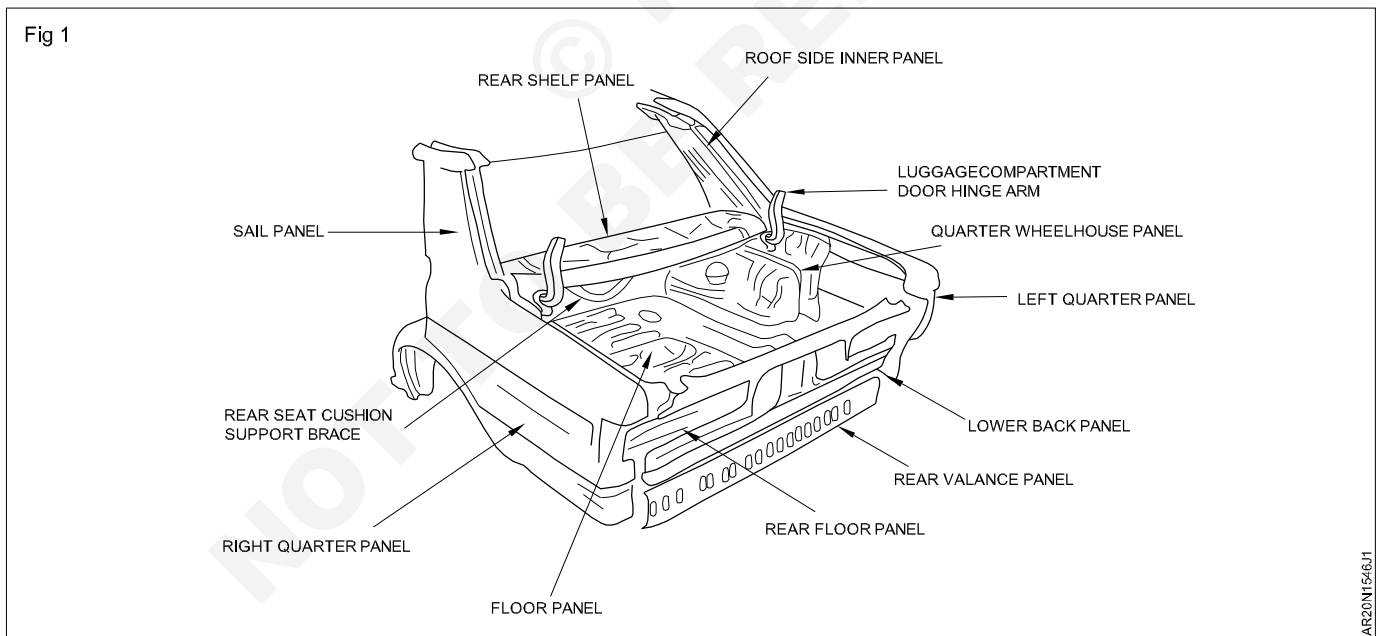
Task 2: Identify and locate the rear body structural components of unibody sedan (Fig 1)

- | | |
|------------------------------------|--|
| 1 Locate the rear shell panel | 3 Locate the luggage compartment door hinge arm. |
| 2 Locate the roof side inner panel | 4 Locate the quarter wheel house panel. |

- 5 Locate the left quarter panel.
- 6 Locate the lower back panel
- 7 Locate the rear valance panel
- 8 Locate the rear floor pan.
- 9 Locate the floor panel
- 10 Locate the right quarter panel
- 11 Locate the rear seat cushion support brace.
- 12 Locate the sail panel.
- 13 write the vehicle parts name and location in table 1.

Table 1 - Vehicle parts and its location

S.No	Vehicle part name	Part location on the vehicle
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		



Mechanic Auto Body Repair - Vehicle Construction Technology and Compressor Air System

Practice on identify the under body front and rear section structural components of unibody sedan

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

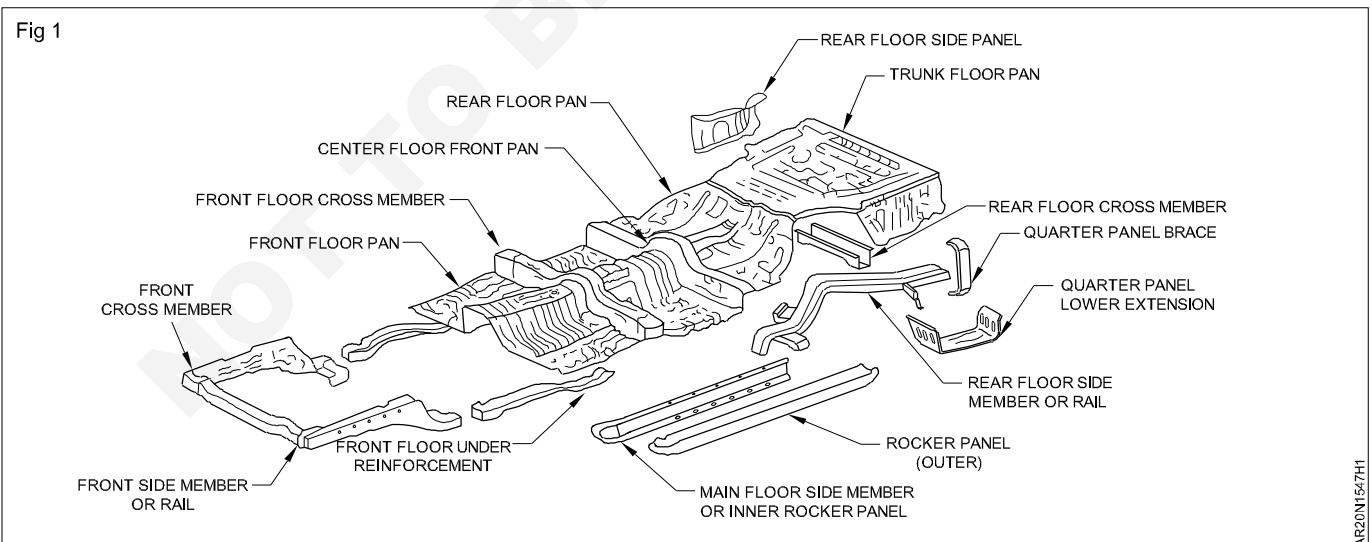
- identify and locate the under body front and rear section structural components.

Requirements		
Tools/Instruments		Materials
<ul style="list-style-type: none"> • Trainee's tool kit • Service manual 	<ul style="list-style-type: none"> - 1 No. - 1 No. 	<ul style="list-style-type: none"> • Cotton waste - as reqd. • Soap oil - as reqd.
Equipments		
<ul style="list-style-type: none"> • Unibody vehicle 	<ul style="list-style-type: none"> - 1 No. 	

PROCEDURE

Identification and locate the front and rear section structural components of unibody sedan (Fig 1)

- 1 Locate the rear floor side panel
- 2 Locate the truck floor pan
- 3 Locate the rear floor cross member.
- 4 Locate the quarter panel brace.
- 5 Locate the quarter panel lower extension.
- 6 Locate the rear floor side member or rail.
- 7 Locate the rocker outer panel.
- 8 Locate the main floor side member/rocker inner panel.
- 9 Locate the front floor under inforcement.
- 10 Locate the front side member.
- 11 Locate the front cross member.
- 12 Locate the front floor fan.
- 13 Locate the front floor cross member.
- 14 Locate the rear floor pan.
- 15 Locate the center floor front pan.



Practice on identify the front and rear body structural components of mid engine vehicle

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

- identify the location of front body structural components of mid engine vehicle
- identify the location of rear body structural components of mid engine vehicle.

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Service manual - 1 No.

Materials

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

Equipments

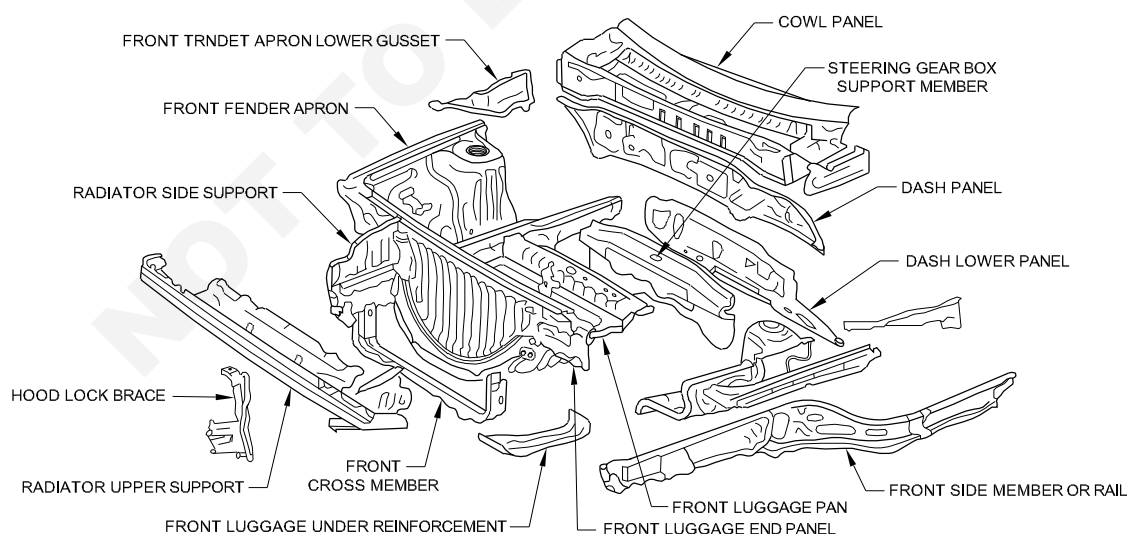
- Unibody vehicle - 1 No.

PROCEDURE

Task 1: Identify and locate the front body structural components of mid engine unibody vehicle (Fig 1)

- 1 Locate the cowl panel.
- 2 Locate the steering gear box support member.
- 3 Locate the dash lower panel.
- 4 Locate the front side member.
- 5 Locate the front luggage pan
- 6 Locate the luggage end panel.
- 7 Locate the front luggage under reinforcement.
- 8 Locate the front cross member.
- 9 Locate the radiator upper-support.
- 10 Locate the hood lock brace.
- 11 Locate the radiator side support.
- 12 Locate the front fender apron.
- 13 Locate the fender apron lower gusset.
- 14 Locate the dash lower panel.

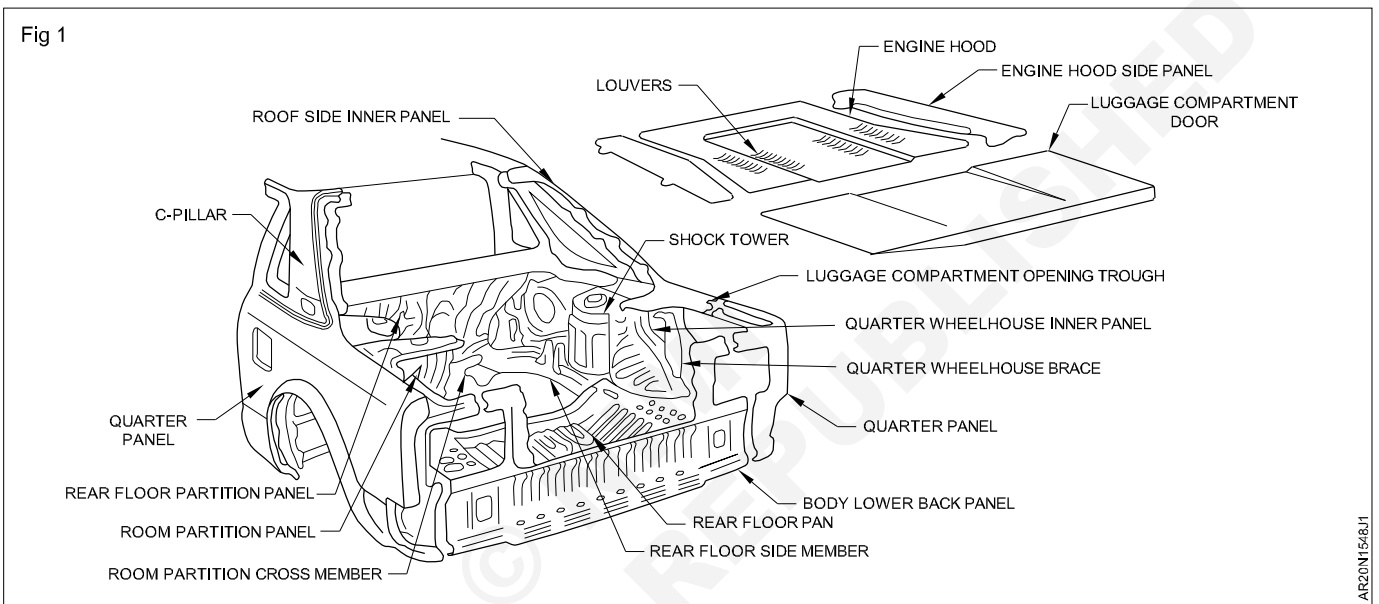
Fig 1



AR20N1548H1

Task 2: Identify and locate the rear body structural components of mid engine unibody vehicle (Fig 1)

- | | |
|---|---|
| 1 Locate the c-pillar. | 10 Locate the quarter wheel house inner panel. |
| 2 Locate the quarter panel. | 11 Locate the opening trough luggage compartment. |
| 3 Locate the rear floor partition panel. | 12 Locate the shock tower |
| 4 Locate the room partition cross member. | 13 Locate the louvers. |
| 5 Locate the rear floor side member. | 14 Locate the engine hood. |
| 6 Locate the rear floor pan. | 15 Locate the engine hood side panel. |
| 7 Locate the body lower back panel. | 16 Locate the luggage compartment door. |
| 8 Locate the quarter panel. | 17 Locate the roof side inner panel. |
| 9 Locate the quarter wheel house brace. | 18 Locate the room partition panel. |



Practice on identify the parts of a full frame of pick up truck and sport utility vehicle

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

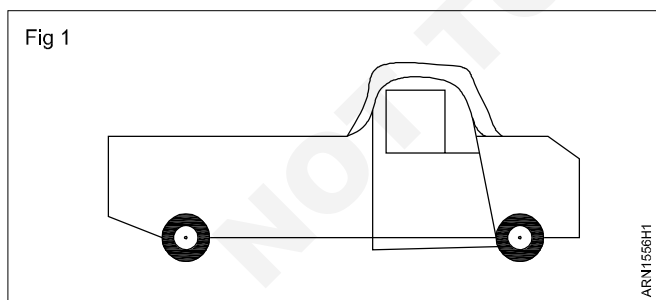
- identify the parts of full frame pick up truck
- identify the parts of sport utility vehicle.

Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Sport utility vehicle	- 1 No.
• Vehicle manual	- 1 No.	Materials	
Equipments			
• Pickup truck	- 1 No.	• Cotton waste	- as reqd.
		• Soap oil	- as reqd.

PROCEDURE

Task 1: Identify the parts of full frame pick up truck (Fig 1)

- 1 Part the vehicle on the shop floor and locate the dash panel.
- 2 Locate the chassis frame of truck.
- 3 Locate the driver cabin of truck.
- 4 Locate the driver side and co-driver side door.
- 5 Locate the engine compartment.
- 6 Locate the cowl panel.
- 7 Locate the luggage carrier.
- 8 Locate the tail board.
- 9 Locate the bonnet cover.
- 10 Locate the drive line.
- 11 Locate the front bumper.
- 12 Locate the shock towers.
- 13 Locate the roof panel.
- 14 Locate the center section.
- 15 Locate the rear section.
- 16 Locate the left and rear sides
- 17 Locate the wheel base.
- 18 Locate the cowl fire wall area.
- 19 Locate the passenger compartment.
- 20 Locate the rear body frame.
- 21 Locate the cross member.
- 22 Locate the body rubber mountings.
- 23 Locate the right & left front fender.
- 24 Locate the frame rail.
- 25 Locate the cowl and hood of the truck.



Task 2: Identify and locate the parts of sports utility vehicle (Fig 1)

- 1 Locate the front bumper and rear bumper.
- 2 Locate the front lower cross members.
- 3 Locate the front side frame.
- 4 Locate the side sill.
- 5 Locate the rear side frame.
- 6 Locate the rear bulkhead center.
- 7 Locate the rear floor cross member.
- 8 Locate the rear bulkhead center lower cross member.

9 Locate the engine mountings.

10 Locate the frame rail.

11 Locate the cowl and hood.

12 Locate the front right or left fender.

13 Locate the rear right and left fender.

14 Locate the car seat mountings.

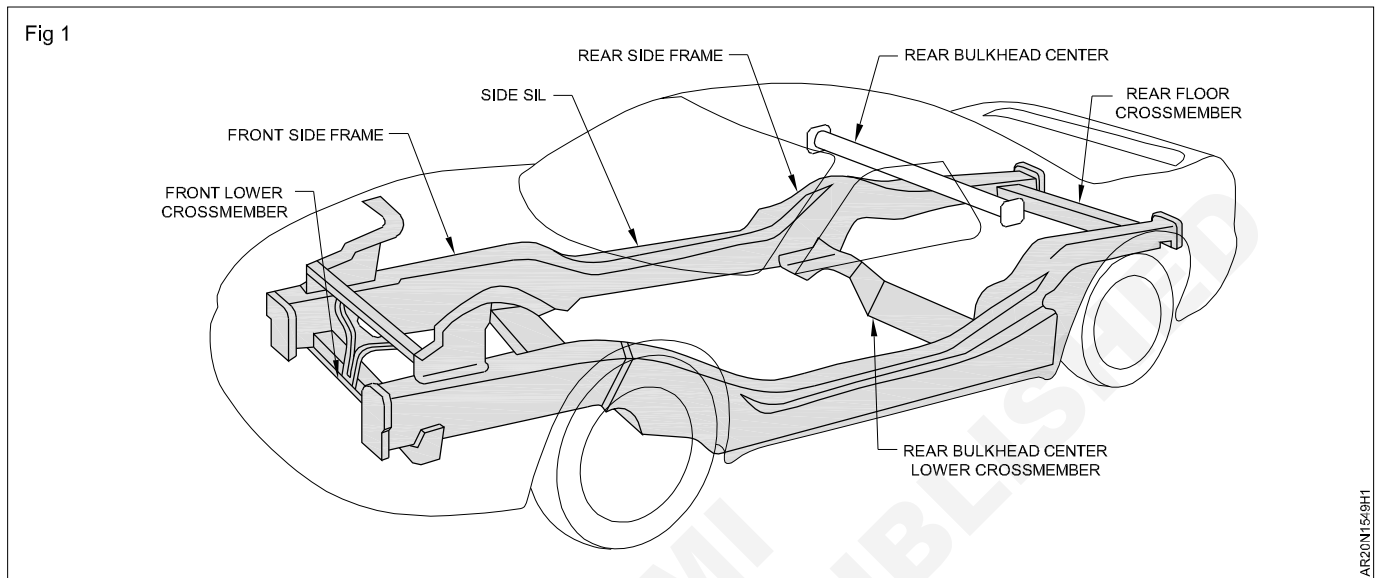
15 Locate the car seat belt mountings.

16 Locate the radiator mountings.

17 Locate the front and rear suspension.

18 Locate the steering mountings.

19 Locate the hook lock brace.



Practice on use of computer - based service information

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

- refer the computer based service information
- use the service manual
- use the collision repair guides
- use the refinishing guides
- use the vehicle dimension manual
- use the color matching guides
- use the parts interchange guides.

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Parts interchange guide - 1 No.
- Service manual - 1 No.
- Collision repair guide - 1 No.
- Refinishing guide - 1 No.
- Dimension manual - 1 No.
- Color matching guide - 1 No.

Equipments

- Vehicle - 1 No.

Materials

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

PROCEDURE

Practice on use of computer based service information during vehicle repair (Fig 1&2)

- 1 Park the vehicle on the shop floor.
- 2 Visually inspect the vehicle damage.
- 3 Open the computer based service information with personal computer and gather the informations from computer as per your repair requirements.
- 4 Compare the computer data with vehicle dimensions measured by you.
- 5 Use the computer based service manual to identify the parts and sequence of repair.
- 6 Use the computer based collision repair guide to repair the accident vehicle.
- 7 Use the computer based refinishing guides to painting related works.
- 8 Use the computer based vehicle dimension guides to measure the vehicle and compare the measured dimensions with computer dimensions manual data.
- 9 Use the computer based service manual to color matching guide with your vehicle physical (painting) paint color.
- 10 Use the vehicle parts interchange guide to refer before changing the damaged parts with other vehicle parts.

Fig 1

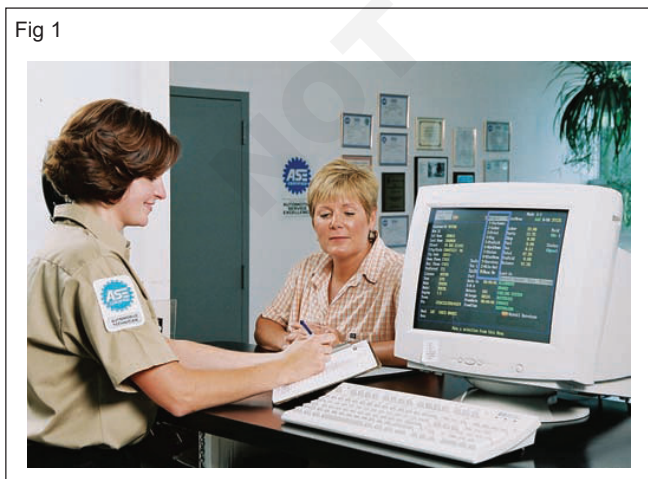


Fig 2



Practice on identify the parts of stationary air compressor

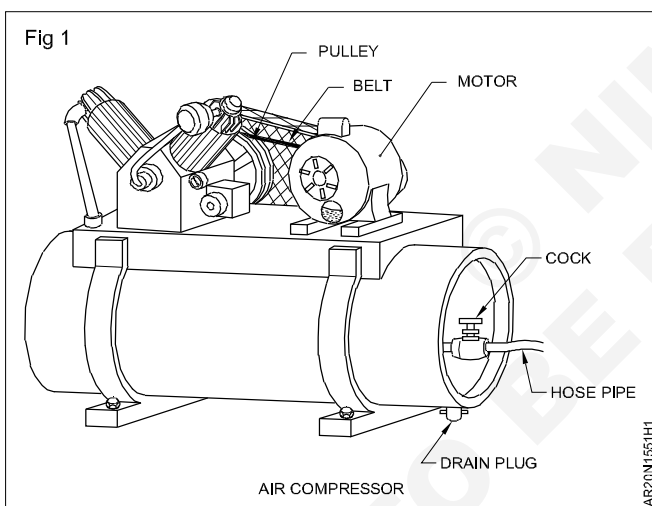
Objectives : At the end of this exercise you shall be able to

- identify the parts of air compressor
- overhauling of air compressor and service unit
- drain the air receiver and moisture separator.

Requirements		
Tools/Instruments		Materials
<ul style="list-style-type: none"> • Trainee's tool kit • Service manual 	<ul style="list-style-type: none"> - 1 No. - 1 No. 	<ul style="list-style-type: none"> • Cotton waste • Soap oil
Equipments		
<ul style="list-style-type: none"> • Air compressor 	<ul style="list-style-type: none"> - 1 No. 	

PROCEDURE

Task 1: Identify the parts of air compressor (Fig 1)



- 1 Identify the compressor pump.
- 2 Identify the electric motor.
- 3 Identify the safety valve.
- 4 Identify the air pressure gauge.
- 5 Identify the discharge valve.
- 6 Identify the drain valve.
- 7 Identify the belt guard.
- 8 Identify the FRL unit.
- 9 Identify the air pressure regulator.
- 10 Identify the filter drier.
- 11 Identify the shut off valve.
- 12 Identify the air pressure gauge.

Task 2: Overhauling of air compressor

- 1 Disconnect the electric power to air compressor's electric motor.
- 2 Loosen the electric motor mountings.
- 3 Move the motor and loose the belt.
- 4 Remove the compressor drive belt and belt guard.
- 5 Disconnect the compressor air output pipe.
- 6 Dismount the air compressor pump mountings.
- 7 Remove the pump unit fan assembly.
- 8 Remove the compressor pump and place it on work bench and remove the crank case oil.
- 9 Dismantle the air compressor pump unit.
- 10 Clean and inspect the dismantled pump parts like valves piston filter, piston ring, crank shaft, connecting rod, oil drain plug, eccentric cam.
- 11 Replace the damaged parts.
- 12 Assemble the pump parts as dismantled reverse in order.
- 13 Rotate the pump and ensure for proper function of it.
- 14 Mount the air compressor pump unit on the air tank and align and tighten the mounting bolts.
- 15 Fix the fan and fan belt with compressor pump unit.
- 16 Adjust the fan belt tension and tighten the electric motor mountings.

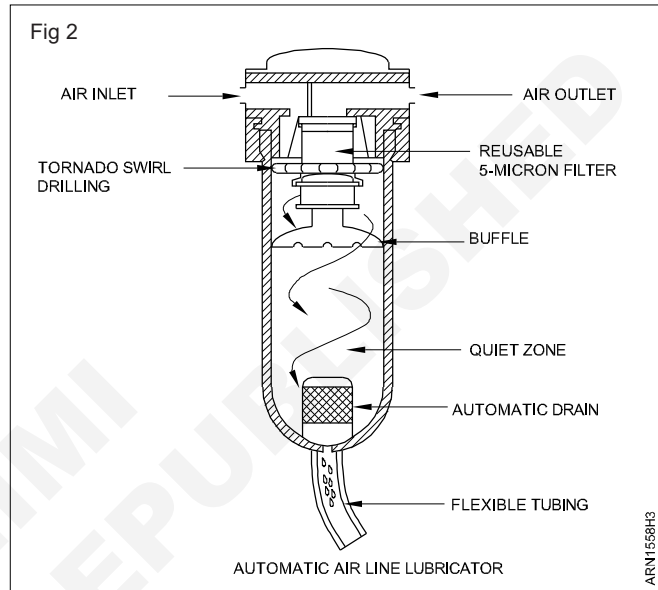
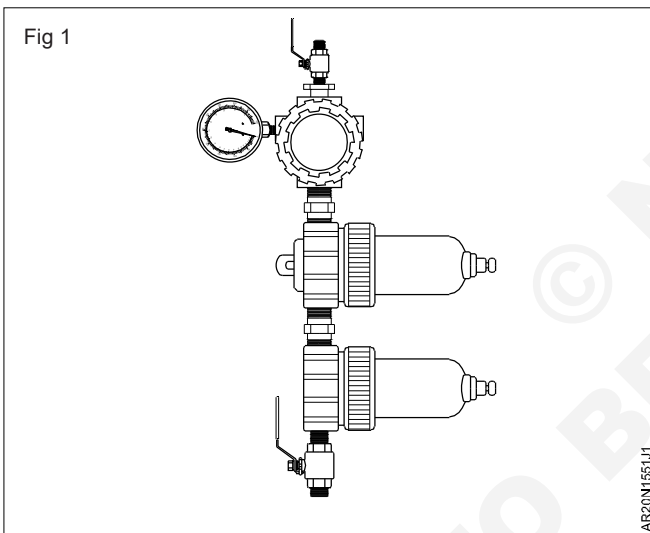
- 17 Connect the air filter hose and air output pipe.
- 18 Connect the electric connection with electric motor.

- 19 Start the air compressor and ensure for proper function.
- 20 Mount the fan belt ground.

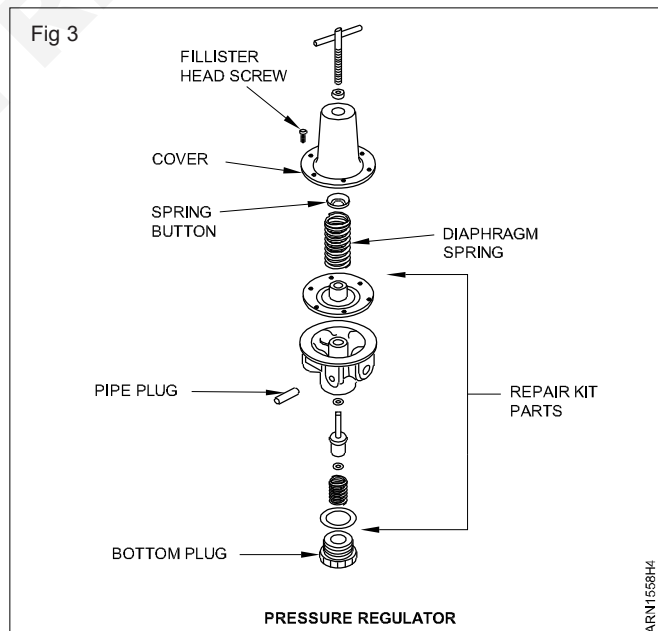
Task 3: **Overhauling of service unit (Fig 1 to 3)**

- 1 Discharge the air from air tank by operating the discharge air valve shown in Fig 1.
- 2 Drain the air by removing drain valve.
- 3 Remove the safety valve.
- 4 Disconnect the air inlet and outlet pipe connection.
- 5 Remove the pressure regulator and dismantle, clean and assemble the parts (Fig 2).
- 6 Open the filter drain valve.
- 7 Dismount the filter unit.
- 8 Remove the filter unit and place it on tray with work bench.
- 9 Dismount the filter and remove the parts shown in Fig 2.

- 18 Fix the safety valve and adjust the air pressure.
- 19 Start the air compressor and wait to yet limited air pressure in air tank.
- 20 Ensure pressure regulator and air tank safety valve is working properly (Fig 3).



- 10 Clean the all dismantled parts of filter (filter debris and moisture).
- 11 Inspect the dismantled parts of filter.
- 12 Replace the damaged parts.
- 13 Assemble the filter parts.
- 14 Mount the FRL unit compressor air system (Fig 3).
- 15 Connect the air inlet and outlet hoses with FRL unit.
- 16 Fix the drain valve with air tank.
- 17 Fix the air discharge valve with air tank.



Mechanic Auto Body Repair - Vehicle Construction Technology and Compressor Air System

Practice on check the air compressor air filter, head fins and air inter cooler

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

- check the air compressors air filter
- check the air compressors cylinder head fins
- check the air inter cooler.

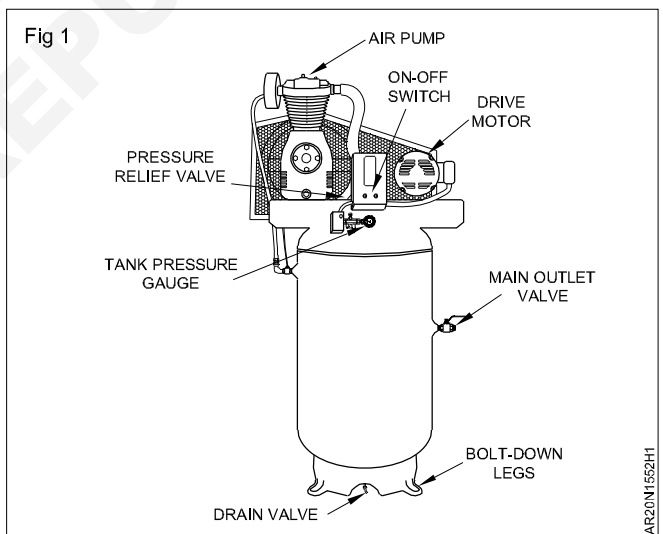
Requirements		
Tools/Instruments		Materials
<ul style="list-style-type: none"> • Trainee's tool kit 	- 1 No.	<ul style="list-style-type: none"> • Cotton waste - as reqd. • Soap oil - as reqd.
Equipments		
<ul style="list-style-type: none"> • Air compressor 	- 1 No.	

PROCEDURE

Check the air filter cylinder head fins and air inter cooler

- 1 Check the air compressor oil level in the crank case, if need top up.
- 2 Check the air filter of air compressor.
- 3 If need remove the filter and clean it, and replace the damaged filter.
- 4 Check the cylinder head fins for damage, bent, blocked and dust or rust formed on the fins if found any damage on the fins repair it possible or replace the cylinder head.
- 5 Check the air inter cooler, which is fitted and locating between air pump cylinder (two stage air compressor)
- 6 Check the intercooler metal hose fins for damage, bent, blocked leaks.
- 7 If found any damage on air inter cooler replace it.

- 8 After check and rectifying the defects start the two stage air compressor and ensure for clean air enter into air pump cylinder and cool air flow between two stage air pump cylinders.



Mechanic Auto Body Repair - Vehicle Construction Technology and Compressor Air System

Practice on check the air filter element and adjust the pressure switch cut in and cut out

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

- overhaul the oil filter element of air compressor
- adjust the air pressure cut in and cut out settings
- check cylinder head pressure exhaust valve
- adjust the air compressor drive belt free play.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Filter element	- as reqd.
Equipments		• Cotton waste	- as reqd.
• Air compressor	- 1 No.	• Filter oil	- as reqd.
		• Soap oil	- as reqd.
		• 'V' belt	- as reqd.

PROCEDURE

Task 1: Overhauling the FRL unit

- 1 Disconnect the air inlet and air outlet hose connection.
- 2 Remove the flexible tubing of filter element.
- 3 Dismount the filter element housing with filter element.
- 4 Clean the filter element housing and filter.
- 5 Clean the baffle, tornado swirl ring and automatic drain.
- 6 Inspect the dismantled parts of filter assembly.
- 7 Replace the damaged parts.
- 8 Assemble the all parts of air compressor as dismantled in reverse order of removing.
- 9 Fill the filter oil and fill it with air compressor and check the performance of working in running condition.

Task 2: Adjust the pressure switch cut in and cut out of air compressor

- 1 Start the air compressor and allow the air to fill in air tank and check pressure cut off.
- 2 If pressure switch is not work properly adjust the pressure relief valve as per specification.
- 3 Check the head pressure exhaust relief valve operation. If it operate improperly adjust the valve or replace the valve for proper function.

Task 3: Adjust the air compressor drive belt free play

- 1 Remove the fan belt guard.
- 2 Visually check the fan belt.
- 3 If the belt is damaged, remove and replace the air compressor drive belt.
- 4 Fix the new air compressor drive belt and align the belt with compressor and electric drive motor.
- 5 Tighten the compressor drive belt by moving electric drive motor.
- 6 Ensure the alignment of drive belt and tighten the drive motors mounting.

Task 4: Check the relief valve for exhausting of air compressors cylinder head pressure

- 1 Start the air compressor and check the performance of air compressor.
- 2 Stop the air compressor by using cylinder head pressure relief valve.
- 3 Even after pulling cylinder head pressure exhaust relief valve the compressor not stopped then replace the compressor cylinder head pressure exhaust valve.
- 4 After replacement of compressor cylinder head pressure exhaust valve start the air compressor and check the performance of cylinder head pressure relief valve.
- 5 Ensure the function of cylinder head pressure relief valve is working properly.

Practice on align a loose air compressor drive motor pulley

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

- check the air compressor drive motor pulley
- align the loose drive pulley of air compressor drive motor.

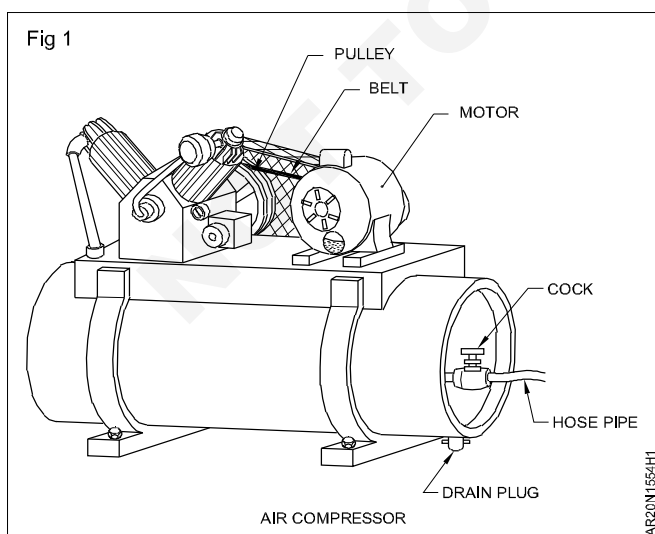
Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
Equipments			
• Air compressor	- 1 No.	• Soap oil	- as reqd.
		• Drive pulley motor	- as reqd.
		• Drive pulley compressor	- as reqd.
Materials			
• 'V' belt	- as reqd.		

PROCEDURE

Check and align the air compressor and electric motor drive pulley (Fig 1)

- 1 Check the electric motor drive pulley while air compressor running.
- 2 If you find the drive motor pulley is loosen, stop the compressor.
- 3 Loosen the electric motor mountings and move the electric motor towards compressor.
- 4 Remove the compressor fan belt safety guard.
- 5 Remove the air compressor drive belt.
- 6 Remove the electric motor drive pulley.

- 7 Check the pulley key and lock nut.
- 8 If found any damage, remove the motor drive pulley.
- 9 Check the pulley and motor shaft condition.
- 10 If found any damage replace the damaged parts.
- 11 Select the new pulley and visually inspect the pulley.
- 12 Clean the pulley and fix the pulley on motor shaft.
- 13 Lock the pulley and ensure electric motor pulley is properly fitted.
- 14 Fix the air compressor drive belt and align the belt inline the air compressor drive pulley and electric motor pulley are inline with each other.
- 15 Adjust the drive belts free play by moving electric motor.
- 16 When you are feeling air compressor drive belt free play and alignment is correct as per specification tighten the electric motors mountings.
- 17 Connect the electric connection with electric motor.
- 18 Start the air compressor and ensure motor pulley is running without wobbling.
- 19 Stop the compressor running.
- 20 Ensure the compressor is fully stopped the rotation and then fix the fan belt safety guard.



Mechanic Auto Body Repair - Vehicle Construction Technology and Compressor Air System

Practice on check the air leaks of air compressor out fit air piping system

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

- check the air compressor outfit leaks
- check the air compressor air piping system leaks.

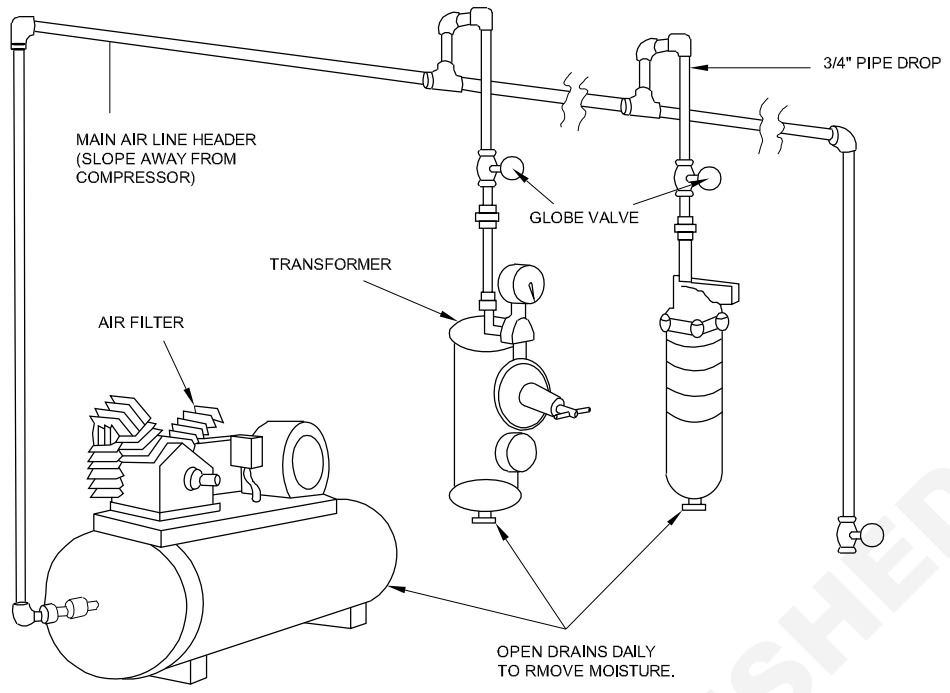
Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Soap oil	- as reqd.
• Air compressor	- 1 No.		

PROCEDURE

Check the air leaks of air compressor out fit air piping system (Fig 1)

- 1 Trace the air compressor air piping system of repair shop floor.
- 2 Clean the air compressor out fit and air piping system.
- 3 Start the air compressor and wait for full air build in the air tank.
- 4 Stop the air compressor when excess air has released from air compressor air tank.
- 5 Note the air pressure shown on air pressure gauge of air compressor air tank.
- 6 Wait for few minutes and again note the pressure gauge reading.
- 7 Now compare the both reading, if both readings are equal means, there is no leakage in compressor air piping system.
- 8 If any variations in reading it means there is air leaks in compressor air piping system.
- 9 Visually check the air compressor outfit and air piping system.
- 10 Use the soap water solvent to identify the leakage point in compressor air system.
- 11 Apply soap water on the pipe joints and check the air leaks.
- 12 If air bubbles comes from pipe joints it means air leaks from the pipe joint.
- 13 Find the cause for air leak from the pipe joints and rectify the air leaks by repairing or tighten the unions or changing the pipe and pipe unions.
- 14 After rectifying the defects, again check the air flows and air leaks in air compressors air flow system.
- 15 Check the air pressure gauge if found defective replace the gauge.
- 16 Check the pressure relief valve, if any leak or damage replace the valve.
- 17 Check the globe valve function if found any leaks or damage rectify or replace the valve (Fig 1).

Fig 1



ARN1562H1

Practice on identify the parts of oxy-acetylene welding equipments

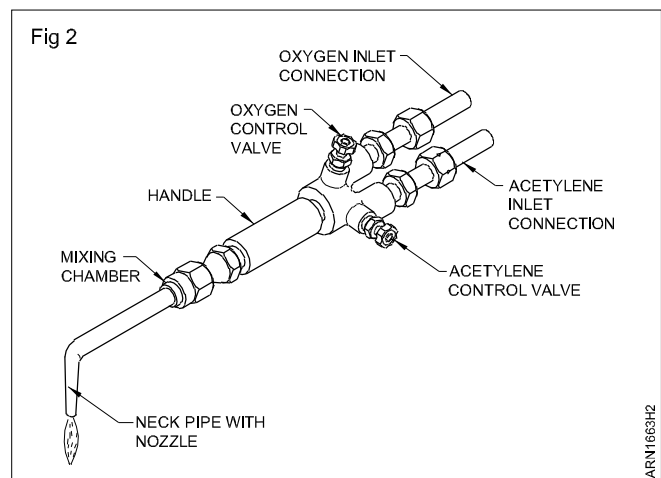
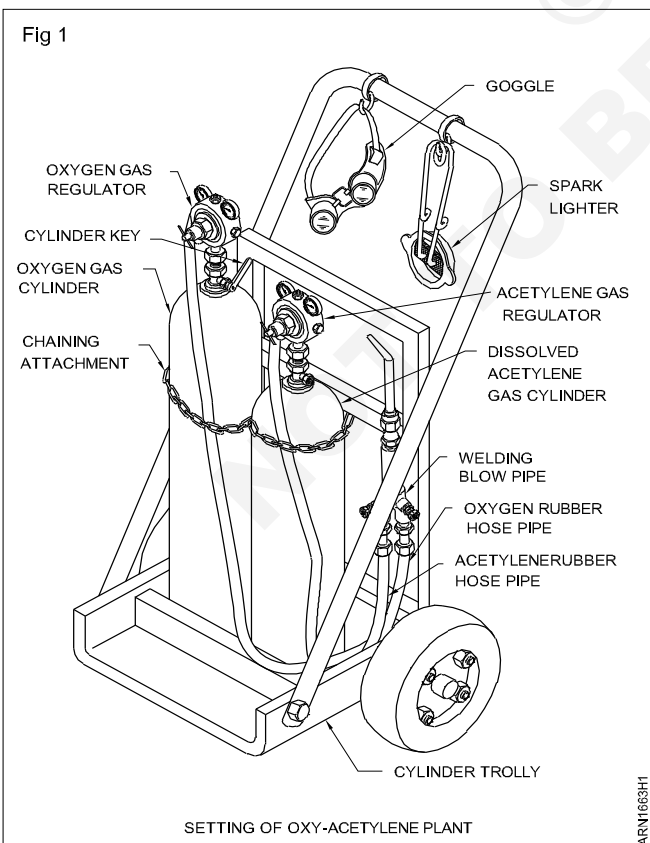
- Objectives :** At the end of this exercise you shall be able to
- identify the parts of oxy-acetylene welding equipments
 - identify the parts of cutting off fit of gas welding.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Welding manual	- 1 No.	• Soap oil	- as reqd.
• Welding plant chart	- 1 No.	• Flux	- as reqd.
Equipments		• Welding rod	- as reqd.
• Oxy-acetylene welding plant	- 1 No.		
• Gas cutting out fit	- 1 No.		

PROCEDURE

Identify the parts of oxy-acetylene welding plant (Fig 1&2)

- 1 Locate the gas cylinders of welding plant.
- 2 Identify the oxygen gas cylinder.
- 3 Identify the acetylene gas cylinder.
- 4 Identify the oxygen gas regulator.
- 5 Identify the acetylene gas regulator.
- 6 Identify the acetylene rubber hose pipe.
- 7 Identify the oxygen rubber hose pipe.
- 8 Identify the welding blow pipe.
- 9 Identify the gas cylinder main opening and closing valves (shut off valve)
- 10 Identify the gas cylinder valve opening and closing key.
- 11 Identify the gas cylinder gas line pressure gauge.
- 12 Identify the spark lighter.
- 13 Identify the eye safety goggles for gas welding.
- 14 Identify the cutting torch.
- 15 Identify the trigger valve.
- 16 Identify the welding nozzle.



Practice on oxy-acetylene gas welding, brazing and soldering process

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

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

Requirements			
Tools/Instruments		Equipments	
• Trainee's tool kit	- 1 No.	• Oxy-acetylene plant	- 1 No.
• Spanner D/E	- 1 No.	• Regulator (Left and Right threads)	- 1 No each.
• Cylinder key	- 1 No.	• Nozzle cleaner	- 1 No.
• Pressure gauge	- 1 No.	Materials	
• Trolley	- 1 No.	• Solder	- as reqd.
• Blow lamp	- 1 No.	• Cotton rag	- as reqd.
• Soldering iron	- 1 No.	• Brazing rod	- as reqd.
• Eye protector	- 1 No.	• Flux	- as reqd.
		• Wire brush	- as reqd.

PROCEDURE

- 1 Setting up oxy-acetylene plant Fig 1.
- 2 Move oxygen and acetylene cylinders with the caps from the store to the gas welding area.
- 3 An oxygen cylinder is identified by the black colour painted on it.
- 4 An acetylene cylinder is identified by the maroon colour painted on it.
- 5 Also the oxygen cylinder will be taller than an acetylene cylinder and the diameter of oxygen cylinder will be less than the diameter of an acetylene cylinder.
- 6 Ensure full cylinders are kept separately from the empty cylinders.
- 7 Position the gas cylinders in a trolley and secure them with a chain.
- 8 Always keep the cylinders upright/vertically in the cylinder stand/on the floor (Fig 2).
- 9 While moving, the gas cylinder should be kept slightly inclined to the vertical position and the protector cap used to avoid damage to the cylinder valves (Fig 3).
- 10 Do not roll the cylinder horizontally on the ground.
- 11 Remove the cylinder caps. Crack the gas cylinder valves by quickly opening and closing them using the cylinder key (Fig 4).

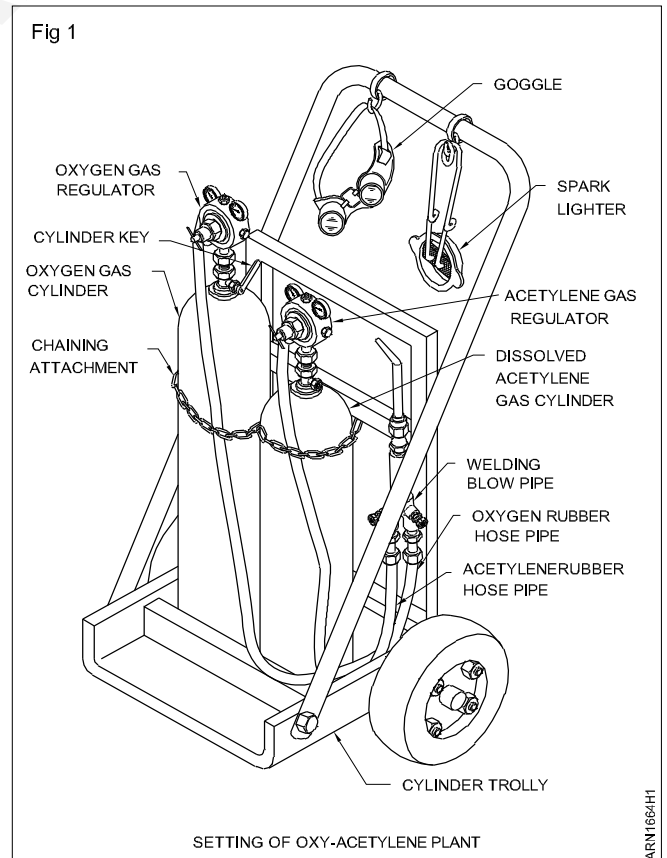
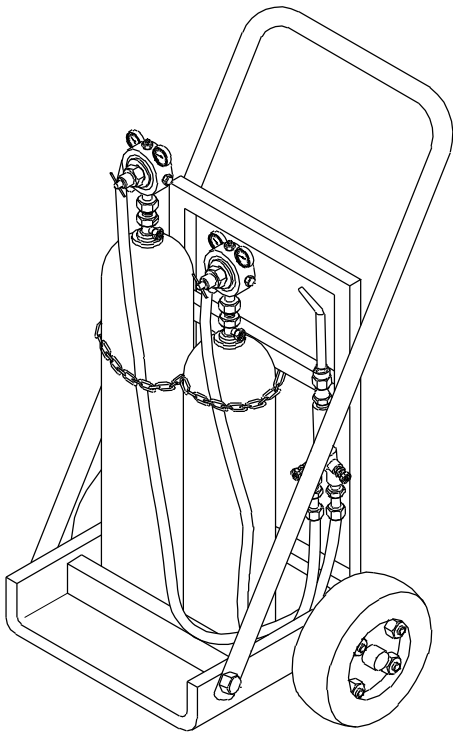
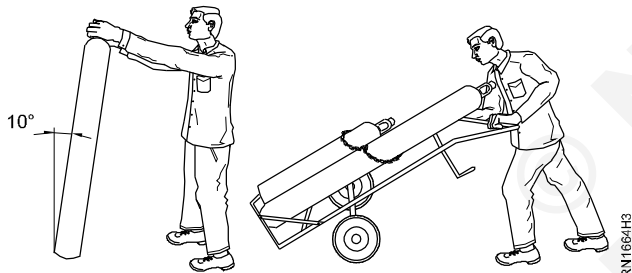


Fig 2



ARN1664H2

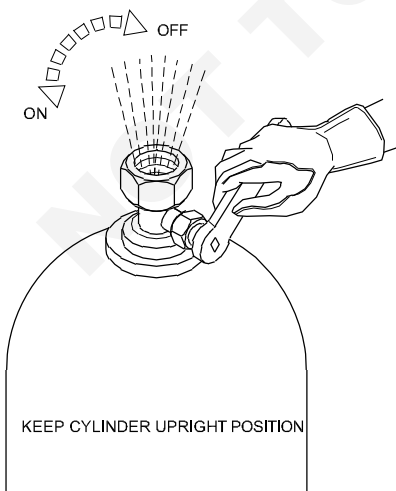
Fig 3



ARN1664H3

Fig 4

BLOW OUT THE CYLINDER VALVE SOCKET BEFORE CONNECTING THE REGULATOR CRACKING OPEN THE CYLINDER VALVE MOMENTARILY



KEEP CYLINDER UPRIGHT POSITION

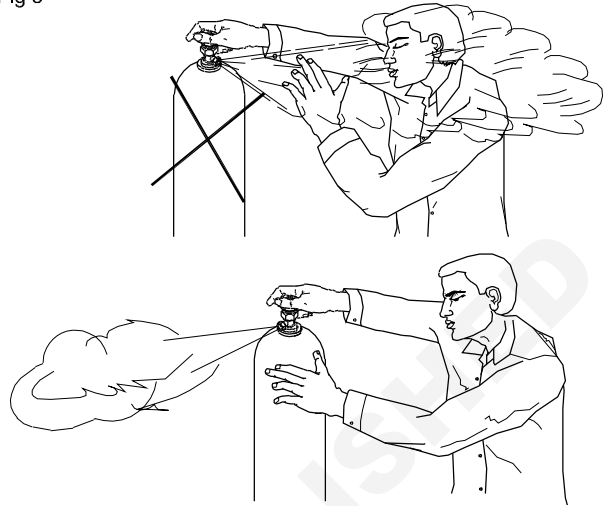
ARN1664H4

12 Dirt and dust particles from the cylinder valve sockets are cleaned by cracking the cylinder valve.

13 This will avoid leakage of gas due to improper seating of the cylinder valve and also to prevent the dust particles from entering into the regulators which may cause damage to the regulators.

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

Fig 5



ARN1664H5

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

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

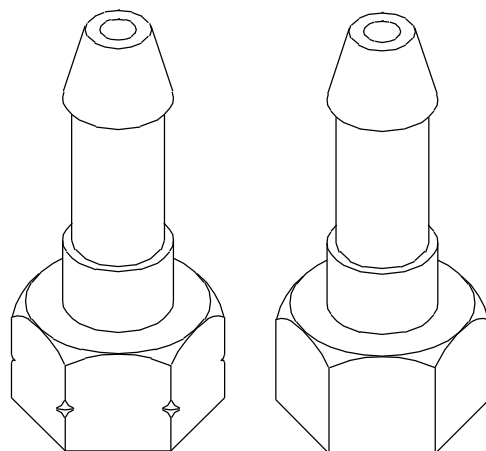
17 Connect the acetylene regulator to the acetylene gas cylinder (left hand threads)

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

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

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

Fig 6

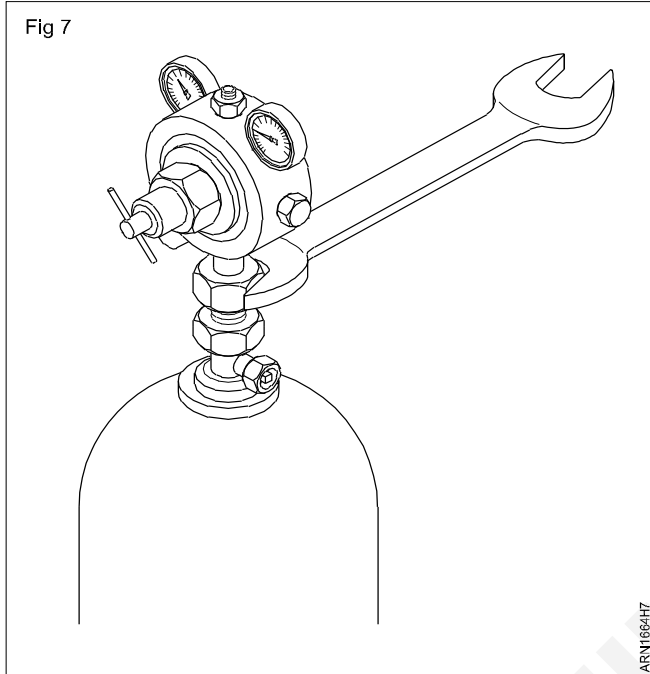


LEFT HAND ACETYLENE

RIGHT HAND OXYGEN

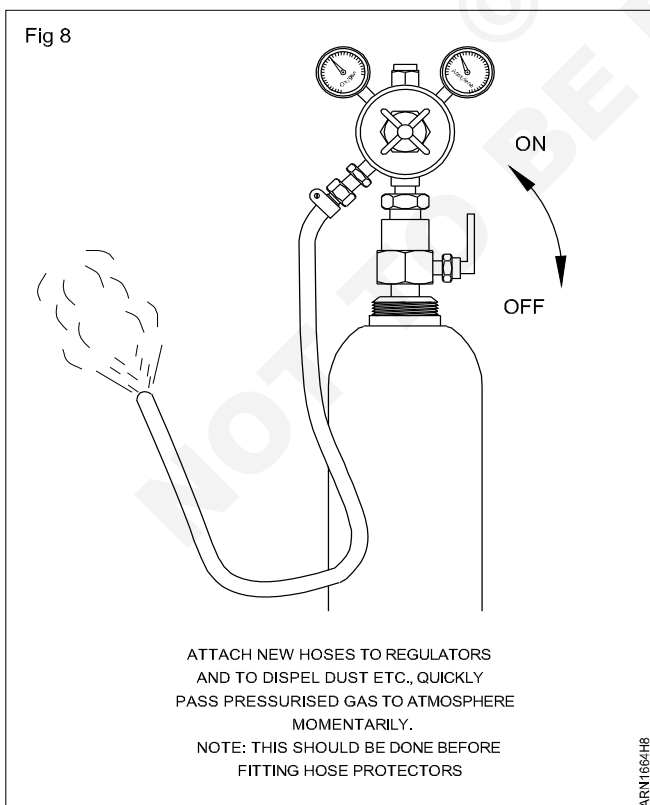
ARN1664H6

- 21 All threaded connections should be fixed initially by tightening by hands and then only a spanner should be used.
- 22 This will help to avoid assembly with cross thread leading to damage to threads.
- 23 Always use the correct size spanner to prevent damage to the threads. (Fig 7)



Attaching blowpipe

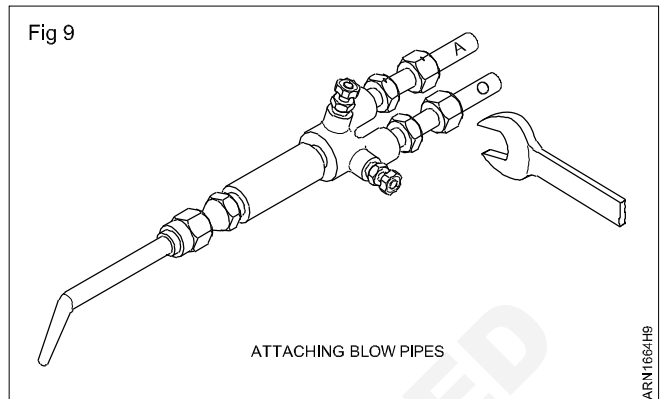
- 1 The other end of the hose-pipe is to be attached to the blowpipe inlets. (Fig 8)



- 2 Fix the hose-protectors at the blowpipe ends. The hose-protectors with a groove at the corners are fixed

on the acetylene hose-pipe and connected to the acetylene inlet of the blowpipe.

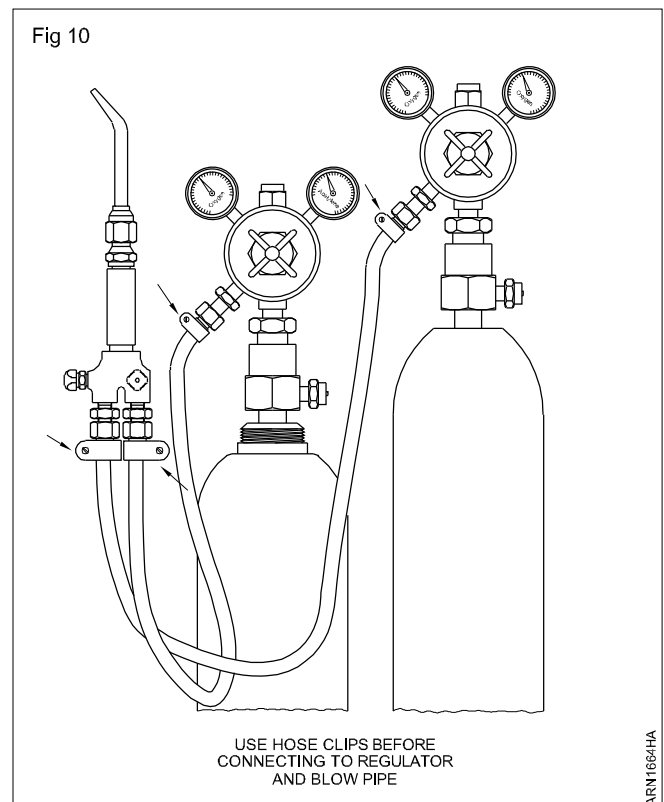
- 3 The hose-protectors without cutting marks are fixed on the oxygen hose-pipe and connected to the oxygen inlet of the blowpipe. (Fig 9)



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

Adjusting the gas pressure

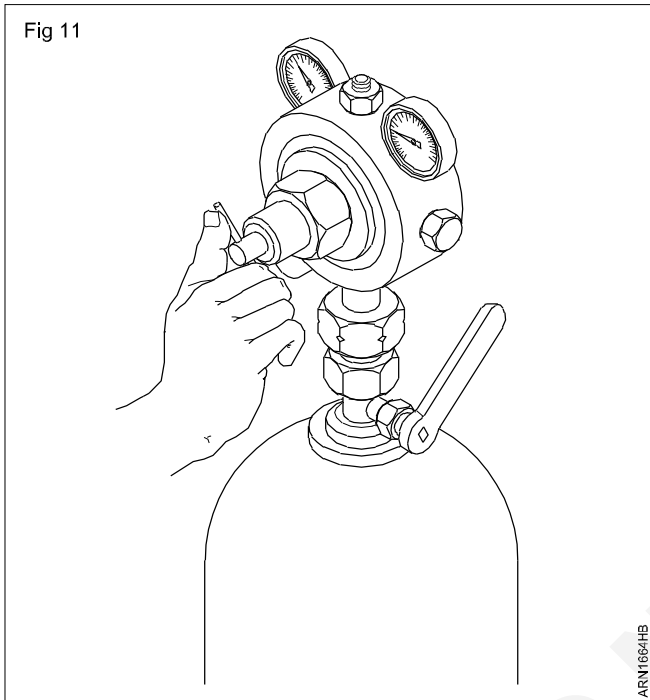
- 1 The gas pressure for both oxygen and acetylene has to be adjusted at regulators according to the size of the nozzle.
- 2 The size of the nozzle is selected according to the material and thickness.
- 3 For adjusting the gas pressure, open the valves of both the cylinders slowly by on turn and set the pressure on both regulators as 0.15 kg / cm² for small size nozzle tightening the pressure adjusting screws. (Fig 10)



- 4 Ensure the blow pipe control valves are kept open while setting gas pressure.
- 5 The pressure can be read on the working pressure of gas regulators.

Testing for leakage

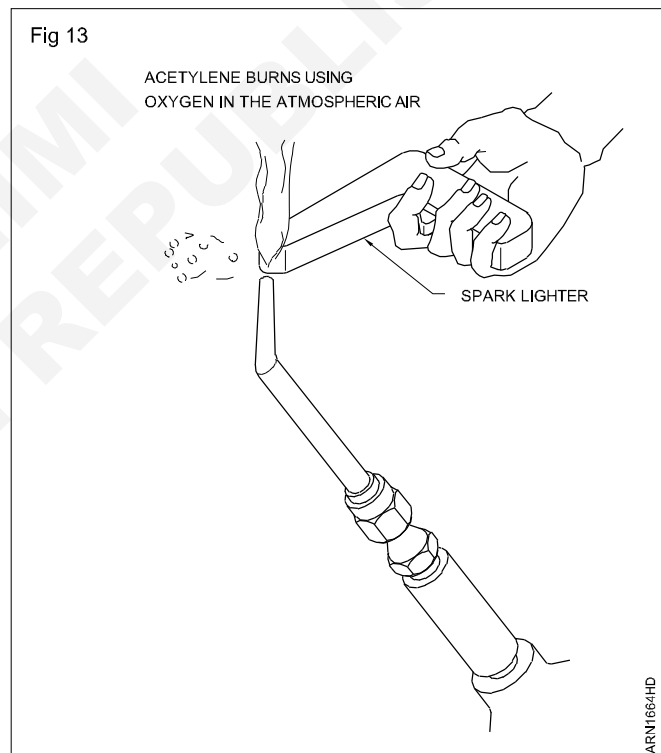
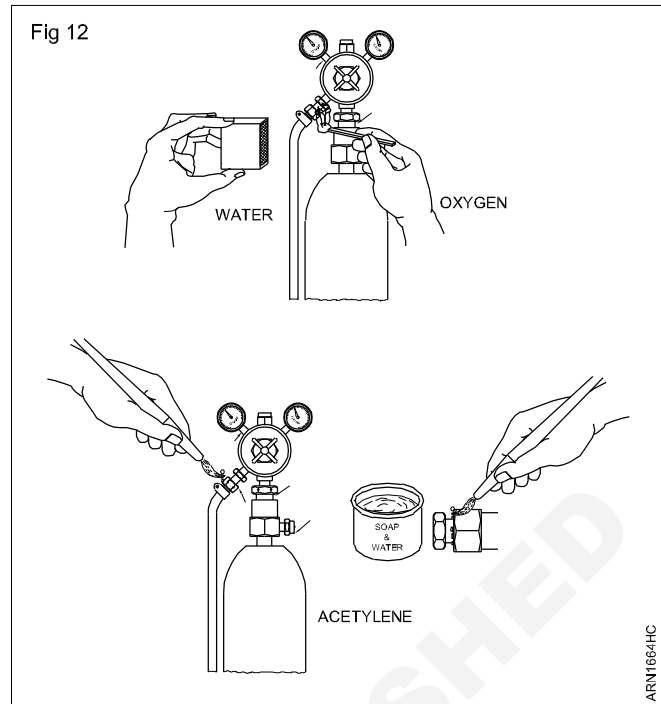
- 1 All connections must be tested for leakage.
- 2 Apply soap water solution for acetylene connections and fresh water for oxygen connections. (Fig 11)



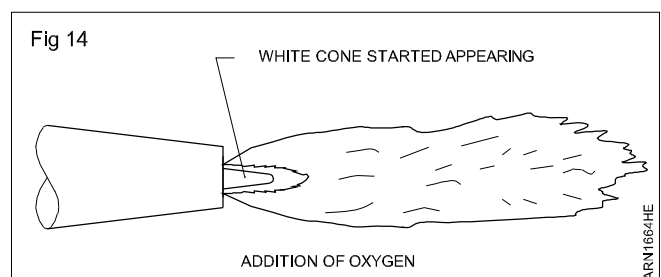
- 3 Use of soap water on oxygen connections may lead to fire hazards.
- 4 Never use matches or flame light during leakage test.

Lighting the flame

- 1 Attach the recommended size of nozzle to the neck of the welding blowpipe i.e nozzle No.3.
- 2 Open the gas cylinders and adjust the recommended gas pressure on the regulators.
- 3 The pressure of oxygen and acetylene is 0.15kgs/cm² for nozzle No.3.
- 4 Open cylinder valves very slowly.
- 5 While setting pressure on the regulator, keep the blowpipe control valve open for accurate setting.
- 6 Open the acetylene control valve 1/4 turn on the blowpipe and ignite with a spark lighter (Fig 12). Acetylene burns using the oxygen in the atmospheric air with a black smoke.
- 7 Avoid using any other source of fire other than the spark lighter.
- 8 Point the blowpipe in a safe direction in the open space, away from you and others.
- 9 Increase the acetylene till the black smoke disappears. (Fig 13)

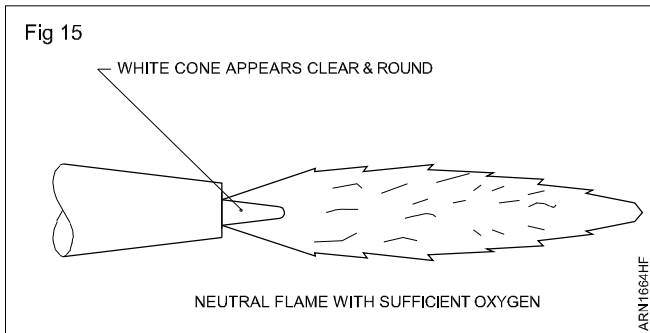


- 10 Observe the flame and add oxygen by opening the oxygen control valve of the blowpipe. Now a bright white cone starts appearing at the tip of the nozzle. (Fig 14)

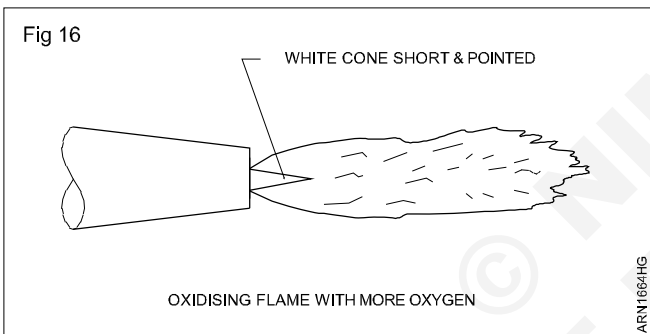


Flame adjusting to set different types of oxy-acetylene flames

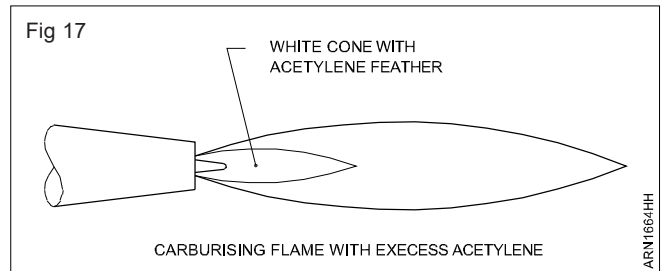
- 1 To adjust the neutral flame, and sufficient oxygen to make the white cone clear and round. (Fig 15)



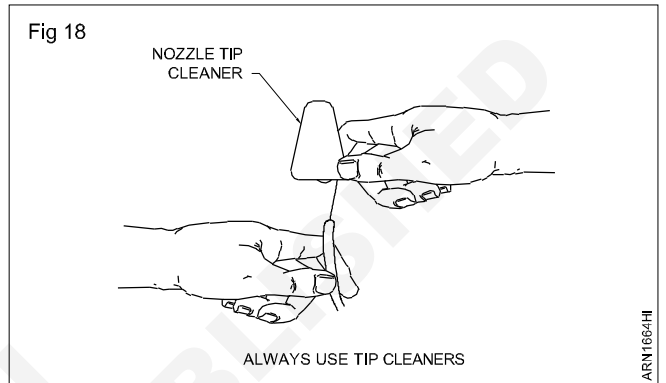
- 2 The gas mixture from the blowpipe has equal volume of oxygen and acetylene.
- 3 To adjust the oxidising flame, from neutral flame decrease acetylene flow.
- 4 The white cone will become short and sharp.
- 5 The flame will produce a hissing sound and will have a short length (Fig 16).



- 6 The gas mixture from the blowpipe has more volume of oxygen than acetylene.
- 7 To adjust the carburising flame, adjust the flame to neutral and then add acetylene.
- 8 The white cone will become long surrounded by a feather like portion.
- 9 The flame will burn quietly having more length (Fig 17)
- 10 The gas mixture from the blowpipe has more volume of oxygen than acetylene than oxygen.



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



- 12 Close the acetylene cylinder valve.
- 13 Close the oxygen cylinder valve.
- 14 Open the blowpipe acetylene valve and release all the gas pressure.
- 15 Open the blowpipe oxygen valve and release all the gas pressure.
- 16 Both the pressure gauges on the regulators should read zero.
- 17 Release the acetylene regulator pressure adjusting screw.
- 18 Close the blowpipe acetylene valve.
- 19 Close the blowpipe oxygen valve.

Ensure the following points

- There is no fire around the equipment.
- The gas is completely exhausted by dipping the nozzle in water.

Skill Sequence

Fusion runs without filler rod in flat position

Objectives: This shall help you to

- fusion runs without filler rod in flat position
- fusion runs with filler rod in flat position.

Fusion runs without filler rod in flat position

Mark and cut the M.S. sheet pieces of size 152 x 122 x 3.15mm using a hand lever shear.

Care should be taken to keep the fingers off from the shearing blades. Wear gloves to avoid injury.

Straighten the cut pieces by hammering on an anvil.

File and finish the sheet to dimensions as per drawing.

Mark and punch parallel lines on the sheet surface as per sketch and set the job piece on the welding table in flat position with fire brick support.

Select and attach nozzle size 3 to the blowpipe.

Wear safety apparels and gas welding goggles.

Set acetylene and oxygen pressure 0.15 kg/cm² on the regulators.

Ignite the oxy-acetylene gases and adjust the neutral flame.

Hold the blowpipe on the job at its right hand end at the required angle.

Start heating the surface on the right end of the sheet with slight circular motion to the blowpipe and produce a molten pool on the marked line.

Move the blowpipe from right to left direction maintaining a uniform speed and blow pipe angle.

Avoid excessive concentration of heat at any one point.

If the metal becomes too hot, lift the blowpipe momentarily away from the molten pool.

Do not touch the inner cone with the molten pool, to avoid backfire and flashback.

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

Stop at the left end and lift the blowpipe quickly.

Extinguish the flame and cool the blowpipe in water.

Clean the fused surface with a steel wire brush and inspect for the uniformity of fusion runs.

If the speed of travel and blowpipe motion are correct, the fusion runs will appear with uniform width and even ripples.

Repeat the above 4 more times to achieve uniform fusion and better manipulation of blow pipe.

Fusion run with filler rod in flat position

Select and fix the nozzle size 5 and set acetylene / oxygen pressure 0.15 kg/cm².

Select copper-coated, mild steel, (CCMS) filler rod of ϕ 1.6 mm.

Wear safety apparels and gas welding goggles.

Ignite the oxy-acetylene gases and set the neutral flame.

Hold the blowpipe on the right hand at an angle of 60° - 70° with the punched line of the job and make a small molten pool at the right hand edge of the line.

Keep the flame cone distance 2.0 to 3.0 mm above the job surface.

Hold the filler rod in the left hand, pointing near the molten pool with an angle of 30° - 40° with the line of weld.

Melt the base metal at the right end of a punched line and create a molten pool/puddle.

Fuse the end of the filler rod by dipping at the centre of the molten pool and add filler metal on the job surface to form a weld bead.

Move both the blow pipe and the filler rod towards left with uniform speed along the punched line with a slight circular motion to the blowpipe.

Move the filler rod up and down (piston like motion) at a constant speed.

Add enough rod into the molten pool to build up the bead evenly in height and width.

Adjust the rate of travel of the blowpipe with the filler rod to control the size of the bead and the required penetration/ depth of fusion.

Keep the filler rod end within the flame outer flame to avoid oxidation.

Stop at the left hand end of the punched line by filling the crater properly.

Extinguish the flame and cool the nozzle.

Clean the weld surface. Inspect for even ripples and uniform width/height of weld bead.

Repeat this for the remaining 4 more punched lines to achieve better manipulation of blow pipe and filler rod.

Practice on soldering and brazing

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

- make a joint by soft soldering
- brazing with M.S plate.

Task 1: Soldering procedure

After the surface has been thoroughly cleaned, proceed as follows;

1 Heat the portion to be soldered. Wipe it with a cloth after heating.

2 Stir solder paste well. Apply it with a brush to an area 1 to 1½ inches (25.4 to 38 mm) larger than the build up area.

3 Heat it from a distance.

4 Wipe the solder paste from the center to the outside.

- 5 Make sure the soldered portion is silver gray. If it is bluish, it is due to overheating. If any spot is not soldered, reapply the paste for soldering.

When soldering, keep the following points in mind;

- It is desirable to use a special torch for soldering. If a gas welding torch is used, the oxygen and acetylene gas pressures must be 4.3 to 5 psi (29.7 to 34 kPa).
- The solder must contain at least 13% zinc.
- Maintain the appropriate temperature.

- Move the torch so that the flame evenly heats the entire portion to be soldered (without heating a single spot only).
- When the solder begins to melt, remove the flame and start finishing with a spatula.
- When additional solder is required the previously built-up solder must be re-heated.
- Using a wet rag, clean off the excess flux.

Task 2: Brazing

- 1 Cut the sheets as per drawing and file the edges to be joined square.
- 2 Clean the joint area.
- 3 Set the sheets as a square butt joint without root gap
- 4 Select nozzle, filler rod, gas pressures, flux.
- 5 Set oxidising flame.
- 6 Use leftward technique.
- 7 Preheat the sheets and joint area to about 800°C.
- 8 Dip the hot filler rod in flux and melt the filler rod into the joint ensuring proper wetting conditions.
- 9 Avoid application of too much heat into the joint.

- 10 Finish the joint in one run only.
- 11 Clean the joint and inspect for weld defects like porosity etc and for slight root penetration and proper bonding.
- 12 Select the nozzle No.5 and 1.6mm** silicon bronze filler rod.
- 13 Apply flux to the filler rod.
- 14 Set the oxidising flame.
- 15 Manipulate the blowpipe and filler rod with flux applied on it using proper angles to fill the bell moulder groove.
- 16 Clean and remove the flux residue.
- 17 Inspect for external weld defects.

Brazing

Objective: This shall help you to

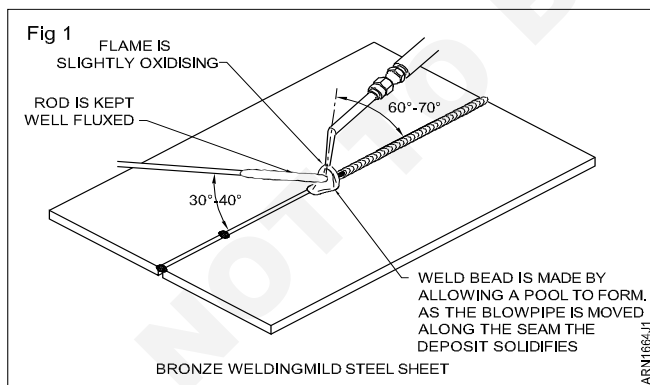
- brazing of MS sheet.

Brazing of MS sheet

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

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

A No.3 size nozzle is used as the base metal is not melted, but heated to around 800°C. Direct the flame to the joint edges and tack weld at the ends and centre of



the joint. (Fig 1)

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

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

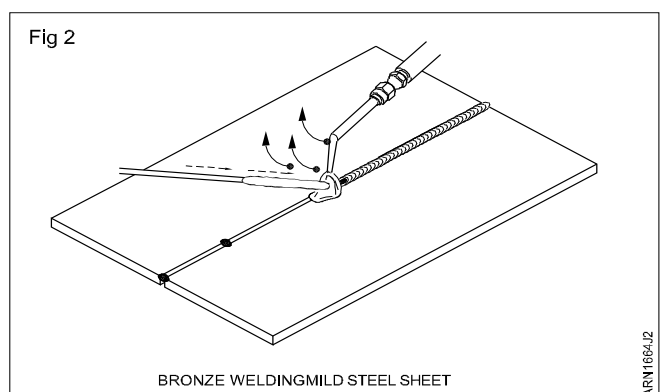
After establishing the molten pool the flame is withdrawn slightly (Fig 2) to permit the deposited metal freeze

partially. Again reintroduce the filler rod to melt further deposit. Observe the brazed area carefully to ensure proper bonding is obtained and a uniform weld size is achieved.

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

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

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



Practice on torch flame adjustment

Objective: At the end of this exercise you shall be able to
 • **adjust the torch flame of gas welding nozzle flame.**

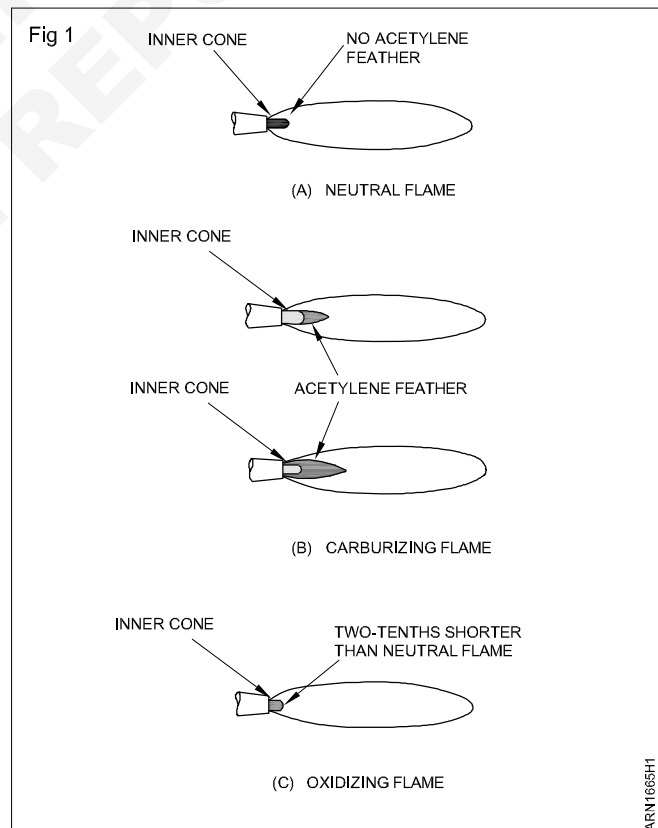
Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Gas lighter	- 1 No.	• Soap oil	- as reqd.
• Eye goggle	- 1 No.	• Flux	- as reqd.
Equipments			
• Gas welding plant	- 1 No.		

PROCEDURE

Gas welding torch flame adjustment

- 1 Position the full gas cylinder in a trolley and secure them with chain.
- 2 Keep the gas cylinder upright vertically in the cylinder stand on the floor.
- 3 Connect the gas cylinder regulators and gas flow rubber hose pipe.
- 4 Connect the welding nozzle.
- 5 Attach the appropriate tip to the end of the torch.
- 6 Use the standard tip for your need of welding flame.
- 7 Set the oxygen and acetylene regulators at the proper gas pressure.
 - Oxygen = 3 to 25 psi
 - Acetylene = 3 to 8 psi
- 8 Open the acetylene valve about half a turn and ignite the gas.
- 9 Continue to open the valve until the black smoke disappears and a radish yellow flame appears.
- 10 Slowly open the oxygen valve until a blue flame with a yellowish white cone appears.
- 11 Open the oxygen valve until the center cone becomes sharp and well defined.
- 12 Adjust the oxygen and acetylene valves for preheating natural flame. (Fig 1A)
- 13 Open the preheating oxygen valve slowly until an oxidizing flame appears.
- 14 To adjust the oxidising flame (Fig 1C) from natural flame decrease acetylene flow. The white cone will become and sharp.

- 15 To adjust the carburising flame (Fig 1B) adjust the flame to natural and then acetylene.
- 16 The carburising flame will burn quietly having more length. The gas mixture from the blow pipe has more volume of acetylene than oxygen gas.



Practice on identify the different parts of MIG welding machine

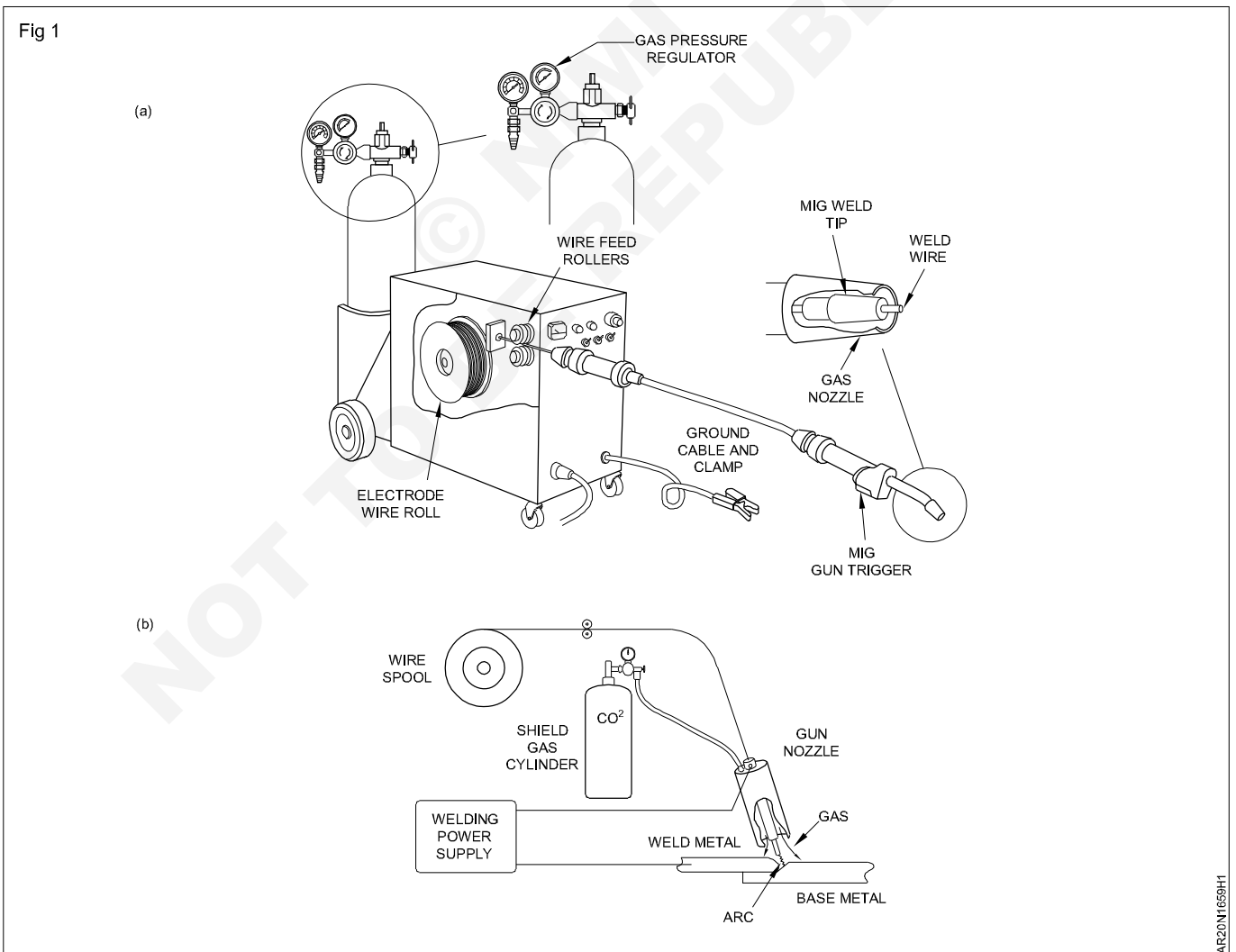
Objectives: At the end of this exercise you shall be able to

- identify the parts of MIG welding machine
- selection of welding specification as per welding manual
- selection of MIG welding wire.

PROCEDURE

Task 1: Identification of MIG welding machine parts (Fig 1)

- | | |
|---|---|
| 1 Identify the MIG welding machine on the shop floor. | 8 Locate the MIG weld wire. |
| 2 Locate the MIG welding shield gas cylinder. | 9 Locate the gas nozzle. |
| 3 Locate the gas cylinder gas pressure regulator. | 10 Locate the MIG welding power supply. |
| 4 Locate the electrode wire roll. | 11 Locate the welding gas gun nozzle. |
| 5 Locate the ground cable and clamp. | 12 Locate the base metal. |
| 6 Locate the MIG welding gun trigger. | 13 Locate the gas blow unit. |
| 7 Locate the MIG weld tip. | |



AR20NT1659H1

Task 2: Selection of weld specification as per manual

- 1 Select the type of metal and thickness of metal.
- 2 Location of factory weld for proper panel removal.
- 3 Preparation of new panel for installation corrosion protection, scaler use, size and location of punched hole for plug weld.
- 4 Number and location of clamps needed to secure panel before welding.
- 5 Measure the points of factory values for accurately positioning a new panel.
- 6 Count the location of the welds required to secure a panel.
- 7 Sizes of hole to be punched in a new flange.
- 8 Type of weld required.
- 9 Select the welding wire for well.
- 10 Select the power supply.
- 11 Refer the manual of a particular vehicle and need for weld specification.

Task 3: Selection of MIG welding wire

- 1 Select the welding wire according your job requirement refer the welding manual for correct specification of welding wire.
- 2 MIG welding electrodes are solid wire ranges from a thickness of .023" to .045" (.023", .030", .035", .045")
- 3 Use the larger thickness for the thicker base metal.
- 4 Select the welding wire usually plated with copper to prevent oxidation.
- 5 Select the weld wire aid in electrical conductivity and increase the life of the welding contact tip.
- 6 Wire should be good wear, excellent heat resistance low temperature resistant.
- 7 High strength anti corrosion.
- 8 Small welding deformation.
- 9 Good adaptability easy to realized continuous automated welding.
- 10 Steel unibody panels are common welded using 0.023" (0.58 mm) MIG wire.
- 11 Vehicle frame weld used the MIG weld wire size is 0.035" (0.89 mm)
- 12 Aluminium alloy body parts weld used the MIG weld wire size 0.030" to 0.035" (0.76 to 0.89 mm)

Practice on surface preparation and setting of MIG and plug welding parameters

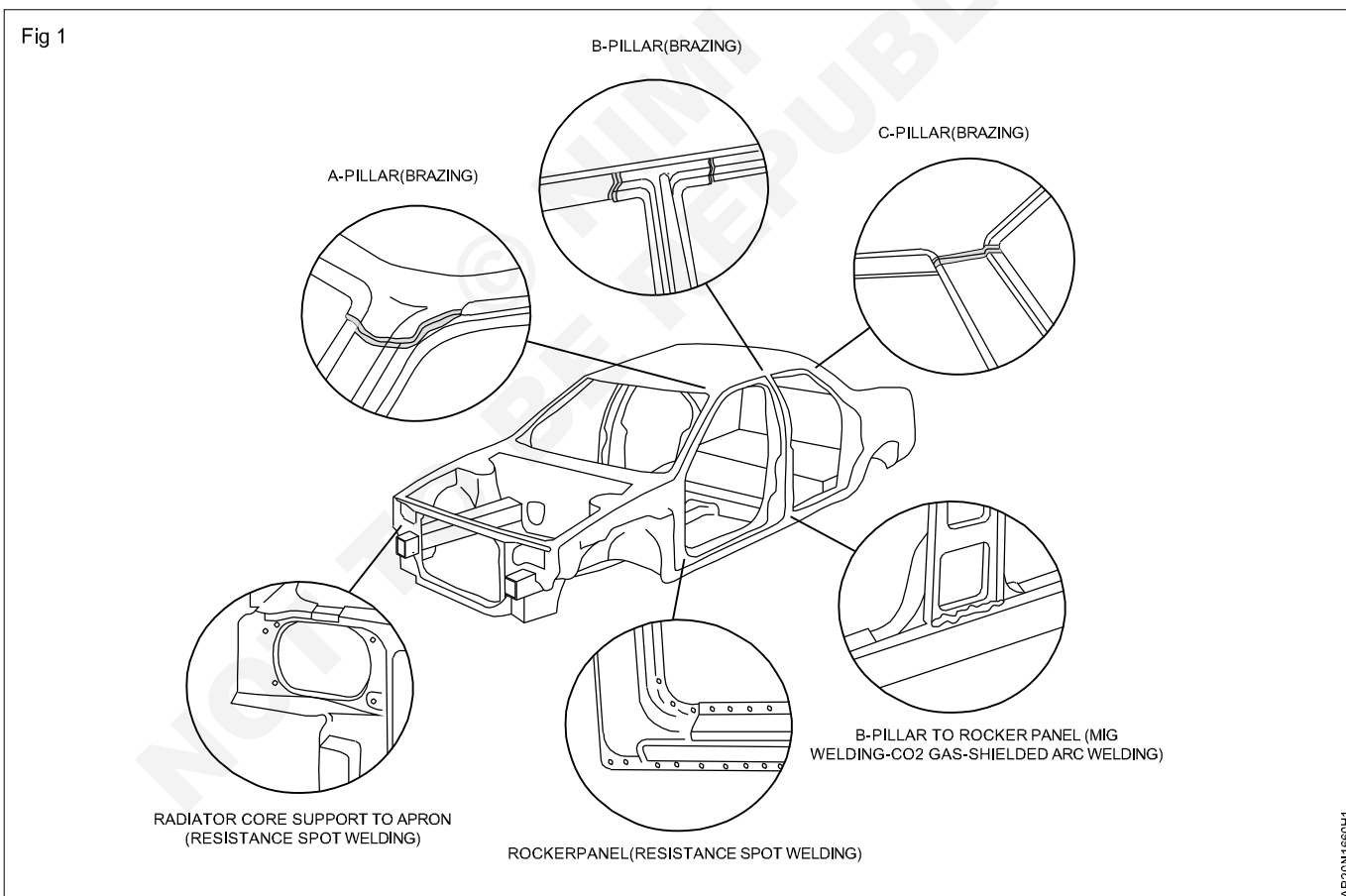
Objectives: At the end of this exercise you shall be able to

- compare the welding methods used in vehicle
- setting of welding parameters
- use of clamping and MIG welding sample panel
- plug weld hole of body panel.

PROCEDURE

Task 1: Welding methods used in vehicle production (Fig 1)

- | | |
|---|---|
| 1 Refer the vehicles service manual before welding. | A - Pillar - Brazing weld |
| 2 All the new welds should be similar in size to the original factory welds. | C - Pillar - Brazing weld |
| 3 The number of replacement welds should be the same as the original number of welds in repair works. | B - Pillar to rocker panel - Mig welding - Co ₂ gas shielded arc welding |
| 4 The following welding methods are used in vehicle production. | Rocker panel - Resistance spot weld |
| | Radiator core support to apron - Resistance spot welding. |
| B - Pillar - Brazing weld | |



Task 2: Surface preparation and setting of welding parameters

- | | |
|---|--|
| 1 Clean the weld area to be welded are completely both front and back use wax, access point remover and a clean rag, clean the metal until sheng with steel wire brush. | 2 Identify the which metal sheet used at damaged panel. |
| | 3 Measure the thickness of sheet. |
| | 4 Select the type of weld required to panel repair work. |

- 5 Match the suitable weld wire to the damaged panel.
- 6 Set the wire speed as suitable for the panel metal.
- 7 Set the voltage for the arc.
- 8 Set the shielding gas flow rate.
- 9 Set work cable and clamp assembly work piece.
- 10 Position the two pieces together and lay a bead along the entire joint. The distance between contact tip and weld should be 8-14 mm.
- 11 Set the power supply to control welding current.
- 12 Adjust the line pressure regulator.
- 13 Adjust and control the gas pressure adjustment valve.
- 14 Refer the table 1 for welding parameters and techniques.

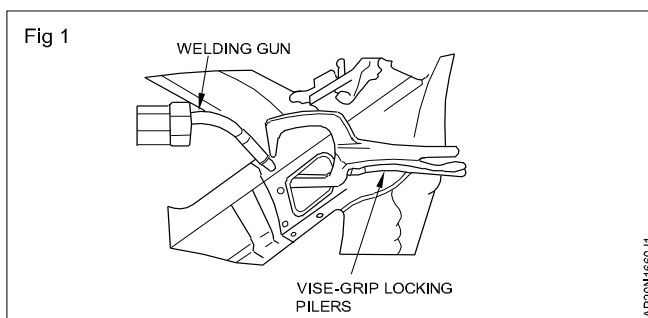
Table 1

Adjustments in welding parameters and techniques

Welding variables to change	Desired changes							
	Penetration		Deposition rate		Bead size		Bead with	
	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease
Current & wire feed speed	Increase	Decrease	Increase	Decrease	Increase	Decrease	No effect	No effect
Voltage	Little effect	Little effect	No effect	No effect	No effect	No effect	Increase	Decrease
Travel Speed	Little effect	Little effect	No effect	No effect	Increase	Decrease	Increase	Decrease
Stickout	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease
Wire diameter	Increase	Decrease	Increase	Decrease	No effect	No effect	No effect	No effect
Shield gas percent CO ₂	Increase	Decrease	No effect	No effect	No effect	No effect	Increase	Decrease
Torch angle	Backhand to 25°	Forehand	No effect	No effect	No effect	No effect	Backhand	Forehand

Task 3: Use of clamping tools for welding (Fig 1)

- 1 Identify the clamping tool required to hold the panel like locking jaw, pliers, c-clamps, sheet metal screws tack weld or special clamps.
- 2 clamping tools are used to clamp panels together.
- 3 Take care and close attention during clamp panels together for welding practice.
- 4 Where both side of panel not possible to use clamp, use the sheet metal screws or pop rivets.
- 5 Always use the proper clamping tool during welding operation.
- 6 To clamp panels together with sheet metal screws punch or drill holes through the panel.



Task 4: Plug weld hole for body panel replacement

- 1 Every holes on the panel is filled with a sheet metal screw.
- 2 The empty holes are plug welded by using proper plug welding techniques.
- 3 After plug weld the holes remove the metal screws.
- 4 After removing the metal screws welded the holes by plug welding.
- 5 Fixture can also be used in case additional clamping required to hold the panels to be welded proper alignments.

Practice on spraying antispatter compound into a MIG nozzle

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

- spraying antispatter compound into a MIG nozzle
- welding in different overhead positions.

Requirements

Tools/Instruments

- Trainee's tool kit

- 1 No.

Equipments

- MIG welding machine

- 1 No.

Materials

- Metal sheet
- Antispatter compound

- as reqd.

- as reqd.

- Welding wire
- Gas cylinder
- Cotton waste
- Soap oil
- Wire brush
- Rag

- as reqd.

- as reqd.

- as reqd.

- as reqd.

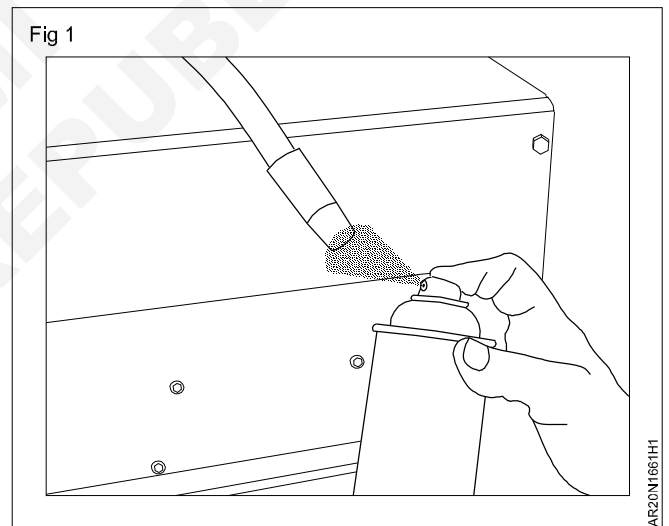
- as reqd.

- as reqd.

PROCEDURE

Task 1: Spraying antispatter compound into a MIG nozzle (Fig 1)

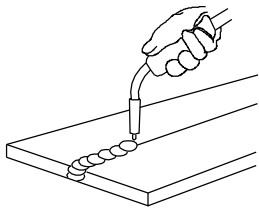
- 1 Remove the weld spatter promptly other wise weld spatter on the tip will prevent the wire from moving freely.
- 2 Use the suitable tool to remove spatter such as a file to remove spatter from the MIG weld nozzle.
- 3 Spray the antispatter compounds into the nozzle as shown in Fig 1 will helps to protect the tip and prevent the wire sticking in the gun.
- 4 The antispatter compound reduce the amount of spatter, that adheres to the nozzle.
- 5 After spray the antispatter compound, check to see that the weld wire comes out smoothly.



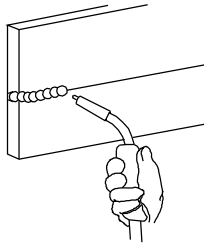
Task 2: Basic overhead welding positions (Fig 2)

- 1 The basic welding position is usually dictated by the location of the weld in the structure of the vehicle.
- 2 Identify the location of damaged area in the vehicle.
- 3 Identify the welding position needed to repair the damaged area of the vehicle.
- 4 If the damaged panel is parallel with shop floor, that panel can be welded in the flat welding position.
- 5 If the vehicle panel damage is locating in side ways that panel can be welded in the horizontal welding position.
- 6 If the panel damage turned upright that can be welded in vertical position welding start the arc at the top of the joint and pull down ward with steady drag.
- 7 If the panel damage turned upside down that can be welded in over head position welding always over head welding at a lower voltage and keeping the arc as short as possible. Press the nozzle against the work to ensure that the wire is not moved away from the puddle wear protective equipment while overhead welding practice on the vehicle.

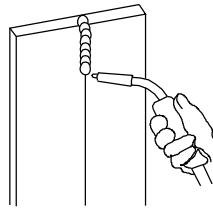
Fig 2



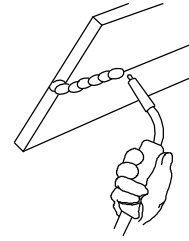
FLAT



HORIZONTAL



VERTICAL



OVERHEAD

AFN1668H2

© NIMI
NOT TO BE REPUBLISHED

Practice on basic welding techniques and identify the parts of spot welding machine

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

- use of basic welding techniques
- identify the different parts of spot welding machine.

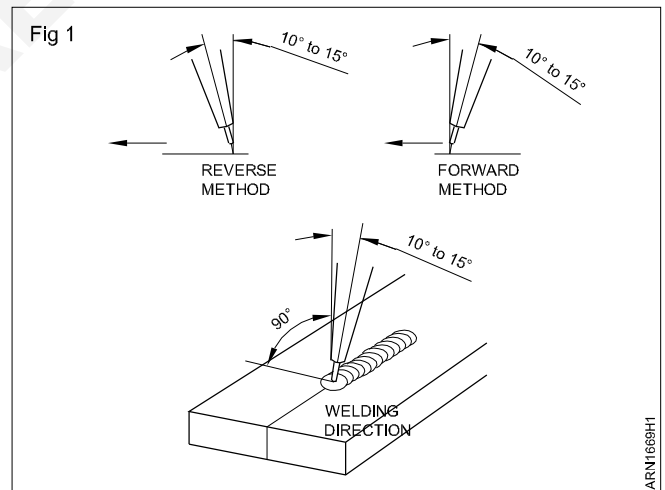
Requirements		
Tools/Instruments		Materials
<ul style="list-style-type: none"> • Trainee's tool kit • Steel wire brush 	<ul style="list-style-type: none"> - 1 No. - 1 No. 	<ul style="list-style-type: none"> • Welding wire • Cotton waste • Soap oil
Equipments		
<ul style="list-style-type: none"> • Spot welding machine 	<ul style="list-style-type: none"> - 1 No. 	<ul style="list-style-type: none"> - as reqd. - as reqd. - as reqd.

PROCEDURE

<p>The following points are to be carryout by before doing welding done</p> <ul style="list-style-type: none"> • Measure the thickness of the metal. • Inspect the condition of the metal. • Measure the amount of gap between the pieces to be welded. • Set the proper welding position as specified.
--

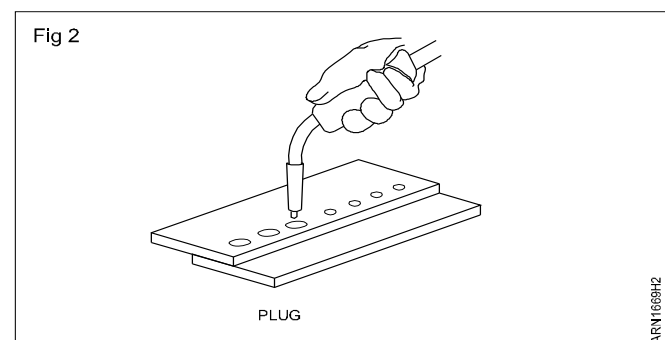
Task 1: Continuous welding techniques (Fig 1)

- 1 Continuous welding used for uninterrupted seam or bead is laid down in a slow, steady on going movement.
- 2 Support the gun securely and use the forward welding method.
- 3 Move the torch continuously at a constant speed and looking frequently at the welding speed.
- 4 Welding gun should be inclined between 10° to 15° angle.
- 5 Always maintain proper tip-to-base metal distance and correct gun angle.
- 6 Bring the gun closer the base metal for proper penetration and a better weld.



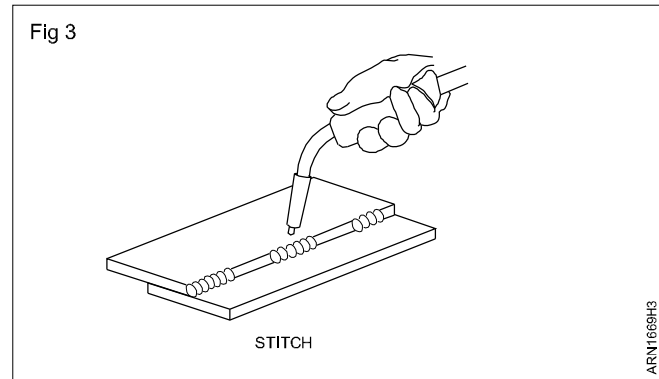
Task 2: Plug welding techniques (Fig 2)

- 1 Place the drilled or punched work piece on the work bench.
- 2 Prepare the welding machine for plug weld.
- 3 Direct the weld arc through the hole to penetrate the inside piece.
- 4 Fill the molten metal in lunched or drilled hole of the workpiece as shown in the Fig 2.



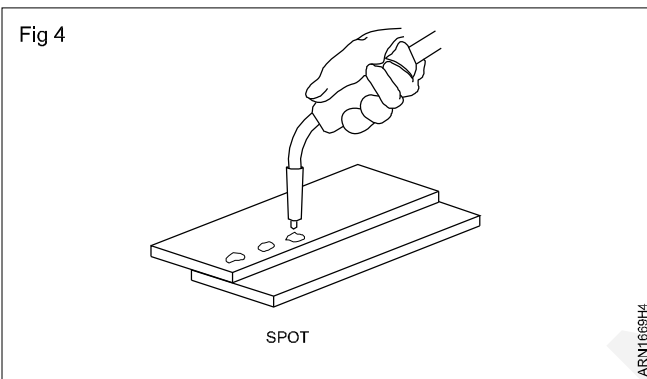
Task 3: Stich welding techniques (Fig 3)

- 1 Place the weld work piece on the work bench.
- 2 Prepare the welding machine for stich welding.
- 3 Clean the work piece with cleaning solvent and dry it.
- 4 Switch on the welding machine and connect earth cable with weld piece.
- 5 Position the welding gun angle as specified limit and maintain the proper tip-to-base metal and correct the gun angle.
- 6 Create a continuous seam weld in a series of connecting stich weld.



Task 4: MIG spot welding techniques (Fig 4)

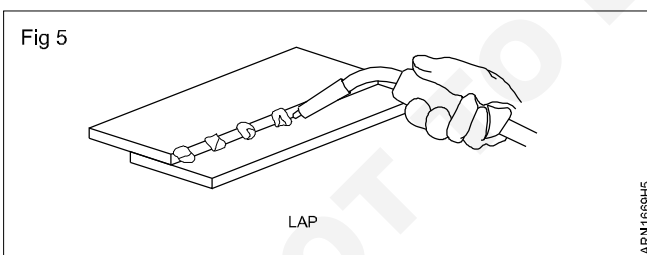
- 1 Place the workpiece on the work bench.
- 2 Clean the weld area with cleaning solvent and dry it.



- 3 Prepare the MIG welding machine and connect the earth cable with work piece.
- 4 Position the weld gun angle and maintain the distance between tip-to-base metal.
- 5 Direct the arc to penetrate both pieces of metal while triggering a timed impulse of wire feed.
- 6 MIG spot weld informations gather from machines owners manual.
- 7 For MIG spot welding a special welding nozzle must be replace the standard nozzle.
- 8 Set the spot timing, welding heat and back burn time.
- 9 Ensure the arc melts through the outer layer and penetrates the inner layer of lower sheet.

Task 5: Lap welding techniques (Fig 5)

- 1 Lap welding techniques are used to fusing two surfaces to be joined at the top edge of two overlapping surfaces.



- 2 Lap welding is used for panel repair works, not for structural panels are involved.
- 3 Clean the damaged panels to be repaired.

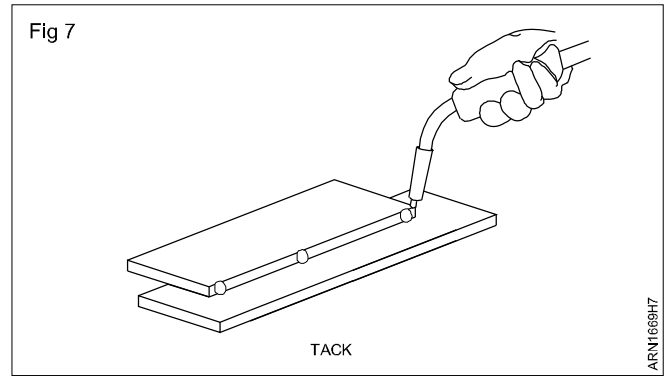
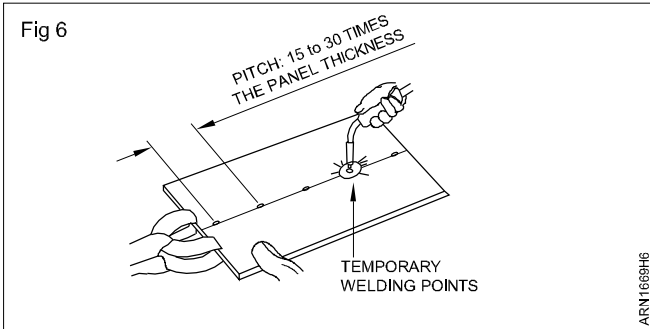
- 4 Clean and remove the original factor lap welds on outer panels.
- 5 Switch on the welding machine and prepare for the panel welding.
- 6 Set the machine and weld gun angle to your suitable position.
- 7 Start the welding and ensure the lap welding work is as uniform manner.
- 8 Welding should never be made continuously.
- 9 Allow for natural cooling to prevent temperature build up in the welding area.

Task 6: Tack welding techniques (Fig 6&7)

- 1 Clean the metal parts to be joined.
- 2 Set the metal sheets to be joined.
- 3 Measure the thickness of the panel and calculate the distance of tack welding required to hold metal sheets on it is position.

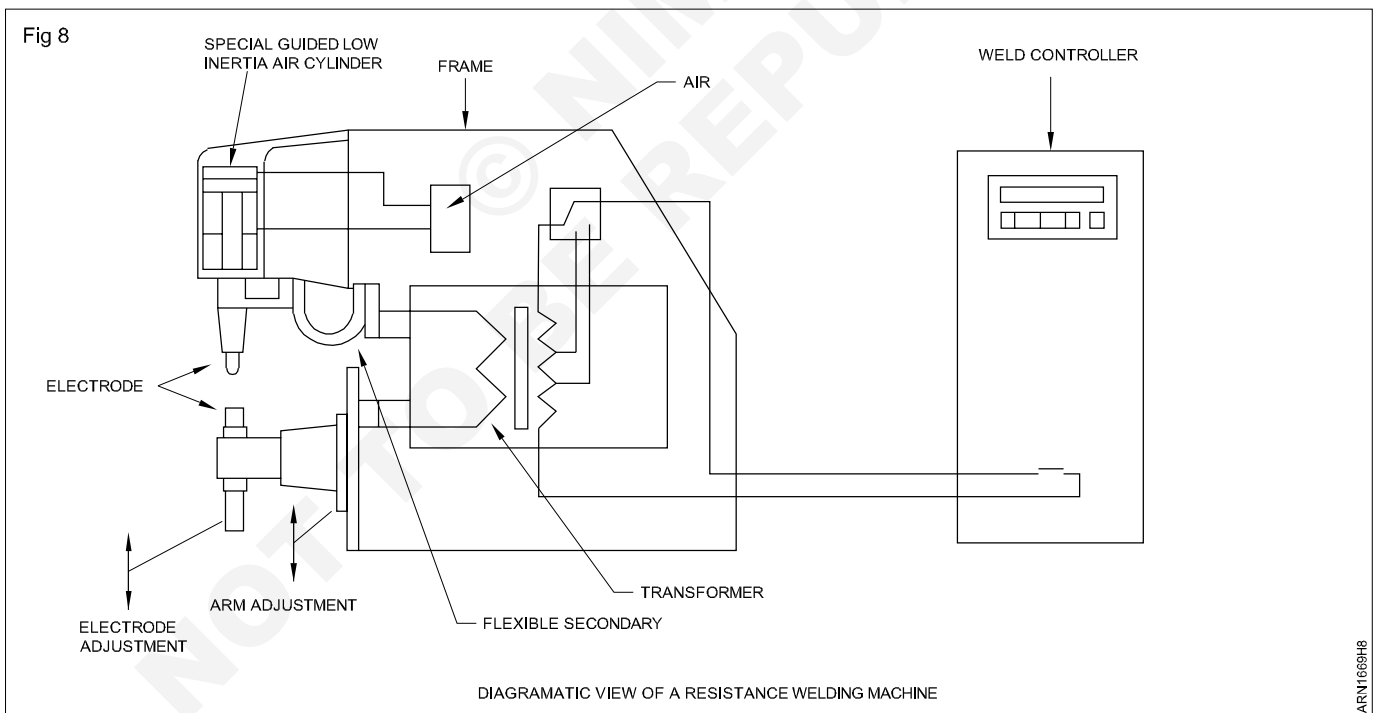
- 4 Tack weld distance should be 15 to 30 times of the panel thickness.
- 5 Prepare the welding machines and weld tack welding in equal distance.

Note: The temporary tack welds are very important in maintaining proper panel alignment and must to be done accurately.



Task 7: Identify the parts of spot welding machine (Fig 8)

- | | |
|-------------------------|------------------------------|
| 1 Electrodes | 6 Weld controller |
| 2 Electrodes adjustment | 7 Air |
| 3 Arm adjustment | 8 Spot welding machine frame |
| 4 Flexible secondary | 9 Low inertia air cylinder |
| 5 Transformer | |



Practice on resistance spot welding process

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

- resistance spot welding process on different thickness materials.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Metal sheet	- as reqd.
Equipments		• Welding wire	- as reqd.
• Resistance spot welding machine	- 1 No.	• Cotton waste	- as reqd.
		• Soap oil	- as reqd.
		• Wire brush	- as reqd.

PROCEDURE

Task 1: Resistance spot welding practice on different thickness metal sheets

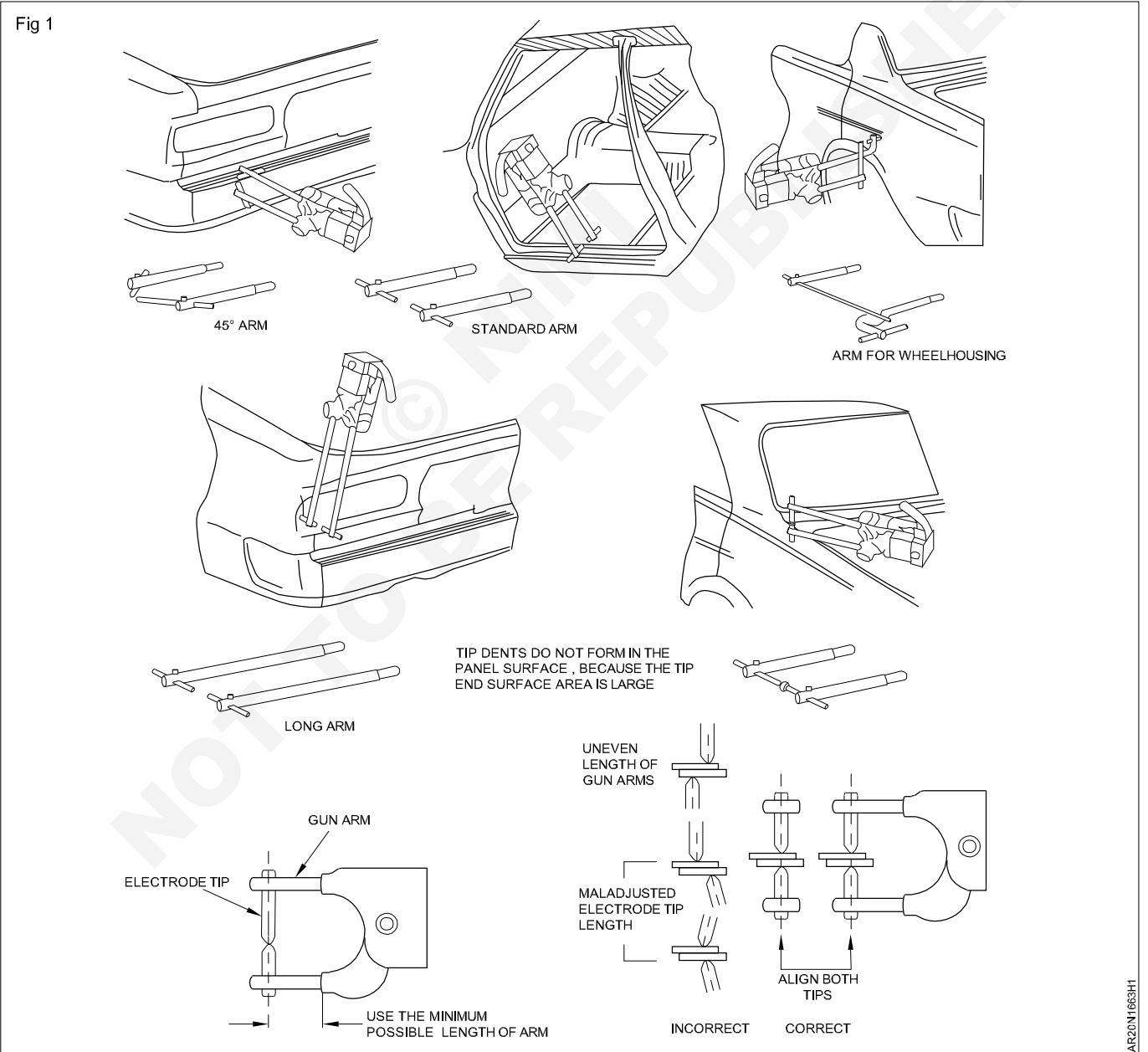
- 1 Check metal sheet thickness.
 - 2 Prepare the resistance spot welding machine.
 - 3 Check the current flows from the tips through the base metal causing the metal to melt and fuse together.
 - 4 Measure the current flow through electrodes and through the two pieces of metal and set the correct current flow.
 - 5 Clean the metal sheet to be spot welded.
 - 6 Refer the operators manual for setting a resistance spot welding.
 - 7 Select the arm according to the area to be welded.
 - 8 Keep the gun arm as short as possible to obtain the maximum pressures for welding.
 - 9 Securely tighten the gun arm and tip.
 - 10 Align the upper and lower electrode tips on the same axis.
 - 11 Decrease the diameter of spot weld when the diameter of the electrode tip increases.
 - 12 Electrical current flow has a relationship to formation a spot weld, when the electrical current flow time increases the generated increases the spot weld diameter and penetrates.
 - 13 Adjust the arm length or welding time according to the thickness of the panels to get best welding result (Fig 1).
- Follow the spot welding positions as table 1&2

Table 1 - Spot welding positions

Panel thickness	Pitch S	Edge distance P	
1/64 in.	7/16 in or more	13/64 in or more	
1/32 in.	9/16 in or more	13/64 in or more	
Less than 3/64 in.	11/16 in or more	1/4 in or more	
3/64 in.	7/8 in or more	9/32 in or more	
1/16 in.	1-9/16 in or more	5/16 in or more	

Table 2 - Positions welding spot from end of panel

Thickness (t)	Minimum Pitch (l)	
1/64 in.	7/16 in. or over	
1/32 in.	7/16 in. or over	
Less than 3/64 in.	15/32 in. or over	
3/64 in.	9/16 in. or over	
1/16 in.	5/8 in. or over	
1/64 in.	11/16 in. or over	



Practice on tip dressing, tip changing, weld test and check the spot weld quality

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

- dressing and changing the welding tip
- chisel and nugget spot welding test
- check the spot weld quality.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Weld wire	- as reqd.
Equipments		• Cotton waste	- as reqd.
• Spot welding machine	- 1 No.	• Soap oil	- as reqd.
• Work bench	- 1 No.	• Welding tip	- as reqd.

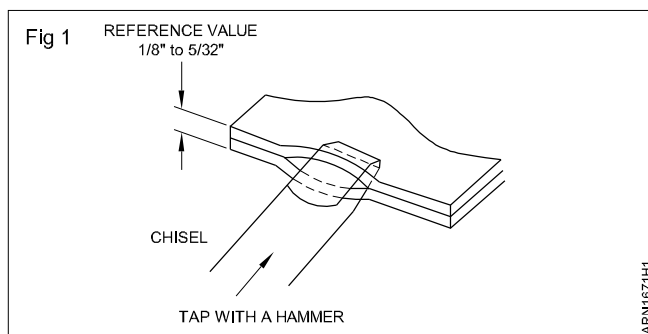
PROCEDURE

Task 1: Dressing and changing the welding tip

- 1 Clean the spot weld gun tip.
- 2 Select the tip dresser pneumatic tool to grid electrode tips.
- 3 Check pneumatic tools cutter holder and cutter blade are in good condition.
- 4 Check the tip dresser tool air supply system.
- 5 Check the dresser tool rotating speed (1300-1500 rpm) it can be used to cut ϕ 8 - ϕ 19 electrode tip.
- 6 Change the dresser cutting tool in cutter blade to the size to tip dressing resets the electrode shape to meet the precise specifications.

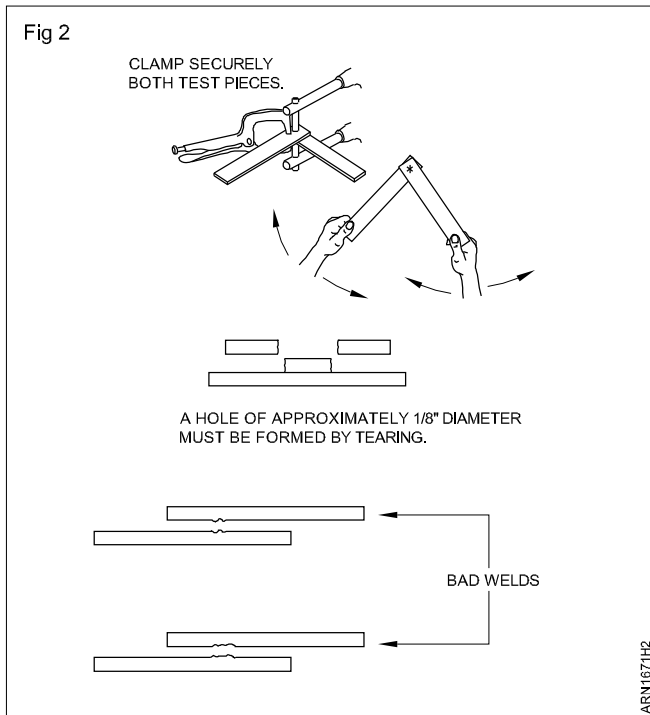
Task 2: Spot welding parameter and testing of chisel test

- 1 Check the electrode force.
- 2 Check the diameter of the electrode contact surface.
- 3 Check the squeeze time taken.
- 4 Check the weld time taken.
- 5 Check the weld current flow through tips.
- 6 Use chisel and hammer to proceed the chisel test.
- 7 Insert the tip of a chisel between the welded plates.
- 8 Tap end of the chisel until a clearance of 1/2 to 1/32 inches (3.2 to 3.97 mm) when the plate thickness is approximately 0.79 mm is formed between the plates.
- 9 If the welded portion remain normal it indicates that the welding has been done properly.
- 10 If the thickness of the plate is not equal, the clearance between plates must be limited to 1.58 to 1.98 mm.
- 11 Repair the deformed portion of panel by use of hammer and chisel (Fig 1).



Task 3: Nugget test for spot welding

- 1 Select the metal as welded piece.
- 2 Check the metal piece thickness is made.
- 3 Weld the piece in the position shown in the Fig 2.
- 4 Apply the force in the direction of arrow.
- 5 Ensure the weld spots are separated and check the weld breaks is satisfactory.
- 6 The test should be noted that since the weld performance cannot be exactly duplicated by this test.



Task 4: **Spot weld quality check**

- 1 Check the finish of the weld visually and by touching.
- 2 Check the spot position should be center of the flange.
- 3 Ensure no tip holes and have no spot weld over sliding the edge.
- 4 Ensure there should be more times the number made by the manufacturers.
- 5 Weld pitch should be a little shorter than that of the manufacturer and spot should be uniformly spaces.
- 6 There should be no dents on the surfaces that exceed half the thickness of the panel.
- 7 There should be no pin holes that are large enough to see rubbed across it.

Practice on plasma cutting operation

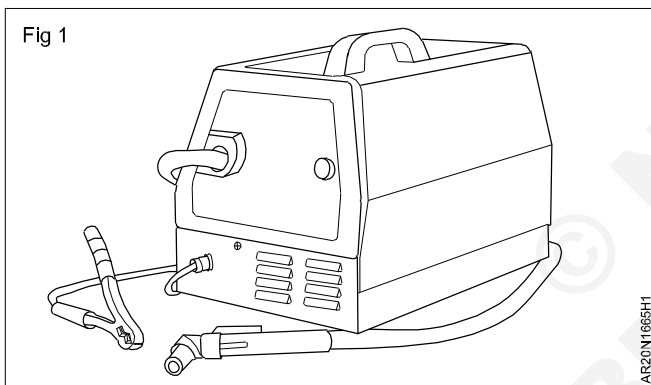
Objective : At the end of this exercise you shall be able to
 • use the plasma cutting operation method.

Requirements	
Tools/Instruments	Materials
<ul style="list-style-type: none"> • Trainee's tool kit - 1 No. • Wire brush - 1 No. 	<ul style="list-style-type: none"> • Cotton waste - as reqd. • Soap oil - as reqd. • Electrode - as reqd. • Cutting nozzle - as reqd.
Equipments	
<ul style="list-style-type: none"> • Plasma arc cutter unit - 1 No. 	

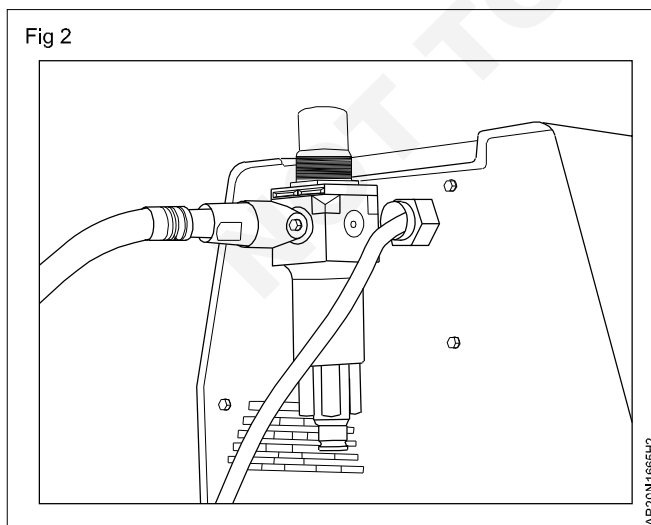
PROCEDURE

Plasma cutting operation

1 Clean the plasma arc cutter use an electric arc and a blast of air to cut metal quickly (Fig 1).

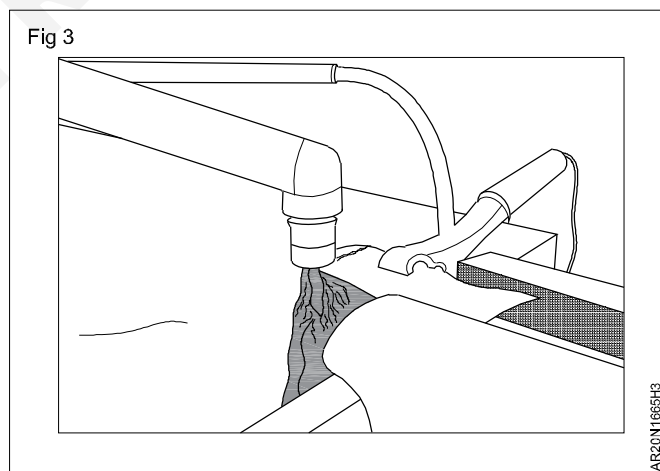


2 Connect the air hose to a filter/drier on back of the plasma arc cutting machine (Fig 2).



3 Provide compressed air with minimum line pressure of 60 psi at the air connection.

- 4 Connect the torch and ground the clamp to the unit.
- 5 Connect the ground clamp to a clean metal surface on the vehicle. The clamp should be as close as possible to the area to be cut.
- 6 Move the cutting nozzle into contact with an electrically conductive part of the work.
- 7 Ensure the satisfy the work safety circuit.
- 8 Hold the plasma torch cutting is perpendicular to the work surface and push the plasma torch down (Fig 3).



- 9 Ensure plasma torch force the cutting nozzle down until it comes in contact with the electrode and check the plasma arc.
- 10 Release the downward force on the torch to let the cutting nozzle return to its normal position.
- 11 Keep the cutting nozzle in light contact with the work.
- 12 Drag the gun lightly across the work surface.
- 13 Move the plasma torch in the direction the metal is to be cut the metal.

14 Increase the speed of arc cutting according to the thickness of the metal sheet.

Note: If the torch is moved too fast it will not cut all the way through. If moved too slowly, it will put too much heat into the work piece and might also extinguish the plasma arc. Torch cooling is important to extend the life of the electrode and nozzle.

15 When making long straight cuts, use a metal straight edge as a guide.

16 For electrode cuts make a template out of the thin sheet metal and guide the tip along that edge.

17 When cutting 6mm material start the cut at the edge of the material.

18 Use the welding blanket to protect the paint and pit glass.

19 Before arc cutting ensure there is nothing behind the panel that can be damaged, check for wiring fuel lines sound dead end materials and other objects that could cause a fire.

© NIMI
NOT TO BE REPUBLISHED

Practice on minor repair of damaged car

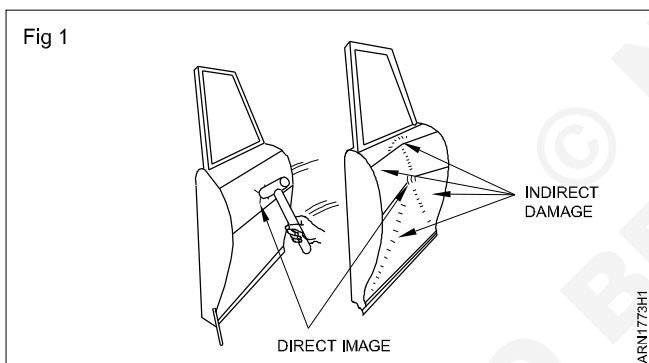
Objective : At the end of this exercise you shall be able to
 • minor repair of damaged car.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Metal sheet	- as reqd.
• Hand and power puller	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Soap oil	- as reqd.
• Minor damaged car	- 1 No.		
• Arc & gas welding equipment	- 1 No.		

PROCEDURE

Minor repair of damaged car

- 1 Park the vehicle on the body repair shop.
- 2 Visually inspect the damaged vehicle and measure and calculate the damaged area.
- 3 Identify the type of damaged on the car (Fig 1).



- 4 Identify which type metal used on the damaged panel.
- 5 Identify whether panel sheet is raising or lowering in its original position.
- 6 Apply force on minor damaged area, the pressure is being held there by the work hardened buckles.

- 7 Due to force appear on damaged area suddenly disappear, the dented metal would return to it is original shape.
- 8 Rough out the damage can be simple as using a rubber or plastic hammer.
- 9 Give pressure on damaged area depend upon condition of damage, whether it is pressure a give pressure pushed up.
- 10 Whether damaged area is tension areas give pressure push down on damaged panel.
- 11 Use the recommended tools to repair the minor damaged area.
- 12 Apply the force in the reverse of how the damage occurred.
- 13 Carefully placed hammer blows on the back of the panel may be all needed to straighten the minor damage and ensure the hammer need strikes the metal squarely.

Mechanic Auto Body Repair - Auto Body Sheet Metal Repair

Practice on using a hammer and dolly for straighten the damaged door

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

- use a hammer on damaged door panel
- use a dolly on damaged door panel for straighten.

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Dolly - 1 No.
- Body hammer (different size) - 1 Set.

Equipments

- Vehicle - 1 No.

- Air compressor - 1 No.

Materials

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

PROCEDURE

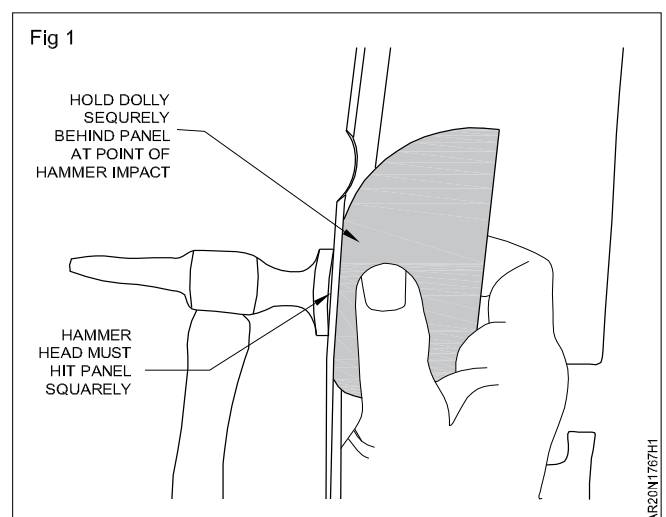
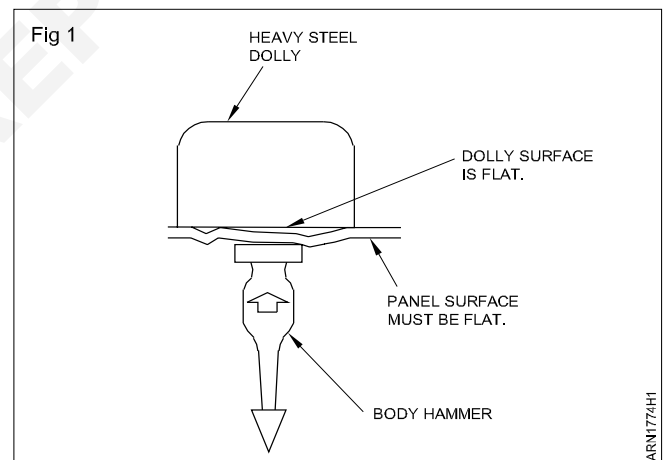
Using a body hammer and dolly to straighten the damaged car door

- 1 Park the vehicle on the vehicle body repair shop.
- 2 Clean the vehicle.
- 3 Visually inspect the vehicle for identifying the damage on the car door.
- 4 Find out the type of damage (direct or indirect).
- 5 Select the tools for repair the minor dent and bumps.
- 6 Mark the damaged area on the door panel.
- 7 Select the body hammer size to repair the damaged panel.
- 8 Hold the hammer end of the handle and hit the right spot at the time with weight hammer and with right amount of force.
- 9 When using a body hammer swing in a circular motion at your risk.
- 10 Hit the part squarely and let the hammer rebound off the metal. Space each blow 9.5 to 13 mm apart until the damaged metal is level.
- 11 Use a flat face on flat panel and use a convex-shaped face when bumping inside curves.
- 12 Use a heavy body hammer for roughing out the damage.
- 13 Finishing or dinging hammer used for final shaping.
- 14 Use the plastic soft faced or rubber faced hammer arc used where do not want to chip paint on a panel.
- 15 Various shapes of dolly used for straighten the sheet metals.
- 16 Strike the back side of a dented panel with the dolly to raise low areas and to unroll buckles.
- 17 The contour of the dolly fit the contour of the back side of damaged area.
- 18 Use accurate hammer blows and start out with light blow from the dolly and sure hitting exactly, where hitting needed. (Fig 1&2)

- 19 Gradually increase the force of your blows to raise the damage.

- 20 Increase rebound blows by releasing pressure as soon as the dolly hits on the panel.

- 21 If need use a large dolly to increase impact and rebound force on the panel.



Practice on a long spoon to pry out a fender

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

- use the long spoon to pry out
- use the hammer for straightening the panel with long spoon.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Dolly	- 1 No.	• Soap oil	- as reqd.
• Long spoon	- 1 Set.	• Emery sheet	- as reqd.
• Body hammer (different size)	- 1 Set.		
Equipments			
• Vehicle	- 1 No.		

PROCEDURE

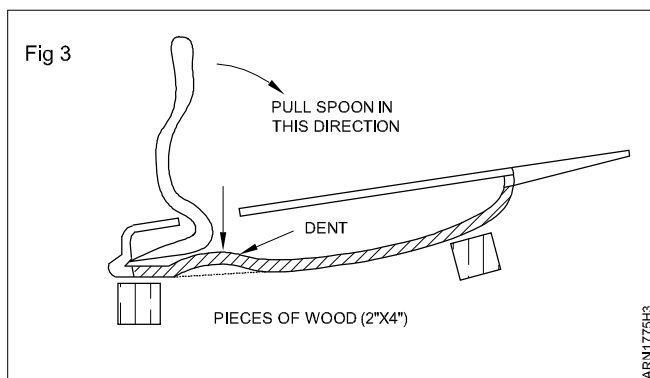
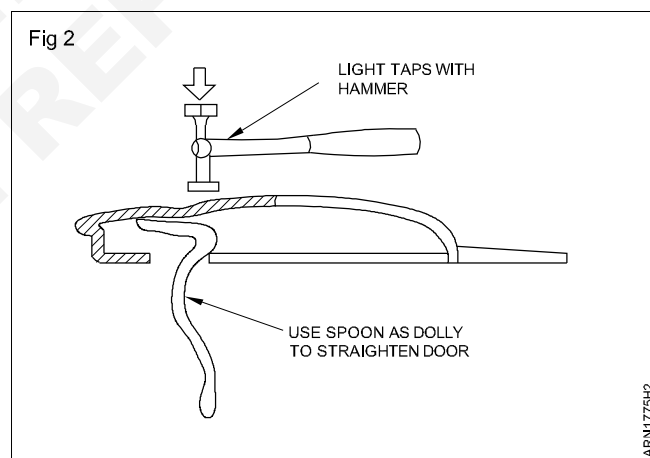
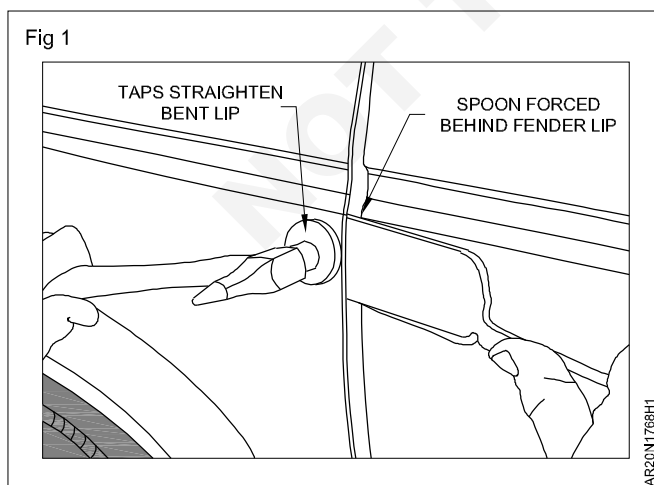
Using long spoon to pry out a fender to allow for hammer straightening

- 1 Park the damaged vehicle on the body repair shop.
- 2 Clean the dust on the panel.
- 3 Protect the wire, fuel line and rubber parts in the damage repair area of the vehicle body.
- 4 Visually inspect the damaged panel and mark the damaged spot on the panel.
- 5 Select the tool for straightening the metal sheet where often reach into places inaccessible to a hammer or dolly.
- 6 Select the long spoon which can easily reach into the damaged spot (Fig 1).
- 7 Insert the long spoon and apply pressure to tension areas with the spoon.

- 8 Use a long spoon as a dolly and use a hammer to work the metal from the front (Fig 2).

- 9 While holding a spoon at the rear of the panels.

- 10 Using the spoon to pry out a dents in a door panel. (Fig 3)



Practice on using pry picks to remove small dents

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

- using a pry picks to remove small dents in hard to reach areas.

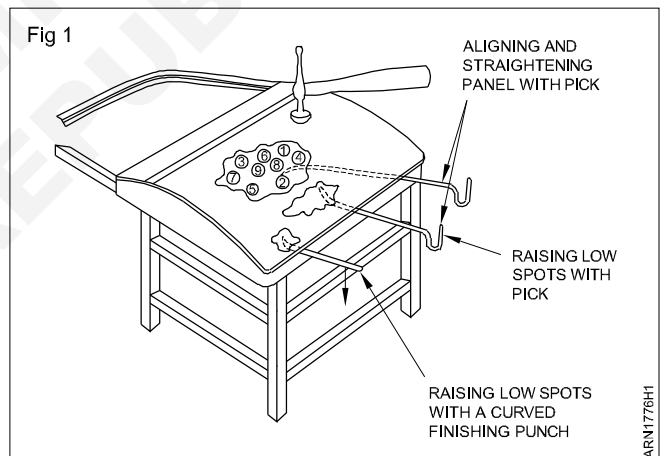
Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Work bench	- 1 No.
• Pry picks	- 1 Set.	Materials	
Equipments		• Cotton waste	- as reqd.
• Vehicle	- 1 No.	• Soap oil	- as reqd.

PROCEDURE

Using the pry picks to remove small dents

- 1 Park the vehicle on auto body repair shop floor.
- 2 Visually inspect the damaged area of the panel door.
- 3 Dismount the door hinges and remove the dented door.
- 4 Place the dented door on the work bench.
- 5 Insert the correct length of pick through openings on the back of the dented panel.
- 6 Place/insert the pry picks to remove small identified dents in hard to reach area as shown in Fig 1.
- 7 Hit next to the area with a body hammer where dents covered by pry picks.
- 8 Ensure the pry picks are properly covered the small dent and hammer strikings are squarely on the dents for straightening.

- 9 Ensure pry directly on the back of all low spots while hammering on them from the fronts.
- 10 Reshape the sheet metal until smooth enough for a thin skim coat of body filler.



Practice on using dent puller to pull out minor damage

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

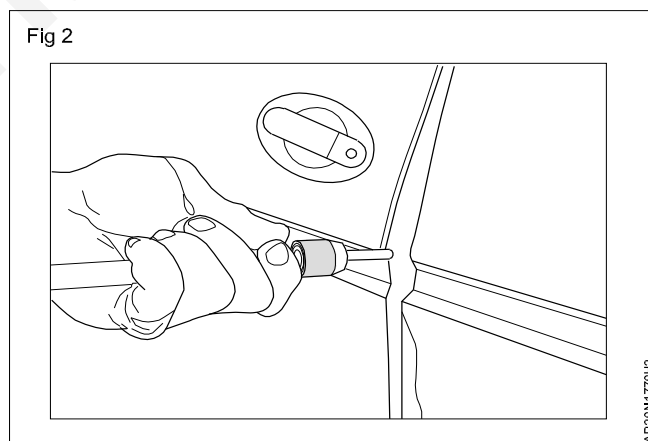
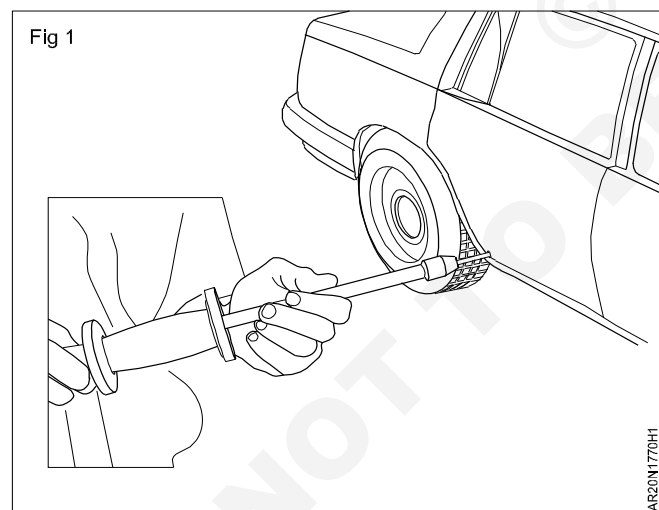
- use the dent pullers to pull out minor damage
- use the vacuum suction cup to pull out large, shallow dents.

Requirements			
Tools/Instruments		Equipments	
• Trainee's tool kit	- 1 No.	• Air compressor	- 1 No.
• Hook tip	- 1 Set.	• Vehicle	- 1 No.
• Vacuum suction cup	- 1 No.	Materials	
• Dent puller	- 1 No.	• Cotton waste	- as reqd.
• Slide hammer	- 1 No.	• Soap oil	- as reqd.

PROCEDURE

Task 1: Pullout the minor damage by use the dent puller (Fig 1&2)

- 1 Park the vehicle on shop floor repair bay.
- 2 Clean the vehicle.
- 3 Visually inspect the damaged spot of the vehicle panel.
- 4 Mark the dented spot and measure the dented area.
- 5 Select the suitable tools to pull out the minor dents.
- 6 Match the tip that matches the shape of the part being straightened.
- 7 Install the flat or occurred tips in the dent puller to match the shape of the panel.
- 8 Thread the appropriate tip on the end of the puller.
- 9 Hold the handle of the dent puller in one hand.
- 10 Slide the weight straight back against the handle.
- 11 Apply a powerful pulling force on the damaged panel.
- 12 Ensure the panel dent is removed and reshaped as original shape.



Task 2: Using the vacuum suction cup to pull out large shallow dents

- 1 Identify and mark the large dented area on the panel.
- 2 Wet the dented area on the panel.
- 3 Install the vacuum suction cup and pull straight out on the cups handle.
- 4 If vacuum suction cup uses a remote power source to produce negative pressure in the cup to increase the pulling power and ensure the cup is forced tightly against the panel larger and deeper dents pulled with a vacuum suction cup.
- 5 Release the remote power source and remove the vacuum suction cup inspect the dent pulled area of the panel and sure the dent is reshaped as original shape.

Practice on using a spot weld dent puller to remove dents

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

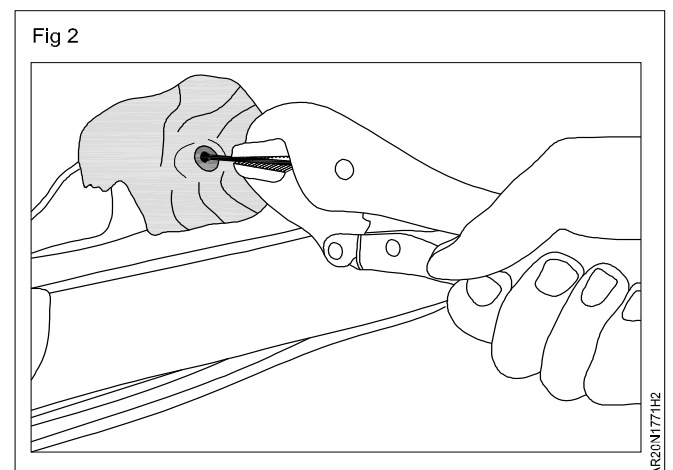
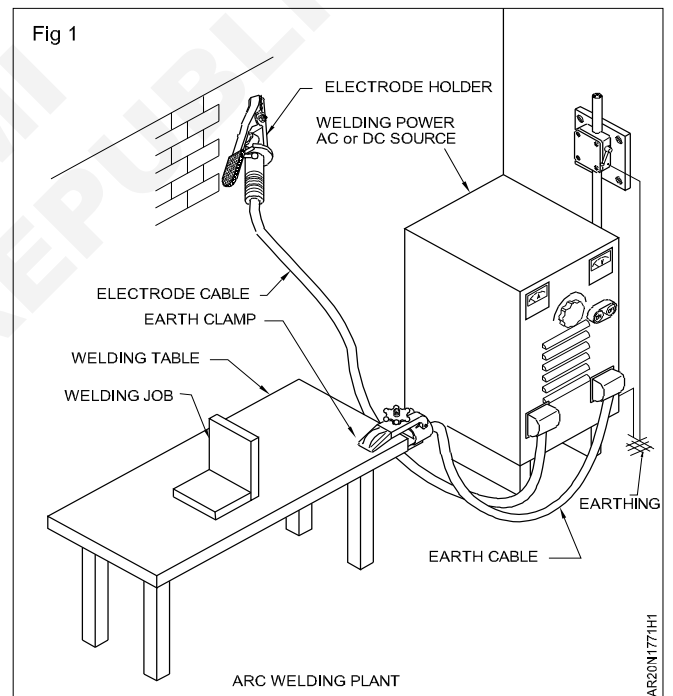
- use the spot weld dent puller.

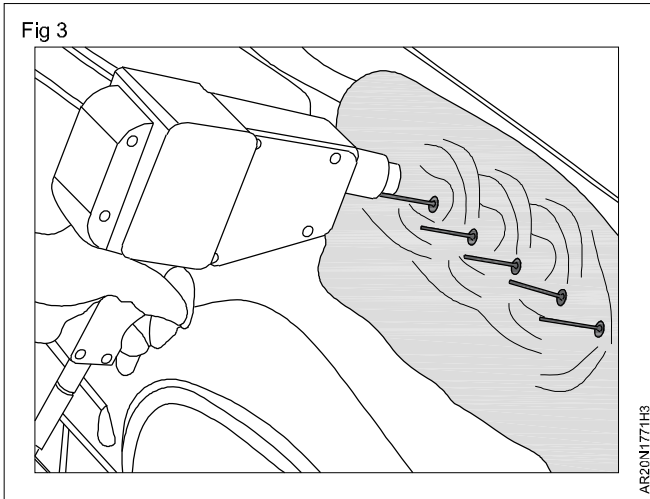
Requirements			
Tools/Instruments			
• Pull pins	- as reqd.	• Vehicle	- 1 No.
• Trainee's tool kit	- 1 No.	Materials	
• Pull chain	- 1 No.	• Cotton waste	- as reqd.
• Clamp	- 1 No.	• Welding rod	- as reqd.
Equipments		• Soap oil	- as reqd.
• Spot welding machine	- 1 No.	• Wire brush	- as reqd.

PROCEDURE

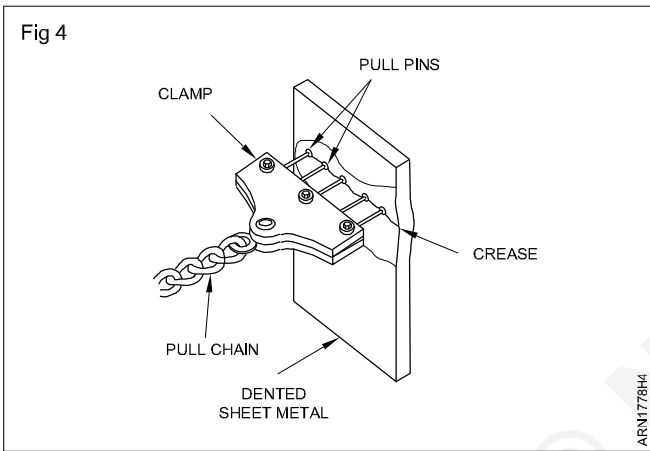
Pullout the minor damage by use the dent puller (Fig 1&2)

- 1 Park the vehicle on the auto body repair shop floor.
- 2 Visually inspect the damaged panel of the vehicle.
- 3 Mark the dented area of the panel.
- 4 Mark around the dent pulling area to protect paint, wire and fuel lines.
- 5 Select the spot weld dent puller weld pins, pull chain and clamp.
- 6 Drilled the holes on the panel dented area.
- 7 Insert the hook pull rods or screws into the drilled holes to pullout the dent.
- 8 spot weld the pins inserted in the drilled holes.
- 9 To use the spot weld dent puller attach the ground cable near the to be repaired (Fig 1).
- 10 Grind a bare metal spot next to the dent.
- 11 Push the spot welding gun and rivet up tight against the damaged body panel.
- 12 Weld the steel pins welded to the dented area.
- 13 Attach the locking pliers on welded pull pin.
- 14 If the dent is very small pull the pin by hand with pliers (Fig 2).
- 15 For deeper dents use the slide hammer (Fig 5) to pulling pin.
- 16 If you welded several pins to pull out the dent added the power source to pull out the dent (Fig 3).
- 17 Carefully locate the pins along the valley of low spots for pulling in a damaged panel.



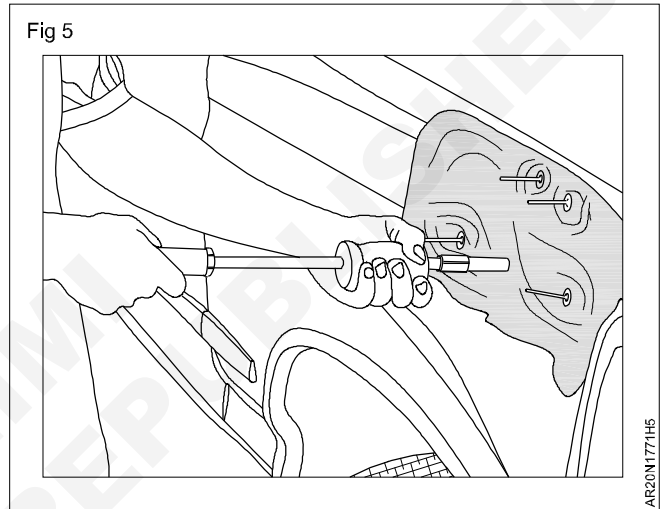


18 Use the several pins lined up in a row as shown in Fig 4.



- 19 Weld the pins a row along the valley of the crease.
- 20 Clamp a frame rack pulling chain to all of the pulling.
- 21 Apply power source to quickly and easily pull out a long low spot in a sheet metal repair area.
- 22 After straighten the dent cut off the pull pins and grind the area flush.
- 23 Finish straightening the panel with a body hammer and dolly.

Note: Set the weld tins on the dent puller to the correct time in seconds for the thickness of the metal on the vehicle body. Make sure you are wearing shaded goggles during resistance spot welding process.



Practice on paint stripping by using single action sander

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

- perform paint stripping
- using a single action sander
- select the abrasive materials.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Wet sander	- as reqd.
• Hand/power sander	- 1 No.	• Dry sander	- as reqd.
Equipments		• Grits	- as reqd.
• Power sander disc unit	- 1 No.	• Grinding discs	- as reqd.
• Air compressor	- 1 No.	• Scuff pads	- as reqd.
		• Cotton waste	- as reqd.
		• Soap oil	- as reqd.

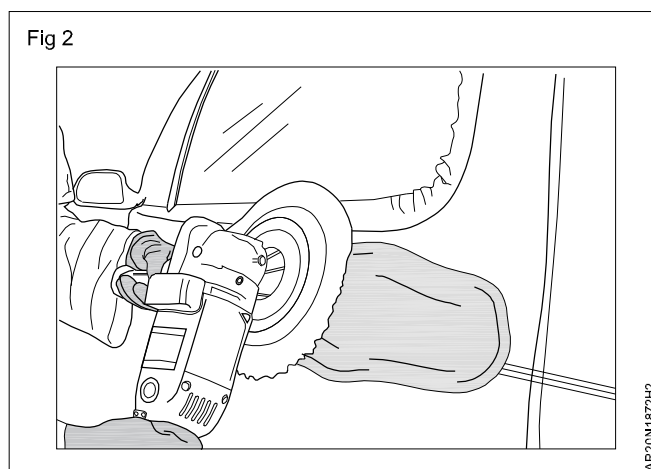
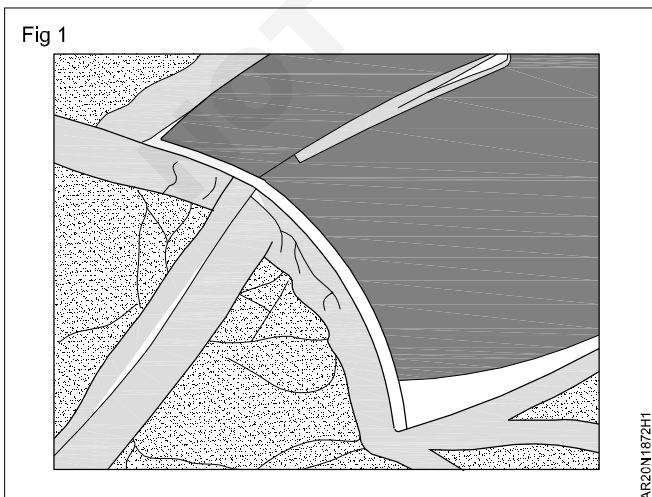
PROCEDURE

Task 1: Perform paint stripping

- 1 Park the vehicle on the paint shop floor.
- 2 Clean the vehicle with water and soap cleaning solvent.
- 3 Dry the vehicle with compressed air.
- 4 Mark the paint damaged area.
- 5 Mask the paper or plastic around the paint damaged area of the panel to protect undamaged paint area.
- 6 Select the sander (Hand/power)
- 7 Select the sander disc 7" or 9".
- 8 Fix the single action sander disc on the grinder spindle.
- 9 Remove the damaged paint by operating single action sander disc.
- 10 Operate the sander disc on damaged paint marked area.
- 11 After sanding the damaged paint clean the sanded area and ensure complete damaged paint is removed.

Task 2: Selection of abrasive materials (Fig 1&2)

- 1 Study the type of paint work like cleaning, sanding, smoothing, paint.



- 2 Select the required abrasive materials such as sand paper, crushed steel grit, aluminium oxide silicon carbide.
- 3 Select the large grit for rough sanding.

- 4 Select the smaller grit for smoothing the surface.
 - 5 Select the grit of 16 to 24 used material removal.
 - 6 Select the grit of 36 to 60 used for rough sanding and smoothing operation.
 - 7 Select the grit of 80 to 120 used for sand old paint.
 - 8 Select the fins grit of 150 to 180 used for sand bare metal and smoothing existing painted surfaces.
 - 9 Select the ultrafine grits rang from 220 to 1500 used for find smoothing operations.
 - 10 Select the larger grits 220 to 320 used for sanding primer.
 - 11 Finer grits 2000 to 3000 used for sand before polishing or buffing.
-

© NIMI
NOT TO BE REPUBLISHED

Practice on maintenance of single action sander

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

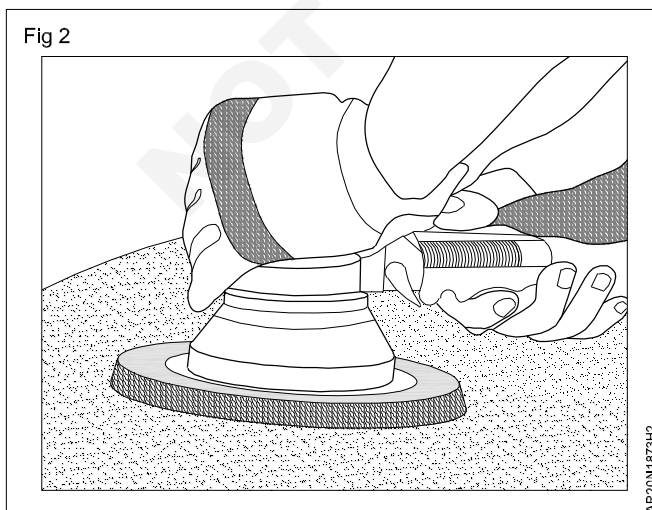
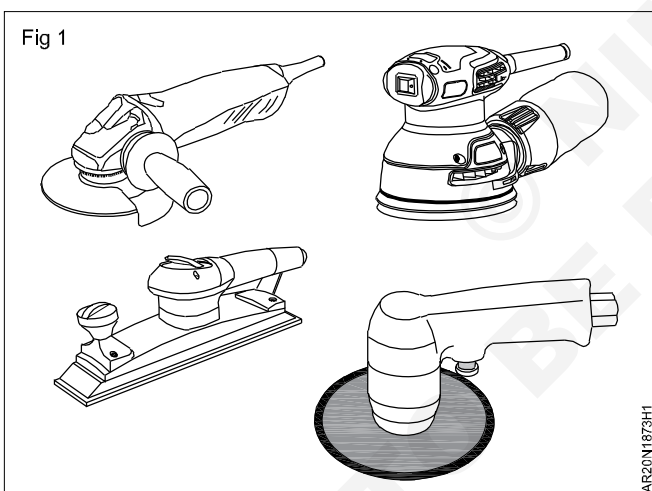
- maintain the single action sander.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Soap oil	- as reqd.
• Hand/power sander	- 1 No.	• Sander grit	- as reqd.
		• Sander disc	- as reqd.

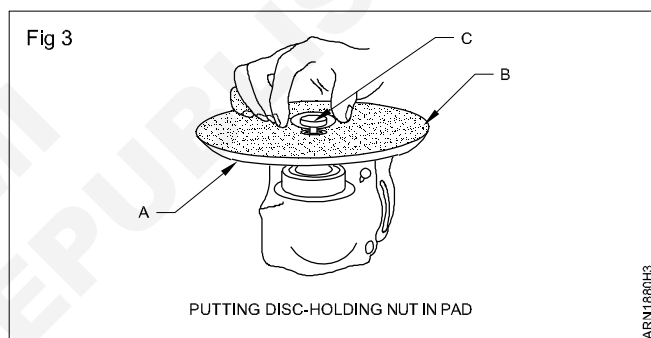
PROCEDURE

Maintenance of single action sander (Fig 1&2)

- 1 Clean the single action sander.
- 2 Visually inspect the single action sander.
- 3 Check the sander disc damage and disc rotation.



- 4 If any damage in disc replace it (Fig 3).



- 5 If disc rotation is hard, lubricate the bearing/ bushing of the air sander.
- 6 If bearing is damaged replace it.
- 7 Check the air pressure line supply if you notice that air sander is not performing consistently.
- 8 Provide sufficient air pressure to operate the sander.
- 9 Check the sander RPM not less than 10,000 RPM.
- 10 Use the vibrating read technometer to check the speed of the sander.
- 11 If you find sander is not spinning in proper RPM.

Oiling the sander and test it again

- 1 Clean the sander from all the particles and debris created from sanding.
- 2 If the sander bearings are not free to move, the disc replace the sander bearings.
- 3 Make sure to oil the sander regularly.
- 4 Keep back up pads fresh and maintained.
- 5 Check the sander pack up pads, if damaged replace it.
- 6 Lubricate the hand pivot pin.

Practice on Auto Body filler application and quality sanding

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

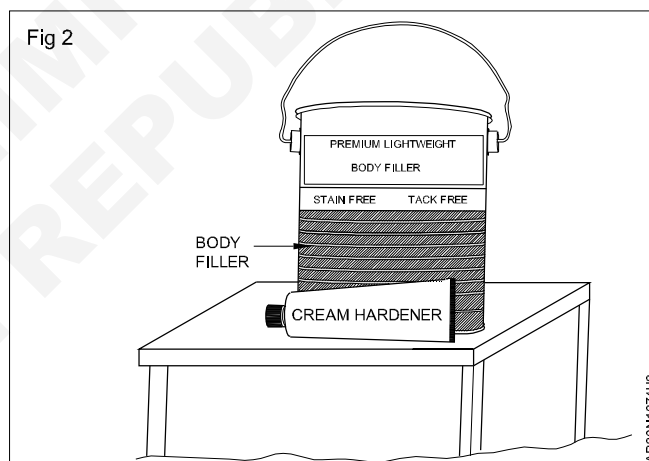
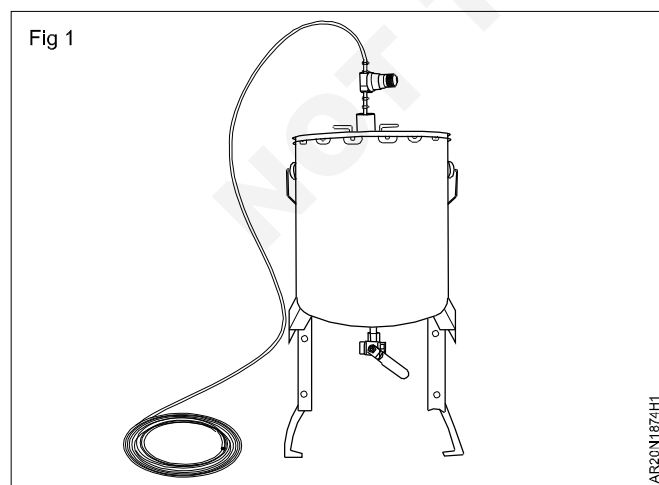
- perform body filler applications
- perform quality sanding for smooth finishing work

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Sander abrasive	- as reqd.
• Paint mixing board	- 1 No.	• Body filler	- as reqd.
Equipments		• Hardener	- as reqd.
• Body power sander	- 1 No.	• Putty	- as reqd.
• Air compressor	- 1 No.	• Tack cloth	- as reqd.
		• Cotton waste	- as reqd.
		• Soap oil	- as reqd.

PROCEDURE

Task 1: Auto body filler applications (Fig 1&2)

- 1 Park the vehicle in auto body repair shop.
- 2 Water wash the vehicle & dry clean by air & dry cloth.
- 3 Visually inspect the vehicle for damage and locate and mark the damage on the panel.
- 4 Discuss with your instructor about vehicle damage.
- 5 Decide which type of repair work is required.
- 6 If auto body panel is damaged, repair the damaged area with new metal sheet.
- 7 If plastic part is damaged replace the damaged part.
- 8 Grind the weld spatters on the parts joining line.
- 9 Sand the parts with suitable tools and correct grade grits.



- 10 After grinding away the finish from the repair area blow away sanding dust with compressed air and wipe the surface with a tack rag to remove remaining dust.
- 11 Apply primer surface to small imperfections on the panel repair surface.
- 12 Ensure the primer surfaces are build up and level feathered areas.
- 13 The primer filler should be very thick form to be filled and smoothen quickly.
- 14 Apply metal conditioner before priming to remove rust and corrosion.
- 15 Apply body filler to level a damaged area of the panel.
- 16 Use the plastic filler on plastic body repair to level the damaged surfaces.

- 17 Mix the body and hardener on the mixing board before applying the body filler.
- 18 Use the light body filler for easy sanding and fast repairs.
- 19 Use the light body filler as a very thin top coat of filler for final leveling and spread thinly over large surfaces for air tool sanding.
- 20 Add the fiber glass material with body filler for rust surface repair it can be applied on both metal and fiber glass substrates.

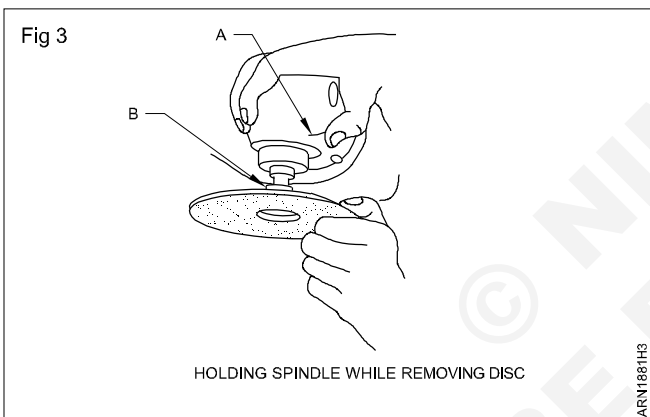
- 21 Use the cream hardeners to cure body fillers.
- 22 Use the glazing putty material for silling small holes or sand scratches.

Note: Once the hardening cream is mixed with body filler will heat and harden.

Body filler comes in cans buckets and plastic bags. Cream hardeners are added to filler to make it cure. Fiberglass resin must be mixed with its own special types of hardener to cure.

Task 2: Quality sanding for smoothen the refinishing work

- 1 Visually check body filler filled area weather body filler is dry or wet.
- 2 Ensure other than the paint area is covered by masking.
- 3 Select the grinding tool with sander disc.
- 4 Fix the correct grade grit to metal finishing work (Fig 3).
- 5 Smoothen the body filler filled area of antibody panel.
- 6 Ensure the applied body filler is completely dry and ready for sanding use a long air file to level the filler when possible.
- 7 Select the sanding machine and sanding disc, if less sanding is needed.
- 8 Select the correct grade of grit.
- 9 Sanding the body filler applied area with finer sand paper to shape the repair area to avoid deep scratches in the filler.
- 10 Ensure sanding is smoothen for refinishing work.
- 11 After sanding blow off the repair area with high pressure air gun.
- 12 Wipe the area with a tack cloth.
- 13 Inspect the filler closely and run your hand over the surface for smoothness.



Practice on identify the thermoplastics and thermosetting of plastics

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

- identify the plastics
- identify the thermosetting of plastics.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Service manual	- 1 No.	• Soap oil	- as reqd.
Equipments			
• Vehicle	- 1 No.		

PROCEDURE

Task 1: Identification process of plastic parts

- 1 Identify the plastic parts filled with the vehicle.
- 2 Check the part very rigid with lots of glass fibers in the broken area.
- 3 If yes probably sheet molded compounds (SMC) repair using method E with 2020 SMC hard set epoxy.
- 4 If NO identify does it bubble and smoke when you try to melt it.
- 5 If NO identify by judging from the feel and appearance of the plastic and test weld with on that matches best rods stick well.
- 6 If not stick well probable TPO, TEO or TPE repair using method C with uni-weld fiber flex.
- 7 If bubble and smoke when you try to melt the plastic repair with selected welding rod using method - B.
- 8 If the plastic is flexible probably polyurethane, repair using method A with 5003 R1 urethane rod.
- 9 If the plastic is rigid thermoset rigid plastic like melton, repair using method E with 2020SMC hard set epoxy.
- 10 Common automotive the thermosetting plastics.

Note: To perform a test well, clean and sanding a small area on the back-side of part. Make a small spot weld on the surface. After the weld cools try to pick it off with your fingernail.

Which one that sticks best is the one to use. Refer the Auto Body manuals for name and types of plastic used in a particular vehicle.

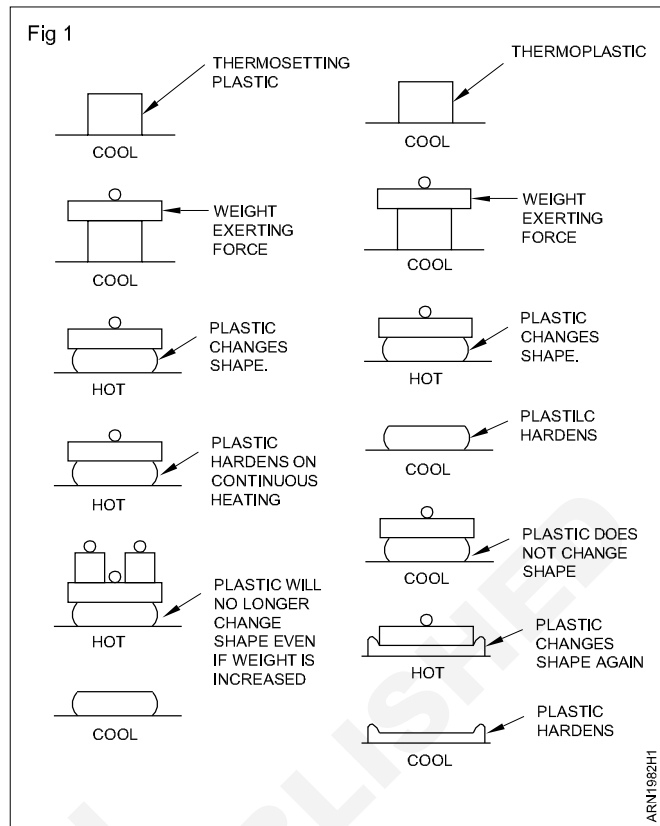
Task 2: Identification process of plastic parts

- 1 Identify the thermosetting plastic parts filled with vehicle.
- 2 Identify the shape of thermosetting plastic parts without load.
- 3 Identify the shape of thermosetting plastic parts with weight exerting force in cool condition.
- 4 Identify the plastic changes shape when it get hot.
- 5 Identify the plastic harden on continuous heating and shape changes by heat.
- 6 Identify the plastic no longer changes shapes even it weight is increased at heating mode.
- 7 Identify the rigid thermosetting plastic in cool condition is shown in Fig 1.

Common Automotive Plastics Identification Table

Identifying Symbol	Chemical composition	Typical usage	Common or trade names	Suggested repair method	Repair tips
PUR (RIM, RRIM)	Thermoset Polyurethane	Bumper covers, front and rear body panels, filler panels	Elastoflex, Bayflex Specflex (Reaction Injection Molding)	Weld with urethane rod (5003R1) or Uni-Weld (5003R8)	Do not try to melt the base material; just melt rod into the V-groove
TPU (TPUR)	Thermoplastic Polyurethane	Bumper covers, soft filler panels, gravel deflectors, rocker panel covers	Pollethane, Estane, Roylar, Texin, Desmopan	Weld with urethane rod (5003R1) or Uni-Weld (5003R8)	Use adhesion promoter before applying filler or coating
TPO, EPM, TEO	Polypropylene+ Ethylene Propylene	Bumper covers, valence panels, fascials, air dams,	TPO (Thermoplastic Olefin), TPR	Weld with Uni-Weld (5003R8) or TPO Blended Gra rod (5003R5)	Use adhesion promoter before applying filler or coating
PP	Polypropylene (polyolefin)	Bumper covers, deflector panels, interior moldings,	Profax, Oreflo, Marlex, Novolen, carlona	Weld with Uni-Weld (5003R8) or Polypropylene Black rod (5003R2)	Preheat groove before welding with polycarbonate rod.
PC + PBT	Polycarbonate + Polybutylene Terephthalate	Bumper covers (Ford)	Xenoy (GE)	Weld with Polycarbonate clear rod (5300R7) or Uni-Weld (5003R8)	Preheat groove before welding with nylon rod. Use fiberglass mat with instant adhesive.
PPE + PA (PPO + PA)	Polypropylene Ether + Polyamide	Fenders (Saturn, GM), exterior trim	Noryl GTX (GE)	Weld with Nylon (5003R6), Uni-Weld Ribbon (5003R8), two-part epoxy system, or instant adhesive	Instant adhesive works great on ABS.
ABS	Acrylonitrile Butadiene Styrene	Instrument clusters, trim moldings, consoles, armrest supports, grilles	Cycolac (GE), Magnum (Dow), Lustran (Monsanto)	Weld with ABS White rod (5003R3) or repair with insta-weld instant adhesive	Preheat groove before welding. Use fiberglass mat with instant adhesive.
PC + ABS	Polycarbonate + Acrylonitrile Butadiene Styrene	Door skins (Saturn), instrument panels	Pulse (Dow), Bayblend (Bayer), Cycology (GE)	Weld with Polycarbonate rod (5003R7), ABS rod (5003R3), two part epoxy, or instant adhesive	The material cannot be repaired with the welder
UP, EP	Unsaturated Polyester, Epoxy (Thermoset)	Fender extensions, hoods roofs, decklids, instrument housings	SMC, Fiberglass, FRP	Repair with two-part epoxy system (2020 or 2021) or polyester resin and glass cloth	Use adhesion promoter before applying filler or coating
PE	Polyethylene (polyolefin)	Inner fender panels, valences, spoilers, interior trim panels	Lacqtene, Lupolen, Dowlex, Hostalen	Weld with Polyethylene Opaque white rod (5003R4)	Preheat groove before welding. (5003R7)
PC	Polycarbonate	Interior rigid trim panels, valence panels	Lexan, Merlon, Calibre	Weld with Polycarbonate clear rod	

Identifying Symbol	Chemical composition	Typical usage	Common or trade names	Suggested repair method	Repair tips
PA	Polyamide	Radiator tanks, headlamp bezels, quarter panel extensions, exterior trim finish parts	Nylon, Capron, cleanese, zytel, Rilsan, Vydne, Minion	Weld with Nylon Opaque white rod (5003R6) or Uni-Weld (5003R8)	Preheat groove before welding especially on radiator tanks
TEEE	Thermoplastic Ether Ester Elastomer	Bumper fascias (Bonneville SSE, Park Ave., '91-'96 Vette front), rocker panel covers (Camaro & Firebird)) or	Bexloy V (DuPont)	Weld with Uni-Weld (5003R8) or two-part epoxy system (2000 or 2020)	
PET	Polyethylene Terephthalate + Polyester	Fenders (Chrysler LH)	Bexloy K (DuPont), Vandar (Hoechst)	Weld with Uni-Weld (5003R two-part epoxy system (2020 or 2021)	
EEBC	Ether Ester Block Copolymer	Rocker cover moldings fender extensions ('91-'96 Deville)	Lomod (GE)	Weld with Uni-Weld (5003R8) or two-part epoxy system (2010)	
EMA	Ethylene/Methacrylic Acid	Bumper covers (Dodge Neon)	Bexloy W (DuPont)	Weld with Uni-Weld (5003R8)	



Practice on identify the common automotive plastic parts

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

- identify the automotive plastic parts.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Auto Body manual	- 1 No.	• Soap oil	- as reqd.
Equipments			
• Vehicle	- 1 No.		

PROCEDURE

Identification of common automobile plastic parts

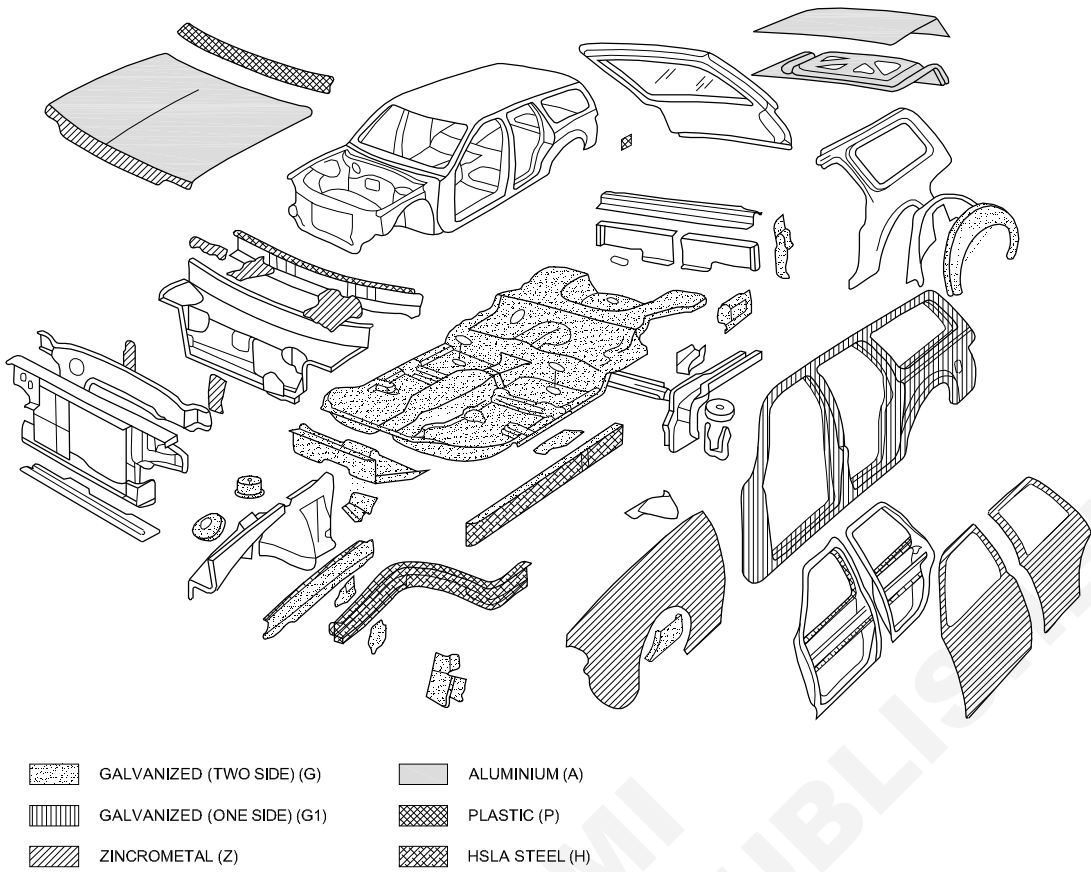
- 1 Park the vehicle on the auto body repair shop floor.
- 2 Clean the vehicle with pressure water.
- 3 Dry the water on the surface of vehicle body.
- 4 Refer the vehicle body manual to identify the plastic parts fitted with vehicle.
- 5 Identify the vehicle plastic bumper.
- 6 Identify and locate defector plastic panels.
- 7 Identify and locate the plastic interior moldings.
- 8 Identify and locate the plastic inner fenders.
- 9 Identify and locate the bumper covers.
- 10 Identify and locate the plastic instrument clusters, trim moldings, consoles, armrest support, grilles.
- 11 Identify and locate the plastic door skins and instrument panels.
- 12 Identify and locate the fender extensions, hoods, roofs, deckholes, instrument housings.
- 13 Identify and locate the radiator tanks, head light bezels quarter panels, rocker cover moldings (Fig 1).

Write the plastic parts name shown in Figure on Table 1

Table 1

S.No	Parts name	Remarks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Fig 1



AR20N1976H1

Mechanic Auto Body Repair - Auto Body Plastic Repair Technology

Practice on using chemical adhesive bonding techniques to plastic repair

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

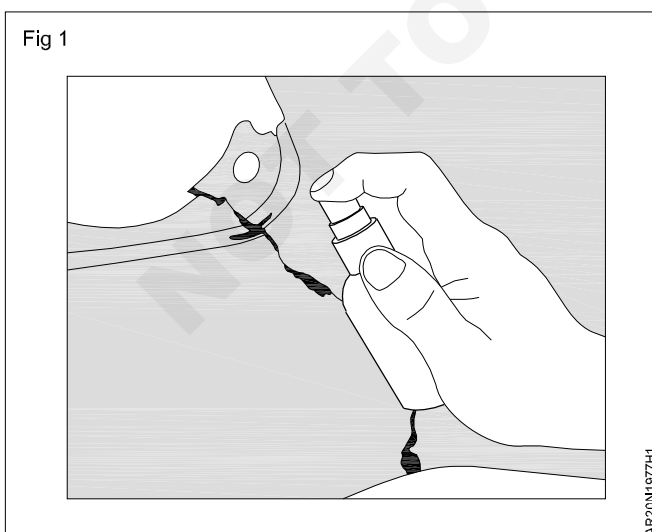
- using chemical adhesive bonding techniques to repair of minor cuts and cracks.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Auto Body repair manual	- 1 No.	• Abrasive	- as reqd.
Equipments		• Soap oil	- as reqd.
• Vehicle	- 1 No.	• Chemical compound	- as reqd.
		• plastic cleaning solvent	- as reqd.

PROCEDURE

Chemical adhesive bonding techniques to repair minor cuts/ cracks on plastic parts

- 1 Park the vehicle on the Auto Body repair shop.
- 2 Clean the vehicle with water and a plastic cleaner and visually inspect the vehicle.
- 3 The surface must be free of wax, dust and grease and allow the parts to warm to 21°C.
- 4 Locate the plastic part cracks and cuts on the vehicle body.
- 5 Mark the damaged area by marker.
- 6 Prepare the minor repair area to adhesive bonding.
- 7 Select the chemical adhesive to bonding the cut or cracks on the damaged parts and spray one side of the cracks with accelerator then apply the adhesive the same side of the crack (Fig 1).
- 8 If you use the cyanoacrylate or CA fast curing adhesive used to repair before applying the final repair material use the valuable tool for the repair of plastic parts.
- 9 Cyanoacrylate chemical adhesive apply as a filler on the cracks or cuts parts to tack parts together.
- 10 Carefully position the two sides of the cut or crack in their original position and quickly press them together with form pressure.
- 11 Hold for a full minute to achieve good bond strength.
- 12 If you use two part adhesive, mix the resin and hardener before use to repair the crack parts.
- 13 After mixing the two part adhesive apply the chemical on crack or cut plastic part.
- 14 Ensure chemical adhesive is properly applied on the specific damaged area.
- 15 Let allow part chemical adhesive setting cure for 3 to 12 hours for maximum strength.
- 16 Check the repaired parts quality and compare with the original parts.



Mechanic Auto Body Repair - Auto Body Plastic Repair Technology**Practice on using heat to reshape the plastics**

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

- using heat to reshape the damage plastic parts.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Soap oil	- as reqd.
• Electric heating element	- 1 No.	• Plastic filler	- as reqd.
• Hot air blow gun	- 1 No.		

PROCEDURE**Reshape the damaged plastic parts by using hot air blow gun**

- 1 Park the vehicle on the auto body repair bay.
- 2 Clean the vehicle with hot water and clean the plastic parts with plastic cleaner.
- 3 Visually inspect the damaged area and mark the damaged spot on the vehicle and use the dermal to bevel crack to be plastic welded (Fig 1a).
- 4 Prepare the damaged area by cleaning and sanding process.
- 5 Align the damaged area.
- 6 Heat the heating element.
- 7 Select the welding rod for a particular type of damaged plastic part.
- 8 Ensure the welding rod must be compatible with the base material in order for the strength, hardness and flexibility of the repair to be same as the part.
- 9 Test a welding rod for compatibility with the base material melt the rod onto a hidden side of the damaged part let the rod cool then try to pull it from the part, if the rod is compatible it will adhere.

- 10 Set the temperature of hot air blow to weld plastic part.

Note

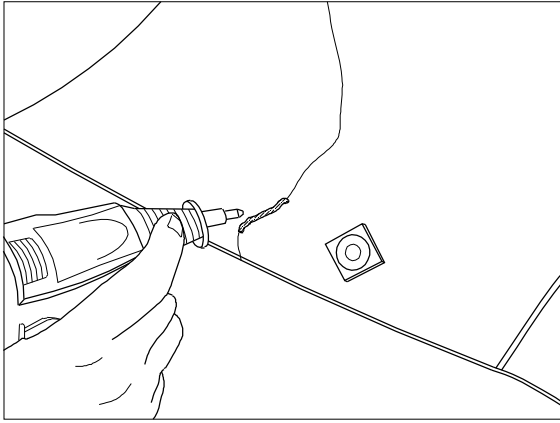
Never use oxygen or other flammable gases with a plastic welder.

Always read and follow the manufactures instructions carefully.

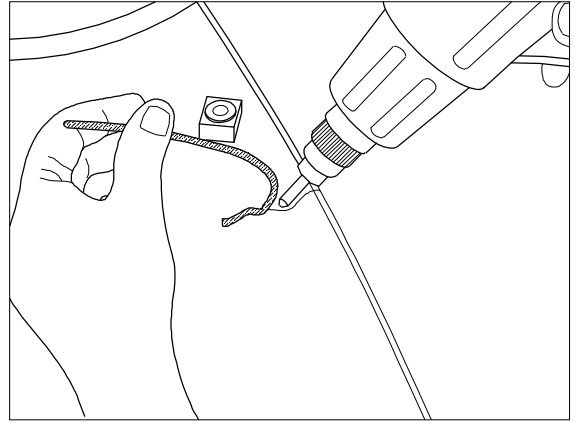
Avoid over heating when you are weld the plastic parts.

- 11 Begin heating joint and apply plastic welding rod (Fig 1b).
- 12 Heat the part and plastic rod enough to make it stick to joint (Fig 1c).
- 13 Finish the weld all the way to end of the crack (Fig 1d).
- 14 Ensure the plastic repair or welding shape is as original plastic parts shape.

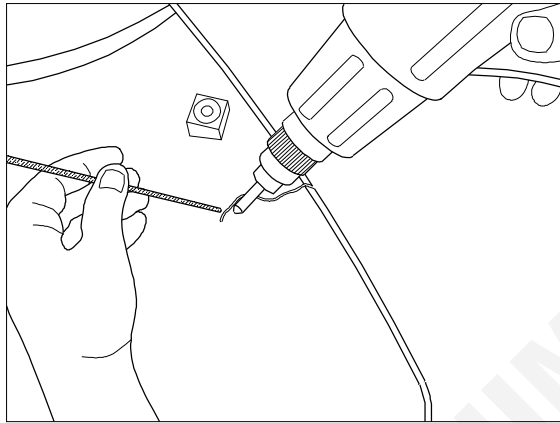
Fig 1



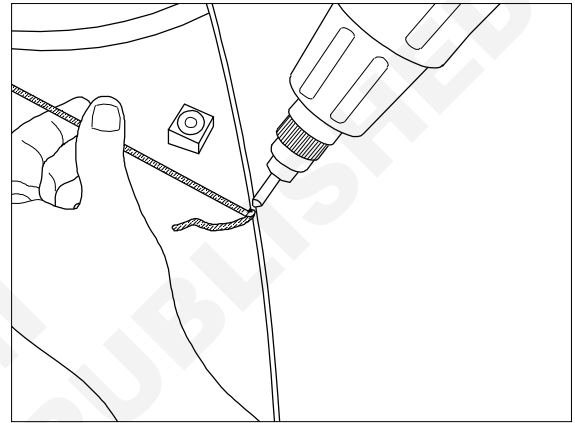
(a)



(c)



(b)



(d)

AFR20N1978H1

Mechanic Auto Body Repair - Auto Body Plastic Repair Technology

Practice on hood removal as per procedure

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

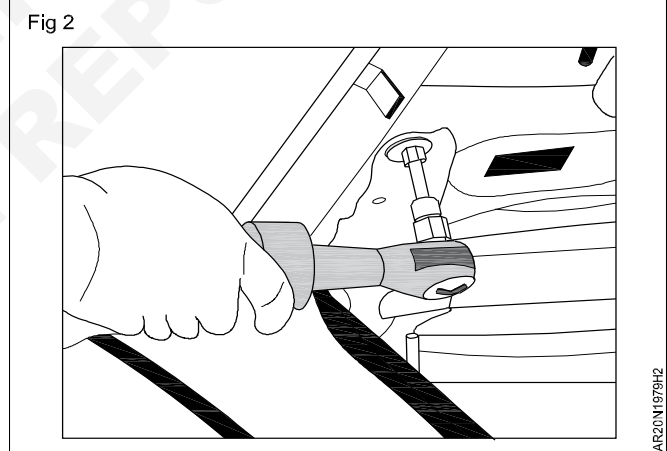
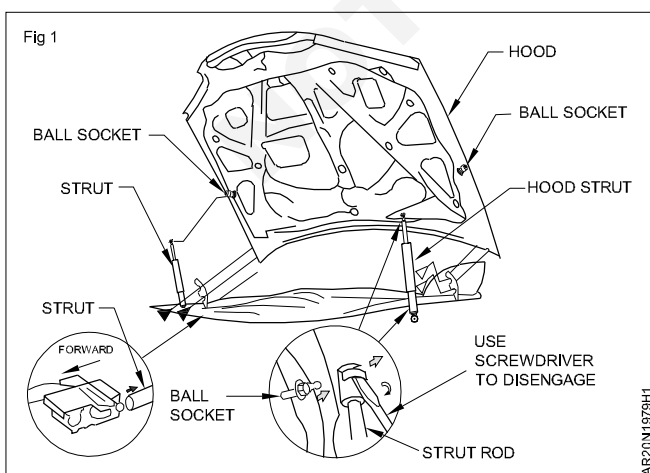
- remove the hood from the vehicle as per procedure.

Requirements	
Tools/Instruments	
• Trainee's tool kit	- 1 No.
Equipments	
• Vehicle	- 1 No.
• Jack stand	- 1 No.
• Crane	- 1 No.
Materials	
• Cotton waste	- as reqd.
• Soap oil	- as reqd.
• Nut bolts	- as reqd.
• Washers	- as reqd.
• Shims	- as reqd.

PROCEDURE

Vehicle hood removal as per procedure (Fig 1&2)

- 1 Park the vehicle on auto body repair shop floor.
- 2 Clean the vehicle before start to remove the hood.
- 3 Refer the service manual for the procedure to remove the hood.
- 4 Disconnect the all wires and hoses often connect to an under hood light wires hoses might run to the hood for the wind shield washer system.
- 5 Select the proper hood tools with rubber tipped extension rod for holding the hood open as you remove the hood shocks and other hood part.
- 6 Use the spring loaded rods to hold the hood open.
- 7 Remove the hood hinge bolts and mark the hood hinge alignment.
- 8 Scribe hood alignment marks around the sides of the hood hinges.
- 9 Use the alignment marks during rough adjust the hinge and hood during reinstallation.
- 10 Place your shoulder under the hood while holding the bottom edge of the hood with one hand.
- 11 Use your shoulder to support the weight of the hood.
- 12 Remove the hood bolts with your free hand (Fig 2).
- 13 Your helper should do the same as above S.No 11.
- 14 Do not let the weight of the hood rest on the bolts as you loosen them.
- 15 Note the location of body shims or spaces fitted with the hood.
- 16 Remove the hood and place hood out of the way where it cannot get it scratched or knocked over.



Practice on vehicle hood adjustment

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

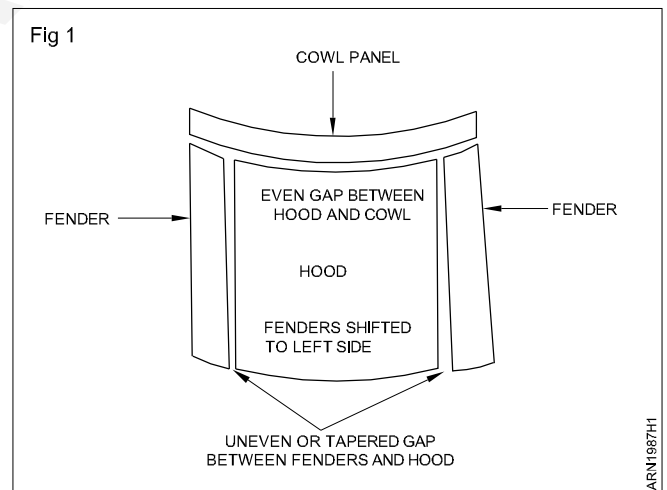
- adjust the hood to hinge
- adjust the hood height
- adjust the hood latch mechanism
- bumper replacement.

Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Soap oil	- as reqd.
Equipments			
• Vehicle	- 1 No.	• Nut bolts	- as reqd.
Materials			
• Cotton waste	- as reqd.	• Washers	- as reqd.
		• Latch	- as reqd.
		• Hood release cable	- as reqd.

PROCEDURE

Task 1: Hood to hinge adjustment

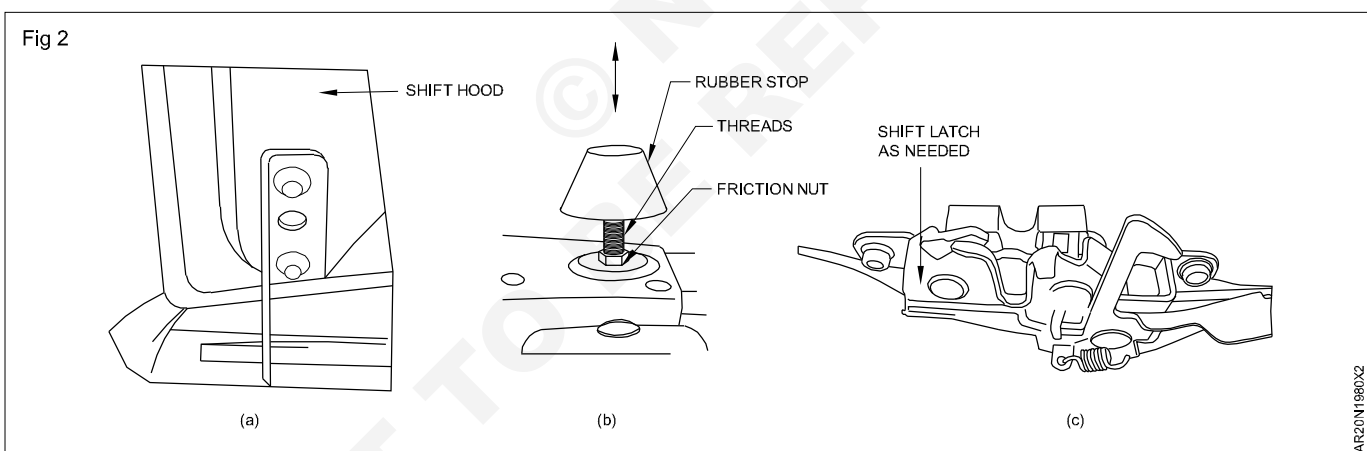
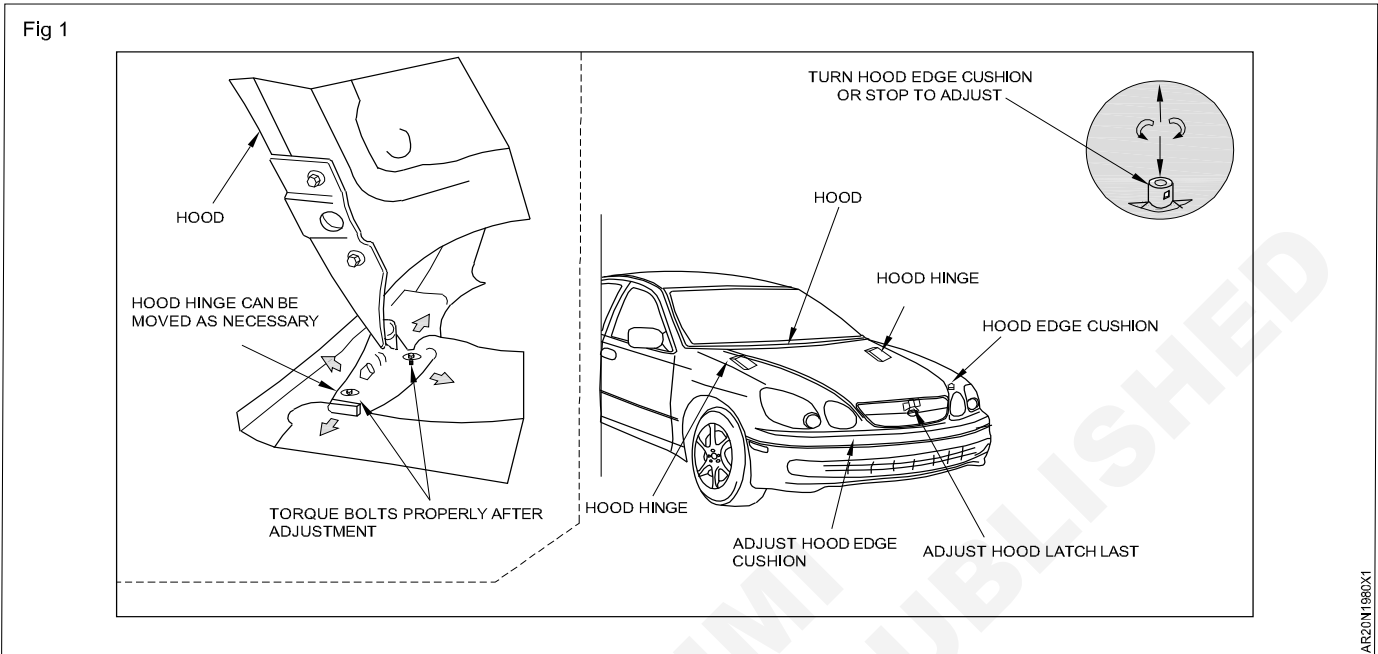
- 1 Install the new or repaired hood in reverse order of removal.
- 2 You have some one help you hold the hood while installing it is mounting bolts.
- 3 Snug down the hinge-to-hood bolts.
- 4 Don't tighten them fully till hood adjustment.
- 5 Check the body-to-hinge bolts are allowed the hood to be moved up and down.
- 6 If the gaps between the hood and fenders, that fender bolts must be loosened and the fenders moved into alignment with the hood.
- 7 Slightly loosen the bolts attaching the hood to the hinges.
- 8 Keep them tight enough to hold the hood during adjustment.
- 9 Loose the bolts enough to shift the hood and close the hood and line it up properly.
- 10 Shift it by hand until the gap around all sides of the hood is equal carefully raise the hood for enough for another to tighten the bolts.
- 11 Align the front of hood with the front of the fenders and panel in front of the hood.
- 12 Ensure sufficient clearance between hood and cowl.
- 13 After proper alignment tighten the hood mounting bolts (Fig 1).



Task 2: Hood height adjustments (Fig 1 & 2)

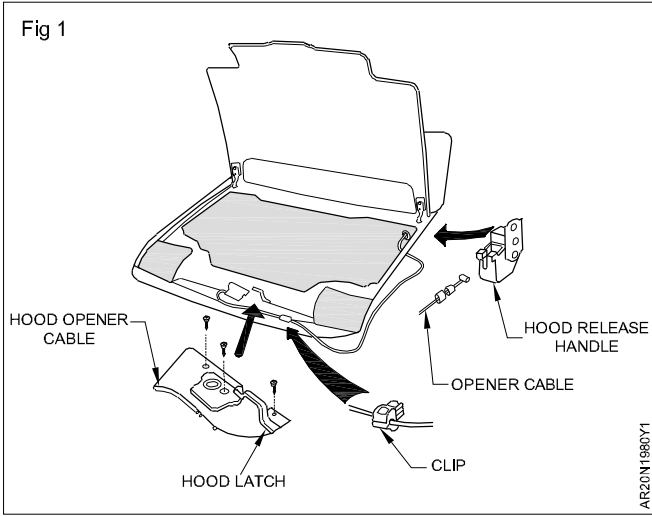
- 1 Slightly loosen the bolts holding the hinges to the fender or cowl.
- 2 Slowly close the hood and raise or lower the rear edge of the hood as necessary.
- 3 Adjust the fenders and cowl to level the rear hood.
- 4 Open the hood and tighten the bolts and ensure the correct height of rear hood.
- 5 Check the adjustable stops and adjust the hood rear stops to touch lightly against the hood.

- 6 Check the front stops control height of the front of the hood.
- 7 Turn the stops in or out until the front of the hood is even with the top of the fender.
- 8 Retighten the lock nut on the stop after adjustment.
- 9 If need adjust the hood up or down, side to side and forward or rearward by loosening the hood-to-hinge bolts (Fig 3).
- 10 Tighten the hood bolts when the hood is centered in the opening.
- 11 Ensure the equal gap around the hoods perimeter.



Task 3: Adjust the hood mechanism (Fig 1 & 2)

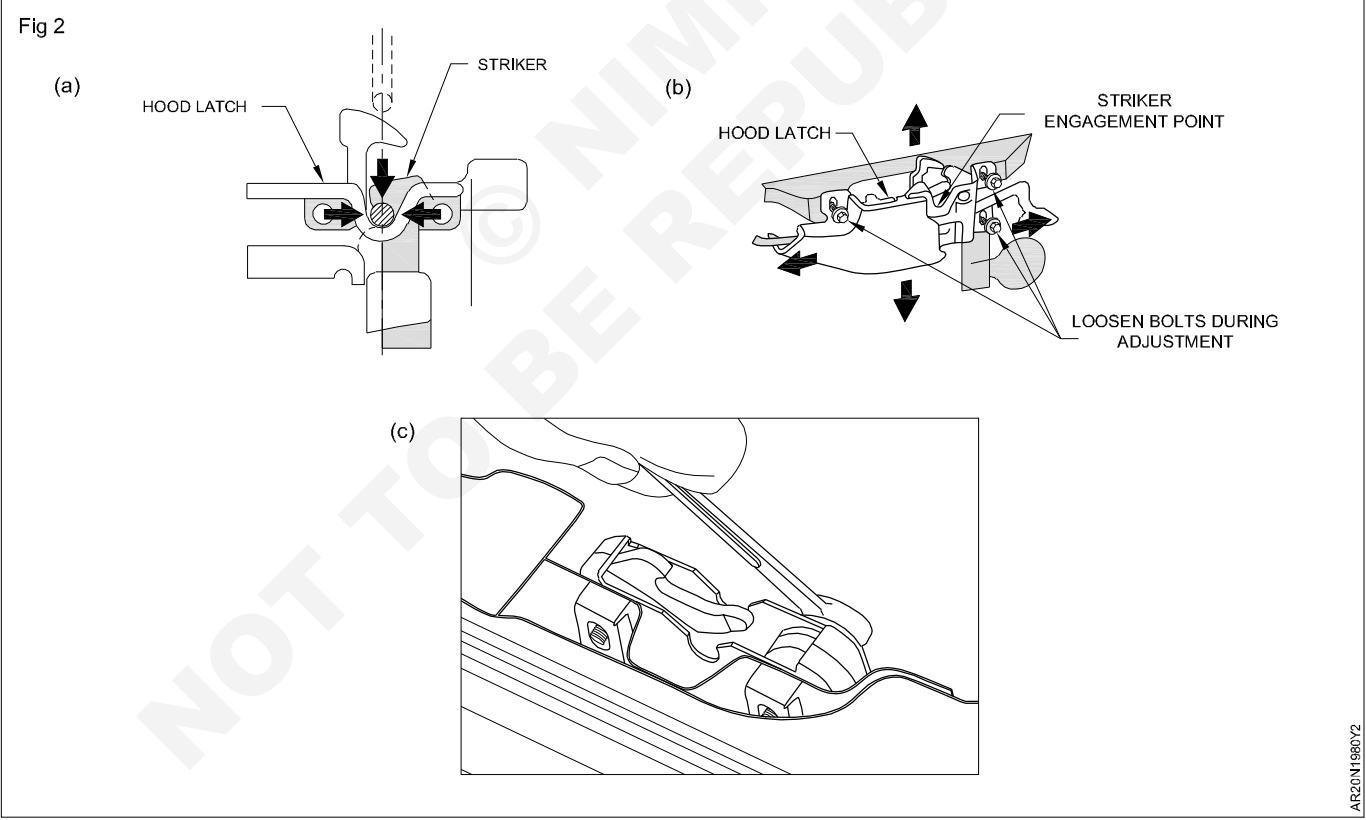
- 1 Check the hood height and position adjustment and ensure adjustment is properly adjusted.
- 2 Check the latch engage in the hood center, if the hood slammed excessively hard to engage the latch, the latch should be raised.
- 3 If the hood does not contact the front stoppers when latched the latch should be lowered.
- 4 To adjust the hood latch follow the steps.
- 5 Remove the hood latch assembly from the radiator support and lower the hood.
- 6 Check that all the gaps around the hood are properly aligned.



- 7 Reinstall the hood latch and lower the hood until it engages or contacts the first latch (auxiliary latch or safety catch)
- 8 Attempt to raise the hood. If it does open, adjust the safety catch so that it engages. Sometimes the hook can be shifted or bent until the auxiliary latch “catches”.
- 9 Lower the hood slowly. Check to see whether the hood

shifts to one side or the other when it is locked. The striker bar bolted to the hood should be centered in the “U” of the latch. When the hood is latched, it should be even with the surrounding sheet metal and fit tightly.

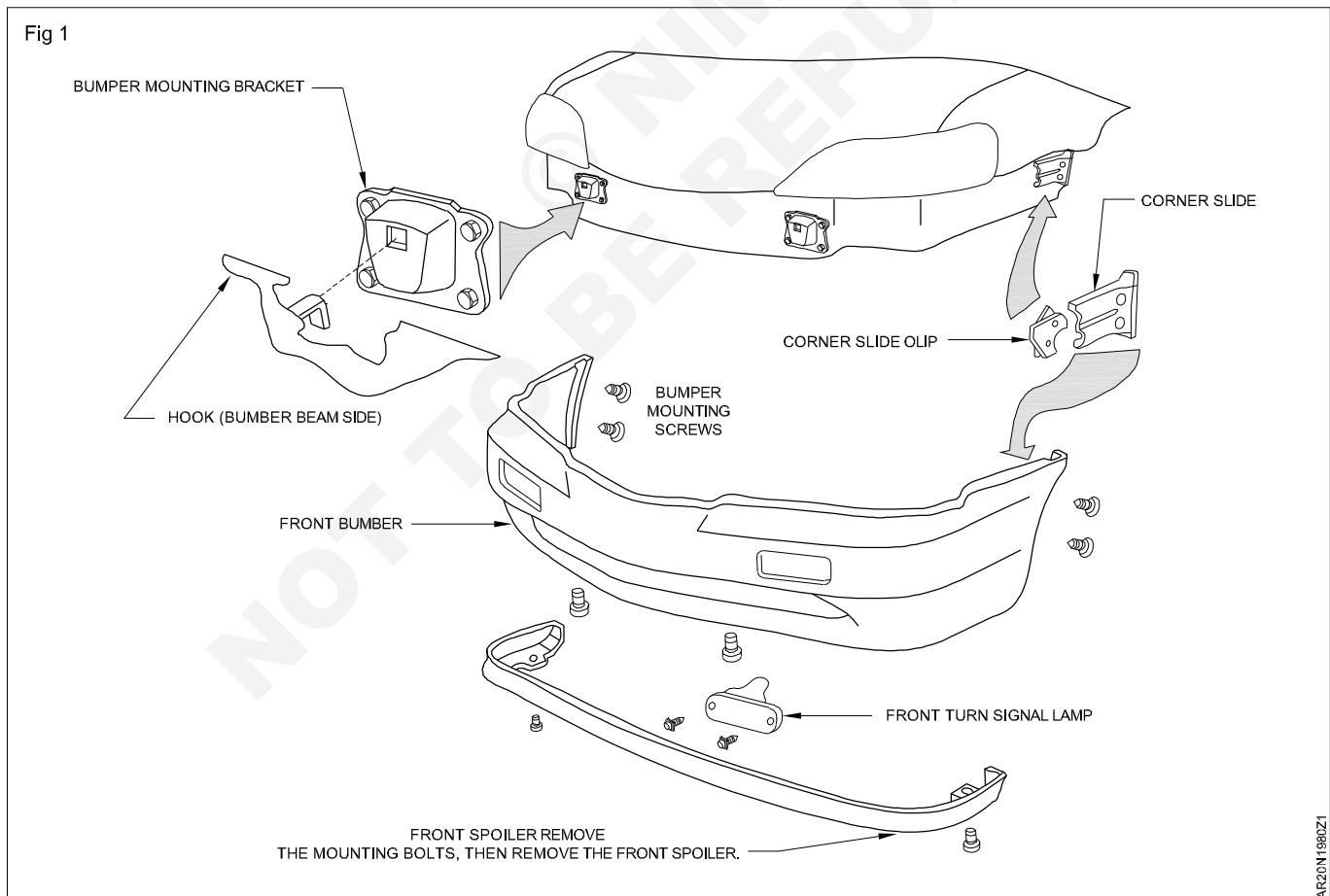
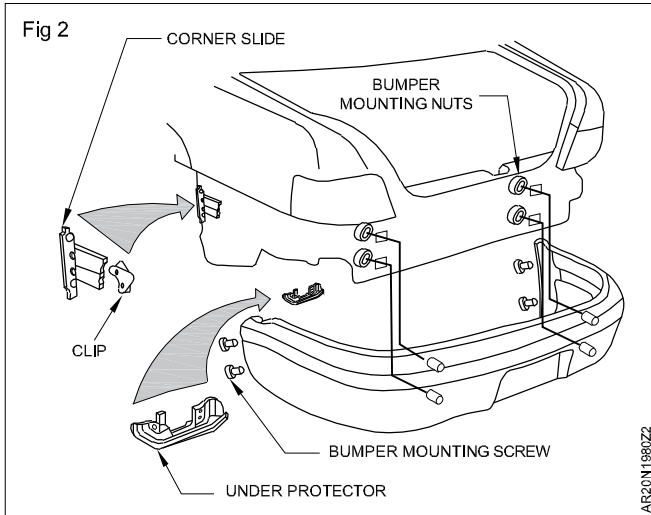
- 10 Loosen the hood latch just enough to maintain a tight fit, but with enough give to allow you to move the latch.
- 11 Move the latch from side to side to align it with the hood latch hook. Move the latch up or down as required to obtain a flush fit between the top of the hood and the fenders when an upward pressure is applied to the front of the hood.
- 12 Tighten the hood latch attaching hardware.
- 13 Open the hood and double-check it is action.
- 14 Close the hood. Make sure it is still at the same height as the fenders. If necessary again, adjust the bumper stops to eliminate any looseness at the front of the hood and ensure a good tight fit.
- 15 Tighten the attaching hardware on the bumper stops.
- 16 Check to see that the side bumper stops (if any) are in place and in good condition.
- 17 Make sure that the safety catch is working properly.



Task 4: Bumber replacement

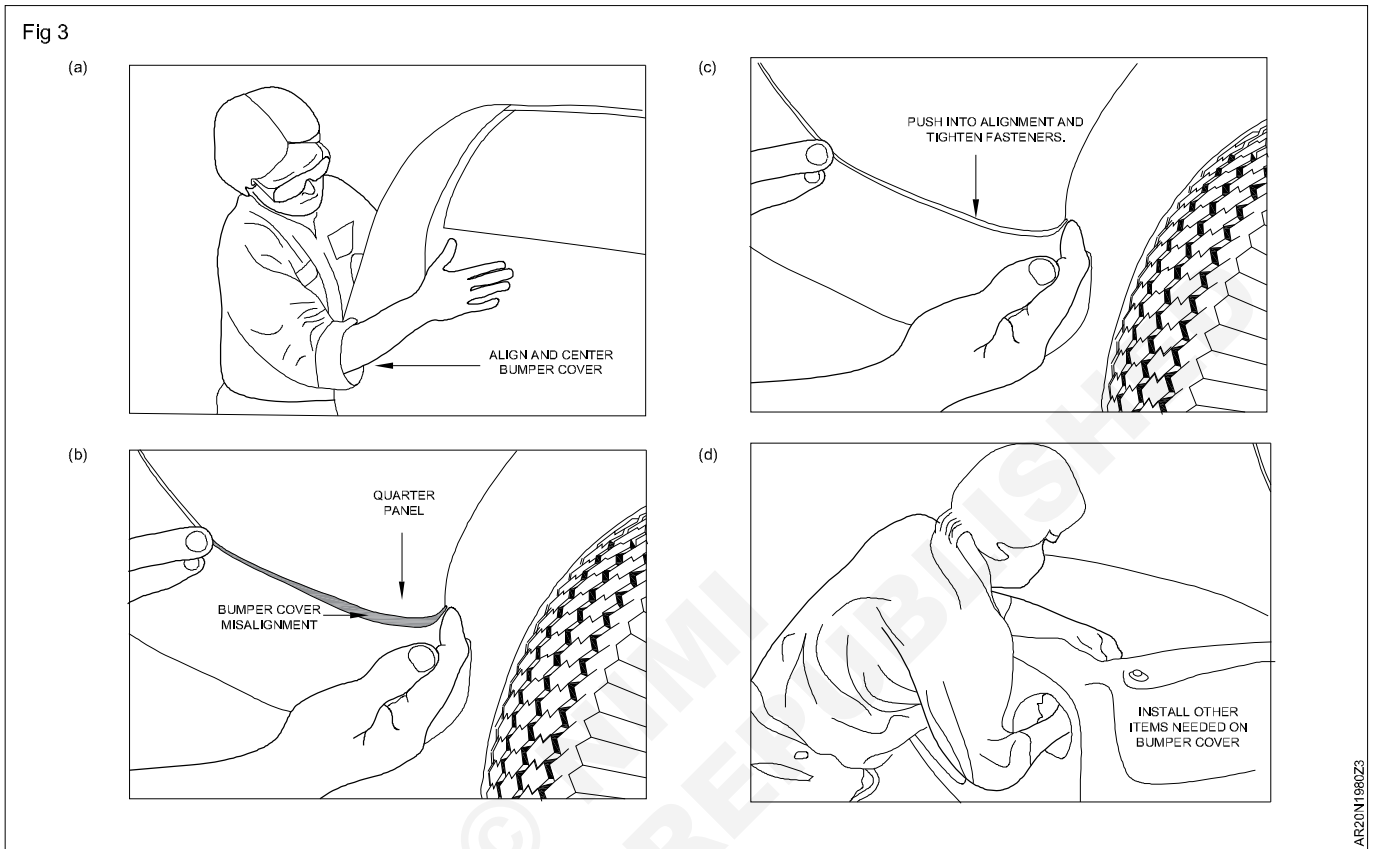
- 1 Remove the stone reflector, parking lights wind shield hoses and wire connection.
- 2 Support the floor jack to hold the weight of bumper.
- 3 Remove the bumper mounting screws as shown in the Fig 1.
- 4 Remove the bumper from the vehicle and place it on the work bench (Fig 2).

- 5 Visually inspect the damages on the bumper.
- 6 Mark the damage area on the bumper whether it is repairable repair the bumper damage.
- 7 If bumper damage is not repairable, replace the bumper.
- 8 Ensure the new bumper is as old bumper specification.
- 9 Clean the new bumper and fix the stone reflector and parking lights, wind shields hose.
- 10 Mount the bumper on the vehicle and align with fenders.
- 11 Mount the bumper bolts and adjust an equal distance from the fenders and front grill.
- 12 Ensure the clearance across the top must be even if need adjustment.
- 13 Move up or down the bumper by moving bumper mounting brackets.
- 14 Move the bumper side to side and out by moving bumper mounting bracket.



- 15 Steel shims to be added between the bumper and the mounting brackets to the bumper alignment as shown in Fig 2.
- 16 Shift the bumper until it is centered on the body and tighten the mounting bolts along the top of the bumper as shown in Fig 3a.

- 17 Aligning and tightening fasteners as the edges are aligned as shown in 3b push the rear bumper cover into alignment with the quarter as shown in Fig 3c.
- 18 Finally reaching through tail light lens to install clips and secure the wiring harness shown in Fig 3d.



Practice on removal and installing the fenders

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

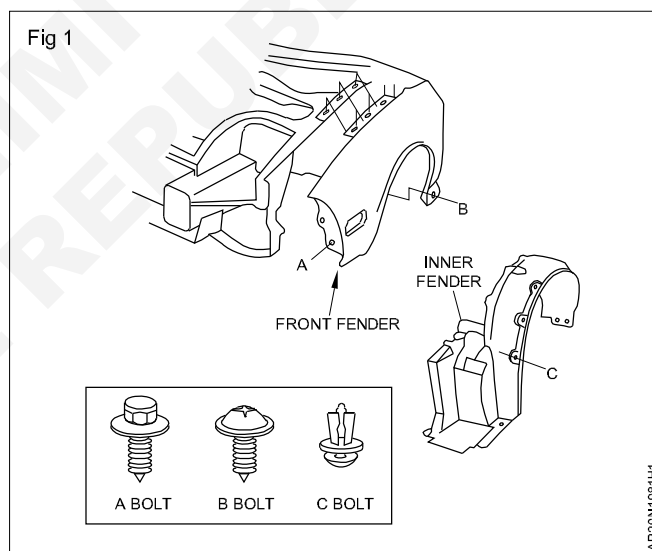
- remove, install and adjust the fenders
- service the grille
- truck lid and panel alignment
- truck bed service.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Soap oil	- as reqd.
• Vehicle	- 1 No.	• Washers	- as reqd.
		• Latch	- as reqd.
		• Hood release cable	- as reqd.

PROCEDURE

Task 1: Fender removal (Fig 1)

- 1 Remove the fender mounting bolts.
- 2 Remove the wires going to fender mounted lights.
- 3 Remove the inner and outer fender panels.
- 4 Remove the fender under the vehicle.
- 5 Note the shims or spacers location during disassembly the fenders.
- 6 Visually inspect the shims or spaces if any damage found replace the shims or spacers.
- 7 If there is no damage on the shims or spacers reinstall in original locations.
- 8 Visually inspect the fenders if any damage replace the fenders.
- 9 Clean the fenders and refinishing the fender for reinstallation paint edging.
- 10 Paint the all fenders before installation on the vehicle.



Task 2: Installing the fenders

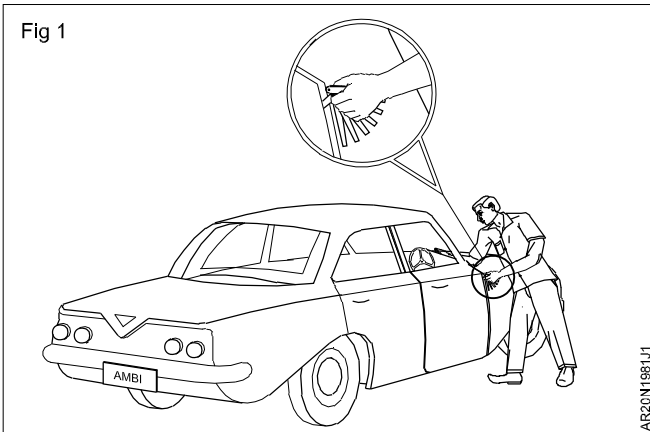
- 1 Install the fenders in reverse order of removal.
- 2 Install the fenders on it is location and hand tighten the bolts.
- 3 Shift the fenders to provide the proper gaps between the door and hood.
- 4 Ensure the fender is properly aligned and then tighten the bolts.

- 5 After installation of fender, open the doors slowly to check the clearance.

Note
Use the shims or spacers to increase or decrease the space between the door and hood.

Task 3: Fender adjustments (Fig 1)

- 1 Visually inspect the fender clearance gap between the door and hood.
- 2 If the space is less than specified limit loosen the fender mounting bolts and move the fender for it is adjustment.
- 3 Start the adjustment by moving the fenders.
- 4 After proper adjustment of rear fender retightening the fender bolts.



- 5 Adjust the top of the door fender to-door gap and correct fender to-hood gap.
- 6 Tighten the fender bolts.

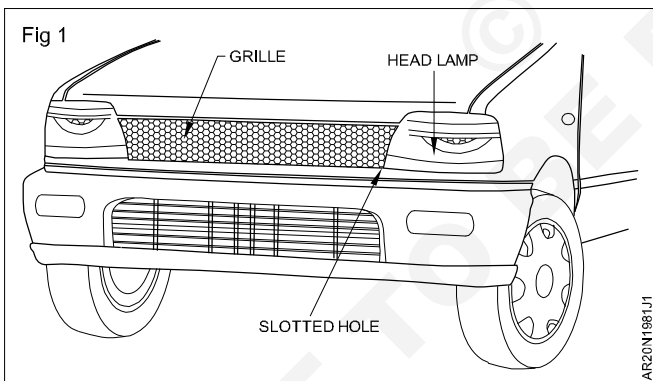
Note: Shift the fender on its bolts so that it properly aligns with other body parts, shift the fender forward until the fender door and cowl have the correct gap.

- 7 Adjust the fender in and out and then tighten the fender bolts.
- 8 Adjust the up and down position of the upper and lower rear mountings to match the door gap.
- 9 Ensure the curvature of the fender matches the shape of the front door edge.

Note: Shims should be used if alignment cannot be achieved without them. Use the plastic feeler gauge to check gaps between fender and vehicle door.

Task 4: Grille service procedure (Fig 1)

- 1 Locate the grille on the vehicle.
- 2 Locate the grille mounting screws.



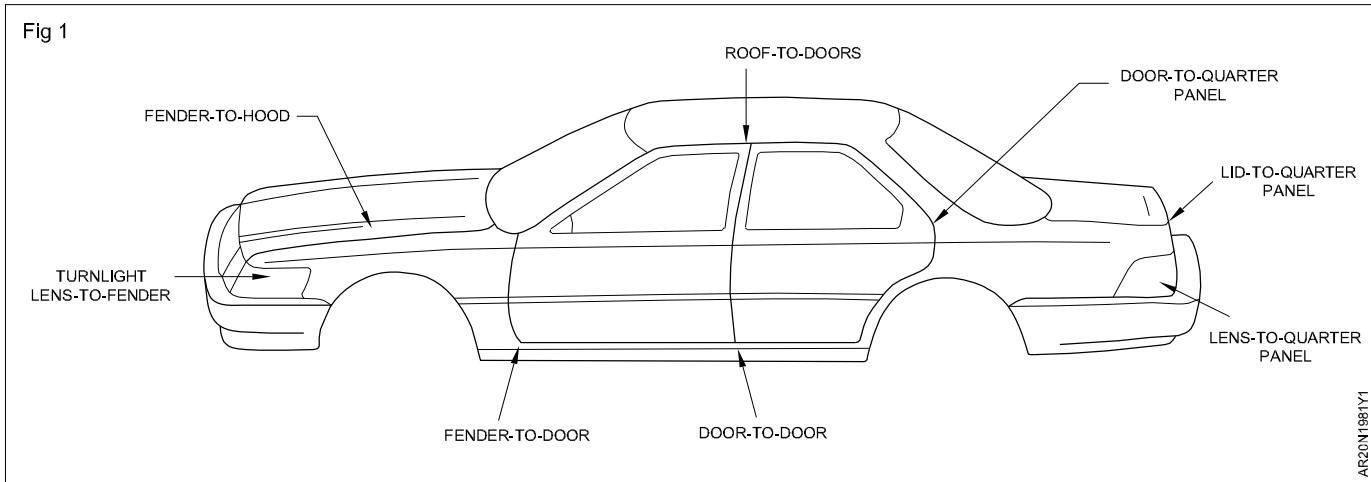
- 3 Remove the screws and clips fitted with grille.

- 4 Remove the grille cover before unscrew the grille fasteners.
- 5 Use the air ratchet to screwing and unscrewing fasteners of the grille.
- 6 Remove the grille and inspect the grille.
- 7 If found any damage on the grille replace it.
- 8 Fix clips on the grille before install it.
- 9 Reinstall the grille on the vehicle and mount the screw and leave the mounting screws bolts loose.
- 10 Shift and align the grille with other parts of a vehicle.
- 11 Once align the grille tighten the mounting bolts slowly.
- 12 Over tighten any bolts or screws could be cracked grille because most grilles are made by plastic.

Task 5: Truck lid adjustment (Fig 1)

- 1 Loosen the truck lid mounting bolts.
- 2 Slightly move forward and rearward and side to side.
- 3 Slightly loosen the attaching hardware on both hinges.
- 4 Adjust the lid forward or backward.
- 5 Close and adjust the lid as required.
- 6 Raise the lid softly and tighten the attaching hardware on both hinge.

- 7 Use the shims to raise or lower the front edges of lid between the bolts and truck lid.
- 8 Place the shims between the hinge and the lid in the front bolt area to raise the front edge.
- 9 Place the shims at the back of the hinge to lower the front edge of the lid.

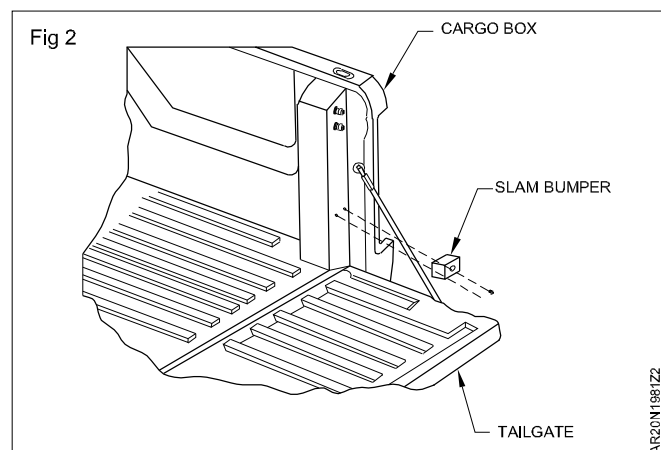
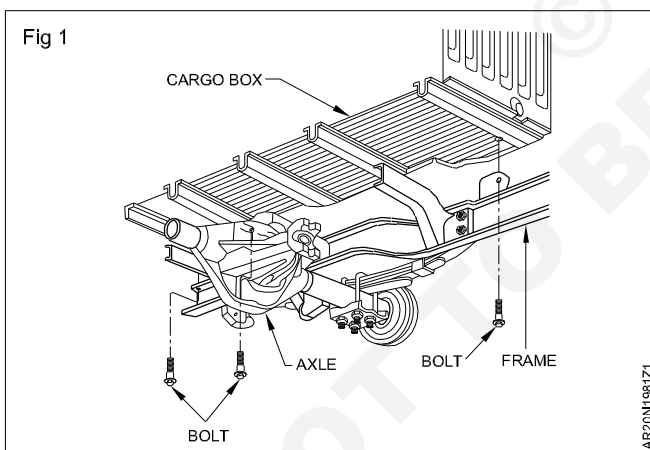


Task 6: Panel alignment

- 1 Install the all new body parts.
- 2 Align the panel as per service manual procedure and adjust the panels until all panel gaps are within specification.
- 3 Ensure the specified clearance between body parts are equal as shown in the Fig 1.
- 4 Check the surfaces of all panels are even with each other.
- 5 Ensure all panels alignment and clearance between the parts are within specifications.

Task 7: Truck bed service (Fig 1 & 2)

- 1 Remove the tail gate hinges and remove the tail gate.
- 2 Remove the bolts that extend up through brackets on the frame (Fig 1).
- 3 Keep the bolts and rubber mountings cushion on it is original positions.
- 4 If any damaged bolts or rubber cushions replace it.
- 5 Check the truck bed, if any damage on the truck bed repair the bed before re-installation.
- 6 Place the rubber cushion on the vehicle frame, position the truck bed on the vehicle frame and align the truck bed holes with rubber cushions and bolt mounting holes.
- 7 Mount the bed bolts and hand tighten the bolts and align the bed.
- 8 Tighten the truck bed mounting bolts as specified limit.
- 9 Position the tail gate on the hinge and mount the hinge pins.
- 10 Before mount the tail gate align the tail gate with truck bed.
- 11 Ensure the tail gate align and properly engage the striker with truck bed (Fig 2).



Practice on removing wind shield and rubber gasket service

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

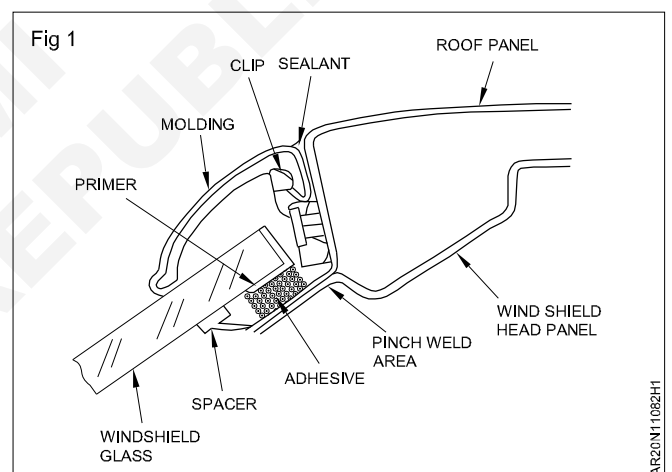
- remove the wind shield glass from the frame
- remove and service the wind shield glass rubber gasket.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Wind shield glass	- as reqd.
• Strip locking tool	- 1 No.	• Wind shield rubber gasket	- as reqd.
Equipments		• Locking strip	- as reqd.
• Vehicle	- 1 No.	• Cotton waste	- as reqd.
		• Baniyan cloth	- as reqd.
		• Soap oil	- as reqd.

PROCEDURE

Task 1: Wind shield glass removing procedure (Fig 1)

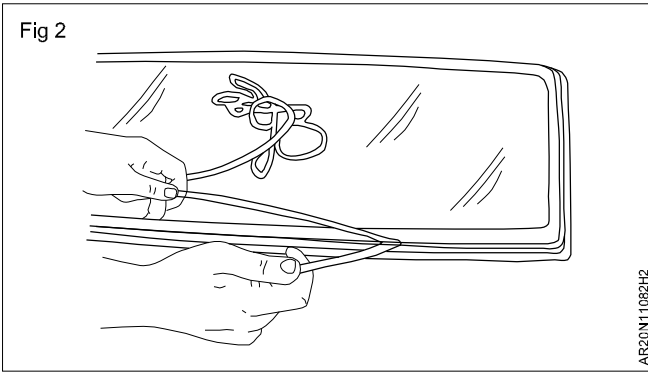
- 1 Remove the wiper blade.
- 2 Remove the wiper motor.
- 3 Remove the rear view mirror.
- 4 Remove the wind shield glass locking strip.
- 5 Use the adhesive material to secure the glass in place.
- 6 Remove the rubber stops and spacers.
- 7 Remove the interior and exterior mouldings fitted with front and wind shield glass.
- 8 Use the clip removal tool to release the clip from under the molding lid.
- 9 Remove the front and rear wind shield glass and place it very safety on a suitable bench.



Task 2: Wind shield rubber gasket service procedure as follow

- 1 Remove the wind shield as mentioned in task 1.
- 2 Place the tape or marking over the dash board.
- 3 Remove the rubber molding trim and hardware.
- 4 Remove the locking strip on the outside of the gasket and pry up the tap and pull tab to open the gasket all the way around the wind shield.
- 5 Use a putty knife to pry the rubber channel away the pinch weld inside and outside of the vehicle.
- 6 Remove the wind shield glass and gasket.
- 7 Clean the wind shield body opening with cleaning solvent.
- 8 Install the stop blocks and spacers.
- 9 Carefully install the glass on the blocks, center the glass and then check the gap between the glass and the pinch weld. Remove the marking tape around the edges of the glass.
- 10 Apply sealer in the glass channel and install the gasket on the glass.
- 11 Insert the cord in the pinch weld groove of the gasket as shown in the Fig 2.
- 12 Squirt a soapy solution in the pinch weld groove to ease installation.
- 13 Apply recommended sealer to the base of the gasket.
- 14 Install the wind shield glass and gasket assembly in the body opening and center it.

15 Very slowly pull the cord ends so that the gasket slips over the pinch weld flange (Fig 2).



16 Work the bottom section of the glass in first, then do the sides and finally the top section and apply a small bead of sealer around the body side of the rubber gasket and remove excess sealer.

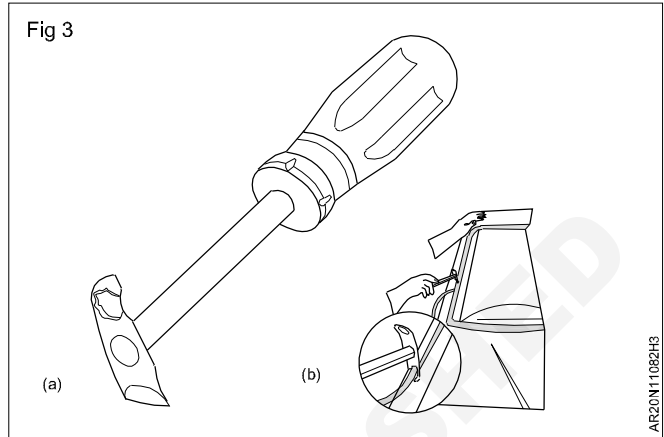
17 Install the reveal and garnish moldings.

18 Check the wind shield for water leaks using a low pressure steam of water.

19 Start at bottom slowly work up each side and do the top last to help isolate the location of the leak.

20 Use the wind shield locking strip tool to spreads the groove and feeds the strip into the opening of rubber grooves (Fig 3).

21 Ensure the wind shield glass and rubber gasket is properly installed.



Practice on aligning wind shield into position

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

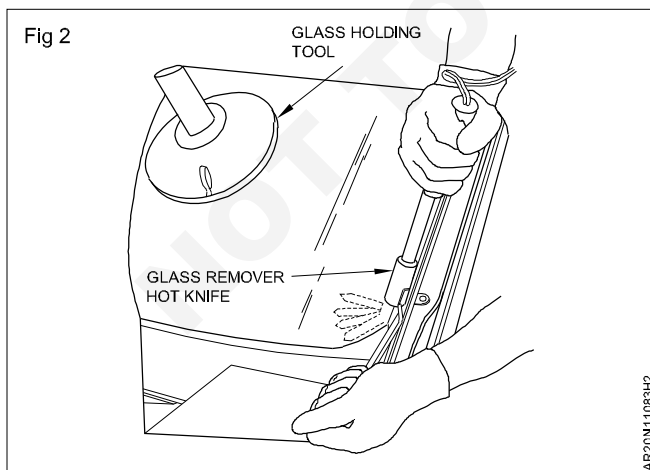
- align the wind shield glass into position.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• White baniyan cloth	- as reqd.
• Locking strip tool	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Soap oil	- as reqd.
• Vehicle	- 1 No.	• Wind shield glass	- as reqd.
		• Rubber gasket	- as reqd.
		• Rubber strip	- as reqd.

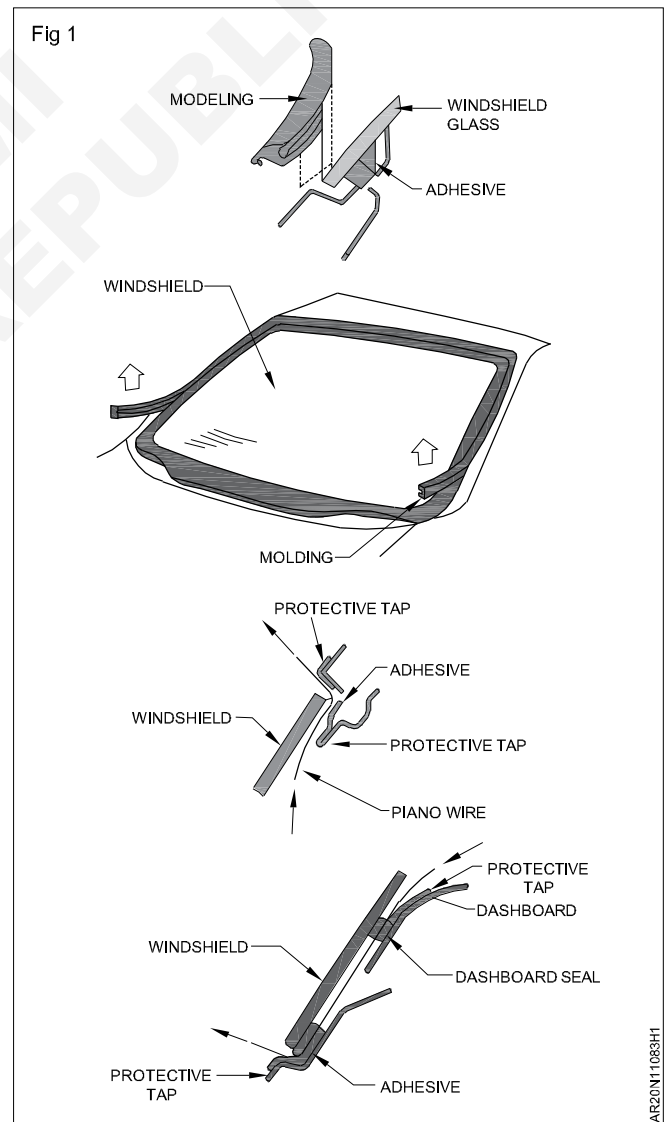
PROCEDURE

Align the wind shield glass into position

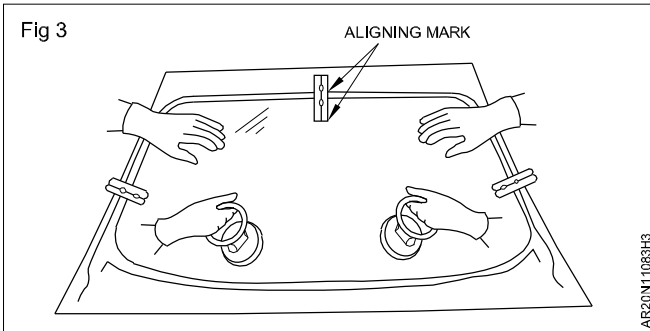
- 1 Soften up the adhesive by using a heat gun.
- 2 Use the steel wire to remove the glass.
- 3 Cut excessive adhesive from the glass edge to the pinch weld with a sharp knife.
- 4 Attach the one end of the wire to a wooden handle. Force the other end of the wire through the adhesive and under the bottom of the glass (Fig 1).
- 5 Work the wire back and forth to cut through the solvent.
- 6 Use the power knife in bottom of the wind shield where is it hard to reach the old adhesive, insert the knife and pull it carefully through the sealant (Fig 2).
- 7 When the adhesive has been cut remove the glass and place it in safe area.



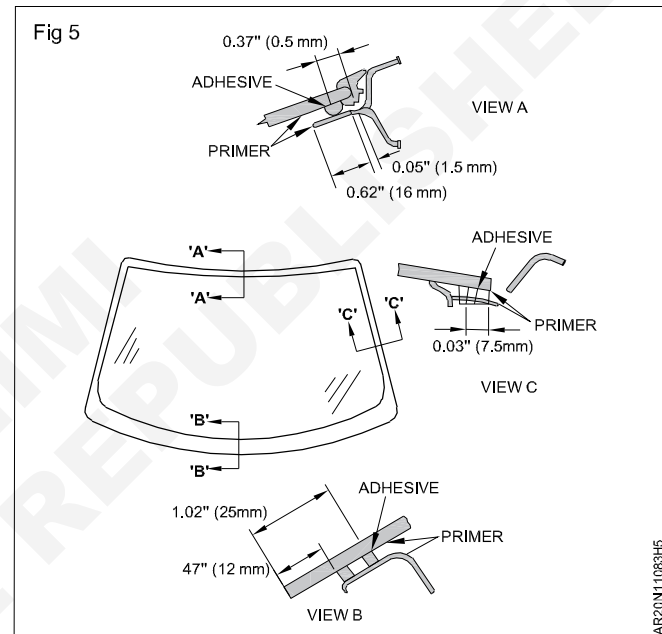
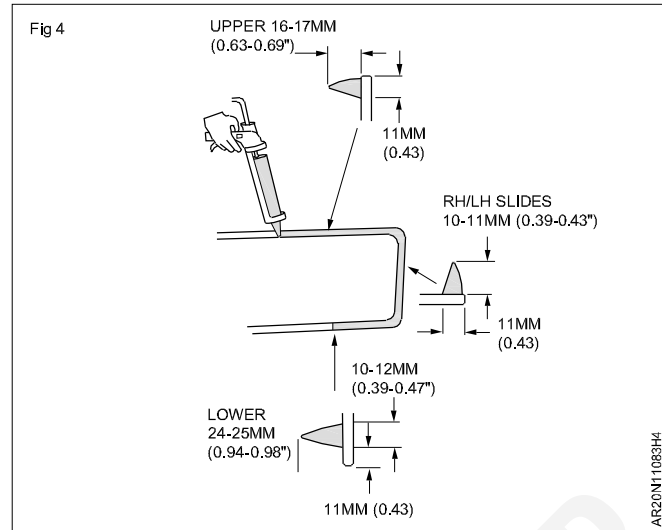
- 8 Wear safety goggles and hand gloves when handling glass.
- 9 Position the new wind shield glass into the opening.
- 10 Align for uniform fit and adjust setting blocks as needed.



- 11 Apply urethane on the glass edge 6.4mm of glass in addition to the space that will be taken up by the butyl tape around the entire perimeter of the glass.
- 12 Mark the position with a crayon or by applying marking tape to the wind shield and vehicle body as shown in Fig 3.



- 13 Shift the tape at the edge of the glass and remove the wind shield.
- 14 Remove the remaining adhesive from the body opening by using a putty knife.
- 15 Usually inspect all reveal molding clips, replace all broken or rusted clips if bent straighten them.
- 16 Remove rust with sanding disc and treat the bare metal with a metal conditioner and prime the areas with a urethane primer.
- 17 Clean the glass and wipe dry with clean cloth.
- 18 Apply urethane primer to the inside edge of the glass and allow it to dry for few minutes.
- 19 Ensure that the glass support are in place and comment the flat rubber spacers in place.
- 20 The spacers should provide equal support around the perimeter of the glass, the spacers on the sides will keep the glass from shifting left or right and align the wind shield.
- 21 Apply the sealant directly behind the ribbon sealer down on the pitch weld do not apply sealant on antenna lead wires (Fig 4).
- 22 With the help of an assistant carefully position the glass in the body opening using the marking tape as a guide (Fig 5).
- 23 Lay the glass in the body opening and press firmly to properly seal the installation.
- 24 Shape any adhesive that has squeezed out around the edge of the glass and remove any excess. Remove the marking tape and protective coverings.



- 25 Check the glass installation using a water spray do not use a direct water on the fresh adhesive.
- 26 Let water flow over the edges of the glass, if found leak apply additional sealant at the leak point.
- 27 Allow the adhesive to cure at room temperature 06 to 18 hours.
- 28 Attach or install all necessary trim parts antenna lead.

Practice on using a adhesive sealer gun

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

- use the sealer gun to apply adhesive to wind shield.

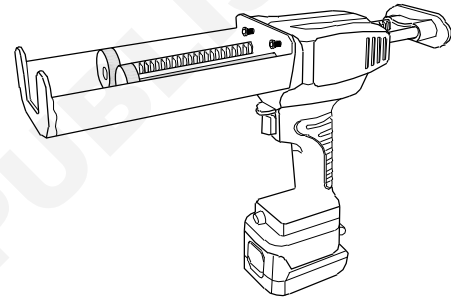
Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Adhesive	- as reqd.
• Adhesive sealer gun	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Soap oil	- as reqd.
• Vehicle	- 1 No.	• Glass cleaning solvent	- as reqd.

PROCEDURE

Apply adhesive to wind shield by sealer gun

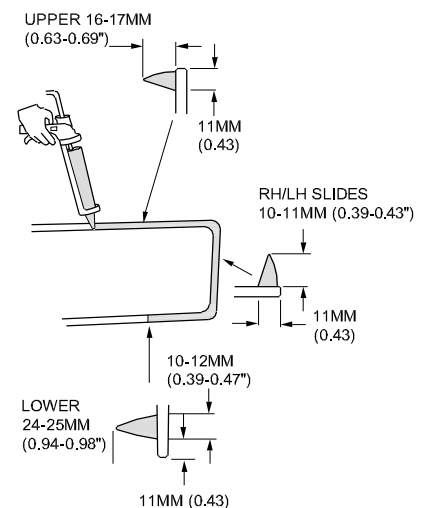
- 1 Clean the wind shield body opening with an acceptable solvent to clear the area of dirt or residual sealant.
- 2 Visually inspect the wind shield glass if it is without any damage reuse it.
- 3 Apply a double layer of marking tape around the outside edge of the glass with 6.4 mm overlap the inside of the glass.
- 4 Install the stop blocks wind shield glass spacers.
- 5 Carefully install the glass on the blocks and align the glass in center and check the gap between the glass and the pitch weld.
- 6 Remove the marking tape around the edges of the glass.
- 7 Apply factory re-commended sealer to the base of the gasket by sealer gun (Fig 1).
- 8 Apply the sealant directly behind the ribbon sealer on the pitch weld.
- 9 Apply sealer adhesive to the glass as shown in Fig 2.
- 10 Ensure the sealer adhesive is applied properly on the edges of wind shield glass.

Fig 1



AR20N11084H1

Fig 2



AR20N11084H2

Practice on identify the basic parts of a door assembly

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

- identify the basic parts of a door assembly.

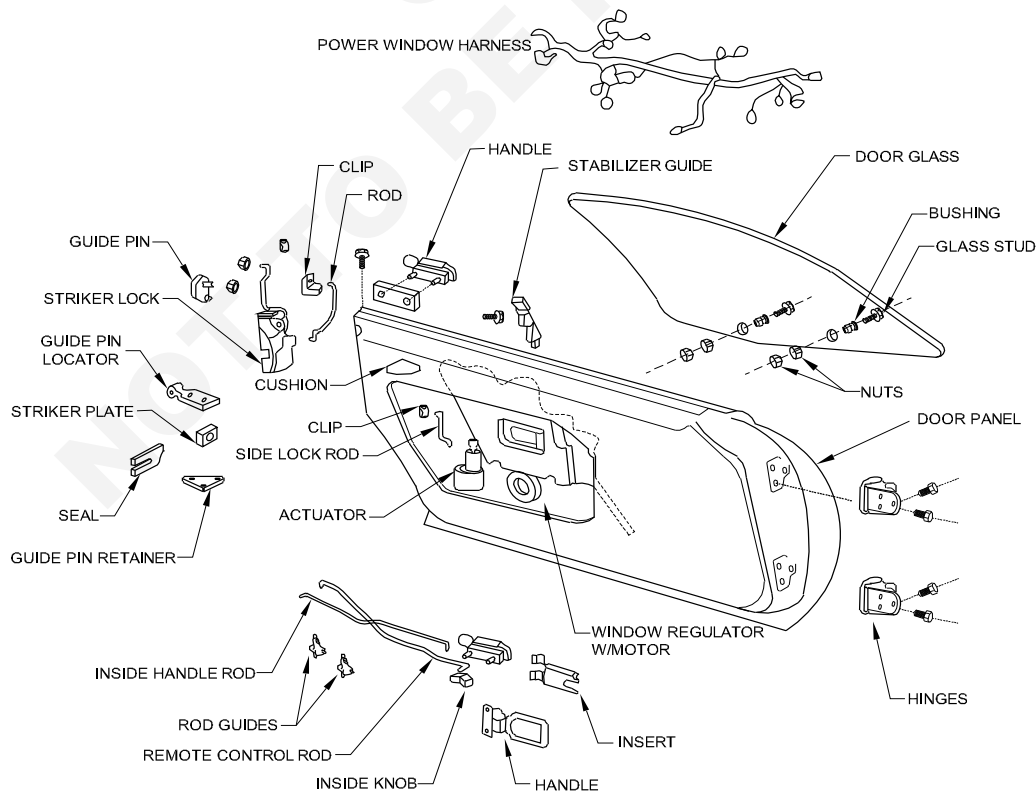
Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Vehicle service manual	- 1 No.	• Soap oil	- as reqd.
Equipments			
• Vehicle	- 1 No.		

PROCEDURE

Identify the basic parts of vehicle door assembly (Fig 1)

- 1 Remove the door pads and compare the parts with service manual.
- 2 Study the vehicle service manual for basic door parts.
- 3 Identify and locate the door glass.
- 4 Identify the door hinges.
- 5 Identify and locate the door panels.
- 6 Identify and locate the door handle.
- 7 Identify and locate the door inside knob.
- 8 Identify and locate the rod guides.
- 9 Identify and locate the inside handle rod.
- 10 Identify and locate the remote control rod.
- 11 Identify and locate the guide pin, seal, sticker plate, guide pin locator and retainer, sticker lock, clip, clip rod, handle.
- 12 Identify and locate the side lock rod and actuator.
- 13 Identify and locate window regulator or motor.
- 14 Identify and locate the door panel.
- 15 Identify and locate the door glass studs, bushing and nuts.
- 16 Identify and locate the power wire harness.

Fig 1



AR20N11085H1

Practice on power window servicing

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

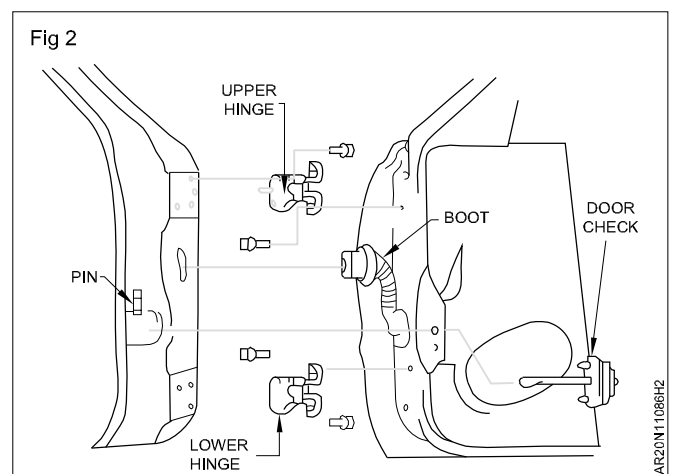
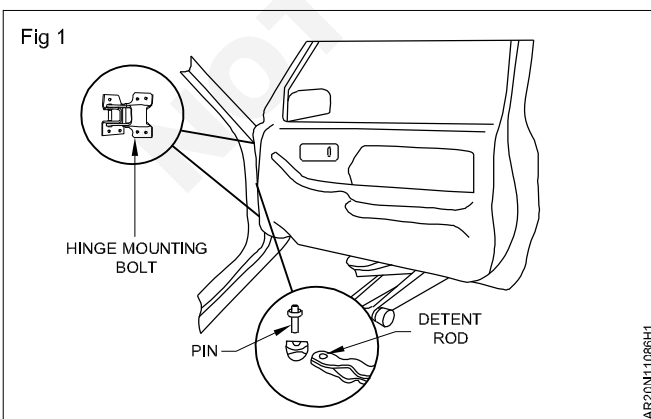
- remove the door
- repair the power window regulator
- repair the door lock and door latch
- repair the welded door hinges
- adjust the door glass
- adjust the door hinges.

Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Window glass	- as reqd.
• Multimeter	- 1 No.	• Door regulator	- as reqd.
Equipments			
• Vehicle	- 1 No.	• Door hinge	- as reqd.
Materials			
• Door lock	- as reqd.	• Door channels	- as reqd.
		• Soap oil	- as reqd.
		• Cotton waste	- as reqd.

PROCEDURE

Task 1: Remove the door from the vehicle (Fig 1&2)

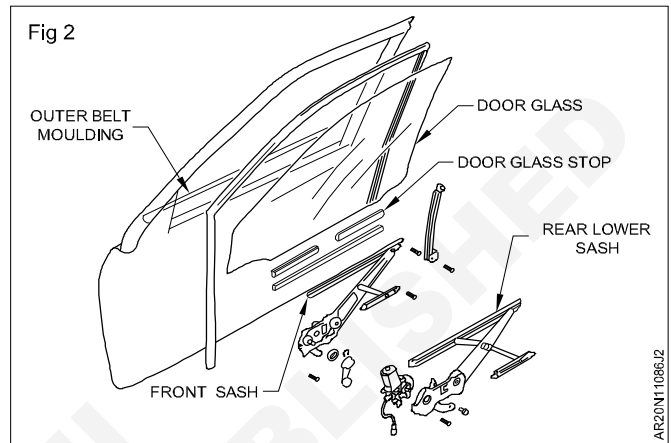
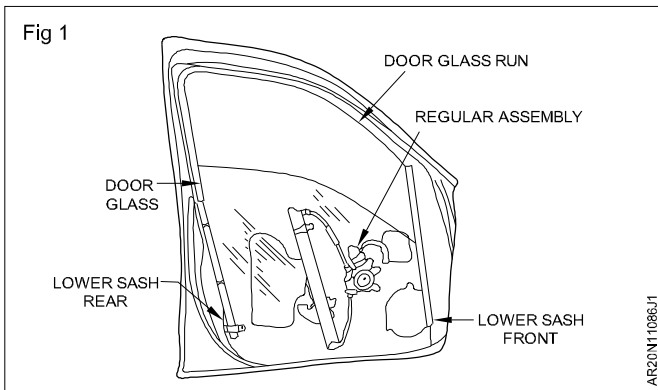
- 1 Park the vehicle on the auto body repair shop.
- 2 Open the door and disconnect the wiring going into the door frame.
- 3 Loosen the door hinges and use the floor jack to support the weight of the door.
- 4 Place a fender cover, rag, notched block of wood to protect the painted edge of the door.
- 5 Insert the rubber jack saddle to engage the bottom of the door flange.
- 6 Raise the jack just enough to take most of the weight off them hinges.
- 7 Balance the weight of the door on the jack to easily unscrew the hinge bolts.
- 8 Before removing last bolt of hinge ask the helper to hold the door and keep it from following off the jack.
- 9 Remove the door and move the door to a work bench.
- 10 Place the door outer panel down on the work surface.
- 11 Place the soft blanket under the door surface to prevent scratches in the finish.



Task 2: Repair the power window regulator (Fig 1 & 2)

- 1 Open the door and remove door glass regulator switch wire connection.
- 2 Remove the door glass stop (both ends)
- 3 Remove the outer and inner belt moulding.
- 4 Lift and remove the door glass and place in on the work bench on safety.
- 5 Dismount the regulator rear and front mounting bolts (sash)
- 6 Remove regulator with motor.
- 7 Visually inspect the regulator frame, front and center channels.

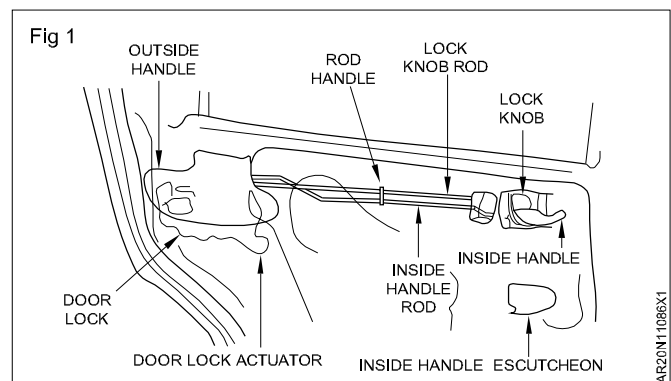
- 8 If found any damaged part replace it.
- 9 Connect power to the regulator motor and check the function of motor, if defective motor drive and inside gear drive, replace the power window regulator assembly.
- 10 Assemble the power window regulator in reverse order of dismantled.
- 11 Install the glass and bolt it to the regulator, fix the inner and outer bolt moulding adjust the door glass.



Task 3: Service the door lock & latch

- 1 Open the vehicle door and disconnect the door wire connection.
- 2 Remove the outer door handle.
- 3 Remove door panels and plastic cover.
- 4 Check the door lock function by operating inner lock operating hand lever.
- 5 Visually inspect the door lock latch assembly and sticker function.
- 6 Check the door lock cylinder.
- 7 Check the door handle in & out side.
- 8 Check the trim plate.
- 9 Check the lock operating lever.
- 10 Check the inside handle rod.
- 11 Check the lock knob rod.
- 12 Check the lock knob.
- 13 Check the rod holder.
- 14 Check the door lock actuator.

- 15 If found any damaged or unserviceable parts, replace it.
- 16 Replace the door handle by raising the window and removing the interior trim, panel and water shield.
- 17 If remote control lock check power supply to solenoids and its linkage and wire connections. Replace damaged part or defective unit.
- 18 After service the door lock and latches ensure the door lock and latches are function properly (Fig 1).

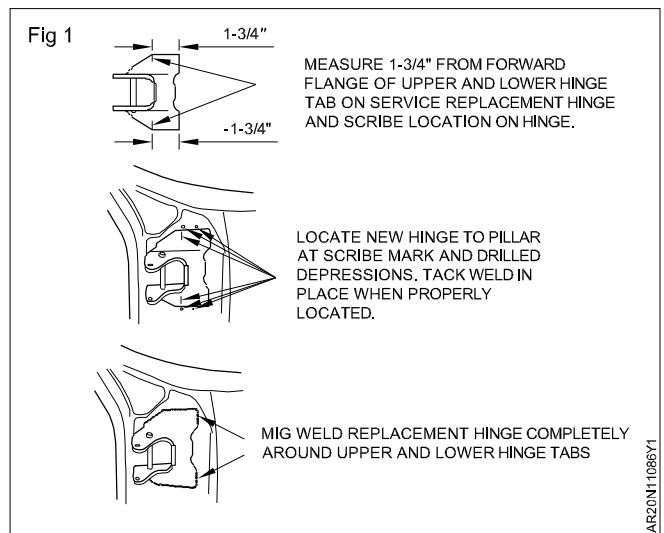


Task 4: Door and door glass adjustments

- 1 With help of some one help hold the door on the floor jack.
- 2 Raise the jack until the door hinges are the same height as their bolt holes in the body.
- 3 Slowly slide the door until you can start the bolts tighten with your fingers.
- 4 Align the hinges against their original positions and snug the bolts down but do not tighten them yet.
- 5 After tighten the hinge bolts check the door operation.
- 6 If need door adjustment, check the hinge pins and bushings.
- 7 Replace the worn hinge pins and bushes and retighten the pin in the hinge and also readjust the door.
- 8 Check the door frame if found any bend correct/straighten the door frame.
- 9 Ensure the door closing is very well sealing with car body.
- 10 Check the door glass operation, if need adjust the glass regulator and glass side channels adjust the glass by loosening nut bolts of inside frame of the door.
- 11 If damage door glass channels, replace the channels and inside urethane strip and outside molding strip.
- 12 Close the door and check the air and water leakage into the passenger air and water leak into compartment straighten the door frame and replace rubber beadings.

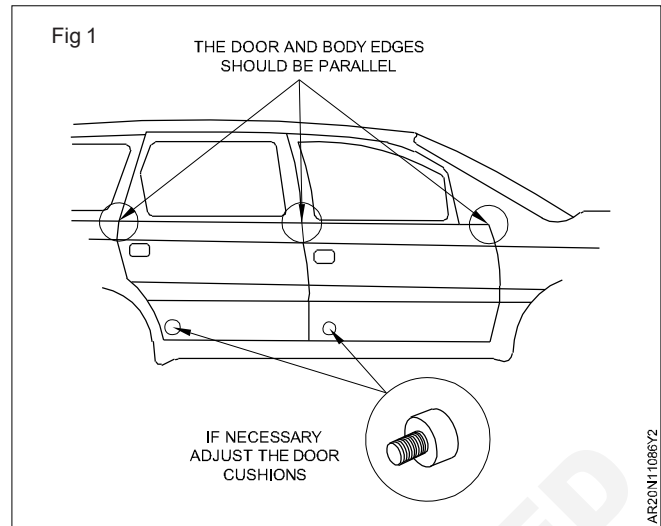
Task 5: Welded door hinges servicing (Fig 1)

- 1 Open and close the car door to check the hinges operation.
- 2 If the door is need adjustment check bar hooks and sticker bar and U-shaped brackets engages the latch.
- 3 Remove the hinge pin by using a special spring compressed tool, ensure tools spring must be seated properly in tool before compressing it.
- 4 After removing hinge pin, the door can be removed from the vehicle.
- 5 To replace the welded door side, hinge first scribe the outline of the hinge on the door.
- 6 Center punch the spot weld and drill on pilot holes completely through the welds. Then weld is drilled out with a larger drill bit.
- 7 Deep enough to penetrate the hinge base to release the hinge from the panel.
- 8 Remove the hinge by use of chisel between the hinge and the base to break it from the panel.
- 9 Remove the body side hinge, use gas cutting torch to cut the tabs holding the hinge together.
- 10 Before use the gas cutting torch, protect the carpet and wires of car.
- 11 Use the grip-type pliers for holding the separated hinge tools are twisted or related to break them.
- 12 Once the tools are removed the pillar should be ground smoothen and prepared to receive the new part.
- 13 Measure the hinge location and transfer these measurements to the new hinge.
- 14 If hinge measurement is as specified limit then tabs weld the hinge tabs with pillar and then hang the door to check it is fit in the door opening and with surrounding panels.
- 15 If door is properly fit, remove the door and weld around the tack welded upper and lower hinge tabs.
- 16 Clean the welded area properly and apply sealer around the perimeter of the hinge. The area then be painted to the proper colour before the door is reinstalled.



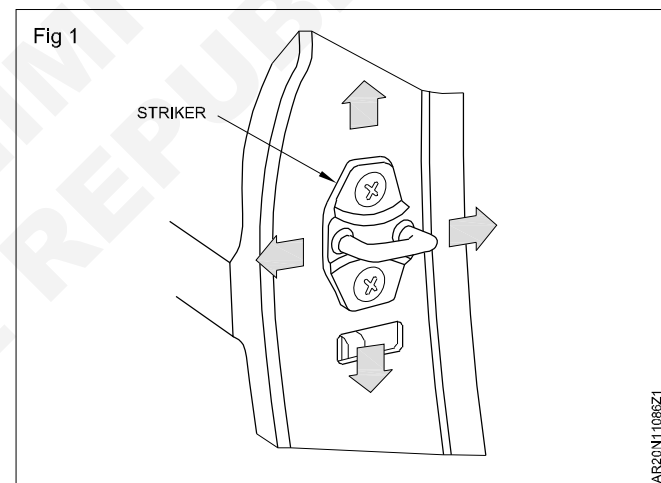
Task 6: Bolted door hinge adjustment

- 1 Check the door adjustment whether they close easily and do not rattle or leak.
- 2 If door is improper adjustment adjust the door sticker to engages the latch smoothly.
- 3 Adjust the front fender to fit the door.
- 4 Adjust the window by fit the weather stripping in hard top models.
- 5 Start from the front door to rear door.
- 6 If the vehicle door is having rubber door stops, you can rotate the door stops to screw them in or out so that the door panel is flush with the adjacent panel.
- 7 All body gaps or edges must be parallel and equal width as shown in the Fig 1.



Task 7: To adjust a door in its opening

- 1 Remove the striker bolt so it will not interfere with the alignment process.
- 2 Determine which hinge bolts must be loosened to move the door in the desired direction. First, establish door height.
- 3 Loosen the hinge bolts just enough to permit movement of the door with a padded pry bar or jack and wooden block. On some vehicles, a special wrench must be used to loosen and tighten the bolts.
- 4 Move the door as needed. Tighten the hinge bolts. Then, check the door fit to be sure there is no bind or interference with the adjacent panel.
- 5 Repeat the operation until the desired fit is obtained.
- 6 Install the striker bolt and adjust it so that the door closes smoothly and is flush with the door is in the full quarter panel. Check that the door is in the full latched position, not the safety latch position (Fig 1).
- 7 On all hardtop models, the door and quarter glass must be checked to ensure proper alignment with the roof rail and weatherstrip.



Practice on door glass adjustment and roof panel service

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

- adjust the door glass
- install the door trim panel
- service the tail gate
- adjust the tail gate of station wagon
- service the rear view mirror
- service the roof panel.

Requirements

Tools/Instruments

- Trainee's tool kit
- Wood spatula

- 1 No.

- 1 No.

Equipments

- Vehicle

- 1 No.

Materials

- Cotton waste

- as reqd.

- Soap oil

- as reqd.

- Masking tape

- as reqd.

- Window glass

- as reqd.

- Roof panel

- as reqd.

- Rear view mirror

- as reqd.

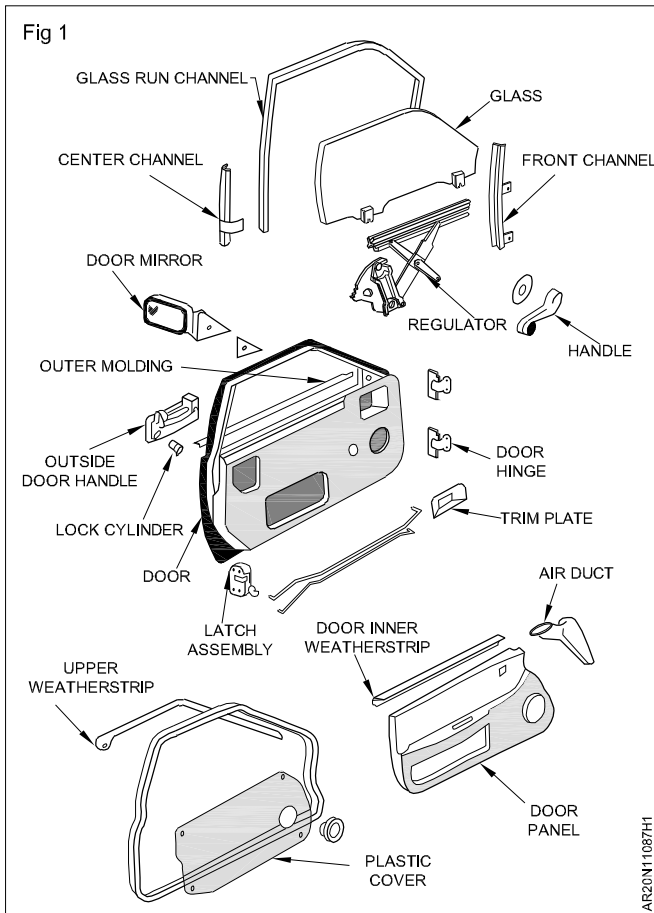
PROCEDURE

Task 1: Adjust the door glasses

- 1 Park the vehicle on the auto body repair shop.
- 2 Check the vehicle door operating and closing is properly adjusted.
- 3 Check the door glass operation whether door glass moves up and down properly.
- 4 Check the type of door glass and operating mechanism.
- 5 Refer the vehicle service manual to adjust the door glass.
- 6 Remove the door pads and door handles.
- 7 Adjust the door glass by loosening nuts or bolts of the glass channels and stops inside of the door frame by moving forward or rearward window adjustments.
- 8 If the door glass having adjustable guide roller in movable channel adjust the glass bracket attached to the lower sash channel or guide attaches to the inner door panels.
- 9 Check the channels, cam roller, guide channels if found damage replace the damaged part before operating door glass.
- 10 Use the dry silicon spray to glass run freely.
- 11 Don't use the oil on rubber parts of the door.
- 12 If defective door glass operating mechanism, replace the regulator refer the manufacturer's manual to obtain the proper removal and installation and adjustment procedure for window door glass adjustment.

Task 2: Door trim panel installation (Fig 1)

- 1 Install all of the door trim pieces and other parts.
- 2 Reposition and press the plastic dust and wind sheet into place on the door frame.
- 3 Make sure all holes in the plastic align with their parts.
- 4 Connect wires plastic controls on the inner trim panel.
- 5 Properly position that all clips on the holes back of the door trim panel.
- 6 Align the clips with the holes in the door frame.
- 7 Use your hand to force the clips into the door to secure the trim panel.
- 8 Install the screws, door handles and other parts.
- 9 Ensure the all door trim panels are installed properly.



Task 3: Tailgate gate glass service

- 1 Dismount the tailgate mounting bolts.
- 2 Remove the tailgate and place it on the work bench with safety.
- 3 Remove the wind shield moldings by using suitable tool.
- 4 Remove the wind shield moldings by using suitable tool.
- 5 Remove the wind shield adhesive and remove the tail gate glass.
- 6 Clean the rear wind shield with glass cleaning solvent.
- 7 Check the tail gate glass if it is reasonable apply masking tape to tailgate glass.
- 8 Remove the adhesive from the tailgate openings by using putty knife or scraper.
- 9 Replace the all broken or rusted clips.
- 10 Position the tailgate glass into opening align for uniform fit and adjust as needed.
- 11 Apply sufficient bonding of urethane, make sure minimum 6.4 mm of the glass in addition to the space that will be taken up by the butyl tape, around the entire perimeter of the glass.
- 12 Ensure the glass supports or spacers are in place. The spacers should be provided equal support around the perimeter of the glass, shift the glass left or right align the glass.
- 13 Start in the bottom center of the wind opening to help avoid leakage.
- 14 Apply a bead of urethane sealant around the glass.
- 15 Use caulk gun to apply adhesive around the perimeter of the tail gate glass.
- 16 With the help of helper carefully position the glass in the body of tail gate opening, lay the glass in the body opening and press firmly to properly seal the installation.
- 17 If need paddle additional sealant between the glass and car tail gate to fill voids. Remove masking tape and protective coverings.
- 18 Check the installation of the glass and ensure glass is fitted properly.

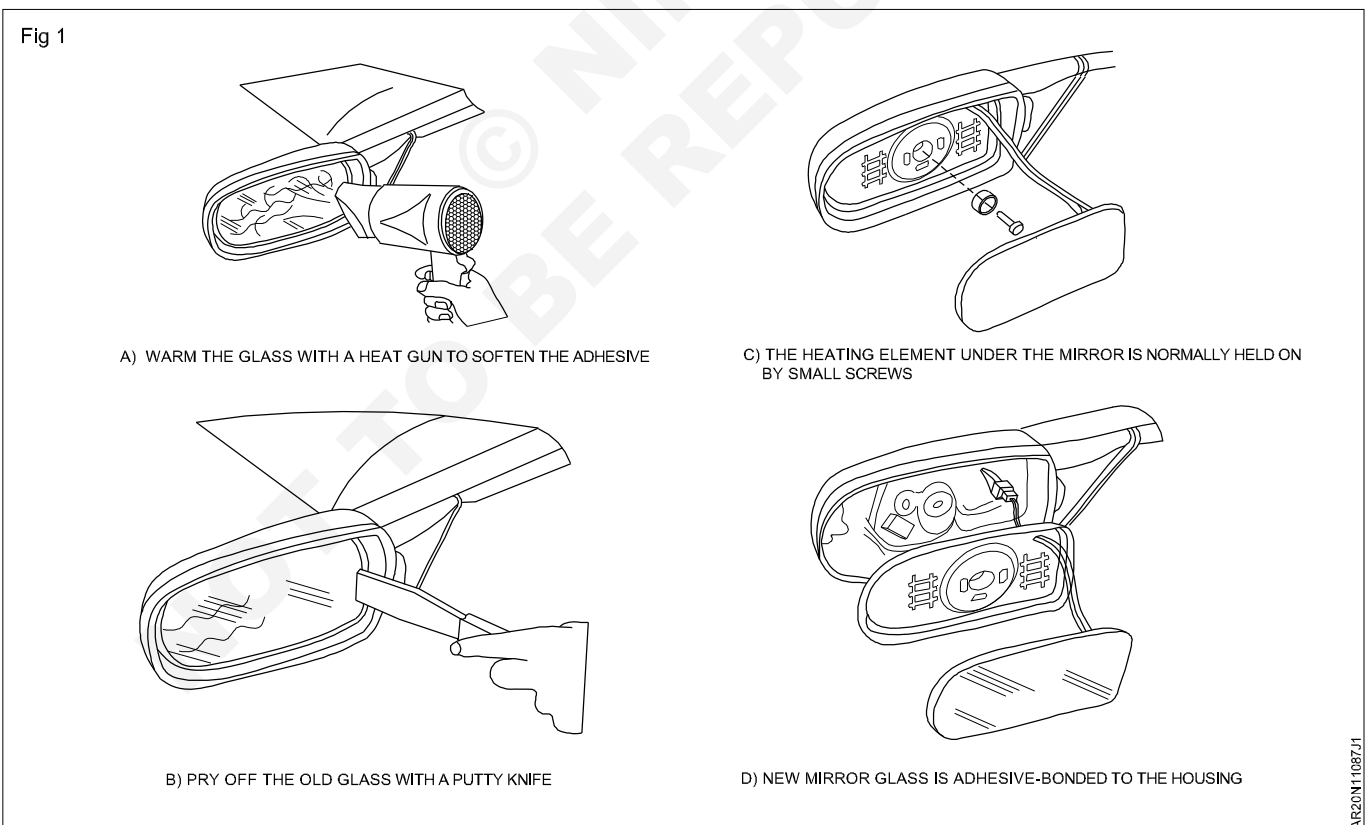
Task 4: Servicing the rear view mirror

- 1 Visually inspect the inside and outside rear view mirror.
- 2 If found damage remove the damaged mirror.
- 3 To service the inside rear view mirror of the vehicle use a sharp putty knife to remove the old mirror mounting.
- 4 Apply heat to the mirror wedge while it warm twist it back and forth with pliers.
- 5 Clean the area where mirror mounted inside of the wind shield.
- 6 Spray clear primer where the mirror is going to be mounted.
- 7 Place the few drops of clear adhesive on wind shield glass and mounting surface of the mirror.
- 8 Press and hold the mounting pad without moving it.
- 9 Hold the mirror or metal pad tight for about a minute.

- 10 If outside rear mirror both sides are damaged, remove the door inner trim panels.
- 11 Remove mirror mounting nuts that secure the outer rear view mirror to the door.
- 12 In case mirror is broken replace the glass with new one.
- 13 In case total unit is damaged replace the unit.
- 14 Make sure rubber gasket is properly positioned between the mirror housing and the door skin.
- 15 Mount the new outside rear view mirror in its place mount the mounting bolts and tighten as specified tightening pressure.
- 16 Ensure the rear view mirror is properly mounted and functioning proper mode.
- 17 Fix door inside trim panel.

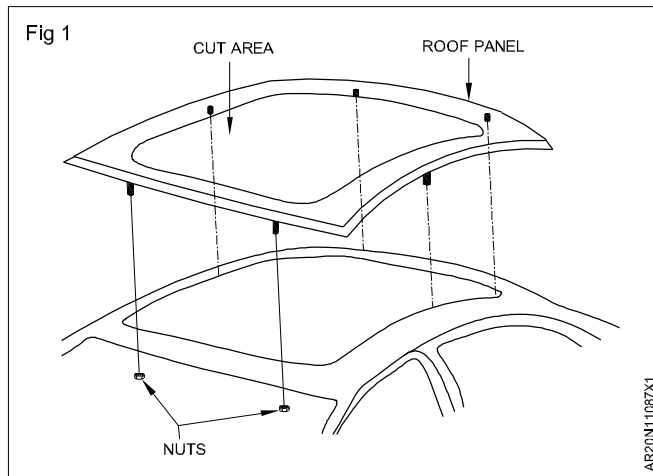
Task 5: Adjustments of station wagon tailgate (Fig 1)

- 1 Check the station wagon tailgate doors.
- 2 Check the tailgate swing open and close.
- 3 Check door roller track.
- 4 Check door lock if damaged replace the lock and track.
- 5 Check the door glass, if damaged replace glass and channels.

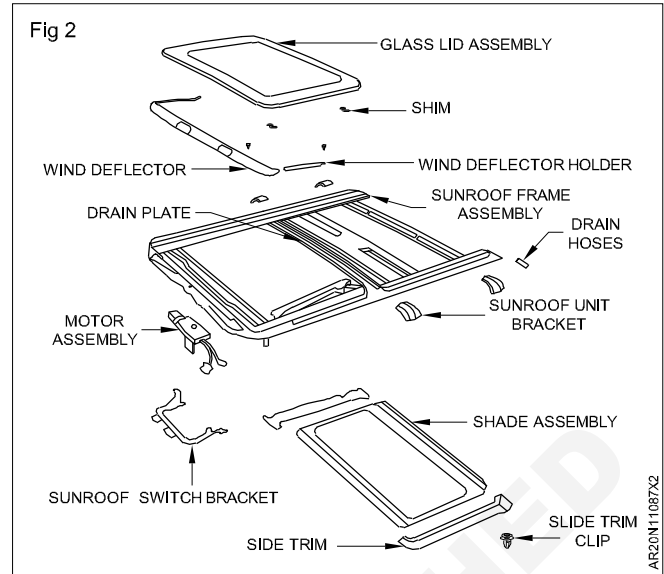


Task 6: Roof panel service (Fig 1)

- 1 Check the vehicle roof panel.
- 2 If found roof panel is damaged by roll over the vehicle.



- 3 Refer the vehicle manufactures service manual for repair the roof panel.
- 4 Remove the head liner and fasteners.
- 5 Remove pried loose adhesive of the old roof panel.
- 6 Clean the lip before installation of the new roof panel.
- 7 Apply the recommended type and bead of adhesive to the mating surfaces.
- 8 Fix the new roof panel down into the adhesive tighten the roof panel fasteners and wipe off any excess adhesive.
- 9 In case vehicle having sun roof panel shown in Fig 2 disconnect motor assembly and sun roof switch bracket.



- 10 Remove the sun roof frame assembly.
- 11 Remove the shade assembly.
- 12 Remove the side trim clip.
- 13 Remove the wind deflector, drain plate, drain hose, glass lid assembly and glass lid shims.
- 14 Inspect the all parts of sun roof panel.
- 15 Replace the damaged part of panel.
- 16 Assemble the sun roof panel in reverse order of dismantled.
- 17 Ensure sun roof switch and motor properly functioning.

Practice on identification the parts of passenger compartment

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

- identify the parts of passenger compartment
- service the passenger seat.

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Vehicle service manual - 1 No.

Materials

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

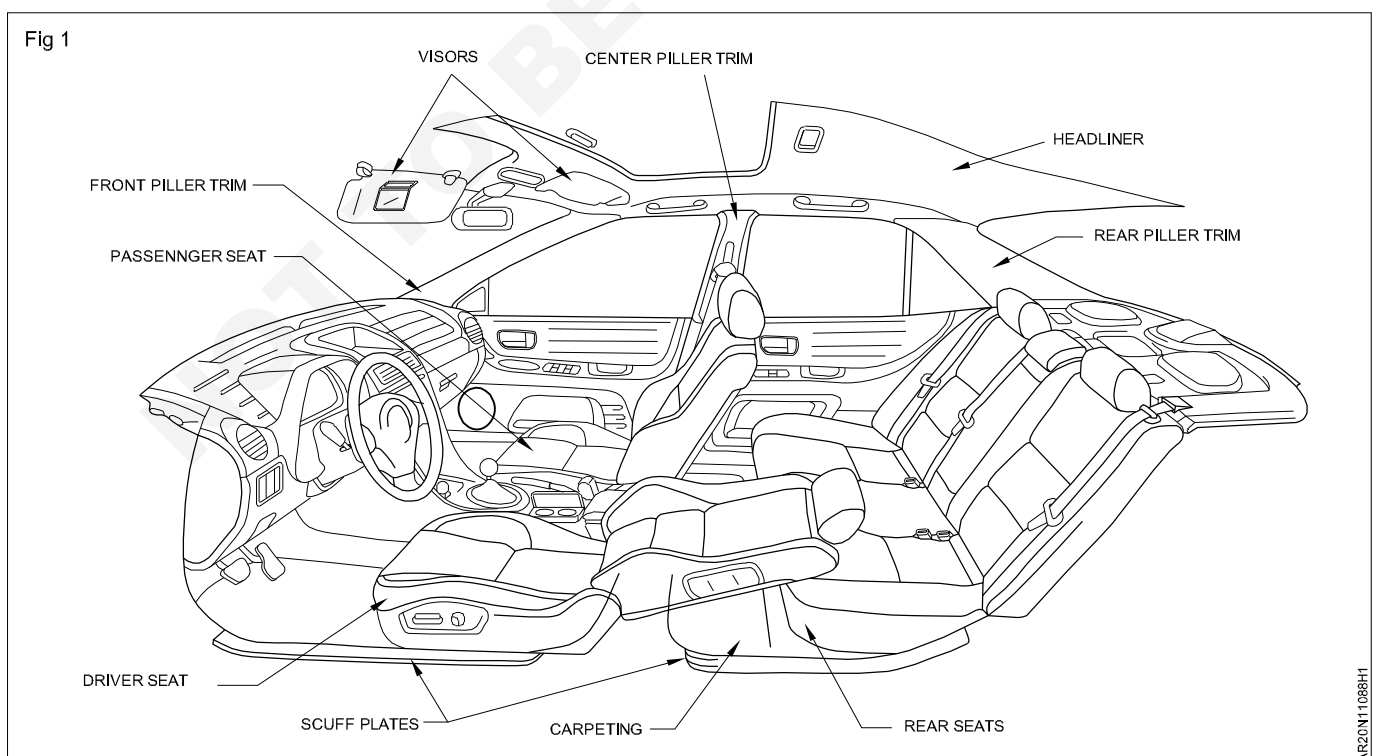
Equipments

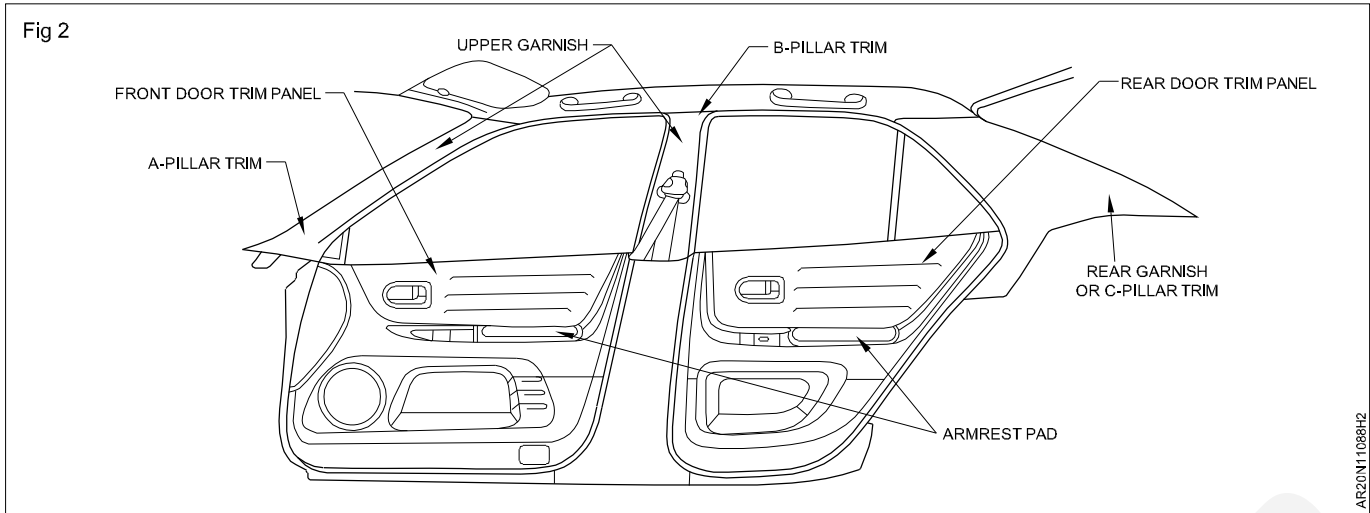
- Vehicle - 1 No.

PROCEDURE

Task 1: Identify the parts of passenger compartment (Fig 1&2)

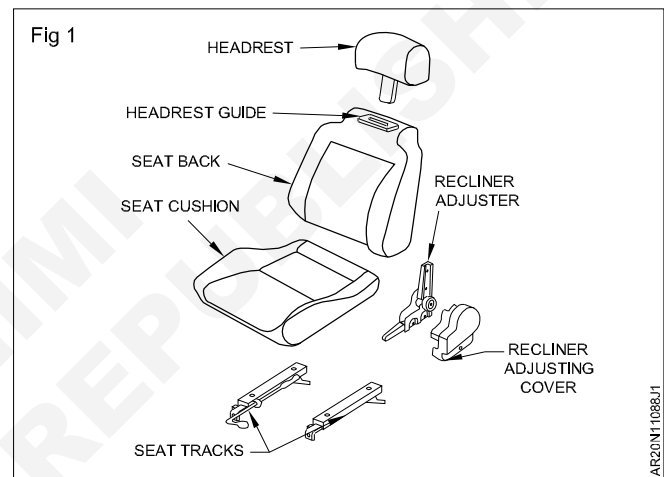
- 1 Identify adhesive the dash board assembly.
- 2 Identify and locate the instrument cluster.
- 3 Identify and locate the seat assembly.
- 4 Identify and locate the interior trim.
- 5 Identify and locate the steering column.
- 6 Identify and locate the head liner assembly.
- 7 Identify and locate the carpeting.
- 8 Identify and locate the weather stripping.
- 9 Identify and locate the center pillar trim.
- 10 Identify and locate the rear pillar trim.
- 11 Identify and locate the scuff plates.
- 12 Identify and locate the visors (Fig 1).
- 13 Identify and locate the door arm rest pad.
- 14 Identify and locate the A,B,C pillar trim, upper garnish, rear door trim panel as shown in the Fig 2.





Task 2: **Service the passenger seat (Fig 1)**

- 1 Check the seat head rest if damaged replace it.
- 2 Check the seat rest guide if damaged replace it.
- 3 Check the seat back if damaged replace it.
- 4 Check the seat cushion if damaged replace it.
- 5 Check the seat racliner adjuster if damaged replace it.
- 6 Check the seat racliner adjuster cover if damaged replace it.



Practice on passenger seat and dash panel service

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

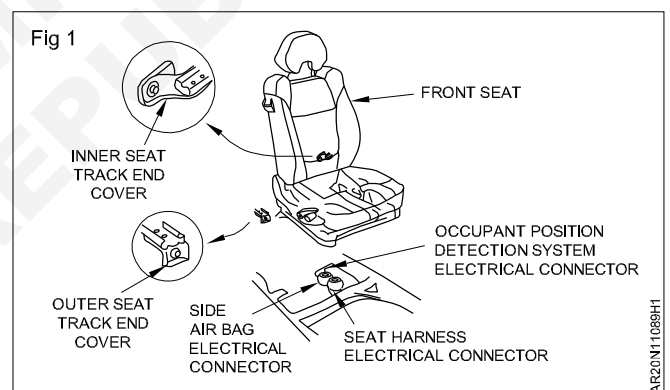
- service the front and rear passenger seat
- service the seat cover and carpentering of the car
- service the dash panel and console service.

Requirements			
Tools/Instruments			
• Trainee's tool kit	- 1 No.	• Seat cover	- as reqd.
Equipments			
• Vehicle	- 1 No.	• Seat track	- as reqd.
Materials			
• Seat cushion	- as reqd.	• Recliner adjuster	- as reqd.
		• Cotton waste	- as reqd.
		• Soap oil	- as reqd.

PROCEDURE

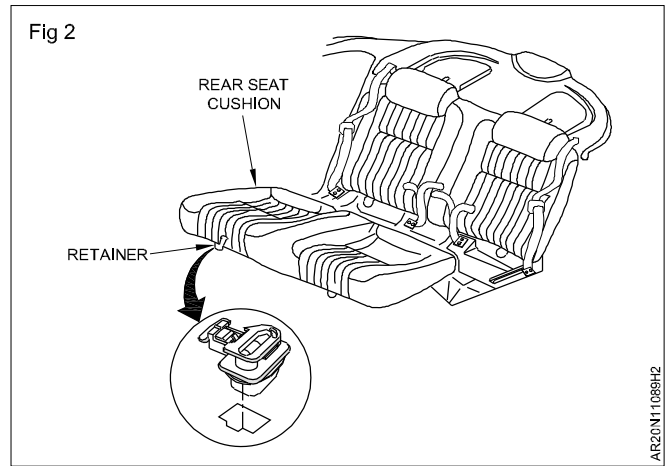
Task 1: Front and bench seat servicing

- 1 Park the vehicle on the auto body repair shop.
- 2 Open the door and inspect the car front and bench seat.
- 3 Identify bolt secure the seat to the floor.
- 4 Push back the seat and loosen the front two mounting bolt.
- 5 Push the seat to forward and loosen the rear mounting bolts.
- 6 Remove the loosen seat mounting bolts.
- 7 Check the seat and seat tracks damages and replace the damaged the parts.
- 8 Check the recliner seat adjuster and recliner adjusting cover and replace the damaged part.
- 9 Check head rest and head rest guide if found any damage in head rest cover and cushions replace the damaged part.
- 10 Check the seat cushions if any damage found on the seat cushion replace cushion and seat cover.
- 11 Assemble the seat and set it back on its original (position on the vehicle)
- 12 Adjust the seat movements and mount the bolts.
- 13 Tighten the bolts as specified tighten pressure by torque wrench.
- 14 Ensure the front seats movement and seat quality is as much as better than before repair the seat.
- 15 If you repairing power or heated seats, up plug the wiring going to the seat before removing seat from the vehicle (Fig 1).



- 16 After repair the seat before installing the seat make sure all tools and items are cleaned out from the floor pan.
- 17 Place the seat on it is position and connect the wire harness of power seat and tighten the anchor bolts by hand and then tighten the bolts by torque wrench.
- 18 Inspect the rear bench seat whether it is mounted by clips or screws.
- 19 Remove the mounting screws or clips of the rear bench seat.
- 20 Push the seat back and lift up the seat and bring it out from the vehicle.
- 21 Inspect the seat frame seat cushion, seat cover and seat retainer.
- 22 If found any damage on the bench seat replace damaged part.
- 23 After repair the seat reinstall the seat on the vehicle.

- 24 Place the seat in position on the vehicle, use your vehicle.
- 25 Place the seat in position on the vehicle, use your knee and blows from the palm of your hand to push the seat down and back.
- 26 If bench seat mounting designed with spring loaded clips when you are pushing the down and back automatically this will engage with these clips.
- 27 If bench seat mounting is designed with screws mount the screw and tighten by hand and then tighten by torque wrench clips.
- 28 Ensure the front and rear seat is fitted properly (Fig 2)

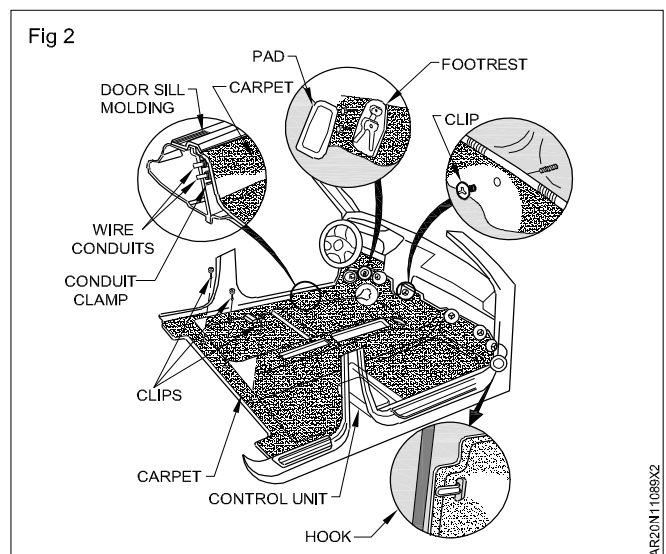
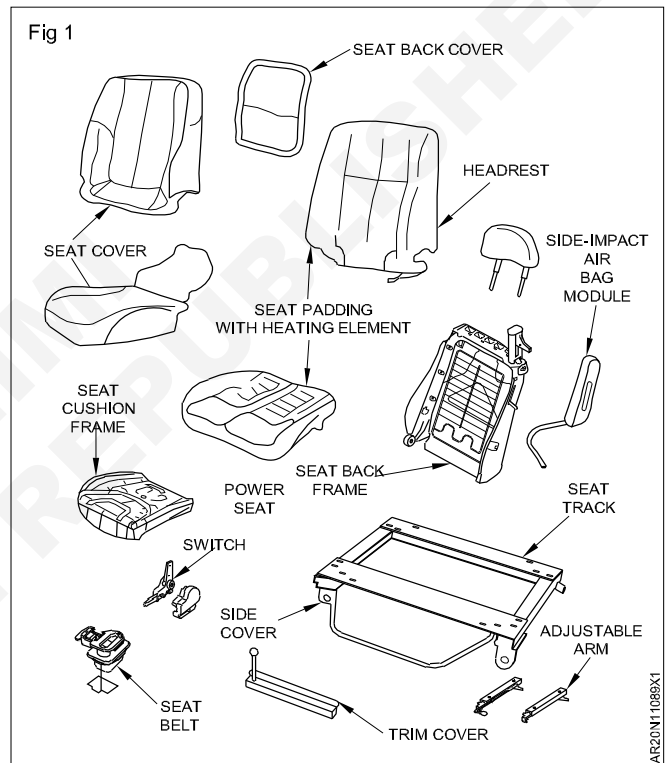


Task 2: Servicing the seat cover and panel carpeting of the car

- 1 Refer the vehicle service manual for detail seat repair procedure.
- 2 Inspect the front and rear seat cover.
- 3 Identify the type of seat cover material (cloth, vinyl, leather).
- 4 Remove the damaged seat cover and check the damaged part of seat cover.
- 5 If the damage is minor like small hole or tear up holster can repair it.
- 6 If the seat cover is unservicable replace it with new one.
- 7 Fix the seat cover on the seat in reverse order of removing the seat cover (Fig 1).

Note: Improper seat installation could endanger the vehicle passengers always use a torque wrench for factory specified values when tightening the front and rear seat fasteners.

- 8 Inspect the vehicle carpeting condition.
- 9 If carpeting is damaged by auto accident or blood stains remove the carpet by removing the seats, seat belt another trim pieces and other parts mounted over the carpet.
- 10 Remove the console, electronic control unit and wiring harness bolted over the carpet (Fig 2).
- 11 Clean the carpet fitted area with cleaning solvent and wipe out the cleaned area.
- 12 Select the new carpet to match the old one.
- 13 Ensure the new carpet is stretched out smooth and properly centered before installing fasteners.
- 14 If an adhesive is required to fasten the carpet before placing the carpet apply adhesive as required between the carpet and floor.

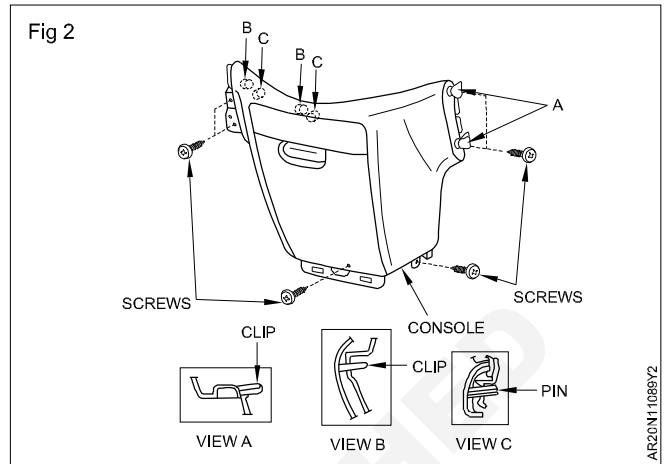


15 Carpeting should be spread out flat and attached starting in the middle.

16 Trim or cut the carpet as needed to fit on the vehicle.

Task 3: Servicing the dash panel and console of the vehicle

- 1 Inspect the damaged dash panel.
- 2 Access the fasteners to remove instrument panel parts shown in the Fig 1.
- 3 Refer the vehicle service manual to remove and reinstalled the dash panel parts.
- 4 Remove the all parts fitted with dash panel.
- 5 Remove the parts of console that attaches to the lower dash.
- 6 Use a specific sequence to remove dash panel part as shown in the service manual.
- 7 Use the proper tools to release and fit the clips.
- 8 Inspect the removed parts for it is damage.
- 9 Replace the damaged dash panel part and console (Fig 1,2 & 3)
- 10 Clean the undamaged parts of dash panel.
- 11 Before assemble the parts check it is functioning.
- 12 Measure the reinforcement bar to make sure it is not bent needed replace the dash board.
- 13 Before installation of the dash panel console the wire hardness of panel should located and connected properly.



14 Assemble the dash board parts as in reverse order of removing the parts or refer the service manual for correct re-assembling procedure and specification limits.

15 Make sure all A/C ducts and vents are pushed over each other properly as you install the dash panel.

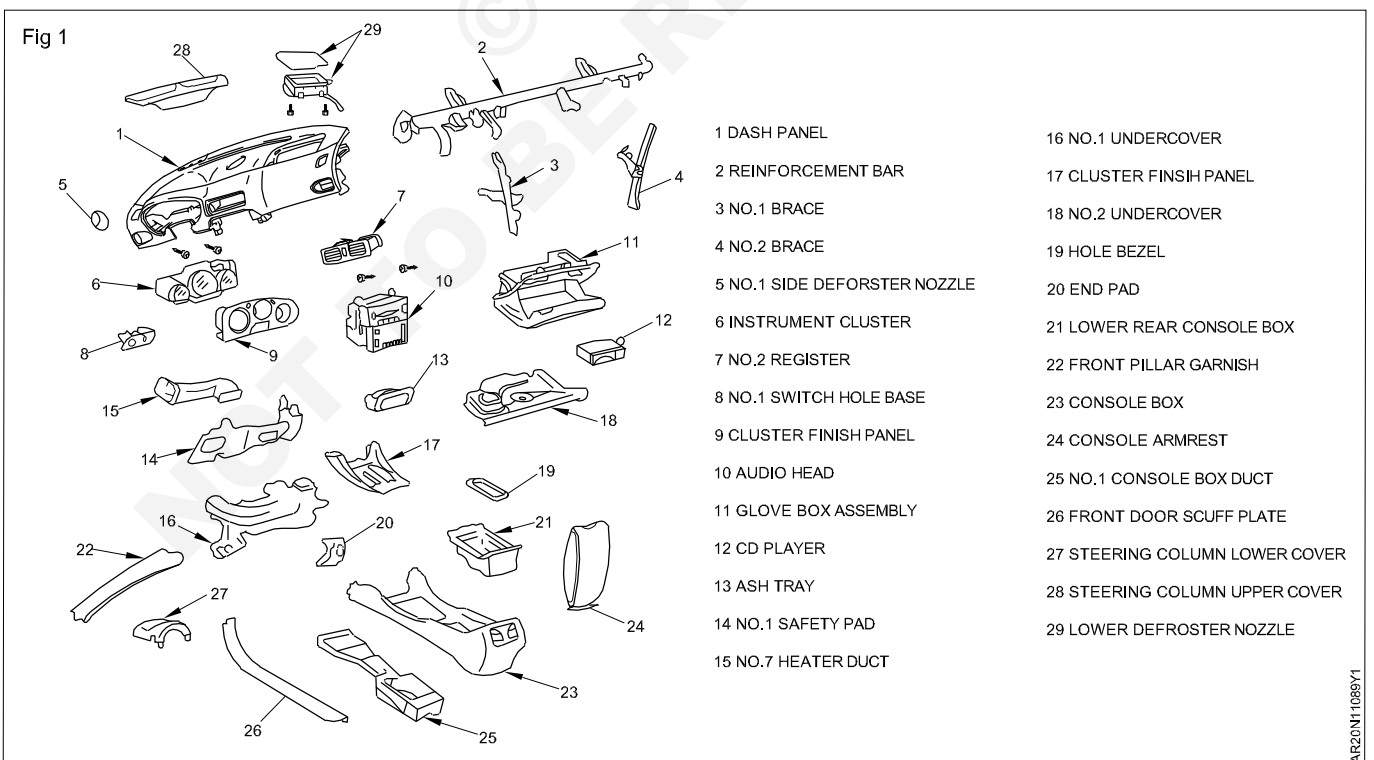
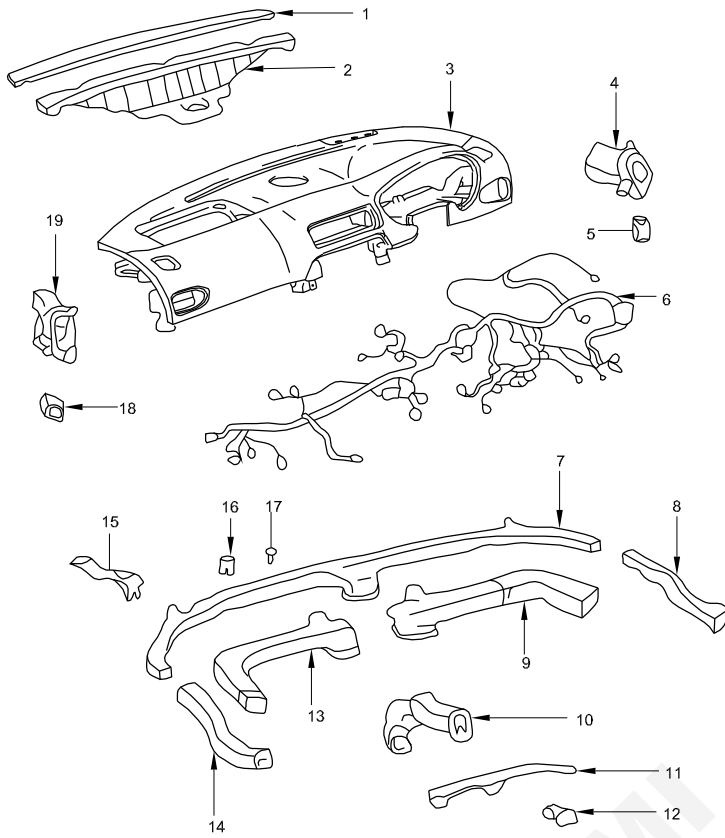


Fig 3



- 1 DEFROSTER NOZZLE GARNISH
- 2 DEFROSTER NOZZLE ASSEMBLY
- 3 INSTRUMENT PANEL SAFETY PAD
- 4 NO.4 REGISTER
- 5 NO.2 SIDE DEFROSTER NOZZLE
- 6 WIRE HARNESS
- 7 NO.5 SIDE DEFROSTER NOZZLE DUCT
- 8 NO.2 SIDE DEFROSTER NOZZLE DUCT
- 9 NO.4 HEATER TO REGISTER DUCT
- 10 HEATER TO REGISTER CENTER SUBDUCT
- 11 CENTER BRACKET SUBASSEMBLY
- 12 GLOVE BOX LIGHT ASSEMBLY
- 13 NO.1 HEATER TO REGISTER DUCT
- 14 NO.1 SIDE DEFROSTER NOZZLE DUCT
- 15 NO.1 MOUNTING BRACKET
- 16 AUTO LIGHT CONTROL SENSOR
- 17 SOLAR SENSOR
- 18 NO.1 SIDE DEFROSTER NOZZLE
- 19 NO.1 REGISTER

AR20N11089Y3

Practice on instrument cluster & head liner service

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

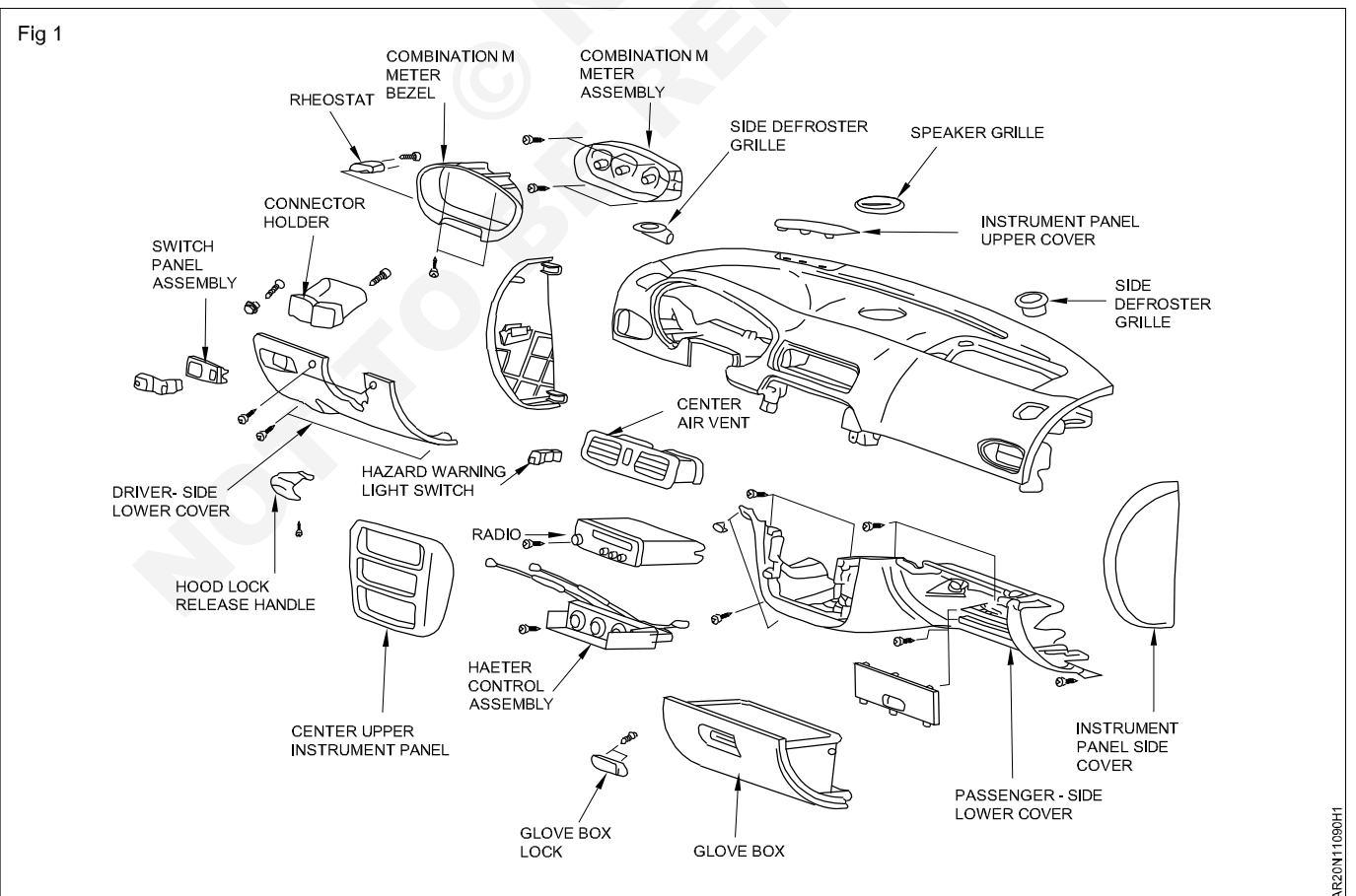
- service the instrument cluster of the vehicle
- service the head liner of the vehicle
- locate the air and water leaks.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Soap oil	- as reqd.
• Vehicle	- 1 No.	• Weather strip	- as reqd.
• Air compressor	- 1 No.	• Nut and bolts	- as reqd.
• Car jet washer	- 1 No.	• Wire	- as reqd.
		• Bulbs	- as reqd.

PROCEDURE

Task 1: Servicing the instrument panel cluster (Fig 1)

- 1 Disconnect the battery to prevent the short circuit during work.
- 2 Remove the instrument panel cover mounting screws.
- 3 Pull out the cluster enough to disconnect the gauge wire connection.
- 4 Disconnect the speedometer cable.



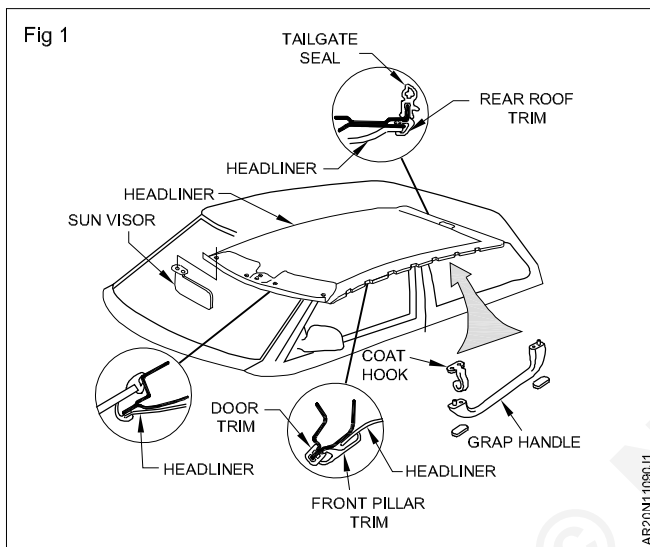
AR20N11090H1

- 5 Remove the cluster unit and replace the gauges bulbs is needed.
- 6 Remove the gauges mounting hex screws which hold the plastic lens plate over the housing.
- 7 Remove the lens and replace the defective gauges and speedometer.
- 8 Assemble the gauges and speedometer.

- 9 Install the instrument cluster parts in reverse order of their removal.
- 10 Connect all wires of gauges and speedometer cable.
- 11 Fix the mounting screw of instrument cluster cover.
- 12 Connect the battery wire and check the operation of the dash board lights and gauges operation after installation.

Task 2: Servicing the headliner of the vehicle (Fig 1)

- 1 Visually inspect the vehicle head liner.
- 2 Check the type of head liner material and method of fatterning with roof.



- 3 If found damaged head liner, remove all of the trim pieces around the edges of the passenger compartment roof.
- 4 Remove the roof panel liner by removing screws and clips secure the trim pieces.
- 5 Remove the sun visors grab handle and other parts fitted with head liner.
- 6 Replace the head liner and install the foam backed head liner be carefully.
- 7 Don't over bend or knik the head liner center the head liner in it is position marked on head panel.
- 8 Install the head liner in reverse order of removal.
- 9 Fix the grips, roof console lamp assemblies, sun roof switch and visors.
- 10 Refer the vehicle service manual to proper service of the head liner as per vehicle specification.

Task 3: Locating air and water leaks

- 1 Close the all doors of the vehicle.
- 2 Spray compressed water solution in the vehicle for few minutes and then apply compressed air to the window - to - panel joint.
- 3 Stop the water spray and clean the vehicle.
- 4 Open the door and visually inspect, whether water is entered into the vehicle.
- 5 If water is leaked into the vehicle, mark the water leaked area.
- 6 Find the cause for water leaks, into vehicle incase

weather strip is damaged replace the weather strip and retainer.

- 7 Weather strip should be cut approximately 1/4" to 1/2" longer than required and bolt together, avoid overlapping.
- 8 You can check the leaks, by using light listening leak detector.

Practice on checking drain hoses, wind noise, repairing leaks and rattle elimination of unibody

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

- check the drain hoses and wind noise
- check the repairing leaks
- check the raffle elimination and fixing rattle.

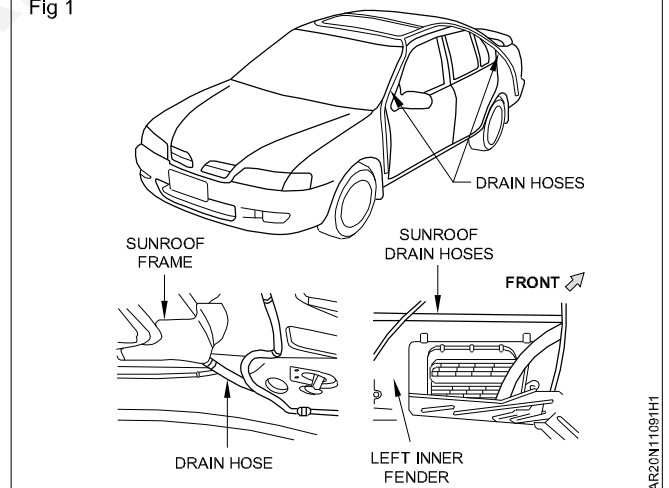
Requirements	
Tools/Instruments	Materials
<ul style="list-style-type: none"> • Trainee's tool kit - 1 No. 	<ul style="list-style-type: none"> • Weather strip - as reqd. • Soap oil - as reqd. • Cotton waste - as reqd.
Equipments	
<ul style="list-style-type: none"> • Vehicle - 1 No. • Air compressor - 1 No. • Car jet washer - 1 No. 	

PROCEDURE

Task 1: Drain hose and wind noise checking

- 1 Check the water drain system for the sun roof frame of the vehicle.
- 2 If any leaves or debries are in the drain hose, clean it.
- 3 If drain hose is clogged by any debries clean it by blast of air through the air nozzle if any damage on the drain hose repair it.
- 4 Check car A/C evaporator's drain hose, if found damage or clogged hose replace it (Fig 1).
- 5 Check the damages of weather strip, misalignment of window glass.
- 6 If damaged weather strip, replace the weather strip, and align the window glass.
- 7 Check the wind noise when the vehicle by moving air hits on the vehicle.
- 8 Find the cause for wind noise produces.
- 9 If you find loose body molding tight it.
- 10 If you find poorly aligned front fender, aligned it properly.
- 11 Check the hood adjustment if found improper adjustment adjust the hood properly.
- 12 Check the breakage of the rubber on the door glass run, if found damaged rubber, replace it.

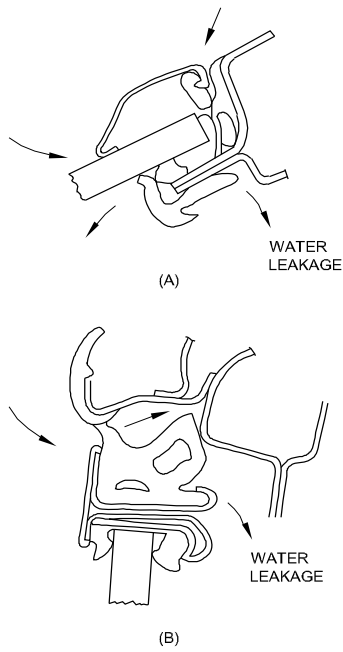
Fig 1



Task 2: Check the repairing leaks (Fig 2)

- 1 Remove all applicable interior trim from the general area of reported leaks.
- 2 If leak spots are some distance from actual leaks, remove all trim seats and floor mats from area that are suspected as possible sources of the leak.
- 3 Find the cause for leaks and sealed the leaks with an appropriate sealing compound, weather stripping and then rechecked to verify that leak is properly sealed.
- 4 Leak checks are checked by using the low pressure water spray, air nozzle leak test, leak checks by light, electronic leak detector as you have learned in your theory part and consult your instructor for proper guide line for your work.

Fig 2



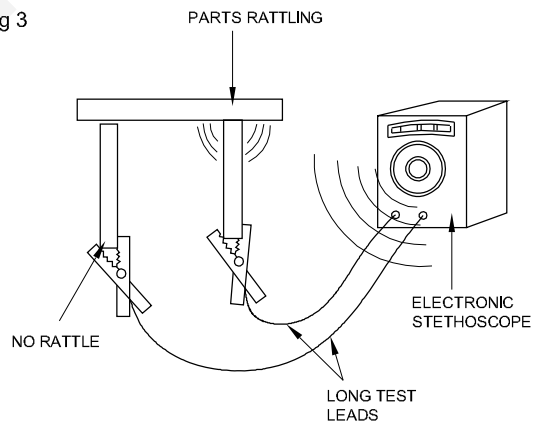
ARN11058H2

Task 3: Check the rattle elimination and fixing rattles

- 1 Check the loose or rubbing parts if found loose or rubbing tighten the parts mounting.
- 2 Check the nut and bolts mounts if loose fitting tighten it.
- 3 Check the vehicle for loose or broken or damaged parts if found any above mentioned defect rectify it.
- 4 After repairing the damaged parts of the vehicle elimination by an electronic stethoscope (Fig 3).
- 5 When you listen the noise while driving the vehicle, connect the alligator clip to a part and the noise is the loudest.
- 6 Effect is generated by the sound traveling through the vehicle body so that the rattle or noise can be accurately located.
- 7 If the noise is outside the passenger compartment near the front check the hood for proper alignment at the front and back.
- 8 Align the front and back hood fittings.
- 9 Check the hood latch pin, rubber hood bumpers, if found looseness fit it properly.
- 10 Readjust the hood flutters, grille, wheel housing, trim moldings and tighten the bumper brackets.

- 11 Check the rubber beadings, if found any damage replace it.
- 12 Tighten the all hardware, especially in the area of the suspected noise source.
- 13 Use the rubber mallet on structural parts by soft blows to rectify the suspected noise.
- 14 Lubricate the moving parts such as hinges to avoid noise.

Fig 3



ARN11058H3

Practice on use of frame gauge for upper body damage measurement

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

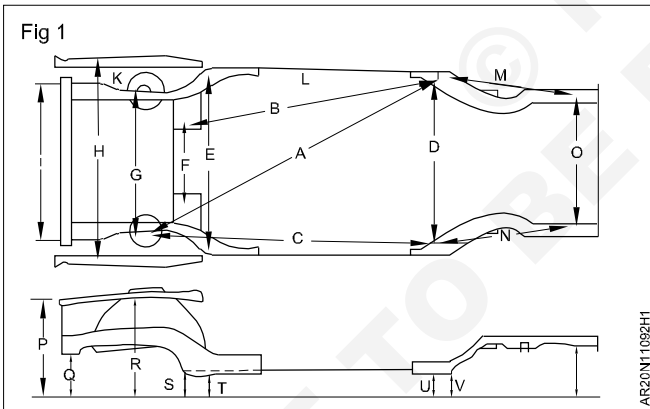
- use of frame gauge
- measure the upper body dimension.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Trame gauge	- 1 No.	• Soap oil	- as reqd.
Equipments			
• Vehicle	- 1 No.		

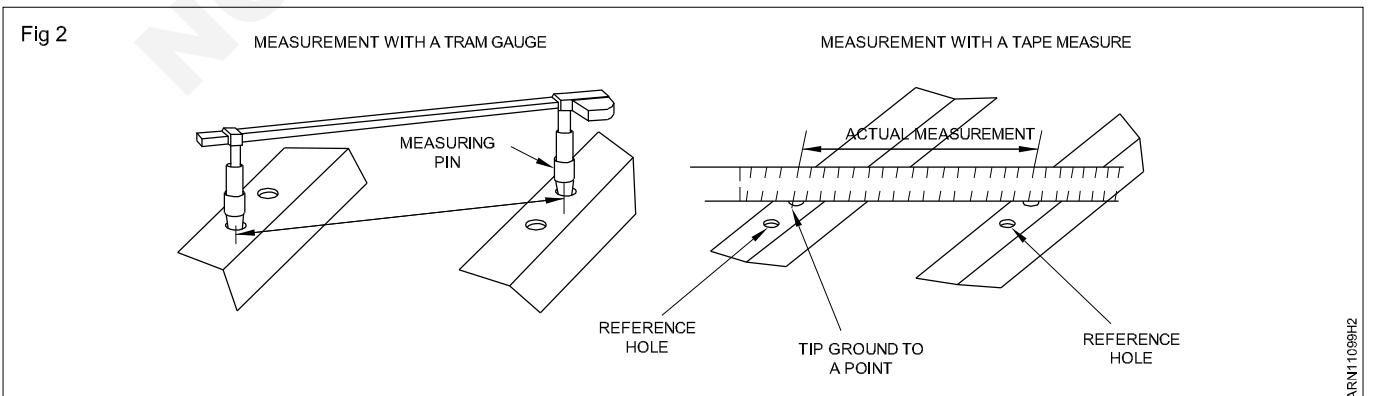
PROCEDURE

Use the trame gauge to measure upper body dimension (Fig 1&2)

- 1 Park the vehicle on the auto body repair shop.
- 2 Clean the vehicle and visually inspect the damaged parts of the vehicle mark damaged area on the print out diagram as shown in Fig 1. Use the letters to easy identification of damage.



- 3 Select the trame gauge to measure the upper body of the vehicle and dimensions.
- 4 Refer the vehicle service manual for correct specifications and dimensions.
- 5 Remove the damaged parts of the vehicle and set the trame gauge on the upper body side as per manufacturers furnished upper reference points.
- 6 Upper body dimensions is measured by trame gauge is basically the same as used to do an under body evaluation.
- 7 Set trame gauge measuring pin securely into the measuring hole.
- 8 Measure the distance between the hole centers of the upper body with a tram gauge.
- 9 You can measure the quick and accurate measurements with a tape. (Measure if the holes are the same size.)
- 10 Measure the crushed areas of vehicle and writ them down next to the factory values on the sheet, as given below.



- 11 Compare the measurement value with factory values.
- 12 If the vehicle upper body damage measurement value are same as factory specific values, it means no damage happen during vehicle accident and pull out repair is not required.

- 13 If different in value you can continue the pull out the damage and note down the value of each pull out repair as given below table 1.
- 14 After find pull out the damage repair should be equal to corresponding factory numbers.

Table 1

Trame gauge data measurement chart

Crushed area location	Manufacturers specification	Measurement after pullout the damage							Actual measurement before st
		1	2	3	4	5	6	7	
A	300 mm	290							280 mm
B	300 mm	145							100 mm
C	1200 mm	1140							
D	1200 mm	1200							
E									
F									
G									
H									

Practice on measurement of front and rear body damage

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

- measure the front body damage area
- measure the vehicle side body panel
- measure the vehicle rear body damage
- use the strut center line gauge.

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Center line gauge - 1 No.
- Trame gauge - 1 No.

Equipments

- Vehicle - 1 No.
- Gas and arc welding unit - 1 No each

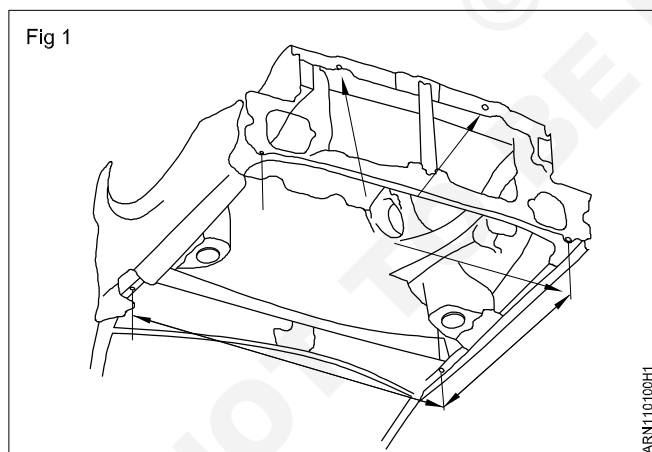
Materials

- Cotton waste - as reqd.
- Soap oil - as reqd.
- Welding rod - as reqd.
- Flux - as reqd.
- Cleaning material - as reqd.

PROCEDURE

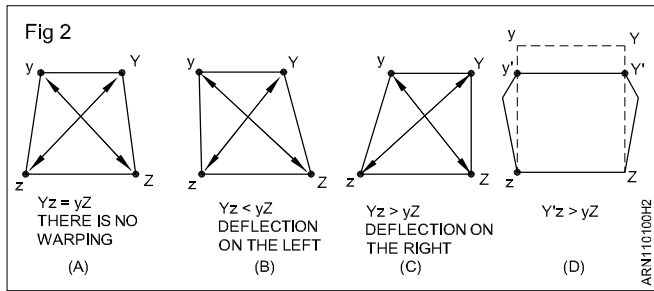
Task 1: Measurement of front body damage (Fig 1)

- 1 Park the vehicle on auto body repair shop.
- 2 Clean the vehicle before start the damage repair.
- 3 Visually inspect the vehicle body front damage area.
- 4 Measure the front side members before making repair.
- 5 Check the extent deformation before remeasuring.
- 6 Check the reference points shown as body dimension diagram.
- 7 Measure across the reference points of front body to analyze the body damage.
- 8 Analyze the damage, if any measurements are shorter or longer than specification, pull or push the body parts back into alignment.
- 9 Use the tram gauge measure the suspension and mechanical components attachment points.
- 10 Each dimension should be checked from two additional reference points out of them one reference point being diagonal measurement.
- 11 For accurate measurement, use longer dimension.
- 12 Use two or more measurement from each reference points to ensures greater accuracy.



Task 2: Measurement of body side panel

- 1 Check the vehicle doors irregularities when it is opened and closed.
 - 2 Use the tram gauge to primary measurement of side panel damage.
 - 3 Measure the damaged side and note the measurement on the paper.
 - 4 Measure the undamaged side and note the measurement on the paper.
 - 5 Compare the measurement reading and find th warping left to right symmetry is different in each side.
 - 6 Measure the damaged side in diagonal lines as shown in Fig 2.
- Carefully study the diagonal line measurement method.
- No straightening needed or same as specs (Fig 2A).
 - Damage to left so pull to right for repair (Fig 2B).



- Door opening or other section has been damaged and pushed right (Fig 2C).
- With this damage measures would be the same and might even be within specs (Fig 2D).
- Other measurement points are needed to pull out damage (Fig 2).
- Measurement and comparison of the left and right lengths between yz and YZ will give an even better indication of damage conditions (Fig 3).
- This method should be used in conjunction with the diagonal line measurement (Fig 3).

Task 3: Rear body damage measuring system

- 1 Visually inspect the rear body damage by opening and closing of the trunk lid.
- 2 Check the water leakage and point damage.
- 3 Measure the rear body together with the under body.
- 4 Fix the measuring points on the vehicle such as bolts, plug or holes.
- 5 Measure between two points of damaged rear body.
- 6 Set the tram bar parallel to the car body (Fig 1).
- 7 Take measurement in different location of rear body by setting different lengths as shown in Fig 1.
- 8 Make all measurements on the damaged vehicle at the points specified in the vehicle body manual.
- 9 Subtract the actual measurement from the specified measurement.

Task 4: Strut center line gauge usage

- 1 Visually inspect the misalignment of the strut lower and upper body parts.
- 2 Set the strut tower gauge to check the visual alignment of the upper body area.
- 3 Set the upper and lower horizontal bar with a center pin Fig 1.
- 4 Adjust the horizontal bar to housing the strut lower/ upper body location as shown in Fig 2.
- 5 Check the strut center line gauge pointer length which change the scale reading and adjust the height at the housing of the upper horizontal bar.

- This method can be applied where there are parts that are symmetrical on the left and right sides (Fig 3)

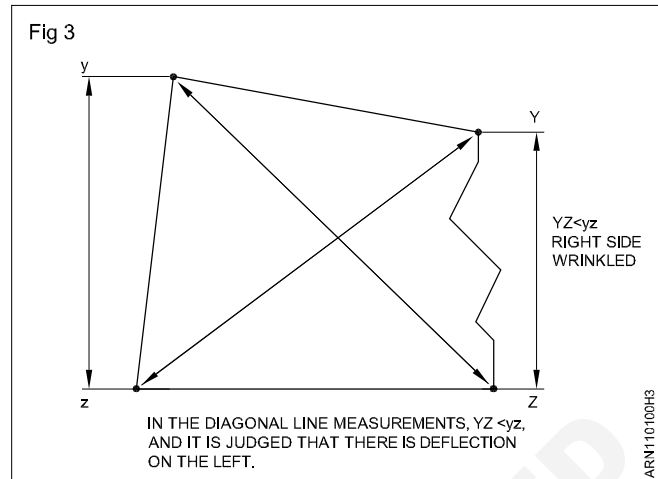
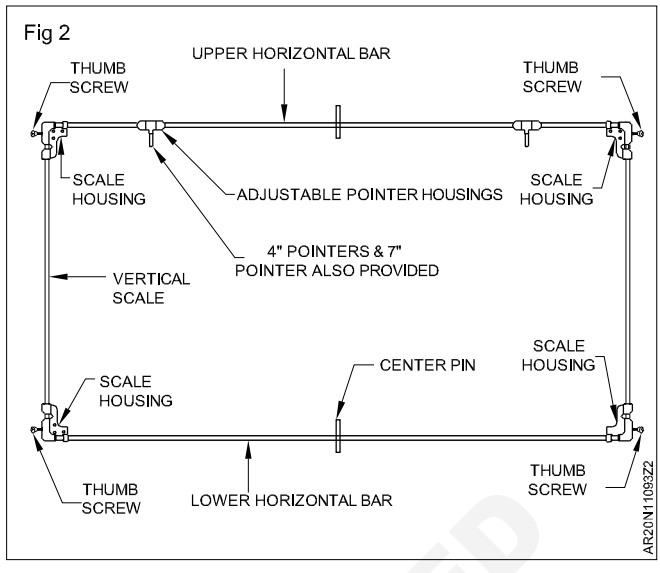
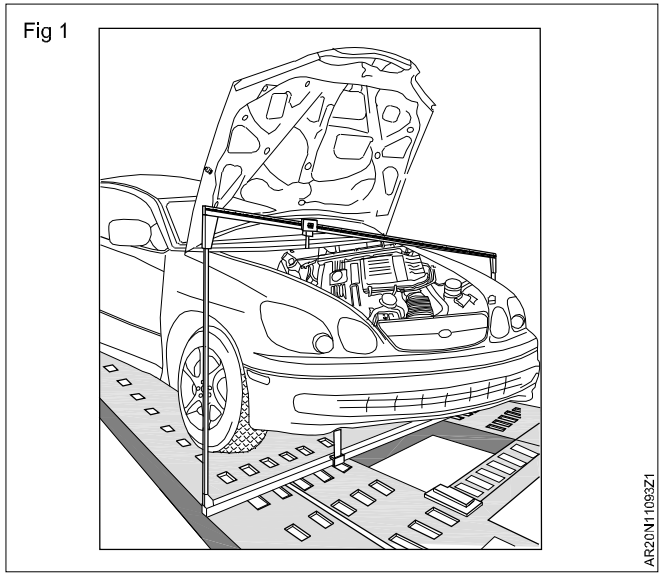


Fig 1



- 6 Adjust the upper and lower horizontal bar to set the lower bar at the datum place with lower bar set properly.
- 7 Upper pointers should be located at reference points on the strut towers.
- 8 If not, the strut towers are damaged and pushed out of alignment.
- 9 Align the front suspension and wheels properly.

Note: The strut tower upper body gauge is used to detect the misalignment of strut towers and misalignment of radiator support, center pillar, cowl, quarter panel.



© NIMI
 NOT TO BE REPUBLISHED

Practice on identify the impact damage of vehicle body

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

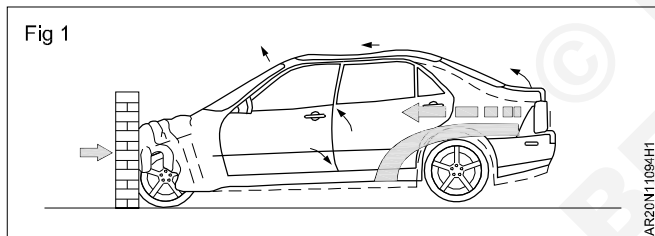
- identify the condition of collision
- identify the influence of impact on a body over-frame vehicle
- visually determine the extent of impact damage.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
Equipments		• Soap oil	- as reqd.
• Vehicle	- 1 No.		

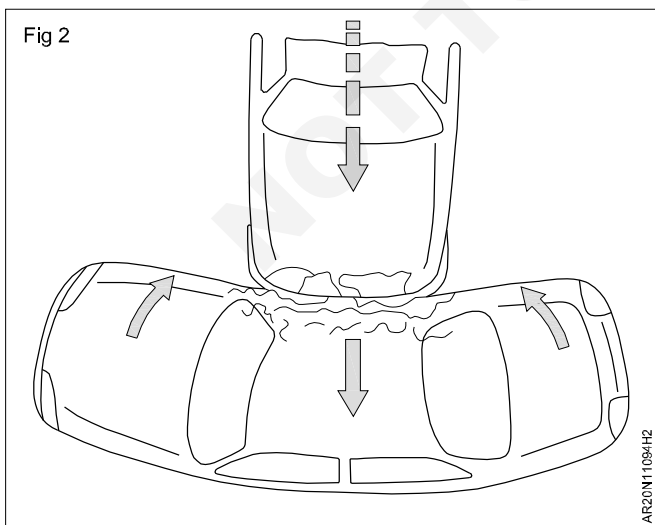
PROCEDURE

Task 1: Identify the condition of vehicle collision

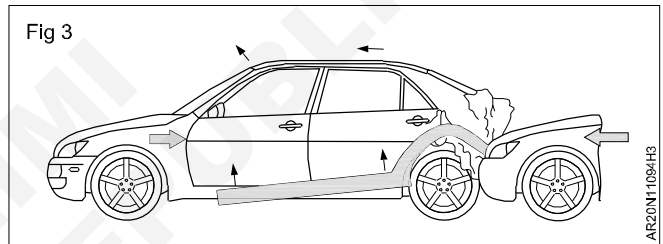
- 1 Park the collision damaged vehicle on auto body repair shop.
- 2 Visually inspect the condition of the vehicle collision damage.
- 3 If the vehicle front parts are damaged it means vehicle met front end collision (Fig 1).



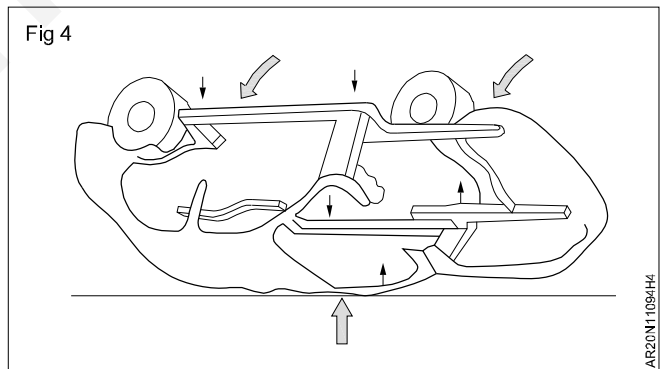
- 4 If the vehicle is side is damage means it means vehicle met side end collision (Fig 2).



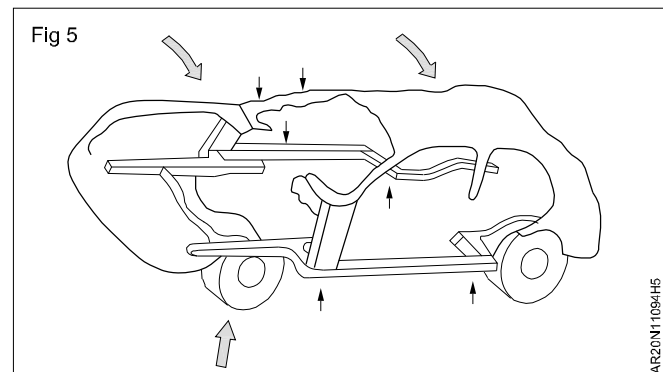
- 5 If the vehicles rear body is damaged it means vehicle met rear end collision (Fig 3).



- 6 If the vehicle body side or slid into a curb before rolling onto it is roof (Fig 4).



- 7 If the vehicle body pillar, side, roof damage means vehicle roll over several times (Fig 5).



Task 2: Influence of impact on a body over frame vehicle

- 1 Visually check the impact Unibody vehicle damage.
- 2 If minor impact, the bumper is pushed back, bending the front side members, bracket, front fender, radiator support and it is related parts are damaged.
- 3 If major impact the front fender, front door, front side member cross members, front body pillars damage.
- 4 If the suspension member, dash panel, front floor is bent or damaged means due to major impact on vehicle.
- 5 If vehicle body, vertical bending is effected by front impact at an angle.
- 6 If the rear bumper, back panel, truck lid and floor pan is deformed means rear impact damage.
- 7 Check the vehicle body parts bending by impact.
- 8 Check the crushing or collapsing parts of the vehicle.
- 9 Check the widening the Unibody structure by impact forces reaching.
- 10 Check the twisting parts of Unibody vehicle by impact and secondary impact on a conventional vehicle frame. Find the damage by measuring the height and width of vehicle frame.
- 11 Correct the damages of vehicle by pulling and pushing the damaged parts or by replacing parts (incase heavy damage)

Task 3: Visually determine the extent of impact damage

- 1 Check the vehicle for impact damage.
- 2 Visually check twisting, bending or slang of the vehicles overall.
- 3 Look the vehicle to determine where the damage occurred.
- 4 Inspect the damaged parts along the path of the impact damage through the weak portions of the body.
- 5 Check the presence of strain, panel joint misalignment, cracks, cracks under coat and scaler on the vehicle.
- 6 Check the clearance and fit of each part.
- 7 After finding the all damages and then start the repair process as per service manual procedure.

Practice on universal measuring and computerized measuring system

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

- inspect the damages of passenger & luggage compartment of the vehicle
- use the universal measuring system to measure the damages of the vehicle
- use the computerized measuring system for measure the vehicle damages.

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.

Equipments

- Vehicle - 1 No.
- Universal measuring gauge - 1 No.
- Computerized measuring unit - 1 No.

Materials

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

PROCEDURE

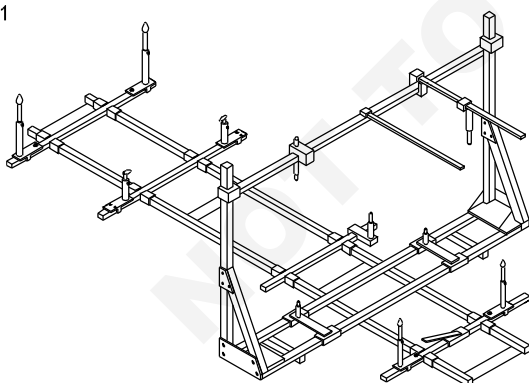
Task 1: Inspect the damages of passenger & luggage compartment during the vehicle collision

- 1 Check the damage of dash panel by secondary impact.
- 2 Check the steering wheel and steering column for damage.
- 3 Check the passengers seat back damage.
- 4 Check the quarter panel damage by vehicle collision.
- 5 Check the luggage compartment damages by vehicle collision.
- 6 Check the door damages and body pillar damage.
- 7 Check the door sagging by checking the door alignment.

Task 2: Application of universal measuring system (Fig 1)

- 1 Remove the detachable damaged body plastic parts.
- 2 Remove the detachable damaged mechanical parts.
- 3 Remove the detachable damaged metal body panels.
- 4 Perform rough straightening to the center section of the vehicle.
- 5 Compensate the parts left in the vehicle.
- 6 Analyse the vehicle damage and select the measuring system of universal measuring system. (Mechanical systems, lesser systems, sonic systems)
- 7 Use the mechanical universal measuring system to measure the three dimensions of the vehicle length, width and height.
- 8 Mount the laser tram on a mechanical measuring system to quickly check the alignment of panels and parts of the vehicle accurately, it shots out a perfectly straight beam of light.

Fig 1



Task 3: Use the computerized measuring system to evaluate structural damage of vehicle

- 1 Check the vehicle damages.
- 2 Use the computerized measuring units to evaluate the structural damage of vehicle.
- 3 Select the type of measuring system (sonic, robot arm, laser).
- 4 Refer the measuring equipment manufacturers specific dimension chart for damage vehicle measurement.

- 5 Before set the computer measuring unit with damaged vehicle open the computer and check monitor displayed data for each vehicle make and models service guide to use before and during the repair.
- 6 Study the service instructions displayed on computer monitor.
- 7 Read the equipment manual before measuring vehicle damage.
- 8 Note the plus or minus in millimeters for length, width and height of damaged part.
- 9 Set the computerized measuring unit as shown in the Fig 2.
- 10 Note the measurement displayed on the computer monitor.
- 11 Compare the measured value with manufacturers specification of part and carried the repair process for correct specification.
- 12 If you use the sonic computerized system slide the micro phone beam under the vehicle and onto the rack as shown in Fig 3a.
- 13 Hang the probe from the bolt for the vehicle reference point as shown in Fig 3b.

- 14 Using the denoted adopter hand the probe from reference point on the vehicle as shown in Fig 3c.
- 15 Give the measurement point for each measurements.
- 16 Note the length, width and height measurement as shown in Fig 3d.

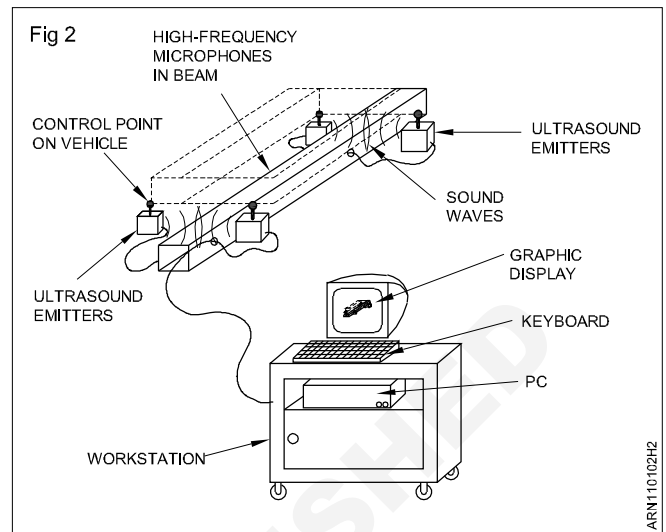


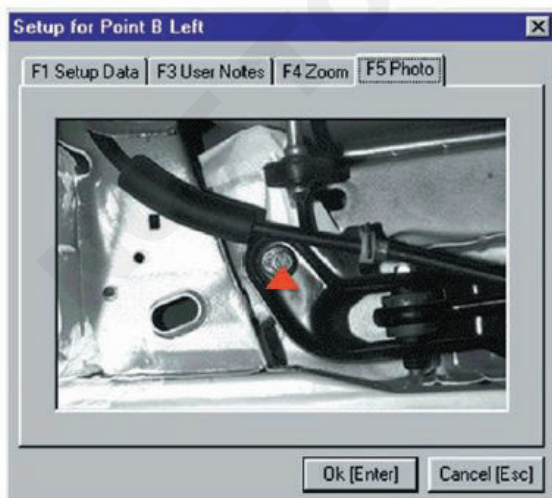
Fig 3



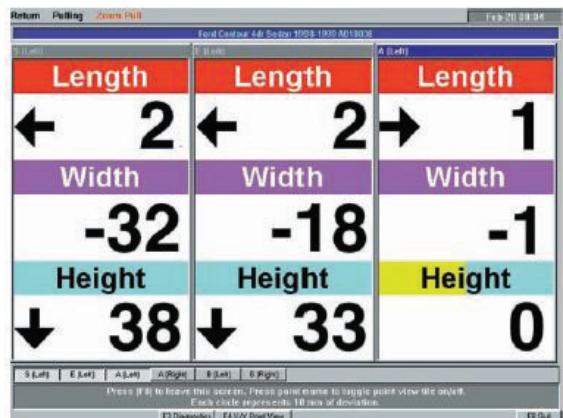
A



C



B



D

Practice on analyzing the length, width and height of damaged parts

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

- analyze the length damage of the vehicle parts
- analyze the width damage of the vehicle parts
- analyze the height damage of the vehicle parts.

Requirements			
Tools/Instruments		Materials	
• Trainee's tool kit	- 1 No.	• Cotton waste	- as reqd.
• Pulling tools set	- 1 No.	• Soap oil	- as reqd.
• Pushing tool set	- 1 No.	• Welding rod	- as reqd.
Equipments		• Flux	- as reqd.
• Vehicle	- 1 No.	• Metal sheet	- as reqd.
• Air compressor	- 1 No.	• Scaling compound	- as reqd.
• Gas/Arc/Welding unit	- 1 No.		

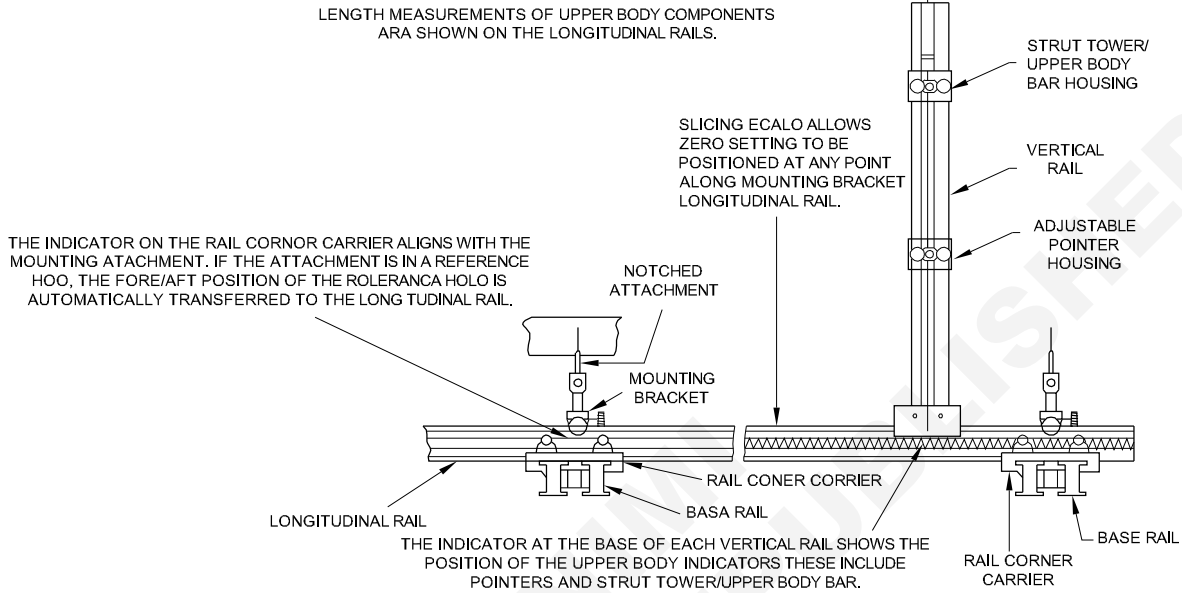
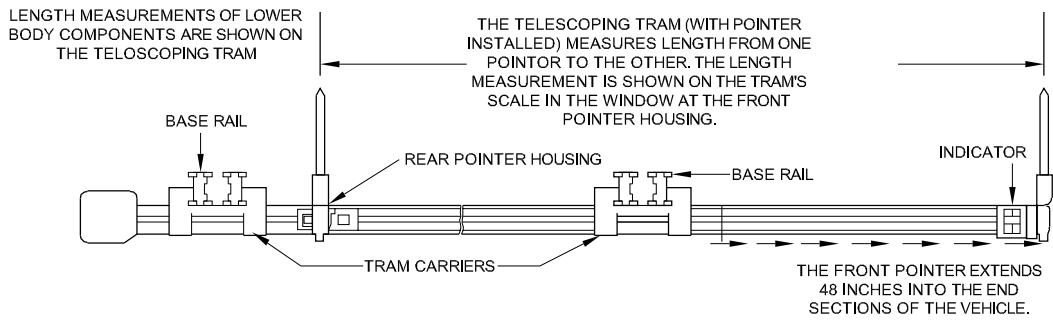
PROCEDURE**Task 1: Analyzing the length of damaged vehicle parts (Fig 1)**

- 1 Park the vehicle in the auto body repair shop.
- 2 Visually inspect the vehicle and identify the damaged parts.
- 3 Refer the manufacturers service guide instruction to repair the damaged parts.
- 4 Use the universal measuring system to measure the length of damaged part by using a telescoping tram and using longitudinal rails (Fig 1).
- 5 Note the reading of damaged part is height.
- 6 Compare the reading with manufacturers specifications.
- 7 If found any difference in reading, repair the damaged part by pulling or pushing the damaged part with suitable tool.
- 8 Again measure the length of damaged part and ensure the length of part is as specified by manufacturer.

Task 2: Analyzing the width of damaged vehicle parts (Fig 1)

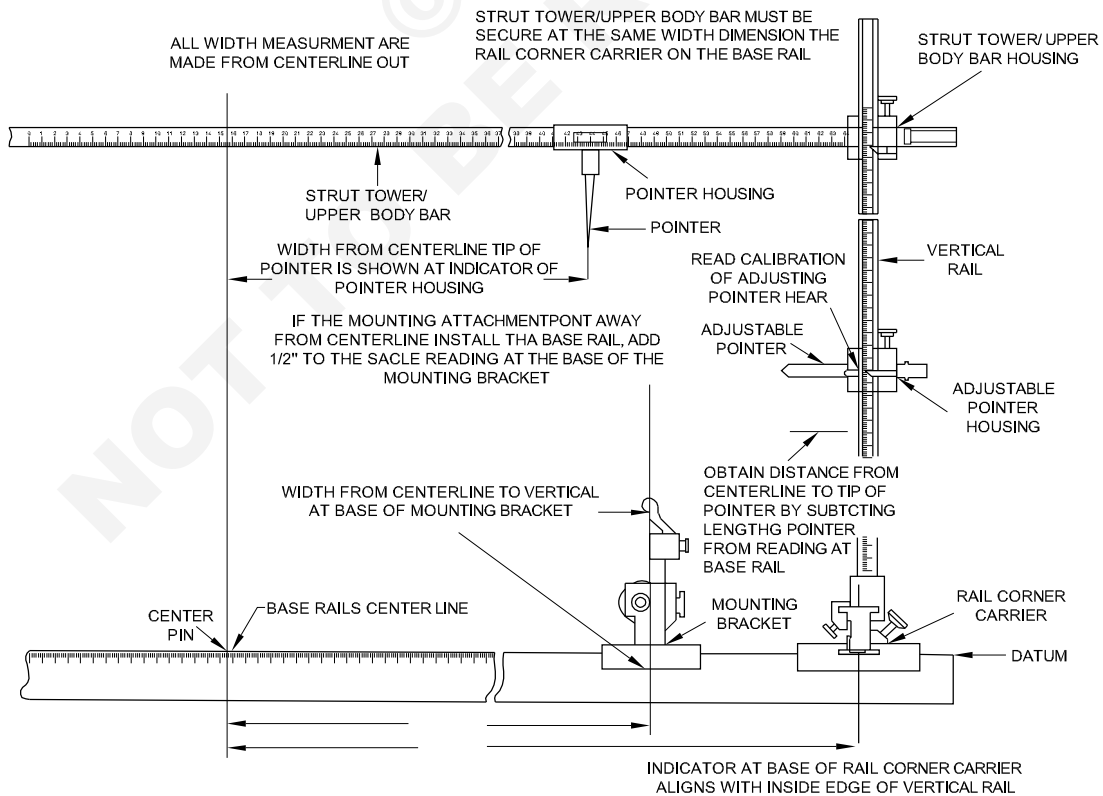
- 1 Visually inspect the width of damaged vehicle parts.
- 2 Measure the width of damaged part by using parts different type of measuring systems as you learned.
- 3 Set the measuring unit on the damaged part.
- 4 Measure the width of damaged part and note the reading shown in Fig 2.
- 5 Compare the measurement reading and analyse the reading with manufacturers specification.
- 6 If found any difference in reading set the mechanical universal system for measuring before and after repair the damage parts.
- 7 Repair the damaged part by pulling and pushing with suitable tools.
- 8 If need heat the part to standardised the part during damage repair.
- 9 After repair ensure damaged parts width is as per manufacturers specification.

Fig 1



AR20N11096H1

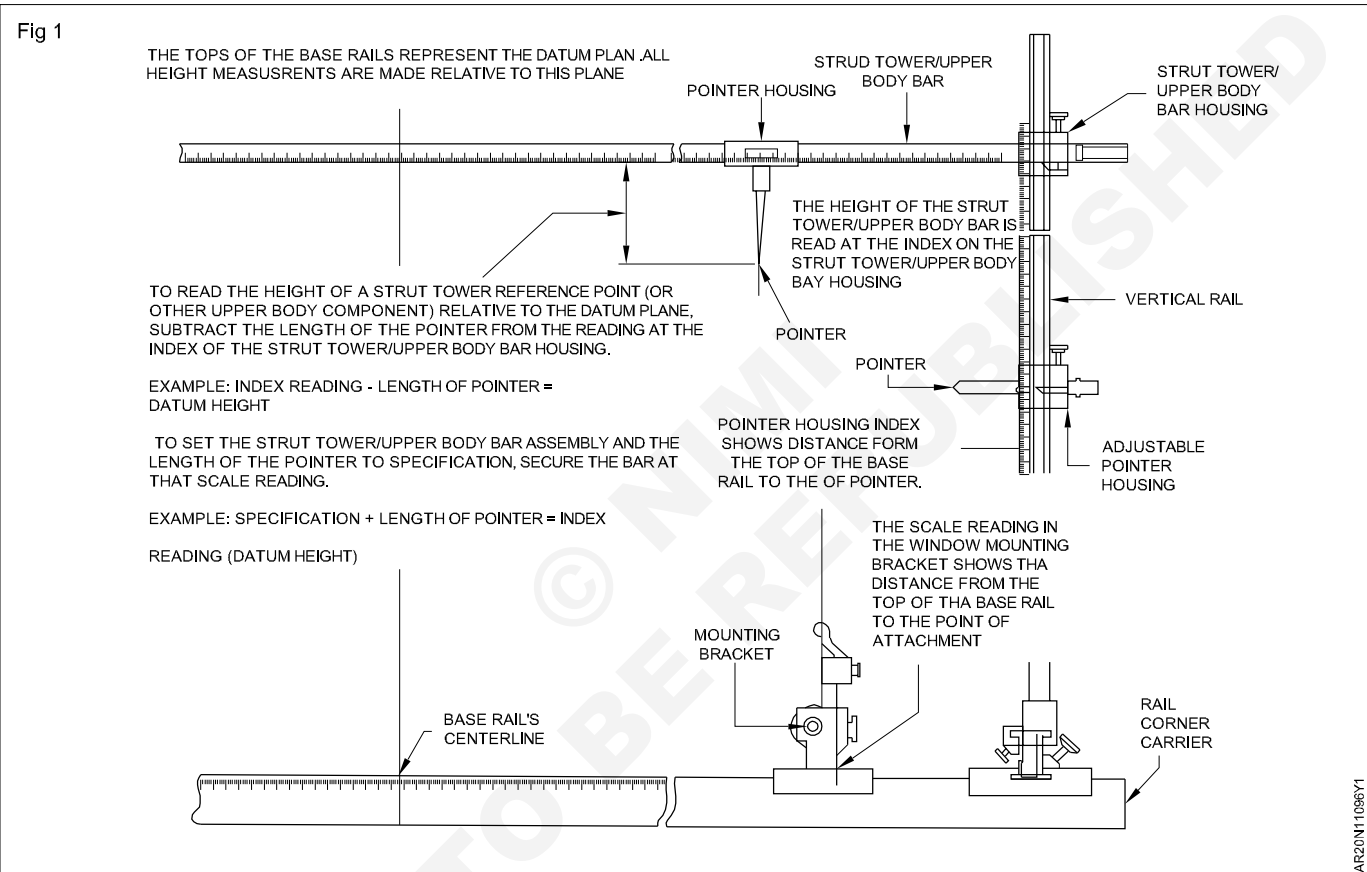
Fig 1



AR20N11096X1

Task 3: Analyzing the height of damaged vehicle parts (Fig 1)

- 1 Inspect the damaged parts height and repair the manufacturer service manual for your reference.
- 2 Set the mechanical measuring unit on the damaged part.
- 3 Measure the height of damaged part.
- 4 Note the height of damaged part shown by the measuring gauge.
- 5 Compare and analyzing the height of the part.
- 6 If the measurement reading in difference than manufacturers specification.
- 7 Correct the height of the damaged part by pushing, pulling, hammering and heating method as suitable for the damaged part.
- 8 After repair once again measure the height of damaged part.
- 9 Ensure the height of the part is as matched with the manufacturers specification limit.



Practice on repair the damaged parts of Unibody vehicle

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

- repair the front, rear, side and sag damage of the vehicle
- repair the twist, diamond, strut tower damage of the vehicle
- repair the stress relieving with heat, stress concentrators
- frame straightening equipment using on damaged part
- use the anchoring the vehicle pulling clamps and chains.

Requirements

Tools/Instruments

- Trainee's tool kit - 1 No.
- Pulling chain set - 1 No.
- Pushing clamps set - 1 No.

Equipments

- Vehicle - 1 No.
- Gas welding unit - 1 No.

Materials

- Cotton waste - as reqd.
- Soap oil - as reqd.
- Metal sheet - as reqd.
- Filler material - as reqd.

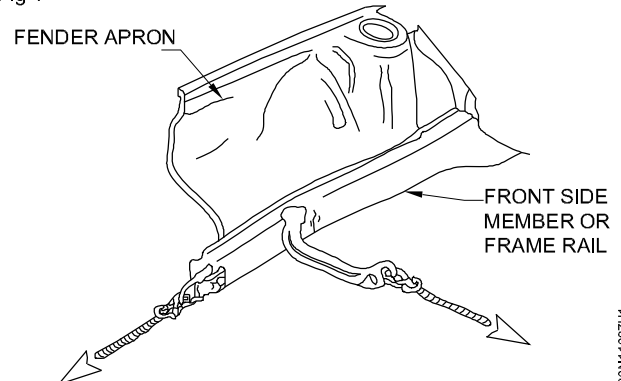
PROCEDURE

Task 1: Repair the damage of front-end, rear-end, side and sag damages (Fig 1&2)

- 1 Park the vehicle on the auto body repair shop.
- 2 Inspect the damaged vehicle parts.
- 3 Measure the damaged area and compare the measured reading with manufacturers specifications.
- 4 If found any damaged part required repair, use the front-end repairing equipments.
- 5 Set the pulling tool to straighten the front-end of the vehicle.
- 6 Pull the damaged side of the body in the direction opposite to the damage input.
- 7 Re-align the damaged part by pulling and then repair front fender apron and side member on the repair side.
- 8 Repair the front fender apron and side member installation areas on the replacement side.
- 9 Pull the fender apron and side member upper at a time.
- 10 If there is service bending damage, detach the front cross member and radiator upper support and repair it separately.
- 11 Grip the inside broken face of the side member while pulling it forward.
- 12 Pull the bent piece from the inside or push it from the outside.
- 13 After repairing the bent portion match up the dimensions to specific limit.
- 14 If major damage cut the fender apron and side member near the installation.
- 15 Clamp near the major panel damage and pull the door fit conditions. At same time the pillar also pulled forward and push the interior side with a power ram.
- 16 Use the front side members as a reference point in the rear that has a tendency to be deflected upward.
- 17 Correct the latter rid bending as shown Fig 2.
- 18 After repairing ensure front end damage is correct by damage repair.

Minor front side member damage often requires pulling from the front and side at same time.

Fig 1



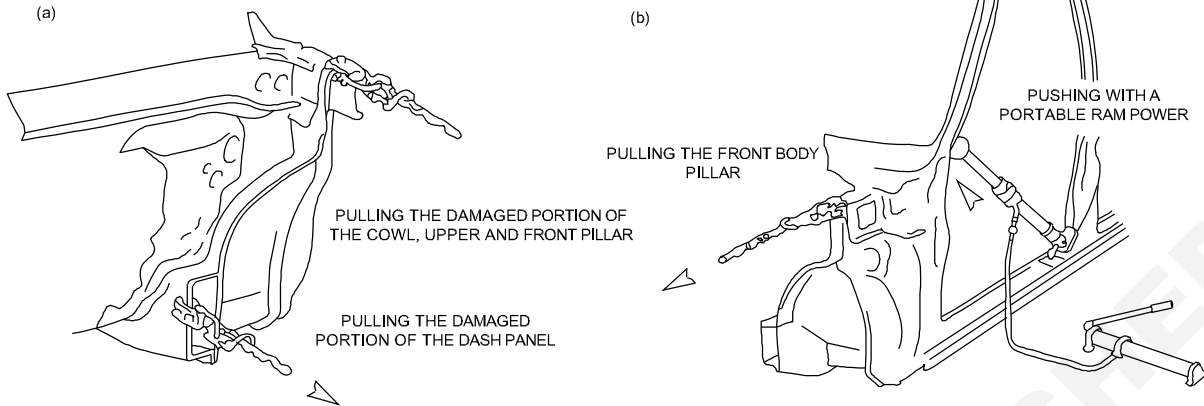
AR20N11097H

If major damage extends to the cage around the passenger compartment, this type of pulling might be needed;

a Pulling on the cowl and rail at same time.

b While pulling from the front, you may also need to use a portable power unit to spread the door opening.

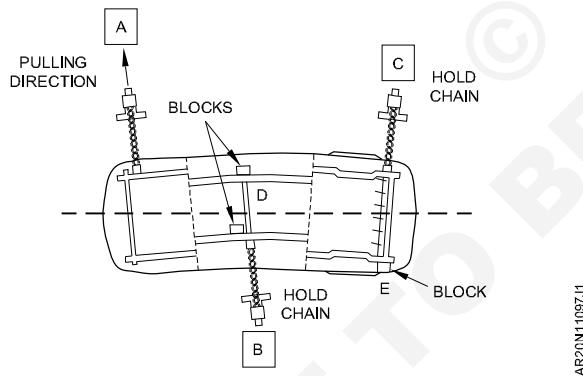
Fig 2



Task 2: Repair the damage of rear body (Fig 1)

- 1 Visually check the rear body of the damaged vehicle.
- 2 Check the rear side rails and panels damage.
- 3 Check the rear wheel housing quarter panel move.
- 4 Check the roof, door panels and center body pillars damage.
- 5 Attach the clamps or hooks to the rear portion of rear side members, rear floor panel or quarter panel.
- 6 Pull the part while measuring the dimensions of each part of unibody.
- 7 Determine the degree of repairs necessary by the conditions of panel fit and clearances.

Fig 1



B is the point of impact that pulls against A and C. Blocking devices at points D and E prevent part damage and help pull all damaged areas together.

Note

Do not clamp and pull a quarter panel that has little or no strain on it when there is major rear damage.

When the rear side on it when the rear side member is pushed into the wheel housing or there are clearance problem at the rear door, you should not pull on the quarter panel.

Relieve the stress in the quarter panel by pulling on the side member only.

If the wheel housing or the roof side inner panel is clamped and pulled along with the rear side member.

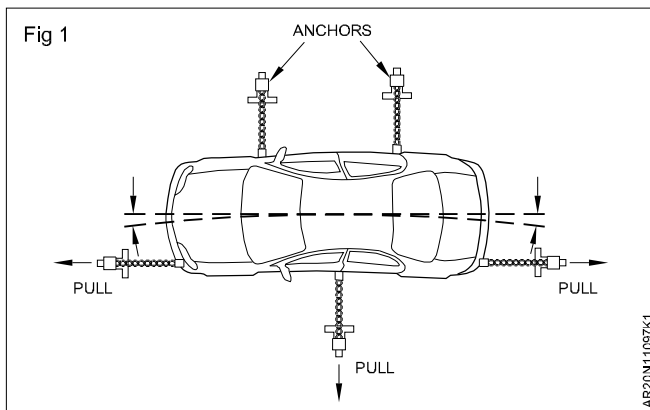
The clearance with the door panel can be maintained properly.

- 4 Check the roof, door panels and center body pillars damage.

Task 3: Repair the damage of rear body

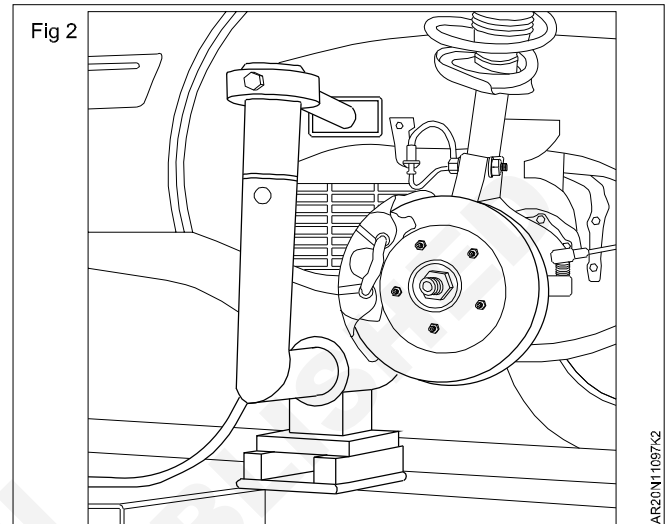
- 1 Visually check the side impact damage.
- 2 Measure the damage dimension and compare it with manufacturers specification.
- 3 Check the entire body and floor if found bend floor.
- 4 Apply straightening a piece of bank wire method to repair the damaged vehicle.

- Two ends of the body are pulled apart and caved in side is pulled outward.
- Apply three way pulling as shown in Fig 1.



- Pull and stretch the length of Unibody while pulling from the side.
- After pulling ensure the body banana shape is removed and bring it in original position.
- Use the portable beam and knee as a side anchor with either inside or outside contact.
- Pull end-to-end stretch pulling outward on the center section of a vehicle.

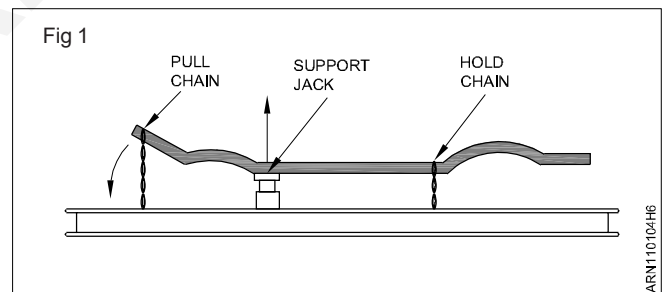
- Attach the portable beam and knee to pull the ram (Fig 2).
- Attach the chain roller in the lowest position on the power tower.
- Start the pulling through attached pulling to straighten the side damage.
- Ensure after the repair side damage of the vehicle is straighten as per manufacturers specification.



Task 4: Straightening the sag damage of the vehicle

- Inspect the sag damage of the vehicle.
- Block the under low area of the frame and fix the hold chain with frame.
- Pull the chain down on the high end of the vehicle to correct sag as shown in Fig 1.
- When using the pulley and base for the downward pull, the tower pull chain must be in the lowest position.
- If sag occurred in the front frame cross member, correct by using three hydraulic rams and two chains plus an anchoring rail.

- Check the repair with a tram gauge and compare the measurements to the specification in the body manual.



Task 5: Straightening the twist damage

- Inspect the twist damage vehicle.
- Position and lock a ram on the side of the platform next to the side of the vehicle.
- Fix the tower chain in the highest position and route the chain under the lower horn and over the high horn.
- Attach a chain hook to the outside edge of the platform bed.

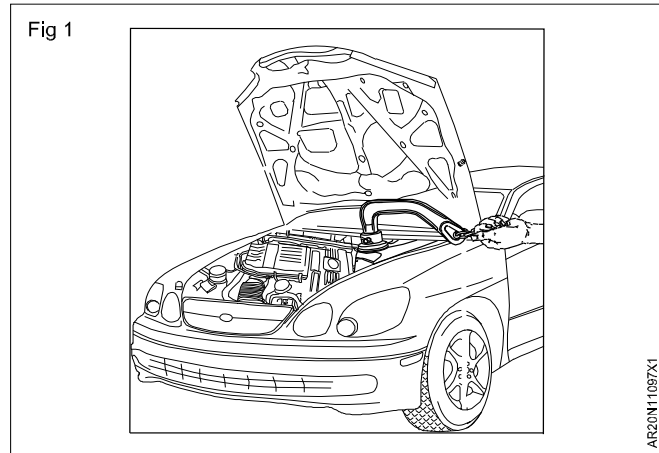
- Fix the identical hook up at the opposite end of the vehicle and block under the center section of the vehicle.
- Apply pressure to the pull chain to correct the twist damage.

Note: The center section of the vehicle should be blocked and tied down.

Task 6: Straightening the diamond damage

- Inspect the diamond damage of the vehicle.
- Place the pulling tower on each end of the frame rack on opposite sides.

- 3 Adjust the chain height and attach it to the vehicle as described for end pull corrections.
- 4 Anchor one side of the vehicle to prevent side movement.
- 5 Activate the pull ram to correct the diamond damage as shown in Fig 7.



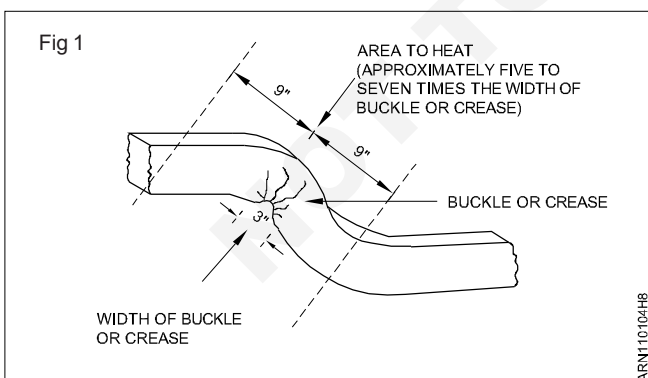
Task 7: Straightening the strut tower damage

- 1 Inspect the strut tower damage of the vehicle.
- 2 Attach the multi pull plate to the vehicle shock tower.
- 3 Connect a pull chain to the plate.
- 4 Position the frame rack pull chain to traction opposite the damage.
- 5 Pull the damage forward and out at an angle from the front side of the vehicle.
- 6 If the both tower are tripped left or right, they can be repositioned by mounting adopter plates to both towers and installing a strap to make the pull.
- 7 After the pull a dimension check should be performed using a strut measuring gauge.

Task 8: Stress relieving with heat (Fig 1)

- 1 Check the misaligned door hood, trunk and roof opening by stress.
- 2 Check the dents and buckles in aprons and rails.
- 3 Check the misaligned suspension and motor mounts.
- 4 Check the damaged floor pans and rack and pinion mounts.
- 5 Check the cracked paint and under coating.
- 6 Check the pulled or broken spot welds.
- 7 Split seams and seam sealer.
- 8 Refer the manufacturers recommendation for heating metal.
- 9 Apply heat on damaged part to release the stress on it without damaging the metal.
- 10 Allow the metal to cool naturally after stress relieving.

Note: Do not apply water to speed cooling. Rapid cooling can cause the metal to become hard and brittle.



- 11 Use heat crayons or a high-temperature non-contact thermometer to determine the exact temperature of the metal.
- 12 Heat the stress area about 2 to 3 minutes greater than the width of buckle.
- 13 Don't heat ultra-high strength steel parts.
- 14 Mark the cold piece with crayon to monitor heat application on stress part.
- 15 After repair check the parts durability and appearance is restored for ensure the quality repair.

Task 9: Stress concentrators

- 1 Inspect the damaged vehicle.
- 2 Note the damaged parts of the vehicle.
- 3 Absorb the collision force impact on the vehicle parts.
- 4 Analyse the damage and estimate the repair parts.

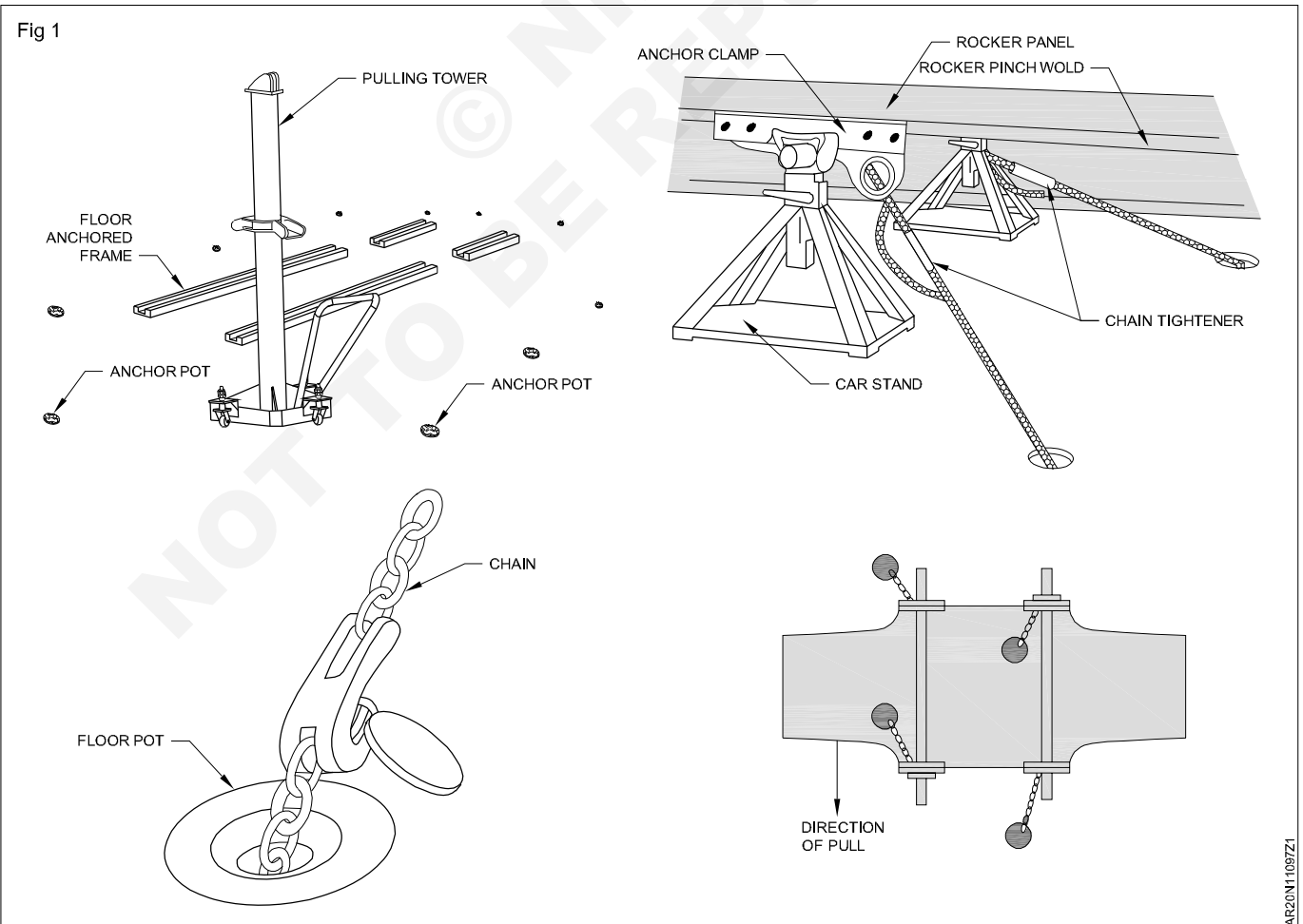
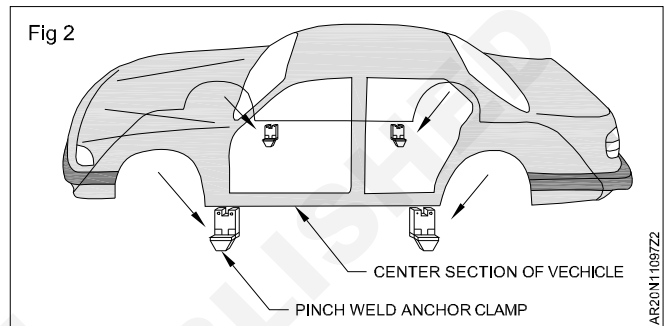
- 5 Refer the damaged parts (straighten or replace the parts).
- 6 If vehicle frame and other parts are damaged first

straighten the vehicle frame by pulled back into alignment and then cut and replace other damaged parts with new ones.

Task 10: Frame straightening equipments to straightening the damage parts

- 1 Check the vehicle and identify the damaged parts of the vehicle.
- 2 Select the straightening equipment to repair the damaged part.
- 3 Note the major parts of pulling system by using floor anchors.
- 4 Connect the pull chain on the concrete floor of shop.
- 5 Anchor the chain extend from the body pinch weld clamps to floor pots to hold the vehicle with pulling damaged.
- 6 If anchoring for a side pull of a vehicles front section anchor the chains be positioned to resist the pulling action.
- 7 Use the large pinch weld clamps to anchor Unibody vehicle.
- 8 Bolt the clamps to the frame rack and to the vehicles pinch weld flanges along the bottom of the rocker panels.

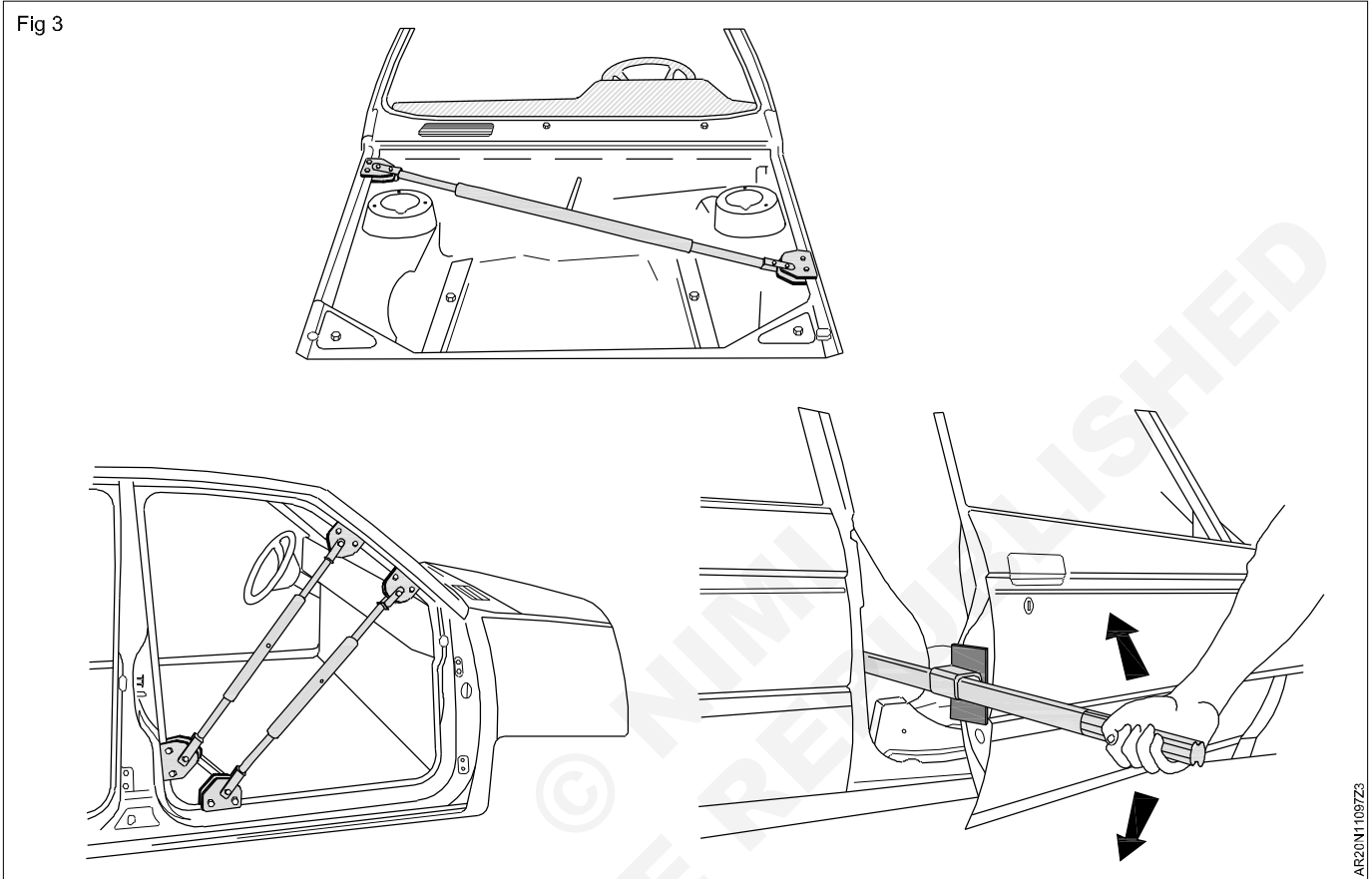
- 9 Raise the vehicle off the rack a few inches with jack.
- 10 Position the four pinch weld clamps under the outer corner of the center section of the vehicle.
- 11 Lower the vehicle down into the clamps then tighten the clamps bolts onto the pinch weld flanges (Fig 2)
- 12 Tighten the anchor clamps bolt (Fig 1).



- 13 Adjust the height of the chain and its pulling force.
- 14 Attach the safety chain to the pulling chain to stop it from flying out, if it is clamp ship off the vehicle.
- 15 Use the chain pulley to pull down from under the vehicle.
- 16 Use the single holding restraint to secured across the fender aprons to hold dimension while pulling (Fig 3A).

- 17 Use the two restraints to secure the door opening dimension (Fig 3B).
- 18 Use the door aligner fits into the door lock and catch for minor adjustment (Fig 3C).

Fig 3



ARC20N11097Z3