DRIVER CUM MECHANIC (LMV)

NSQF LEVEL - 3

TRADE THEORY

SECTOR : AUTOMOTIVE

(As per revised syllabus July 2022 - 1200 Hrs)

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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 : Six Months

Trade : Driver Cum Mechanic (LMV) - Trade Theory - NSQF Level - 3 (Revised 2022)

Developed & Published by

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Post Box No.3142
Guindy, Chennai - 600 032
INDIA
Email: chennai-nimi@nic.in
Website: www.nimi.gov.in

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FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, by 2022 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 comprising various stakeholders viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Driver Cum Mechanic (LMV) - Trade Theory - NSQF Level - 3 (Revised 2022) in Automotive Sector** under **Annual pattern**. The NSQF Level - 3 (Revised 2022) Trade Theory will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 3 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 3 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these Instructional Media Packages IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

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

Jai Hind

ATUL KUMAR TIWARI, *I.A.S*
Secretary
Ministry of Skill Development & Entrepreneurship,
Government of India.

May 2024
New Delhi - 110 001

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PREFACE

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

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

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

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

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

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

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

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

Chennai - 600 032 **EXECUTIVE DIRECTOR**

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ACKNOWLEDGEMENT

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

MEDIA DEVELOPMENT COMMITTEE MEMBERS

Shri. A. Thangavelu	-	Asst. Training Officer (Retd) MDC, NIMI, Chennai.

NIMI COORDINATORS

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

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

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

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

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INTRODUCTION

TRADE PRACTICAL

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

This manual is divided into Seven modules.

Module 1 : General Safety Precaution and Driving Regulations

Module 2 : Automobile Engine and Vehicle Controls

Module 3 : Simulator Driving and Vehicle Pre-Driving Checks

Module 4 : Traffic Regulations and Vehicle Mechanism

Module 5 : Vehicle Electrical System

Module 6 : Tyre Repair and Inspection

Module 7 : Vehicle Maintenance and Driver's Personal Management

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 **Driver Cum Mechanic (LMV) NSQF LEVEL - 3 (Revised 2022)** in **Automotive**. The contents are sequenced according to the practical exercise contained in NSQF LEVEL - 3 (Revised 2022) syllabus on TradeTheory attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This correlation is maintained to help the trainees to develop the perceptional capabilities for performing the skills.

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

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

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

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LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

S.No	Learning Outcome	Ref. Ex.No.
1	Comply with environment regulations and housekeeping in the workshop (5S / Kaizen) following safety precautions. ASC/N9414	1.1.01 - 1.1.06
2	Identify Vehicle Components. ASC/N9704	1.2.07 - 1.2.09
3	Drive in conformance to standard driving practices. ASC/N9704	1.3.10 - 1.3.37
4	Ensure road worthiness of the vehicle through pre-operational checks, checks in-between journey and end of the Journey. ASC/N9704)	1.3.10 - 1.3.37
5	Drive vehicle following Traffic Regulations maintaining good road conduct. ASC/N9704	1.4.38 - 1.4.51
6	Perform Daily Maintenance/Daily Inspection on Vehicle. ASC/N9704	1.4.38 - 1.4.51
7	Carry out checks of Vehicle aggregates. ASC/N9704	1.4.38 - 1.4.51
8	Check ignition circuit for proper functioning. ASC/N9704	1.5.52 - 1.5.57
9	Check wheel alignment and Perform Wheel Rotation. ASC/N9704	1.6.58 - 1.6.62
10	Carry out the general servicing of vehicle components. ASC/N9704	1.7.63 - 1.7.71

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SYLLABUS

6 Months **Duration: 6 Months**

Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
Professional Skill 29 Hrs; Professional Knowledge 07 Hrs .	Comply with environment regulations and housekeeping in the workshop (5S / Kaizen) following safety precautions. ASC/ N9414	1. Importance of trade training, List of tools & Machinery used in the trade. (05 hrs) 2. Health, Safety and Environment guidelines, legislations & regulations as applicable. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Basic safety introduction. (06 hrs) 3. Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. (06 hrs) 4. Preventive measures for electrical accidents & steps to be taken in such accidents. (06 hrs) 5. Practice Use of Fire extinguishers. (06Hrs) 6. Arrange to obtain Lerner license from concern RTO .	Importance of safety and general precautions observed in the in the industry/shop floor. All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. **Soft Skills: its importance and Job area after completion of training.** Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept & its application. Response to emergencies e.g.; power failure, fire, and system failure. **DRIVING THEORY:** Qualities required for a good driver: Good behaviour, Patience, Responsibility, Self Confidence, Anticipation, Concentration, Courtesy, Consideration for other Road Users, Defensive Driving, Knowledge of Road Rules and Regulations, Knowledge of Vehicle Controls, Maintenance, simple mechanism and effect of Competitiveness, Over-Confidence, impatience. Driving Regulations: Road Rule Regulations made under sec 118 of Motor Vehicle Act 1988, Hand Signals of a driver, Traffic & Road Signs, Hand signals of traffic constable and traffic wardens, Introduction to Automatic Light Signals, Introduction to Road markings, Speed regulation on city road and highways. (07 hrs.)
Professional Skill 20 Hrs; Professional Knowledge 07 Hrs	Identify Vehicle Components. ASC/ N9704	7. Perform Preliminary checking / identification of various vehicle parts / aggregates. (8 hrs) 8. Identify various gauges & Tell-tale Lamps in the instrument panel & interpretation of readings. (7 hrs) 9. Perform Identification & use of different types electrical switches. (05 hrs)	Simple introduction to Automobile Engines and their working. Location of VIN plate / Engine serial Number. Vehicle Controls and its Response: Foot Control – Accelerator, Brake, Clutch

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Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
			Hand Control – Steering Wheel, Gear Shifting Lever, Hand Brake, Switches for direction Indicators, Head Lights, Horns, Ignition Switch, Dim-Bright Switch, and Wiper switch – Speed Control etc. Other Controls – Rear View mirrors – Types- adjustments, Instrument Cluster, Description of Speedo meter/Trip meter, RPM Gauge, Oil pressure Gauge, Temp Gauge, Fuel Gauge, and Ammeter other Gauges and Dials, Tell-tale lamps, Audio warnings, Wind Screen – their purpose & Working. Adjustment of seat and knowledge on seat belts, door locks. Fuse carrier location, Fuse layout. Knowledge on Latest Information systems: On Board Diagnosis system. Intelligent transport system. Air Bags, Audio warning systems Automated Manual Transmission, Dual power mode (Power or Economy Mode). (07 hrs.)
Professional Skill 20 Hrs; Professional Knowledge 07 Hrs	Drive in conformance to standard driving practices. ASC/ N9704	10. Practice in Simulator. (10 hrs) 11. Practice Initial freeway Driving. (10 hrs)	Introduction to Driving Simulator (07 hrs.)
Professional Skill 29 Hrs; Professional Knowledge 07 Hrs .	Ensure road worthiness of the vehicle through pre-operational checks, checks in-between journey and end of the Journey. ASC/N9704	12. Perform Pre – Driving Checks: Before sitting on driver seat, After sitting on driver seat. (07 hrs) 13. Checking the document pertains to the driver and vehicle. (05 hrs) 14. Perform Adjustment of seat, Rear View mirrors and wearing seat belt. (05 hrs) 15. Carryout Vehicle Starting Practice. (05 hrs) 16. Check the leaks of tyres in between the journey. (02 hrs) 17. Ensure Main Switch off, windows, doors are closed, apply wheel chokes and complete paper work. (05 hrs)	Pre – Driving Checks: - Before sitting on driver seat, Leakage of Fuel, Oil, water, Air, Battery etc - After sitting on driver seat, Guages etc. - Checking the document pertains to the driver and vehicle. Starting: Precautions and Procedure to be followed while starting. Clutch down start Accelerator: Proper use of Accelerator. Moving: Precautions to be followed while moving. Use of first gear.(07 hrs.)

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Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
Professional Skill 132 Hrs; Professional Knowledge 36 Hrs	Drive in conformance to standard driving practices. ASC/N9704	18. Perform Clutch Practice: Biting and Balance point. (10 hrs) 19. Perform Steering practice: In basic yard - In bare land and between tyres to develop Judgment Straight, Left and Right Turn, Steering in '8' shaped bend. (10 hrs)	Use of Clutch: Correct Leg position on the Clutch pedal Biting Point, Balance Point. Steering - Holding Steering Wheel: - Push and pull method - On the move - While gear changing - While turning - While sounding Horn - While operating dash board switches - While Signaling - On emergency (05 hrs.)
		20. Perform Gear Practice: Practice Selection of gears, up shifting, down shifting. (10 hrs) 21. Brake practice: In level ground and in Slope and Braking and Stopping Practice. (10 hrs)	Gear Shifting - Up shifting, Down Shifting – Procedures. Use of Over Drive Gear. Gear shift pattern on different vehicles. Pressure point shifting method in synchromesh & AMT Vehicle. Stopping: Normal stopping, Emergency stopping, use of Engine Brake. Stopping distance= Reaction Distance +Braking Distance. (05 hrs.)
.		22. Practice Driving on the Road. (10 hrs) 23. Perform Overtaking Practice: (05 hrs) 24. Practice Overtaking stationary and Moving vehicles from Left and Right Side. (07 hrs)	Driving on the Road: Anticipation, Judgment, Positioning the Vehicle according to other Road users. Use of IPDE(Identification, Prediction, Decision, Execution) principles while Driving MSPSL(Mirror Signal Maneuver) – Routine Use of Indicators. Defensive Driving Techniques: Judgment, Anticipation, Escape route. Priority for certain Vehicles: Emergency Vehicles, Fire Engines and Ambulance.

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Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
			Overtaking: Overtaking stationary vehicle, Moving vehicle in Left and right side – IPDE principle. Traffic Education MV Act Section 118. (05 hrs.)
		25.Practice 3 Point Turn, 5 Point Turn, 'U' Turn. (5 hrs) 26.Practice on following distance. (5 hrs)	Other Maneuvers: Merging, Diverging, turning to left and Right, 3-point Turn, 5 point turn, Passing, Crossing, Cornering. Following Distance: Meaning, Distance Method, Car length Method, 2 seconds time rule method, Distance between cars while driving at Railway crossing. (05 hrs.)
		27. Perform Reverse Practice: Straight, Left, right and Reverse practice in'8' shaped bend. (5 hrs) 28.Perform Parking Practice: Angular Parking, Perpendicular parking, Parallel Parking – Forward Entry and Reverse Entry. Parking facing Uphill and Parking facing downhill. (10 hrs)	Reversing: Locating Reverse gear, Confidence, Speed control, Steering Control, Weaving in '8' shaped Bend. Parking: Parallel, Angular, Perpendicular, Parking facing uphill, Parking facing downhill. (04 hrs.)
		29.Practice Night Driving. (5 hrs) 30. Practice Driving According to Lanes: Single, Two, Four and Six lane Roads. (05 hrs) 31.Practice Village Road Driving & Perform Highway Driving. (05 hrs) 32. Practice Driving in Crowded Street. (05 hrs) 33.Perform Cross country Driving. (05 hrs)	Night Driving: Location of Head light switch, Use of Head light, Use of Dipper at night- Procedure. Lane Selection and lane Discipline: Single, double, 4 and 6 lanes Village and Highway Driving: Procedures and precautions. Driving under Special Condition: In wet weather, In dawn, dusk and misty road, In dense traffic, Cross country driving - Knowledge on Ground Clearance. (04 hrs.)
		34.Practice Hill Driving: Driving uphill, driving downhill, Driving in Hairpin bend. 4 WD Drive Practice. (5 hrs) 35.Perform Vehicle Towing Practice. (5 hrs)	Hill Driving: Starting in hill using parking brake method and slipping the clutch method – Procedures. Selection of gear – uphill and downhill – procedures. Towing a disabled Vehicle:

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Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
			Procedures, Precautions, Limitations under road rule regulations 1989, Identification of Towing Eye. Speed limit, 'ON Tow' board. (04 hrs.)
		36. Practice on stopping the vehicle using Handbrake. (5 hrs) 37. Perform Simulator Driving Practice: With Simulation of extreme conditions. (5 hrs)	Emergency Manoeuvres: Skidding, Horn Stuck, Fire, Wheels Coming out, Brake failure, Broken Stub axle, burst of front tyre, Sudden steering wobbling, snapping of steering linkage, Jamming of accelerator pedal, Snapping of clutch linkage, under special circumstances of collision with disabled vehicle. Brake failure during downhill, sudden obstruction in front of vehicle etc. – Prevention is better than cure. (04 hrs.)
Professional Skill 20 Hrs; Professional Knowledge 07 Hrs	Drive vehicle following Traffic Regulations maintaining good road conduct. ASC/	38. Practice Driving on Various road as per Road Rule Regulation 1989. (07 hrs) 39. Practice Demo on Hand Signals of a Driver. (07 hrs) 40. Perform Driving test at concern RTO(6)	TRAFFIC EDUCATION: Motor Vehicle Act, Important definitions and salient features of motor vehicle Act. Vehicle registration and insurance of motor vehicle. Learner's license and its particulars, Driving License particulars and its renewal. Knowledge about log book and different Forms and papers related to vehicles. Vehicle fitness certificate, Permit and Tax and production of documents on demand by checking officers. Knowledge on seating Capacity and load limit. Knowledge on loading and load distribution on vehicle while loading of goods. Know your Road: Functional classification, Design Speed, Road Geometrics, Surface types and characteristics, Slopes and Elevation. Sight Distance: At bends, At intersections Road Junctions: Principles and Types, T junction, Y junction, 4-Arm junction, Staggered Junction, Controlled Junction, Uncontrolled Junction.

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Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
			Traffic Islands: Types of roundabouts, channelisers, Median Bye-Pass, Subway, Over-bridge and flyovers: Purpose, precautions and procedures Driving according to other Road Users Characteristics: Pedestrians, drunkards, Children, blind, deaf, dump, youth, aged, women with children, Slow-moving vehicles, Mopeds, Motor cycles, Autos, Tempos, Vans, Buses, Trucks, VIP, Ambulance, Fire Engine and Animals etc.. Accidents: Types, Causes, Preventive methods, Drivers duties and responsibilities on the occurrence of accidents. Symbols on the vehicle which is carrying Hazardous goods: Panel Board, Class Labels. Important provision of motor vehicle Act section 122,125,126 ,128,131,132,133,134,135,136 & 139. Legal awareness. Traffic offences and penalties stipulated under the act and rules. Driving Test: Sub rule 3 of Rule 15 of Central Motor Vehicle Rules 1989. (07 hrs.)
Professional Skill 20 Hrs; Professional Knowledge 07 Hrs	N9704 Perform Daily Maintenance/ Daily Inspection on Vehicle. ASC/N9704	ENGINE BASICS: 41. Identification of different types of vehicle and engine components. (04 hrs) 42. Familiarization of operator manual. Check / replenish / top up – lubricating oil, engine coolant, power steering hydraulic oil, wind screen wiper water, battery electrolyte and transmission oil. (05 hrs) 43. Replace – air cleaner, oil filter & fuel filter. (5 hrs) 44. Apply Grease to parts / through greasing points (if necessary). (06 hrs)	VEHICLE MECHANISM: Nomenclature of different parts of vehicle and their locations. Classification of vehicle & load carrying capacities. Pattern of loading various goods. E C & I C Engine – Types, engine terminologies, parts description & functions. Types of fuels used in vehicle. Working principle of 4 stroke SI & CI engines. Differences between 2 strokes & 4 strokes engine, petrol & diesel engines. Concept of MPFI, CRDI, Turbo Chargers, EDC Fuel supply layouts in diesel engines, Injection systems. Brief introduction on injectors.

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Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
			Lubrication system, types of filters & lubricants. Types of Greases & greasing points. Recommended vehicle maintenance schedules.(07 hrs.)
Professional Skill 46 Hrs; Professional Knowledge 14 Hrs	Carry out checks of Vehicle aggregates. ASC/N9704	TRANSMISSION SYSTEM: 45. Check / replenish / transmission oil. (05 hrs) 46. Check breathers and Clutch Pedal Play. (05 hrs) BRAKE SYSTEM 47. Check and top up Brake fluid in the Reservoir. (10 hrs) 48. Perform Brake Bleeding. (05 hrs) 49. Perform Adjustment of brake paddle play. (04 hrs)	Layout of power flow from Engine to wheels. Purpose of clutch, Types of Clutch, Knowledge on Clutch play, Types of gear box- Gear Shifting procedures General defects in clutch, manual gearbox Knowledge on Automatic transmission and Automated Manual Transmission. Propeller Shafts, & Knowledge on differential. Knowledge on 2 and 4 wheel drive. Types of Brake systems – working principle of drum and disc brakes General defects in brake systems. Tandum Master Cylinder Procedure to be followed in case of brake failure. (07 hrs.) Antilock Brake System
		STEERING SYSTEM 50. Check level of power steering oil in the reservoir. (07 hrs) SUSPENSION SYSTEM 51. Grease the points in suspension system. (10 hrs)	Types of steering System and its working, Power assisted steering, Steering linkages. Types of suspension system, Greasing points Effect of tampering the suspension system. Brief on suspension and its effects on steering. (07 hrs.)
Professional Skill 29 Hrs; Professional Knowledge 07 Hrs	Check ignition circuit for proper functioning. ASC/ N9704	BATTERY AND IGNITION SYSTEM: 52. Remove and refit of Fuses, head lamp, Signal lamps, Parking lamp bulbs. (05 hrs) 53. Check and adjust Head Lamp High Beam, Low Beam, Pass by beam. (04 hrs) 54. Check Combination switches, Directional indicators, Wiper-Intermittent operation, low & high speed operations. (05 hrs) 55. Perform Cleaning and topping up of a lead acid battery. (5 hrs) 56. Remove and refit lead acid battery. (05 hrs)	Ignition system circuit & components. Actions to be taken when Ignition key lost. Spare/Duplicate key information & location. Definition of Fuses & need for fuses in electrical circuits. Brief introduction on ignition Description of chemical effect, Batteries and cells, lead acid batteries & stay maintenance free (SMF) batteries. Fuse Ratings. (07 hrs.)

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Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
		57. Carry out checks on Alternator unit, Battery and Power units. (05 hrs)	
Professional Skill 29 Hrs; Professional Knowledge 07 Hrs	Check wheel alignment and Perform Wheel Rotation. ASC/ N9704	TYRE REPAIR/INSPECTION: 58. Practice Removal & re-fitting of wheel from vehicle. (07 hrs) 59. Perform Measurement of tread wear. (07 hrs) 60. Carryout Inflating the tyres with compressed Air /Nitrogen from Tyre inflator. (05 hrs) 61. Repair a Puncture Tyre using Tubeless puncture Repair kit. (05 hrs). 62. Practice on Tyre rotation as per vehicle manufacturers recommendation. (05 hrs)	Types of wheels, designation, construction. Types of tyres & tubes (solid & pneumonic tyre – Cross ply & Radial ply, desirable properties component & function, designation, tyre ratings for temperature & traction. Maintenance of tyre & tubes. Reasons for defects of tyre. Tread patterns & their applications. Inspection procedure. Tyre pressure monitoring system. Procedure for retreading the Tyre. Procedure for tyre rotation for Different make of vehicle. Tubeless Tyres. Thread wear Indicator. DOT (Manufacturing Date code) Importance of Two wheel & four wheel alignment. Reasons for Alignment problems – steering pull, off-center steering, steering shimmy, excessive steering effort, poor self-centering and memory steer, bump steer, torque steer & steering harshness-alignment diagnostics chart & steering problem diagnostic chart. Meaning of balance, causes & effects of imbalance, vibration. Identification of source, transfer path & responder of vibration(can be felt & can be heard) Steering wheel shake – shimmy, wobble & waddle Brief on static balance, dynamic balance, Mounting errors (radial & lateral) & excessive (Tyre& rim) run out-lateral & radial and mismatches. (07 hrs.)
Professional Skill 46 Hrs; Professional Knowledge 14 Hrs	Carry out the general servicing of vehicle components. ASC/ N9704	Maintenance of Vehicle Systems: 63. Perform Air bleeding in diesel vehicle. (05 hrs) 64. Check and replacing wiper blades. (05 hrs) 65. Checking coolant reservoir tank. (03 hrs)	Cooling system & types of Anti-freeze /Anti rust solutions use. Air intake and Exhaust System Knowledge about CNG & LPG Gas kit. Cooling and lubrication system. Air Intake System. Exhaust system, Different types of fuel. Fuel Properties,

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Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
		66. Practice Cleaning air cleaner. (06 hrs) 67. Perform Cleaning of cooling motor. (06 hrs) 68. Carryout Emission testing. (06 hrs) 69. Check the Air conditioner and heater unit. (06 hrs) JACKS & HAND TOOL KITS: 70. Practice on using different type of vehicle jacks. (05 hrs) 71. Practice on using vehicle hand tool kit. (04 hrs)	Stoichiometric Ratio. Introduction to HVAC system. Specification, types and uses of different kinds of vehicle jacks. Description, care and maintenance of Mechanical & Hydraulic jacks. Description, care and maintenance of vehicle tools in kit. Identification of Jacking Points. Basics of computer, Email operation system. Fluency in reading and writing Writing of Reports Mathematical calculations on loads/freight/fares/KMPL. Management of personal expenses. Need to Cultivate habit of Savings for future needs. Knowledge on various general and personal Insurance Knowledge on Various saving schemes available with nationalized bank. (14 hrs.)

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Importance of driver cum mechanic trade training

Objectives : At the end of this lesson you shall be able to
- **state the importance and scope of the trade training**
- **state the importance soft skills for trained drivers.**

Scope of the driver cum mechanic trade training: This trade comes under the craft men training scheme (CTS) NSQF level-03. Duration of this course is six month. Driver cum mechanic (LMV) trade is one of the popular course delivered nationwide through a network of I.T.I.S. This trade training consists of trade theory and practical to imports professional skills and professional knowledge. After passing the trade examination the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

After completion of this course the trainee will be able to do the following activities

- drive a light motor vehicle safely on the assigned route
- follow the traffic regulations on the road
- Apart from driving the vehicle the trainee will also be carry out the basic servicing of vehicle
- Check the function of vehicle operating systems
- Confident communication skill with customers

Carrier progress pathways: The trained Driver Cum Mechanic trainees can be able to

- Join as driver cum mechanic is industry/public sector/government sectors
- Driver cum mechanic will progress further as senior driver/technician, supervisor and can raise up to the level of manager by his experience
- Can become entrepreneur in the related field
- Can join apprenticeship programme in different types of industries leading to National Apprenticeship Certificate (NAC)
- Can join Craft Instructor Training Scheme (CITS) in the trade for becoming instructor in I.T.I.S

General discipline in the institute: Always be polite, courteous while in institute

Do not arguments with others, on matters related to your training or with the office while seeking clarification

Do not bring bad name to your institute by your bad habits

Do not waste your precious time in gossips with your friends and on activities other than training

Do not be late to the theory, practical and other classes

Do not interfere in other's activities

Attention and listen to the lecture carefully during the theory class and practical demonstration given by the instructor

Give respect to your trainer and all other staffs and co-trainees in your institute

Be interested in all the training activities

Do not make noise and play while undergoing training

Keep the institute premises neat and clean avoid polluting the environments.

Do not take away any material from the institute which does not belong to you Always attend the institute with well dressed and good physical appearance

Be regular to attend the training without fail and avoid absent from the theory or practical classes for simple reasons.

Prepare well before writing a test/examination.

Avoid any malpractice during the test/examination.

Write your theory and practical records regularly and submit them on time for correction.

Take care of your safety as well as other's safety while doing the practical

Time-table

Practical and theory class hours are schedulated in advance and working hours is generally 8 hrs. Including lunch hours. There are two shifts are provided for training in the ITI generally 1st shift working hours 7.30 AM to 4.00 PM and 2nd shift working hours 9.00 AM to 5.30 PM. The training timing will be change in different states as per their policy.

Facilities in I.T.I

Hostel facilities, first aid kit, visiting doctor's and also libraries are available in mandatory of the I.T.I's

Course content in the syllabus

- Environment regulations and workshop safety precautions
- Identify the vehicle components
- Standard driving practice
- Vehicle pre-operational checks
- Check the vehicle between journey and end of the journey

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- Drive the vehicle by following traffic rules and regulations
- Perform daily vechile maintenance or daily vehicle inspection
- Carry out the general vehicle servicing as per owner's manual service schedule.
- Check wheel alignment and perform wheel rotation
- Carry out the tyre repair and inspection
- Study the vehicle mechanism etc.

I.T.I Store process: The trainees demand the vehicle parts oil, grease and other consumable items to their instructor. The instructor will be produced the indent and signed by the principal. The indent should be produced to store incharge. The storekeeper issue the indent demanded items to the trade instructor. Store issued parts or consumable items take charge and entry in their ledger. There after instructor will issue the items to the trainees for training practice. Trainers resubmit the old items to their instructor for deposit in I.T.I store.

Importance of soft skills for trained drivers: Soft skills make it easier to form relationships with client and public people, create trust and dependability and lead the teams. Soft skills are personal attitudes that insufficient how will interact with others. The soft skills are included the following skills.

1 **Body language and non- verbal communication skill:** When you are not able to talking, you can communicate through your body language it is one of the most required soft skills for professional driver. Driver body language determines the way customers perceive you.

2 **Verbal communication skills:** Verbal communication skills are often required to perform your job as you climb up the ladder verbal communication skills as a branch of soft skills, it is not limited to presenting a talk during a conference meetings.

3 **Social skills:** Social skills determine the way of driver get along with your co-drivers, friends, clients and acquaintance in formal and informal situations.

4 **Negotiation skills:** Negotiation is the ability to arrive at an agreement, where the both parties are benefits.

5 **Conflict resolution skills:** It is the way you handle a conflicting situation impacts your personal as well as your goal achieve. Listening carefully, placing your opinion smartly and thinking logically will help you resolve many conflicts effectively

6 **Self- awareness skills:** People usually have low self- esteem because they have a fear of being judged. This bear of being judged, and lack of self- confidence can inhibit a personal growth, self -confidence must be balanced act under confidence are very danger.

Self-awareness goes beyond collecting information about yourself, it also about paying attention to your inner state with a beginners mind and open heart.

Self- awareness refers to your ability to look inverse and monitor your thought process for certain situation to make you become more prepared for similar challenges.

7 **Time management:** Lack of drivers time management skill leads to lose their customers. Your time functuality performance at work and increase your customer.

8 **Stress management skills:** Stress is one of the biggest hurdles to success, as it brings down your regular customer and kills your motivation. Too much stress could affect your health adversely. Always avoid stress, while you are driving the vehicle.

9 **Personality development skills:** Personality development soft skill is about creating a brand for your- self. Personality development is an essential life skill, it includes several aspects like the way you talk, wear of your dress, and way of your behavior and more.

10 **Creativity thinking skills:** Creativity is the ability to come up with original ideas, and think differently to solve problems

11 **Interpersonal skills:** Inter personal skills are paramount to building a better soft skill package, it is the mover system of convey his ideas to others

12 **Customer service skills:** Customer service professional must have a clear knowledge of their service to the public and patience to deal with the customer or client and the ability to make quick decisions.

13 **Leadership and management skills:** Leadership is about inspiring people to perform to the best of their ability. Soft skills are not just good to have anymore but they are necessity.

Elementary first - aid

Objectives: At the end of this lesson you shall be able to
- **define first aid**
- **list out the first aid key points**
- **describe the responsiveness.**

First aid is defined as the immediate care and support given to an acutely injured or ill person, primarily to save life,

First aid procedure often consists of simple and basic life saving techniques that an individual performs with proper training and knowledge.

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The key aims of first aid can be summarized in three key points

- **Preserve life:** If the patient was breathing, a first aider would normally place them in the recovery position, with the patient learnt over on their side, which also has the effect of clearing the tongue from the pharynx. The first aider will be taught to deal with this through a combination of 'back slaps' and 'abdominal thrusts'. Once the airway has been opened, the first aider would assess to see if the patient is breathing.
- **Prevent further harm:** Also sometimes called prevent the condition from worsening, or danger of further injury, this covers both external factors, such as moving a patient away from any cause of harm, and applying first aid techniques to prevent worsening of the condition, such as applying pressure to stop a bleed becoming dangerous.
- **Promote recovery:** First aid also involves trying to start the recovery process from the illness or injury, and in some cases might involve completing a treatment, such as in the case of applying a plaster to a small wound.

ABC of first aid

ABC stands for airway, breathing and circulation.

- **Airway:** Attention must first be brought to the airway to ensure it is clear. Obstruction (choking) is a life-threatening emergency.
- **Breathing:** Breathing if stops, the victim may die soon. Hence means of providing support for breathing is an important next steps. There are several methods practiced in first aid.
- **Circulation:** Blood circulation is vital to keep person alive. The first aiders now trained to go straight to chest compressions through CPR methods.

When providing first aid one needs to follow some rule. There are certain basic norms in teaching and training students in the approach and administration of first aid to sick and injured.

Important guideline for first aiders

Evaluate the situation

Are there things that might put the first aider at risk. When faced with accidents like fire, toxic smoke, gasses, an unstable building, live electrical wires or other dangerous scenario, the first aider should be very careful not to rush into a situation, which may prove to be fatal.

Avoid moving the victim

Avoid moving the victim unless they are immediate danger. Moving a victim will often make injuries worse, especially in the case of spinal cord injuries.

Call emergency services

Call for help or tell someone else to call for help as soon as possible. If alone at the accident scene, try to establish breathing before calling for help, and do not leave the victim alone unattended.

Determine responsiveness

If a person is unconscious, try to rouse them by gently shaking and speaking to them.

If the person remains unresponsive, carefully roll them on the side (recovery position) and open his airway.

- Keep head and neck aligned.
- Carefully roll them onto their back while holding his head.

First aid

- Call EMERGENCY number.
- Check the person's airway, breathing, and pulse frequently. If necessary, begin rescue breathing and CPR.
- If the person is breathing and lying on the back and after ruling out spinal injury, carefully roll the person onto the side, preferably left side. Bend the top leg so both hip and knee are at right angles. Gently tilt the head back to keep the airway open. If breathing or pulse stops at any time, roll the person on to his back and begin CPR.
- If there is a spinal injury, the victims position may have to be carefully assessed. If the person vomits, roll the entire body at one time to the side. Support the neck and back to keep the head and body in the same position while you roll.
- Keep the person warm until medical help arrives.

Electrical safety tips

Objectives: At the end of this lesson you shall be able to
- **state the electrical safety tips**
- **rescue a person who is in contact with a live wire**
- **treat a person for electric shock/injury.**

Electrical safety tips

Many injuries occur as the result of contact with electrical equipment or appliances. If the part of the body comes in contact with the electrical circuit, a shock will occur. The current will enter the body at one point and leave at another and this passage of electricity can cause severe pain, burning of skin at the point of contact, and even death. So it is need safe and free from electrical hazards.

Safety tips

1 Use only properly grounded or double insulated items/ equipment's.

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2 Do not overload outlets.

3 Do not plug multi-outlet bars to other multioutlet bars.

4 Only use equipment that has been approved by national testing laboratory.

5 Minimize the use of extension cards.

6 Do not cover power cords with rugs or mats.

7 Do not run electrical cord through pedestrian aisles.

8 Disconnect the power before servicing the equipment.

9 Do not ignore warning signs.

10 Replace the defective cords immediately.

11 Cover or guard any exposed electrical components or wire.

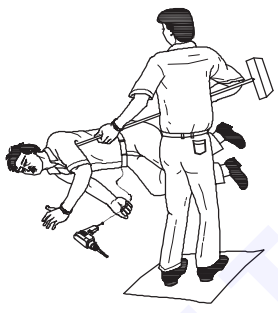
12 Don't use electrical equipment when your hands or equipment's are wet and don't use it near wet surface/ water.

13 Don't pull the power cord from a distance.

The severity of an electric shock will depend on the level of current which passes through the body and the length of time of contact. Do not delay, act at once. Make sure that the electric current has been disconnected.

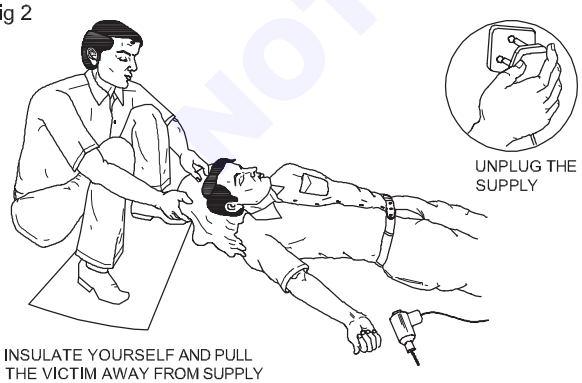
If the casualty is still in contact with the supply - break the contact either by switching off the power, removing the plug or wrenching the cable free. If not, stand on some insulating material such as dry wood, rubber or plastic, or using whatever is at hand to insulate yourself and break the contact by pushing or pulling the person free. (Figs 1 & 2)

Fig 1



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Fig 2



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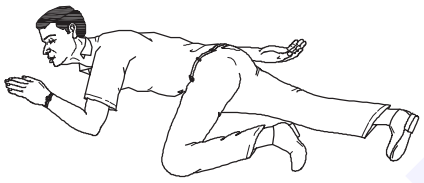
In bare foot, do not touch the victim with your bare hands until the circuit is made dead or he is moved away from the equipment.

If the victim is aloft, measures must be taken to prevent him from falling or at least make him fall safe.

Electric burns on the victim may not cover a big area but may be deep seated. All you can do is to cover the area with a clean, sterile dressing and treat for shock. Get expert help as quickly as possible.

If the victim is unconscious but is breathing, loosen the clothing about the neck, chest and waist and place the casualty in the recovery position.(Fig 3)

Fig 3



KEEP THE VICTIM AT EASE

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Keep a constant check on the breathing and pulse rate.

Keep the casualty warm and comfortable. (Fig 4)

Send for help.

Fig 4



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Do not give an unconscious person anything by mouth.

Do not leave an unconscious person unattended

If the casualty is not breathing - Act at once - don't wate time!

Safety practice first - aid

Electric shock: The severity of an electric shock will depend on the level of the current which passes through the body and the length of time of the contact.

Other factors that contribute to the severity of shock are:

- age of the person
- not wearing insulating footware or wearing wet foot wear
- weather condition
- floor is wet or dry
- mains voltage etc.

Effects of electric shock: The effect of current at very low levels may only be an unpleasant tingling sensation, but this in itself may be sufficient to cause one to lose his balance and fall.

At higher levels of current, the person receiving the shock may be throne off his feet and will experience sever pain, and possibly minor burns at the point of contact.

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At an excessive level of current flow, the muscles may contract and the person unable to release his grip on the conductor. He becomes conscious and the muscles of the heart may contract spasmodically (fibrillation). This may be fatal.

Electric shock can also cause burning of the skin at the point of contact.

Treatment of electric shock

Prompt treatment is essential.

If assistance is close at hand, send for medical aid, then carry on with emergency treatment.

If you are alone, proceed with treatment at once.

Switch off the current, if this can be done without undue delay. Otherwise, remove the victim from contact with the live conductor, using dry non-conducting materials such as a wooden bar, rope, a scarf, the victim's coat-tails, any dry article of clothing, a belt, rolled-up newspaper, non-metallic hose, PVC tubing, bakelite paper, tube etc. (Fig 5)

Fig 5



Avoid direct contact with the victim. Wrap your hands in dry material if rubber gloves are not available.

Electrical burns: A person receiving an electric shock may also sustain burns when the current passes through his body. Do not waste time by applying first aid to the burns until breathing has been restored and the patient can breathe normally - unaided.

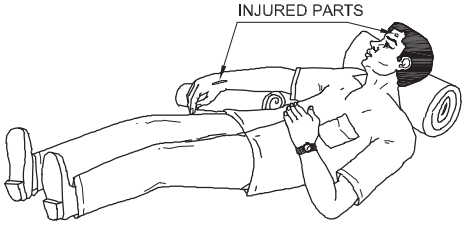
Burns and scalds: Burns are very painful. If a large area of the body is burnt, give no treatment, except to exclude the air, eg.by covering with water, clean paper, or a clean shirt. This relieves the pain.

Severe bleeding: Any wound which is bleeding profusely, especially in the wrist, hand or fingers must be considered serious and must receive professional attention. As an immediate first aid measure, pressure on the wound itself is the best means of stopping the bleeding and avoiding infection.

Immediate action: Always in cases of severe bleeding

- make the patient lie down and rest
- if possible, raise the injured part above the level of the body (Fig 6)

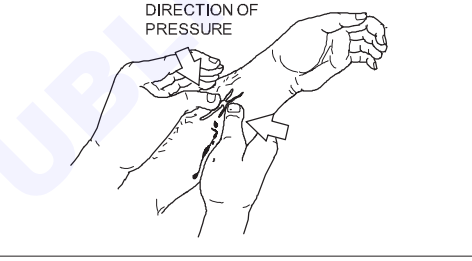
Fig 6



- apply pressure to the wound
- summon assistance.

To control severe bleeding: Squeeze together the sides of the wound. Apply pressure as long as it is necessary to stop the bleeding. When the bleeding has stopped, put a dressing over the wound, and cover it with a pad of soft material. (Fig 7)

Fig 7

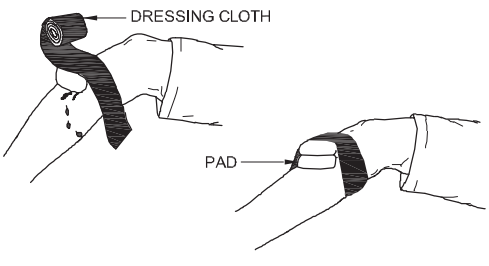


For an abdominal stab wound, such as may be caused by falling on a sharp tool, keep the patient bending over the wound to stop internal bleeding.

Large wound: Apply a clean pad (preferably an individual dressing) and bandage firmly in place. If bleeding is very severe apply more than one dressing. (Fig 8)

Follow the right methods of artificial respiration.

Fig 8



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Knowledge of personal safety and general precautions observed in the shop

Objectives: At the end of this lesson you shall be able to
- **state the is personal protective equipment and its purpose**
- **name the two categories of personal protective equipment**
- **list the most common type of personal protective equipment**
- **list the conditions for selection of personal protective equipment**
- **state the safety precaution in handling diesel machines.**

Personal Protective Equipment (PPE)

Devices, equipment, clothing are used by the employees, as a last resort, to protect against hazards in the workplace. The primary approach in any safety effort is that the hazard to the workmen should be eliminated or controlled by engineering methods rather than protecting the workmen through the use of personal protective equipment (PPE). Engineering methods could include design change, substitution, ventilation, mechanical handling, automation, etc.

The Factories Act, 1948 and several other labour legislations 1996 have provisions for effective use of appropriate types of PPE.

Ways to ensure workplace safety and use personal protective equipment (PPE) effectively.

- Workers to get up-to-date safety information from the regulatory agencies that workplace safety in their specific area.
- To use all available text resources that may be in work area and for applicable safety information on how to use PPE best.
- When it comes to the most common types of personal protective equipment, like goggles, gloves or bodysuits, these items are much less effective if they are not worn at all times, or whenever a specific danger exists in a work process. Using PPE consistent will help to avoid some common kinds of industrial accidents.
- Personal protective gear is not always enough to protect workers against workplace dangers. Knowing more about the overall context of your work activity can help to fully protect from anything that might threaten health and safety on the job.
- Inspection of gear thoroughly to make sure that it has the standard of quality and adequately protect the user should be continuously carried out.

Categories of PPEs

Depending upon the nature of hazard, the PPE is broadly divided into the following two categories:

1 **Non-respiratory:** Those used for protection against injury from outside the body, i.e. for protecting the head, eye, face, hand, arm, foot, leg and other body parts

2 **Respiratory:** Those used for protection from harm due to inhalation of contaminated air.

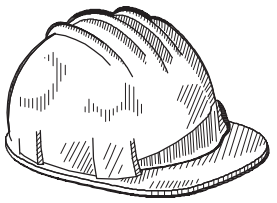
They are to meet the applicable BIS (Bureau of Indian Standards) standards for different types of PPE.

The guidelines on 'Personal Protective Equipment' is issued to facilitate the plant management in maintaining an effective programme with respect to protection of persons against hazards, which cannot be eliminated or controlled by engineering methods listed in table1.

Table1

No.	Title
PPE1	Helmet
PPE2	Safety footwear
PPE3	Respiratory protective equipment
PPE4	Arms and hands protection
PPE5	Eyes and face protection
PPE6	Protective clothing and coverall
PPE7	Ears protection
PPE8	Safety belt and harnesses

Fig 1



HELMET

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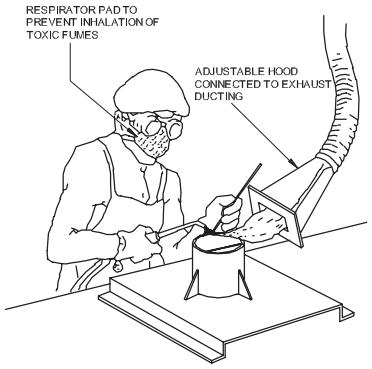
Fig 2



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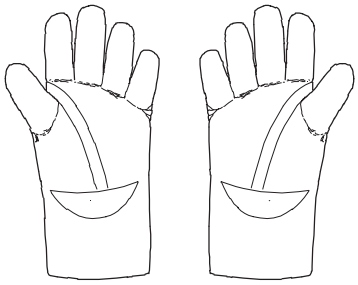
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Fig 3



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Fig 4



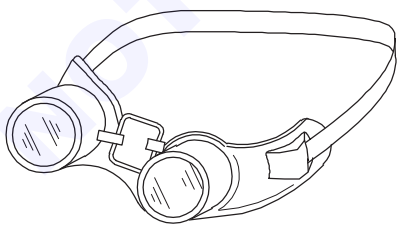
GLOVES

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Common type of personal protective equipments and their uses and hazards are as follows

Types of protection	Hazards	PPE to be used
Head protection (Fig 1)	1. Falling objects 2. Striking against objects 3. Spatter	Helmets
Foot protection (Fig 2)	1. Hot spatter 2. Falling objects 3. Working wet area	Leather leg guards Safety shoes Gum boots
Nose (Fig 3)	1. Dust particles 2. Fumes/ gases/ vapours	Nose mask
Hand protection (Fig 4)	1. Heat burn due to direct contact 2. Blows sparks moderate heat 3. Electric shock	Hand gloves
Eye protection (Fig 5, Fig 6)	1. Flying dust particles 2. UV rays, IR rays heat and High amount of visible radiation.	Goggles Face shield Hand shield Head shield
Face Protection (Fig 6, Fig 7)	1. Spark generated during Welding, grinding 2. Welding spatter striking 3. Face protection from UV rays	Face shield Head shield with or without ear muff Helmets with welders screen for welders
Ear protection (Fig 7)	1. High noise level	Ear plug Ear muff
Body protection (Fig 8, Fig 9)	1. Hot particles	Leather aprons

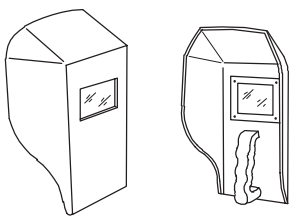
Fig 5



GOGGLES

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Fig 6

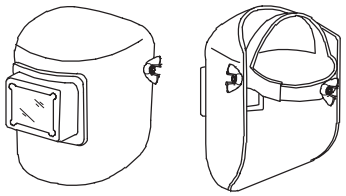


HAND SCREEN

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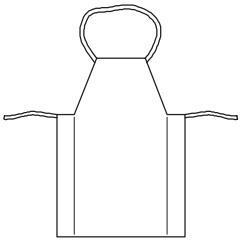
Fig 7



WELDING HELMET

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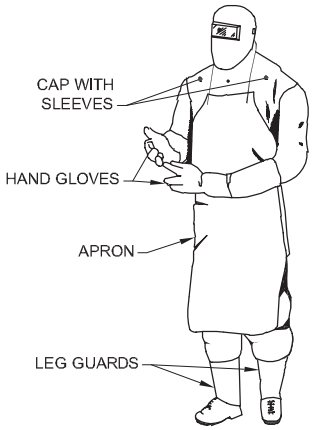
Fig 8



APRON

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Fig 9



LEG GUARDS

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Safety precaution in handling diesel machine

Mechanic must know the safety rules first and then practice to handling diesel machine as well as we known, when accident starts means safety rules are not followed during the handling of diesel machine. So safety precautions are always based on good sense.

The following precautions are to be observed to keep a personal accident free.

General safety

- Do not spill the fuel and lubricant on work place, the spills may cause for the risk of slipping.
- Keep all flammable material away from the diesel machine.
- Always keep clean hand and tools while work on machine.
- Keep the diesel machines operating area free from any form of fire.
- Safety operation of diesel machine.
- Don't operate the machine with loose engine mounting
- Don't operate the machine without lubricant
- Don't spill diesel fill in to the fuel tank.
- Keep the empty diesel/ lubricant cans away from the machine.
- Ensure the stationary engine exhaust gas outlet should be far away from work place otherwise it will be harm full to human health.
- Use preheat before start the diesel engine.
- Use safe guard around rotating part of the engine.
- Maintain the coolant and lubricant level in the engine.
- Always keep engine in an upright places for easy handling and safety.
- Use specified grade lubricant and coolant in an engine.

Safety of rubber hose and pipes

- Inspect the rubber hose periodically and replace the damaged parts.
- Inspect the fuel leaks in fuel system and rectify the leakage
- Inspect the exhaust gas leaks and rectify the leakages
- Check the engine performance if any air lock in fuel system, bleed the fuel system.

Safety of engine operation

- Check the coolant circulation and pressure cap function
- Check the oil pressure
- Check the tappet noise and rectify the noise/adjust the defective tappet
- Check the abnormal noise in the engine
- Check leakage of lubricant and coolant in the engine and rectify the leakages.
- Ensure free air circulation in engine operating place.

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Occupational health and safety

Objectives: At the end of this lesson you shall be able to
- **define safety**
- **state the goal of occupational health and safety**
- **explain need of occupational health and safety**
- **state the occupational hygiene**
- **list types of occupational hazards.**

Safety

Safety means freedom or protection from harm, danger, hazard, risk, accident, injury or damage.

Occupational health and safety

- Occupational health and safety is concerned with protecting the safety, health and welfare of people engaged in work or employment.
- The goal is to provide a safe work environment and to prevent hazards.
- It may also protect co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are impacted by the workplace environment.
- It involves interactions among many related areas, including occupational medicine, occupational (or industrial) hygiene, public health, and safety engineering, chemistry, and health physics.

Need of occupational health and safety

- Health and safety of the employees is an important aspect of a company's smooth and successful functioning.
- It is a decisive factor in organizational effectiveness. It ensures an accident-free industrial environment.
- Proper attention to the safety and welfare of the employees can yield valuable returns.
- Improving employees morale
- Reducing absenteeism
- Enhancing productivity
- Minimizing potential of work-related injuries and illnesses
- Increasing the quality of manufactured products or rendered services.

Occupational (Industrial) Hygiene

- Occupational hygiene is anticipation, recognition, evaluation and control of work place hazards (or) environmental factors (or) stresses
- This is arising in (or) from the workplace.
- Which may cause sickness, impaired health and well being (or) significant discomfort and inefficiency among workers.

Anticipation (Identification): Methods of identification of possible hazards and their effects on health.

Recognition (Acceptance): Acceptance of ill-effects of the identified hazards.

Evaluation (Measurement & Assessment): Measuring or calculating the hazard by Instruments, Air sampling and Analysis, comparison with standards and taking judgment whether measured or calculated hazard is more or less than the permissible standard

Control of Workplace Hazards: Measures like Engineering and Administrative controls, medical examination, use of Personal Protective Equipment (PPE), education, training and supervision

Occupational Hazards

"Source or situation with a potential for harm in terms of injury or ill health, damage to property, damage to the workplace environment, or a combination of these"

Types of occupational health hazards

1 Physical Hazards
2 Chemical Hazards
3 Biological Hazards
4 Physiological Hazards
5 Psychological Hazards
6 Mechanical Hazards
7 Electrical Hazards
8 Ergonomic Hazards

1 Physical Hazards
- Noise
- Heat and cold stress
- Vibration
- Radiation (ionizing& Nonionizing)
- Illumination etc.,

2 Chemical Hazards
- Inflammable
- Explosive
- Toxic
- Corrosive
- Radioactive

3 Biological Hazards
- Bacteria
- Virus
- Fungi
- Plant pest
- Infection.

4 Physiological
- Old age
- Sex
- ill health
- Sickness
- Fatigue.

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5 Psychological

- Wrong attitude
- Smoking
- Alcoholism
- Unskilled
- Poor discipline
  - absertecism
  - disobedience
  - aggressive behaviour's
- Accident proneness etc,
- Emotional disturbances
  - violence
  - bullying
  - sexual harassment

6 Mechanical

- Unguarded machinery
- No fencing
- No safety device
- No control device etc.,

7 Electrical

- No earthing
- Short circuit
- Current leakage
- Open wire
- No fuse or cut off device etc,

8 Ergonomic

- Poor manual handling technique
- Wrong layout of machinery
- Wrong design
- Poor housekeeping
- Awkward position
- Wrong tools etc,

Safety Slogan

A Safety rule breaker, is an accident maker.

Safety practice

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

- **state the causes for accidents in general terms**
- **state the safe attitudes**
- **list out the four basic categories of safety signs.**

Causes for accidents: Normally accidents do not just happen. They are caused.

Causes for accidents are many. Some of the important causes are listed below.

- Unawareness of danger
- Disregard for safety
- Negligence
- Lack of understanding of proper safety procedures
- Untidy condition of workplace
- Inadequate light and ventilation
- Improper use of tools
- Unsafe conditions

Safe attitudes: People's attitudes govern what they do or fail to do. In most cases where someone is working with unsafe equipment or in an unsafe situation, somebody has allowed that state of affairs to come about by something they have done or failed to do.

Most accidents don't just happen; they are caused by people who (for example) damage equipment or see it is faulty but don't report it, or leave tools and equipment lying about for other people to trip over.

Responsibilities: Safety doesn't just happen - it has to be organized and achieved like the work-process of which it forms a part. The law states that both an employer and his employees have a responsibility in this behalf.

Employer's responsibilities: The effort a firm puts into planning and organizing work, into training people, into engaging skilled and competent workers, maintaining plant and equipment, and checking, inspecting and keeping records- all of this contributes to the safety in the workplace.

The employer will be responsible for the equipment provided, the working conditions, what employees are asked to do, and the training given.

Employee's responsibilities: You will be responsible for the way you use the equipment, how you do your job, the use you make of your training, and your general attitude to safety.

A great deal is done by employers and other people to make your working life safer; but always remember you are responsible for your own actions and the effect they have on others. You must not take that responsibility lightly.

Rules and procedures at work: What you must do, by law, is often included in the various rules and procedures laid down by your employer. They may be written down, but more often than not, are just the way a firm does things - you will learn these from other workers as you do your job. They may govern the issue and use of tools, protective clothing and equipment, reporting procedures, emergency drills, access to restricted areas, and many other matters. Such rules are essential; they contribute to the efficiency and safety of the job.

Safety signs: As you go about your work on a construction site you will see a variety of signs and notices. Some of these will be familiar to you - a 'no smoking' sign for example; others you may not have seen before. It is up to you to learn what they mean - and to take notice of them. They warn of the possible danger, and must not be ignored.

Safety signs fall into four separate categories. These can be recognized by their shape and colour. Sometimes they may be just a symbol; other signs may include letters or figures and provide extra information such as the clearance height of an obstacle or the safe working load of a crane.

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The four basic categories of signs are as follows. (Fig 1)

- Prohibition signs
- Mandatory signs
- Warning signs
- Information signs

Prohibition signs



Shape Circular.

Colour Red border and cross bar. Black symbol on white background.

Meaning Shows it must not be done.

Example No smoking.

Mandatory signs



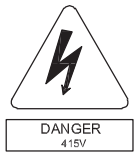
Shape Circular.

Colour White symbol on blue background.

Meaning Shows what must be done.

Example Wear hand protection.

Warning signs



Shape Triangular.

Colour Yellow background with black border and symbol.

Meaning Warns of hazard or danger.

Example Caution, risk of electric shock.

Information signs



Shape Square or oblong.

Colour White symbols on green background.

Meaning Indicates or gives information of safety provision.

Example First aid point.

Prohibition signs (Fig 2)



Mandatory signs (Fig 3)



Warning signs (Fig 4)



Concept of house keeping & 5S method

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

- **elements of house keeping and cleanliness at work place**
- **state the concept of 5'S' techniques.**

Concept of house keeping

House keeping is the systematic process of making home/ work place neat and clean. House keeper is responsible for systematic administration of activities that provide segregation, storage, transfer, processing treatment and disposal of solid waste (which is collected during cleaning)

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Scope of house keeping maintenance

The scope of work highly depend on where the house keeping activity is performed in general, maintains clean lines and orderlines, Furnishes the room, office, work-place, house keeping supervisor assisted by an assistant house keeper.

- eye appeal
- safety
- maintenance

Elements of housekeeping and cleanliness at workplace

The major elements which are normally included in the housekeeping and cleanliness practices at the workplace are described below.

- **Dust and dirt removal:** Working in dusty and dirty area is unhygienic as well as unhealthy for the employees, regular sweeping the workplace for the removal of dust and dirt is an essential housekeeping and cleanliness practice. Further, compressed air is not to be used for removing dust or dirt off employees or equipment. Compressed air can caused dirt and dust particles to be embedded under the skin or in the eye.
- **Employees facilities:** Adequate employees facilities such as drinking water, wash rooms, toilet blocks, and rest rooms are to be provided for the employees at the workplace so that employees can use them when there is a need. Cleanliness at the place of these facilities is an important aspect of the facilities.
- **Flooring:** Floors are to be cleaned regularly and immediately if liquids or other materials are spilled. Poor floor conditions are a leading cause of accidents in the workplace. It is also important to replace worn, ripped or damaged flooring that poses a trip hazard.
- **Lighting:** Adequate lighting reduces the potential for accidents. It is to be ensured that inoperative light fixtures are repaired and dirty light fixtures are cleaned regularly so that the light intensity levels are maintained at the workplace.
- **Aisles and stairways:** Aisles and stairways are to be kept clear and not to be used for storage. It is also important to maintain adequate lighting in stairways. Further stairways need to have railings preferably round railings for adequate grip.
- **Spill control:** The best method to control spills is to prevent them from happening. Regular cleaning and maintenance on machines and equipment is an essential practice. When cleaning a spill, it is required to use the proper cleaning agents or absorbent materials. It is also to be ensured that the waste products are disposed of properly.
- **Waste disposal:** The regular collection of the waste materials contribute to good housekeeping and cleanliness practices. Placing containers for wastes near the place where the waste is produced encourages orderly waste disposal and makes collection easier. All recyclable wastes after their collection are to be transferred to their designated places so that the waste materials can be dispatched to the point of use or sold.
- **Tools and equipment:** Tools and equipment are required to be inspected prior to their use. Damaged or worn tools are to be taken out of service immediately. Tools are to be cleaned and returned to their storage place after use.
- **Maintenance:** One of the most important elements of good housekeeping and cleanliness practices is the maintenance of the equipment and the buildings housing them. This means keeping buildings, equipment and machinery in safe and efficient working condition. When a workplace looks neglected means there are broken windows, defective plumbing, broken floor surfaces and dirty walls etc. These conditions can cause accidents and affect work practices.
- **Storage:** Proper storage of materials is essential in a good housekeeping and cleanliness practice. All storage areas need to be clearly marked. Also it is important that all containers be labeled properly. If materials are being stored correctly, then the incidents of strain injuries, chemical exposures and fires get reduced drastically.
- **Clutter control:** Cluttered workplaces typically happen because of poor housekeeping practices. This type of workplace can lead to a number of issues which include ergonomic as well as injuries. It is important to develop practices where items like tools, chemicals, cords, and containers are returned to their appropriate storage location when not in use.
- **Individual workspace:** Individual workspace need to be kept neat, cleared of everything not needed for work. It is necessary to make a checklist which is to be used by the employees to evaluate their workspace.

It can be said that a clean work area demonstrate the pride employees have with the job and the culture of safety at the workplace.

5 Steps (5s) - Concept (Fig 1)

5s is a people-oriented and practice-oriented approach. 5s expects every one to participate in it. It becomes a basic for continuous improvement in the organization.

The terms (5s) 5 steps are

Step 1: SEIRI (Sorting out)

Step 2: SEITON (Systematic arrangement)

Step 3: SEISO (Shine cleanliness)

Step 4: SEIKTSU (Stanardization)

Step 5: SHITSURE (Self discipline)

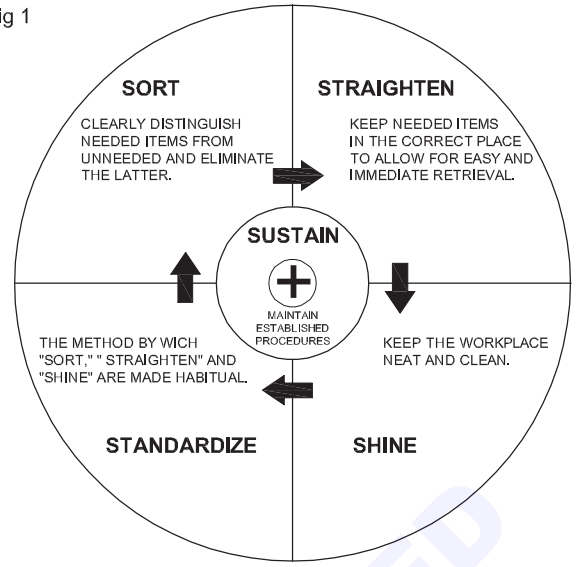
Fig 1 shows the 5s concept wheel.

The list describes how to organize a work space for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items and sustaining the new order.

Benefits of 5s

- Work place becomes clear and better organized.
- Working in working place becomes easier.
- Reduction in cost.
- People tend to be more disciplined.
- Delay is avoided.
- Less absenteeism.
- Better use of floor space.
- Less accidents.
- High productivity with quality etc.

Fig 1



5S CONCEPT WHEEL

Safety practice - fire extinguishers

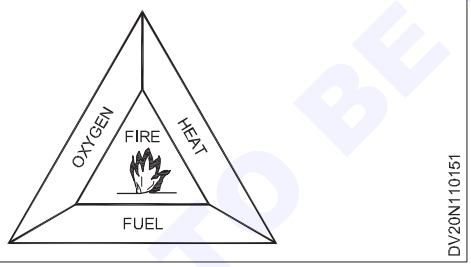
Objectives: At the end of this lesson you shall be able to

- **state the effects of a fire break out**
- **state the causes for fire in a workshop**
- **state the conditions required for combustion relevant to fire prevention**
- **state the general precautionary measures to be taken for prevention of fire.**

Fire is the burning of combustible material. It might injure people, and sometimes cause loss of life as well. Hence, every effort must be made to prevent fire.

The following are the three factors that must be present in combination for a fire to continue to burn (Fig 1).

Fig 1



Fuel: Any substance, liquid, solid or gas will burn, if there is oxygen and high enough temperatures.

Heat: Every fuel will begin to burn at a certain temperature. It varies and depends on the fuel. Solids and liquids give off vapour when heated, and it is this vapour which ignites.

Some liquids do not have to be heated as they give off vapour at normal room temperature say 15°C, eg. petrol.

Oxygen: Usually exists in sufficient quantity in air to keep a fire burning.

Extinguishing of fire: Isolating or removing any of these factors from the combination will extinguish the fire. There are three basic ways of achieving this.

- **Starving** the fire of fuel removes this element.
- **Smothering** - ie. isolate the fire from the supply of oxygen by blanketing it with foam, sand etc.
- **Cooling** - use water to lower the temperature.

Removing any one of these factors will extinguish the fire.

Preventing fires: The majority of fires begin with small outbreaks which burn unnoticed until they have a secure hold. Most fires could be prevented with more care and by following some simple common sense rules.

Accumulation of combustible refuse (cotton waste soaked with oil, scrap wood, paper, etc.) in odd corner's are a fire risk. Refuse should be removed to collection points.

The cause of fire in electrical equipment is misuse or neglect. Loose connections, wrongly rated fuses, over loaded circuits cause overheating which may in turn lead to a fire. Damage to insulation between conductors in cables causes fire.

Clothing and anything else which might catch fire should be kept well away from heaters. Make sure that the heater is shut off at the end of the working day.

Highly flammable liquids and petroleum mixtures (thinner, adhesive solutions, solvents, kerosene, spirit, LPG gas etc.) should be stored in the flammable material storage area.

Blow lamps and torches must not be left burning when they are not in use.

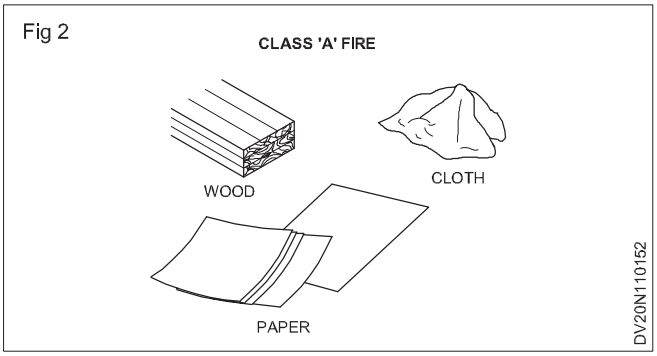
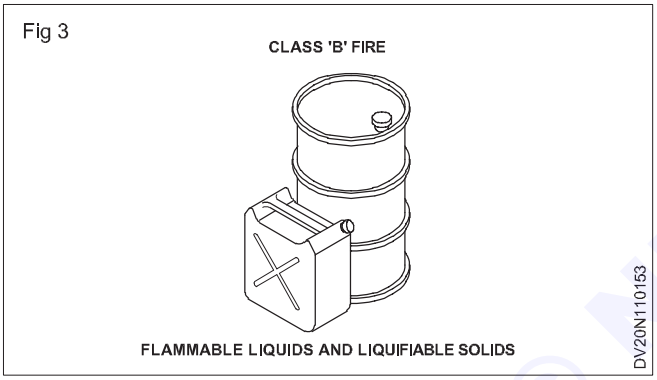
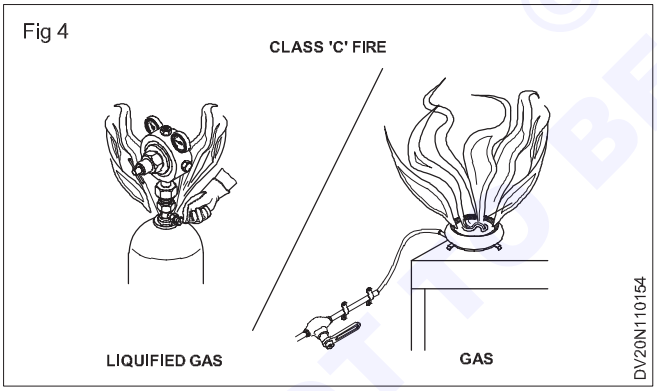
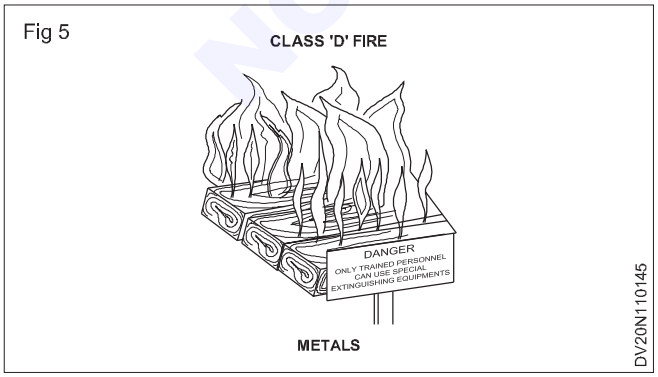
Extinguishing fires: Fires are classified into four types in terms of the nature of fuel.

Different types of fire have to be dealt with in different ways and with different extinguishing agents.

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An extinguishing agent is the material or substance used to put out the fire, and is usually (but not always) contained in a fire extinguisher with a release mechanism for spraying into the fire.

It is important to know the right type of agent for extinguishing a particular type of fire; using a wrong agent can make things worse.There is no classification for ‘electrical fires’ as such, since these are only fires in materials where electricity is present.

Fuel	Extinguishing
Fig 2  	Most effective ie. cooling with water. Jets of water should be sprayed on the base of the fire and then gradually upwards.
Fig 3  	Should be smothered. The aim is to cover the entire surface of the burning liquid. This has the effect of cutting off the supply of oxygen to the fire. Water should never be used on burning liquids.Foam, dry powder or CO_2 may be used on this type of fire.
Fig 4  	Extreme caution is necessary in dealing with liquefied gases. There is a risk of explosion and sudden out break of fire in the entire vicinity. If an appliance fed from a cylinder catches fire - shut off the supply of gas. The safest course is to raise an alarm and leave the fire to be dealt with by trained personnel. Dry powder extinguishers are used on this type of fire. Special powders have now been developed which are capable of controlling and/or extinguishing this type of fire.
Fig 5  	The standard range of fire extinguishing agents is inadequate or dangerous when dealing with metal fires. Fire on electrical equipment. Halon, Carbon dioxide, dry powder and vapourizing liquid (CTC) extinguishers can be used to deal with fires in electrical equipment. Foam or liquid (eg. water) extinguishers must not be used on electrical equipment under any circumstances.

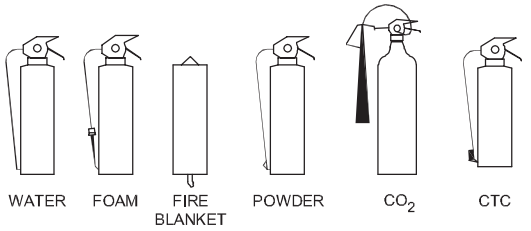
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Types of fire extinguishers

Objectives: At the end of this lesson you shall be able to
- **distinguish different types of fire extinguishers**
- **determine the correct type of fire extinguisher to be used based on the class of fire**
- **describe the general procedure to be adopted in the event of a fire.**

Many types of fire extinguishers are available with different extinguishing 'agents' to deal with different classes of fires (Fig 1).

Fig 1

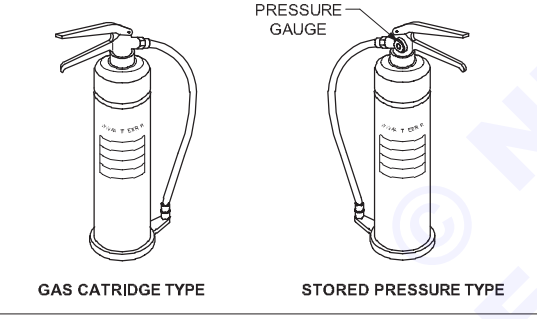


Water-filled extinguishers

There are two methods of operation (Fig 2).

- Gas cartridge type
- Stored pressure type

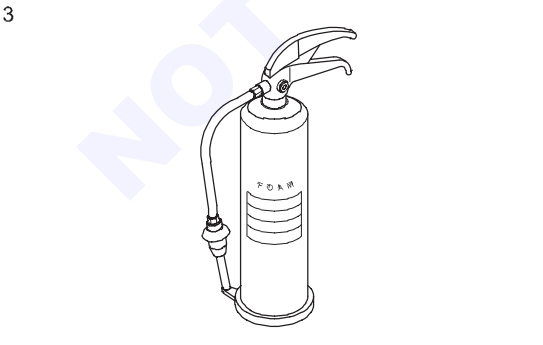
Fig 2



With both methods of operation the discharge can be interrupted as required, conserving the contents and preventing unnecessary water damage.

Foam extinguishers (Fig 3): These may be of stored pressure or gas cartridge types. Always check the operating instructions on the extinguisher before use.

Fig 3



Most suitable for

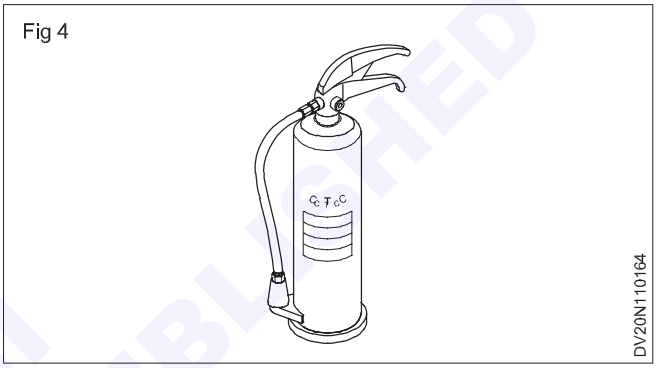
- Flammable liquid fires
- Running liquid fires

Must not be used on fires where electrical equipment is involved.

Dry powder extinguishers (Fig 4)

Extinguishers fitted with dry powder may be of the gas cartridge or stored pressure type. Appearance and method of operation is the same as that of the water-filled one. The main distinguishing feature is the fork shaped nozzle. Powders have been developed to deal with class D fires.

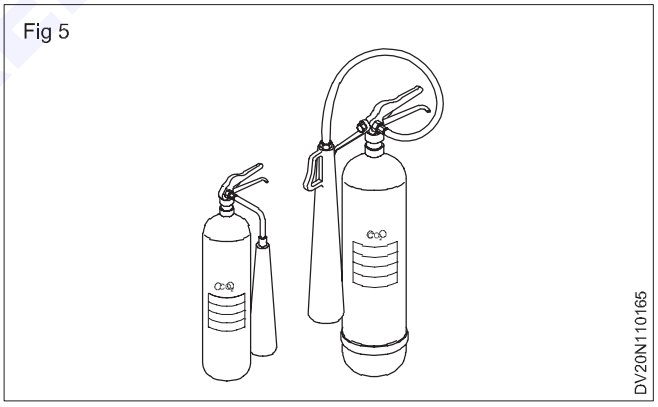
Fig 4



Carbon dioxide (CO_2)

This type is easily distinguished by the distinctively shaped discharge horn. (Fig 5)

Fig 5



Suitable for Class B fires. Best suited where contamination by deposits must be avoided. Not generally effective in open air.

Always check the operating instructions on the container before use. Available with different gadgets of operation such as - plunger, lever, trigger etc.

Halon extinguishers (Fig 6)

These extinguishers may be filled with carbon-tetrachloride and Bromochlorodifluoro methene (BCF). They may be either gas cartridge or stored pressure type.

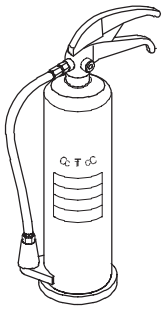
They are more effective in extinguishing small fires involving pouring liquids.

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These extinguishers are particularly suitable and safe to use on electrical equipment as the chemicals are electrically non-conductive.

The fumes given off by these extinguishers are dangerous, especially in confined space.

Fig 6



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The general procedure in the event of a fire

- Raise an alarm.
- Turn off all machinery and power (gas and electricity).
- Close the doors and windows, but do not lock or bolt them. This will limit the oxygen fed to the fire and prevent its spreading.
- Try to deal with the fire if you can do so safely. Do not risk getting trapped.
- Anybody not involved in fighting the fire should leave calmly using the emergency exits and go to the designated assembly point. Failure to do this may mean that some person being unaccounted for and others may have to put themselves to the trouble of searching for him or her at risk to themselves.

Qualities of good driver

Objectives: At the end of this lesson you shall be able to
- **state the qualities of good driver**
- **state the road rules and regulations**
- **state the vehicle controls and maintenance**
- **state the yoga and stress management.**

Qualities of good drovers: Personal skills and abilities are make a good and safe driver. So drivers should learn and develop skills and abilities for safe driving. The following characters make a good and safe driver.

Vehicle controls: Acquire and excellent sense of navigation: The driver must be able to read the road map, GPS system, be aware of which road can or cannot be driven on and be able to look out for road safety signs.

Responsibility: Driver should be responsible and reliable for self and others around you, which include passengers and other drivers on the road.

Defensive driving: Keep in mind that vehicle speeding does not save time, speed driving can put you and others around you at a safety risk. So, it is advisable not to go beyond the stipulated speed limit on the road, street, and market. A safe driver will not rush through crowded streets.

Courtesy: Driving extremely slow or road hogging is also an offence.

Concentration: Keep in mind your vehicle fuel tank cap location (side) which is help the car fuel tank cap is on (open) without having to get out of the car, while filling fuel in petrol bunk.

Self- confidence: Good and safe driver is being alert and ready to handle any situation on the road. Sudden unwanted situations could arise and put your driving skills to test. Always be alert yourself.

Knowledge of road rules and regulations:

Understand the road rules and regulations. Always follows the road rules and regulation, road signs, while drive your vehicle on the road.

Concentration on self discipline : Practice to maintain your self- discipline, it is easy to expect others to obey traffic rules and drive reasonably. A safe driver is a self-disciplined reasonably. A safe driver is a self-disciplined driver. Always remember that your life and the life of others around you can risk even with slightest display of recklessness.

Patience on driving: Be patient, remember, you are not in a race to get to your destination first, instead, you should be concerned about getting to your destination safely. Patience is a necessary quality of a good driver as it keeps you safe and helps you stay calm.

Concentration for other road users:

Good driver need to be cautious at all times in order to avoid mishaps and accidents, good driver always keep in mind that there are many people on the road who may not practice safe driving like good driving skill driver.

Anticipation: Always ensure your vehicle is fit to drive you need to check the vehicle each time before you drive out to ensure it is in good working condition.

Good behavior: Behavior is involving action and response to stimulation. Human behavior is the potential and expressed capacity of human individuals to respond to internal and external stimuli throughout their life human good behaviors are as follows.

- walk all times and maintain time management
- keep hands/feet to yourself maintain self-discipline
- use manners
- be a good listener
- allow others to learn

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- respect others/clients
- complete your designed work.

Effective way to change behavior:

- change your environment
- change your friends at work
- reward your self
- change your bad habits
- always keep in mind set your goals.

Characteristics of a defensive driver: The characteristics of defensive driver are the same characteristics that apply to many aspects of our lives. The most important requirement for defensive driving as follows.

Knowledge: Educate him/herself about safe driving techniques and traffic rules and regulations in their country. Driver should know how to properly maintain their vehicles in safe operating condition.

Alertness: The driver pay attention to the traffic situation to the front and rear, side by glancing in rear and side view mirror many times in a minute.Driver always give all their attention to the task of driving only.

Fore sight: Drivers should be practice to long-range foresight by keeping this vehicles distance well maintained by checking them before driving, driver should be always wearing a seat belt for driver safety.

Judgment: Good driver should be used clear thinking and knowledge to make decision wisely and quickly, driver should be maintain control of his behavior, resisting the temptation to make risky maneuvers to get somewhere faster or to out maneuvers other drovers. They pass only when it is safe and always look for the safest rather than the speediest, alternatives in any traffic situation. Driver should be courteous, even though other drivers are not courteous.

Driving skill: Defensive drivers develop the skills is necessary to operate a vehicle properly and safely , drivers should be know the safe and legal way to make them turns, change gears, brake and pass. Driver can listen to their vehicles for warning signs of engine trouble they can perform simple emergency repairs. Such as changing tyre on the way.

Knowledge of vehicle controls: Good driver should be know the function of vehicle controls like clutch, brake, suspension, steering, Transmission, engine cooling system, lubrication system, ignition system , fuel system, intake and exhaust systems, light circuit and dash panel gauges and warming lights etc.

Maintenance: Vehicle maintenance and servicing is carried out after completion of certain kilometers or certain periods, it is suggested that the vehicle owners carryout regular and periodical checks on their vehicles. Maintenance check list is given in the vehicle owner's manual. Maintenance such as daily inspection check tyre pressure, radiators coolant, fan belts tension, engine oil level, wind screen glass cleaning, clutch and brake pedal free play nut, bolt, looseness etc. Monthly maintenance and periodical maintenance also carried out as mentioned in vehicle owner's manual . There are four types of essential maintenance they are as corrective, preventive, risk based and condition based maintenance.

Vehicles simple mechanism and effect of competitiveness : Vehicles simple mechanism and their function are most important to safely drive the vehicle on the road. Proper function of vehicle operating system will help to driver getting to desired destination in case any vehicle system is failed to function during travel, it will be effect the travel and unable to yet desired destination in time.

Over confidence: Driver over confidence is very danger, it will be leads to accident over confidence is one example of a miscalibration of subjective probabilities (over estimation of one is actual performance/knowledge/judgment)

Impatience: Drivers or humans impatience due to his physical factors such as sort temper, hunger, dehydration or fatigue. The following steps will help to stop being impatient .

- Be mindful of the things that make you impatient
- Make yourself wait for things actually makes you happier in the long run.
- Stop doing work that are not important
- When you are feed impatience, relax and take deep breath
- Practice to gratitude in improving your health
- Take sound sleep at night or take a good rest for relax your body and mind.
- Always don't be quick to react in any situation think and act in emergency situation
- Eat slowly during travel time or at home.
- Meditate daily, daily and consistent meditation helps in building inner calmness, it will help yourself in any stressful situation.
- Provide validation and instruction to avoid impatience.

Traffic rules,signals & controls

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

- **state the different type of regulatory traffic sign**
- **state the different type of cautionary traffic sign**
- **state the different type of information traffic sign**
- **state the yoga and stress management.**

Road traffic signals

The Motor Vehicle Act 1988 under chapter VIII prescribes traffic signs which are important for the driver for safe driving. The section 119 stipulates the duty of the driver to obey traffic signs as under.

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Every driver of a Motor Vehicle shall drive the vehicle in conformity with any indication given by the mandatory traffic signs and in conformity with to the driving regulation made by the Central Government and shall comply with all directions given to him by any police officer for the time being engaged in the regulation of traffic in any public place.

The following signs and signals are approved by an Act passed by the parliament. Both old and new signs are given below. (Figs 1, 2, 3, 4, 5)

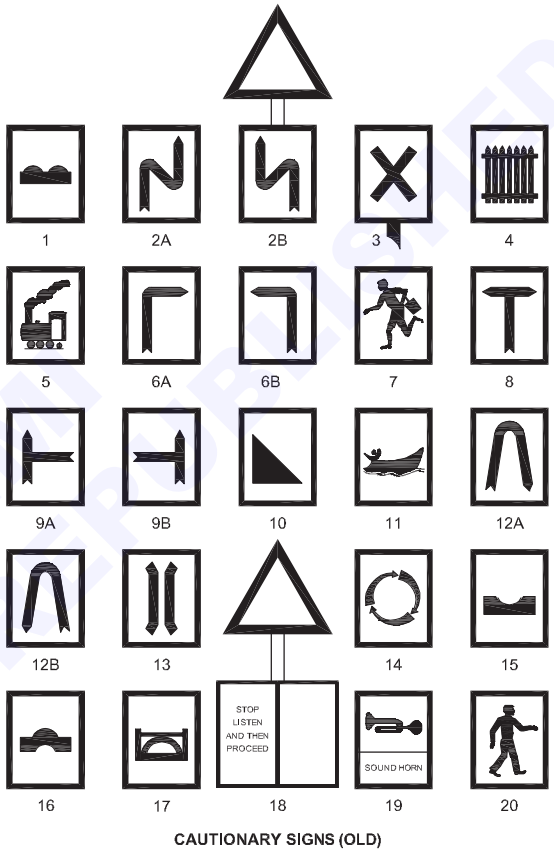
The Central Motor Vehicle Rules 1989 Rule No.135 states that the owner of every goods carriage, transporting dangerous or hazardous goods shall ensure to the satisfaction of the consigner that the driver of the goods carriage has received adequate instructions and training to enable him to understand the nature of the goods being transported by him, the nature of the risk arising out of such goods and the precautions he should take while the goods carriage is in motion or stationary and the action he has to take in case of any emergency.

The following are important signs that a driver should learn and keep in mind.

Fig 1

CAUTIONARY SIGNS (OLD)

1. ROUGH ROAD
2A. ZIGZAG RIGHT
2B. ZIGZAG LEFT
3. WARNING AND CROSS - ROAD
4. GUARDED LEVEL CROSSING
5. UNGUARDED LEVEL CROSSING
6A. TURN RIGHT
6B. TURN LEFT
7. SCHOOL ZONE
8. DEAD END CROSS ROAD
9A. SIDE ROAD RIGHT
9B. SIDE ROAD LEFT
10. STEEP HILL
11. FERRY
12A. HAIRPIN BEND RIGHT
12B. DAIROIN BEND LEFT
13. NARROW BRIDGE
14. ROUND ROAD (OR) CAUSEWAY ROAD
15. DEPTH ROAD (OR) CAUSEWAY ROAD
16. SPEED BREAKERS (OR) BUMP ROAD
17. OVERHEAD CHANNEL
18. CAUTION BOARD
19. SOUND HORN
20. PEDESTRIAN CROSSING



CAUTIONARY SIGNS (OLD)

DV20N1101T1

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Signals and signalling devices

Motor Vehicles Act 1988 section 121 prescribes that the driver of a motor vehicle shall make such signals and on such occasions as may be prescribed by the Central Government:

Provided that the signals of an intention to turn to the right or left or to stop -

a In the case of a motor vehicle with a right hand steering, control may be given by a mechanical or electrical device of a prescribed nature affixed to the vehicle.

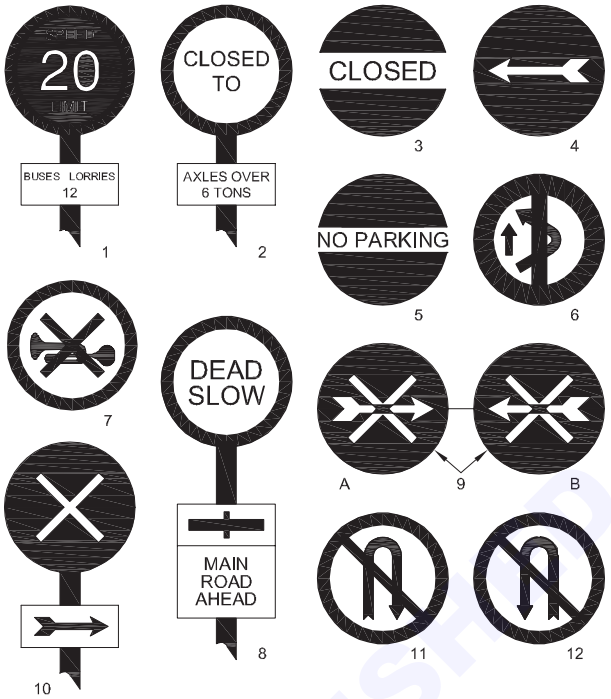
b In the case of a motor vehicle with a left hand steering, control shall be given by a mechanical or electrical device of a prescribed nature affixed to the vehicle.

The central Motor Vehicle Rules 1989 section 102 provides instructions and information on signaling devices, lamp and reflectors and direction indicators and stop lights.

Fig 2

MANDATORY SIGNS (OLD)

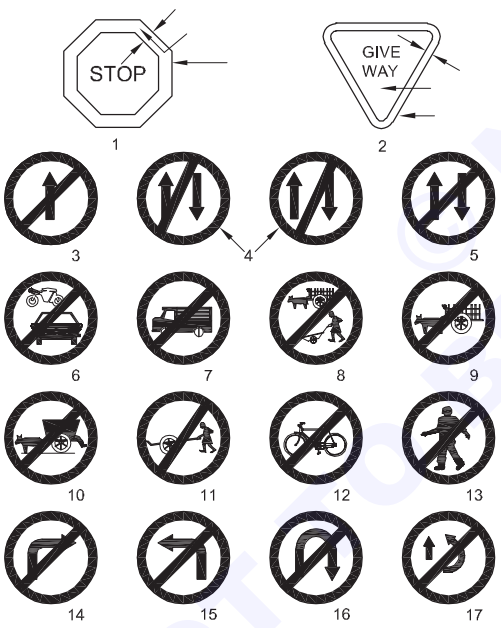
1. SPEED LIMIT
2. CLOSED TO AXIES OVER 6 TONES
3. ROAD CLOSED
4. GO LEFT
5. NO PARKING
6. NO OVERTAKING
7. HORN PROHIBITED
8. DEAD SLOW
9. 'A' RIGHT SIDE NOT ALLOWED
   'B' LEFT SIDE NOT ALLOWED
10. LORRY NOT ALLOWED
11. 'U' TURN PRODIBITED
12. RESTRICTION ENDS



MANDATORY SIGNS (OLD)

DV20N1101T2

Fig 3



REGULATORY SINGNS (NEW-PROPOSED)



REGULATORY SIGNS (NEW-PROPOSED)

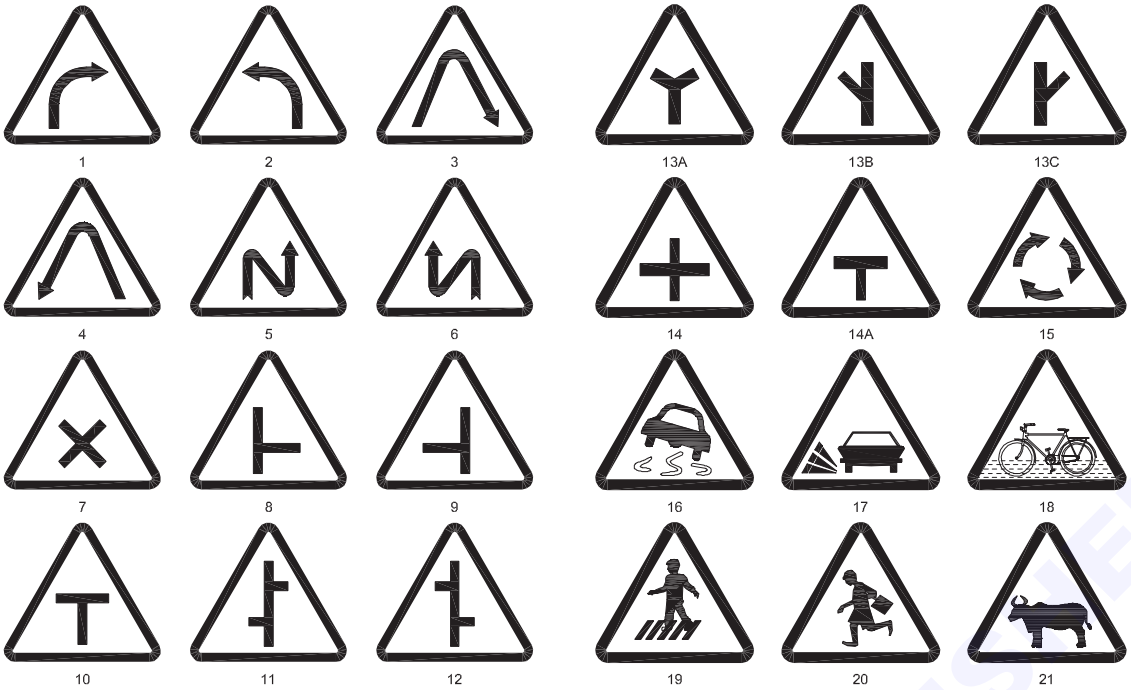
REGULATORY SIGNS (NEW)

1. STOP
2. GIVE WAY
3. STRAIGHT PROHIBITED - NO ENTRY
4. ONE WAY
5. VEHICLES PROHIBITED IN BOTH DIRECTIONS
6. ALL VEHICLES PROHIBITED
7. TRUCK PROHIBITED
8. BULLOCK CART AND HAND CART PROHIBITED
9. BULLOCK CART PROHIBITED
10. TONGA PROHIBITED
11. HAND CART PROHIBITED
12. CYCLE PROHIBITED
13. PEDESTRIANS PROHIBITED
14. RIGHT TURN PROHIBITED
15. LEFT TURN PROHIBITED
16. 'U' TURN PROHIBITED
17. OVERTAKING PROHIBITED
18. HORN PROHIBITED
19. NO PARKING
20. NO STOPPING OR STANDING
21. SPEED LIMIT
22. WIDTH LIMIT
23. HEIGHT LIMIT
24. LENGTH LIMIT
25. LOAD LIMIT
26. AXIE LOAD LIMIT
27. RESTRICTION END
28. COMPULSORY TURN LEFT
29. COMPULSORY TURN RIGHT
30. COMPULSORY AHEAD ONLY
31. COMPULSORY TURN LEFT AHEAD
32. COMPULSORY TURN RIGHT AHEAD
33. COMPULSORY MOVE AHEAD (OR) TURN LEFT
34. COMPULSORY MOVE AHEAD (OR) TURN RIGHT
35. COMPULSORY KEEP LEFT
36. COMPULSORY CYCLE TRACK
37. COMPULSORY SOUND HORN

DV20N1101T3

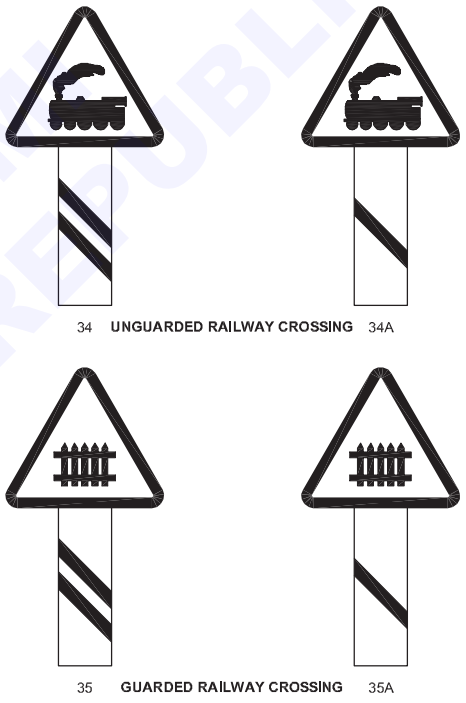
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Fig 4





WARNING SIGNS (NEW-PROPOSED)



WARNING SIGNS (NEW)

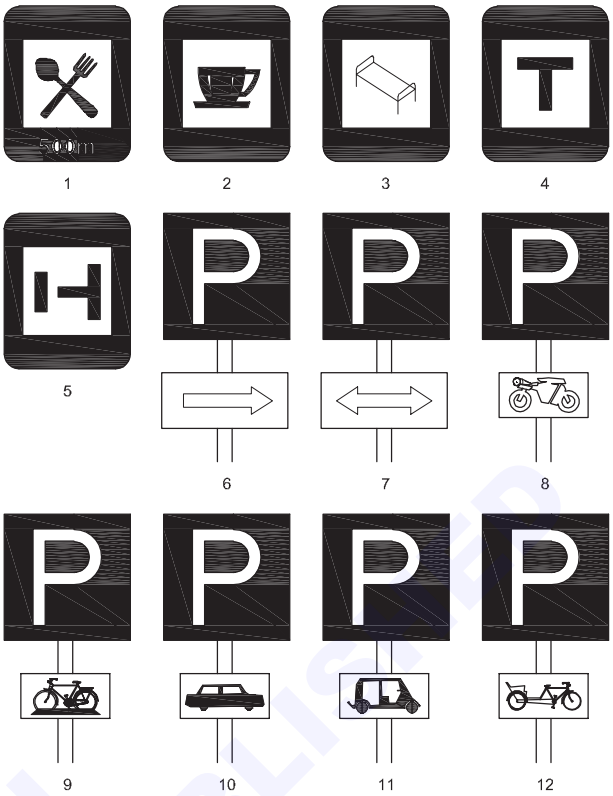
1. RIGHT HAND CURVE
2. LEFT HAND CURVE
3. HAIRPIN BEND RIGHT
4. HAIRPIN BEND LEFT
5. REVERSE BEND RIGHT
6. REVERSE BEND LEFT
7. CROSS ROAD
8. SIDE ROAD RIGHT
9. SIDE ROAD LEFT
10. T INTERSECTION
11. STAGGERED
12. INTERSECTIONS
13A. 'Y' INTERSECTIONS BOTH SIDES
13B. 'Y' INTERSECTIONS LEFT SIDES
13C. 'Y' INTERSECTIONS BOTH SIDES
14. MAJOR ROAD
14A. AHEAD
15. ROUND ABOUT
16. SLIPPERY ROAD
17. LOOSE GRAVEL
18. CYCLE CROSSING
19. PEDESTRIAN CROSSING
20. SCHOOL
21. CATTLE
22. MEN AT WORK
23. FALLING ROCKS
24. FERRY
25. STEEP ASCENT
26. STEEP DESCENT
27. GAP IN MEDIAN
28. NARROW BRIDGE
29. NARROW ROAD AHEAD
30. ROAD WIDENS AHEAD
31. DANGEROUS DIP
32. ROUGH ROAD
33. BARRIER AHEAD
34. UNGUARDED RAILWAY
34A. CROSSING
35. GUARDED RAILWAY
35A. CROSSING

DV20N1101T4

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Fig 5

1. EATING PLACE
2. LIGHT REFRESHMENT
3. RESTING PLACE
4. NO THROUGH ROAD
5. PARK THIS SIDE (RIGHT)
6. PARK BOTH SIDES
7. SCOOTER AND MOTORCYCLE STAND
8. CYCLE STAND
9. TAXI STAND
9. AUTORICKSHAW STAND
10. CYCLE RICKSHAW STAND



INFORMATION SIGNS (NEW-PROPOSED)

DV20N1101T5

Following are the important hand signals prescribed for safe driving.

A driver signals to traffic control person or approaching traffic

While you are in your car you may give the following signals to the traffic control person.

1 Right arm extended upwards, palm facing front

'I intend to go straight'.

2 Right arm crossed over body facing the left

'I want to turn to left'.

3 Right hand stretched outside the car

'I want to turn to right'.

4 All the above signals are applicable for the approaching vehicles as well.

5 Right hand stretched with palm facing downward moving up and down

'I want to slow down'.

6 Right hand stretched with palm facing front and moving front and back

'I am ready to be overtaken'.

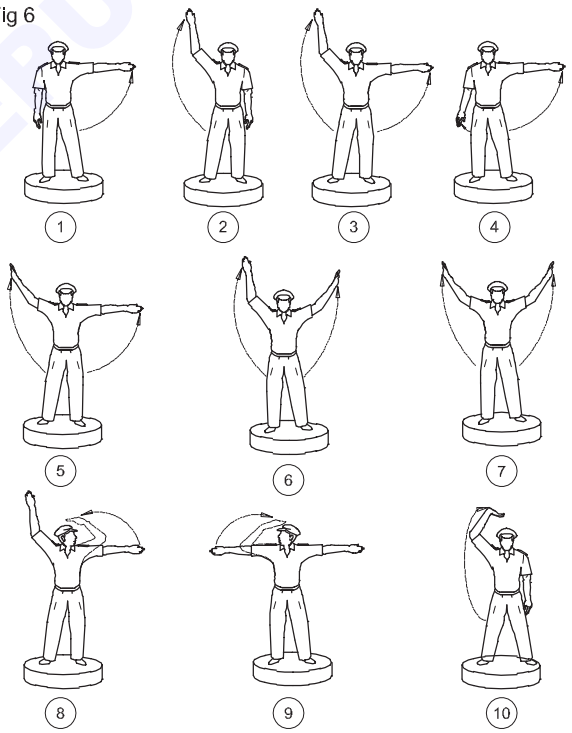
7 Right hand stretched with plain facing front, moving round about anticlockwise

'I am going to turn to my left'.

8 Right hand stretched outside and forearm lifted vertically up and to the right of the vehicle, palm facing front

'I intend to stop the vehicle'.

Fig 6



POLICE SIGNALS

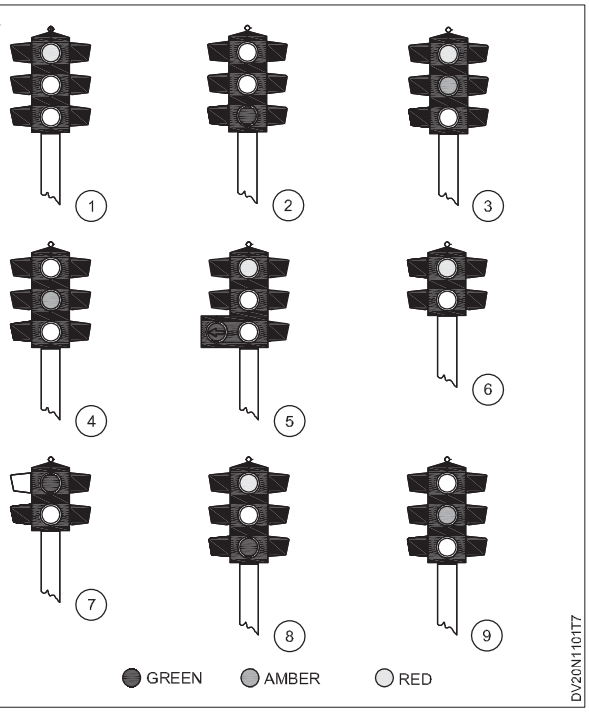
1. STOPPING VECHICLE COMING FROM BEHIND
2. STOPPING VECHICLE COMING FROM FRONT
3. STOPPING VECHICLE COMING FROM FRONT AND BEHIND
4. STOPPING VECHICLE WANTING TO TURN RIGHT
5. STOPPING VECHICLE COMING FROM RIGHT
6. ALLOWING TRAFFIC FROM RIGHT AND TURNING RIGHT BY STOPPING TRAFFIC FROM LEFT
7. CLOSING ALL TRAFFIC
8. ALLOWING VECHICLES COMING FROM LEFT
9. ALLOWING VECHICLES COMING FROM RIGHT
10. ALLOWING VECHICLES COMING FROM FRONT

DV20N1101T6

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E crossing electrical signals (Fig 7)

Fig 7



1 Red light

Stop and wait behind the stop line

2 Green light

GO if road is clear

3 Orange with or after red

Alert and start moving if road is clear

4 Orange after green

Stop at stop line

5 Green with arrow to the left

Move to the left

6 Pedestrians not to cross

7 Pedestrians Cross now

8 Flashing red light stop at stop line and proceed if way is clear

9 Flashing orange Proceed with caution

10 Green light with arrow and right and straight

Move straight or right as you like

11 Green light with man on pedestrian line

Pedestrians to cross the road on this line.

D Back and front vehicle lights

1 Back stop white light -

'Intend to slow down or stop'.

2 Back red light -

Indicates back side of a vehicle.

3 Back or front left turning light-

'Intend to move to left'.

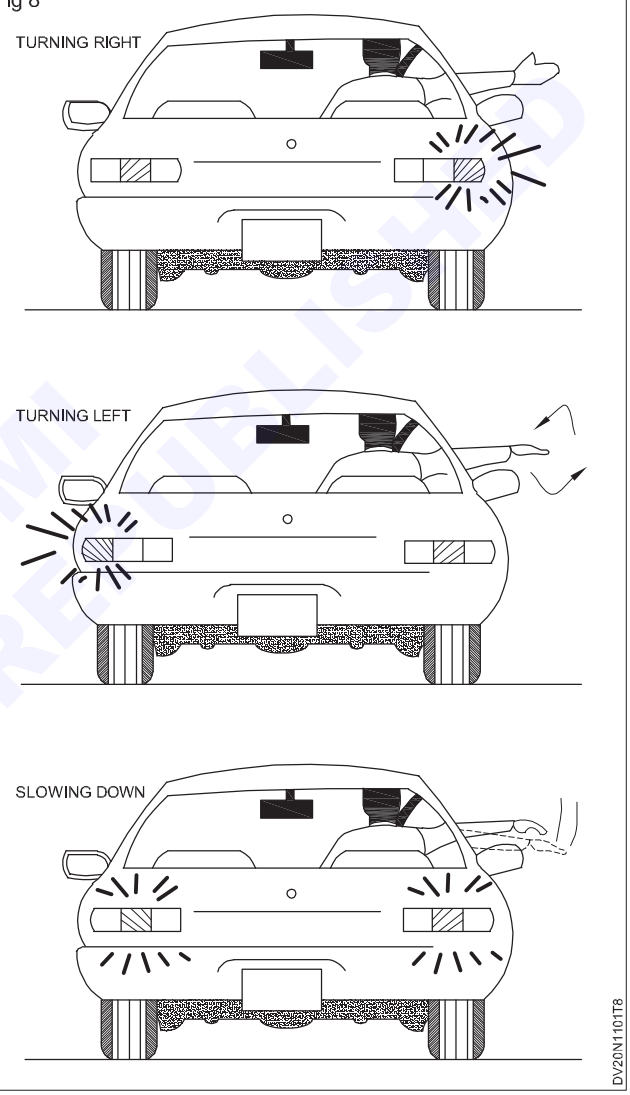
4 Back of front right turning light -

'Intend to move to right'.

Use dipper at night or half covered headlights.

- When your direction indicators have working
- When you want to make it clear to drivers of vehicles coming up fast behind you that you are slowing down or turning.(Fig 8)

Fig 8



Knowledge of seating capacity and vehicle load limit: Vehicle manufacturers designed the vehicle seating capacity and vehicle loading capacity. These details are mentioned in owner's manual and Vehicle Registration Certificate

Speed regulation on the road: In poor road conditions, the driver must adjust speed of the vehicle so that others as much as possible. On other roads, the speed of the vehicle may not exceed the following limits drive the vehicle as mention on the side of the road sign.

- In dense built-up areas 50km per hour.
- Outside of dense built up areas 80 km per hour.

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- On motor highway the vehicle speed may not exceed 130km per hour.
- The general vehicle speed limit can be set as per circumstance including traffic flow, dictate this and critical traffic safety consideration.
- Road bend speed limit is 40 Km per hour.

Functional classification of road: There are six types of roads in India according to their use and capacity. Indian roads are classified as follows.

- National high way are connects all states of the country.
- State highways are connects all district head quarters.
- District roads are connects all Taluks and Panchayat Union office.
- Rural roads (village roads) are connects all the connected with village.
- Border roads are used by defense to protect our nation. This road covers the boarder of our nation.
- Golden Quardrilateral (Expressway)

Commonly roads are constructed by different types materials used for make a structure of roads.

Mud road: uneven, not hard and not small surface

Crusher stone paved road: uniform and smooth surface

Cement road: uniform, hard and smooth surface

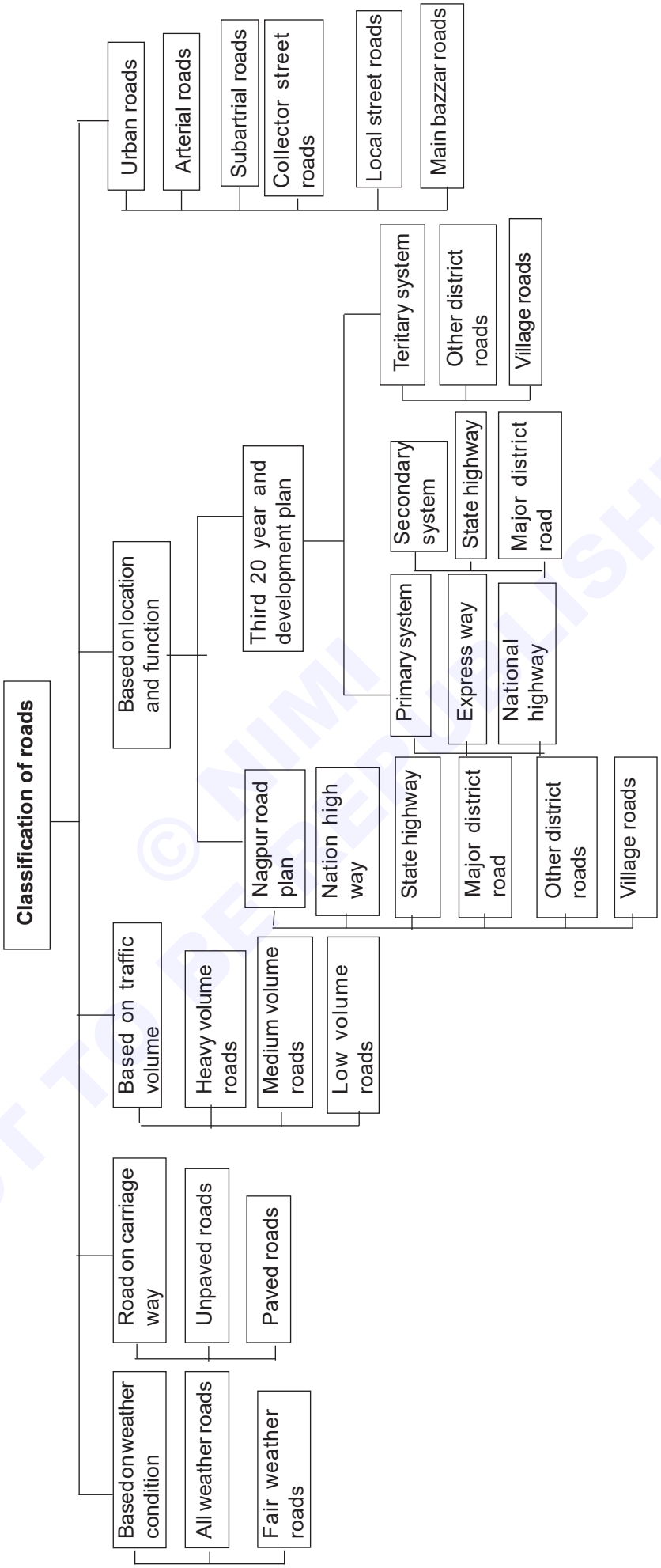
Tharcoal paved road: uniform and smooth surface

Rubber and tharcoal road: smooth and uniform surface

Indian roads are classified as below

1 Based on weather condition
2 Based on Carriage way
3 Based on Traffic Volume
4 Based on Nagpur road plan
5 Based Third 20 year road development plan
6 Urban roads

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Road design and vehicle speed limit: Indian roads are designed as per land and weather condition. The vehicle speed on road also limited as per road condition. Road speed limit is specified in traffic rules and regulations of motor vehicle Act 1989. Design speed is defined as the highest continous speed at which industrial vehicles can travel with safety on the highway.

Road geometrics: The geometric design of highway deals with the dimensions and layout of visible features of the highway. The road geometric fulfill the requirements of the road user and vehicle such as safety, comfort, efficiency etc. The features are considered are the cross section, elements sight distance consideration, horizontal curvatures, gradients, and road intersection proper geometric design will help to reduction of accidents and their severity.

Road surface types and characteristics: In our country transportation is an essential network for our country development Road surface classification is based on many factor such as materials, locations, and traffic. Road classification is as follows

Earthen mud roads

Gravel roads- compacted mixture of gravel and earth in used as pavement material.

Murrum Roads- Murrum is used to paved on the road.

Kankar roads- lime stone is used to paved on the road.

WBM Roads- Water bound macadam (WBM) roads contain crushed stones aggregate in its base course.

Bituminous roads - The road types are low cost and suitable for driving

Concrete roads - Cement concrete is used to construct the pavements of concrete road.

National highway- Minimum two lane road is provided.

State highway - it is used to connect National Highway.

District roads - it is used to connect state and National Highway.

Village roads - it is used to connect the nearest villages.

Light traffic roads – Daily average 400 vehicle passing on the road

Medium traffic roads - Daily 400-1000 vehicle pass way through this road

High traffic roads - More than 1000 vehicle passing through this road.

Based on traffic type:

Pedestrian ways - No vehicle are permitted in this way

Cycle tracks - it is provide both sides of the highways since your cyclist can travel safely

Motor ways – Motor ways makes travel quick and provides comfort for high speed vehicle

Based on Rigidity

Flexible roads – Flexible layer on a pavement road surface.

Rigid road – Rigid material pavements are non flexible and cement roads are fall in this category

Based on topography

Plain area road – This road is constructed on level surface

Hilly area road – This road is constructed in hilly regions

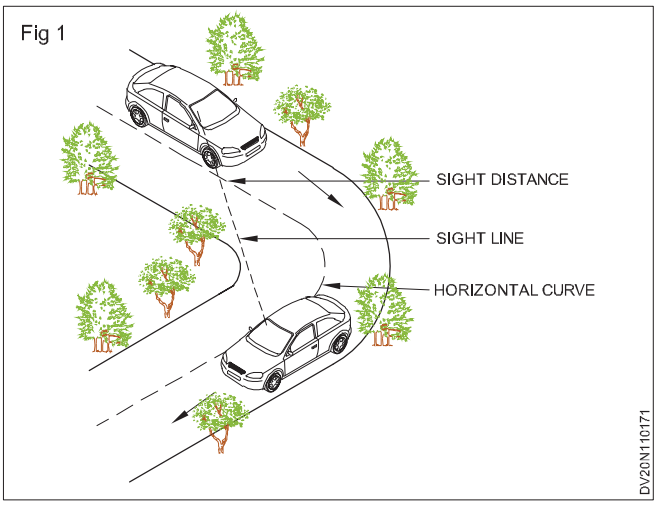
Desert road – The roads are classified based on many factors as follows

- Materials
- Location & Function
- Traffic volume
- Width
- Economy
- Traffic type
- Rigidity
- Topography

Slope and Elevation of roads: Road surface is topography is a measurement of elevation and road slope is the percent changes in that elevation over a certain distance. Topography is measured with lines that connect points representing the same elevation.

Sight distance at road bend: Fig 1 Driver's sight distance require by drivers applies to both geometric designs of highways and for traffic control. Road sight distance is length of road visible a head to the driver at any instance. Road bend distance is actual distance a driver with his eye level at specify height above the pavement surface has visibility of any stationery or moving object of specify height. The sight distance be taken the driver and the object is measure along the road seaface. (Fig 1)

Fig 1

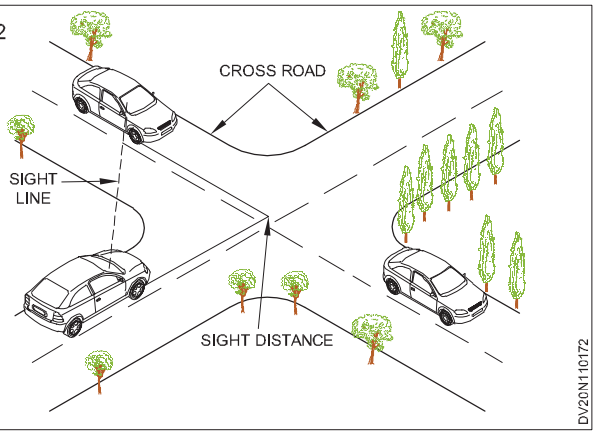


Sight distance at intersection: Fig 2 At on intersection road when a driver from one of the approach is able to sight to vehicle from another approach road proceeding

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toward the intersection. The sight distance for each vehicle proceeding toward the intersection. The sight distance for each vehicle driver is the distance from the position, when two on see each other up-to the intersection point of the two roads.

Fig 2



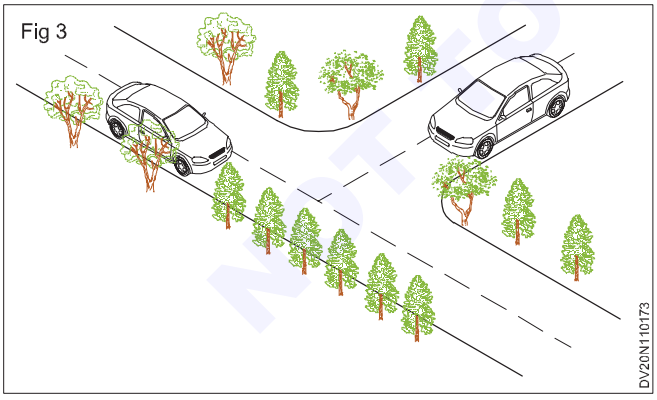
Road junction: Road junction is classified on the basis of the shape of the road junctions. They are as follows

- T junction
- Y junction
- Acute angle junction
- Multiple junction

The above types of road junction are designed at places where vehicular traffic can moves in different direction in a systematic way. The road junctions decrease the probability of accidents. The traffic at road junction is controlled and resumed in a systematic way to proceed further in their respective directions with the help of traffic signal.

T Junctions: A. "T" junction has three arms of which one arm is a main road, whereas the other one is usually a minor road connecting the main road. The roads of T junction meet at right angles and is preferably used for convenience. (Fig 3)

Fig 3



'Y' junction: A 'Y' junction has three arms of which all the three roads are equal sizes. It is generally seen at places of heavy traffic. (Fig 4)

Acute angle junction: It can be used at very low density and very less space for a junction (Fig 5)

Staggered junction: This is a place where several roads meet a main road at a slight distance apart thus they do not at come together at the same point.

Fig 4

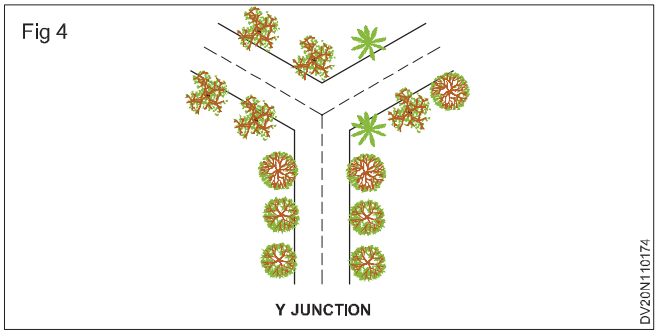
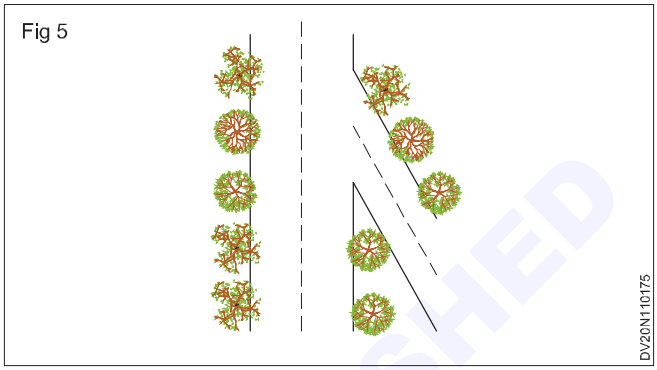


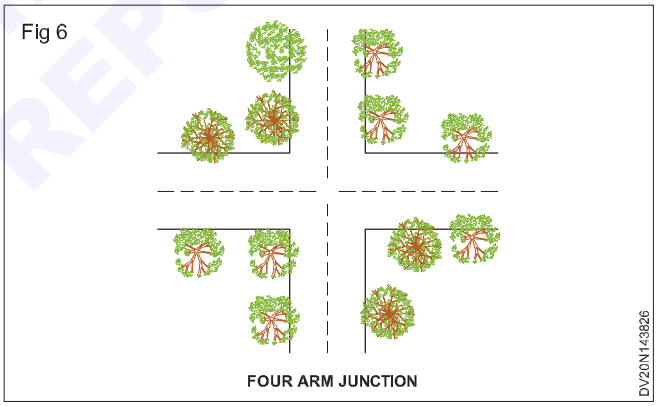
Fig 5



Multiple junction: Where multiple roads meet at a same point, the junction is termed as multiple junction.

Four arm junctions: This is usually involve a crossing over of two streets or roads. In areas where the crossing roads are perpendicular to each other. However the two roads cross a different angle. (Fig 6)

Fig 6



Controlled junctions: The controlled junctions use traffic lights to dictate the flow of traffic, Busy controlled junctions can often feature multiple lanes at the light and often have a cycle waiting area just before the lights. The signal lights are often used at controlled junctions to allow a certain lane of traffic to proceed, when safe keep a good eye on the signal light if applicable as it can be easy not to notice. Not making progress on a green light can load to test failure. Most type of junctions are taken on the driving test including controlled junction.(Fig 7)

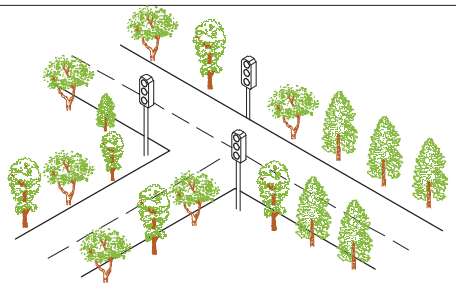
Uncontrolled junction : Uncontrolled junctions are not use a signal lights. Driver can be drive very carefully when changing line in uncontrolled junctions. Uncontrolled junction road is used where traffic flow is less than 400 vehicles passing through this junction road.(Fig 8)

Island and mini-round about : These type of roads are more appropriate for D type street and above. This island

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may be any shape subject to the minimum dimensions given below. The round abouts for type A and B streets should comply with the design manual for road and bridges standards on size and signing.(Fig 9)

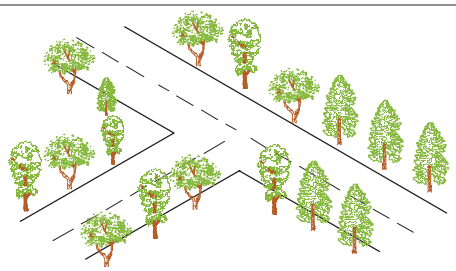
Fig 7



CONTROLLED JUNCTION

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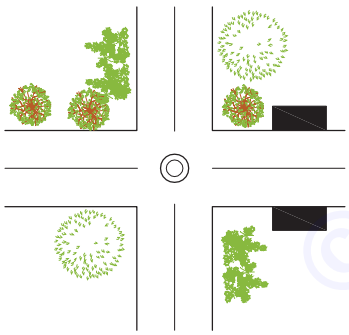
Fig 8



UNCONTROLLED JUNCTION

DV20N110178

Fig 9



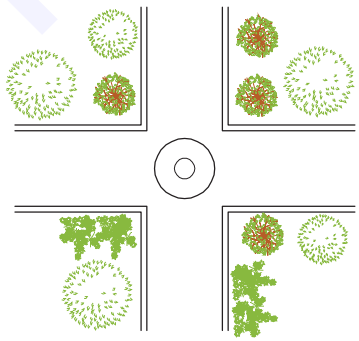
ISLAND AND MINI-ROUND ABOUT

DV20N110179

Round about : Round about road is circular junction and it proven to be safer than traditional intersections, with far fewer possible collision points. There are many types of round about are used in our country, they are as follows.

Single lane roundabouts - These junction appear when two or more roads meet and feature just one lane around a central island. There are no traffic lights on this design road even though you may see signs on your approach to the roundabout. When you are driving and passing a single lane roundabout use rear view mirrors, signal maneuver routinely.(Fig 10)

Fig 10

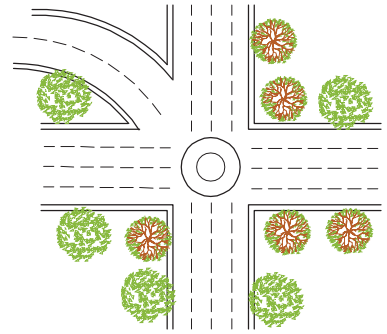


SINGLE LANE ROUND ABOUTS

DV20N11017A

Multilane roundabouts: Multilane roundabouts come in all sizes and with varying designs of complexity. The real requirement here is for a driver to take when on the roundabout itself.(Fig 11)

Fig 11

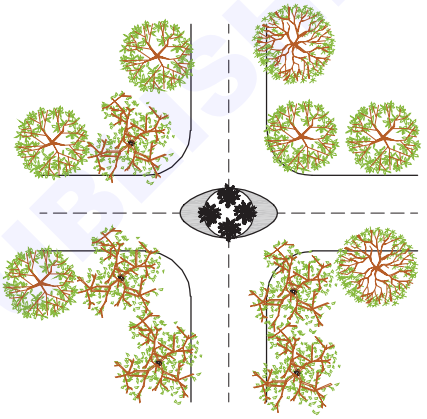


MULTI LANE ROUND ABOUTS

DV20N110178

Turbo round abouts : Turbo roundabouts are a form of two lane roundabout that require the driver to choose their intended direction upon approach.(Fig 12)

Fig 12



TURBO ROUND ABOUTS

DV20N11017C

Access – controlled roundabout : This type of road is used as alternative to traffic lights controlled junctions. In certain instances, though traffic lights may be placed at entrances to a round about to help control the traffic flow.

Magic roundabouts: This type of road is made up of a series of mini roundabouts. You should treat each of them separately giving way on your approach and signaling when you intend to leave, don't panic – you know what to do here.

Cut through roundabouts: This type of roads are combine a roundabout with a straight road. This road design necessities to used the traffic lights – it would be impossible to safely cross the area where the roundabout and main carriage way intersect other way. Obey the traffic lights to travelling such junction safely.

Tram roundabouts : This type of road sees tram tracks crossing through the centre of the junction.

Round about interchanges : These type of road junctions tend to be stacked, where one of the roadway is grade separated in certain instances, there may be a 3 level stacked round about where the roundabout and two main roadways are all on separate levels.

Road channelizes : Road channelizes are known as traffic control device. This traffic control devices

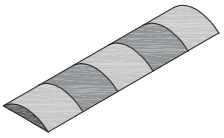
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direct guide and inform drivers by offering vessel or tactile indicators. Device fail into four main categories, sign, signals, road design and marking and barriers or channelizer.

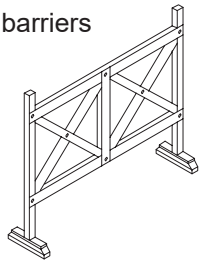
Public road use a wide selection of traffic control tools which can be adapted to smaller facilities. However on public roads driver focus tends to be on signs and signals. In smaller facilities pavement markings and barriers may take greater share of the road.

The following road channelizes are commonly used to road traffic control.

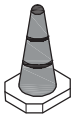
- speed bumps



- channelizes and road barriers



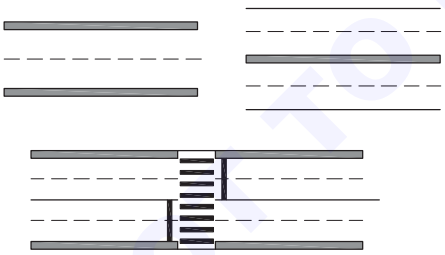
- Traffic delimiters and cones



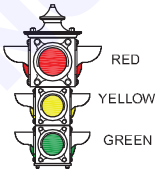
- Road construction



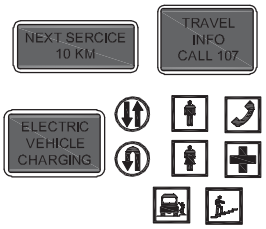
- Road markings



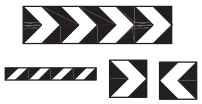
- Traffic signals



- Guiding information signs



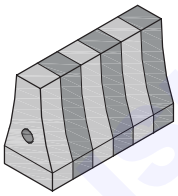
- Warming signs



- Regulation signs



- High way barriers



Road median Bye-pass : A road median is the area between opposing lanes of traffic excluding turn lanes or road median is the portion in between the dual carriage way which separates the traffic flow in opposite direction.

Purpose of road medians : Road medians used for the following purpose.

- To avoid from accidents
- To install lighting system
- Place provided for the pedestrians to pass the road
- to install traffic signs and traffic signals
- It provides to avoid from glare of lights from opposite side traffic vehicle's light glare.
- Some times in rural areas can park on medians in case of emergency.

Types of medians :

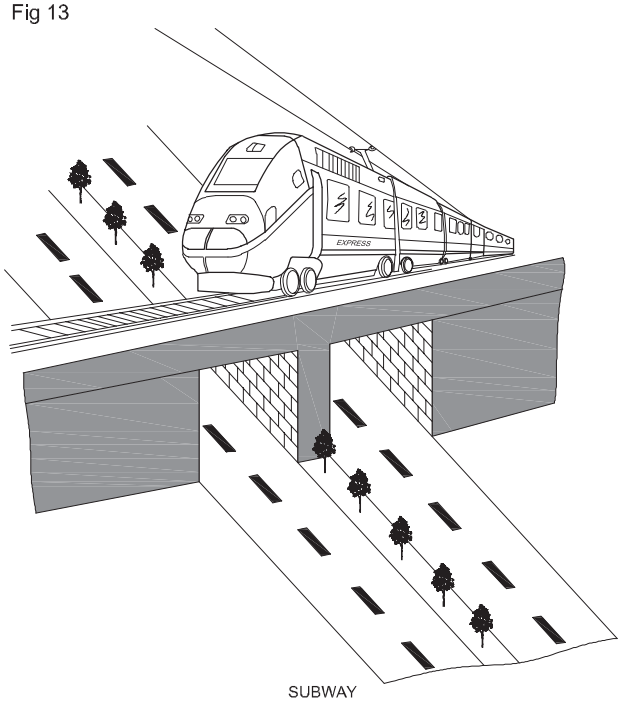
- Traversible
- Barrier
- Deterring

Subways : The subway also known as an under pass is a grade separated pedestrian crossing which crosses underneath a road or railway in order to entirely separate pedestrians and cyclists from motor traffic or trains respectively or tunnel or underground passage.(Fig 13)

Over bridge : Over bridge are constructed where road alignment crosses above the railway alignment where road pass above a railway. The bridge is called over bridge. The under bridge from the point of the view of the road. Passes under the railway line. Under bridge allows traffic to pass under a road, river, railway etc.(Fig 14)

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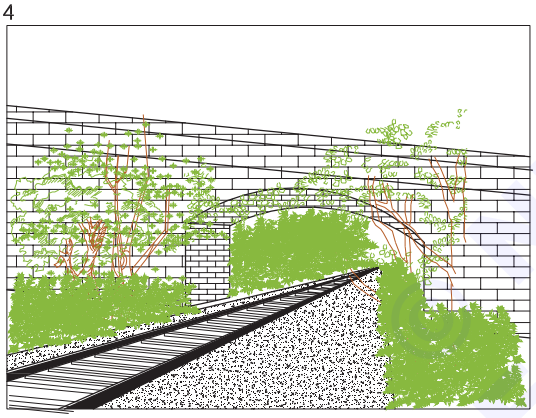
Fig 13



SUBWAY

DV20N11017D

Fig 14

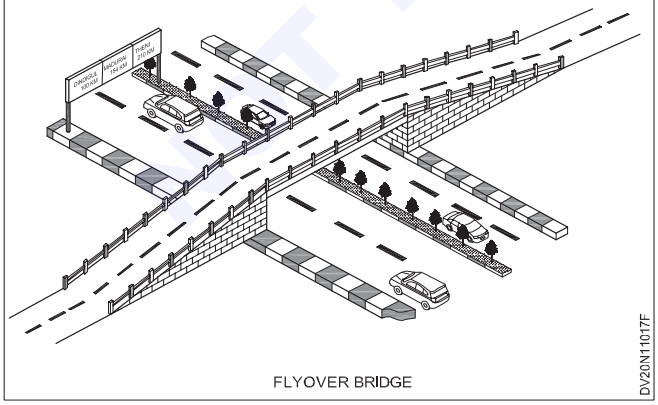


OVER BRIDGE

DV20N11017E

Flyover : A flyover is long structure that allows a road over another road and structure connects to another road. There are two types of fly over used by Indian road 1. Simple flyover 2. Cloverleaf junction.(Fig 15)

Fig 15

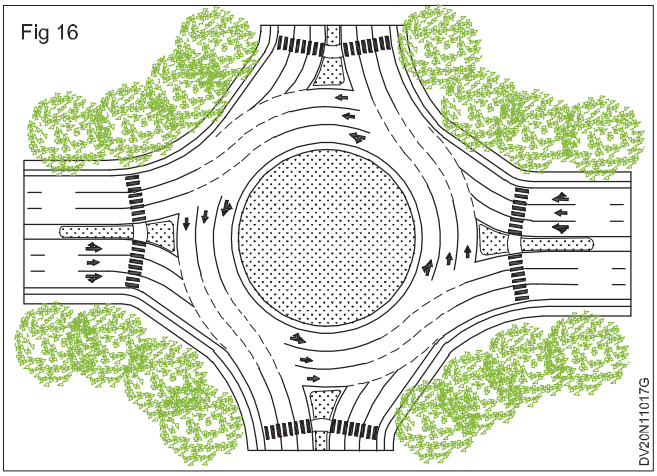


FLYOVER BRIDGE

DV20N11017F

Bypass road : A bypass road is goes around a town or village so that traffic which is passing that town does not how to go through town centre. Bypass road reduces the amount of traffic in the centre where the people live and work (Fig 16)

Fig 16



DV20N11017G

Precautions and Procedure to use the over bridge and flyovers:

- While up the over bridge, under bridge and flyover road follow the precaution as below.
- Select the proper road lane
- Select the vehicle speed to cross the bridges
- Use the head lights while passing through tunnels and long under bridge roads.
- Keep the vehicle distance from your vehicle to ahead vehicle.
- Don't overtake the until permit your ahead vehicle.
- Don't overtake without using hand signals and indicators.
- Follow the road lane traffic rule.

Driving according to other road users characteristics: The pedestrians, drunkards, childrens, blinds, deaf & dump, youth, aged women with children, slow moving vehicles, mopeds, motor cycles, auto's, tempos, vans, buses, trucks, VIP, ambulance, fire engine and animals have the same rights and responsibilities on the road as other drivers because they are less protected. So that the vehicle driver must take extra care and precautions to avoid colliding with them. Follow the steps to drive on the road safely.

- When the pedestrians are crossing the road or street, wait until the pedestrian is completely across the road or street before going ahead.
- When turning a corner check for pedestrian crossing on the road.
- do not pass a vehicle that is stopped at a cross walk. There may be a pedestrian hidden from your view in the cross walk.

Note : Certain pedestrian require extra caution, senior and disabled people may not hear or see well and and can't move fasts to get of the unpredictable and could run into the street at anytime, drive slowly, when they are present on the sidewalks. Pedestrian who is drunk may be unaware of traffic lights or oncoming vehicle.

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- The way of hazards childrens are when driving behind a motor cycle allow a four second following distance. The extra time also gives you extra free way i8n case the motor cyclists falls.
- Beware of the road hazards, such as potholes loose ground or slipper surface, that can cause to change vehicle speed and direction suddenly.
- Remember that bicyclists have the same rights to the roadway as other driver
- When passing a bicycle, wait unit it is safe to do, so without crowding the bicycle.
- When parked by the road, don't open the car door without looking for other vehicles.
- If you encounter a slow moving vehicle, stay far enough back so you can see around the vehicle.
- if you find it is safe, legal and necessary to pass the vechile will pull over and let overtake the slow moving vehicle.
- Let allow the passing your vehicle such as school bus, VIP Vehicle, Ambulance, fire engine public cars etc.
- You must yield the right way to emergency vehicle, if you hear a siren or see a flashing light, pull over as far as possible to left lane and stop or slow your vehicle until vehicle has passed.
- Get plenty of horn sound and indicator before turn your vehicle at only type of turning, vehicle because animals can cross the roads.
- Drive slowly enough that you don't need to brake during a turn your vehicle.
- Always follow the traffic rules and regulation and road signs to allow any type of accident happen with your vehicle.

Accidents : Driver's physical condition and mental conditions, affects the driving safely. The following causes are for a vehicle accidents on the road.

- distracted driving is top cause for vehicle accident
- over speeding vehicle
- driving under the influence of alcohol
- peekless driving
- car accident happen very often in the rain
- Night driving with sleeping by the driver
- Vehicle design defects
- Unsafe lane changes
- vehicle high speed
- running a vehicle on stop signal
- untrained teen age drivers
- wrong way driving
- improper turning
- toll gating
- Ice land with cold weather climate
- road rage by rail gating another driver in anger
- potholes on the road
- drowsy driving most of the car accidents caused by drowsy driving over at night
- vehicle type blow outward
- Fog makes it extremely difficult to see some times it cause for accident.
- dangerous curve and careless driving makes a accident
- unexpectedly animal crossing on the road is also a cause for accident
- race car speed drive in a street may cause for accident.

Types of vehicle accidents : A vehicle accidents can happen to any one in virtually any situation. Types of accidents are as follows.

1 Head on collisions
2 Rear end collisions
3 Side impact accidents
4 Chain reactions on the highway
5 Rollovers the vehicle by high speed
6 Hit and run accidents
7 Vehicle sliding accidents
8 Vehicle slippery accidents

Vehicle Accident preventive method : Vehicle accidents happen anytime and anywhere unexpectedly. But we can prevent the accident by taken preventive methods. They are as follows

- Avoid over speed
- Maintain speed limit and stopping distance
- Follow the correct road lane.
- Give hand signal and side indicators while overtaking
- Follow the traffic signs on the road
- always take care on prevent in maintenance of your vehicle
- Use wiper during rainy season to wipe the windshield glass

Symbols on the vehicles : Which vehicle is carrying hazardous goods that vehicle marked by standard symbol on the vehicle body to given awareness to the public.

Hazardous goods vehicle symbols : Hazard symbols are used to alert the people to the presence of a potentially harmful substance carrying in the vehicle. The products labeled as flammable are at a particularly high risk of catching fire. Petrol is one of examples.

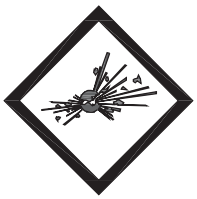
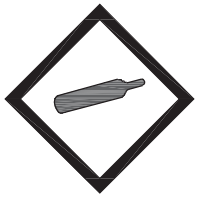
Explosive substances labeled (correctly) with the symbol require specialists care and candle should always be keep away from heat sources such as open flame, Hazardous substance

- Flammable

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- Oxidizing
- Explosives
- Gas under pressure
- Toxic
- Serious health hazard
- Health hazards
- Corrosive and environmental hazard

GB CLP hazard pictograms

	Explosive (Symbol: exploding bomb)
	Flammable (Symbol: flame)
	Oxidising (Symbol: flame over circle)
	Corrosive (Symbol: corrosion)
	Acute toxicity (Symbol: skull and crossbones)
	Hazardous to the environment (Symbol: environment)
	Health hazard/hazardous the ozone layer (Symbol: exclamation mark)
	Serious health hazard (Symbol: health hazard)
	Gas under pressure (Symbol: gas cylinder)

Motor Vehicle Act 1988

The Motor Vehicles Act was passed in the year 1988 and regulates almost all aspects of road transport vehicles. It provides detailed guidelines on licensing of the drivers and conductors. Registration of motor vehicles, the provision on controlling their permits, traffic regulations, related insurances, liabilities, and penalties. The motor vehicle act makes it mandatory for any driver to have a valid driving licence and no vehicle can be driven without being registered under the motor vehicle act.

Motor Vehicle Act Section

Section 122 Motor Vehicles Act, 1988 – July 22, 2021

Section 122 of MV Act 1988 says the Leaving vehicle in dangerous position – No person in charge of a motor vehicle shall cause or allow the vehicle or any trailer to be abandoned or to remain at rest on any public place in such a position or in such a condition or in such circumstances as to causes or likely to cause danger, obstruction or undue inconvenience to other users of the public place or to the passengers.

Section 125 Motor Vehicles Act, 1988 – July 22, 2021

Section 125 of MV Act 1988 explain the Obstruction of driver – No person driving a motor vehicle shall allow any person to stand or sit or to place anything in such a manner or position as to hamper the driver in his control of the vehicle.

Section 126 Motor Vehicles Act, 1988 – July 22, 2021

Section 126 of MV Act 1988 explain the Stationary vehicles – No person driving or in charge of a motor vehicle shall cause or allow the vehicle to remain stationary in any public place, unless there is in the driver's seat a person duly licensed to drive the vehicle or unless the mechanism has been stopped and a brake or brakes applied or such other measures taken as to ensure that the vehicle cannot accidentally be put in motion in the absence of the driver.

Section 128 Motor Vehicles Act, 1988 – July 22, 2021

Section 126 of MV Act 1988 explain the Safety measures for drivers and pillion riders – (1) No driver of a two-

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wheeled motor cycle shall carry more than one person in addition to himself on the motorcycle and no such person shall be carried otherwise than sitting on a proper seat securely fixed to the motorcycle behind the driver's seat with appropriate safety measures.

(2) In addition to the safety measures mentioned in sub-section (1), the Central Government may, prescribe other safety measures for the drivers of two-wheeled motorcycles and pillion drivers thereon.

Section 131 Motor Vehicles Act, 1988 – July 22, 2021

Section 131 of MV Act 1988 explain the Duty of the driver to take certain precautions at unguarded railway level crossings – Every driver of a motor vehicle at the approach of any unguarded railway level crossing shall cause the vehicle to stop and the driver of the vehicle shall cause the conductor or cleaner or attendant or any other person in the vehicle to walk up to the level crossing, and ensure that no train or trolley is approaching from either side and then pilot the motor vehicle across such level crossing, and where no conductor or cleaner or attendant or any other person is available in the vehicle, the driver of the vehicle shall get down from the vehicle himself to ensure that no train or trolley is approaching from either swide before the railway track is crossed.

Section 132 Motor Vehicles Act, 1988 – July 22, 2021

Section 132 of MV Act 1988 explain the Duty of driver to stop in certain cases – (1) The driver of a motor vehicle shall cause the vehicle to stop and remain stationary so long as may for such reasonable time as may be necessary, but not exceeding twenty-four hours- -

When required to do so by any police officer not below the rank of a Sub inspector in uniform, in the event of the vehicle being involved in the occurrence of an accident to a person, animal or vehicle or of damage to property. Or

When required to do so by any person in change of an animal if such person apprehends that the animal is, or being alarmed by the vehicle will become unmanageable. Or And He shall give his name and address and the name and address of the owner of the vehicle to any person affected by any such accident or damage who demands if provided such person also furnishes his name and address.

The driver of a motor vehicle shall, on demand by a person giving his own name and address and alleging that the driver has committed an offence punishable under section 184 give has name and address to that person.

In this section the expression "animal" means any horse, cattle, elephant, camel, ass, mule, sheep or goat.

Section 133 Motor Vehicles Act, 1988 – July 22, 2021

Section 132 of MV Act 1988 say the Duty of owner of motor vehicle to give information - - The owner of a motor vehicle, the driver or conductor of which is accused of any offence under this Act shall, on the demand of any police officer authorized, in this behalf by the State Government, give all information regarding the name and address of, and the license held by, the driver or conductor which is in his possession or could by reasonable diligence be ascertained by him.

Section 134 Motor Vehicles Act, 1988 – July 22, 2021

Section 133 Motor Vehicles Act, 1988 in Hindi and English

Section 133 of MV Act 1988 say the Duty of driver in case of accident and injury to a person – When any person is injured or any property of a third party is damaged, as a result of an accident in which a motor vehicle is involved, the driver of the vehicle or other person in charge of the vehicle shall –

a Unless it is not practicable to do so on account of mob fury or any other reason beyond his control, take all reasonable steps to secure medical attention for the injured person by conveying him to the nearest medical practitioner or hospital, and it shall be the duty of every registered medical practitioner or the doctor on duty in the hospital immediately to attend to the injured person and render medical and or treatment without waiting for any procedural formalities, unless the injured person or his guardian, in case he is a minor, desires otherwise.

b Give on demand by a police officer any information required by him, or, if no police officer is present, report the circumstances of the occurrence, including the circumstances, if any, for not taking reasonable steps to secure medical attention as required under clause (a), at the nearest police station as soon as possible, and in any case within twenty-four hour of the occurrence.

c Give the following information in writing to the insurer, who has issued the certificates of insurance, about the occurrence of the accident, namely :

  i Insurance policy number and period of its validity.

  ii Date, time and place of accident.

  iii Particulars of the persons injured or killed in the accident; and

  iv Name of the driver and the particulars of his driving license.

Explanation – For the purposes of this section. The expression "driver" includes the owner of the vehicle.

Section 135 Motor Vehicles Act, 1988 – July 22, 2021

Section 135 of MV Act 1988 explained the Schemes to be framed for the investigation of accident cases and wayside amenities. Etc. – (1) The state Government may, by notification in the Official Gazette, make one or more schemes to provide for

a An in depth study on causes and analysis of motor vehicle accidents

b Wayside amenities on highways

c Traffic aid posts on highways

d Truck parking complexes along highways; and

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e Any other amenities in the interests of the safety and the convenience of the public.

Every scheme made under this section by any State Government shall be laid, as soon as may be after it is made, before the State Legislature.

The Central Government may, by notification in the Official Gazette, make one or more schemes to conduct in-depth studies on the causes and analysis of road accidents.

Section 136 A Motor Vehicles Act, 1988 – July 22, 2021

Section 136A of MV Act 1988 expalin the Electronic monitoring and enforcement of road safety

1 The State Government shall ensure electronic monitoring and enforcement of road safety in the manner provided under sub-section (2) on national highways, state highways, roads or in any urban city within a State which has a population up to such limits as may be prescribed by the Central Government.

2 The Central Government shall make a rules for the electronic monitoring and enforcement of road safety including speed cameras, closed-circuit television cameras, speed guns, body wearable cameras and such other technology.

Explanation– For the purpose of this section the expression "body wearable camera" means a mobile audio and video capture device worn on the body or uniform of a person authorized by the State Government.

Section 139 Motor Vehicles Act, 1988 – July 22, 2021

Section 139 of MV Act 1988 say the 139. Power of Central Government to make rules – (1) The Central Government may by notification in the Official Gazette, make rules for all or any of the following purposes, namely :

a The grant and authentication of travelling passes, certificates or authorizations to persons temporarily taking motor vehicles out of India to any place outside India or to persons temporarily proceeding out of India to any place outside India and desiring to drive a motor vehicle during their absence from India.

b Prescribing the conditions subject to which motor vehicles brought temporarily into India from outside India by persons intending to make a temporary stay in India may be possessed and used in India; and

c Prescribing the conditions subject to which persons entering India from any place outside India for a temporary stay in India may drive motor vehicles in India

For the purpose of facilitating and regulating the services of motor vehicles operating between India and any other country under any reciprocal arrangement and carrying passengers or goods or both by road for hire or reward, the Central Government may, by notification in the Official Gazette, make rules with respect to all or any of the following matters, namely

- The conditions subject to which motor vehicles carrying on such services may be brought into India from outside India and possessed and used in India.
- The conditions subject to which motor vehicles may be taken from any place in India to any place outside India.
- The conditions subject to which persons employed as drivers and conductors of such motor vehicles may enter or leave India;
- The grant and authentication of travelling passes, certificates or authorizations to persona employed as drivers and conductors of such motor vehicles.
- The particulars (other than registration marks) to be exhibited by such motor vehicles and the manner in which such particulars are to be exhibited.
- The use of trailers with such motor vehicles.
- The exemption of such motor vehicles and their drivers and conductors from all or any of the provisions of this Act [other than those referred to in sub-section (4)]
- The identification of the drivers and conductors of such motor vehicles.
- The replaced of the travelling passes, certificates or authorizations, permits, licenses or any other prescribed documents lost or defaced, on payment of such fee as may be prescribed;
- The exemption from the provisions of such laws as relate to customs, police or health with a view to facilitate such road transport services.
- Any other matter which is to be, or may be, prescribed.

No rule made under this section shall operate to confer on any person any immunity in any State from the payment of any tax levied in that State on motor vehicles or their users.

Nothing in this Act or in any rule made there under by a State Government relating to

The registration and identification of motor vehicles. Or

The requirements as to construction, maintenance and equipment of motor vehicles or

The licensing and the qualifications of drivers and conductors of motor vehicles, shall apply –

To any motor vehicle to which or to any driver of a motor vehicle to whom any rules made under clause (b) or clause (c) of sub-section (1) or under sub-section (2) apply, or

To any conductor of a motor vehicle to whom any rules made under subsection (2) apply.

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Offence covered under the Motor Vehicle Act

Section under Motor Vehicle Act	Offence
Under section 3 r/w 181 Motor Vehicle Act	A person driving his vehicle without a valid license
Under section 5 r/w 180 Motor Vehicle Act	A person allowing his vehicle to be driven by a person who does not have a valid license
Under section 130(3) r/w 177 Motor Vehicle Act	A person not having all their relevant documents
Under section 130 r/w 177 Motor Vehicle Act	A person driving his vehicle without a valid insurance
Under section 130 r/w 177 Motor Vehicle Act	A person driving his vehicle without a valid permit
Under section 130 r/w 177 Motor Vehicle Act	A person driving his vehicle without a valid fitness
Under section 39 r/w 192 Motor Vehicle Act	A person without a valid R.C, for his vehicle
Under section 4 r/w 181 Motor Vehicle Act	A minor driving the vehicle
Under section 5 r/w 180 Motor Vehicle Act	Allowing an unauthorized person to drive
Under section 129 r/w 177 Motor Vehicle Act	A person riding without a helmet
Under section 138(3) r/w 177 Motor Vehicle Act	A person his vehicle without fastening his seat belt
Under section 184 Motor Vehicle Act	A person found over-speeding and doing rash driving
Under section 112-184 Motor Vehicle Act	A person found doing hasty or dangerous driving
Under section 17(i) RRR 177 Motor Vehicle Act	A person driving in a one way against the way

There are offences under the motor vehicle act for various scenarios relates to road offences, number plate related offences, vehicle light related offences, horn related offences, traffic signal related offences, speed and overtake related offences, offences related to pollution, offences related to condition of your vehicle, offences related to parking, etc.

Changes in the Motor Vehicle Act 2019

There are significant changes in the new Motor Vehicle Act and driving errors.

Penalties- Some penalties are enhanced, and some new penalties are introduced. Check the complete list of new traffic fines.

Updated List of Traffic Fines for Different Violations in India

Violation	New Penalty from 1st Sept-2019	Old Penalty
Driving/Riding without License	₹5,000 and/or community service	₹500
Driving/Riding Under the Influence of an Intoxicating Substance	₹10,000 and/or 6 months prison / ₹15,000 and/or 2 years jail for repetitive violation.	₹2,000
Over speeding	1. LMVL; ₹1,000, ₹2,000 MPV/HPV; ₹2,000-₹4,000 (+license seizure)	₹400
Driving without Seat Belt	₹1,000 and/or community service	₹100
Driving/Riding without Insurance	₹2,000 and/or 3-months prison, community service/ ₹4,000 for subsequent offence	₹1,000
Violating Road Regulations	₹500-₹1000	₹100
Dangerous Driving/Riding and jumping Red Light	₹1,000-₹5,000 and/or 6-months to 1 year in prison, license seizure	₹100-₹300
Driving/Riding While on the Mobile (Handheld)	₹5,000	₹1,000
Speeding, Racing	₹5,000 and/or 3-months prison, community service/₹10,000 for subsequent violation and up to 1 year in prison, community service	₹500
Not Giving Way to Emergency Vehicles like Ambulances, Fire Engineers, etc.	₹10,000 and/or community service	₹500
Riding without Helmet (rider and pillion rider)	₹1000, and or license disqualification, community service for 3-months	₹100

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Overloading Two-Wheelers	₹2,000 and license disqualification and/or 3-months of community service	₹100
Juvenile Offences	₹25,000 with 3-years prison, cancellation of registration for 1-year, juvenile ineligible for license until 25 years of age.	-
Driving/Riding Despite Disqualification	₹10,000, and/or community service	₹500
Over boarding Passengers	₹200 for every extra passenger and/or community service	-
Driving/Riding without Ticket	₹500	₹200
Offence Committed by Enforcing Authorities Such as Offering Bribes	Twice the penalty (varies according to traffic rules violated)	-
Unauthorized Use of Vehicle Without License	₹1,000-₹5,000	₹1,000
Disobedience of Orders of the Authorities	₹2,000	₹500
Vehicles without Permit.	₹10,000 and/or up to 6-months prison, community service	Up to ₹5,000
Oversized Vehicles	₹5,000 to ₹10,000 and/or community service	-
Overloading	₹20,000 + ₹2,000 for every extra tone and/or community service	₹2,000 + ₹1,000 for every extra tone
Driving/Riding without License (for Aggregators)	₹25,000 to ₹1,00,000	-
Driving/Riding without Registration	₹5,000/₹10,000 for subsequent offence	-
Using Horn in Silent Zone	₹2,000/₹4,000 for subsequent offence	-

Central Motor Vehicles Rules, 1989

Section 15 Driving test

1 No person shall appear for the test of competence to drive unless he has held a learner's license for a period of at least [1] thirty days.

2 The test of competence to drive referred to in sub-section (3) of section 9 shall be conducted by the licensing authority or such other person as may be authorized in this behalf by the State Government in a vehicle of the type to which the application relates.

3 The applicant shall satisfy the person conducting the test that he is able to-

- Adjust the rear-view mirror.
- Take suitable precautions before starting the engine.
- Move away safely and smoothly straight ahead at an angle, while at the same time engaging all gears until the top gear is reached.
- To change to the lower gears quickly from the top gear when the traffic conditions warrant such change;\(e) change quickly to lower gears when driving downhill;
- Change quickly to lower gears when driving downhill;
- Stop and re-start the vehicle on a steep upward incline making proper use of the hand-brake or of the throttle and the foot-brake without any rolling back, turn right and left corners correctly and make proper use of the rear-view mirror before signaling.
- Overtake, allow to be overtaken, meet or cover the path of other vehicles safety and take an appropriate course of the road with proper caution giving appropriate signals.
- Give appropriate traffic signals at the appropriate time, in clear and unmistakable manner by hand or by electrical indicators fitted to the vehicle.
- Change lanes with proper signals and with due care;
- Stop the vehicle in an emergency or otherwise, and in the latter case, bring it to rest at an appropriate course on the road safely, giving appropriate signals.
- In the case of vehicle having a reverse gear, driving the vehicle backwards, reverse it into a limited opening either to the right or left under control and with reasonable accuracy.
- Cause the vehicle to face in the opposite direction by means of forward and reverse gears.
- Take correct and prompt action on the signals given by traffic signs, traffic lights, traffic controllers,

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policemen and take appropriate action on signs given by other road users.

- Act correctly at pedestrian crossings, which are not regulated by traffic lights or traffic police, by giving preference to preference to persons crossing the roads.
- Keep well to the left in normal driving.
- Regulate speed to suit varying ro0ad and traffic conditions;
- Demonstrate general control of the vehicle by confident steering and smooth gear changing and braking as and when necessary;
- Make proper use of the rear-view mirror before signaling, beginning manoeuvring, moving away, altering the course to overtake, turning right or stopping;
- Use the proper side when driving straight, turning right, turning left and at junction of the road;
- Make proper use of accelerator, clutch, gears, brakes (hand and foot) steering and horn;
- Anticipate the actions of pedestrians, drivers of other vehicles and cyclists;
- Take precautions at cross roads and on road junctions with regard to-
- Adjustment of speed on approach,
- Proper use of rear-view mirror,
- Correct positioning of the vehicle before and after turning to the right or left,
- Avoidance of cutting right hand corners.
- Looking right, left and right again before crossing or emerging.
- Concentrate in driving without his attention being distracted and to demonstrate the presence of mind;
- Show courtesy and consideration for the safety and convenience of other road users, such as pedestrians, drivers of other motor vehicles or cyclists

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Automobile engines and their working

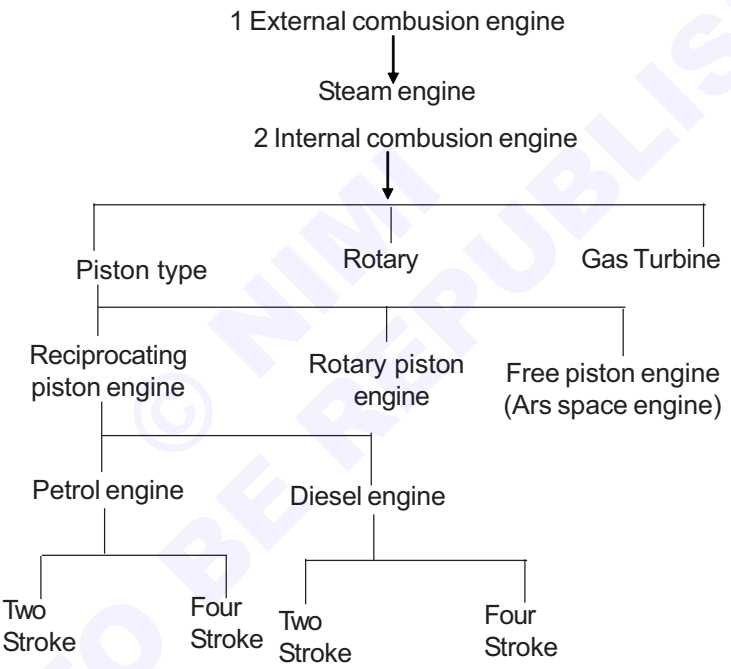
Objectives : At the end of this lesson you shall be able to
- **state the function of heat engine**
- **state the type of heat engine**
- **state the location of VIN number and Engine Serial Number.**

Introduction to automobile engine

Internal combustion engines create energy by burning a fuel and air mixture under pressure inside the cylinder and it is converted into movement by the engines pistons, connecting rods and crank shaft .

Note: The heat engine converts heat energy into mechanical energy

Types of heat engines



Main parts of internal combustion engine

Objective: At the end of this lesson you shall be able to
- **locate the engine parts.**

Internal combustion engine parts

Internal combustion engine's function is associated with the different types of components and it is connected in outer & inside of the engine.

Name of the components (Figs 1, 2 & 3)

1 Air compressor
2 F.I.P
3 Injector
4 Air cleaner
5 High pressure fuel line
6 Fly wheel
7 Oil filter
8 Fuel filter
9 Fan belt
10 Alternator
11 Self starter
12 Water pump
13 Cam shaft
14 Inlet manifold
15 Exhaust manifold
16 Valve door (cover)
17 Rocker assembly
18 Push rod
19 Tappets
20 Cylinder head
21 Piston
22 Timing chain / Belt
23 Oil sump
24 Strainer
25 Fly wheel housing
26 Dip stick
27 Connecting rod
28 Crank shaft

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29 Timing gear

30 Turbo charger

31 Oil pump

32 Oil pipes

33 Strainer

Petrol Engine

- Carburettor
- Distributor
- Super charger
- Spark plug
- Ignition coil

Fig 1

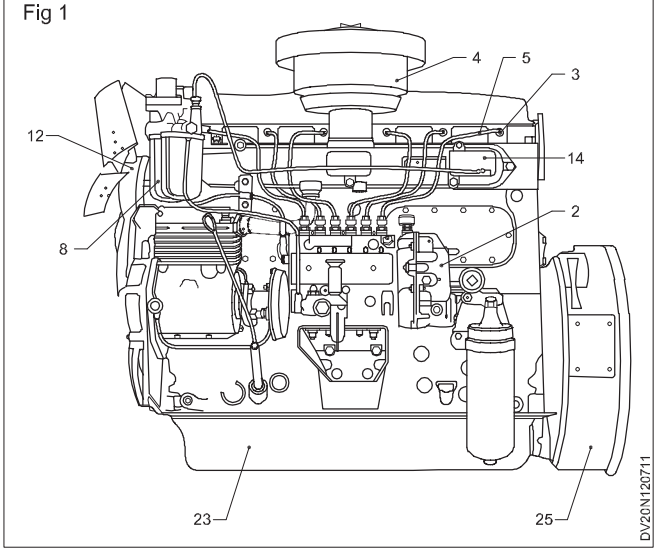
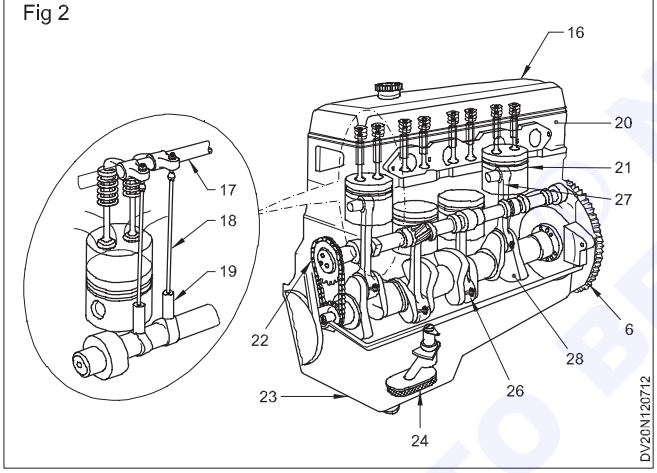
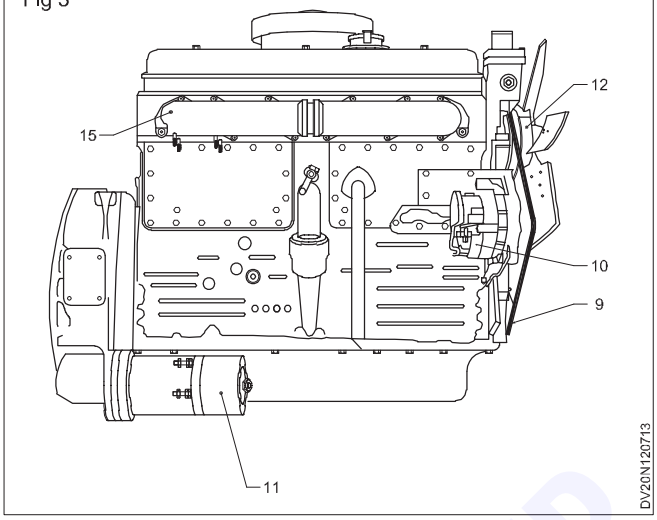


Fig 2



Vehicle information number Location: Vehicle identification number contains 17 characters, that are unique to the vehicle like a vehicles unique identity code, issuing a VIN is mandatory for all vehicles and it is standard practice across the world, it helps to mark out every vehicle, make, model, manufacturer and year.

Fig 3



Vehicle information number is mostly printed and located on the dashboard found on the driver side. Some of the VIN is printed on the chassis. The vehicle identification number is important to know the specific data of the vehicle.

Note: The VIN and engine numbers are not the same, VIN number is usually printed on a sticker and it is locate on the corner of dashboard meet the wind shield, in the driver side door. Engine number is stamped on the engine block.

The 17 digit VIN numbers first digit is details of where it was manufactured, while the second number and third digit shows details about the manufacturer. Fourth digit through eight digits show case details of the vehicle brand, engine type, engine capacity and fuel type. The ninth one is security code provided by the manufacturer, the tenth and eleventh digits show the vehicle manufacturing year and plant of manufacturers respectively. The remaining six digits are the unique ID provided for the vehicle.

Engine Number: It is found on the body of the car engine. The vehicle manufacturer ensures that the engine number is stamped very easily and clearly visible. The car manufacturer stamp the engine on the engine block, but this location can vary based on the engine models. You can trace it by using owner's manual to find out exact location of engine number and VIN and Chassis number of the vehicle.

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Vehicle controls

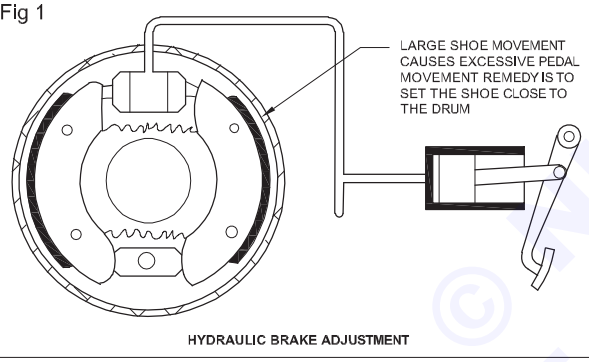
Objectives : At the end of this lesson you shall be able to
- **state the vehicle controls and it's response**
- **state the vehicle hand controls systems**
- **state the vehicle other controls and seat adjustment.**

Vehicle controls: Every vehicle (provided) with different type of control systems it helps to control the vehicle by operator. The following vehicle control systems are provided with the vehicle.

Control systems operated by Foot: Accelerator, Brake, Clutch

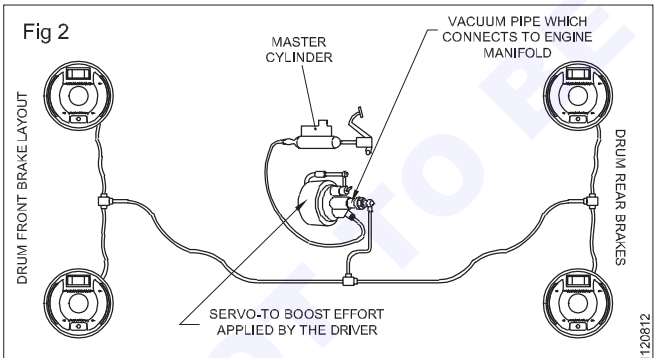
Brake: Vehicle foot brake systems used to reduce the vehicle speed and stop the vehicle. There are two types of foot brake used in auto-mobile (1) drum brake (Fig 1) (2) disc brake (Fig 2). Both purpose is same as mentioned above.

Fig 1



HYDRAULIC BRAKE ADJUSTMENT

Fig 2



HYDRAULIC BRAKE LAYOUT

Brake operating systems: Normally three types of brake operating system used in Indian vehicle. They are (1) hydraulic (2) Pneumatic (3) Mechanical

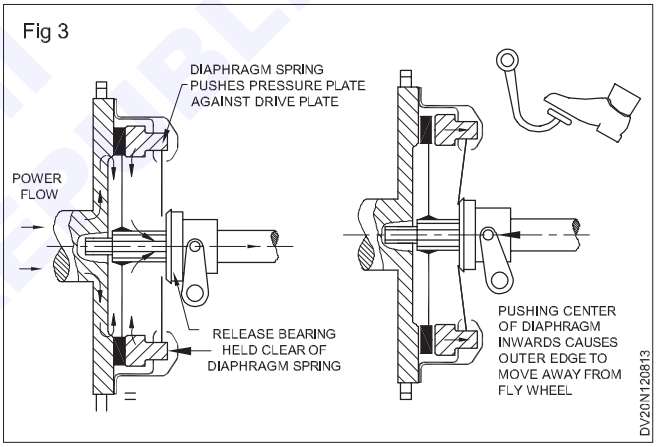
Clutch: Clutch is used for connect and disconnect the power from the engine to transmission. Clutch helps smoothly and gradually transmission the power without effecting the other components.

Types of clutch activation: There are two types of clutch actuation. They are as follows

1 Mechanical actuation (Fig 3)

2 Hydraulic actuation (Fig 4)

Fig 3

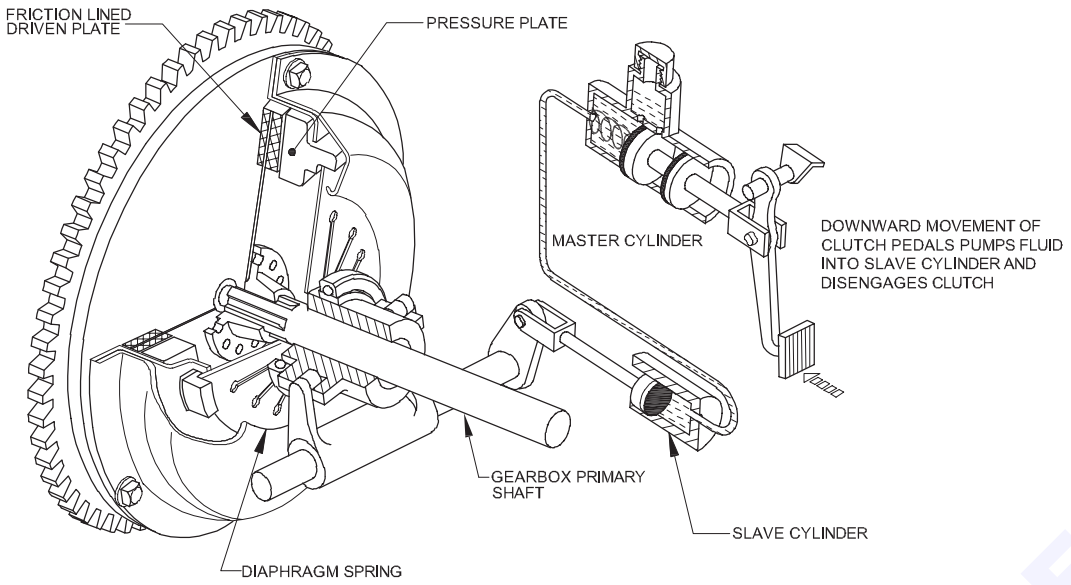


Types of clutch: There are different types of clutch used in an automobile, there are as follows

- Cone clutch (Fig 5)
- Dog clutch (Fig 6)
- Single plate with coil spring (Fig 7, 8)
- Diaphragm clutch (Fig 9, 10, 11)
- Multi plate dry and wet clutches (Fig 12, 13)
- Semi centrifugal clutch (Fig 14, 15)
- Fully centrifugal clutch (Fig 16)
- Fluid coupling (Fig 17)

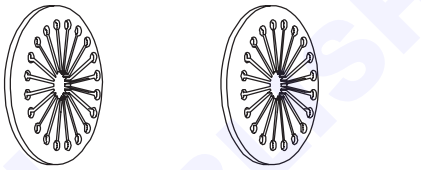
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Fig 4



ACTION OF CLUTCH

DIAPHRAGM SPRING

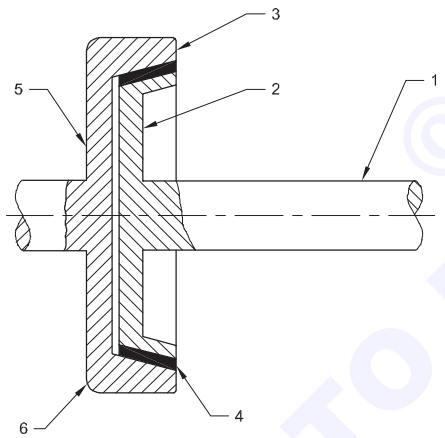


SHAPE PRIOR TO FITTING TO CLUTCH

SHAPE THRUST CAUSED BY FLATTENING

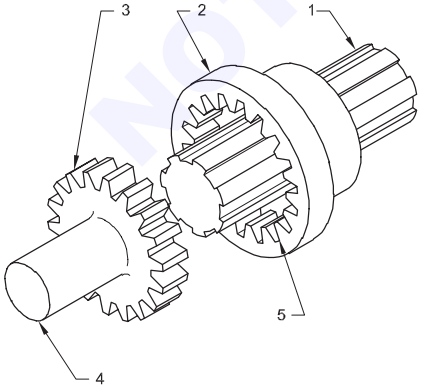
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Fig 5



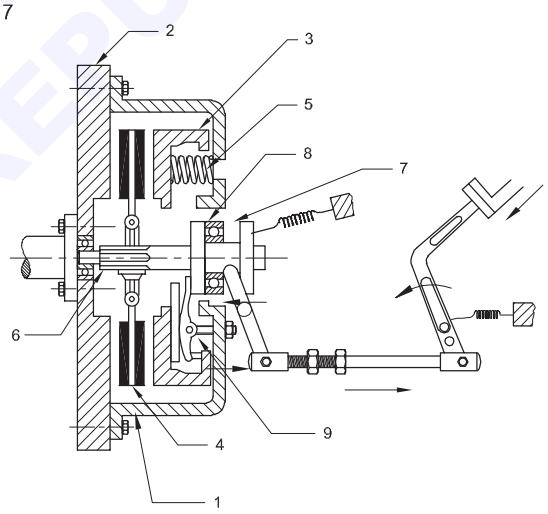
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Fig 6



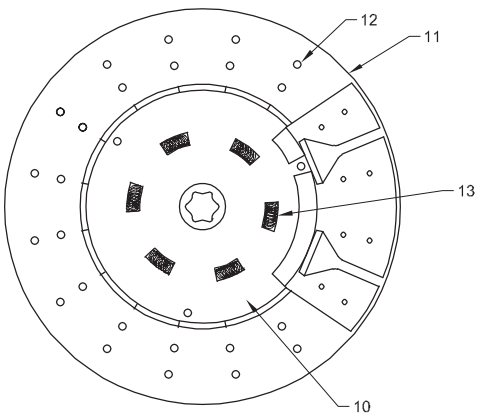
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Fig 7



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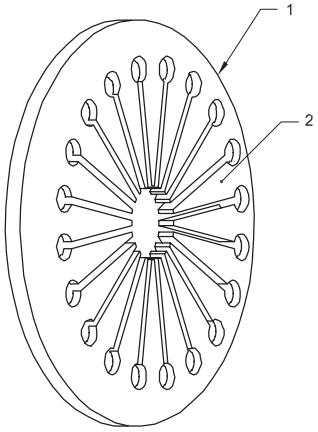
Fig 8



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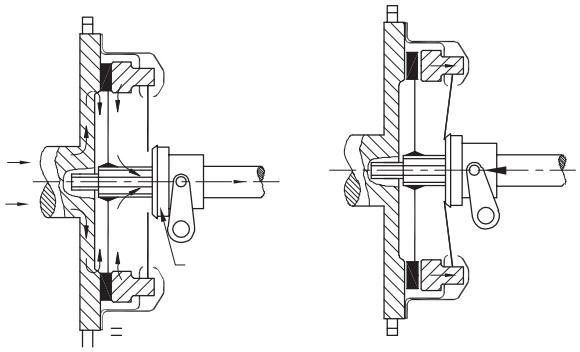
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Fig 9



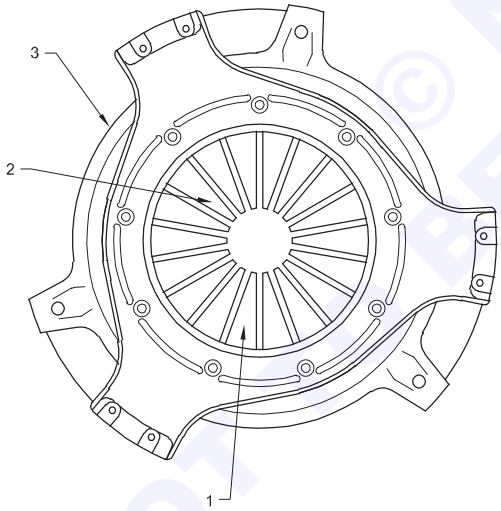
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Fig 10



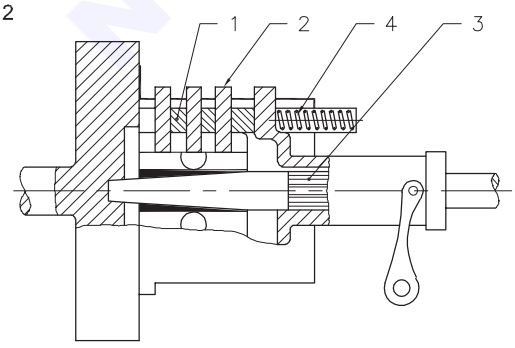
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Fig 11



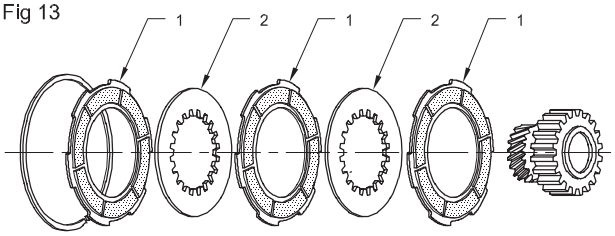
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Fig 12



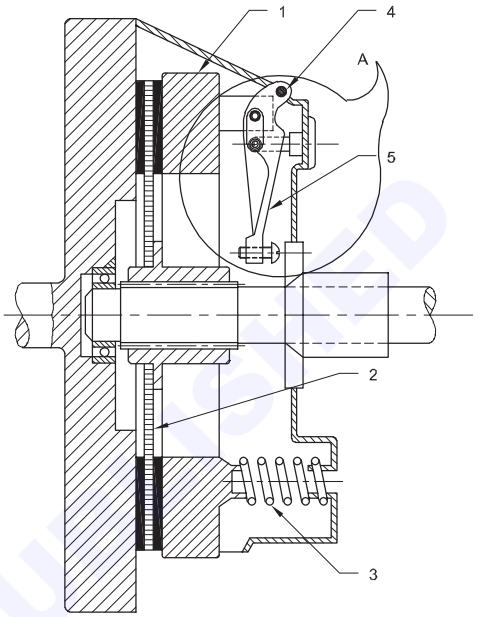
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Fig 13



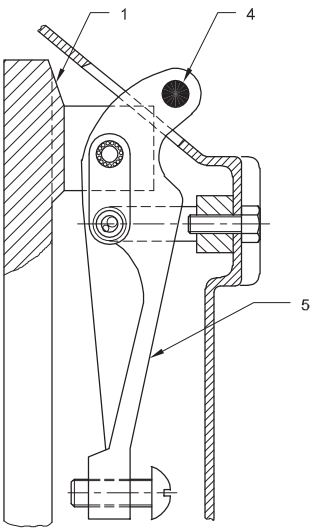
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Fig 14



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Fig 15



DETAIL 'A'

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Fig 16

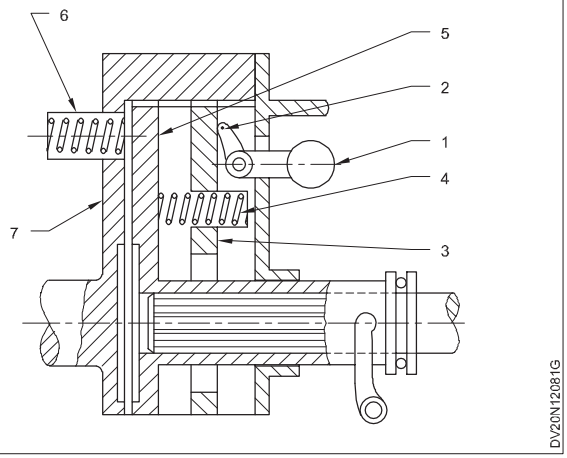
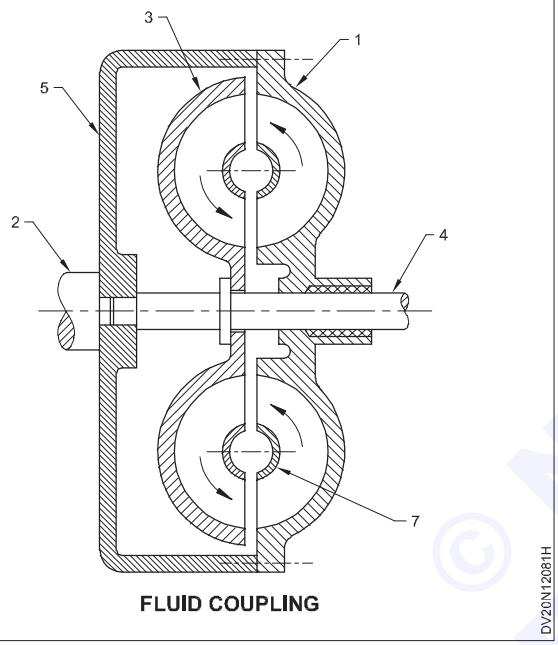


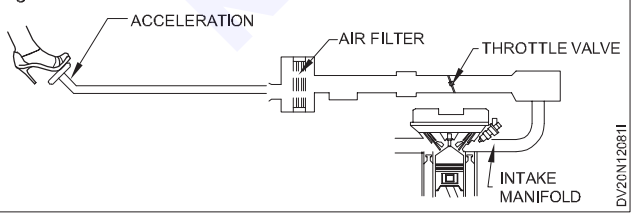
Fig 17



FLUID COUPLING

Accelerator: The accelerator is also known as gas pedal, it is located on the floor on the far-right, accelerator pedal control the amount of gas being fed into the engine and there by controls the speed of the vehicle, accelerator pedal is operated by right foot of the operator with heel resting on the foot board. The linkage of the accelerator pedal control is valve that regulate the intake air/ air fuel mixture in to the engine when operator press the pedal, the wide open the valve becomes and the move air/air fuel mixture is let into the engine. (Fig 18)

Fig 18

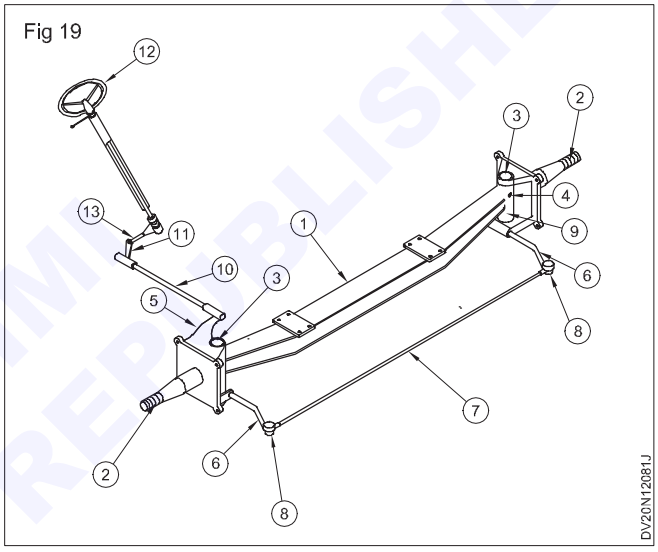


Hand controls: Most of the vehicle operating systems are used to operate by hand like steering wheel, gear shifting lever hand brake, direction indicator lever, head lights switch, horn switch, wiper dim bright switch, parking light switch

Steering wheel: (Fig 19) When the steering wheel (12) is turned its motion I carried to the steering box through the steering cross-shaft (13). In the steering box this motion is converted into angular motion of the drop arm (11) which is connected to the drag link rod (10). The drag link rod's (10) other end is connected to the steering lever arm (5). The steering lever arm (5) is connected to the stub axle spindle (2). At the lower end of the stub axle, the spindle steering arm (6) is fitted. Both the steering arms (6) are connected the drop arm (11) moves towards or away from the front wheel depending upon the direction of turn (right or left).

For example if the vehicle is to be turned to the right side the steering wheel is rotated clockwise. The drop arm (11) is pushed towards the front wheel, which forces the stub axle (2) spindle to turn right through the drag link rod (10) and the steering lever arm (5). The revers will happen when the vehicle is turned left.

Fig 19



Gear shift lever (Fig 20,21,22)

Function of gear shift mechanism

The gear shift lever is located either on the steering column or on the floor board.

The engage the gear, the gear shift lever moves the selector rods. The gear shift lever moves the selector rods. The gear shift forks are fixed on the selector rod. The shifting forks sit in the slot of the sliding dog clutch or gear. When the selector rod moves, the shifting fork also moves and pushes the respective sliding dog clutch or gear to engage the respective gear.

When the selector shaft is moved, it forces the pin into a groove cut in the opposite rail and the lock or spring loaded ball hold selector shaft in locking position.

Hand brake: Hand brake also called as parking brake. Hand brake is operated by hand lever, all two wheeler's front wheel hydraulic and mechanic brake is operated by hand lever to reduce the vehicle speed or stop the two wheeler. The four wheeler hand brake is used to avoid rollover the vehicle in parking area. Sometimes hand brake is used in emergency along with foot brake to stop the vehicle on the spot.

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Fig 20

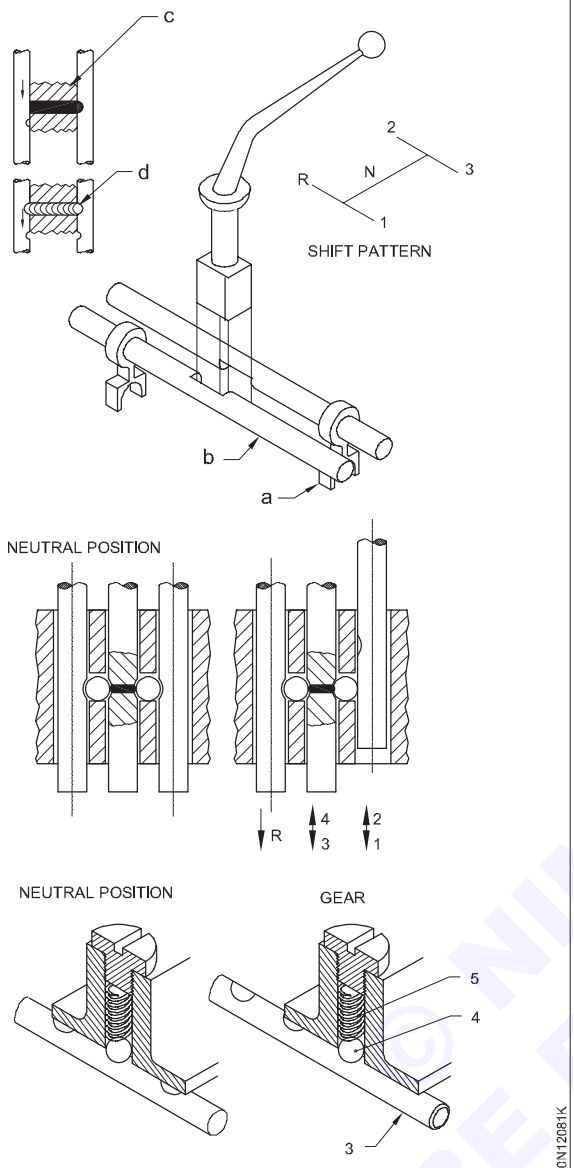


Fig 21

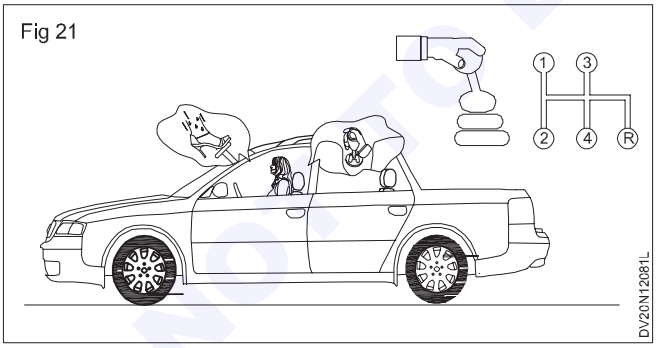
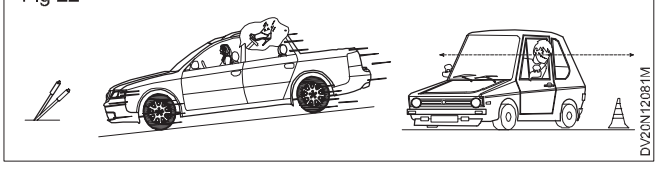


Fig 22

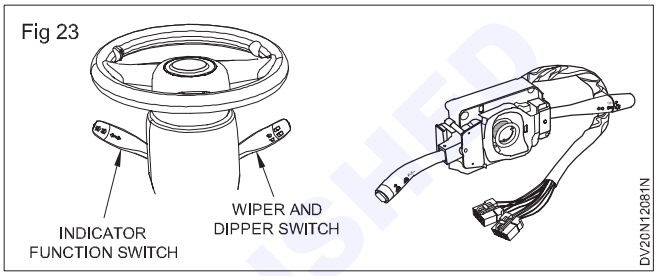


While apply hand brake, when stopping the vehicle on a slope and pulling the brake down lever all the way and check to ensure that the parking/hand brake is fully effective.

Direction indicator switch: All vehicles have been provided with flasher type direction indicators. This direction indicator switch permit the driver of the vehicle to signal his intentions to make a right or left turn during driving a vehicle on road. These indicator light also help to allow free flow of traffic from behind the vehicle and also prevent accidents between two vehicles, while turning right or left on cross road junction or change the road lane on highway.

Direction indicator switch is generally fitted on the steering column of the vehicle. When you turn on the left or right turn signals, the corresponding green arrow on the instrument panel will flash along with the respective turn signal lights (Fig 23)

Fig 23

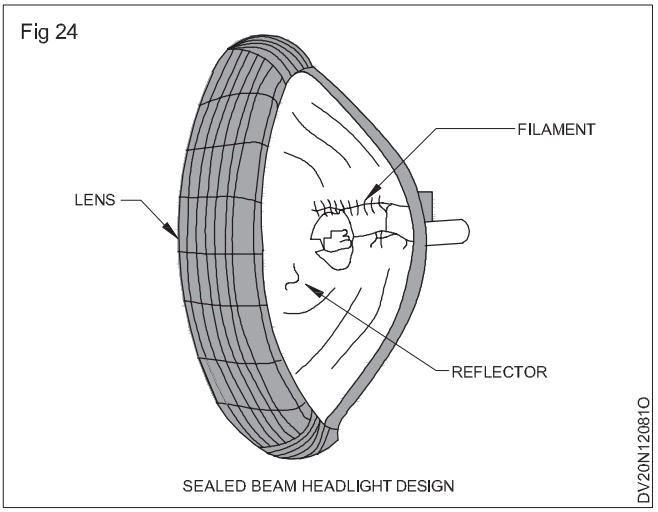


Main beam indicator comes on when head light main beam (high beams) are turned on.

Head lights: The head light system provides illumination on the road to ensure good visibility for the driver, it consists of a double filament a pre-focused bulb, reflector, holder, head light switch, a dim and dip switch and a fuse.

When the head light switch is on current flows through a bulb filament, it become very hot. This process of changing electrical energy to heat energy that produce light. The filament is surrounded by a vacuum that prevents overheating and destruction of the filament (Fig 24)

Fig 24



Dim-bright switch: Dim-bright switch is fitted with indicator switch below steering wheel on the steering column Dim-bright switch is used to operate the head light high and low beam light as shown in Fig 25&26, if the head light bulb has two filaments, the lower filament is for high beam and the upper filament is for low beam

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Fig 25

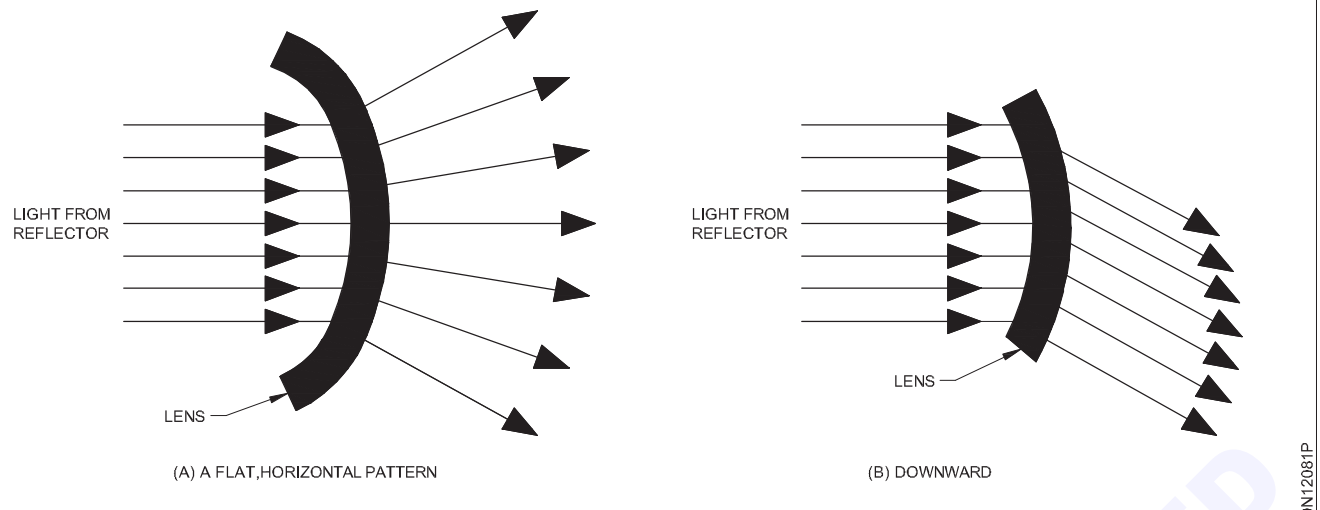
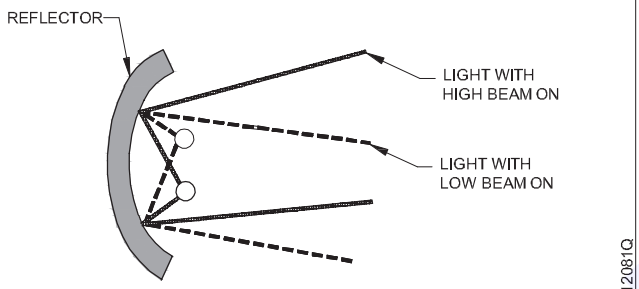
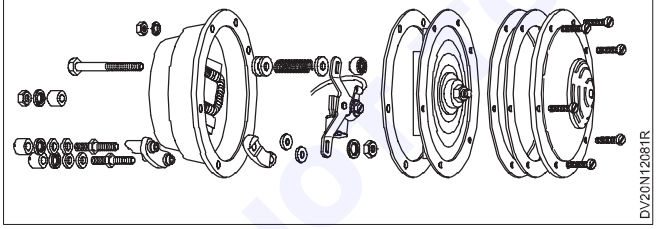


Fig 26



Horn: Generally horn is fitted in the front end of the vehicle, it produces sound waves due to the vibration set up in the diaphragm to clear or worn the traffic on the road. It is used single or in pairs to produce sound and it is operated through the horn switch in the driver cabin. The horn switch does not operate the twin horn directly, but it operates the horn through horn relay. (Fig 27)

Fig 27

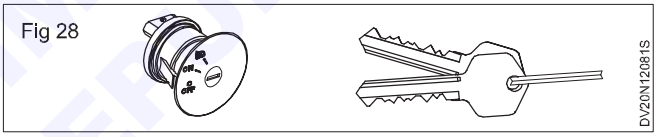


Ignition switch: Vehicle ignition switch or starter switch in the control systems of a motor vehicle that activates the main electrical systems for the vehicle including (radio, power, windows, camera)and other electrical accessories. The ignition switch provides power to the starter motor and other electrical systems,like a (ignition circuit, wiper, Horn, lights mobile charger etc.)

Ignition switch Is used for ON or OFF the battery power flow to the vehicle various electrical circuits. (Fig 28)

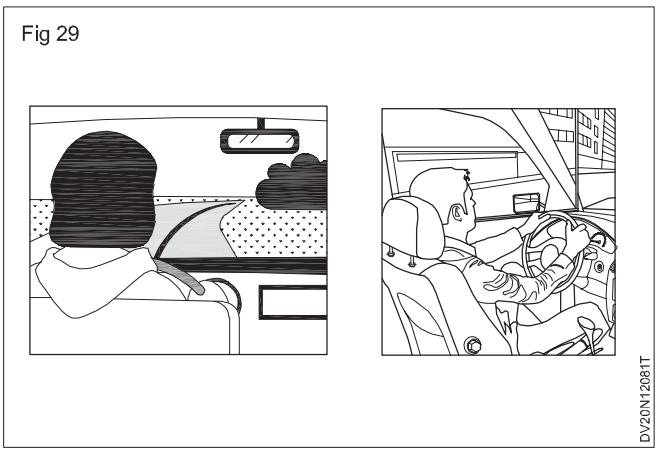
Wiper switch: Wiper switch is included with vehicle combination switch. It is used for operate the wiper motor with various speed as required. The wiper circuit consists of a battery, fuse, wiper switch and a wiper unit. The wiper circuit consists as battery is connected to the main ignition switch. The main switch power is connected to wiper switch through wiper fuse. Wiper switch connect the battery power to wiper motor terminal. Wiper motor terminal power activate the wiper motor to operate the wiper blade to clean wind screen.

Fig 28



Rear view mirror: Rear view mirror is provided on left and right side and drivers cabin of the vehicle. Rear view mirror helps to watch behind the vehicle is coming. Vehicles and other activities rear view mirror can adjust manually or electrically as our requirement rear view (Fig 29)

Fig 29



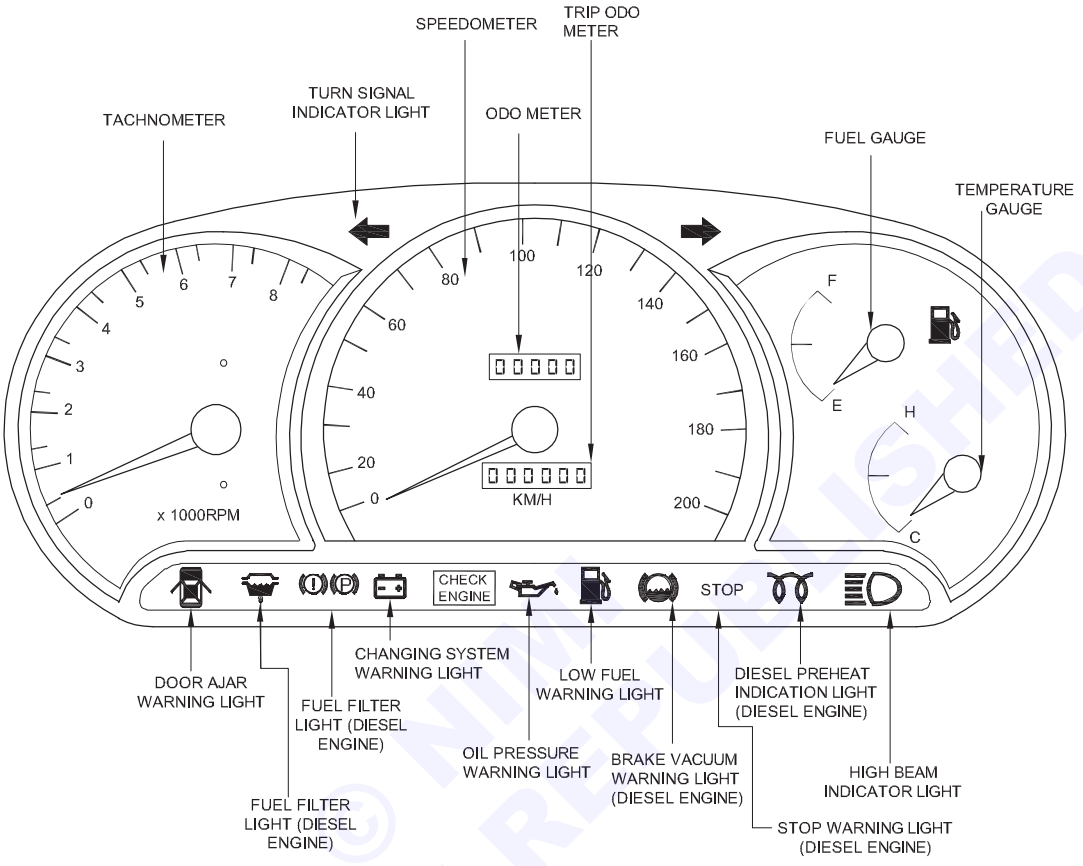
Types of rear view mirror: There are two types of mirror used in car 1. Convex mirror 2. Concave mirror, some vehicle plain flat mirror also used.The side mirror and rear view mirror of the vehicle is made up of convex mirrors. This is because the image formed by a convex mirror is diminished and erect image, thus provides a larger field of view. A larger field of view helps the driver to know better about the traffic behind.

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In a car, the rear view mirror is usually affixed to the top of the windshield on a double swivel mount allowing it to be adjusted to suit the height and viewing angle of any driver and to swing harmlessly out out of the way

Instrument cluster: A vehicle instrument cluster houses the various displays and indicators that gives information to a driver for effectively operate the vehicle among there are several gauge and indicators are provided in the instrument panel fitted on the vehicle dash board as shown in Fig 30

Fig 30



Speedometer: The speedometer is used to read the vehicle running speed km/h

Trip meter: Trip meter is fitted with odometer, it is used calculate the total distance covered in each trip of the vehicle from starting point to end point of the journey.

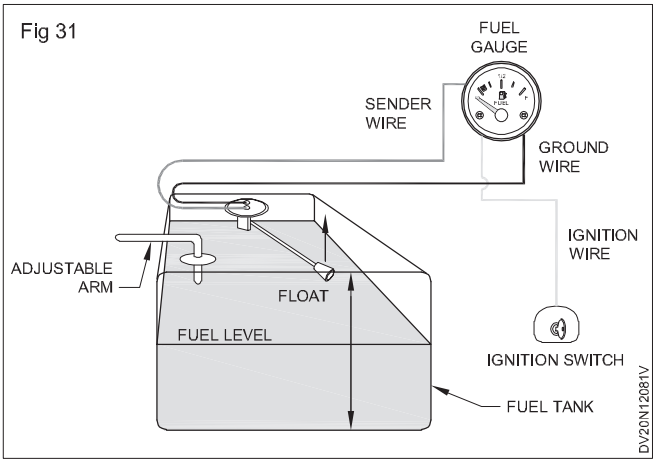
RPM gauge: RPM gauge (Tachometer) is used read the revolution per minute of the engine (while engine running)

Oil pressure gauge: Oil pressure gauge is used to read the oil pressure supply from the oil pump to engine lubrication system. Some of the modern vehicle is used the oil pressure warning light Make sure that these light stay off while the engine is operating, if any of these comes on during the engine operation it means that something is wrong with the engine lubrication and hence immediate inspection is necessary.

Temperature gauge: Temperature gauge is used to measure the engine temperature, while operating the engine or indicates engine coolant temperature. If the temperature gauge shows overheating stop the engine for checkup, if needle goes out of normal range and moves across to red mark.

Fuel gauge : Fuel gauge is fitted on the dash board instrument panel Fuel gauge is used to know the fuel quantity in the fuel tank. Fuel gauge is connected by electric wire with fuel tank float unit. Gauge bulb also connected in fuel gauge with head light switch wires connection.(Fig 31)

Fig 31



Ammeter: Ammeter is fitted in dash board instrument panel. It is used to measure the current supply, to the battery by the alternator.

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Tell tale lamps : Tell tale lamps are used to know the function of engine systems like lubrication system, seat belt, air bag, crush warnings and Engine failure, brake failure warnings, improper door closing etc.

Audio warnings : Audio warning system is provided in the vehicle. When the vehicle is engaged with reverse gear that time audio system start to give warning to surrounding people. As it is when the start to move, if door is not closed properly that time also give audio warning to the driver.

Wind screen and their purpose : Wind screen is a solid and transparent barrier that is placed at the front of the vehicle it's purpose is to shield the driver and passengers from the wind enter into the vehicle as well as other environment elements such as rains, snow, bugs, wind, dust and flying debris . wiper motor and blade is provided to clear the rain water deposited on the wind screen.

Air bag & seat belt

Objectives: At the end of this lesson you shall be able to
- **state the need of air bag and seat belt**
- **state the electrical and electronic architecture**
- **state functions of seat belt**
- **state the types of seat belt restraints**
- **describe the passive seat belt restraints**
- **state safety points for driver & passengers**
- **describe the air bag system**
- **describe air bag system warning light**
- **describe the multi stage air bag deployment**
- **describe seat belt pre tensioners.**

Electrical and electronics architecture

Instead of simply being modes of conveyance as in the past today cars are also expected to entertain and inform passengers in a safe and protected environment. Further,they are supposed to ease the complexity of driving by providing different forms of assistance to the driver.To support these increasing demands automotive specific buses and gateways.Moreover emerging functionally like car to car to infrastructure communication,as well as infotainment and driver assistance systems have increased the number of vehicle components with communication interfaces to the outside world.Such compels E/E and connected automotive architectures are increasingly vulnerable to malicious attacks and recent this topic considering security side by side with safety is crucial for the overall reliability of an automotive E/E architecture ,Since vulnerable electronic component might undermine the passenger's safety to the extent as a faulty one. However,in the highly competitive automotive domain,the cost of security features often pose an obstacle to their adoption.

Need of air bag & seat belt

Vehicle safety is one of the most important considerations of the average vehicle buyer today. In simple terms, safety sells vehicles! Therefore, vehicle manufacturers have spent a large amount of money engineering improved safety systems. Passive restraints at the present time include the drivers air bag, passenger side air bag, side - impact air bags, air bag curtains, and seat belt pre tensioners. The seat belt and air bag systems are intended to work together to protect the driver and passengers.

Functions of seat belts

An air bag equipped vehicle, conventional seat belts perform these functions:

1 Hold the occupants in proper position when air bags inflate.

2 Reduce the risk of injury in a less severe collision in which the air bags do not deploy.

3 Reduce the risk of occupant ejection from the vehicle and thus reduce the possibility of injury.

State types of seat belt restraints

All vehicles manufactured and sold vehicles must have passive restraints.

Passive restraints may be air bags or automatic seat belts. Most vehicles with air bags also have active restraints.

These are

1 Passive restraints

2 Active restraints

Passive restraints

Operate automatically with no action required by the driver. Active restraints require action by the driver or passengers before the restraints provide any protection.

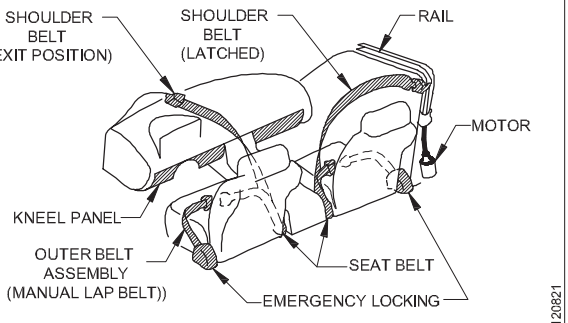
Passive seat belt restraints

A passive seat belt system uses electric motors to automatically move the shoulder belts across the driver and front seat passenger. The upper ends of the belts are attached to a carrier mounted in a track just

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above the top of the door frame. The other end of each shoulder belt is secured by an inertia lock retractor that is mounted in the center console. When a front door is opened, the outer end of the shoulder belts move forward in the door tracks to allow easy entry and exit from the vehicle (Fig 1). When the door is closed and the ignition switch turned on, the shoulder belts move rearward in the door tracks to secure the front seat occupants. The active lap belt must be buckled by the driver or passenger and must be worn with the shoulder belt.

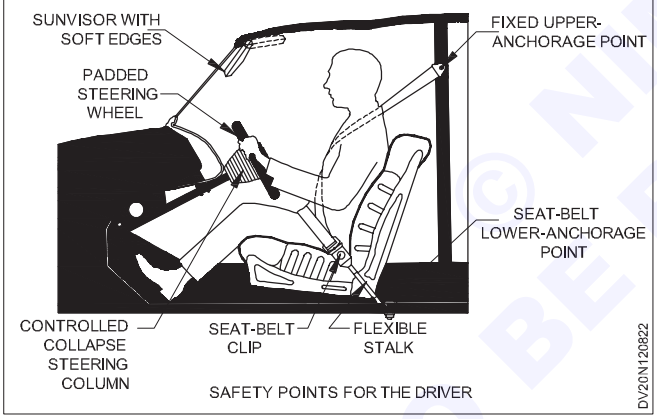
Fig 1



A APSSIVE SEAT BELT RESTRAINT SYSTEM

Safety points for driver and passenger (Fig 2)

Fig 2



SAFETY POINTS FOR THE DRIVER

Some of the better modern front seats embody an adjustable lumber support in the backrest. Where the seat must hinge forward to give access to the rear compartment, a catch is usually fitted on recent models to secure it in a collision. Fascia's and parcel shelves are now well padded to minimize injury, and some inside mirrors are designed to break from their mountings on impact, instead of shattering.

Comfort

The seat belt anchorage, which incorporates the retaining clip, should be so located that the belt can be put on and taken off quickly, using only one hand. The belt must fit comfortably and must not slip off or cut into the wearer. A settled, restful position reduces strain and fatigue a considerable safety factor.

Adjustment of seat

Comfortable seak position of driver in a vehicle so more important to safe driving a vehicle.So that driver can adjust this/her seat by manual electronic control system.

The comfortable driver siting position provide clear vision of the road and easy to operate the steering gear clutch and break.

Note : The driver has to adjust his/her seats before move the vehicle for safe driving.

Air bag system components

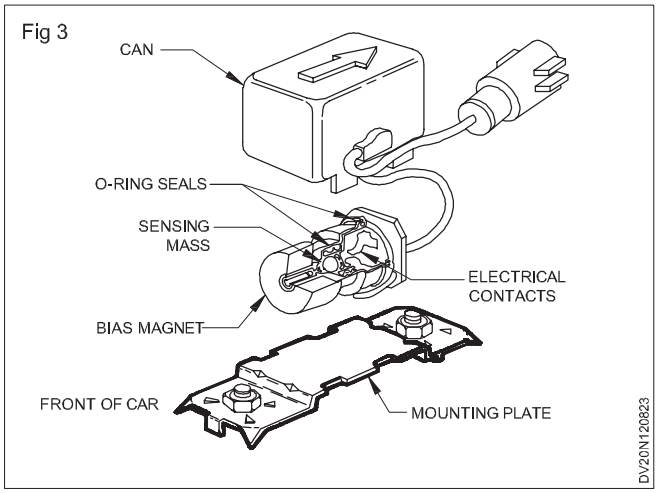
Understanding air bag system components is essential to comprehend the complete system operation. A knowledge of air bag system operation is absolutely necessary to maintain, diagnose and service air bag systems quickly and accurately.

Sensors

Some air bag system sensors contain a set of normally open, gold plated contacts and a gold plated ball that acts as a sensing mass (Fig 2). This ball is mounted in a stainless steel - lined cylinder. A magnet holds the ball about 1/8 in away from the contacts. When the vehicle is involved in a collision of sufficient force, the ball moves away from the magnet and closes the switch contacts. These contacts remain closed for 3 milliseconds before the magnet pulls the ball away from the contacts. The sensor is completely sealed in epoxy to prevent contaminants and moisture from entering the sensor. Sensors must be mounted with the forward marking on the sensor facing toward the front of the vehicle. To operate properly, sensors must be mounted in their original mounting position and sensor brackets must not be distorted.

Some air bag sensors contain a roller on a ramp. This roller is held against a stop by small, retractable springs on each side of the roller. If the vehicle is involved in a collision of sufficient force, the roller moves up the ramp and strikes a spring contact completing the electrical circuit between the contact and the ramp. (Fig 3)

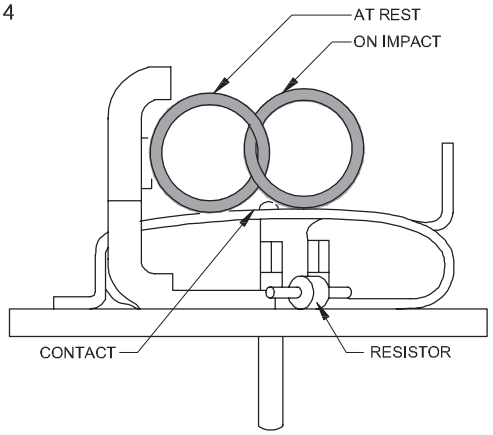
Fig 3



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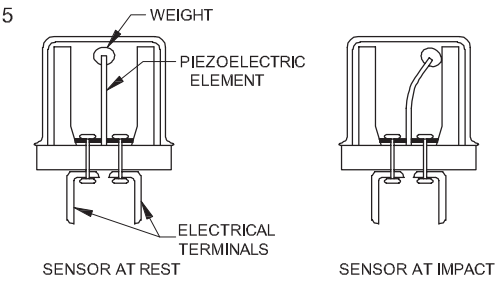
Some air bag sensors contain an accelerometer that contains a piezoelectric element (Figs 4 & 5). If the vehicle is involved in a collision, this element is distorted. The voltage signal from the sensor to the air bag system module depends on the force of the collision and the amount of element distortion.

Fig 4



A MASS-TYPE AIR BAG SYSTEM SENSOR

Fig 5

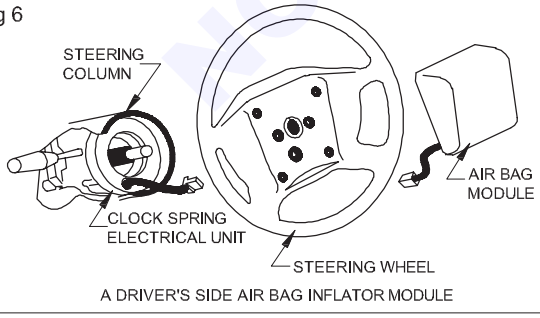


AN ACCELEROMETER-TYPE AIR BAG SYSTEM SENSOR

Inflator module

The inflator module contains the air bag, air bag container and base plate, inflator, and trim cover. The retainer and base plate are made from stainless steel and are riveted to the inflator module. The air bag is made from porous nylon and some air bags have a neoprene coating. The purpose of the inflator module is to inflate the air bag in a few milliseconds when the vehicle is involved in a collision. A typical driver's side air bag has a volume of 2.3 cubic feet. The driver's side air bag inflator module is usually retained with four bolts in the top of the steering wheel. (Fig 6)

Fig 6



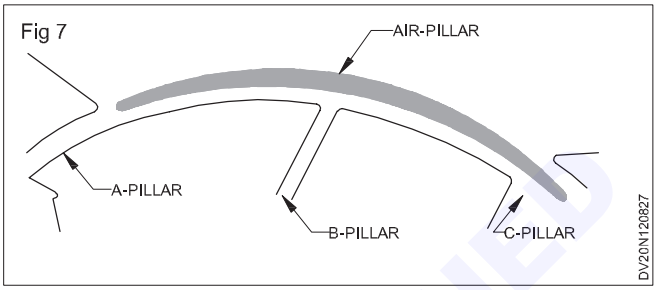
A DRIVER'S SIDE AIR BAG INFLATOR MODULE

Air bag system warning light

The air bag system warning light is mounted in the instrument panel. The air bag system warning light should come on when the ignition switch is turned on. If the ignition switch is left in the on position without starting the engine or when the engine is started, the air bag system warning light should flash a few times and then go out. This light action indicates the air bag system is satisfactory. If the air bag system warning light is on with the engine running, there is an electrical defect in the air bag system and the air bag system may not be operational in a collision.

Side impact air bags (Fig 7)

Fig 7



Some vehicles are now equipped with side impact air bags that protect the driver or passengers during a side collision. The side impact air bag systems are separate from the drivers side and passengers side air bag systems. Side impact air bag systems have their own sensors and ASDM. (Adaptive Security Device Manager). Separate ASDMs are usually installed for each side impact air bag. The ASDMs for the side impact air bags may be under the front seats or behind the B-pillar panels.

Left and right side ASDMs for side impact air bags are not interchangeable.

Some vehicles have a side impact air bag that deploys out of the door paneling. In other systems, the side air bags are mounted in the side of the seat back near the top. Some vehicles have a side air bag curtain that deploys out of the headliner just above the doors. This type of air bag protects the front and rear seat occupants from head injury.

Smart air bag systems

Some air bag systems have a switch in the passenger's side of the front seat. This switch informs the ASDM if anyone is sitting in the front passenger seat or not. If no one is sitting in this seat, the passenger's side air bag does not deploy if the vehicle is involved in a collision. Some smart air bag systems can detect from the passengers weight. If a child below a certain weight is occupying this seat, the air bag does not deploy. In some air bag systems, the weight of the person in the passenger's side air bag deploys.

On some smart air bag systems, if a rearward facing child's seat is place in the front passenger's seat, the passenger's side air bag does not deploy.

If a child in a rearward facing child's seat is placed in the front passengers seat and the air bag deploys, the deployed air bag may force the seat and the child against the vertical part of the front seat causing the child to suffocate.

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Some vehicles have a small knee air bag that deploys out of the dash in front of the drivers knees. This air bag protects the driver from knee injury and also keeps the driver from sliding under the seat belt during an accident. This action maintains the driver in a better position to be protected by the driver's side air bag.

Seat belt pre tensioners

Some vehicles have seat belt pre tensioners on the seat belts. The pre tensioners contain materials similar to a single stage air bag inflator module. The pre tensioners may be mounted on the buckle side of the seat belt (Fig 7). If the front air bags are deployed, the ASDM also fires the pre tensioners. A thin cable sis connected between the buckle and a small piston in the pre tensioner. When a pre tensioner is fired, the piston moves up the cylinder and the cable pulls the buckle tight. This action holds the occupant tightly against the seat and helps to prevent injury.

Power window

Objectives: At the end of this lesson you shall be able to
- **explain the purpose of power window**
- **explain the operation of power window**
- **state safety for power window.**

Power windows are usually inoperable when the car is not running. This is primarily a security feature. It would be a simple thing to allow electric power windows to be operable when the ignition is turned off, however it would also make the car much easier to steal. As a compromise, some systems offer the compromise of leaving power applied to the windows until a passenger door is opened at which time the window power is removed.

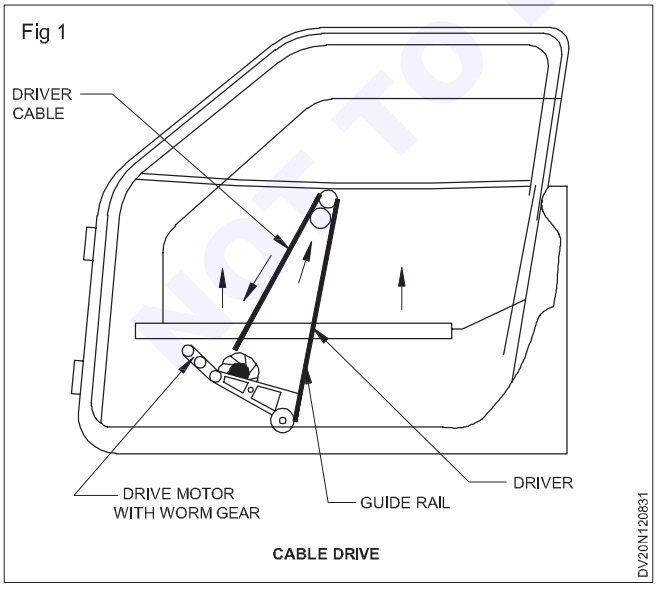
Electric power windows operation

Comfort and convenience systems

This allows electric opening and closing of the windows and where fitted, sliding sunroof via a rocker switch (pushbutton switch).

To power the windows up and down, a cable drive system is normally used (Fig 1). The drive motor actuates a cable via a worm gear mechanism, which will open or close the window depending on the direction of motor rotation. The self - locking effect of the worm gear mechanism prevents the window from opening in response to application of force.

Fig 1



CABLE DRIVE

Electrically - operated windows

In this system a DC permanent magnet motor is normally used to operate each window, and a three position rocker switch changes the polarity of providing up and down motion of the window. Four main window switches one for each window are installed on the drivers panel, and an isolation switch is also added to disconnect the supply to the rear windows. Two relays control the current to each motor and are powered by a common feed.

A gearbox forms the drive between the motor and the window glass and amplifies the torque sufficiently to undertake upward motion of the window, which is more difficult than the downward motion.

To limit the current during overloading one or more thermal cut out switches are installed in the circuit, sometimes in the motor. The cut out is opened if the operating switch is held closed when the window has reached its limit of movement or in case where free movement of the glass is arrested by ice. A main overload switch, if used, is generally of a requiring resetting after encountering an overload situation.

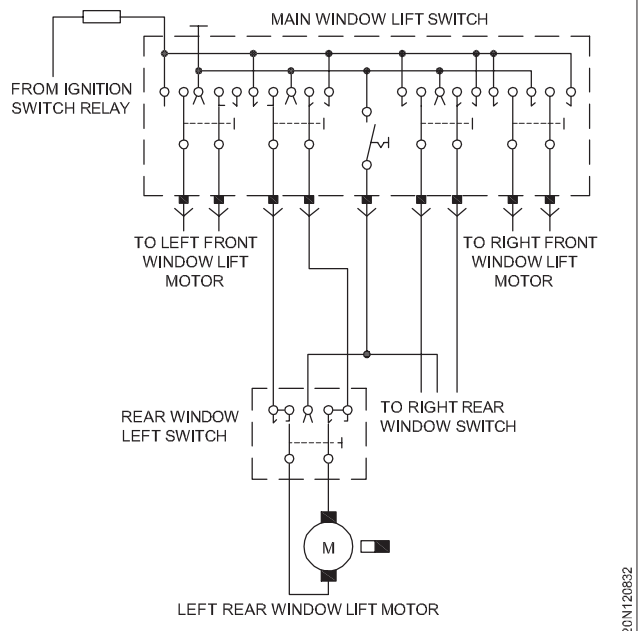
Fig 2 shows the circuit for electric operation of a rear passenger window, but the balance of the circuit has not been shown for simplicity. The motor in this layout is powered directly through the ignition switch. The ganged switch supplies the current with suitable polarity to rotate in the required direction during the operation of the window.

Safety

Power windows have come under some scrutiny after several fatal accidents in which children's necks have become trapped, leading to suffocation. Some designs place the switch in a location on a hand rest where it can be accidentally triggered by a child climbing to place his or her head out of the window. To prevent this many vehicles feature a driver controlled lockout switch, preventing rear-seat passengers (usually smaller children) from accidentally triggering the switches. This also prevents children from using them as toys and pets riding with their heads out windows from activating the power window switch.

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Fig 2



Door locks:

Vehicle door locks are provided for open and close the door. These door locks are operate by manual or electronically The vehicle door is open and close by remote key Operation system while vehicle drive on the road child lock system provide lock the all doors for safety for all passers travel in the vehicle.

Central door locking

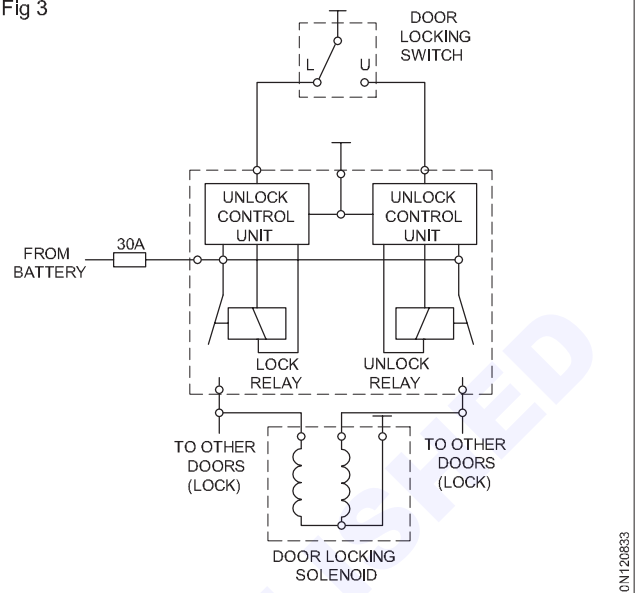
A door locking system normally locks all doors, including the tailgate or boot simultaneously when the driver's door lock is activated. When the key is turned or the driver's door lock button is operated the electrical system actuates all the locking activators installed adjacent to the door locks. Unlocking the door takes place in the similar way except the locking actuators work in the opposite direction. Both for convenience and safety reasons, a mechanical latches system is fitted which unlocks each door manually from inside the car. Various types of control are incorporated to provide the locking / unlocking pulse for operation of the actuators. In some designs two relays are used, one for locking and the other for unlocking the doors. A transistorised switching circuit controls these relays. The circuit timed by the charge - discharge action of capacitor to provide a current pulse length sufficient to actuate the locks. (Fig 3)

Now a days almost all door actuators use small motors which, via suitable gear reduction, operate a linear rod in either direction to lock or unlock the doors. A simple motor reverse circuit is presented in Fig 4 & 5, where the driver's door switch operates the locks on four doors. More sophisticated systems are now becoming popular for consideration of safety as well as improved comfort.

Key less entry system

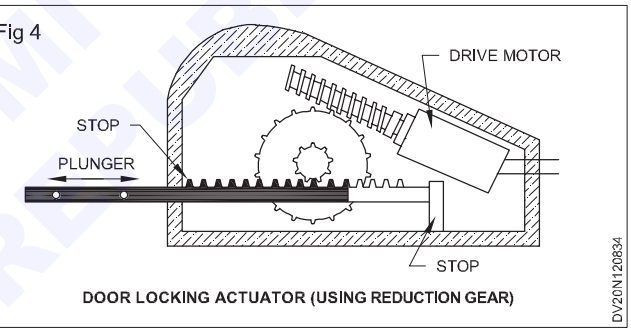
A keyless entry system is an electronic locks that controls access to a building or vehicle without using a traditional mechanical key. The term keyless entry system originally meant a lock controlled by a keypad located at or near the driver's door, which required entering a predetermined numeric code. Such systems now have hidden touch - activated keypad and are still available on certain modern cars.

Fig 3



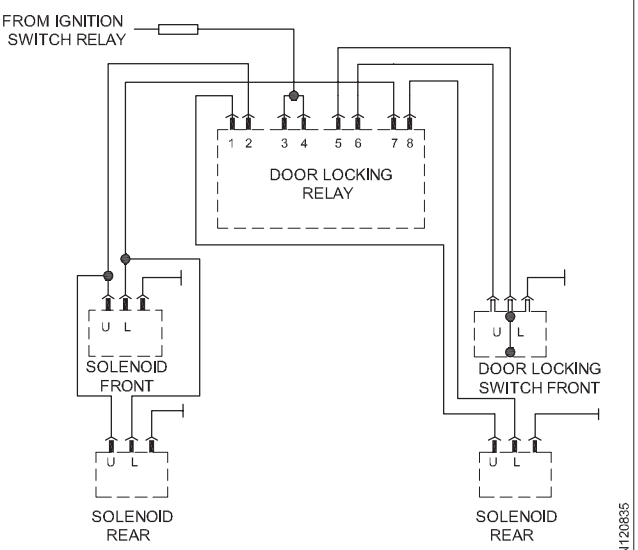
CENTRAL DOOR LOCKING CIRCUIT (TRANSISTORIZED CONTROL)

Fig 4



DOOR LOCKING ACTUATOR (USING REDUCTION GEAR)

Fig 5



EXTERNAL CIRCUIT FOR CENTRAL DOOR LOCKING

Remote control locking refers to a lock that uses an electronic remote control as a key which is activated by a handhold device.

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Keyless entry system performs the functions of standard car key without physical contact. When within a few yards of the car, pressing a button on the remote car lock or unlock the doors, and may perform other functions. A remote keyless entry system which unlocks the doors.

Car anti theft system

Though most of the car modes are with immobilizer, still the number of cars stolen are on raise. Gear locks considered one of the base defense a car thief would be in a very rare circumstance puts up time to break gear lock in the car.

Ignition cut off

A key operated or hidden manual switch that interrupts the power supply from the battery to the ignition system. This manual switch can be taken out by the driver once the car is locked.

Introduction

What is a hybrid? A hybrid vehicle combines any two power (energy) sources. Possible combinations include diesel/electric, gasoline/fly wheel, and fuel cell (FC)/ battery. Typically, one energy source is storage, and the other is conversion of a fuel to energy. The combination of two power sources may support two separate propulsion systems. Thus to be a True hybrid, the vehicle must have at least two modes of propulsion.

For example, a truck that uses a diesel to drive a generator, which in turn drives several electrical motors for all-wheel drive, is not a hybrid . But if the truck has electrical energy storage to provide a second mode, which is electrical assists, then it is a hybrid Vehicle.

These two power sources may be paired in series, meaning that the gas engine charges the batteries of an electric motor that powers the car, or in parallel, with both mechanisms driving the car directly.

Fuse

Objectives: At the end of this lesson you shall be able to
- **state the need of a fuse in the circuit**
- **explain the construction of a fuse**
- **list out the types of fuses**
- **explain the working of fuses**
- **explain the circuit with and without a fuse**
- **explain circuit breakers.**

Introduction

A fuse is a protective device. It is a weakest portion in the electrical circuit.

An electric current heats the wire when the current passes through it. The amount of heat depends upon the current and resistance in the wire.

In automobiles, this heating effect is utilized in heaters, bulbs and gauges etc.

The heating effect in the circuit is limited by the fuse. If this limit is not controlled, the circuit an accessories will be overloaded causing severe damage to them.

Fuse carrier location:

Most of car fuse carrier is located below the steering and fuse carrier is mounted on the vehicle body some light vehicle and heavy vehicle fuse carriers are locating in engine compartment.Fuses are covered by fuse carrier cover for protect the fuses.

Purpose of fuse (Fig 1)

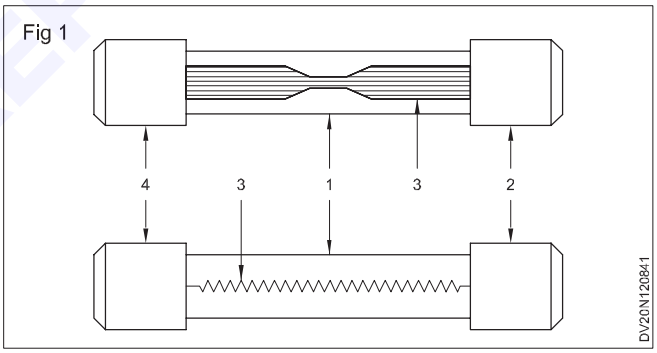
A fuse opens the circuit by blowing out when current (overload) flows in the circuit to prevent severe damage to the accessories.

The flow of excess current in a circuit may be caused by a short circuit.

Construction

Fuse elements are of lead-tin or tin-copper alloy wire in strip of correct amperage for each circuit.

Fig 1



The fuse is assembled in a fuse carrier of glass or ceramic material.

Nowadays fuse elements assembled in glass tubes, called cartridges, are widely used in automobiles.

It consists of a glass tube (1) with metal end caps (2) & (4).

A soft fine wire or strip (3) carries the current from one cap to another (4).

The conductor (3) is designed to carry a specific maximum current.

Working

The current flows through the conductor (3) between two metal caps (2) & (4) and then to the equipment.

If the current value exceeds the limit prescribed on the fuse, the fuse element (3) melts and opens the circuit and prevents the equipment from damage.

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Identification of blown fuse

If you look at the burnt fuse and if the element is broken the fuse is burnt due to overloading.

The glass is foggy white or black the fuse is blown out due to short circuit.

Circuits protected with fuse

- Headlight circuit
- Tall - light circuit
- Number -plate circuit
- Panel lamp circuit
- Interior lamp circuit
- Side indicator circuit
- Horn circuit
- Wiper circuit
- Dashboard / panel instruments circuit
- Header and air conditioner
- Charging circuit
- Radio
- Cigarette lighter
- Reverse lamp

Circuits without fuse

- Starting circuit
- Ignition circuit
- Fuel pump
- Stop - light circuit
- Oil pressure lamp circuit
- Ignition warning lamp circuit.

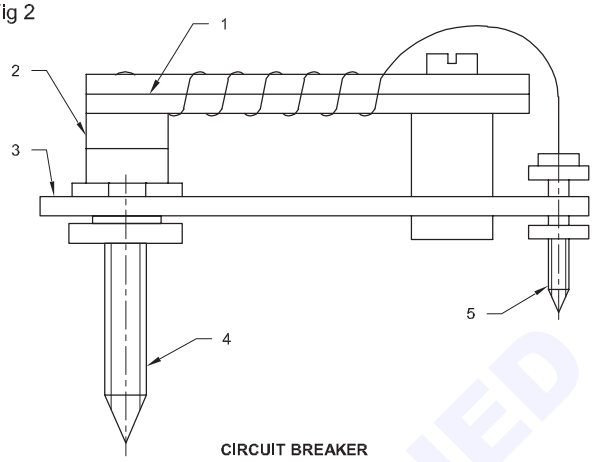
Fuse rating and colour

Rating	Colour
3 Amp	Violet
5 Amp	Tan
10 Amp	Red
20 Amp	Yellow
25 Amp	White
30 Amp	Light green

Circuit Breaker

Circuit Breaker (Fig.2): These units are regarded as a non- replaceable type of fuses. Generally fitted in the headlight circuit, it consists of a bimetallic strip (1) with moving contact (2). A fixed contact (3) is provided with the terminals (4) & (5). The strip (1) bends as soon as the current exceeds the maximum permissible value for the electrical component concerned. This way it opens the points to break the circuit. When this type of device is used in the lighting circuit, the lamp will light and then go out. Thus giving an indication of a faulty circuit. The circuit breakers are made in ratings up to 50 amps.

Fig 2



Rectifiers are provided inside the meter to convert AC to DC in the AC measurement circuit.

Fuse link (Fig 3)

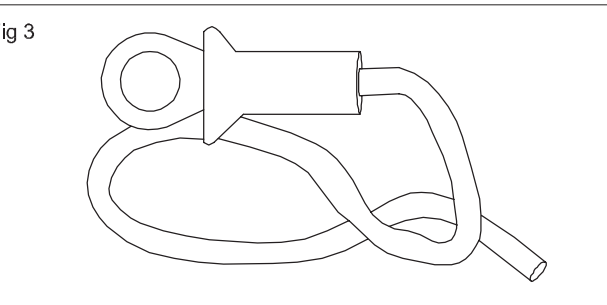
An electrical fusible link is a type of electrical fuse that is constructed simply with a short piece of wire typically four standard wire gauge sizes smaller than the wiring hamess that is being protected

Electrical fusible links are common in high -Current automotive applications.The wire in an electrical fusible link is covered with high -Temperature fire resistant insulation to reduce hazards when the wire melts and also encased in special materials that are designed to not catch on fire when exposed to high temperature.

Fusible links can be found in a variety of places in cars and truck,but they are commonly used in high amperage applications.such as stater motors,alternator where load exceeds rated amps.

When this type of fusible link blows,the vehicle will no longer start,but the risks of fire are eleminated.

Fig 3



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Global positioning system (GPS)

Objectives: At the end of this lesson you shall be able to
- **state the uses of global positioning system (GPS)**
- **describe working of GPS**
- **describe the uses of crash sensors**
- **describe on integrated communications system**
- **describe the uses of proximity sensor**
- **describe the uses of reflective displays**
- **describe triangulation / trilateration**
- **describe telematics**
- **describe networking & multiplexing.**

Global positioning system (GPS)

A system known as a Global Positioning System, or GPS can be used to determine the exact location of a vehicle on the earth's surface.

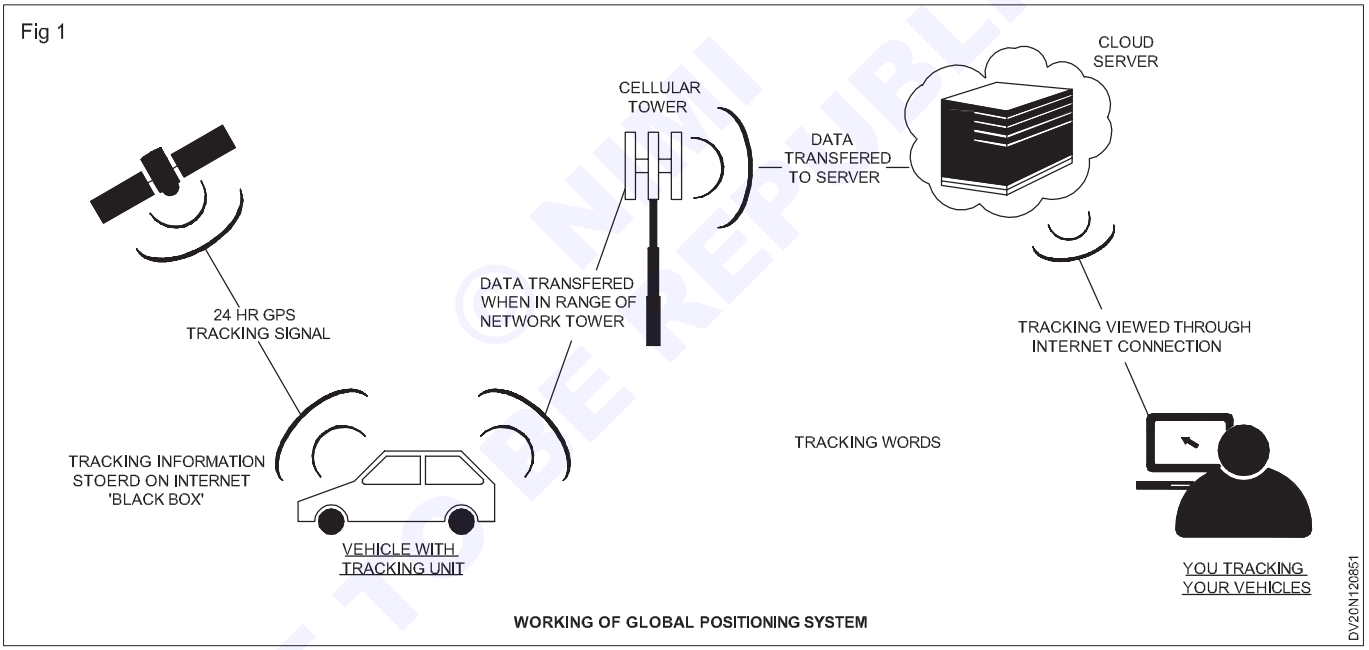
Thousands of satellites, service a variety of purposes, are continually in orbit high above the earth. The use of satellite technology in vehicle systems provides an ever increasing array of options for vehicle manufacturers. It is an area of automotive technology that increases the flexibility and power of many onboard systems.

Satellite technology is used in: Navigation, vehicle tracking, vehicle theft recovery, communication and internet access.

Mountains, tunnels, large buildings and other objects can interfere with satellite communication and make it unreliable. Most vehicle tracking systems can work very accurately without satellites once their initial position has been determined. On board sensors can be used to keep track of the exact vehicle location.

Working of global positioning system (Fig 1)

Fig 1



WORKING OF GLOBAL POSITIONING SYSTEM

The basis of the GPS is a constellation of satellites that are continuously orbiting the earth. These satellites, which are equipped with atomic clocks, transmit radio signals that contain their exact location, time and other information. The radio signals for the satellites, which are monitored and corrected by control stations, are picked up by the GPS receiver. A GPS receiver needs only three satellites to plot a rough, 2D position, which will not be very accurate. Ideally, four or more satellites are needed to plot a 3D position, which is much more accurate.

Crash sensor (Fig 2)

Sensors are located behind the front bumper, headlights, dash and doorsill or 'B' pillar. Some manufacturers also place sensors with the electronic control unit.

Crash sensors can be fitted in various positions throughout the vehicle. Their location depends upon the direction of deceleration they are designed to detect.

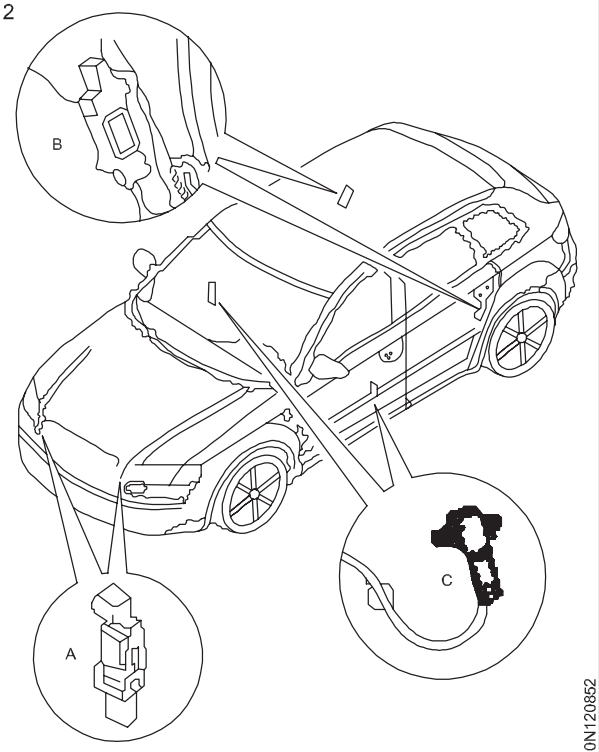
Some manufacturers place the sensors within the electronic control unit. Others are located behind the front pumper, headlights and dash.

Side impact sensors are located in the doorsills or "B" pillar. They will inform the SRS control unit of side impact and whether to deploy the left or right side air bags.

When the sensors indicate that a predetermined deceleration rate has been exceeded and it is from the appropriate direction, the SRS control unit deploys the relevant air bags.

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Fig 2



LOCATION OF CRASH SENSORS

If the collision is from the front, the driver and passenger air bags will deploy.

If the collision is from the side, the sensor determines whether the seat mounted air bag, or curtain air bags for one side of the vehicle will deploy.

With more refined designs, the passenger air bag deploys only if there is an occupant in the seat. Deployment can also depend on the weight of the occupant and whether the passenger air bag switch, if fitted, is turned on.

To prevent incorrect and unnecessary deployment, systems include a saving sensor mounted within the SRS control unit. The SRS control unit will only pass current through the squib if both the saving sensor and a crash sensor indicate simultaneously that a predetermined deceleration rate has been exceeded.

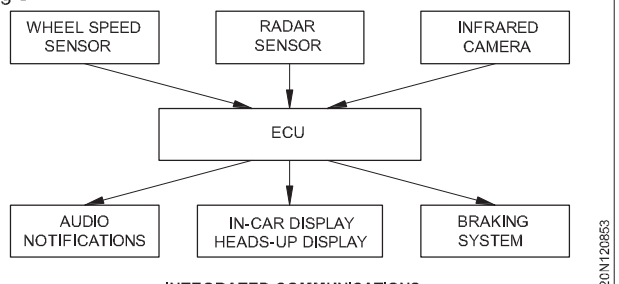
The SRS warning light is illuminated, and stays on, if a fault is detected in the system.

Capacitors within the SRS (Supplemental Restraint System) control unit are used to store electricity and act as a back up power supply. If a vehicle has its battery destroyed or disconnected in an accident, the capacitors supply the electricity required to keep the SRS system operational.

Some seat mounted side impact air bags also operate without electricity. When the side of a vehicle is crushed inwards, a detonator mounted on the lower outside edge of the seat is detonated. Pyrotechnic tubes connect the detonator to the air bags, which in turn ignite the squib. Many vehicles use two stage side impact bags. This provides protection to the upper chest over a more extended time.

Integrated communications (Fig 3)

Fig 3



INTEGRATED COMMUNICATIONS

Modern vehicles integrate audio, video and communication systems into a network.

Modern vehicles integrate audio, video and communication systems into a network. This allows for a high quality, compact and ergonomic system, which combines entertainment features with simple operation.

Controls are centralized with hardware, such as CD stackers, and DVD players located remotely.

Communication between components uses a combination of hard wiring and data buses.

With data being used, audio messages can be broadcast over the audio system that relate to other vehicle systems. For example, a voice message can say “the park brake is on” or “left rear tire is under inflated”.

The system allows for features such as the interruption or replacement of audio entertainment when there is an incoming phone call, or simply muting the audio to allows for safer driving.

The music played on a system usually comes from one of several sources. Magnetically on a cassette tape, optically on a CD or DVD, by radio frequency from radio stations or satellites, or from other portable devices.

The information is decoded or processed by the control unit and outputted to drive speakers located throughout the vehicle.

Another function provided by the body control unit is that of speed dependent volume. The control unit has an input from the vehicle speed sensor, which allows it to gradually increase audio system volume proportionally with road speed. As speed and therefore engine and road noise increases, the audio volume will increase. As speed decreases the audio volume will decrease.

Viewing screens for onboard TV, DVD and games can be located in the dash, however, if the screen is viewable by the driver it must disable when the vehicle is in motion. Other mounting points are from the roof or integrated into the rear of seat headrests.

Control units can be hard wired, or wireless using an infrared remote control.

Proximity sensors (Figs 4 & 5)

Proximity sensors are mounted in the front or rear bumpers. The control unit determines the distance

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between the sensor and an obstacle by measuring the time taken for sound waves to leave and return to the sensor.

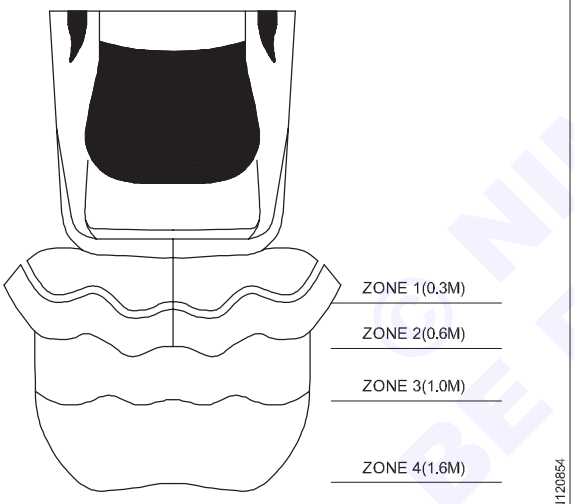
To allow for safer parking, proximity sensors can be mounted in the front or rear bumpers.

These color matched sensors emit ultrasonic sound waves that the human ear cannot detect.

These piezo sensors are used to transmit and receive coded sound waves. The control unit determines the distance between the sensor and an obstacle by measuring the time taken for the sound wave to leave and return to the sensor. Normally 4 sensors are used to allow for full coverage across the width of the vehicle.

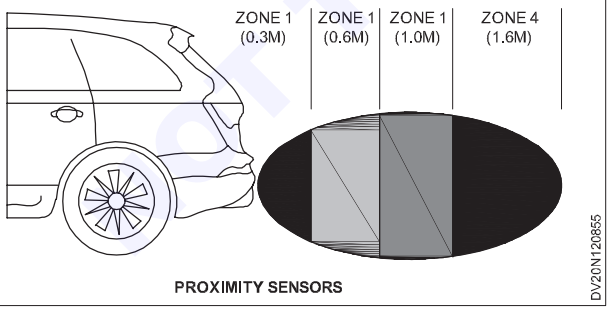
Proximity to obstacles can be indicated by separate audible and visual alarms, or by integrating warning sounds with the vehicles audio system. If a trailer is attached to a coupling, the rear sensors are disabled automatically when the harness plug is inserted. Front sensors can be disabled manually in start or stop and go traffic.

Fig 4



PROXIMITY SENSORS

Fig 5



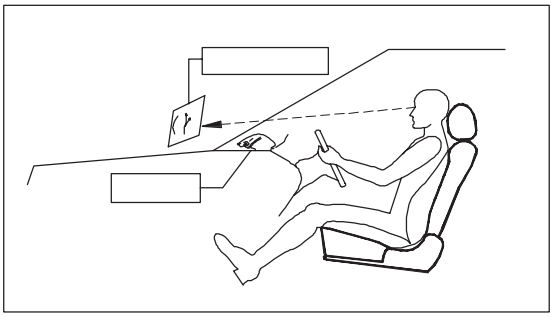
PROXIMITY SENSORS

Reflective displays (Fig 6)

Reflective displays use a mirror embedded in the dash so the instruments appear further away than they are actually , This way the drivers focal point changes less when looking from the road to the instruments and back.

Conventional instrument panels require the driver to change the line of sight and their visual focal length to read information on the instrument cluster. This means the driver is looking away from the road for a significant distance when travelling at speed.

Fig 6



REFLECTIVE DISPLAYS

Reflective displays are mounted within the dash panel. They use a mirror embedded in the dash, forward of the driver, to reflect an image of the instrument cluster. The actual instruments are hidden in the dash and it is a reflected view of them that the driver sees.

This has the effect of the instruments appearing to be located further away than they actually are. The benefit of this system is that the drivers focal point changes less when looking from the road to the instruments and back.

Triangulation / trilateration

Trilateration or triangulation is the system whereby a vehicles location is determined by forming a triangle with a group of four or more satellites.

The Global Positioning System or GPS uses a group of at least 24 satellites orbiting approximately 12 600 miles or 20 200 kilometers above the earth. The vehicle is equipped with a receiving antenna and computer system. The GPS receiver on the vehicle has to locate four or more of these satellites, determine the distance to each, and use this information to establish its own location. This operation is based on a mathematical principle called “trilateration”.

“Trilateration” in three dimensional space is quite complex. For ease of understanding, the term that is generally used in the automotive industry to describe how the GPS positioning system operates, is “Triangulation”. “Triangulation” is the process of finding the position of an unknown point based on forming a triangle with two known points.

For simplicity, the dimensions used to determine these points are commonly known as latitude, longitude and elevation.

If a group of three satellites are taken to form a triangle, 12 600 miles or 20 200 kilometers above the earth, the shape and size of this triangle will never change.

Equally any fixed point on the surface of the earth will triangulate with the satellites. The numbers of fixed points are infinite.

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What the GPS does to work, is form many triangles with triangulate with the satellites. The numbers of fixed points are infinite.

What the GPS does to work, is form many triangles with different pairs of satellites.

Each satellite has an atomic clock onboard and regularly transmits a unique radio frequency signal simultaneously with all other global positioning satellites. The RF signals travel out across space in all directions.

The speed at which RF signal travels in space is approximately 186,000 miles or 300,000 kilometers per second, the speed of light in a vacuum.

Each of these transmitted signals will reach the GPS antenna of the vehicle. The time taken for the RF signal to travel from each satellite and arrive at the vehicle is dependent on the distance each satellite is from the vehicle. The greater the distance the longer the time taken.

The vehicle's onboard GPs system needs to know three things to determine the location of the vehicle.

The time it takes for the signal to travel from the satellites to the vehicle.

The location of each satellite.

And accurate time.

Given these facts, enough information is available to form a three dimensional figure of a pyramid with a triangle base.

The base of the pyramid is formed by the location of the satellites and the apex of the pyramid is the location of the vehicle on the earth, a point derived from triangulation of the known points of the base.

The GPS equipment knows that all of the apexes (the position of the GPS) of each triangle must be in the same literal position.

Telematics

Automotive telematics is a satellite based system that combines two way communication and information technology within the vehicle.

Using this system allows for: vehicle tracking, monitoring of onboard systems, messaging, travel information, entertainment, security, safety and fleet management systems which monitoring of onboard systems, messaging, travel information, entertainment, security, safety and fleet management systems which monitor information such as location, distance traveled, speed, stops and fuel usage.

A vehicle manufacturer may offer telematics as a service to its customers. The benefits of this can include: the location & immobilization of a stolen or lost vehicle, notification to emergency services after SRS deployment, engine shut down and door unlocking in the event of a severe accident, roadside assistance and remote diagnosis.

Car becomes a connected mode on the network

Network & multiplexing

A multiplex network reduces the number of wires in the wiring harness and greater vehicle content flexibility.

Even the most basic vehicles include many electronically controlled systems. If each electronic system had its own ECU, harness and sensors, the weight of the added components would negate any efficiency it provided. A vehicles multiple electronic systems could require over 1 mile or 1.6 kilometers of insulated wiring, consisting of around 1000 individual wires and many terminals.

One solution to the problem is the use of a system that integrates sensors into a common wiring harness by combining all the individual systems, where possible, into a multiplexed serial communications network, so they can share the information.

An added advantage of such a system is that if there is less wire and connections there is less chance of dirty connections causing faults.

This system is referred to as a controlled Area Network BUS or BUS and it uses two thin wires to connect, or multiplex, all the control units and their sensors to each other. The output devices are referred to as nodes.

The advantage of a multiplex network is that it enables a decreased number of dedicated wires for each function, and therefore a reduction the number of wires in the wiring harness, reduced system cost and weight, improved reliability, serviceability and installation.

In addition, common sensor data such as vehicle speed engine temperature etc. are available on the network, so data can be shared, thus reducing the number of sensors.

Also, networking allows greater vehicle content flexibility because functions can be added or modified through software changes.

Other control units can be added to the system by simply connecting them to the network.

A diagnostic tool can be connected to the CANBUS to extract operation information to assist in diagnosis and fault.

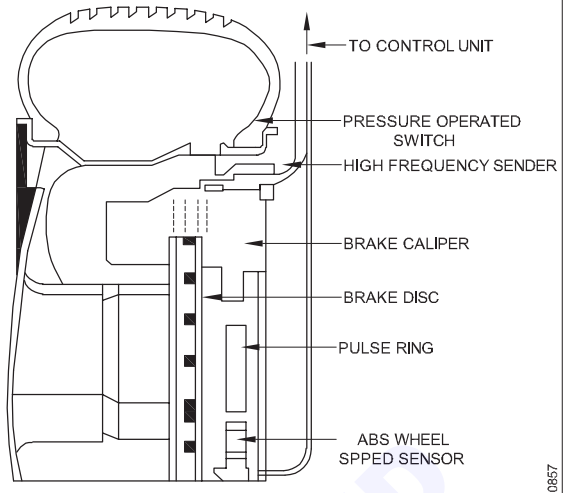
Tyre pressure warning

Poorly inflated tyre causes loss if control and increase fuel consumption. Fig 7 shows the layout and circuit of the tyre pressure warning system. The main idea is to give the driver warning of reduced pressure. There are three basic components used in the system. A pressure operated switch is mounted in the wheel rim, the contacts of which close when pressure falls. This is recognized by a high frequency pulser transmits an appropriate pulse to the electronic evaluator. When the pressure drops below the set valve, the switch contacts close. this causes the high frequency pulser to interrupt its stream of pulses to the evaluation circuit so that the warning lamp lights up. The system measures the tyre pressure with an accuracy of $\pm$ 5kPa. The design of the switch is such that changes in the temperature of the air in the tyre do not cause false

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readings. If a tyre pressure warning system is used in conjunction with wheels fitted with limp home tyres.

Fig 7



HIGH FREQUENCY SENDER

Immobilizer system

Objectives: At the end of this lesson you shall be able to
- **description of immobilizer system**
- **state immobilizer circuit.**

Engine immobilizer

The engine immobilizer is a theft protection system that prevents someone from starting the engine with an incorrectly coded key.

> **Do not shield the car keys with metal objects. This may prevent the receiver from recognizing that key as a valid one.**

Engine immobilizer system description

The engine immobilizer system is designed to prevent the vehicle from being

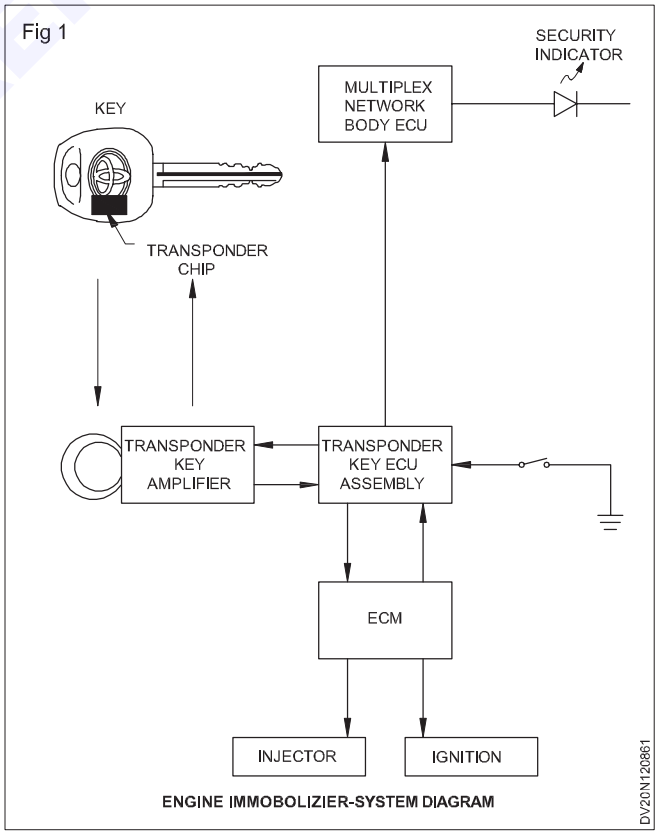
This system uses a transponder key ECI that stores the key codes of authorized ignition keys. If an attempt is made to start the engine using an unauthorized key, the ECU sends a signal to the ECM to prohibit fuel delivery and ignition, effectively disabling the engine.

When the ECU detects that the unlock warning switch is ON, the ECU provides current to the transponder key coil and produces a faint electric wave. A transponder chip in the key grip receives the faint electric wave. Upon receiving the faint electric wave, the transponder chip outputs a key ID code signal. The transponder key amplifier amplifies it, and then the signal is transmitted to ECU. The ECU matches the key's ID code with the vehicle's this signal, the transponder key amplifier amplifies it, and then the signal is transmitted to the ECU. The ECU matches the key's ID code with the vehicle's ID code, which was previously registered in the ECU and then communicates the results to the ECM using the SFI communication.

After the identification results show that the key's ID code matches the vehicle's ID code and the ECU has confirmed their match:1) the immobilizer system is canceled and the engine starting controls (fuel injection control and ignition control) enter standby mode; and 2) the ECU transmits a security indicator signal that communicates "indicator OFF" to the multiplex network body EXU. Then, the multiplex network body ECU turns OFF the security indicator lamp.

Immobilizer circuit (Fig 1)

Fig 1



ENGINE IMMOBOLIZIER-SYSTEM DIAGRAM

Car alarms/Audio warming system

There are several alarm systems that will serve to deter or discourage vehicle thefts and alert others of forced entry

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into the car. You need sure that these noise speakers should be installed in such a way as not to be easily accessible on glance, else will be forts disabled by them.

Various sensors are provided in a vehicle for protect from damage and give warming signal by light signal or audio signal.

For example: Vehicle reverse audio warming driver seat belt non wearing warning vehicle side and front distance warming by beep sound.

Steering lock

A long metal bar with a lock that fits on the steering wheel and is designed to prevent the steering wheel from turning, steering wheel locks are effective.

ICAT

ICAT means Intelligent Computerized Anti - Theft system under this system the car starts only when car starts only when the sensor in the vehicle accepts the chip in the key. Even sensors creates alarms buzz, when someone tries to insert the fake key in a car.

GPS tracker

A GPS facility, which can help tracking a stolen car. In fact, it can also alert a misuse of your car by any service station.

Tyre lock

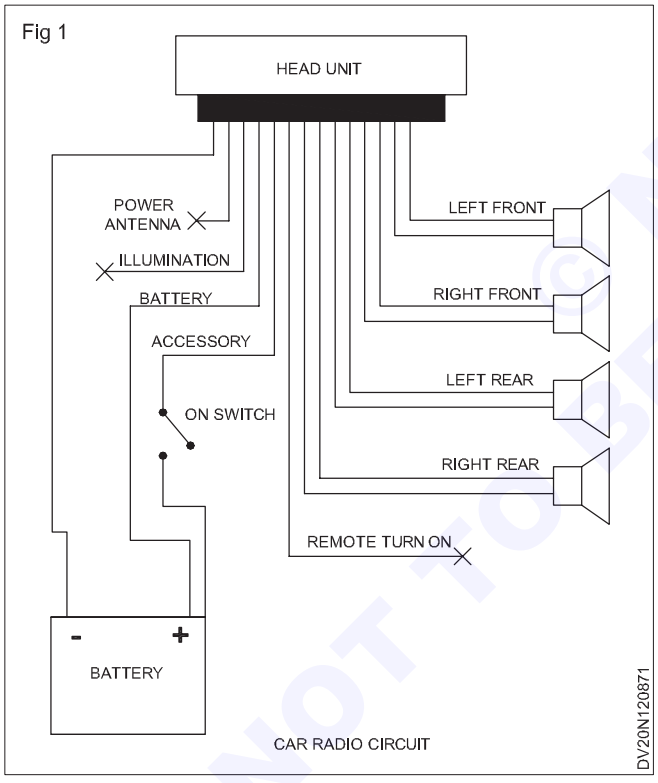
Tyre lock device is very difficult to lock and unlock the car wheel, but its cost is very lower than other anti theft system device.

Audio system

Objectives: At the end of this lesson you shall be able to
- **describe head unit**
- **describe the amplifier**
- **describe the speaker.**

Head unit (Fig 1)

Fig 1



A car audio system uses separate electronic components - a radio tuner, DVD player, preamp, amplifier - connected by various cables. The head unit performs two main functions are controlling the overall system volume and the various audio and video sources in a vehicle.

Head units can also be used to control media players like the iPod or navigate the content of a USB flash drive that's connected to the stereo system. Head units with Blue tooth audio can also play music that's streamed wirelessly from a compatible mobile phone.

In addition to controlling the system's volume, head units usually include basic tone controls such as bass and treble to tailor the sound to the listener's taste. Many audio systems also include signal processing that automatically adjusts the volume, depending on the ambient noise in a moving vehicle. Some audio systems also have a separate subwoofer and subwoofer level controls.

The amplifier (Fig 2)

A car stereo system has to have an amplifier to increase the power of an audio signal so its strong enough to move the speakers and create sound. Amplification is a two stage processes handled by a preamp and a power amplifier.

The preamp is usually housed inside the head unit and takes data from a radio, CD player or other audio source and prepares it for the power amplifier. This process includes slightly boosting the audio signal, which makes it compatible with the input of the power amplifier and ensures that its resistant to noise that can radiate from other electronics in a vehicle. The power amplifier then takes the preamp's low -level single and significantly boosts it so it can move the speakers and create sound.

Many head units have a small, built - in low power amplifier that can "drive" smaller speakers. This allows the audio system to be reduced to just a head unit and a few speakers. But better sound requires more power. So higher - end systems have separate power amplifiers that are mounted away from the head unit due to their size and the heat they generate.

The speakers (Fig 2)

Speakers take an amplified electrical signal and convert it into mechanical energy that moves the speaker cone back and forth to create sound. Sound is essentially vibrations in the air that we hear, and a speaker cone

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creates these vibrations. The human ear hears these vibrations in a frequency range from about 20 hertz (very low bass) to 20,000 Hz (very high notes).

The most basic automotive speakers are designed to be “full range” to cover the entire frequency range. But by trying to cover the entire frequency spectrum, bass response is generally nonexistent and higher frequencies are dull. You can get more accurate sound reproduction by using an assortment of speakers dedicated to reproducing a smaller range of sound.

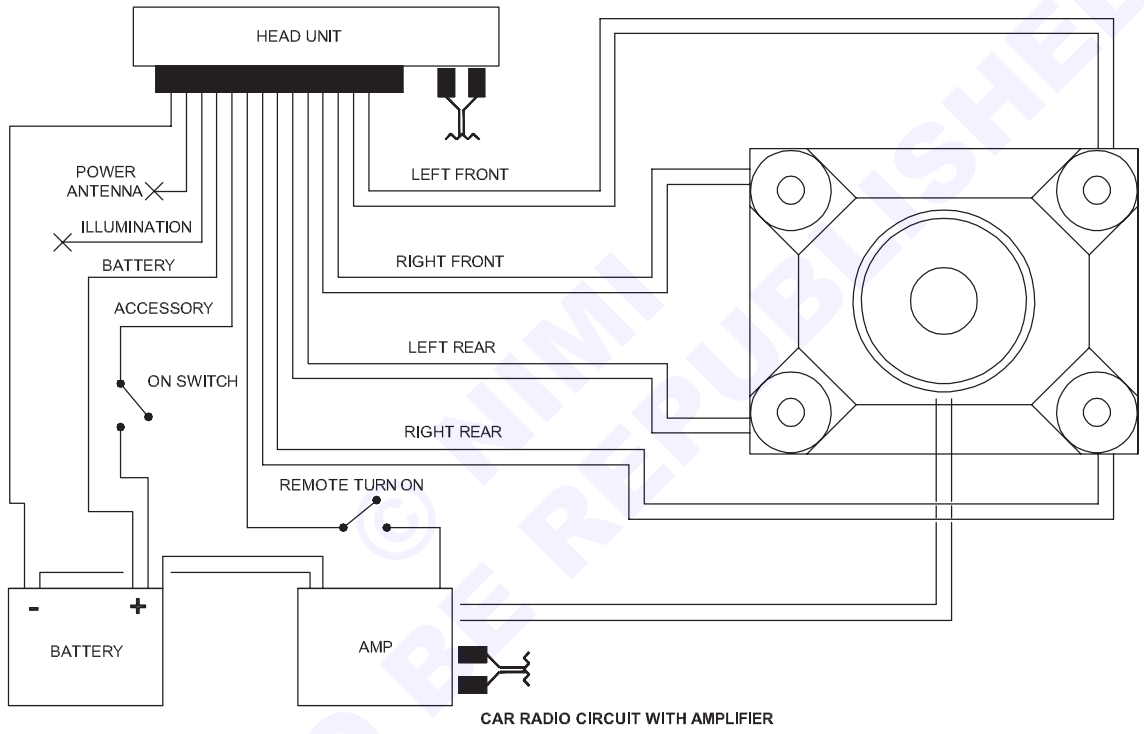
Woofers and subwoofers are large speakers designed to reproduce only low frequency bass sounds. The aptly named midrange drivers handle the middle range frequencies. Some systems take it one step further and use a specialized midas driver to handle the troublesome frequencies between low bass and midrange. Tweeters are the smallest of the specialized drivers and reproduce the upper treble frequencies.

Car videos

A car video system uses separate electronic components LCD monitor is connected with DV players, speakers and rear view camera.

In many car sound systems, two speakers of different sizes are combined on one frame to create a two way speaker. For example a coaxial speaker mounts a small tweeter directly above and on the same axis as a small woofer. That creates a full -range speaker from two separate drivers.

Fig 2



CAR RADIO CIRCUIT WITH AMPLIFIER

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Vehicle service informations

Objectives: At the end of this lesson you shall be able to
- **Vehicle information report**
- **use scan tool data**

Vehicle Information Report

A Vehicle Information Report (VIR) provides information about a vehicle’s registration history in Alberta only. The report is produced using the Vehicle Identification Number (VIN). A VIN is the unique serial number assigned to every vehicle by the manufacturer. An accurate and complete VIN must be provided to complete a VIR request.

The information contained in the VIR includes:

- The date and time of the report
- **Vehicle description -** year, make, model, style, colour, fuel type, odometer reading if available
- **Vehicle status -** active, salvage, non-repairable, unsafe, rebuilt, etc.
- **Vehicle registration -** date vehicle first entered on system, license plate classification, registration history date and location.
- **Lien information -** provides the number of liens and other related instruments which are registered in the province of Alberta and associated with the serial number (detailed information, such as the secured party and the party to whom the money is owed, can be determined by purchasing a separate Personal Property lien search)

- The VIR ONLY shows information from the Alberta Motor Vehicle System.

Locating vehicle information

RTO vehicle information about car or bike with owner's and vehicle details verify the vehicle registration details, on which person's name it is registered, it is not on your name change it immediately with VAHAN RTO INDIA anytime.

All RTO registration number verification at one place. This APP works for all vehicle types such as cars, M/C, trucks, autos etc.,

How to use this APP?

Type your name vehicles first 6 letters (e.g GJ01RM) in box.

Now type vehicle number in seen box (e.g 4321)

Click on "Check RC status" and get details.

Details available

- RTO vehicle registration data
- Vehicle owner name
- Vehicle age
- Vehicle registration authority
- Vehicle engine number
- Vehicle chassis number
- Vehicle maker model
- Vehicle class
- Vehicle fuel type
- Vehicle state and city
- Vehicle age and fitness certificate expiry date of Vahann.
- Insurance information of Vahaan.
- Motor vehicle tax details

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Obtaining and interpreting scan tool data

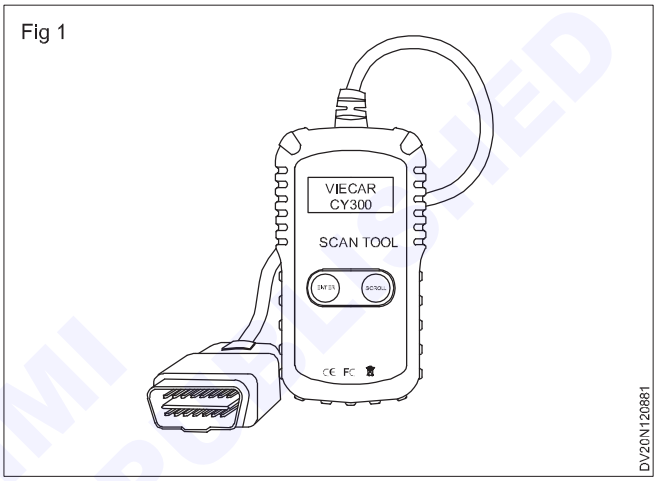
OBD I & II stands for on board diagnostics second generation superstanding that of OBD I, OBD II is a system that was mandated by the federal EPA and was developed by the society of automotive electronic diagnostics, ao technicians can use the scan tool to test all makes and model of automobiles with ou special adoptors or factory seamers. When the EPA mandated OBD II computer systems, they also mandated that all manufacturers would also mandated that anybody. Scanner could have access to the computer system with the proper software and adoptors. The information would have the same code terminology data parameters, freeze frame data and system monitors updated scanner software will usually have OBD II genericmode and allow you to retrieve codes, data, monitor inforamtion and freeze frame data without having to buy specific software for that manufacturer.

Standardization of OBD computer system

- Universal diagnostic test connector or data link connector (OBD - II)
- Standard location for the DLC (dash board)
- Standardized list of generic diagnostic trouble code (DTC)
- The ability to clear all hard and pending codes with a scan tool
- The ability of the computer system to record a frame of data as a fault occurs within the computer system known as freeze, frame data

Obtain an OBD II scan tool (Fig 1)

Fig 1



- Locate the diagnositic link connector in your vehicle.
- Insert the scan tool connecter or code reacter into the DLC
- Enter your vehicle information
- Find the menu

Malfunction Indicator lamp (MIL)

The MIL is that terrible little light in the dash that indicates a problem with the car.There are a few variations, but they all indicate an error found by the OBD -II protocol.

Scan tool letter codes

First unit identifies the type of error code

- **Pxxxx** for power train
- **Bxxxx** for body
- **Cxxxx** for chassis
- **Uxxxx** for class 2 network

Second digit shows whether the code is manufacturer unique or not

- **x0xxx** for government - required code
- **x1xxx** for manufacturer - specific code

Third digit shows us what system the trouble code references

- **xx1xx/xx2xx** show air and fuel measurements

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- **xx3xx** shows ignition systems
- **xx4xx** shows emissions systems
- **xx5xx** references speed / idle control
- **xx6xx** deals with computer systems
- **xx7xx/xx8xx** involve the transmission
- **xx9xx** notates input/ output signals and controls

Digits four and five show the specific failure code

- xxx00 to xxx99 - these are based on the systems defined in the third digit.

Learn the letter with code number

For example

P 0XXX - Models

P1XXX - Manufacturer

P07XX - Transmission

Read engine fault code - P0301 - Misfire on No.1 cylinder.

Terminology

Before we get too much farther, let's make sure we understand all the keywords used in these protocols.

Engine/Electronic Control Unit (ECU)

The ECU can refer to a single module or a collection of modules. These are the brains of the vehicle. They monitor and control many functions of the car. These can be standard from the manufacturer, reprogrammable, or have the capability of being daisy-chained for multiple features. Tuning features on the ECU can allow the user to make the engine function at various performance levels and various economy levels. On new cars, these are all typically microcontrollers.

Some of the more common ECU types include

- Engine Control Module (ECM) - This controls the actuators of the engine, affecting things like ignition timing, air to fuel ratios, and idle speeds.
- Vehicle Control Module (VCM) - Another module name that controls the engine and vehicle performance.
- Transmission Control Module (TCM) - This handles the transmission, including items like transmission fluid temperature, throttle position, and wheel speed.
- Powertrain Control Module (PCM) - Typically, a combination of an ECM and a TCM. This controls your powertrain.
- Electronic Brake Control Module (EBCM) - This controls and reads data from the anti-lock braking system (ABS).
- Body Control Module (BCM) - The module that controls vehicle body features, such as power windows, power seats, etc.

Diagnostic Trouble Code (DTC)

These codes are used to describe where an issue is occurring on the vehicle and are defined by SAE . These codes, can either be generic or unique to the vehicle manufacturer.

Using a diagnostic car code reader

Diagnose car problems with an auto code reader. Simply plug it into the car's computer system, then interpret the trouble code readout.

Plug your car code reader into the diagnostic link connector under the dash (engine off). Then start the vehicle and follow the auto code reading procedure in the instruction manual.

An engine code reader/scanner can help you make the drive/no drive decision and even help you fix the problem. It works by plugging into the car's computer system and displaying a "trouble code."

An engine code reader/scanner is worth buying if you're a fairly competent amateur mechanic who understands how an engine works. But it's not a silver bullet that will always tell you exactly what's wrong. An auto code reader give you a head start, but you'll still have to do some detective work before you start pulling and replacing parts (more on this later).

The least expensive auto code reader units are simple car code readers that burp up an alphanumeric trouble code but no information about what it means. You'll have to look up the code in a reference book or search the Internet. Midpriced units actually display the problem on the screen, like "P0115 Engine Coolant Temperature Circuit Malfunction." One model even accesses the Internet, so you can upload the trouble code to a Web site that has information on the most likely cause of the problem.

Here are three ways to get to the root of a problem without replacing good parts.

1 Go to the car code reader/scan tool manufacturer's Web site to see if it has information on your trouble code.

2 Take advantage of Internet forums. Just search for your car's model and add "forum" to the search term. Register for the site (usually free) and post your question, including your vehicle's year, mileage, code number and what you've done so far. You'll be surprised by the number and quality of responses you get.

3 Subscribe to an online shop manual. It will have not only all the carmaker's technical service bulletins listed but also the complete diagnostic procedure for your particular code. It will walk you through the testing procedure, telling you which wires to check and what voltages you should see. The services also include component locators to help you find the part in your vehicle, and wiring diagrams showing the connector position for each wire.

Required tools for this project

You'll need a code reader or scanner, along with a computer with internet access for interpreting the trouble codes.

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Interpreting generic scan data

Generic scan data provides an excellent foundation for OBD II diagnostics./ Recent enhancements have increased the value of this information when servicing newer vehicles.

One of the best places to start is with a factory scan tool.

Example

The Mass Airflow (MAF) Sensor, if the system includes one, measures the amount of air flowing into the engine. The PCM uses this information to calculate the amount of fuel that should be delivered, to achieve the desired air/fuel mixture. The MAF sensor should be checked for accuracy in various rpm ranges, including wide-open throttle (WOT), and compared with the manufacturer's recommendations, volumetric efficiency and help with MAF diagnostics.

When checking MAF sensor readings, be sure to identify the unit of measurement. The scan tool may report the information in grams per second (gm/S) or pounds per minute (lb/min). For example, if the MAF sensor specification is 4 to 6 gm/S and your scan tool is reporting .6 lb/min, change from English units to metric units to obtain accurate readings. Some technicians replace the sensor, only to realize later that the scan tool was not set correctly. The scan tool manufacturer might display the parameter in both gm/S and lb/min to help avoid this confusion.

Oxygen Sensor Output Voltage B1S1, B2S1, B1S2, etc., are used by the PCM to control fuel mixture. Another use for the oxygen sensors is to detect catalytic converter degradation. The scan tool can be used to check basic sensor operation. Another way to test oxygen sensors is with a graphing scan tool, but you can still use the data grid if graphing is not available on your scanner. Most scan tools on the market now have some form of graphing capability.

The process for testing the sensors is simple: The sensor needs to exceed .8 volt and drop below .2 volt, and the transition from low to high and high to low should be quick. In most cases, a good snap throttle test will verify the sensor's ability to achieve the .8 and .2 voltage limits. If this method does not work, use a bottle of propane to manually richen the fuel mixture to check the oxygen sensor's maximum output. To check the low oxygen sensor range, simply create a lean condition and check the voltage. Checking oxygen sensor speed is where a graphing scan tool helps.

Note:The sensor should be tested with a lab scope to verify the diagnosis before you replace it.

Automatic Transmission

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

- **define automatic transmission**
- **state the controlling variables of the automatic transmission**
- **identify the major components**
- **explain the working principle of automatic transmission**
- **state the electro hydraulic transmission control.**

Definition

Automatic transmission of an automobile is defined as to shift the gears automatically depending upon the speed and load of the vehicle.

Operation of an automatic transmission:

The engine transmits power to the pump of the torque converter, the pump converts this power into transmission fluid that powers the turbine of the torque converter. This apparatus increase the power of the fluid and transmits even more power back to the turbine, which creates a vortex power rotation that spins the turbine and the attached central shaft. The power created by this rotation is then transmitted from the shaft to the transmission first planetary gear set.

The transmission fluid is pressurized by an oil pump, which allows the speed to change depending on the vehicles speed, tire revolutions per minute and other factors. The gear pump is placed between the planetary gear set and torque converter, where it pulls and pressurizers transmission fluid from a sump. The pump input lead directly to the housing of the torque converter attached to the flex plate of the engine. When the engine is not running, the transmission does not have the oil pressure needed to operate and thus the vehicle cannot push started.

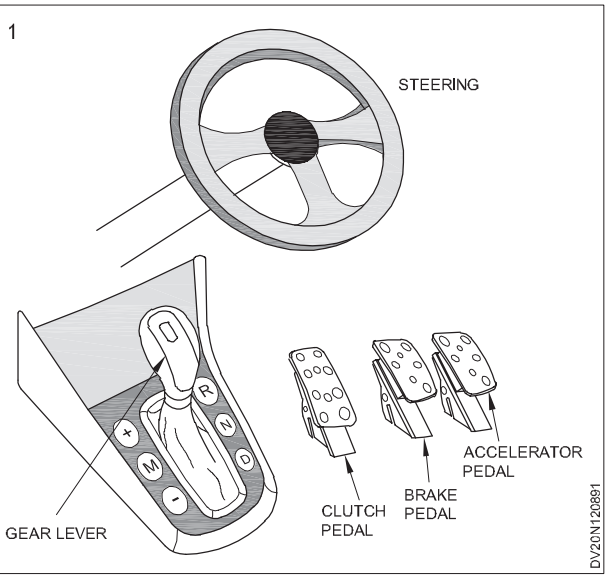
The planetary gear train is a mechanic system in which the gears are connected with a set of bands and clutches. When the driver changes gears, the bands hold one gear skill while the driver changes gears, the bands hold one gear skill while rotating another to transmit torque from the engine and increase or decrease gears.

Note: Six speed automatic transmissions are the most common number of gears, but older cars and entry level car may skill have four or five gears.

Automated manual gear box have two operation position automatic transmission and manual transmission, automatic transmission system carriers out gears changes, independently without driver input. In manual transmission the driver can change gear manually too by putting the gear lever is manual mode and selecting gears irrespective of driving in automatic or manual mode (Fig 1).

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Fig 1



Controlling parameters of the automatic transmission

The main controlling variables are

- Selector lever position
- Driving speed
- Engine load (accelerator pedal position)

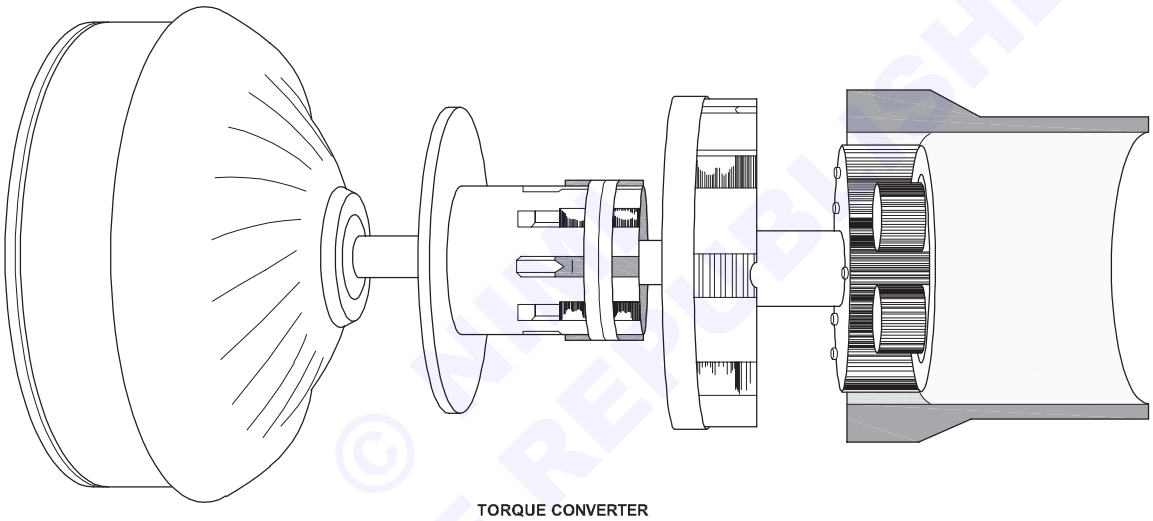
Major automatic transmission components

- Torque converter (Fig 2)
- Planetary gear unit
- Electro hydraulic control

Advantages of Automatic transmission

- Simple driving control
- Improved acceleration and hill climbing

Fig 2



- Reduced fuel consumption
- Less wear and tear due to planetary gearing
- Less fatigue to operator
- No need clutch pedal and gear lever
- Vehicle smooth running under all conditions due to automatic gear change
- Noiseless gear shifting
- Longer life
- No jerky driving

Torque converter

Torque converter is used to transfer power from the engine to the transmission input shaft. It acts as an automatic clutch to engage and disengage the engine and the transmission. It allows the engine to run idle when the vehicle is standing still.

The torque converter is mounted on the transmission input shaft and connected with the fly wheel of the engine.

Functions of torque converter

- It convert and transmit the engine torque
- It facilitate smooth, comfortable starting
- It damp the engine torsional vibrations
- The major components of torque converter are
- Impeller
- Turbine
- Stator

The impeller, turbine wheel and stator are designed as curved blade wheels and operate in an enclosed housing which is filled with hydraulic fluid.

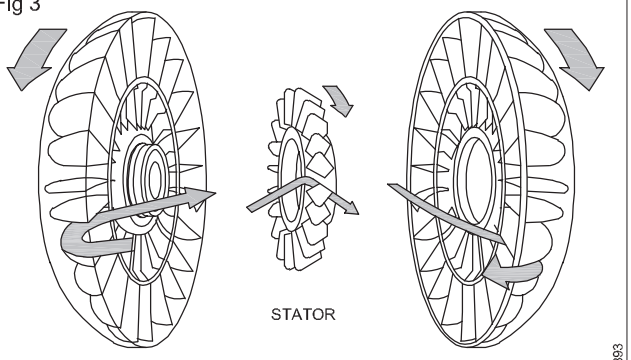
The impeller is driven by the engine flywheel. Guide rings are provided on the inner edges of the vanes to provide smooth fluid flow. When the impeller is driven by the engine, the centrifugal force causes the fluid to flow outward towards the turbine.

The input shaft of the transmission is attached with the turbine hub which is splined. The curvature of the vanes in the turbine is opposite is opposite of the impeller vanes.

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This makes the turbine to rotate when the fluid is forced from the impeller vanes. Therefore the turbine is also starts rotating in the direction of engine rotation. (Fig 3)

Fig 3



TORQUE CONVERTOR

The stator is located in between the impeller and the turbine. It is mounted on the reaction shaft which is fitted to the transmission case. The vanes of the stator catch the fluid as it leaves the turbine and redirects it back to the impeller. This gives the impeller an added torque.

The over running clutch drive in the stator allows the stator to rotate in one direction. Normally it rotates in the direction of the crank shaft. The over running clutch drive does not allow the stator to rotate in opposite direction.

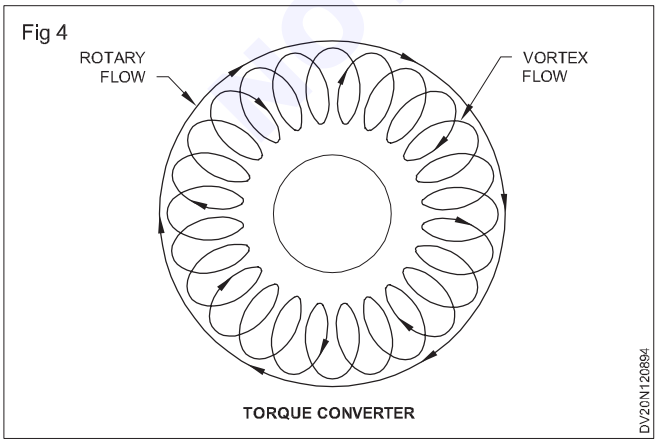
Working principle

During starting, the impeller rotates at the engine speed, while the turbine wheel and stator are stationary. The fluid flows from the impeller to the turbine wheel, dissipates its energy to the turbine and it deflected in the process.

During idling speeds the speed of the impeller is low and the fluid flow will not be able to rotate the turbine. But when the engine sped increases, the fluid moves fast and rotates the turbine.

There are two types of fluid flow (Fig 4). Vortex flow and radial flow. The flow will be vortex till the speed of the impeller and the turbine is not same. Vortex flow is a spiraling flow. Radial flow is fluid flow which circulates with the converter body rotation. This radial flow usually happens when the speed of the impeller and the turbine will be same.

Fig 4



TORQUE CONVERTER

When the engine is accelerating, the speed difference in the impeller and the turbine will be very high and the flow is called high vortex. During this time, fluid from the impeller directed towards the outer surface of the turbine and from the turbine it strikes the front of the vanes of the stator and locks it on the stator reaction shaft, preventing it from rotating in the anti-clockwise direction. The fluid passing through the stator is redirected by the shape of the vanes and strikes on the back of the vanes of the impeller which increase the torque of the impeller.

When the flow is rotary, the fluid from the turbine strikes the stator which allows the stator to rotate in the clockwise direction. This happens normally when the speed of the impeller and the turbine are in the same speed.

The rotary flow inside the torque converter happens when the vehicle is running in constant speed. This is called the coupling point.

Lock up clutch mechanism (Figs 5, 6 & 7)

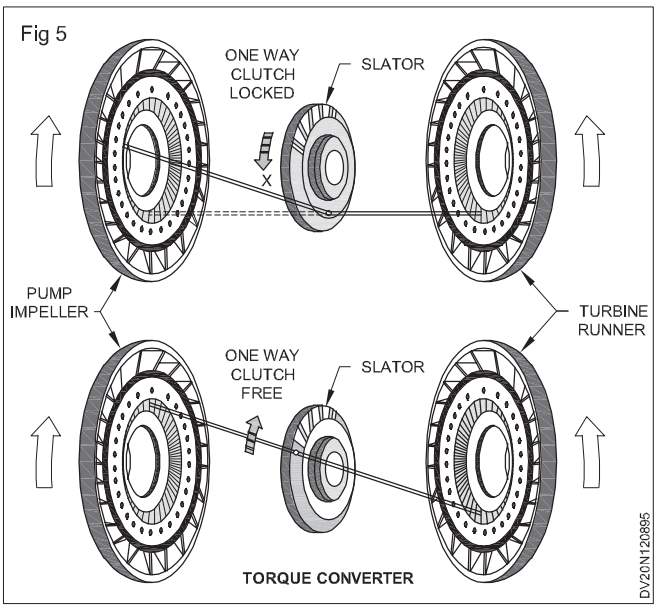
When the impeller and turbine are in the same speed, there is no torque multiplication takes place. The ratio is almost 1:1. However, it is not possible to get 100% power transmission in the torque converter, there is some power loss. The lock up clutch mechanically connects the impeller and the turbine when the vehicle speed is 60kmph and above. Thus 100% power transmission is possible.

The lock up clutch is fitted on the turbine hub. The lock up clutch is normally in disengaged position. When the clutch is operating, it engages the turbine with the torque converter case. It operates with the fluid. Relay and signal valves are control the hydraulic fluid flow.

When the vehicle is running at low speeds, the pressurized fluid flows in to the front of the lock up clutch and the clutch is disengaged. (Fig 6a)

When the vehicle is running at medium and high speeds, the pressurized fluid flows in the other side of the lock up clutch, creating low pressure in the front side of the lock up clutch. The difference in pressure makes the lock up clutch engaged (Fig 6b). As a result, the turbine and the case rotate together.

Fig 5



TORQUE CONVERTER

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Fig 6

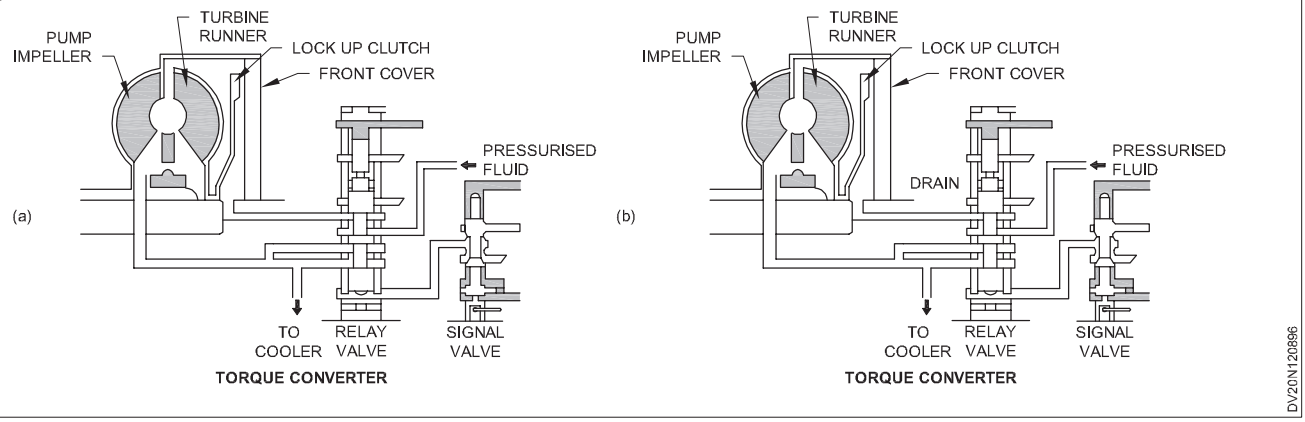
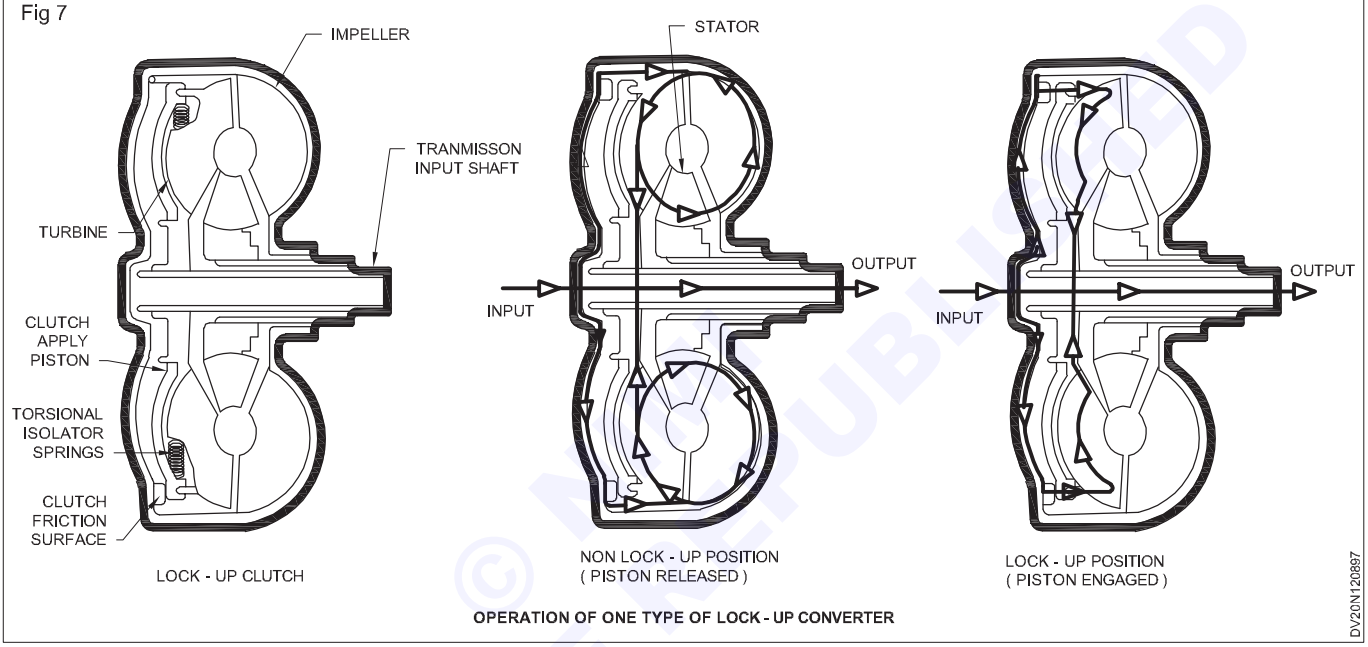


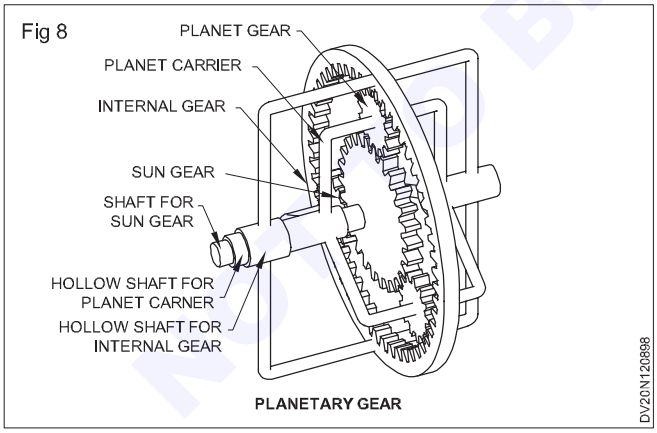
Fig 7



OPERATION OF ONE TYPE OF LOCK - UP CONVERTER

Planetary gear (Fig 8)

Fig 8



PLANETARY GEAR

A simple planetary gear set consists of

- Sun gear
- Planet gears
- Ring gear
- Planet carrier

The planet gears are supported with their axis in the planet carrier. The planet gears circulate on the internal teeth of the ring gear and the outer teeth of the sun gear. All gears are constantly meshed. The sun gear, planet carrier and ring gear are driven and braked. Output is effective through the ring gear or the planet carrier. Different gear ratios are achieved by this planetary gear set.

Three different forward gear ratios and one reverse gear radio are possible in this type. The drive of the planetary gears is set through the multi plate clutch. Different gear ratios and directional change are obtained by braking any one of the component.

Working principle of planetary gear set

1st gear (Fig 9)

The sun gear is the driving gear and the sun gear blocked. The planet gears circulate on the inner teeth of the ring gear. The power transmitted to the output shaft through the carrier. A larger gearing down takes place.

2nd gear (Fig 10)

The ring gear is the driving gear and the sun gear blocked. The planet gears circulate on the outer teeth of the sun gear. Power output from the carrier. The smaller gearing down takes place.

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Fig 9

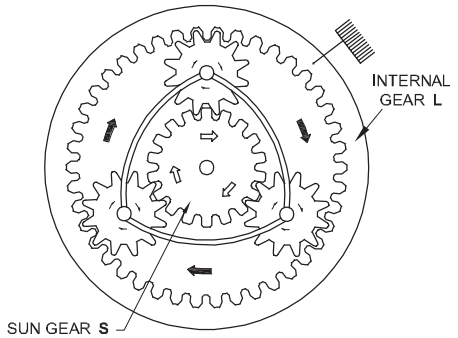
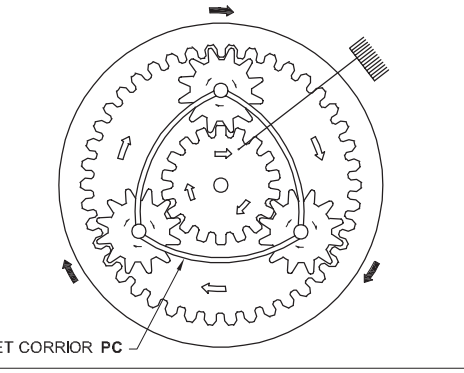


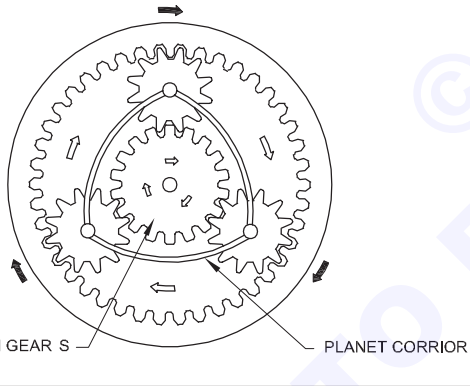
Fig 10



3rd gear (Fig 11)

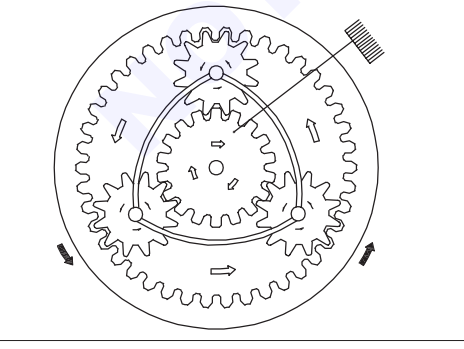
The planetary gear set is blocked the planet gears stop rotating and act as drivers. The output rotates same as input and power flow takes from planet carrier.

Fig 11



Reverse gear (Fig 12)

Fig 12



The planet carrier is braked. The sun gear is the driving gear and planet gears reverse the direction of rotation of the ring gear. A large gearing down takes place.

Shifting logic

The table 1 shows the shifting logic for a simple planetary gear set with three forward and one reverse speed.

Normally two or three planetary gear sets are used to get sufficient gear ratios.

Table 1: Shifting logic, 3 gear planetary gear

Gear	Input	Braked	Output
1st gear	S	I	PC
2nd gear	I	S	PC
3rd gear	S+1	--	PC
Rear	S	PC	I

S-Sung gear, I-Internal gear PC-Planet Carrier

Electro hydraulic transmission control

The electro hydraulic transmission control involves sensors, solenoid and hydraulic valves. The sensors recording specific operating status. The solenoid valves operate hydraulic valves which control the hydraulic pressure to the respective shift elements. The gear shifting is effected by driving and braking of different shift elements.

The electronic gear box control unit (EGS) processes the input signals from the sensors and other ECUs.

Vehicle side signals

Select lever contains

- P - Park
- R - Reverse
- N - Neutral
- D - Drive (all forward gears)
- Gear box side signals
- Gear box input speed
- Driving speed
- Transmission fluid temperature
- Engine side signals
- Acceleration pedal position
- Engine load
- Engine speed
- Coolant temperature

The gear shift sequences are selected using stored program in the EGS. The gear shift process and the control of the lock up clutch are effected by solenoid valve.

Shift elements

- Multi plate clutches
- Brake clutches
- Overrunning clutches

These are used to lock the sun gear, planet carrier or ring gear. These are all actuated by the electronic gear box control unit. By operating this, any one of the planet gear set component can be braked.

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Driving Simulator

Objectives : At the end of this lesson you shall be able to
- **state the driving simulator**
- **state the types of simulator**
- **state the need of simulator**
- **state the benefits of simulator – driving training**

Introduction to driving simulator: The driving simulator is built upon a number of software. The driving simulator is suitable for different types of application. In this system driver training and driver assessment programs generally use a fixed set of driving scenarios.

A virtual driving simulator is a device that allows user to feel.(Fig 1&2) Live experience of driving an actual vehicle within virtual reality it is effectively used for studying the interaction of a driver and vehicle and for developing new vehicle systems, human factor study, and vehicle safety research by enabling the reproduction of the actual driving environments in a safe and tightly controlled environments mostly vehicle simulators consist of physical mockups as examples steering wheel, gear shift and pedals.

Fig 1

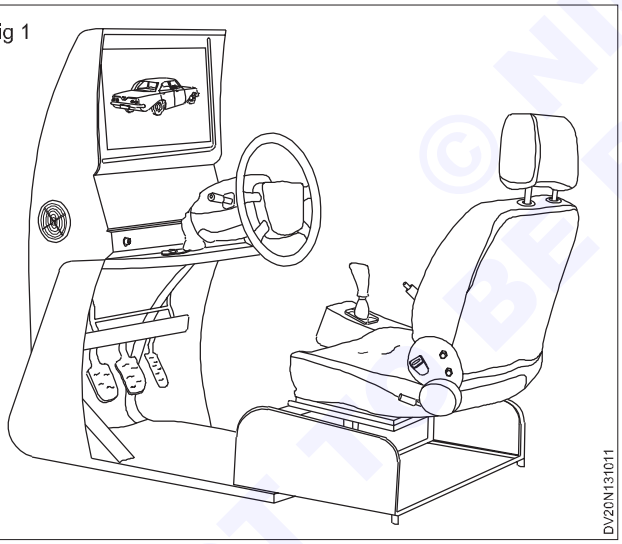
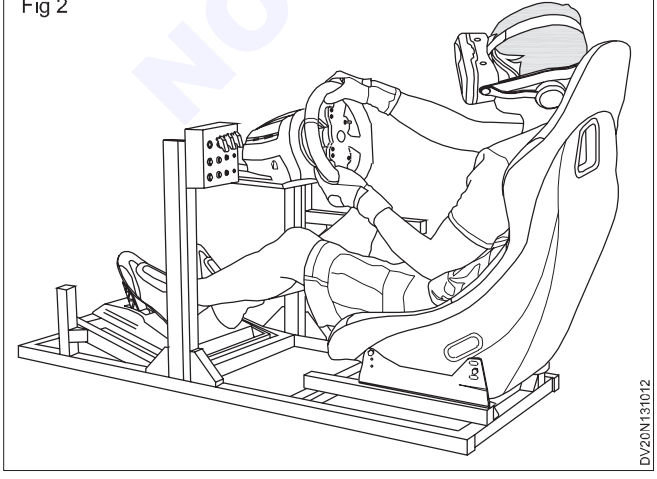
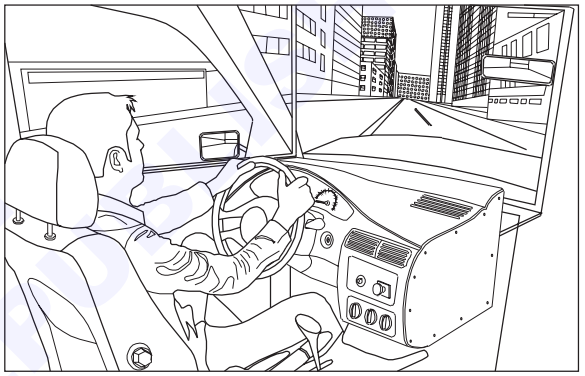


Fig 2



These are essential in trying to simulate real conditions then it is become as a draw back for system becomes more expensive more huge and then limited to reflect changes on the vehicles type, dimension or interior design. (Fig 3)

Fig 3



The virtual driving simulator environment consists of static universe, dynamic objects and interior of driver's vehicle. The static universe can be building, trees, road and others. The dynamics objects can include any moving objects in virtual scene like cars, people, and crowd. With more complex virtual scene will contain many thousands of polygons which need more graphic processing power and more computation cost to render the scene. Even on latest graphic hardware processing, the increase in complexity in virtual environment will increase computational power. The complex scene is needed to manage so it can be efficiently render in real time and avoid memory leak. Implement of 3d scene graphic management techniques help to reduce computational burden in complex driving simulator environment.

Most simulators act in isolation from the real world, so when we see one that breaks out of its virtual shell, we're more than a little intrigued. Driving simulator that's directly linked to an actual car's components sitting on a six-axis motion system. The whole affair works as a form of virtuous circle for testing, where the real parts feed on the simulator and vice versa : since the simulator is based on the internal model of the car, it can translate road results directly to the suspension and steering of the physical components, which promptly loop around and dictate force feedback in the simulator through

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actuators in the steering wheel. Apart from creating what amounts to the real driving simulator.

Types of simulator: Simulator can be divided as interactive and non-interactive. The interactive driving simulator responds to the driver, just as the driver responds to the simulator or called as a closed-loop driving simulator, but the simulator does only, what it was programmed to do, regardless of the drivers action often referred to as an open-looped system, interactive driving simulation represents real world such as actual road ways through computer generated imagery, auditory feedback, and realistic vehicle instruments and controls such a brake pedal, steering wheel, turn signal indicator, speedometer and mirrors.

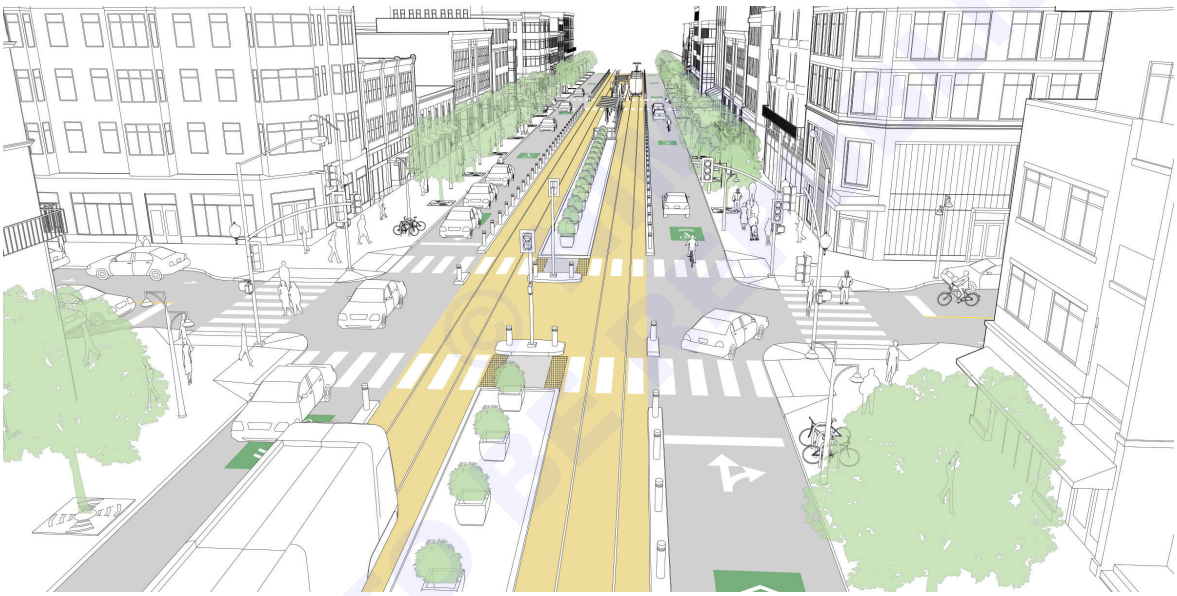
Using the simulator: First of all implies the definition of a simulation environment and task before the simulation can be executed, preparing and executing a simulation task requires the use of a number of software modules. Select the mode of drive and language for respond to the simulator.

Designing a simulation: Driving simulator is designed with road design and scenario. Road designs are erected by logical and graphical road network databases. The graphical design creates road segments and intersection in a 2D top view window with adding other elements (buildings tree's any other 3D objects etc.) from selection lists and integrates these in the stimulation road environment. (Fig 4 & 5)

Fig 4



Fig 5



Practicing basic driving skill: Theoretically learn about the basic driving tasks so that can do them simultaneously while driving. Practice these motions until you can do them without thinking.

Vehicle control tasks include handling the steering wheel, using the gas and brake pedals, shifting gears, visually scanning the road and using the turn signal

- Test various braking sceneries' to learn how to safely stop your car. Use the simulator to drive in down town area with lots of pedestrian foot traffic suddenly in the street and braking for ordinary reasons to get used to braking component in everyday driving.
- Use traffic sign sceneries' to practice responding to different road signs.
- Practice to turning and changing lanes by using your vehicle turn signal
- Avoid going over the speed limit or being distracted while driving the vehicle
- Park your simulator car in a variety of spots. Common parking, diagonal parking and parallel parking
- Gain experience with driving in both manual and automatic settings of the vehicle it will helps to your while actually driving.
- Handling dangerous driving conditions driving the vehicle on a crowded road can be stressful experience.
- Simulator driving at night to get accustomed to driving on slick surfaces. Practice driving in simulated rain to learn what to do in these conditions in a risk free environment.

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- Navigating different environment simulate driving on steep inclines, if you drive in a hilly area. Consider practice driving on simulated hills, if you plan to drive in an area with lots of steep inclines.
- Practice driving on rural roads, and the rural roads are number of safety hazards, such as relatively fewer traffic signs, a lack of shoulder or guard rails, a lack of street lights and others.
- Practice driving for get experience driving in bustling city centers.
- Drive on a simulated high way to practice driving under stress.

Note: Simulated driving is no replacement for the real things although a driving simulator will help you for driving practice in the real road in order to fully learn how to drive on rural, urban, hilly, city, highway roads.

Simulator car drive: Follow the following steps to drive the simulator car.

- Start a car
- Adjust your seat to the proper position before start driving
- Press the clutch pedal and engage the gear and gradually release the clutch pedal, simultaneously press the accelerator pedal.
- Drive practice on all types of road and change lane
- Use U turn signal while steer your car on turning the vehicle.
- Stop your vehicle at a stop signal by pressing brake pedals.
- Use the center turning lane on the highway drive
- Practice the braking slow down the vehicle while drive on the road
- Practice park the simulator car on a hill, parallel, angled, straight position (Reverse and forward parking)
- Practice to drive in reverse

Note:

- **Adjust the car rear view mirror and side mirror before start driving practice**
- **Wear seat belt before move the vehicle.**

Driving simulators need for training and testing of drivers

Our country's road transport ministry of India introduced a new rule in 2021 that permits applicants to skip the driving test conducted at regional transport office instead, drivers can now undergo training at an accredited driver training centre and passes the test on a simulator to obtain a driving license.

The accredited driving centres in India will be equipped with simulators and dedicated testing track to import high quality training and testing. The centres will also have infrastructure like bio metric attendance, real time and online evolution if the driving candidates successfully pass the test at these centres, they will be exempted from appearing for driving tests at RTO at the time of getting a license. Simulator-based training is widely gaming popularity in the back up of a large number of road accidents in India.

Benefits of simulator based training and testing

- Realistic operating environment
- Inbuilt instructor for continual guide-ness
- Self paced training modules in local language
- Intelligent traffic and weather for advanced training
- Objective reporting system with record and reply
- Training and testing under complete safety.

Graphical picture of the intersection from 2D top view windows

extended intersection including environmental elements 3D objects

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Pre - Driving checks

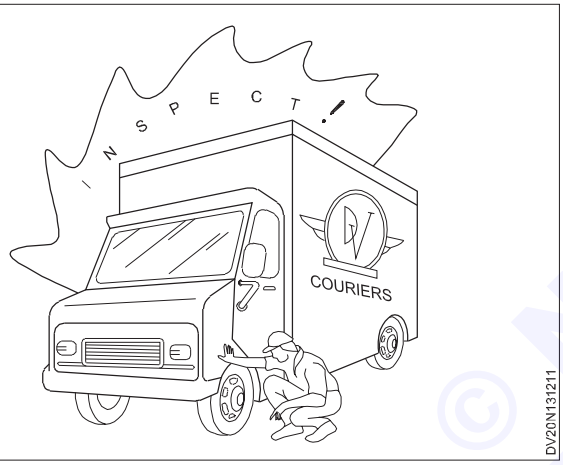
Objectives : At the end of this lesson you shall be able to
- **check the vehicle before sitting on driver seat**
- **check the dash board gauges and warning lights after sitting on drier test**
- **Check the documents pertains to the driver and vehicle.**

Vehicle pre-driving checks: Vehicle operator need to check the vehicle before and after start the engine as following steps

A Before sitting on driver seat: Before start the vehicle check the following systems

- Check the tyre air pressure for correct air pressure as specified by the manufacturer. (Fig 1)

Fig 1



- Check the fuel level in fuel tank and fuel leakages in the fuel system, if found any fuel leakages rectify the defects before start the engine.
- Check the engine oil level in oil sump, if found oil level is low top-up to high level marked in dip stick
- Check the Coolant level in radiator, if need top-up.
- Check the leakage of coolant, if found any leakage, rectify it before start the engine
- Check the battery condition, if found fungi on the battery terminal clean it
- Check the battery charge condition, and electrolyte level in each cell, if top up with distilled water

B After sitting on driver seat: After sitting on driver seat check the following

- Sit on the driver seat and adjust the driver seat for your comfortable driving
- Adjust the rear view mirror and side mirrors
- Insert the key in main ignition switch and switch on the key
- Check the panel board gauges and warning light.
- Start the engine and check the warning lights off incase warning lights are continuously glowing, it means some problems are in your vehicle if any problems found in your vehicle engine, stop the engine running and rectify the defects and start the engine for use.
- Check the fuel gauge, oil pressure gauge, temperature gauge engine rpm meter etc.
- Check the function of head light, indicator light, brake light, parking light, reverse light, gauges light and interior lights etc.
- Check the clutch and brake pedal function
- Check the gear shift lever and parking brake
- Check the gear shifting by pressing clutch pedal.
- Check the car A/c and Audio system
- Check the function of steering system and brake system
- Check the wiper and horn function before move the vehicle

C Checking the documents pertains to the driver and vehicle: The following documents should be keep with driver while vehicle drive in public places

- Vehicle Registration Certificate (RC book or smart card)
- Vehicle insurance certificate
- Vehicle fitness certificate
- Smoke test certificate
- Vehicle log book
- Vehicle duty register
- Vehicle owner's manual
- Driver's driving license

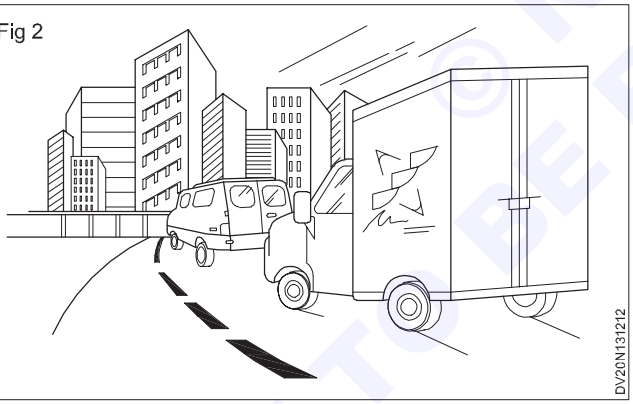
D Precautions and procedure to be followed while starting the vehicle

- Check the fuel system, fuel level engine oil sump oil level and coolant level etc. before start the engine
- Check the battery charge condition and battery terminal

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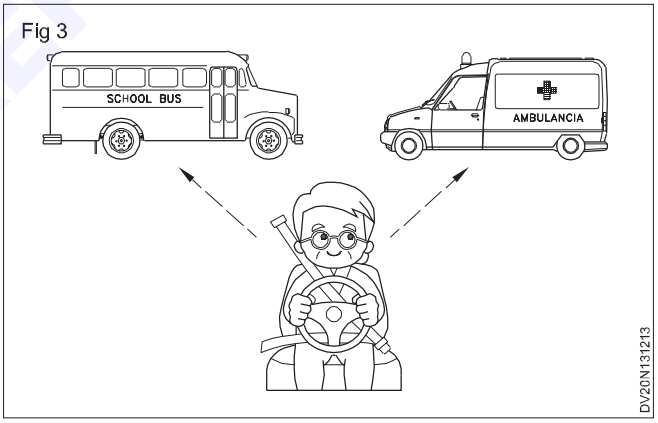
- Before start the engine, ensure gear lever is in neutral position
- Switch on the ignition key
- Start the engine and let it allow to run in idle speed
- Release the parking brake and press the clutch pedal
- Switch on the ignition key
- Engage the gear with help of gear shifting lever
- Release the parking brake and press the clutch pedal
- Engage the gear with help of gear shifting lever
- Release the clutch pedal gradually and simultaneously press an accelerator pedal for smooth move the vehicle
- Use the first gear to initial move the vehicle.
- Shift up and down the gears, depend upon the road condition
- Use the hand signal with indicator signal while move the vehicle
- Use the brake to slow down or stop the vehicle
- Use the parking brake on emergence
- Maintain the proper distance between up going vehicle and your vehicle (Fig 2)

Fig 2



- Look around your vehicle not just ahead
- Follow the traffic rules and traffic light signals
- Avoid sound horn near school and hospital or other sensitive area
- Pick up speed smoothly and gradually. It is safer and save fuel
- Stay alert and ready to apply the brake at any time
- When braking, begin smoothly and gradually increase pressure. Use firm, even pressure
- Tap your car brakes to signal cars behind that you intend to stop
- Get ready to brake each time you enter on intersection roads
- Plan ahead to avoid sudden vehicle stop
- Press the brake pedal evenly and smoothly
- Product your vehicle brakes from failure on hill by using low gear
- Maintain your vehicle brakes by having them serviced regularly
- Maintain proper speed and drive the vehicle safely
- Allow to pass over the emergency vehicles and school buses (Fig 3)

Fig 3



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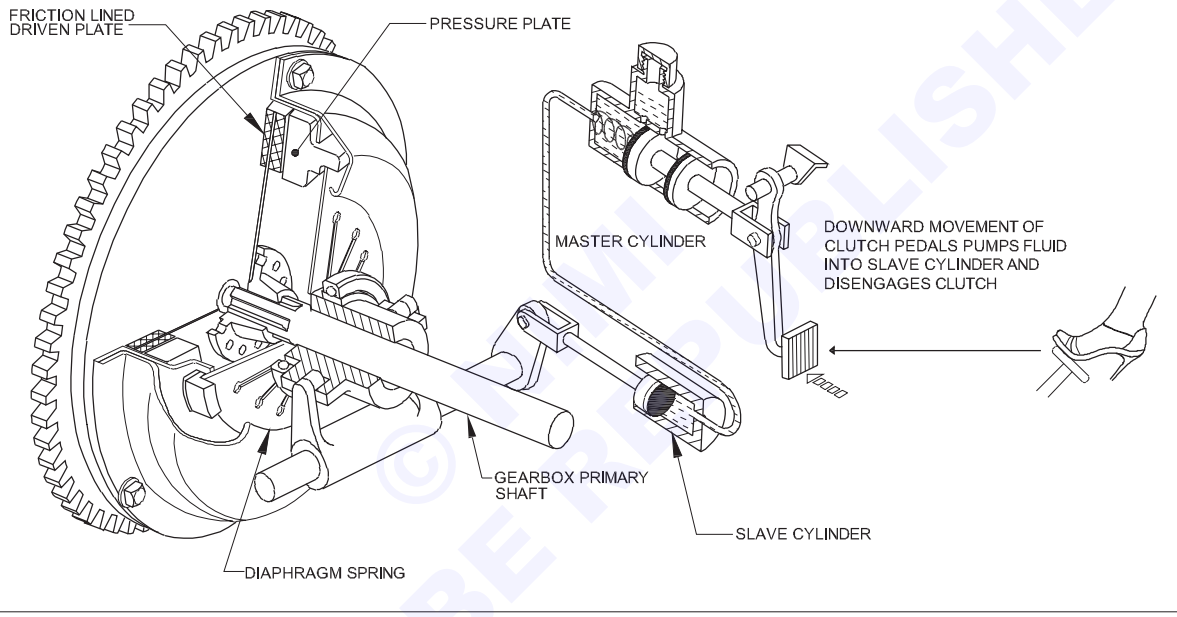
Use of clutch

Objectives : At the end of this lesson you shall be able to
- **state the use of clutch**
- **state the correct leg position on the clutch pedal**
- **state the biting point and balance point**
- **state the steering wheel hand grip and hand position.**

Clutch: The clutch is used to engage and disengage the engine power from fly wheel to gear box.

Leg position on the clutch pedal: When the vehicle operator applying clutch pedal to shift gears, the vehicle drivers left leg should be properly put on the clutch pedal for proper (press the clutch pedal to engage and disengage the engine power to gear box) clutch operation.

Fig 1



Clutch pedal biting point: Vehicle operator uses his left leg to operate the clutch pedal and his right leg is used to operate the brake pedal and accelerator pedal as per required situation of moving vehicle.

Whenever the vehicle driver puts his left leg on the clutch pedal his leg foot front position should be properly biting on the clutch pedal rubber pad covered position fully at flat position. His leg biting position on the clutch pedal should be comfortable to operate for the clutch engage and disengage it. When you are pressing the clutch pedal clutch consisted friction disc that separate from the power transmission. When you lift up the the clutch pedal, the clutch bite point is the stage in which the two discs connected to the engine is rotating constantly with the speed of the engine and the disconnected gear box is rotating much slower speed.

While raising the clutch pedal from the floor, It is at the bite point area that you must raise the pedal much slower. As the clutch disc begin to push together, the disc connected to the gear box will begin to rotate faster and providing the car is in first gear and the car will begin to move slowly.

As you slowly raise the clutch pedal through the bite point, the car speed will increase. Due to the car having the momentum and the clutch discs almost rotating at the same speed . When you fully release the clutch pedal from the floor, slowly through the bite point. and once the car has gained momentum . You can lift off for reminder of the clutch pedal.

Clutch pedal balance point: The slower raise the clutch pedal through the bite point. the slower the car will move off. if you release the clutch faster to allow the car to move off more quickly , if you release the clutch pedal faster the engine will be stalling.

To reduce the risk of engine stalling, raise the engine speed by gently pressing the accelerator. It will be balance the torque between moving off smoothly and safely spinning the wheels.

Now you have basic understanding what happens to the clutch when you press down and lift up the clutch pedal , it will help your ability of clutch control.

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Note: Where the clutch plate is contacting area with fly wheel is known as clutch biting point. When clutch plate is engaged with fly wheel and transmit the engine power to the gear box without the engine stalling that is known as clutch balancing point.

Steering: Vehicle steering is used to control the vehicle movement like straight, right and left movements.

Holding the steering wheel: Vehicle operator uses both the hands to hold and operate the steering wheel which is fitted with the steering inner column. (Fig 2)

Fig 2



DV20N131812

The wheels on the car turn 20 degrees during one rotation of the steering wheel .The vehicle front wheel are steered via rods connected to the steering wheel.

Steering push and pull method: Keep your hands on the steering wheel at all times unless changing gears or using one of the vehicle controls.

Your right hand must always stay on the right half of the steering wheel and your left hand should always stay to left half of the steering wheel.

Steering right: To steer maximum right, you would start with both at the top of steering wheel you would pull down with your right hand gripping and left hand would not grip as it would slide down the left side of the steering wheel opposite to your right . Your hands would then meet at the bottom.

Now your left hand grips the steering as it pushes up and your right hands slides up(opposite to your right hand) to meet at the top.

your right hand now grips as it pulls the steering down and the left hand slides down opposite.

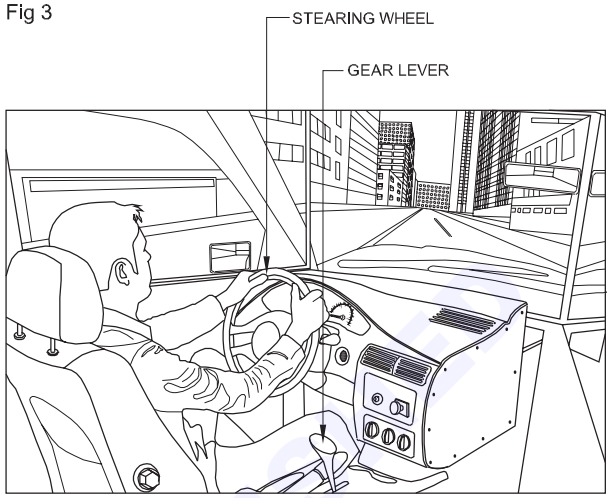
Steering left: To steer left is the same process. Start with both hands at the top of the steering wheel. Your left hand will now grip the steering and pull the steering wheel down as and pull the steering wheel down as your right hand slides down to meet at the bottom.

Your right hand will now grip the steering wheel and it will push up or left hand slides to the top to meet your right hand and it continues until you can't steer any more.

Vehicle on the move: A group of parts called the steering system it transmits the movements of the steering wheel down the steering the shaft to move the vehicle wheels left and right or straight.

While gear changing: Vehicle operator's both hands always grip the steering wheel, When ever changing the gear, driver's left hand move to gear shift lever and his / her right hand hold the steering wheel. (Fig 3)

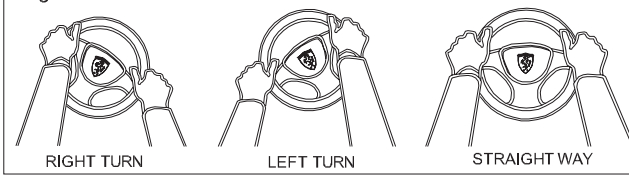
Fig 3



DV20N131813

While steering wheel turning: When the steering wheel turn to left side, steering wheel pull to left side downward by your left hand and your right hand go to the top of the steering wheel as the same for the steering wheel right turning, pull down the steering wheel to right side down ward by your right hand at the same time your left hand side will go to top of the steering wheel while turn the vehicle to the right side. After right turning the wheel straight the steering wheel pull by left hand and push it by right hand for the steering wheel. (Fig 4)

Fig 4



DV20N131814

While sounding horn: When the vehicle is running on the road need sound horn to give awareness to road walker at the time of sounding horn operator's right hand used to operate the horn switch and his left hand is used to grip the steering wheel. some of the vehicle left hand is used to operate the horn switch. (Fig 5)

Fig 5



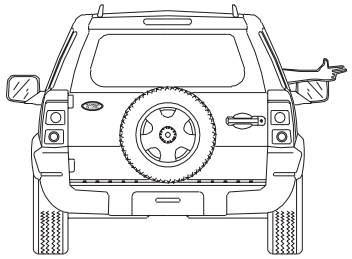
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While operating dash board switches, vehicle operator normally uses his left hand once modern vehicle and dash board switches operated by left and right hand.

While signaling: When the vehicle is moving, maximum operator's right hand is used for hand signal in right hand drive vehicle, in left drive vehicle left hand is used for signaling. (Fig 6)

On emergency: On emergency steering wheel is griped by both hands to drive a vehicle on desired direction.

Fig 6



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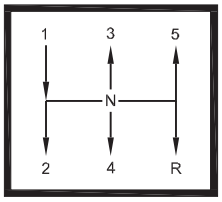
Gear shifting

Objectives : At the end of this lesson you shall be able to
- **state the gear shifting procedure**
- **state the vehicle stopping with braking distance.**

Gear shifting: Gear shifting is very essential to increase or decrease the vehicle speed.

Gear up shifting : Present days most of the vehicles use automatic gear box, there is no need to change the gears, only speed increase or decrease depend upon accelerator pedal activation . To increase the vehicle speed gear up shifting used like 1 st gear to 2ndgear , 2nd gear to 3 rd gear , 3rd gear to 4 th gear , 4 th gear to 5th gear etc. (Fig 1)

Fig 1



Gear down shifting: To decrease the vehicle speed, shift the gear from upper gear to lower gear. Press the clutch pedal and neutral the gear shift lever and de clutch the clutch pedal and shift the gear , upper gear to lower gear to decrease the vehicle speed at the same time vehicle pulling increased down gear shifting 5th,4th,3rd,2nd to1st gear

Use of over drive gear : Over drive gear allows the engine to operate at a lower RPM for given road speed. This allows to achieve better fuel efficiency, and after quieter operation on the high way.

With the popularity of front wheel drive cars the separate gear box and final drive have merged into a transaxle.

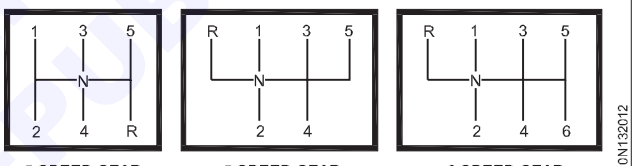
In the conventional rear wheel drive layout the transmission system normally contains two sections gear box or transmission mounted behind the engine, and the final drive mounted in the rear axle at the rear of the vehicle allow the drive shaft to run at the lower torque by using higher RPM . As power is the product of RPM and torque running the shaft at higher RPM allowed more power to be transferred at lower torque. Doing so reduce the torque, the over shaft has to carry and thus the strength and weight required .final drive ratio is 4:1

Gear shift pattern on different vehicle: Modern cars are fitted with automatic gear box. These types of cars need not do gear shifting. This automatic gear box gears are automatically shifting up and down gears as per accelerator pedal motion (pressing and depressing).

Gear shift pattern: The gear shift pattern refers to the gear box gear's layout. In a typical of 5 speed manual transmission vehicle 's first gear is located to the left and forwards. In many trucks and some sports cars it is instead in a dog leg position to the left and rearwards. There is usually a spring loading to return the stick to the central position

Gear shift lever is attached to manual transmission, while in an automatic transmission, a similar lever is known as a gear selector. Gear shift lever is used to change gear while depressing the clutch pedal with left foot to disengage the engine from drive train and wheels. (Fig 2)

Fig 2



Types of gear shifting;- There are many types of gear shifting mechanism used in an automobile they are as follows

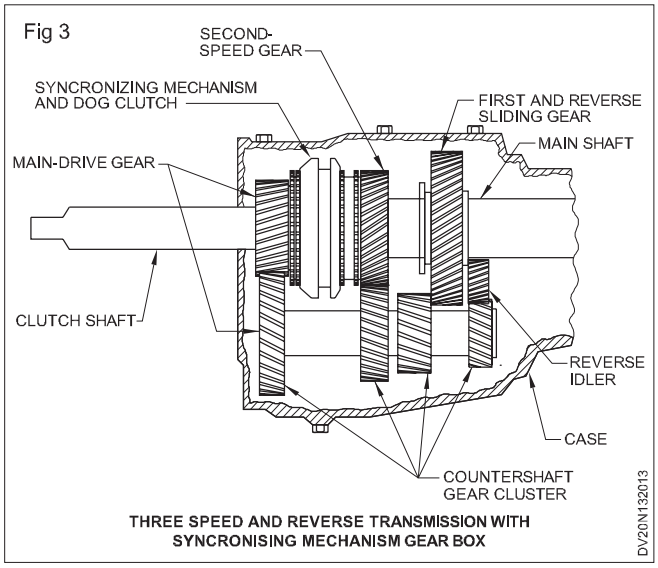
1 Manual transmission
2 Automatic transmission
3 Semi automatic transmission
4 Automatic manual transmission.

Synchromesh gear box: This type of gear box is used for easy gear shifting, while a vehicle is in motion, with synchromesh action gears can be changed without using double declutching. Whenever any particular gear is engaged, the sleeve is pushed towards the selected gear. Synchromesh gear box is designed to obtain uniform pressure between the ring and designed to obtain uniform pressure between the ring and sleeve. The synchromesh gear box and power flow in different gears as shown in Fig 3.It has 3 forward speed and one reverse speed for selection.This is closed as manually operated selective type because the driver can selective type because the driver can select the required gear ratio by shifting the gear by the operation of the gear shift lever.

Automatic manual transmission : AMT's operate like an automatic, while providing the affordably and fuel saving benefits of a manual transmission. With this type of transmission, the driver can manually shift gears or

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option for automatic shifting. Automatic transmission system is operated by a hydraulic system only.

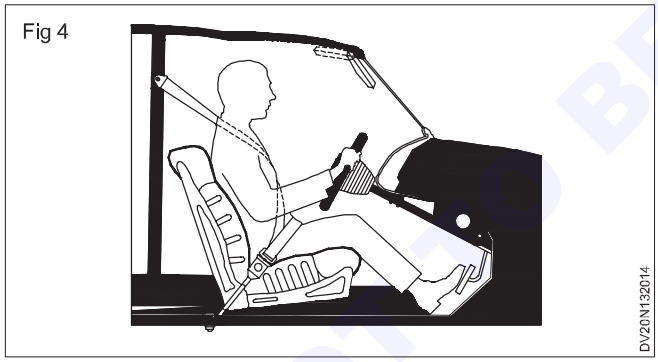


THREE SPEED AND REVERSE TRANSMISSION WITH SYNCRONISING MECHANISM GEAR BOX

The automatic manual clutch operation is performed by sensors and electric system. These automatic gear system does not have clutch but will directly work with the hydraulic system.

AMT is computing module over the regular manual transmission which takes care of gear changes. AMT is relatively a simple gear box system where the manual clutch operation is performed by sensor and electronic system.

Vehicle normal stopping: When the vehicle is in motion the operator reduce the accelerator pedal pressure and shift the gear to reduce the gear ratio and apply foot brake to stop the vehicle (Fig 4)



Vehicle emergency stopping: When the vehicle need emergency stop it is a braking maneuver performed in response to hazards on the roads that require you to stop suddenly. Follow the following steps to reduce the speed and stop the vehicle by applying service brake.

- Look out and get regular updates on what is behind your vehicle.
- Do not signal, both hands on the steering wheel for maximum control, your seat belt should keep you in your seat. and your hands on the steering wheel will help to balance the vehicle.
- Press the brake pedal firmly and fully to stop the vehicle as quickly as possible it is preferable to use the clutch to stop the engine stalling or cutting out, in a real emergency situation.
- After stop the vehicle apply hand brake and select the gear lever in neutral.
- Suppose if you stopped the vehicle, middle of the street or road again move the vehicle to safe place. Take a good look around using all the mirrors and windows and check both left and left hand blind spots, making sure there is no bicycles or other road users passing you. So always take care when moving off.
- **Use of engine brake :** Engine exhaust breaking system is useful to avoid wear or service brake components and can help a driver maintain control of vehicle. Active use of braking by shifting into low gear and apply engine brake system can help control speed while vehicle driving down very steep and long slopes, saving the service brakes from overheating or excessive wear.

When driver apply engine exhaust brake, alters the operation of the engine's exhaust valves, so that the engine work as a power absorbing air compressor. This action provides a relationship or slowing action to the vehicles drive wheels, it helps into improved vehicle control without using the service brake. Engine exhaust brake helps to the following

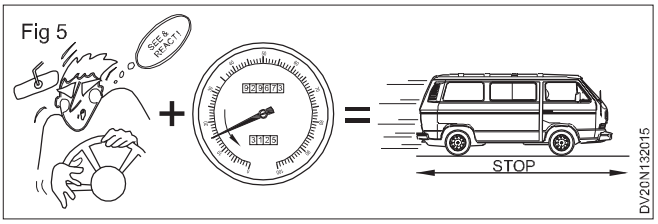
1 Reduce the vehicle speed
2 Increase the vehicle service brake life
3 Avoid service brake overheating
4 Avoid the frequent use of service brake in hill area road.

Stopping distance of a vehicle: Stopping of your vehicle during highway drive , leaving enough distance between you and the car in front of your car.

- Give you a better view of the road ahead.
- Let you react and stop in time in cases ahead suddenly brake .
- Help with fuel economy, drive more smoothly and wont be braking every time the vehicle in front slows down.

Stopping distance: Stopping distance is the time that it takes to bring a moving a car to a complete stop of the vehicle. This also includes, time it takes you to react the hazard and the time it takes for the brakes to stop the car (braking distance)

Stopping distance = reaction distance + braking distance (Fig 5)



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The stopping distance may vary depending upon the factors like the weather and vehicle driving speed. The stopping distance at 20 km/hr is around 3 car lengths. At 50 km/hr it is around 13 car length. If you are travelling at 70 km/hr the stopping distance will be more like the 24 car length.

Perception / Reaction Distance is distance traveled in the time it takes the driver to see hazard and move foot from accelerator to brake pedal.

Braking distance is distance traveled from time brakes applied till vehicle comes to complete halt.

Your perception and reaction distance in feet take the first digit of your speed add it to the total speed and double it.

Stopping formula = speed + first digit= reaction distance = 22 feet x 2 = 44 feet.

At….	Perception/ Reaction distance	+	Braking Distance	=	Stopping distance
20 km/hr	44 feet	+	18 to 22 feet		= 62 to 66 feet
55 km/hr	120 feet	+	192 to 224 feet		= 312 to 344 feet
65 km/hr	142 feet	+	267 to 316 feet		= 404 to 458 feet.

Reaction distance : This is the distance of vehicle travels between spotting a hazard and starting to brake.

It will take your time to react to what is happening and decide to brake, and then hit the brake pedal. The high way thinking distance on thinking time of just under 0.7 seconds. Drinking and taking drugs both slow down the vehicle operators reaction time. The slower the reaction increase the distance covered before you react to danger ahead. Mobile uses while vehicle driving and tiredness also increase the distance covered before you react to danger ahead.

Braking distance: Breaking distance is the distance your car will travel once you hit the brakes before it comes to a complete stop the vehicle. The braking distance will increase as your vehicle speed goes, up so vehicle operator should leave at least the recommended distance, when driving a well maintained vehicle with good road and weather conditions. However many factors can increase braking distance like brake components conditions, worn suspension, worn tyres, tyre pressure, wet roads, damaged roads, muddy road surface and weight of vehicle etc. However vehicle stopping distance consists of three factors, Driver's reaction time + brake lag+ Braking distance.

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Driving and overtaking a vehicle on the road

Objectives : At the end of this lesson you shall be able to
- **state the anticipation, judgment, positioning the vehicle on the road**
- **state the use of IPDE**
- **state the use of indicators**
- **state defensive driving techniques**
- **state the priority for certain vehicle**
- **state the traffic education and motor vehicle act section-118.**

Driving a vehicle on the road: While driving the vehicle on the road, vehicle operator should keep in mind and act quickly as anticipation, judgment, and positioning the vehicle according to other road users.

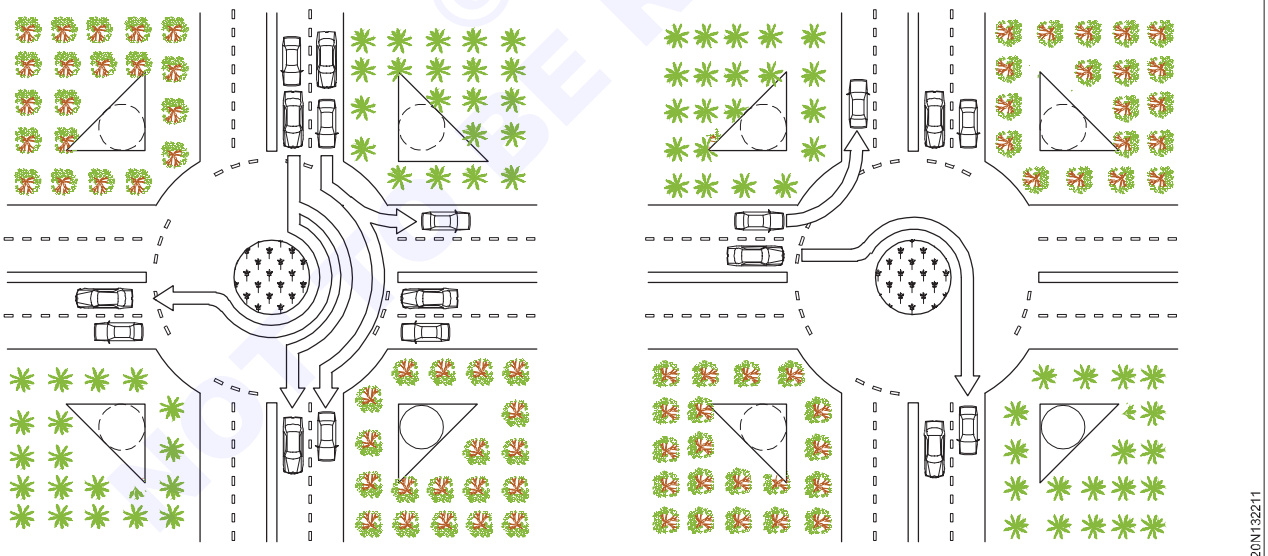
Anticipation: Anticipation is to take action when you expect something will or might happen while you drive a vehicle on the road or rather when a road hazards will cause you to slow down, change direction or stop. To do anticipate effectively driver need to be constantly aware of surrounding situation of your vehicle at the same time driver should constantly the scanning the road ahead and checking your mirror. Take as much information as you can.

Note: Always expect the unexpected , not all hazards can be anticipated.

Judgment: Keep your eyes moving and pay attention to the middle and far distance not just what is happening immediately ahead of you. Don't allow your eyes to be drawn to one area, Looking further ahead will enable you to see things earlier and give you more time to deal with any hazard that might be developing. Pay attention to other users, signals given by other road users, road signs and markings and judge your road type and road condition.

- Judge you are following too closely behind the vehicle.
- Scan left and right as you approach cross roads(Fig1)

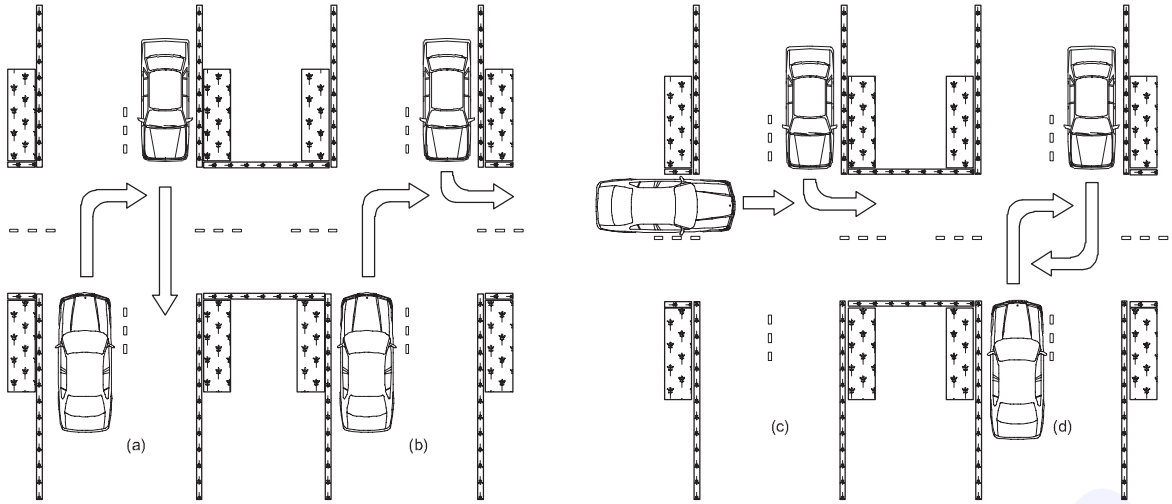
Fig 1



- Asses the distance between passing vehicles and your vehicle. (Fig 2)
- Judge the distance maintained from your vehicle left, right, and ahead vehicles on the road.
- Judge the distance between the beside vehicles while overtaking at left of your vehicle.
- Judge the vehicle braking distance while driving the road. (Fig 3)
- Judge the weather condition and driving vehicle.
- Judge the road traffic signals and your vehicle braking distance. (Fig 4)
- Judge the marking lines between road lines.

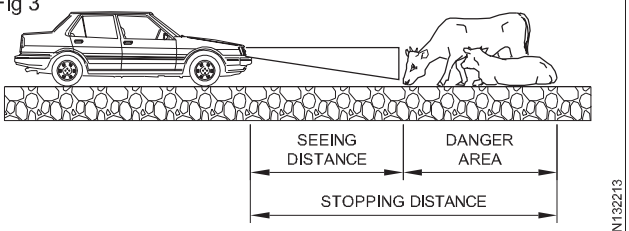
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Fig 2



GIVE WAY OTHERS ONCOMING VEHICLES

Fig 3



THE DRIVER WILL NOT SEE THE CATTLE IN TIME TO STOP

Fig 4

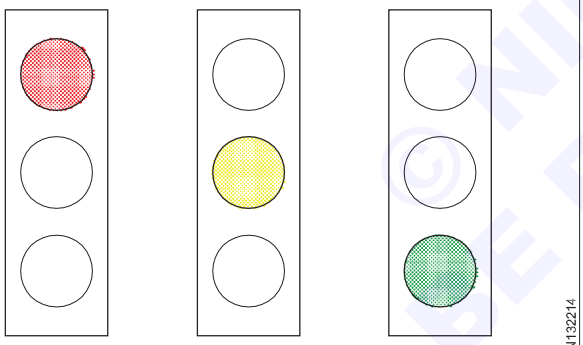
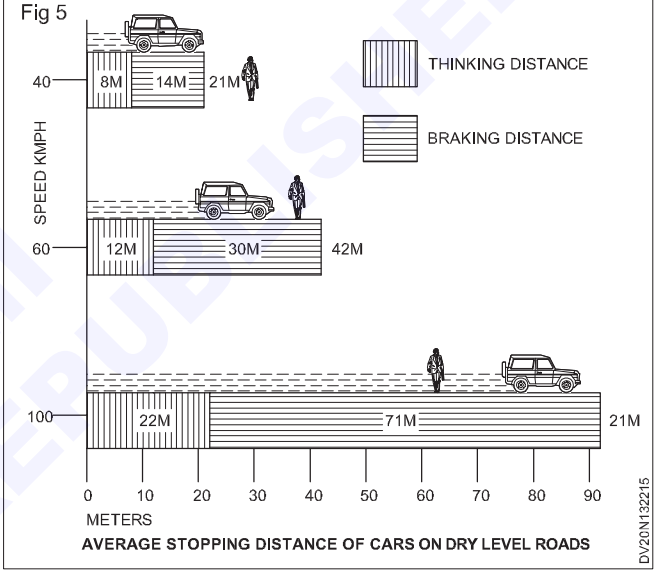
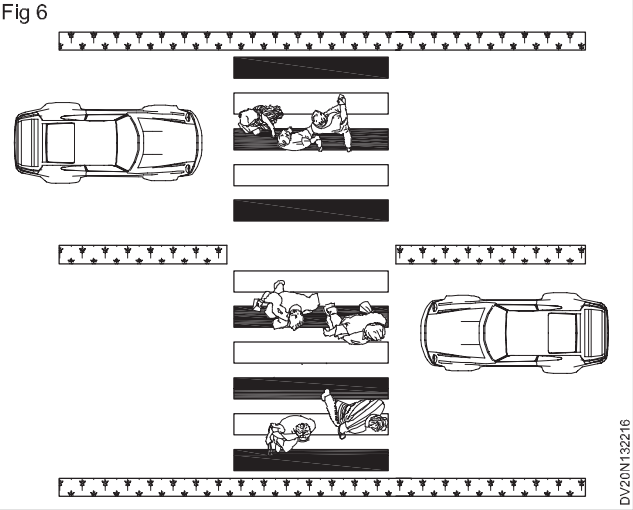


Fig 5



AVERAGE STOPPING DISTANCE OF CARS ON DRY LEVEL ROADS

Fig 6



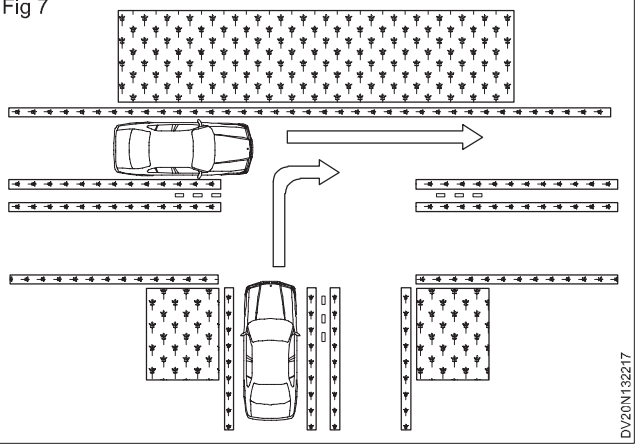
Positioning vehicles according to other road users: High ways and other roads are not only for one person, it is used by cyclists, bike riders, pedestrians, car, bus, van, truck etc. Positioning of vehicles as follows

- Stop your vehicle where traffic signal line marked on the road. (red signal light glowing) (Fig 5)
- Stop your vehicle when pedestrians are crossing road at pedestrian crossing marks (Fig 6)
- Drive your vehicle at the left side of the road until you over take the other vehicle.
- Allow the emergency vehicle immediately, Let and allow the vehicle to overtake with ride side of your vehicle.

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- Slow down your vehicle while pass over other from your right side.
- Let allow to move other road users, while you drive your vehicle on the road (Fig 7)

Fig 7



- Park your vehicle in proper parking area and keep proper space on all sides of your vehicle.

Vehicle positioning is a key requirement to many safety applications. Active safety systems used to precise vehicle positioning in order to assess the safety threats accurately especially for those systems, which are developed for warning in safety and critical situations. Global positioning systems and digital maps have become major tools for vehicle positioning providing not only vehicle location information but also geometry preview of the road being used. Vehicle positioning technology is used for improving road safety.

Use of identification, prediction, decision, execution principles

IPDE principle approach to drive to deal with potential and real hazards . Four steps of IPDE process as follows

Identify ⟶ Predict ⟶ decide ⟶ Execute

1 Identify and locate the potential hazards with the driving (scene) road/ area.

2 Judge where the possible points of conflicts may occur.

3 Determine what action to take.

4 Act by maneuvering the car to avoid conflicts.

The vehicle driver need to improving the IPDE driving knowledge to becoming a more protective driver.

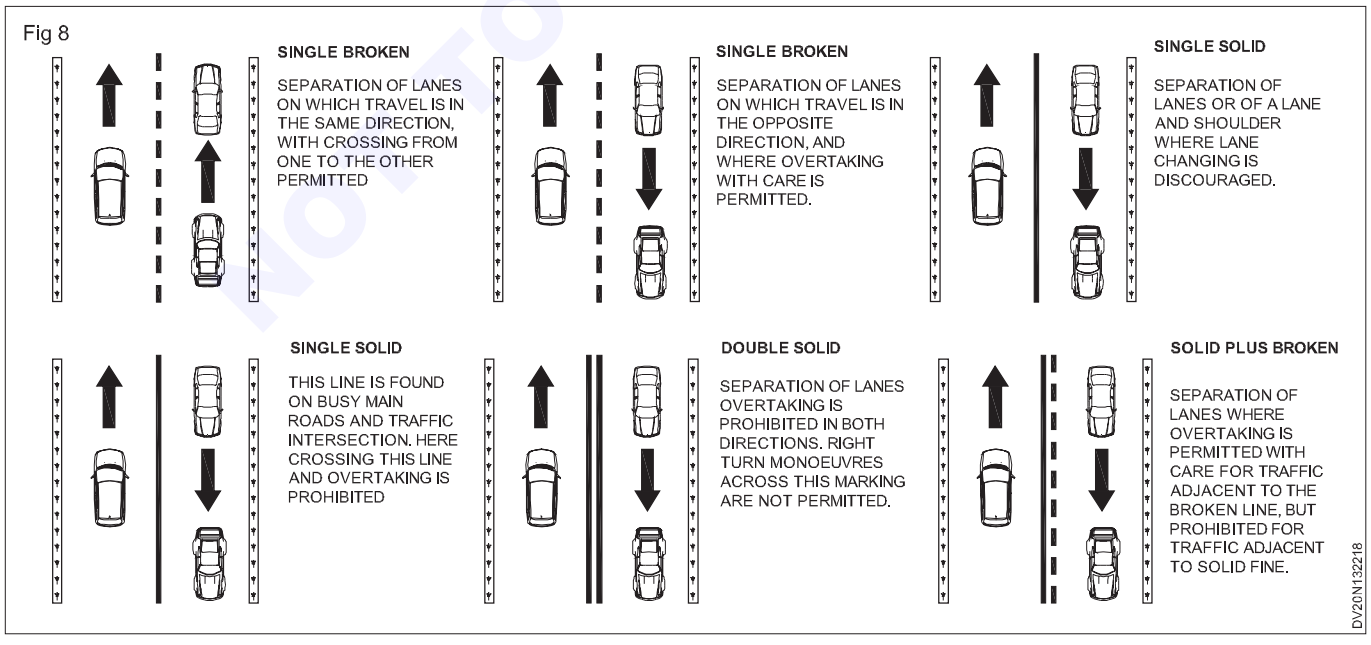
Mirror, signal, speed and lock system (MSPSL): The MSPSL is an extension of the familiar of MSM (mirror, signal, maneuvere) routine. MSPSL is often applied to other driving situations such as changing lanes and over taking.

Mirror: Mirror must be checked on the approach to any junction type. The main interior mirror initially, followed by the door side mirror of the direction you are travelling. For instance you may be approaching a left, you have checked your left mirror and see multiple cyclists, pedestrians to your left close to your vehicle. If a vehicle is driving extremely close to your vehicle behind you , it may be hazardous to slow down in time to allow the cyclists and others pass and to safely make the left turn. it may be safer to continue ahead and not take left turn. If it is necessary situation such as this to be check the vehicle behind spot just after the mirror. Always watch rear mirror and side mirror while taking left, right turn and change over road lane.

Position: The correct road position must be applied depending on the direction you are taking, the width of the roads if lanes are used. Correct road position can be found in the left and right turns and junctions (Fig 8&9)

Signal: The use of signals are to left other vehicles know your intentions to change directions. Signaling too early to too late can be dangerous. Signals must be applied approaching left or right turns, T- junctions, roundabout and changing lanes. (Fig 10)

Fig 8



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Fig 9

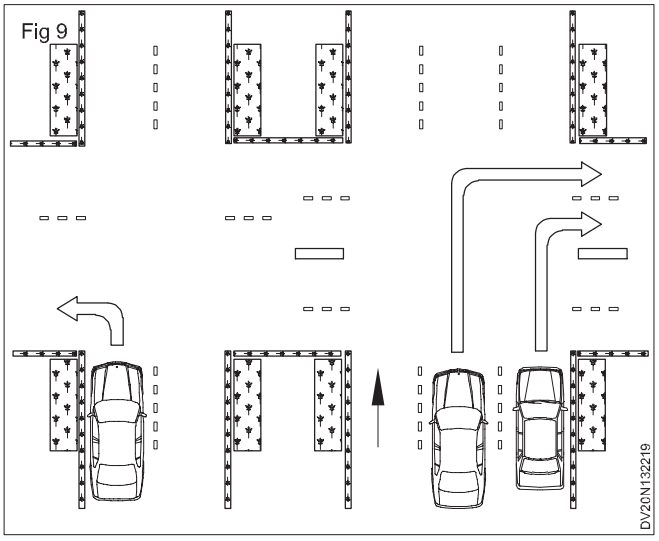
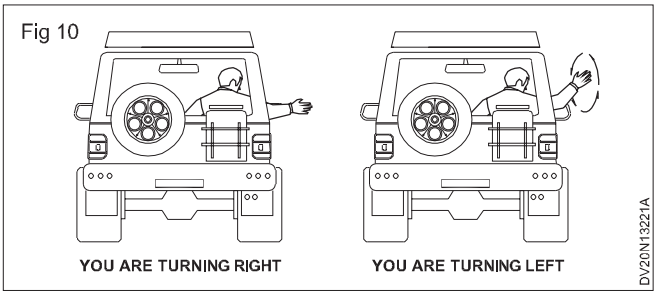


Fig 10



Speed: Vehicle speed is relevant to the location and situation. The location may be a residential street with a closed junction this may require a much slower speed that a wide open road with a junction. In the high way vehicle should be driven as mentioned on the road sign board, like 20kmph, 40 km/ph, 80 km/ph etc.

Look: Vehicle driver's looking refers to all round observation , before making a turn, it is important that there is no other vehicle moving into your path.

Driver's routine work: Drivers should use the MSPL and turn indicators, head light dip and dim light as on requirements on roads vehicle driving.

Use of indicators: Vehicle drivers should use vehicle turn indicator lights while vehicle turn to left side or right side or change road lane to warning information to other road users. Use of indicator light may be a chance to avoid accident. Vehicle parking indicator light indicates and give warning that vehicle is parked and not in moving position.

Defensive driving techniques: Defensive driving saves lives, time and money in spite of the conditions around you and the actions of others. Defensive driving does not require a high degree of special training. The characteristics of a defensive driver are the same characteristics that apply to many aspects of our lives.

Judgment: Good driver uses a clear thinking and knowledge to make decisions wisely and quickly . They maintain control of their behavior, resisting the temptation to make risky maneuver to get somewhere faster or to out maneuver other drivers. They pass only it is safe and always look for the safest, rather than the speed, alternatives in any traffic.

Anticipation: Driver should anticipate the hazards by scanning the road to size up the traffic situation as far ahead as possible. Driver should prepare himself for hazards rather than simply reach to them. Practice long range foresight by keeping the vehicle well maintained by checking them before driving on the road. Always wear seat belt before driving the vehicle.

Escape route: Defensive drivers should develop the skills necessary to operate a vehicle properly and safely. Driver should know the safe and legal way to make turns, change gears, and pass. Defensive drivers should be alert both to traffic conditions and to how their own mental and physical condition may affect their own driving. Drivers should pay attention to the traffic situation to the front sides and rear , glancing in rear and side view mirror many times a minute. Driver should give his attention to the task of driving and select the escape route, in case of any hazard happen on driving route.

In general there are three options to escape from the hazard. (1)Go left (2) Go right (3) Stop in time. The most appropriate option will always depend upon the circumstances such as the type of road. Drivers should always look ahead by at least 12- 15 seconds, so that the driver is always aware of what is happening in the distance. This can help to identify upcoming hazards and able to stop safely in plenty of time rather than steer towards escape route at the side of the road. Vehicle stopping safely is always a better option than steering off the road or into another lane.

E- Ensure you look well ahead for hazards.

S- Steer to the side only if you are it is safe.

C- Check for escape options as you drive.

A- Always keep the distance from the vehicle in front.

P- Plan escape route in advance.

E- Environmental factors will dictate escape options.

Priority for certain vehicles

School buses and emergency vehicles are so important to the safety of our society. There are special laws for driving around buses and emergency vehicles . Such as police cars, fire engines, ambulances or VVIP vehicles. While it is important to get to know the laws as they apply in your state.

Vehicle drivers must yield the right of way to emergency vehicles if drivers have a siren or see a flashing light, pull over as far as possible to the left and step until the vehicle has passed. Don't stop in the intersection of the road. Usually the emergency vehicle can pass you on the right if necessary, the vehicles driver may give instructions by loud speaker. If you find yourself at the scene of disaster, get away as quickly as possible, being careful not to run over unprotected fire hases.

Overtaking: Vehicle overtaking also known as passing in changing lanes or driving around another vehicle to move fast than slower vehicle. Do not over take a

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vehicle unless you are sure that you can do so without placing yourself in a dangerous position.

On high ways the speed of the lanes are designated. The fastest lane is closest to the centre of the road and slowest to the edge of the road. The following features are common on the high ways.

- The lane designated for the faster traffic is on the right.
- The lane designated for slower traffic is on left side.
- Over taking is permitted on right side of ahead of the vehicle.
- Never overtake on curves and road bends.
- Never overtake when you do not have full view of road ahead.
- Never race if the vehicle you are passing speeds up. I n that situation get back into your original lane.
- Use the right turn indicator and your hand signal give information to signal that you want to overtake. Be sure you are without danger in your way ahead and behind is clear before over taking.
- Check out for scooter, motor cyclists, animals , pedestrians and others that may be hidden from view in front of that may be turning right.
- Watch for vehicles that may be turning right immediately after over taking give indicator that you want to get back to the same lane. Get back to the previous lane when you can see all the front of the vehicles you are passing in your rear view mirror. Do not cut off a vehicle by suddenly moving in front of it.

Note: Never over take within 30 meters of a pedestrian crossing.

Changing lanes: When you are driving a vehicle on a road with more than one lane, lane changing may be required to overtake another vehicle, to avoid a parked vehicle. Proper signal is required to overtake another vehicle , toensure safe move. Follow the the following rules to vehicle overtaking on the high way.

- Check out for a space in traffic where you can enter safely.
- Check your behind spot by looking over your shoulder in the direction of the lane change. Give a hand signal or indicator in the direction you want to move.
- Recheck to ensure the way is clear and no one is coming at fast speed from behind.
- Turn steadily into the new lane and remember to turn off your signal after changing lanes or entering free way.
- Never change the lane suddenly by cutting in front of another vehicles. Avoid lane changing unless required and also do not change in or near an intersection.

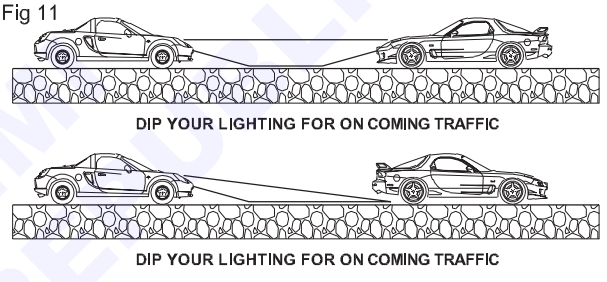
Note: If you have to cross several lanes take them one lane at a time. Avoid slowing down or speeding up directly to change lanes.

Plan ahead so that you have plenty of time to change lanes.

Vehicles overtaking at night: While vehicle overtaking at night, the following guidelines are important to avoid any hazard.(Fig 11)

- If you approach a vehicle from behind, switch your head lights to low beams.
- To warn the drivers ahead of overtaking switch your high beams on and off quickly.
- Check your mirrors and blind spot perfectly and pull out to overtake while moving beside the vehicles that may be turning left or right in front of you.
- When you are able to see all of the front of the vehicle you are overtaking in your rear view mirror pull back into previous lane. Give indicator to ensure other drivers that you are getting back into the lane.

Fig 11



Overtaking a stationary vehicle: Before overtaking a stationary vehicle you should make sure the following

- Identify the stationary vehicle and predict the road is sufficiently clear ahead.
- Decide how to overtake the vehicle and road users are not beginning to overtake you.
- Ensure there is a suitable gap in front of the road user you plan to overtake.
- Not get too close to the stationary vehicle you intend to overtake.
- Use your mirror, signal when it is safe to do so, take a quick sideways glance, if necessary into the blind spot area and then start to move out.
- Ensure there may be only enough space for one vehicle overtaking a stationary vehicle.

Moving vehicle in right and left side - IPDE principle:

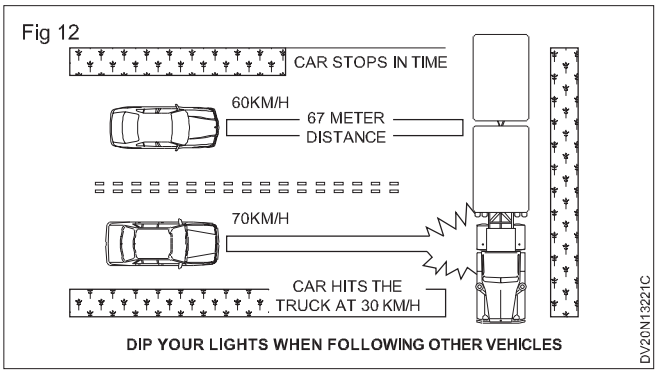
Follow the methods to move the vehicle left to right side and right side lane to left lane.

- Identify the ahead vehicle type and speed.
- Predict the vehicle to move and prepare yourself to overtake ahead going vehicle.

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- Decide yourself to move right or left side to move your vehicle.
- Analyze the speed of the front going vehicle and speed need to overtake the vehicle.
- Look and check there is no any other vehicle coming in front side of the road.
- Check through the rear view mirror and door side mirrors, no any vehicle is behind you and no one is trying to overtake your vehicle. (Fig 12)
- Give signal or warning to ahead going vehicle and gradually press accelerator pedal to raise the speed of the vehicle. (Signal by hand signal, horn sound, side indicator, at night indicator + dip and dim light)

Fig 12



- Move your vehicle from right side road lane.
- Cross over ahead going vehicle and after covered certain distance, change your lane to left side. Keep the distance from the ahead going vehicle and behind and side passing vehicles.

Traffic education MV Act section 118

The traffic education act is focused on learning and improving the knowledge, insight, skills, and attitudes that are necessary for safe traffic participation, including the will to safely take part in the traffic motor vehicle Act section 118 explain about driving regulations for the driving of motor vehicles.

Motor vehicle Act 1988 section 118: The central government may be notification in official gazette, make regulations for driving for motor vehicles.

Motor vehicles Act 1988 regulates almost all aspects of road transport vehicles it has provisions of traffic regulations, vehicle insurance, registrations of motor vehicles, controlling permits and penalties.

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Other Maneuvers of Driving

Objectives : At the end of this lesson you shall be able to
- **state the merging, diverging, turning to left and right**
- **state 3 point turn and 5 point turn**
- **state the passing, crossing and cornering**
- **state the car length method and two seconds time rule method.**

Merging: The trickiest part of free way driving is getting on to the freeway, specifically if the traffic is heavy and moving fast, when entering the free way you must simultaneously speed up , scan the free way for an opening and adjust your speed to fit into the opening. Following tips can smooth the merging process.

- Always enter the free way at or near the speed of the traffic.
- Do not stop unless it is absolutely necessary.
- Allow a five second gap in traffic - a three second following distance from the car in front of you and two seconds behind you.
- A five second gap means five seconds between when the car in front of you Passes on ramp and when the car behind you passes.
- Turn on your turn signal early and adjust your speed to put you in the middle of the gap.
- Before you merge, use your mirror and look over your left shoulder to make sure no traffic is in your blind spot, or moving into right lane from the left.
- For merge the vehicle is safe, speed up or slow down to get around traffic.
- When merging remember the freeway traffic has the right of way and should not be expected to slow down to let you in.
- Be careful in merging in front of a large vehicle, such as truck.
- Large vehicles have very large stopping distance and cannot stop or slow down quickly, if you cut in front of them.

Diverging: Exiting the freeway method is as follows.

Carefully read the road signs to allow plenty of time to get into your exit lane.

- When exiting, maintain the proper speed - fast enough to interrupt the flow of traffic and slow enough to exit safely.
- Use your signal at least five seconds before exiting.
- If freeways are fast, efficient and safe but they take skill and practice to negotiate safely.
- If you are unnerved by driving in heavy freeway traffic practice during hours, when traffic is light, you will soon develop the confidence to get on and off the freeway safely.

Turning the vehicle left and right road lane: Follow the same merging/ diverging principles as follows.

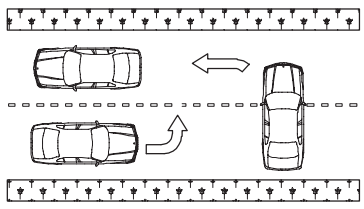
- Allow a four second gap.
- Check your blind spot and mirror.
- Use your turn signal to left or right.
- Remember to turn off your signal after changing lanes or entering the freeway.
- If you cross several lanes, take one lane at a time.
- Avoid slowing down or speeding up drastically to change lanes.
- To turn the vehicle to left use the left side indicator.
- To turn the vehicle to right side use right side indicator .
- Before turning the vehicle ensure the space and see no vehicle coming fast in front and behind your vehicle.
- After turning the vehicle straighten the steering wheel and center the vehicle with road lane.

3 point turn: Three point vehicle turn is a way of turning a vehicle around in a small space by giving forward turning to one side, then backing up, turning to one side, then backing up, turning in order to face the other direction then going forward again. This type of turn is usually done, when the road is too narrow for ‘u ‘ turn.

successfully completing a 3 point turn(three point turn) is a common requirement for most driver’s license examination.

Simple steps for successful three point turn (Fig 1):

Fig 1



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- Move to outer part of the lane.
- Check your rear view mirror for traffic.

Note: Do not attempt three point turn on a busy road way.

- Three point turn should be used only in emergency situation.
- Check for other cars behind or in front of your vehicle.
- Turn your steering wheel all the way to the left, approach the edge of the opposing lane.
- Shift into reverse, turn your steering wheel to right and back up towards the side of the road you originally started in.
- Shift back into forward and steer left to begin driving in the lane opposite of the one you started in.
- This is the third point and the conclusion of the three point turn during maneuver.

Note: Three point turn driving strategy should be used if there is no other options are available.

Five point turn: Five point is basically a modified three point turn. A five point turn is a vehicular maneuver that involves turning around the middle of a narrow road way. It is used on a long stretch of road, where there is nowhere else to safely turn around.

Follow the points to perform a five point turn around.

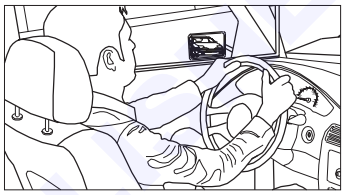
- Look at the road ways ahead as far as possible and check your rear view mirror to ensure the roadway is fully clear both the a head off and behind you.
- Pull as near to the side of the road you are driving on as possible.
- Be sure to leave a couple of inches clearance at the edge to give your tyres room to turn.
- Give your steering wheel a sharp turn to the left as you press the accelerator, turning towards the opposite side of the road, keep this turn as right as possible.
- Stop before going off the opposite side of the road , ideally leave several inches at the front of your vehicle to be safe.
- Your passenger side tyre will be nearest to the edge of the road .
- Put the car into reverse and turn the steering wheel sharply to the right as you press the accelerator Back up until the tyre you can see the driver side tyre is a few inches from the edge of the road.
- Return the car to drive.
- Turn the wheel sharply to the left - pull forward again leaving enough space at the front of your car that you would not go off the edge of the road.
- Return the car to reverse. turn the wheel sharply to the right. Back up until your driver side tyre is few inches from the edge of the road.
- Put the car into drive lane. Drive forward in the appropriate lane.

Note: Vehicles turning in the middle of the road is the most dangerous , Due to this you must pay attention to the traffic on both sides of the roads all times.

Passing: Vehicle overtaking an another vehicle is known as passing. Passing is changing lanes on the high way or driving around another vehicle to move faster than slow going vehicles . Proper signal and warning is required to passing another vehicle.

Passing and Being Passed

Fig 2



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One of the most common causes of deadly head on collisions is improper passing. Before undertaking any pass, ask yourself, ‘ is this pass really necessary? Is it safe? “The majority of passes don’t save enough time to be worth the risk. If you must pass another vehicle follow these safety tips.

Before Passing

When getting ready to pass another car, maintain safe following distance. Intending to pass is no excuse for tail- gating .The other car could stop at any time. And the closer you are to the vehicle you want to pass, the harder it is to see what’s in front of it.

Before passing, signal left. Scan the road ahead and behind continually. Check your blind spots, those areas right behind or on either side of you that you can’t see in your mirrors, by turning your head and looking over your shoulders. Make sure nobody is trying to pass you. If there is any doubt about in oncoming traffic,wait.

Moving Into The Right Lane

On a two-lane road, moving into oncoming traffic lane is the most dangerous part of passing. In 55 km per hour traffic, and oncoming vehicles are approaching each other at an effective speed of 110 km per hour. It takes a full mile to complete a pass at this speed. After moving right increase your speed to pass, giving the vehicle plenty of room. You should not pass if you have to exceed the legal speed limit to do so. Signal right to begin moving into the right lane in front of the passed car.

Completing the Pass: by turning your head. This is important

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It's safe to return to your driving lane when you can see the pavement in front of the vehicle you have passed in the rear view mirror. Move to the left and turn off your turn signal. But first check your blind spot by turning your head. This is important in multi-lane road where another car may be moving into the lane from the right or in a situation where the car is being passed is nearly stopped, and another car may be coming on the road in front of it.

When Not To Pass: Remember that is illegal to pass a stopped school bus with its signals on. Other areas where it is unsafe or illegal to pass include

- No passing zone
- School zone
- Curves with passing restrictions
- Any road with solid line in the middle
- Within 300 feet of the crest of the hill

It is also illegal in most cases to pass where there are

- Rail road crossings
- Intersections
- Tunnels
- Bridges
- Or within 300 feet of these areas.

Being Passed : If someone is passing you, maintain your speed or slow down if necessary to allow the vehicle to pass safely. Never speedup to prevent someone from passing you. If you are driving more slowly than the flow of traffic, find a safe place to pull off the road and let vehicles pass by. You will be safer and more relaxed without a string of cars behind you.

How many times you have passed a vehicle simply because it is in front of you? Passing on a two lane road is difficult and dangerous maneuver that usually cuts only a drive more if you decide to pass only when it is absolutely necessary and completely safe.

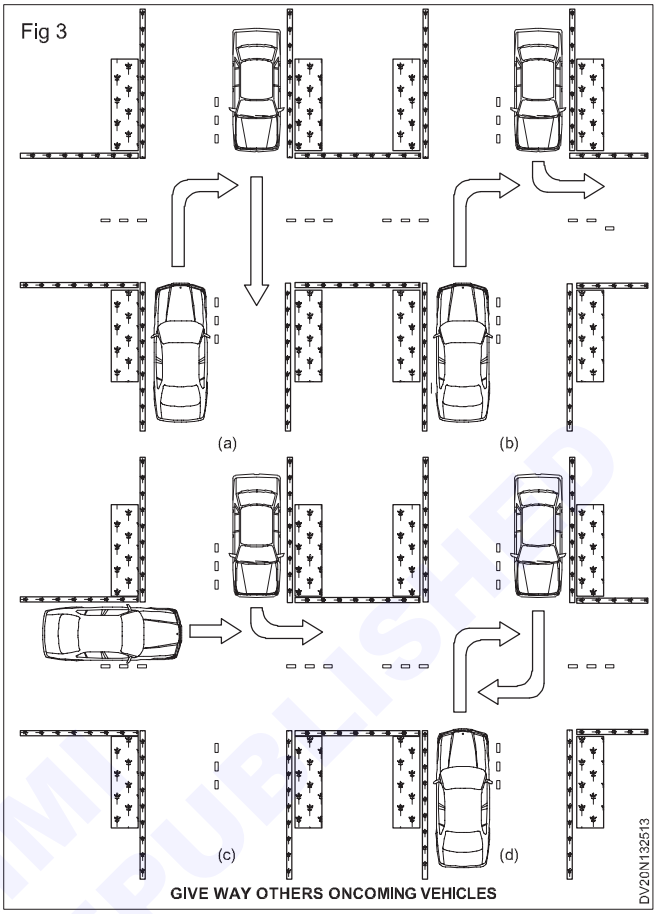
Crossing: On some cross roads there are no traffic signal lights or signs, When you come to one of these intersections, you must give way to vehicles travelling in the intersection on your right at intersection where the lights have failed. If you and oncoming vehicle are turning right at intersection both vehicles should pass in front of each other.(Fig 3)

Cornering: When turning your vehicle at right, make proper hand or turn indicator signal, move as close to the centre lane as possible and then turn., only, where there is no on-coming vehicle when turn to left remember to give way to pedestrians. (Fig 4)

Note: Don't turn your vehicle at sharp cornering of the road.

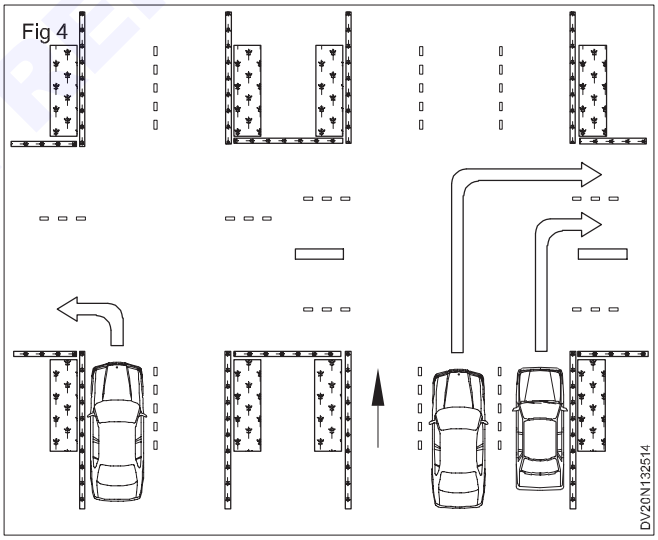
Following vehicle distance : Distance means maintaining an adequate distance from the vehicle ahead of you, to avoid collision. if that vehicle suddenly slows down or stops.

Fig 3



GIVE WAY OTHERS ONCOMING VEHICLES

Fig 4



Distance method : Ordinary cars on good roads need to allow at least three seconds to stop following time in day time conditions. The time should be increased at night in heavy traffic or bad weather. But lane vehicles need to start out with more followers time at least four seconds even under perfect conditions.

A vehicle's stopping distance is simply the distance the vehicle travels before it comes to a full stop. It is the combination of the driver's reaction distance and the vehicle's braking distance. While driver's reaction distance is the same no matter. Allow one second for each 10 feet of vehicle length plus one second if you are

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travelling over 400 km/hr. For example a 50 feet vehicle going 65 km/hr should allow 6 seconds.

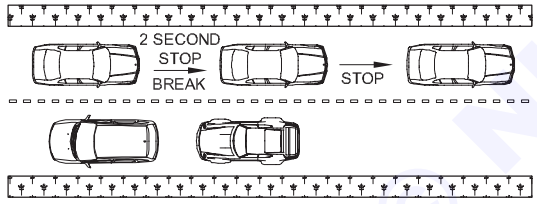
Whenever you follow another vehicle , you need enough space to stop suddenly . If the other vehicle brakes suddenly . A safe following is at least two seconds behind the vehicle in front. This is the minimum reaction time you need to stop safely.

2 seconds time rule method : The two seconds time rule is a way for the defensive driver to judge the minimum safe following distance to help avoid collisions under ideal driving conditions. The rule is that a driver should ideally stay at least two seconds behind any vehicle that is directly in front of the driver's vehicle.

The two second rule is useful as it works at any speed. It is equivalent to one vehicle length for every 8 km/hr of current speed, but driver cannot find it difficult to estimate the correct distance, that are required for given speed . The 2 seconds rule gets around these problems and provides a simple and common sense way of improving and range for all drivers.

The two second rule needed to reduce the risk of collision under ideal driving condition. The allotted two second is a safety buffer to allow the following driver time to respond. (Fig 5)

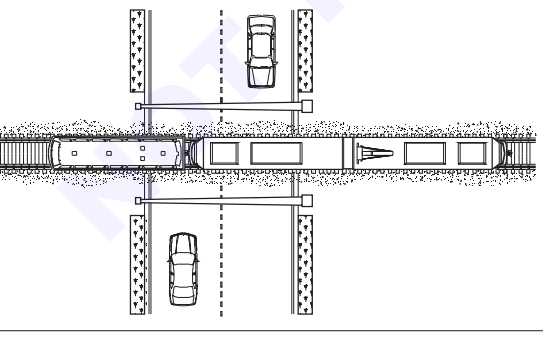
Fig 5



Measure the following distance by choosing a land mark such as a tree. When the rear bumper of the vehicle in front of you passed that land mark, Start counting seconds one, two if you reach the land mark before you finish counting you are following too closely.

Distance between cars while driving at railway crossing (Fig 6)

Fig 6



Train injuries or accidents happen by misjudge a train distance and speed. This is not surprising, since their large size makes trains appear at a distance to be travelling slower than they are. The parallel track also make an approaching train look farther away than it is . It all adds upto increased risk-taking by drivers.

To avoid train accidents, follow these precautions

- Look ahead for the round yellow warning sign and white pavement markings of a train crossings.
- Slow down and be prepared to stop at all train crossings.
- Be prepared to stop if you are following commercial vehicles that are required to stop at all railroad tracks whether the trains are coming or not.
- Use both eyes and ears to detect trains coming from both directions.
- Stop if you see the train coming or you hear the whistle of a train close by.
- Stop at least 15 feet from the first track.
- After a train passes, don't go ahead until you can see clearly in both the directions.
- In heavy traffic, wait until there is room for you on the other side of the tracks before crossing.
- Once you start to cross a track, keep going, especially you see a train approaching. Never shift gears on the track.
- Never try to outrun a train, or go around a closed railroad gate.
- Don't over drive your head lights. The most common night time train accidents occur when motorists drive into trains. Look up and out in distance, looking for reflections and road sign.

If your vehicle stalls on the railway track: First everyone get out of the car and tracks immediately. Since it takes a full mile to stop at 65km/hr, it is unlikely the train will be able to stop in time to avoid hitting your vehicle. If a train is coming get far away from the tracks and run towards the oncoming train to avoid being hit by debris from the vehicle and warn the train conductor.

If there is no train coming, post lookouts while you try to start to push it off tracks. Be ready to give up if a train approaches.

A collision with a train means almost certain death. With odds like that, it pays to be careful and alert every time you approach a crossing even if you cross it every day.

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Reversing and parking a vehicle

Objectives : At the end of this lesson you shall be able to
- **locating reverse gear**
- **state the driving confidence and reverse gear control**
- **state the steering control**
- **state the weaving in 8 shaped bend**
- **state parking in different shape.**

Reverse gear position

By operating the gear shift lever, the larger gear of the main shaft is meshed with the reverse idler gear. The reverse idler gear is always in mesh with counter shaft reverse gear, Interposing idler gear between the counter shaft reverse gear and main shaft bigger gear, the main shaft turns in the direction opposite to that of the clutch shaft. This reverse the rotation of the wheels so that the vehicle go backs. (Fig 1 & 2)

Fig 1

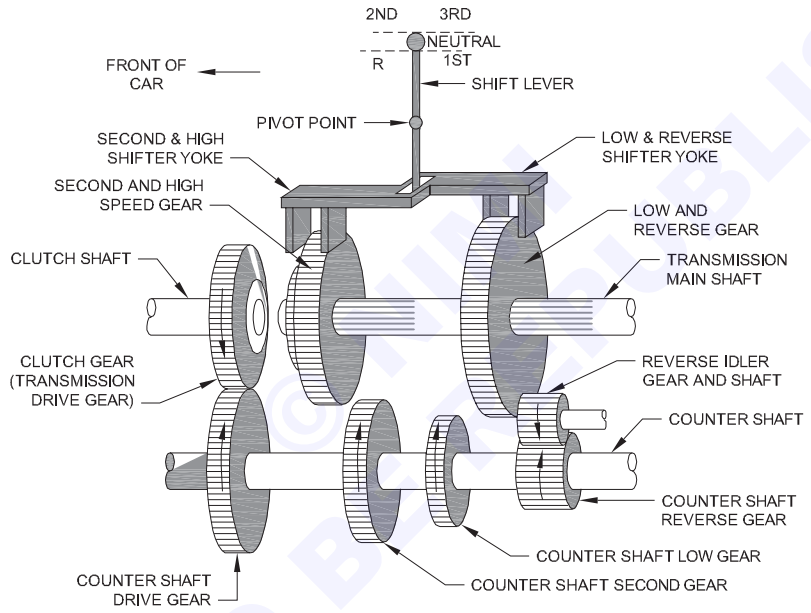
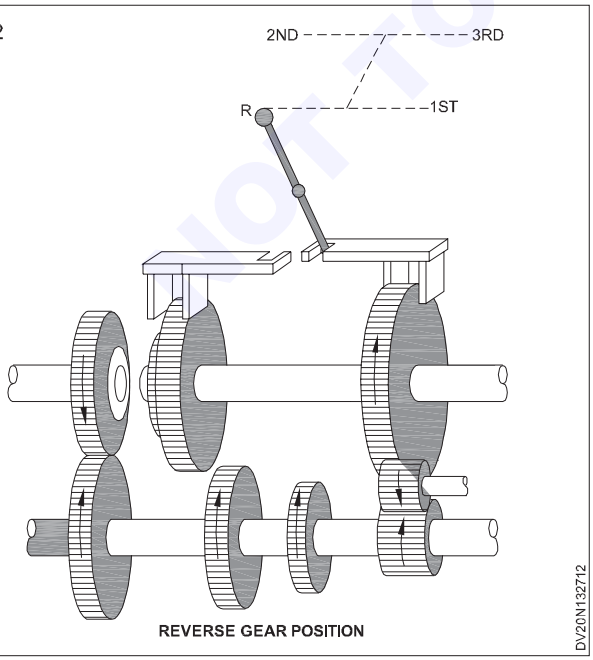


Fig 2



REVERSE GEAR POSITION

Confidence: Driver's physical conditions such as fatigue problems can affect to drive safely. Mental conditions such as emotions, stress or attitude can also affect the driver's safety. If the driver recognize the signs of excess stress, emotions or attitude as occasional travelling companions. Follow the following points to improve the driver's confidence.

- Identify what makes you anxious as a driver.
- Know the rules inside out of the vehicle ,it can help by getting familiar with your driving theory. This will help you become a more confident driver.
- Stay safe while driving the vehicle on the road.
- Use your driving lessons effectively to improve your confidence.
- Driving practice on your vehicle to improve confident.
- Build your confidence by pushing out of your comfort zone.

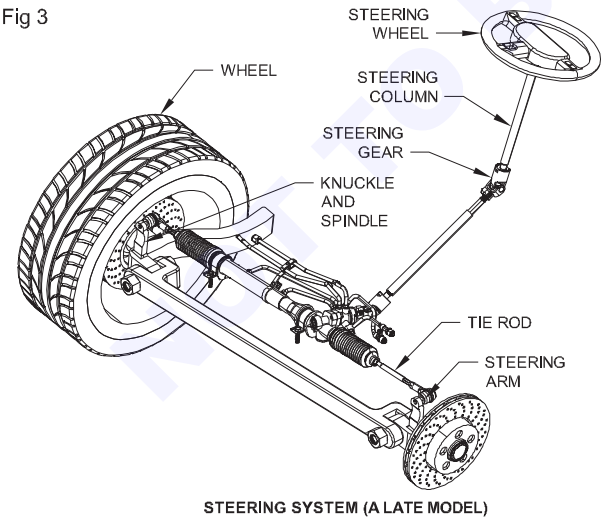
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- Build your confidence by trying to reconcile your surroundings.
- Practice driving to different destinations within familiar area.
- Drive alone at different times of the day and night but stick to routes you are familiar with.
- Practice parking in new different places.
- Give yourself to improve your driving confidence.
- Wear appropriate clothing while you are going to drive a vehicle.
- Take your time to drive the vehicle to improve your confidence.
- Limit the distractions.
- Keep calm with breathing exercises, the breathing techniques will help to lower your heart rates.
- Rule out any other factors impacting your confidence in driving.

Vehicle speed control: Vehicle speed control helps to avoid any accident by the driver. Vehicle speed is controlled by applying service brake and reduce the pressure on the accelerator pedal. Drivers should have steady mind and confidence needed in speed control as on situation while driving a vehicle on the road. Vehicle speed control can be improved by practicing yourself to drive the vehicle on free space day and night and other weather conditions.

Steering control: Steering system is used to control the vehicle movement. The function of the steering system is to convert the rotary movement of the steering wheel into angular turn of the front wheels. The steering system also absorb a large part of the road shocks, thus preventing them from being transmitted to driver. (Fig 3)

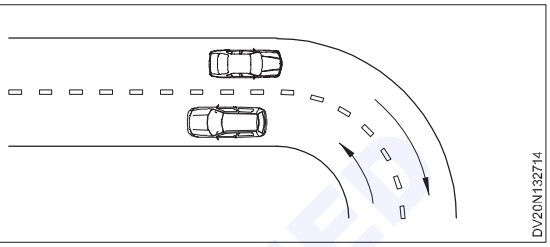
Fig 3



STEERING SYSTEM (A LATE MODEL)

Weaving method: Every vehicle has blind spots. The larger vehicle has larger blind spots. While turning your vehicle in shaped bend, signal before braking to turn and up to 50 0 feet on the high way, watch your mirror closely for any pedestrians, vehicles, by-cyclists, that might be on your path, when you turn to remember that they are harder to see from a large vehicle. Be prepared to stop until you are sure that any potential hazard has closed out of the way in any vehicle you have to drive farther past the corner, allowing only half the length of your vehicle to pass the corner before beginning turn the vehicle. Otherwise your rear wheel may run over the curb in right turn or crowd the lane going opposite directions in the left turn. Drive slowly enough that you don't need to brake during a turn. Allow a larger turning radius. (Fig 4)

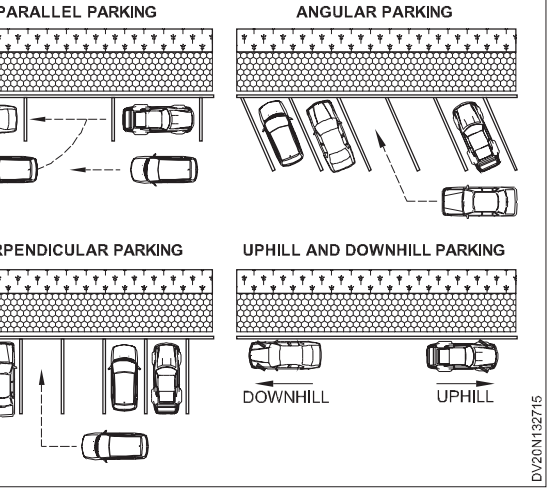
Fig 4



Parking: A car parking is a covered parking structure used to offer limited protection to vehicle from rain and sun's rays, snow, wind, dust etc. The structure of the car parking has different shapes . They are as follows

- Parallel parking
- Angular parking
- Perpendicular
- Parking facing uphill
- Parking facing downhill. (Fig 5)

Fig 5



Parking methods: Follow the following methods to park the vehicles safely

1 You must be extra alert and make right decisions.

2 You must be extra cautious of the surroundings depending upon where you are parking the vehicle. If you are parking the car designated parking lot, you need to concentrate on keeping a safe distance with other vehicle.

If you are parking it in an open space like a building compound or beside the road, you need to watch out for stray dogs, children, older goats other pedestrians among others.

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3 Getting used to the vehicles rear view mirror and side view mirror. Make sure you position the mirror well so that you can get clear view while parking.

4 Use rear view camera to parking it will be helpful to you.

5 Practice car parking to perfect it, whether in forward or reverse parking.

6 While parking the vehicle, check for space between your car and the one in front ,side, or behind it.

7 Make sure there is ample space for your vehicle and other vehicle to move out of parking.

8 While parking your vehicle in uphill position, use the wooden block rear of the vehicle wheel(front or rear)and use the parking brake to avoid roll over the vehicle towards reverse.

9 While parking your vehicle in downhill position, use the wooden block in front of the wheel and apply hand brake and engage the reverse gear to avoid roll over in front.

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Night driving and lane discipline

Objectives : At the end of this lesson you shall be able to
- **state the use of head light**
- **state the road lane and selection of road lane**
- **state the village and high way driving procedures and precautions**
- **state the vehicle driving under special condition**
- **state the ground clearance.**

Location of head light switch: Head light switch is located on dash board in old vehicles. But in modern vehicles head light switch is fitted with combination switch including low beam, high beam, indicator, wiper low speed and high speed.

Use of head light: Head light provides illumination on the road to have enough visibility for the driver. It consists of a double filament, a dim and dip switch and fuse.

Use of head light dipper at night: Most of the time vehicles approaching from the opposite side with high beam mode cause temporary blindness creating conditions for any accidents. Dipper switch works on combined high beam and low beam lights and can be effectively used during night driving. The dipper mode is useful to avoid glaring effects. Upper beam is useful to increase the visibility for long range. The long range is useful to find any objects like parked vehicles, pedestrians, bikes and animals and also control the vehicle to go away from the roads. The switch can be used manually when it is required at night driving a vehicle. The lower beam is used when an opposite vehicle is coming with high beam. Low beam is used to clear view of nearest road and avoid temporary blindness effect of opposite vehicles high beam light brightness.

Lane selection and lane discipline: Most of the Indian people drive vehicles every day. But people are not aware of what type of road are they driving on? There are 5 different type of roads, each with different set of rules and overtaking permission through the color pattern of the line going through the middle.

The road lane selection and lane discipline strategically planned by the ministry of road transport and placed across the country to suit the location they are living in Indian. India places are carefully thought by them to ensure the civilians have the safest driving experience in India.

This will ensure the road rules correctly for a safe and sound driving experience.

Types of roads in India: There are many types of roads in India The roads are called as per their usage. They are as follows.

- Express ways
- National highways
- State high ways
- District high ways
- Rural roads
- Border roads

Roads are one of the oldest means of transportation in India. Different types of highways and other roads offer much needed connectivity between states, cities, towns and villages. It has played crucial role in our nation's economy , social, and even cultural development.

Express ways: Express ways are used to drive the vehicle without any disturbance and stoppage signals on the route from the beginning to the end of the express high way.

National High ways: National high ways are the roads that connects between the cities in the country connects between the cities in the country. These are used to connect the capitals of the states with each other. Some national high ways connect India with other neighboring countries and make many famous tourist destinations easily accessible.

A highway is typically a large width well designed road traffic signs, lights, bridges, etc at appropriate locations. These roads are indicated by NH-1, NH- 10 etc. The following are the types of national highways

- Single lane high way
- Double lane high way
- Four lane high way
- Six lane high way
- Eight lane high way

The National highways authority of India (NHAI) and national high ways and National High ways and infrastructure development corporation limited (NHIDCL) is taking care of development, Management and maintenance of National highways.

State high ways: State high ways include roads that connect all major cities in a state. At the same time, they offer connectivity with neighboring state high ways and National high ways. The state roads are designated

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with state code. The state roads are maintained by respective state high way authorities.

Districts roads in India: District roads or urban roads in India are connected to different parts of city. These roads allow connectivity with neighboring state/ National/ Village roads.

Village/ Rural Roads: Village roads offer connectivity for the villages to commute to markets, farms, fields, offices and residences etc.

Different types of road line marks: There are different types of color line marks used to make awareness of the road users. They are as follows

- Broken white line
- Continuous white line
- Continuous yellow line
- Double continuous yellow line
- Broken yellow line

Broken white line: A broken white line gives permission to change lanes, overtaking, beforehand that the road is clear and it is safe to perform such maneuver. (Fig 1)

Fig 1



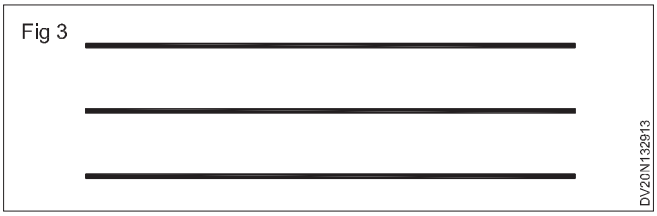
Continuous white line: A continuous white line on the road means you are not allowed to overtake other vehicles or take 'U' turns on the road. Continuous white line roads are mostly seen on hill areas. The continuous white lines are drawn in hilly areas to avoid accidents or to take 'U' turn. This type of road is allowed crossing the line. (Fig 2)

Fig 2



Continuous yellow line: Where continuous yellow line marked on the road overtaking is allowed but only when you are on your side.Crossing the yellow line is not permitted on either side, low visibility to establish that you need to stay on your side of the road (Fig 3)

Fig 3



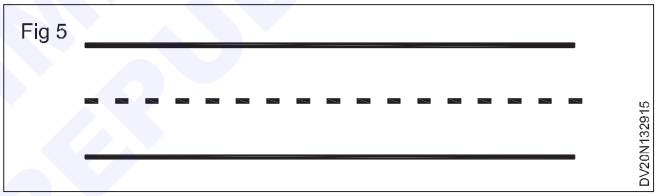
Double continuous yellow line: Double continuous yellow line implies that crossing the line is strictly not permitted for 'U' turns or no lane changes. Where there is a high potential for disasters. (Fig 4)

Fig 4



Broken yellow line: Broken yellow lines allow to overtake and 'U' turns and could do both, while driving on the road marked by broken yellow lines.(Fig 5)

Fig 5



Road lane selection: The Indian road users are used to systems of lanes. Each road lanes exists for a particular purpose to allow only certain types of lanes. Each road lanes exists for a particular purpose to allow only certain types of vehicles to move over them.

In India we have only right hand drive vehicles, so we drive on left side of the road. As a general rule as you move to the right side of the road, the speed increases. So the left most side of the road is only slow moving traffic.

In the event of overtake a vehicle, You first look at the right lane and ensure if it is empty, then you indicate to the side you are switching and overtake the person in front of you. You must ensure you make this happen very smoothly. when you are changing line you have to indicate to the side you are shifting and complete the change in one smooth motion. Look out for the traffic behind you and slow down just a bit in case you see a vehicle approaching really fast. Let the vehicle pass and then perform the change. Be at right speed and ensure you are not making any sudden direction changes.

The three lane road structure works as slow medium and fast as you move from the left most to the right most lane of the road. It is the safest bet to be on the middle lane on the high ways. The slower vehicles always be on your left side and faster one will easily overtake you

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from the right. In case you are in the right most lane and faster vehicle is behind you, just indicate to the left and give way, You can switch back to the faster lane after the faster vehicle has crossed.

In two lane road never swerve all the way from the right most lane to left most lane. For 2 lane highways is as same as 2 lane city road rule.

Road lane discipline: The vehicle operator must follow the road lane rules while travelling on highways.

First rule: While you drive your vehicle on the four way high way, it is quiet essential to stay on the left and use your right lane just to overtake vehicle front.

If you are travelling on a six lane high way , raise the wheel speed to go from the left to right lane. As a result, the left is normally reserved for slower vehicle. Middle is for medium speed vehicle and third lane is for fast moving vehicles.

Second Rule: When switching in six- lane or four lane high way, it becomes fundamental to begin with corresponding indicator lighting. The fact is that when the car next to your indicator is turned on. the driver in front will change lanes within some five to ten seconds. As a result, it is even more crucial to respect the driver, who is in front of you, when they switch on the vehicles indicator to change the lanes. When you are changing lane surely need to keep using cautions in the situations because honking is usually not audible at higher speeds. As a result it is preferable to flash the headlight and wait for a car in front to yield.

Third Rule: If your vehicle brakes down while on a highway put on a hazard warning light and safety transfer the vehicle to service lanes (left most part of the high way). It is critical to be aware of the difficulties with the vehicle before the brake down and to shift to your left most lane as soon as possible in the event of an emergency. When a brake down vehicle moves in front of you with the warning lights on, you must always be particularly cautious only. That is mainly because the driver in front will be suggesting that their vehicle is in danger and is likely to go across any direction. Ensure that you follow these rules when you are drive a car on the high ways in case of emergency.

Village and highway driving procedures: While drive a vehicle in rural road, there are many dangers associated with driving on back roads so follow the some safety tips that will help to ensure your safety while driving on rural roads.

- Be aware of speed limit because rural roads often have very low speed limits that are sparsely posted. You should drive at below speed limit regardless of how unnecessarily slow it may seem.
- Use caution when passing long, straight stretches of rural roads often allow drivers to pass slower vehicles if you choose to pass a vehicle make sure that the section of road on which you intend to pass is marked accordingly.
- Watch out for rural drive way, if a road is curvy or hilly, drive ways can be difficult to see until you are very close to them . This could put you in danger of colliding with another vehicle as it is pulling out on the road.
- Keep safe distance between your vehicle and farm equipment's on the rural roads. Farm equipment drivers might have limited visibility, if attempt to pass a large piece of equipment on a rural roadway, make sure that you have plenty of time and space to make the maneuver safely.
- In some areas livestock may be moved across rural roads from time to time. There should be road signs marking these areas and warning drivers to slow down and up caution. If you happen upon a group of cattle or other animals moved from one side of a rural road to another side, bring your vehicle to a halt and wait patiently for the animals to clear the road ways completely. Do not blow horn and stay inside your vehicle safely.
- When driving on rural roads at night use your car's high beam lights more than usual to increase your visibility. Driving on a rural road requires attention to your surroundings and respect for the people and animals and that inhabit.

Driving procedures on highways

- Ensure your vehicle fitness for drive on the road.
- Maintain safe distance between ahead vehicle.
- Use indicator while change lane or over taking a vehicle.
- Use head light at darker places and night.
- Stay on the left lane if you are not confident with high speed.
- Follow the right most side for fast moving.
- Always over take at the right side of ahead vehicle with warning horn and indicator light signal.
- Use the middle lane for safe driving in six lane road.

Driving precautions in rural and highways

- Do not drink and drive.
- Prepare your vehicle before start travel .
- Wear your seat belt.
- Keep safe distance from ahead vehicle.
- Don't drive on wrong side.
- Always give an indicator while changing lane or overtaking a vehicle.
- Drive within speed limits.
- Don't use mobile phones while you are driving a vehicle.
- Be patient while driving.
- Do not use horn unnecessarily.

- Allow side to emergency vehicle.
- Don't drive on one way opposite direction.
- Always stop your vehicle behind the stop lines, on roads with no stop lines, make sure your vehicle comes to a halt before zebra crossing
- No horn at school, hospital zone.
- Traffic lights and signs should be always obeyed or respect the instructions given by a traffic police.
- When driving in reverse you should make sure you do cautions to other people on the road.
- Keep all the vehicles documents and your personal documents with in the vehicle.

Driving under the special conditions: Driver cum mechanic trade trainee should be trained in wet weather, desert land, dusk and misty road, very thick dense traffic, cross country driving knowledge about vehicle ground clearance. These driving practice leads to achieve different kind of driving techniques.

In wet weather driving a vehicle: Wet weather it is a light rain or a heavy rain with strong winds make the streets and roads wet and even create potholes and bad roads. Driving at these conditions often reduce the visibility and one needs to depend on the rain splashed wind shield for guidance, which makes the entire experience, wet weather road condition easily leads to an accident. However follow the following tips to avoid accident and reduce the risk of driving in wet weather.

Double check your vehicle before start driving specially give attention on windshield wiper head light horn, brake, tyre and tyre air pressure,tail lights etc.

- Avoid driving during heavy rain.
- Drive slowly and use safety process.
- Reduce your speed if you see brake lights going up ahead.
- Use your rear and side view mirror for checking traffic to your rear about every five seconds.
- Avoid driving in blind spot of your vehicles.
- Check your own blind spot before changing lanes.
- Switch on the head lights during rain it helps to improve the visibility.
- Slow down your vehicle during heavy rain it will help you to avoid skidding or slipping the vehicle.
- Pay attention to the road and passing vehicles and keep both your hands firmly on the wheels for better controls.
- Increase your following distance between your car and the vehicle in front of you during wet weather.
- Try to drive on tracks of vehicles ahead of your vehicle.
- Keep mindful eye on large vehicles and maintain more distance will help avoid a collision with them.
- Always use wind shield wipers to clean rain water staying on the wind shield.
- Defog your vehicle windows for minimizing the visibility.
- Do not brake or sudden turn the wheels during a hydro place.
- Avoid driving on standing water, driving around it, if possible drive extremely slowly is the best move in this situation.
- Avoid cruise control, If you use cruise control, it increases the risk of losing control over the car in wet condition.
- Very carefully drive the vehicle on intersections and merging road lanes by using blowing horn, turn indicator and burning on head lights etc.
- You can easily increase your safety levels, while driving in wet weather by using safety precautions. use the presence of mind and judgment while you are driving in wet weather.

Dawn and dusk and misty road driving: Early morning driving is very dangerous for drivers, so follow the steps to safe driving in dawn of the day.

- If you are tired by driving the whole night stop the vehicle and take rest.
- Turn on your vehicle head lights to make your vehicle easy to see by other road users.
- Dim your dash board lights.
- Don't drive drowsy on the road.
- Watch the road walkers and others.
- Keep an eye on animals lying or crossing the road.
- Drive up to the speed limit.
- Make sure your wind shield is clean inside and outside.
- Wear polarized sun glasses if the sun is in your eyes.
- Take advantage of that flip down visor.
- Be aware of your surroundings and slow down your vehicle.

Driving at dusk: Dusk may be actually be more dangerous time to be on the road.

Sun rise and sun set are two of the most dangerous times to be behind the wheel, because the driver's view and vision are compromised. It is due to the fact that the light sky prevents driver's eyes from adjusting to the dark roadway, which makes, it very challenging to see pedestrians, cyclists and other vehicles.

- Give your attention to the road and allow your eyes to adjust according sun rays during sun rise or sun sets.
- Driving drowsy could affect your decision making ability and with the sun setting, that may contribute to any sleepiness your body is experiencing .pull over if you are struggling to stay awake while driving.

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- Rush hours is dangerous for drive so slow down and stay focused on safety drive.
- Turn on your head lights as soon as you start noticing the sun is setting. This will help you start noticing the setting. This will help you drive at night and help other drivers be aware of your vehicle on the road.
- Limit your vehicle distance.
- Follow all other road rules and regulations.

Misty road driving a vehicle: Driving during foggy days can be a complete night mare. Follow the safety tips for misty road driving as follows.

- Reduce your vehicle speed according to how far ahead you can see. Suppose you can see only 100 feet ahead slow drive your vehicle at 20-30 km/hr if visibility reduced the distance then you reduce the vehicle speed at 10 km/hr.
- Switch on the emergency flasher .
- Maintain your vehicle distance depending on conditions.
- Look out for pedestrians, animals, or stopped cars.

Note : Foggy road is wet, so it will take longer stop to your car.

- Turn your low beam lights in the fog.
- Do not use harsh beam light it may be make visibility more difficult.
- Use the wiper to clean the wind shield glass.
- Ensure there are no objects on the dash board that might block the heat from the defroster.
- Drive your vehicle slowly in dense fog to look for tail lights of vehicle up ahead.
- Check your rear view mirrors for lights of vehicle coming from behind.
- Keep your eye glass clean.
- Clean the wind shield inside and outside for clear visibility.
- Don't apply sudden brake, if you apply sudden brake on a misty road, it may be a cause for accident.
- Follow the road signs and traffic rules.
- Follow and stick to your road lane.
- Use the indicators to alert others.
- Keep windows clean.
- Adding the antifreeze mixture with coolant .
- Getting the winter tune up in snow area.
- Use the winter engine oil in snow area.

Driving in dense forest: Heavy traffic will require you to be extra aware of your surroundings and your full attention to be on driving conditions. However you follow the general safe driving guidelines for safe driving traffic jam without problem.

- Turning off your cell phone or putting it in silent mode.
- Switching off your music.
- Don't talk with your co- driver or others in your vehicle.
- Keep your eyes scanning traffic and road conditions.
- Identify vehicles that appear unsafe such as those that are erratically merging across the lanes, speeding dangerously or drifting with in a lane.
- Follow the flow of traffic.
- Signal before making a turn or merging into a lane.
- Allow plenty of space between your vehicle and other vehicles.
- Never drive while tired or emotionally agitated.
- Plan your driving time to avoid heavy traffic.
- Pay attention to heavy traffic in the distance.
- Use lower gears to improve your engine efficiency.
- Allow two seconds distance between you and traffic in front of you.
- Drive your vehicle below the speed limit even in a high way.
- Prepare yourself for emergency maneuvers.
- Keep your eyes scanning traffic.
- Leave the free way if you feel too uncomfortable.
- Take rest and start your driving.

Cross country driving: Cross country roads are narrow and poorly surfaced and not maintained. While driving your vehicle in cross country road follow steps for your safety driving.

- Prepare the vehicle for cross country road driving.
- Scan the road condition.
- Slow down your vehicle as on the condition of the road.
- If there is any pot holes, sand stone, dirt, oil, wet sand, wet mud on the road drive slowly.
- Control your steering while drive on cross country road.
- Some cross country roads are blind curves and hills, use indicators and sound warnings. while drive on blind curve.
- Track your vehicle on stretch lane.
- Don't overtake on blind curve cross country road. Allow to pass the vehicle where space is provided in narrow roads.
- Slow down your vehicles while passing your vehicle by others.
- Keep your head lights on blind curve even in day time.

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- If road has prolonged steep grade, use your low gears to prevent brake failure from overheating.
- Pay attention to cross country side roads.
- If you drive into construction zone slow down and increase your following distance. while because traffic may be rerouted through much narrow lanes around construction area. The road shape and surface of the road may suddenly change.
- Get ready to stop your vehicle on emergency or unexpected changes in the road surface caused by recent bad weather or land condition. (Fig 6)

Fig 6



Knowledge on ground clearance : Every driver should know about knowledge of ground clearance of their vehicle, that will help to avoid damage of their vehicle while driving on the ground or road.

Vehicle ground clearance is measured from the lowest point of the vehicle to the ground. Normally ground clearance is provided in our Indian vehicles 165mm to 180mm . Road and ground's (drive way) obstacles height is not fixed but vehicle ground clearance is fixed by vehicle manufacturer . While driver drives his vehicle on the road or cross country road, manage himself to save his vehicle as per the vehicle's clearance. Low ground clearance gives a vehicles better stability and handling characteristics on the road, the higher ground clearance is always better, which is stand tall with higher ground clearance. like SUVs, Trucks, Bus, Tipper lorry etc.

Ground clearance helps to avoid the risk of hitting its underside of the vehicle. Beside numerous obstacles like speed bumps, pot holes on the road, un paved roads, debris and others are common on Indian roads. Therefore vehicle need to get with adequate ground clearance.

Ground clearance approximately need for tackle the following

- Speed breakers- 100mm to around 150 mm
- Pot holes- 50mm to 200 mm
- Boulders- 40 mm to 450 mm or even more.

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Uphill and downhill driving procedures

Objectives : At the end of this lesson you shall be able to
- **state the use of parking brake, slipping the clutch method**
- **state the selection of gear in uphill and downhill**
- **state the towing the disabled vehicle.**

Parking brake using in hill driving

While driving your vehicle on hill roads you require to engage the correct gears before climbing up or descending a steep road. Complete the gradient selection without changing the gear. When driving downhill, don't try to apply sudden foot brake but use exhaust brake to reduce the vehicle speed and apply the lower gear, over use of foot brake may result in total brake failure.

While parking on uphill gradient, use the parking brake and shift the lever into first gear position ON a downhill gradient shift the lever to the reverse position.

Note:

1 **Use the parking brake if you stop at red light or up or low gradient drive in hill area**

2 **Never turn off the engine or put the gear in neutral position while going downhill as it is very difficult to control a vehicle**

3 **Keep the parking brake engaged to avoid roll backward in uphill driving.**

Clutch control: Hill driving not only do involve measured clutch control but with gravity working against you, Your vehicle can roll backwards if the start is not performed correctly. However new vehicles are fitted with hill start assist technology. Hill driving and vehicle clutch driving is important for all motorists to able to do it with confidence.

When you are making a hill start, simply pulling away from a parked position. You should always start with your hand brake firmly on to stop your vehicle rolling backwards. Engage the gear and select first gear. Then push down gently on the accelerator while bringing the clutch up to the biting point. You will know that you have hit the biting point, because the engine sound will change slightly and your car will feel like it wants to move. After checking it's move release the hand brake and let the clutch bite a little more until the vehicle slowly starts rolling forward, gradually push down further on the accelerator, while bringing the clutch up slowly and the car will make up the hill. Remember uphill driving require to stay in a lower gear.

Towing disabled vehicles: Now a days we can see the roads with something in tow with towing trailer. Disabled vehicle and towing trailer need more time to accelerate and brake space when changing lanes, passing, entering the free way and turning corners. On the free way stay in left lane except when passing. Avoid sudden turns and sudden stops on the hill roads. Ensure towing trailer brakes are adjusted and ready to apply the towing vehicle's brake. Apply brake slowly sudden brake can cause for accident.

When turning the towing vehicle, adjust your lane position to increase the turning radius.after checking the passing lane traffic, exiting the free way and stay on the outside of the exit curve. Check the rear view and side view mirror before change over lane.

Note:

1 **Load the disabled vehicle and drive the trailer according to the trailer manufacturer 's instruction given on trailer owner's manual.**

2 **Improper disabled vehicle loading can cause serious safety problems including tyre fires, brake failure, and suspension system failure.**

Towing vehicles instructions are given in Indian Government Act the rules of the road regulations in (1989) is given as follows.

Central Government Act

Rules of the road regulations, 1989

1 Short title and commencement

a These regulations may be called the Rules of the Road Regulations,1989.

b They shall come into force on the first day of July, 1989.

2 Keep left

The driver of the motor vehicle shall drive the vehicle as close to the left side of the road as may be expedient and shall allow all traffic which is proceeding in the opposite direction to pass on his right hand side.

3 Turning to left and right - The driver of a motor vehicle shall

a When turning to the left, drive as close as may be to the left hand side of the road from which he is making the turn and of the road where is entering.

b When turning to the right draw as near as may be to the centre of the road along which he is

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travelling and arrive as near as may be at the left hand side of the road which the driver is entering.

4 Passing to right

Except as provided in regulation 5, the driver of a motor vehicle shall pass to the right of all traffic proceeding in same direction as himself.

5 Passing to the left

The driver of a motor vehicle may pass on either side, a tram car or other vehicle running on fixed rails whether travelling in the same direction as himself or otherwise provided that in case shall he pass a tram car at time or in a manner likely to cause danger or inconvenience to other users of the road including persons leaving or about to enter tram cars.

6 Overtaking prohibited in certain cases- The driver of a motor vehicle shall not pass a vehicle travelling in the same direction as himself:

a If his passing is likely to cause inconvenience or danger to other traffic proceeding in any direction;

b If he is near a point, a bend or corner or a hill or other obstruction of any kind that renders the road ahead not clearly visible;

c If he knows that the driver who is following him has begun to over take him;

d If the driver ahead of him has not signaled that he may be overtaken.

7 Overtaking not to be obstructed

The driver of a motor vehicle shall not, when being overtaken or being passed by another vehicle, increase speed or do anything in any way to prevent the other from passing him.

8 Caution at road junction -

The driver of a motor vehicle shall slow down when approaching at a road intersection, a road junction, Pedestrians crossing or a road corner, and shall not enter any such intersection, junction or crossing until he has become aware that he may do so with endangering the safety of persons there on.

9 Giving way to traffic at road junction

The driver of the motor vehicle shall, on entering road intersection at which traffic is not being regulated, if the road entered, is a main road designated as such, give way to vehicles proceeding along the road, and any other case give way to all traffic approaching the intersection on his right hand.

10 Fire service vehicles and ambulance to be given free passage

Every driver shall, on the approach of a fire service vehicle or an ambulance allow it free passage by drawing to the side of the road.

11 Right of way

The pedestrians have the right of way at uncontrolled pedestrian crossings. When any road is provided with footpath or cycle track specially for other traffic, except with permission of a police officer in uniform, a driver shall not drive on such footpath or track.

12 Taking 'U' turn

No driver shall take a 'U' turn where 'U' turn is specially prohibited and on a busy traffic road. If a 'U' turn is allowed the driver shall show signal by hand as for right turn, watch in the rear view mirror and turn when safe to do so.

13 Signals to be given by drivers

The following shall be used by the drivers all motor vehicles namely

a When about to slow down, driver shall extend his right arm with the palm, down ward and to the right of the vehicle and shall move the arm and so extended up and down several times in such a manner that a signal can be seen by the driver of any vehicle which may be behind him.

b When about to stop, a driver shall raise his right forearm vertically outside of and to right side of the vehicle, palm to the right.

c When about to turn to the right or to drive to right hand side of the road in order to pass another vehicle or for any other purpose, a driver shall extend his right arm in a horizontal position out side of and to the right of his vehicle with the palm of the hand turned to the front.

d When you turn to left to drive to the left hand side of the road a driver shall extend high right arm and rotate it in anti clockwise direction.

e When a driver wishes to indicate to the driver of a vehicle behind him that the desires that driver to overtake him he shall bring the arm backward and forward in a semi- circular motion.

14 Direction indicator

The signals referred to in regulation 12, may be simplified also by mechanical or electrical devices.

15 Parking of the vehicle

a Every driver of a motor vehicle parking on any road shall park in such a way that it does not cause or is not likely to cause danger, obstruction or undue inconvenience to the road users and the manner of parking is indicated by any sign board or markings on the road side, he shall park his vehicle in such manner.

b A driver of a motor vehicle shall not park the vehicle

i At or near road crossing, a bend, top of a hill or a hump backed hill

ii On a foot path

iii Near a traffic light or pedestrian crossing

iv In a main road or one carrying fast traffic

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v Opposite another parked vehicle or as obstruction to other vehicle

vi Alongside another parked vehicle

vii ON roads or at places or roads where there is a continuous white line or or without a broken line

viii Near a bus stop, school or hospital entrance or blocking a traffic sign or entrance to a premises or a fire hydrant;

ix On the wrong side of the road;

x Where parking is prohibited;

xi Away from the edge of the foot path.

16 Visibility of lamps and registration marks

a No load or other goods should be placed on any motor vehicle so as to mask or otherwise interrupt vision of any lamp, registration mark, or any other mark required to be carried by or exhibited on any motor vehicle by or under Act, unless a duplicate of the lamp or mark so marked or otherwise obscured is exhibited in the manner required by or under the Act for the exhibition of the marked po obscured lamp or mark.

b All registrations or other marks required to be exhibited on a motor vehicle by or under the Act shall at all times be maintained in a clear and legible condition.

17 One way traffic- A driver shall not

a Drive a motor vehicle on the road declared 'one way' exception the direction specified by sign boards.

b Drive a vehicle in reverse direction into a road designed 'one way'

18 Driving on channelized roads (lane traffic)

Where any road is marked by lanes for movement of traffic, the driver of a motor vehicle shall drive with in the lane and the change the lane only after giving the proper signal.

Where any road is marked by a yellow - line dividing road, the vehicle proceeding in the same direction trying to overtake each other shall not cross the lane.

19 Stop sign on road surface

a When an line is painted on or inlaid into the surface of any road at the approach to the road junction or to a pedestrian crossing or otherwise, no driver shall drive a motor vehicle so that any part there of projects beyond that line at any time when a signal to stop is being given by a Police Officer or by means of a traffic control light or by the display of any traffic sign.

b A line for the purpose of this regulation shall not be less than 50 mm in width at any part and may be either in white, black or yellow.

20 Towing

a No vehicle than a mechanically disabled motor or incompletely assembled motor vehicle, a registered trailer or a side car, shall be trawled or drawn or towed by any motor vehicle, except for purposes of delivery and to the nearest filling station or garage.

b No matter vehicle shall be drawn or towed by any other motor vehicle unless there is in the driver's seat of the motor vehicle being drawn or towed a person holding a license authorizing him to drive the vehicle or unless the steering wheels of the motor vehicle being towed, are firmly and surely supported clear of the road surface by some crane or other device on the vehicle which is drawing or towing it.

c When a motor vehicle is being towed by another motor vehicle the clear distance between the rear of the front vehicle and front of the rear vehicle time shall at no time exceed 5 meters. The tow ropes or chains shall be of a type easily distinguishable by other road users and there shall be of a type easily distinguishable by other road users and there shall be clearly displayed on the vehicle being towed in black letters not less than seventy- five millimeters high and on a white background the words 'ON TOW'

d NO motor vehicle when towing another vehicles other than a trailer or signs car shall be driven at a speed exceeding 24 km per hour.

21 Use of horns and silence zones- a driver of a vehicle shall not

a sound the horn needlessly or continuously or more than necessary to ensure safety

b Sound the horns in silent zones

c Make use of a cut out by which exhaust gases are released other through the silencer;

d Fit or use any multi toned horn giving a harsh, shrill, loud or alarming noise

e Drive a vehicle creating undue noise when in motion

f Drive a vehicle with a muffler causing alarming sound.

22 Traffic sign and Traffic Police- A driver of a motor vehicle and every other person using the road shall obey

a Every signal given by police or otherwise by a police officer or any un authorized for time being in-charge of the regulation of traffic.

b Any direction applicable to him and indicated on or by notice traffic sign or signal fixed operated by an authority, competent to do so;

c Any direction indicated by automatic signaling devices fixed at road intersections.

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23 Distance from vehicles from front

The driver of the motor vehicle moving behind another vehicle shall keep at a sufficient distance from that other vehicle to avoid collision if the vehicle in front should suddenly slow down or stop.

24 No driver of the vehicle apply brake abruptly unless it is necessary to do so for safety reasons.

25 Vehicles to the uphill to be given precedence

On mountain roads and steep roads, the driver of a motor vehicle travelling downhill shall give precedence to a vehicle going uphill where ever the road is not sufficient ly wide to allow the vehicles to pass each other freely without danger, stop the vehicle to the side of the road in order to allow any vehicle proceeding uphill to pass.

26 Obstruction of driver

A driver of a motor vehicle shall, not allow the person as hamper his control of his vehicle.

27 Speed to be restricted

The driver of the motor vehicle shall, when passing or meeting a procession or body of troops or police on the march or when passing workman engaged on road repair, drive at a speed not exceeding more than 25 km an hour.

28 Driving of tractors and goods vehicles

A driver when driving a tractor shall not carry or allow any person to be carried on tractor. A driver of goods carriage shall not carry in the driver's cabin more number of persons. Than is mentioned in the registration certificate and shall not carry passengers for hire or reward.

29 Projection of loads

No person shall drive in any public place any motor vehicle which is loaded in a manner likely to cause danger to any person in such manner that road or any part thereof or anything extends laterally beyond the side of the body or to the front or to rear or in height beyond the permissible limit.

30 Restrictions to carry dangerous substances

Except for the fuel and lubricants necessary for the use of the vehicle no explosive , highly inflammable or otherwise dangerous substance shall be carried on any public service vehicle.

31 Restrictions on driving backwards

No driver of a motor vehicle shall cause the vehicle to be driven backwards without satisfying himself that he will not thereby cause any danger or undue inconvenience to any person on in any circumstances for any greater distance or period ofntime than may be reasonably necessary in order to turn the vehicle around.

32 Production of documents A person driving a vehicle

a Shall always carry with him his driving license ,certificate of registration, certification of taxation and certificate of insurance of the vehicle in case of transport vehicle the permit and fitness certificate, also;

b Shall on demand by police officer in uniform or an officer of the Motor Vehicle Department in uniform or any other officer authorized by the government, produce the document for inspection. [Provided that where any or all documents are not in possession, he shall produce in person an extract or extracts of the documents duly attested by any police officer or by any other officer pr officer said to the officer who demanded the documents, by registered post, within 15 days of the demand.]

33 Every driver must be conversant with the provisions of sections 112, 113, 121, 122, 125, 132, 134, 185, 186, 194 and 207 of the Motor Vehicles Act, 1988.

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Emergency maneuvers and prevention

Objectives : At the end of this lesson you shall be able to
- **state the emergency maneuvers and prevention method.**

Emergency maneuvers and prevention methods: When the driver moves the vehicle on the road, un expected defects are happened due to improper vehicle operation and vehicle maintenance.

Vehicle skidding: Vehicle skidding occurs when vehicle tyre lose their grip on the road or on the ground vehicle driver lose his steering control of the vehicle and skidding might be cause for an accidents.

Types of skidding - There are many types of skidding that occur, out of them the following is the main

- Over steer
- Under steer
- Hydro planning
- Wheels spin.

Cause for skidding :

1 Vehicle tyres lose traction on the road surface
2 Too much accelerator
3 Sudden braking
4 Low turning angle
5 Too much turning force on the road. Skid is caused by applying too much braking force when your vehicle don't have antilog (ABS) brake.

How to avoid vehicle skidding:

- Make sure your vehicle fitted with good condition tyres.
- Choose the speed based on the current weather conditions, not the speed limit.
- Be attentive while moving on wet or icy road.
- Decrease the speed while your vehicle turning or rounded bend road.
- Never slam on the brakes and be aware of upcoming turns or stops.

Horn stuck: All of a sudden horn does not work or continuously working due to electrical defects.

Cause of horn stuck: The following reason for horn stuck

- Faulty horn relay
- Stuck horn button
- Wiring short circuit
- Improper adjustment

How to prevent horn stuck: Follow the following method to prevent horn stuck while drive your vehicle on the road.

- Check horn button before you move the vehicle
- Check horn relay function if need replace it
- Check horn circuit and avoid loose wire connection.
- Turn up the horn.
- Check the fuse if need replace it
- Check the horn, if need replace it.

How to get horn unstuck:

1 Pushing on steering wheel a few times may dislodge a stuck switch in the horn's assembly. You can also try trusting your steering wheel back and forth a few times.
2 Disconnect the car battery.
3 Disconnect the fuse connected to the horn.
4 Remove the horn relay.
5 Remove the horn wire.

Fire: Incase fire accident happen while driving your vehicle on the road follow the steps

1 Stop the vehicle in the safe place.
2 Identify the type of fire.
3 Apply fire extinguishers on fire to shut off or inform to fire service if not possible shut off the fire.

Cause for vehicle fire : Following are the main reasons for the fire

- Tyre burst or low tyre pressure with over load.
- Fuel leakage
- Vehicle crash
- Electrical problems
- Leaking flammable fluids
- Engine over heating
- Vehicle design flaws.

Preventing automotive fires : Follow the preventive methods for automotive fires

- Perform regular maintenance on the vehicle with professional mechanic.
- Only use certified transport gasoline.

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- Never park the vehicle near flammable items it can touch the catalytic converter or exhaust pipe line.
- Always put bumpers front and rear of the vehicle for safety,
- Use proper air tyre pressure
- Use proper specified load only.
- Use good tyres.

Wheels coming out: Vehicles wheel come out due to bad maintenance of vehicles.

Cause for wheels coming out: Vehicle wheels are coming out due to mechanical mismanagement . Causes for wheels coming out

- Over tighten the wheel nuts
- Wheel mounting loose fitting
- Wheel bolts are broken
- Wheel hub mounting nuts loose fitting
- Wheels hub nuts thread worn out Stub axle broken

Preventive methods for the wheel coming out :

- Tighten the wheel nuts.
- Replace the damaged nut and bolt of wheel.
- Tighten the wheel hub nut as recommended tightness.

Brake failure:

Vehicle brake failure will be damaged for the vehicle, vehicle operator and public , prevention is better than cure.

Cause for brake failure:

The following reasons for vehicles brake failure.

- Water or oil in brake drum inner surface.
- No brake fluid in master cylinder.
- Brake fluid leaks
- Brake shoe worn out.
- Improper brake apply
- Brake shoe over heating
- Damaged brake hopes
- Bad brake booster.
- Worn out brake disc and brake pad .
- Air lock in brake system.

Preventive measure for brake failure:

- Periodically service the brake system.
- Top up the brake fluid .
- Replace the damage brake system parts.
- Bleed the brake system to remove air from the brake line.
- Skimming the brake drum or brake disc if need.

How to tackle in case of brake failure : The following tips can help in case of brake failure.

- Take your foot off the accelerator as soon as you discover a brake failure.
- Pump the brakes repeatedly.
- Turn on your hazard lights.
- Gently steer your vehicle toward a safe area to slow down , but don't turn your wheel sharply.
- Down shift the gear and use the emergency brake, when your vehicle has slowed down.
- Only turn the engine off after you have slowed down to a stop.
- Call road side assistance as soon as possible
- You stay in your vehicle until help arrives to your vehicle .

Broken stub axle : While driving a vehicle very rarely broken a stub axle.

Cause for stub axle broken : The following factors can be cause for broken stub axle.

- Poor maintenance.
- Vehicle accident.
- Vehicle hitting curbs.
- Vehicle met with pot hole on the road.
- Road bumps too hard while driving on the road.
- Over loading of the vehicle beyond the bearing capacity.
- Poor road condition and high vehicle speed.

Prevention method of stub axle broken

- Avoid over load on the vehicle.
- Drive safely with traffic speed limit.
- Properly tighten the stub and nuts bolts
- Don't over speed drive on rough up and down roads.

Burst of front tyre: While driving the vehicle, the front tyre sometimes burst and make a dangerous situation to the vehicle, driver and passengers.

Cause for tyre burst : The following factors can cause for vehicle front tyre burst.

- Over inflation of of tyre pressure.
- Poor tyre condition
- Over load
- Vehicle accident
- Road bumps
- Poor road condition and vehicle speed drive.
- Tyre manufacturing defects
- High temperature.
- Under inflation.

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Prevention method of tyre burst

- Always run with the correct tyre pressure.
- Replace damaged or worn out part.
- Don't over load your vehicle.
- Choose the type with the appropriate speed rating at all costs.
- Always use the reputed brand tyres only.

Sudden steering wobbling : Vehicle steering system is to control the angular moments. The following factor can cause for sudden steering wobbling while vehicle is driven on the road .

- Steering linkage excess play.
- Wheel bearing worn out or loose fitting.
- Stub axle ball joints are damaged.
- King pin worn out.
- Knuckle bearing worn out.
- Tie- end loose fitting.
- Pull and push rod mounting loose.
- Tyres out of balance.
- Problem with brake rotors or wheel cylinders.
- Worn suspension components.

Prevention method of steering wobbling: Use the balanced wheel and good equal condition tyres.

- Replace the worn suspension components.
- Replace the worn out or damaged steering system parts.
- Tighten the steering system's all parts. Joints as specified tighten pressure.
- Replace the worn out ball bearing.
- Use correct pressure for all tyres.
- Periodically lubricate the all moving parts of steering system.

Jamming of accelerator pedal: Vehicle accelerator pedal is used to control the engine speed by controlling a fuel or gas. Some time accelerator pedal is jamming due to the following reasons.

- Floor mat or other object getting jammed the gas pedal.
- Accelerator pedal linkage bend.
- Defective electronic controls.
- Electromagnetic interface in accelerate electronic system.
- A broken accelerator links.
- Defective vacuum hose.
- frictional wear in accelerator linkage joints.

Prevention method of accelerator pedal

- Set the foot mat properly.
- Ensure the accelerator pedal linkage are connected properly.
- Ensure if electronic control is provided in accelerator system, check for it proper function.
- Replace the broken accelerator cables.
- Replace damaged vacuum hose.
- Replace the damaged throttle control valve.
- Lubricate accelerator pedal linkage joints.

Snapping of steering linkage: The following fact for cause of steering linkage snapping .

- Loose or worn steering linkage.
- Loose or worn steering gears.
- Worn out king pin, steering knuckle bushing, bearings, spherical joints.
- Front wheel bearing too loose or worn.
- Loose steering gear housing on frame.
- Loose steering wheel on steering column.
- Bent steering knuckle.
- Inoperative stabilizer
- Too tight king pin, bushings.

Preventive method of snapping the steering linkage

- Periodically maintain the steering system and wheel bearing.
- Replace the damaged steering linkages.
- Lubricate all moving parts steering linkages.
- Grease the wheel bearings.
- Set the steering geometry.
- Replace the damaged suspension bushes.

Snapping of clutch linkage : Clutch system is used for engage and disengage the engine power with gear box (transmission system) . Sometimes clutch linkages are snapping while engage or disengage clutch pedal. The following factors can be caused for snapping the clutch linkage.

- Clutch linkage bend.
- Clutch linkage improper adjustment.
- Clutch pressure plate finger height improper.
- Damaged driven plate.
- Worn parts in release mechanism
- Graphite release bearing loose on throw out fork.
- Mis adjustment distorts the plate.
- Broken facing of driven plate.
- Dirt or foreign matter in the clutch.
- Bent clutch pedal.
- Clutch pedal touch with foot(board) floor.

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Prevention method of clutch linkage snapping : You can prevent the clutch linkage snapping by carrying out the preventive maintenance and periodical maintenance as specified by the vehicle manufacturers.Even though follow the steps to avoid clutch linkage snapping.

- Use the standard clutch linkages.
- Periodically maintain the clutch system.
- Lubricate all moving parts of clutch linkages.
- Replace all damaged parts of clutch system.
- Properly set the foot floor mat.
- Adjust the clutch pedal.
- Replace the damaged parts of suspension system. (bushes or bearings)

Under special circumstances of collision with disabled vehicle:

A collision is serious injury or damage to the vehicle or others. Suppose if you are involved in a collision, you must stop along with the vehicle when your vehicle is under collision with disabled vehicle, get your vehicle out of traffic and park safely. Place reflective triangles or other warning lights/ devices 200 to 300 feet behind the vehicles to warn approaching motorists.

Give your first aid attention to any one appears injured by your vehicle collision. Use emergency first aid where needed and notify the police or highway patrol as soon as possible. Inform to the vehicle owner , if any media arrive on the scene do not talk to them . Avoid arguing with other participants or discussing who is to blame.

If they are witness to the collision get their names addresses and phone numbers if possible as well as their RC book copy and vehicle's driver's license number and Xerox copy. Fresh up your mind . Make a written record. of the accurate help to sketching a diagram of the vehicle , include this information in your report to the police and your vehicle owner/ employer. Inform to the vehicle insurance company. Take a photograph in your mobile.

Try to locate the owner of the disabled vehicle involved in collision. If you can't leave a note in an obvious but secure place of the vehicle. Give your phone number to the insurance agent and lawyer. Report the collision to the appropriate police at the first opportunity appropriate police at the first opportunity.

Note : No one expects to be involved in a collision, but being prepared forth unthinkable can save lives and money and protect you from legal proceedings.

Brake failure during downhill: If unexpected brake failure during down hill road, follow the steps to safe guard your vehicle.

- Take your foot from accelerator pedal.
- Turn on hazard lights.
- Down shift your gears slowly.
- Pump the brake pedal hard.
- Continuously apply emergency brake.
- Steer yourself to safety.
- Use the engine brake and hand brake to stop the vehicle.
- If you drive automatic gear vehicles release the throttle pedal and the car should to lower gear.
- Get off the road.

Identification of brake failure :

- Screeching and grinding noise
- Shaking brake pedal / steering wheel.
- Burning smell from the brakes.
- Brake mal function light glow on dash panel board.
- Brake fading.
- Brake fluid leak.

Prevent method of brake failure : Service your vehicle in regular intervals.

- Pay attention to how the brake feels.
- Replace the damaged parts as soon as possible.
- Top up brake fluid regularly.
- Use the engine brake on emergency to increase the life of service brake parts.

Sudden obstruction in front of the vehicles : Most of the vehicles happen due to unexpected things . Obstructions happen on the drive way, (like pedestrians, animals, children, motor cyclist, all of a sudden come in front of vehicle while driving on the road). So that driver cannot control his vehicle all of a sudden.

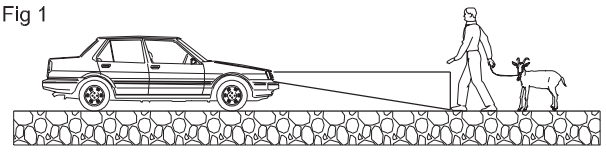
In case of sudden obstruction come in front of vehicle, apply emergency brake and reduce the gear. ratio and pull out to the side of the road safely. The best way to stop the vehicle is quickly is to drive a vehicle slowly. Follow the following steps to avoid accidents due to sudden obstruction happen in front of the vehicle.

- Pay attention to road ahead, side and rear of the vehicle.
- Use the high beam light on the road at night. (Fig 1)
- Use the emergency brake along with parking brake of effective sudden stop of the vehicle.

Note : While applying emergency brake with parking brake, it may cause for collision of the vehicle. Be careful and balance the vehicle speed by reduce gear top to low gear.

- Use the sound horn while turning your vehicle at the sharp bend road.
- Don't over take on narrow and sharp bend road.

Fig 1



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Laws governing to use of motor vehicle & vehicle transport

Objectives : At the end of this lesson you shall be able to
- **state the ministry concerned with the motor vehicle act**
- **state the motor vehicle law in India**
- **state the definition of law**
- **state the vehicle log book**
- **state the vehicle fitness certificate.**

The subject of motor vehicles is dealt by the Central Government / State Government the ministry concerned with the Motor Vehicle Laws in India is Ministry of Road Transport & Highways.

The ministry has two separate wings

1 Roads Wing

2 Transport wing

There are a number of legislation in India that deal with different aspects of motor vehicles

Motor vehicle laws in India

1 The carriage by Road Act, 2007

2 The motor vehicle Act, 1988

3 The national highways Act.1956

4 The national highways authority of India Act, 1988

5 The control of national highways (Land and traffic) Act. 2002

6 The multimodal transportation of goods act, 1993.

7 The motor transport workers Act, 1961.

8 The public liability insurance act, 1961.

9 The road transport corporation act, 1950

10 The fatal accidents act, 1855.

The act deals with

- Construction equipment and maintenance
- Standards for components and parts
- Anti-pollution control devices
- Issue of testing fitness certificates
- Registration marks

MV ACT

1 Extends to whole of India

2 Came into force on 1 July 1989

3 No. of Chapters -14

4 No. of Sections - 217

The Act categories motor vehicles into different types. Generally the categorization is based on size, type and utility of such vehicles.

Definition of Law

It is a command enforced by some of action. It is a rule of action to which men are obliged to make their conduct conformable.

All laws in the country, whether of the Union or of the States have to conform to the constitutional scheme.

The term automobile includes all vehicles propelled by other than muscular power, except rail road and railway cars and motor vehicles, running only on rails and tracks and road rollers. A crane is a motor vehicle. A crane is a motor vehicle.

Definition of goods carriage

“Goods carriage” means any motor vehicle constructed or adapted for use solely for the carriage of goods, or any motor vehicle not so constructed or adapted when used for the carriage of goods.

Definition of heavy passenger motor vehicle

“Heavy passenger motor vehicle” means any public service vehicle or private service vehicle or educational institution bus or omnibus the gross vehicle weight of any of which, or a motor car the unladen weight of which, exceeds 12,000 kilograms;

Definition of light motor vehicle

“Light motor vehicle” means a transport vehicle or omnibus the gross vehicle weight of either of which or a motor car or tractor or road-roller the unladen weight of any of the which, does not exceed 7.,500 kilograms.

Definition of maxicab

“Maxicab” means any motor vehicle constructed or adapted to carry more than six passengers, but not more than twelve passengers, excluding the driver, for hire or reward;

Definition of contract carriage

“Contract carriage” means a motor vehicle which carries a passenger or passengers for hire or reward and is engaged under a contract, whether expressed or implied, for the use of such vehicle as a whole for the carriage of passengers mentioned therein and entered into by a person with a holder of a permit in relation to such vehicle of any person authorized by him in this behalf on a fixed or an agreed rate or sum.

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Licensing of drivers & conductors

Objectives: At the end of this lesson you shall be able to
- **state the necessity of driving license**
- **state the age limit & grant of driving license**
- **state the different type of driving license**
- **pursue the procedure to obtain a learners and permanent license**
- **pursue procedure of renewal of driving licenses**
- **state the necessity of conductor license.**

Licensing of drivers of motor vehicles

Driving license

While driving a vehicle a person or driver must have a valid document of driving a vehicle. This document is called Driving License.

Necessity for driving license

No person shall drive a motor vehicle in any public place unless he holds an effective driving license issued to himself authorizing him to drive the vehicle.

Age limit in connection with driving of motor vehicles

After completion of 16 years of age, for driving motor cycles with engine capacity not exceeding 50cc with the consent of the parent / guardian.

After completion of 18 years of age, motor cycles with engine capacity exceeding 50cc and light motor vehicle.

After completion of 20 years of age, for an endorsement to drive transport vehicles.

Grant of driving license

At the regional transport office or motor vehicles inspectors office, having jurisdiction over your residential area.

Types of driving license in India

There are different types of licenses issued by the RTO offices.

Learner driving license

This is a temporary license that is valid up to 6 months from the date of issue. It is basically issued to learn driving of Motor Vehicles.

Permanent Driving License

Permanent driving license is issued to those who become eligible for it after thirty days (to apply within 180 days) from the date of issue of the learner license. Person suppose to get permanent driving license should be conversant about the vehicle systems, driving traffic rules & regulations.

Duplicate driving license

In case of loss, theft or on mutilation, Duplicate License is issued. The documents to be produced are FIR of the lost license, challan clearance report from RTA office (in case of commercial license renewal) and an application in Form prescribed. The particulars are verified by the authority from the records. The duplicate license will have the valid period same as the previous license. If the license is lost and expired by more than 6 months it requires remission from Head Quarter or Transport Department.

It is recommended to keep a photocopy of the original license or particulars of license noted in order to make it easier for the issuing authority to locate the particulars from their record.

International Driving license

The motor licensing authority also issues International Driving License. The validity of this license is for one year. Person visiting the country is required to collect the license from there within one year period. Apart from address proof and birth certificate, one has to produce a valid passport and valid visa while applying.

Motorcycle license or two-wheeler license

Two - wheeler license is issued by the Regional Transport Authority (RTO) to permit driving of only two wheeler vehicles like bike, scooter and moped.

Light Motor Vehicle License (LMV)

Light Motor Vehicle License is issued to drive light vehicles like auto rickshaws, motor car, jeep, taxi, three-wheeler delivery vans, etc.

Heavy Motor Vehicle License (HMV)

Heavy Motor Vehicle License is issued to drive heavy vehicle like trucks, buses, tourist coaches, cranes, goods carriages, etc. A person with HMV license can drive light vehicle but Light Motor Vehicle.

Procedure to obtain a Learner's License

Applicants for a Learner's License should appear personally before the Licensing Authority with the following:

- Application in prescribed form
- Fees
- Proof of age, appropriate for relevant class of vehicle. For example Birth Certificate, Secondary School Certificate, Life Insurance Policy, Passport etc.
- Proof of residence like Ration Card, Electoral Roll, Electricity/Telephone Bill etc., showing in the name of the person.
- Medical Certificate wherever applicable.
- 3 recent passport size photographs of the applicant.

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- Applicants for Transport Vehicle License must apply in prescribed Form and produce a Permanent Driving License for Light Motor Vehicle held by him, at least for one year.
- Applicants for Learners license shall pass a test regarding basic traffic signs and driver's responsibilities.
- The Learner's License so issued is valid for a period of six months from the date of issue and is renewable for another period of six months, during its validity.

Procedure to obtain a permanent license

The applicant should appear in person along with a registered motor vehicle of the relevant category before the Licensing Authority with the following:

- Application in prescribed form
- Fee for test and License
- Valid Learner's License held by the applicant for the relevant class, which is older than 30 days.
- 4 recent passport size photographs of the applicant.
- Applicants for Transport Vehicle License should enclose a Training Certificate issued by a recognized driving school.
- The applicant shall pass a driving test on a vehicle of the type he has applied for.

Validity period of the Driving License

License to drive a Non-Transport Vehicle is valid for 20 years from the date of issue or until the holder attains the age of 50 years, whichever is earlier. After that, the license is renewed every 5 years.

Transport Vehicle License is valid for a period of 3 years from the date of issue or renewal.

Effectiveness of licenses to drive motor vehicle

Any license whether learner's or permanent license issued for the fixed duration issued by any competent authority under this act shall be effective throughout India.

Procedure of renewal of driving licenses

Any licensing authority may, on application made to it, renew a driving license issued under the provisions of this act with effect from the date of its expiry.

Powers of a licensing authority to disqualify from holding a driving license or revoke such license

- He is a habitual criminal or a habitual drunkard ; or is a habitual addict to any narcotic drug or psychotropic substance Act, 1985 ; or
- is using or has used a motor vehicle in the commission of a cognizable offence ;
- or has by his previous conduct as driver of a motor vehicle shown that his driving is likely to be attended with danger to the public ; or
- has obtained any driving license or a license to drive a particular class or description of motor vehicle by fraud or misrepresentation or has committed any such act which is likely to cause nuisance or danger to the public, or
- has failed to submit to, or has not passed, the tests referred to in provisions.

The procedure of maintenance of state registers of driving licenses

Each State Govt. has power to maintain the registers regarding driving licenses issued or renewed by licensing authorities in a form as may be prescribed by the Central Govt. with the full particulars of name, address, license no., date of issue or renewal of licenses, expiry of licenses, class and type of vehicle authorized to drive and other particulars.

Licensing of conductors

Necessity of conductors licenses

For acting as a conductor of a stage carriage one should have an effective conductors license issued by on competent authority authorizing him to act as such conductor and also no person shall employer permit any person who is not so licensed to act as a conductor for a period not exceeding one month.

Revocation of conductors license

A conductors license may at any time be revoked by any licensing authority has reasonable grounds to believe that the holder of the license is suffering from any disease or disability which is likely to render him permanently unfit to hold such license and where the authority revoking a conductors license is not the authority which issued the same and also it shall intimate the fact of such revocation to the authority which issued the license.

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Registration of vehicle

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

- **state the definition of certificate of registration**
- **state the necessity and grant for registration**
- **state the condition of refusal registration**
- **pursue the procedure for temporary, permanent, extension & renewal of registration**
- **pursue the procedure for transfer of ownership**
- **pursue the procedure for motor vehicles subject to hire-purchase agreements.**

Registration of vehicle

Definition of certificate of registration

The certificate issued by a competent authority to the effect that a motor vehicle has been duly registered in accordance with the provisions of this Act.

Necessity for registration

No person shall drive any Motor Vehicle and no owner of Motor Vehicle shall cause or permit the vehicle to be driven in any public place or any other place, unless the vehicle is registered in accordance with Chapter 4 of IMV Act 1988.

Grant of registration

Every owner of Motor Vehicle shall cause the Vehicle to be registered by a Registering Authority in whose Jurisdiction he has resistance or place of business where the vehicle is normally kept.

Procedure for registration

An owner of the vehicle have to apply for it by an application by himself or on behalf of the owner of vehicle in such form and shall be accompanied by such documents, particulars and information and which shall be made within such period as may be prescribed by the Central Govt. after this the registering authority shall issue to the owner of a motor vehicle registered by it a "certificate of registration" in such a form and containing such particulars and information and in such a manner as may be prescribed by the Central Govt. The registering authority shall also enter the particulars of the certificate in a register, which is to be maintained by him.

Conditions for refusal of registration

The registration authority may, be order, refuse to register any motor vehicle, if in that case the registering authority has reason to believe that,

- it is a stolen motor vehicle or
- the vehicle is mechanically defective or fails to comply with the requirements of this Act or
- the rules made there under or if the applicant fails to furnish particulars of any previous registration of the vehicle or etc the registering authority shall furnish the applicant whose vehicle is refused registration a copy of such order together with the reasons for such refusal.

The same procedure is to be followed by the registering authority in the case of renewal of the certificate of registration. So, that authority also refuses the application for the renewal of certificate of registration on the same grounds.

Procedure for temporary registration of a vehicle

An application for temporary registration shall be made in Form 20 of the Central Motor Vehicle Rules, 1989 prescribed for registration, under the Act marked "Temporary" to the Registering Authority or to the dealer dealing in the sale of New Motor Vehicles recognized by the Transport Commissioner. It shall not be necessary to fill in the items 23 to 32 of the form not withstanding that be may be a transport vehicle.

Extension of temporary registration

An application for extension of the period of temporary registration shall be made to the registering authority specifying the period up to which extension is necessary and shall be accompanied by the Temporary Registration Form.

A Copy of sales certificate in prescribed form.

B Copy of road worthiness certificate in prescribed form from the manufactures.

C Copy of valid insurance certificate.

D Pollution Under Control Certificate

E Copy of proof of address (Ration card, electricity bill)

F Copy of design approval copy of STA in case trailer or semi trailer.

G Copy of original sales certificate from the concerned authorities in prescribed form in the case of Ex-Army vehicle.

H Copy of customs clearance certificate in the case of imported vehicles.

I Tax as per state MVT Act.

- Non-transport vehicles
- Transport vehicles

(Form mentioned in A,B, G will be given by manufacturer / dealer along with invoice)

Procedure for permanent registration

An application for registration of a Motor Vehicle shall be made in prescribed form to the registering authority within a period of 7 days from the date of delivery of such vehicle excluding the period of journey and shall be accompanied by

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- Sales certificate in prescribed form.
- Roadworthiness certificate in prescribed form from the manufacturers.
- Valid insurance certificate.
- Proof of address (Ration card, electricity bill)
- Design approval copy of STA in case Trailer or Semi Trailer.
- Original sales certificate from the concerned authorities in prescribed form in the case of ex-army vehicle.
- Pollution under control certificate.
- Customs clearance certificate in the case of imported vehicles.
- Appropriate fee.
- Tas as per state MVT Act.
- Non-transport vehicles.
- Transport vehicles (manufacturer/dealer along with invoice)

Procedure for renewal of registration certificate

An application for renewal of certificate of registration shall be made in prescribed form not more than 60 days before the date of its expiry, by paying the appropriate fee as specified in Rule 81 of the Central Motor Vehicle Rules 1989, to the Registrating Authority in whose Jurisdiction the vehicle is.

Requirements

- Vehicle
- R.C.Book
- Pollution Under Control Certificate.

Procedure for motor vehicle subject to hire-purchase agreements

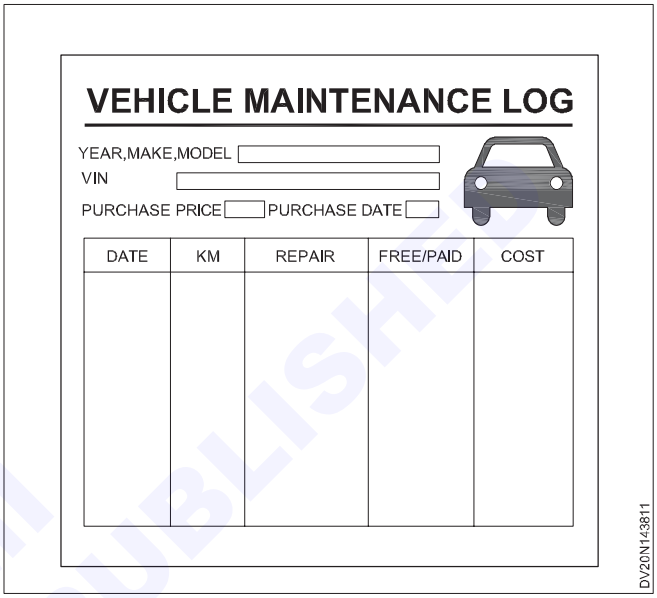
When an application for registration of a motor vehicle, which is held up a hire-purchase lease or hypothecation agreement, is made, the registering authority shall make an entry in the certificate of registration regarding the existence of the said agreement.

Where the ownership of any motor vehicle registered under this chapter is transferred and the transferee enters into the said agreement with any person, shall on receipt of an application in such form as the Central Govt. may prescribe from the parties so the said agreement make entry as to the exercise of the said agreement in the certificate registration;

Any entry made under upper 2 provisions may be cancelled by the authority on proof of the termination of the said agreement by the parties concerned on an application being made in such form as the Central Govt. may prescribe.

No entry regarding the transfer of ownership of any motor vehicle, which is held under the said agreement, shall be made in the certificate of registration except with the written consent of the person whose name has been specified in the certificate of registration as the person with whom the registered owner has entered into the said agreement.

Vehicle log book: Vehicle log book (Fig 1) is used for maintain a vehicle 's history like, travel record, repair records, free and paid service records, E.tag up fuel cost and volume of distance since last fill up and driver initials etc.



Log book is record of events, presented in a systematic manner. Vehicle log is used to record business related trips vehicle log book is maintained by the drive , it contains specific information. Log book is considered an official record and it is often submitted to audit and tax authority by government and private sectors.

Common details are recorded in log book include the distance of vehicle run, Date and time of driving and destination, purpose of journeys. Log book is available for purchase at book shops and online and range in paper size: A new log book in the market is available, it can be in the form of a GPS device you place your vehicle or mobile application. Electronic and app log books are typically customized to fit different countries requirements and record your driving automatically. App log book produce the record your driving automatically. App log books produce the record stored mileage for re imbursement or deductions.

Vehicle fitness conditions : A new vehicle come with condition certificate for fitness (15) years Post that period that vehicle renew the fitness certificate to comply with motor vehicle act or rules and regulations ACT 18 Oct 2022.

Important of vehicle fitness certificate : A fitness certificate (FC) is a document that certificate ensure the vehicle is fit in every aspect to play on roads. The renewal process includes a thorough vehicle inspection by the RTO.

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A fitness vehicle certificate is mandatory for all motor vehicles in India. The fitness certificate ensures that the vehicle is safe to drive on roads as the vehicle undergoes a thorough inspection to determine its mechanical condition.

Steps to apply for a fitness on line

- Visit the official website of Parvahan Portal.
- Click on vehicle related services from the online service section.
- Select the state of residence from the drop down list.
- On the next page, enter the vehicle registration number and click on the proceed button.
- Select apply for fitness certificate and read the instructions .Acknowledge the instructions and click on proceed.
- Input the vehicle chassis number and registered mobile number and click on " Generate OTP "
- Enter the OTP to view the vehicle details.
- Verify the same, fill out the vehicle insurance details and click on the payment button.
- Pay the applicable fees via available digital payments mode.
- An application number will be generated, also down load the on line receipt for future reference.
- Visit the RTO with your vehicle and relevant documents and complete the vehicle inspection.

Documents required to obtain a FC

- Form- 21
- Form- 22
- Road tax payment receipt
- Vehicle insurance policy certificate.
- Original registration certificate
- Pollution certificate.
- Temporary R.C
- Address proof
- Pencil impression of the chassis number
- Passport size photographs.

Different types of forms

Objectives: At the end of this lesson you shall be able to
- **state the different type of forms applicable for driving license**
- **state the different type of forms applicable for registration certificate**
- **state the different type of forms applicable for transaction regarding registration certificate**
- **state the different type of forms applicable for fitness certificate.**

Forms required for driving license

Form 1-Application cum declaration as to the physical fitness

Form 1A- Medical certificate

Form 2- Application for the grant or renewal of learners license

Form 9-Application for the renewal of driving license

Form LLD- Intimation of loss or destruction of driving license and application for duplicate

Forms required for registration certificate

Form 20 - Application for registration of a motor vehicle

Form 26 - Application for the issue of duplicate certificate of registration

Form 28- Application for No objection certificate

Forms required for transactions regarding registration certificate

Form 29- Notice of transfer of ownership of a motor vehicle

Form 30 - Report of transfer of ownership of a motor vehicle

Form 33 - Intimation of change of address for recording in the certificate of registration and office records.

Forms required for fitness certificate

Form - C.F.A
Application for certificate of fitness

Form - C.F.R.A
Application for renewal of certificate of fitness

Form C.F.Sub
Temporary authorization of use of vehicle when the certificate of fitness expired.

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FORM 1

APPLICATION-CUM-DECLARATION AS TO PHYSICAL FITNESS [See Rule 5(2)]

1 Name of the Applicant .....

2 Son/Wife/Daughter of .....

3 Permanent address .....

.....

.....

4 Official / Temporary address (if any) .....

.....

.....

5 Date of birth Date..... Month..... Year .....

6 Identification marks (1).....

(2).....

DECLARATION:

a Do you suffer from epilepsy, or from sudden attacks of loss of consciousness or giddiness from any cause? **Yes/No**

b Are you able to distinguish with each eye (or if you have held a driving license to drive a motor vehicle for a period of not less than five years and if you have lost, the sight of one eye after the said period of five years and if the application is for driving a motor vehicle other than a transport vehicle fitted with an outside mirror on the steering wheel side) or with eye, at a distance of 25 metres in good day light (with glasses, if worn) a motor car number plate? **Yes/No**

c Have you lost either hand or foot or are you suffering from a defect or muscular power of either arm or leg? **Yes/ No**

d Can you readily distinguish the pigmentary colours, red and green? **Yes/No**

e Do you suffer from night blindness? **Yes/No**

f Are you so deaf as to be unable to hear (and if the application is for driving a light motor vehicle, with or without hearing aid) the ordinary sound signal? **Yes/No**

g Do you suffer from any other disease or disability likely to cause your driving of a motor vehicle to be a source of danger to the public, if so, give details. **Yes/No**

I hereby declare that to the best of my knowledge and belief, the particulars gives above and the declaration made therein are true.

(Signature or thumb impression of the application)

Note: 1 Applicant who answers `Yes' to any of the questions (a), (c), (e), (f) and (g) or `No' to either of the questions (b) and (d) should amplify his answers with full particulars, and may be required to give further information relating thereto.

2 This declaration is to be submitted invariably certificate in Form 1-A.

Preliminary written test for obtaining learners licence

Question paper No: **Date:**

Note: A minimum of six questions must be answered correctly to get through the test

Question Numbers	1	2	3	4	5	6	7	8	9	10
The correct answer numbers must be filled in these boxes										
Marks										
Total marks	/10			Total Result			Passed / Failed			
Signature of the applicant				Signature of the motor vehicle inspector						

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FORM 1-A

MEDICAL CERTIFICATE

[See Rule 5(1), 3(), 7, 10(a), 14(d) and 18(d)]

(To be filled in by a registered medical practitioner appointed for the purpose by the state government or person authorized this behalf by the state government referred to under sub-section (3) of section 8)

1 Name of the Applicant .....

2 Identification marks (1).....

(2).....

3 (a) Does the applicant to the best of your judgement suffer from any defect of vision? Is so, has it been corrected by suitable spectacles ? Yes/No

(b) Can be applicant to the best of your judgement, readily distinguish the pigmentary colours, red and green ? Yes/No

(c) In your opinion, is he able to distinguish with his eye sight at a distance of 25 metres in good day light a motor car number plate Yes/No

(d) In your opinion, does the applicant suffer from a degree of deafness which would prevent his hearing the ordinary sound signals ? Yes/No

(e) In your opinion, does the applicant suffer from night blindness ? Yes/No

(f) Has the applicant any defect or deformity or loss of member which would interfere with the efficient performance of his duties as a driver ? Is so give your reasons in details Yes/No.

(g)

OPTIONAL

(a) Blood Group and RH factor of the applicant (if the applicant so desires that the information may be noted in his driving licence)

(a) Blood Group _____ (b) RH factor _____

Declaration made by the applicant in Form-I as to his physical fitness is attached.

CERTIFICATE OF MEDICAL FITNESS

Declaration made by the applicant in Form 1 as to his physical fitness is attached. I Certify that I have person ally examined the applicant

I also certify that while examining the applicant I have directed special attention to the distant vision and hearing ability, the condition of the arms, legs, hands and joints of both extremities of the candidate and to best of my judgement he is medially fit/not fit to hold a Driving Licence.

Signature

1 Name and designation of the Medical Officer/Practitioner

(Seal)

2 Registration Number of Medical Officer

Date : Signature of thumbs impression of the candidate

Note : The Medical Officer shall affix his signature over the photograph in such a manner that part of the his signature is upon the photograph affixed and part on the certificate.

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Particulars to be furnised by applicant

1 Full Name (in Capital) .....

2 Son/Wife/Daughter of .....

3 Permanent of address .....

(Electoral roll/LIC policy/Passport/Pay slip issued by any office of the Central Government / State Government or a local body/Any other document or documents as may be prescribed by the State Government / Affidavit sworn before an executive magistrate or a first class judicial magistrate or a notary public to be enclosed).

4 Temporary/Official address, if any .....

5 Duration of stay at the present address .....

6 Date of Birth..... Day..... Month..... Year.....
(Proof of age to be enclosed)

7 Place of birth .....

8 If place of birth outside India when migrated to India .....

9 Educational Qualification .....

10 Identification mark (s) 1.....

2.....

11 Declaration of citizenship status .....

(i) If deemed citizen or Citizen by birth

(Birth certificate and school certificate)
In support of citizenship as Indian to be enclosed)

(ii) If citizenship is acquired by Descent/Registration (in case citizenship acquired by descent, birth certificate, land /property document of parent/In case of citizenship acquired by registration certificate to be enclosed)

(iii) If citizenship by naturalization (Certificate of naturalization and certificate of registration to be enclosed)

(iv) If non - Indian citizen
(Valid passport or other travel documents and such other document or authority as may be prescribed by law to be enclosed)

12 Blood group .....
RH (Rhesus) factor

13 I hold an effective driving licence to drive: Motor cycle /light motor vehicle /transport vehicle with effect from .....

14 Particulars of any driving licence previously held by applicant. Whether it was cancelled and if so, for what reason .....

15 Particulars of any learners licence previously held by applicant in respect of the description of vehicle to which the applicant has applied. .....

16 Have you been disqualified for holding or obtaining driving licence of learner's licence. If so, for what reasons. .....

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*** Strike out whichever is inapplicable.**

Date : _____ Signature or thumb impression of the applicant

Place : _____

Specimen signatures or thumb impression of the applicant

1 .....

2 .....

Declaration under sub-section (2) of section 7 of the Motor Vehicles Act 1988

Shri/Kumari .....son/daughter of.....who is a minor is under my care and I accept responsibility for his/her driving. If at a later date I decide not to

Signature .....

Name and full address of the Parent/guardian

.....

.....

Relationship .....
(To be signed in the presence of the Licensing Authority or person authorised in this behalf by the Licensing Authority)

For Office Use

The applicant is exempted from the medical test under rule 6 and the preliminary text under rule 11(2) of the Central Motor Vehicle Rules 1989, Learner's Licence may be issued.

The applicant was tested with reference to rule 11 (1) of the Central Motor Vehicle Rules, 1989. He/She has passed the test. Learner's Licence may be issued.

Learner's Licence may be refused.

Signature of licensing authority or
other person authorized in this behalf.

* Strike out whichever is inapplicable.

Note: The application along with the scanned copies of the required documents may also be sent to the concerned Licensing Authority through Electronic Mail, if allowed by the concerned state government / Union territory administration.

In such cases, the licensing authority shall scrutinse the application and intimate the applicant about the acceptance / any / discrepancy.

In case the application is accepted, the applicant shall be intimated through electronic mail to report to the authority concerned on an appointed date along with the documents for further verification, submission of application fee and examination of the applicant.

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FORM 9

[See Rule 18 (1)]

Form of application for the renewal of driving licence

I, Shri/Smt./Kumari…….....Son/wife/Daughter of ……
hereby apply for the renewal of my driving licence which is attached and particulars of which are as follows:

(a) Number ……

(b) Date of Issue ……

(c) Licensing authority by which the licence was issued ……

(d) Licensing authority by which the Licence was last renewed ……

No. and dated of renewal ……

(e) Class of vehicles authorized to be driven ……

(f) Date of expiry of licence to drive

Transport vehicle ……

Vehicles other than transport vehicles ……

My present address is ……

If this address is not entered on the licence, I do/ do not wish that it would be so entered.

If the licence is not attached, reasons why it is not available? ……

……
…….

If the licence was not renewed within thirty days of the date of expiry, reasons for delay…….....

…….....

The renewal of licence has not been refused by any licensing authority.

I have not been disqualified for holding or obtaining a driving licence. My licence has not been revoked.

I enclosed a medical fitness certificate in (Form 1A),

I enclose three copies of my recent photograph (5 cm x 6 cm)

I have paid the fees of Rupees ……

I hereby declare that to the best of my knowledge and belief the particulars given above are true.

Dated……..

Signature or thumb impression of the Applicant

Name ……

Address ……

……

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Form L. L. D.

Intimation of loss or destruction of driving licence and application for duplicate (See Rule 25)

To

The Licensing Authority,

.....

1 .....of (Permanent Address).....

and (present address).....(Father's Name) ..... hereby report that driving Licence No .....is issued by Licensing Authority ..... on or about the day of ..... in No ..... and on ..... for the period up to ..... has been lost / destroyed (i) in the following circumstances:

2 I furnish below further details of the licence -

a) Class of vehicles for which the licence is valid

.....

b) The number and date of the Authorisation and the Licensing Authority which issued the authorisation to drive as a paid employee (if so authorised)

.....

c) Whether authorised to drive transport vehicles if so, the date and authority

.....

d) Serial number of Badge, if any, issued and by whom issued?

.....

e) Endorsement of punishments

.....

3 I hereby apply for a duplicate licence and tender Rupees.....

4 I attach two clean copies of a recent photograph of myself (i)

5 I hereby declare that the above particulars are to the best of my knowledge correct.

.....

Date : Signature of applicant

Note : (i) Strike out alternative not required and items not applicable. If the column is not sufficient, particulars to be furnished on a separate sheet to be appended.

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FORM 20

(See Rule 47)

Application for Registration of a Motor Vehicle

(To be made in duplicate if the vehicle is held under an agreement of Hire-purchase/Lease/Hypothecation and Duplicate copy with the endorsement of the Registering Authority to be returned to the Financier simultaneously on Registration of motor vehicle).

To

The Registering Authority

1 Full name of person to be registered as Registered owner ----------
Son / Wife / Daughter of

2 Age of person to be registered as Registered owner ----------

3 Permanent address ----------
(Electoral Roll/Life Insurance Policy/Passport/Pay slip ----------
issued by any office of the Central Government/ State
Government or a local body/ Any other document or ----------
documents as may be prescribed by the State Government/
Affidavit sworn before an Executive Magistrate or a First ----------
Class Judicial Magistrate or a Notary Public to be enclosed)

4 Temporary address / Official address, if any ----------

5 Duration of stay at the present address ----------

6 The annual income and PAN/GIR number of the owner ----------

7 Place of birth ----------

8 Place of birth is outside India, when migrated to India ----------

9 Declaration of citizenship status

i If deemed Citizen or Citizen by Birth

ii (Birth certificate and school certificate in support of Citizenship as Indian to be enclosed)
If Citizenship is acquired by Descent /
(In case citizenship acquired by Descent, Birth Certificate, ----------
land/property document of parent/in case of

iii citizenship acquired by registration, certificate to be enclosed)
If Citizenship by Naturalization

iv (Certificate of Naturalization and Certificate of Registration to be enclosed)
If non-Indian Citizen
(Valid passport or other travel documents and such other document or authority as may be prescribed by law to be enclosed)

10 Name and address of the Dealer or Manufacturer from ----------
whom the vehicle was purchased
(sale certificate and certificate of road worthiness issued by the manufacturer to be enclosed)

11 If ex-army vehicle or imported vehicle, enclose proof. If locally ----------
manufactured Trailer/Semi-trailer, enclose the approval of design by the State Transport Authority and note the proceedings number and date of approval

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12 ---------- Class of vehicle
(if motor cycle, whether with or without gear)

13 The motor vehicle is

(a) A new vehicle ----------

(b) Ex-army vehicle ----------

(c) Imported vehicle ----------

14 Type of body ----------

15 Type of vehicle ----------

16 Maker's Name ----------

17 Month and Year of manufacture ----------

18 Number of cylinders ----------

19 Horse power ----------

20 Cubic capacity ----------

21 Maker's classification if not known, wheel base ----------

---

22 Chassis No. (Affix Pencil print) ----------

23 Engine Number or Motor Number in case of Battery Operated Vehicles. ----------

24 Seating capacity (including driver) ----------

25 Fuel used in the engine ----------

26 Unladen Weight(ULW) ----------

27 Particulars of previous registration and registered number (if any) ----------

28 Colour or colours of body wings and front end ----------

I hereby declare that the motor vehicle has not been registered in any State in India.

Additional particulars to be completed only in the case of transport vehicle other than motor cab

29 Number, description, size and ply rating of tyres, as declared by the manufacturer

a Front axle ----------
b Rear axle ----------
c Any other axle ----------
d Tandem axle ----------

30 Gross vehicle weight Kgms ----------

a As certified by manufacturer ---------- Kgms
b To be registered ---------- Kgms

31. Maximum axle weight

a Front axle ---------- Kgms
b Rear axle ---------- Kgms
c Any other axle ---------- Kgms
d Tandem axle ---------- Kgms

32 a Overall length ----------
b Overall width ----------
c Overall height ----------
d Over hang ----------

The above particulars are to be filled in for a rigid frame motor vehicle of two or more axles for an articulated vehicle of three or more axles or, to the extent applicable, for trailer, where a second semitrailer or additional semi-trailer are to be registered with an articulated motor

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The following particulars are to be furnished for each semi-trailer.

33 Type of body ----------

34 Registered Laden weight(RLW) ----------

35 Number, description and size of tyres on each axle ----------

36 Maximum axle weight in respect of each axle ----------

37 The vehicle is covered by a valid certificate of Insurance under Chapter XI of the Act.
Insurance Certificate or Cover Note ----------

Date :----------

Name of :----------

Valid From ---------- To ----------

The relevant order is enclosed.

38 The vehicle is exempted from Insurance.

39 I have paid the prescribed fee of Rs.

Signature or thumb impression of the
Person to be registered as registered

Date: ----------

Note: The motor vehicle above described

i Subject to Hire-purchase agreement/lease agreement

ii Subject to hypothecation in favor of

iii Not held under Hire-purchase agreement, or lease agreement or subject to Hypothecation Strike out what ever is inapplicable, if the vehicle is subject to any such agreement the signature of the Financier with whom such agreement has been entered into is to be obtained

Signature of the financier with whom an
Agreement of Hire-purchase, Lease or
Hypothecation

Signature or thumb impression of
the registered owner

Certificate of inspection of motor vehicle

Certified that the particulars contained in the application are true and that the vehicle complies with the requirements of the Motor Vehicles Act, 1988 and the Rules made there under

Signature of the Inspecting Authority

Name ----------

Date ----------

Designation ----------

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Office endorsement

Ref. No.---------- Office of ----------

The above said motor vehicle has been assigned the Registration number ---------- and registered in the name of the applicant and the vehicle is subject to an agreement of Hire purchase/ Lease/ Hypothecation with the Financier referred above.

Date ----------

Signature of the Registering Authority

To

The Financier

Confirmed Date :

(To be sent by registered post acknowledgement due)

Specimen signature or thumb - impressions of the person to be registered as Registered Owner and Financier are to be obtained in original application for affixing and attestation by the Registering Authority with office seal in Forms 23 and 24 in such a manner that the part of

Specimen signature of the Financier	Specimen signature of the Registered
1.	1.
2.	2.

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FORM 26

[See Rule 53]

Application for the Issue of Duplicate Certificate of Registration

(To be made in Duplicate and Triplicate where the Original Authority different, the duplicate copy and the Triplicate copy with the endorsement of the Registering Authority to be returned to the finance and Registering Authority simultaneously on the issue of duplicate certificate)

To,

The Registering Authority,

The Certificate of Registration of my/our motor Vehicle, the Registration Mark of which is _____ has been lost/destroyed/completely written off/soiled /torn/mutilated in the following circumstances

I/ We hereby declare that to the best of my/our knowledge the Registration of the Vehicle has not been suspended or cancelled under the provisions of the Act of Rules made there under and the circumstances explained above are true.

I/We do hereby apply for the issue of a duplicate certificate of Registration.

The written off/soiled/torn/mutilated* Certificate of Registration is enclosed.

The Vehicle is not held under any agreement of Hire/Purchase/Lease/Hypothecation.

The Vehicle is also not superdari and free from all encumbrances.

I/We herey declare that I/We on ---------- (date) have filed a complaint (copy enclosed) with the police about the loss of certificate of registration immediately after the loss has been noticed.

Date : Signature/Thumb Impression of Applicant

*Strike of whichever is not applicable

The Vehicle is held under Hire-Purchase/Lease/Hypothecation agreement with _____ and the 'No Objection Certificate (NOC)' has been Granted/ Refused by the Financier hereunder: Where 'No Objection Certificate (NOC)' is refused, applicant shall make a declaration as required under sub-section (8) of Section 51. "

Signature/Thumb Impression of the Owner

Name _____

Date _____

Full Address :_____

_____

_____

Note (1) Full Particulars of the circumstances shall be furnished in the case of loss or destruction of the Registering Certificate.

(2) Strike out whichever is not applicable.

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Consent of the financier for grant of "No Objection Certificate" (Under section 51(6)]

I/We being a party to an agreement of Hire-Purchase/Lease/Hypothecation in respect of Motor Vehicle specified above:

1 Have 'No Objection' in issue of the duplication Certificate of Registration of the said Vehicle.

2 Have 'Objection' in issue of the duplicate Registration Certificate of the said Vehicle for the reason given here under

Date : _____ Signature of the Financier

Office endorsement

Ref Number _____ Office of the _____

A duplicate Certificate of Registration as requested above is issued with the note agreement of Hire-Purchase/Lease/Hypothecation on _____ and is noted in the Original Registration Records in Form 24.

Date : _____ Signature of Registering Authority

To,

The Financier_____

The Registering Authority_____

(By registered post or delivered under proper acknowledgement)

Specimen Signatures of the Financier are to be obtained in original Application for affixing and attestation by the Registering Authority with his office Seal in Form 23 & Form 24. In such a manner that the part of impression of Seal of Stamp and Attestation shall fall upon each signature.

Specimen Signatures of the Financier	Specimen Signatures of the registered Owner
1.	1.
2.	2.

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FORM 28

Application and grant of No Objection Certificate

(To be made in Quadruplicate if the vehicle is held under an agreement of Hire-Purchase/Lease/Hypothecation, the duplicate copy, the triplicate copy and the Quadruplicate copy with the endorsement of the Registering Authority to be returned to the Registered owner of the Vehicle, the Registering Authority in whose jurisdiction the Vehicle is to be removed and the removed and the Financier simultaneously on grant/refuse of `No Object Certificate')

PART-1 APPLICATION

To

The Registering Authority,

.....

.....

I/We intend to transfer the vehicle to the jurisdiction of the Registering Authority .....

I/We intend to sell the Vehicle to Sri/Smt./Kumari .....

Who resides in the jurisdiction of the Registering Authority of the State.....if I/We therefore request for the issue of a no objection Certificate for my/our vehicle, the particulars which are furnished below:

1 Name and Address .....

2 Son/ Wife/ Daughter of .....

3 Registration number of the Vehicle .....

4 Class of Vehicle.....

5 Registering Authority which originally registered the vehicle.....

6 Engine Number .....

7 Chassis Number (Affix also pencil print).....

8 Period of stay in the State.....

9 Period upto which Motor Vehicle Tax been paid.....

10 Whether any demand for tax pending, if so, give the wave .....

11 Whether the Vehicle is involved in any theft case, if so give details.....

12 Whether any action under section 53, 54 or 55 of the motor Vehicle Act, 1988 is prescribed Authority if so give details .....

13 Whether the Vehicle is involved in any case of transport of prohibited goods, if so, give details.....

14 Whether the Vehicle is held under an agreement of hire-purchase/Lease/ Hypothecation, if so give name and address of the financier .....

I/We solemnly declare that the above statement is true.

Date.....

Signature or thumb impression of the owner of vehicle

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PART-II

Consent of the financier in the case of motor vehicle subject to an agreement

I/We being a party to an agreement of the Hire-Purchase/Lease/hypothecation in respect of the above said Vehicle hereby,

1 Give consent to issue the No. Objection Certificate for the said vehicle only for the purpose referred above.

2 Refuse to give consent for issue of No. Objection Certificate for the said vehicle due to the reasons furnished under .....

Date..... Signature of the Financier

PART-III

Office endorsement

(Grant /Refusal of "No Objection Certificate" under sub-section 3 of section 48 of motor vehicle Act 1988)

1 No Object Certificate in respect of the Vehicle, the detailed particulars whereof recorded over above is here by granted under section 48 (3) of M.V. Act, 1988 (Valid for use at the Registering Authority on whom it is issued).

2 No Objection Certificate in respect of the Motor Vehicle, the detailed particulars where of recorded over above is hereby refused under section 48 (3) of M.V. Act, 1988 for the reasons recorded as under:

.....

Date .....

Signature with seal of registering authority

Address .....

.....

.....

*Strike out whichever is inapplicable

To

The Registered Owner.....

The Financier.....

The Registering Authority.....

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FORM 29

[See Rule 55(1)]

Notice of Transfer of Ownership of a Motor Vehicle

(To be made in duplicate and the duplicate copy with the endorsements of the Registering Authority to be returned to the Transferor immediately or making, entries of Transfer of Ownership in Certificate of Registration and Form 24)

To,

The Registering Authority,

_____ (in whose jurisdiction the transferee resides)

I/We_____ Resident of _____

have on the _____day of the _____sold and delivered my/our Vehicle No._____Make _____Chasis No._____Engine No_____to Sri/Smt _____

_____Son/Wife/Daughter of _____ residing at _____House No/ Street/Village/Town/District/State under an Agreement of Hire-Purchase/ Lease/Hypothecation with _____.

The registration certificate & Insurance Certificate have handed over to Him/Her/Them.

To the best of my/our knowledge and belief the vehicle is not suberdari and free from all encumbrances and information furnished is true. I/We undertake to hold my/our self responsible for any inaccuracy or suppressions of information.

Signature of the Financier
(to give his consent)

Signature or Thumb Impression of the
Registered Owner (Transferor)

Date _____

Date _____

Copy to : Registering Authority in whose jurisdiction the Transferer resides.

Note : To be sent to both the Registering Authority by Regd. Post - Acknowledgement due

Office Endorsements

Reference No. _____Date _____Office of the_____ "The ownership of the Vehicle has been transferred to the Name of _____with the note of the said agreement with effect from (Date)_____.

Date : _____

Signature of the Registering Authority
(with office seal)

(The transferor)

By registered post or under proper acknowledgement.

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FORM 30

[See Rule 55 (2) and (3)]

Application for intimation and transfer of ownership of a motor vehicle

(To be made in duplicate if the Vehicle is held under an agreement of Hire-Purchase/Lease/Hypothecation. The Duplicate copy with the endorsement of the Registering Authority to be returned to the Financier simultaneously making the entry of the transfer of Ownership in the Certificate of Registration and Registration Record in Form 24).

PART-I For the use of the transferor

To

The Registering Authority
.....
.....
.....

Name of the Transferor : .....

Son/ Wife/ Daughter of : .....

Full address : .....

.....

.....

I/We, hereby declare that I/We have on this.....day of year.....sold my/our motor vehicle bearing Registration mark.....to Shri/Smt.....Son/Wife/Daughter of .....residing at .....(full address) and handed over the Certificate of Registration and the Certificate of Insurance to him/her/them.

I/We hereby declare to the best of my/our knowledge the certificate of Registration of the Vehicle has not been suspended * or cancelled.

** - I/We enclose the 'No Objection Certificate' issued by the Registering Authority.

*** - If the 'No Objection Certificate' issued from the Registering Authority is not enclosed, the transferor should file along with this application a declaration as required under sub-section (1) of section 50.

Date..... Signature of impression of the Transferor

** - Details of suspension or cancellation
*** - Strike out, whichever is inapplicable

PART-II For the use of the transferee

To

The registering authority

.....

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Name of the Transferee : .....

Son/Wife/Daughter of : .....

Full Address (proof of address to be enclosed) : .....

.....

.....

I hereby declare that I/We have on this ..... day ..... the year ..... purchased the motor vehicle bearing registration number ..... from ..... (Name and full Address) are request that necessary entries (regarding the transfer of ownership of the vehicle) in my / our name may be recorded in the certificate of registration and certificate of fitness of teh vehicle, which is enclosed.

* The certificate of Insurance is also enclosed. To the best of my knowledge and behalf I/We have not suppressed any facts and information furnished is true. The vehicle is not superdari and free from all encumbrances. I/We undertake to hold my/our self responsible for any inaccuracy of the information.

Date ..... Signature of thumb impression of the transferee

Consent of the financier in the case of motor vehicle subject to an agreement of hire - purchase / lease / hypothecation.

I/We being a party to an agreement of Hire-Purchase/Lease/Hypothecation in respect of motor vehicle specified above, give consent to the transfer of ownership of the said motor vehicle in the name of the Transferee named above, with I/We have entered into an agreement of Hire-Purchase/Lease/Hypothecation.

(Full name and address of the Financier) Signature of the Financier

Date ..... Date.....

Office endorsement

Ref. No. ..... Dated.....Office of the .....

.....

The Transfer of ownership of motor vehicle under continuation of an endorsement of Hire-Purchase/Lease/Hypothecation agreemental has been recorded with effect from..... in Registration Certificate of vehicle.....and in the Registration record of this office in Form 24.

Date ..... Signature of the Registering Authority

To To

....

....

....

(Name and address of the transferor) (Name and address of the transferor)

(To be sent to both the above parties by Registered Post Acknowledgement Due)

Specimen signature or thumb impression of the Regd. owner and the financier to be obtained in the original application for affixing and attestation by The Registering with the office seal in Form 23 and 24, in such manner that the part of impression of seal or stamp and attestation shall fall upon each signature.

Specimen signatures of the Financier Specimen signatures of the Registered owner

1. 1.

2. 2.

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FORM 33

[See Rule 59]

Intimation of change of address for recording in the certificate of registration and office records

(To be made in Triplicate if the vehicle is held under agreement of Hire /Purchase/Lease/Hypothecation, the duplicate copy and the triplicate copy with the endorsement of the Registering Authority to be returned to the financier and the Registering Authority (from whose jurisdiction the vehicle is removed) simultaneously, on making the entry of change of address in the Certificate of Registration in Form-24)

To,

The Registering Authority

I/We…….. Son/Wife/Daughter of ……..……
(Full Address) .....
……..Registered owner of the vehicle number, have ceased to reside, do not have the place of business at the address recorded in the certificate of Registration with effect from…….....……The present Address is given below (evidence to be enclosed).

……..

……..

- The vehicle is not held under any agreement of Hire/Purchase/Lease/Hypothecation.
- The vehicle is held under an agreement of Hire/Purchase/Lease/Hypothecation with

……..

……..

(Name & Full address of the financier)

……..

……..

The Certificate of Registration is enclosed. I/We request that the change of address may be recorded in the Certificate of Registration in Form 24.

Date…….. Signature of the Registered owner of the vehicle

* - Strike out whichever is inapplicable.

Consent of the financier in the case of motor vehicle held under an agreement

I/We being a party to an agreement of Hire/Purchase/Lease/Hypothecation in respect of the above said vehicle, hereby:

1 Give consent for effecting the above Change of Address with the note of an agreement in my/our favour in Form 23 & 24 by the Registering Authority.

2 Refuse to give consent for effecting the above Change of Address by the Registering Authority, due to reasons furnished here-under:

……..

……..

Date……. Signature of the Financier

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Office Endorsement

Ref. Number …….. Office of the …….. The above change of address has been entered with the note of agreement of Hire / Purchase / Lease / Hypothecation in favour of the financier in the Certificate of Registration and in Form 24.

Date…… Signature of the Registering Authority

To

The Financier……

The Registering Authority……

(To be sent to both the parties by Registered Post Acknowledgement due)

Specimen signature or thumb impressions of the Registered owner and Financier are to be obtained for affixing and attestation by the Registering Authority with official seal in Form 23 & 24 in such manner that part of impression of the seal or a stamp and attestation shall fall upon each signature.

Specimen signature of the Financier

1.

Specimen signature of the Registered owner

1.

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FORM CFA

(See Rule 116)

Application for certificate of fitness

To

The Registering Authority

.....

The Motor Vehicles Inspector

I hereby apply for the issue of a certificate of fitness as required by Section 56 of the Motor Vehicles Act, 1988.

Registration mark of vehicle : ----------

Name of the owner : ----------

Address of the owner : ----------

Place where the vehicle is ordinarily kept: ----------

Name of the manufacturer of vehicle : ----------

Manufacturer's model, or if not known, wheel base : ----------

Type of vehicle :

Engine number :

Chassis number :

Particular of any previous certificate of fitness granted in respect of this vehicle and the authority by which granted.

Date when certificate was lost or destroyed or ceased to be valid reason of cessation of validity.

Date: Signature or Thumb impression of Applicant

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Form C F R A
Application for renewal of certificate of fitness

(See Rule 116)

To

The Registering Authority / The Motor Vehicles Inspector

.....

I hereby apply for renewal of certificate of fitness as required by section 56 of the Motor Vehicles Act, 1988.

Registration mark of Vehicle : .....

Type of Vehicle : .....

Name of owner : .....

Address of owner : .....

Place where the vehicle is ordinarily kept : .....

Number of the certificate of fitness and
Date of issue of last renewed : .....

Authority by which the certificate of
fitness was issued or last renewed : .....

.....

Date : Signature of applicant

FORM CF Sub.

Temporary authorisation of use of vehicle when the certificate of fitness expired.

(See rule 117)

The Certificate of fitness of (1).....Registration mark.....last renewed by..... on.....has expired.

I hereby authorise the use of the vehicle until the day of.....provided that it is forthwith removed with all reasonable dispatch to the area of the authority by whom the certificate of fitness is due to be renewed :

Provided also that, while being used under this authorisation, the vehicle shall not (2) -

(a) Carry more than.....persons excluding the driver (2)

(b) Carry any goods (2)

(c) Be driven at a speed in excess of..... kilometer per hour (2)

Dated at.....on the.....day of.....

.....

Signature and designation of authority.

(1) Here enter brief description of vehicle

.....

.....

(2) Strike out if not required

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Accidents, causes & analysis, responsibility of driver

Objectives: At the end of this lesson you shall be able to
- **state the inspection of vehicle involved in accident**
- **state the duty of driver incase of accident and injury to a person.**

Inspection of vehicle involved in accident

When any accident occurs in which a motor vehicle is involved, any person authorized in this behalf by the State Government may, on production if so required of his authority, inspect the vehicle and for that purpose may enter at any reasonable time any premises where the vehicle may be, and may remove the vehicle for examination:

Provided that the place to which the vehicle is so removed shall be intimated to the owner of the vehicle and the vehicle shall be returned after completion of the formalities to the owner, driver or person-in-charge of the vehicle within 24 hours.

Duty of driver in case of accident and injury to a person

When any person is injured or any property of a third party is damaged, as a result of an accident in which a motor vehicle is involved, the driver of the vehicle or other person in charge of the vehicle shall:`

a unless it is not practicable to do so on account of mob fury or any other reason beyond his control, take all reasonable steps to secure medical attention for the injured person, and, if necessary, convey him to the nearest hospital, unless the injured person or his guardian, in case he is a minor, desires otherwise;

b give on demand by a police officer any information required by him, or, if no police officer is present, report the circumstances of the occurrence, including the circumstances, if any, for not taking reasonable steps to secure medical attention as required under clause (a), at the nearest police station as soon as possible, and in any case within twenty-four hours of the occurrence.

Offences, penalties & procedures

Objectives: At the end of this lesson you shall be able to
- **state the offences relating to licenses**
- **state the inspection of vehicle involved in accident**
- **state the definition of permit**
- **state the necessities, duration and renewal for permit**
- **state the grounds on which permits are suspended or cancelled.**

Offences, Penalties and procedures

Offences relating to licenses

When any person drives any motor vehicle in any public place without having any license to drive that particular motor vehicle from any licensing authority or whosoever have any license but by hiding the actual eligibility of obtaining that license and not been entitled to have a driving license issued to him shall be punishable with imprisonment for a term which may extend to three months or with time which may extend to five hundred rupees or with both and any driving license so obtained by him shall be of no effect.

And if the same offence relating to licenses is done by any conductor of a stage carriage without having any conductors license; here the punishment is imprisonment for the term which may extend to one month or with time which may extend to one hundred rupees; or with both and any conductors license so obtained by him shall be of no effect. (Section 182)

Power of Police officer to impound documents

Any police officer or other person authorized in this behalf by the State Government may, if he has reason to believe that any identification mark carried on a motor vehicle or any license, permit, certificate of registration, certificate of insurance or other document produced to him by the driver or person-in charge of a motor vehicle is a false document within the meaning of Section 464 of the Indian Penal Code (45 of 1860) seize the mark or document and call upon the driver or owner of the vehicle to account for his possession of or the presence in the vehicle of such mark or document.

Definition of "permit"

A permit issued by a state or regional transport authority or an authority prescribed in this behalf under this Act, authorizing the use of a motor vehicle as a passport vehicle.

Necessities for permits

No motor vehicle shall be used as a transport vehicle in any public place whether or not such vehicle is actually carrying any passengers or goods save in accordance with the conditions of a permit granted or countersigned by a Regional or State Transport Authority or any prescribed authority authorising him the use of the vehicle in that place in the manner in which the vehicle is being used.

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Provided that a stage carriage permit shall, subject to any conditions that may be specified in the permit, authorize the use of the vehicle as a goods carriage either when carrying passengers or not.

Provided further that a stage carriage permit may, subject to any conditions that may be specified in the permit, authorize the use of the vehicle as a contract carriage.

Provided also that a goods carriage permit shall, subject to any conditions that may be specified in the permit, authorize the holder to use the vehicle for the carriage of goods for or in connection with a trade or business carried of by him.

Duration of this permits

A permit other than a temporary permit issued under section 87 or a special permit issued under sub-section (8) of section 88 shall be effective 2[from the date of assurance or renewal thereof] for a period of five years: Provided that where the permit is countersigned under sub-section (1) of section 88, such counter-signature shall remain effective without renewal for such period so as to synchronize with the validity of the primary permit.

Renewal of permit

A permit may be renewed on an application made not less than fifteen days before the date of its expiry.

Grounds on which permits are suspended or cancelled

Whenever the Transport Authority finds that there the breach of any condition specified under section 84 shall suspend or cancels or allows a vehicle to be used in any manner not authorized by the permit or if the holder of the permit/causes to own the vehicle covered by the permit; or if the holder of the permit ceases to own the vehicle covered by the permit, or if the holder of the permit has obtained the permit by fraud or misrepresentation, or if the holder of the goods carriage permit, fails without reasonable cause, to use the vehicle for the purposes for which the permit was granted, or if the holder of the permit acquires the citizenship of any foreign country. Provided that no permit shall be suspended or cancelled unless an opportunity has been given to the holder of the permit to furnish his explanation.

Rules regarding construction of motor vehicles

Objectives: At the end of this lesson you shall be able to
- **state the basic dimension of construction of motor vehicle.**

Construction of motor vehicles

Section 109 of the MV act 1988 sets out general provisions regarding construction and maintenance of motor vehicles.

1 Every motor vehicle shall be so constructed and so maintained as to be at all times under the effective control of the person driving the vehicle.

2 Every motor vehicle shall be so constructed as to have right hand steering control unless it is equipped with a mechanical or electrical signaling device of a prescribed nature.

3 If the central government is of the opinion that it is necessary or expedient so to do in the public interest, it may, by order published in the official Gazette, notify that any article or process used by a manufacturer shall conform to such standard as may be specified in that order.

The overall dimension of motor vehicles

1 The overall width of a motor vehicle, measured at right angles to the axis of the motor vehicle between perpendicular planes enclosing the extreme points, shall not exceed 2.6 meters.

2 The overall length of a motor vehicle other than a trailer shall not exceed

i in the case of motor vehicle other than transport vehicle having not more than two axles, 6.5 metres;

ii in the case of transport vehicle with rigid frame having two or more axles, 12 meters;

iii in the case of articulated vehicles having more than two axles, 16 meters;

iv in the case of truck-trailer or tractor-trailer combination, 18 meters;

v in the case of 3 axle passenger transport vehicles, 15 meters

vi in the case of double articulate passenger transport vehicles, 25 meters

"overall length" means the length of the vehicle measured between parallel planes passing through the extreme projection points of the vehicle exclusive of-

i a starting handle;

ii any hood when down;

iii any fire-escape fixed to a vehicle;

iv any post office letter-box, the length of which measured parallel to the axis of the vehicle, does not exceed 30 centimeters;

v any ladder used for loading or unloading from the roof of the vehicle or any tail or indicator lamp or number plate fixed to a vehicle;

vi any spare wheel or spare wheel bracket or bumper fitted to a vehicle.

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3 The overall height of a motor vehicle measured from the surface on which the vehicle rests

i in the case of a vehicle other than a double-decked 9[transport veliicle], shall not exceed 3.8 meters;

ii in the case of a double decked transport vehicle, shall not exceed 4.75 meters;

(ii-a) in the case of tractor-trailer goods vehicle, shall not exceed 4.20 meters;

iii in the case of a laden trailer carrying ISO series 1 Freight Container, shall not exceed 4.2 meters:

Tax exemption & tax renewal, insurance types & significance - comprehensive third party insurance

Objectives: At the end of this lesson you shall be able to
- **state the tax exemption provision**
- **state definition of "certificate of insurance"**
- **state the necessity for insurance against third party risk.**

Tax exemption

The government may by notification and subject to such conditions, if any, as the government may, specify in such notifications.

1 Make an exemption reduction in rate or other modification in regard to the tax payable.

a By any person or class of person or

b In respect of any motor vehicle or class of motor vehicles or motor vehicles running in any particular area; and

2 Cancel or vary such exemption, reduction or other modification.

Definition of "certificate of insurance"

It means a certificate issued by an authorized insurer and includes a cover note complying with such requirements as may be prescribed or where more than one certificate has been issued, all those certificates or that copy, as the case may be.

Necessity for insurance against Third Party risk

Any motor vehicle cannot be used in public place by any person except as a passenger, unless there is in force in relation to the use of the vehicle by that person or that other person, as the case may be, a policy of insurance complying with the requirements of this chapter. Provided that in the case of a vehicle carrying, or meant to carry, dangerous or hazardous goods, there shall also be a policy of insurance of the Public Liability Insurance Act, 1991. for e.g. A person driving a motor vehicle merely as a paid employee, while there is in force in relation to the use of the vehicle no such policy as is required by this provision, shall not be deemed to act in contravention of the subsection unless he knows or has reason to believe that there is no such policy in force.

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Vehicle Parts and its Location

Objectives : At the end of this lesson you shall be able to
- **state different parts of vehicle and their location**
- **classification of vehicle and load carrying capacities.**

Vehicle parts and their locations : Vehicle is assembled with various parts . Most of the vehicle parts are mounted on either a chassis or body shell.

Major parts of the vehicle

- Cassis frame
- Vehicle body shell
- Engine
- Steering
- Clutch
- Brake
- Wheels
- Gear box
- Differential
- Suspension
- Propeller shaft.

Chassis frame (Fig 1,2,3)

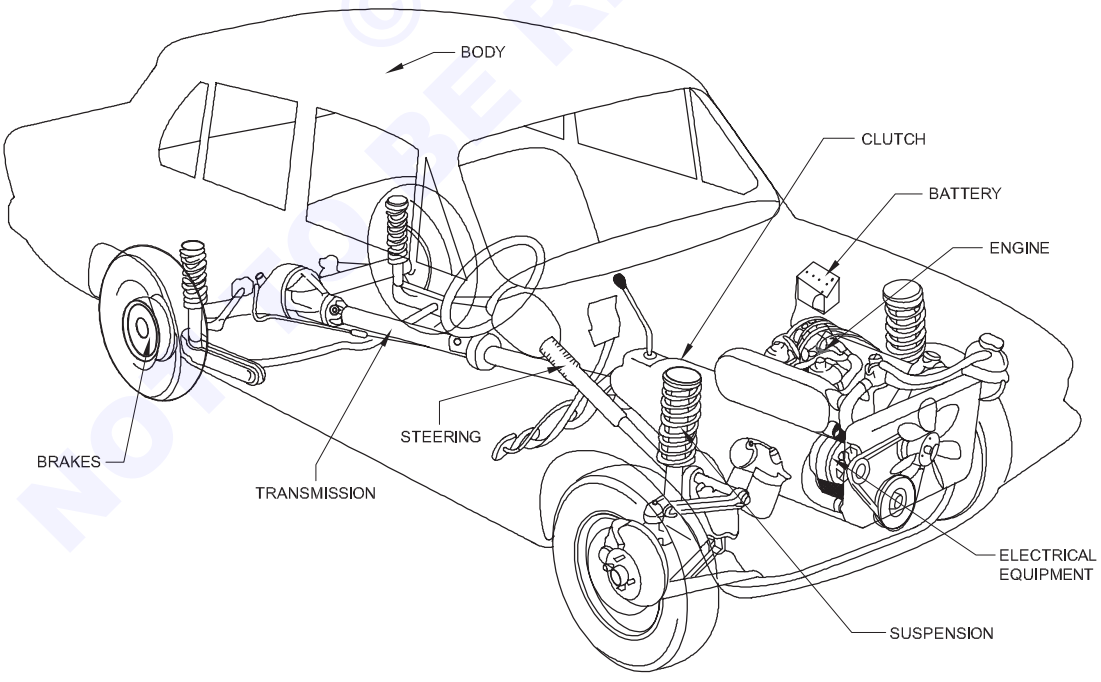
Chassis frame is the backbone of the vehicle.It is normally a separate steel frame to provide the rigidity. Needed to support various loads. The two long side members of channel section are riveted to a number of cross members to give a low weight frame. This type of chassis frame is used in commercial vehicle.

Modern cars use the separate frame. instead the body shell acts as the shelter around which the vehicle is built This integral type of body is made up from very thin and soft steel sheet, which is pressed into various shapes and welded together to form a very rigid but light weight unit.

Vehicle body shell : Heavy vehicle body shell is fitted on the chassis.

Engine : Most of the vehicle engine is fitted in front of the vehicle. There are two types of engine used in an automobile. (1) Spark ignition engine (2) Compression ignition engine. these two engines are called as heat engines (Fig 4).

Fig 1



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Fig 2

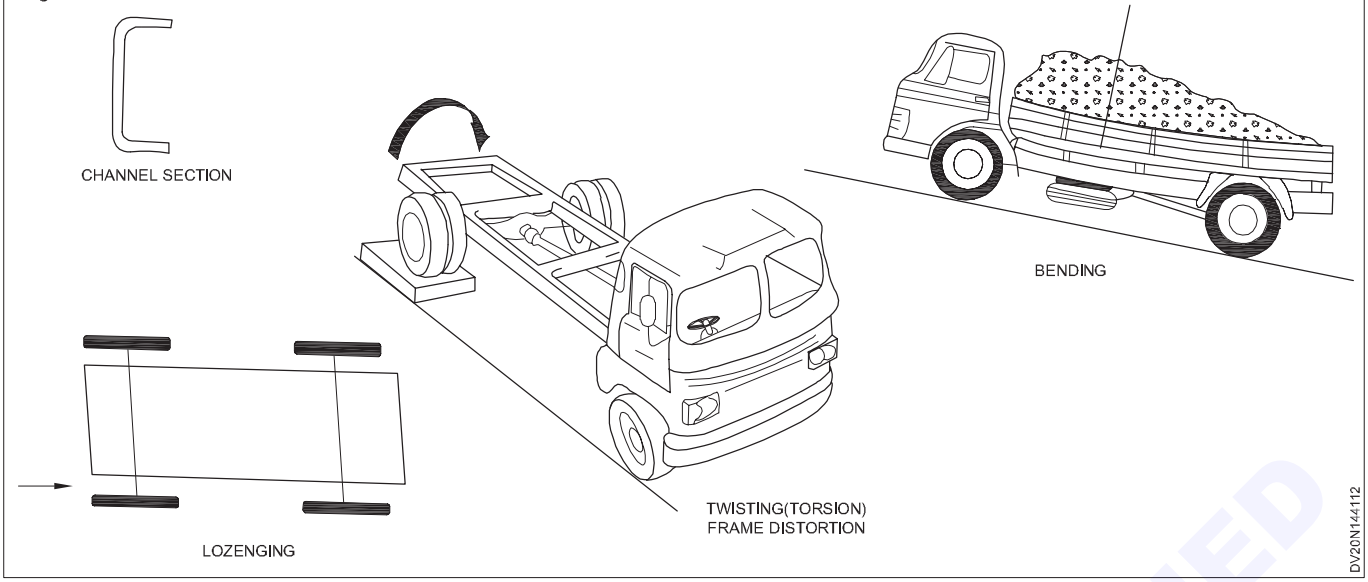


Fig 3

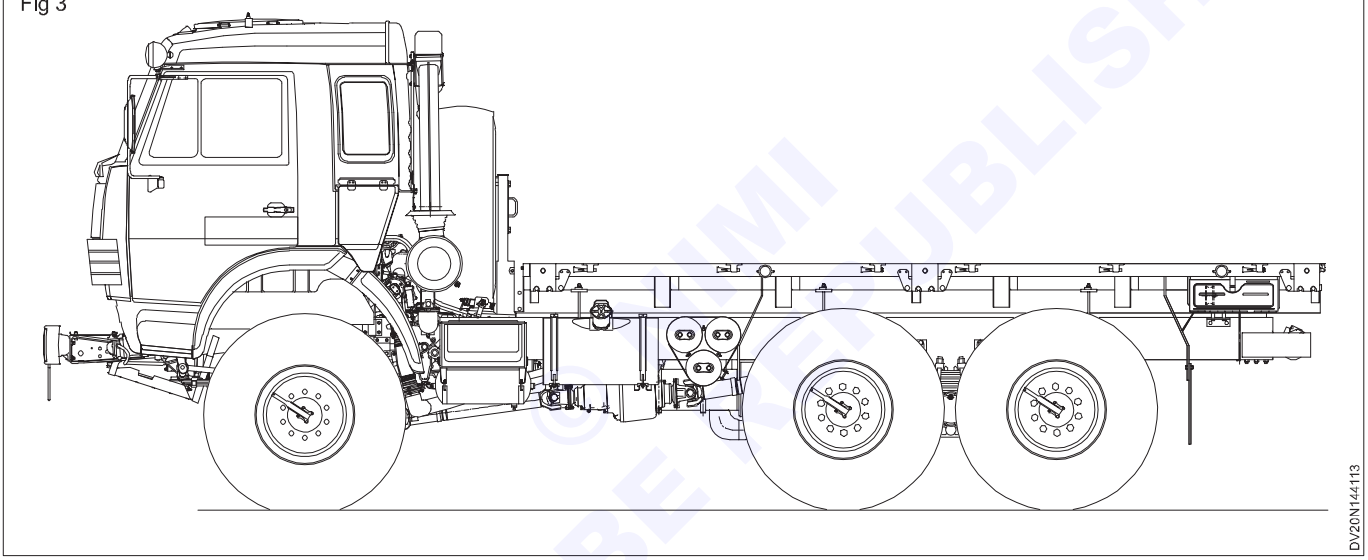
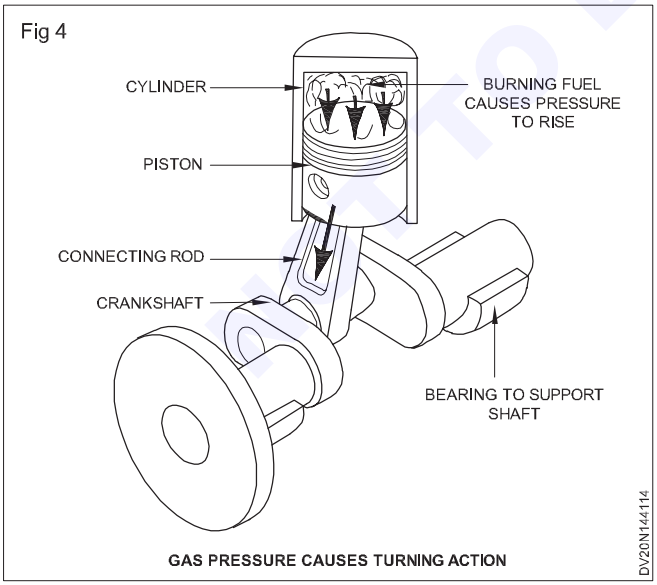


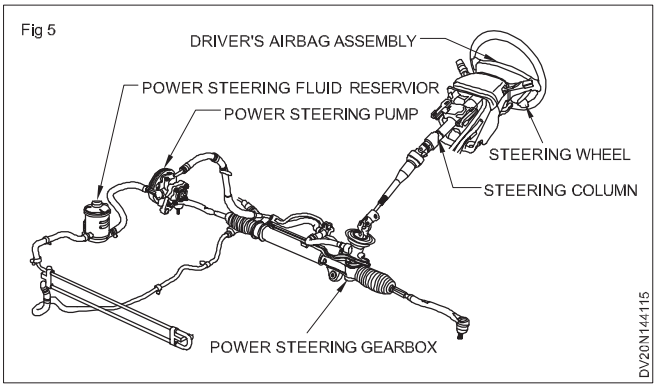
Fig 4



Steering (Fig 5)

Vehicle steering is located in driver compartment ,it is used to control the vehicle movement direction. It is convert steering wheel rotary motion into angular motion.

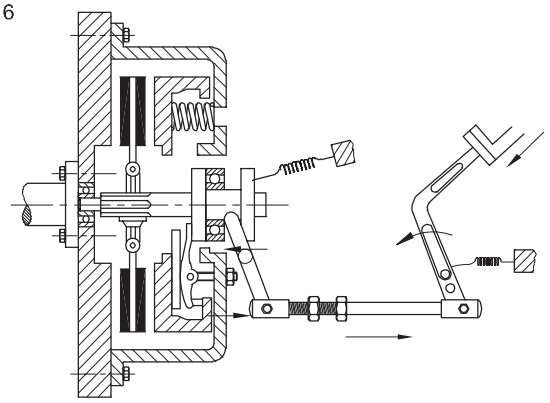
Fig 5



Clutch : Clutch is fitted on engine fly wheel. It is located in between engine fly wheel and gear box. It is used to connect and disconnect the engine power to transmission system or gear box. clutch operating pedal is located in driver's foot board floor. (Fig 6)

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Fig 6



DV20N144116

Brake (Fig 7)

Vehicle brake system is used to control the vehicle speed and stop the vehicle from the rolling movement.

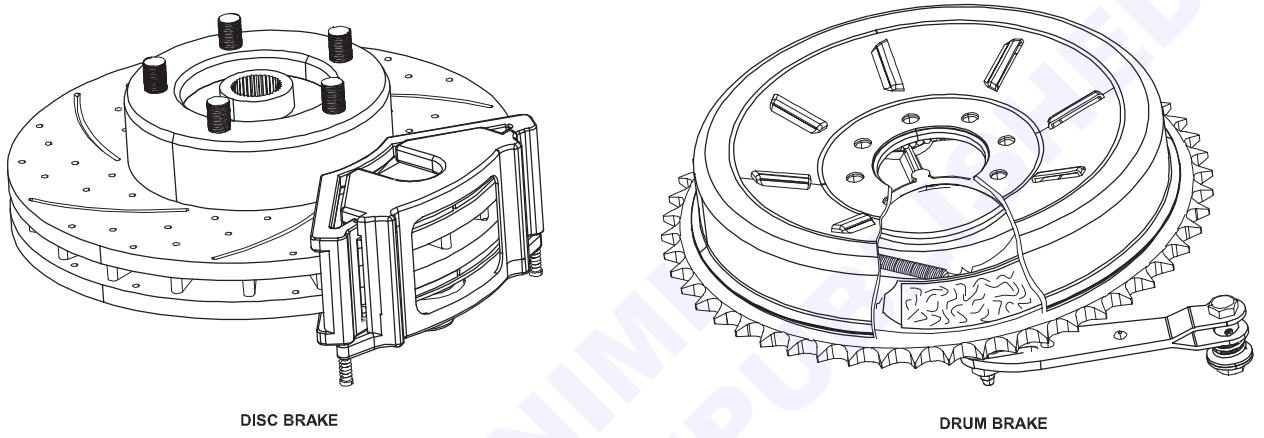
Wheels : Wheels are fitted on the axle shaft. It gets its power to rolling from the differential through half shaft.

Battery : Battery is located in engine compartment in light vehicle and heavy vehicle battery is located in driver's compartment or below the vehicle near the chassis.

gear box (Fig 8)

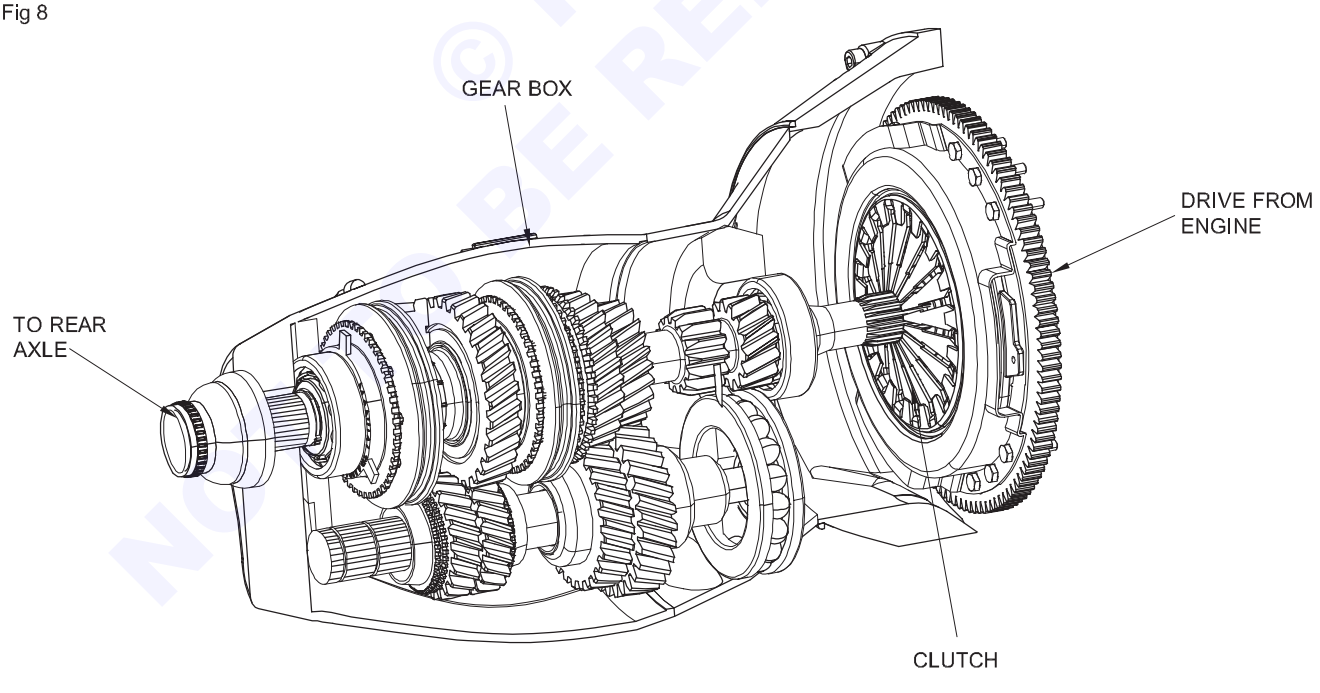
Gear box is a part of transmission system .Gear box fitted between clutch assembly and propeller shaft

Fig 7



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Fig 8



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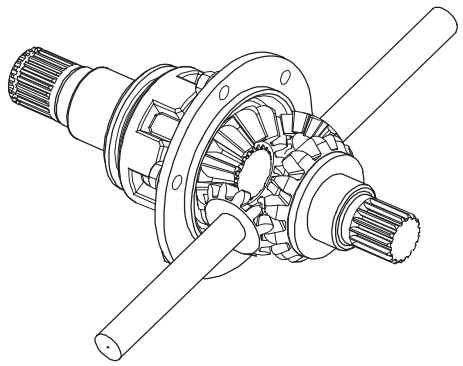
Differential (Fig 9): Differential assembly is fitted in the rear axle of the vehicle . It gets its drive from propeller shaft and it transmits the power to wheels.

Suspension (Fig 10 &11)

Suspension system is fitted with chassis of vehicle axle assembly . It absorbs the vehicle shocks and jerks while vehicle moving on the road.

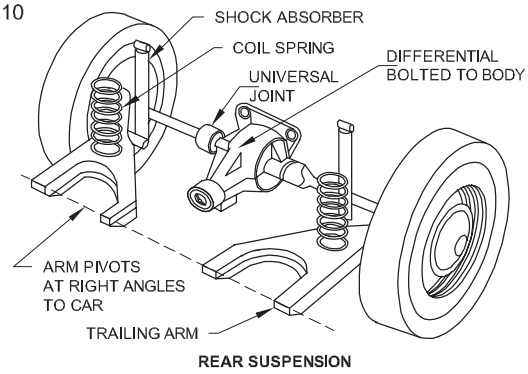
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Fig 9



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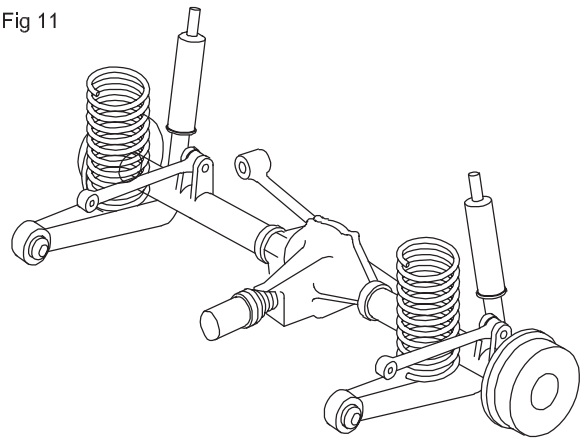
Fig 10



REAR SUSPENSION

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Fig 11

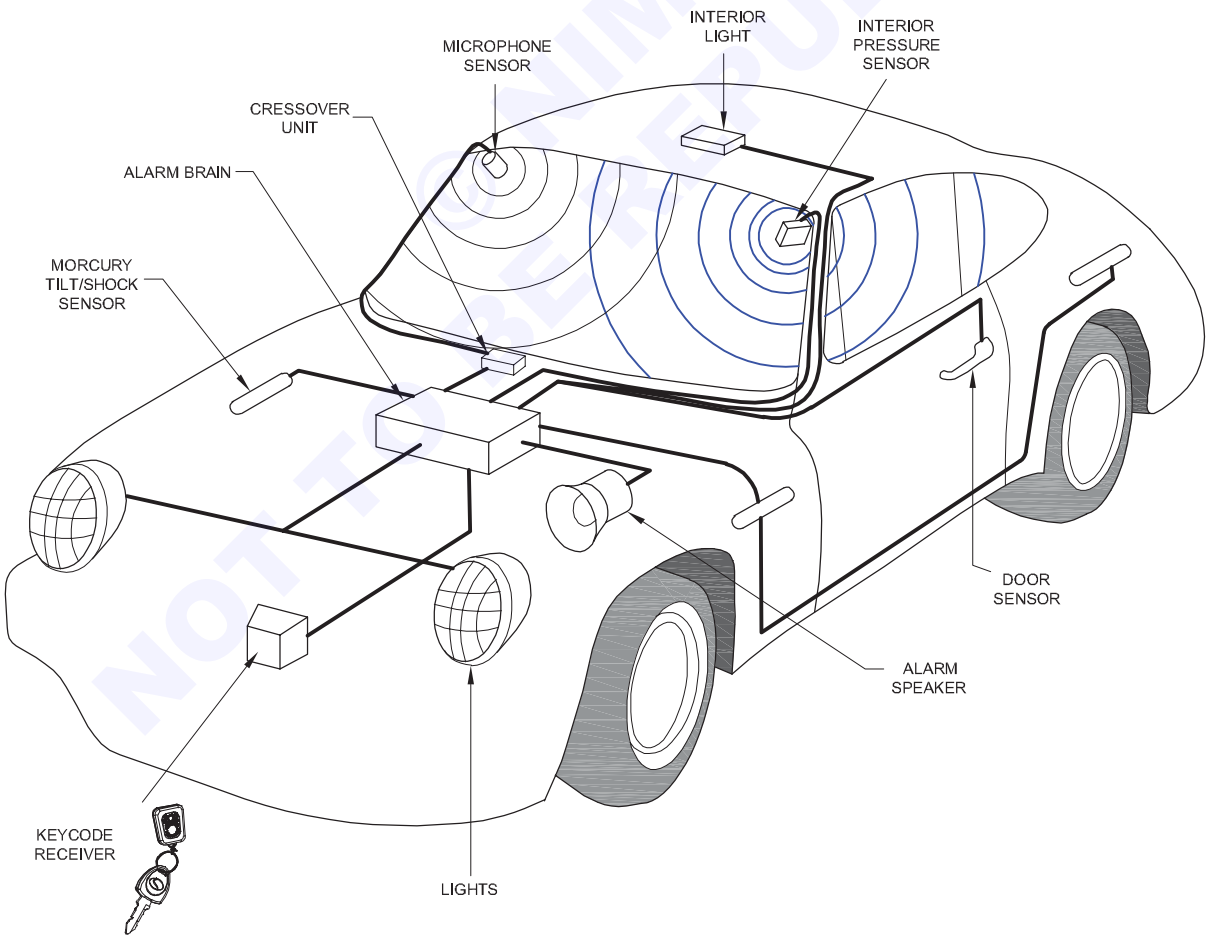


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Propeller shaft : Propeller shaft is located between gear and differential assembly.

Modern vehicles have some safety devices for vehicles and vehicle passengers safety. They are shown in the location and parts in the (Fig 12 &13)

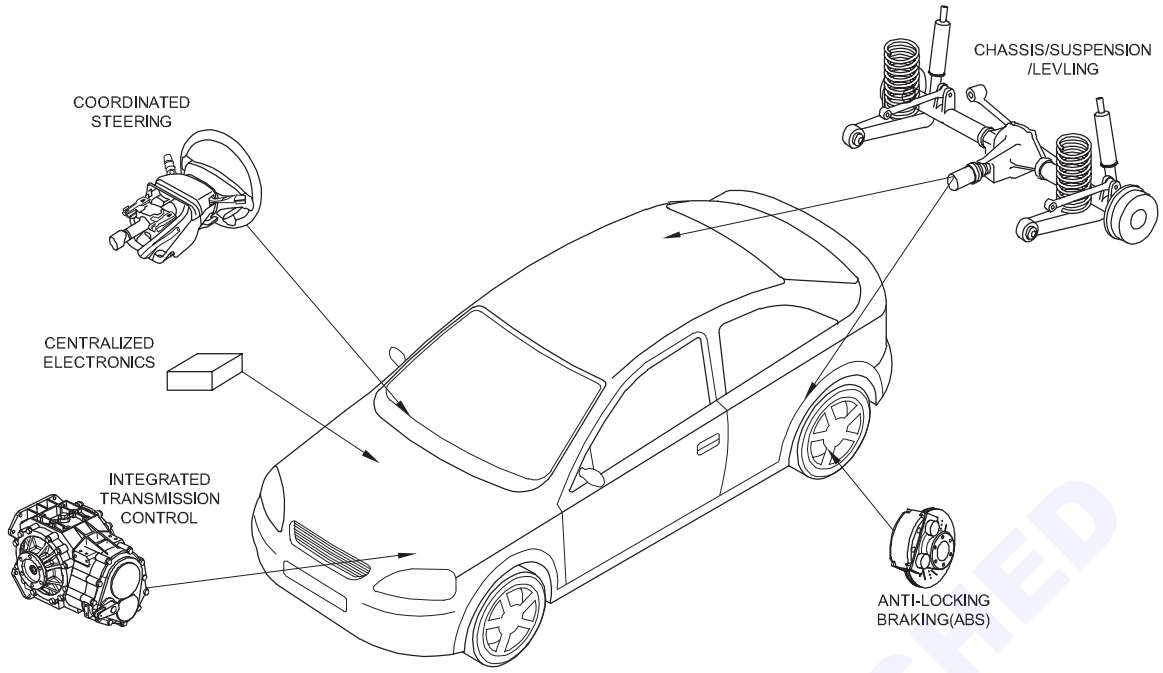
Fig 12



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Fig 13



Classification of vehicle

Objective: At the end of this lesson you shall be able to
- **state the vehicle load carrying capacity**
- **state the classification of vehicle.**

Classification of vehicles

Based on central motor vehicle act

- Motor cycle
- Invalid carriage
- Three wheelers
- Light motor vehicle
- Medium passenger vehicle
- Medium goods vehicle
- Heavy passenger vehicle
- Heavy goods vehicle
- Any other motor vehicle of a specified description

Based on wheel

- Two wheeler
- Three wheelers
- Four wheelers
- Six wheelers
- Multi axles

Based on fuel used

- Petrol vehicle
- Diesel vehicle
- Gas vehicle (CNG & LPG)
- Electric vehicle

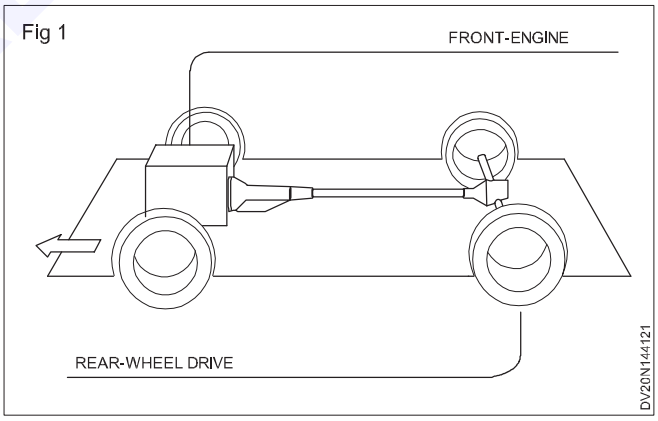
Based on body

- Saloon (BMW, AUDI)
- Sedan (Maruti ciaz, ambassador etc)
- Hatch back (Alto, i10, santro, Tata Tiago)
- Convertible (Jeep, maruti gypsy)
- Station wagon (Innova, Ertiga, etc)
- Van (Omni, Touristor)
- Special purpose (Ambulance, Milk van, etc)

Based on drive

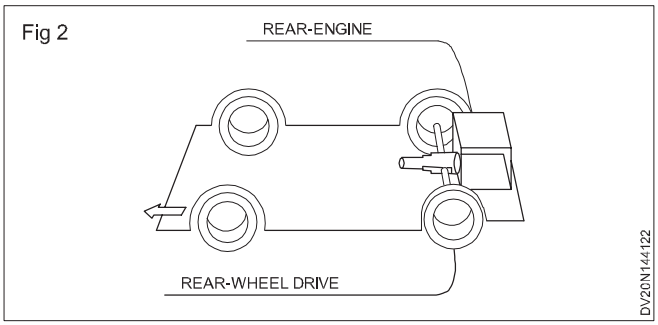
Front engine rear wheel drive (Sumo, Omni, Ambassador, etc.) (Fig 1)

Fig 1



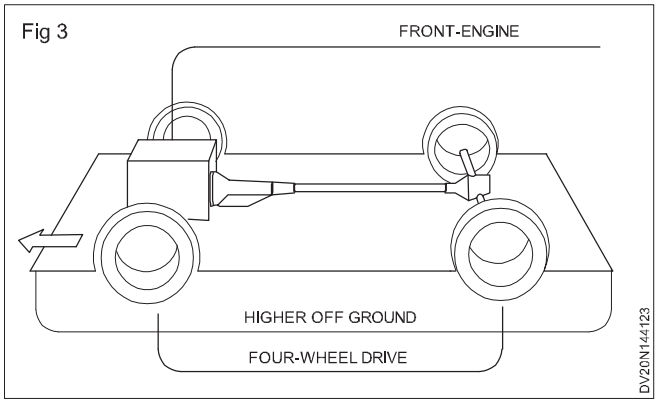
Rear engine rear wheel drive (Tata Nano, Bajaj auto, Volvo bus etc) (Fig 2)

Fig 2

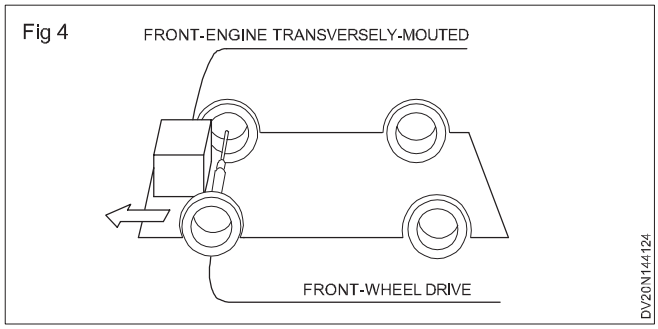


Four wheel/ All wheel drive (Jeep, Scorpio, Gypsy etc.) (Fig 3)

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Front engine front wheel drive (Alto, Ertiga, santro, Tiago etc.) (Fig 4)



Based on position of engine

- Front transverse engine (Example ; Maruti 800)
- Front longitudinal engine (Example ; Maruti Omni)
- Rear Transverse engine (Example ; Volvo bus)

Based on steering

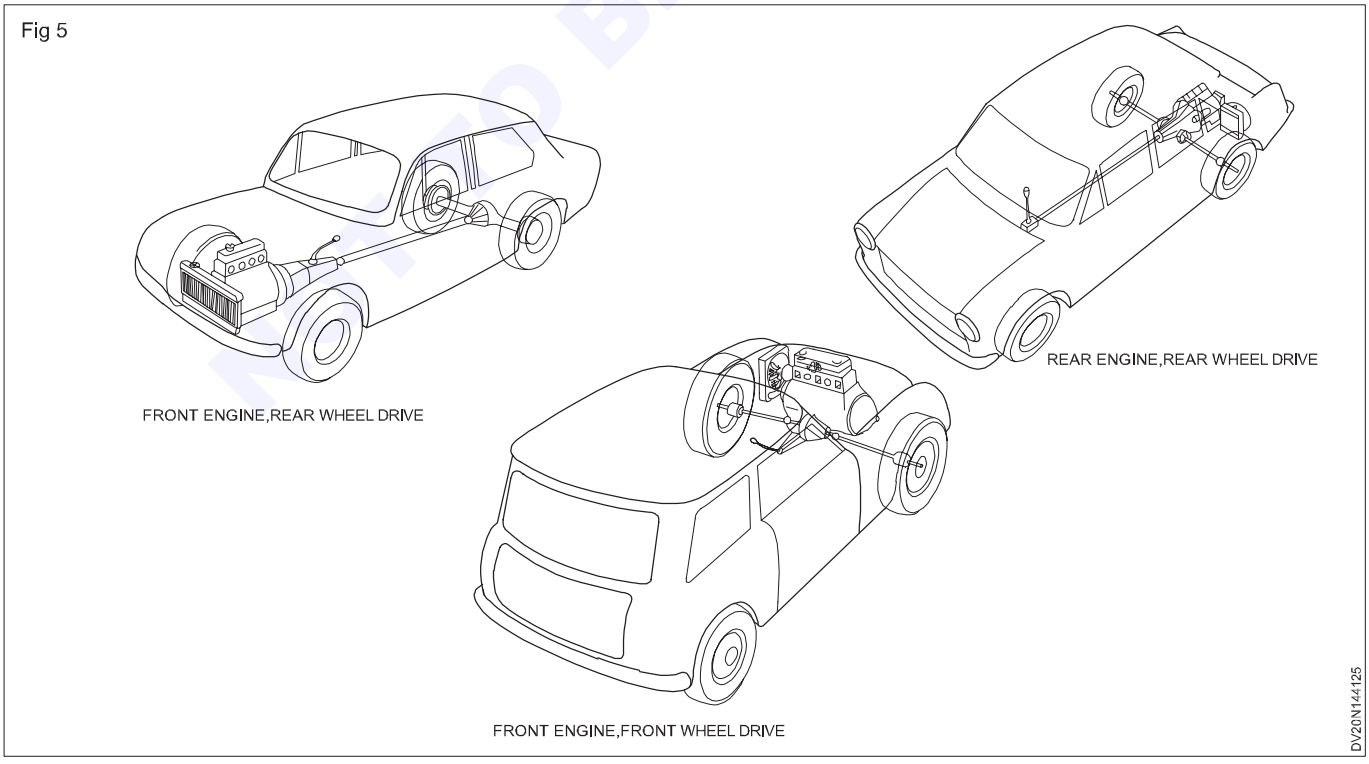
- Conventional manual steering
- Power steering hydraulic
- Power steering electric

Based on transmission

- Manual transmission
- **Automatic transmission:** This is transmission that uses a torque converter, planetary gears set and clutches or bands to shift a vehicle's forward gears automatically.
- **Automated manual transmission (AMT):** This is an automated manual transmission it employs a mechanical clutch, but the action of the clutch is not controlled by the driver's clutch pedal. Gears shifts done by using automated electronic, pneumatic or hydraulic controls.
- **Continuously Variable Transmission (CVT):** This transmission has a continuously variable drive ratio and uses belts, pulleys and sensors rather than gears to maintain a steady acceleration curve with no pauses for gear changes. Because of this, a CVT can keep the engine in its optimum power range, thereby increasing efficiency and gas mileage.

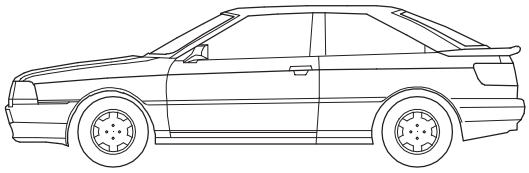
Vehicle Load carrying capacities : Vehicles are constructed according to the public's requirements. Different type of vehicles have different type load carrying capacities . They are classified as follows (1) Passenger vehicle (2) commercial vehicle.

Passenger vehicle's load carrying capacities as 2,5, 7, 9, 12, 20, 44, 56 and 80 passenger load carrying capacity vehicles are used in our country. Vehicles such as car, van, bus, tempo etc. are articulated vehicles. Load carrying vehicles are called as commercial vehicles like truck, tipper, mini truck, crane, tractor, bulldozer, poklain etc. It's local carrying capacities as 1 ton to 20 ton according to vehicle's engine capacity and body construction. A heavy vehicle is defined as a vehicle which has a gross vehicle weight (gvh) than about 3 ton. Heavy vehicles have more than 6 wheels eg. 6x4 indicates a six wheel vehicle having four driving wheels.(Fig 5, 6, 7, 8)

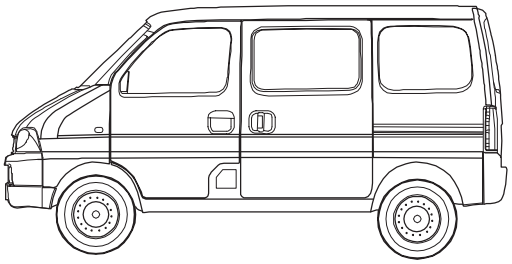


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Fig 6



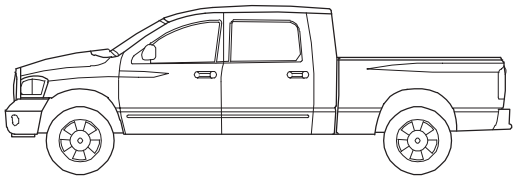
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VAN

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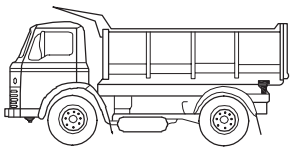
Fig 7



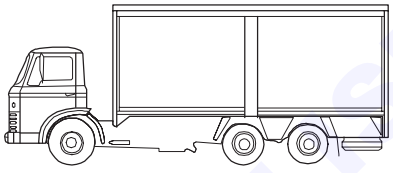
PICK UP

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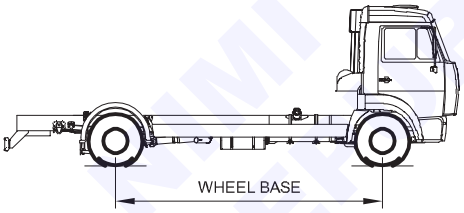
Fig 8

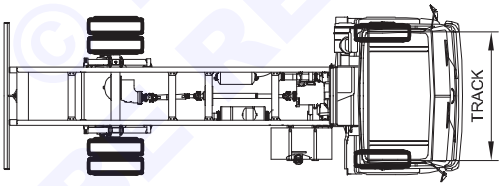


4 X 2 REGID

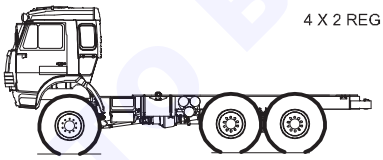


6 X 4 REGID (TWO DRIVING AXIES)

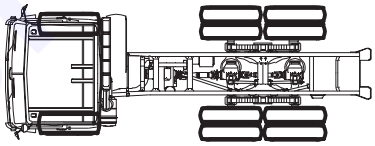




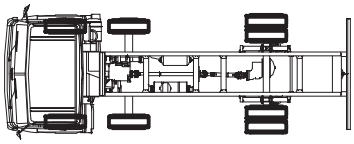
4 X 2 REGID (FORWARD CONTROL)



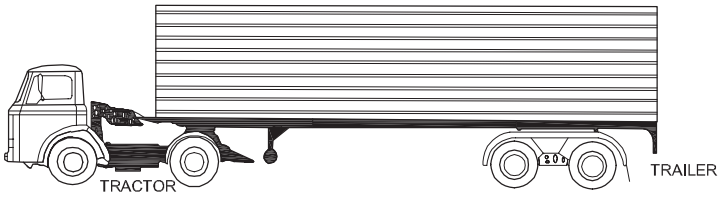




8 X 2 RIGID (TWO DRIVING AXIES,TWO STEERED AXIES)



6 X 2 RIGID



ARTICULATED VEHICLE

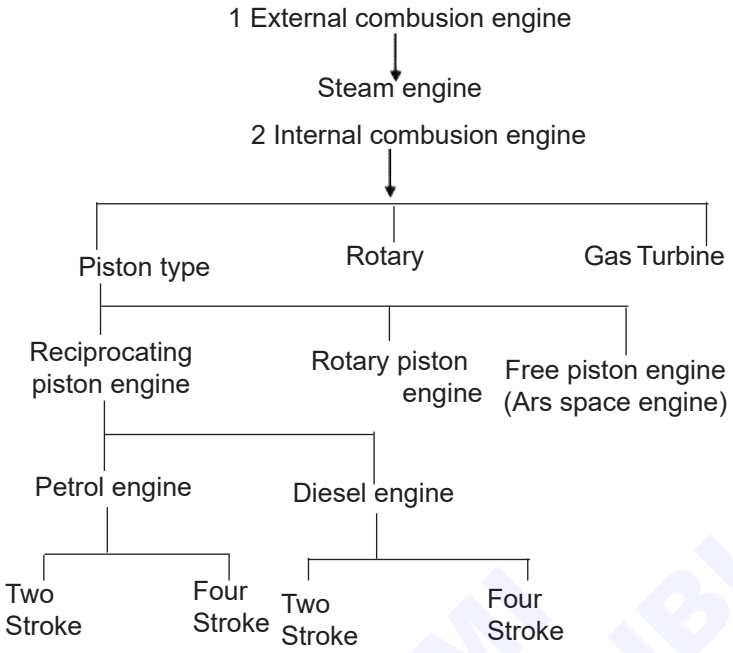
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Internal and external combustion engine

Objectives: At the end of this lesson you shall be able to
- **type of heat engine**
- **state the internal and external combustion engine**
- **difference between an internal and external combustion engine.**

Types of heat engines



Internal combustion engine

Internal combustion engines are those heat engine, that burns their fuel and takes combustion inside the cylinder, this definition including the two stroke and four stroke engine, spark ignition and compression ignition engine, austine and jet engines are also internal combustion engine. Ex: Wankel.

External combustion engine

The external combustion engines are those heat engine that burn their fuel outside the engine cylinder. The energy developed during the combustion of fuel is transmitted to steam. This steam acts on the piston inside cylinder example - railway steam engine.

Difference between internal and external combustion engine

Sl.No.	Internal combustion engine	External combustion engine
1	Occupies less space.	Occupies more space.
2	Lighter in weight.	Heavier in weight.
3	High speed engine.	Slow speed engine.
4	Combustion of fuel takes place inside the engine.	Combustion of fuel takes place outside the engine.
5	No fuels used in when engine is not running.	Solid or liquid fuels used to form steam.
6	No loss of fuel when engine is not running.	Fuel has to burn even when the engine is not running for small halts.
7	Could be started or stopped at will.	Cannot be started unless steam is prepared which takes much time.
8	Temperature produced inside the cylinder is too high.	Works at comparatively low temperature.
9	Cooling arrangement necessary.	No cooling of the cylinders required. Rather it is steam jacketed.
10	Single acting.	Mostly double acting.
11	Exhause gas temperature as high as 300°C.	The temperature of exhaust steam is quite low.
12	Thermal efficiency of diesel engine up to 40%.	Thermal efficiency up to 24% as that of petrol engine.
13	No needs boiler, furnace or condenser.	Boiler, furnace and condenser are must.

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Classification of I.C engines

Objective: At the end of this lesson you shall be able to
- **state the classification of engines.**

Engines are classified according to the following factors.

Number of cylinders

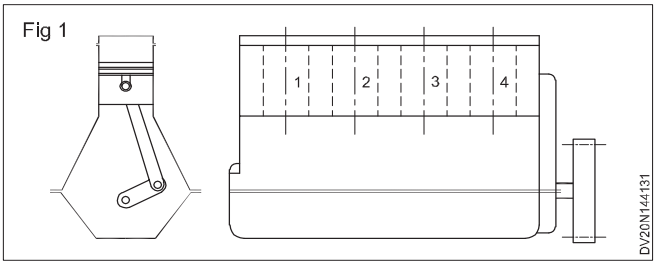
Single cylinder

Multi cylinder

Arrangements of cylinders

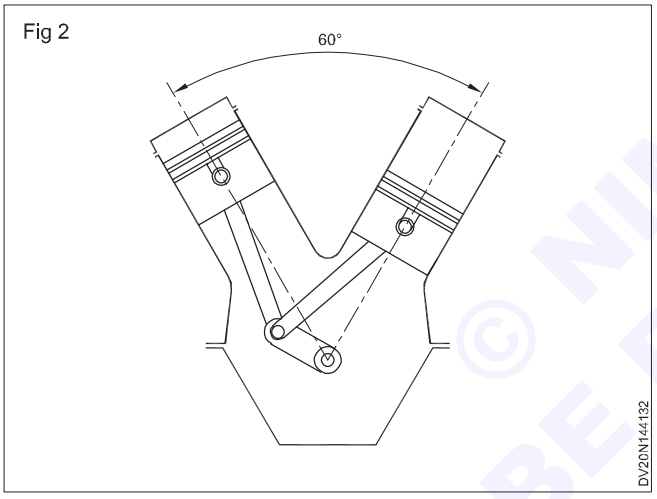
In-line engine (Fig 1)

Fig 1



`V' shape engine (Fig 2)

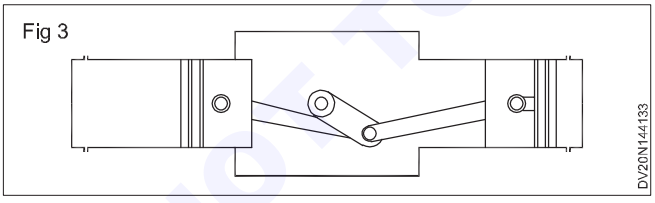
Fig 2



Opposed engine (Fig 3)

Horizontal engine

Fig 3



Radial engine (Fig 4)

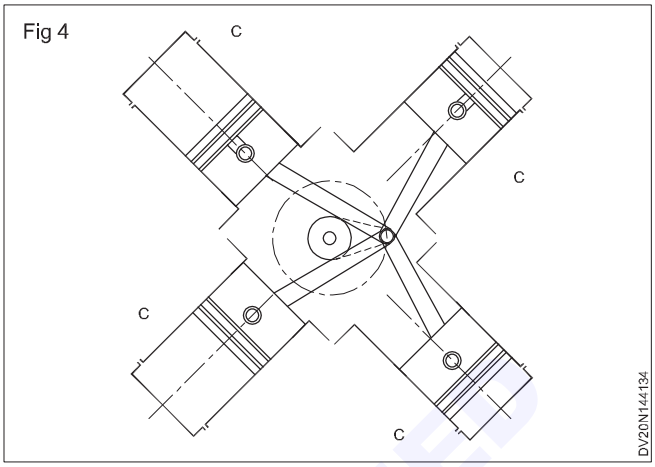
Vertical engine

Types of engines as per cylinder arrangement

In-line engines

In this type, the cylinders are arranged in one line. The length of the crankshaft is longer than that of the other types of engines, and hence a limited number of cylinders are used. Better balancing and more uniform torque is obtained in this type.

Fig 4



'V' shape engines

In this type, the cylinders are arranged in V shape at an angle, of usually 60°. This engine is more economical and compact. For multi-cylinder engines, the length of the crankshaft is much shorter than that of the in- line engine. In this type, the engine height is also lower than it is in the in-line engine.

Opposed engines

In this type the cylinders are arranged horizontally opposite to each other. This provides better mechanical balance. This type of engine can run smoothly even at a much higher speed. It also gives higher output. The length of the engine is too much, and therefore engine has to be placed in the transverse direction in the vehicle.

Radial engines

In this type, the cylinders are arranged radially. This type of engine is shorter, lighter and more rigid. Since it is rigid, a higher engine speed is possible and a higher combustion pressure can be obtained. This leads to high fuel efficiency. The radial type engines are used mostly in aeroplanes.

Types of engine as per number of cylinders

Single cylinder engines

An engine which has only one cylinder is called a single cylinder engine. Since it is a single cylinder engine it cannot develop more power. It is normally used only in two wheelers like scooters and motor cycles.

Multi cylinder engines

These engines have more than one cylinder. Two-cylinder engines are usually used in tractors. Three or four cylinder engines are used in cars, jeeps and other vehicles. In heavy vehicles six-cylinder engines are used. A greater number of cylinders gives smoother engine operation.

Types of fuel used

Petrol

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Diesel

Gas

Types of valve arrangements

`I' head engine

`F' head engine

`L' head engine

`H' head engine

`T' head engine

Application of engine

Constant speed engine

Variable speed engine

Engine Cooling system

Air cooled engine

Water cooled engine

Strokes of engine

Four-stroke engine

Two-stroke engine

Function of diesel engine

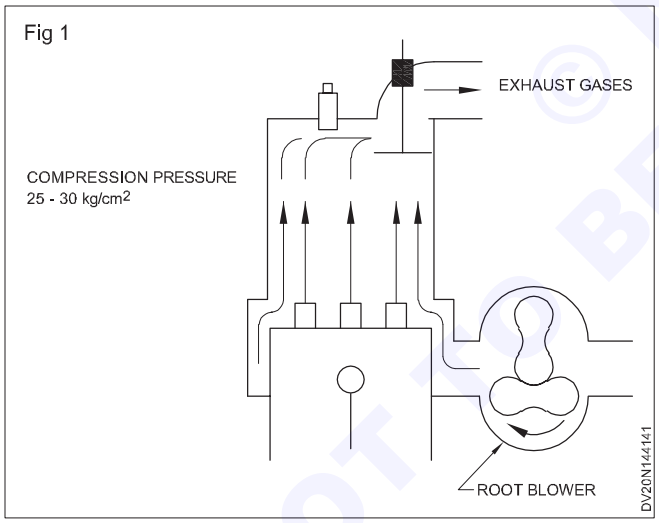
Objectives: At the end of this lesson you shall be able to
- **describe the function of a two-stroke diesel engine**
- **describe the function of a four-stroke diesel engine.**

Two stroke diesel engine

To produce power in a two stroke engine the following operation take place in the sequence given.

First stroke: Piston at BDC to TDC, the scavenging port and outlet valve open (Fig 1). A root blower sucks in pure air and presses it through the scavenging port into the cylinder. The tangential layout of the scavenging port brings the air into a turbulent motion. The cylinder is completely flushed out in the direct current and filled with fresh air. The exhaust gases flow out towards the outlet valve.

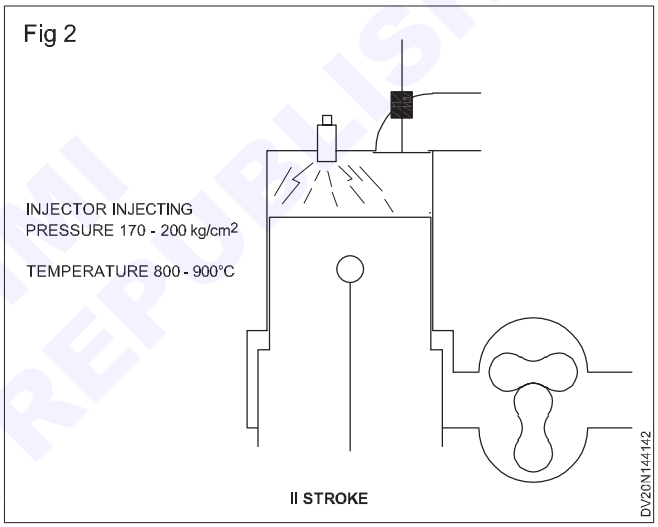
Fig 1



As the piston moves up from BDC to TDC the scavenging port and outlet valve closed. The piston compresses the fresh air to the compression chamber. The air temperature increases intensively.

Second stroke: Piston at TDC (Fig 2) scavenging port and outlet valve closed. The fuel is directly injected into the cylinder with the help of a fuel injection pump and an injector fitted in the cylinder head. The fuel gets vaporised into an ignitable fuel air mixture by the hot air. After attaining the ignition temperature the mixture gets automatically ignited and burns. The heat increases the pressure in the combustion chamber. The gases get expanded and push the piston towards the bottom dead centre.

Fig 2



Four-stroke engine

To produce power in a four-stroke engine the following operations take place in the sequence given.

Suction stroke

The piston moves from TDC to BDC (Fig 3). A vacuum is created inside the cylinder. The inlet valve opens while the exhaust valve remains closed. The charge air enters into the cylinder.

Compression stroke (Fig 4)

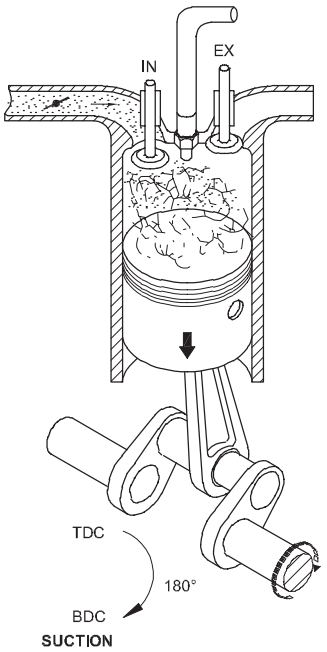
The inlet and exhaust valves are closed. The piston moves from BDC to TDC (Fig 4). The charged air is compressed in the cylinder. The compressed air pressure and temperature is increased upto 800°C.

Power stroke

At the end of the compression stroke diesel fuel is injected into the hot compressed air in the combustion chamber; result burning of diesel with an explosion the gas expand and pressure develops inside the cylinder. The piston moves from TDC to BDC (Fig 5). Both the valves remain closed. Power is supplied to the fly wheel.

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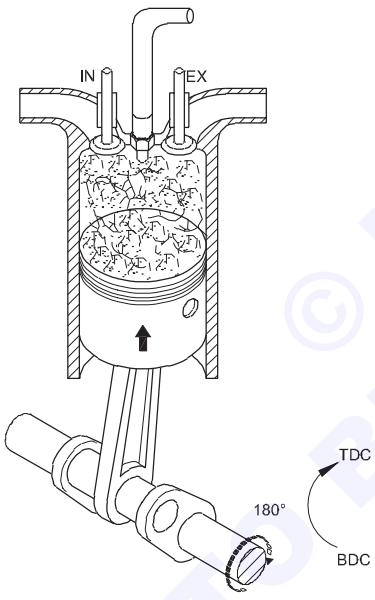
Fig 3



SUCTION STROKE

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Fig 4



COMPRESSION STROKE

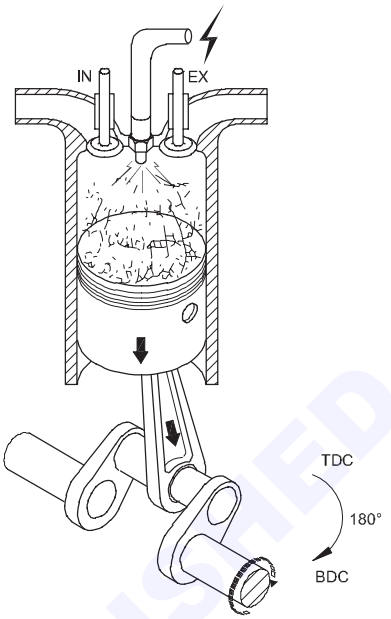
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Exhaust stroke

The inlet valve remains in closed position. The exhaust valve opens, the piston moves from BDC to TDC (Fig 6) due to the energy stored in the flywheel. The burnt gases inside the cylinder go out through the exhaust valves.

The cycle of suction, compression power and exhaust are repeated. In this type of engines one power stroke is obtained in two revolutions of the crankshaft.

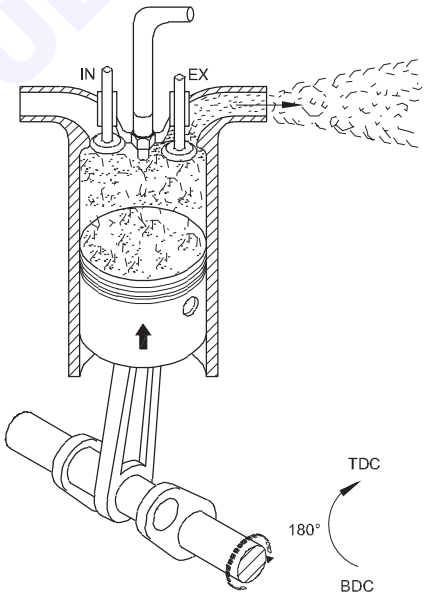
Fig 5



POWER STROKE

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Fig 6



EXHAUST STROKE

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Function of spark ignition engine

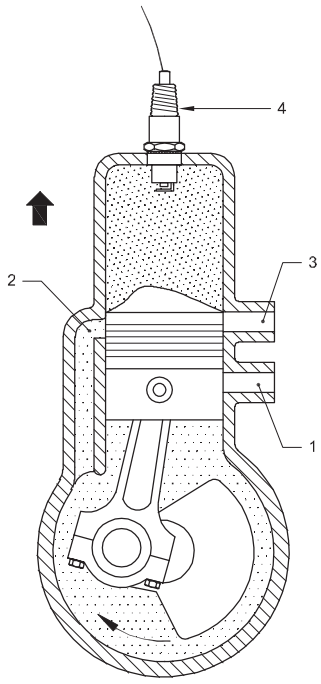
Objectives: At the end of this lesson you shall be able to
- **describe the function of a two-stroke engine**
- **describe the function of a four-stroke engine**
- **differentiate between a four-stroke and a two-stroke engine**
- **explain an OTTO cycle**
- **explain a diesel cycle.**

Two-Stroke spark ignition engine

To produce power in two stroke engine the following operations take place in the sequence given below.

First stroke (Suction and compression) (Fig 1)

Fig 1



As the piston moves up from BDC,(Fig 1) it closes the inlet port (1), the exhaust port (3) and the transfer port (2). Further upward movement of the piston results in compressing the mixture in the cylinder and opening of the inlet port (1). The upward motion of the piston creates a partial vacuum inside the crank-case below the piston, and the air/fuel mixture is drawn into the crank-case through the inlet port (I). The exhaust and transfer ports remain closed during the operation of the upward stroke and the charge which reached above the piston during the previous stroke is compressed.

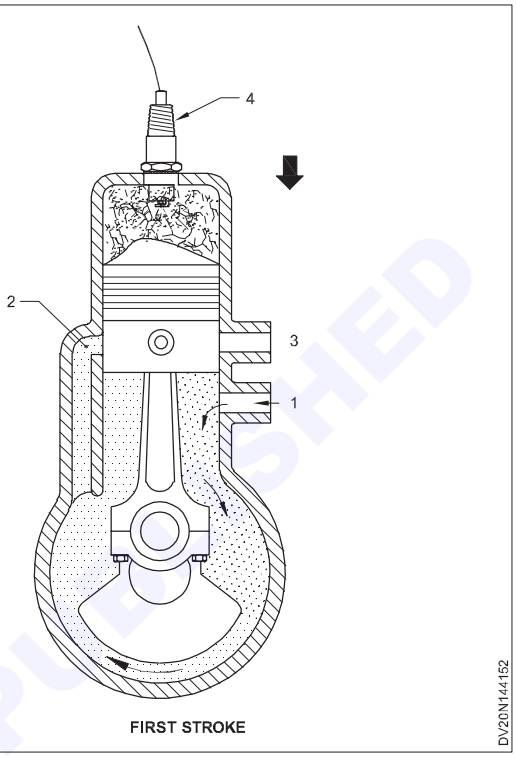
At the end of this stroke the mixture is ignited by an electric spark (4). This causes the pressure to rise.

Second stroke (power and exhaust)

The piston is forced downward from the TDC (Fig 2). During this stroke the exhaust port opens and burnt gases escape into the atmosphere.

Further downward movement of the piston opens the transfer port and allows the partially compressed mixture, received during the previous stroke, to reach the combustion chamber from the crankcase.

Fig 2



The piston head has a special shape. It deflects a fresh change of fuel mixture up into the cylinder. The mixture flows down and pushes the burnt gas out. Through the exhaust port. This process is called scavenging. Once the flywheel has completed one revolution, the cycle is repeated. In this engine one power stroke is obtained in each revolution of the crankshaft.

Spark ignition (Fig 3)

In a spark ignition (SI) engine, petrol is used as fuel. During the suction stroke the air and fuel mixture is sucked into the cylinder. The quantity of the mixture is metered by the carburetor according to the load and speed. The ratio of air/fuel mixture is also metered by the carburetor. During the compression stroke, this air/fuel mixture is ignited by the spark and the mixture is burnt. It raises the pressure of the gas above the piston. The piston is forced down and this power is supplied to the flywheel. During the exhaust stroke burnt gases escape through the exhaust port/valve.

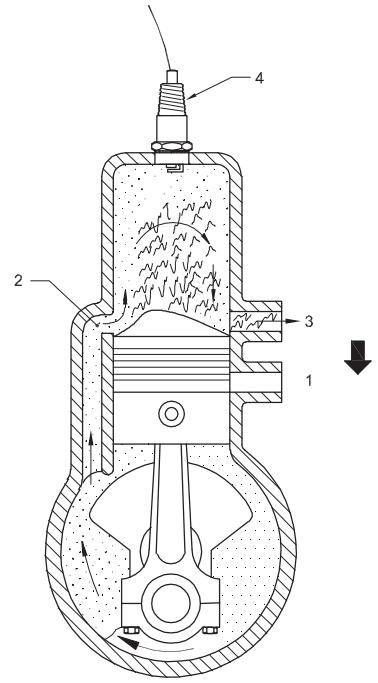
In this type of engine the compression ratio is low.

Four-stroke spark ignition engine

To produce power in a four-stroke engine the following operations take place in the sequence given below.

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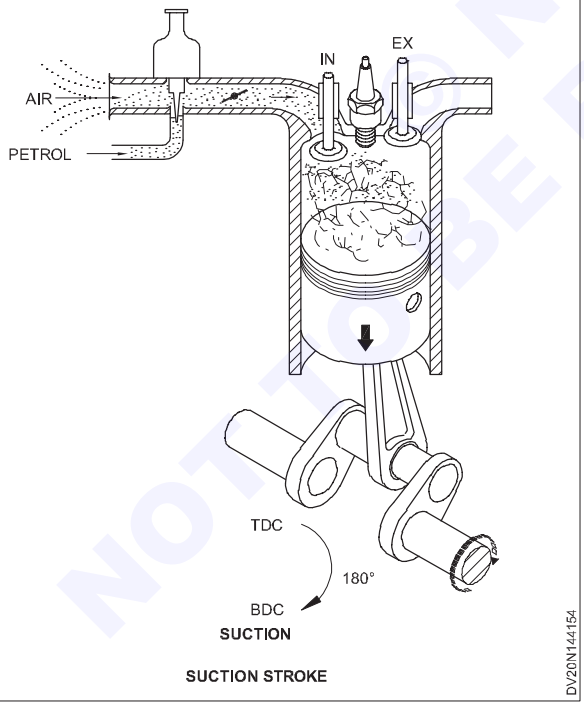
Fig 3



Suction stroke

The piston moves from TDC to BDC (Fig 4). A vacuum is created inside the cylinder. The inlet valve opens while the exhaust valve remains closed. The charge (air/air-fuel mixture) enters the cylinder.

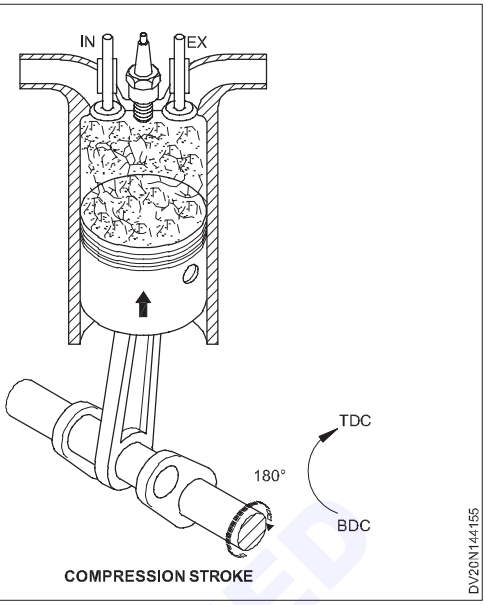
Fig 4



Compression stroke

The inlet valve closes. The exhaust valve remains closed. The piston moves from BDC to TDC (Fig. 5). The charge (air/air-fuel mixture) is compressed. The pressure and temperature rise.

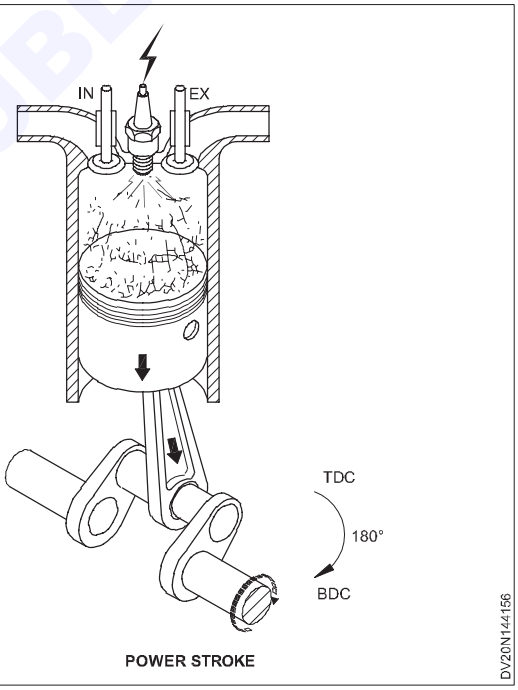
Fig 5



Power stroke

The compressed is ignited air fuel mixture and pressure develops inside the cylinder. The gas expands and the piston is forced down from TDC to BDC (Fig 6). Both the valves remain closed. Power is supplied to the flywheel.

Fig 6



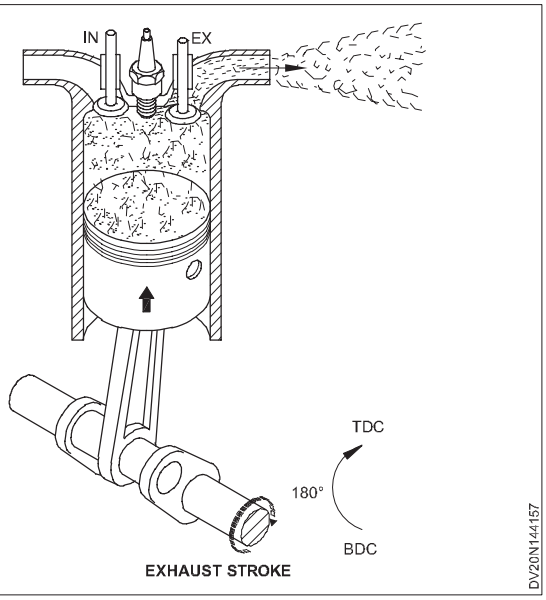
Exhaust stroke

The inlet valve remains in the closed position. The exhaust valve opens, the piston moves from BDC to TDC (Fig 7) due to the energy stored in the flywheel. The burnt gases inside the cylinder go out through the exhaust valves. At the end of the stroke the exhaust valve closes.

The cycle of suction, compression power and exhaust are repeated. In this type of engines one power stroke is obtained in two revolutions of the crankshaft.

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Fig 7



Comparison between four-stroke engine and two-stroke engine

Four-stroke engine	Two-stroke engine
- Four operations (suction, compression, power and exhaust) take place in the four strokes of the piston.	- The four operations take place in two strokes of the piston.
- It gives one power stroke in two revolutions of the crankshaft. As such three strokes are idle strokes.	- The power stroke takes place in every two strokes i.e one power stroke one revolution of the crankshaft.
- Due to more idle strokes and non-uniform load on the crankshaft, a heavier flywheel is required. a lighter flywheel is used.	- The engine has more uniform load as every time the piston comes down it is the power stroke. As such
- The engine has more parts such as valves and its operating mechanism. Therefore, the engine is heavier.	- The engine has no valves and valve-operating mechanism therefore it is lighter in weight.
- The engine is costlier as it has more parts. number of parts	- The engine is less expensive as it has a lesser
- The engine efficiency is more as the charge gets completely burnt out. Consequently the fuel efficiency more.	- The engine efficiency is less. A portion of the charge escapes through the exhaust port, and because of is the fuel efficiency is less.

Comparison between S.I and C.I. Engine

SI engine	CI engine
Petrol is used as fuel.	Diesel is used as fuel.
During the suction stroke air and fuel mixture is sucked in the engine cylinder	During the suction stroke air alone is sucked in to the cylinder
Compression ratio is low. (Max. 10:1)	Compression ratio is high. (Max. 24:1)
Compression pressure is low. (90 to 150 PSI)	Compression pressure is high. (400 to 550 PSI)
Compression temperature is low.	Compression temperature is high.
It operates under constant volume cycle (otto cycle).	It operates under constant pressure cycle (diesel cycle).
Fuel is ignited by electric spark.	Fuel is ignited due to the heat of the highly compressed air. Combustion takes place at constant pressure.
Spark plug is used	Injector is used.
A carburetor is used to atomize, vaporize and meter the correct amount of fuel according to the requirement.	Fuel injection pumps and atomizers are used to inject metered quantities of fuel at high pressure according to the requirement.
Less vibration, and hence, smooth running.	More vibration, and hence, rough running and more noisy.
Engine weight is less.	Engine weight is more.
It emits carbon monoxide. (CO)	It emits carbon dioxide. (CO_2)

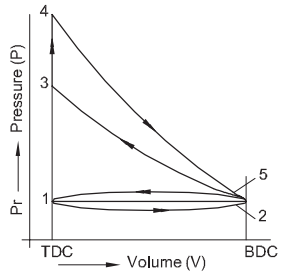
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Otto Cycle

1 - 2 - Suction
2 - 3 - Compression
3 - 4 - Heat addition
4 - 5 - Power
5 - 2 - 1 - Exhaust

In otto cycle engine, (Fig 8) combustion takes place at constant volume.

Fig 8



Suction takes place at a pressure below atmospheric pressure when piston moves from TDC to BDC. (1-2)

Compression takes place when piston moves from BDC to TDC. (2-3)

Fuel mixture is ignited by introducing a spark at constant volume. (3-4)

The gas expands during the power stroke (4-5), reducing both pressure and temperature.

Heat is rejected at constant volume. (5-2)

Burnt gases exhaust when piston moves from BDC to TDC. (2-1)

Diesel Cycle

1 - 2 - Suction
2 - 3 - Compression
3 - 4 - Heat addition
4 - 5 - Power

Suction takes place at (Fig 9) pressure below atmospheric pressure when piston moves from TDC to BDC. (1-2)

Compression takes place when piston moves BDC to TDC. (2-3) (Both the valves closed).

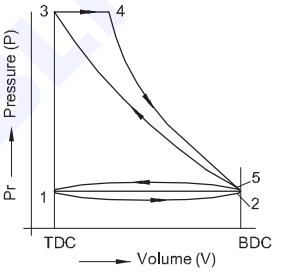
Fuel is sprayed at high pressure and ignited by hot compressed air (3-4), and this process takes place at constant pressure.

Fuel ignites, pressure of burnt gas increases, gas expands and piston is forced from TDC to BDC. (4-5)

Heat is rejected at constant volume. (5-2)

Burnt gases exhaust when piston moves from BDC to TDC. (2-1)

Fig 9

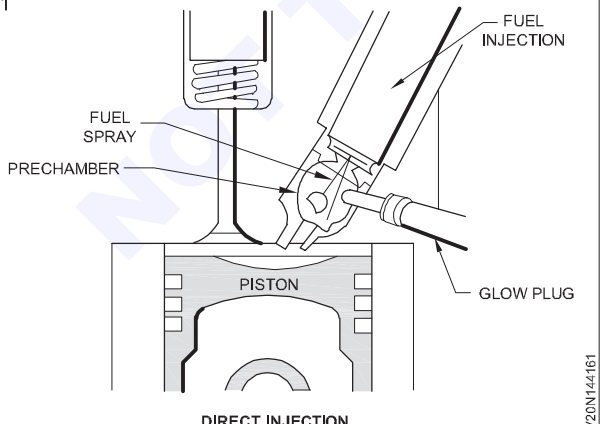


Direct and indirect fuel injection system

Objectives: At the end of this lesson you shall be able to
- **state the function of direct fuel injection**
- **state the function of indirect fuel injection.**

Direct Fuel Injection Works (Fig 1)

Fig 1



DIRECT INJECTION

Gasoline engines work by sucking a mixture of gasoline and air into a cylinder, compressing it with a piston, and igniting it with a spark. The resulting explosion drives the piston downwards, producing power. Traditional indirect fuel injection systems pre-mix the gasoline and air in a chamber just outside the cylinder called the intake manifold. In a direct injection system, the air and gasoline are not pre-mixed. Rather, air comes in via the intake manifold, while the gasoline is injected directly into the cylinder.

Advantages of Direct Fuel Injection

Combined with ultra-precise computer management, direct injection allows more accurate control over fuel metering, which is the amount of fuel injected and injection timing, the exact point when the fuel is introduced into the cylinder. The location of the injector also allows for a more optimal spray pattern that breaks the gasoline up into smaller droplets. The result is a more complete combustion - in other words, more of the gasoline is burned, which translates to more power and less pollution from each drop of gasoline.

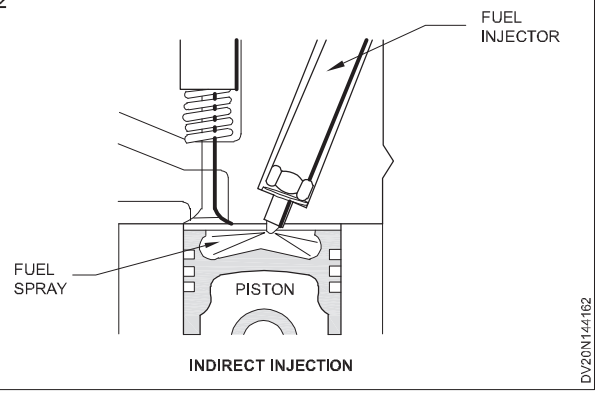
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Disadvantages of Direct Fuel Injection

The primary disadvantages of direct injection engines are complexity and cost. Direct injection systems are more expensive to build because their components must be more rugged. They handle fuel at significantly higher pressures than indirect injection systems and the injectors themselves must be able to withstand the heat and pressure of combustion inside the cylinder.

Indirect injection (Fig 2)

Fig 2



INDIRECT INJECTION

Indirect injection in an internal combustion engine is fuel injection where fuel is not directly injected into the combustion chamber. In the last decade, gasoline engines equipped with indirect injection systems, wherein a fuel injector delivers the fuel at some point before the intake valve, have mostly fallen out of favor to direct injection. However, certain manufacturers such as Volkswagen and Toyota have developed a 'dual injection' system, combining direct injectors with port (indirect) injectors, combining the benefits of both types of fuel injection. Direct injection allows the fuel to be precisely metered into the combustion chamber under high pressure which can lead to greater power, fuel efficiency. The issue with direct injection is that it typically leads to greater amounts of particulate matter and with the fuel no longer contacting the intake valves, carbon can accumulate on the intake valves over time. Adding indirect injection keeps fuel spraying on the intake valves, reducing or eliminating the carbon accumulation on intake valves and in low load conditions, indirect injection allows for better fuel-air mixing. This system is mainly used in higher cost models due to the added expense and complexity.

Port injection refers to the spraying of the fuel onto the back of the intake port, which speeds up its evaporation.

An indirect injection diesel engine delivers fuel into a chamber off the combustion chamber, called a rechamber, where combustion begins and then spreads into the main combustion chamber. The prechamber is carefully designed to ensure adequate mixing of the atomized fuel with the compression-heated air.

Classification of indirect combustion chambers

- 3.1Swirl chamber
- 3.2Precombustion chamber
- 3.3Air cell chamber

Overview

The purpose of the divided combustion chamber is to speed up the combustion process, in order to increase the power output by increasing engine speed.[2] The addition of a prechamber, however, increases heat loss to the cooling system and thereby lowers engine efficiency. The engine requires glow plugs for starting. In an indirect injection system the air moves fast, mixing the fuel and air. This simplifies injector design and allows the use of smaller engines and less tightly tolerance designs which are simpler to manufacture and more reliable. Direct injection, by contrast, uses slow-moving air and fast-moving fuel; both the design and manufacture of the injectors is more difficult. The optimization of the in-cylinder air flow is much more difficult than designing a rechamber. There is much more integration between the design of the injector and the engine.[3] It is for this reason that car diesel engines were almost all indirect injection until the ready availability of powerful CFD simulation systems made the adoption of direct injection practical.

Advantages of indirect injection combustion chambers

- Smaller diesels can be produced.
- The injection pressure required is low, so the injector is cheaper to produce.
- The injection direction is of less importance.
- Indirect injection is much simpler to design and manufacture; less injector development is required and the injection pressures are low (1500 psi/100 bar versus 5000 psi/345 bar and higher for direct injection)
- The lower stresses that indirect injection imposes on internal components mean that it is possible to produce petrol and indirect injection diesel versions of the same basic engine. At best such types differ only in the cylinder head and the need to fit a distributor and spark plugs in the petrol version whilst fitting an injection pump and injectors to the diesel. Examples include the BMC A-Series and B-Series engines and the Land Rover 2.25/2.5-litre 4-cylinder types. Such designs allow petrol and diesel versions of the same vehicle to be built with minimal design changes between them.
- Higher engine speeds can be reached, since burning continues in the prechamber.

Disadvantages

- Fuel efficiency is lower than with direct injection because of heat loss due to large exposed areas and pressure loss due to air motion through the throats. This is somewhat offset due to indirect injection having a much higher compression ratio and typically having no emissions equipment.
- Glow plugs are needed for a cold engine start on diesel engines.

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- Because the heat and pressure of combustion is applied to one specific point on the piston as it exits the precombustion chamber or swirl chamber, such engines are less suited to high specific power outputs (such as turbocharging or tuning) than direct injection diesels. The increased temperature and pressure on one part of the piston crown causes uneven expansion which can lead to cracking, distortion or other damage due to improper use; use of " starting fluid" (ether) is not recommended in glow plug, indirect injection systems, because explosive knock can occur, causing engine damage.

Basic technical terms used in relation to engines

T.D.C. (Top dead centre)

It is the position of the piston at the top of a cylinder, where the piston changes its direction of motion from the top to the bottom.

B.D.C. (Bottom dead centre)

It is the position of the piston at the bottom of the cylinder where the piston changes its direction of motion from the bottom to the top.

Stroke

The distance travelled by the piston from TDC to BDC or BDC to TDC.

Cycle

A set of operations performed in sequence by the motion of the piston in an engine to produce power.

Swept volume (VS)

Displacement volume of a piston.

Clearance volume (VC)

Volume of the space above the piston when it is at TDC.

Compression ratio (CR)

Ratio of compression volumes before the stroke and after.

$$CR = \frac{VS + VC}{VC}$$

where VS = Swept volume

VC = Clearance volume

VS+VC = Total volume at BDC.

Power

Power is the rate at which work is done in a specific time.

$$\text{Power} = \frac{(\text{Force} \times \text{Distance moved})}{\text{Time}}$$

Horsepower (HP)

It is the measurement of power in SAE. One hp is the power required to lift a load of 33000 lbs, through one foot in one minute or 4500 kg through one meter in one minute (in metric system)

Thermal efficiency

It is the ratio of work output to the fuel energy burnt in the engine. This relationship is expressed in percentage.

Brake horsepower (BHP)

It is the power output of an engine, available at the flywheel,

$$BHP = \frac{2\pi NT}{4500}$$

where N is r.p.m of the crankshaft, and T is the torque produced.

Indicated horsepower (IHP)

It is the power developed in the engine cylinder.

$$IHP = \frac{PLAN}{4500} X K$$

Where Pm is the mean effective pressure in kg./cm².

L is length of stroke in metres

A is the area of the piston in cm²

N is the No. of power strokes per minute

K is the No. of cylinders.

Frictional horsepower

It is the horsepower lost in the engine due to friction.

FHP = IHP - BHP

Mechanical efficiency

It is the ratio of power delivered (BHP) and the power available in the engine (IHP). It is expressed in percentage

$$\text{Mechanical efficiency} = \frac{BHP}{IHP} \times 100$$

Volumetric efficiency

It is the ratio between the air drawn in the cylinder during the suction stroke and the volume of the cylinder.

Throw

It is the distance between the centre of the crank pin to the centre of the main journal. The piston stroke is double the throw.

Firing order

The firing order is the sequence in which the power stroke takes place in each cylinder in a multi-cylinder engine.

Technical Specification of an engine

Engines are specified as per the following types.

Number of cylinders

Bore diameter

Stroke length

Capacity in cu.cm/cu.inch

Maximum engine output at specified r.p.m.

Maximum torque

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Compression ratio

Firing order

Idling speed

Air cleaner (Type)

Oil filter (Type)

Fuel filter

Fuel injection pump

Weight of engine

Cooling system (type)

Type of fuel

Multipoint fuel injection system (MPFI)

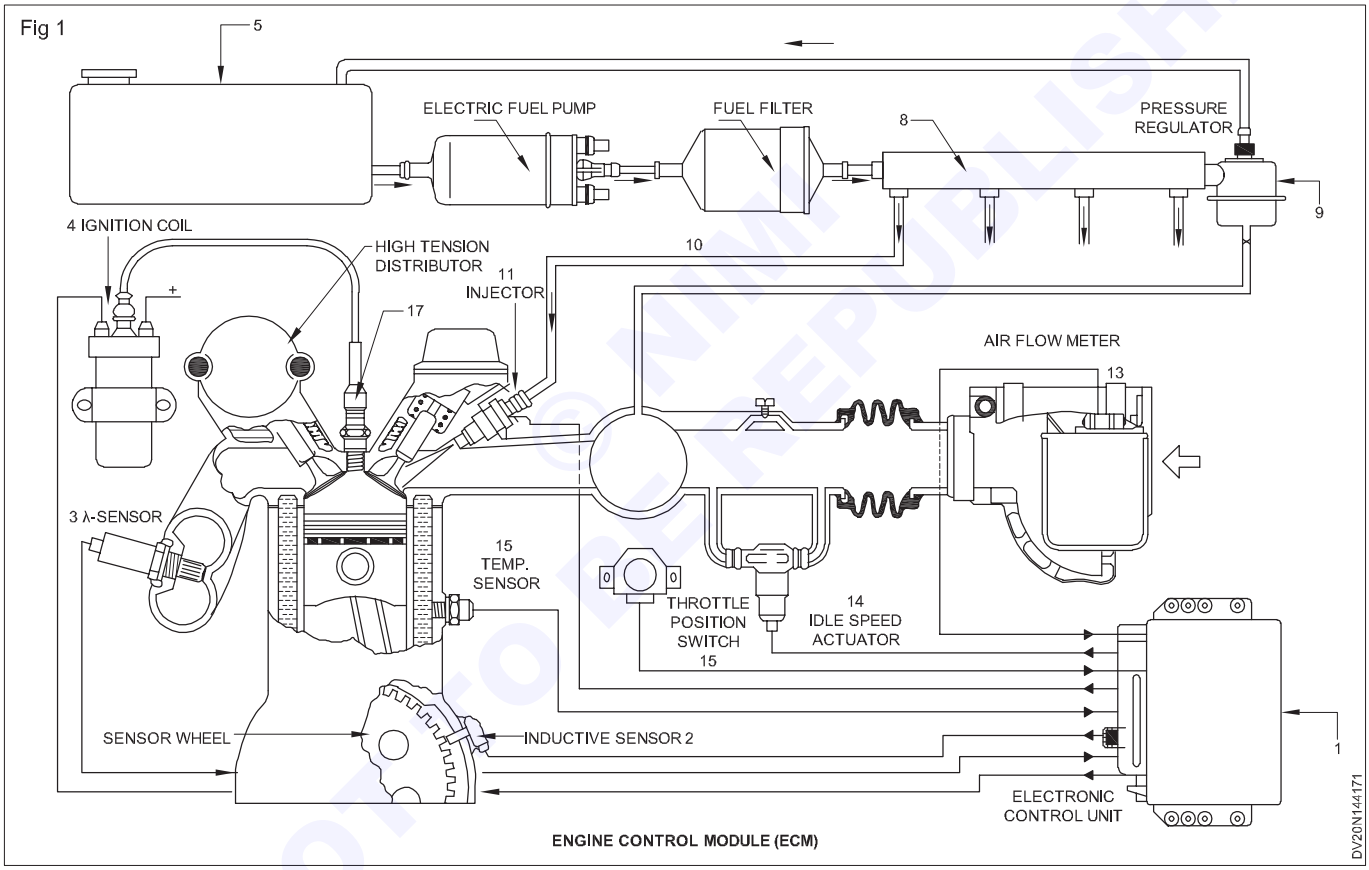
Objectives: At the end of this lesson you shall be able to
- **state the concept of MPFI.**

Concept of MPFI system

Petrol vehicles uses device called carburetor for supplying the air fuel mixture in correct ratio to cylinders in all rpm ranges. Due to construction of the carburetor is relatively simple, on the gasoline engine in the past. However in response to recent demands for cleaner exhaust emission, more economical fuel consumption, improved drivability etc., the carburetor now must be equipped with various compensating devices, making it more complex system. So in place of carburetor, therefore, the MPFI multi point fuel injection system is used, assuring proper air fuel ratio to the engine by electrically injecting fuel in accordance with various driving conditions.

Main components of MPFI system (Fig 1)

Fig 1



Common Rail Diesel Injection (CRDI)

Objectives: At the end of this lesson you shall be able to
- **describe the construction of CRDI**
- **explain the working of the CRDI**
- **state the concept of turbo charger.**

Construction and working of CRDI system (Fig 1&2)

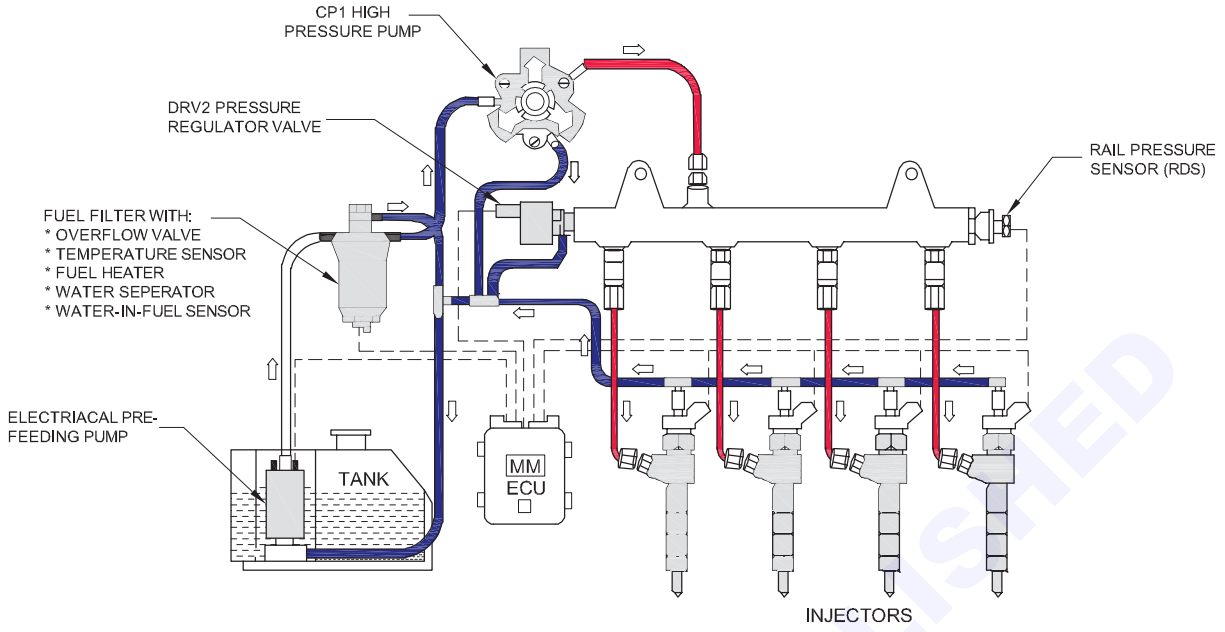
The common rail fuel system consists of fuel tanks fuel pump, Common rail, pressure regulator, injectors and sensors. The electrical fuel pump(low pressure)in placed inside the fuel tank, It develops pressure up to 6 bar and supplies to the high pressure fuel tank, it develops pressure fuel pump (CRDI) through fuel filter and water separator. The high pressure fuel pump (CRDI) through fuel filter and water separator. The high pressure fuel pump develops pressure 200 to 2000 bar and supplies to the common rail to fuel injectors inject fuel into the combustion chamber. Fuel injector are operator by ECM through solenoid valve. Common rail consists the fuel

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pressure sensor and fuel pressure regulator supplies the excess amount of fuel to fuel tank (≤1 bar pressure). The common rail pressure sensor send information to ECM/ EDC, the existing pressure in common rail will control the RPM of the fuel to all the cylinder with equal pressure, then all cylinders will develop uniform power which will reduce vibration and noise of the engine.

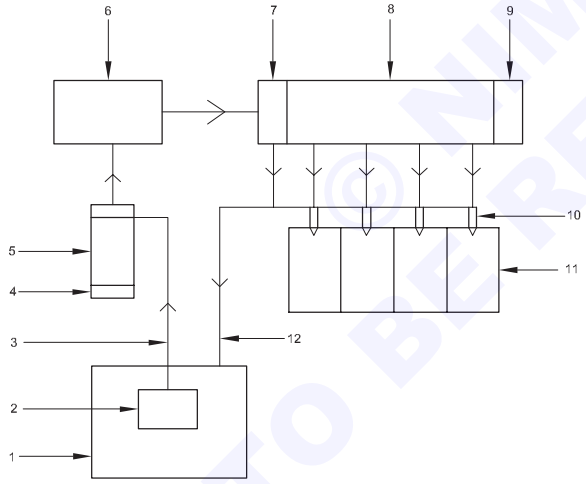
Diesel Direct injection (Fig 1)

Fig 1



DIESEL DIRECT INJECTION SUSTEM (DDIS) -- FUEL SYSTEM LAYOUT

Fig 2

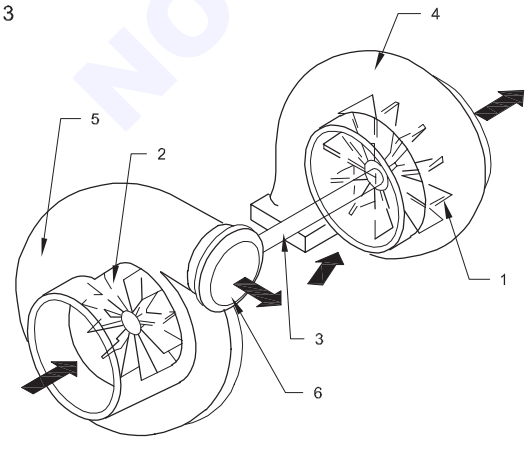


1. FUEL TANK
2. ELECTRICAL FUEL PUMP
3. FUEL SUPPLY LINE
4. WATER SEPARATOR
5. FUEL FILTER
6. HIGH PRESSURE FUEL PUMP (CRDI PUMP)
7. FUEL PRESSURE REGULATOR
8. COMMON RAIL
9. FUEL RAIL PRESSURE SENSOR
10. FUEL INJECTOR
11. ENGINE
12. FUEL RETURN LINE

COMMON RAIL DIRECT INJECTION SYSTEM (CRDI) FUEL SUPPLY SYSTEM

Concept of turbo technology (Fig 3)

Fig 3



The turbo technology is powered by the kinetic energy of exhaust gases in an internal combustion engine. A turbo charger is a forced induction device that is powered by the flow of exhaust gases. Its uses this energy compress the intake gas forcing more air into the engine in order to practice more power for given engine firing order

Turbo charger increases the amount of air delivered to the engine cylinder, there by more fuel can be burnt which increases the engine power. Whenever the density of air is less than the density at atmospheric pressure specially at higher altitudes, turbo chargers helps the engine to get the sufficient air. An engine may have one or more turbo chargers.

A turbo charger is mounted on the exhaust manifold. It has a turbine wheel(1) and a compressor wheel (2) on the

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same shaft (3). Exhaust gases enter in turbine housing (4) and rotate the turbine wheel(1). Compressor housing's (5) inlet is connected to the air cleaner and compressed air is discharged to inlet manifold through the outlet (6).

Turbo charger

Fixed Geometry Turbo chargers(FGT)

A turbo charger consists of a turbine and a compressor linked by a shared axle. The turbine inlet receives exhaust gases from the engine exhaust manifold causing the turbine wheel to rotate. This rotation drives the compressor, compressing ambient air and delivering it to the air intake manifold of the engine at higher pressure, resulting in a greater amount of the air and fuel entering the cylinder. In FGT, (Fig.2)the amount of compressed air which has to be entered in the engine is controlled by a waste gate valve which regulates the turbo output depending on engine's speed.

Electronic Diesel Control (EDC) system

Objectives: At the end of this lesson you shall be able to
- **state the function of electronic diesel control device.**

Electronic diesel control the Fig 1 is a diesel engine fuel injection control system for the precise metering and delivery of fuel into the combustion chamber of modern diesel engines used in trucks and cars.

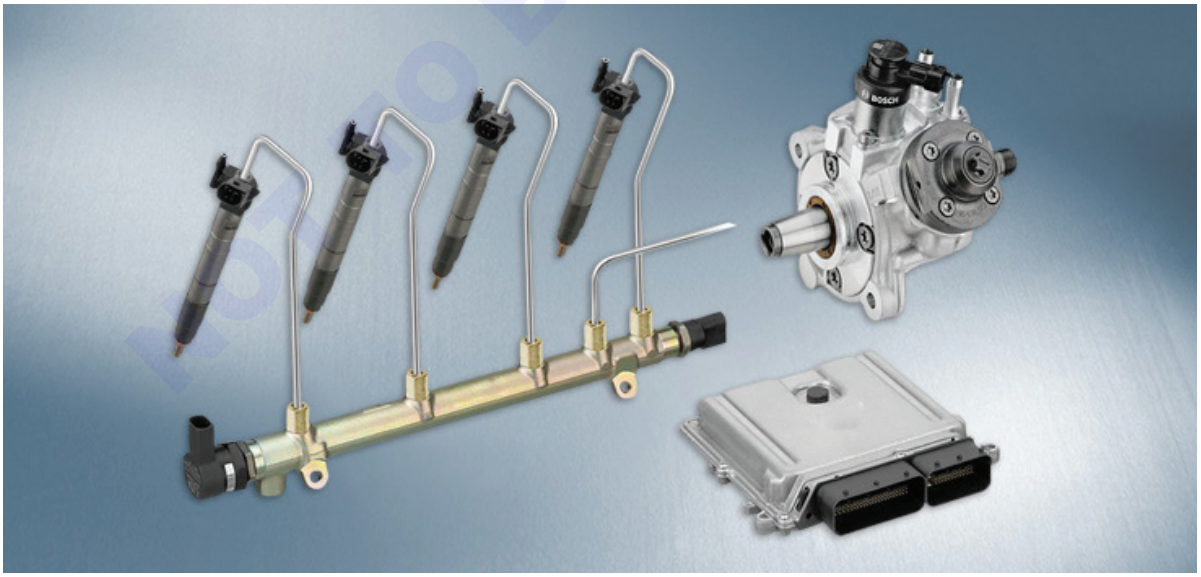
Fig 1



The electronic control, the system which provides greater ability for precise measuring, data processing environment flexibility and analysis to ensure efficient diesel engine operation.

- It receives the information from sensor, analyze/ calculate it and sends the instructions to the actuators.
- It converts information from analog to digital.
- It consists of micro processors to process the information from sensor to ECM and ECM to actuators.
- Number of micro processors depends upon the number of sensors and actuators.
- It also consists of memory to store the data.
- Speed is in the form of 8 Bit, 32 Bit, 64 Bit etc., to pass the information from sensor to ECM ,ECM to actuator and also in networking system.
- Individual programs have to be made for each sensor and actuator.(Fig 2)

Fig 2



COMMON RAIL WITH FUEL INJECTORS

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Main control systems in diesel engine

- It controls the fuel for idling.
- It controls the fuel for high speed.
- It controls the fuel according to the speed and load conditions.
- It controls the exhaust gas recirculation (EGR)valve.

Working

It gets the input from the different sensors named are as follows

1 Throttle position

2 Cam position TP (in take air quantity)

3 Crank position CKP (for valve timing)

4 Engine coolant temperature ECT (cylinder temperature)

5 Inner temperature IT(Temperature of inlet air)

6 Manifold absolute pressure MAP (inlet air pressure)

7 Oxygen O2(Percentage of oxygen in exhaust gas.)

After receiving the above inputs, it analyzes/calculates the amount of fuel is required for the cylinder, accordingly it supplies the voltage to the injector solenoid. The solenoid will open the injector to supply the fuel into the combustion chamber. The minimum injector opening period is 1/10th second.

Minimum 3 important sensors (TP, CKP & CMP) Inputs are required at the time of starting, If any one of the sensor fails, engine does not start.

Rest of the sensors (IAT, ECT, MAP and O2)fails, engine does not start but performance of the engine will affect.

Note:

- **In a vehicle minimum one EDC/ECM is required.**
- **More than one EDC/ECM are used and depend on number of controls.**

Examples of control units EDC/ECM in a vehicle

1 Engine management

2 Automatic transmission

3 Power steering

4 SRS(Air Bag) supplemental restraint system

5 ABS (Anti lock braking system)

Exhaust gas recirculation (EGR)EGR value allows the exhaust gases into the inlet manifold, to burn the un burn gases to reduce the emission.

The opening angle of the valve is controlled by the EDC, depending upon the amount -(%) of oxygen passing through exhaust gases.

EDC gets the percentage of oxygen from the oxygen from the oxygen sensor,

Sensor

It senses the information in the form of physical or chemical variables and sends that information to the ECM in the form of voltage i.e between 0-6 volts or 0-12 volts.

Ex: Throttle valve opening position (Angle)information sends to the ECM in the form of voltage.

ECM

It analyzes or calculates the information which have come which have come from the sensors and gives the instruction to the actuators.

Ex: It supplies the current to the solenoid to open the injector opening duration depends on inputs.

Actuators

Based on instructors from the ECM, it does the mechanical work.

Ex: Injector opens duration depends on ECM instruction

Types of fuel injection system

There are two types of injection system for diesel engines.

Air blast injection

Mechanical injection

Air blast injection

In the air blast injection system, a high pressure air blast drives the fuel at a very high velocity in to the cylinder where it is mixed with the compressed air in the cylinder and ignites.

Mechanical injection

In mechanical injection fuel injection system, fuel is forced in from a mechanical fuel injection pump through injectors. These are two types

Low pressure fuel supply system

Metering injection system

All fuel systems use the same components, although the components vary size and location with in the system.

Low pressure fuel supply system

The low pressure fuel system consists of one or more fuel tanks, a feed pump, fuel filters. hand priming pump, overflow valve and return office.

Metering injection system

It consists primarily of injection pump and injector and categorized as below, depending on the metering system.

i Pump controlled system

This is operated with a high pressure plunger and metering mechanism.

ii Unit injectors system

This system is similar to the pump controlled system except that the high pressure pumping and metering mechanism are an integral part of the fuel injector.

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iii Common rail system

This type of system uses a high pressure fuel pump that is connected to a common fuel rail. Each cylinder's fuel injector is connected to the common fuel rail.

Governors

The governor is a device for holding any speed steady between idling and maximum speed. The fuel injection pump operates in conjunction with a governor, which is required to control the injected quantity of fuel so that the engine neither stalls when idling nor exceeds the maximum speed for which it is designed.

Following types of governors are used

Mechanical

Pneumatic

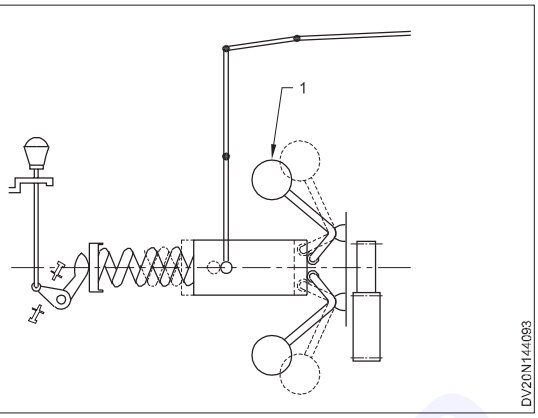
Servo

Hydraulic

Mechanical Governor

Mechanical governors have speed measuring mechanism and fuel controlling mechanism actuated by mechanical arrangement. Two fly weights (Fig 3) (1) are mounted to the governor's drive gear directly fastened to the camshaft. The centrifugal force of the fly weights actuates the fuel control mechanism.

Fig 3



Cooling and lubrication

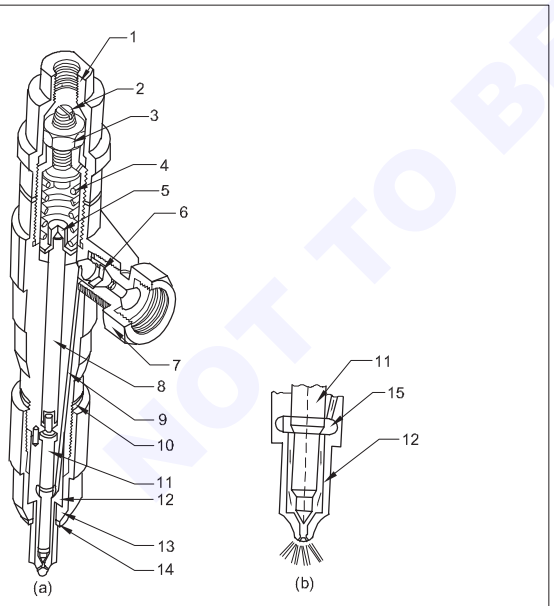
The single- plunger injection pump can be mounted in any position. In operation, it's interior is completely filled with diesel fuel under slight pressure in order to prevent intrusion of air and dust and also to prevent rust formation caused by condensation. Excess fuel is re circulated within the pump to provide adequate coiling and lubrication.

Nozzles

Objectives: At the end of this lesson you shall be able to
- **explain function of injectors**
- **list out different types of injector nozzles**
- **explain special features of various types of nozzles**
- **explain specification of nozzle and nozzle holder.**

Fuel Injectors (Fig 1)

Fig 1



(a) Construction :
(b) Illustrating the operation of the injector :
1-Cap nut.
2-Adjusting screw.
3-Lock nut.
4-Spring.
5-Spring nut
6-Screen filter.
7-Inlet fitting.
8-Spindle.
9-Fuel passage.
10-Nozzle holder.
11-Nozzle needle valve.
12-Nozzle body.
13-Nozzle cap nut.
14-Washer.
15-Nozzle pressure chamber (gallery)

FUEL INJECTOR

The function of the fuel injector is to deliver finely atomized fuel under high pressure to the combustion chamber for the engine. All component parts of the injector are carried in nozzle holder(10.) The main part of the injector is the nozzle comprising nozzle body (12) and nozzle valve (11)The nozzle body and needle valvel are fabricated from alloy steel. They are thoroughly machined and have high surface harness necessary for operation in condition of high temperatures and elevated pressures. The bore in the nozzle body and the nozzle needle valve are lapped to a close tolerance and are a matched set, so that neither the nozzle body nor the needle valve may be replaced individually. The needle valve is pressed against a conical seat in the nozzle body by spring (4) acting through the intermediary of stem 8. The spring pressure, hense injection pressure, is adjusted by adjusting screw (2). The adjusting screw is screwed in the bottom of the injector spring cap nut which in turn is screwed in the nozzle holder. Lock nut (3) is used to prevent the adjusting screw from unscrewing spontaneously. The screw is covered by nozzle holder cap nut (1) provided with a threaded hole to connect the leak-off pipe through which the leak-off fuel (used to lubricate the nozzle valve) filling the pressure spring and adjusting screw area is returned to the fuel tank or the secondary fuel filter.

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In operation, fuel from the injection pump enters pressure chamber (gallery) (15) in the nozzle body through supply passage (9) and a high-pressure pipe. When the fuel pressure in the pressure chamber becomes so high that the force acting on the pressure taper of the needle valve from below exceeds the set spring force on the stem, the needle valve lifts off its seat and comes to rest with its upper shoulder against the face of the nozzle holder. Fuel is then forced out of the nozzle spray holes into the combustion chamber in a spray pattern which depends on the type of nozzle used.

After the injection of fuel has been ended, the fuel delivery from the injection pump ceases, the pressure in pressure chamber 15 of the nozzle drops instantly, and the pressure spring snaps the needle valve onto its seat, preventing unpressurized fuel from leaving the nozzle. The fuel injector is installed in a brass injector tube, or sleeve, which is fitted in a hole in the cylinder head, and is held in place by a special clamp.

Injectors are provided to atomize the fuel into engine cylinder. This is done to achieve complete combustion.

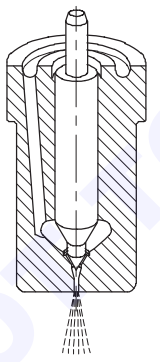
Types of nozzles are used in engine.

Following are the types of nozzles used in the engine

- Single hole type (Fig 2)
- Multi hole type (Fig 3)
- Long stem type (Fig 4)
- intel type (Fig 5)
- Delay nozzle(Fig 6)
- Pentax nozzle (Fig 7)

Single hole type (Fig 2)

Fig 2



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In this type, one hole is drilled centrally or in an angle through its body which is closed by nozzle valve.

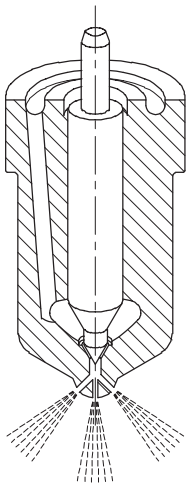
Multihole type (Fig 3)

In this type varying number of holes are drilled at the end of the body. The actual number of holes depend upon the engine requirement.

Longstem type (Fig 4)

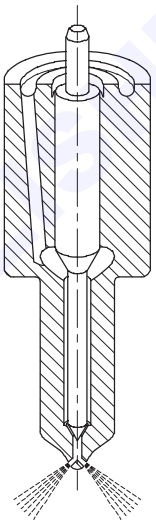
For providing adequate cooling for the standard short stem nozzle, a different type of nozzle with a small diameter extension has been developed. This is called long stem nozzle.

Fig 3



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Fig 4

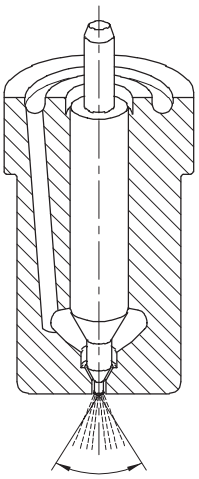


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Intel type (Fig 5)

In this type the valve stem is extended to form a pin or pintle which protrudes through the month of the nozzle body.

Fig 5



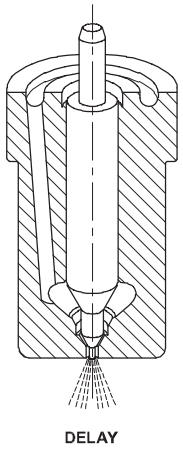
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Delay nozzle (Fig 6)

In this type spray pattern is controlled by the modification in pintle design. This will reduce the amount of fuel in combustion chamber, when the combustion begins. This modified nozzle is known as delay nozzle.

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Fig 6

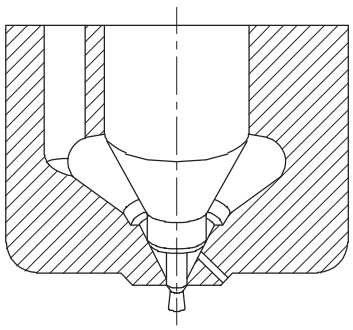


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Pentax nozzle (Fig 7)

This is the further development of pintle type nozzle, having an auxillary spray hole to assist easy starting under cold condition.

Fig 7



DV20N1441A7

Vehicle maintenance

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

- **State the engine lubrication system**
- **State the types of lubricants and filters**
- **State the types of greases and greasing points**
- **State the vehicles maintenance schedule.**

Need for lubrication of engine

An automotive engine needs lubrication to avoid excessive wear and tear of the engine parts. Engine lubrication plays a vital roles in an engine as it aids its working efficiency and longevity of an engine.

When engine moving parts experience a film of lubrication, they are separate from each other. So engine moving parts reduce the friction and generate heat between two moving parts.

Most of modern vehicles are designed with indicator lights which are 'on' when engine oil pressure is low. Although some engine uses the indicator to show the quality of the engine oil in the engine.

Types of lubricating system

The following types of lubricating systems are used in engines

1 Petrol oil-lubrication

2 Dry sump lubrication

3 Splash lubrication

4 Pressurized lubrication

5 Combined lubrication

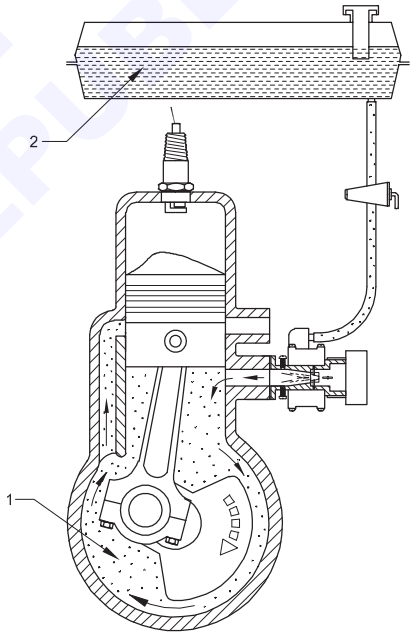
Petrol oil-oil lubricating system (Fig 1)

In this system the lubricating oil is mixed with the petrol(2). The ratio of petrol-oil is 20:1. When fuel goes in the crankcase chamber(1) and crankshaft bearings, the oil mist sticks to the moving parts and gives the lubricating effect. This system is used mostly in two stroke engine

Dry sump lubricating system (Fig 2)

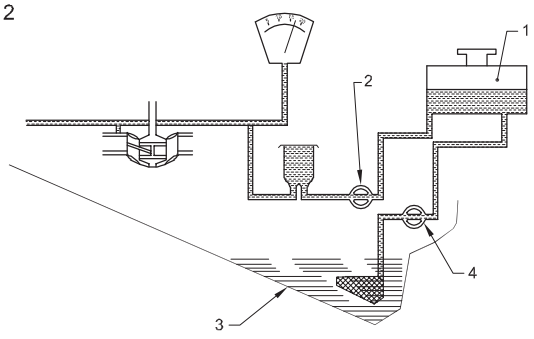
In this system the lubricating oil is delivered from a separate tank(1) to components by an oil pump(2)

Fig 1



DV20N1441B1

Fig 2



DV20N1441B2

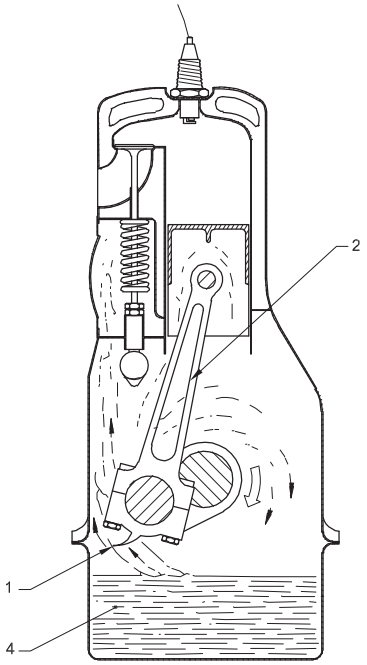
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The oil lubricates the moving parts and flows back to the oil sump(3). A scavenging pump(4) is provided to pump oil from the sump to the tank.

The lubrication effect is not affected when the vehicle is climbing up or moving down.

Splash type lubricating system(Fig 3)

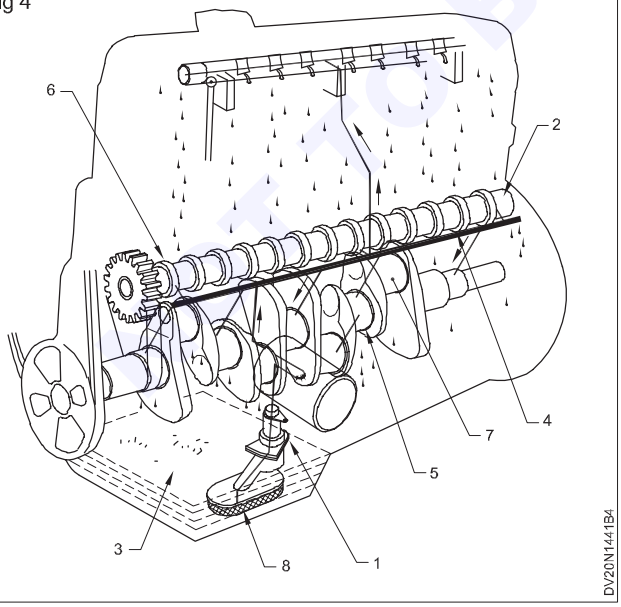
Fig 3



In this system the lubricating oil is stored in a sump.(4). Adipper (1) is made at the lowest part of the connecting rod (2). When crankshaft rotates the dipper(1) dips in the oil once in every revolution of the crankshaft and splashes oil on cylinder walls.

Pressure lubricating system (Fig 4)

Fig 4



In the system the lubricating oil is circulated to all the moving parts of the engine under pressure, by the oil pump (1) driven by the camshaft (2).

The oil from the sump (3) is sucked by the oil pump (1) through the strainer (8) and suction pipe. The strainer filters the solid dust particles. The oil flows to the main gallery (4) from the filter's outlet. From the main oil gallery (4) the oil flows to the crankshaft main journals (5) and camshaft bushes (6).

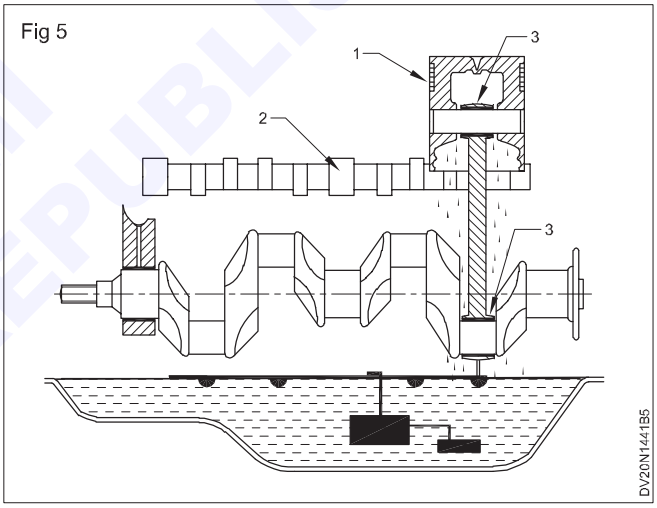
From the crankshaft main journal (5) the oil flows to the crankpin (7). From the camshaft bush it flows to the cylinder head and lubricates the rocker bushes. When the crankshaft rotates the oil splashes from the connecting rod bearings and lubricates the piston rings and liner. In some engines an oil hole is drilled from the connecting rod big end to the small end to lubricate the gudgeon pin bush.

A relief valve is provided in the path between the oil pump and the filter. The relief valve limits the maximum pressure of the oil in the system. An oil pressure gauge or indicating lamp is provided to indicate the oil pressure.

After lubricating the various parts of the engine, the oil reaches the oil sump.Combined lubricating system

Combined lubricating system (Fig 5)

Fig 5



It is a combination of splash lubricating system and pressure lubricating system. Some parts are lubricated by the splash lubricating system - such as the cylinder wall (1), camshaft bearings (2), connecting rod bearing (3) and the remaining parts are lubricated by pressure lubricating system.

Pressure relief valve

The pressure relief valve is used to limit the maximum pressure of the oil. When the oil pressure increases more than the prescribed limit, the relief valve opens and allows oil to return back to the oil sump directly.

Following types of relief valves are used.

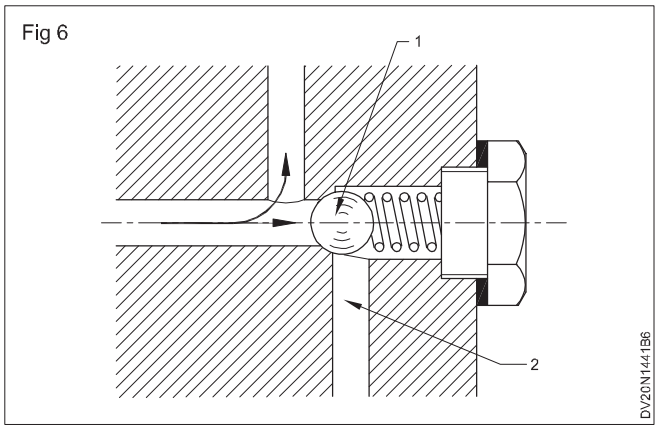
- Ball type
- Plunger type

Ball type (Fig 6)

In this type of relief valve a spring-loaded ball (1) opens the connection to the return channel (2) when the oil

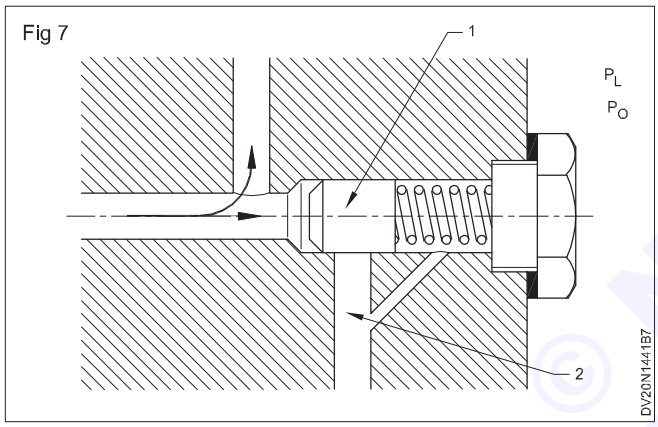
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pressure over comes the spring force. The oil flows through the return channel back to the oil sump.

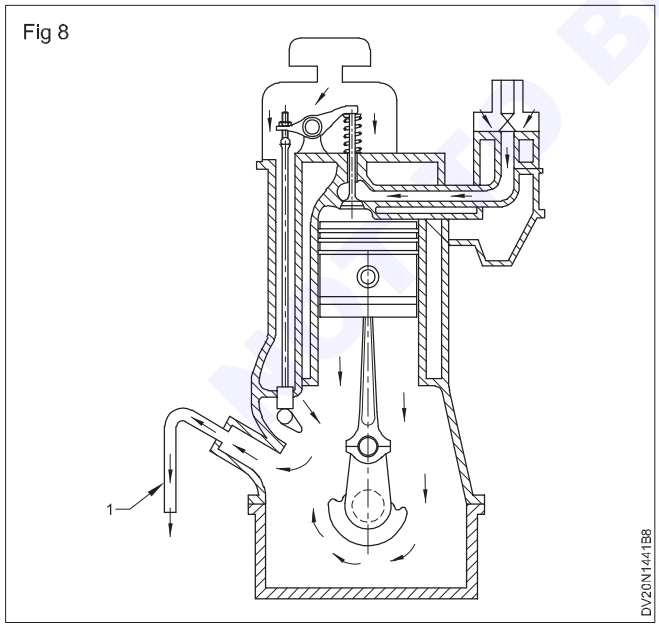


Plunger type relief valve (Fig 7)

This type of relief valve is similar to that of the ball type except that a plunger (1) is used instead of a ball. A leakage oil return passage is provided to allow oil to return to the oil sump which has passed through the plunger (1).

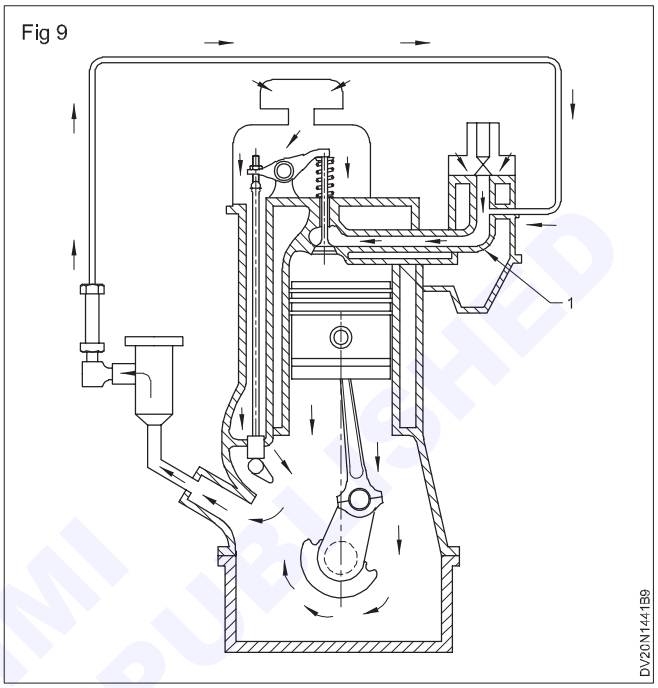


Crankcase ventilation (Fig 8)



In the crankcase oil gets diluted due to the mixture of blow by gases, carbon particles, metallic particles, sand, dust, dirt and the acids formed out of the exhaust gas condensation such as sulphuric acid and phosphoric acid. This affects lubrication and forms a sludge (accumulation of dirty oil). Frequent cleaning and change of oil is needed. To overcome this problem, crankcase ventilation is provided. Fresh air is allowed in the crankcase which passes out after circulation through a breather pipe (1) in the rear. This arrangement is known as Open Type Crankcase Ventilation.

Positive crankcase ventilation (Fig 9)



The exhaust gases and other particles going out of the engine are toxic and injurious to public health. To overcome this positive crankcase ventilation or closed type ventilation is provided. In this arrangement all air flowing out of the engine crankcase is drawn back into the inlet manifold (1) and fed into the engine. This prevents the flow of gases outside the engine.

Function of sump

Oil sump is the lowest part of the crank case (Engine). It provides a covering for the crankshaft and contains oil in it. In wet sump lubricating system, the oil is taken out from the sump and after lubricating different parts of engine again oil drops in to oil sump. It is made of steel pressing/aluminium/east iron. It contains drain plug at its lowest part to drawn out the oil. In dry sump lubricating system the oil is stored drain in a separate oil tank.

Oil collection pan

Oil pan is the lowest part of the engine. In dry sump lubricating system oil pan is collect the oil after lubricating different parts the engine oil drops in an engine and then oil is sent back to the oil tank by a separate delivery pump.

Oil tank

In dry sump lubrication system, two oil pumps are used one for feed the oil from tank to lubricating system and another pump scavenging pump is sent oil from dry sump to oil tank. In this system oil is not stored in oil sump.

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Oil pick up tube: The oil pick up tube is located in oil pump and it is connected from oil strainer to oil pump in wet sump lubrication system.

In dry lubrication system two pick up tube is used to pick up oil from oil tank to engine main gallory and oil drop sump to oil tank through suction pump and scavenging oil pump.

Pick up tube

In dry sump lubricating system pick up tube is connected between delivery pump and oil tank, to pick up the oil from sump to oil tank. In wet sump system pick up tube is connect the stainer and oil pump.

Oil pump & Filter

Objectives: At the end of this lesson you shall be able to
- **state function of oil level and pressure indicator**
- **list out the types of oil pump**
- **list out the type of oil flow system**
- **purpose of the oil cooler.**

Oil level indicator

It is a steel stick graduated at the front end for measuring the level (amount) of oil in the sump. The graduations are “Full” , “Half”, “Low” marks are provided on the bottom end of the dip stick. These marks show whether the oil is up to the required full or half level or the level is so low. The low oil level may cause danger to engine life.

For measuring oil level, remove the stick from the engine, clean and dipped into the oil sump and again taken out to see graduation oil has sticked.

Oil pressure indicator

Oil pressure gauge or oil waring light is provided on the dash board to indicate the lubrication.Oil pressure during engine running.

Oil pressure gauge

It is equipped with pressure lubricating system to warn the engine operator, what is the oil pressure is in the engine. The oil pressures are following types

1 Pressure expansion type

2 Electric type

a Balancing type

b Bimetal thermal type

Oil pressure indicating light

The light comes when the ignition switch is turned on and the oil pressure is low. The circuit uses four stage diaphragm switch, which operates a warning lamp according to the pressure required for different engine speeds. The switch is located at the oil main gallery. Its connection with the warning light is through the ignition switch.

Components of the lubrication system

Oil pumps

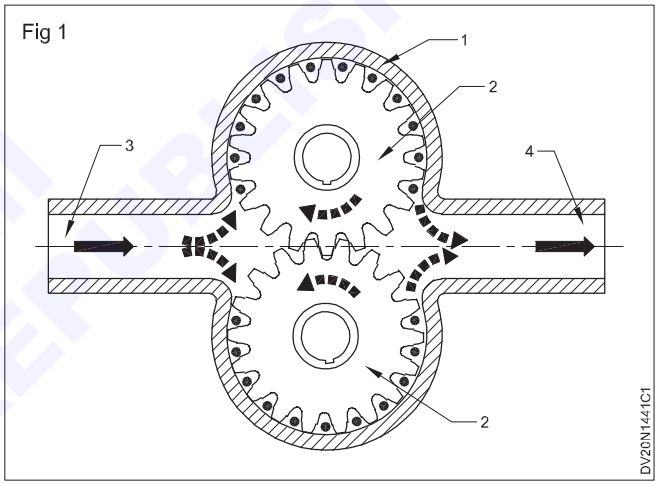
The oil pump is used to pump oil from the oil sump to the oil galleries at a certain pressure.

It is located in the crankcase and is driven by the camshaft. Four types of oil pumps are used.

- Gear type oil pump
- Rotor type oil pump
- Vane type oil pump
- Plunger type oil pump

Gear type oil pump (Fig 1)

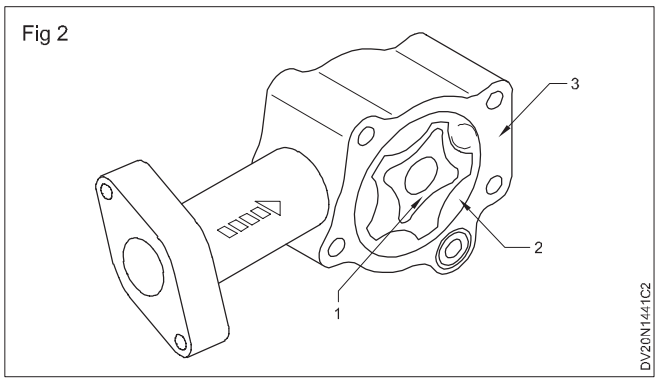
Fig 1



In this type two gears are fixed in the pump housing (1). The gears (2) have little clearance with the pump housing (1). When the gears rotate a vacuum is created in the casing. Oil is sucked through the inlet (3) and pumped to the oil gallery through the outlet (4).

Rotor type oil pump (Fig 2)

Fig 2



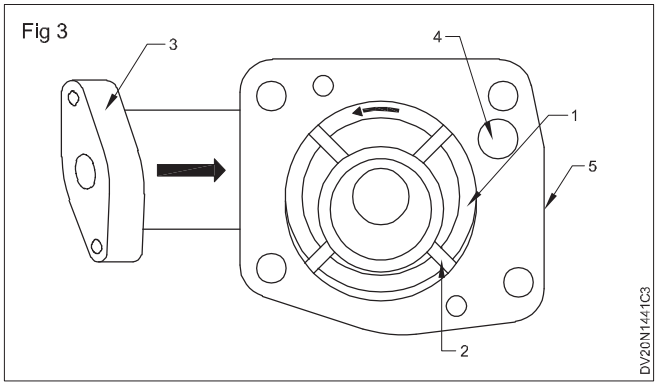
The rotor type oil pump consists of an inner driving rotor (1), and an outer drive rotor (2) which rotates freely in the pump housing (3) and runs eccentrically in relation to the inner rotor.

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The oil is sucked into the pump in the side where the volume between the rotor teeth increases and is pumped out on the side where the volume decreases.

Vane pump (Fig 3)

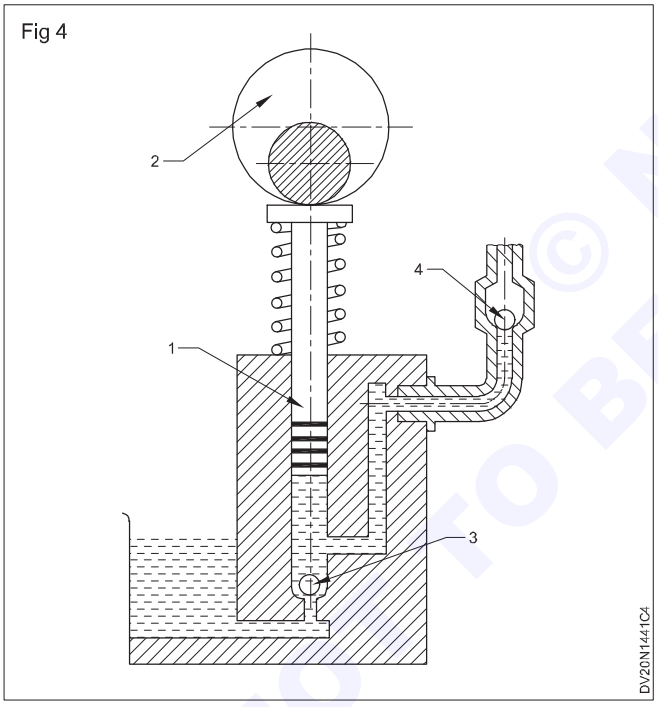
Fig 3



In the vane type pump the rotor (1) runs eccentrically in the pump housing (5). Spring- loaded vanes (2) slide against the pump housing walls. Suction us created by the vanes (2) when the rotor (1) rotates. Oil is sucked through the inlet duct (3) and discharged through the discharge duct (4).

Plunger type oil pump (Fig 4)

Fig 4



In this type of plunger (1) moves up and down in the cylinder. It is operated by a special eccentric cam (2). This pump has two non-return ball valves (3) & (4). These valves are spring-loaded balls. One of these is on the suction side (3).

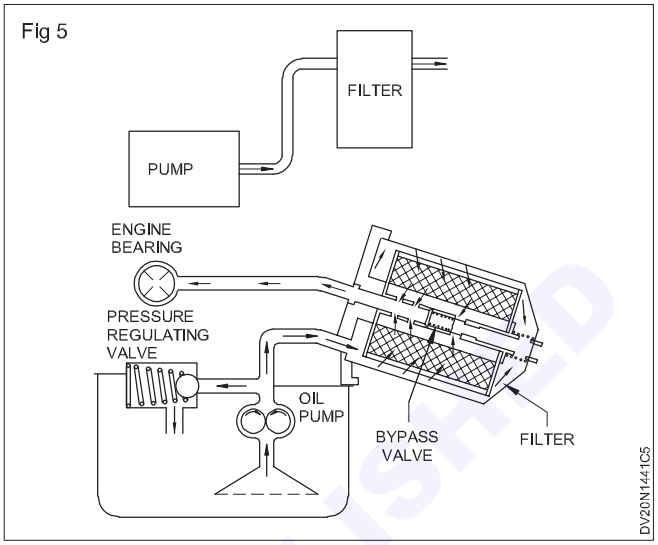
During the upward stroke the oil is sucked through the valve (3). During the downward stroke the non-return valve (3) closes. The other non-return valve (4) which is on the delivery side opens and permits the oil to flow out from the pump. This type of plunger pump is used in medium and high pressure lubricating systems.

Oil filter

Full flow oil filter system (Fig 5)

In this system all the oil passes through the filter before reaching the main oil gallery. One bypass valve is provided in the filter which allows oil to reach the main oil gallery directly if the filter is choked.

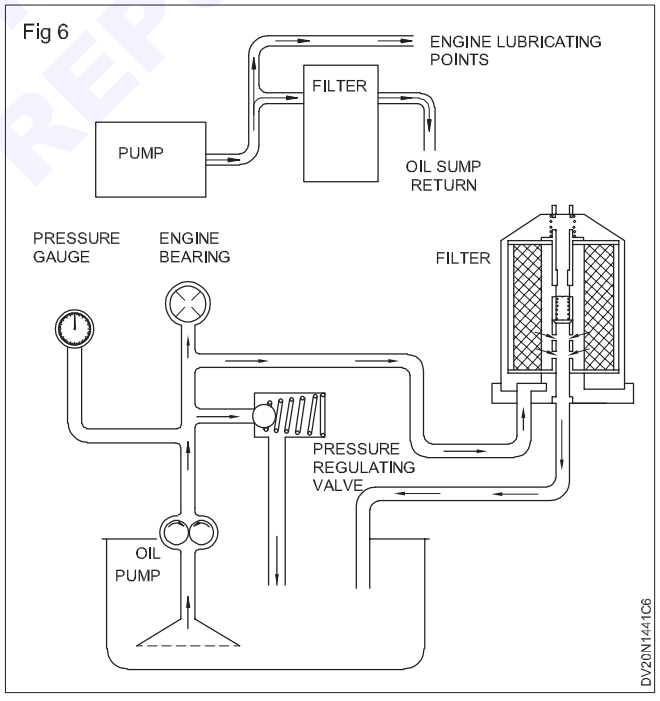
Fig 5



Bypass oil filter system (Fig 6)

In this system only a part of the engine oil enters the filter. After filtering, the oil goes to the oil sump. The remaining oil goes directly to the main oil gallery.

Fig 6



Filter element

Filter elements are made of felt, cotton waste, cloth and paper. Oil filters are replaced after certain kilometer's of running of the engine as specified by the manufacturer.

Oil coolers (Fig 7)

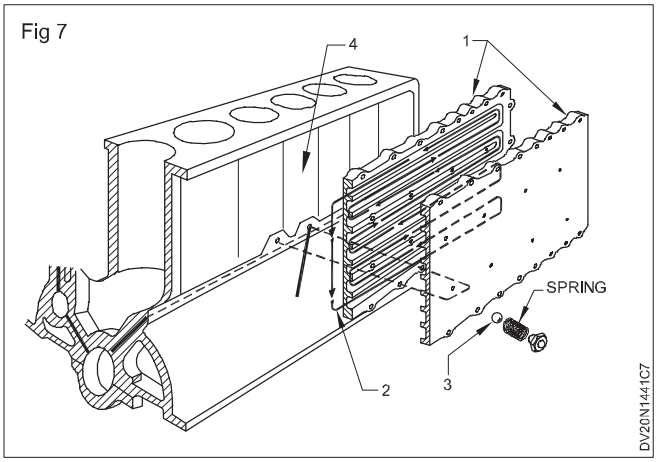
Oil cooler consists of two halves (1). Passages (2) are provided in between the cooler's halves for oil circulation. A ball valve (3) is provided to maintain the required oil

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pressure. This is made of cast iron. The purpose of the oil cooler is to transfer the heat from engine oil to cooling water and cool the engine oil.

The inner wall of the oil cooler is in contact with cooling water. The engine oil which is made to circulate through the passages provided in the oil cooler, transfers its heat to the cooling water circulating in engine block (4), and the inner wall of oil cooler. This maintains the temperature of the engine.

Fig 7



Oil cooler purpose (Fig 8)

The purpose of an oil cooler us to cool the lubricating oil in heavy duty engines where the oil temperature become quite high the oil must be kept cold in the lubricating system.

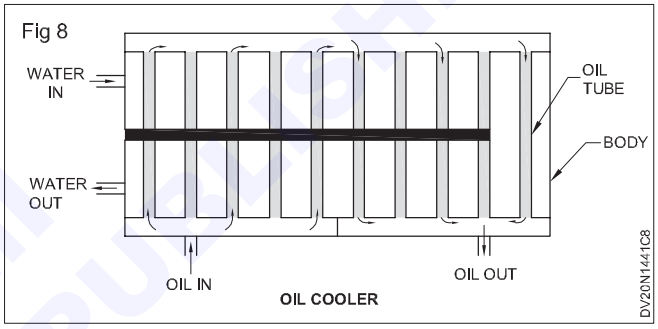
An oil cooler is just like a simple heat exchanger. The oil may be cooled in it either by cold water from the radiator. At the time of starting when the water is hotter that the oil, the oil is heated to provide complete circulation in the system. At higher temperatures, when the oil becomes hotter than water, the water cools the oil.

A water type oil cooler, simply consists of tubes in which oil circulates. The water circulates outside the tubes in the casing of the cooler. The heat of the oil is carries away by the circulating water.

Spurt holes and maingallory

The engine parts are lubricated under pressure feed. The oil pump takes the oil through oil strainer and delivers it at pressure of 2.4 kg/cm^2 to main gallory. Further the pressurized oil goes through different size of spurt holes to main bearing camshaft bearing cranks pin, rocker arm and valves, main gallory is act as hub for oil distribution to engine moveable working parts.

Fig 8



Lubricant

Objectives: At the end of this lesson you shall be able to
- **state the need of lubricating an engine**
- **list out the properties of lubricating oils**

Functions of a lubricant

The main function of a lubricant is to minimise the friction between two moving surfaces which are in contact with each other.

It also helps to

- absorb heat from the moving parts due to friction.
- Minimise wear and tear of the components.
- Provide a cushioning effect between the moving parts.
- Clean the parts by carrying away metal chips with it.
- Protect parts from corrosion.
- Prevent blow-by of gases by providing an oil film between the rings and the liner/bore.

Properties of a lubricant

- It should have viscosity to suit the operating conditions.
- The viscosity should remain the same in both hot and cold conditions.
- Its boiling temperature should be high.
- It should be corrosion-resistant.
- It should not develop foam.
- It should withstand critical operating pressure.

Viscosity

It is most important properties of lubricating oils for it determines their ability to flow. An oil with excessively high viscosity is very thick, and it is difficult for penetrate the clearance between the rubbing engine parts, while an oil with too low viscosity flows easily and does not stay in the clearances. So that the engine oil should be used as particular engine specifications and the season (plain area or high attitude area).

Oil additives

Any mineral oil by it self does not posses all the properties. The oil companies add a number of additives into the oil during the manufacturing process main oil additives

- Pour point depressants
- Oxidation inhibitors
- Corrosion and rust inhibitors
- Foaming resistance

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- Detergents depressants
- Extreme pressure resistance

Synthetic oil

- Synthetic oils are made from substances other than crude oil
- They can be made from vegetable oils

Types

1 Polyalkylene glycols and their derived

2 Silicon which are manufactured from coal and sand

Application

a This oil can provide longer service life, less friction and improved fuel economy than convention oil.

b It, costs is more than regular SAE graded oils.

SAE oil grade

When expected atmospheric temperature are-	Single viscosity graded oil	Multi viscosity graded oil
Below minus 10° F	SAE5W	SAEFW-20
Above minus 10° F	SAE10W	SAE10W-20, or SAE10W-30
Above plus 10° F	SAE20W	SAE 20W-30 or SAE10W-30
Above 32° F	SAE20 or 20 W SAE 30 Some manufacturers	SAE 20W-30 or SAE10W-30
Above 90° F	SAE 30 SAE 30 Some manufacturers	SAE 20W-30 or SAE 10W -30

Types of greases and greasing points

Objectives: At the end of this lesson you shall be able to
- **state the types of greases**
- **state the vehicle greasing points.**

Introduction to grease: Grease is used to keep the vehicle and their working components lubricated at all times. The different types of grease produce different results based on the unique properties they process.

Types of grease and their uses: There are many types of greases are available in the market . They are as follows.

Calcium grease : It is one of first grease and used for general use it is a multi purpose grease with a great water resistance good corrosion protection and greater mechanical stability. Calcium grease and calcium complex grease are used in Automotive and agricultural applications.

Lithium grease : It is used as multipurpose grease and suitable for variety of applications including automotive.

Aluminum complex grease: It can withstand extremely high temperatures, and it has impressive water resisting properties prevents rust, corrosion and oxidation and it has good shear stability.

Barium complex grease : It is mostly used in demanding heavy load applications such as industrial, aeronautical, marine and manufacturing industries.

Benton grease : It is a clay based lubricant developed with the help of bentonite clay , it is a non melt lubricant it is used in steel manufacturing, construction, mining and ceramic industry.

Poly urea grease: It is recommended for long lift applications and used across various industries, steel plants and electric motors.

Sodium grease : It has poor water resistance and oxidation stability mainly it is used for the lubrication of rolling contacts bearings. More over it is commonly mixed with other greases in an effect to produce grease of higher quality and value.

Note:

1 Power and manual grease gun is used to feed lubricate at grease nipple under air pressure or human manual pressure.

2 Base material of grease is base oil, additives, thickner. Base oil is used for lubrication thus reducing friction . Thickner is used for hold the oil like a sponge until it is used. Additives is used for boost and support base oil capacities.

Vehicle greasing points : Different vehicles have different grease points. Refer the vehicle owner's manual for correct vehicle grease points. For example truck

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grease points as follows

- Upper kingpins
- Lower kingpins
- Drag link
- Slack adjuster
- 'S' cam
- Tie rod ends
- Road spring pins
- Road spring shackles
- 5thwheel pivot & plate
- Clutch linkages
- Transmission parts

Greasing points in a car

- All four door hinges
- Bonnet rear lever
- Dicky rear door hinges
- Seat rails
- Battery terminals
- Steering linkages
- Clutch pilot bearing/ release bearing
- Cooling fan
- Wheel bearing
- Belt pulleys
- Alternator.

Vehicle maintenance schedule

The most common cause of damage or parts failure is lack of lubrication, but over lubrication is also dangerous. It is important to use right amount of lubricant at the right time in the right place of the vehicle. Poor lubrication also causes for metallic noise in addition to increase in wear rate.

The vehicle manufacturers mention the vehicle maintenance schedule in the vehicle owner's manual. The manual is a guidance of vehicle maintenance. The manual maintenance guide gives the following information

- Lubrication points of the vehicle
- Types of lubricants required for a particular lubrication point.
- Maintenance point.
- Maintenance period or interval after which to lubricate or change oil.
- Lubricant quantity and grade of lubricant required for different points.
- The grade of lubricant differ from season to season. region to region and climatic condition.

The vehicle maintenance are of two types

- Preventive maintenance
- Periodical maintenance

daily checks/maintenance/weekly maintenance monthly maintenance/yearly maintenance.

Preventive Maintenance

It is the care to prevent troubles which often lead to a major over haul, For trouble free working of the vehicle keep in view following points relating to preventive maintenance

- Clean the fuel line, fuel filter, fuel tank
- Flash out the cooling system
- Use the auto freezing of the cooler, water
- Use the lower viscosity oil during winter as prescribed by the manufacturer keeping to view the temperature.
- Keep the batteries well charged.
- Check up all joints and rectify immediately any leakage.
- If need touch up the points.
- Don't let water stay under the floor mat, but keep clean otherwise it rusts.
- Keep the head lamps rings tight , least water traps into the reflector and that leads to rusting.
- Replace the defective gaskets .
- Keep the engine warm during extreme cold temperatures by balancing the radiator with water proof curtain rather than cutting out fan.
- Mount the anti skid chains on the rear wheels of heavy vehicle to prevent skidding in ice land.

Periodic Maintenance

Periodic maintenance refers to activities performed on equipment based on a set time interval. The purpose of periodic maintenance or time based maintenance is to maintain smooth operation of a machine. Wear and tear in equipment is un avoidable even though the periodic maintenance increases the equipment's life. The periodic maintenance activities are planned a head of time and performed regardless of whether signs of deterioration are prevalent. Time based maintenance usually solve replacement and repair replacement problems for example include

- Changing lubricating oil
- Changing/ checking bearing grease
- Replacing oil, fuel filters
- Cleaning up corrosion
- Checking pressure/ temperature gauges.

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Periodic Maintenance carried by the following methods

1 Pack method is used to lubricate ,it is packed over the bearing surface.

2 Direct pouring method is used to directly filled into machine housing.

3 Hand operating gun is used to grease/oil is pumped out to particular. spot/ space.

4 Simple grease gun method is employed to feed grease through grease nipple.

5 Power lubrication method is used to lubricate under air pressure.

6 Automatic lubrication method is used for feeding lubrication automatically to all points.

Cleaning, Inspection and Adjustments

The vehicle manufacturer provide instruction manuals and charts to carry out the job systematically maintenance instructions should be strictly followed to carry out the periodic maintenance

for example

Every 500 km

Check water level in radiator Add water if water is low if water level is very low and the engine is rather warm, do not pour in cold water , when temperature drops to 0 degree C change to anti freeze mixture.

In case of refilling water in the radiator, pull up cook control knob of heater radiator, fill water in radiator to maximum level, run the engine at idle speed for few minutes and then top up at once more.

Every 1000 km

Check electrolyte level with battery at rest and cold. Add distilled water upto 5mm above separators if necessary.

Every 6000 km

- Remove the filter gauge from oil delivery filter and wash it in kerosene. When the engine is new, the filter must be cleaned after 5,500- 6,500 km.
- Replace cartridge of bypass oil filter after every two oil renewals. When engine is new, the cartridge must be replaced after first 5,500- 6,500km.
- Check up fan belt tension, adjust if necessary. Belt sag is 1-1.5 cm when under a pressure of 10 kg.
- Checkup C.B point gap which should be 0.42 -0.48 mm. Adjust if necessary, by sliding the stationary C.B carrier plate after slackening the screw. Relock screw after adjustment.
- Check the condition of the spark plugs. Clean and adjust gap at 7mm.
- Check level of brake fluid in master cylinder and add fluid if required.
- Check battery terminals qqand clamps for tightness and cleanliness. Coat them with pure copy Vaseline.
- Remove air cleaner rear cover and clean cartridge with air under pressure. If restriction is excessive replace.
- Exchange tyres in crisscross manner to ensure long life and equalize wear.

Every 12000 km

- Replace air cleaner cartridge. Industry condition clean and replace cartridge more often.
- Checkup clutch pedal free play which should be 15 to 20 mm. Adjust if necessary.
- Check up and adjust brake shoes.
- Inspect shock absorbers. Add shock absorber fluid if necessary.
- Inspect, clean and lubricate. ball articulations of steering rods.
- Check up front wheel bearing. Adjust if necessary.

Every 24,000 km

- Clean generator commutator. Check brushes for wear and contact conditions and replace if necessary.
- Inspect the entire valve gear. Replace valve sets and decarbonize combustion chambers.
- Check up water pump seal and replace if necessary.
- Check up the operation of thermo stat valve. It should open only when the coolant temperature reaches 80 degrees 87 degrees C.
- Check the differential bearings and final drive gears and adjust if necessary.
- Clean self starter commutator. Check wear and contact conditions of brushes and replace if necessary.

Occasional inspections

- Check idle speed of the engine,and if necessary, correct idle running adjustment. Inspect and clean all carburrator parts if required.
- Check back lash in steering gear. Adjust if necessary.
- Check worn screw roller bearings and adjust by removing shims between lower cover and box

Maintenance schedule differs from vehicle to vehicle. Hence particular instructions should be followed for the vehicle for which they are meant. Maintenance is done period wise or on the basis of mileage..Period wise maintenance is split up into different periods such as weekly,monthly, quarterly, half yearly, yearly etc.. Daily checks are usually under :

- Check engine oil level
- Check water level in the radiator
- Check fan bet tension
- Check air cleaner
- Check tyre pressure
- Check brake pedal toe board clearance

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- Check clutch pedal toe board clearance
- Check tightness of wheel nuts
- Check lights and horns.
- Check tools and equipments.

Check your safety and maintenance

The following checklist for daily, weekly, monthly and seasonal checkups will help you to drive more confidence and will extend the life and safety of your vehicle.

Daily

- Check the outside of the vehicle for body trim damage, cracked lights or windows and worn out tyres.
- Check under the vehicle for spots under the radiator, oil pan or transmission. Be sure to put on the emergency brake and block the tyres before getting under the vehicle.
- Check inside the vehicle. Are mirrors, safety belts, lights, door latches and dash board gauges functioning properly.? adjust mirrors as needed.

Weekly

- Be sure to this check with engine off and cool and the car on level ground, or you can have it done at a service station with every other fill up.
- Check the oil, when adding oil, use the type recommended in your owner's manual.
- Check the coolant in the radiator reservoir or in the radiator itself if your vehicle has no over flow reservoir. Remove the radiator cap only when the engine is cool.
- Look under the hood for anything cracked, loose or leaking.
- Keep track of your fuel consumption. If miles per gallon goes down significantly. Its time for a tune-up and repairs.
- Check the pressure before driving, While tyres are cold. For safety and better gas mileage, keep tires including the spare - Inflated to the pressure recommended in your manual.
- Check brake lights by looking at reflections in store windows or against a wall.

Monthly

- D o this every month or every 1,000 km when the engine is off and cool.
- Check all fluid levels - Oil. coolant, brake fluid power steering fluid and wind shield washer fluid. Check automatic transmission fluid with the engine running at normal temperature and the transmission in "park".
- Look for cracks, loose connections and signs of wear in the radiator, heater and air conditioner hoses, as well as the vacuum hoses and fuel lines.
- Check the battery fluid for frayed edges, cracks splits or looseness.
- Look for loose wire connections or worn insulation.
- Be sure all lights and gauges are functioning properly, inside the vehicle and out.
- Recharge the air conditioner by running it for a few minutes, in the months when you are not normally using it.

Seasonal

Have a professional make the following checks in spring and fall

- Look for abnormal or excessive wear in tyres. Align wheels or replace tyres if needed. Rotate tyres. Mount or remove snow tyres. Make sure jacks works.
- Check coolant and hoses. Drain and flush the radiator.
- Test the battery charge and fluid level.
- Check wind shield wipers and replace worn out blades. In the fall start using winter blades.
- Make sure the heater and defroster operate properly.

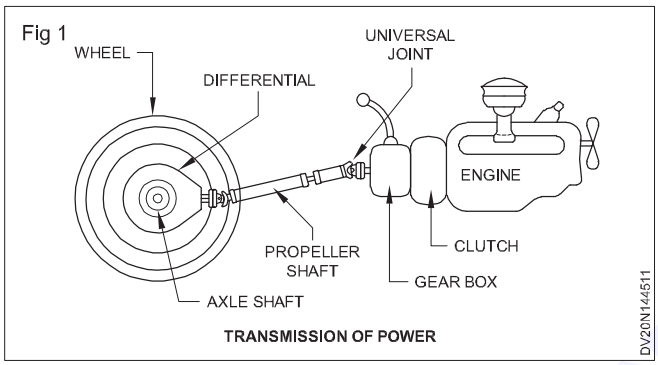
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Transmission system

Objectives : At the end of this lesson you shall be to
- **state the layout of power flow from engine to wheel**
- **state the clutch types and their function**
- **state the function of gear box and their types**
- **state the automatic transmission and automated manual transmission**
- **state the propeller shaft and differential.**

Lay out of power flow Fig 1 : In an automobile, engine is a prime source of power generation. Which power produced by engine is stored in fly wheel. The torque developed by the engine is transmitted to the drive wheels through the transmission system to propel the vehicle.

Fig 1

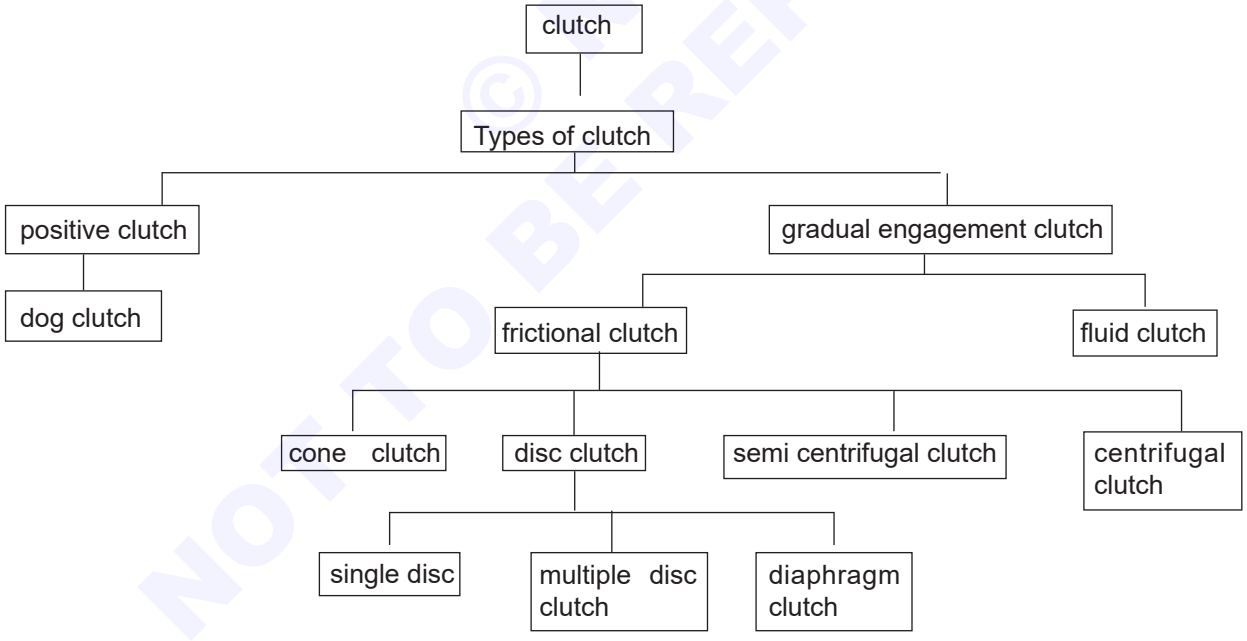


TRANSMISSION OF POWER

When the torque reaches the road wheels it acts as a attractive effort to drive the wheels.

Purpose of clutch

It is a mechanism by means of which engine is connected or disconnected from the rest of the transmission



Function of the clutch: Automobile clutch is used for connect and disconnect the engine power to transmission smoothly and gradually without effecting the other components. Torque transmission by clutch depends upon the

- Size of the clutch plate
- Co-efficient of friction
- Spring pressure and number of clutch plates used.

Types of clutch actuation

There are two types of clutch actuation

- Mechanical actuation
- Hydraulic actuation

Knowledge of clutch play

In an automobile engine, there is a mechanical device that allows the engine to work at stationary position. The component engages power transmission especially

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from driving shaft to the driven shaft. In other words clutch connects and de connects the two rotating shafts.

Clutch pedal free play is the slack provided before the actual clutch operation start, the distance till which you press the clutch pedal. and the clutch pedal feels light is called clutch pedal free play. It should not be too low or high, generally it is about 40mm in a car. It is the actual space between release bearing and clutch pressure plate fingers tip.

Types of gear box

An automobile gear box is used to get different torques and speeds, which are required to overcome the following

1 Road resistance
2 Air resistance
3 Gradient resistance
4 load on vehicle

By engaging different gears, engine torque is increased while speed is decreased. In top gear the rpm and torque of the engine and gear box remain the same.

Types of gear boxes : There are many types of gear boxes used in an automobile vehicle. certain types of gear boxes are as follows.

1 Sliding mesh gear box (by gear shape) (Fig 2)
2 Consistent mesh gear box (by gear shape) (Fig 3)
3 Synchro. mesh Gear box (By gear shape) (Fig 4)
4 Automatic gear box (by Operation shape) (Fig 5)

Fig 3

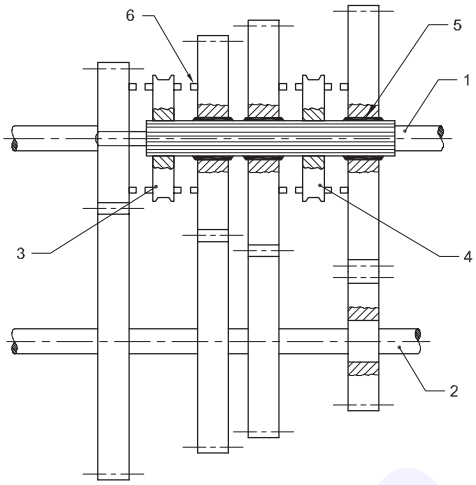
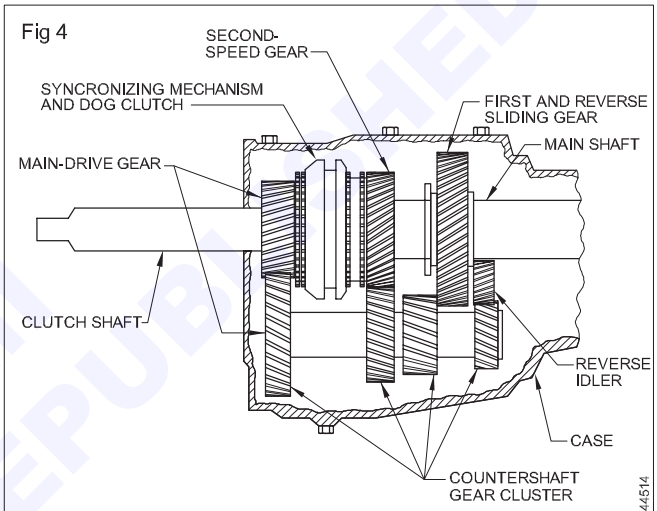


Fig 4



THREE SPEED AND REVERSE TRANSMISSION WITH SYNCRONISING MECHANISM GEAR BOX

Fig 2

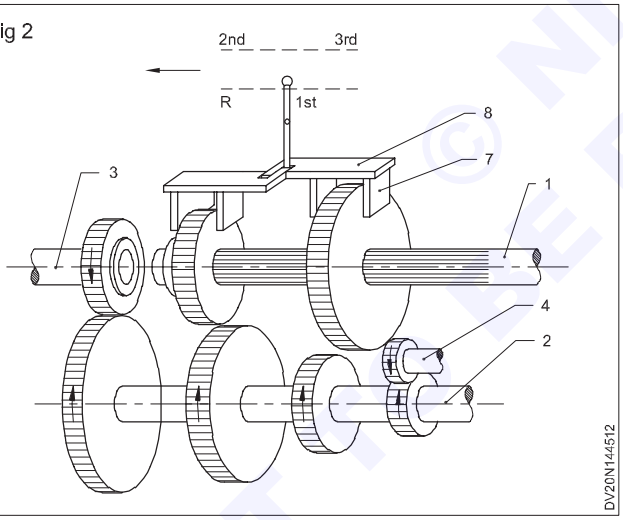
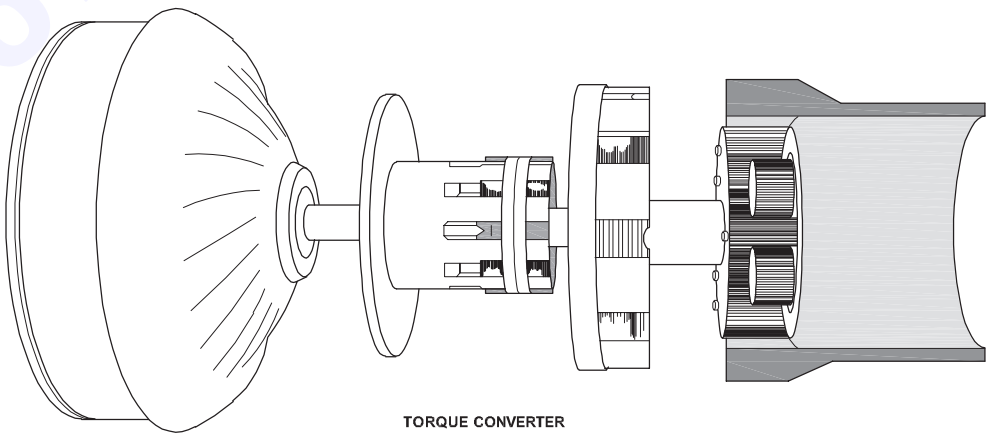


Fig 5



TORQUE CONVERTER

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Gear shifting procedures: Sit on the vehicle driver seat , study the gear lever gear positions. Start the vehicle engine and release the parking brake. Follow the correct sequence for changing gear is as follows

- Make sure that it is safe to change gear at any place, when it is necessary to use both hands to steer the car, such as corner or bend.
- Ease off the accelerator pedal just prior to depressing the clutch pedal. The two actions are almost simultaneous .
- Press the clutch pedal and select the appropriate gear by using your left hand, while being careful to look ahead and not at the gear lever.
- Release the clutch pedal just prior to the reapplying pressure to the accelerator pedal your right foot. Again clutch and accelerator pedal actions are almost simultaneous.
- This above procedure will dramatically reduce the power being transmitted from the engine to the gear box enabling you to select a gear without causing any damage to the gear mechanism.

Common defects in clutch: Clutch defects happen due to weak material, bad workmanship, bad clutch operation etc. common defects are as follows

- Low or high clutch pedal free play
- Half clutch operation
- Clutch plate worn out
- Clutch rattling
- Worn release bearing
- Clutch pedal returning spring weak
- Worn release fork
- Clutch plate hub rivet loose/ broken.
- Clutch pedal bend.

Common defects in manual gear box

A gear box is a mechanical unit that contains a series of consolidated gears within the enclosure. It is used to transfer energy from one instrument to another. These gear box may be chance to various defects by the following causes.

Causes for inadequate lubrication of gears the following defects

- Gear noise
- Gear worn out
- Gear teeth broken
- Gear box oil spillage
- Grinding noise and buzzing during gear shifts
- Difficult in gear shifting
- Gear slipping
- Gear oil burning smell
- Gear box mounting loose.

Knowledge on automatic transmission (Fig 5)

Automobile automatic transmission is defines as to shift gears automatically depending upon the speed and load of the vehicle. The automatic clutch is used to engage and dis engage the engine and transmission power. It allows the engine to run idle, When the vehicle is standing idle. Automatic gear box gear selection, timing and engagement of gear speed are accomplished automatically, when accelerator is pressed or depressed. Automatic transmission need no gear change lever and clutch pedal.

Major automatic transmission components: This transmission is operated hydraulically and is often known as automatic transmission. This transmission employ the following components

- Torque converter
- Fluid coupling
- Planetary gear unit
- Electro hydraulic control
- The torque converter is mounted on the transmission input shaft and connected with the fly wheel of the engine.

Functions of the torque converter

- it converts and transmits the engine torque
- It facilitates smooth, comfortable starting
- It damp the engine torsional vibrations
- The major components of torque converter are
- Impeller
- Turbine
- Stator

The impeller, turbine wheel and stator are designed as curved blade wheels and operate in an enclosed housing which is filled with hydraulic fluid.

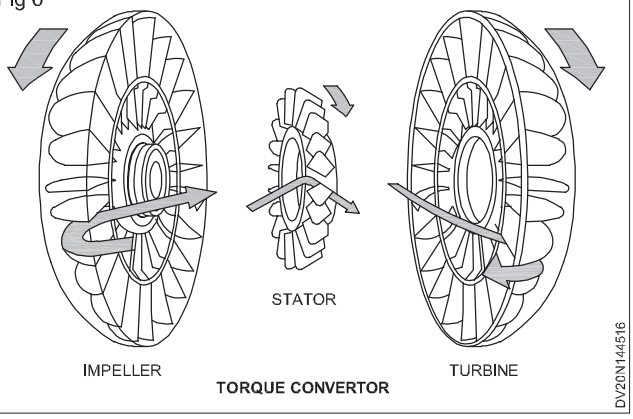
The impeller is driven by the engine flywheel. Guide rings are provided on the inner edges of the vanes to provide smooth fluid flow. When the impeller is driven by the engine, the centrifugal force causes the fluid to flow outward towards the turbine.

The input shaft of the transmission is attached with the turbine hub which is splined. The curvature of the vanes in the turbine is opposite of the impeller vanes. This makes the turbine to rotate when the fluid is forced from the impeller vanes. Therefore the turbine also starts rotating the direction of engine rotation (Fig 6)

The stator is located in between the impeller and the turbine. It is mounted on the reaction shaft which is fitted to transmission case. The vanes of the stator catch the fluid as it leaves the turbine and redirects it back to the impeller. This gives the impeller an added torque.

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Fig 6



The over running clutch drive in the stator allows the stator to rotate in one direction. Normally it rotates in the direction of the crankshaft. The over running clutch drive does not allow the stator to rotare in opposite direction.

Advantages of Automatic transmission

- Simple driving control
- Improved acceleration and hill climbing
- Reduced fuel consumption
- Less wear and tear due to planetary gearing
- Less fatigue to the operator
- No need clutch pedal and gear lever
- Vehicle smooth running under all conditions due to automatic gear change.
- Noiseless gear shifting
- Longer life
- No jerky driving.

Automated manual transmission: Nowadays automated manual transmission gear box is used in modern cars. This type of gear box is constructed for work as automatic gear change depend upon accelerator pedal pressure. As well as this gear box gear position can change to operate by driver manually.

The automated gear manual gear boxes are fully automatic in which conventional 5 or 6 speed manual gear boxes with clutches are automatically shifted. The automated gear box with

- Diaphragm spring clutch
- Spur gears
- The gear ratio change is stepped

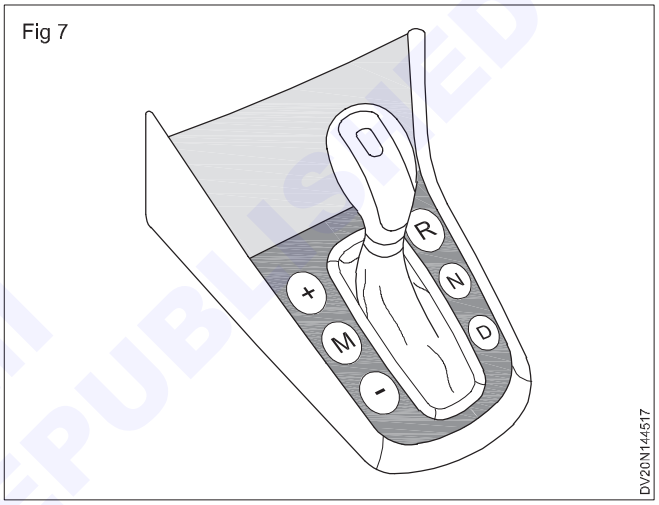
The automated manual transmission uses hydraulic and computers linked with the electronic control unit ECU of the vehicle. The gear shift patterns are preprogrammed on the ECU and work mainly on the preset revolutions per minute range.

The AMT uses the exact same gear and clutch set up as seen in a manual transmission. The AMT transmission has a hydraulic accelerator system mounted inside the gear box, Which operates clutch and gear. The actuators of the AMT system are linked to the ECU of the vehicle. Which gives it the inputs and the output goes to the gears and clutch.

The gear shift pattern is pre-programmed from the factory and that data is stored by the ECU, so whenever the RPM climbs to a certain level, the ECU automatically controls the actuator to operate both the clutch and gear box in synchronization. Although in most of the vehicle have a gear box lever with three drive modes. R(Reverse), N (Neutral) and D (drive) there is also an option of shifting into manual mode just parallel to drive mode.

In the manual mode, the gear operation is significantly simple, move the lever forward to shift into a higher gear and move it backwards to shift into a lower gear mode , no clutch and no multi-directional shift paths. (Fig 7)

Fig 7

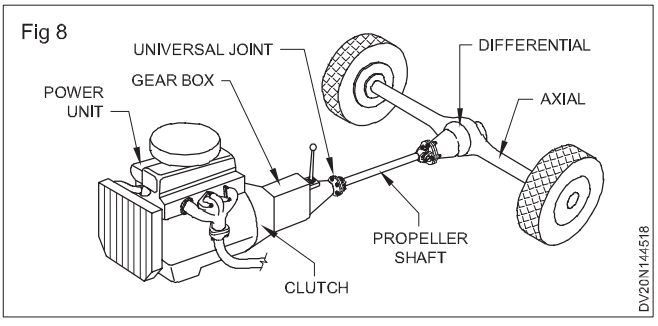


An AMT is composed of a dry clutch, gear box and an embedded dedicated control system that uses electronic sensors, processor and actuation to actuate gear shifts on the driver's command.This removes the need for a clutch pedal.while the driver is still able to decide,when to change the gear.The clutch itself is actuated by electronic equipment that can synchronize the timing and the torque required to make gear shifts. quick and smooth. This system designed to provide a better driving experience.

Propeller shafts: The propeller shaft transmits the drive from the gear box mainshaft to the differential unit. The propeller is long so it is made of tubular section and balanced to reduce vibration.

A shaft connecting the final drive to an independent spring driving road wheels is called a drive shaft that are short in length so a solid shaft is used for compactness. (Fig 8)

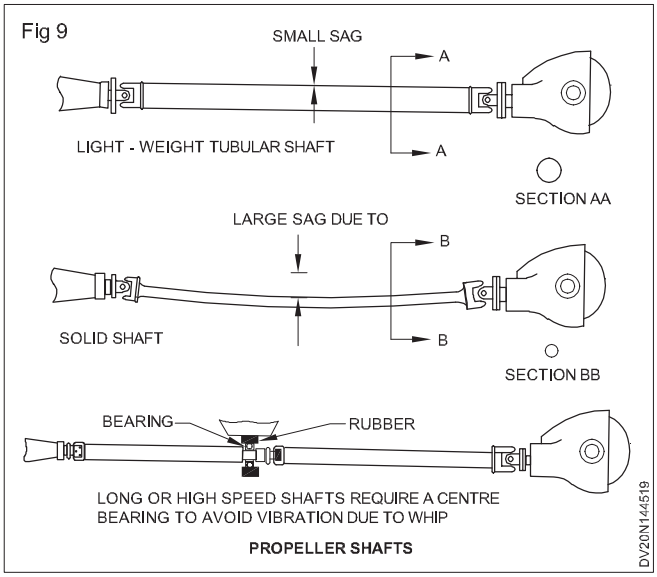
Fig 8



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Function of propeller shaft (Fig 9): The propeller shaft connects the gear box and final drive. The pinion shaft of differential is connected to propeller shaft. One universal joint is used in between the propeller shaft and pinion shaft of the differential. Another universal joint with one slip joint is also used between the propeller shaft and the gear box and rear axle is very long, more than one propeller shaft is used for torque transmission. Center bearing is used to connect the two propeller shaft.

Fig 9



PROPELLER SHAFTS

Universal joints: (Fig.10, 11, 12)

Fig 10

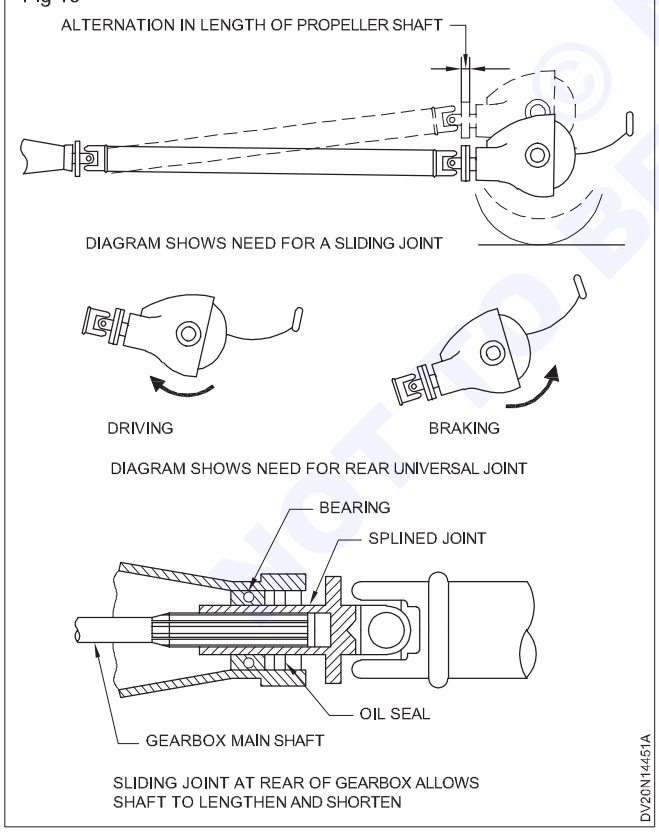


Fig 11

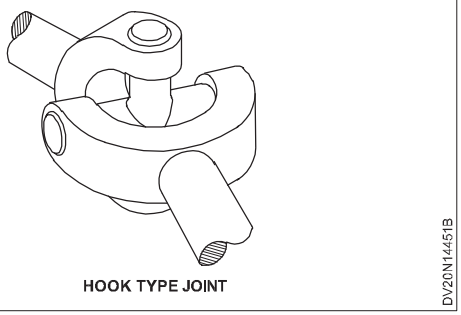
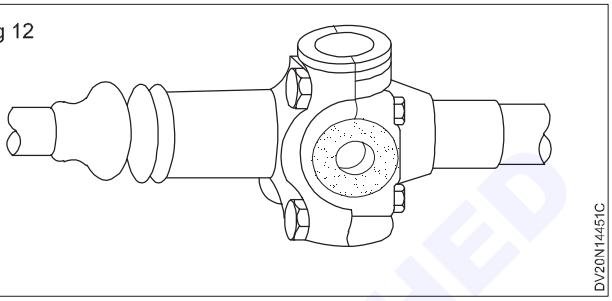


Fig 12



Universal joint is a device to transmit the drive through a varying angle.

Axle movement due to bumps on the road cause distance between the gear box and rear axle to alter, a sliding splined joint or flexibility within the joint must be provided to allow this.

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Final drive

Objectives: At the end of this lesson you shall be able to
- **state the function of the differential**
- **state the internal parts of differential**
- **state the need for the differential.**

Final Drive (Differential) - function

The final drive serves two purposes.

- It transmits power at a right angle.
- It increases the torque by reducing the speed.

Types of differential

1 Conventional

2 Power or Non-slip

3 Double reduction type

Internal parts of differential (Figs 1 & 2)

Fig 1

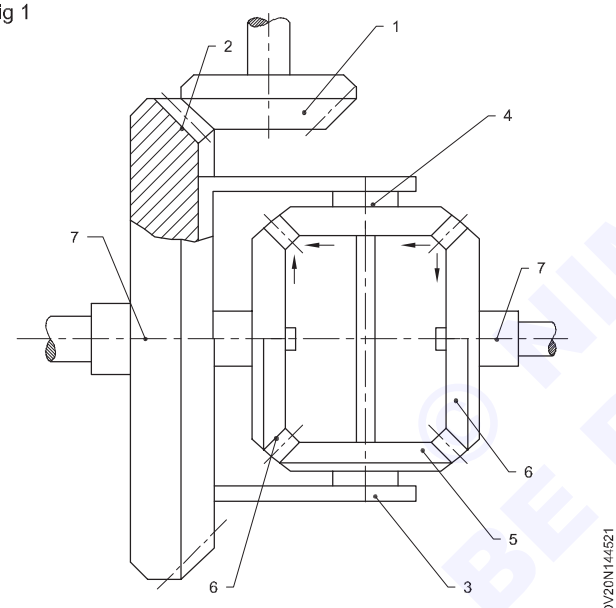
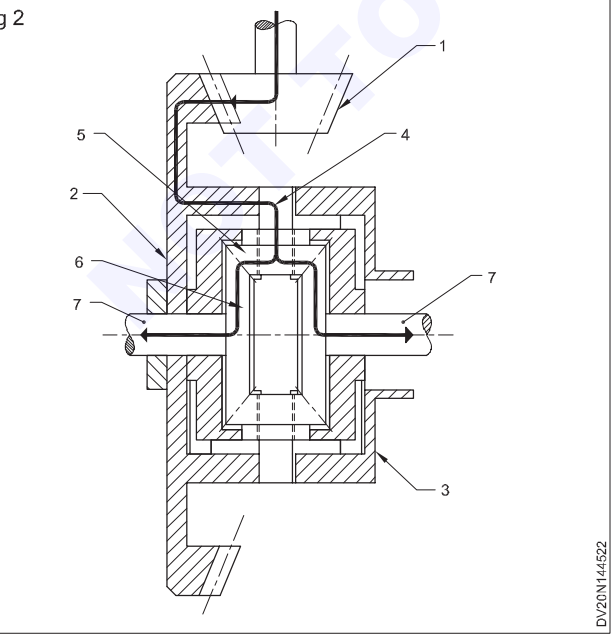


Fig 2

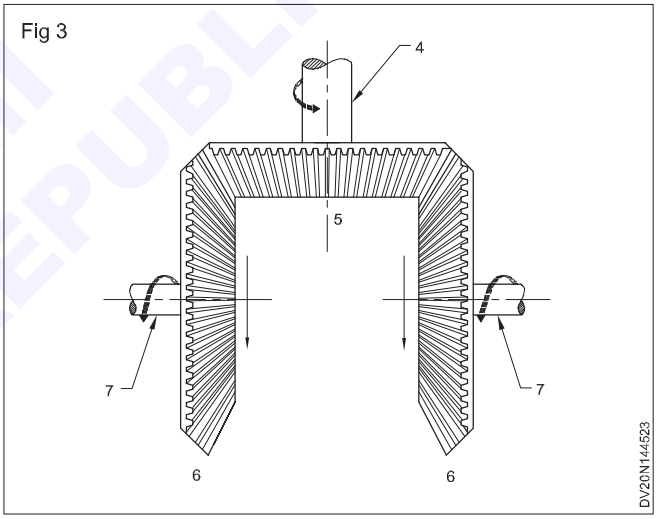


The final drive consists of a pinion (1) crown wheel (2) and a differential cage (3). Inside the cage the spider-cross (4) with planetary gears (5) are assembled. Also two sun gears (6) are assembled on both sides of the planetary gears (5). The sun gears (6) have internal splines in which the axle shaft's (7) spline end sits.

The crown wheel is fixed on the cage (3). The axle shaft's splined end is fixed to the sun gears and the other end is bolted to the wheel hub.

When the vehicle is moving straight, (Fig 3) the power is transmitted from the pinion (1) to the crown wheel (2) and to the cage (3). When the cage (3) is rotating the spider (4) also rotates along with the star gears (5). The sun gears (6) are pushed by the star gears, and power is transmitted to the axle shafts(7). During a straight line run the star gears (5) do not rotate on their axis.

Fig 3

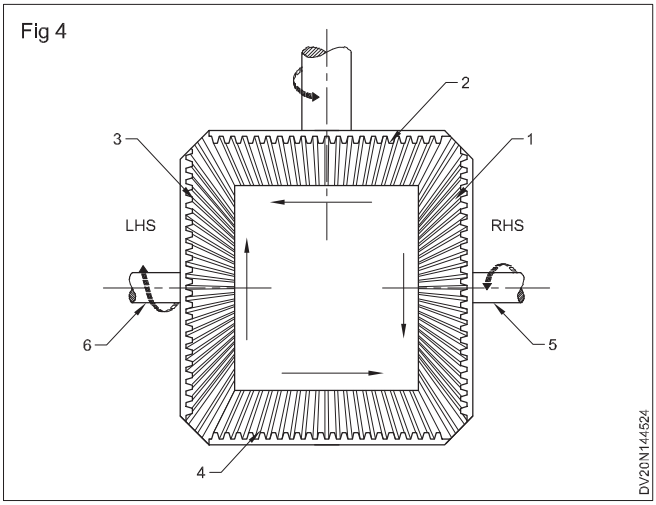


Need for the differential

When the vehicle makes a turn (Fig 4), the inner wheel has more grip on the road than the outer wheel. So the respective inner sun gear (6) offers more resistance. At that time, the star gears (5) rotate on their own axis and move the inner sun gear slowly and allow the outer sun gear to rotate faster. So the outer wheel travels more distance in the same time.

To examine differential action, raise the rear axle assembly till both wheels clearly ground and support them on two jacks. Rotate RHS wheel by 1 turn in forward direction. You will observe LHS wheel runs in opposite direction by 1 turn. While taking a LHS turn the outer wheel has to travel longer distance and turn several turn etc. compared to left wheel. This is how the differential turns is achieved between the inner and outer wheels.

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Limited slip differential

A limited slip differential (LSD) in a type of differential that allows its two output shafts to rotate at different speed but limit the maximum difference between the two shaft.

Working of a Limited Slip Differential

Limited slip differentials(LSD) are used in automobile to overcome the traction difference problem of drive wheels. A vehicle fitted with a standard differential moves straight, and one drive wheel is on a surface with good traction and the other wheel is on a slippery track. In a standard differential the left and right axle rotations are completely independent. Since one wheel is on a slippery track, the standard differential will make that wheel spin in excessive speed, while the good traction wheel will remain almost dead. This means high power supply to the slippery wheel and low power flow to the good traction wheel. So the vehicle won't be able to move.

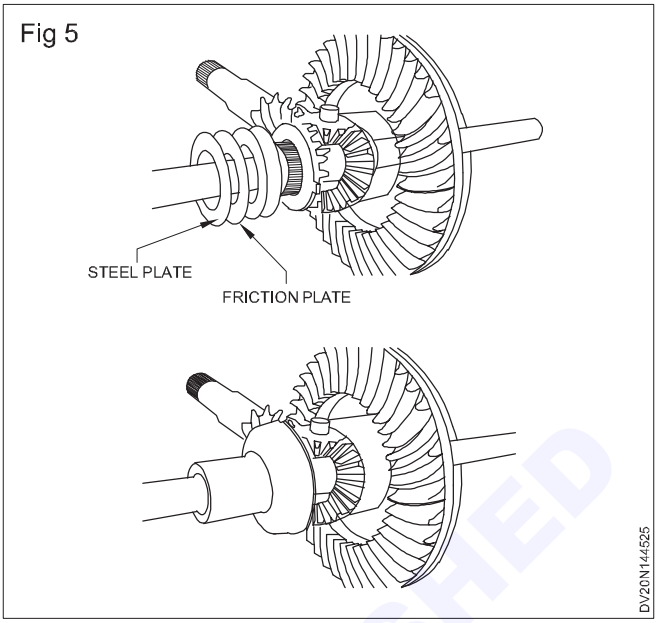
One way to overcome this problem is to limit the independency or relative motion between the left and right axles. Limited slip differentials are introduced for this purpose. One of the most commonly used LSD technology is clutch-pack based.

Constructional Features of LSD

The basic components of a standard differential are shown below. It has got pinion gear, ring gear, case, spider gears and side gears.

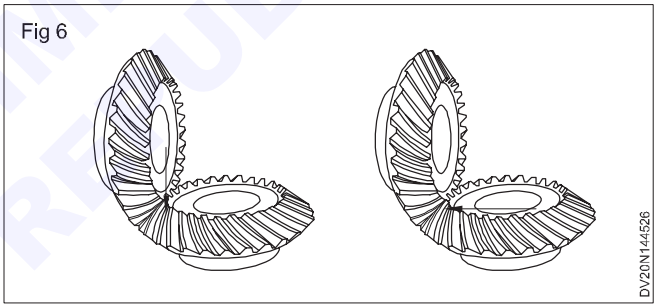
Apart from its basic components a Limited slip differential has got a series of friction and steel plates packed between the side gear and the casing. Friction discs are having internal teeth and they are locked with the splines of the side gear. So the friction discs and the side gear will always move together. (Fig 5)

Steels plates are having external tabs and are made to fit in the case groove. So they can rotate with the case. If any of the clutch pack assembly is well pressed, the frictional force within them will make it move as a single solid unit. Since steel plates are locked with the case and friction discs with the side gear, in a well pressed clutch pack casing and the clutch pack will move together. Or motion from the casing is directly passed to the corresponding axle.



Space between the side gears is fitted with a pre-load spring. Pre load spring will always give a thrust force and will press clutch pack together.

Separating action of Bevel gears (Fig 6)



Spider and side gear are bevel gears. It has got one specialty. When torque is transmitted through a bevel gear system axial forces are also induced apart from the tangential force. The axial force tries to separate out the gears. Side gear and axle are 2 separate units. The side gear has got a small allowance for axial movement.

So during high torque transmission through spider-side gear arrangement, a high separating thrust force is also transmitted to the clutch pack. This force presses and locks the clutch pack assembly against wall of the casing.

Since one wheel is on a high traction surface, the torque transmitted to it will be higher. So the thrust force developed due to the bevel gear separation action also will be high at that side. Thus clutch pack at high traction wheel side will be pressed firmly and clutch pack will be locked. So power from the differential casing will flow directly to high traction axle via clutch pack assembly.

On the other hand clutch pack on the low traction wheel side is not engaged yet, so power flow will be limited to that side. So the vehicle will be able to overcome the traction difference problem.

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However while taking a turn the LSD can act like a normal differential. In this case thrust force developed due to bevel gear separation action won't be that high. So the plates in clutch pack will easily overcome frictional resistance and will be able to slip against each other. Thus the right and left wheel can have different speed just like an open differential.

Four wheel drive

Objectives: At the end of this lesson you shall be able to
- **explain the necessity of a four wheel drive**
- **explain the purpose of the transfer case**
- **explain the operations of a four wheel drive**
- **explain the shifting mechanism in the transfer case.**

Necessity of a four wheel drive

In the four wheel drive mechanism, there is provision to supply power to all the four wheels, whenever it is needed. When the vehicle is moving on sand, slushy ground, traction between wheels and road is lost and the drive wheel tends to slip on the ground. In this condition, the vehicle cannot be pushed. Therefore, power is transmitted to other wheels also through the transfer case.

Purpose of transfer case

The transfer case is mounted in the back of the main transmission. It is sometimes called auxiliary gearbox.

The transfer case can transmit engine power either only to the rear wheels of the vehicle or to all the four wheels according to the driving requirements.

The transfer case can also provide low or high speed transmission.

A low speed transmission drive is mostly used when moving with the heavy load requiring high traction torque.

Operation of transfer case (Four wheel drive)

The transfer case consists of a main shaft (9) on which the low range gear (4) and the high range gear (3) are fixed. These gears rotate freely on bushes. The sliding gear (5) slides on the main shaft. An idler gear shaft (1) is fixed between the main shaft and the rear differential drive shaft (10) and the front differential drive shaft (11). A clutch locking drive gear (12) is fixed on the front differential drive shaft (11).

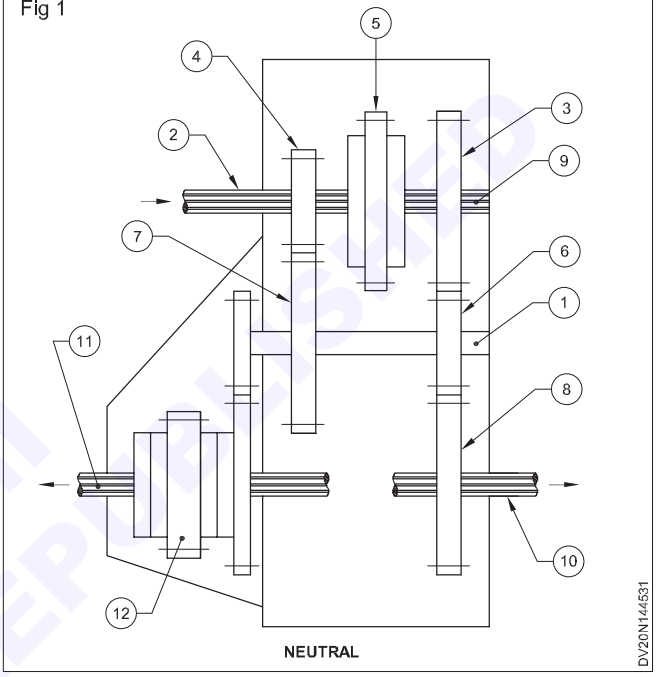
During neutral position, (Fig 1) the sliding gear (5) and clutch drive gear (12) are not engaged with their respective gears and power is not supplied to the front and rear wheels.

When power is to be supplied to the rear wheels only, the front drive clutch gear is kept in neutral position and the sliding gear (5) on the main shaft is engaged to low or high range gears (4) or (3), depending upon the requirements. In this condition, power flows only to the rear axle.

When a vehicle is driven over slushy ground the drive wheels tend to spin without moving the vehicle.

In this position, the clutch drive gear to front wheels is engaged. Now power will be supplied to all the four wheels.

Fig 1



When the lever is shifted to engage a high range four wheel drive position, the drive from the primary gearbox shaft (2) goes to the main shaft (9). The main shaft's sliding gear (5) engages with the high range gear (3) (Fig 2) and power is transmitted to the front wheel's drive output shaft (11) and the rear wheel's output shaft (10) through the idler gears. (Fig 2)

When the lever is shifted to engage the low range four wheel drive position, the drive from the primary gear shaft (2) goes to the main shaft (9). The main shaft's sliding gear (5) engages with the low range gear (4) (Fig 3) and transmits the drive to the output shafts of the front and rear drive shafts (10 & 11) through the idler gears.

Shifting mechanism in four wheel drive

The transfer case is provided with a shift mechanism to operate the four-wheel drive mechanism.

A gear shifting lever is provided in the driver's cabin and it is connected to a clutch locking drive gear of the first gear through a shifting rod and fork. Similarly another lever is provided to engage the sliding gear (5) with low range or high range gears, and is connected with the sliding gear through the shifting fork and rod.

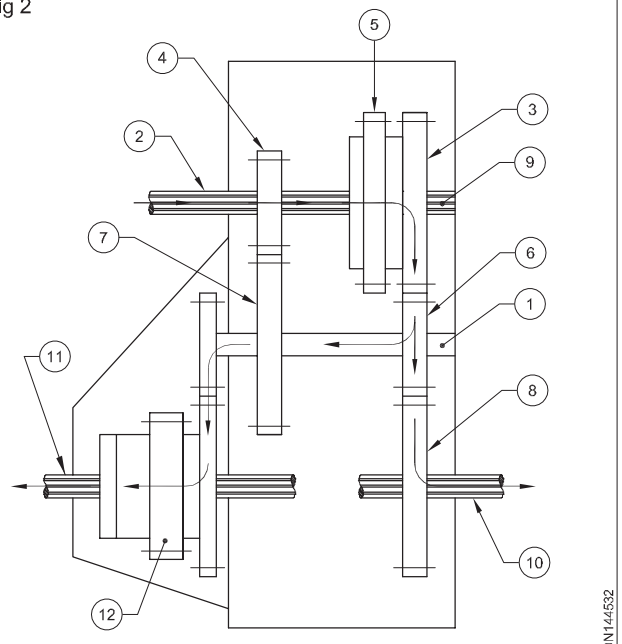
Differential & transfer case

Vehicles are equipped with at least one differential and some also have a transfer case. Each need to work

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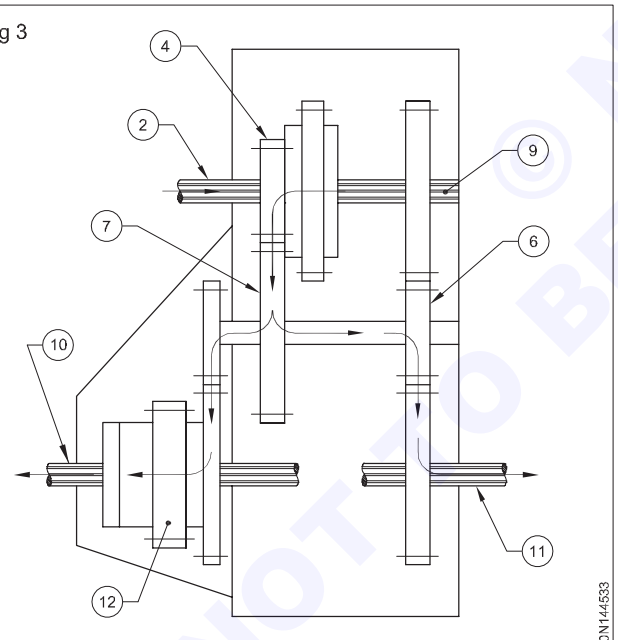
efficiently in order transfer torque from the transmission to the wheels. A four-wheel drive (4WD) and an all-wheel drive (AWD) vehicle, however, needs a ransfer case in addition to differentials on each axle. While both operate similarly, there is a difference between transfer case and differential.

Fig 2



HIGH RANGE FOUR WHEEL DRIVE

Fig 3



LOW RANGE FOUR WHEEL DRIVE

Differential

As part of the front and/or rear axle assembly, the differential is designed to drive wheels while allowing them to rotate at different speeds when turning by providing proportional rpms between the left and right wheels. The power from both the engine and transmission is directed through the differential and out to the wheels.

Transfer case

The transfer case is located between the transmission and front and rear differentials via the drive shafts, creating a two-wheel drive (2WD) or four-wheel drive vehicle. On a four-wheel or all-wheel dirve (AWD) vehicle, it directs power to two or four wheels. When the transfer case engages the front shaft, which feeds power to the front wheels, the vehicle then becomes a four-wheel drive. All-wheel drive vehicles receive power through the transfer case at all times. Each vehicle has a different setup. Pick-up trucks have two-wheel and four-wheel drive options, some crossovers have an option of all-wheel or two-wheel drive, while some SUVs have an option of all-wheel drive. Performace vehicles also are available in 2-wheel or all-wheel drives. Four wheel and all-wheel drive options offer better traction and maneuverability for steep roads.

The transfer case with its neutral, high and low ratio selection and choice of two or four wheel drive is generally operated by a floor mounted lever. This lever is normally located near the gear lever. This lever is normally located near the gear lever. It has four positions:

H2-High ratio, two wheel drive

H4-High ratio, four wheel drive

N-Neutral (for power take off use)

L4-Low ratio, four wheel drive.

A shift between H2 and H4 can be made at any speed below 50km per hour, in any gear. Ensure the freewheeling hubs are at LOCK when 4WD is engaged.

To shift between H4 and L4 or L4 and H4 the vehicle should be stationary.

Purpose of a transfer case

Vehicles equipped with a transfer case (4WD & AWD) for better on slippery surfaces, giving them the ability to accelerate more efficiently, when purchasing a vehicle its important to ask yourself if you will be travelling with your vehicle on snowy, wet, sandy or rocky roads. If so considering a vehicle with four-wheel or all-wheel drives may be tight for you. Four wheel drive and all-wheel drive vehicles are ideal for off-roading and the needed traction with adverse weather conditions.

Maintaining the differential & transfer case

Transaxle oils, differential fluid and gear oils should be changed between 30,000 - 60,000 miles by a certified technician. Clean, fresh oil provides better protection of the differential and well-lubricated parts as with any component on the vehicle ensure the best performance. Transfer case fluid should be replaced every 30,000 miles to remove any debits or contaminants and to better lubricate components. This is highly recommended for trucks that two loads and utilize four wheel drive frequently.

Symptoms of trouble in the differential

- Wiring or whining noises when decelarating.
- A howl or whine during acceleration over high or low speeds.

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- Rumbling whining at speeds over 20 miles per hour but changes while turning.
- Frequent clunking sound every few feet or when starting to move.
- Vibration that increases with speed.

Transfer case will need to be inspected unable to or have trouble switching from two wheel drive to four wheel drive or the vehicle shudders when turning.

Neglecting any maintenance service on vehicle is unwise in any situation. Spent differential fluid after time, becomes dirty and contaminated. Continuing to drive with unclean fluid is risky as it may result in undue wear or components leading to permanent damage. Avoiding maintenance on the transfer case may impair the vehicles ability to convert to four wheel drive. Drivers should take extreme caution trouble with the transfer case and avoid rough or slippery terrains.

All wheel drive

An A.W.D vehicle with 4 driven wheels can, with the same drive power and weight distribution, transmit twice as much motive force as a vehicle with 2 wheel drive.

Ex:	Total weight	=	2800 kg
	Each wheel - 2800/4	=	700 kg
	2 WD = 2 x 700	=	1400 kg
	4 WD = 4 x 700	=	2800 kg

All wheel drive is used to drive the vehicles at rough roads, hills, sandy surface and it can be used for sports. These vehicles are also called as sports utility vehicles (SUV).

All wheel drive has two types

1 Conventional switchable All wheel drive

Here the wheels on a powered axle are always drives. While the other axle wheels are engaged whenever necessary. The selector switch or knob is provided inside the driver cabin for this purpose.

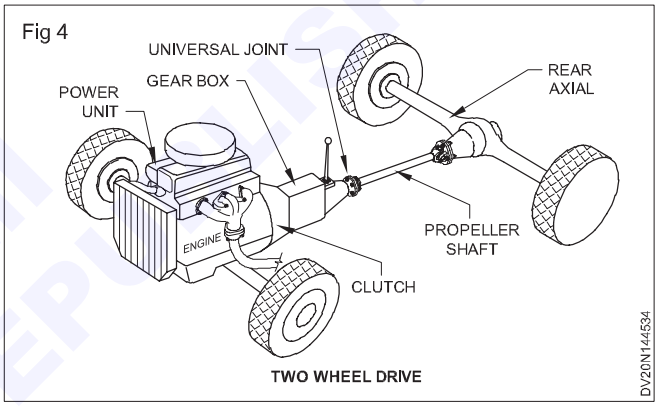
2 Permanent All wheel drive

All the four wheels (front & near) are permanently driven by the transfercase.

Two wheel drive

In two wheel drive mechanism, there is provision to supply to rear wheels or front wheels only. This type of drive system is not provided with transfer case. (Fig 4)

Fig 4



TWO WHEEL DRIVE

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Brake system

Objectives: At the end of this lesson you shall be able to
- **state the principle of brake**
- **state the various types of brake systems**
- **draw a layout of the mechanical brake system**
- **state the function and operation of mechanical brakes.**

Purpose of brake system

- To stop the vehicle.
- To slow down the vehicle.
- To park the vehicle.

Types

According to application

- Foot brakes
- Hand brakes

According to operation

- Drum type
- Disc type
- Mechanical brake
- Hydraulic brake
- Air brake
- Air-assisted brake
- Vacuum-assisted brake

Foot brake

The brake which is applied by foot is called the foot brake.

Hand brake

The brake which is applied by hand is called the hand brake, e.g. a scooter's front brake and a commercial vehicle's and car's parking brake.

Drum brake (Figs 1 & 2)

In this type of brakes, the brake shoes (1) & (2) are placed inside the brake drum (3). When the brake is applied, the brake shoes expand through linkages, come in contact with the brake drum and stop the wheels.

Disc brakes (Fig 3)

In this type the brake pads (4 & 5) are arranged at both the sides of the disc (6) which is connected with the wheel hub. When the brake is applied the pads (4 & 5) move towards the disc (6) and stop the wheels. The following types of disc brakes are used.

Fig 1

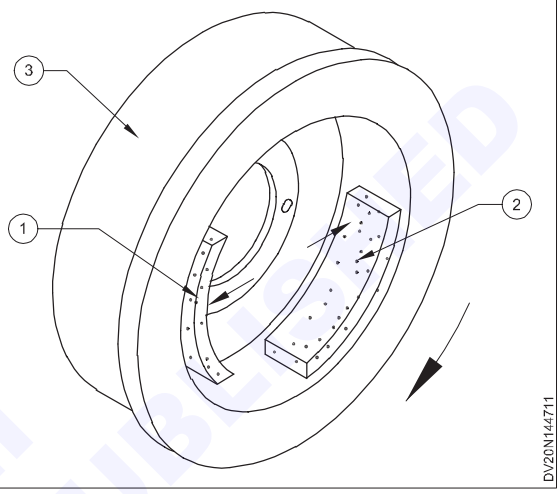


Fig 2

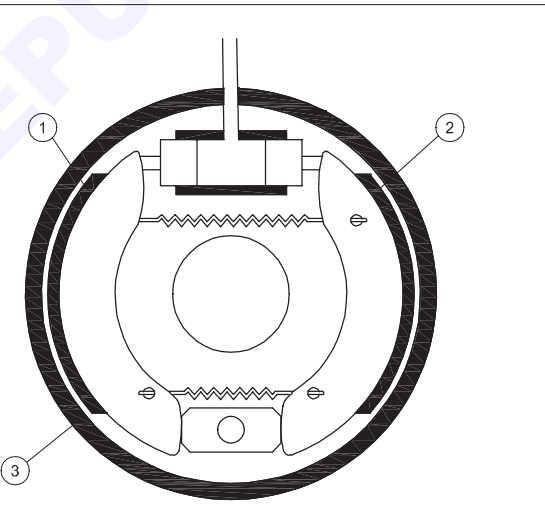
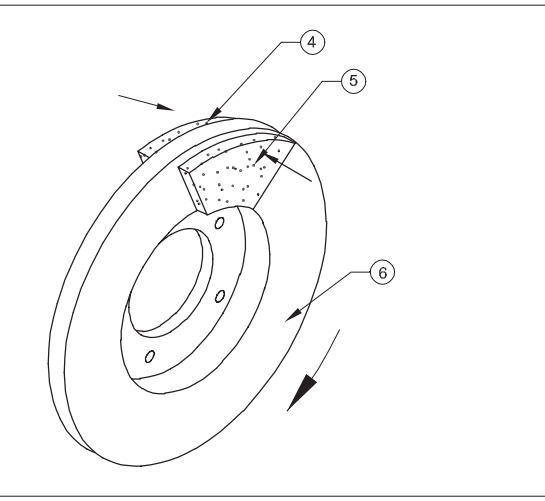


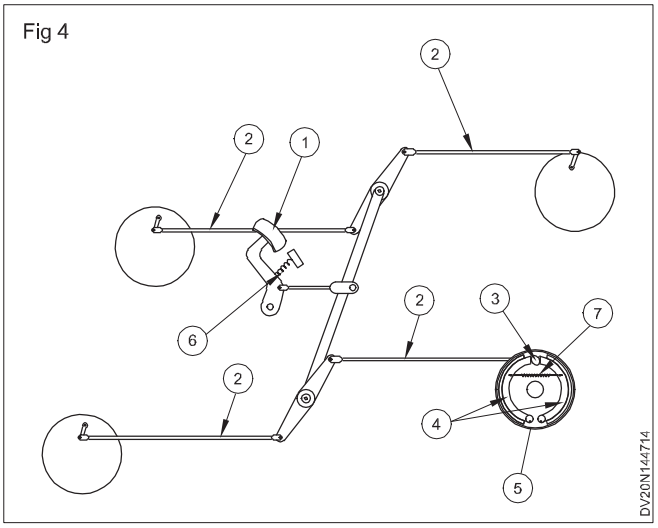
Fig 3



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Mechanical brakes (Fig 4)

Fig 4



When the brake pedal (1) is pressed, the linkage (2) operates the cam (3) and expands the brake shoes (4). The brake shoe comes in contact with the brake drum (5) and stops the brake drum. When the brake is released the brake pedal goes back to its original position with the help of the pedal- return spring (6). The brake shoe comes to its original position with the help of the brake shoe rectracting spring (7), and allows the brake drum to rotate. The mechanical brakes are used in two wheelers, three wheelers and the parking brakes of the commercial vehicles.

Mechanical advantage

Mechanical advantage is the ratio of force produced by a machine to the form applied to it. A simple machine that exhibits mechanical advantage is called as lever.

In brake system, the multiplied and applied on the wheel by means of mechanical linkage, hydraulic power, pneumatic power or vacuum power.

Hydraulic brakes

Objectives: At the end of this lesson you shall be able to
- **state the principle of a hydraulic brake**
- **state the function of the master cylinder.**

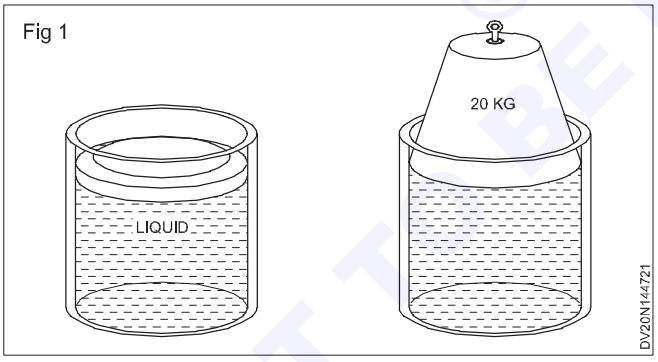
Principle

Hydraulic brakes work under the principle of Pascal's law.

Pascal's law

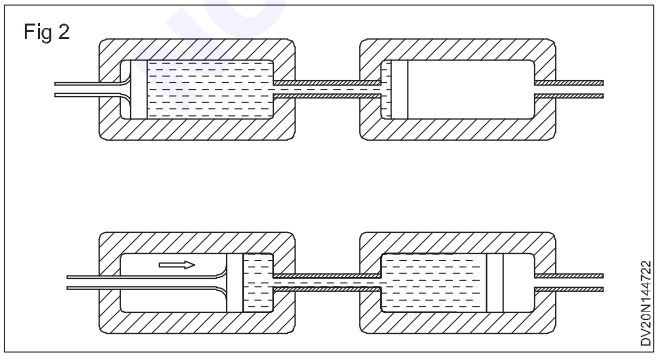
- Liquid cannot be compressed. (Fig 1)

Fig 1



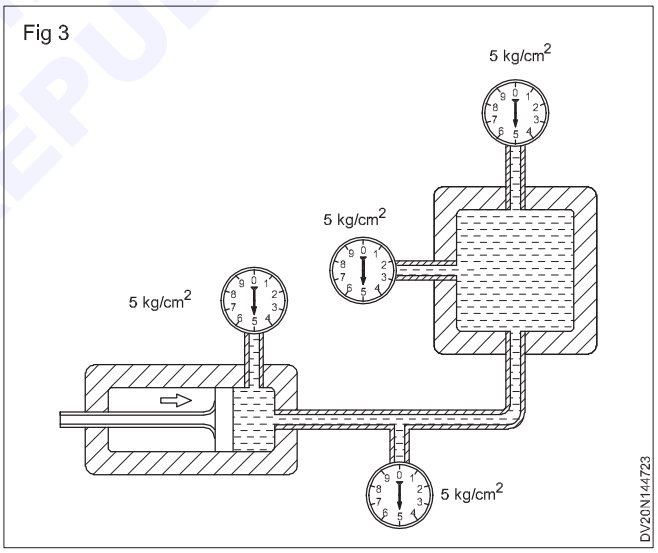
- Motion can be transmitted through a liquid. (Fig 2)

Fig 2



- Liquid pressure is transmitted equally in all directions. (Fig 3)

Fig 3

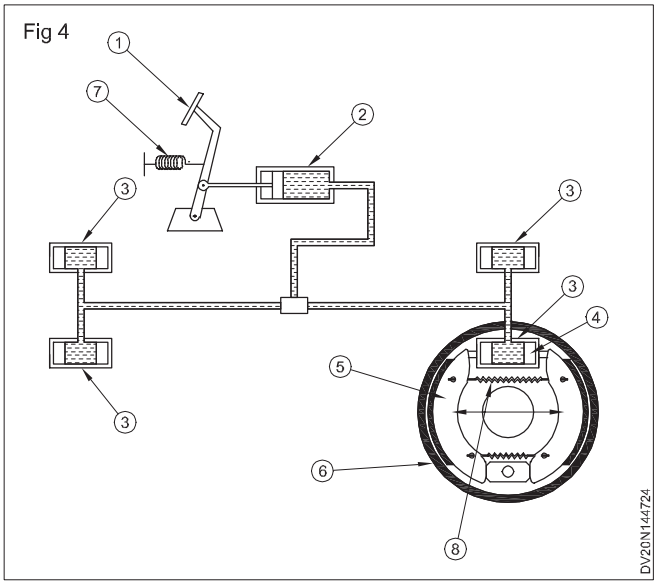


Operation (Fig 4)

When the brake pedal (1) is pressed the fluid inside the master cylinder (2) is pressurized and supplied to the wheel cylinders (3). The wheel cylinder pistons (4) push the brake shoes (5) towards the brake drum (6). The friction between the brake shoe lining and the brake drum stops the rotation of the brake drum (6).

When the brake is released the brake pedal comes to its original position with the help of the pedal return spring (7). The brake shoes come to their original position with the help of the brake shoe retracting spring (8). When the brake shoe returns to its position, it pushes the wheel cylinder pistons inside, and the pressurized fluid is sent back to the master cylinder.

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Components of hydraulic brakes they are

Master cylinder

Wheel cylinder

Connecting pipes

Brake fluid

Brake fluid reservoir

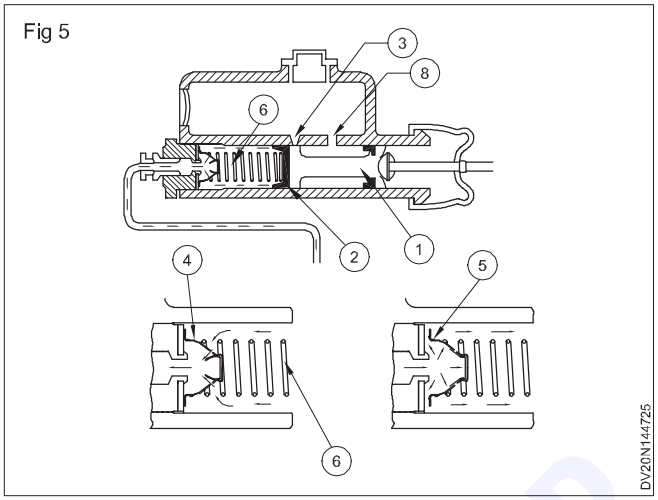
Master cylinder

It serves as a pump to build up hydraulic pressure to operate the brakes. It maintains the level of the fluid in the system.

Types

- Single barrel master cylinder
- Tandem master cylinder
- Centre feed master cylinder
- Tank type master cylinder

Single barrel master cylinder (Fig 5)



When the master cylinder reservoir is filled, the fluid reaches only on the back side of the primary cup.(2) When the pedal is pumped (pumping action) the master cylinder piston returns quickly, and a partial vacuum is created in front of the piston (1). Due to the partial vacuum in the front side of the primary cup, the fluid from the back side of the primary cup reaches the front side of the primary cup via the transfer port (8) by the folding edges of the primary cup. When the brake pedal is pressed the master cylinder piston (1) moves forward and the primary cup (2) covers the compensating port (3). The fluid inside the master cylinder is pressurized and supplied to the wheel cylinders through the non-return check- valve (4).

When the brake is released the pressurized fluid is sent back to the master cylinder by lifting the check-valve (4) from its seat (5) against the master cylinder spring (6) tension.

When the brakes are in a fully released position the master cylinder piston spring keeps the check-valve assembly to its seat trapping some pressure in the wheel cylinders and lines, normally about 15 to 17 lbs. This pressure is to keep the wheel cylinder cups and lines from leaking and avoid the possibility of air entering the system.

Master cylinder (Types)

Objectives: At the end of this lesson you shall be able to
- **state the different types of master cylinders**
- **state the advantage of a tandem master cylinder**
- **state the function of a tandem master cylinder**
- **state the function of the centre feed master cylinder**
- **state the function of the tank type master cylinder.**

The other three types of master cylinders are

– tandem master cylinder

– centre feed master system

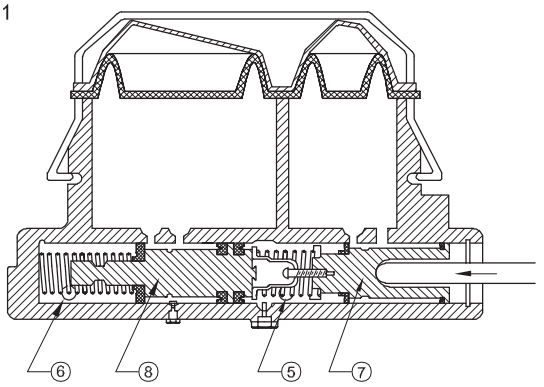
– tank type master cylinder.

Tandem master cylinder (Fig 1)

In a tandem master cylinder two separate cylinders and reservoirs are provided in the same body. There are two check-valves, one each for the front and rear brakes. In this type,in the event of failure of one brake line (front or rear), the other continues to work and stops the vehicle. This is also called dual line brake. This is compulsory as per current motor vehicle act in India in all heavy vehicles.

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Fig 1

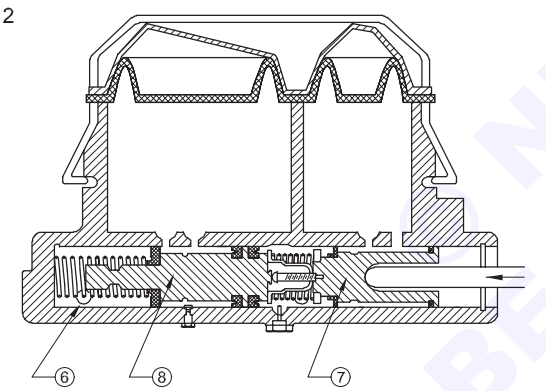


Operation

When the brake pedal is pressed, the primary piston (7) is forced in the cylinder. Fluid is forced to go to the pipelines passing through the check-valve (5) to the front brakes. Further pressing of the brake pedal forces the primary piston (7). The fluid pressure forces the secondary piston (8) into the cylinder. The fluid is forced through the check-valve (6) to the rear brakes. Further pressure on the brake pedal exerts equal pressure on the shoes of all the four wheels.

Failure of brakes (Fig 2)

Fig 2

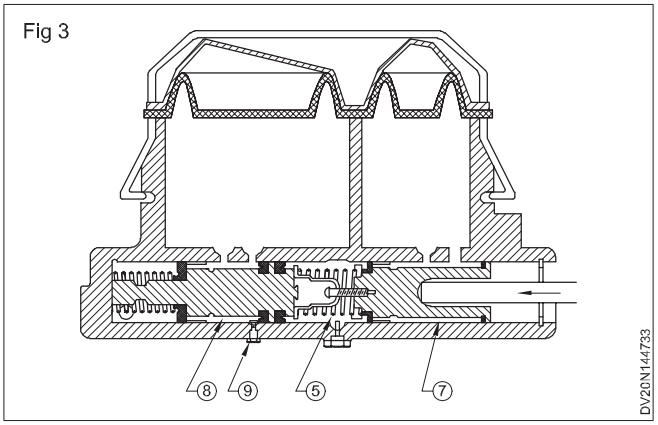


When the front brake fails the primary piston (7) is forced forward till it contacts the secondary piston (8). Now, both the pistons move together.

Pressure is created on the secondary side and this forces the fluid through the check-valve (6) to the rear brakes and the vehicle is stopped.

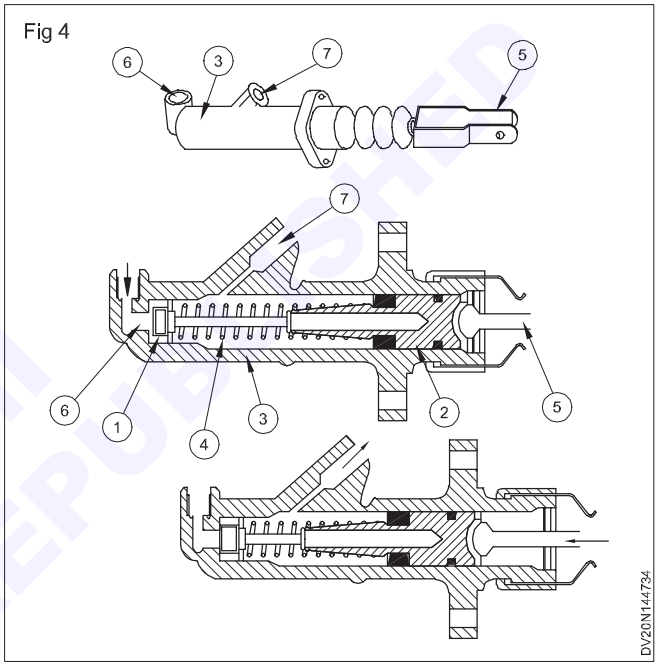
When the rear brake fails (Fig 3) there is no pressure on the secondary side. The pedal effort pushes the primary piston (7) which forces the secondary piston (8) to stop (9). Further movement of the piston (7) builds up the fluid pressure which is transmitted to the front wheel cylinders through the check-valve (5) and the vehicle is stopped.

Fig 3



Centre feed master cylinder (Fig 4)

Fig 4



In this type of a master cylinder a non-return valve (1) is provided on the piston's (2) head. When the brake is released, a vacuum created by the rapid return of the piston causes the fluid to flow into the cylinder (3) by lifting the light coil spring (4) and opening the non-return valve (1). When the system is at rest, the non-return valve sits on its seat and thus full compensating is effected through the bypass port. When the brake pedal is pressed the push-rod (5) moves inside the cylinder. The non-return centre valve (1) seals the inlet (6). The pressurized liquid is sent to the wheel cylinders through the outlet passage (7) to apply the brake.

Drum brake

Objectives: At the end of this lesson you shall be able to
- **state the various components of drum brake**
- **state the functions and operation of drum brake.**

Types of brakes

There are two types of brakes

1 Drum brake

2 Disc brake

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a fixed - caliper disc brakes

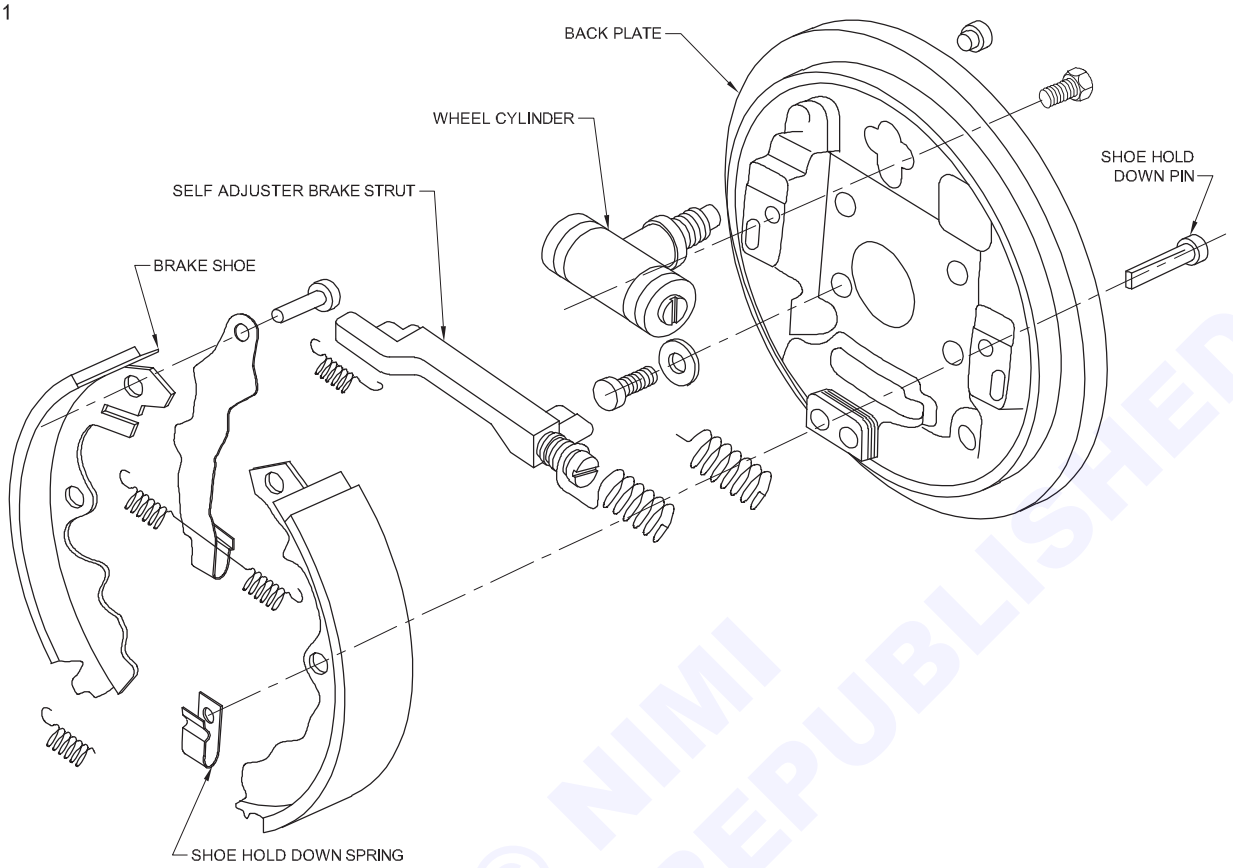
b floating - caliper disc brake

1 Drum brake

A drum brake is a brake that uses friction caused by a set of shoes or pads that press against a rotating drum.

Components of drum brake (Fig 1)

Fig 1



COMPONENTS OF A DRUM BRAKE

Back plate

The back plate provides a base for the other components. It attaches to the axle and forms a solid surface for the wheel cylinder, brake shoes, and assorted hardware. Since all braking operations exert pressure on the back plate, it must be strong and wear resistant.

Brake drum

It is positioned close to the brake shoe without touching it, and rotates with the wheel and axle. When a driver applies the brakes, the lining pushes against the inner surface of the drum which generates friction heat of high amount. So, the brake drum is generally made of a special type of cast iron that is heat conductive and wear resistant.

Wheel cylinder

The wheel cylinder consists of a cylinder that has two pistons, one on each side. Each piston has a rubber seal and a shaft that connects the piston with a brake shoe. When brake pressure is applied, the piston are forced out pushing the shoes into contact with the drum. One wheel cylinder operates the brake on each wheel. Hydraulic pressure from the master cylinder acts on the piston cup, pushing the pistons toward the shoes, forcing them against the drum. When the driver releases the brakes, the force of the brake shoe retract spring returns the piston to its original position.

Brake shoe

Brake shoes are typically made of two pieces of sheet steel welded together. The friction material is either riveted to the lining table or attached with adhesive. The crescent - shaped piece is called the web and contains holes and slots in different shapes for return springs, hold down hardware, parking brake linkage and self adjusting components. All the application force of the wheel cylinder is applied through the web to the lining table and brake lining. Each brake assembly has two shoes a primary and secondary. The edge of the lining table generally has three “V” shaped notches or tabs on each side called nibs. The nibs rest against the support pads of the backing plate to which the shoes are installed.

Self adjuster brake strut

The self - adjuster is used to adjust the distance between the brake shoe and the drum automatically as brake shoes wear.

Operation

When brake pedal is pressed, either through Mechanical / hydraulic / pneumatic means, brake shoes expands

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against the drum. Many drum brakes are self-actuating. The brake shoes contact the drum, there is a kind of blocking action, which has the effect of pressing the shoes into the drum with more force. Because of this action, the shoes must be pulled away from the drum when the brakes are released. For which springs are provided to hold the brake shoes in place and return the adjuster arm after it actuates.

Advantages

Self reinforcement , Dirt-proof design, Parking brake easier to use.

Disadvantages

Maintenance is costly; Pad replacement is time consuming, Poor heat dissipation Tendency towards fading.

Disk brake

Objectives: At the end of this lesson you shall be able to
- **state the various components of disk brake**
- **state the functions and operation of different types of disc brake.**

Disk brake

Disc brake also works on the principles of the drum brake, disc which rotates along with the vehicle wheel and is partially held by a brake caliper assembly mounted on the suspension. When the brake pedal is depressed, the brake pads mounted on the inside and outside of the housing are pressed hydraulically against the rotating disc.

Major components of disc brake are

Disc, Piston, Brake pads and piston housing bracket.

Types of disc brakes

Disc brakes categorized into

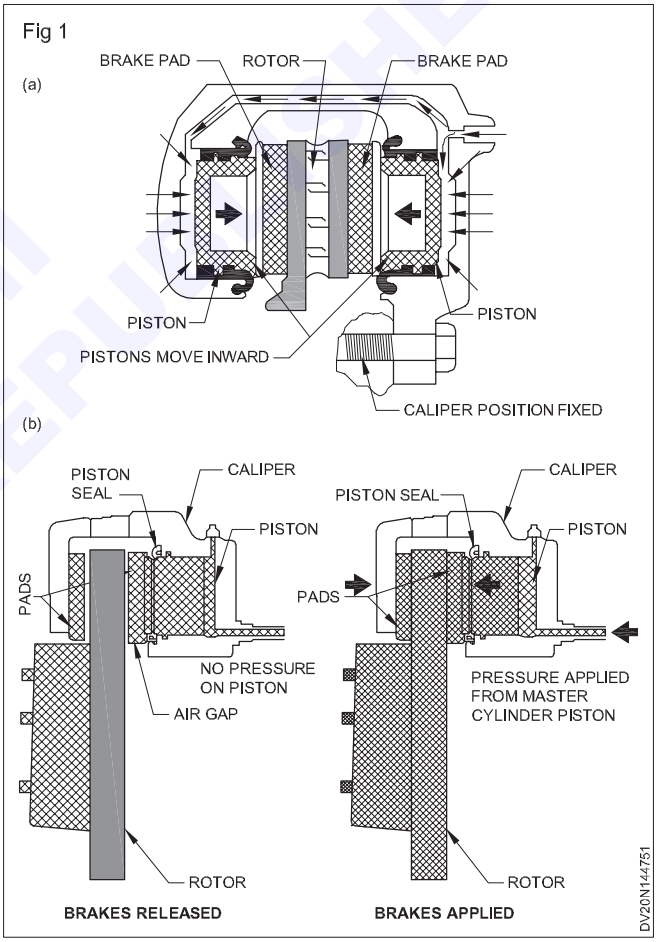
a Fixed caliper disc brakes (Fig 1a)

It contains two pistons in housing and brake pads on the piston. On applying force over brake pedal, the hydraulic fluid passes through piston housing bracket and makes the two pistons move against the brake pads located in the housing and after closing the air cap these are pressed against the rotating brake disc. Nowadays, this type is rarely used.

b Floating caliper disc brakes (Fig 1b)

When the brakes are applied, the piston moves in the housing and recesses the inner pad against the rotating brake disc. The hydraulic pressure in the cylinder of the piston housing acts both on the surface of the piston and on the bottom of the piston housing. As result, the piston housing slides on the locating studs in the opposite direction and the outer brake pad is drawn against the brake disc with same force from the wheel side. when the brake release, the air gap between the pads and the brake disc is restored force of the piston sealing ring.

Fig 1



Wheel cylinder

Objectives: At the end of this lesson you shall be able to
- **state the function of a double piston wheel cylinder**
- **state the function of a stepped wheel cylinder**
- **state the function of a single piston wheel cylinder**
- **state the function of the baffle type wheel cylinder.**

The fluid pressure of a pipeline is increased in the wheel cylinder by using a bigger diameter piston. This increased fluid pressure is applied on the brake shoes by the pistons, and braking action is achieved.

Operation of wheel cylinder

The space in the cylinder bore between the cups (2) always remains filled with fluid. When the brake pedal is pressed, additional brake fluid is forced into the cylinder

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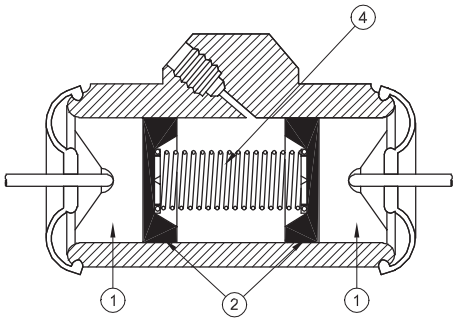
bore under pressure. Due to this pressurized fluid, the cups (2) and pistons (1) move outward and expand the brake shoes. The expanded brake shoes come in contact with the brake drum and stop the vehicle.

There are four types of wheel cylinders used with drum brakes.

Double piston with straight bore (Fig 1)

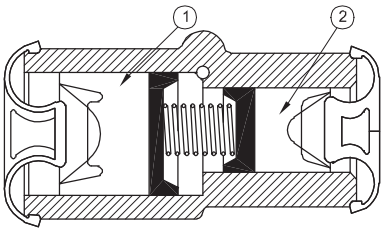
In this type two pistons (1) are used in a single bore. These pistons are separated by a spring (3). Each piston is connected to one brake shoe.

Fig 1



Double piston with step bore (Fig 2)

Fig 2



This type of wheel cylinder is similar to the double piston with a straight bore with the difference that a stepped bore is used instead of a straight bore. Both the pistons (1) & (2) have different diameters, so the pressure on each brake shoe is different.

Single piston wheel cylinder (Figs 3 & 4)

Fig 3

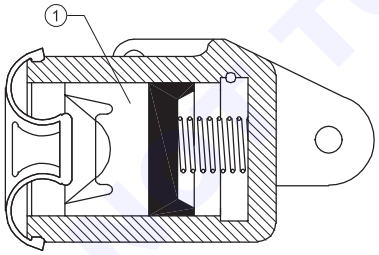
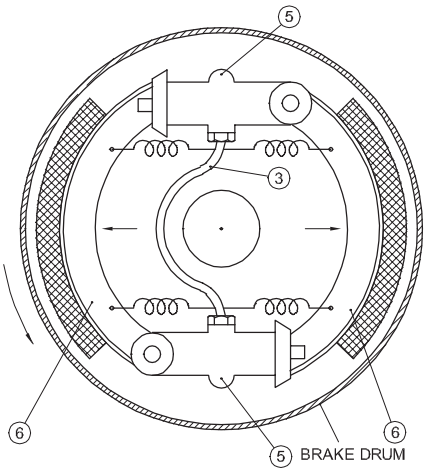


Fig 4



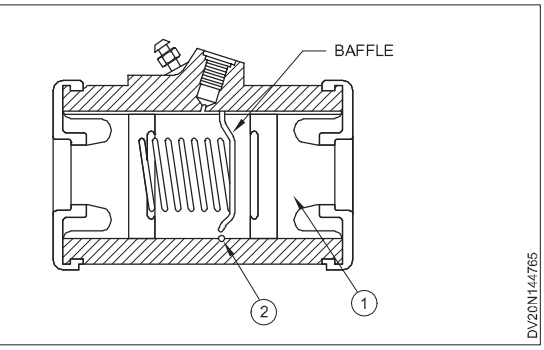
There are two wheel cylinders each of which will operate one shoe independently. In this type one piston (1) is used in one cylinder. One end of the wheel cylinder (5) is pivoted and the other end is connected to the brake shoe and actuates the brake shoe (6) when the pedal is pressed.

The two wheel cylinders are connected by a pipe line (3). Both the wheel cylinders have equal diameter; so equal pressure is exerted on both the brake shoes. In this type both shoes becomes leading shoes in the forward direction. This allows equal wear on both the brake shoes.

Baffle type piston wheel cylinder (Fig 5)

This type is used to avoid clinking noise during braking while the vehicle is moving in reverse. In this type an orifice (2) is drilled on the base of the cylinder. The orifice (2) reduces the flow of fluid from the front half to the rear half, thereby causing the primary shoe to operate first and the secondary shoe expands a little later. So the noise is avoided.

Fig 5



Brake fluid

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

- **state the necessity of bleeding the brake system**
- **state method of brake pedal adjustment**
- **state the characteristics of brake fluid**
- **state the advantages and disadvantages of a hydraulic brake.**

Bleeding of hydraulic brake system

The hydraulic brake system must be bleed whenever the fluid line has been disconnected or air gets into the system. A leak in the system may sometimes be indicated by a spongy brake pedal. Air trapped in the system is compressible and does not permit pedal effort

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to be transmitted to the brakes. The system must be absolutely free from air at all times.

Brake pedal adjustment

There should be always at least 12.7mm (1/2") free pedal travel, before the push rod engages the master cylinder piston. This adjustment is accomplished by shortening or lengthening of the brake master cylinder eye-bolt. This is done so that the primary cup will clear the bypass port when the piston is in the off position. This will prevent the compensating action of the master cylinder against temperature changes of the brake fluid.

Brake fluids

Characteristics of brake fluid

- It should be able to flow freely at extremely high and low temperatures.
- It should be able to serve as a lubricant.
- It should be anti-corrosive and anti-rust.
- It should show resistance to evaporation.
- It should not damage or swell the rubber parts.

Use only approved brake fluids in a brake system. Any other fluid such as power steering fluid, automatic transmission fluid, or engine oil, which has a petroleum base, must never be used in the brake system. Petroleum based fluids will damage the rubber components in the brake system, like the piston cups and seals, and cause them to swell and disintegrate.

Advantages of a hydraulic brake

- Simple in construction.
- Equal braking at all the wheels.
- Wear of the parts is less.
- Little maintenance is required.

Disadvantages

- Any leakage of fluid in the line will lead to brake failure.
- Chances of the brake fluid reaching the brake shoes are very high. This will damage the brake shoes.
- If fluid enters the lining it reduces the braking efficiency.

Brake lining

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

- **state the material required for the brake lining.**

Two types of brake linings are used

- Organic brake lining
- Semi-metallic brake lining

Organic brake lining

These linings are molded from a mixture of asbestos, fibre glass, asbestos fibres etc. Resin is used as a binding material.

The blend of raw materials for our friction materials (brake pads, brake linings)

Disc brake pads and drum brake linings are made from a blend of 10 to 20 kinds of raw materials. Depending on their specific roles, the raw materials are divided into three categories; "blending material", "stiffener: and "friction adjustment material".

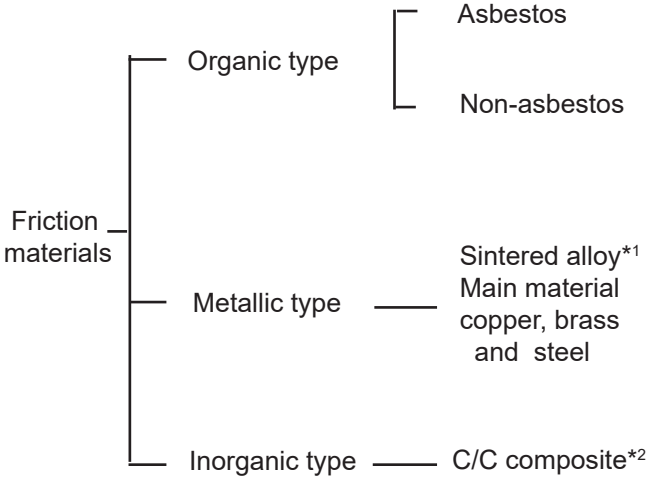
The bonding material hardens raw materials and gives the materials their intensity. Mainly phenol resin is used currently.

The stiffener gives the friction materials further intensity. Various kinds of organic and inorganic, fibers, such as aramid fibers and metal fibers are used.

The friction adjustment material mainly adjusts the effectiveness of friction materials. It is used for strengthening the effectiveness or stabilizing a lubricants, organic, fillers, inorganic fillers, abrasive material and metal powder are blended as necessary.

1 Sintered alloy

The phenomena where the particles of powder material join together and turns into a solid substance by pressurizing and fabricating the powder matetial and heating it at temperature below the melting point. Material that is not made by melting metal, but instead by sintering metal powders is called sintered alloy.



2 C/C composite

Carbon fiber reinforced carbon composite. Carbon composite material has been strengthened with carbon fiber. It is extremely thermally stable and light-weight. This material is often used for brake rotors and brake pads for aircraft and racing cars.

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Performance requirements for friction materials (brake pad, brake lining)

Further more, friction materials are required to exercise stable effectiveness (minimum fluctuation of effectiveness) under varying conditions, such as vehicle speed, laden weight or temperature change from brake, usage as well as under different environment influences including humidy, water and mud. Strength to withstand thermal disturbances and mechanical strength are also important design criteria.

Durability is another important property of friction materials as they wear with use. Moreover, when brakes are applied, squeal, noise and vibrations must be minimized. Further more, the friction materials should not cause damage to the material they get into contact, such as the disc roots. Friction materials also require to have low thermal conductivity to prevent temperature buildup of the brakes themselves or brake oil.

Main performance requirements for friction materials are:

- Optimum effectiveness, i.e. appropriate friction coefficient (μ).
- Stable effectiveness under various usage and/or environmental conditions.
- Strength to withstand thermal disturbances and mechanical strength.
- High level of durability.
- Minimized brake sequel, noise and vibrations.
- Low damage to the contact material, such as the disc rotor.
- Low thermal conductivity.

Semi-metallic brake linings

These linings are mostly used for front disc brakes in front wheel drive vehicles. It is made of fine polished steel wool. It also includes iron powder and graphite. Plastic resin is used as a binder. The mixture is heated and pressed to form the lining. Semi-metallic linings are more wear and heat resistant than organic linings. Semi- metallic linings can retain their coefficient of friction when operating at very high temperatures.

Anti lock brake system

Objectives: At the end of this lesson you shall be able to
- **state the advantages of ABS**
- **list out the different types**
- **state wheel lock up condition**
- **state hold mode**
- **state normal braking**
- **state electronic brake distribution advantage**
- **traction control system.**

Anti lock brake system

Advantages of ABS

Anti-lock brake systems are designed to prevent wheel lockup under severe braking conditions irrespective of any type of road conditions.

The result is that, during heavy braking ABS:

– retains directional stability (vehicle stability)

– stops faster (shortened stopping distance)

– retains max. control of vehicle (steerability)

– If front wheels lock-up it is no longer possible to steer the vehicle.

– If rear wheels lock-up the car can become unstable and can start to skid sideways.

Split suface braking: When brakes are applied on a combination of slippery and high friction surfaces, the wheels on the slipper surface easily locks-up and the vehicle loose stability and will be dragged towards the high friction side, which may lead to accidents through the oncoming vehicle. But ABS prevent this and offers stability until the vehicle comes to a complete halt.

Types of ABS systems

4-Sensor 4-Channel type: This type is generally used for FF (Front engine Front driving) car. This type has four wheel sensors and four hydraulic control channels and controls each wheel independently.

4-Sensor 3-Channel type: This type is generally used for FR (Front engine Rear driving) car. This type has 2 channels for front wheels and the other one is for rear wheel control.

3-Sensor 3-Channel type: In this type the front wheels are controlled independently but rear wheels are controlled together by one wheel speed sensor (ex. On differential ring gear)

1-Sensor 1-Channel type: In this type only the rear wheels pressure are controlled by one sensor.

How ABS Detects wheel lock up condition

ABSS has got wheel speed sensors on all the four wheels. It continuously calculates the slip ratio of all the four wheels.

Slip ratio: It is the percentage ratio between difference of vehicle speed and wheel speed to vehicle speed.

$$\text{Clip ratio} = \frac{(\text{Vechicle speed} - \text{Wheel speed})}{\text{Velocity speed}}$$

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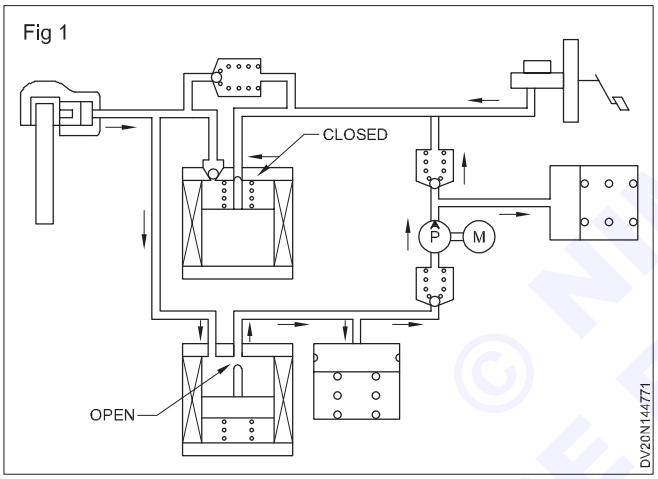
While wheel speed information is directly taken from wheel speed sensor, vehicle speed information is not attained directly from vehicle speed sensor. There is no vehicle speed sensor information to ABS. It is attained with some logic using wheel speed sensor information only. The reason being exact vehicle speed cannot be attained from sensor, when the wheel is locked and vehicle skidding.

How Abs calculates vehicle speed

At the time of braking the speed of individual wheels differ hence slip ratio also differs. Two wheel drive vehicles uses the maximum wheel speed as vehicle speed at the time of wheel lockup. This gives a fairly correct information above vehicle speed, because the vehicle will tend to propel at that speed.

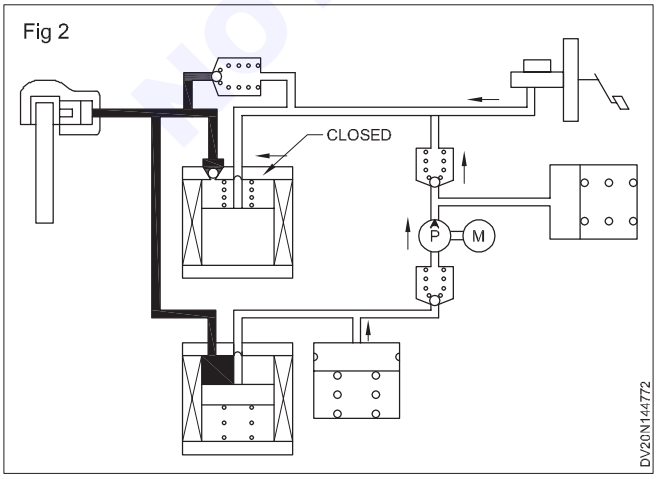
For ex: At braking if the wheel speed information from all the four wheels in car are 20, 30, 20, 20 Kmph. Then vehicle speed is taken as 30 Kmph for calculating slip ratio of individual wheels.

Dump mode (Fig 1)



When ABS unit detects a wheel lock up condition it tries to avoid wheel lockup by releasing pressure from wheel cylinder. In this case Solenoid Valve - In, Solenoid valve - Out and motor is ON. Solenoid Valve - In closes the passage from master cylinder. Solenoid Valve - Out opens the passage to pump, which pumps the fluid out reducing the pressure at wheel cylinder.

Hold mode (Fig 2)



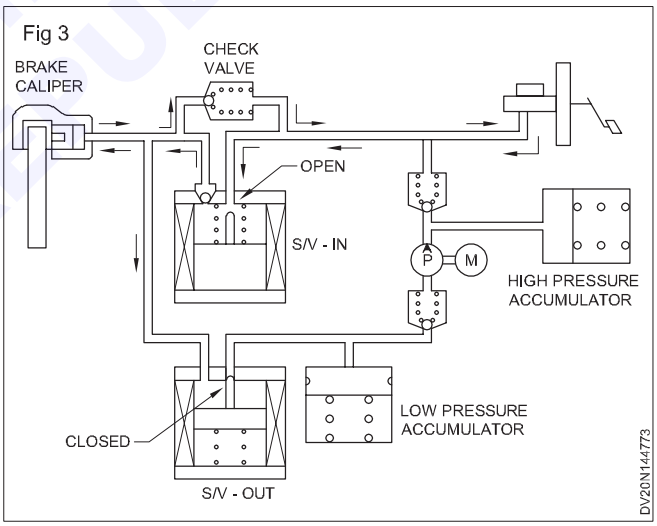
Once the pressure is released to some extent to avoid wheel lock up condition, pressure is locked inside wheel cylinder by switching off the Solenoid Valve - Out alone i.e. Solenoid Valve - Out closes the passage from wheel cylinder to pump locking the pressure inside wheel cylinder.

In four wheel drive vehicles since torque is transmitted to all four wheels the chances of four wheel lockup in low friction surfaces are more. Calculation of vehicle speed from wheel speed gives wrong result. Hence four wheel drive vehicle use additional “G” sensor to calculate vehicle speed.

G-Sensor (Acceleration sensor)

G-Sensor is used by the ABS for measuring the deceleration rate of the vehicle whenever brakes are applied. G-Sensor signal output is directly proportional to the Acceleration/Deceleration of the vehicle. Using wheel speed sensor logic has its own disadvantages as there are chances of all the four wheels getting locked up during braking on very low friction surfaces like on ice or slippery surfaces. Under these conditions, it is impossible to calculate the deceleration rate of the vehicle from the wheel speed sensors. In this case, ABS cannot perform efficiently.

Normal Braking (Fig 3)



In normal braking Solenoid Valve - In, Solenoid Valve - Out and motor is off. Brake pressure applied to the master cylinder goes to wheel cylinder through Solenoid valve - In Solenoid valve - IN is normally open type (NO) i.e. it is open when it is off. Solenoid Valve - OUT is normally closed type (NC) i.e. it is closed when it is off. Brake fluid return to master cylinder through check valve in Solenoid valve - IN. This is like conventional braking. ABS operates in normal mode till lockup condition is detected. Once wheel lockup condition is detected ABS comes into operation i.e. Dump, Hold and Increase mode are executed.

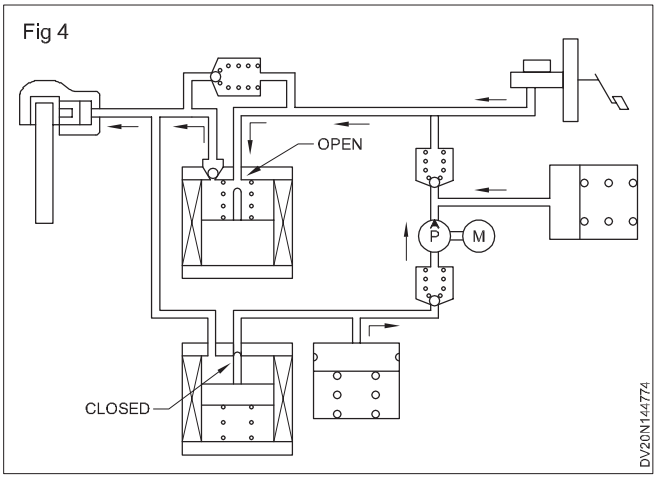
Dump mode

When ABS unit detects a wheel lock up condition it tries to avoid wheel lock up by releasing pressure from wheel cylinder. In this case Solenoid Valve - In, Solenoid

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Valve - Out and motor is ON. Solenoid Valve - In closes the passage from master cylinder. Solenoid valve - Out opens the passage to pump, which pumps the fluid out reducing the pressure at wheel cylinder.

Increase mode (Fig 4)



In this mode pressure is increased to compensate for the released pressure. The Solenoid Valve condition is similar to normal mode except motor is ON. The pump pushes brake fluid into master cylinder circuit to increase the brake pressure applied to wheel cylinder. The pedal pressure applied by the driver and the motor pressure together from the pressure applied to wheel cylinder. Once the ABS unit does the dumping operator (pressure release) the pressure increase is done in steps of hold and increase for better steering control, stability and better stopping distance.

EBD (Electronic Brake-force Distribution)

The EBD system is a sub-system of the ABS system, it is very effective in controlling the effective adhesion utilization by the rear wheels. It controls the slip of the rear wheels in the partial braking range. The brake force is moved even closer to the optimum range, thus dispensing with the need for a mechanical proportioning valve.

The mechanical proportioning valve has its limitations when speaking about achieving the idea brake force distribution to both the front and rear wheels.

EBD doesn't have any new components in face the same ABS components like wheel speed sensor, electronic unit are used. It is only a logical extension of ABS logic in ECU memory. EBO system provide the solenoid valves to reduce the brake pressure to the rear wheels when the slip ratio of rear wheels ar emore than that of front wheels. EBD failure is indicated by glowing the parking lamp.

EBD advantage (Fig 5)

– Function improvement of the base-brake system

– Appropriate brake force distribution to front and rear wheels with respect to load variations

– Possible to achieve ideal brake force distribution with EBD

– Compensation for the different friction coefficients

– Elimination of the mechanical proportions valve

– Failure indication through warning lamp in cluster.

Maintenance of ABS Brake Systems

The following table should only act as a guide; the manufacturer's recommendations should always be followed.

Traction control system (TCS) (Fig 6)

The TCS system prevents the drive wheels spinning when pulling away and accelerating.

This stabilizes the vehicle in the longitudinal direction, the cornering stability is maintained and the vehicle is prevented from breaking away at the powered axle.

The TCS is an enhancement of ABS. Both systems use common sensors and actuators and often have a common ECU where the data exchange is usually carried out via a CAN bus. When the vehicle is being driven with snow chains, the TCS can be deactivated. A distinction can be made between:

- TCS systems with engine intervention.
- TCS systemswith brake intervention, otherwise known as ELSD Electronic Limited Slip Differential.
- TCS systems with engine and brake intervention.

TCS/ELSD brake circuit of a wheel

Advantages

- Improvement of traction when pulling away or accelerating.
- Increase of driving safely at high motive forces.
- Automatic adjustment of engine torque to the grip rates.
- Driver information about reaching dynamic limits.

TCS with brake intervention/electronic limited slip differential ELSD

An electro-hydraulic system is used as a starting off aid. The lock effect is created as a result of brake intervention on the spinning wheel in order to achieve better traction.

Structure

Hydraulic system

This is composed of a hydraulic pump with suction and delivery valves inter and outlet valves, a hydraulic changeover valve and a check valve with pressure limiter.

Electrical system

This is composed of ABS/TCS (ELSD) ECU and wheel speed sensors.

Operating principle

Pressure build-up

If a driven wheel spins, this is detected by the ECU with a speed sensor. It activates the hydraulic pump and the check valve. The check valve (CV) closes and the pressure generated by hydraulic pump P brakes the spinning wheel.

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Pressure holding The inlet valve (IV) is closed.

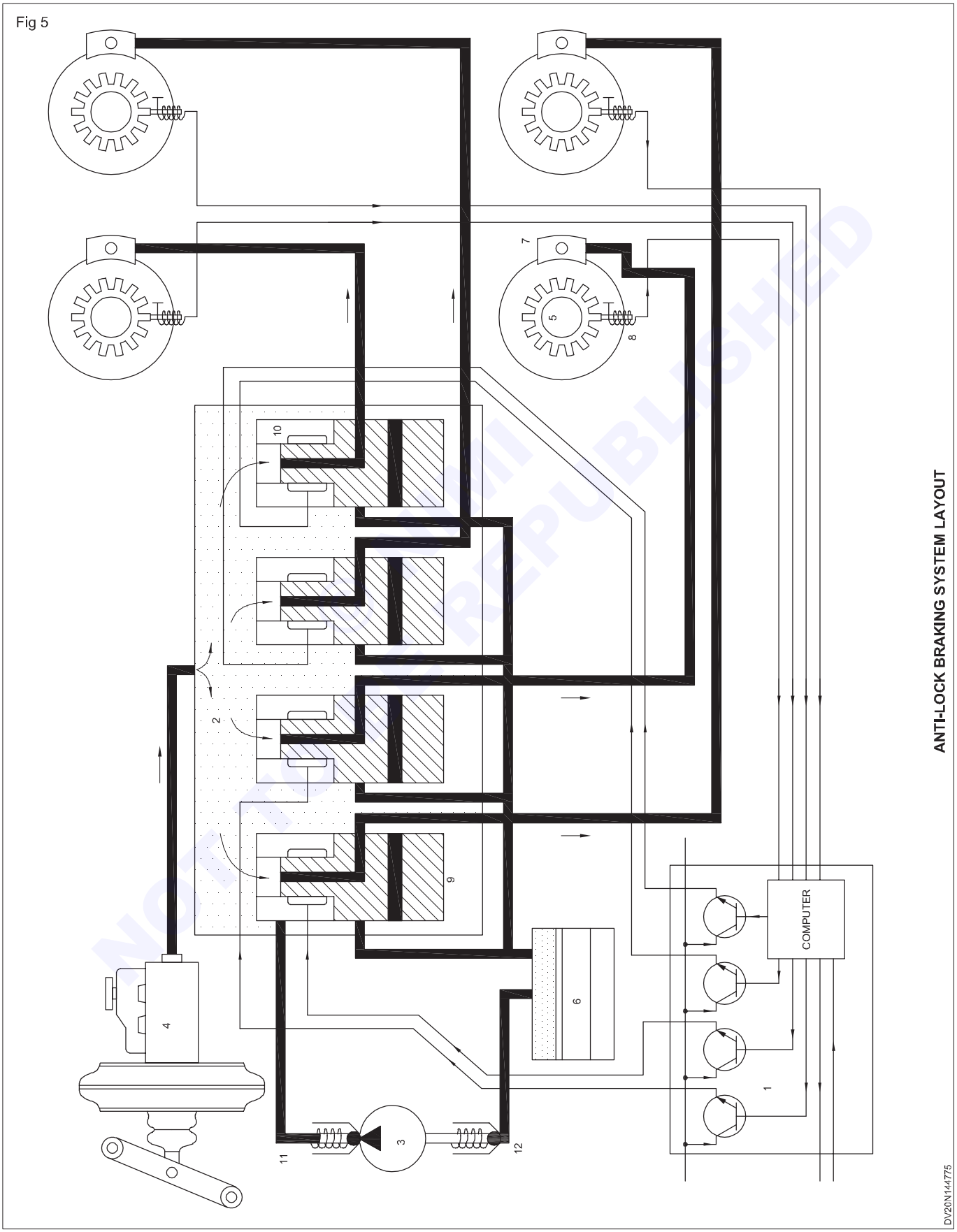
Pressure reduction

If the wheel has stopped spinning, then the inlet and check valves are opened and the pressure is relieved to the expansion tank via the master cylinder.

TCS with engine and brake intervention (Fig 7)

The system works with engine or brake intervention, according to the driving situation. The block collaboration of engine and brake intervention for preventing unreliable wheel slip when pulling away. (TCS operation/ELSD operation) or in overrun mode. (EDTC operation)

Fig 5



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Fig 6

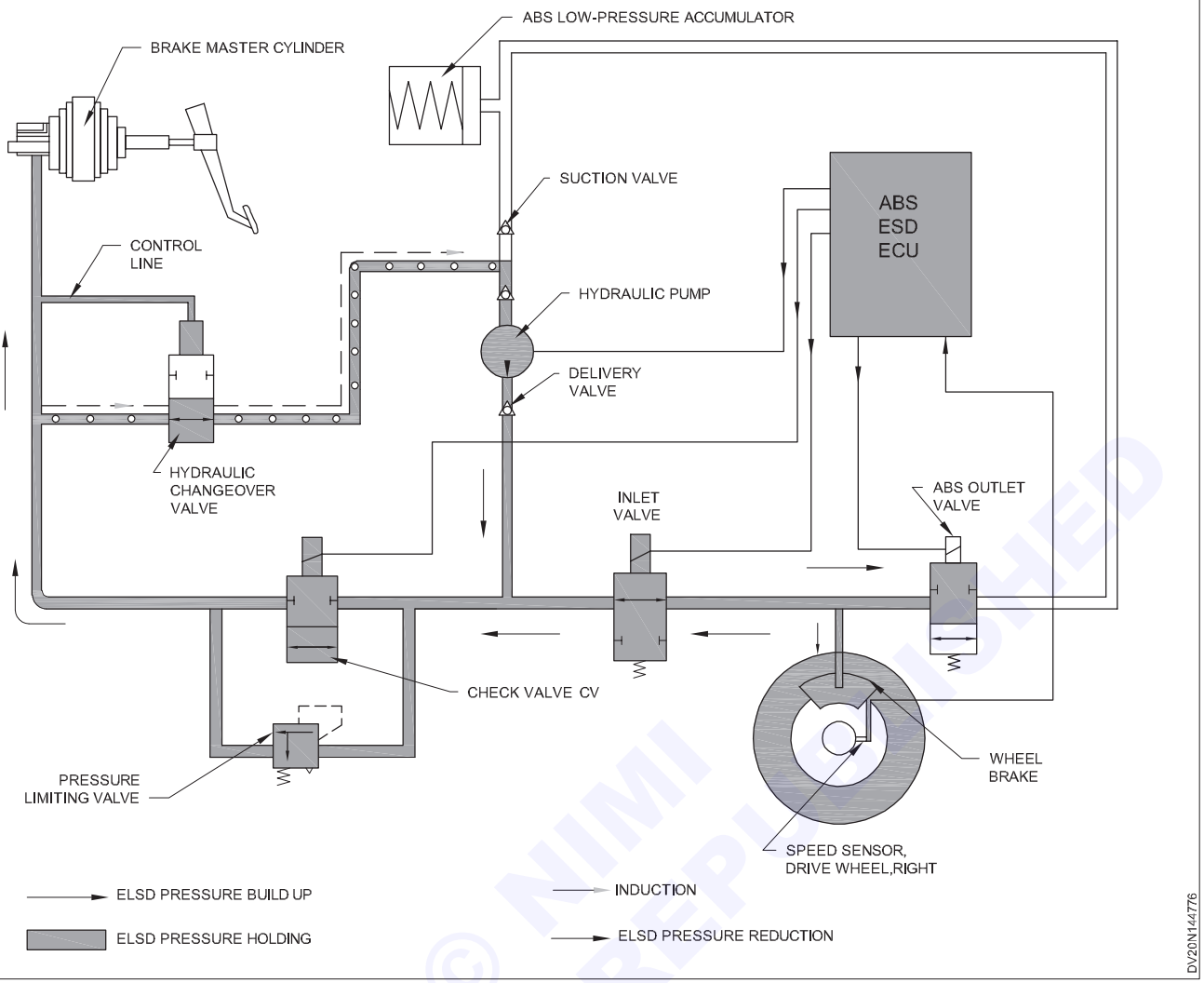
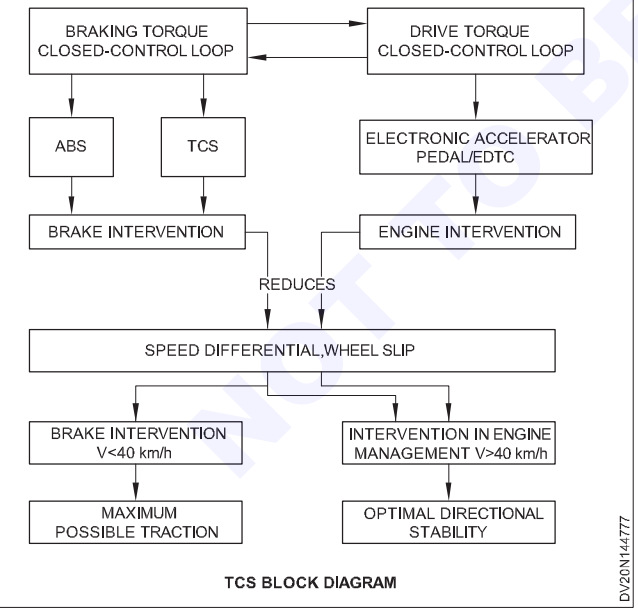


Fig 7



TCS BLOCK DIAGRAM

General defects in brake systems: Vehicle brake system Defects are as follows

- Drum brake making a sound while apply brake
- Smells come from brake drum
- Sensation signal brake problem
- Screeching noise while applying brake
- Grinding noise while applying brake
- Squealing and rubbing
- Eardrum piercing noises in disc brake
- Brake shoe worn out
- Brake fluid leaking
- Brake pedal hard.
- Brake air lock
- Pedal sinks to floor
- Dragging brakes etc.

Procedure to be followed incase of brake failure

- incase of brake failure stop the vehicle safely in a surface land.
- apply parking brake
- check the brake fluid level in marker cylinder
- if need top-up the brake fluid up to level
- check the brake pedal operation and pedal free play

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- check the brake line leakages and brake fluid line damage
- check brake shoe, wheel cylinder and master cylinder operation
- Bleed the brake system in case of brake sponge-or air lock in brake system
- check the wheel drum or disc in case of noise while brake apply
- check the caliber unit and brake pedal in a disc brake system
- Replace the all damaged parts of brake system
- Adjust the brake shoe clearance and brake pedal free play.

Steering system

Objectives: At the end of this lesson you shall be able to
- **state the functions of the steering system**
- **state the Ackerman geometry of steering mechanism**
- **describe steering linkages**
- **state the 4 wheel steering system**
- **state the collapsible steering column.**

Function

The main function of the steering system is to convert the rotary motion of the steering wheel into angular motion of the front wheels to negotiate a turn.

The other functions of steering system are as follows.

- To turn the vehicle whenever required.
- To provide stability to the vehicle on road.
- To provide true rolling motion of the wheels at all times.
- To provide self-centering action after negotiating a turn.
- To minimize tyre wear.
- To multiply the driver's effort to turn the vehicle for easy operation.
- To prevent road shocks reaching the driver.

Steering mechanisms

Two types of steering mechanism are used.

- Ackerman steering mechanism.
- Davis steering mechanism.

Only Ackermen steering mechanism is used in vehicles nowadays because of its simplicity and less wear of the parts.

Ackerman steering mechanism

To avoid skidding of tyres when the vehicle is negotiating a turn (Fig 2), it is necessary that all the wheels turn on an arc which has a common centre (4). The inner wheel turns at a larger angle (3) than that of (2) of the outer wheel. When the front wheels are in the straight ahead position and lines are drawn through the kingpin's centre and the steering arm's end, they will meet at a point at the centre of the rear axle just ahead of the differential. The included angle is called Ackermen angle (A) (Fig 1). The Ackermen steering results in different angles, through which the front wheels turn. This is achieved by setting the steering arms not exactly at right angle with the spindle body. Steering arms are slanted slightly towards the centre of the vehicle to get the Ackerman angle.

Fig 1

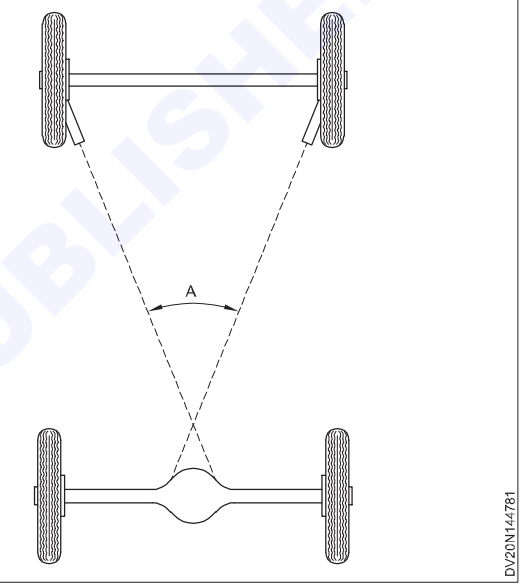
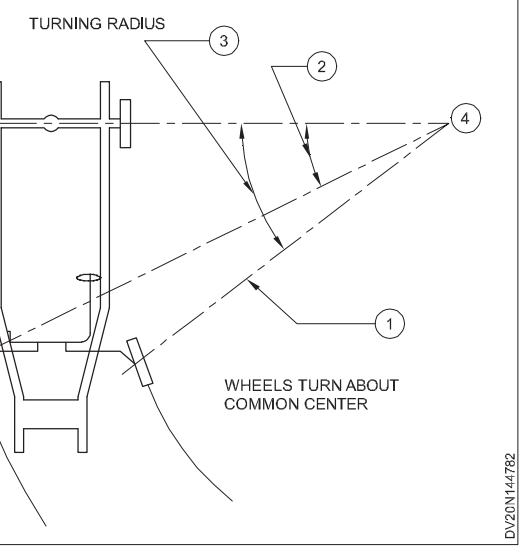


Fig 2



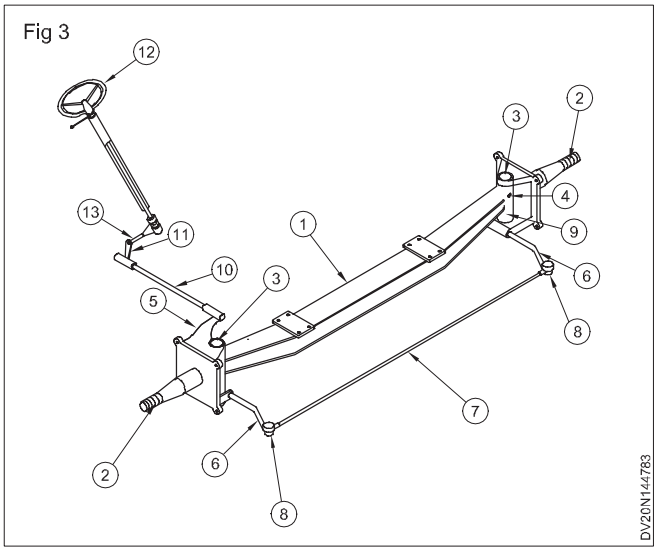
Principles of steering

The steering system along with the suspension system, allow the driver to safely and easily control the vehicle's direction while driving/

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Steering linkages (Fig 3)

Fig 3



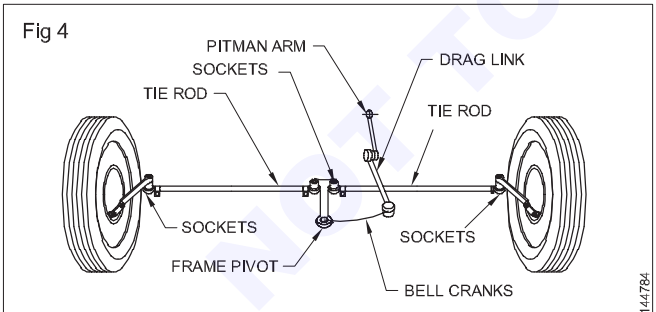
When the steering wheel (12) is turned its motion is carried to the steering box through the steering cross-shaft (13). In the steering box this motion is converted into angular motion of the drop arm (11) which is connected to the drag link rod (10). The drag link rod's (10) other end is connected to the steering lever arm (5). The steering lever arm (5) is connected to the stub axle spindle(2). At the lower end of the stub axle, the spindle steering arm (6) is fitted. Both the steering arms (6) are connected by a track rod (7). When the steering wheel is rotated the drop arm (11) moves towards or away from the front wheel depending upon the direction of turn (right or left).

For example if the vehicle is to be turned to the right side the steering wheel is rotated clockwise. The drop arm (11) is pushed towards the front wheel, which forces the stub axle (2) spindle to turn right through the drag link rod (10) and the steering lever arm (5). The reverse will happen when the vehicle is turned left.

Different types of steering linkages (Figs 4-9)

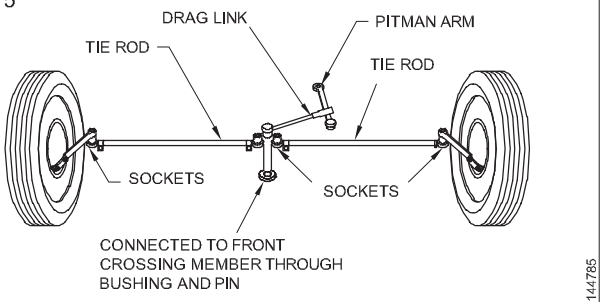
Following types of steering linkages are used.

Fig 4



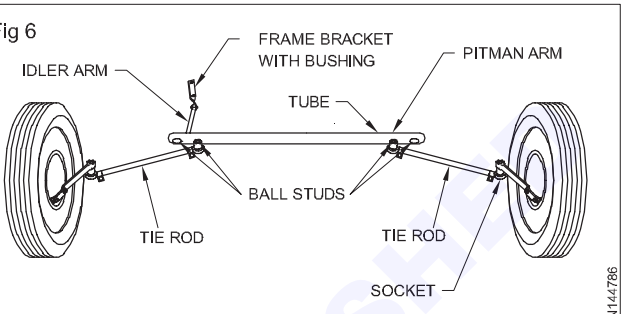
(a) CENTER-ARM STEERING WITH BELL CRANK INTERMEDIATE ARM

Fig 5



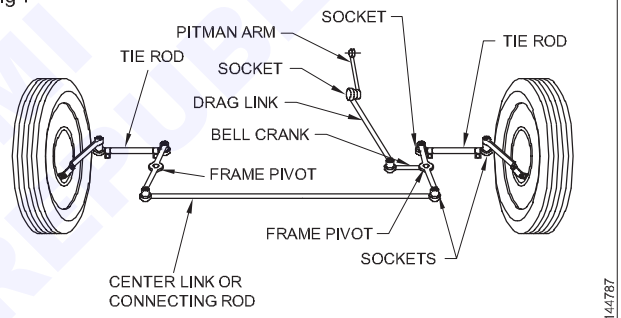
(b) CENTER-ARM STEERING WITH TRANSVERSE DRAG LINK

Fig 6



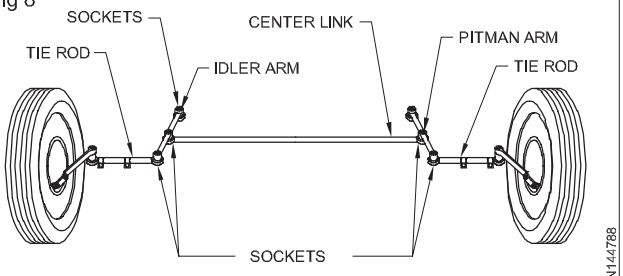
(c) PARALLELOGRAM LINKAGE WITH TUBULAR CENTRE LINK

Fig 7



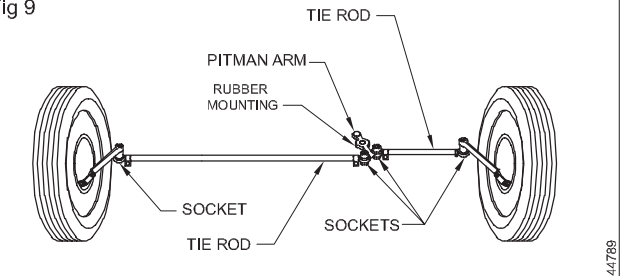
(d) PARALLELLOGRAM LINKAGE WITH CENTER LINK AHEAD OF AXLE

Fig 8



(e) PARALLELLOGRAM LINKAGE WITH CENTRE LINK BEHIND OF AXLE

Fig 9



(f) LONG-ARM, SHORT-ARM LINKAGE

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Four wheel steering system

This paper deals with the details of four wheel steering (4WS) system. With the help of this system all the four wheels can be turned to any direction using the steering. Thus the vehicle can be controlled more effectively especially during cornering and parking. Also the speed of the vehicle can be increased or decreased.

There are three types of production of four wheel - steering systems:

1 Mechanical 4WS

2 Hydraulic 4WS

3 Electro / hydraulic 4WS

The mechanical 4WS uses two separate steering gears to control the front and rear wheels. The hydraulic 4WS uses a two way hydraulic cylinder to turn both the wheels in the same direction. It is not possible to turn them in the opposite direction. The electro/hydraulic 4WS combine computer electronic controls with hydraulics to make the system sensitive to both steering angle and road speeds.

This system finds application in off-highway vehicles such as forklifts, agricultural and construction equipment and mining machinery. It is also useful in passenger cars, mainly SUVs. Four-wheel steering, 4WS, also called rear-wheel steering or all-wheel steering, provides a means to actively steer the rear wheels during turning maneuvers. It should not be confused with four wheel drive in which all four wheels of a vehicle are powered. It improves handling and help the vehicle make tighter turns.

Production - built cars tend to understeer or, in few instances, oversteer. If a car could automatically compensate for an understeer/oversteer problem, the driver would enjoy nearly neutral steering under varying conditions. 4WS is a serious effort on the part of automotive design engineers to provide near neutral steering. The front wheels so most of the steering. Rear wheel turning is generally limited to 50-60 during an opposite direction turn. During a same direction turn, rear wheel steering is limited to about 10-1.50.

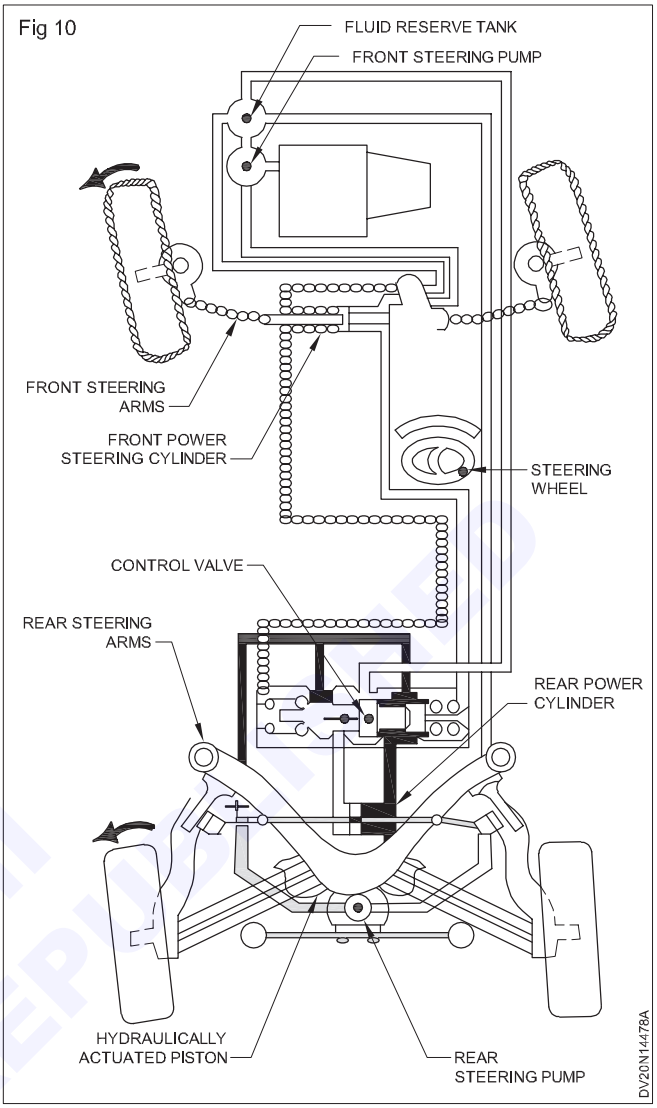
When both the front and rear wheels steer toward the same direction, they are said to be in-phase and this produces a kind of sideways movement of the car at low speeds. When the front and rear wheels are steered in opposite direction, this is called anti-phase and this produces a kind of sideways movement of the car at low speeds. When the front and rear wheels are steered in opposite direction, this is called anti-phase, counter-phase or opposite - phase and it produces a sharp, tighter turn.

Need of four wheel steering system (Fig 10)

In India, road trains used for passenger transportation in city bus service, use 4 wheel steering to enable the extra long vehicles to pass through the present turnings on the road.

Besides multi axle vehicles fitted with twin front axle where both the front axles are simultaneously steered.

Fig 10



For parking vehicles in congested parking area, 4 wheel steering in cars are very helpful.

To understand the advantages of four wheel steering, it is wise to review the dynamics of typical steering maneuvers with a conventional front steered vehicle. The tires are subject to the forces of grip, momentum, and steering input when making a movement other than straight - ahead driving. These forces complete with each other during steering maneuvers. With a front-steered vehicle, the rear end is always trying to catch up to the directional changes of the front wheels. This causes the vehicle to sway. As a normal part of operating a vehicle, the driver learns to adjust to these forces without thinking about them.

When turning, the driver is putting into motion a complex series of forces. Each of these must be balanced against the others. The tires are subjected to road grip and slip angle. Grip holds the cars wheels to the road, and momentum moves the car straight ahead. Steering input causes the front wheels to turn. The car momentarily resists the turning motion, causing a tire slip angle to form. Once the vehicle begins to respond to the steering input. Cornering forces are generated. The vehicle sway as the rear wheels attempt to keep up with the cornering forces already generated by the front tires.

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This is referred to as rear - end lag, because there is a time delay between steering input and vehicle reaction. When the front wheels are turned back to a straight - ahead position, the vehicle must again try to adjust by reversing the same forces developed by the turn. As the steering is turned, the vehicle body sways as the rear wheels again try to keep up with the cornering forces generated by the front wheels.

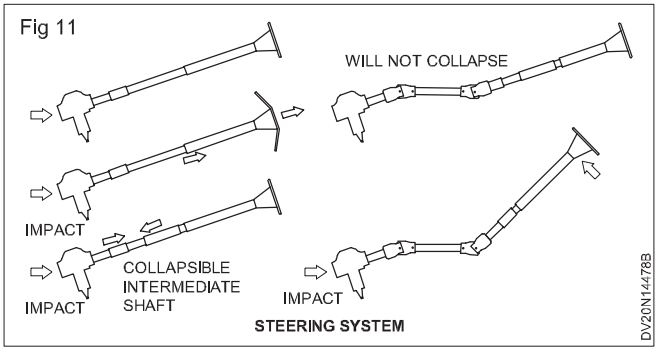
The idea behind four - wheel steering is that a vehicle requires less driver input for any steering maneuver if all four wheels are steering the vehicle. As with two wheel steer vehicles, tire grip holds the four wheels on the road. However, when the driver turns the wheel slightly, all four wheels react to the steering input, causing slip angles to form at all four wheels. The entire vehicle moves in one direction rather than the rear half attempting to catch up to the front. There is also less sway when the wheels are turned back to a straight - ahead position. The vehicle responds more quickly to steering input because rear wheel lag is eliminated.

Collapsible steering column (Fig 11)

A typical car from 50 years ago not only had a massive steering wheel with a metal horn rim, but it connected to a steering column that was one piece. So in frontal collision the driver was getting injured by the steering wheel hit in the stomach.

With collasible steering system is made of several joints and intermediate pieces. During impact the intermediate pieces, act like fuse, which collapses saving the life of driver.

Fig 11



General arrangement of steering system

The arrangement of steering linkage depends upon the type of from suspension and also with the location of the steering gear in relation to the front wheels.

Steering columns

The steering column is always at an inclination to vertical for comfort in driving. In fact, the driver comfort and the location of the steering gear bore on the classis frame. Due to this two factors, the inclination of column is about 20° in commercial vehicles and 50° in motor cars and upto 70° in sports car. The steering wheel is connected to the steering linkages to turn the front wheels with great effort.

Steering gear box

Objectives: At the end of this lesson you shall be able to
- **state the various types of steering gear boxes**
- **state the maintenance of the various steering gear box.**

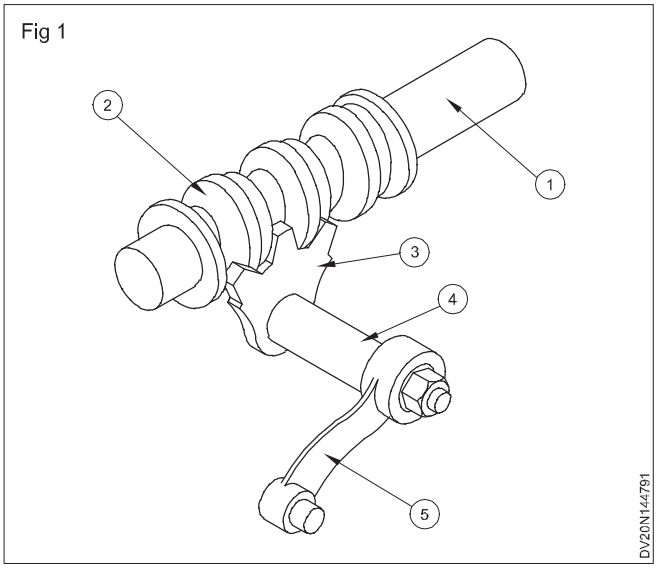
The following types of steering boxes are used.

- Worm and sector
- Worm and wheel
- Worm and nut
- Worm and roller
- Worm and recirculating ball and nut
- Rack and pinion

Worm and sector type (Fig 1)

The steering gearbox consists of the steering shaft (1) fitted with a worm (2) at one end. The worm (2) is in mesh with the sector (3). When the steering wheel is rotated, its motion is transmitted to the sector (3), through the worm (2). The sector (3) rotates at a certain angle. The sector shaft (3) in turn rotates a cross-shaft (4) which is connected to the drop arm (5). This angular movement is transmitted to the front wheels through the linkages to turn the vehicle.

Fig 1

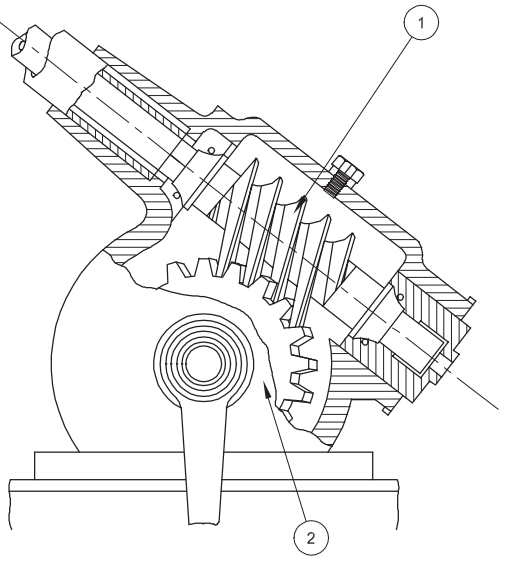


Worm and wheel type (Fig 2)

In this type a complete gear (2) is used instead of a sector. The worm (1) and gear (2) can be rotated to a new position as the sector portion wears out faster on use.

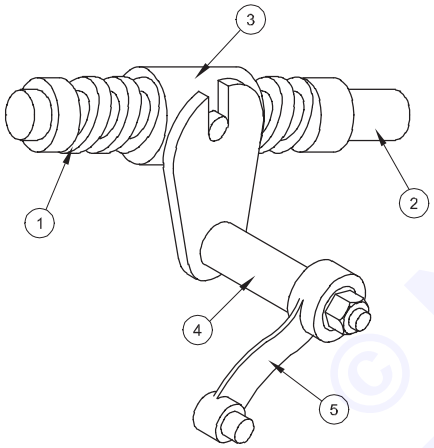
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Fig 2



Worm and nut type (Fig 3)

Fig 3

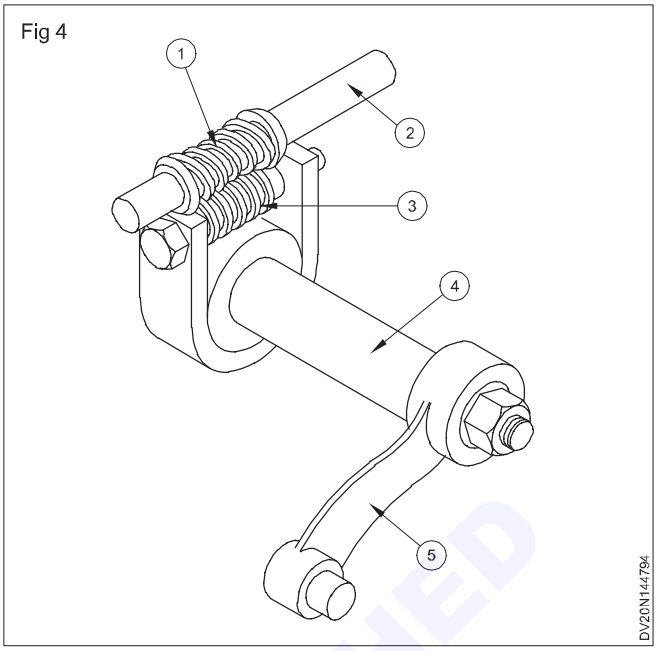


In this type the worm (1) is an integral part of the steering column (2). When the steering column (2) rotates the worm (1) also rotates. The worm (1) is in mesh with the nut (3). When the worm rotates the nut (3) moves up and down on column (2). This enables the cross-shaft (4) to rotate in an arc. This in turn rotates the drop arm (5) in an arc. This movement is transmitted to the front wheels to turn the vehicle.

Worm and roller type (Fig 4)

The worm (1) is at the end of the steering column (2). The diameter of the worm (1) is more at its ends. Its diameter is gradually reduced at the centre. This enables the roller (3) to keep the contact with the worm (1) at all the positions. It also provides a variable ratio to permit faster and efficient steering. The roller (3) is mounted on the cross-shaft (4). The cross-shaft (4) is fitted to the drop arm (5). When the steering wheel is rotated, the column (2) also rotates along with the worm (1), which allows the roller (3) to rotate in an arc. This makes the cross-shaft (4) and drop arm (5) to move in an arc, which in turn moves the front wheels to the left or right through the linkages.

Fig 4



Worm and recirculating ball and nut type (Fig 5 & 6)

Fig 5

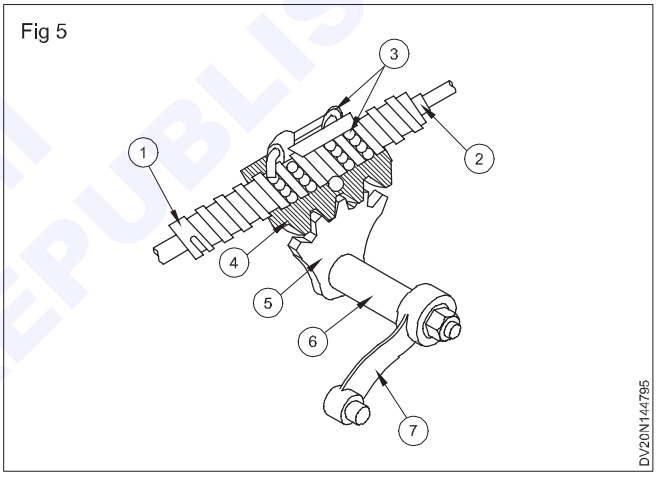
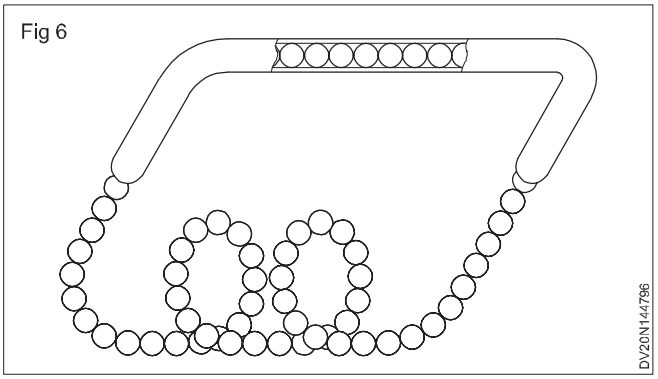


Fig 6



The worm (1) is at the end of the steering column (2). A ball nut (4) is fixed on the worm (1). Several balls (3) circulate in between the ball nut (4) and the worm (1). This reduces friction between the worm (1) and nut (4). A sector (5) is in mesh with the ball nut (4). When the steering wheel is rotated the steering column (2) also rotates and the ball nut (4) moves downward or upward on the worm (1). This makes the sector (5), cross-shaft (6) and drop arm (7) to move in an arc. This movement is transmitted to the front wheels to turn the vehicle.

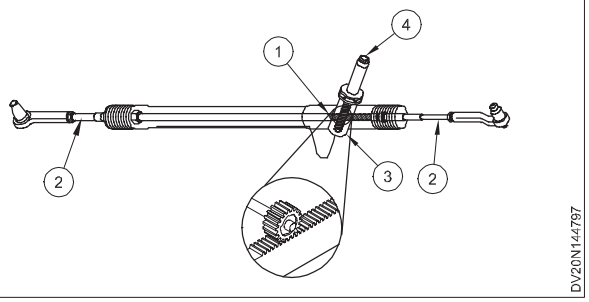
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Arrangement of balls is shown in Fig 6. During overall always count the number of balls and ensure that the correct quantity is inserted. Lesser quantity of ball will affect the response from steering.

Rack and pinion type (Fig 7)

In this type a rack (1) is either connected or made part of a divided track-rod (2). The pinion (3) is attached to the steering column (4). The pinion (3) always remains in mesh with the rack (1). When the steering wheel is rotated the pinion (3) also rotates and the rack (1) moves left or right, causing the wheels to turn.

Fig 7



Helix gear

Helical gears are one type of cylindrical gears with slanted tooth face compared to spur gears, they have the larger contact area and excel in quiteness and less vibration and able to transmit large force a pair of helical gears has the same helix angle but the helix hand is opposite.

Maintenance of steering components

Fill oil upto the recommended level with the prescribed grade of lubricant. Remove the oil at prescribed intervals. Steering becomes hard in the absence of lubrication. After same run, the mating parts wear out, increasing the play this leads to steering noise & vibration.

The drop arm nut is to be tightened to a prescribed toque.

Drop arm and rocker shaft is to be fixed only at a prescribed position. It can be assembled only in one way. Otherwise make punch marks in both rocker shaft and drop arm at the time of removal.

'O' rings, seals, used in steering box are to be renewed during over haul or renewed in case of oil leaks.

Universal joints (single or double) are provided at the end of steering column, to provide

i Comfortable steering angle as per design

ii Absorb road shocks, which is not transmitted to drivers hand.

Backlash between mating gears are specified based on design. Rocker shaft end plays are specified by the supplier and the same is to be adjusted. Bearing preload is to be done during assembly of steering.

Helix's new steering box uses state of art CAD/CAM technology to ensure the quickest and smoothest steering on the market.

Power steering

Objectives: At the end of this lesson you shall be able to
- **state the need of power steering**
- **state the benefits of power steering**
- **state the types of power steering**
- **state the features of power steering**
- **state the construction of fully integral power steering**
- **state the operation of power steering**
- **state the shock absorption by power steering**
- **explain flow control valve of power steering**
- **briefly explain on pressure relief valve.**

Need for power steering

The need to achieve the greatest possible road safety under

- Increasing traffic density
- High axle loads
- Poor road conditions

Led to the development of power steering.

Benefits of power steering

- Effortless steering - reducing drivers fatigue
- Quick response - power assistance is immediate
- Positive road feel to the driver
- Absorbs road shocks
- Greater safety (in case of front tyre burst)
- Steering can be operated manually, in case of loss of power assistance
- Absolute control during driving
- Greater maneuverability

Types of power steering

There are three types of power steering system used in automobiles

1 Integral power steering

2 Linkage power steering

3 Electronic power steering

Fully integral power steering gear

Salient features of power steering gear

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Rotary valve

This device provides responsive steering control

Unloading valves

Furnish power steering pump protection and reduce pressure to unload steering linkage at the ends of steering gear travel.

Recirculating balls

Combines high mechanical efficiency with smooth operation.

Torsion bar

Provides positive valve centering with ultimate feel of the road.

Balanced area cylinder

Back pressures cannot affect steering stability.

Manual steering capability

Provides for steering control in the event of hydraulic failure

Construction

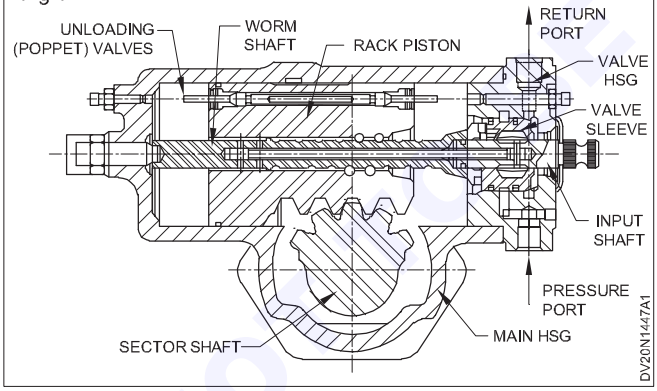
The fully integral power steering gear consists of

- A manual steering mechanism (Re circulating ball & nut type)
- Hydraulic power cylinder and piston
- A rotary control valve.

In a single compact package.

Normal operation (Fig 1)

Fig 1



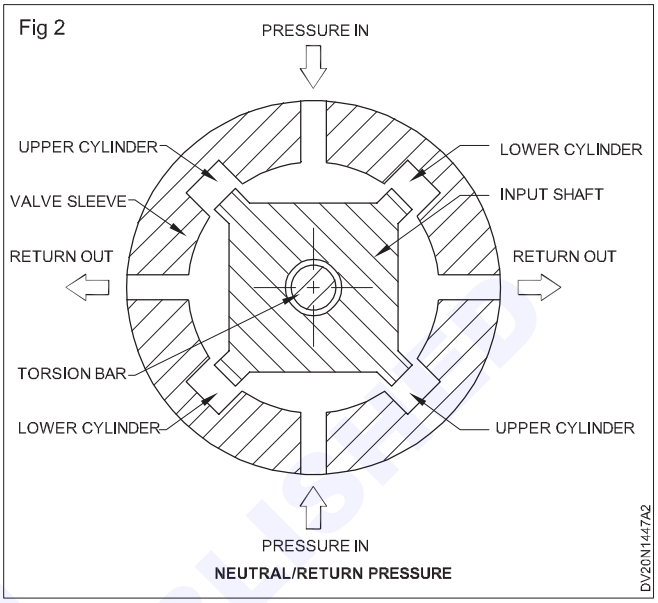
When the driver turns the steering wheel, he activates the steering gear input shaft. A torsion bar pinned at its one end to the input shaft and the other end to the worm shaft, turns with the input shaft and exerts a rotational force on the worm shaft. In response to this rotational force the worm shaft acting through the re-circulation ball mechanism, tries to move the rack piston axially through the gear housing cylinder bore.

Hydraulic power assistance

The rack piston's axial movement is resisted by its engagement to the sector shaft, which is connected by linkage to the steered wheels. Because of this resistance, the torsion bar is twisted by the input shaft, thereby actuating the control valve. Pressurized fluid directed by the control valve assists in moving the rack piston axially through the cylinder bore. The rack piston then turns the sector shaft to steer the vehicle to the desired direction.

Neutral condition (Fig 2)

Fig 2



The rotary control valve mechanism, which is the heart of power steering system comprises of input shaft, worm shaft, torsion bar and valve sleeve. When all these components assembled together this becomes "valve assembly". The input shaft has four lands and the valve sleeve has four pockets assembled in neutral condition. The valve sleeve has keyed connection with the worm shaft. The diagonally opposite pockets connect the oil to the lower or upper cylinder. Always the valve will be in neutral condition. In this condition the oil flows to both sides of the cylinder and return back to the reservoir.

Right turn (Fig 3)

When the driver rotates the input shaft to the right through the steering wheel. Because of the road resistance the torsion bar gets twisted and the input shaft alone will twist to the right and disturbs the valve neutral position, thereby causing all the oil to flow to the lower cylinder and pushes the rack piston towards top. Once the driver stops rotating the steering wheel the torsion bar will gain its original position, as the worm shaft rotates and bring back the valve sleeve to the neutral position.

Left turn (Fig 4)

When the driver rotates the input shaft to the left through the steering wheel. Because of the road resistance the torsion bar gets twisted and the input shaft alone will rotate to the left and disturbs the valve neutral position, thereby causing all the oil to flow to the upper cylinder and pushes the rack piston towards bottom. Once the driver stops rotating the steering wheel the torsion bar gain its original position, as the worm shaft rotates and bring back the valve sleeve to the neutral position.

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Fig 3

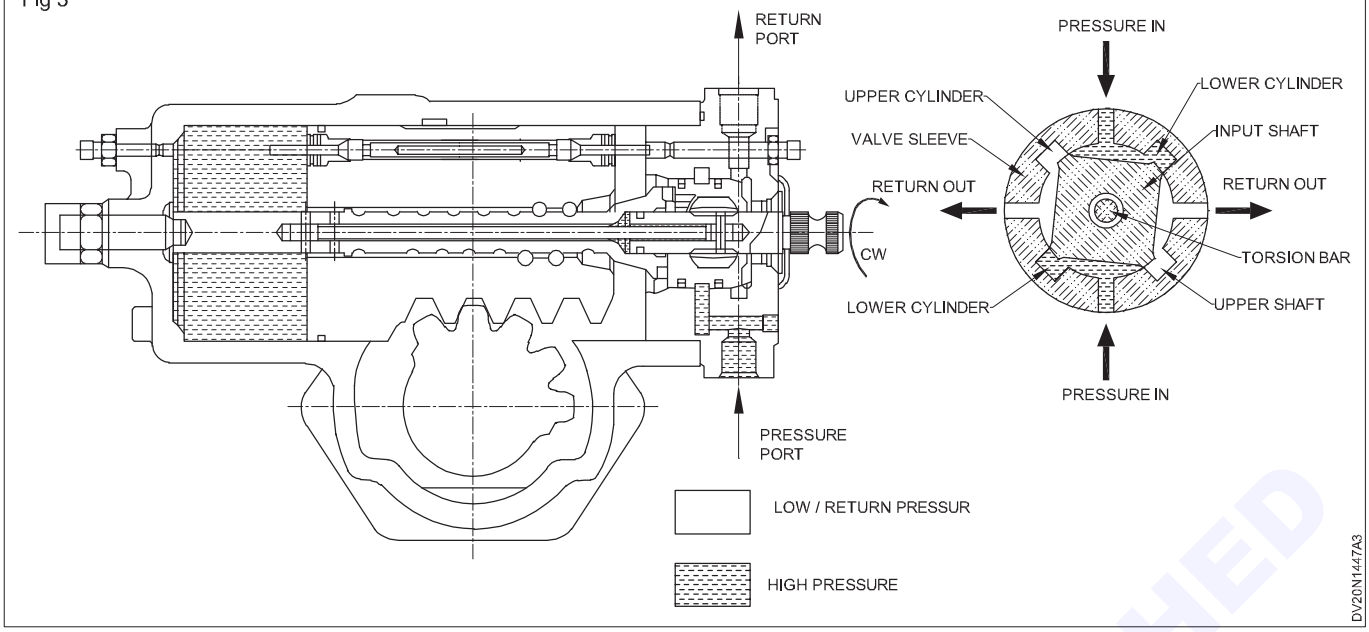
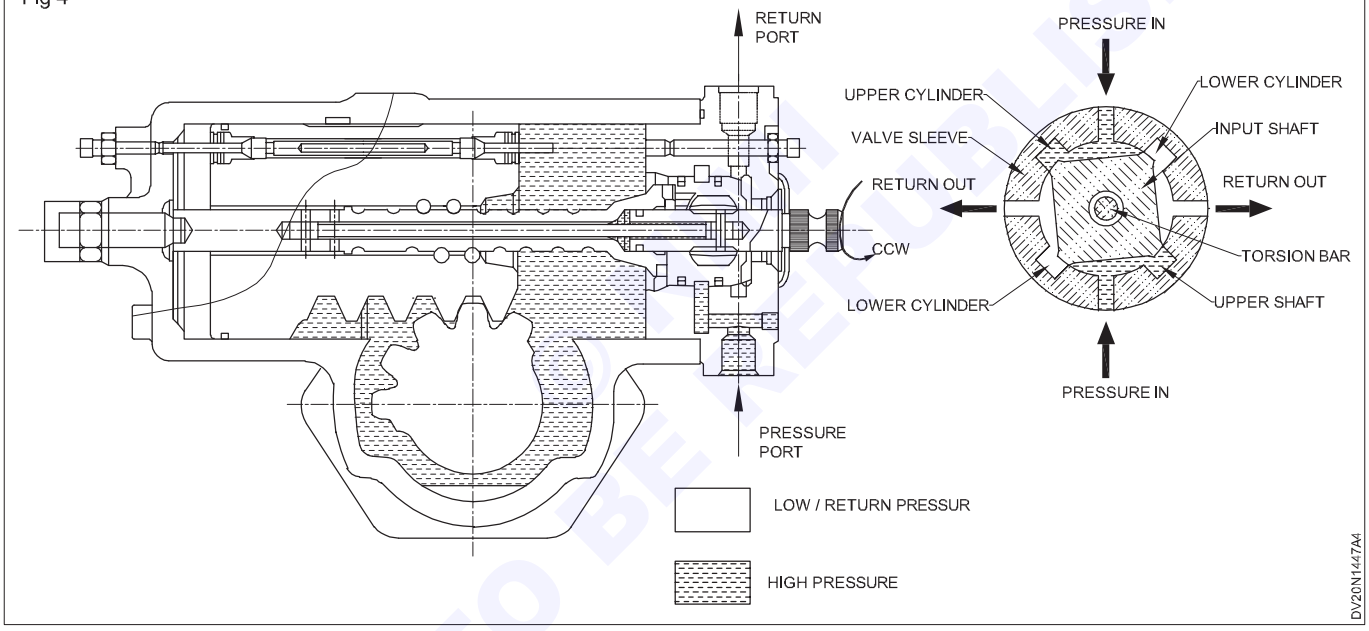


Fig 4



Shock absorption

Valve in shock absorption (Fig 4)

In general during the turns the driver disturbs the valve neutral position, causing the oil to flow to the respective cylinder. During shock absorption the road shocks force the worm shaft to rotate causing the valve sleeve to move from neutral condition, thereby causing the neutral condition disturbed and the oil flow on the opposite side resisting the Rack piston's movement, thus the oil absorbs all the road shocks and prevent shocks getting transmitted to the driver.

Flow control valve (Fig 5)

Function

The flow control valve controls the rate of flow within the power steering circuit. This is because, since the discharge rate per oil pump revolution (characteristic discharge rate) is constant, the discharge rate per unit time increases and decreases in proportion to the engine speed. To maintain uniform performance, the power steering requires a flow rate that remains within certain fixed range. The flow rate required by power steering is determined by the speed at which steering wheel is tuned, but must be such that power steering can respond at higher speeds. Consequently when the oil pump discharge rate exceeds a certain value in respective to the engine speed increase, the excess flow escapes to the interior of the pump or the reservoir so that the hydraulic fluid is always supplied to the system at the required rate.

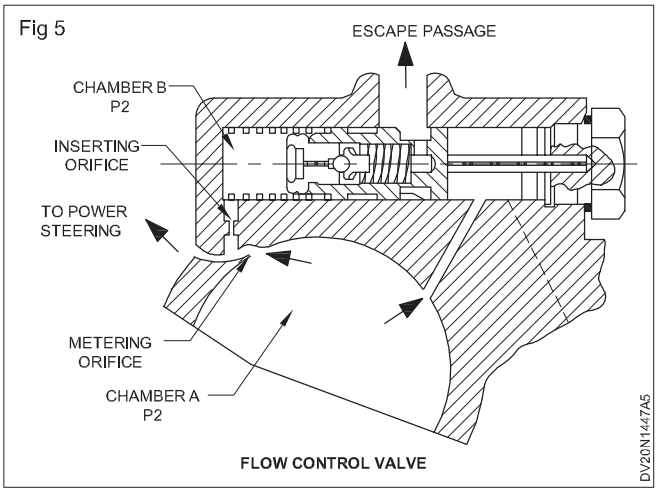
Operation

The hydraulic fluid discharged by the oil pump enters the pressure chamber, from it passes through the metering orifice to power steering chamber. When the pump discharge rate is lower than the adjustment flow rate, the fluid pressure differential between the chambers,

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movement of the flow control valve is prevented by the pressure of the spring and all of the fluid from the oil pump supplied to the power steering gear box.

Fig 5

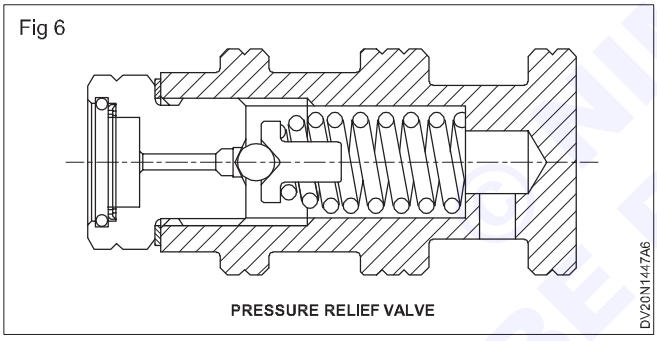


FLOW CONTROL VALVE

The oil pump speed increases together with the engine speed, which increases the hydraulic fluid rate. When the discharge rate exceeds the adjustment flow rate (spring force) the spring is deformed from its original position and the flow control valve will move in and the excess oil will bypass to the suction line.

Pressure relief valve (Fig 6)

Fig 6



PRESSURE RELIEF VALVE

Function

The pressure relief valve controls the maximum pressure in the power steering circuit. That is the load on the oil pump is directly proportional to the steering wheel resistance. When steering wheel resistance is high, the hydraulic pressure required for power steering is also high and vice versa. Whenever the road wheels contact an obstacle or wheel stopper, which requires additional force to steer the wheel, the pressure will increase infinitely. Therefore a mechanism is required to prevent excessive force being applied and to protect the steering mechanism.

Operation

The pressure relief valve is built into the flow control valve. When the steering wheel is not being operated and during normal steering wheel operation the operating pressure will never raise above the adjustment pressure. Therefore the relief valve and the steel ball are seated by the force of the spring to close the passage.

The steering wheel is turned fully, therefore the power steering valve remains closed. In this state the hydraulic fluid from the oil pump is under pressure and the pressure exceeds the force of the spring, the relief valve and steel ball are lifted from its seat causing the oil to bypass to the suction side of the pump.

Trouble shooting

Noise in steering - Presence of air in the fluid will make it noisy and spongy (not responding) low fluid level also lead to noisy operation and unresponsive steering.

The remedy is to fill fluid upto the level and bleed the system to remove air.

Electronic power steering

Objectives: At the end of this lesson you shall be able to
- **state the working principle of electronic power steering.**

Electronic power steering (Fig 1)

There is a provision to protect the electric motor from being overloaded and also from the voltages surges from a faulty alternator or charging problem.

The electronic steering control unit is capable of self-diagnosing faults by monitoring the system's inputs and outputs and the driving current of the electric motor. In case of a problem, the control unit turns off the entire system by actuating a fail-safe relay in the power unit, the system reverts back to manual steering and warning light on the dashboard alerts the driver.

An electronic power steering has the following advantages over the hydraulic power steering, due to which it is being increasingly used in modern cars:

1 No problem of leakage of fluid.

2 Energy being consumed only while steering.

3 Steering assistance available even when the engine is not running.

4 While steering manually lesser force is required compared to a hydraulic system since there is no fluid to forced through valves.

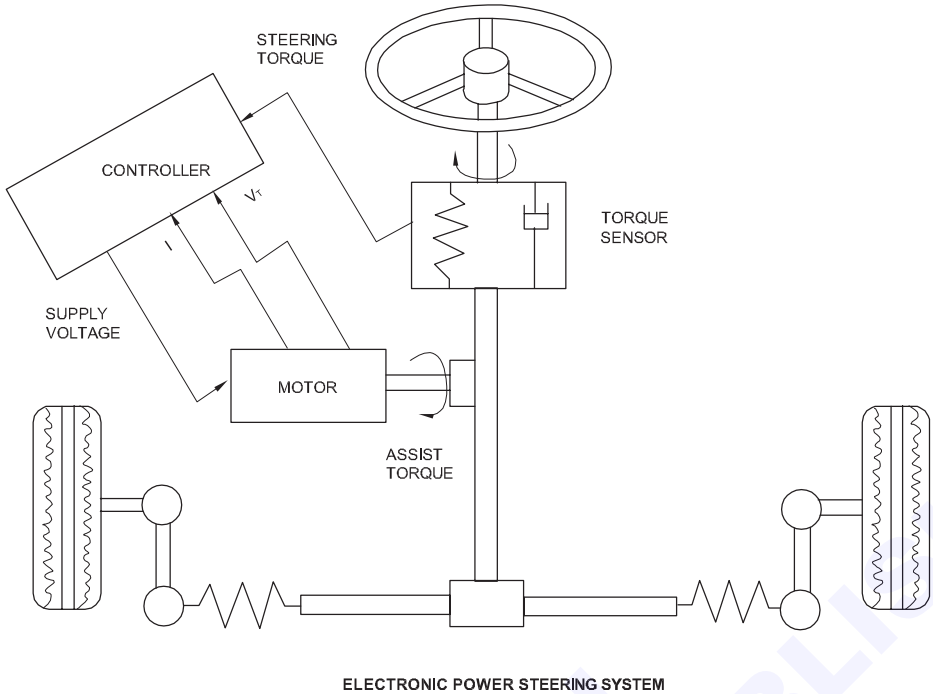
In an electronic power steering system (Fig 2), steering sensor consisting of in fact two sensors, viz, a 'torque sensor' that converts the steering torque input and its direction into voltage signals, and a 'rotation sensor' that converts the rotation speed and direction into voltage signals, is located on the input shaft of the steering-gear box.

Inputs from the steering sensor and the vehicle speed sensor are fed to a microprocessor control unit where these are compared with a preprogrammed force assist map. The control unit then sends out the appropriate command signal to the current controller which supplies

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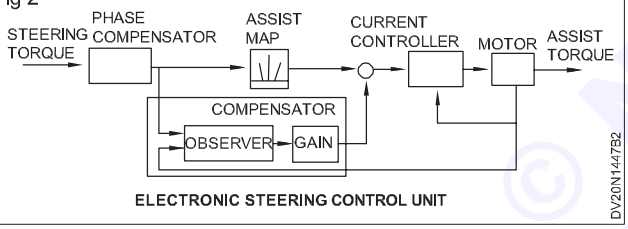
the appropriate current to the electric motor. The motor pushes the rack to the right or left depending on in which direction the current flows. Increasing the current to the motor increases the amount of power assist.

Fig 1



ELECTRONIC POWER STEERING SYSTEM

Fig 2



ELECTRONIC STEERING CONTROL UNIT

Suspension system

Objectives: At the end of this lesson you shall be able to
- **state the function of the suspension system**
- **describe unsprung of and sprung weight**
- **list out the different types of suspension forces.**

While vehicle need of suspension system moving on the road the wheels are thrown up and down due to the unevenness of the road. This results in strain on the components of the vehicle and the passengers. To prevent damage to the working parts and also to provide riding comfort, suspension is used in the vehicles.

Functions of the suspension system

- It maintains the body level.
- It prevents road shocks reaching the frame and other units and provides riding comfort to passengers.
- It gives cushioning effects.
- It transfers the driving torque to wheels of the dead axle.
- It transfers the braking torque to the chassis.

Unsprung weight and sprung weight

Unsprung weight is largely a function of the design of a vehicle's suspension and the a materials used in the construction of suspension components. Beam axle suspension, in which wheels on opposite sides are connected as a rigid unit, generally have greater unsprung weight than independent suspensions systems, in which the wheels are suspended and allowed to moe separately. Heavy components such as the differential can be made part of the sprung weight by connecting them directly to the body (as in a de Dion tube rear suspension). Light-weight materials, such as aluminium, plastic, carbon fiber, and / or hollow components can provide further weight reductions at the expense of greater cost and/or fragility.

In a ground vehicle with a suspension, the unsprung weight (or the unsprung mass) is the mass of the suspension, wheels or tracks (as applicable) and other

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components directly connected to them rather than supported by the suspension. (The mass of the body and other components supported by the suspension is the sprung weight includes the mass of components such as the wheel axles, wheel bearings, wheel hubs, tires and a portion of the weight of drive shafts, springs, shock absorbers, and suspension links. Even if the vehicle's brakes are mounted outboard (i.e., with the wheel), their weight is still considered part of the unsprung weight.

Scooter-type motorcycles use an integrated engine-gear-box-final drive system that pivots as part of the rear suspension and hence is partly unsprung. This arrangement is linked to the use of of quite small wheels, further affecting the reputation for road - holding.

Driving uneven surface

If a vehicle is driven over a hump at high speed, the body initially remains balanced due to the large mass. The wheel, with its small mass in relation to the body, is accelerated upwards very rapidly, and in doing so it compresses the spring. Only the force corresponding to this spring travel is acting on the body.

On the other side of the hump, the wheel is accelerated downwards by the preloaded spring. Only the load relief of the spring corresponding to the bump acts on the body.

If the force the wheel is greater than the initial tension of the spring, the wheel loses adhesion on the road surface for a short time, as the initial spring tension is insufficient to move the wheel downwards quickly enough.

To achieve good driving safety and the best possible comfort, the unsprung mass should be as small as possible.

Body vibration frequencies

These can be determined by the vibration at the front or rear of the vehicle. A complete vibration consists of the spring compression and rebound process. The number of vibrations per minute then gives the body-vibration frequency. Vibration dampers do not control the vibration frequency, the amplitude of oscillation is down rated by the greater resistance. In contrast, the mass plays a large part. The heavier the vehicle or the larger the payload, the lower the vibration frequencies become.

Frequency: This is the number of vibrations per second. Since a body does not vibrate very quickly, the number of vibrations is also given per minute (vibration frequency, body-vibration frequency).

A large mass and soft springs result in a low frequency (vibration frequency) and a large spring level.

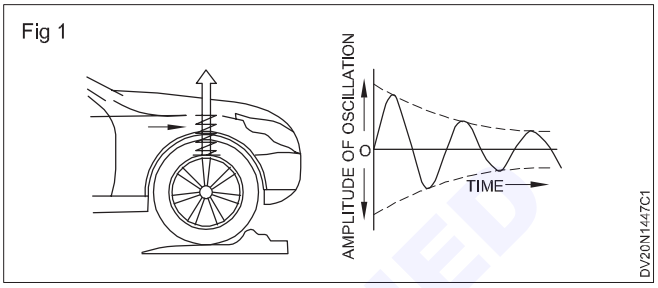
Damping vibration

If the wheel of a motor vehicle travels over an obstacle, both the body and the wheel start to vibrate. The upwards movement of the wheel causes the helical spring to be compressed, the spring force accelerates the body upwards. The spring force generated when the spring expands slows the body down again, the upper reversing point is reached. The body is accelerated downwards by the weight, beyond the rest position. The spring is compressed (tightened), the resulting spring force slows the movement of the body to the lower reversing point.

The travel from the upper to the lower reversing point of a vibration is known as the amplitude of oscillation.

This motion sequence is repeated until the kinetic energy is converted into heat by spring and air friction. (Fig 1)

Fig 1



Location of suspension system

The suspension system is provided in between the axles and chassis frame. There are two type of axles generally used in motor vehicles. They are:

1 **Solid Axle:** A solid axle (also called live axle or beam axle) houses the vehicle differential inside the axle itself connected to the wheels by rigid half shaft.

   The entire axle moves as one, so if a left wheel drops into a pot hold, right wheel moves upto response.

2 **Dead Axle:** The axle shaft does not transmit power to the wheels and if it is provided for supporting the wheels and the suspension parts then it is called as dead axle.

Leaf springs: Leaf springs were the first type of suspension spring used on automobiles, today they are generally found on light-duty & heavy trucks, vans, and some passenger cars. There are three basic types of leaf springs: multiple leaf, monoleaf and fiber composite.

Multiple-Leaf springs: Multiple-leaf springs consist of a series of flat steel leaves that are bundled together and held with clips or by a bolt placed slightly ahead of the center of the bundle. One leaf called the main leaf, runs the entire length of the spring. The next leaf is a little shorter and attached of the main leaf. The next leaf is shorter yet and attaches to the second leaf, and so on. This system allows almost any number of leaves to be used to supported the vehicle's weight. (Fig 2)

Multiple-leaf springs have a curve in them. This curve, if doubled, forms an ellipse. Thus, leaf springs are sometimes called semielliptical or quarter elliptical. The semi or quarter refers to how much of the ellipse the spring actually describes. The vast majority of leaf springs are semielliptical.

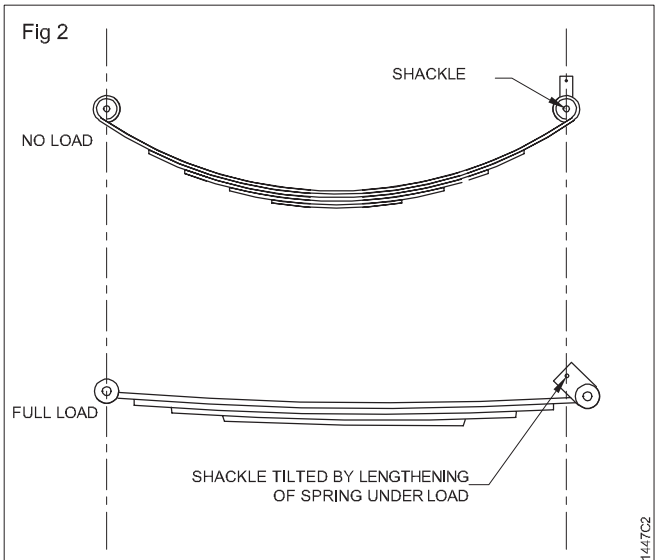
Leaf springs are typically mounted at right angles to the axle.

Monoleaf springs: Monoleaf or single-leaf springs are usually the tempered plate type with a heavy or thick

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center section tapering off or both ends. This provides a variable spring rate for a smooth ride and good load-carrying ability. In addition, single-leaf springs do not have the noise and static friction characteristic of multiple-leaf springs.

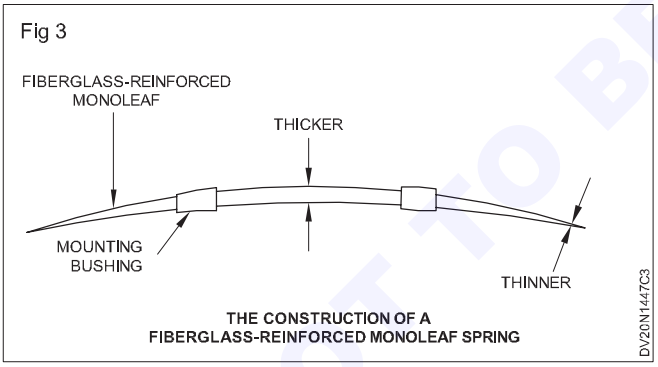
Fig 2



THE ACTION OF A LEAF SPRING AS IT COMPRESSES

Fiber composite springs: While most leaf springs are still made of steel, fiber composite types are increasing in popularity (Fig 3). Some automotive people call them plastic springs in spite of the fact that the springs contain no plastic at all. They are made of fiberglass, laminated and bonded together by tough polyester resins. The long strands of fiberglass are saturated with resin and bundled together by wrapping (a process called filament winding) or squeezed together under pressure (compression molding).

Fig 3



THE CONSTRUCTION OF A FIBERGLASS-REINFORCED MONOLEAF SPRING

Fiber composite leaf springs are incredibly lightweight and possess some unique ride control characteristics. Conventional monoleaf steel springs are heavy weights, tipping the scale at any where

Coil spring: These are mainly used as compression springs in passenger care. Generally open coil helical springs are used in vehicles.

Advantages: Low weight, low space requirements,

Disadvantages: Almost no damping, no transmission of wheel forces (longitudinal and transverse forces).

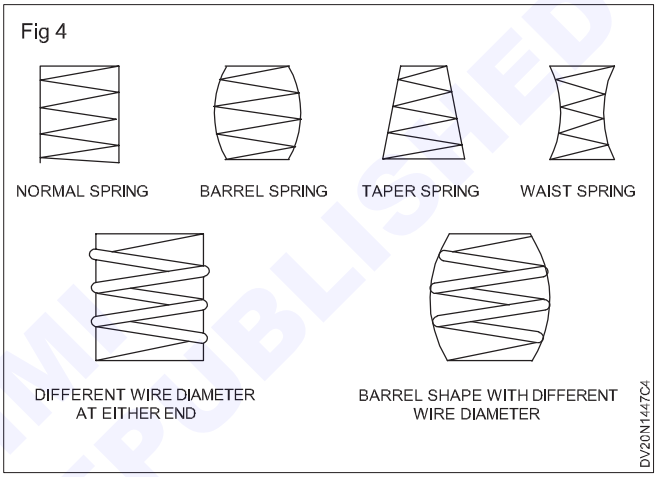
Helical springs usually have a linear spring characteristic. Soft helical springs differ from hard helical springs in that they have a:

- Smaller wire diameter
- Larger spring internal diameter
- More loosely would coil

Helical springs with a progressive characteristic must be fitted to allow a greater pay load and adequate comfort when the vehicle is unladen. This can be achieved with the following:

- Different sizes of the internal diameter, e.g. taper shape, barrel shape, waist shape
- Different wire diameters. (Fig 4)

Fig 4

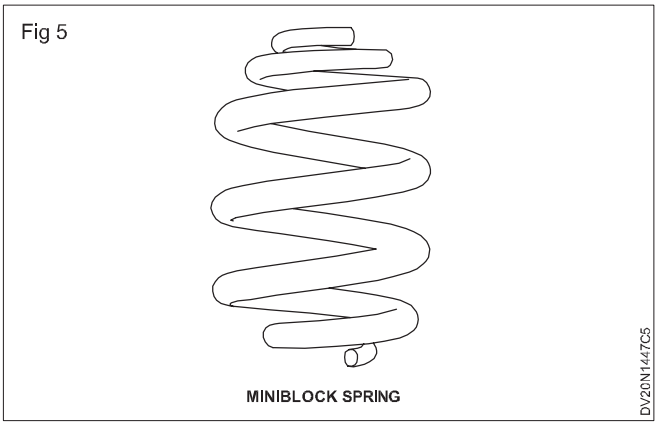


Types of helical springs

The barrel-shaped miniblock spring has the advantage over the cylindrical helical spring that the spring coils cannot touch when the spring is compressed while the vehicle is in motion because each coil lies inside the larger ones forming a spiral (Fig 5). This means that the spring can be shorter without sacrificing a long spring range for a high load-carrying capacity. The miniblock spring incorporates all the options for a progressive spring.

Helical springs cannot transfer wheel guidance forces.

Fig 5



MINIBLOCK SPRING

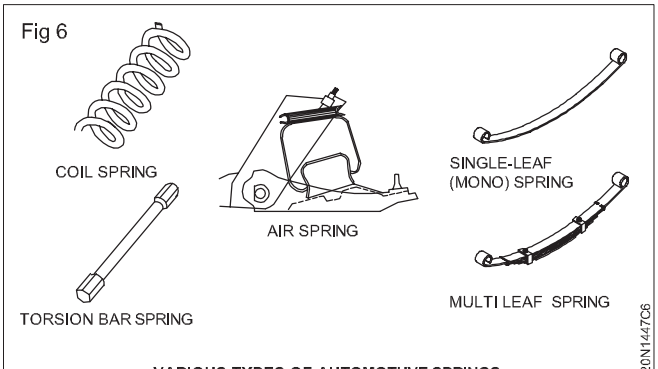
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They are therefore only used in axle designs in which the motive, braking and lateral forces are transferred by other elements (control arm, trailing arm McPherson-suspension strut). Vibration dampers are nowadays only rarely used inside the helical spring (Fig 5) because fitting and removal are very time consuming.

Rubber spring

Natural and synthetic rubber are very elastic and have high interia damping characteristics. Hence it is used with vehicle springs. The high internal damping and elasticity of the rubber is used to intercept high-frequency vibrations, e.g. the control arm, are mounted in rubber cushions. This also improves the transverse suspension. (Fig 6)

Fig 6

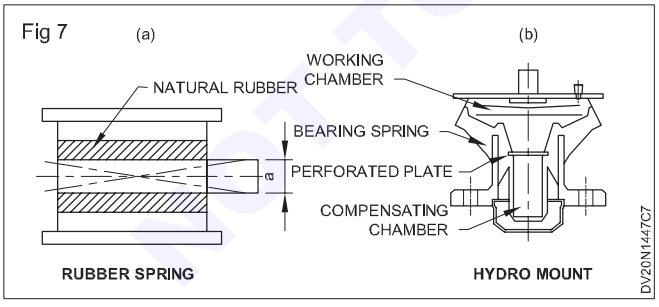


VARIOUS TYPES OF AUTOMOTUVE SPRINGS

Rubber spring & Hydro mount

Hydraulically damped elastomer mountings (hydro mount, Fig 7) are used instead of simple rubber springs to prevent vibrations of various frequencies from being transferred from the engine to the body. These consist of an elastic bearing spring made from natural rubber, which forms the mechanical connection between the engine and the body, and a hydraulic section, which consists of a working chamber and a compensating chamber and which is filled with hydraulic fluid. A perforated plate between the two chambers impedes the flow of fluid into the compensating chamber and damps any vibrations that have been transfered here.

Fig 7



RUBBER SPRING HYDRO MOUNT

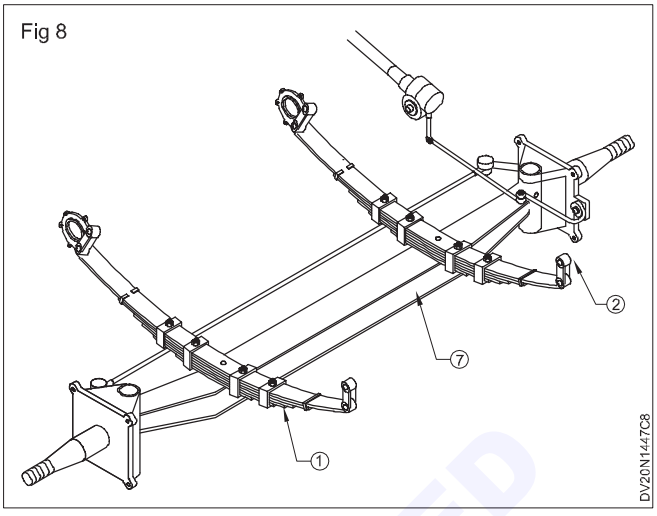
Different types of suspensions system

The following types of suspensions are used in automotive vehicles.

- Conventional suspension system (fixed axle suspension)
- Independent suspension system
- Air suspension system
- Rubber spring suspension system

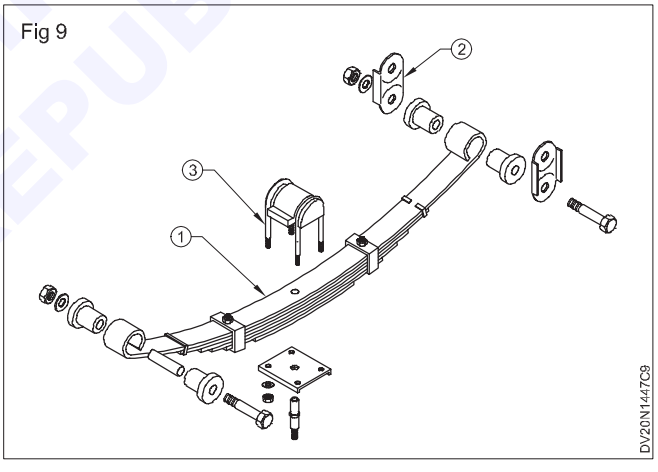
Conventional suspension system (leaf spring) (Fig 8)

Fig 8



In this system, a set of leaf springs (1) is used which connect the frame and axle (7). One end of the spring is fixed to the frame (8) and the other end is anchored by the shackle(2). The spring is mounted on the axle by 'U' bolts (3) (Figs 9 & 10). When the vehicle moves on bumps or ditch etc. the spring (1) elongates and the shackle (2) moves backward to accommodate the change in the spring length.

Fig 9



The following types of leaf springs are used.

- Semi-elliptical spring (Fig 11)
- Quarter elliptical spring (Fig 12)
- Three quarter elliptical spring (Fig 13)
- Transverse spring (Fig 14)
- Full elliptical spring (Fig 15)

In some vehicles a helper spring is used to relieve heavy load from the main spring assembly. The helper spring (4) is mounted on the top of the main spring assembly and its ends are kept loose. When the main spring deflects upward under heavy load, these loose ends rest against the brackets (5). A rubber buffer (6) is mounted on the frame so in the event of a heavy jerk spring does not hit the chassis frame. (Fig 16)

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Fig 10

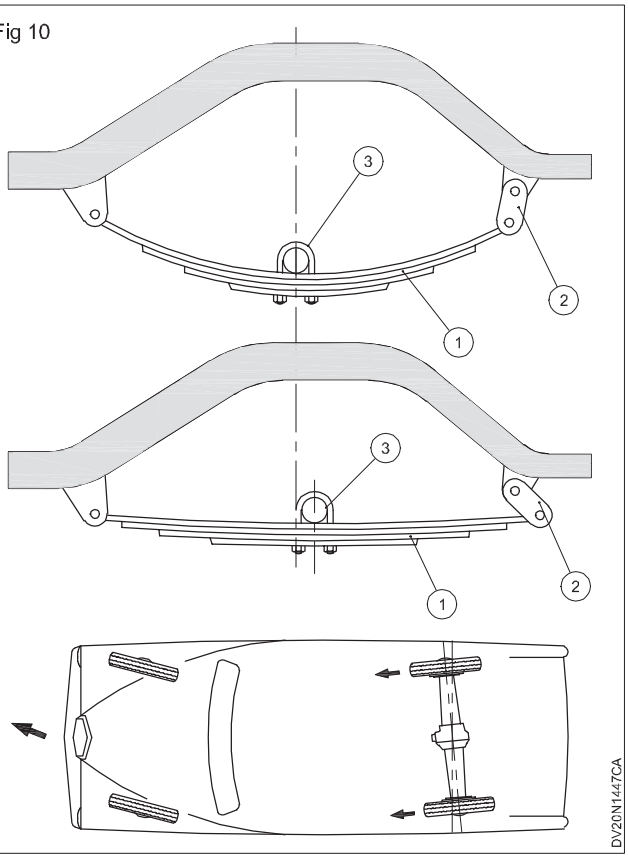


Fig 11

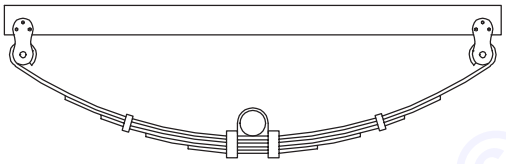


Fig 12

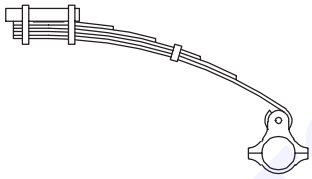


Fig 13

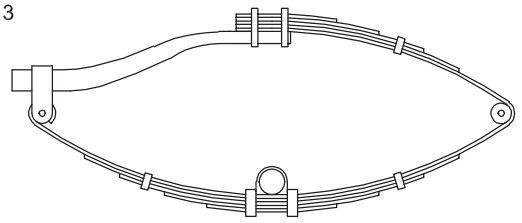


Fig 14

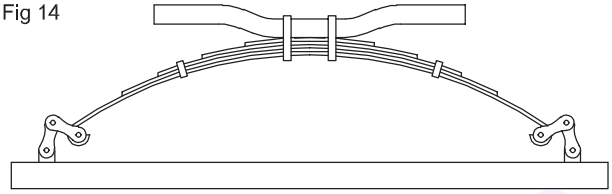


Fig 15

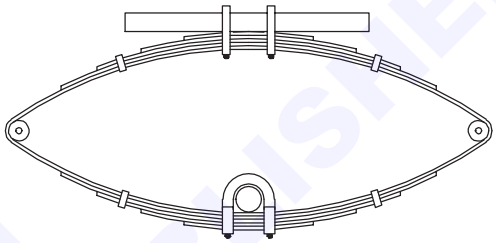
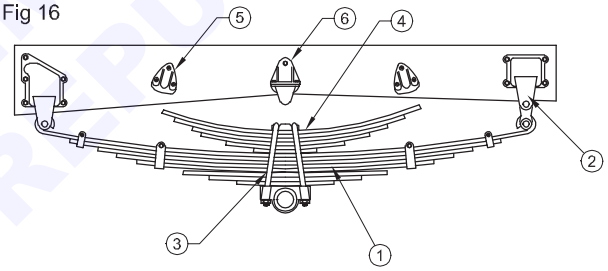


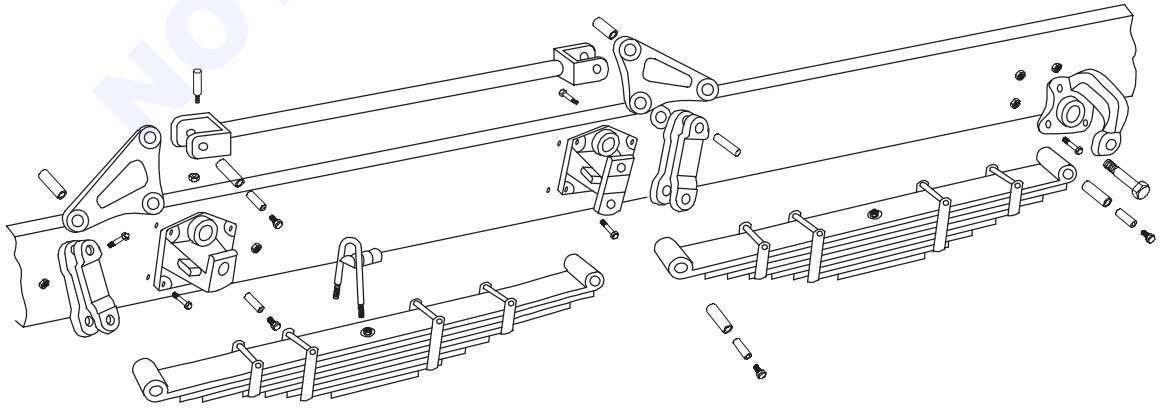
Fig 16



Non reactive suspension arrangement on multi-axle vehicles (Fig 17)

The suspension allows the load on the spring of one axle to be shared by the spring of the other, when an uneven road surface is encounter and result in minimal vertical movement of the frame.

Fig 17



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The braking efficiency in both the rear wheels are good, because of good road grip, due to balancing action of bell crank levers and connecting tie rod (3)

We weller suspension

These suspension is mostly used for front springs in commercial passenger vehicle for better riding comfort and spring life.

The main purpose of rubber spring attachment is to prevent metal to metal contact between spring and chassis, by making use of rubber as a shock absorbing medium. Another advantage is prevention of rattles.

Rubbers in which the ends of springs are enclosed are fitted in the spring supports, attached to the chassis frame.

Independent suspension system

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

- **state the constructional features of the coil spring suspension**
- **state the constructional features of the torsion bar suspension system**
- **state the constructional features of the strut suspension system**
- **state the adaptive air suspension operation**
- **state the electronic air suspension system.**

Independent suspension system (Figs 1 & 2)

Fig 1

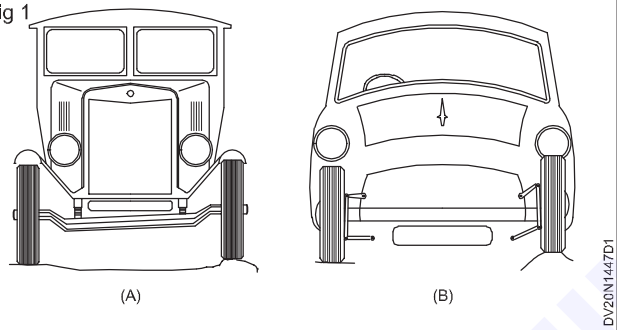
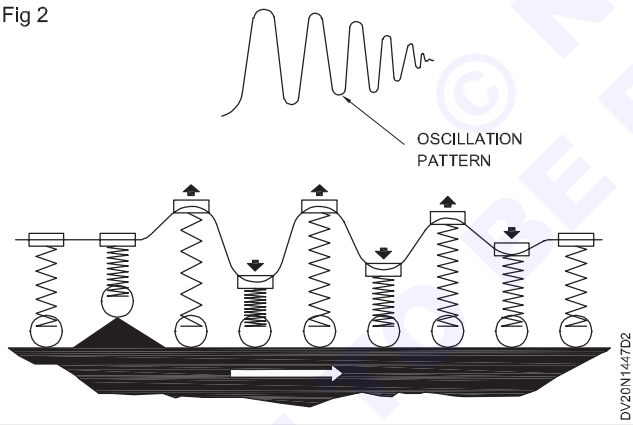


Fig 2



In this type, the up or down movement of one wheel does not affect the other wheel (B). Each wheel moves independently on pot holes and bumps unlike in rigid suspension (A). The following types of independent suspension systems are used.

- Coil spring suspension
- Torsion bar suspension
- Strut type suspension

Coil spring suspension (Figs 3 & 4)

A leaf spring does not deflect quickly due to stiffness under light load. A coil spring responds quickly to road shocks. It can store more energy than a leaf spring and it is light in weight.

Fig 3

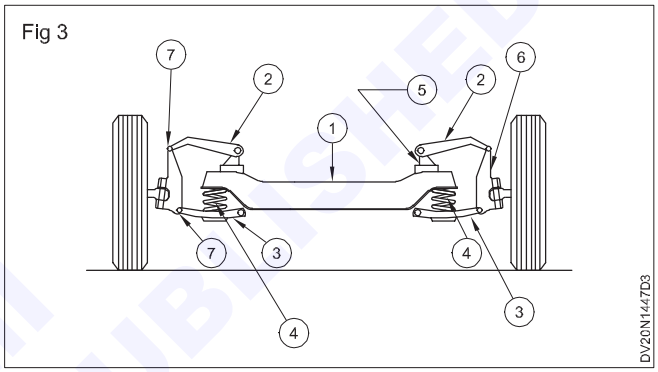
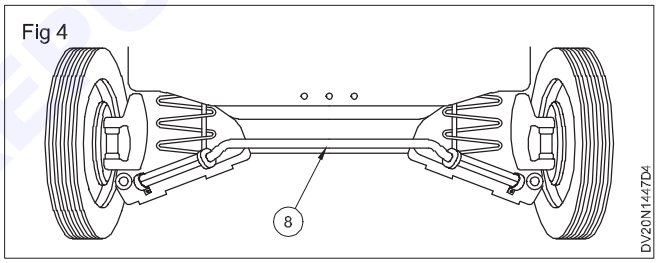


Fig 4



In the coil spring suspension, each wheel is independently supported by a coil spring. Shocks are sustained by each spring.

Construction

A coil spring suspension system comprises a frame (1), an upper control arm (2), a lower control arm (3), a coil spring (4) and a shock absorber (5). The coil spring (4) is seated on rubber pads between the lower control arm (3) and the upper control arm (2) and the frame. A steering knuckle (6) is pivoted at each end of the upper and lower control arms through ball joints. (7) This allows for angular movement of linkages. This suspension is called wish-bone suspension.
A stabilizer bar (8) is used on the radius rods to guide the cushioning motion of the springs.

Torsion bar suspension (Figs 5 & 6)

In this suspension, a torsion bar (1) is used as a spring between the upper (2) and lower (3) control arms. The torsion bar stores energy like a coil spring by twisting when the vehicle goes over a pot hole. When the wheel comes on plain surface the torsion bar untwists and comes to its normal position.

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Fig 5

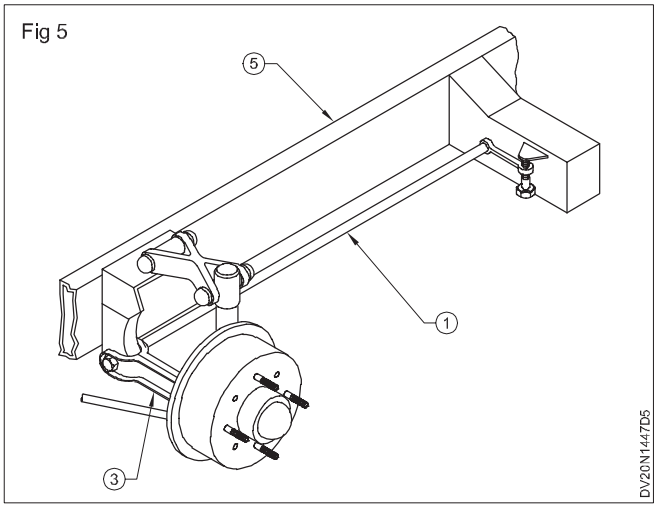
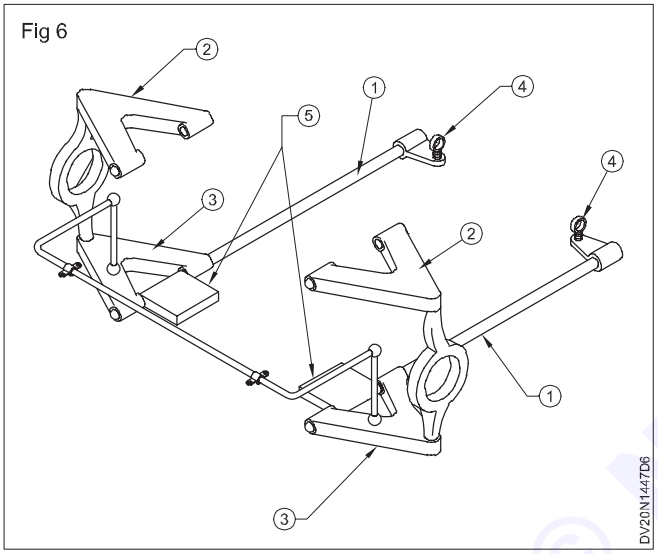


Fig 6



A torsion bar (1) is fixed on each side of the frame (5). One end of this is connected to the wheel hub spindle and the other end is connected to the frame cross-member. As the wheel moves on a pothole the lower wish-bone (3) tries to rotate the torsion bar (1). The torsion bar (1) twists and tries to keep the lower control arm (3) in a straight position.

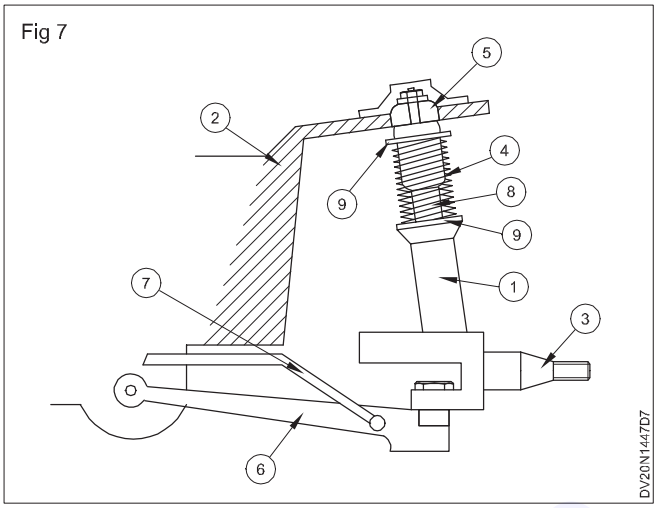
In this system an eye bolt adjuster (4) is provided to adjust the height of the lower control arm (3). This system is used in Ambassador cars.

Strut type suspension (Fig 7)

In this type a strut (1) is mounted between the frame (2) and the stub axle (3). A shock absorber (8) is fixed inside the strut (1). A coil spring (4) is mounted on two collars (9). A rubber pad (5) is used between the upper end of the strut (1) and the frame (2). A transverse link (7) is attached to the frame (2) and stub axle (3) by a ball joint or rubber pad. It controls the wheel path. A stabilizer bar (6) connects the two lower transverse members.

This suspension system is known as MCPHERSON strut type suspension. It is simple in construction and light in weight. It allows more deflection of the front wheel without any effect on the steering.

Fig 7

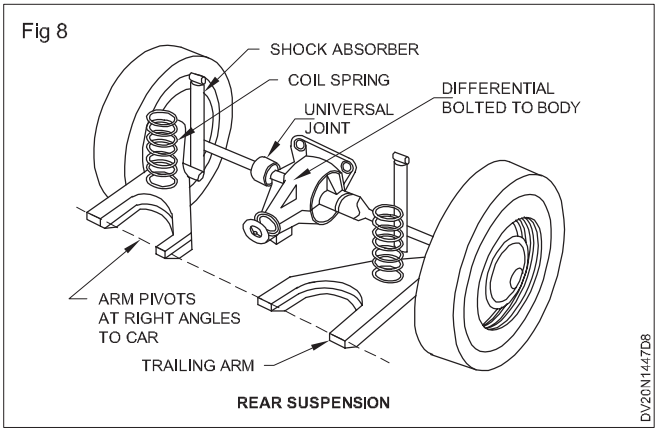


Rear independent suspension (Fig 8)

independent coil-spring rear suspensions can have several control arm arrangements. For example, A-shaped control arms are sometimes employed. When the wide bottom of a control arm is toward the front of the car and the point turns in to meet the upright, they are called trailing arms. When the endure A-shaped control arms are mounted at an angle, they are known as semi trailing control arms or multilink suspensions. Coil springs are used between the control arm and the vehicle body. The control arms pivot on a cross member and are attached at the other end to a spindle. A shock absorber is attached to the spindle or control arm.

Some vehicles use a rear-suspension system that used a lower control arm and open driving axles. A cross member supports the control arms, while the tops of the shock absorbers are mounted to the body. The springs are set in seats at the bottom and tops of the cross member.

Fig 8



Multilink rear suspension (Fig 9)

A multilink rear suspension uses several control arms to guide the wheel. Different models feature different types of multilink rear suspensions that satisfy the varying demands of vehicle dynamics, ride comfort, and space requirements. These include the double-whishbone rear suspension, trailing-link double-wishbone rear suspension, and trapezoidal-link rear suspension.

In the double-wishbone suspension, the wheel is guided by two triangulated lateral control arms (the wishbone)

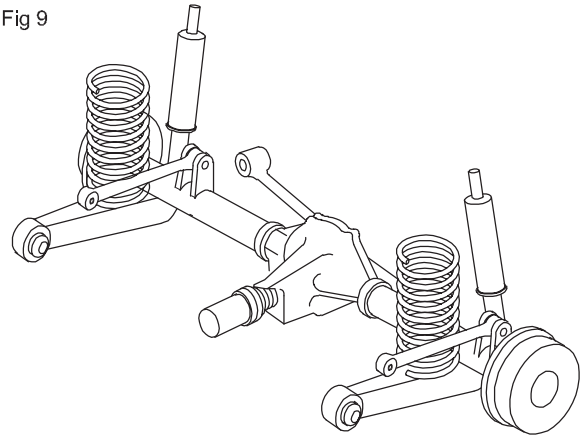
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and a tie rod. The suspension strut is attached to the lower wishbone to provide vertical support.

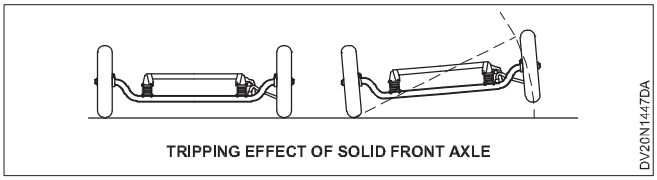
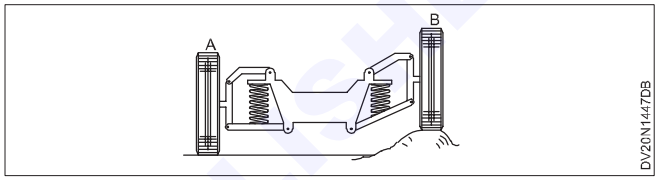
The trailing-link double-wishbone suspension has a trailing link that also carries the wheel and upper and lower wish bones. The spring is located on the trailing link ahead of the center of the wheel; the shock absorber is behind it.

The trapezoidal-link rear suspension permits excellent performance, handling, and comfort. The rear wheel is fixed by an upper lateral control arm and a trapezoidal lower link with a tie rod behind it. For reduced weight, the trapezoidal link and upper control are hollow aluminum castings.

Fig 9



Comparison between rigid and independent suspension

Rigid axle suspension system (Fig10)	Independent suspension system (Fig 11)
 TRIPPING EFFECT OF SOLID FRONT AXLE	
1 This is a simple arrangement. 2 In this system leaf springs are used. The wheels swivel on each end by a pivot arrangement between the axle and the wheel spindle. 3 The up and down movement of either of the front wheels causes a vertical tipping effect on the other wheel as these wheels rotate on a common axle. 4 Shocks are transmitted from one wheel to the other wheel. 5 This system does not allow more deflection of the front wheels and have some effect on steering. 6 In this system the spring weight is more. 7 Vibration damping is less effective. 8 Because of its simplicity, it requires less maintenance, and, therefore, the maintenance cost is less.	1 This is complicated as compared to the rigid axle suspension. 2 In this system a coil spring is used on each side. 3 In the independent suspension system each front wheel is free to move up and down with minimum effect on the other wheel. 4 Shocks are not transmitted from one wheel to another. 5 This system allows more deflection of the front wheels without any effect on the steering. 6 Spring weight is less. 7 Vibration damping is more effective. 8 Because of its complexity, it requires more maintenance, thereby, the maintenance cost is more.

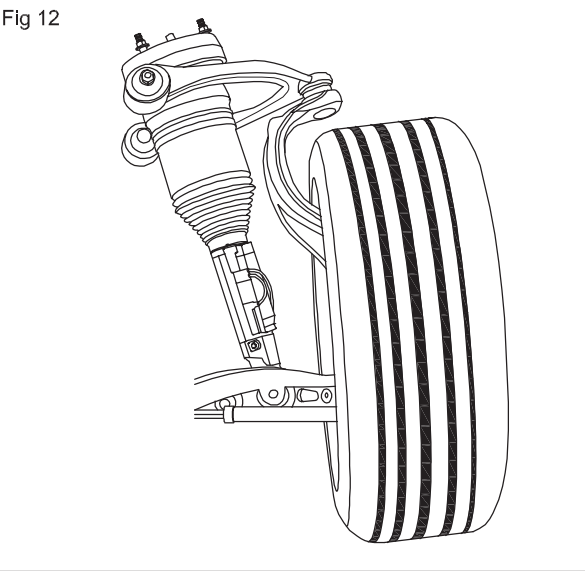
Adaptive air suspension operation (Fig 12 & 13)

Additionally, the air suspension allows the speed-dependent lowering of the body-this change in ride height means a low center of gravity and significantly increased directional stability as a result. The vehicle's handling characteristics are improved at the same time. Some European vehicles have air suspension struts at all four wheels.

The information obtained from sensors on the axles and acceleration sensors on the body is evaluated in the adaptive air suspensions central control unit. This computer can control the adjustment of the individual shock absorbers in milliseconds, depending on driving situation.

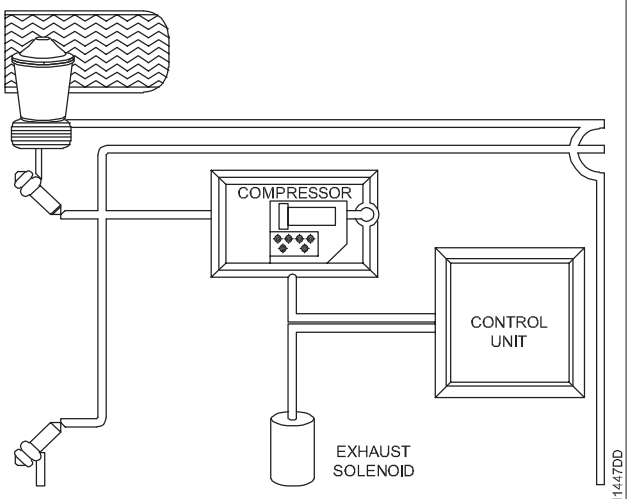
Provided no higher damping forces are required - for instance when driving straight ahead on good rods - the damper setting remain comfortably soft.

Fig 12



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Fig 13



SIDE VIEW OA AIR SUSPENSION SYSTEM (REAR AXLE)

Specific adjustments to the damping force at individual wheels eliminates body movement, which could affect occupant comfort.

The height sensor uses the induction principle to constantly monitor the distance between the vehicle's axle and its chassis.

When the ignition is switched on, when the vehicle's door is opened before ignition, the control system is activated. The height sensor uses the induction principle to constantly monitor the distance between the vehicle's axle and its chassis.

When the vehicle is being loaded, unloaded, or lowered due to driver command or vehicle speed, the electronic readings from the height sensor monitor the change. This is picked up by the electronic control unit and compared to the stored reference values.

The ECU either activates the electric motor of the compressor, or the exhaust solenoid vale. This also requires the solenoid valve block to be actuated, in order to maintain the required level. The corner solenoid valves are subject to stringent leakage requirements to maintain the vehicle's height even without system operation.

When the vehicle is being loaded, the compressor delivers air into the four air suspension bellows, until the normal level has once again been reached. For additional air delivery or rapid response, the reservoir solenoid valve is opened and air flows directly from the reservoir.

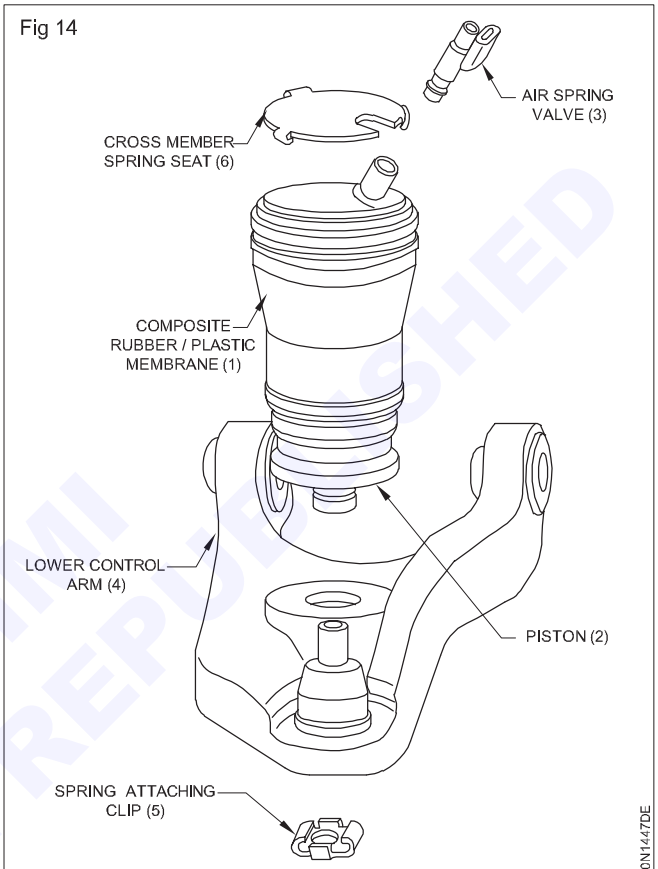
When the vehicle is being unloaded, the solenoid valve block is activated. This results in airflow from the air suspension bellows being removed via the air dryer solenoid valve in the compressor, then via the relay valve. The air is then exhausted into the atmosphere.

Any dynamic air spring movement while the vehicle is in motion is ignored and does not cause the control system to respond.

Adaptive air suspension system (Fig 14)

In an air suspension system, the air springs replace the coil springs in a conventional suspension system. These air springs have a composite rubber and plastic membrane (1) that is clamped t a piston(2) located in the lower end of the spring. An end cap is clamped to the top of the membrane and air spring valve(3) is positioned in the end cap. The air springs are inflated or deflated to provide a constant vehicle trim height. Front air springs are mounted between the control arms(4) and the cross member (Fig.14). The lower end of these air springs is retained in the control arm with a clip (5) and the upper end is positioned in a cross member spring seat (6).

Fig 14



FRONT AIR SPRING SUSPENSION

The rear air springs are the same as the front air springs except for their mounting. The lower ends of the rear springs are bolted to the rear suspension arms and the upper ends of these springs are attached to the frame.

An air spring valve(3) is mounted in the top of each air spring. These valves are an electric solenoid - type valve that is normally closed. When the valve wining is energized, plunger movement opens the air passage to the air spring. Under this condition, air may enter or be exhausted from the air spring. Two O-ring seals are located on the end of the valves to seal them into the air spring cap. The valves are installed in the air spring cap with a two stage rotating action similar to a radiator pressure cap.

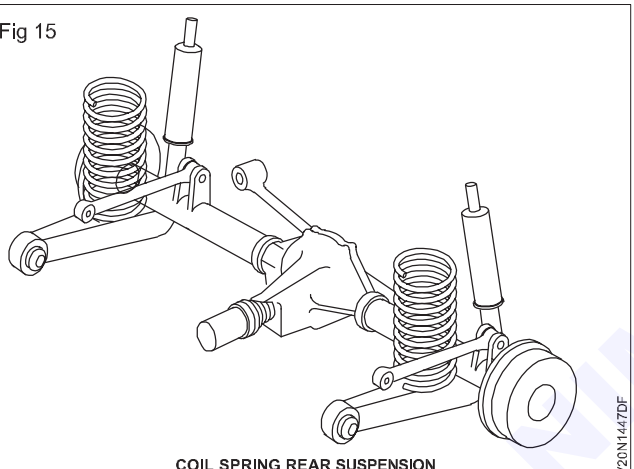
Never rotate an air spring solenoid valve to the release slot in the cap fitting until all the air is released from the spring. If one of these solenoid valves are loosened with air pressure in the spring, the air pressure drives the solenoid out the spring with extreme force. This action may result in personal injury.

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Coil spring rear suspension

Some rear - wheel drive vehicles have a coil spring rear suspension. Upper and lower suspension arms with insulating bushings are connected between the differential housing and the frame (Fig 15). The upper arms control lateral movement and the lower trailing control arms absorb differential torque. In some rear suspension systems, the upper arms are replaced with strut rods. The front of the upper and lower arms contain large rubber bushings. When strut roads are used in place of the upper arms, both ends of these rods contain large rubber bushings to prevent noise and vibration transfer from the suspension to the chassis. The coil springs are usually mounted between the lower suspension arms and the frame, while the shock absorbers are mounted between the back of the suspension arms and the frame.

Fig 15

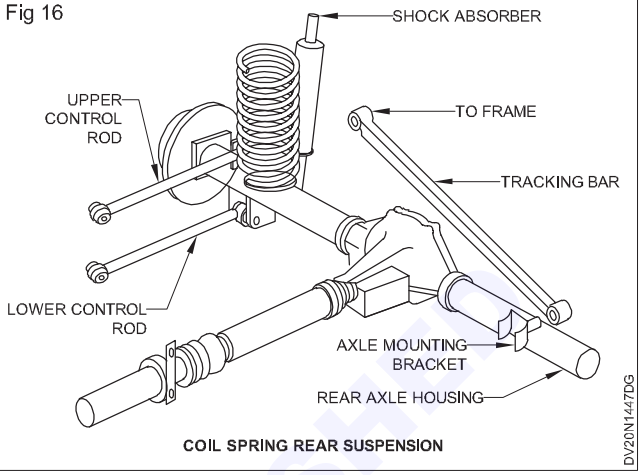


COIL SPRING REAR SUSPENSION

DV20N1447DF

Some rear suspension systems have a tracking bar connected from one side of the differential housing to the chassis to prevent lateral chassis movement (Fig 16). Large rubber insulating bushing are positioned in each end of the tracking bar. A tracking bar may be referred to as a pan hard or Watts rod.

Fig 16



COIL SPRING REAR SUSPENSION

DV20N1447DG

Air suspension

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

- **state air suspension**
- **state the major parts of air suspension**
- **explain the function of the air supply system**
- **explain the construction of air bag**
- **describe the construction of height control valve (HCV)**
- **describe the functions of air suspension.**

Air suspension

An air suspension supports the vehicle on the axles with an arrangement of air bags instead of some type of steel spring, leaf or coil, or some type of torsion spring arrangement. The air bags are sometimes referred to as air springs or bellows. Suspensions that have steel or torsion springs that are supplemented by the use of air bags are not considered air suspensions. There are combination systems that have both air and steel springs. Usually the air suspension components are used on the rear of the vehicle. Depending on the situation, this type of air suspension will probably have to be dealt with for leveling purposes.

Normally, the air suspension is just one part of the air system on the vehicle. Most vehicles with an air suspension also have air brakes along with other equipment that may be operated with air.

Major components of air suspension

An air suspension has three basic components

i Air supply system

ii Air bag (bellows)

iii Height control valve (HCV)

Air supply system

The air supply: The air supply is engine air compressor, the air tanks, air valves and air lines. The engine air compressor supplies air for every piece of air equipment on the vehicle. The maximum pressure supplied by the compressor varies. For many years, the air supply was maintained around 120 to 125 psi but on some newer, larger vehicles this has been increased to 135 psi.

Air bags (bellows) (Figs 1 & 2) : Air bags are simply a rubber balder that holds air. Air bags are also referred to as air springs or bellows. The air bags are located

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between the frame of the vehicle and the vehicle axles. Air bags are rated for weight and pressure capacities.

Air bags placement and arrangements very amongst chassis manufacturers. At the very least, there will be one air bag for each side of each axle in the vehicle. There can be two air bags for each side of the axles. Some manufacturers use two air bags for each side fo the drive axle and some use two air bags for each side of the drive and front axles. Space between air bags for side to side placement also varies. Some place the air bags outboard as far as they can and some have the bags closer together. When two bags per side are used, one will be in front of the axle and the other behind the axle. Again, spacing can vey.

Most air bags will have some device such as a cone that keeps that air bag from being crushed or damaged when fully deflated. Inflating air bags is limited to the available air pressure to the suspension system. How much lift the air bags will have various with vehicles and air bags, but the average lift the air bags will supply, when maximum available system air pressure is used, is between 5 1/2 and 6 1/2 inches from a totally deflated state.

Fig 1

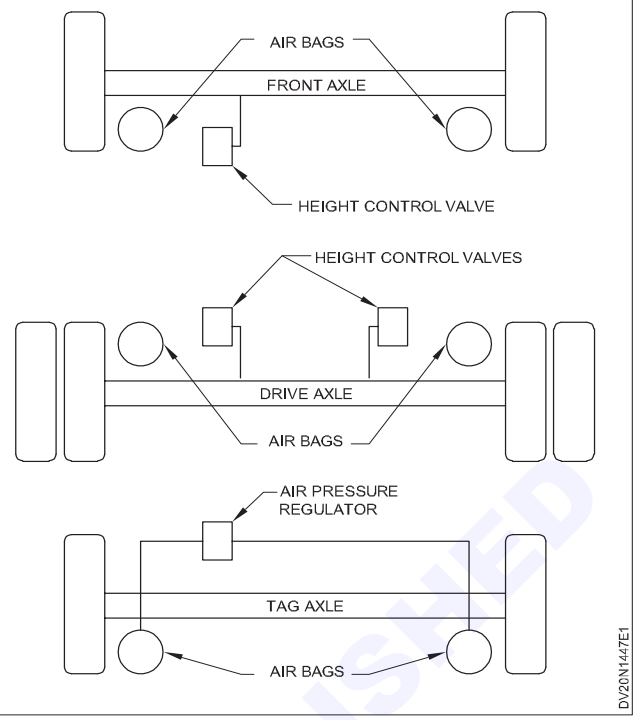
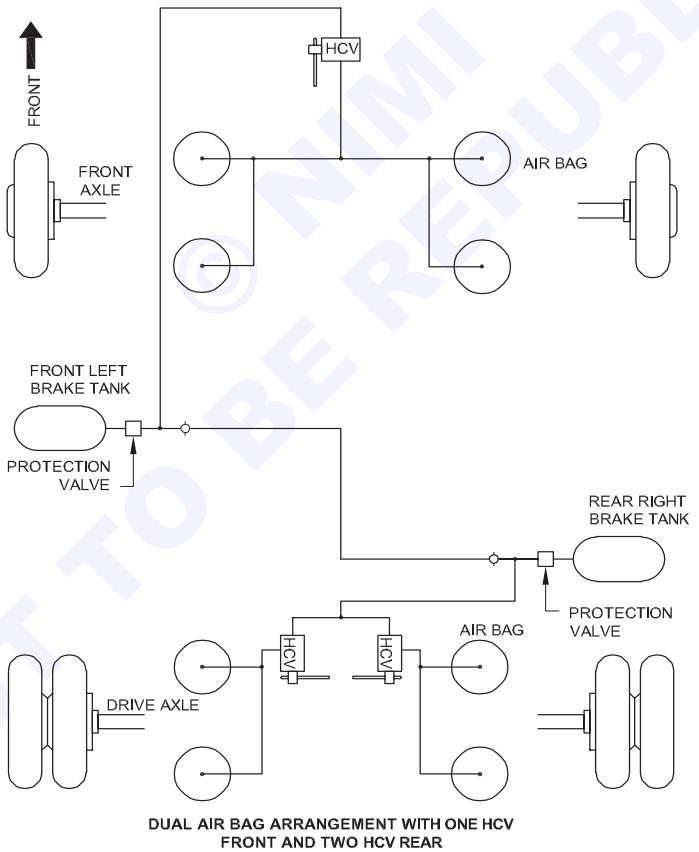


Fig 2



DUAL AIR BAG ARRANGEMENT WITH ONE HCV FRONT AND TWO HCV REAR

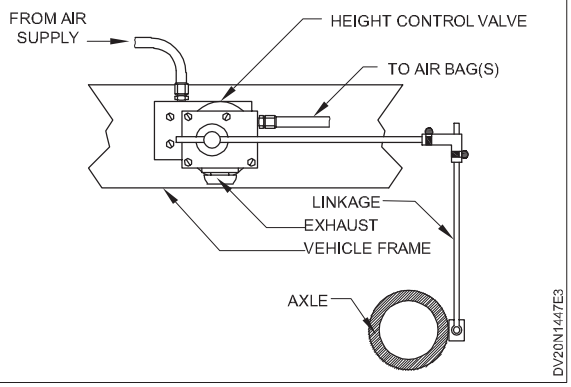
Construction of height control valves: The height control valves (HCV from now on) (Fig 3) are kind of the brains of the system. They dictate how much air is in the air bags. This dictates the height the vehicle sits at, thus Height Control Valve. Most HCVs are mechanical valves but electronic height control mechanisms are available. The HCV is mounted to the frame of eth vehicle. An L shaped linkage attaches the HCV to the axle. As the axle moves up and down in relationship to the frame, the linkage moves the valve or electronic mechanism. With mechanical valves, there is an air line from the air supply to the HCV. There is an air line from the HCV to the air bag or bags that it controls. The HCV also has an exhaust port. When the connecting linkage moves up, the HCV connects the air supply to the air bag(s) to the exhaust port, deflating the bag(s). This controls the

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height of the vehicle. If the Height Control is electronic, as the control linkage moves up or down, an electronic sensor sends information to an electronic control. These controls will open or close air solenoid valves as needed to inflate or deflate the bags.

Typical height control valve mounting and connection to axle

Fig 3



There are two basic styles of mechanical HCVs, the instant response valve (IR valve) and the delay valve. These names are accurate descriptions of how the valves react. The IR valve will start to inflate or deflate the air bags as soon as the valve activating lever moves. The delay valve has a slight delay when the activating lever moves before inflating or deflating the air bags.

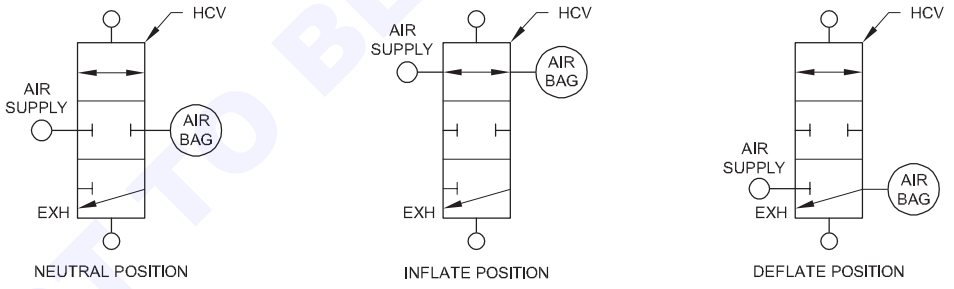
The number and arrangement of HCVs used on a suspension varies a little. There are normally three HCVs used on a suspension. Either there is one for the front axle and two for the rear, (most common arrangement) or some use two on the front axle and one on the rear. A few chassis have been done with one HCV for each side of the front and rear axles, a total of four, but this would not be very common. Vehicle with a tag axle use regulated air or tie the tag air bags to the driver air bags to control the tag air bags. Although it may be done, no one using HCVs to control the tag axle air bags.

The following diagrams show the basic mounting of a HCV and several air bag and HCV arrangements.

Functions of air suspensions : The vehicle is supported on the frame with an arrangement of air bags. The vehicle air system, engine air compressor, tanks, lines, etc. supplies air to the height control valves (HCV) mounted to the frame of the vehicle. The height control valves are connected to the air bags with an air line. The linkage which connects the HCVs to the axles rotates the HCV valving as it moves up and down. When weight is added to the vehicle or transferred through the suspension of the vehicle, the air in the air bag(s) is compressed, the frame moves closer to the axle. This forces the HCV linkage up. As the linkage moves up, the valving of the HCV connects the air supply to the air bag(s). The added pressure and volume inflates the air bag(s), causing the frame to move away from the axle. As the frame moves back to the proper ride height, the HCV linkage moves to the neutral position. This moves the valving away from the air supply and locks the air in the air bag to maintain the proper ride height. As weight is removed from the vehicle or the suspension shifts weight away, the existing pressure in the air bag(s) can push the frame away from the axle. The HCV linkage is pulled down. This connects the air bag(s) to the HCV exhaust port. As air is exhausted from the air bag(s), the frame lowers back down towards the axle. As the linkage moves up to the neutral position, the exhaust port is closed and the air is again locked in the air bag(s), maintaining proper ride height.

These three drawings (Fig 4) show as schematic example of the height control valve in he neutral position, inflate position and deflate or exhaust position.

Fig 4



Suspension and its effects on steering: The vehicle suspension system is used to reduce the vibration and shock reach to the vehicle body. Suspension systems play a important role in passenger safety in all phases of drive,

Vehicle steering system is used to turn the vehicle into various angle direction of the road. Steering system is helps to comfortable drive a vehicle on the road.

Incase suspension system failure, road shocks and vibration can effect the steering system, The road vibrations directly reach to steering wheel and steering linkages, it cause steering linkages and other parts can be damaged. For example cars and trucks will have multiple ball joint assemblies, depending on their type of suspension system like any other suspension component ball joints will eventually wear out and become loose. Ecessive play in the joint can affect the wheel alignment and tire wear. Loose joint can also cause for suspension noise if ball joints fails, the suspension can collapse, causing a loss of control the vehicle.

Common symptoms of tampering defects in steering and suspension system

- Steering wheel vibration (shacked)
- Climbing noise from front tires
- Vehicle moves to the right to left
- Vehicle tires have abnormal wear.
- Vehicle cannot be aligned if suspension parts are damaged.

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Ignition Circuit

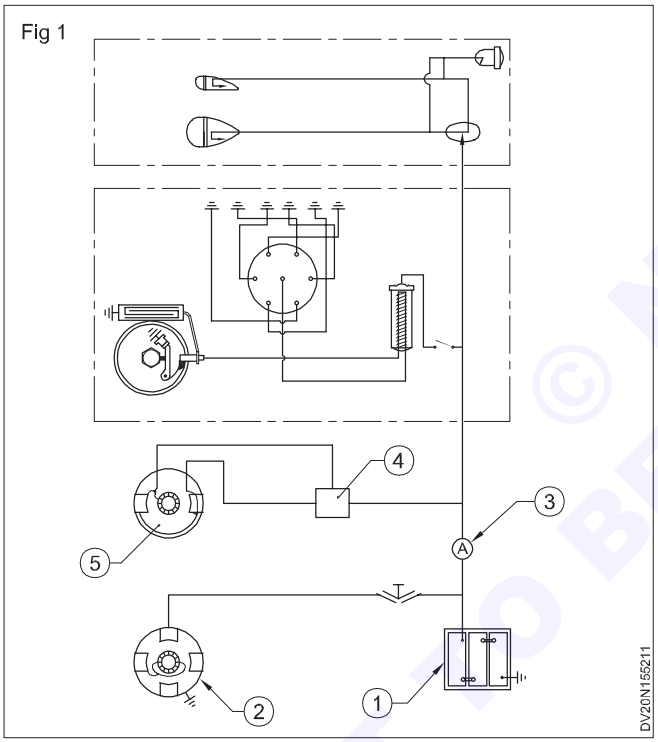
Objectives : At the end of this lesson you shall be able to
- **explain the different electrical circuits in automobiles**
- **explain the ignition circuit**
- **explain the need of ignition coils**
- **explain the need of condensers**
- **explain the need of spark plugs.**

Description of automobile electrical circuits

The present day automobile almost contains an electric power plant under its hood and stores electrical energy. This energy is delivered either at low voltage or in the form of high voltage surge.

The automotive electric system is classified under five main headings (Fig 1)

Fig 1



i Generation, storage and distribution system (charging system)

ii Starting system

iii Ignition system

iv Lighting system

v Auxiliary system

All the circuits are connected together and linked to the car battery (1). The starting or cranking system is connected directly to the battery (1) through cables and switch to provide a low resistance path for the large current required by the starter motor (2).

The generating circuit is connected to the battery via the ammeter (3) which register in the charge when current is supplied to the battery (1). A control box (4) is provided in the circuit to control voltage and current. The control box (4) connects and disconnects the battery (1) and the generator (5).

the ignition primary circuits, the lighting circuit and the auxiliary circuits are connected to the same side of the ammeter (3) as in the generator so that when the generator is in operation they receive current directly from the generator (5). When the generator is not running, these circuits draw current from the battery. (1) All the circuits are controlled by the individual switches in between the battery and the load.

Faraday's Law of Induction

Faraday's law of induction which states that the induction of electromotive force (EMF) in any closed circuit is equal tothe time rate of change of the magnetic flux through the circuit.

Ignition system

All spark ignition engines require an ignition system to ignite a fuel mixture in the cylinder. A very high voltage is required to generate sparks to ignite the cylinder charge at the set time. Two types of ignition systems are used.

i Battery ignition system

ii Magneto ignition system

Battery ignition system (Fig 2)

The battery ignition is used in passenger cars, light trucks and a few two wheelers. This system consists of the following parts.

i Battery

ii Ignition switch

iii Ignition coil

iv Distributor

v Contact breaker

vi Spark plug

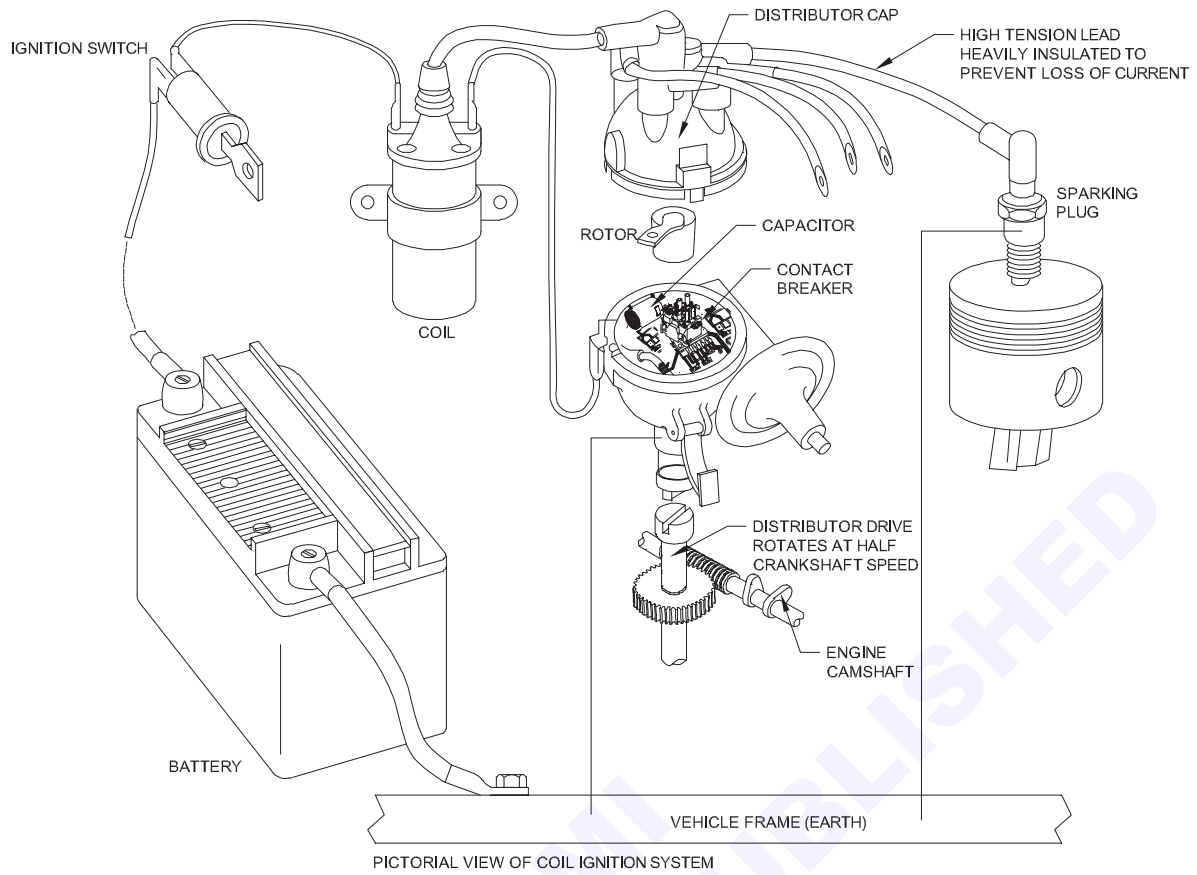
Ignition switch

It is fitted on to the panel board in between the battery and the ignition coil. It connects or disconnects the primary circuit from the battery (1).

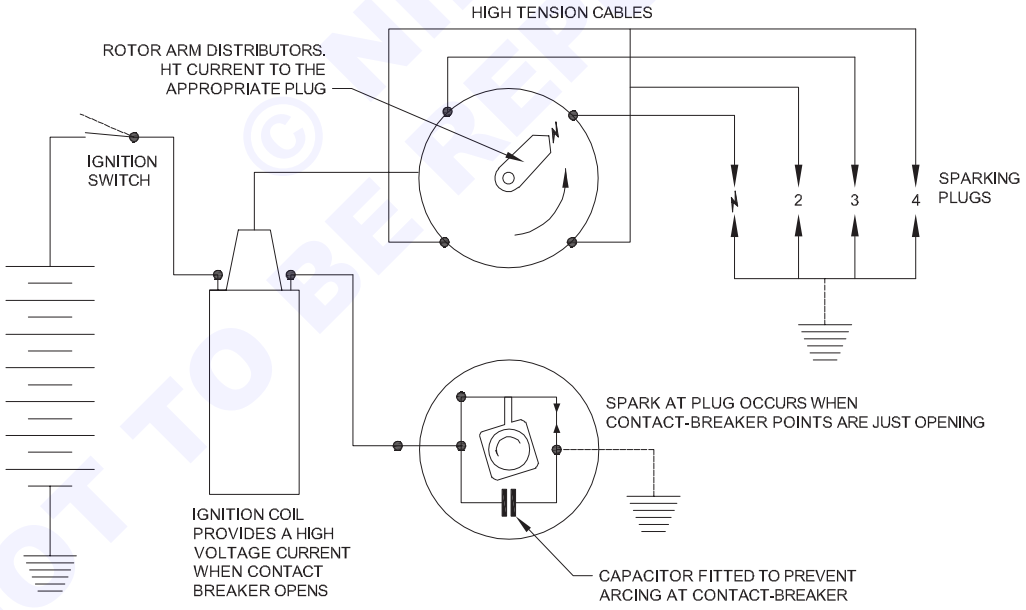
Ignition coil (Fig 3)

It is used to step up low voltage to high voltage to generate sparks. It consists of two windings, one is wound over soft

Fig 2



PICTORIAL VIEW OF COIL IGNITION SYSTEM



OPERATION OF COLL IGNICON SYSTEM

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iron core. The secondary windings (1) is grounded over the core (2). It consists of about 21,000 turns. One end of the windings is connected to the secondary terminal (3) and the other end of the primary winding (4). The primary winding (4) is wound over the secondary winding (1) and consists of about 200 - 300 turns. The ends are connected to the external terminal (5,6). the backlite cap (7) insulates the secondary terminal from the container and primary terminals.

Distributor

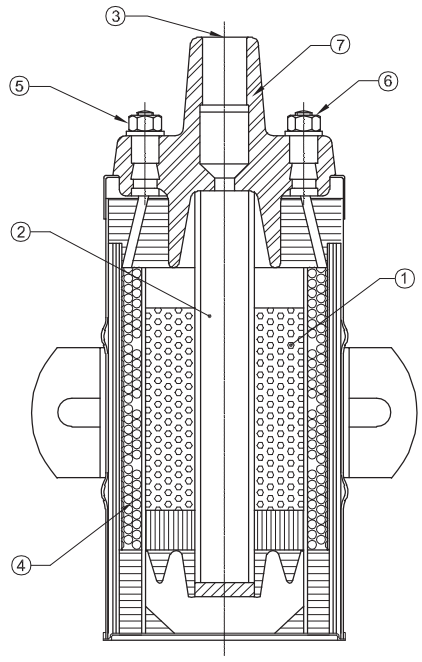
A distributor is fitted on the engine. It is driven by the engine camshaft. The distributor opens and closes the primary circuit of the ignition coil. It distributes the resulting high tension surges from the secondary winding of the ignition coil to the various spark plugs of the engine at a set time.

Contact breaker

It connects and disconnects the primary circuit at regular intervals to produce high voltage in the secondary winding

of the coil. The points are two in number, one is directly fitted to the base plate and the other is insulated and operated by the rotating cam.

Fig 3



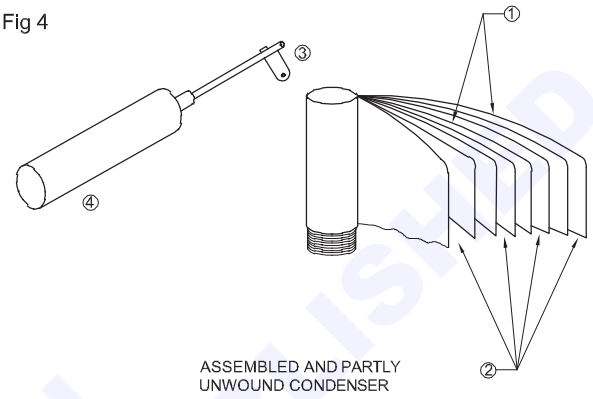
IGNITION COIL

Condenser (Fig 4)

The condenser is fitted on the base plate of the distributor. It is connected in parallel to the contact breaker's points. The condenser absorbs current in the primary circuit which passes through the ignition points but which is suddenly stopped by their separator. It consists of aluminium or lead foil (1). Foils are insulated from each other. One end of the foil is connected to the condenser terminal (3) and the other end of the condenser case (4).

The condenser prevents arcs at the points and helps the ignition coil to release its energy in the form of high voltage surge through the secondary winding.

Fig 4



ASSEMBLED AND PARTLY UNWOUND CONDENSER

Spark plug

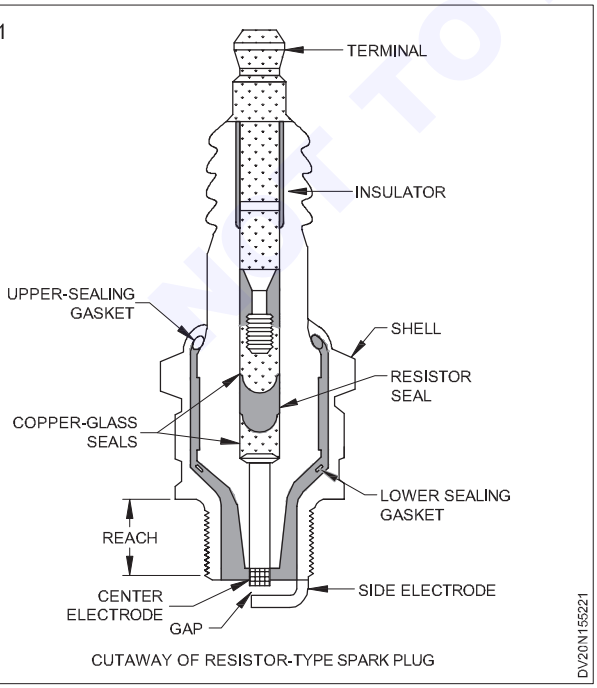
Objectives: At the end of this lesson you shall be able to

- **state the purpose of spark plug**
- **explain the cross-section and working of spark plug**
- **types of spark plug.**

Purpose of spark plugs

A spark plug (Fig 1) is basically two electrodes positioned to form a gap. The gap is between the insulated center electrode and the ground electrode. This is the gap that the spark jumps to start the ignition of the compressed air - fuel mixture in the engine cylinder.

Fig 1

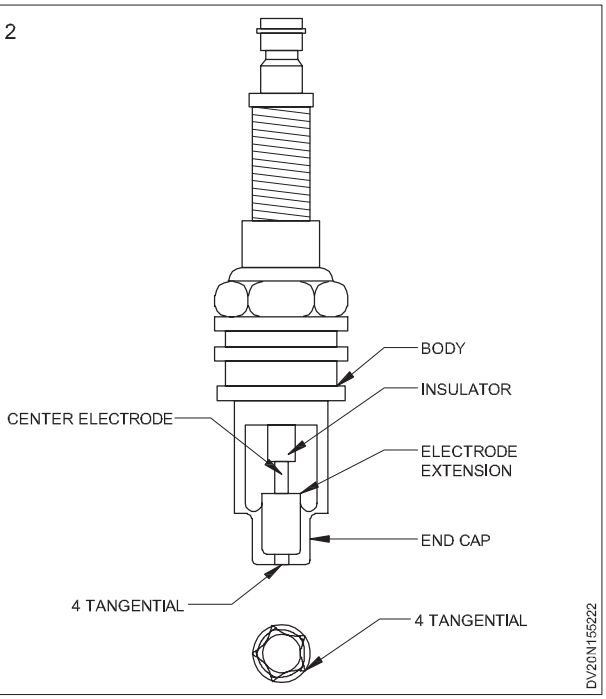


CUTAWAY OF RESISTOR-TYPE SPARK PLUG

Explain the working of spark plug

The number one job of the ignition system is to produce the high - voltage surges that cause the sparks at the spark plug gaps. Fig 2 shows in simplified form, how this is done. The ignition coil has two windings: a primary winding of a few hundred turns of relatively heavy wire,

Fig 2



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and a secondary winding of thousands of turns of very fine wire.

Now see what happens when the ignition switch is turned on, and the trigger has closed the circuit between the ignition coil primary winding and ground (the other battery terminal). Battery current will flow through the primary winding. This causes a magnetic field to form around the winding.

Now, when the trigger opens the circuit between the winding and ground, current stops flowing. The magnetic field collapses.

Spark plug with end cap designed to improve combustion swirl. (Fig 2)

Spark plug has an end cap with a gap to the end cap. When the air fuel mixture is compressed, some of it enters the cap. Then, when the spark occurs, ignition starts in the cap. The burning mixture streams out through the orifices to ignite the rest of the compressed mixture. Note that the tangential orifices are at an angle. As the burning mixture streams out through these orifices, it sets up a swirling motion that speeds the burning of the mixture. This is said to improve engine performance.

Some spark require gaskets when installed in order to assure a leak proof seat. Many engines use plugs with tapered seats (Fig 3) which produce a good seal when installed.

Precautions

Spark plugs for modern engines with electronic ignition systems have gaps of up to 0.080 inch (2.03mm), as previously noted. They are not interchangeable with the plugs used on earlier systems, which used gaps of less than half as much. Use only the specific spark plugs specified for the engine. Attempting to use the earlier type of plug by bending the outer electrode to get the right gap can cause trouble. The plug will not fire right.

Types of spark plug (Fig 4)

Two important characteristics of spark plugs are their heat range and their reach. The heat range of the plug determines the temperature the spark plug will attain in the engine, that is, how hot the plug will get. This controlled by the shape of the plug and the distance heat must travel from the center electrode of the plug to reach the cooler cylinder head. If the path the heat must travel is long the plug will run hot. If the path is short, the plug will run cooler.

Fig 3

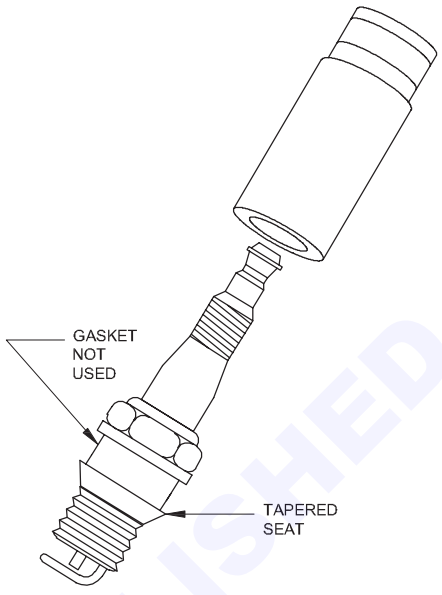
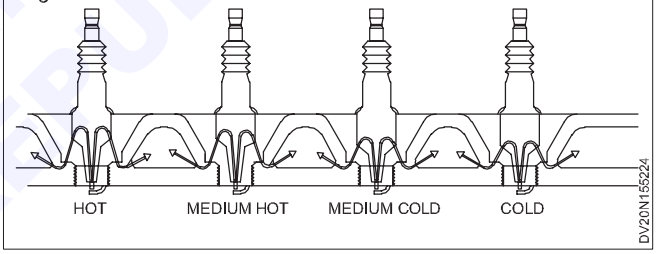


Fig 4



If the plug runs too cold, it will not become hot enough to burn away sooty deposits that collect on the insulator around the center electrode. It can foul and miss. That is, the high voltage surges will leak across the sooty deposit and not jump the spark gap. If the plug runs too hot, it will wear, or burn the electrodes more rapidly. This also can lead to a miss because the gap becomes too wide for the spark to jump.

Distributor

Objectives: At the end of this lesson you shall be able to
- **state the need of a distributor**
- **state the constructional features of the distributor**
- **state the different types of advance mechanism**
- **state the function of the centrifugal advance mechanism**
- **state the function of the vacuum advance mechanism.**

The distributor (Fig 1) is used to distribute the high voltage surges from the ignition coil to the individual spark plugs in a specified sequence and at the set time.

The distributor consists of a distributor shaft (1), advance mechanism, bushes, breaker plate (2) carrying C.B. points (3), cam (4) condenser (5) rotor (6) and distributor cap (7) (Fig 2).

The bowl shaped distribution housing (8) closed from the top by a distributor cap (7) and clip (9) is made of high quality molded insulating material (bakelite). The cap has segments terminal towers equal to the number of cylinders. These towers are connected by high tension leads with the spark plugs as per the firing order. The center tower of the cap is connected with the H.T terminal of the ignition coil. A spring loaded carbon brush conducts

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the ignition surge to the electrode of the rotor (6). From the rotor arm (6) the H.T. current/ surge flows to the side segment of the distributor cap. (7), provided on its circumference.

Fig 1

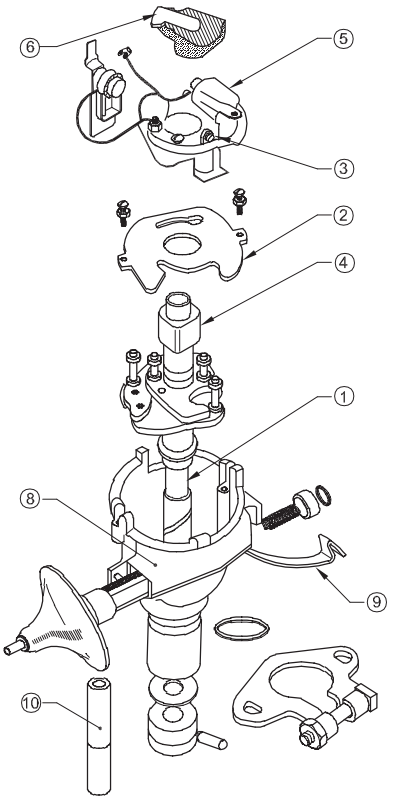
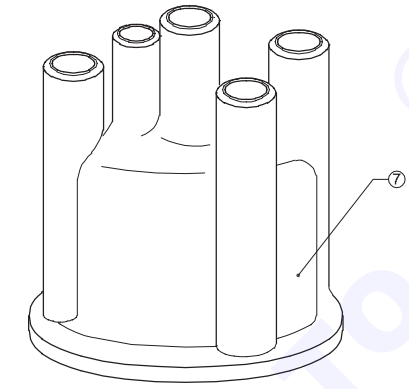


Fig 2

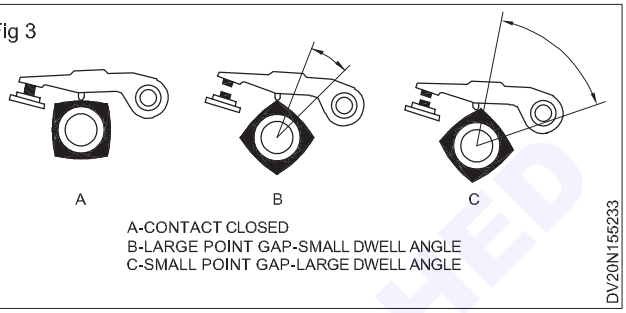


The distributor housing has a cylindrical shaft supported by bush bearing (10). A shield made of a metal called ‘breaker plate’ (2) is fitted in between the distributor compartment and the contact breaker compartment. This shield also prevents dirt, carbon and moisture from entering into the distributor section.

A platinum contact and breaker points are provided in the distributor, which is operated by rotating the cam (4). When the point breaker’s level rides on the rotating cam (4) it results in breaking the primary circuit of the ignition coil. During each rotation of the camshaft the contact breaker opens and closes an equal number of times, as the engine has cylinders. The points remain closed when the moveable point fiber block rests on the base circle dia. of the cam (4). It is called the dwell period is known as the dwell angle. During this period the ignition in the secondary winding of the coil drops is less.

The condenser or capacitor (5) is feed on the plate of the distributor. It is made of a number of aluminium and tin foils with a separator. The foils are rolled up in a solid roll. One end of the foil is attached to the terminal and the other to the body. It is connected to the moveable C.B point in parallel. (Fig 3) When the C.B. points close the condenser absorbs current and preserves it. When the C.B points open, the stored current is reversed to the ignition coil, tp impulse high tension surge in the secondary winding. The condenser also prevents arcing at the C.B. points.

Fig 3



An advance mechanism is provided in the distribution to ensure that under every condition of engine operation, ignition take place at the set time. The advance angle is set in such a way that ignition occurs before the T.D.C of the piston to have better fuel economy.

There are two types of advance mechanism.

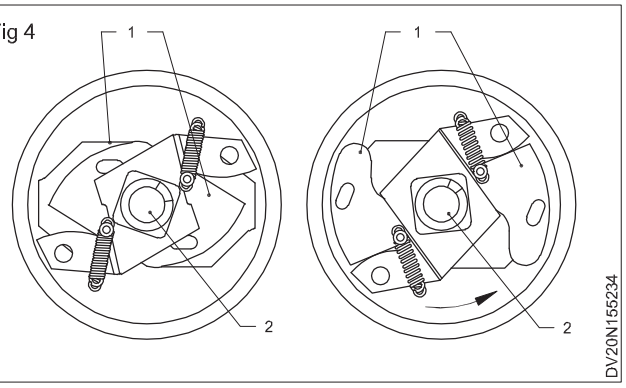
i Centrifugal advance mechanism

ii Vacuum advance mechanism

Centrifugal advance mechanism (Fig 4)

The centrifugal advance mechanism consists of a pair of weighs (1) attached with the distributor shaft (2). As the speed of the shaft increases, the flyweights (1) swing outward and shift the cam in the rotation of the shaft. As a result the cam lobe contact the moveable C.B. points fiber block a little early. Hence, the contact also opens a little early. Thus the ignition point is shifted in the ‘early’ or ‘advance’ direction.

Fig 4



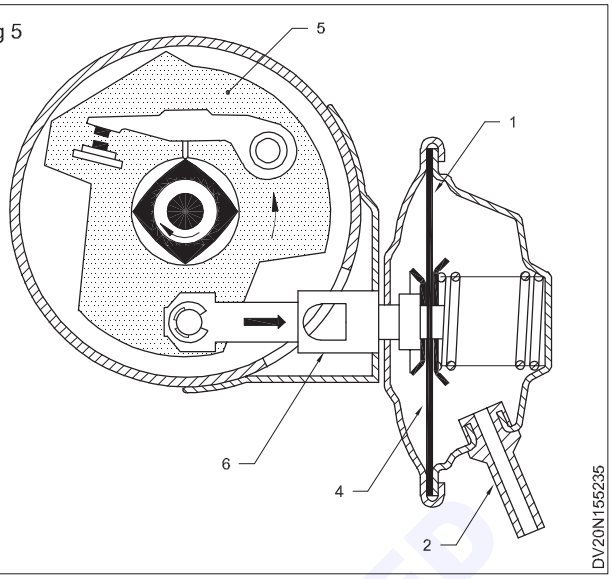
Vacuum advance mechanism (Fig 5)

The vacuum advance mechanism consists of a vacuum unit (1) fitted on the distributor. A hose (2) is connected with the carburetor vacuum. The diaphragm (4) of the vacuum unit is moved by the carburetor. An engine which is running under light or moderate load above the idle speed, requires additional spark advance, to increase fuel economy. When vaccum is applied to the

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diaphragm from the carburetor throat, the breaker plate (5) is pulled with the arm (6) in the direction opposite to the cam rotation. This causes the points to open earlier. When the throttle is in he idle or closed positions there is no vacuum available to pull the diaphragm and ignition takes place at the set time.

Fig 5



Electronic ignition system

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

- **describe the principle of electronic ignition system**
- **describe the pulse generator**
- **describe the hall effect sensor**
- **state the factors of electronic spark advance**
- **describe the distributor less ignition system.**

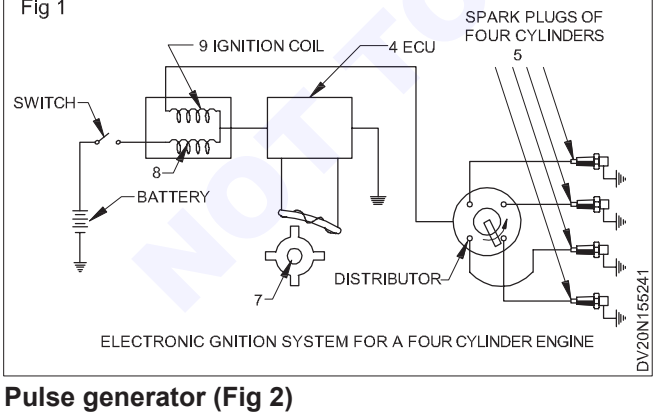
Principle of electronic ignition system (Fig 1)

A timer (7) is used in the distributor(6) of electronic ignition system. It sends electrical pulses to an electronic control unit (4)(ECU) which switches off the flow of current to the primary winding (8). As a result, a high voltage is induced in the secondary winding(9) which is then distributed to the spark plugs(5) as in the case of the breaker point ignition system.

The electronic control unit later switches on the flow of current to the primary circuit so that the primary circuit current can be built up for the next cycle.

The timer may be a pulse generator or a hall effect sensor.

Fig 1



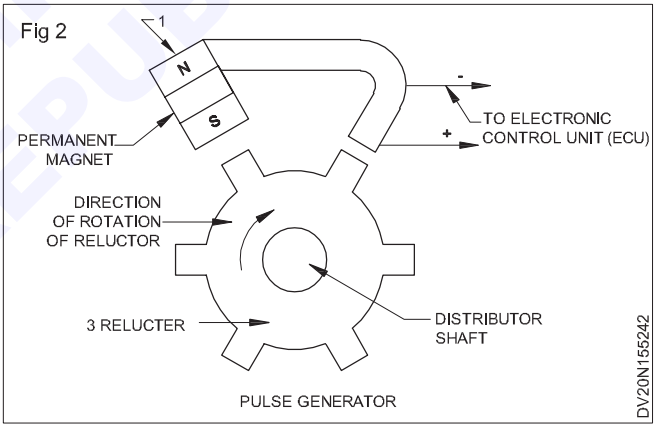
ELECTRONIC GNITION SYSTEM FOR A FOUR CYLINDER ENGINE

Pulse generator (Fig 2)

A pulse generator consists of a permanent magnet (1), a timer (2) coil and reluctor(3). The permanent magnet and the time coil remain stationary. The reluctor is fitted to the distributor shaft and is in the shape of a wheel with teeth.

When the distributor shaft revolves, the reluctor wheel rotates, its teeth moving very near to the pole plates of the permanent magnet.

Fig 2



PULSE GENERATOR

The reluctance of the air gap between the other inductor tooth and the timer coil is reduced. At the same time, the reluctance of the air gap between the reluctor tooth and the magnet is also reduced. This results in a strong magnetic field around the timer coil.

Current is permitted to flow through the timer coil to the electronic control unit, where the primary current flows. As a result, the ignition coil builds up a strong magnetic field.

As the reluctor wheel rotates slightly further, the reluctor tooth moves away from the timer coil. The air gap becomes wider offering a high reluctance. This results in a weaker magnetic field for the timer coil and the induced voltage reverses. The flow of current to the primary circuit is stopped.

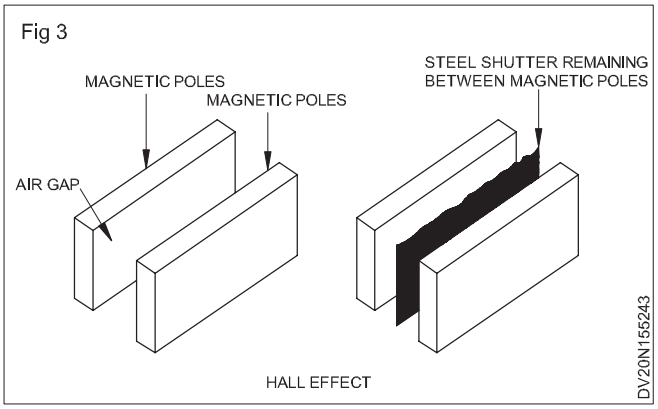
The magnetic field in the ignition coil collapses and enough high voltage is produced for producing spark at the spark plug.

The reluctor wheel in the figure has six teeth. This wheel is used for a six - cylinder engine. The reluctor wheel

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has the same number of teeth as there are cylinders in the engine.

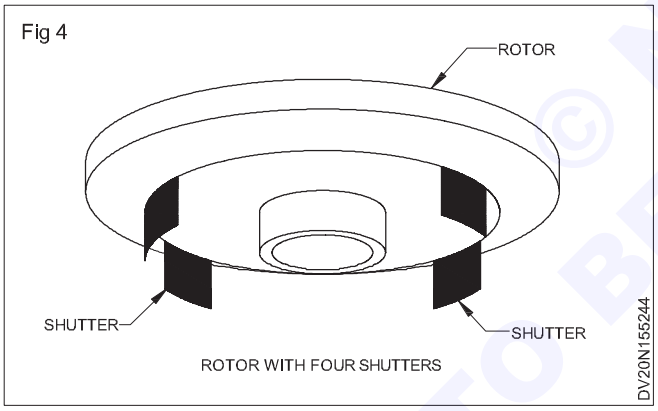
Hall effect sensor (Fig 3)



The hall effect was named after the scientist who discovered the effect. Magnetic sensors used in electronic distribution utilize the principle of Hall effect.

As shown there is magnetism in the air gap between the two poles of a magnet. When a steel shutter is placed or moved between these poles, the magnetism in the air gap is cut off. This principle is called Hall effect.

A rotor with curved plates is used in the Hall effect distributor of an electronic ignition system. These curved plates are called shutters (Fig 4). The shutters are curved in such a way that they can move between the two poles of the magnetic sensor with the movement of the rotor.



The number of shutters is the same as the number of cylinder in the engine.

Whenever a shutter passes between the two poles of the magnetic sensor, it cuts off the magnetism in the air gap between the poles. This sends a signal to the electronic control unit.

When a shutter moves away from the air gap, the magnetic sensor develops a voltage. ECU then receives a single from the magnetic sensor, to permit the current to pass through the primary winding of the ignition coil. However, when a shutter passes between the poles, the magnetic field is cut off and the signal voltage comes to zero.

When the ECU suddenly cuts off the flow of current to the ignition coil primary winding, the magnetic field collapses. This results in the production of high voltage in the secondary winding which gives rise to a spark in the spark plugs.

The Hall effect magnetic sensor is more accurate than the magnetic pulse generator explained earlier.

Electronic spark advance

The mechanical centrifugal advance mechanism and the vacuum advance mechanism are not used in some electronic ignition systems. However, the electronic spark advance systems are adopted in the electronic ignition system.

To control the spark advance, several engine sensors feed information to a computer.

The following information is fed to a computer:

(i) Movement of the throttle

(ii) Pressure of air

(iii) Temperature of air coming to the air cleaner.

(iv) Temperature of engine coolant.

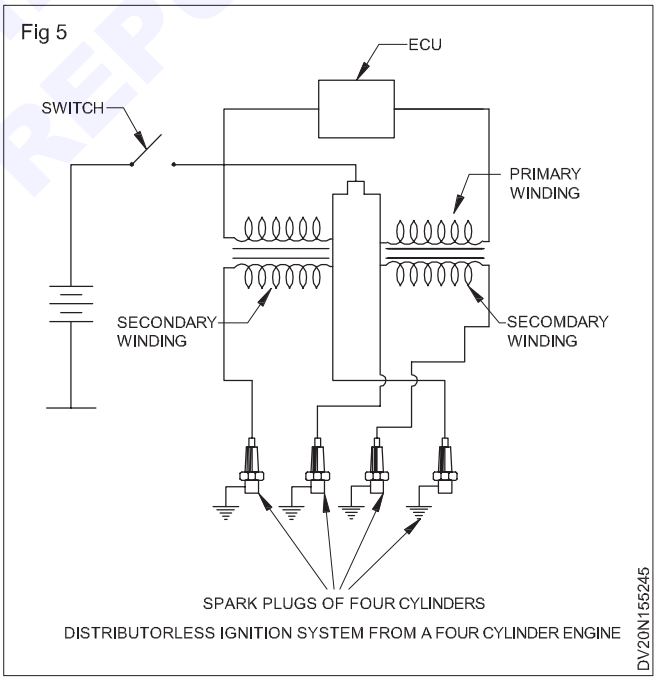
(v) Vacuum in the intake manifold.

(vi) Speed of the engine.

(vii) Position of the piston.

The sensors send the appropriate signals to the computer which then correlates the signals. After processing the information, the computer provides the best spark advance for the operating conditions.

Distributor less ignition system (Fig 5)



This engine has no distributor. In this system, two spark plugs are ignited at the same time. Out of these two spark plugs, one provides ignition in one cylinder during its exhaust stroke. However, the ignition has no effect, as only burnt gases are present inside the cylinder during the exhaust stroke.

The other spark plug ignites the mixture in another cylinder when the piston is at the end of the compression stroke. Here normal combustion takes place.

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In the ignition coil, there are two primary and two secondary windings. The rotary hall effect sensor on the crankshaft controls the flow of current through the primary winding and consequently, the production of high voltage in the secondary winding.

The trigger has two triggering points, one for each primary winding. Each triggering point sends a signal to the electronic control unit (ECU) so that the flow of current through one of the two primary windings is stopped. When the flow of current is stopped, the magnetic field in the primary winding collapses suddenly and a high voltage is produced in the secondary winding.

A four cylinder engine with the firing order 1,3,4,2 has a special arrangement in which cylinders 1 and 4 and cylinders 3 and 2 are paired.

In a six cylinder engine, which has no distributor, there are three pairs - cylinders 1 and 4, cylinders 5 and 2, and cylinders 6 and 3.

Each ignition coil is a true transformer.

Action to be taken when ignition key is lost:

When vehicle ignition key is lost , use the spare key issued by the vehicle manufacturers. Suppose there is spare key with you just you call the key maker and prepare(fabricate) new duplicate key for your vehicle ignition switch or replace the ignition switch with new standard switch.

Battery

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

- **state classification of cells**
- **explain the construction of a lead acid battery**
- **explain the chemical action during discharging**
- **explain the chemical action during charging**
- **explain maintenance of a battery**
- **explain testing of a battery**
- **explain battery selection and rating**
- **explain battery charging method**
- **explain advantages of maintenance free battery.**

A cell is an electrochemical device consisting of two electrodes and an electrolyte. The chemical reaction between the electrodes and the electrolyte produces a voltage.

Cells are classified as:

– dry cells

– wet cells

Dry cells : A dry cell has paste or gel electrolyte. It is semi-sealed and could be used in any position.

Wet cells : It consists of two plates and a liquid electrolyte. These cells have vent holes to allow the gases to escape during charging and discharging. The most common wet cell is the lead acid cell; wet cells can be recharged for reuse.

Primary cells : Primary cells are those cells which are not rechargeable. Chemical reaction that occurs during discharge is not reversible. The following types of primary cells are used.

– Voltaic cell

– Carbon zinc cell

– Alkaline cell

– Mercury cell

– Silver oxide cell

– Lithium cell.

Secondary cell (Lead acid battery) : These cells can be recharged by supplying electric current in the reverse direction to that of a discharged battery.

Lead acid battery (Figs1&2)**:** This battery is an electrochemical device for converting electrical energy into

Fig 1

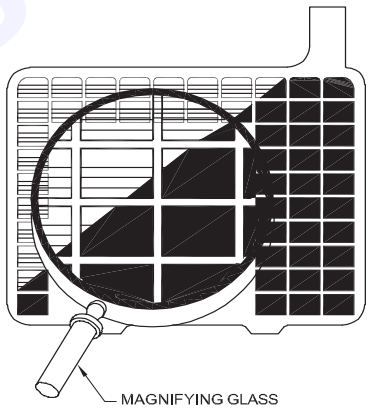
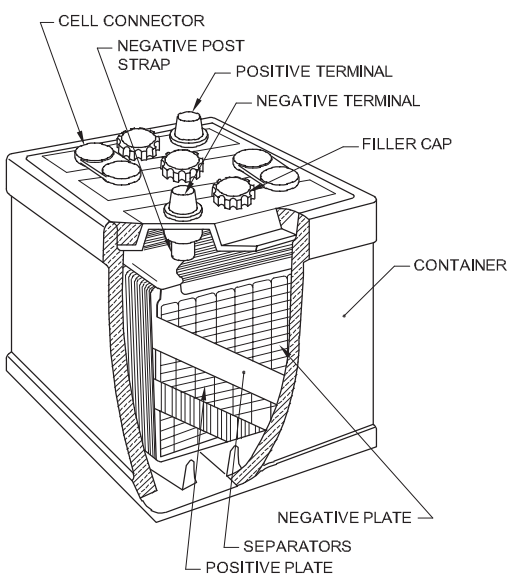


Fig 2



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chemical energy and vice versa. The main purpose of the battery is to store electrical energy in the form of chemical energy. It provides supply of current for operating various electrical accessories, when the engine is not running. When the engine is running it gets electric supply from the dynamo/alternator. It is also known as accumulator and storage battery.

Construction: The automobile battery's plates are rectangular. They are made of lead. Antimony alloy is used to provide them strength.

The group of plates, which are connected to the positive terminal of the cell, consists of grids filled with a paste of lead peroxide. This lead is brown in colour. The group of plates, which are connected to the negative terminal of the cell, consists of grids filled with metallic lead which is spongy in nature. This lead is dull grey in colour.

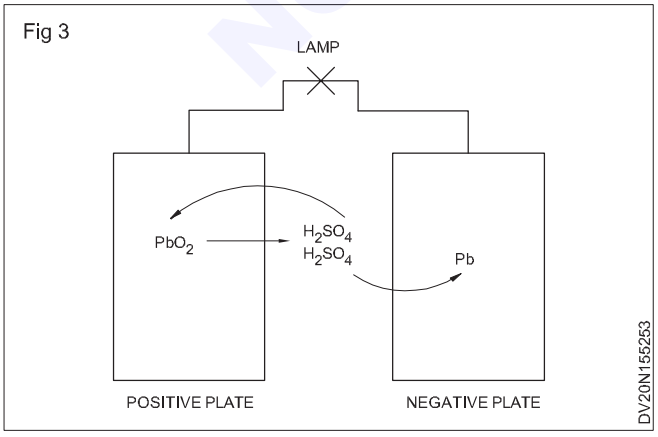
Each a group of plates is held together by a post strap, to which individual plates are welded. The post strap is extended up to the cell cover to provide battery terminals. The positive and negative plates are arranged alternatively, and in between the plates, separators are used to prevent contact of the positive and negative plates. Separators are made of specially treated wood, hard rubber, resin, integrated fibre or in combination with rubber or mats of glass fibres. The container in which the plates are placed is made of hard rubber which is not affected by the electrolyte. A solution of sulphuric acid and distilled water is added until the level of the liquid in the container is about 1/4" to 3/8" above the top of the plates. A filler cap with air vents is provided to allow gases to escape out.

Chemical Reactions

Discharging (Fig 3)**:** During discharging, the sulphuric acid is broken into two parts, hydrogen (H_2) and sulphate (SO_4). The hydrogen is liberated at the lead peroxide plates (PbO_2) reducing them to lead oxide (PbO) which combines with parts of the sulphuric acid to form lead sulphate ($PbSO_4$) and water (H_2O). The SO_4 is liberated at the spongy lead plate (Pb) and combines with them to form lead sulphate ($PbSO_4$). During this process the electrolyte becomes less concentrated due to absorption of the sulphate by the lead plates.

$$PbO_2 + 2H_2SO_4 + Pb \rightleftharpoons PbSO_4 + 2H_2O + PbsO_4$$

(+ve) (electrolyte) (-ve) (+ve) (water) (-ve)

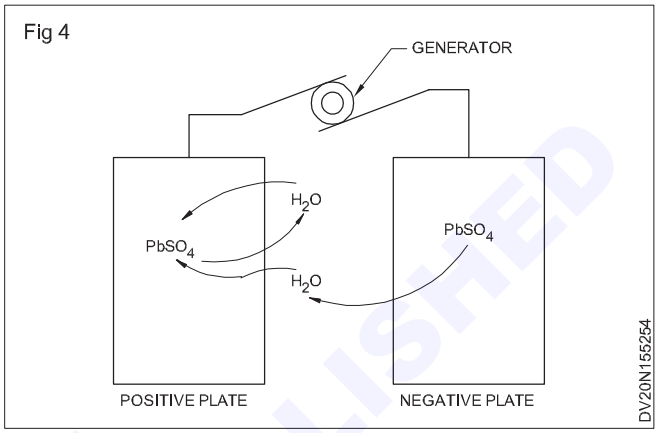


Charging (Fig 4)

When the battery is charged by passing current through a dynamo or charger in the opposite direction, the reverse chemical reaction takes place. The lead sulphate on one plate becomes lead peroxide (+ve plate). The lead sulphate on the other plate (-ve plate) becomes spongy lead and the electrolyte becomes more concentrated because of the increased amount of sulphuric acid.

$$PbSO_4 + 2H_2O + PbSO_4 \rightleftharpoons PbO_2 + 2H_2SO4 + Pb$$

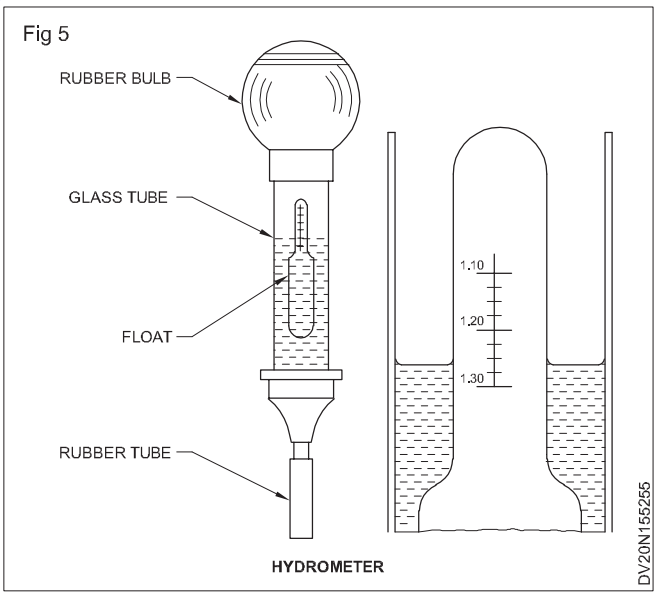
(+ve) (water) (-ve) (+ve) (Electrolyte) (-ve)



Maintenance of battery: Batteries are expensive items to replace. They should be serviced regularly as recommended by the manufacturer. If maintained properly, they can be used for longer periods. The following aspects are to be checked to maintain the battery in good condition.

Check and top up electrolyte level every week. Electrolyte should be 10 mm to 15 mm above the plates.

Check the specific gravity of the battery with a hydrometer. (Fig 5) If the specific gravity falls below 1.180 then add a few drops of sulphuric acid.



Sp. gravity readings and the state of charge of the battery are as follows.

Check the voltage across the cell terminals of each cell by using a cell tester. Cell voltage is 2 to 2.3 volts per cell for fully charged condition.

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Sl.No.	Specific	State of charge of the battery
1	1.260 - 1.280	Fully charged
2	1.230 - 1.260	3/4 charged
3	1.200 - 1.230	1/2 charged
4	1.170 - 1.200	1/4 charged
5	1.140 - 1.170	About run down
6	1.110 - 1.140	Discharged

If the voltage of each cell is less than specified, then the battery should be recharged.

While charging do not overcharge the battery.

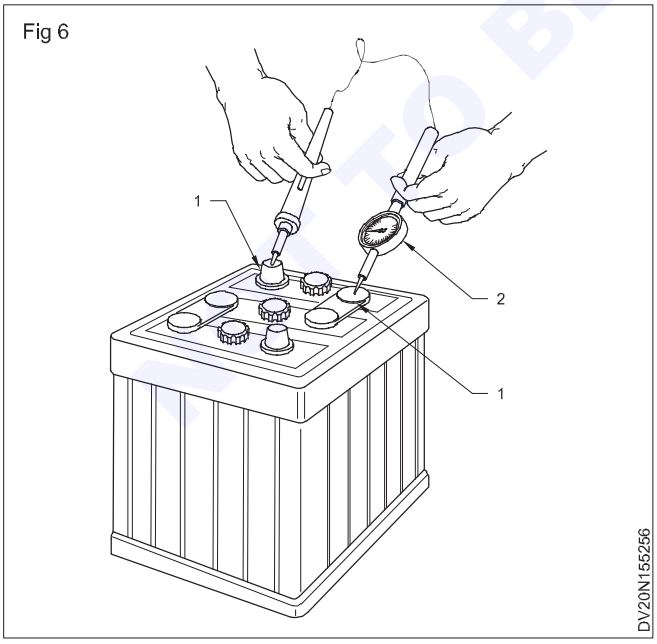
Keep the battery terminals always tight and clean.

To prevent formation of corrosion on the terminals smear petroleum jelly on it.

Voltage check of battery: With the help of a voltmeter the voltage of battery is tested. This will commonly vary from 12-13V

Battery selection (Fig 6)**:** Most cars in current production are equipped with a 12V battery. When a manufacturer installs a battery in a new car that battery is chosen to meet the requirements of that particular car. Prime importance is the battery's ability to crank and start the engine. The current required to crank on engine can range from 150A to over 500A depending on the size of the engine, the temperature and the viscosity of the oil in the engine. Those factors are all considered in battery selection. The number and type of electrical options installed in the car are also considered.

Fig 6



The lead acid batteries are made for different vehicle application to suit the electrical demands, while the voltage of the battery remains same for all application, the ampere-hour rate changes as per demand.

The following examples reveal the importance of ampere-hour of a battery.

Vehicle type	Battery applicable
2.5 Amps 12V	Two wheeler without starter
7 Amps 12V	Two wheeler with starter motor
35 Amps 12V	800CC - 1000 car petrol
40 - 45 Amps 12V	1300 Diesel vehicles
60 Amps 12V	2.5 Lit LCV
80 Amps 12V	4 Lit medium
120 Amps 12V	6 Lit Diesel HCV
180 Amps 12V	6 Lit Diesel passenger

Battery rating

Ampere-hour rating: The ampere-hour rating provides a measure of how much current a battery at 80^0F (27^0C) will deliver for a fixed period of time without the cell voltage dropping below 1.75V (10.5 total terminal volts). Due to a specified 20 hour time period, this test is sometimes referred to as the "20 hour test". The rating number is determined by multiplying the current delivered by 20. If a battery can deliver 3A for the 20 hour period, it receives a 60 ampere-hour rating. If a battery can deliver 5A for the 20 hour period, it receives a rating of 100 ampere-hour.

Conventional Batteries

Battery Capacity (Ampere Hours)	Discharge Rate (Amperes)
36	155
41	145
45	190
53	175
54	225
68	220
77	228

Maintenance-Free Batteries

Battery Capacity (Ampere Hours)	Discharge Rate (Amperes)
53	200
63	215
68	235

Battery charging: A discharged battery in good condition can be charged and retuned to service.

Many types of battery in use, but all chargers operate on the same principle. They apply an electrical pressure that forces current through the battery to reverse the electro chemical action in the cells.

Charging rates: The amount of charge a battery receives is equal to the rate of charge, in amperes, multiplied by the amount of time, in hours, that the charge is applied.

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As an example, a battery charged at the rate of 5A for a period of 5 hours would receive a 25 ampere-hour charge. To bring a battery to a fully charged condition.

Initial rate for constant voltage taper rate charger.

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

1 Electrolyte temperature exceeds 125^{o}F.

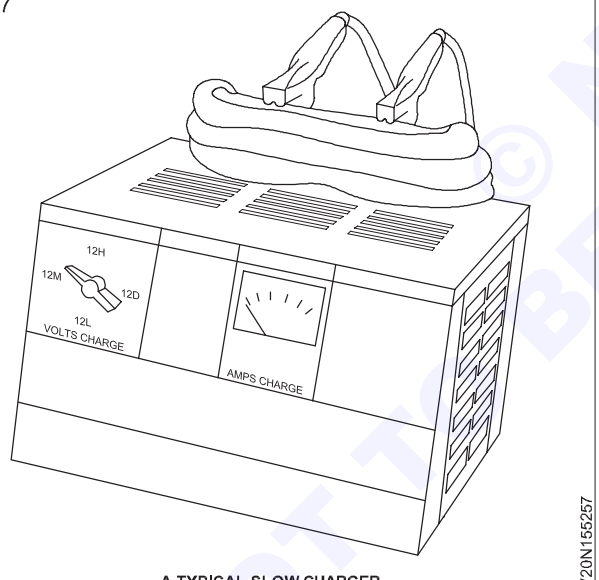
2 Violent gassing or spewing of electrolyte occurs.

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

Full charge specific gravity is 1.260 - 1.280 corrected for temperature with electrolyte level at split ring.

Slow charging (Fig 7)**:** Slow charging consists of charging a battery at a rate of about 5A for a time sufficient to bring the specific gravity of the electrolyte to its highest reading. Slow charging many require from 12 to 24 hours of time. A battery that is sulphated may require even more time. During the charging period, the electrolyte temperature should not exceed 110^{0}F (43^{0}C). If the electrolyte temperature rises above 110^{0}F (43^{0}C), the charging rate should be decreased.

Fig 7

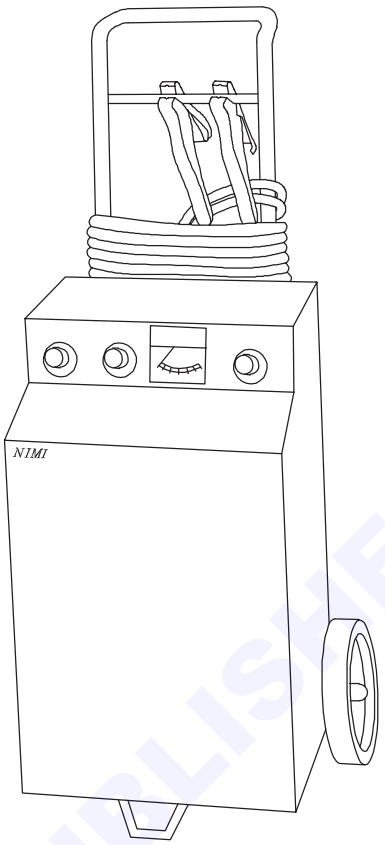


A TYPICAL SLOW CHARGER

A conventional battery with vent plugs is considered fully charged when the electrolyte is gassing freely and when no further rise in the specific gravity is noted at intervals of 1 hours. A sealed battery should be slow charged until the green dot appears in the built-in hydrometer. In some instances, a sealed battery must be slightly shaken to allow the green dot to appear.

Fast charging (Fig 8)**:** Fast charging will not fully recharge a battery, it will restore the charge sufficiently to allow the battery to be used.

Fig 8



A TYPICAL FAST CHARGER

Fast charging consists of charging a battery at a rate from 10 to 50A. The exact charging rate depends on the construction of the battery, the condition of the battery and the time available. The temperature of the electrolyte provides an indication of the current charging rate. If the electrolyte temperature rises above 125^{0}F (65^{0}C), the charging rate is too high and should be reduced. Since a high charging rate and the resultant high temperature can damage a battery, a battery should be charged at the lowest possible rate.

Features of sealed maintenance free battery

- No need for checking electrolyte level and tapping throughout the life.
- Seal construction ensures no leakage of electrolyte from terminal or casing.

Benefits

- Saving of 100 litres of distilled water through out its life time as compared to convention batteries.
- Saving of man power for regular topping up & cleaning corroded terminals as in conventional batteries.
- No damage of flooring by spoilage of batteries acid or water during maintenance.
- No need of separate battery room.

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Electricity effects

Objectives: At the end of this lesson you shall be able to
- **state electro chemical process**
- **state the effect of an electric currents.**

Chemical sources (Electro chemical process) (Fig 1)

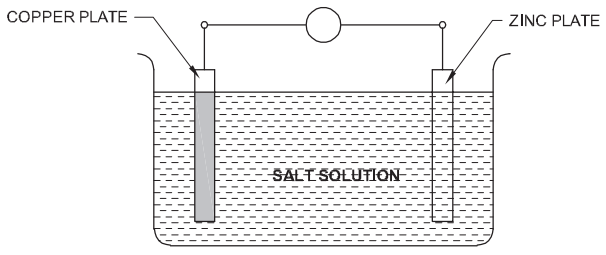
If two electrically conducting materials (metals) are immersed in salt solutions, an electric charge is produced between the two metals (electrodes, poles). Two examples are given below.

Copper and Zinc in salt solution is one combination

Lead and sulphuric acid is another combination.

This arrangement is known as wet cell and gives direct current. The second combination is used in a Lead Acid Battery for Motor vehicles.

Fig 1

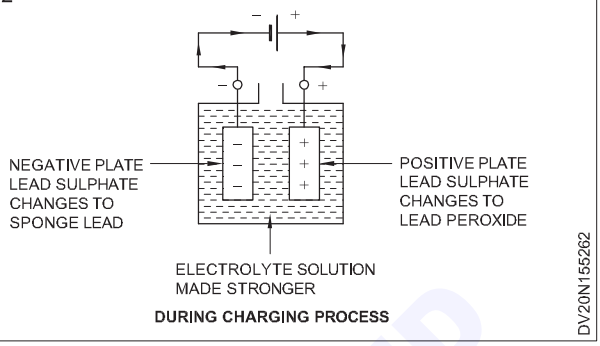


ELECTRICITY GENERATION BY DISSOLVING IN ELECTROLYTES

Dynamic electricity (Fig 2)

The current is produced by A/C or D/C generators, by conversion of mechanical energy into electrical energy. The generation of electric current is based on the fact when a conductor is moved in a magnetic field an E.M.F is set up in the conductor. When a large number of conductors are moved in a powerful magnetic field, high voltages and current are produced. This is the Principle of Dynamo.

Fig 2



DURING CHARGING PROCESS

The effect of an electric current

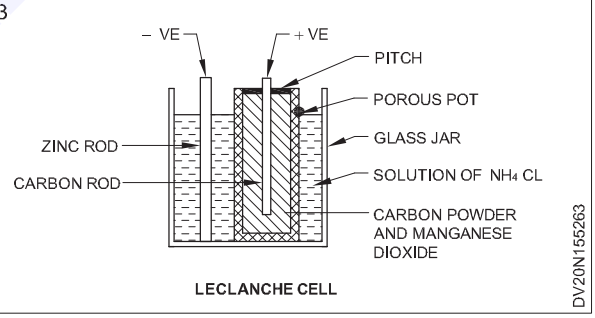
Let us now study effects of an electric current. When an electric current flows through a circuit, its presence could be analyzed by its effects. They are stated below.

Chemical effect (Fig 3)

When a current is applied to a battery from a battery charger various chemical reactions are produced which enable the electrical energy to be stored in a chemical form.

The process is called charging a battery by electrolysis method (using electric current).

Fig 3



LECLANCHE CELL

Fuse

Objectives: At the end of this lesson you shall be able to
- **state the need of a fuse in the circuit**
- **explain the construction of a fuse**
- **list out the types of fuses**
- **explain the working of fuses**
- **explain the circuit with and without a fuse**
- **explain circuit breakers.**

Introduction

A fuse is a protective device. It is a weakest portion in the electrical circuit.

An electric current heats the wire when the current passes through it. The amount of heat depends upon the current and resistance in the wire.

In automobiles, this heating effect is utilized in heaters, bulbs and gauges etc.

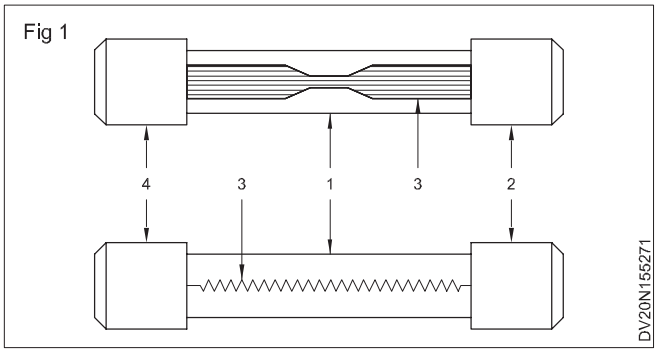
The heating effect in the circuit is limited by the fuse. If this limit is not controlled, the circuit an accessories will be overloaded causing severe damage to them.

Purpose of fuse (Fig 1)

A fuse opens the circuit by blowing out when current (overload) flows in the circuit to prevent severe damage to the accessories.

The flow of excess current in a circuit may be caused by a short circuit.

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Construction

Fuse elements are of lead-tin or tin-copper alloy wire in strip of correct amperage for each circuit.

The fuse is assembled in a fuse carrier of glass or ceramic material.

Nowadays fuse elements assembled in glass tubes, called cartridges, are widely used in automobiles.

It consists of a glass tube (1) with metal end caps (2) & (4).

A soft fine wire or strip (3) carries the current from one cap to another (4).

The conductor (3) is designed to carry a specific maximum current.

Working

The current flows through the conductor (3) between two metal caps (2) & (4) and then to the equipment.

If the current value exceeds the limit prescribed on the fuse, the fuse element (3) melts and opens the circuit and prevents the equipment from damage.

Identification of blown fuse

If you look at the burnt fuse and if the element is broken the fuse is burnt due to overloading.

The glass is foggy white or black the fuse is blown out due to short circuit.

Circuits protected with fuse

- Headlight circuit
- Tall - light circuit
- Number -plate circuit
- Panel lamp circuit
- Interior lamp circuit
- Side indicator circuit
- Horn circuit
- Wiper circuit
- Dashboard / panel instruments circuit
- Header and air conditioner
- Charging circuit
- Radio
- Cigarette lighter
- Reverselamp

Circuits without fuse

- Starting circuit
- Ignition circuit
- Fuel pump
- Stop - light circuit
- Oil pressure lamp circuit
- Ignition warning lamp circuit.

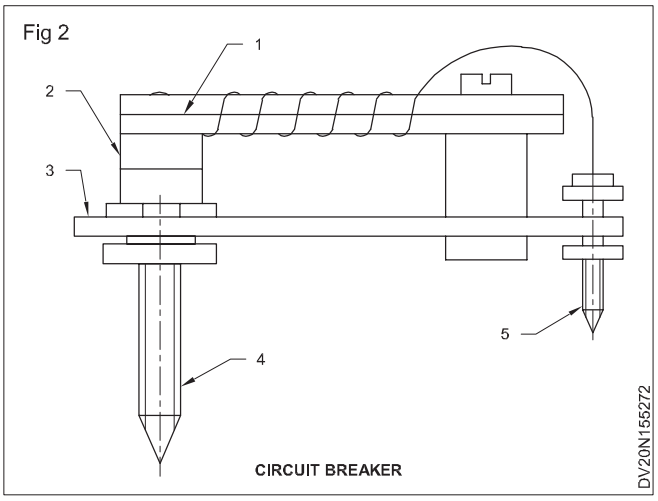
Fuse rating and colour

Rating	Colour
3 Amp	Violet
5 Amp	Tan
10 Amp	Red
20 Amp	Yellow
25 Amp	White
30 Amp	Light green

Circuit Breaker (Fig 2)

These units are regarded as a non- replaceable type of fuses. Generally fitted in the headlight circuit, it consists of a bimetallic strip (1) with moving contact (2). A fixed contact (3) is provided with the terminals (4) & (5). The strip (1) bends as soon as the current exceeds the maximum permissible value for the electrical component concerned. This way it opens the points to break the circuit. When this type of device is used in the lighting circuit, the lamp will light and then go out. Thus giving an indication of a faulty circuit. The circuit breakers are made in ratings up to 50 amps.

Rectifiers are provided inside the meter to convert AC to DC in the AC measurement circuit.



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Wheels

Objectives: At the end of this lesson you shall be able to
- **state the function of wheels**
- **list out the varies types of wheels**
- **state wheels construction**
- **explain static and dynamic wheel balance and effect of unbalance.**

Wheels

Wheels are connected to the front and rear axles. As power is supplied to either front or rear axle, axle shafts turn the wheels and the vehicle moves.

The wheel assembly consists of a hub, rim, tyre and tube. To perform its function the wheel should be:

- able to withstand the driving and braking torque, and support the weight of the vehicle
- able to absorb road shocks
- statically and dynamically balanced
- able to grip the road surface.

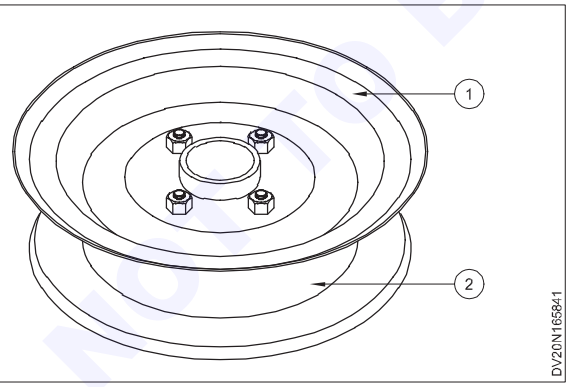
Types of wheels

- Disc wheel
- Wire wheel
- Split wheel
- Heavy vehicle wheel

Disc wheel (Fig 1)

In this type, a steel rim (1) is welded on to a steel disc (2). The tube and tyre are fitted on to the rim (2). The disk is provided with holes to mount it on the hub.

Fig 1



Wire wheel (Fig 2)

In this type the hub and rim are connected by a number of wire spokes. Alternate spokes are screwed to slope forward and backward towards the rim to absorb the braking and driving torque respectively. (Eg.Bicycle/ Motor cycle wheels)

Split wheel (Figs 3 & 4)

In this type two separate discs are clamped together and a flange of discs provide seating surface for the tyre and tube. This types of wheels are used in car and scooter.

Fig 2

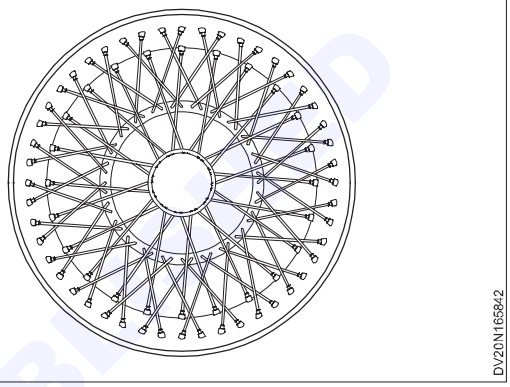
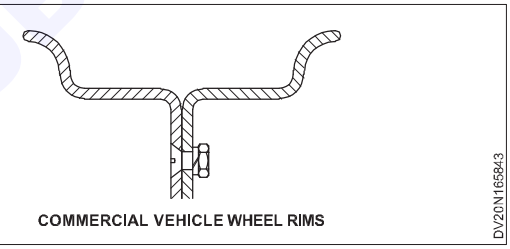
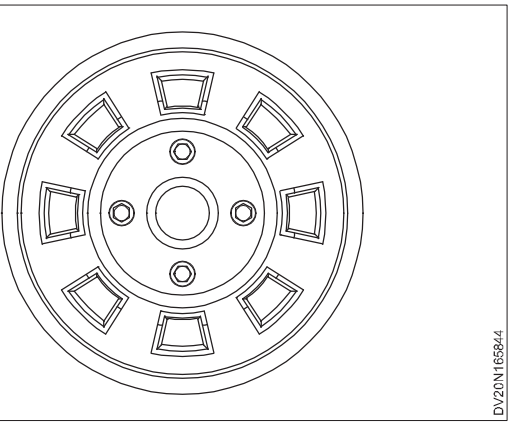


Fig 3



COMMERCIAL VEHICLE WHEEL RIMS

Fig 4



Heavy vehicles wheels

These wheels are similar to disc wheels except that a thicker plate is used for the disc.

Rims

The rim provides seating surface for the tyre and tube.

Two types of rims are used.

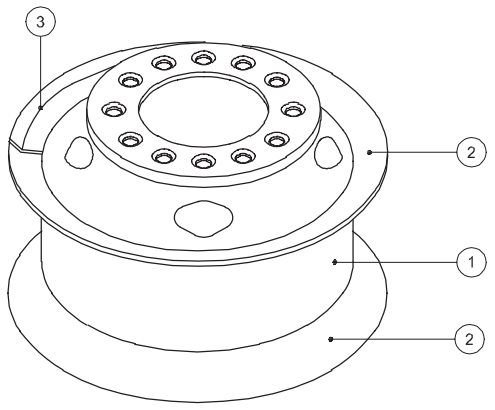
- Flat base rim
- Drop centre rim.

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Flat type rim (Fig 5)

In this type the rim's centre position (1) is kept flat. One edge of the rim has a projection (2), and the other end is removable to install into or remove the tyre and tube from the rim. One plain ring and one split lock ring (3) are provided on the removable end of the rim to lock the tube and tyre in position. This arrangement enables the removal of the tyre without stretching the bead.

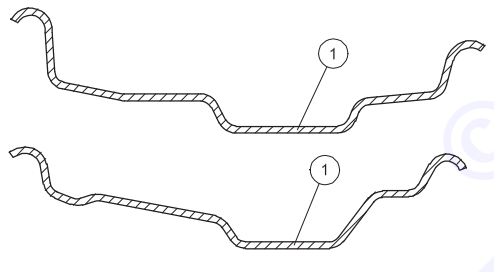
Fig 5



Drop centre rim (Fig 6)

In this type a small diameter well (1) is provided at the centre of the rim. It enables removal or installation of the tyre by stretching beads and throwing them in or out of well.

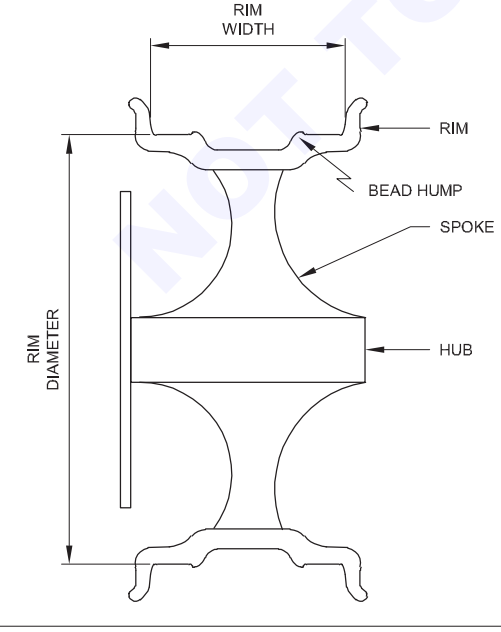
Fig 6



Wheel construction (Fig 7)

Function of each part

Fig 7



Wheels must have the strength to endure shocks and repulsion forces from the road surface as well as braking and driving forces. At the same time they must have the rigidity to maintain stability and maneuverability. Lastly, they must be light in order to reduce unsprung weight.

Wheel can be divided into three parts with the following functions.

Hub

This is the part linked with the frame. It has bearings in the center. The bearings link the rotating wheel to the non - rotating frame. High linkage rigidity and dimensional precision are required for the non-rotating part, while smooth rotation and no play are required for the rotating part. This part supports the spokes and is required to have the appropriate supporting function. It is also designed to facilitate the rotating parts of the brake, the drive system and speedometer.

Spokes

The spokes support the rim while fulfilling the following conditions:

Assure accurate roundness of the rim and ensure its center aligns with the center of the axle shaft (Vertical vibration).

Ensure high degree of flatness with no distortion, and the surface is perpendicular to the axle shaft (horizontal vibration)

RIM

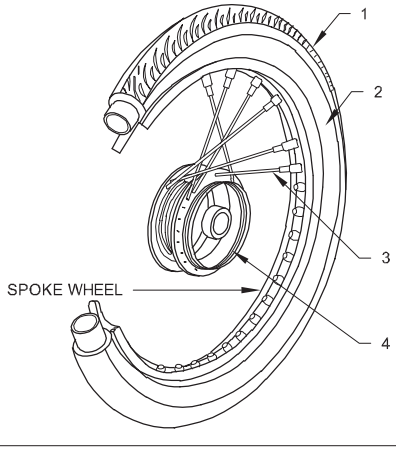
The rim holds the tyre in the correct position. In the case of tubeless tyres, internal pressure is maintained by close adhesion between the bead surface of the tyre and the flange surface of the rim. The rim width indicates the internal width of the flange and is given in inches. The rim diameter is the diameter at the bottom of the rim and is also given in inches. A rim on which tubeless tyre can be fitted is stamped, "Tubeless Tyre Applicable".

Wheel construction

Wire spoke wheels (Fig 8)

Thin steel spokes connect the rim and the hub. This type of wheel is light and inexpensive

Fig 8



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Main parts of spokes wheel are

1 Tyre

2 Rim

3 Spokes

4 Hub

5 Tube

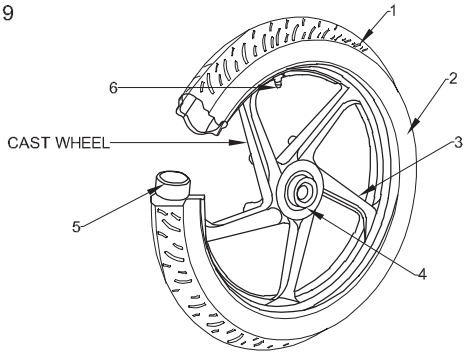
6 Valve

Cast wheel

This wheel is cast from aluminum alloy as a single component. The design became possible following technological development of new materials and manufacturing methods. This type of wheel has high precision, lightweight, high rigidity and high flexibility of design.

Major parts of cast wheel are (Fig 9)

Fig 9



1 Tyre

2 Rim

3 Spokes

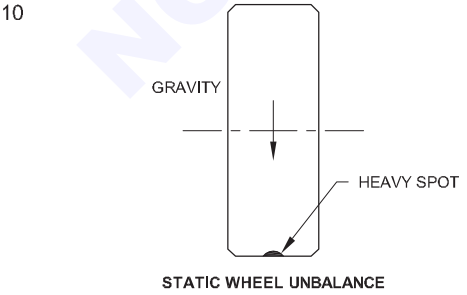
4 Hub

5 Tube

Some vehicles are equipped with cast aluminum alloy wheel rims or cast magnesium alloy wheel rims. Sometimes these wheels are referred to as “mag” wheels. These wheels are lighter and generally more accurately designed compared to pressed steel wheel rims.

Static wheel balance (Fig 10)

Fig 10

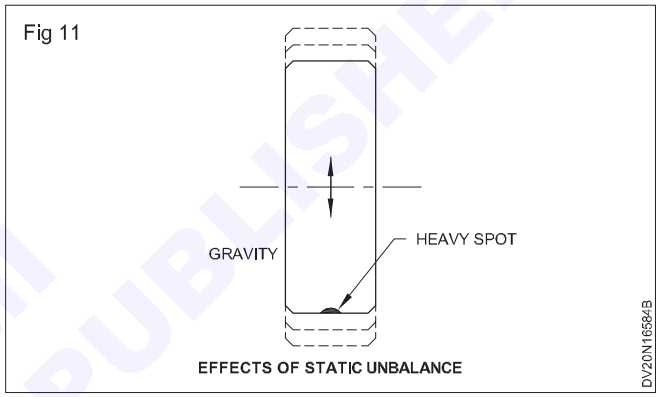


When a wheel and tire has proper static balance, it has the weight equally distributed around its axis of rotation and gravity will not force it to rotate from its rest position. If a vehicle is raised off the floor and a wheel is rotated in 120 degree intervals, a statically balanced wheel will remain stationary at each interval. When wheel and tire are statically unbalanced, the tire has a heavy portion at one location. The force of gravity acting on this heavy portion will cause the wheel to rotate when the heavy portion is located near the top of the tire.

Results of static unbalance

Centrifugal force may be defined as the force that tends to move a rotating mass away from its axis of rotation. As we have explained previously, a tire an d wheel are subjected to very strong acceleration d deceleration forces when a vehicle is in motion. The heavy portion of a statically unbalanced wheel is influenced by centrifugal force. This influence attempts to move the heavy spot on a tangent line away from the wheel axis. This action tends to lift the wheel assembly off the road surface. (Fig 11)

Fig 11



The wheel lifting action caused by static unbalance may be referred to as wheel tramp (Fig 12). This wheel tramp action allows the tire to slip momentarily when it is lifted vertically. When the wheel and tire move downward as the heavy spot decelerates, the tire strikes the road surface with a pounding action. This repeated slipping and pointing action causes severe tire scuffing and cupping. (Fig 13)

Fig 12

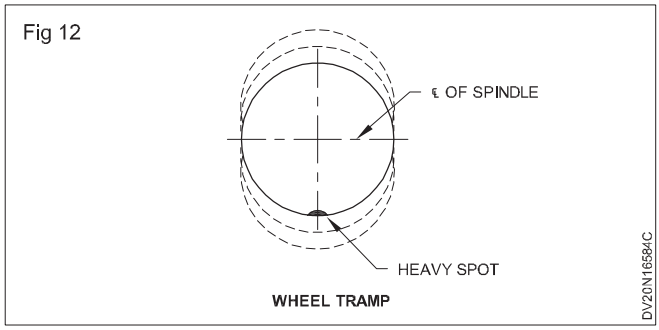
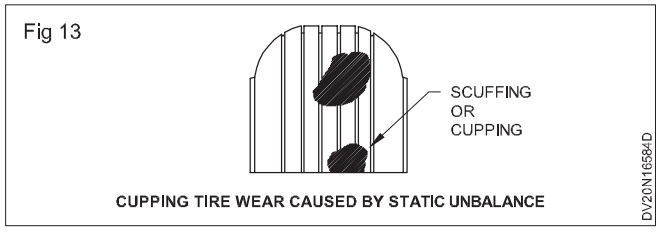


Fig 13



The vertical wheel motion from static unbalance is transferred to the suspension system and is then absorbed by the chassis and body. This action causes rapid wear on suspension and steering components.

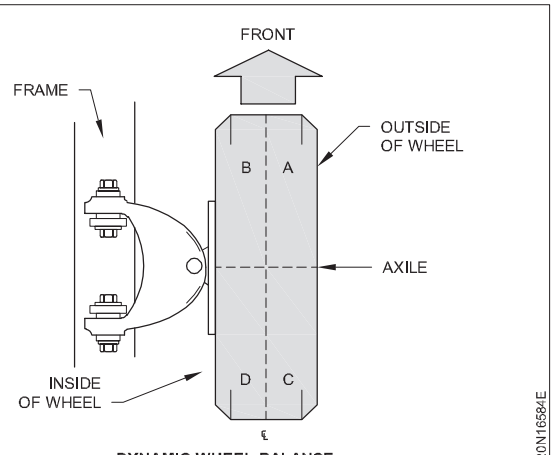
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The wheel tramp action resulting from static unbalance is also transmitted to the passenger compartment which causes passenger discomfort and driver fatigue.

Dynamic wheel balance theory

When a wheel and tire assembly has correct dynamic balance, the weight of the assembly is distributed equally on both sides of the wheel center viewed from the front. Dynamic wheel balance may be explained by dividing the tire into four sections (Fig 14)

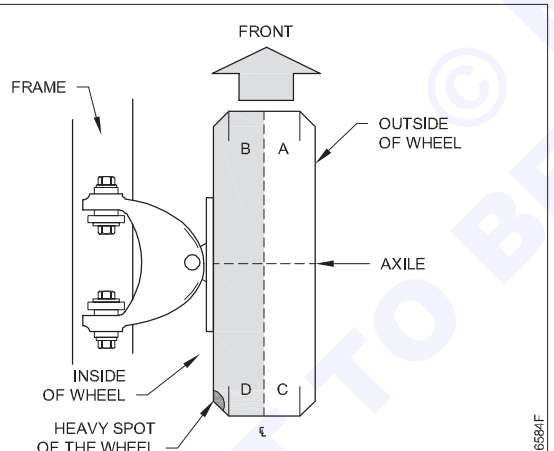
Fig 14



DYNAMIC WHEEL BALANCE

In Fig 14, if sections A and C have the same weight and sections B and D also have the same weight, the tire has proper dynamic balance. If a tire has dynamic unbalance, section D may have a heavy spot and thus sections B and D have different weights. (Fig 15)

Fig 15



DYNAMIC WHEEL UNBALANCE

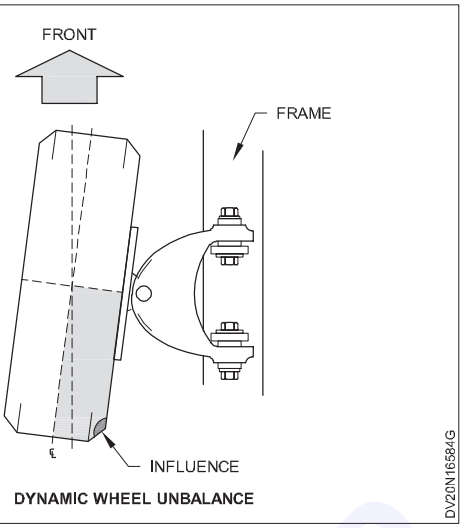
From our discussion of dynamic balance, we can understand that a tire and wheel assembly may be in static balance but have dynamic unbalance. Therefore, wheels must be in balance statically and dynamically.

Results of dynamic wheel unbalance

When a dynamically unbalanced wheel is rotating, centrifugal force moves the heavy spot toward the tire center line. The center line of the heavy spot are is at a 90 degree angle to the spindle. This action turns the true center line of the left front wheel inward when the heavy spot is at the rear of the wheel (Fig 16)

When the wheel rotates until the heavy spot is at the front of the wheel, the heavy spot movement turns the left front wheel outward.

Fig 16



DYNAMIC WHEEL UNBALANCE

From the these explanations we can understand that dynamic wheel unbalance causes wheel shimmy. This action causes steering wheel oscillations at medium and high speeds with resultant driver fatigue and passenger discomfort. Wheel shimmy and steering wheel oscillations also cause unstable directional control of the vehicle. Wheel shimmy is the rapid, repeated lateral wheel movement.

Importance of two wheel and four wheel adjustment: Wheel adjustment is most important to avoid uneven wear of tyre, and achieve good fuel efficiency, and good overall performance of the vehicle.

Tyre retreading process

- Inspect the retreading tyre strength and condition.
- Mark the punctures, ruptured cords, separators or other faults in the tyre.
- If found all the casing that fail the inspection test are rejected.
- Tyre casing should be clean.
- Tyre channels must be cleaned well.
- Inspection to be done inadequate light arrangement.
- Tyre inspections to be done with proper tools (Hammer, poker/ crayon/cloth)
- Check for separation with topping hammer at shoulder area and at the crown hear the change of sound. Harmonious at separation points give different thumping sounds. Mark that point crayon and reject the tyre.
- Use your palm and run it over the bead area, inside and outside to feel a bulge of ply separation. Mark it with a crayon and reject the tyre if the bulge is there.
- Examine the extent of cut at the crown are with the help of poker, if the cut is too large or too deep and cannot be repaired, then reject the casing.
- Bleeding out any air entrapped in the casing at the time of curing. Venting is recommended for bias tyres only and not radial tyres.

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- Cutting out the worn out tread portion of the casings. Crown into a uniform surface. The uniform surface allows more flexibility and correct placement of the new tread on the top of casing to provide exact bonding, while curing.

Note: The selected casing needs to be buffed precisely and inflated at the specified rim size and tyre pressure as recommended in original use to ensure the proper radius and profile of the buffed area.

The improper buffing tyre will have a non uniform radius and surface area for the tread to be placed on the casing resulting in an unsuccessful bonding between the new tread and the old casing.

- Remove the loose or damaged part from the buffed crown area of the tyre casing.
- After buffed and skiving area is quickly coated with a rubber solvent. This process to be done with in 2 hours of buffing and skiving.
- Repeat the cuts and damage of the before retreading.
- Based on the size of the damage or cut repair by spot repair or reinforced repair or sectional repair.
- The size and shape of the paths should be selected based on the size of the damage and the type of tyre.
- The pre-cured tread rubber belt is cut exactly to the length determined in the buffing machine.
- Apply bonding gum on the under-tread area of the PTR and stitched with a roller, and it is ensured that there is no air entrapment between the bonding gum and the tread.
- Cut the tread edges straight perpendicular and a strip of bonding gum is applied at the edges. The tread is then rolled and sent to the building machine.
- Mount the tyre casing on builder and inflated with exact size rim as in original usage.
- Coated with bonding gum on the crown surface of the casing.
- Rotate the casing slowly so that the tread completely sticks to the crown surface with no air entrapments.
- Give uniform pressure at all points of the tread, including the tread voids to achieve perfect bonding of the tread with the casing.
- Avoid any distortion of the casing while tyre curing.
- If need place a thin film of perforated poly between the envelop and the tyre to facilitate bleeding out of any entrapped air between the envelope and the poly with an envelope valve placed over it to act as an exit for the air entrapped between the envelop and the casing.
- Enveloped tyre to be placed in an electrically heated pressurized chamber for curing. Ensure curing process makes strong chemical bonding with tread rubber and the casing, making them inseparable.
- Maintain a constant temperature while tyre in curing chamber.

Note: Ensure the basic parameters of time, temperature and pressure are maintained throughout the curing process.

- After curing the tyre bring out from the curing chamber and let allow to cool before final inspection.
- Inspect the retreaded tyre for perfection and high standards.
- Polish the retreaded tyre to give it a shine and look as good as a new tyre.

Tyres

Objectives: At the end of this lesson you shall be able to
- **state the functions of tyre**
- **state the types of tyres**
- **state the construction of tyres**
- **state the tyre specification**
- **state the tyre inflation**
- **state the run flat tyres**
- **state the need of tyre valves**
- **state the tyre ratings**
- **tyre pressure monitoring system**
- **state tyre traction rating**
- **state the tyre temperature rating**
- **state the concept of compact spare tyres.**

Function of tyres

Tyres should be able to:

- absorb shock
- grip the road surface in both wet and dry condition
- withstand vehicle load.

Types of tyres

- Tube tyre
- Tubeless tyre

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Tube tyre (Figs 1 & 2)

It is the most commonly used tyre. A tube (1) is used inside the tyre (2). The tube is inflated with air at a pressure recommended by the manufacturer. It provides cushioning. The outer portion of the tyre which keeps contact on the road is made of synthetic rubber. This portion is called tread (3). Steel beads (4) are provided at the inner edge. A number of plys (5) of rayon cord are provided to give strength to the tyre. The beads (4) and plys (5) provide strength to the tyre.

Fig 1

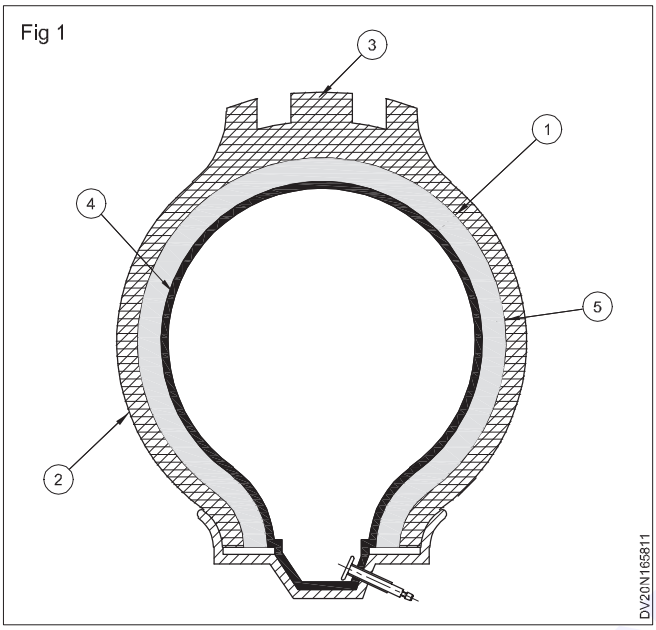
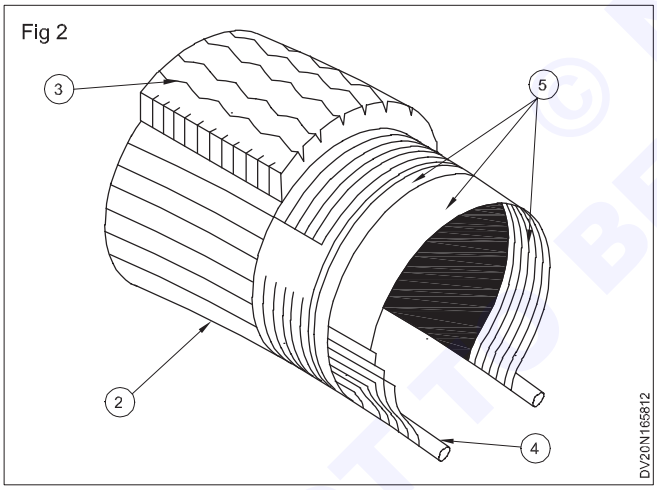


Fig 2



Tubeless tyre (Fig 3)

Its construction is similar to that of the tube tyre except that it does not have a tube and air is directly inflated in the tyre. The tubeless tyre can retain air for a longer period than the tube type tyre after puncture. This tyre need not be removed from the wheel to set right a puncture.

Material of tyre

- Rubber - for tread
- Nylon/rayon - for cord
- High tensile steel wire - for bead.

Tyre specification (Fig 4)

Tyre is specified in terms of the shoulder width, bead circle diameter and ply rating (PR).

Fig 3

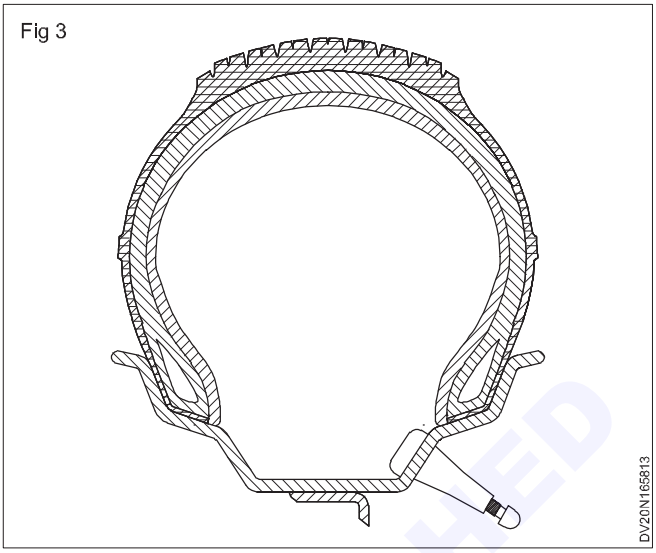
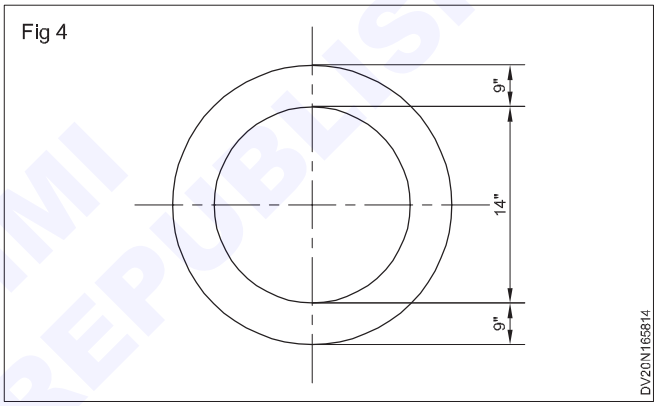


Fig 4



Eg. 9”x14” - 14 PR

Here the shoulder width is 9”. The bead circle diameter is 14” and the No. of plies (Ply rating PR) is 14.

Structure of tyre

Tyre outer diameter (Fig 5)

It is the outer most diameter of the tyre (1)

Tyre width

The width of the tyre corresponds to the distance between the most protruding portions on both sides.

Overall tyre width

Rectilinear distance between both side, including all patterns and characters on tyre sidewalls.

Tyre height

Half of height obtained by subtracting the rim diameter from the tyre outer diameter.

Thread width

The width of the tyre tread surface. This corresponds as a rule to the distance between the most protruding portions on both sides.

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Thread radius

This also referred to as the crown R. The radius of curvature is expressed in millimeters.

RIM width

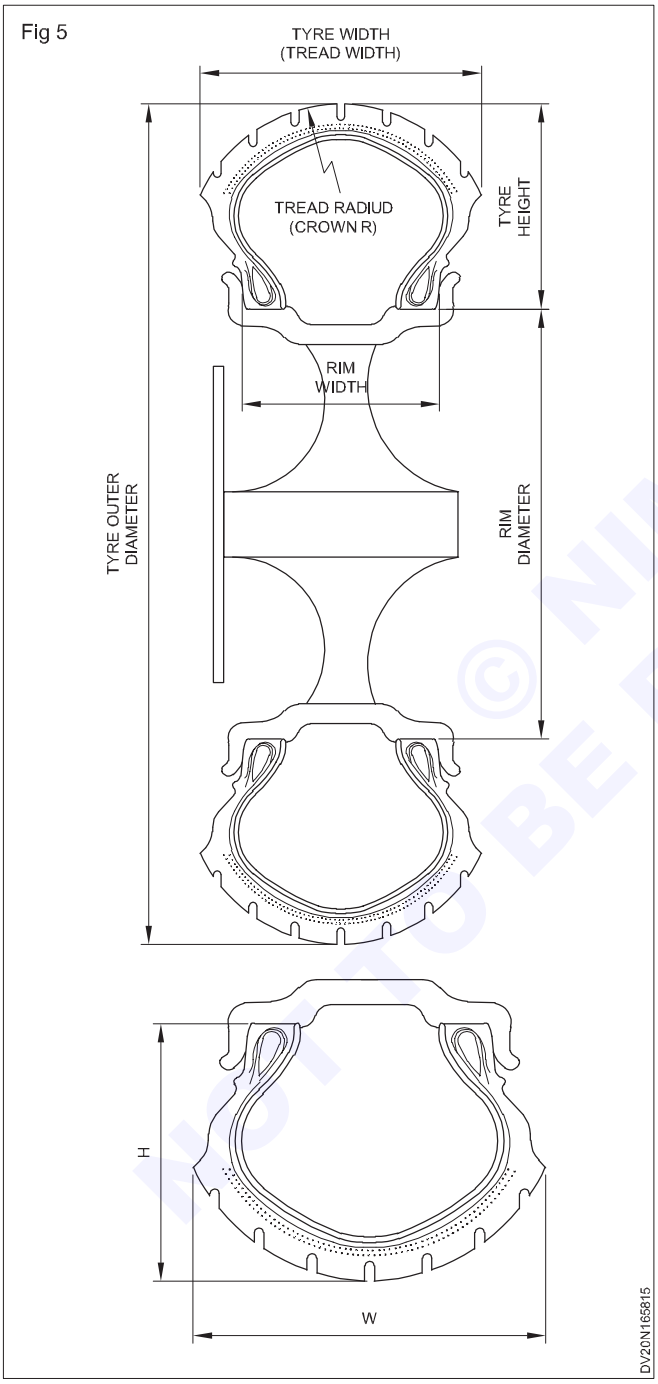
Rim width suitable for effective tyre performance

Bead circle diameter

The inside diameter of the tyre rim diameter is called as bead circle diameter of tyre.

Aspect ratio (Fig 5)

Fig 5



The aspect ratio, is, as shown in the drawing, percentage ratio of tyre height to tyre width.

Aspect Ratio (%age)= H/W x 100

Aspect Ratio (%age)= H/W x 100

H: Tyre height (mm)

W: Tyre width (mm)

1-Tyre outer diameter

2- Tyre height

3-Tyre width / Thread width

4-Thread radius

5-Rim width

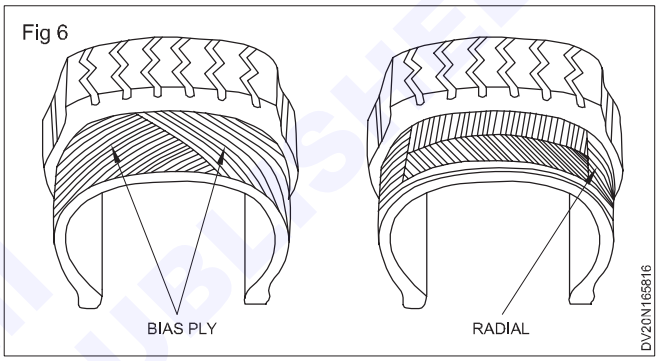
6-Rim diameter (or) bead circle diameter.

Construction of a tyre (Fig 6)

It is divided into two types.

- Radial ply
- Cross-ply

Fig 6



Radial ply

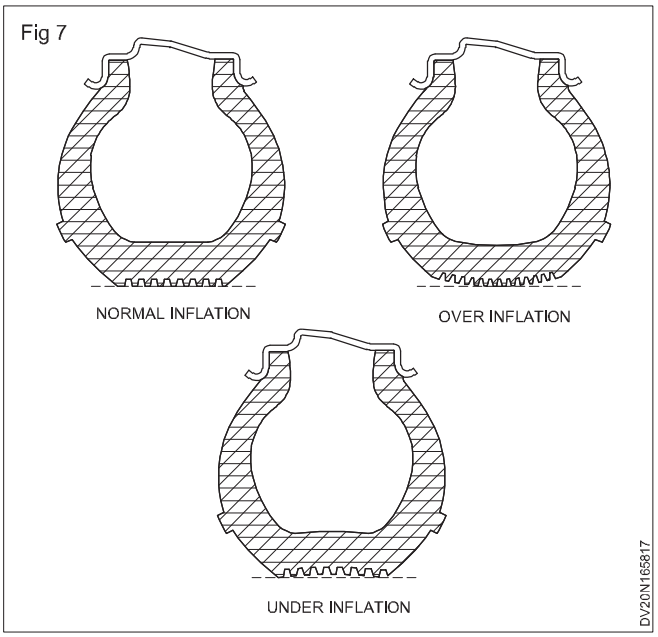
In this type plys are provided radially from bead to bead.

Cross-ply

In this type alternate plys are provided in opposite diagonal directions.

Tyre inflation (Fig 7)

Fig 7



All vehicle manufacturers specify pressure at which air should be inflated in the tyre. It depends upon the tyre size and load of vehicle etc. A tyre should be normal inflated at the specified pressure to have complete

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contact on road(1). If the tyre is over-inflated, it will have contact with the road only at the centre and the tyre will wear out faster at the centre (2). If it is under-inflated it will have contact with the road only at the edges which will wear out faster (3).

Tyre storage

- Tyres should be stored on a clean surface free from oil, grease, diesel or other liquid.
- Tyres should be kept vertically on the surface. So that they rest on their treads.
- Tyres should be stored away from electric appliances, gas heaters etc.
- Tyres should be protected from strong sunlight.

Size indication

METRIC INDICATION

	110	/	70	R	17	54	V
	a		b	c	d	e	f
a: Tyre width(110mm)			b:Aspect Ratio (70%)				c: Radial structure
d: Rim Diameter (17inch)			e: Max. Load (212 kg at 290 kpa)				f:speed limit (240 km/h)
	130	/	90	-	18	69	H
	a		b	c	d	e	f
a: Tyre width(130mm)			b:Aspect Ratio (90%)				c: Radial structure
d: Rim Diameter (18inch)			e: Max. Load (325 kg at 280 kpa)				f:speed limit (210 km/h)

INCH INDICATION

	4.00	H	-	18	4PR
	a	b		c	d
a: Tyre width(4 inch)		b:Speed limit (210 km/h)			c: Rim diameter (18 inch)
d: Tyre strength (4 ply rating)					

Load index

Maximum air pressure for each speed code. (P:225 kpa, S:250 kpa. H:280 kpa, V:290 kpa)

Load Index (kg)	Max. Load (kg)	Load index	Max. Load (kg)	Load index	Max. Load (kg)	Load index	Max. Load (kg)	Load index	Max. Load (kg)
30	106	40	140	50	190	60	250	70	335
31	109	41	145	51	195	61	257	71	345
32	112	42	150	52	200	62	265	72	355
33	115	43	155	53	206	63	272	73	365
34	118	44	160	54	212	64	280	74	375
35	121	45	165	55	218	65	290	75	387
36	125	46	170	56	224	66	300	76	400
37	128	47	175	57	230	67	307	77	412
38	132	48	180	58	236	68	315	78	425
39	136	49	185	59	243	69	325	79	437

Speed index

Speed symbol	Max. speed (km/h)
J	100
N	140
P	150
S	180
H	210
V	240
ZR	Over 240

Tyre pressure monitoring systems

Tire pressure monitoring systems are mandatory on all new vehicles produced in the United States starting in the 2004 model year. Some tire pressure monitoring systems have a pressure sensor strapped to the drop center in each rim (Fig.8). Other systems have a pressure sensor threaded onto the end of the valve stem. The pressure Sensors end radio frequency (RF) signals to the module in the tire pressure monitoring system. These RF signals change if the tire is deflated a specific amount. When the module senses a tire with low air pressure the module illuminates a warning light in the instrument panel.

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Other tire pressure monitoring systems use the wheel speed sensor signals in the ABS to monitor tire inflation pressure. When a tire is deflated to some extent, the tire diameter is smaller and wheel speed increases. Therefore, the wheel speed sensor signals may be used to indicate low tire pressure.

Location	Color code
Right front	Blue
Left front	Green
Right rear	Orange
Left rear	Yellow

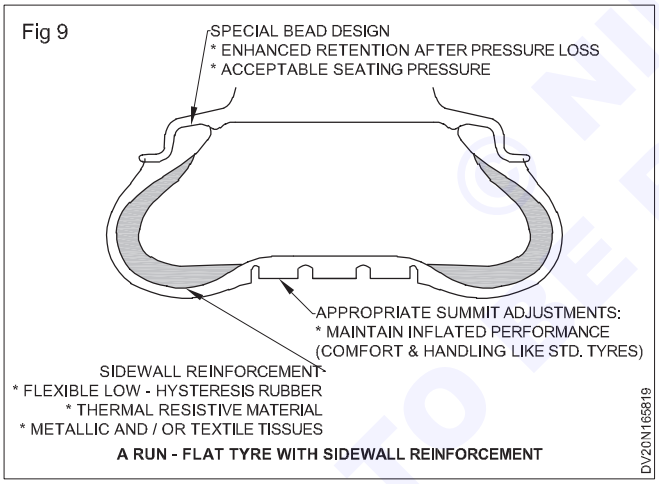
Warning: Pressure sensor inside tyre avoid contacting sensor with tire changing equipment tools or tire bead.

Service note: Pressure sensor must be mounted directly across from valve stem.

Run flat tyres (Fig 9 &10)

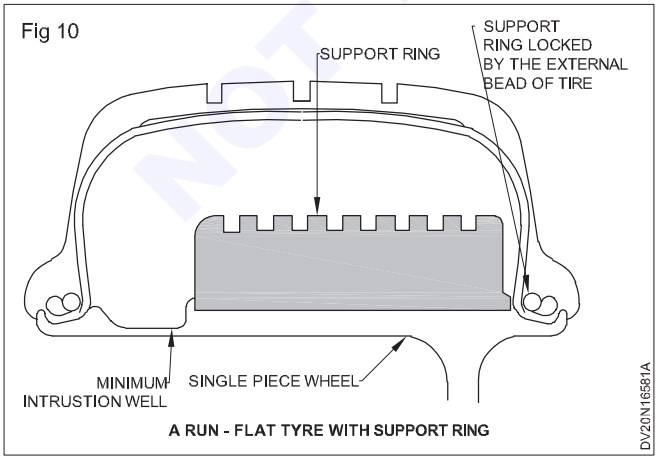
Some luxury and sport type vehicles are equipped with run-flat tires. Run-flat tires eliminate the need for a spare tire and a jack on these cars. This provides a weight and space savings. Run-flat tires must minimize the difference between run-flat tires and conventional tires and provide sufficient zero-pressure durability so the vehicle can be driven a reasonable distance to a repair facility.

Fig 9



A RUN - FLAT TYRE WITH SIDEWALL REINFORCEMENT

Fig 10



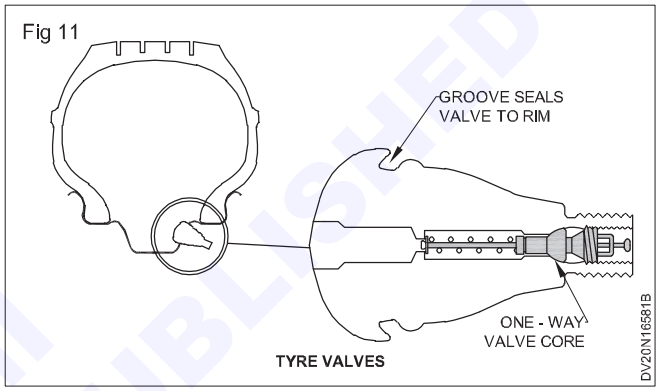
A RUN - FLAT TYRE WITH SUPPORT RING

Some run-flat tires have stiffer sidewalls that partially support the vehicle weight without air pressure in the tire. Other run-flat tires have flexible rubber support ring mounted on a special rim to support the vehicle weight if deflation occurs.

Tyre valves (Fig 11)

The tire valve allows air to flow into the tire and it is also used to release air from the tire. The core in the center of the valve is spring loaded and allows air to flow inward while the tire is inflated. Once the tire is inflated, the valve core seats and prevents airflow out of the tire. The small pin on the outer end of the valve core may be pushed to unseat the valve core and release air from the tire. An air tight cap on the outer end of the valve keeps dirt out of the valve and provides an extra seal against air leakage. A deep groove is cut around the inner end of the tire valve. When the valve assembly is pulled into the wheel opening, this groove seals the valve in the opening.

Fig 11

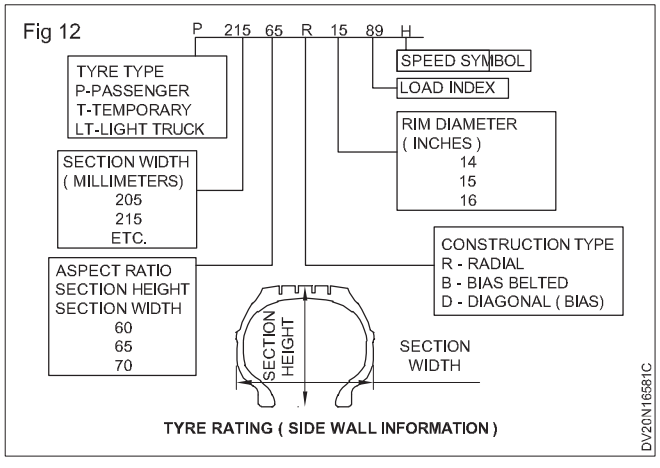


TYRE VALVES

Tyre ratings

A great deal of important information is molded into the sidewall of the average passenger car or light truck tire. The tire rating is part of the information located on the sidewall. The tire rating is a group of letters and numbers that identify the tire type, section width, aspect ratio, construction type, rim diameter, load capacity, and speed symbol. When a tire has a P215/65R15 89H rating on the side wall, the P indicates a passenger car tire (Fig 12).

Fig 12



TYRE RATING (SIDE WALL INFORMATION)

The number 215 is the size of the tire in millimeters measured from sidewall to sidewall with the tire mounted on the recommended rim width.

The number 65 indicates the aspect ratio, which is the ratio of the height to the width. With a 65 aspect ratio, the tire's height is 65 percent of its width. The letter R indicates a radial-ply tire design. A belted bias-ply

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tire design is indicated by the letters A B. The letter D indicates a diagonal bias ply - tire.

The number 15 is the rim diameter in inches. The load index is represented by the number 89. This load rating indicates the tire has a load capacity of 1,279 pounds. Various numbers represent different maximum loads. Some tire manufacturers use the letters B,C, or D to indicate the load rating. The letter B indicates the lowest load rating and the letter C represents a higher load rating. A tire with a D load rating is designed for light - duty trucks. This tire will safely carry a load of 2,623 pounds when inflated to the specified pressure.

Traction rating

Traction ratings indicate the braking capabilities of the tire to the consumer. To determine the traction rating, ten skid tests are completed on wetted asphalt and concrete surfaces. Test conditions are carefully controlled to maintain uniformity. The results of the ten skid tests are averaged and the traction rating is designated A, B or C with an A rating having the best traction.

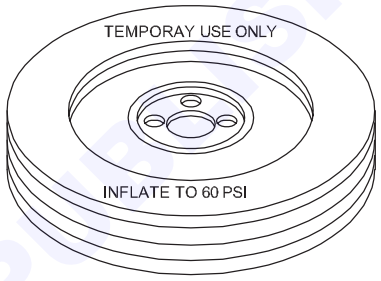
Temperature rating

Temperature resistance ratings indicate the tire's ability to withstand heat generated during tire operation. The National Highway Traffic Safety Administration (NHTSA) has established controlled procedures on a laboratory test wheel for temperature resistance testing of tires. The tire's temperature rating indicates how long the tire can last on the test wheel. Temperature ratings are A,B, or C. An A rating has the best temperature resistance. Tires must have a minimum letter C temperature rating to meet NHTSA standards in the United states.

Compact spare tyres

Since cars have been downsized in recent years, space and weight have become major concerns for vehicle manufactures. For this reason, many car manufactures have marketed cars with compact spare tires to provide a weight and space savings. The high - pressure mini spare tire is the most common type of compact spare (Fig13). This compact spare rim is usually 4 inches wide, but it is 1 inch larger in diameter compared to the other rims on the vehicle. The compact spare rim should not be used with standard tires, snow tires, wheel covers, or trim rings. Any of these uses may result in damage to these items or other parts of the vehicle. The compact spare should be used only on vehicles that offered it as original equipment. Inflation pressure in the compact spare should be maintained at 60psi (425 kpa). The compact spare tire is designed for very temporary use until the conventional tire can be repaired or replaced. Limit driving speed to 50mph (80 kph) when the high - pressure mini space is installed on a vehicle.

Fig 13



A CMPACT , HIGH - PRESSURE MINI SPARE TIRE

Tube

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

- **state tuff up tube**
- **state the structure of tuff up tube**
- **state hole plugging mechanism**
- **state nitrogen filling in tyre**
- **state tyre thread patterns.**

Tuff up tube

The two chamber tube has two separate chambers that are independent from each other. One is the air and other is the liquid chamber. The newly developed anti-puncture sealant gel is sealed in the chamber located on the tyre tread side during the manufacturing process. As the sealant chamber is always pressed against the tyre by the pressure from the air chamber, when there occurs a hole the sealant gel enters in the hole and closes it.

Structure of tuff up tube

This show how the two chamber tube closes the hole. Usually in an event of a puncture, a hole is pierced through the sealant gel chamber to the air chamber. When a hole occurs, the gel is forced into the hole, and the fibrous material contained in the gel is squeezed out. At that time, the fine ceramic particles fill the openings of the fiber, and the vacant spaces are filled with the gel. As there is a pressure inside of the inner tube, minimal quantity seeps into the air chamber but without causing any harm as it is a water based gel.

Hole plugging mechanism

This shows a picture of the cross - section of the hole closed by the newly developed anti-puncture sealant gel, taken after the sealant gel oozes out, dries and seals the puncture.

Tuff up tube can be repaired like an ordinary tube

Though it is an innovative technology, tuff up tube is easy to repair and with some simple precautions, it can be repaired at any repair shop or by road side mechanic.

Nitrogen filling in tyres

1 Car tyres are normally inflated with compressed air

2 Air is approximately 80% nitrogen, 20% oxygen

3 Nitrogen is comparatively inert, oxygen is a reactive gas.

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4 The nitrogen used for inflation in tyre depots is normally generated by a separation process from compressed air. It still contains about 5% oxygen.

5 Nitrogen used at race tracks and in industry may be 99%+ pure and contained in high pressure cylinders at 2000+psi.

6 Both sources of nitrogen will be treated to reduce the amount of water vapour.

Now a days nitrogen is used in all tyres in place of air. It is used because it doesn't expand and compress like normal air in altitude and temperature changes. That is why it is used in aviation applications.

Nitrogen is chemically a non-flammable, non - toxic inert gas. An inert gas does not react with any other gas at any temperature. This basic nature of nitrogen helps in keeping minimum moisture in the tyres.

Pros

- Nitrogen reduces the running temperature of the tyre, which is advantageous when the car or bike is operating at its maximum load and speed capacity.
- Nitrogen in tyres improves the ride quality. That gas is very slightly lighter than air, benefits the tires in terms of un-sprung weight.
- It is assumed that nitrogen increases tyre life. It reduces the operating temperature during times of load and speed and thus, enhances the life of a tyre.
- It is believed that nitrogen keeps tyre pressures more constant. The gas is assumed to provide more stable pressure range in connection to the tyre temperature. However, again, the factor is applicable in times of heavy load/high - speed conditions.
- Tyres are susceptible to loss of pressure as a result of being porous in nature. Due to its chemical structure, nitrogen leak out slowly as compared to compressed air. Therefore, it slows the rate of pressure loss.
- Oxygen reacts with the tyre and rim materials causing oxidation or the rust formation in the metal parts. Nitrogen, being an inert gas, does not react with the tyre and rim materials.

Cons

- Inflating tires with nitrogen is quite costly.
- Filling tyres with nitrogen requires more maintenance as compared to compressed gas.
- The availability factor is the biggest disadvantage of inflating tyres with nitrogen, as the gas is not readily available. It is usually found only with specialist tyre dealers.
- Generally its not that much advantages in case of commuter bikes. More ever 78% air is itself nitrogen. It is advantages only in case of formula cars, high speed racing cars & motorcycles & high load carriage vehicle.

Tyre tread patterns

- Function
- Improve grip
- Arrest skidding
- Keeps tyre cool
- Provide longer life
- Can be retreaded

Indicators are provided to show the limits upto which it can be used before renewing or ready for rectreading different commercial names are given by manufactures.

Types of tyre tread (samples)

- Knobby tread
- Lug tread
- Diamond tread
- Highway tread
- Saw totth trade

Sketches given below (Fig 1)

Fig 1



Monitoring systems

Tyre pressure monitoring systems are designed both to recognize the air loss in the tyre and also to warn the driver.

The following types of tyre pressure monitoring systems are used in motor vehicles:

- Indirect measuring systems
- Direct measuring system

Indirect measuring systems

When pressure is lost, the tyre's rolling circumference, which increases the engine speed in relation to the other tyres, is reduced. The engine speeds are determined via the ABS or ESP sensors. However, the driver is not warned until there is a difference in air pressure of ore than 30% between the tyres.

Direct measuring system

The pressure is measured directly by sensors in the tyre. The following functions are fulfilled:

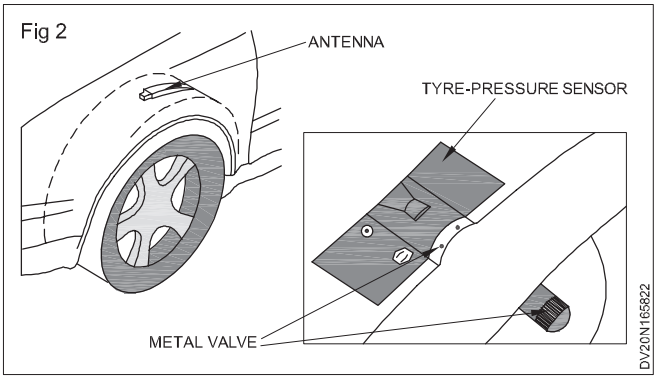
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- Continued monitoring of tyre pressure whilst driving and when the vehicle is stationary.
- The driver is given early warning in the event of a pressure loss, reduced pressure and flat tyre.
- Automatic individual wheel recognition and wheel positioning.
- Diagnostic procedure for systems and components in the workshop.

The system is composed of

- 1 tyre-pressure sensor per wheel (Fig 2)

Fig 2



- Antennae for tyre pressure monitoring
- Instrument panel with display
- ECU for tyre-pressure monitoring
- Function-selector switches

Tyre-pressure sensor and antenna

Tyre-pressure sensor: This sensor is bolted to the metal valve and can be reused when changing the tyres or wheel rims. In addition, a temperature sensor, transmitting antenna, measuring and control electronics as well as a battery with a service life of approximately 7 years are integrated. Since the filling pressures are altered by temperature inflences the pressures and temperatures recorded in the ECU to a standard temperature of 20°C.

To avoid damaging the sensor irreparably when changing a tyre, the tyre must be pressed down on the side opposite the valve.

ECU: The ECU obtains the following information from the transmitting antenna:

- Individual identification number (ID code), ised for individual wheel recognition.
- Current inflation pressure and current temperature.
- Condition of the lithium battery.

The ECU evaluates the signals transmitted by the antenna for the tyre pressure monitoring and imparts the information for the driver on the display screen, according to the importance of this information. If wheels are changed on the vehicle, for example, from the axle to the rear axle and vice versa, the ECU must be recoded with the new pressures.

Individual wheel recognition: The sensors belonging to the vehicle are recognized by the ECU and stored. The sensors are recognized when the vehicle is being driven, to avoid interference from the sensors on cars parked nearby.

Nitrogen Air	Atmospheric Air
1 It is 99% purity nitrogen gas	It is the mixture of 78% Nitrogen plus other constituents
2 It does not react or oxidised with rubber of tyre hence tyre life increases.	It reacts with rubber and gets oxidised life of tyre decreases
3 Tyre runs cooler	Tyres becomes hot

Tyre rotation

Objectives: At the end of this lesson you shall be able to
- **state tyre rotation**
- **state the tyre wear pattern.**

Tyre rotation

Uneven tyre wear on all the wheels will cause instability of the vehicle. Front tyres wear out faster than the rear tyres, as the front wheels steer the vehicle at turns. In order to have uniform wear on all the wheels, it is necessary that the wheel position is changed after completing a specified travel.

Changing the position of wheels in a set pattern is called tyre rotation. All manufacturers recommend a set pattern of tyre rotation after covering certain kilometers. A simple pattern of tyre rotation is shown in the Fig 1. In this, at the time of tyre rotation the spare wheel (5) is fitted to the rear right. The rear right (1) to front left. The front left (2) is fitted to rear left. The rear left (3) to the front right and the front right (4) is kept as the spare wheel.

Tyre wear

Tyre wear depends upon its position (front or rear), load, road condition, inflation and mechanical faults of the car.

The different types of tyre wear are as follows.

Rapid wear at shoulders (Fig 2)

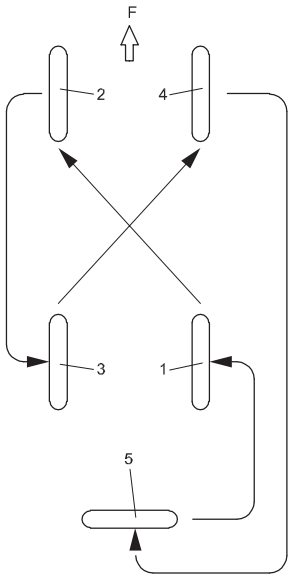
Tyre wears out faster at the shoulder. Under-inflation is the main cause for this.

Rapid wear at centre (Fig 3)

Over-inflation is the main cause for this.

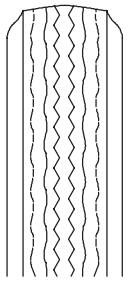
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Fig 1



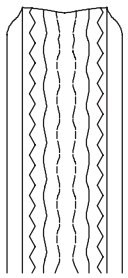
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Fig 2



DV20N165832

Fig 3



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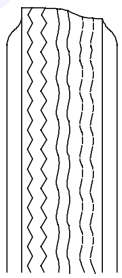
Cracked treads

The main causes for this are under-inflation or excessive speed.

Wear on one side (Fig 4)

The main cause for this is improper camber.

Fig 4

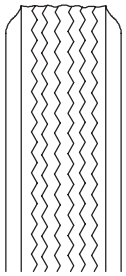


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Feather edge (Fig 5)

The main cause for this is incorrect toe-in.

Fig 5

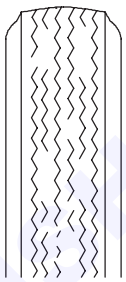


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Bald spots wear (Fig 6)

The main cause for this is improper dynamic and static balancing of wheels.

Fig 6



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Fierce braking driving habits also may lead such to such patchy wear.

Tyre properties

A tyre must have the following desired properties

1 **Non-skidding:** The tyre should not skid or slip on the road surface. It show grip.

2 **Uniform wear:** The tyre must get wear uniformly over its outer circumference.

3 **Load carrying:** The tyre should be able to carry the vehicle load, and stresses during each revolution.

4 **Cushioning:** The tyre should be able to absorb vibrations set-up by the thus providing cushioning effect.

5 **Power consumption:** While rolling on the road, the tyre should consume power developed by the engine.

6 **Noise:** The tyre should create minimum noise while running on the road.

7 **Balancing:** The tyre should be balanced dynamically as well statically.

Tube

A tube - tyre enclose a tube inside it. The tube is held between the rim and the tyre. Air is forced under pressure inside the tube, through a non - return valve, which projects outside through a hole in the rim. Tubes are made of rubber by moulding to conform the shape tyre. Special tyres of tubes are available which minimize the danger of punctures or blowouts. These tubes are self sealing constructions.

Tubes are manufactured with the same care and attention as tyres. Raw material are analyised and tested before use. In the manufacture of tubes but rubber is

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used of because of its superior qualities. Front warm - up mills the tube stock goes to machine from which it comes out on to a conveyor as an endless sleeve. This is then marked with the proper size, cut to length and stored in specially designed skids.

The ends of the tubes are then joined together on automatic splicing machines and are then fitted with the valves specified for each size. Each tube is then put around a forming ring and inflated to mould shape and is then cured in a steam heated mould. The mould opens automatically at the end of curing period and the cure tube is taken out. Each tube is thoroughly inspected for defects, then polished, packed and made ready for shipping out.

Dot Number

Dot stands for department of transportation. Dot number is located on the lower side wall of each type showing that the tyre meets or exceeds the departments transportation safety standards.

Under standing tyre Dot serial numbers, 12 digit number 2000 ‘s production 11 digital number

1990’s production. For example m6 MJEHOR0911

M6 : Manufacture plant code

MJ- Manufacture plant code

EHOR: Manufacture construction code

0911 – Tyre build date (9 th week of 2011)

Tyre wear indicator: A tread wear indicator is a narrow elevation across the longitudinal grooves of the tyres tread pattern on the side of the tyre are the letters TWI. When the tyre thread depth is down to 1.6 mm, the tread will be level in height with the tread wear indicator change to new tyres as soon as possible.

Every tyre has two bars in the main grooves and TWI indicators in the shoulder region on at least 6 locations around the circumference. Different manufactures use different marks symbols to indicate TWI.

Maintenance of tyre and tubes

Tyre and tube care maintenance is important to increase the life of tyre and tube as well as the vehicle.

Following care and maintenance is very important to obtain maximum life and performance.

- Use the proper tyre mounting and de-mounting.
- Always use a new tube for new tyre.
- Tyre and tubes should be same size and brand.
- Always use a designated tube for the particular type and size of tyre being used.
- Always use correct combination of the tyre and rim.
- Rim should be free from the dirt and rust and should be free of bends.
- Rim valve hole should be round and smooth.
- Clean the tyre interiors before placing the tube inside.

Tyre pressure

Conversion table for PSI and kg/cm²

PSI	Kg/cm²
23	1.6
26	1.8
29	2.00
32	2.2
35	2.4
38	2.6
41	2.8
44	3.00
46	3.2
50.3	3.5
54.62	3.8
57.5	4.00
60.00	4.15
71.87	5.00
86.25	6.00
100.625	7.00
115.00	8.00
129.375	9.00
143.75	10.00

- Use tyre mounting machine as much as possible for tyre mounting and demounting.
- Before inflating the tyre check whether the beads are seating correctly on rim seats.
- Never exceed 44 PSI to seat the beads. After beads are seated adjust inflation pressure to the level recommended by vehicle manufacturers.
- Always keep the wheel balancing.
- Un- balanced wheel may cause vibration to the vehicle.
- Wheel balancing must be done after every 5000 km covered.
- Tyre rotation must be done after every 5000kms or when ever any irregular wear on tyre is found.
- Always maintain proper wheel alignment.
- Every time check the exterior of the vehicle tyre, if found any damage replace the tyre.
- Replace the tyre where the tread wear indicator 1.6mm height is exposed.
- Always maintain tyre air pressure recommended by the vehicle manufacturer. Tyre inflation pressure should be checked when the tyre is cold.
- Check tyre air pressure before long trips.
- Check the valve air leakage, if air leak renew the valve cord.

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- Keep the spare tyre inflation pressure 5PSI higher than the recommended pressure before using bring inflation pressure to the recommended air pressure.
- Never mix the radials and non radial tyres.
- Don't overload your vehicle.
- Maintain vehicle suspension and wheel alignment and wheel balance and tyre rotation.

Wheel alignment problems

Objectives: At the end of this lesson you shall be able to
- **Find the reason for steering pull to one side**
- **Find the cause for off-center steering**
- **Find the cause for steering shimmy**
- **Find the cause for need of excessive steering effort**
- **Find the cause for steering poor self centering**
- **Find the cause for bump steer**
- **Find the cause for torque steer and steering harshness**
- **Prepare the wheel alignment diagnostic chart and steering diagnostic chart.**

Cause for wheel alignment problem

Vehicle wheel alignment problem occurs due to bad workmanship, weariness of steering linkages, improper fitting of steering system parts.

Cause of steering pull to oneside

- Front axle shifted away from seat
- Lack of lubrication
- Improper front end alignment
- Bent frame.
- Tyres under inflated
- Bent or twisted steering arm

Cause for off centre steering

- Steering wheel not aligned correctly
- Improper vehicle manufacturing
- Excessive play in steering linkage
- Steering system components damage
- Vehicle end alignment is damaged.

Cause for steering shimmy

- Wheel bearing worn out
- Displace the front axle
- Vehicle tyres are flat spotted
- Improper maintenance steering suspension
- Uneven tyre wear
- Shaky steering wheel
- Warped brake rotors/drums
- Wheels are out of balance

Cause for excessive steering effect

- improper lubrication of steering linkage
- Low tyre air pressure
- Improper toe in or toe out adjustment
- Defective wheel bearing
- No oil in the steering gear box.
- Steering wheel bent.

Cause for poor self centering and memory steer

- Worn steering linkage connection
- Uneven tyre wear
- Unbalanced wheel
- Excessive back lash in steering gears
- Improper steering linkage fitting.
- Unevenly inflated tyres
- No fluid in power steering booster
- Power steering valve problem.

Cause for bump steer

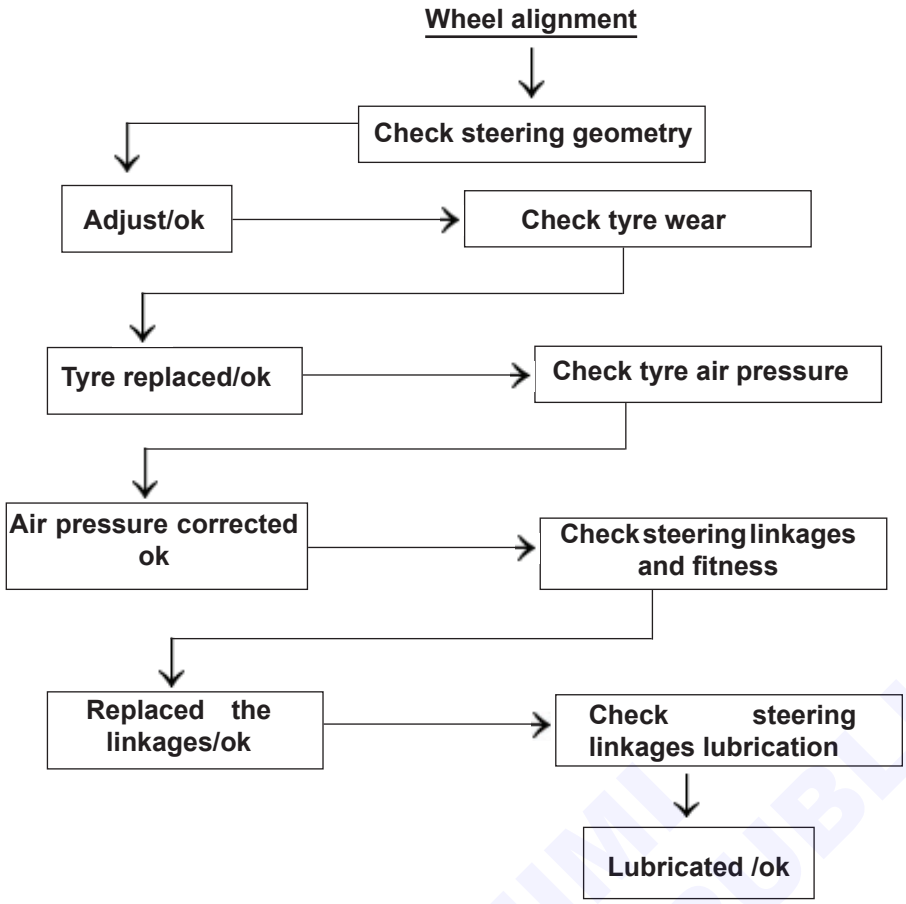
- Ball joint tight or worn out
- Vehicle wheel falls down into a hole
- Vehicle's one wheel hits a bump
- Improper adjustment of toe -in and toe-out
- Vehicle modification is lowered or height increased

Cause for torque steer and steering harshness

- Front axle shifted away from seat
- Lack of steering linkage lubrication
- Improper front end alignment
- Vehicle frame bent
- Tight steering gear setting
- Pull and push joints are tight
- Twisted steering arm
- Distorted steering column
- Low air pressure in front tyres
- Uneven wear of tyres.

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Wheel alignment diagnostic chart



Steering problem

Causes	Remedies
Loose steering wheel	Tightening the steering wheel nut
Lug nuts loose	Tighten the lug nuts
Axle nut loose	Tighten the axle nut
Strut or spring worn out	Replace the strut
Lower ball joint badly worn out	Replace the ball joint
Tie and loose	Tighten the tie rod end
Steering coupling too tight	Tight it at correct torque
Improper wheel alignment	Adjust the proper wheel alignment
Steering pulls to one side	Check steering angle and linkages and tyre air pressure
Steering hard	Check steering linkages and lubricate the steering system parts
Steering noisy	Lubricate the steering system parts
Vibration at high speed	Replace damaged tyre or bent rim and check tyre air pressure
CV joint w/o	Replace the CV joint.

Meaning of balance

Wheel balancing is integral to smooth driving, safety, tyre wear, and vehicle stability and wheel balancing allows the tyres to spin without carrying vibration. The tyre balancing refers to compensation for any weight imbalances in wheel tyre combination

Wheel balancing is the process of balancing the weight of the tyre and wheel assembly. Wheel balancing requires putting a mounted wheel and tyre on a balance which centers the wheel and spin it to determine where the weight should go. Every time a wheel is first mounted on to a vehicle with new tyre, it has to be balanced wheel balancing is to make sure the weight is evenly distributed throughout each of wheels and tyres on a vehicle

Causes and effects of wheel imbalance

Wheels and tyres and never exactly the same weight all around. At high speed even a tiny imbalance in weight can become a large imbalance in out force. Which could cause the wheel and tyre assembly to spin in a heavy

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and uneven motion. This usually turns into a vibration in a vehicle as well as that could cause uneven and damaging wear on the tyres.

Identification source of vibration

When a vehicle is moving on the road imbalanced vehicle driving and steering vibration could be happen. So that check the following steering systems parts. Wheel bearing, tyre air pressure, tyre weariness, steering linkage lubrication and weariness of parts steering geometry etc.

Cause for steering wheel (wobbling)

- Un evenly inflated tyre
- Loose ball pin of the tie rod end
- Loose hub nut
- Loose wheel nut
- Excessive hub end play
- Wheel hub bearing worn out
- Less pre load of steering inner column
- Steering inner column worn out.

Wheel mounting error (Radial & lateral)

- In case wheel mounting are improperly fitted tyre or wheel effect the tyre pressure monitoring system, run flats and other special technologies
- Improper handling of reverse mount wheel affected by scratching on chrome rim turn into rust
- Not using the proper amount of lubrication when tyre mounted and when it is removed
- Insert the bead breaker the worn way
- Holding the bead in the drop center by using hand hold bars
- improper tyre and rim fitting
- Improper tube fitting
- Improper air pressure in tyres (less or high)

Run out lateral, radial tyre and mismatches

- Mismatch tyre fitting effect on steering wheel and steering operation
- Mismatch tyres effect on steering linkages and tyre
- Mismatch tyres effects on brake efficiency
- Tyre run out create vibration while vehicle on the road.

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Engine cooling system

Objectives : At the end of this lesson you shall be to

- **state the necessity of the cooling system**
- **list out the different types of cooling systems**
- **state the advantages of the forced type of cooling system**
- **draw the water circulation path in an engine block**
- **state the function of the water pump, radiator, temperature indicator, pressure cap**
- **state the need and function of the thermostat valve, recovery system**
- **state the different types of thermostat valves.**

Combustion of fuel inside a cylinder develops a very high temperature (Appx. 22000C). At this temperature the engine parts will expand and tend to seize. Similarly the lubricating oil will loose its property. Therefore it is necessary to keep the engine temperature to operating limits. This is done by the cooling system. Heat is removed from the engine by cooling media (water or air) and is dissipated to the atmosphere.

Types of cooling systems

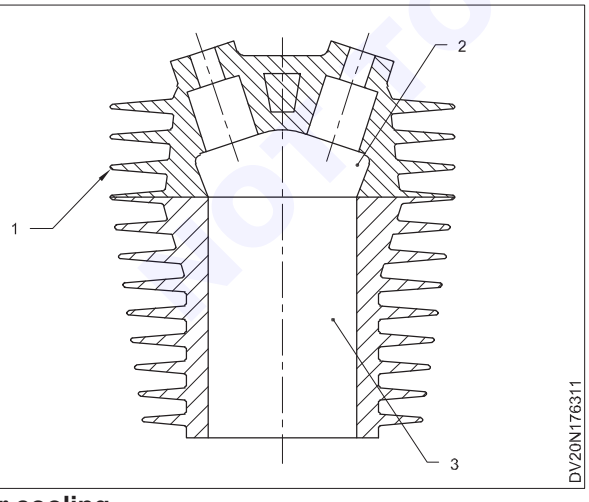
There are two types of cooling systems used in engines.

- Direct cooling - air cooling.
- Indirect cooling - water cooling.

Air-cooled engines

In air-cooled (Fig 1) engines, cylinders are semi-independent. They are not grouped in a block. Metal fins (1) are provided on the head (2) and cylinder (3), to help dissipate heat from the engine. In some engines fans are also used to improve air circulation around the cylinders and heads. This type of cooling system is employed in two-wheelers and small stationary engines. These are used in both S.I. and C.I. engines.

Fig 1



Water cooling

Two types of water cooling systems are used.

- Thermo-siphon system (Fig 2)
- Forced circulation system (Fig 3)

Fig 2

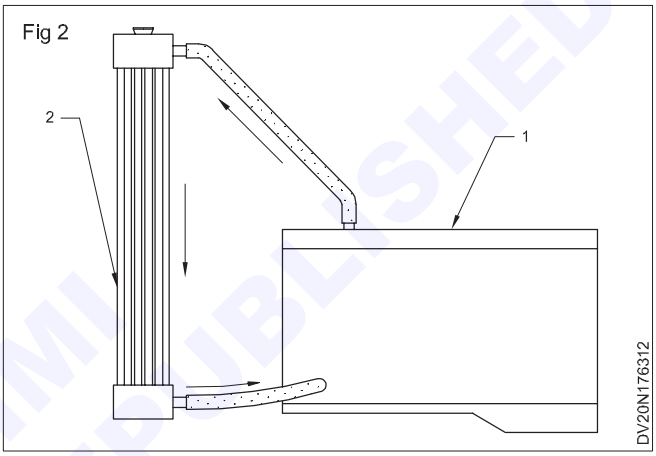
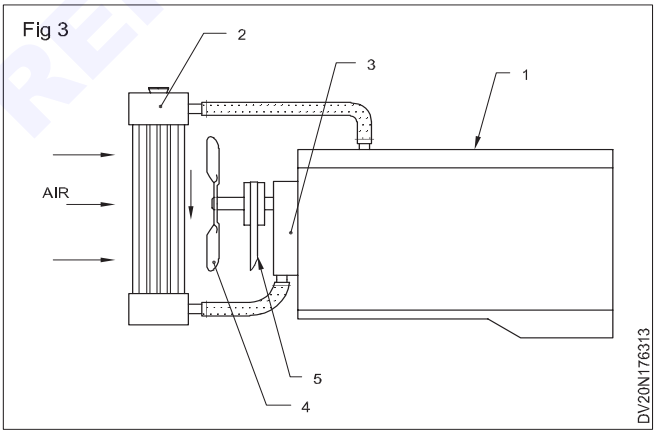


Fig 3



Thermo-siphon system

In this system no pump is used for water circulation. Water circulation is obtained due to the difference in the densities of hot and cold water. Water absorbs the heat and rises up in the block (1) and goes to the radiator's (2) top side. Water is cooled in the radiator (2). It again goes to the water jackets in the engine. To maintain a continuous flow of water the level of water is maintained at certain minimum level. If the water level falls down the circulation will discontinue. This system is simple but the rate of cooling is very slow.

Pump circulation system (Forced feed system)

In this system water is circulated by a pump (3). The pump is driven by a belt (5) which is connected with the crankshaft pulley. The circulation depends upon the engine speed. More water is circulated at higher engine speed.

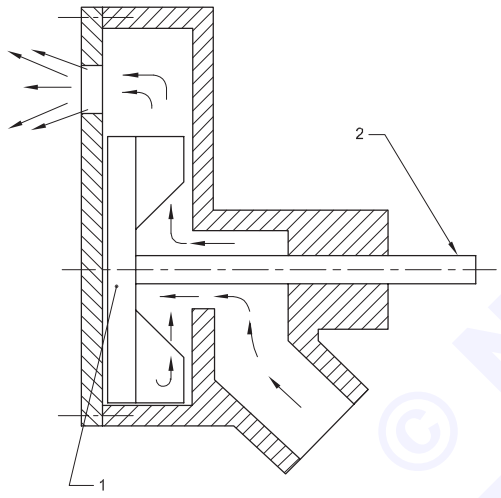
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The water absorbs heat from the engine and flows to the radiator's (2) top tank. Water from the top tank of the radiator (2) flows down to the bottom tank. The fan (4) draws the air through the radiator's fins and cools the hot water. Cold water from the bottom tank is again pumped to the engine and the cycle is repeated.

Water pump

The centrifugal type water pump (Fig 4) is used in engines. It is mounted on the front side of the cylinder block or head. The water pump is driven by the crankshaft pulley through the fan belt. The impeller (1) is mounted on one end of the water pump shaft (2). The shaft (2) is fitted in the pump housing with bearings. A water seal is provided in the pump to prevent leakage of water and to prevent water entering into the bearings. When the impeller rotates it draws water from the lower tank of radiator, and pumps water to the engine block, by centrifugal force under pressure. The fan is mounted on the water pump pulley.

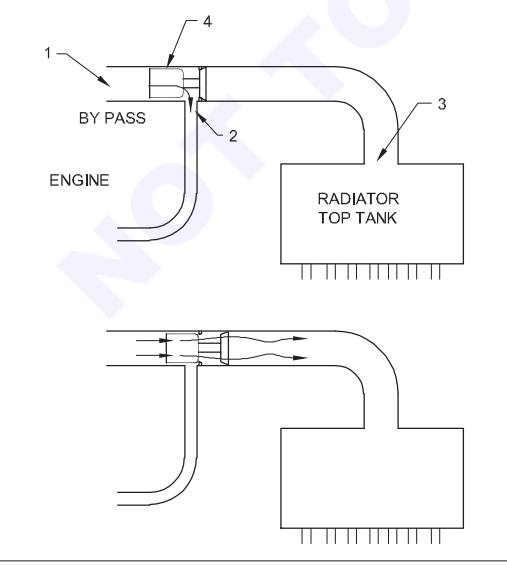
Fig 4



Thermostat

The thermostat (Fig.5) helps to bring the cold engine to the operating temperature quickly.

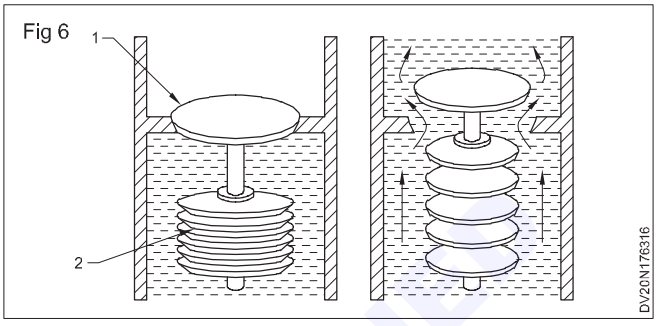
Fig 5



It is fitted in between the water outlet of the cylinder head (1) and the inlet (2) of the radiator in the water cooling system. When the engine is cold, the thermostat (4) is closed. It does not permit water to enter the radiator. Water recirculates in the engine through the bypass hole (2) and the engine reaches the operating temperature quickly. Once the engine has reached the operating temperature the thermostat (4) opens. It closes the bypass hole (2) and now permits water to enter the radiator tank (3). Thermostats are rated to open at different temperatures. Two types of thermostats are used.

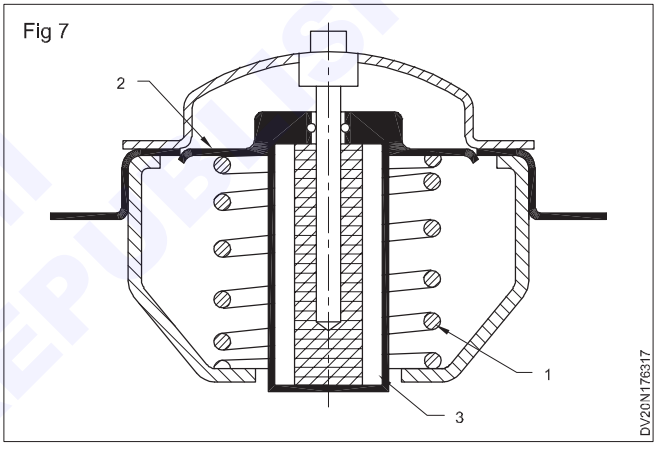
- Bellows type (Fig 6)

Fig 6



- Wax type (Fig 7)

Fig 7



Bellows type

It has a flexible metal bag closed at both ends. The metal bag is partially filled with ethyl which has a low boiling temperature.

When the engine is cold the valve (1) closes its outlet passage and does not allow water to reach the radiator top tank from the engine, but is circulated through the bypass port to the engine.

When the water reaches the working temperature, ethyl in the closed bellow (2) expands and opens the valve (1). Now the water reaches the radiator top tank from the engine. In the valve's opened position the bypass passage is closed.

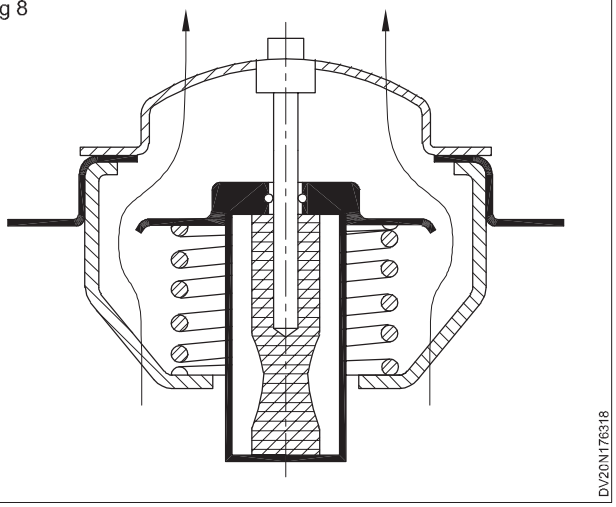
Wax pellet type

In this type a wax pellet (3) (Fig 8) is used as a heating element. When the circulating water's temperature is lesser than the operating temperature, the spring (1) keeps the valve (2) in the closed position and the water does not reach the radiator top tank from the engine.

As the water reaches the operating temperature the wax pellet expands and forces the valve (2) to open against the spring tension. Now the water reaches the radiator top tank, from the engine. At this position the bypass port is closed by the valve.

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Fig 8



Components of water cooling system

Objectives: At the end of this lesson you shall be able to
- **state the constructional features of a radiator**
- **state the need of a pressure cap**

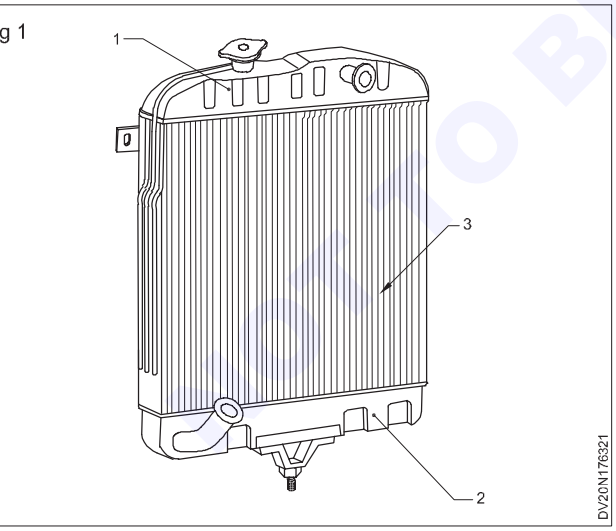
Radiator

The purpose of a radiator in the cooling system is to cool hot water coming out of engine.

It has a large cooling surface area to allow enough of air to pass through it. Water circulated through it is cooled by the passing air.

The radiator (Fig 1) consists of an upper tank (1),a lower tank (2) and in between the upper and lower tank radiator cores (3) are provided. The upper tank (1) is connected to the water outlet of the engine through a rubber hose. The lower tank (2) is connected to the water pump through rubber hoses.

Fig 1



Radiator cores are classified into two types.

- Tubular core (Fig 2)
- Cellular core (Fig 3)

Fig 2

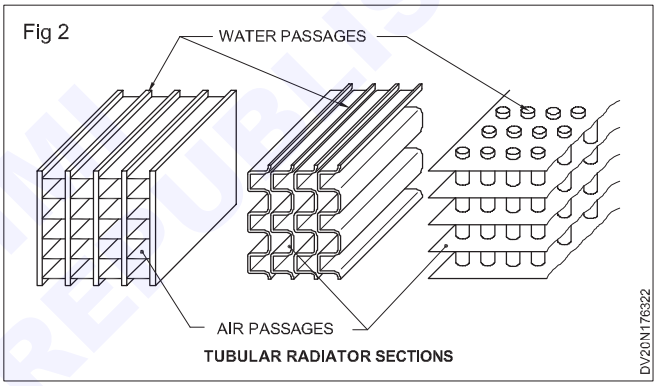
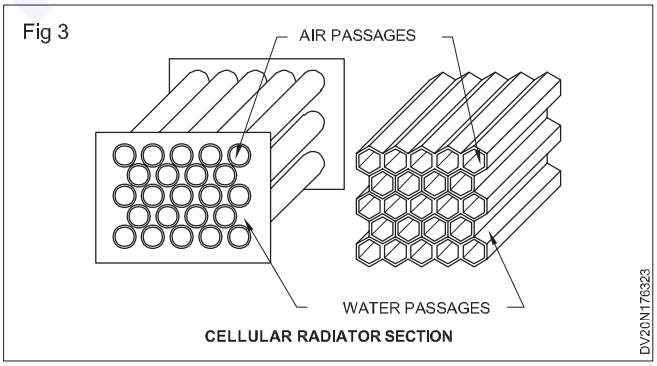


Fig 3



Tubular core

In a tubular type the upper and lower tanks are connected by tubes. Water passes through these tubes. Cooling fins are provided around the tubes, to absorb and radiate heat to the atmospheric air.

Cellular cores

In the cellular type a large number of individual air cells are provided and surrounded by water. Because of its appearance, the cellular type is known as a 'honeycomb' radiator.

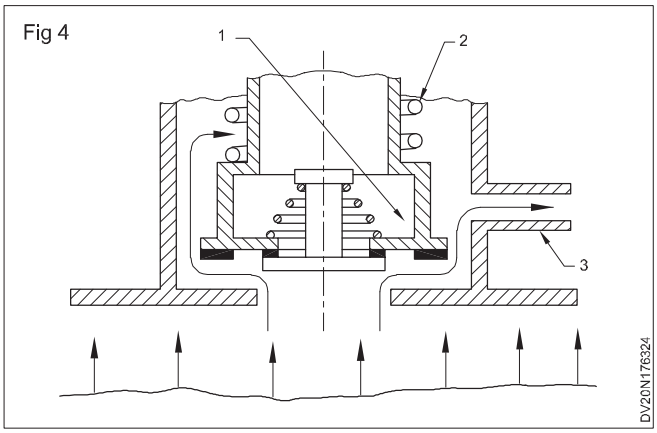
The material of the core is of copper and brass. The parts are normally connected together by soldering.

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Pressure cap

In normal atmospheric conditions water boils at 100°C. In higher altitude height the atmospheric pressure is low and water boils at a temperature below 100°C. To increase the boiling temperature of water the pressure of the cooling system is increased. This is achieved by providing pressure caps to seal the system. The coolant loss, due to evaporation is also minimized, by using a pressure cap. (Fig 4)

Fig 4



It also permits the engine to operate at a higher temperature so that better efficiency of the engine is achieved.

The pressure cap is fitted in the filler neck portion on the top of the radiator tank. If pressure is increased by 15 P.S.I., the boiling temperature raises to 113°C. The pressure cap has two valves.

- Pressure valve
- Vacuum valve

Pressure valve

If the pressure in the system rises it may damage the components. To avoid this a pressure relief valve (1) is used to release the excess pressure. It is a spring-loaded valve. The spring's (2) tension depends on the system's pressure.

When the cooling water of the engine is heated up it expands which results in high pressure in the system. If the force due to pressure is more than the spring's (2) tension the valve opens and water vapour/steam escapes through the overflow pipe (3) until the pressure is lowered to the preset value.

Vacuum valve

When the engine cools down the pressure in the system decreases due to loss of the coolant and a vacuum is created.(This valve is also located in the cap and fitted in the filler neck of the radiator)

At this time the vacuum valve (4) (Fig 5) opens and air flows into the system until the vacuum is filled up in the system.

In some engines an overflow pipe is connected to an expansion tank (5). The expansion tank (5) (Fig 6) collects the water vapour during the pressure valve operation, and the same vapour, after condensing, goes to the radiator when the vacuum valve is in operation.

Fig 5

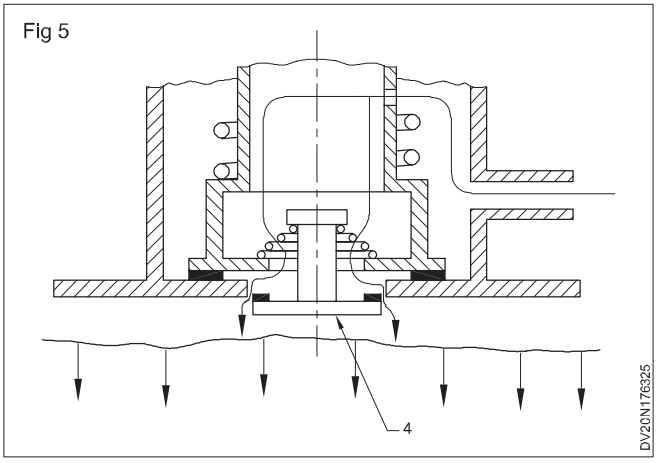
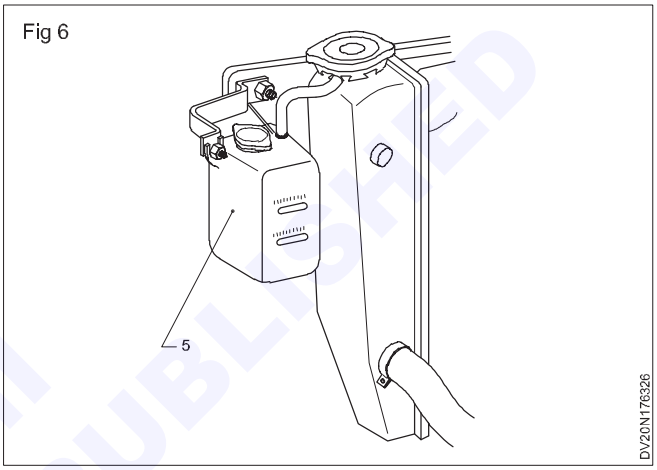


Fig 6



Temperature indicator

The temperature indicator is fitted on the instrument panel it indicates the temperature of the water in engine water jackets. There are two types of temperature indicator used in an automobile.

1 Mechanical type

2 Electric type

Mechanical type temperature indicator consists of a sealed bulb that fits in the cylinder head water jacket and connected by a fine tube to temperature pressure gauge on the dash board.

The electric type water temperature sending unit is fitted in the cylinder head water jacket and it is connected through electric wire from ignition switch to temperature use sending units cold terminal through panel indicator bulb, another wire is connected from temperature sending units hot terminal to temperature warning lamp. When the engine temperature reaches normal, the green light circuit is completed by the engine unit and the dial indicates green light. When the engine is over heated the engine unit completes red light circuit and the dial indicates the red light.

In latest vehicle engine coolant temperature (ECT) sensors are using.

Thermo switch

This device is prevents the engine from over heating by activating radiator cooling fan, measuring the coolant temperature and controlling the level gauges and warning

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lights on the engine control unit. This device have upto four terminals and be installed on the radiator, the cooling system tubes or thermostate, so that the coolant flows across the sensing element (bimetal disc or thermistor).

Function of thermo switch

Theremo switch operates independent from any current supply, temperature detection is effected by means of a by metal disk switch on temperature. When this fixed switch on temperature is reached this bimetal disk well snap over, closing a contact the circuit system and there by closing the electric of device to be started. After cooling down and reaching the cut off temperature. The bimetal disk will auto mechanically return into its original position and open the contact. The electric circuit is opened again.

Coolant properties of an engine

A efficient cooling system removes 30 to 35% of the heat generated in the combustion chamber.

- Coolant should be remove heat at a fast rate, when the engine is hot.
- Coolant should be remove heat at a slow rate when the engine is started until the engines reaches at its normal operating temperature.
- Coolant should not remove too much heat from the engine. Too much removal of the heat decreases thermal efficiency of the engine.
- It should circulate freely in the coding system.
- It should be prevent frequency and rust formations.
- It should be reasonably cheap.
- It should not waste by vaporization.
- It should not deposit any foreign mater in the water jackets/radiator.

Change of engine coolant interval

1 Coolant should be replace as per specified by the manufacture.

2 Coolant should be replace during major repair in an engine or radiator.

3 Coolant should be replace at dilute (oil mix with water).

Types of Anti- Freeze mixtures

1 Wood alcohol

2 Denatured alcohol

3 Glycerin

4 Ethylene glycol

5 Propylene glycol

6 Mixture of alcohol and glycerin

Fan: The fan is mounted behind the radiator on the water pump shaft. When engine is running the fan is drawn air through radiator core tubes and fins to cool the water in radiator.

In modern vehicles cooling fan is operated through electric power and it has fun actioning as per sensor base signal delivered by ECU normally it is not operating till water temperature is not reached as specified temperature limit.

Antirust Solution

Antirust solution is used to protect the metal parts of the vehicle from natural rusting it is prevent moisture from reacting with metal. Types of antirust solutions.

- Anti Corrosive paints.
- Apcalite rust shield.
- Antirust epoxy coating.
- Antirust metal primer.
- Liquid anti corrosion coating
- Poly fix
- Micaceous iron oxide.
- Metal guard with anti rust coating.
- Plasma paints.
- Polyethylene, Epoxy resin, binder etc.

Description of induction and exhaust system

Objectives: At the end of this lesson you shall be able to
- **state the function of induction system**
- **state the function of exhaust system**

Induction system

In engine only air is drawn into the cylinder from atmosphere through air cleaner, turbocharger, induction manifold, intake port and inlet valve. The induction manifold provides passage for the flow of fresh air from air cleaner via turbo charger towards the engine cylinder. The intake valve provides entrance for the fresh air charge into the combustion chamber and cylinder. The following air flow system is used in diesel induction system.

Air cleaner, Turbo charger, Induction manifold, Intake port, Inlet valve, Combustion chamber and cylinder

Exhaust system

The diesel engine used gases go out of the cylinder and combustion chamber through exhaust valve, which act as gate to provide exit for the burnt gases. The gases flow out through exhaust valve mouth space to the connecting passage of exhaust port into the exhaust manifold. The used exhaust gases from the manifold are let out into the atmosphere through catalytic converter muffler and tail pipe. The catalytic converter reduced the emission from the exhaust gases and muffler silence the noise of exhaust gases by reducing the pressure of the exhaust gases by slow expansion and cooling.

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Further exhaust gases used for exhaust brake system to control the vehicle speed and to drive the turbo charge's turbine unit. The flow of exhaust gases.

Engine cylinder, used exhaust gases, exhaust port- exhaust manifold, exhaust brake, Turbin, catalytic converter, muffler, tail pipe, atmosphere.

Air compressor, exhauster and super charger

Objectives: At the end of this lesson you shall be able to
- **explain constructional features of an air compressor**
- **explain operation of an air compressor**
- **explain constructional features of an exhauster**
- **explain operation of an exhauster**
- **explain constructional features of a supercharger**
- **explain operation of a supercharger**.

Air Compressor: An air compressor is part of an engine. It is driven either from the timing gear or from the camshaft to maintain air pressure for different purposes.

Normally, it is of a single cylinder type consisting of a piston assembly, connected to the crankshaft by means of a connecting rod. It has an inlet valve and a delivery valve. An aircompressor is having an inbuilt air cooling system with fins on its head. Valves are automatic in action and consist of hardened and lapped spring loaded steel discs against removable seats. Engine lubricating oil is circulated to lubricate the parts of air compressor

Operation: During the downward stroke of piston partial vacuum is created in cylinder which opens the inlet valve, air to enter into the cylinder. During the upward stroke, the pressure closes the inlet valve. So air is compressed in the cylinder which opens the delivery valve sending compressed air to the reservoir.

Exhauster

Vane type exhauster

Exhausters are fitted on diesel engine to develop vacuum to assist the pneumatic governor of F.I.P. A vane type exhauster is held by bolt over an opening in the engine and consists of a rotor, keyed to a shaft. The rotor is mounted eccentrically to the barrel (body) of the exhauster. Vanes are fitted with sliding fit in the slots of the rotor. A shift valve fitted on the exhauster, limits the vacuum to a predetermined pressure.

Impeller type exhauster

The impeller type exhauster has two spindles. One has an impeller. It is driven by auxiliary driving shaft and the other spindle has rotor whose vanes engage with those on the driven rotor.

Operation of exhauster

The vane type exhauster unit works on the principle of centrifugal force. When the engine is running due to centrifugal action, the vanes which have a sliding fit, fit into the slots in the rotor, which come out to the interior surface of the body (barrel). Air is thus evacuated through out the section and is discharged into the crank case. Lubrication for vanes is provided by splash of oil from the crank case.

Supercharger: A super charger is a device which increase the pressure of the airfuel mixture from the carburetor before it enters the engine. It is connected between the carburetor and the cylinder in the way of intake manifold. It is usually driven by the engine through suitable gears and shafts. There are three general types of superchargers:

1 Centrifugal type

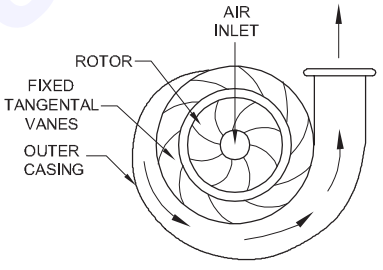
2 Vane type

3 Roots air-blower type

Centrifugal type supercharger (Fig 1)

It consists of an impeller which rotates at a very high speed, about 10,000 r.p.m. The air-fuel mixture enters the impeller at the centre and after passing through the impeller and diffuser vanes goes out of the casing to the engine cylinder. Due to the high speed of the impeller, the mixture is forced into the cylinder at a high pressure.

Fig 1

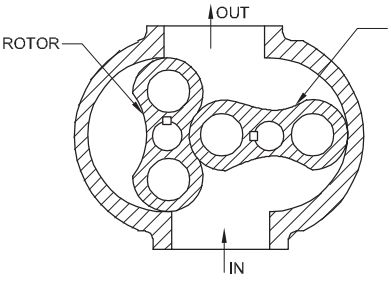


CENTRIFUGAL TYPE SUPERCHARGER

Roots air-blower type supercharger (Fig 2)

It consists of two rotors of epicycloid shape. Each rotor is fixed to a shaft by a key. The two shafts are connected whether by means of gears of equal size the two rotors rotate at the same speed. The working action of such a supercharger is just like a gear pump, so that the mixture at outlet side is at a high pressure.

Fig 2



ROOTS AIR-BLOWER TYPE SUPERCHARGE

Vane type supercharger (Fig 3)

It consists of a drum on which a number of vanes are mounted in such a manner that they can slide in or out against some spring force, so that all the times they are

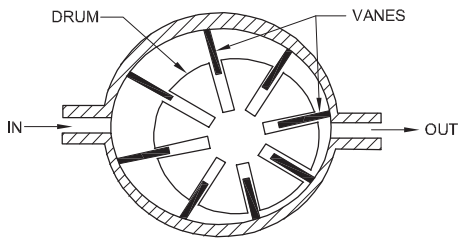
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in contact with the inner surface of the super charger body. The space between the body and the drum goes on decreasing from the inlet to the outlet side. Thus, the air-fuel mixture entrapped between any two vane at inlet goes on decreasing in volume and increasing in pressure as in reaches the outlet.

The roots supercharger is simpler in construction and requires least maintenance. It has comparatively long life. It works well even at lower speed ranges. Centrifugal type supercharger has poor working characteristics at lower speeds. Vane type supercharger has the problem of wear of vane tips.

Turbo charger passes compressed hot air into inter cooler and it heats up expands air the pressure increase from a turbocharger is the result of heating the air before it goes into the engine. In order to increase the power of the engine and get more air molecules into the cylinder.

Fig 3

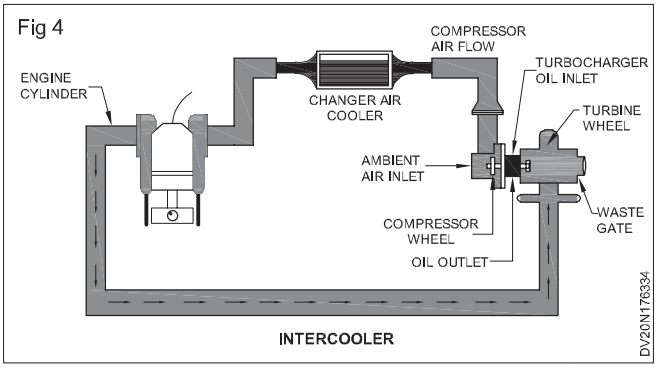


VANE TYPE SUPERCHARGER

Intercooler (Fig 4)

The intercooler (Fig 4) is an additional component that looks like a radiator, except that air passes through the inside as well as the outside of the intercooler. The intake air passes through sealed passageways inside the cooler, while cooler air from outside is blown across fins by the engine cooling fan.

Fig 4



INTERCOOLER

Charge air cooler and turbo charger

Charge air cooler and turbo charge are part of a high tech induction system that increases engine combustion efficiency. The turbo charger uses exhaust gases to compress air before it entire the charge - air cooler.

The compressed air going through the charge-air cooler is then cooled by the ambient air flowing across the cooler fins. The cooled air is more dense than warm air. So when it flow into the intake side of the engine, the increased density improves horse power, fuel economy and reduce the emissions.

Air cleaner and air cooler

Objectives : At the end of this lesson you shall be able to
- **state the need of an air cleaner**
- **state the different types of air cleaners**
- **state the function of induction manifold**
- **state the function of an air cleaner.**

Atmospheric air consists of a large quantity of dirt and dust. Uncleaned air will cause faster wear of and damage to the engine parts, so air is filtered before entering inside the cylinder bore.

Purpose of air cleaner

- It cleans the intake air.
- It reduces the noise of the intake air.
- It acts as a flame arrester during engine backfire.

Location

It is mounted on the top of the air inlet manifold.

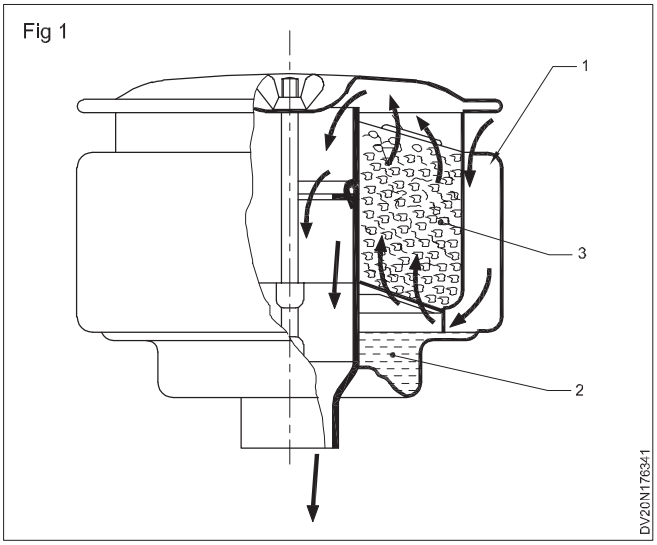
Types

- Wet-type (Fig 1)
- Dry-type (Fig 2)

Wet type air cleaner

The atmospheric air enters the air cleaner through the side passage (1) and strikes on the surface of the oil (2). Heavy dust particles are absorbed by the oil. The partially filtered air, along with oil particles, moves upward through the filter element (3). Fine particles and oil particles are collected by the filtering element (3). Cleaned air then passes through the passage to the inlet manifold.

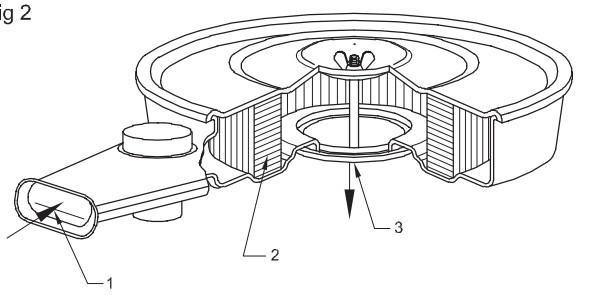
Fig 1



Dry type air cleaner: In this type of air cleaner, a specially treated paper element is used to filter the intake air.

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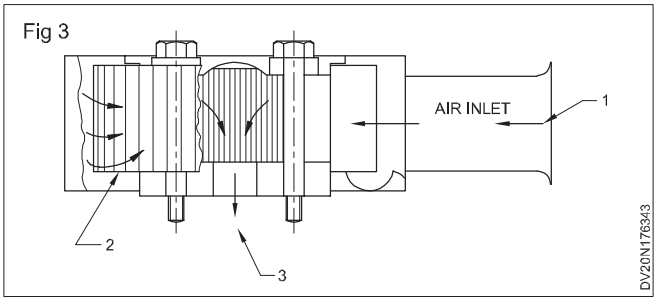
Fig 2



Function: The atmospheric air enters the air cleaner (Fig 3) through the air entrance (1) and passes through the paper element (2). The filtered clean air goes to the intake manifold entrance (3).

Intake manifold: The intake manifold is connected with air cleaner and cylinder head intake port of the cyliner head. It is allow the fresh air to flow from air cleaner to cylinder through inlet valve. The intake manifold is made of a cast iron or aluminium.

Fig 3



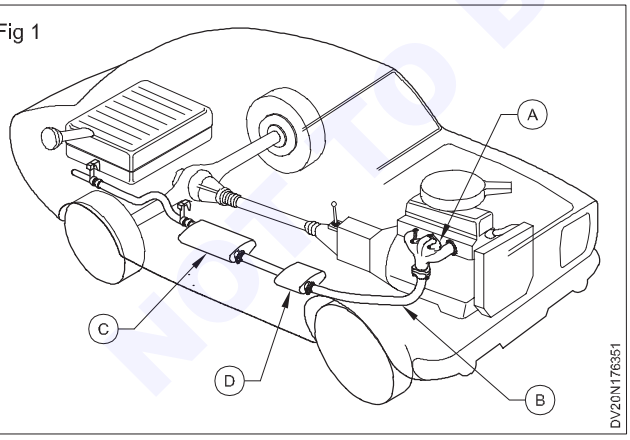
Manifolds and silencer

Objectives: At the end of this lesson you shall be able to
- **explain the purpose of the inlet manifold**
- **explain the purpose of the exhaust manifold**
- **explain the purpose of the muffler and tail pipe**
- **explain the constructional features of the mufflers**
- **list out the different types of mufflers.**

Manifolds and silencer: The inlet manifold is used to supply the air-through from the carburetor to the intake ports in the cylinder head. The inlet manifold is generally made of aluminum alloy or cast iron.

The exhaust manifold (A) (Fig 1) is used to collect the exhaust gases from the different cylinders and send them to the silencer. The exhaust manifold is generally made of cast iron. The exhaust manifold may include a heat control valve (Fig 2) or a heat riser which has a thermostatically operated butterfly valve (2) fitted in exhaust manifold. (Fig 2) When the engine is cold, the valve is closed and hot gases are directed around the inlet manifold. When the engine attains operating temperature the valve opens and the exhaust gases are directly sent to the muffler.

Fig 1



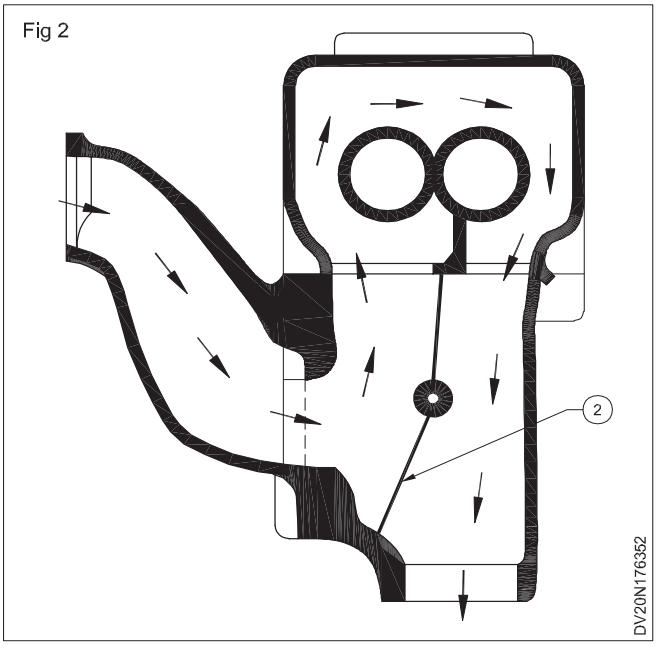
Exhaust pipes

The exhaust pipe takes the burnt gases from the manifold to the muffler. The pipes are steel tubes, suitably shaped and routed below the chassis to lead the gases away from the vehicle at the rear and to direct the gases down and under the vehicle. It is kept in place by flanges or clamps at either end. In some vehicles, a flexible mounting to the body or chassis is used.

Muffler

The muffler (C) (Fig 2) is normally located under the body of the vehicle and attached to the body or chassis with flexible mountings. In some trucks in which exhaust gases are directed upward, the muffler is mounted at the rear end of the cab and surrounded with a guard to prevent accidental touching. The muffler reduces the engine exhaust noise. It is a large cylindrical shaped container, fitted with passages and chambers that absorb and dampen the noise of the exhaust gases. Often a small or pre-muffler (D) is fitted in the exhaust system between the manifold and the main muffler.

Fig 2

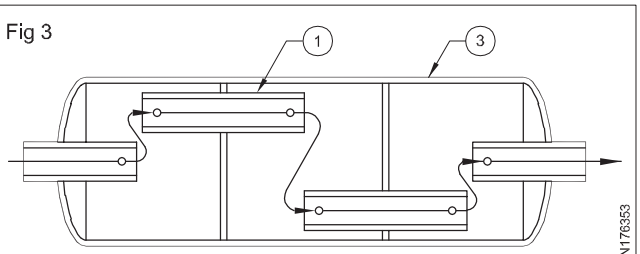


Types of mufflers

i **Reverse flow muffler (Fig 3):** In this type, small pipes (1) (Fig 3) are placed in the housing (3) of the muffler. Exhaust gases flow in a zigzag way, thus reducing the sound, by travelling through a longer length.

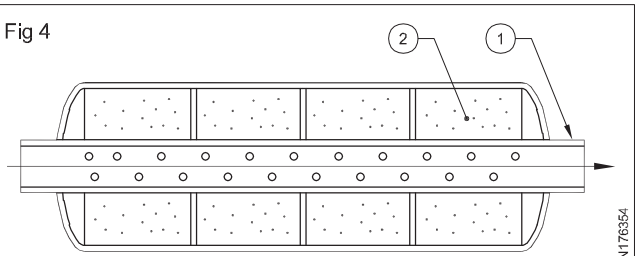
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Fig 3



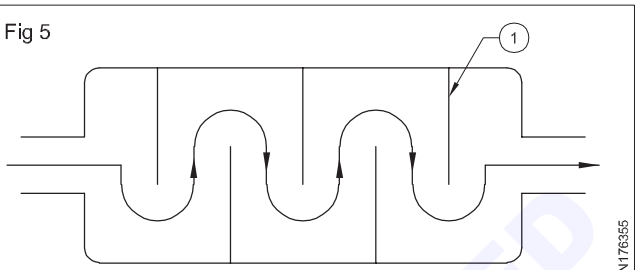
REVERSE-FLOW MUFFLER

Fig 4



STRAIGHT-THROUGH MUFFLER

Fig 5



BAFFLE TYPE MUFFER

ii Straight through muffler : In this type a straight perforated tube (1) (Fig 4) is placed throughout the length of the muffler. Glass wool or steel wool (2) is filled in between the perforated tube and the muffler housing, which acts as a sound absorbent.

iii Baffle type: In this type, a series of baffles (1) (Fig 5) are placed in the muffler which causes restriction and back pressure to the exhaust gases, thereby reducing the sound of the exhaust gases.

Mufflers

Objectives: At the end of this lesson you shall be able to
- **describe the back pressure**
- **describe the back pressure muffler**
- **describe the electronic muffler.**

Back pressure

Any restriction to exhaust flow in the exhaust system creates back-pressure. Some back-pressure can be beneficial, excessive back-pressure reduces volumetric efficiency and reduces engine efficiency.

Variable flow exhaust/Back pressure muffler

A movable valve fitted within the exhaust system is used to change the amount of exhaust back-pressure. At higher engine speeds when exhaust noise levels are unacceptable, the valve is closed, thus reducing the bore of the exhaust. This enables greater back-pressure and noise reduction is the result. The valve can be operated by

- Pneumatics - exhaust gas pressure
- Electronics - a computer

When a variable flow exhaust is added to the baffle and chamber system, quieter noise emissions are the result. This is because the system can partially respond to changes in engine speed and load.

Electronic mufflers

Electronic mufflers are designed to produce anti noise without restricting exhaust flow. This computer-controlled system uses a microphone to detect the sound waves produced within the exhaust system. As the exhaust gas leaves the tail pipe, computer driven loudspeakers are operated to generate the correct amount of anti-noise.

The result is virtually silent exhaust without generating additional and unwanted back-pressure across all engine operating conditions. This increases fuel economy and reduces exhaust emissions.

Sensors and microphones pick up the pattern of the pressure waves an engine emits from its exhaust pipe (Fig 1 & 2). This data is analyzed by a computer. A mirror-image pattern of pulses is instantly produced and sent to speakers mounted near the exhaust outlet. Opposite waves are created that cancel out the noise. Noise is removed without creating back pressure in the muffler. Electronic mufflers can be designed to emit certain sounds or no sound at all.

Fig 1

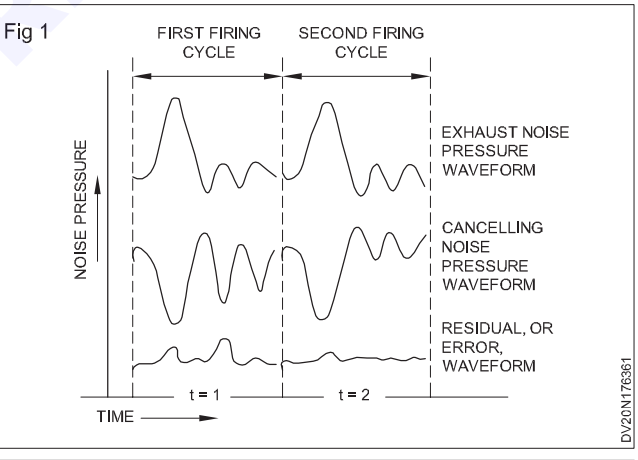
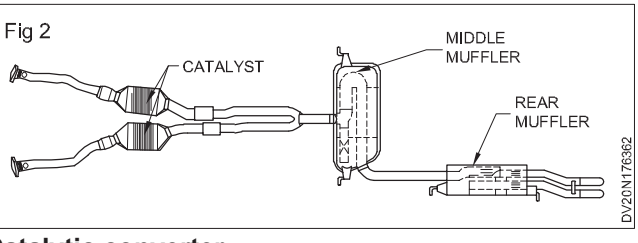


Fig 2



Catalytic converter

Extractor manifolds

The extractor exhaust manifold system for an internal combustion engine, which improves its efficiency by using precise geometry to reflect the pressure waves form the exhaust valve at a particular time in the cycle.

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Advantages of extractor manifold

- Separating the gas flow from the individual cylinders.
- Avoid the inter cylinder gas interference
- Maintaining an optimum gas velocity by chosen tube diameter
- Allowing the individual cylinders to assist one to another where the individual exhausts merge.

This type of exhaust system can be used with or without a muffler and so can be used on both race car and road vehicles.

Absorption mufflers in exhaust system: This type of mufflers are almost indispensable element of modern exhaust systems. The absorption material is just modern exhaust systems. The absorption material is just as important as a calculation method for designing the mufflers in order to ensure that they are optimally used.

Absorption: Automotive exhaust noise can be attenuated is several ways. A distinction is generally made between active and passive attenuation. The modern engine exhaust system consist of more than one absorption muffler to reduce the noise and pollution. The absorption mufflers are dissipating the sound energy through the use of porous materials.

Noise absorption components: Reactive / absorption silencers in single package unit

Flexible connection: The exhaust pipe takes the burning gases from the exhaust manifold. The silencer pipes are fitted under the chassis body to lead the exhaust gases away from the manifold. The silencer pipes are mounting with flexible connection to the chassis or body of the vehicle. The flexible connections are prevent the damages by heavy jerks or rough up and down movement of the vehicles.

Ceramic coatings: Ceramic coating is capable of with standing of high temperature and it has very good chemical and corrosion resistance and possess excellent thermal barrier characteristics, providing a dramatic reduction in radiated heat. It is self-cleaning properties.

Ceramic coatings contain the gaseous heat with in exhaust pipes. This causes the gasses to heat up and expand as a result exhaust flow is boosted.

Catalytic converter: The catalytic converter looks like a muffler. It is located in the exhaust system a head of the muffler. Inside convertor are pellets or a honeycomb made of platinum or palladium The platinum or palladium are used as a catalyst (a catalyst is a substance used to speed up a chemical process). Catalyst is chemically oxidized or converted to carbon dioxide and water. This converter works to clean the (exhaust) unburnt hydrocarbons before they fly out the tail pipe.

CNG and LPG car gas kit: CNG (Compressed Natural Gas)is better than LPG CNG is lighter and less dense than air. This means that CNG cannot catch fire, even if it mixes with air. There are two types of CNG kits.

They are

- Venturi CNG kit
- Sequential CNG kit

Venturi CNG kits: Venturi CNG kit is a mixing unit that delivers an amount of gas into the vehicle's engine. Venturi kits are a lot more affordable and easier to install in cars, when compared to other kits. These kits deliver a fixed amount of gas into the engine's intake manifold based on the input from the throttle. Venturi CNG kits can be easily installed into any auto mobile, fuel injected or carburetor driven. It can also be installed with or without the use of an ECU.

Sequential CNG kits: Sequential CNG kits are considered the better option when it comes to automobile installation as they control the gas flow through the injectors fitted alongside petrol injectors in the manifold. There is also a separate ECU for the CNG kits which electrically control and monitor the amount of gas pushed into the engine while sequential CNG kits are the better option, they can only be installed into electronic fuel injection supported vehicles.

Different types of fuels

- Petrol
- LPG
- Diesel
- CNG
- Electric (battery)

Motor vehicle engine fuel is a fuel that is used to provide power to the engine in a vehicle. Currently most of the vehicle engines are powered by petrol or diesel or LPG or CNG. Some vehicles use the battery power as electronic driven car.

Fuel properties: Gasoline or diesel fuel needs to runs the engine,

The fuels have several fuel properties they are as follows

- **Heat value or calorific value -** measured by calori meter.
- **Specific gravity -** Ratio of density of fuel.
- **Velocity -** Fuel to get converted into vapors on burning at a specific temperature.
- **Flash point -** Which fuel must be heated to get flammable vapors.
- **Fire point -** Which the vapor will continue to burn after being 10° to 21° higher than the flash point
- **Pour point -** It is the temperature at which the fuel becomes ignited insoluble to prevent flow under specified conditions.
- **Viscosity -** Fuel low resistance measurement
- **Octane number -** Standard measure of a fuel ability to with stand.
- Cetane number is similar to the octane number rating it is a measure to the ignition value of the diesel.

- **Carbon residue -** Carbon residue is an indication of the fuel to decompose and form carbonaceous material that can plug diesel fuel injection nozzle.
- **Sulphur content -** Sulphur content is expressed as weight account of sulphur in oil.
- **Gum content -** Fuel forming resinous, polymeric and non volatile materials with high molar mass.

Stoichiometric Ratio : The stoichiometric ratio is the exact ratio between air and flammable gas or vapor at which complete combustion takes place. The stoichiometric ratio of combustion verify from different types of fuels and oxidizers.

Fundamentals of air conditioning

Objectives: At the end of this lesson you shall be able to
- **state that typical air conditioning system**
- **define the operating principle in air conditioning**
- **list the parts of an auto air conditioning system.**

Fundamentals of air conditioning

Air conditioning lowers the temperature of the incoming air before it enters the inside of the vehicle. It therefore cools and dehumidifies the air space in the driver passenger compartment and when rapidly demists the insides of the surrounding window. As a result an improvement in comfort, alertness and reduction in driving fatigue is achieved for both driver and passenger.

Operating principle

Air conditionings main principles are **Evaporation and Condensation,** then **Compression and Expansion.**

Evaporation: Heat take away from the object.

Eg. If you rub a little surgical spirits on your hand, then you hand will feel cold. It is because the spirits on the back of your hand start to evaporate. As the spirit evaporates, it takes away heat from the surface of your skin. It's evaporation.

Condensation: It is the change of water from its gaseous form (water vapor) into liquid water.

Eg: When somebody walks in form the cold, their glasses steam up?. The moist air of the take away cools as it contacts the cold surface of the glasses and the air has less capacity to hold moisture, so it condenses into water on the glasses. It's condensation.

Heat of compression: Have you ever noticed when you pump up a bicycle tyre with a hand pump, that the end of the pump gets hot? This is because the energy that you have put into the air by pumping it has not only compressed it, but has also caused the air molecules to push closer together so giving off heat with the friction.

Compression: At some point all gases will eventually become liquid

Eg: Deodorant - its liquid inside the can (because you can hear it when you shake it) but is a gas when it comes out and hits your underarm. The pressure inside the can is higher, so the propellant inside is liquid.

Cooling by expansion: Going back to the deodorant, you will notice also how cold it feels that's because the propellant has just expanded in volume quickly.

Basic components of A/C system

1 Compressor

2 Magnetic clutch

3 Condenser

4 Driver/receiver

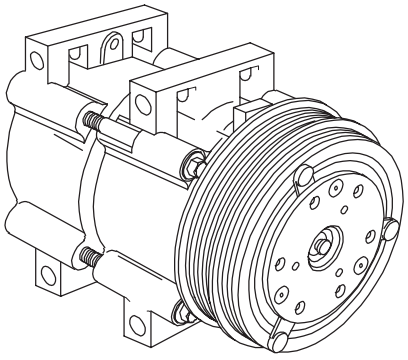
5 Evaporator

6 Blower

7 Expansion valve

1 Compressor: The compressor (Fig 1) takes low-pressure, cool refrigerant and makes it hot by compressing it. Two to six pistons that resemble the ones in your engine do the actual compressing. A V-belt from the engine drives the unit, and a magnetic clutch on its front disconnects it when the air conditioner is switched off. (Some systems cycle the compressor on and off to control the temperature inside the car. In these the magneric clutch is wired to the on/off switch and a thermostat.

Fig 1



COMPRESSOR

The compressor should be easy to find. Look for a comparatively large object with a pulley and fan belt, two rubber hoses about an inch in diameter, and valves on top that took like the ones on your tires. When you find it, track down the compressor clutch wire I there should be only one wire going to the compressor), and see if there's fuse inline nearby. If so, note its rating, and buy a replacement to keep as a spare in the glove compartment.

2 Magnetic clutch (Fig 2)

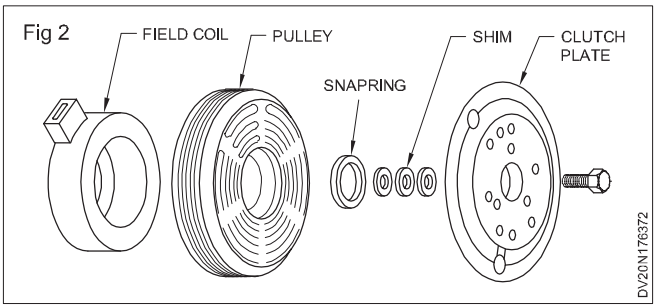
Function: A magnetic clutches is used to connect or disconnect the drive to the compressor.

Operation: When the voltage is applied to the clutch field coil, the clutch plate (which is connected to the compres-

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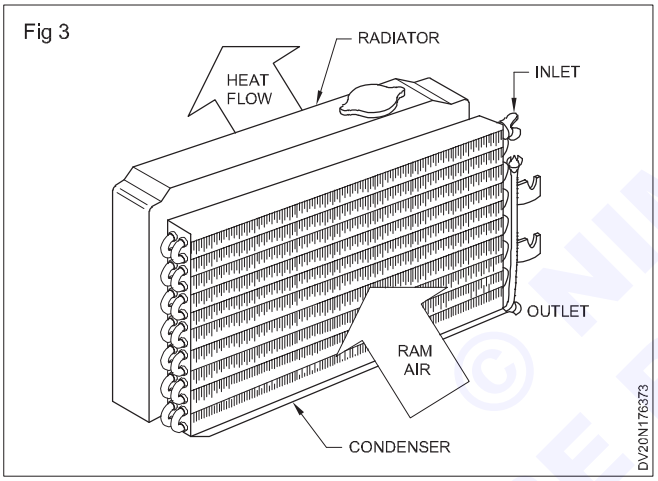
sor shaft) is drawn into contact with the pulley and the compressor rotates.

When voltage is disconnected from the clutch field coil the clutch plate is released and the compressor ceases to rotate.



3 Condenser (Fig 3)

The condenser is very similar to evaporator except for the fact it is used to cool the refrigerant i.e hot refrigerant (high pressure high temperature) vapour is converted into liquid by air flowing over the tubes also made of brazed copper or aluminum tubes.



Function: The function of the condenser is to cool the hot refrigerant vapour ensuring it condenses into a liquid.

Operation

- Condenser receives refrigerant vapour from teh compressor under high pressure.
- The refrigerant vapour enters the top of the condenser and flows down through the condenser tube.
- As cool air passes the condenser fins the refrigerant is cooled and it condenses before leaving the bottom of the condenser as liquid.

4 Driver / receiver (Fig 4)

Function

1 The primary function is to ensure that only liquid refrigerant is passed on the expansion valve.

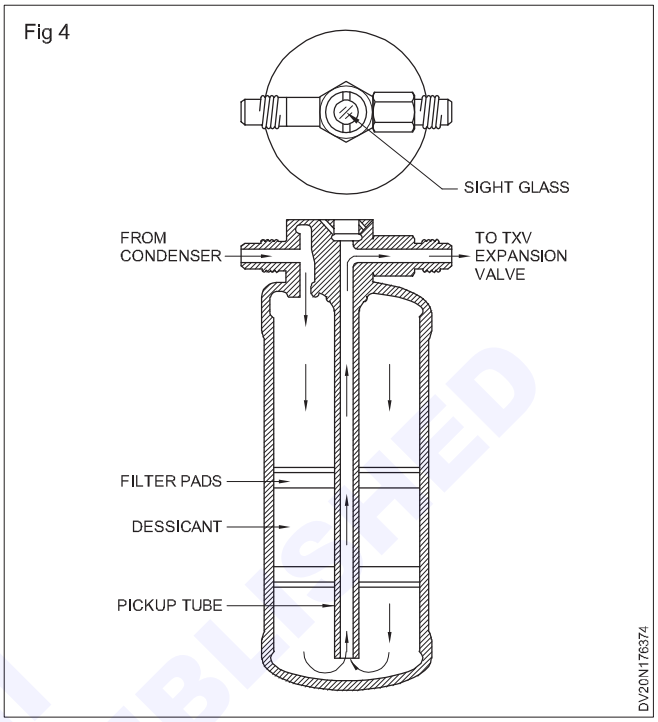
2 Filters the impurities in the system

3 Absorbs moisture in the system

Operations

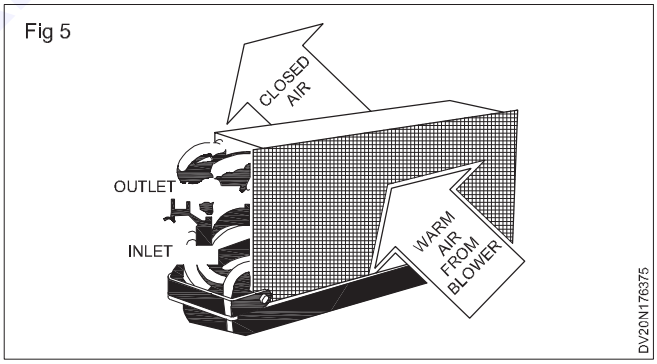
1 High pressure liquid refrigerant passes from the condenser through the inlet line into teh drier, and a drying element (Desiccant) absorbs mosutre from the refrigerant and filters foreign matter/particles.

2 From the drier the refrigerant reaches the expansion valve.



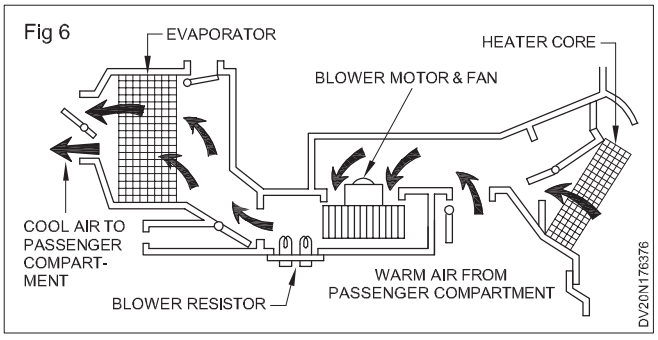
5 Evaporator (Fig 5)

Purpose evaporator: A heat exchanged which removes the heat from air circulating in the passenger compartment air distribution system and transfer that heat to the refrigerant in the A/C system.



Purpose - blower motor assembly (Fig 6)

The blower, which is always an integral part of the heater/ air conditioning case assembly, performs two functions:



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1 It pulls air from the passenger compartment, or from outside of the vehicle, into the heater and air conditioners case assembly.

2 It flows air through the heater core or the evaporator, or by passes both the flows it straight out the dash vents depending on the position of the doors in the heater case. (Fig 6).

The motor input ranges from 60V(5A) to 150W(12.5A) the motor speed is controlled by resistors in 3 to 6 steps.

6 Expansion valve (Fig 7)

Expansion valve controls refrigerant flow into evaporator.

A temperature sensitive power element bulb is attached to the evaporator outlet, a capillary tube (length of tubing of small diameter which acts as a throttle on refrigerant) control.

Accumulator dryer dehydrator is located in system low-pressure side, between evaporator and compressor. The receiver - dehydrator filters and removes moisture through means of a desiccant (drying agent).

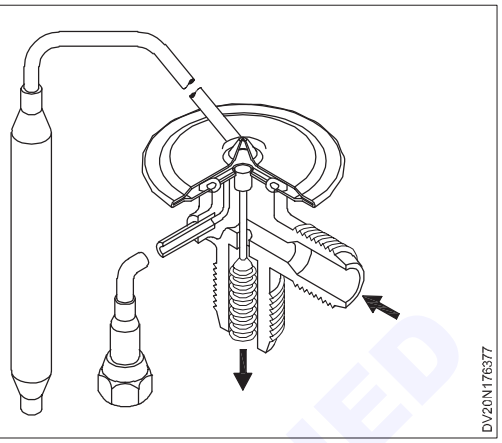
Expansion valve

Function (Fig 7)

1 Controls the flow of refrigerant into the evaporator.

2 Ensures complete evaporation of the liquid refrigerant.

Fig 7



Expansion valves are not adjustable and are changed as a complete service unit.

Uses of hoists, jacks and stands

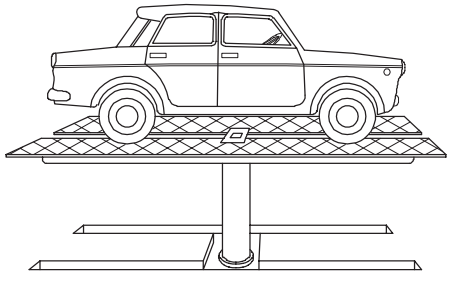
Objectives: At the end of this lesson you shall be able to
- **state the function of vehicle hoists**
- **state the function of engine hoists**
- **sate the function of jacks**
- **state the function of axes stand.**

The modern automobile service stations are used the various types of equipment's to lift the vehicles. They are as follows.

- Single post hydraulic car hoist
- Two post car hoist
- Four post car hoist
- Engine hoist
- Jacks
- Stands

Single post hydraulic car hoist (Fig 1): It is facilitate the servicing and repair works conveniently. It is constructed for dependable, trouble free performance and ensuring smooth and safe operation. The post is made of high grade steel. The car hoists are specially designed for resistant to wear and damage during water wash. Single post type is suitable for vehicle up to 6 tones.

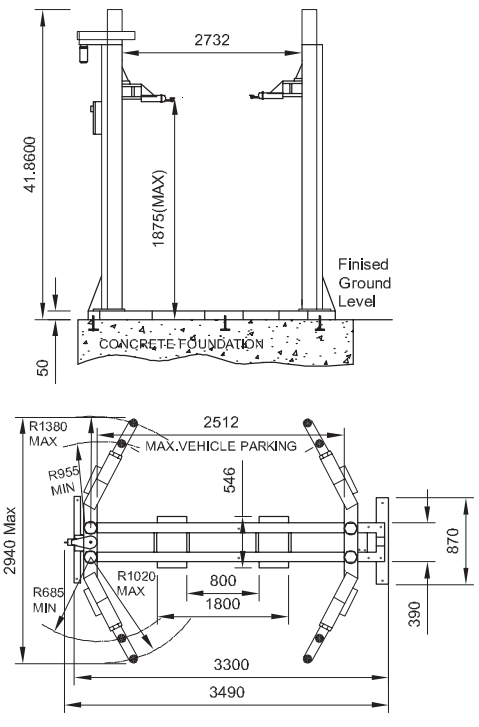
Fig 1



HYDRAULIC CAR HOIST

Two post hoist (Fig 2): It is operate by electro -hydraulic system. it is easy to operate and maintain the double post hoist and safety provision also provided to hold the vehicle. Double post type suitable for vehicle up to 4 tones.

Fig 2

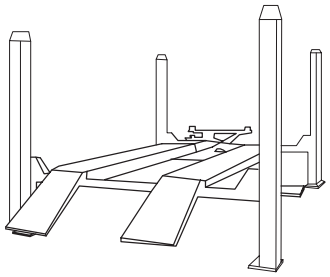


TWO POST HOIST

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Four post car hoist (Fig 3): It is operate by electro hydraulically and balancing the lifting vehicle. It is easy to operate and maintain the moving parts. Four post hoists is work as single and double post hoist it is suitable for lift the vehicle light and heavy vehicle.

Fig 3

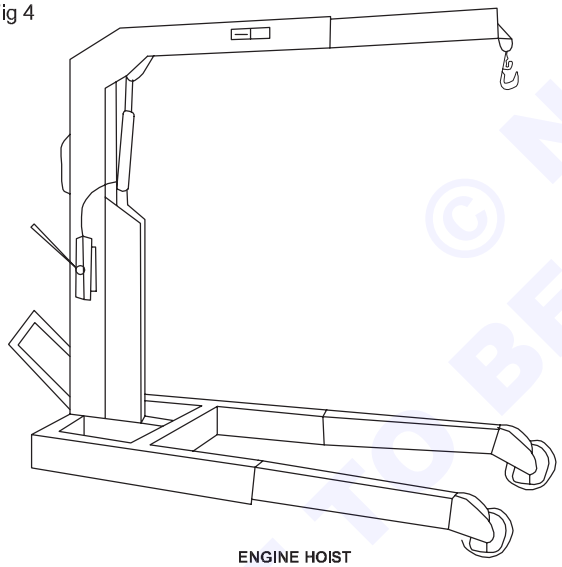


FOUR POST HOIST

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Engine hoist (Fig 4): The engine hoist helps to lift an engine from a car/truck. The hydraulic pressure converts power to a mechanical advantage and lifts the engine from the car with less effort. When using a block and tackles for lifting an engine, use a lifting plate attached to the intake manifold or use a chain bolted at each end of the block so on. They are operated by moving the handle up and down. The other type of portable floor jack is the pneumatic jack which uses compressed air to lift a car or truck. It is mostly used in production side.

Fig 4



ENGINE HOIST

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Never work under a car without safety stands or jack stands

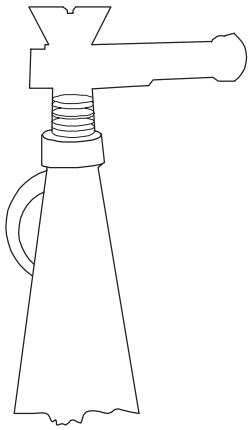
On roads mostly mechanical jacks are used to lift the car/vehicle for small jobs. These jacks work under the principle of screw and nut.

Jacks: It is used to lift the vehicle, which are operated by mechanically and hydraulically, Jack is designed to lift the vehicle and hold the vehicle load during the repair works. Jack is a standard accessory with many vehicles.

Types of jacks

- Light weight screw jack (Fig 5)
- Heavy duty bottle type hydraulic jack (Fig 6)
- Trolley types hydraulic jack (Fig 7)

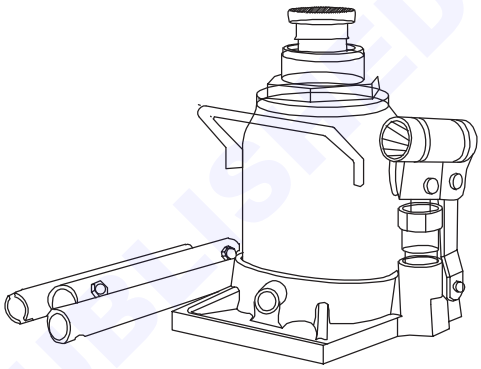
Fig 5



MANUAL TYPE LIFITING JACK

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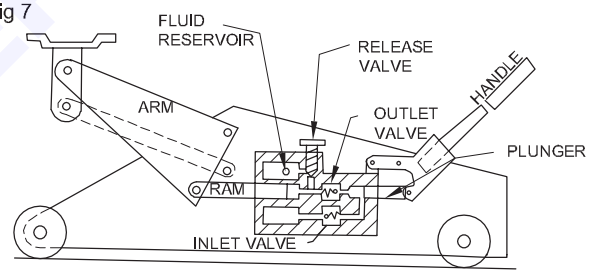
Fig 6



HEAVY DUTY BOTTEL TYPE LIFITING JACK

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Fig 7



TROLLEY TYPE JACK

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In raising front vehicle end off the floor by jacking , be sure to apply jack against front jacking bracket(1) (Fig 8).

In raising rear vehicle end off the floor by jacking, be sure to apply jack against the center portion of rear axle (2).

Caution: Never apply jack against suspension parts (i.e., stabilizer, etc.) front bumper or vehicle floor, Otherwise it may get deformed.

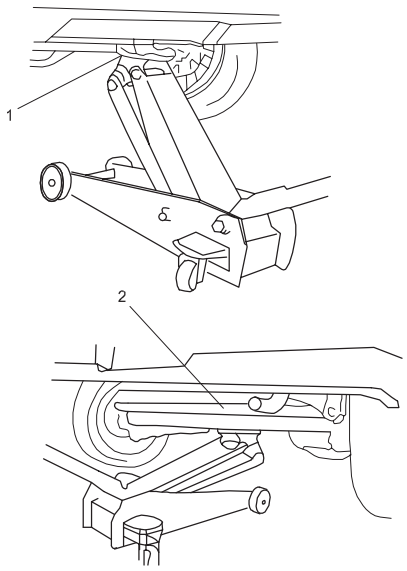
Warning: If the vehicle to be jacked up only at the front or rear end, be sure to block the wheels on ground in order to ensure safety.

After the vehicle is jacked up , be sure to support it on stands. It is extremely dangerous to do any work on the vehicle raised on jack alone.

Axle stand (Fig 9): It is always injure safety before starting the work under the lifted vehicle, Jack support is not enough, it could be dangerous. Always use axle stands for safety work. Different size of stands are used depend upon the vehicle load.

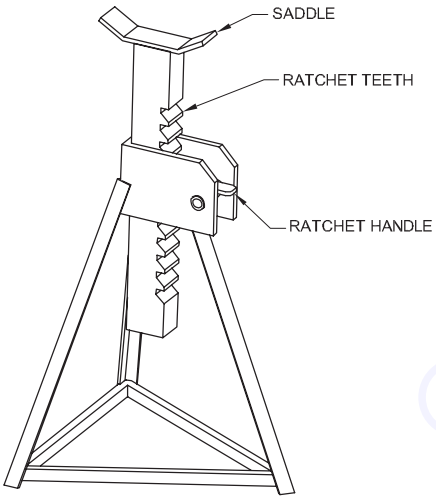
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Fig 8



FLOOR JACK

Fig 9



TYPICAL ADJUSTABLE JACK STAND

To perform service with either front or rear vehicle end jacked up, be sure to place safety stands (1) under body so that body is securely supported. And the check to ensure that body does not slide on safety stands and the vehicle is held stable for safety.

- **Care and maintenance of vehicle jacks**

1 Before storage the jacks you need to clean and lubricate the moving parts.

2 Tipping a jack over on its side or front or rear of hydraulic trolley jacks leads to an increased risk of potential leaks.

3 If you use outdoor environment the foreign matter can accumulate on the jack and if not cleaned off quickly enough can work its way into the system and contaminate the operating system of jack.

4 Part of jack maintenance should include regular inspection before and after use the jack.

5 Check for any leaks in hydraulic jack circuit.

6 Check for cracking nuts or loose nuts and bolts.

7 Keep an eye for outside foreign objects deposited on the jack moving parts.

8 After you use clean the mechanical/ hydraulic jack, clean before you store it. Use mild soap solution to clean the exterior of the jack parts.

9 Apply grease to caster wheels, front axle, elevator arm, handle base pivot bolts, release mechanism and all other bearing surfaces of hydraulic jacks.

10 Check the seals after the use to check for possible oil leakages and replace the seals immediately if you notice any don't use the jack again until you have done so.

11 Change hydraulic oil periodically after oil change bleed the oil from the system.

12 Check the oil level but add more when the rod does not move easily, be sure that you add oil in the port usually located on the side of power unit.

13 Clean and grease the mechanical jack before storage.

- **Care and maintenance of vehicle tools kit:** Vehicle tool kit is very essential for car maintenance. The following tools are used for car maintenance

1 Socket

2 Pliers and wrenches

3 Wire cutters

4 Torque wrenches

5 Screw driver

6 Rubber mallet

7 Work light or Inspection lamp

8 Latex gloves

9 Zip ties

10 Multimeter

11 Impact wrench

12 Lubricants and cleaners

13 Drip pan

14 Desiecant

15 Electrical tape and duck tape

16 OBD scanner

17 Hydraulic or mechanical jack

18 Double end spanner set

19 Ball peen hammer

20 Brass dript

21 Feeler gauge

22 Steel rule

23 Hand grease gun

24 Allen key

25 Rubber mat etc.

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The above car maintenance kit should be clean before and after use. when store tools for a long term apply grease oil or on it to avoid rust deposit on tools.

Identification of jacking points: Check the owner's manual to identify the particular vehicle's jacking points. Mostly jacking points are located behind the front wheel and front of the near wheel. Square type marked spot is provided under the vehicle chassis body frame.

Basics of Computer

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

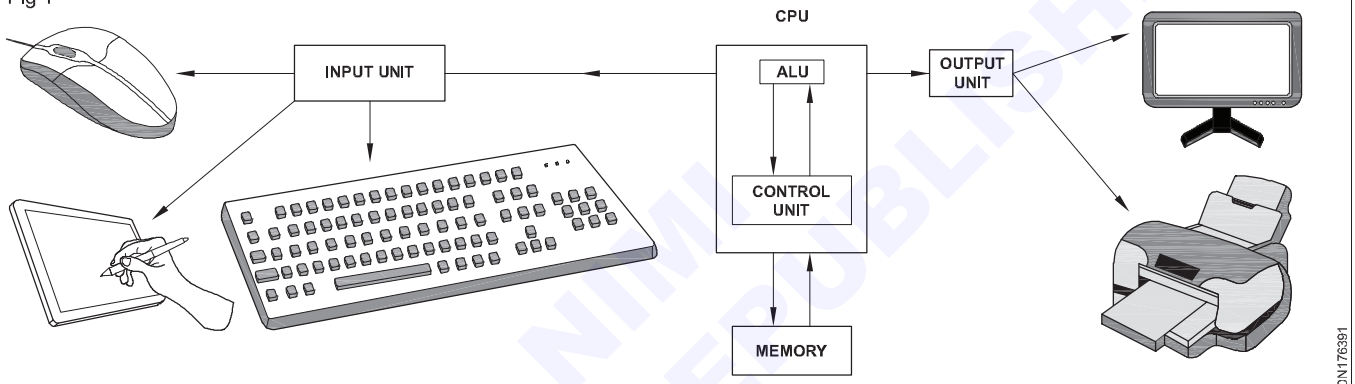
- **explain the basics of computer**
- **describe the various components of a computer**
- **describe hardware, software and peripherals**
- **describe applications of computer**
- **explain how to connect accessories to computer**
- **switch on and shutdown a computer.**

What is a computer?

The term computer is used to describe a device made up of electronic and electro mechanical components. The computer itself cannot perform any task and is referred to as hardware.

A computer system consists of three elements (Fig 1).

Fig 1



1 Hardware

2 Software

3 People

Hardware : The physical components which you can see, touch and feel in the computer system are called hardware Eg monitor, keyboard, mouse etc.

Software : Software is used to describe the instructions that tells the computer how to perform a task. Software is categorized as

1 System software's (eg . operating systems, compilers, editors, etc)

2 Application software's (MS-word, excel, accounting packages, etc)

People : People who operate the computer and also create computer software instructions

Introduction

A computer is an electronic, digital device used to process data, converting the data into information that is useful to People/users.A computer system consists of hardware and software components.

Hardware is the physical equipment such as the case, storage drives, keyboards, monitors, cables, speakers, and printers.

Software is the operating system and programs.

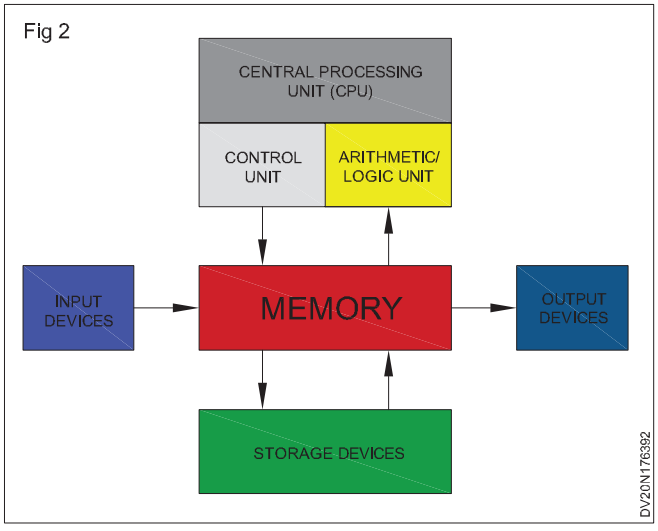
The operating system instructs the computer how to operate.

Programs or applications perform different functions.

Information Processing Cycle (Fig 2)

It is a sequence of events in processing information which includes input, processing, storage and output. These processes work together & repeat over & over

Fig 2



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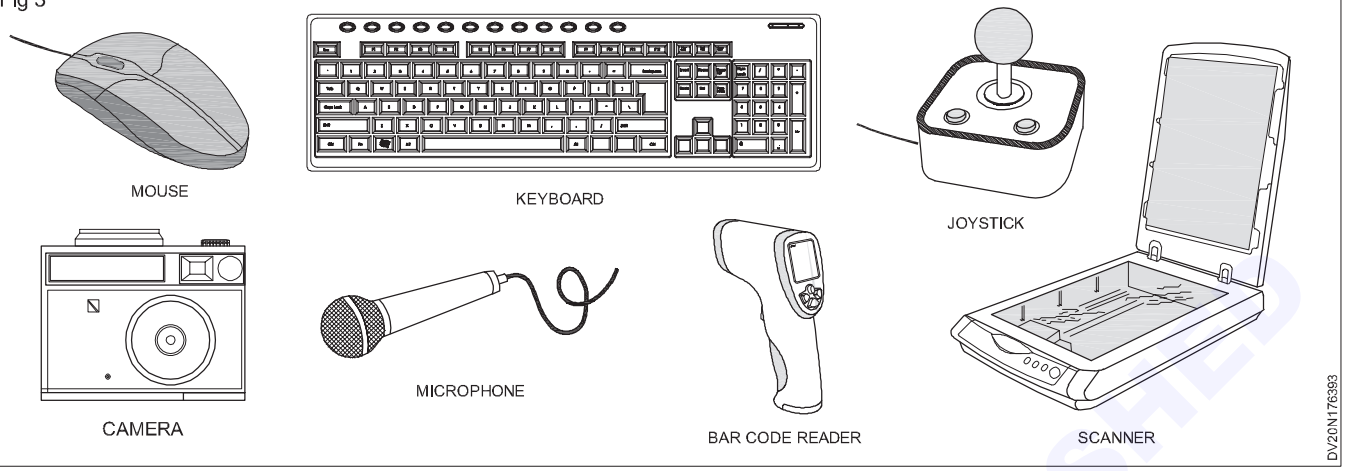
- **Input -** Entering data into the computer.
- **Processing -** Performing the operation on the data.
- **Output -** Presenting the result
- **Storage -** Saving data program or output for future use.

Components of Computer

Input Devices (Fig 3)

Input devices used to enter data or instructions into a computer

Fig 3



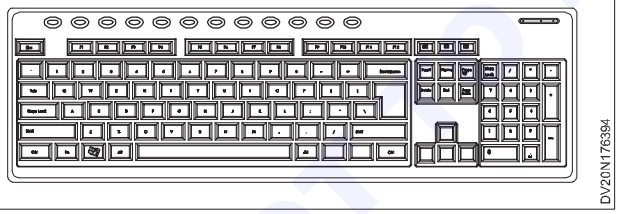
- Keyboard
- Mouse
- Digital camera
- Scanner
- Mic
- Bar code reader
- Joystick

Keyboard Standard Layout (Fig 4)

A standard computer keyboard has about 100 keys.

Most keyboards use the QWERTY layout, named for the first six keys in the top row of letters.

Fig 4



Mouse (Fig 5)

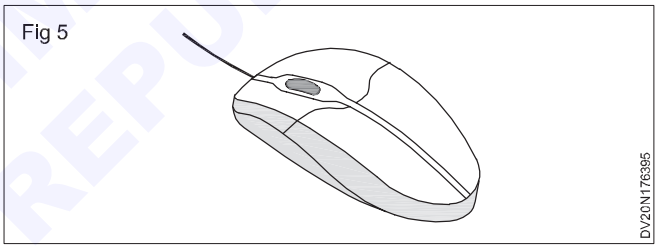
The mouse is a pointing device. You use it to move a graphical pointer on the screen.

The mouse can be used to issue commands, draw, and perform other types of input tasks.

Using the mouse involves five techniques:

- **Pointing -** Move the mouse to move the on-screen pointer.
- **Clicking -** Press and release the left mouse button once.
- **Double-clicking -** Press and release the left mouse button twice.
- **Dragging -** Hold down the left mouse button as you move the pointer.
- **Right-clicking -** Press and release the right mouse button.

Fig 5



Output Devices (Fig 6)

- Printers, Scanners, and Fax Machines - Printers are output devices that create hard copies of computer files. Other all-in-one type printers are designed to provide multiple services such as printing, fax, and copier functions.
- Speakers and headphones are output devices for audio signals.

Most computers have audio support either integrated into the motherboard or on an adapter card. Audio support includes ports that allow input and output of audio signals.

- Visual display unit (Monitor, Screen etc.)
- Printer/Plotter
- Multimedia projector
- Speaker

Printers

Impact printers

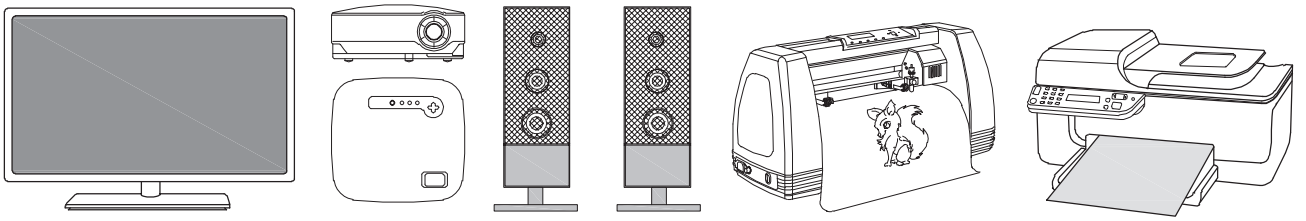
- Dot matrix printers

Nonimpact printers

- Ink jet

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Fig 6



- Laser

Monitors

The most important difference between these monitor types is the technology used to create an image:

- Cathode-ray tube (CRT) monitor is the most common monitor type. Most televisions also use this technology.
- Liquid crystal display (LCD) is commonly used in laptops and some projectors. LCD comes in two forms, active matrix and passive matrix.

CRT (Cathode Ray Tube) (Fig 7)

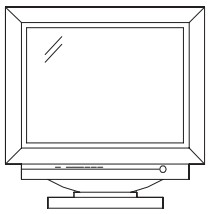
1 Most inexpensive monitor.

2 It has a quite a large case.

3 Pixels, made up of phosphors, are the tiny components that make up the image shown onscreen.

4 These pixels are struck by electrons, which make the pixels glow and eventually form the desired image on the screen.

Fig 7



LCD (Liquid Crystal Display) (Fig 8)

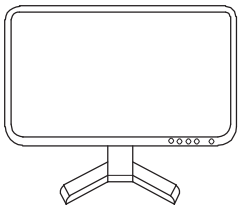
1 Also known as flat screen monitors. But with its proliferation, prices are continuing to drop.

2 LCD technology reduces blurring and colour smudging during motion pictures, which makes this type of monitor appropriate for gamers or film enthusiasts.

3 Requires less space and energy.

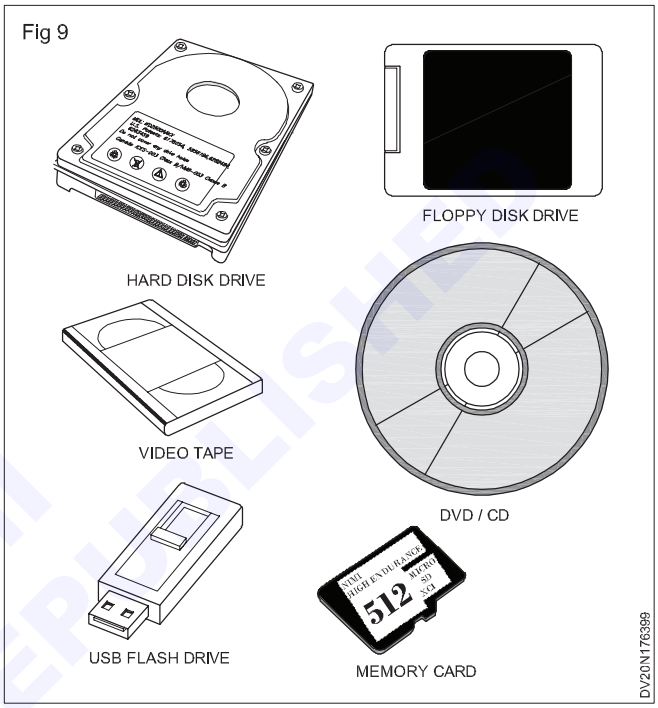
4 The display is far superior than the CRT monitor's.

Fig 8



Storage Devices (Fig 9)

Fig 9



Floppy Disks

- 3.5-inch disks store 1.44MB of data

Hard Disks

- Spins at 5,400 - 7,200 rpm.
- Can store anywhere between GB to TB of data.

CD's-Compact Discs

- Available in a variety of formats-CD-ROM, CD-R, CD-RW
- A typical CD holds about 700 MB of data

DVD's

- Available as DVD-ROM, DVD-R, DVD-RW
- Can hold 4.7 GB of data (standard)

USB Flash Drive

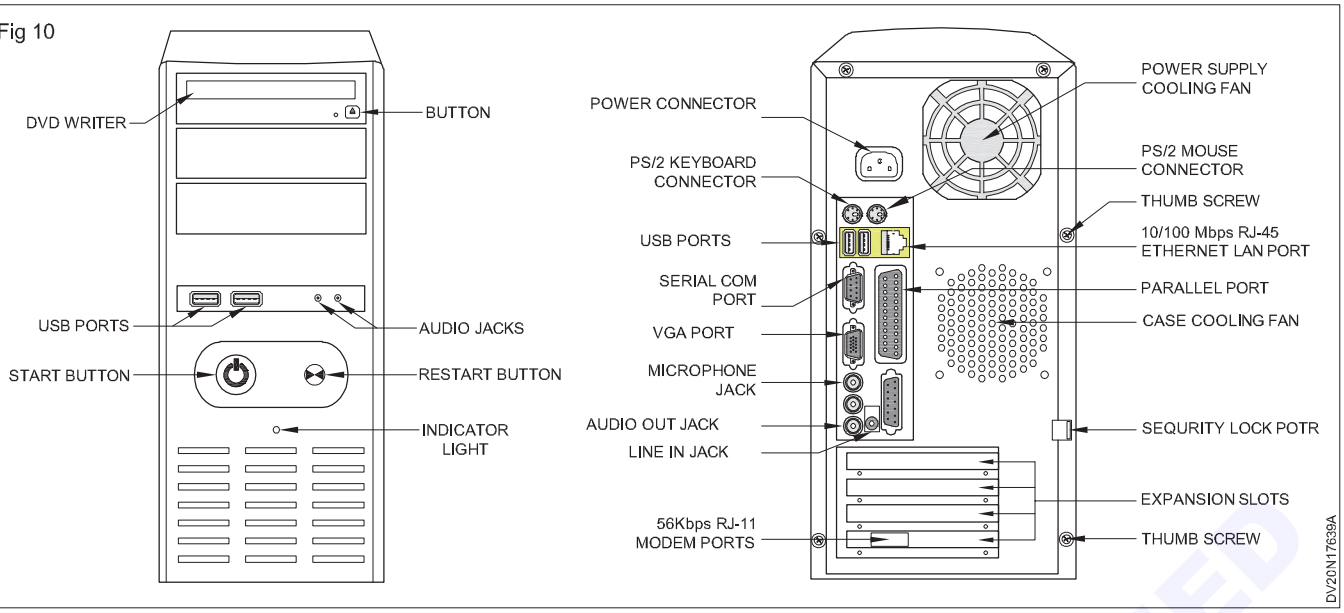
- Storage capacity between MB - GB

Central Processing Unit (CPU) (Fig 10)

The computer CPU is responsible for handling all instructions it receives from hardware and software running on the computer. In the CPU, the primary components are the ALU (Arithmetic Logic Unit) that performs mathematical, logical, and decision operations and the CU (Control Unit) that directs all of the processors operations

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Fig 10



There are different brands and speeds

- Pentium made by Intel
- Celeron made by Intel
- Athlon made by AMD
- Memory
- RAM-also called Random Access Memory
- ROM- also called Read Only Memory

Random-access Memory (RAM)

- Temporary storage for data and programs that are being accessed by the CPU
- Volatile memory, which means that the contents are erased when the computer is powered off
- More RAM means more capacity to hold and process large programs and files, as well as enhance system performance.

Types of RAM:

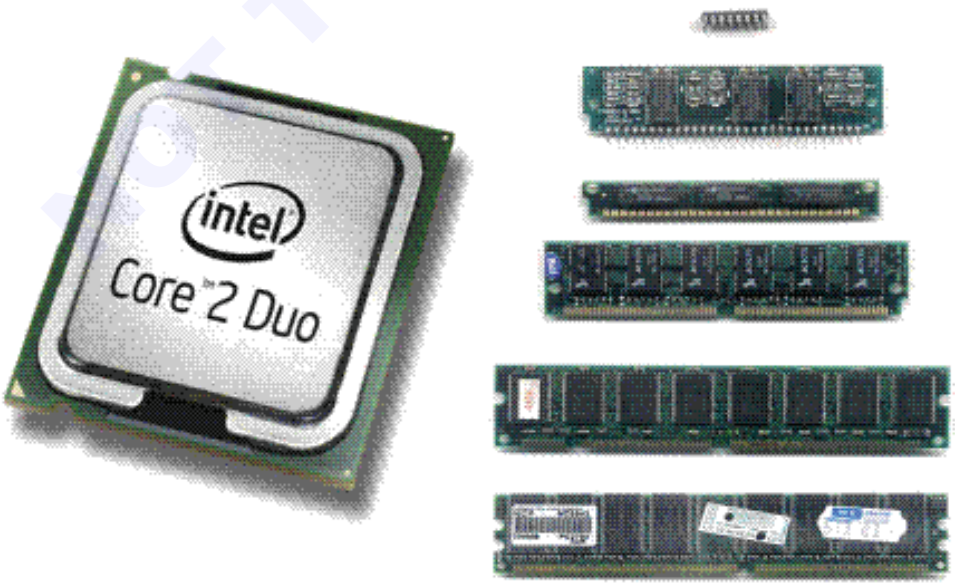
- Dynamic Random Access Memory (DRAM)
- Static Random Access Memory (SRAM)
- Fast Page Mode DRAM (FPM Memory)
- Extended Data Out RAM (EDO Memory)
- Synchronous DRAM (SDRAM)
- Double Data Rate SDRAM (DDR SDRAM)
- Double Data Rate 2 SDRAM (DDR2 SDRAM)
- RAMBus DRAM (RDRAM)

Processors & Memory (Fig 11)

Data Representation

- Byte-one character of data (8 bit)
- 1 Kilobyte (KB) =1024 Bytes
- 1 Megabyte (MB)=1024 Kilobytes
- 1 Gigabyte (GB)=1024 Megabytes
- 1 Terabyte (TB)=1024 Gigabytes

Fig 11



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ROM Types	ROM Types	Description
ROM	Read-only memory chips	Information is written to a ROM chip when it is manufactured. A ROM chip cannot be erased or re-written and can become obsolete.
PROM	Programmable read-only memory	Information is written to a PROM chip after it is manufactured. A PROM chip cannot be erased or re-written.
EPROM	Erasable programmable read-only memory	Information is written to an EPROM chip after it manufactured. An EPROM chip can be erased with exposure to UV light. Special equipment is required.
EEPROM	Electrically erasable programmable read-only	Information is written to an EEPROM chip after memory is manufactured. EEPROM chips are also called Flash ROMs. An EEPROM chip can be erased

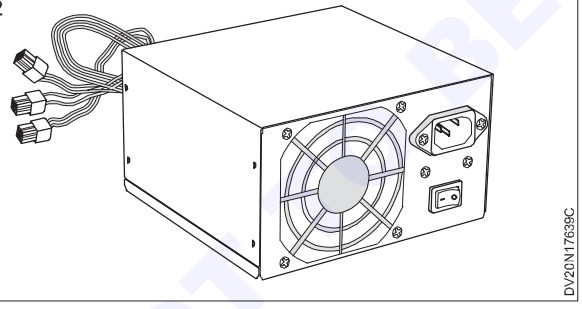
Read-only Memory (ROM)

- Basic instructions for booting the computer and loading the operating system are stored in ROM.

Power Supply (Fig 12)

The computer gets its power from the external power supply to system through SMPS (Switch Mode Power Supply) which acts as a AC to DC converter and step down the volts to 3 - 12 DC. The external power card is to be connected to the power supply plug in system and the power supply on/off switch is switched on and the power switch in the front side of the system is also switched on then the power supply fan must run, if it is not running then there may be a problem of power supply, if it runs properly then we can assure that we got power to our system.

Fig 12



Application of Computer

Word Processing: Word Processing software automatically corrects spelling and grammar mistakes.Copy and paste features repeats the content of the document. Images can be added to your document.

Internet: A network of almost all the computers in the world., we can browse through much more information than you could do in a library because computers can store enormous amounts of information. It is very fast and convenient access to information. Through E-Mail you can communicate with a person sitting thousands of miles away in seconds. Chat software enables one to chat with another person on a real-time basis. Video conferencing tools are becoming readily available to the common man.

Digital video or audio composition: Audio or video composition and editing have been made much easier by computers.The Graphics engineers use computers to generate short or full-length films or even to create three-dimensional models. Special effects in science fiction and action movies are created using computers.

Desktop publishing : The desktop publishing, we can create page layouts for entire books on the personal computer.

Computers in Medicine : Computer can diagnose diseases. we can learn the cures. Software is used in magnetic resonance imaging to examine the internal organs of the human body. Software is used for performing surgery. Computers are used to store patient data.

Mathematical Calculations : Large calculations are made easy in computer.

Banks : All financial transactions are done by computer software. They provide security, speed and convenience.

Travel : We can book air tickets or railway tickets and make hotel reservations online. So The time wastage and travel time are saved

Telecommunications : All mobile phones have software embedded in them for maintaining customer details and also sending message, audio and video through the mobile software.

Defence : Software embedded in almost every weapon. Software is used for controlling the flight and targeting in ballistic missiles. Software is used to control access to atomic bombs.

E-Learning : Book it is easier to learn from E-learning software. It not only contains text also contain image and animation

Gambling : Gamble online instead of going to a casino.

Examinations : Online exams and get instant results. The results online.

Computers in Business : Shops and supermarkets use software, which calculate the bills. Taxes can be calculated and paid online.

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Accounting is done using computers. One can predict future trends of business using artificial intelligence software. Software is used in major stock markets. One can do trading online. There are fully automated factories running on software.

Certificates : Different types of certificates can be generated layouts can be prepared.

ATM machines : The computer software authenticates the user and dispenses cash.

Marriage : There are matrimonial sites through which one can search for a suitable groom or bride.

News : There are many websites through which you can read the latest or old news.

Classmates : There are many alumni websites through which you can regain contact with your classmates.

Robotics : Robots are controlled by software.

Washing Machines : Operate using software.

Microwave Oven : They are operated by software.

Planning and Scheduling : Software can be used to store contact information, generating plans, scheduling appointments and deadlines.

Plagiarism : Software can examine content for plagiarism.

Greeting Cards : We can send and receive greetings pertaining to different occasions.

Sports : Software is used for making umpiring decisions. There are simulation software using which a sportsperson can practice his skills. Computers are also employed to identify flaws in technique.

Aeroplanes : Air Pilots trained on software, which simulates flying operation.

Weather analysis : Supercomputers are used to analyses and predict weather, and issue warning signals/ warning siren specifically for fisherman.

Browsing & searching websites text/images & use of E- mails

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

- **explain the term internet**
- **list the services of internet**
- **explain the terms world wide web and website**
- **explain the Domain Name system used in internet**
- **explain the purpose of a browser**
- **explain the use of Search Engines**
- **explain the basics of down loading content from the internet**
- **name various protocols used on the internet**
- **describe E-mail and its feature**
- **list the email server.**

Internet

The internet is a world wide collection of network, servers, gateways and computers using a common set of telecommunication protocol to link and inter operate them together.

The internet provides world wide access to information and resources. It is possible to find information about almost any subject imaginable from universities, government organizations, the military or libraries which may be in any part of the world.

The internet evolved from a US department of defence project. The advanced Research Projects Agency (ARPA) of the department funded a project to connect university computer scientists and engineers together via their computers and telephone lines. This project called ARPANET, allowed researchers to share each others computer facilities over long distances. It was also used to exchange electronic mail (e-mail) with other users. The network protocol used by the project was TCP/IP which continues to be used on the Internet today. With the combination of electronic mail, file transfers and mailing lists this network of networks called internet began to take shape.

The simplest definition of internet is that its the longest computer network in the world. A study in 1997 estimated that the internet has 16.1 million hosts or computers connected to it.

Technically, the internet is actually a network which is made up of many smaller networks that exist all over the world, but this is as invisible to the user as the telephone network which provides national to international calls (STD/ISD). There is no particular person or company who controls the internet. It can be considered as a vast and growing online library in which anyone can publish anything they want.

Services of the internet

Over the last few years the primary users of the internet have shifted from research based activity and business use of the internet is increasing. All types of software and hardware companies are finding new ways to promote and sell their products on the internet. Lot of business applications like stock market trading, shopping on line, ordering of parts, booking of tickets, train accommodation and reservations etc. have been developed and already in use. An engineer can use the internet as a resource for current topic relating to products, technologies, tools and troubleshooting. One can also find latest news update, weather, sports and other information like travel advice, listen to music etc. Even internet telephony has come into place and at the expense of local call charges long distance and international calls can be established through the internet.

Some of the best known services available on the internet are

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- WWW or World Wide Web
- FTP or File Transfer Protocol
- E-mail or Electronic mail
- Mailing lists
- Newsgroups
- Search engines
- Telnet
- Telephony
- VPN

World Wide Web

It is the internets multimedia service. It is also the widely used part of internet. It is a vast storehouse of documents known as hyper text documents. These documents are written using the hypertext markup language (HTML). Hypertext is a method for presenting text, images, sound and videos that are linked together in a document. It allows a user to browse through topics in any order. It also includes dynamic links or connections which will take you to access those pages. Using WWW, you have access to millions of pages of information.

The sum of all the hyper text and connecting links connected via the internet form is known as the world web wide or WWW or the web. The web allows you to move among linked documents stored on host computers that may be physically very distant from one another.

You can read a hyper text file, look at its illustrations and even listen any audio in it and also follow its links. Certain words or phrases appear in text of a different colour than the text and is also underlined. When you move the cursor and point it on these words a small hand appears which indicates that it is a link. You click this word and a new hypertext document gets opened.

Website

A website is a collection of hypertext documents. A document on the site is called a web page. The first page in a series of related documents or a site is called a home page. The first document you access at any site is called the home page. Many individuals on the internet have their own home page - a document about them and their interests - that anyone on the internet can access. This is a very useful way to represent a company or individual.

The web combines TCP/IP, the protocol for sending documents across network, with an entirely new method of locating and accessing documents on different networks. It involves a simple coding mechanism around a string of characters called a URL or a Universal Resource Locator. The URL identifies the name and address of each document available to the web.

The URLs specify the server to access as well as the access method and the location. Each website on the internet has its own URL.

An URL consists of

1 The server protocol to be used where the document is located. A server setup specifically for web documents uses hypertext transfer protocol (HTTP).

2 A colon

3 The type of site generally world wide web (WWW), file transfer protocol (FTP), a protocol used specifically to transfer files from one computer to another or Gopher, a client server application that organizes the files on a server, so users need not know or enter the exact file name.

4 The address of the host computer. Also known as domain address. The address begins with two forward slashes. It consists of the name of server or site, the network, university or computer name and the domain (two or three letter designation of the type of institution). The specific location of the document on that computers network

Example:

1 http://www.microsoft.com/home.htm

http	- Server protocol
www	- Type of site
microsoft	- Company name
com	- Domain name
home.htm	- Location of the document

2 ftp://ftp.microsoft.com

3 gopher://gopher.microsoft.com

Domain name system

In addition to URLs every computer on the internet has a unique IP address. The IP address is four sets of digits separated by dots. (198.64.3.20)

Because these numbers are hard to remember and difficult to type, the domain name system was created. Domain names enable short, alphabetical names to be assigned to IP addresses to describe where a computer is located. In the e.g. http://www.microsoft.com, www.microsoft.com is the domain name.

The last three characters of DNS or URL address indicate the type of domain. Some common domain names used in US are

com	-	commercial organizations
edu	-	educational institutions
gov	-	government organizations
mil	-	military
net	-	network, companies and groups who administer the internet
org	-	organizations

Countries outside the US use a two letter country code as their domain name.

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au - Australia

in - India

fr - France

uk - united kingdom

Browser

To view the web sites/pages you need a graphical user interface, called a web browser. It is a piece of software, that lets you visit different web sites on the internet and display their pages on your own computer. You can visit the site by supplying the browser with an address or URL.

A browser displays a document from the internet on the computer screen. Like any windows based program, a browser has a number of features - buttons, menus, scroll bars, toolbars etc, that let you control its operation. The latest version of the browser is recommended, since the technologies involved in publishing information on the internet are constantly changing.

Once you have your browser and a internet connection, accessing the internet is fairly straight forward. Commonly used browsers are Netscape Navigator and Microsoft Internet Explorer.

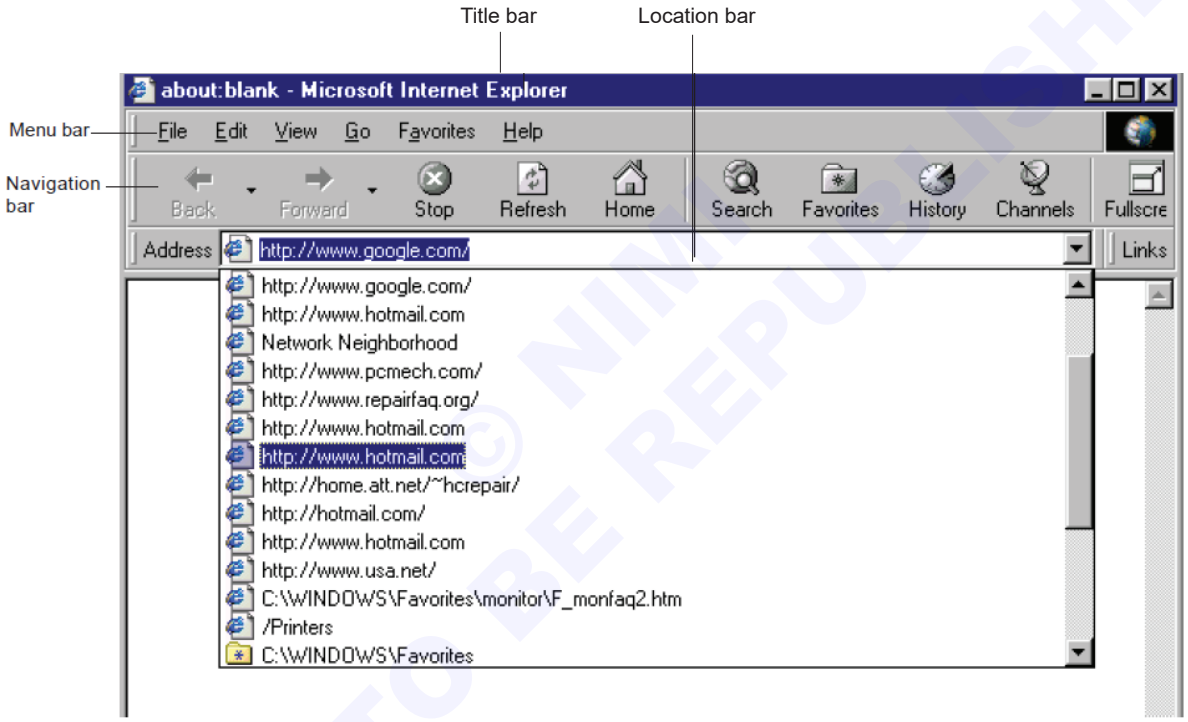
Fig 1 gives the home page of Microsoft internet explorer.

Title bar: Shows the name of the page you are currently viewing on the documents file name if it is not a web page.

Menu bar: Provides with drop down menus contains almost all the commands you will need in the browser.

Navigation toolbar: Provides command action buttons. Click the icon for the specified action to occur. If you point at a button for a few seconds, without clicking, a tool tip will appear describing the action of the button.

Fig 1



Location tool bar: Type the URL you want to connect in the "document URL" area of the location toolbar. On the right side of the window a small arrow appears. Click the arrow and the URLs you have most recently visited will pop up as a list.

Internet options: Select view on the menu bar and select internet options to edit internet explorers default settings.

Search Engines

A search engine is an application on the web that allows you to search for particular web pages on sites based on key words or concepts. There are growing number of search engines found on the world wide web and each one produces different results.

Some of the popular search engines are www.msn.com, www.rediff.com, www.google.com etc.

In the window provided, type the text to be searched for and click 'submit'. You will be returned with the matching documents and related websites. Point the mouse cursor over the URL and a hand appears and click to open the document.

Chat: When you send email or post news, you have to wait till the mail is sent, read by the recipient and he has to reply the mail and receive the answer. Instead chat allows people to converse more in the way, as it happens in person or on the phone. You talk something, people hear it and respond on the spot. In case of chat, this exchange happens on your computer screen. The communication happens in real time without delay.

E mail: Electronic mail, the sending and receiving of electronic messages, is currently one of the most popular activities on the internet. E-mail is used on

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most commercial online services, and for many people, is the primary reason for getting onto the internet or an online service.

To send e-mail, you must know the recipients e-mail address. These addresses are composed of the user's identification, followed by the @ sign, followed by the location of the recipient's computer. For example, the email address of an individual will be name @hotmail.com

When you access the internet through a local service provider or one of the large commercial online services, you can exchange email without incurring the long distance charges of a telephone call. Email has the added advantage of allowing you to access messages at your convenience. You can also send an identical message to any number of people at one time.

News

Network News Transfer Protocol (NNTP) is an Internet standard protocol defined for distribution, inquiry, retrieval and posting of news articles. Network news (USENET) is a popular use of NNTP. It offers bulletin boards, chat rooms, and Network News. Network News is a massive system with over 5000 ongoing conferences, called newsgroups, conducted 24 hours a day, 365 days a year. To access these newsgroups, download a special program from the internet that allows you to participate in any newsgroup you want. Most commercial browsers, including the Microsoft Internet Explorer, have this capability built in. You then "subscribe" to the newsgroups that interests you and communicate through a message system similar to email. The difference between Network News and email is that the Network News conversations take place in a public forum called a news group.

You can simply view an ongoing dialog without participating; this is called lurking and is encouraged for newcomers. To enter the conversation, you post an article in the newsgroup and you become part of the forum. As with email, Network News is usually informal communication with little distillation of content. However, some newsgroups are managed by a monitor who may elect not to post responses that are deemed inappropriate for that forum. Network News operated at a very high speed, with posting appearing quickly and constantly. Group administrators set the length of time that messages remain posted before being deleted from the system. Most do not keep postings longer than a week.

FTP: File transfer protocol is the internet's standard method for moving/downloading text files, data files and binary program files from one computer to another. A browser can be used for some FTP transfers. Its often faster and easier to use a dedicated FTP client software to download.

The procedure is essentially the same for all.

1 Connect your client program/browser to an FTP server

2 Log on as 'anonymous' and give your email address as the password

3 Move to the directory on the server that contains the file you want

4 Specify the directory on your computer where you want to store downloaded files

5 Transfer the file from the FTP server to your computer

6 Disconnect the server.

Telnet: Telnet makes your computer as a remote terminal that sends commands and receives data from the remote server through internet. When you type on your own keyboard, the data goes directly to the remote computer, as if you are directly connected to it. You should have an account and connection to the remote computer.

To make a telnet connection, one has to use the terminal emulation program such as hyper terminal in windows.

Making an internet connection

In order to access servers on the internet, your computer needs to be connected to the internet service provider.

It can be achieved through

a PSTN dial up lines

b ISDN dial up

c Dedicated leased line

Dial up link: Requires a telephone line, a dial up modem and dial up account with the ISP. Whenever IE needs access to internet, it has to establish the dial up connection first. Use dial up networking which makes the call and gets connected. But only 33kbps speed is achieved typically, can be used to connected only one computer to the ISP.

ISDN: This service connects networks through digital lines. It provides a faster connection and can be more economical than dial up service. A special ISDN modem can be used to access the ISP. An ISDN dial up account should also be taken from the ISP.

ISDN can be used from a LAN, which connects multiple users at a specific location to the internet. To enable this, a special type of computer called proxy server is required to act as a gateway between their local network and the internet. The proxy server filters the requests from internet and makes it more difficult for unauthorized requests to reach local network.

Leased line connection: For users demanding more bandwidth and internet availability for 24 hrs all days, leased lines are recommended. The typical speeds which can be used are 64 kbps, 128 kbps and 2.048 Mbps. It requires a router attached with a leased line modem to be interfaced with the leased line. A leased line account is also required from the ISP.

Web server

A Web server is a program that, using the client/server model and the World Wide Web's Hyper Text Transfer Protocol (HTTP), serves the files that form Web pages to Web users.

Every computer on the Internet that contains a Web site must have a Web server program. The most popular Web servers are; The Microsoft's Internet Information Server which comes with the Windows NT server; Netscape Fast-

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Track and Enterprise servers; and Apache, a Web server for UNIX-based operating systems. Other Web servers include Novell's Web Server for users of its NetWare operating system and IBM's family of Lotus Domino servers, primarily for IBM's OS/390 and AS/400 customers.

Web servers often come as part of a larger package of Internet related programs for serving e-mail, downloading requests for File Transfer Protocol(FTP) files and building and publishing Web pages. Considerations in choosing a Web server include how well it works with the operating system and other servers, its ability to handle server-side programming, and publishing, search engine, and site building tools that may come with it.

Internet Service Provider (ISP)

An ISP (Internet service provider) is a company that provides individuals and other companies access to the Internet and other related services such as Web site building and virtual hosting.

An Internet service provider (ISP) has the equipment and the telecommunication line access required to have POP on the Internet for the geographic area served. Larger ISPs have their own high-speed leased lines so that they are less dependent on the telecommunication providers and can provide better service to their customers. Among the largest ISPs are AT&T WorldNet, IBM Global Network, MCI, Netcom, UUNet, PSINet, etc.

ISPs also include regional providers such as VSNL, NEARNet, BARNet etc. They also include thousands of local providers. In addition, Internet users can also get access through online service providers (online service provider) such as America Online and Compuserve.

An ISP is also sometimes referred to as an IAP (Internet Access Provider). ISP is sometimes used as an abbreviation for independent service provider to distinguish a service provider that is an independent, separate company from a telephone company.

Internet Access Provider

The basic service that any Internet Service Provider (ISP) offers is the means to provide a dial-up link via a public telecommunication service such as telephone or ISDN, which supports an IP(Internet Protocol) packets coming from and going to that link.

In order to support the IP link across the telephone system, an additional protocol is required, which an ISP must also be able to support. This will either be the Point-to-Point Protocol (PPP) or Serial Line Internet Protocol (SLIP). PPP has largely replaced SLIP access now a days, hence in the following discussions will assume PPP.

The ISP must also provide a means of resolving what are known as 'Domain Name' address queries. This process will be supplied by the ISP's Domain Name Server. The IP protocol provides a means of converting Domain Names which people can understand, into IP addresses (e.g., 012.345.678.9) which computers can understand. Thus when you type a URL into your web browser, the Domain Name part of the URL must first be converted into its IP address before the web page can be located and delivered to the browser. Each Domain Name is assigned its specific IP address when it is created, and so the process of converting one to the other is simply a matter of looking up its entry in a database. Finding where that particular Domain Name/IP address relationship is recorded and then using this information to make the correct conversion is the job of the 'Domain Name Server' (DNS).

The minimum basic services that an ISP must provide can be summarized as follows:

– Dial-up access for either analogue (public telephone) or digital (ISDN) telecom links.

– Support for handling IP packets

– Support for the PPP protocol

– Access to a Domain Name Server

As these are the basic minimum, most ISPs will provide these as a matter of course and will not necessarily advertise these capabilities.

Cc: stands for "carbon copy". Anyone listed in the Cc: field of a message receives a copy of that message when you send it. All other recipients of that message can see that the person you designated as a Cc: recipient has received a copy of the message.

Bcc: stands for "blind carbon copy". This is similar to the Cc: feature, except that Bcc: recipients are invisible to all the other recipients of the message (including other Bcc: recipients). For example, if you send a mesagge To: suryaamehta@yahoo.co.in and Bcc: jayashrimehta@yahoo.co.in, then suryaamehta sees himself as the message's only recipient. Jayashrimehta, on the other hand, is "in the know" - she can see that you sent the message To: suryaamehta, and that you blind-copied her. To add an entry in the Bcc: field, click the "Show BCC" link to the right of the "To:" field.

Note: To send a message, you must always specify atleast one recipient in the "To:" field. If you don't an error message appears when you attempt to send the message.

The maximum attachment size using Yahoo! Mail account for sending and receiving messages upto 10MB.

Search Engine

According to another survey done by **Net craft** in August 2006, there are **92,615,362** sites

(**92 million**) and this is an increase of 4.4 million sites (4.8%) from the July, 2006 survey.

The end user uses the Internet heavily in accessing information in their day to day needs

since the Internet is the biggest repository of knowledge in the history of mankind. Thus

the Internet has become the world's widely accessed information source and Websites are added, updated, and obsolete daily. Therefore, "Finding the right information at the right time" is the challenge in the Internet age. Hence there is a need for a more effective way of retrieving information on the Internet.

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There are three ways of finding information on the Internet.

1 Guessing the URL (Uniform Resource Locater)

2 Using a Search engine

3 Using a Subject Directory or a Subject Gateways

If the URL (Uniform Resource Locater) is known, it can be typed in the Internet browsers' (Example: Internet Explorer, Netscape Navigator, etc.) address bar and can be accessed the Website soon. Otherwise use directories (Yahoo!, dmoz, Look Smart) for broad, general topics. Subject directories select and classify resources into subject categories and subcategories. Some include reviews and/or ratings which can be accessed by keyword search or by browsing the classifications.

A subject gateway can be defined as a facility that allows easier access to network-based resources in a defined subject area. The simplest types of subject gateways are sets of Web pages containing lists of links to resources. The resources accessible through these gateways are reviewed, selected, evaluated and catalogued by information professionals or subject experts.

What is a search engine?

A search engine is a searchable database which collects information on web pages from the Internet, and indexes the information and then stores the result in a huge database where it can be quickly searched. The search engine then provides an interface to search the database.

Examples : Google, Alta Vista, Exite

A Search engine has **three** parts.

- **Spider:** Deploys a robot program called a spider or robot designed to track down web pages. It follows the links these pages contain, and add information to search engines' database. Example: **Google robot** (Google's robot program)
- **Index:** Database containing a copy of each Web page gathered by the spider.
- **Search engine software :** Technology that enables users to query the index and that returns results in a schematic order.

How does a search engine work?

Types of search engines

In broad sense, search engines can be divided into two categories.

1 Individual search engines

An individual search engine uses a spider to collect its information regarding websites for own searchable index. There are two types of individual search engines.

i General search engines

Examples: Google, AltaVista, HotBot, Lycos

ii Subject specific search engines

Examples: MetaPhys, Chritech, ReligionExplorer, Chordie, ChemFinder

2 Meta search engines

A Meta search engine searches multiple individual engines simultaneously. It does not have its own index, but uses the indexes collected by the spiders of other search engines.

Example: metacrawler, Ixquick, mamma

Advantages of using search engines

Search engines are best at finding unique keywords, phrases, quotes, and information buried in the full-text of web pages since they normally index WWW documents word by word. Search engines allow the user to enter keywords, and then they are searched against its database. Users can use advanced search techniques such as phrase searching, truncation/wildcard searching, as well as for Boolean operators (AND, OR, NOT combinations). With comparison to web directories, search engines are huge databases and contain a large amount of materials. Also, the database is updated at a variable rate.

Download content

Downloading content from internet has become a commonplace activity for all internet users – in the home, in business and in schools. All internet users download content from time to time – typically programs, games, pictures, music, video and documents. Downloading content can be troublesome. Downloads can fail. Downloads can take excessive time. Downloads can be password-protected. Some content cannot be downloaded using your web browser. A download manager is a utility designed to fix all the problems you may be having downloading content from the internet. They have quickly become a must-have utility for all internet users. Download managers can accelerate your downloads, allow you to resume broken downloads and contain numerous features that allow to you get hard-to-get files from the internet.

Key terms

URL

A URL (or Uniform Resource Locator) is the location of a resource on the internet. The format of a URL includes the protocol (e.g. http://, https://, ftp://, mms://, etc.), the domain name (or IP address), and additional path information (or folder & file name). A URL may address a web page file, a program file, an image file, a CGI file, or any other type of file, folder or program. Download managers use URLs to find the location of files, web sites and FTP sites that you want to download. You input URLs when download content from the internet.

Examples of URLs are:

- http://www.conceiva.com/downloads/downloadstudio2200.exe
- ftp://ftp.microsoft.com/pub/msoffice.zip
- http://www.google.com
- http://www.itunes.com/hiphop/newtrack.mp3

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Servers, Domains and Groups

A server name represents a single web server. For example, "www.conceiva.com" and "www.google.com" are examples of server names. Even "google.com" counts as a different server name since it is not the same as "www.google.com" – even though if you visit "http://www.google.com" and "http://google.com" in your web browser you may see the same content. A domain name is the most general part of a server name. For example, "conceiva.com", "google.com" and "zdnet.co.uk" are examples of domain names. When downloading files, if you set the download job to span across Domains, it will download files from any servers that share the same domain name. For example, "www.conceiva.com", "images.conceiva.com" and "downloads.conceiva.com" all belong to the same domain "conceiva.com".

A group name refers to any number of servers that share the same name regardless of the country-specific part of the name. For example, "www.conceiva.net", "ftp.conceiva.org.au" and "images.conceiva.co.jp" would all be part of the same group, because they all contain the word "conceiva" directly before the country specific part of the name.

Using the URL "http://www.conceiva.com/images/logo.gif" as an example:

- "www.conceiva.com/images" is the folder name
- "www.conceiva.com" is the server name
- "conceiva.com" is the domain name
- "conceiva" is the group name

MIME Type

MIME (Multipurpose Internet Mail Extensions) types are a standard for defining the types of files attached to standard internet mail messages and on web servers. The MIME standard is used by software applications such as download managers to communicate with web servers to determine what type of file is being transferred. The MIME type of a file can be a more accurate method of determining the type of a file rather than using the file extension of a file to guess the type of file on a web site.

Examples:

- HTML files have a MIME type of "text/html"
- JPEG files have a MIME type of "image/jpeg"

RSS feed

RSS feeds have become a popular way for web sites to inform you about its latest news or its latest content. RSS stands for Really Simple Syndication and is an XML based file that contains information and links about content from a web site. Popular RSS feeds are latest headlines from news web sites, latest music titles from music sites, latest company news from business web sites, latest topics from blogs, and more.

Podcast

Pod casts are RSS feeds that contain information and links to audio and video files. They have become very a popular way to get your favorite music, due mainly to the popularity of portable media players such as Apple's iPod.

Streaming media

Streaming audio and video is used to view movies and listen to music from the internet. Media players such as Windows Media Player and Real One Player can connect to streaming media servers and play streaming audio and video. Streaming media servers send audio and video as small packets of data to your media player on your computer. Once played, the packets of data are discarded – so there is no way for you to save the file using your web browser or media player.

Important: Notice about copyright ownership

Download managers, including Download Studio, are designed to assist you to download files from the internet. If you do not own the copyright to these files or do not have permission to copy these files from the copyright owner, you may be violating copyright law and be subject to payment of damages and other remedies. If you are uncertain of your rights, contact your legal advisor. All examples of downloading that are contained in this White Paper are for illustration purposes only. These URLs (or web site addresses) may or may not exist. The use of the example URLs does not imply that you have consent to download content from them.

Various types of content to download

The internet has many different types of files and content that you may be interested in downloading. Some popular examples of content are

Programs

Programs are executable files that usually are downloaded and installed onto your computer. Programs can be large files that take significant bandwidth and time to download.

Images & pictures

Images are located all over the internet on web sites and ftp sites. They are probably the most popular content downloaded by internet users. The popular image file formats are JPEG, GIF and PNG. Images are typically small files (< 100 kilobytes) so that they can be displayed quickly in web browsers. Images can be small thumbnails or larger-sized images. Typically, internet users want to download the larger-sized images.

Movies & video

Video content has become very popular for internet users who have broadband connections. Video content is either streamed onto your computer from a streaming media server into your media player, or it is a file that can be downloaded and then played in your media player. Video content is typically very large in size and can take significant bandwidth and time to download. Video content that is streamed into your media player cannot be downloaded in the traditional file based manner using your web browser or media player.

Music, audio & pod casts

With the popularity of portable media players, audio has become a very popular download for internet users. Audio is either streamed onto your computer from a streaming media server into your media player, or it is a file that can be downloaded and then played in your media player.

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Pod casts have become a very popular way to subscribe to music and video you are interested in. Pod casts are specialized RSS feed (XML-based) files on the internet that describe and link to a collection of audio or video files. Audio content is typically medium-to-large in size. Audio that is streamed directly into your media player cannot be downloaded in the traditional file-based manner using your web browser or media player.

Web sites

Some internet users often wish to download a complete web site (or certain pages of a web site) so that they can view it later at their convenience. This is called offline browsing. All files for a web site are downloaded and saved onto your computer so that you can view the web site locally on your computer in your web browser. Web site content typically contains many small files.

Flash

Macromedia Flash (.SWF) content is used widely on web sites to enhance sites with a more dynamic presentation. Flash content can be diverse in nature – ads, games, movies, complete web sites and more. Flash content is displayed in your web browser using an additional component (e.g. ActiveX control). The use of these additional components can make downloading flash content onto your computer difficult. Typically, flash content is small-to-medium in size.

RSS feeds

Really Simple Syndication (RSS) feeds are now being used widely on web sites to provide up-to-the-minute news and information about topics of interest on a web site. RSS feeds are XML based files that describe topics of interest and contain links for internet users to gain more information. Typically, RSS feeds are viewed in RSS readers that are capable of presenting the RSS feed in a well formatted manner. RSS feeds are typically small files that are updated regularly.

Games and game files

Games are executable files that are usually downloaded and installed onto your computer. Games files are typically extensions or additions to existing games that you have already installed onto your computer. Games are typically large files that take significant bandwidth and time to download.

Compressed files

Compressed files are collections of files that have been compressed to make them smaller to download. Internet users require a program installed on their computer to de-compress the files once downloaded. Popular formats for compressing files are ZIP, TAR and RAR. Typically, compressed files are very large in size and can take significant bandwidth and time to download.

Documents

Document files are often available for download on the internet. Popular document formats are Acrobat PDF files, Word DOC files, EXCEL XLS files and PowerPoint PPT files. Document files can be large in size, requiring significant bandwidth and time to download.

Data files

An increasing number of businesses download data files from the internet on a daily basis – often as a regular scheduled backup of their online data or to simply get the latest up-to-date data for their business. Data files can be any type of file and can be large in size, requiring significant bandwidth and time to download.

Various protocols used on the internet

Along with different types of content on the internet, there are several standard protocols that are used to access files and content. The popular internet protocols are:

- **http://.** The hypertext transfer protocol is used to access and view web sites and is the most widely-used protocol by internet users. Any type of file may be accessed using this protocol. Example: http://www.example.com/folder/file.zip.
- **https://.** The secure hypertext transfer protocol is used to access and view web sites. Any type of file may be accessed using this protocol. Example: https://www.example.com/folder/file.zip.
- **ftp://.** The file transfer protocol is one of the oldest protocols still in use today and is used to upload and download to servers. Example:

ftp://ftp.example.com/folder/file.zip.

- **mms://.** The multi-media server protocol is used to connect to Windows media streaming servers so that Windows media streaming audio and video can be played. Valid file types are .WMA, .WMV, .WAX, .WVX, .ASF and .ASX. Example:

mms://www.example.com/folder/file.wmv.

- **rtsp://.** The real-time streaming protocol is used to connect to streaming servers so that streaming audio and video can be played. Valid file types include Real Audio/Video (.RA, .RM), Windows Media (.WMA, .WMV, .WAX, .WVX, .ASF, .ASX) and QuickTime (.QT, .MOV). Example: rtsp://www.example.com/folder/file.rm.

Email

Most people will be familiar with the term email (electronic mail) in this day and age. It basically covers all messages sent over the Internet, normally between computer users, but also is now used with other internet-connected devices such as mobile phones. Email messages can be just text based or can also contain graphical or other multimedia information. One common misconception with email is that messages will always arrive immediately or at least very quickly (within minutes). Whilst this is often the case, any email relies on many computers and networks to be working, therefore emails are at risk of delays at any stage. However, sending messages within one system (such as the SHU First Class email service) should be immediate. To send email messages all you need to know is a valid address of the recipient - see addressing below. Messages can either be like formal letters or increasingly they are much more “conversational” where

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the emotions of the writer are expressed as emoticons (also called "smilies").

Internal and External Email Addresses

To send an email to someone else, you need to know their email address. Users can have internal and external email addresses.

Internal Email Addresses

Internal email addresses are listed in the directory of the email system you are using. At Sheffield Hallam University this is on First Class which is the email system used by all students. Staff use another system, Exchange, but are also listed in the First Class directory. All you need to know when you are searching for someone in the internal directory is usually their real name and the faculty they belong to. Using the directory to find the internal address of users depends a little on whether you are using the First Class client or the web interface. You can normally find the name you want by just typing part of the first and last names of a particular user.

Example: Open a New Message in First Class

Typing in: **Vir Woo** into the To: field will match to a fictitious student user called "Virginia Woolf". If you are using First-Class client software you will need to press **Enter** to complete the name; if you are logging into your mailbox using the web interface via the Portal you will need to click on the **Add** button.

External Email Addresses

External email addresses are required for sending or receiving email outside the university. An external email address is also often known as an Internet email address. External email addresses have a very specific format - please see the example below. When using them you must type them exactly as specified. And if you quote your address for others to use it must be exactly right. External email addresses are made up of two parts separated by an @ (pronounced "at") sign: - the first part is the email name - the second part is the Internet address of an Internet "post box". The post box address is the address of a central server within the organization in which the mailbox is located which handles all email before relaying on to personal mailboxes.

Example: Below is the external email address of our example student Virginia Woolf at Sheffield Hallam University.

virginia.woolf@student.shu.ac.uk is Internet email name and student postbox address. This address would be pronounced as:

" **virginia** dot **woolf** at **student** dot **S H U** dot **A C** dot **U K** ".

You can try sending test messages to Virginia Woolf to try out the different address formats.

Other Email Features

Other features you will commonly find when using email:

Cc: This stands for "carbon copy" or "courtesy copy" and is the field where you can put extra addresses in to send to other mailboxes if not the main recipient.

Bcc: Like c:, but the mailbox address entered in this field is not visible to the main recipient of the mail.

Attachment: Any file being sent along with the main message; eg a Word file, a picture etc.

SPAM: Any unwanted and often malicious unsolicited emails. At SHU we try and detect these and mark them appropriately so that they can be deleted by the user without needing to open them.

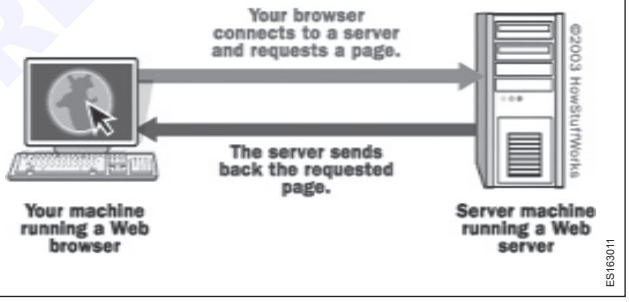
How E-mail Works

A Simple E-mail Server

Given that you have an e-mail client on your machine, you are ready to send and receive e-mail. All that you need is an **e-mail server** for the client to connect to. Let's imagine what the simplest possible e-mail server would look like in order to get a basic understanding of the process shown in Fig 2. Then we will look at the real thing.

If you've read How Web Servers Work, then you know that machines on the Internet can run software applications that act as **servers**. There are Web servers, FTP servers, telnet servers and e-mail servers running on millions of machines on the Internet right now. These applications run all the time on the server machine and they listen to specific **ports**, waiting for people or programs to attach to the port. The simplest possible e-mail server would work something like this:

Fig 2



1 It would have a list of e-mail accounts, with one account for each person who can receive e-mail on the server. My account name might be **mbrain**, John Smith's might be **jsmith**, and so on.

2 It would have a text file for each account in the list. So, the server would have a text file in its directory named MBRAIN.TXT, another named JSMITH.TXT, and so on.

3 If someone wanted to send me a message, the person would compose a text message ("Marshall, Can we have lunch Monday? John") in an e-mail client, and indicate that the message should go to mbrain. When the person presses the Send button, the e-mail client would connect to the e-mail server and pass to the server the name of the recipient (mbrain), the name of the sender (jsmith) and the body of the message.

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4 The server would format those pieces of information and append them to the bottom of the MBRAIN.TXT file. The entry in the file might look like this:

From: jsmith

To: mbrain

Marshall,

Can we have lunch Monday?

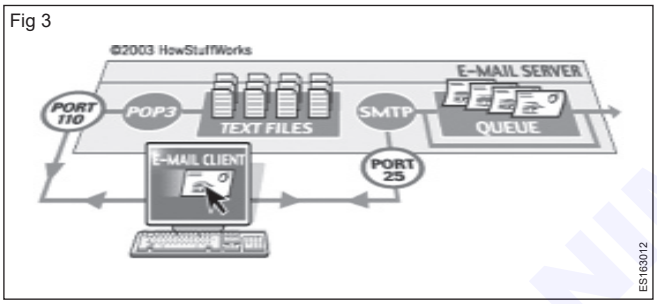
John

There are several other pieces of information that the server might save into the file, like the time and date of receipt and a subject line; but overall, you can see that this is an extremely simple process.

The SMTP Server

Whenever you send a piece of e-mail, your e-mail client interacts with the SMTP (Simple Mail Transfer Protocol) server to handle the sending. The SMTP server on your host may have conversations with other SMTP servers to deliver the e-mail shown in Fig 3.

Fig 3



Let's assume that you want to send a piece of e-mail. your e-mail ID is brain, and you have account on howstuffworks.com. You want to send e-mail to jsmith@mindspring.com. You are using a stand-alone e-mail client like Outlook Express.

When you set up account at howstuffworks, Outlook Express the name of the mail server — mail.howstuffworks.com. When you compose a message and press the Send button, here's what happens:

1 Outlook Express connects to the SMTP server at mail.howstuffworks.com using port 25.

2 Outlook Express has a conversation with the SMTP server, telling the SMTP server the address of the sender and the address of the recipient, as well as the body of the message.

3 The SMTP server takes the "to" address (jsmith@mindspring.com) and breaks it into two parts: the recipient name (jsmith) and the domain name (mindspring.com). If the "to" address had been another user at howstuffworks.com, the SMTP server would simply hand the message to the POP3 server for howstuffworks.com (using a little program called the **delivery agent**). Since the recipient is at another domain, SMTP needs to communicate with that domain.

4. The SMTP server has a conversation with a **Domain Name Server**, or **DNS** ,It says, "Can you give me the IP address of the SMTP server for mindspring.com?" The DNS replies with the one or more IP addresses for the SMTP server(s) that Mindspring operates.

5 The SMTP server at howstuffworks.com connects with the SMTP server at Mindspring using port 25. It has the same simple text conversation that my e-mail client had with the SMTP server for HowStuffWorks, and gives the message to the Mindspring server. The Mindspring server recognizes that the domain name for jsmith is at Mindspring, so it hands the message to Mindspring's POP3 server, which puts the message in jsmith's mailbox.

If, for some reason, the SMTP server at HowStuffWorks cannot connect with the SMTP server at Mindspring, then the message goes into a queue. The SMTP server on most machines uses a program called **sendmail** to do the actual sending, so this queue is called the **sendmail queue**. Sendmail will periodically try to resend the messages in its queue. For example, it might retry every 15 minutes. After four hours, it will usually send you a piece of mail that tells you there is some sort of problem. After five days, most sendmail configurations give up and return the mail to you undelivered.

The SMTP server understands very simple text commands like HELO, MAIL, RCPT and DATA. The most common commands are:

- **HELO** - introduce yourself
- **EHLO** - introduce yourself and request extended mode
- **MAIL FROM:** - specify the sender
- **RCPT TO:** - specify the recipient
- **DATA** - specify the body of the message (To, From and Subject should be the first three lines.)
- **RSET** - reset
- **QUIT** - quit the session
- **HELP** - get help on commands
- **VRFY** - verify an address
- **EXPN** - expand an address
- **VERB** - verbose

More Complex Servers

As other people sent mail to mbrain, the server would simply append those messages to the bottom of the file in the order that they arrived. The text file would accumulate a series of five or 10 messages, When I wanted to look at my e-mail, my e-mail client would connect to the server machine. In the simplest possible system, it would:

1 Ask the server to send a copy of the MBRAIN.TXT file

2 Ask the server to erase and reset the MBRAIN.TXT file

3 Save the MBRAIN.TXT file on my local machine

4 Parse the file into the separate messages (using the word "From:" as the separator)

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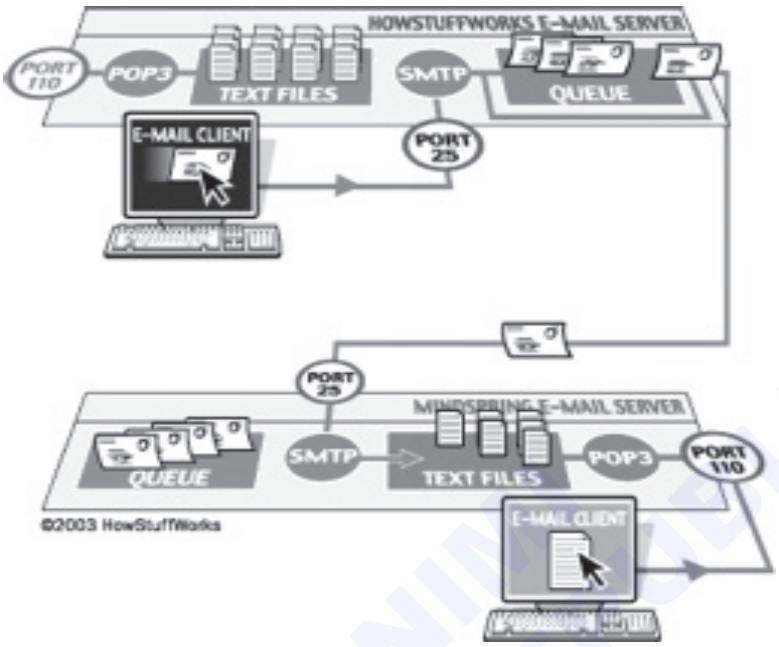
5 Show me all of the message headers in a list

When you double-clicked on a message header, it would find that message in the text file and show me its body.

As you can see, this is a very simple system. Surprisingly, the real e-mail system that you use every day isn't much more complicated than this.

The Real E-mail System For the vast majority of people right now, the real e-mail system consists of two different servers running on a server machine. One is called the **SMTP server**, where SMTP stands for Simple Mail Transfer Protocol. The SMTP server handles outgoing mail. The other is either a **POP3 server** or an **IMAP server**, both of which handle incoming mail. POP stands for Post Office Protocol, and IMAP stands for Internet Mail Access Protocol. A typical e-mail server looks like Fig 4.

Fig 4



Verbal Communication

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

- **describe verbal communication**
- **explain about oral and written communication**
- **explain about the use of right words in verbal communication**
- **explain the process to send an e-mail communication and communicate through phone**
- **state about SMS and content writing**
- **explain about public speaking and useful strategies to overcome nervousness and discomfort.**

Verbal Communication

Unlike non-verbal communication, verbal communication needs commonly accepted meanings for sounds to be understood by others. In order to communicate it needs a person who not only knows the language but also the cultural context, underlying relationships between the people involved in communication and other relevant details. Verbal communication could either be oral or written. Not all verbal communication is planned and systematized. Animals and birds too use verbal communication, but they have their own language of sounds, grunts, barks, chirps etc., each having its own meaning.

We can also further divide communication as formal and informal communication. A meaning of a sentence changes depending on the context. If a sentence spoken in an informal set up means one thing, would probably mean something else in a formal context.

Oral and Written communication

Oral communication is the transfer of information from sender to receiver using words and at times visual aids. Examples of oral communication include discussions, speeches, presentations and face to face interaction. For effective oral communication, we need to have clarity, brevity(using few words) and precision in our communication.

Benefits of oral communication:

- It is quick and direct method
- Feedback is immediate, be it praise or criticism

One problem with this communication is that it cannot be used for documentary evidence.

Written Communication

Any form of communication that is written and documented from the sender to the receiver is known as written communication. Examples of written communications

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are letter, memos, academic research paper, reports, newspaper etc.

Written communication has the advantage of providing records, references and legal evidences. It should have clarity, correctness and logical continuity. In this communication ,we will not get immediate feedback.

It has its own limitations as it does not have additional help from body language and tone of voice.

Choosing the Right Words in verbal communication

"Good words are worth much and cost little" by George Halic Herbert

In order to communicate our message to our listeners, we need to choose the right words that clearly express out thoughts. Very often, in both informal conversation and public speaking, we make statements that are not very clear. For example:

- Unclear: Let's go to a place where they sell those things we need for the office.
- Clear: Let's go to the bookstore that sells books and school supplies.

1 We should use simple words and phrases rather than the complex or difficult ones.

Simple Words	Difficult Words
dislike	abhor
increase	abound

2 We should use precise words that expresses our thought and feeling accurately. Avoid using vague words. It confuses the listener and does not clearly expresses our intended meaning.

Vague: We had a bad meeting yesterday.
Precise: We had a disorganized meeting yesterday.

3 We should use specific words - these identify items within a category while general words refer to an entire category. Specific words help our listeners to form a picture in their minds of the exact images we want them to see.

General Word: The purchasing officer bought a lot of THINGS at the bookstore.

Specific Word: The purchasing officer bought pencils, brown envelopes, white board pens, and bond paper at the bookstore.

4. Avoid repeated use of 'filler' and 'favourite' words in your conversation Some people have an habit of using them all the time. They add nothing to the conversation, are completely unnecessary and can be very distracting and annoying.

Filler words are words like 'you know', 'sort of'

Favourite words are words like 'obviously', 'actually', 'basically'

5. Avoid using jargons, acronyms, abbreviation. Jargon is familiar to the people who are in the same group and not outsider.

For example:

BTW →By the way

FAQ →Frequently asked questions

ASAP→As soon as possible

HTH →Hope this helps.

Email

Electronic mail or email is called an important means of communication in the modern world. Using e-mail one can have a message delivered within minutes to anyone in any part of the world. The only condition is that both the sender and the receiver should have an Internet account or at least access to an internet account.

With e-mail one can

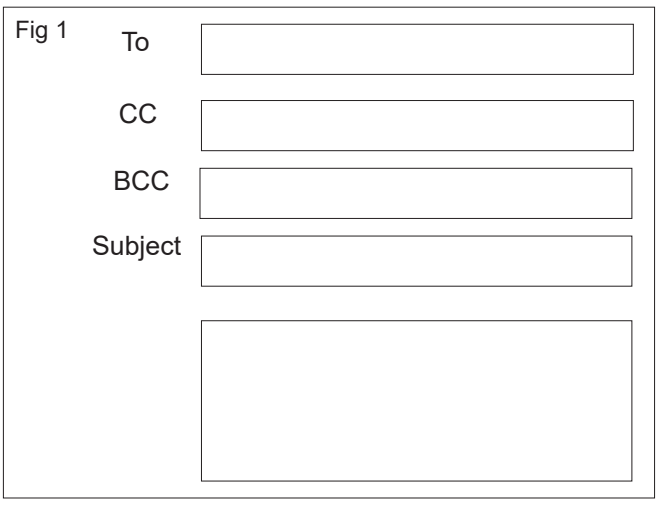
- Send messages to individuals.
- Send messages to groups.
- Send formatted files such as word documents and spreadsheets as attachments.
- Send photos, music, videos, or any other kind of files as attachment.

One can also use the email for advanced communication purposes like subscribing to electronic newsletters or magazines, or writing and sending articles to electronic newsletters or magazines, participating in electronic discussion groups etc. Many organizations prefer to use the email for official communication because it can save both time and money.

Before one uses the email it is important to know how email is different from a written letter. Email as we know is typed or keyed into a computer by the sender unlike a letter which is written. Email is received and read online by the receiver. This itself gives email one of its important features. Because the email is seen on the screen, it is preferable not to have a very long message. Formal emails are usually kept short and easy for the receiver to read.

Email messages have their own format just like a letter (Fig 1). The following is a sample picture of an email screen.

Fig 1



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In the column "To" you must key in the receiver's email id. (eg. name@gmail.com / name@hotmail.com etc.) The column titled "Subject" should express the subject of the message in four or five words. (eg. Request for leave / Work completion report etc). If you want someone other than the email receiver to get a copy of the email just to be informed then you key in that person's email id in the CC column. If you wish to send the email to someone else without the receiver's knowledge then you key in that person's id in the BCC column. The body of the message is typed into the blank space for the message. If you need to send a file as attachment you can click on "Attach a file" and select a file to attach. Once the file is attached then you can click on Send and the message will be sent.

Email etiquette

Just like any other form of communication email too has its own rules and codes of behavior. This is called email etiquette. Some of the following tips can help you use the email more effectively.

- Before you send a message, make sure that it is what you wish to send. Don't be in a hurry to click on the "send" button. Don't send anything you don't want to send.
- Keep emails short. Many people don't like to scroll down the screen to read a very long email.
- Use the correct words in the subject line. Many people decide not to open the email if the subject is not clear.
- Don't forward false messages.
- Use a current antivirus software. Don't send mail that may have virus.
- If you are forwarding a message say why you think it will interest the receiver.
- Reply to email if you have received one. Even if the mail does not need a reply, make sure the sender is informed that you have received his email.
- Don't use all caps or all small letters in email.
- Don't paste attachments in the body of the mail. Some files should be sent only as attachment.

Activity

You are sending an email to your friend in Delhi that you are coming to Delhi for a job interview and you will be reaching there at 10.00 pm on 26th of June. You are also requesting your friend to come and pick you up at the railway station and accommodate you in his house for one day. Your friend's email id is ganesh@yahoo.com. Now fill in the email details in the following columns. Leave out whatever is not applicable to your message. Also compose the actual email message in the space provided.

SMS

Another common form of communication is the SMS. SMS stands for short message service. Other names of SMS are texting, sending text messages or text messaging. Short messages can be sent from one cell phone to another cell phone or from the Web to another cell phone. Including spaces, text messages traditionally can't exceed 160 characters.

SMS is a unique form of communication. It was originally considered informal. But now it has become an accepted form of official communication. SMS is also unique because it has given rise to the creation of a new SMS language which is full of short forms.

Column A	Column B
Msg	Tonight
ASAP	Are you there?
2moro	Message
Gr8	By the way
Abt	As soon as possible
u	Great
2nite	Tomorrow
BTW	For your information
FYI	About
R u de	You

Activity

Can you match the sms forms in column A with their long forms in column B.

Because of the necessity to stick to the size limit of the SMS, most people even in the official context use the short forms in their messages. The SMS has become a very popular means of communication because it is short, easy to use and inexpensive.

Content of writing

It is seen that the content of writing is becoming briefer and briefer and the emphasis is on conveying the message and leaving out every word that does not contribute to the message. Therefore you must pay attention to developing or writing the content without wasting words. An easy way to do this is to give your message to a friend or a partner and check whether they are able to understand what you are trying to say. If they do then your written message is clear. Otherwise you will need to change it.

Fluency in reading and writing

Driver cum mechanic should know English and local language for reading and writing skill to communicate the information to others. Communication is a process of transferring information from one entity to another. The information can be writing as a report to send it to higher official. Fluency in writing should be easily helps to understand the message being conveyed. To ensure a text is fluent the writer should use phrases or expressions that are natural to a native speaker. Fluency makes your report easy to read.

Need of fluency reading a any language writings

Fluency is a ability to read a text with accuracy, automatically and prosody (Expression) sufficient to enable comprehension. Fluency is a key skill to becoming a strong reader because it provides a bridge between word recognition and comprehension.

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Fluency is important for several reasons. First fluent reading comprehension . Because fluent readers do not have to concentrate on decoding words, they can focus their attention on what the text means. They can make connections between the ideas in the text and their background knowledge.

Reading fluency also affects a driver cum mechanic's motivation to read. Drivers do not enjoy activities may contribute even further to a decline in the reading skills. Fluent reading is a product of strong decoding and strong language comprehension. Less fluent readers however must focus their attention on figuring out the words, leaving them little attention for understanding the text.

Report Writing : A report writing is a notification account that presents the facts about a particular event, topic or issue. The idea is that people who are unfamiliar with the subject can find everything they need to know from a paper report. Reports make it easy to catch someone up to speed on a subject, but actually writing a report is anything but easy. A report is written by an expert on any subject or someone assigned to investigate it. The following information is shared in reports.

- Report subject or topic
- Introduction on report
- Details of event or situation
- The consequences of an event
- Evolution of statistical data or analysis
- Interpretations from the information in the report
- Recommendations based on the information provided in the report.

The reports should be closely related easy writing and understanding. If need use the tables of contents of the reports. This make it easier for readers to scan reports for the information they are looking for essays.

Types of reports: There are few different types of reports depending on the purpose.

Common types of reports

1 Academic report
2 Business report
3 Scientific report
4 Vehicle reports
5 Driver's duty report.
6 Vehicle accident report.
7 Vehicle repair report.

Report writing method

Follow the steps on report writing below to take you from an idea to a completed report paper.

- Conduct event research
- Choose a topic based on the assignment
- Write a driver's statement
- Prepare the statement outline
- Write a rough draft
- Revise and edit your report
- Proof read and check for mistakes of report

The driver cum mechanic should be practiced to write a report on vehicle loads / freight/ fares/kmpl

- write a report on vehicle loads and vehicle trips on a particular day
- Write a report on how much fare collected from the customer
- Write a report to vehicle owner about fuel consumption kilometer per liter of fuel
- Write a report on any accident occurred with your vehicle.

Mathematical calculation: How much load is loaded on the vehicle can calculated and measure the total load of the vehicle through the vehicle weighing machine. Calculate the distance between starting point to delivery point, calculate the fare per kilometer

Calculate the total distance covered and total fuel consumed and calculate the fuel consumed per kilometer.

Management of personal expenses

Driver should be learn to handle the money according your stock money in your hand. Whatever money is with your hand, you can distribute the amount depend upon your need per day/month/year for your expense.

Need to cultivate habit of savings for future needs Every humans income is not standard in his/her whole life. So that every human need to save the money for their future needs. In our country different type of savings schemes are available from the nationalized banks, post office, stock market, LIC, Investment on land, building mutual funds, fixed deposit, savings account, term deposit, recurring deposit, private chit funds etc.

Knowledge on various general and personal insurance: In our country various types of insurance is provided by insurance company which is controlled by IRDA India. There are many types of insurance covered by the insurance company. They are as follows

Personal insurance company

The main purpose of insurance company is to offer financial freedom support and protection to the family of the concerned personal in case of accident or death in such an event life insurance policies ensure that such a thing does not happen by providing financial assistance to affected family in the event of your passing.

Types of life insurance.

There are primarily seven different types of insurance policies, when it comes to life insurance. They are

- Term plan
- Endowment plan
- Unit linked insurance plan

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- Whole life insurance
- Child's plan
- Money back policies
- Retirement plan

Benefits of life insurance: If you posses a lift insurance plan, you can enjoy the following advantages from the policy

- Tax benefits
- Encourages savings habit
- Secures family's financial future
- It helps to plan your retirement

Motor insurance

It refers to policies that offer financial assistance in the event of vehicle met with an accident, The motor insurance can be availed for three categories of motorized vehicle including

1. Two wheeler insurance

2. Commercial Vehicle Insurance

Types of motor insurance policies: It is based on the event extent of cover or protection offered by motor insurance policies are three types namely

Third party liability

This is most basic type of motor insurance cover in India. It is minimum mandatory requirement for all motorist vehicle owners as per the motor vehicle act of 1988. This insurance policies plans only pay the financial liability to the third party affected in the said mishap ensuring that you don't face legal hassle due to the accident. However the insurance company do not offer pay any financial assistance to repair the policy holders vehicle after accidents.

Comprehensive cover: Compared to the third party liability option comprehensive insurance plans offer better practice and security. Apart from covering third party liabilities, these plans also cover the expenses insured for repairing damages to the policy holder. Own vehicle due to an accident.

Additionally comprehensive plans also offer a payment, in case your vehicle sustains damage due to fire, manmade and natural calamities, riots and other such instances. Last you can recover your vehicle cost if gets stolen when you have a comprehensive cover in places you can also opt for several add on with their comprehensive motor insurance policy that can make or better rounded.

Own damage cover: This is a specialized form of motor insurance Companies offer to consumers, if you purchase the new vehicle after September 2018. If you already have third party liability motor insurance policy in place, with own damage cover, you basically receive the same benefits on a comprehensive policy without the third party liability portion of the policy.

Benefits of motor insurance policies

- Prevents legal hassle
- Meets all third party liability
- Financial assistance to repair your own vehicle
- Vehicle theft/ loss cover.

Health insurance

It refers to a type of general insurance, which provides financial assistance to policy holders, when they are admitted to hospital for treatment. Additionally some plans also cover the cost of treatment undertaken at home, prior to a hospitalization or after discharge from the same.

Types of health insurance policies: There are eight main types of health insurance policies issued by the various insurance companies.

- Individual health insurance
- Family floater insurance
- Critical illness cover
- Senior citizen health insurance
- Group health insurance
- Maternity health insurance
- Personal accident insurance
- Preventive health care plan.

Benefit of health insurance

- Medical cover
- Cashless claim
- Tax benefits

Travel insurance: It is a policy that ensures the financial safety of a traveler during a trip. Travel insurance is a short term cover depending on the provider you choose, travel insurance policy may offer financial aid at various times such as during loss of baggage trip cancellation and much more.

- Domestic travel insurance
- International travel insurance
- Home holiday insurance

This type of insurance is covered the flight delay baggage loss or delay, reclaim lost travel documents, Trip cancellation cover

Property insurance

Any type of property insurance you can insured as a property insurance. You can claim financial assistance from the insurance you can claim financial assistance from the insurance provider.

Types of property insurance

- Home insurance
- Shop insurance

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- Office insurance
- Building insurance

Benefits of property insurance

- Protection against fires
- Burglaries
- Floods
- National calamities

Mobile insurance: It allows you to retain money that you opened on repairing your phone in the event of accidental damage you can also claim the sum, in case of phone theft, making it easier to replace the hand set with new phone.

Benefits of mobile insurance

- Comprehensive protection for new device
- Coverage against damage to screen
- Theft or robbery of smart phone

Cycle insurance

Cycle insurance policy provide financial assistance regardless of where your bicycle under goes damage.Even if we meet with a cycling accident in a different country such a plan will offer aid and cover protection against fire and riots and accidental death benefits.

Bite - size insurance: These insurance plans allow you to protect your finances against specific damages.

Saving schemes of Nationalized bank and post office

Every human need money for run their day to day life. Some times they are sicked and unable to go for work and earn money. So that they are suffering for money need. To avoid this situation ,He/She should save the part of money from his earning. This saving amount will be help for his/her family's emergency need and their retirement life entertinement.The government of india offers a wide range of saving schemes to fulfil the various needs of citizens across different sections of society

There are two types of saving systems are available in Nationalized bank and Post office one is national saving certificate (NSC) and national saving scheme.There are many types of saving scheme are available with bank and post office they are as follows

- Savings account
- Term deposit
- National pention scheme
- Public provident fund
- Capital gains A/c scheme
- Gold savings scheme
- Senior citizens savings
- Sukanya samidhi account
- RBI bonds
- Mutual funds
- Pradhan Mantri Jan dhan Yojana.
- Recurring deposit account.

The above saving schemes are designed to encourage the people to savings by making small deposits with banks or public financial institution branches savings scheme in India. Even public equity also a one type of saving scheme, but it is used for share holders.

The above various type of saving schems provide interest.The interest rates on these schemes are revised quarterly, half yearly and yearly. The interest rates, investment amount and tax treatments are vary according to the Indian government and reserve bank of India.

Note : Saving schemes are safe instruments that will be helpful to meet long term financial goals.

The saving schemes helps a person from unexpected personal and medical emergencies. Savings amount also support in meeting personal aspiration such as pursuing the additional education course, children higher education and marriage. The saving scheme also additional income souce by interest earning. The habit of participation in regular savings will give financial discipline to a person.

Post office saving scheme: Post office savings scheme also same as Nationalized bank saving scheme the following savings account systems are available in post office.

- Post office savings accounts.
- National savings recurring deposit account.
- National savings term deposit account.
- National savings monthly income accounts.
- Senior citizens savings account.
- Public provident fund account.
- Sukanya Sammiddhi account.
- National savings certificate.
- Kisan Vikas patra.
- Mahila Samman savings certificate.
- P.M cares for children schemes 2021and many more saving account system.

The deposit schemes may be vary time to time.

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