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SCHOOL OF MECHANICAL ENGINEERING

DEPARTMENT OF AUTOMOBILE ENGINEERING

SAU1307 VEHICLE MAINTENANCE AND RECONDITIONING

UNIT I MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS

UNIT I

MAINTENANCE, WORKSHOP PRACTICES SAFETY AND TOOLS

IMPORTANCE OF MAINTENANCE

Maintenance is the routine repairing work, required to keep the vehicle in good condition so that it can be Utilized for designed capacity and efficiency.

Repair is the restoration of the vehicle to a condition substantially equal to its original condition by changing Parts (or) by reconditioning it.

Objectives of maintenance system

* To keep the vehicle available for protective work for maximum period.

* To extract optimum life for the vehicle.

* To get maximum utilization of vehicle at minimum cost.

PREVENTIVE (SCHEDULED) AND BREAK DOWN (UNSCHEDULED) MAINTENANCE

Scheduled maintenance system:-

In this system, servicing of the vehicle is done at pre determined time interval, in order to avoid breakdown of the vehicle

Un Scheduled maintenance:-

In this system, servicing or repairing work is done only after the vehicle breakdown.

Advantages of scheduled maintenance:-

It reduces cost of operation It renders work scheduling easy. It reduces starting problem. Control of store inventory easy

LAYOUT OF AN AUTOMOBILE REPAIR, SERVICE AND MAINTENA NCE SHOP.

SERVICE STATION:

A service is a place where in addition to care of the motor vehicle like mechanical service and minor repairs, petrol is supplied, cars are lubricated, and cleaned, washed and other types pf simpler services that are required daily are performed. In general it includes a number of sections like garage general services, mechanical service, major repair shop, tyre shop, paint shop, body shop etc.

A service station is addition to the equipment available is garage is usually run in conjunction with a sales agency for a particular type of motor vehicle to provide comprehensive repair service for that particular vehicle.

The equipment available, in general garage will be added with specialized equipment like lifting tackle, and different types of jigs, fixtures and tools specially designed for checking, adjusting and repair of particular type and make of vehicle. A service station may consist of a machine shop having a lathe, drilling machine etc.

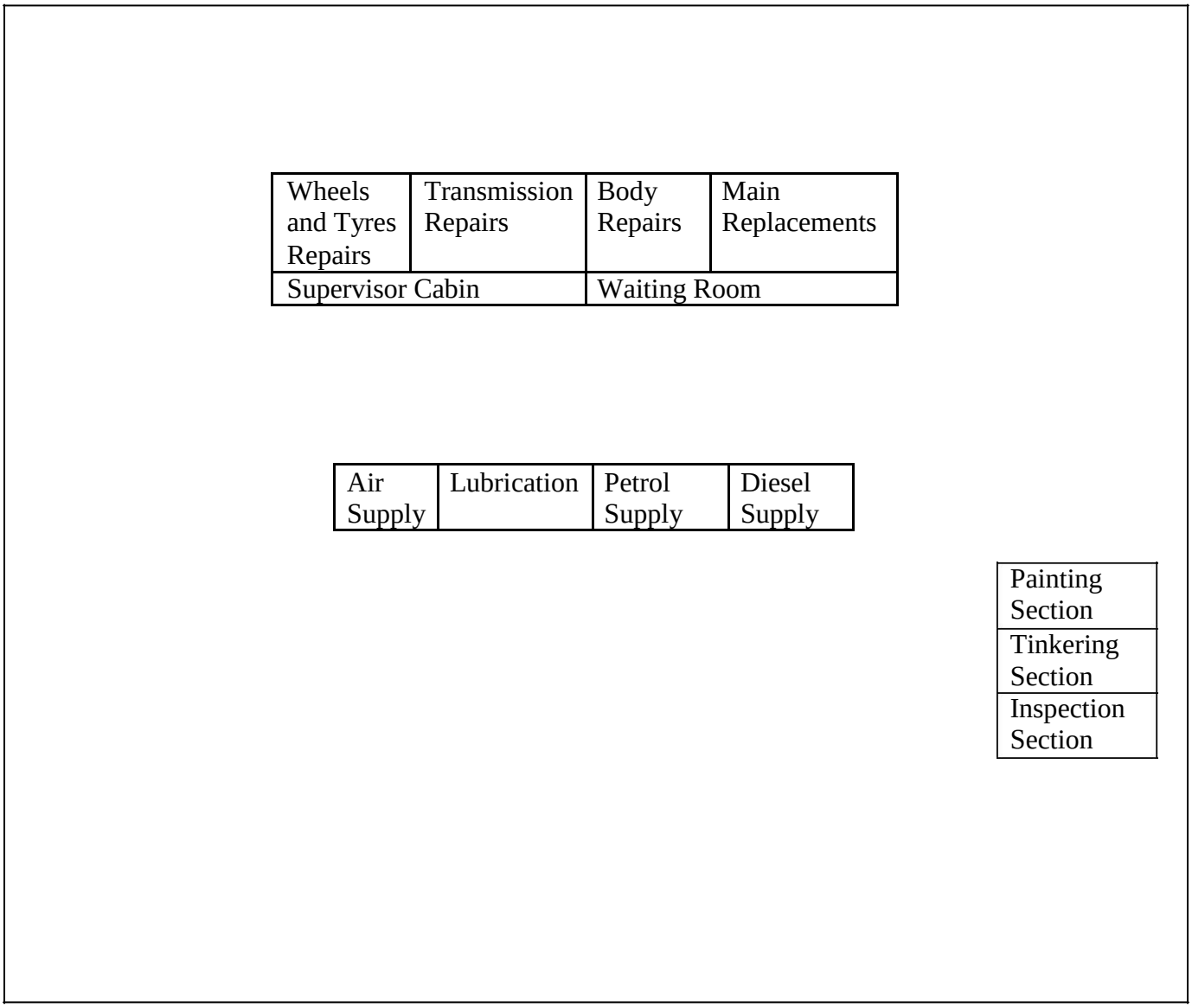
In case of big service station special types of machines like crankshaft grinding machine, valve refacer, surface grinder, reboring and boring machine, brake drum lathe also will be used. In service station fuel filling and water servicing facilities are available. It has a small workshop to provide repair for

particular make of vehicle. It may have sales agency for a particular type of vehicle. All the equipment in the garage plus small workshop tools: viz, lathe, drilling machine, jigs, fixtures are available.

LAYOUT OF GARAGES AND SERVICE STATION :

The internal layout of a garage should be such as to make it water proof, clean and spacious to provide sufficient space for small workbenches to storage and repair benches. Following considerations should be made in the layout of garage and service stations:

- To provide light to the workbenches, openings the windows should be provided at the proper place.
- To keep the floor cleanable, it should be a smooth concrete floor with a surface-scaling compound.
- The doors are provided as many members as required for easy flow of men and materials.
- The electrical control should be accessible to the operators.
- To form a neat storage for hanging tools, hooks or screw eyes should be provided on the pegboards.
- To provide a deposit of waste material.



Repair :
Engine oil changed at :
Gear box overhauled at :

Maintenance Checklist:-

1. Check the oil level in the sump
2. Check the replacement of engine oil period
3. Check the oil level in the fuel injection pump
4. Check the steering gear box.
5. Check the condition of the rubber sleeve on cylinder head cover.
6. Check the belt tension of the cooling fan.
7. Check and adjust clutch free pedal play.
8. Check the wheel alignment parameters.
9. Check the level of battery electrolyte level.
10. Check all the lighting system.
11. Check the sock observers.
12. Check the brake shoe pins and holes.
13. Check the tyre inflation pressure.
14. Check the level of fluid in fluid coupling.
15. Check all the instruments working in dashboard.

GENERAL LUBRICATION SERVICE

It is recommended that general lubrication service is rendered at an in revel of 5000km.

1. Fuel injection pump.
2. Gear box
3. Steering gear box.
4. Front and rear wheel bearing.
5. Steering linkage.
6. Lubricants used – Engine oil, Transmission oil, General grease, Bearing grease.

Periodic Maintenance Check Sheet

Dealer: Place: Date of Sale: SERVICE TYPE			Ro No: Mileage: Kms:			Ro Date: Engine No. Fraame No:		
Mileage(Kms)	10000	30000	50000	70000	90000	110000	130000	150000
Service type								
Mileage(Kms)	170000	190000	210000	230000	250000	270000	290000	310000
Service type								
Mileage(Kms)	330000	350000	370000	390000	410000	430000	450000	470000
Service type								
Mileage(Kms)	490000	510000	530000	550000	570000	590000	610000	630000
Service type								

S. No	CHECK ITEM	CHECK	STATUS	REMARKS
1	BASIC ENGINE COMPONENETS Engine Oil Engine oil filter	 R R		
2	IGNITION SYSTEM Battery	 T		
3	FUEL AND EMISSION CONTROL Pre-filter Water sediment filter	 R CA		

	Air cleaner filter	C		
4	CHASSIS AND BODY			
	Brake pedal, Parking brake	CA		
	Brake pads and discs	CA		
	Brake linings and Brake drums	CA		
	Brake line pipes and hoses	CR		
	Brake fluid	R		
	Clutch	CA		
	Power steering fluid	CR		
	Ball Joints and dust covers	CR		
	Tyres and inflation pressures	CA		
	Lights, horns, wipers	CA		
	Steering wheel linkage and gear box oil	CA		
	Front and rear suspension	CA		
	Tightening of bolts and nuts	T		
5	AC / Cooler Refrigerant	NA		
C → Clean; R → Replace; CA → Check& Adjust; CR → Check & Replace; T → Tighten				
ADDITIONAL JOB:				
MILEAGE	1.50,000	4,50,000		
TIMING BELT	Replace	Replace		
Name of the Inspector		Signature		

Periodic maintenance check sheet

The periodic maintenance check sheet is used to record the inspection status made during the maintenance check operation. It contains various details such as the dealer name, place, date of sale, manufacturers name, mileage, frame number, chassis number etc. the mileage and service type are indicated in the various cells of the check sheet. The check sheet also contains the check item name, status and remarks.

The check items include the following:

- Basic engine components.
- Engine oil
- Engine oil filter
- Ignition system
- Battery
- Fuel and Emission Control
- Pre- Filter
- Water sediment filter
- Air cleaner filter
- Chassis and Body
- Brake pedal, parking brake
- Brake pads and discs
- Brake linings & brake drums
- Clutch
- Power steering fluid
- Ball joints and dust covers
- Tyres and inflation pressures
- Lights, horns, wipers
- Steering wheel linkage & gear box oil etc.

The status and remarks for all the items mentioned above are indicated on the check sheet during the maintenance operation.

Vehicle Reg No: Job No :
Chassis No : Date :

Test Report / Inspections Forms

S.No	Parameter to check	Before work	After work
1	Front side abnormal noise		
2	Rear side abnormal noise		
3	Front/rear suspension noise		
4	Steering noise		
5	Brake caliper noise		
6	Misfiring / starting		
7	Hunting problems / Stopping problems		
8	Underbody noise		
9	Abnormal noise from doors / glasses and body		
10	Overheating of engine on AC and Non AC operation		
11	Brakes poor / Weak line effective / noisy		
12	Wheel bearings noisy		
13	Drive shaft noise / vibration		
14	Vehicle pulling to one side		
15	Poor pick up of vehicle (with AAAC and without AC)		

Table 2.3 TRIP SHEET

<table>
<tr><td colspan="2">Name and Address of the Agency</td><td colspan="3">REPORT TO
Mr. / Mrs. ----------

----------</td></tr>
<tr><td colspan="5">Engaged by Arranged by ---------- No. ---------- Date: ----------
Vehicle Number ----------
Driver Name ----------</td></tr>
<tr><td>Closing Time----------
Starting Time----------
TOTAL Time

Signature of the Customer</td><td>Hire Charges
Charge Per km
Driver Batta
Excess Hours
Excess Kms
Service Tax
Permit Charges</td><td>Rupees</td><td>Paise</td><td></td></tr>
<tr><td colspan="2">Advance Rs. ----------

Driver‟s Signature</td><td colspan="3">TOTAL

For Agency</td></tr>
</table>

ROAD TEST REPORT:

1. The road test inspector or the machine makes the road test report after the completion of the maintenance operation.
2. This report contains the vehicle reg number, chassis number, job no, date of test etc.
3. The parameters to be checked include the following:
   - Front side and rear side abnormal noise.
   - Steering and brake caliper noise.
   - Ilunting, misfiring, sudden stoppage of vehicle.
   - Brake condition.
   - Wheel and bearing check.
   - Pick up of the vehicle.
   - Mileage of the vehicle etc.

The road test report gives a fare idea of the condition of the vehicle before and after the maintenance operation.

TRIP SHEET :

The trip sheet gives the entire details of the vehicle be fore and after a trip. The starting km and ending km, time of start and closing of the journey time and the charges per km and also the overall cost of trip is described in the trip sheet.

LOGBOOK :

The logbook of a vehicle gives the details of the vehicle, which will be useful not only for the owner of the vehicle but also to the mechanic who might take the job of vehicle maintenance latter.

The logbook contains the following details:

- Distance covered
- Fuel consumption
- Average fuel consumption
- Best and worst mileage
- Total maintenance cost
- Running costs
- Faults in the vehicle
- Likes and dislikes

DATE OF THE PREVIOUS MAINTENANCE REPORT

Vehicle Log Book

vehicle reg..... gas ..... Diesel..... Miles ..... Kms.....

week beginning..... vehicle Name.....

	Start millage	Finish millage	How may journey?	Daily total	signature
MONDAY					
TUESDAY					
WEDNESDAY					
THURSDAY					
FRIDAY					

SATURDAY					
SUNDAY					
			Weekly total		

Gas/Diesel and engine oil

	Odo reading	Fuel in liters	Product (gas or diesel or oil)	Cost of fuel
MONDAY				
TUESDAY				
WEDNESDAY				
THURSDAY				
FRIDAY				
SATURDAY				
SUNDAY				
	total		total	

Other Maintenance Record Forms

Vehicle service form

Vehicle name ..... vehicle reg.....

Date of service ..... mileage.....

service to be carried out every three months/periodically

Unit	Yes	No	comments
oil			
Air filter			
Distributor cap			
Oil spindle			
Ignition leads			
Check spark plug gap			
Check and adjust fan belt			
Check and adjusting power steering belt			
Check OHC belt			
Check and replace broken bulbs			
Check front brakes			
Check Rear brakes			
Adjust hand brake			
Renew brake fluid			
Check battery water level			
Check and clean battery			
Grease steering			

VEHICLE REPAIR FORM

Vehicle reg..... vehicle mileage.....

Drive ..... date.....

Description of repairs carried
out:.....
.....
.....

Why were repairs necessary?

.....

Total cost of repair.....

Details of person / company who carried out repairs:

Name..... Phone.....

Address.....

Were repairs supervised.....

Quality of repairs.....

poor..... satisfactory..... Good..... Excellent.....

supervisor..... Date.....

VEHICLE ACCIDENT REPORT FORM

Employee ..... Age..... Sex.....

Department..... Supervisor.....

Date of accident.....

Nature of injuries .....

Causes of accident.....

If employee left work.....

If employee returned to work.....

Name & address of physician:

If hospitalized name and address of hospital.....

Actions taken to avoid similar incident.....

Comments.....

DRIVERS INSPECTION REPORT

checks defects only..... Explain under remarks.....

Location/ Department..... Date.....

vehicle description: Year..... Make..... Model.....

Serial NO..... Mileage.....

General condition	Interior	Exterior
cab/door/windows	gauges / warning indicators	lights
body /doors	windshield wiper	Reflectors
oil leak	horn	suspension
Grease leak	Heater	tires
coolant leak	Mirrors	Wheels / Rims / tubes
Fuel tank	Steering	Battery
oil level	Emergency brakes	spare tire
coolant level	Fire extinguisher	Other coupling

Protection

seat belt.....

Remarks.....

Reporting driver..... Date.....

Reviewing driver..... Date.....

Maintenance action..... Repair made..... No repair.....

Work order/ purchase order no.....

Repaired by.....

SCHEDULED AND UNSCHEDULED MAINTENANCE

Scheduled Maintenance

In this system, servicing of the vehicle is done at pre-determined time interval, in order to avoid breakdown of the vehicle, this type of maintenance is also called as preventive, periodic and operative maintenance

- Maintenance scheduled for car
- Wash and lubricate chassis, do not spray under chassis
- Drain drum, gear box and axle, flush and refill with proper lubricants.
- Check under chassis for evidence of water, oil, brake fluid, shock absorber and petrol leaks
- Tighten engine, steering joints, U bolts and chassis bolts to torque specifications.
- Lubricate rear axle bearing. Tighten rear axle shaft nuts to torque specification.
- Check operation of body hardware, doors, glasses, locks and keys
- Check and fill battery, clean and tighten terminals
- Check operation of all instruments, lights horns and accessories
- Check and adjust fan belt tension
- Check clutch pedal free travel and linkage
- Adjust brakes. Check and adjust pedal free travel.
- Check master cylinder fluids
- Check wheel alignment
- Aim headlights
- Tune engine, including adjustment tappets
- Adjust ignition timing and carburetor
- Clean body rim and tires
- Carry out daily and weekly maintenance

Un scheduled maintenance

In this system, servicing or repairing work is done only after the vehicle brakedown. This type of maintenance is also called as breakdown maintenance.

Placing an emergency vehicle out of service

1. Braking system
    - Air line leak or bulge
    - Loose compreeor mounding bolts
    - Evidence of oil seepage
    - Cracked brake drums

- Inoperative low air warning device
- Master cylinder leakage

2. Steering system
    - Excessive free play
    - Worn or faulty universal joints
    - Steering wheel not properly secured
    - Loose tire rod ends
    - Any conditions that interferes with free movements
3. Exhaust system
    - Exhaust leak forward or below the gas
4. Frame
    - Cracked loose, or broken frame member
5. Fuel system
    - Visible fuel leak
    - Fuel tank not securely attached
6. Spring and suspension
    - Cracked, loose or missing U bolt or other spring to axle clamp
    - Any broken main leaf in the leaf spring
    - Any displaced leaf that could result in contact with tire
    - Broken or missing shocks
    - Missing or broken axle bolts
7. Windshield / Wipers
    - Visuals cracks or distortion that impair or inoperative
    - Both brake lights missing or inoperative
    - Both tail lights missing or inoperative
    - Any turn signal missing or inoperative
    - Inoperative siren
    - Emergency lighting not visible from all sides
8. Drive train
    - Engine overheating
    - Motor oil in engine
    - Engine coolant in motor oil
9. Broken or missing fan belts
    - Coolant leak at water pump
    - Any major coolant leak
    - Automatic transmission overheating
    - Defective clutch components
    - Defective foot throttle
    - Defective charging system
10. Cab / Body components

- Missing or broken mirrors that obstruct or limit the driver view
- Defective door latches

Classification of maintenance

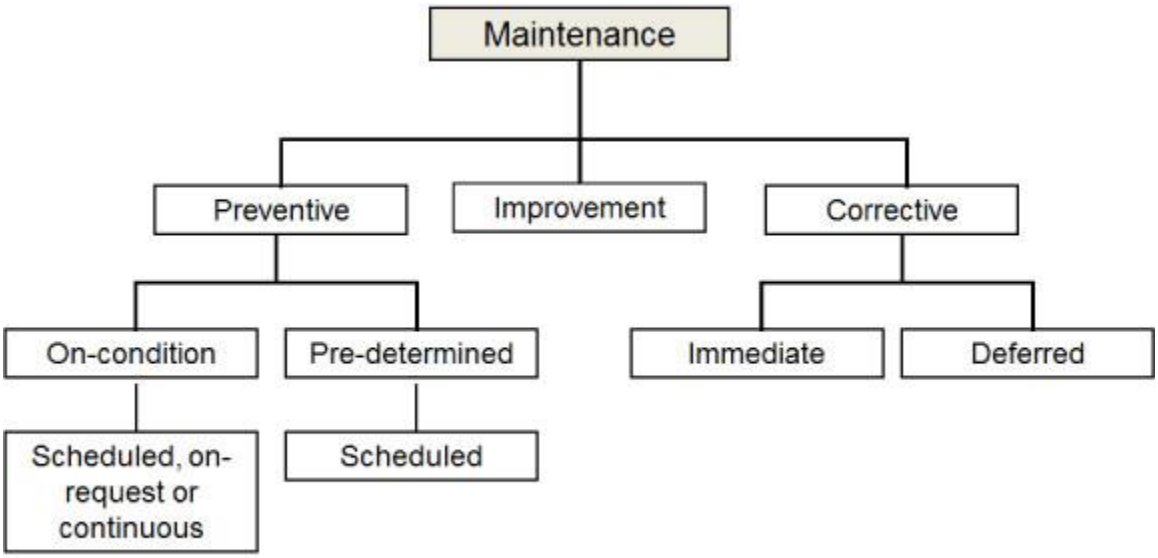


Figure 2: Major maintenance types or tactics (Adapted from BS 13306 [11])

Vehicle insurance.

Vehicle insurance (also known as car insurance, motor insurance or auto insurance) is insurance for cars, trucks, motorcycles, and other road vehicles. Its primary use is to provide financial protection against physical damage or bodily injury resulting from traffic collisions and against liability that could also arise there from. Vehicle insurance may additionally offer financial protection against as theft of the vehicle, and against damage to the vehicle sustained from events other than traffic collisions, such as keying and damage sustained by colliding with stationary objects. The specific terms of vehicle insurance vary with legal regulations in each region.

Automotive service procedure.

- Check Service Log Book for history & other work due
- Check if vehicle is registered, so it can be test driven legally
- Check to see how many KM since last oil change
- If over 7,000km recommend engine flush to Service Adviser
- Test drive vehicle and report
- Carry out Safe T Stop test, dynamically testing steering, suspension and brakes
- Checks for lights, wiper, washer and horn (report)
- Check cooling system hoses (report)
- Check and test brake fluid (report)
- Check air filter and clean if not replaced (report)

- Check radiator condition (report)
- Test coolant / inhibitor condition with test strips (report)
- Connect cooling system pressure tester
- Check power steering fluid level and condition (report)
- Check automatic transmission level and condition (report)
- Visual check over the whole engine bay (report)
- Audible check for anything unusual (report)
- Check accessory belts with testers, check tensioner and tensions (report)
- Test battery, alternator output, print report, attach to job card ü Disconnect pressure tester (report)
- Raise vehicle and drain engine oil ü Perform 65 point check under vehicle (report)
- Check all diff levels, Transfer case levels and Gearbox levels
- Grease all grease nipples, look for blanking plugs where grease nipple need to be fitted (report) Grease steering stops
- Measure brake pad wear, remove wheels if needed (report)
- Drum brakes, remove drums wipe down shoes, check brake wheel cylinders for leaks 'pulling back rubbers' & (report)
- Measure tyre tread depth (report)
- Check flexible brake hoses for cracks (report)
- Check shock absorbers for leaks (report) ü Check oil leaks (report)
- Check all mounts and rubbers (report) ü Remove oil filter if accessible under vehicle and fit new filter Adjust brakes and it wheels
- Check tyre pressures
- Fit sump plug & clean around oil filter area and sump plug area
- Fill engine oil, start engine and recheck ü Wipe down under bonnet
- Fill out new service sticker
- Clean off old service sticker & residue & fit new service sticker
- Lube door strikers
- Wash and chammy vehicle & apply tyre shine
- Test drive ü Park vehicle & give keys to Service adviser to check.

MOTOR VEHICLE WORKSHOP OPERATION

A motor vehicle workshop operation consists of operating a workshop on a commercial basis involving any of the following relating to motor vehicles:

- Maintaining mechanical components, engine cooling radiators or body panels; • Spray painting body panels; or
- Detailing or washing. A motor vehicle workshop for the purposes of this legislation does not include:
- Operating a workshop for the purposes of a farming, gas, mining or petroleum activity
- A fleet vehicle workshop to maintain or repair fewer than 10 vehicles;

- Washing motor vehicles if all the water used is discharged to a sewerage infrastructure under a trade waste approval or the washing is required under a law of the State for weed or pest control;
- Operating a workshop to maintain or repair:- – auto electrical, exhaust, suspension or air conditioning components of motor vehicles; or – wheels or tyres of motor vehicles, including wheel alignments; or – minor scratches, chips or dents using a brush, air brush or paintless method; or – motor vehicle hoses.
- operating a mobile and temporary workshop

SAFETY RULES FOR AUTOMOTIVE MAINTENANCE

- Eye protection is mandatory for all operations which produce sparks, chips, flying objects or involve use of corrosive chemicals. Face shields shall be worn for all operations that involve use of a high-pressure steam system. Appropriate gloves and protective clothing shall also be worn.
- Mechanics shall not wear loose clothing around rotating equipment. Clothes saturated with oil, grease, or solvents shall not be worn.
- Compressed air shall not be used to clean clothing.
- Shop floors will be kept free of grease, oil, gasoline, or other slipping hazards.
- Employees shall not use defective electrical or mechanical shop equipment or hand tools. All automotive shop machinery shall be grounded.
- Vehicles shall not be towed unless appropriate tow bars or other approved equipment is used.
- Jacks, hoists, or other lifting devices shall not be used beyond the safe load capacity recommended by the manufacturer. Employees shall not remain in vehicles being lifted by hydraulic lifts or jacks.
- Mechanics shall not work under vehicles that are not properly supported with approved stands. Makeshift stands made of wood, cement blocks, or boxes shall not be used.
- Gasoline, acetone, kerosene, or similar solvents shall not be used to clean hands, floors, walls, or other surfaces. Parts shall be cleaned only in approved containers using appropriate solvents.
- Employees shall not use standard sanitary sewer drains for the disposal of gasoline, oil, or solvents. Contact EH&S for disposal guidelines.
- Tanks or containers that are used for gasoline or other flammable solvents shall not be mechanically opened or repaired by welding without purging and cleaning.
- Do not begin tire inflation before the rim is properly seated. It is dangerous to attempt adjustment with a hammer when the tire is being inflated.
- Do not place hands or arms between mounted dual tires during inflation. Always use a long air chuck for inflation.

- Do not change tires on the road unless wheel chocks and warning devices are used. Flares should be used to warn others whenever a vehicle tire is changed while on a heavily used road.
- Changing of tires on split-rim wheels will be performed only by individuals with proper training and using only appropriate equipment.

VEHICLE SAFETY EQUIPMENT'S

Service technicians help ensure that each vehicle has the following safety equipment:

- Portable Fire Extinguishers – proper type, size, and rating
- Emergency Reflective Triangles – warning devices for stopped vehicles
- Wheel Chocks – prevent accidental movement of vehicle while parked
- First Aid Kits – to match the maximum capacity of persons per vehicle

The US Department of Transportation and the Federal Motor Carrier Safety Administration (FMCSA), regulate the safety of commercial motor vehicles used on highways for transporting passengers or property.

FMCSA regulation 49 CFR Part 393.95 requires safety equipment on all of the following trucks, truck tractors, and buses:

Vehicles with GVWR, GCWR, or gross vehicle weight over 10,000 lb

Buses for compensation with over 8 persons and non-compensation buses with over 15

Vehicles transporting hazardous material requiring placards

FIRE EXTINGUISHERS

All buses, trucks, and tractors require a portable fire extinguishers for compliance with FMCSA. A 10-B:C unit is required for vehicles with hazardous materials and 5-B:C for all others. An extinguishing agent that doesn't freeze is required, and each unit must be secured in a manner that prevents sliding, rolling, and vertical movement. Most installations include a extinguisher in a vehicle bracket..

EMERGENCY REFLECTIVE TRIANGLES

The FMCSA requires warning devices for stopped vehicles. Although flares are acceptable, the following equipment is most commonly carried on each vehicle, as a minimum, for compliance:

At least 3 bidirectional emergency reflective triangles (P/N TKB1)

WHEEL CHOCKS

Wheel chocks (P/N HDLWC) are typically carried on all commercial motor vehicles to prevent accidental movement while vehicles are parked and during loading and unloading. Chocks are used against the rear tires in the direction of grade. On even surfaces, chocks are placed on both sides of tires. Chocks should always be used in pairs.

FIRST AID KITS

Be sure to check existing first aid kits for proper contents and replace depleted kits after getting the owner's consent. Every commercial motor vehicle should carry a complement of the right safety equipment. Others will appreciate your knowledge of the federal safety requirements and your recommendations for products and equipment that will help ensure the safety of vehicles, passengers, and drivers.

TEXT / REFERENCE BOOKS

1. Ed May, “Automotive Mechanics”, Volume 1 and 2 , McGraw Hill Publications, 2003

2. Vehicle Service Manuals of reputed manufacturers

3. Bosch Automotive Handbook, Sixth Edition,2004

4. John Doke, “Fleet Management”, McGraw Hill Co., 1984

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SAU1307 VEHICLE MAINTENANCE AND RECONDITIONING

UNIT 2 ENGINE AND ENGINE SUBSYSTEM MAINTENANCE

UNIT – II

ENGINE AND ENGINE SUBSYSTEM MAINTENANCE

TOOLS AND SPECIAL INSTRUMENTS REQUIRED:

1. Double spanner
2. Ball-peen hammer
3. Pliers
4. Feeler gauge
5. Hydrometer
6. Battery charger
7. Files
8. Socket Spanner
9. Cell tester
10. Wrenches
11. Screwdriver
12. Dial indicator
13. Piston ring expander
14. Piston ring compressor
15. Valve spring compressor
16. Puller

DESCRIPTION :

Double end spanner

These are the most commonly used types of spanner. The opening should be the right size to fit the nut or bolt. If the spanner opening is too large it could round off the corners of the hex. This makes the use of the proper spanner more difficult. These spanners are available in different size ranging from 6 to 32 mm.

Hammers

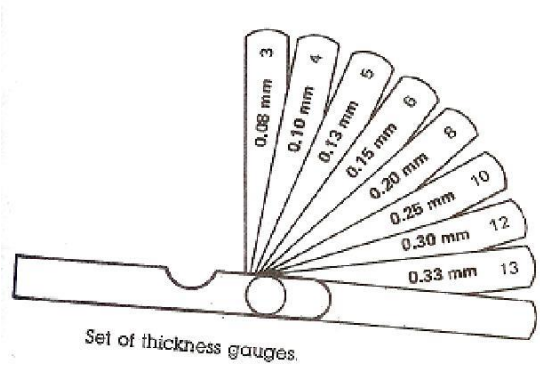
The ball-peen hammer should be gripped on the end of the handle. When you swing the hammer the face should strike the object squarely, and not at an angle. Rawhide, plastic-tip, brass and rubber hammers are used to strike easily marred surfaces.

Pliers

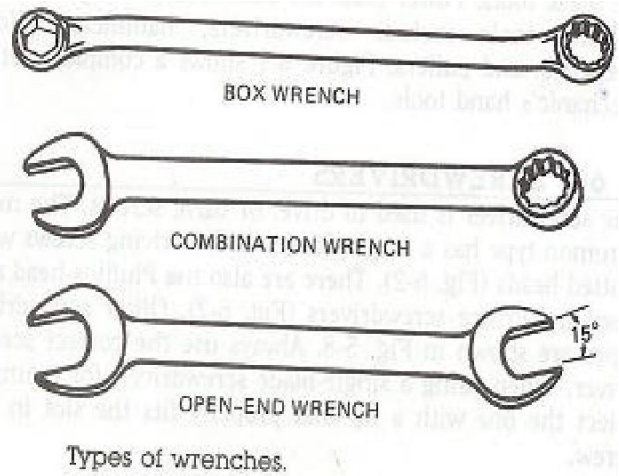
Pliers are special types of adjustable wrench. The two legs move on a pivot so that item of various sizes can be gripped. There are two basic types, gripping pliers and cutting pliers.

Feeler gauge

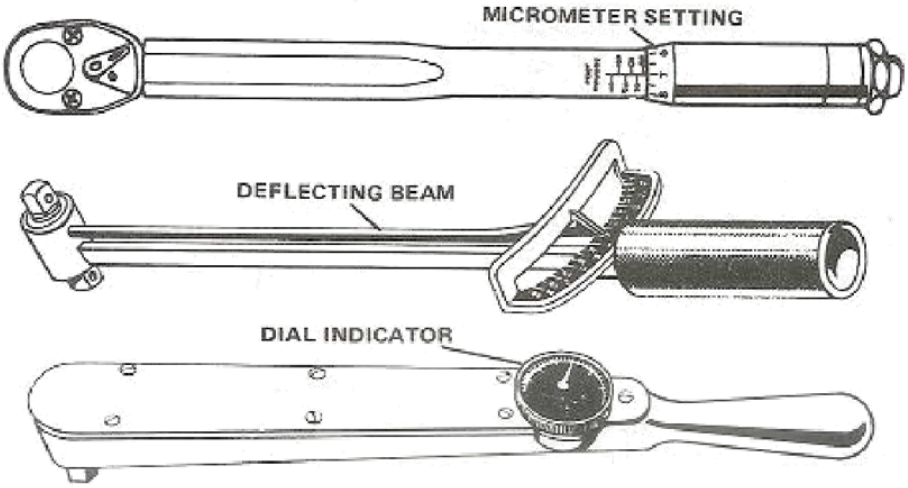
Thickness gauges or "feeler" gauges are strips or blades of metal of various thicknesses. Many thickness gauges are dual-dimensioned. For example, the 3 and 0.08mm on the first blade means it is 0.003 inch (or 0.08mm) thick. Some thickness gauges are stepped. The tip is thinner than the rest of the blade. Thickness gauges are used to measure small distance such as the clearance



Set of thickness gauges.



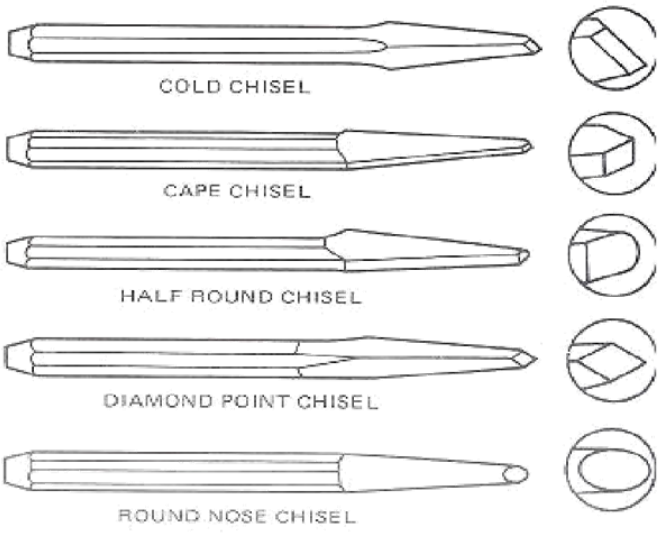
Types of wrenches.



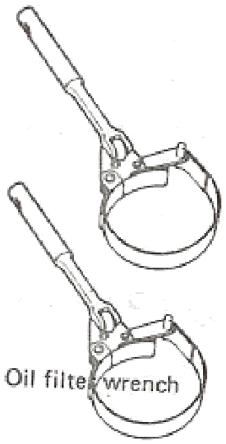
Torque wrenches.

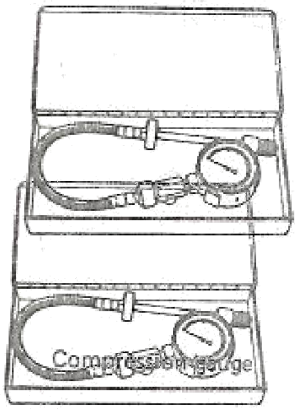
Snap ring plier (closing type)

END-CUTTING (NIPPERS)

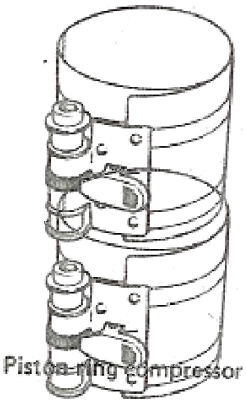


Various types of chisels

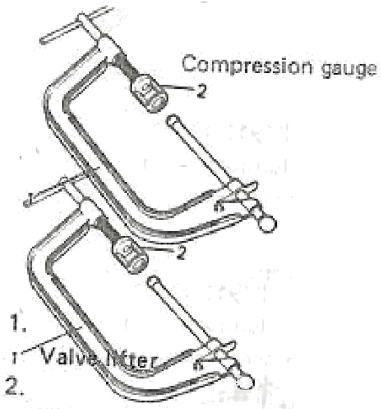




Oil filter wrench



Piston ring compressor



Valve lifter attachment

1. Valve lifter
2. Valve lifter attachment

between two parts. It is used to check the clearance between the rocker arm and valve stem in an engine.

Hydrometer

The float-type hydrometer has a float with a stem that sticks up above the electrolyte level in the tube. The float stem is marked to indicate the specific gravity of the electrolyte. The height of the stem above the electrolyte indicates the battery state of the charge. It varies from a high 1,280 in a fully charged (good condition) battery to a low 1.125 in a completely discharged (bad condition) battery.

Socket spanners

These types of spanners are useful in restricted spaces where common types of spanners cannot be used. They consist of sockets of different sizes, which can be used with various types of handles. The handle has projections at one end around which the sockets fit.

Wrenches

The wrenches are used to fit nut or bolt. The combination wrench has a box on one end and

an open end on the other.

Screwdrivers

It is used to drive, or turn screws. The most common type has a single flat blade for driving screws with slotted heads.

Dial indicator

It is a guage that uses a dial face and a needle to register measurements. It can be us ed to measure the endplay in shafts or gears. Also, it can be used to measure taper in engine cylinders.

Pullers

Pullers are used to remove the wheels, gears and bearing from shafts or to remove shafts from housings.

Torque wrench

It is a specialized form of socket spanners. Important nuts and bolts in automobile work have to be tightened with a specified amount of torque, because excessive torque may result in their breakage while less torque, they will remain loose. This is made possible by torque wrench.

Piston ring expander

It is generally used to expand and remove the piston rings from their grooves without breaking it.

Piston ring compressor

Piston ring compressors are places around the piston covering the rings. As the compressor is tightened, it compresses the piston rings into their grooves on the piston. Then the piston and rod assembly is installed into the cylinder.

Valve spring compressor

Valve spring compressor or lifters are used to compress the valve spring to facilitate the removal of the valve retain lock or keeper from the valve stem

ASSEMBLY OF ENGINE FROM VEHICLE – REPAIR AND OVERHAULING

PETROL ENGINE TUNE-UP :

Ridge in cylinder liner:

The wear starts in the linear from the height of ring travel i.e., on top of liner; there is practically no wear. Since this portion does not come in contact with the rings. In worn out engine you can feel this area by your finger running up and down in the liner. In case with worn out liner when rings have to be changed to check up this ridge, in case it is prominent it should be cut with ridge cutter. Then only new set of rings can be placed, otherwise there are chances of new rings being thicker in width then the used worn out rings may strike the ridge and break. Secondly, the piston assembly can easily slide in Boring and honing of cylinder liners.

The cylinder bores do wear out after some use. The amount of wear can be controlled to some extent by cleaning the air cleaner, keeping watch on proper working of cooling system and lubrica tion system, in spite of all this care after 40 to 50 thousand kms in diesel engine and in petrol engine 60 to 70 thousand kms wear is predominant in the liner which you can see when you dismantle the engine for overhauling. From the worn out cylinder bores few more life can be taken by boring the same with boring machine. When using the

boring machine, the boring tool will leave very fine line on the bore, which cannot be seen by naked eyes. Presence of these lines of honing is not desirable. To rub these lines, bores are honed, i.e., polished with the help of honing stone fixed in the cylinder hone head. These hones are driven with portable electric hand drill and while working quickly up and down motion are given.

Maintenance of flywheel:

Flywheel does not require much maintenance except that is mounting bolts with crankshaft should be tightened with proper torque, the face where the clutch plate is fixed sometimes gets scored because of loose rivals or rivets touching the face when lining is worn out. Under such circumstances the face of flywheel should be got skimmed. The face of flywheel should be examined at each overhaul and while changing clutch plates this face should be rubbed with emery paper to remove the glaze. The flywheel after fitting should be checked that it is running true. For checking run out, place the crankshaft with the flywheel mounted on V-block to avoid scoring of crankshaft main journal place paper in the V of V block. Fix up dial gauge. With its point resting on clutch plate mating surface, remove the crankshaft and note the run out. It should not be more than 0.2 mm.

VALVE SERVICING:

The valve is subjected to very high temperature, runs at high speed and is one of the critical parts which requires careful examination at the time of overhaul while inspecting the valve, take care of the following points:

Head:

Check the head for crack, burning, valve seat and radial run out. It should not have knife edge warped and should have good margin. For checking radial runs out place the valve in V block, fix up the pointer of dial guage on edge of valve head. Revolve the valve and note the reading if run out is more than 0.33 mm. Discord the valve.

Valve system :

Valve system should be straight without scoring. If it is slightly bent it can be straightened, but in case it is bent too much, valve should be replaced.

Refacing of valve:

Valve after dismantling from the head should be examined, if there is a good margin still left over, it can be refaced and reused. It is desirable to mark each valve as it is removed from the guide so that it may be put back to its original position. This may save quite a lot of time in adjusting tappet clearance when the engine is reassembled. Moreover, fitting valve back to its own-guide will ensure proper working clearance. For refacing valve, refacing machine is used. It has a grinding wheel and a revolving chuck to hold the valve. The post on which revolving chuck is fixed is movable, angle of which can be set and locked in any specific angle.

Before starting grinding, check up that valve head is running true and valve head is not protruding out much from the chuck. Otherwise it will not give desired finish, then start the coolant supply directing it jet on grinding stone, bring the valve closer to the regular hammering action, the tip of the valve also gets damaged, provision is also made in the valve-refacing machine to reface

GASOLINE ENGINE TUNE UP :

Battery

- Clean the battery terminals
- Check the loose connections.
- Check the battery for fixing in box or cradle.
- Check up electrolyte level in the battery.
- Check up the capacity of battery.

Charging System

- Visually inspect the dynamo for any wear
- Check up for any loose connections
- Check the belt from which dynamo gets power
- Check the charging rate.

Starting System

- Visually inspect the self-starter, cable and switch
- Check the working switch for any loose connections
- Check the consumption of current by starter motor.

Ignition System

- Check the cable connections from distributor to spark plugs
- Check the distributor shaft bushes for any looseness
- Check the contact breaker point
- Check the wear on distributor cam.
- Check the wear in distributor cap
- Check the ignition system with oscilloscope

Fuel System

- Visually inspect for any leak
- Clean the air cleaner
- Check the functioning of choke
- Check the fuel pump pressure
- Check the plunger assembly

Carburettor

- Check the fuel line from fuel pump to float chamber
- Check the butterfly of the carburetor
- Adjust the height of the float
- Adjust the jet needle and needle jet
- After assembling, adjust the idle and high-speed adjustments

Lubrication System

- Check the level of lubrication oil in the crankcase
- Check the lubrication oil filter, if clogged replace it with new one
- If the oil is bad, remove the oil and introduce new oil of the correct grade

Cooling System

- Check the radiator for any damage and blocks
- Check the hoses that connect radiator and engine
- Check for any leakage
- Check the fan belt
- Use clean water in the radiation

Transmission Line

- Visually inspect the transmission line for damages, cracks etc.

- Check the propeller shaft
- Check the differential assembly
- Check the state of lubrication oil in the differential assembly

DIESEL ENGINE TUNE UP

Fuel Injection Pump

- Visually inspect the flow lines from tank to pump and to injector
- Check the injection pressure
- Check for any wear and tear in the fuel injection pump
- Check the entire components of the fuel pump

Fuel Injector

- Check the injector nozzle for any block and clean it thoroughly
- Check the pressure at which the nozzle sprays the fuel droplets
- Adjust the screw for correct pressure

Heater Plug

- Check the heater plug by connecting it with battery terminal
- Check the heater plug for any dirt deposition
- Replace it after cleaning ii thoroughly

Also check the air induction system, fuel feed system and other important components have to be checked for performing the tune up operations.

ELECTRICAL IGNITION SYSTEM

The function of ignition system is to produce a spark in the engine cylinder towards the end of the compression stroke. In 4-S engine a spark should occur in each cylinder after two revolutions of the crankshaft whereas in a 2-S engine a spark in each cylinder is required every revolution of the crankshaft.

- Spark at the plug electrodes must be regularly timed with respect to the cylinder piston position at all speeds and loads.
- The spark should be sufficiently strong so as to start ignition of the charge.
- It should be light and compact
- The system must be easy to maintain
- It should not cause radio interference.

GASOLINE FUEL SYSTEM

The basic fuel supply system in an automobile with petrol engine consists of a fuel tank, fuel lines, fuel pump, fuel filters, air cleaners, carburetor, inlet manifold, and supply and return lines.

Fuel tank

It is made of steel or aluminum alloy steel. The tank is usually coated on the inside with a lead-tin alloy to protect against corrosion. It is placed in the vehicle at any suitable location. The fuel tank is divided into compartments by means of baffle plates to reduce surging of fuel during sudden braking or acceleration.

Fuel pump

The fuel pump is used to deliver the fuel at the correct of pressure to the carburetor.

Fuel filters

Fuel filters are usually used to filter the fuel before it e nters the fuel pump. It may be a plastic or ceramic fuel filter.

Air cleaners

The air cleaners are usually used to remove the dust particles that enter into the combustion chamber. It is connected to the intake manifold

TROUBLE SHOOTING OF GASOLINE FUEL SYSTEM

S.No	Troubles	Causes	Remedies
1.	High fuel consumption	Air cleaner may be choked Fuel may be leaking Wrong idle adjustment	Clean Inspect the plug and the leak Adjust
2	Difficult starting	Carburetor jet may be clogged Fuel filter clogged Fuel pump pressure not constant	Service carburetor Clean the filter Check the pressure and rectify the defect
3.	Poor acceleration	Fuel line clogged Fuel filter clogged	Check the fuel line Clean the filter
4.	Lack of power	Incorrect carburetor setting Faulty inlet manifold	Adjust Replace

TROUBLE SHOOTING OF DIESEL FUEL IGNITION SYSTEM

S.No	Troubles	Causes	Remedies
1.	Engine cranks normally but will not start	Incorrect or dirty fuel No fuel to nozzle or injection pump Plugged fuel return	Flush system use correct fuel Check for fuel to nozzles
2.	Rough idle with abnormal noise and smoke	Injection pump timing off Nozzle trouble	Check return, clean Retime Check in sequence
3	Idle correct, but misfires as throttle opens	Plugged fuel filter Injection-pump timing off Incorrect or dirty fuel	Replace filter Retime Flush system-use correct fuel
4	Combustion noise with excessive black smoke	Timing off Injection-pump trouble Nozzle sticking open Internal engine problems	Reset Replace the pump Clean or replace

DIESEL FUEL SYSTEM :

Fuel supply system in a diesel engine has to perform certain functions. These functions along with the names of the components, which perform the same, are given.

Filtering

Water and dirt must be removed from diesel for which two filters are employed. Primary filter is usually in the form of coarse wire gauge. It prevents large solid particles and water. The secondary filter is used after the fuel feed pump and is meant to remove fine particles of dust, dirt, etc.

Delivery of fuel to injection pump

From the fuel tank the fuel is delivered to the fuel injection pump by means of fuel feed pump. The rate of fuel delivery depends upon the engine requirements.

Controlling the speed:

Diesel engine speeds tend to overshoot to dangerous values on reduction of load. This is controlled by means of a governor, which besides limiting the maximum speed, also regulate the fuel supply under all conditions

CLEANING METHODS

A layer of oil, grease and dirt gets coated to motor vehicle and its parts with passage of time and usage. Before performing servicing of the vehicle the unwanted layer should remove. This can be done by hand cleaning or by means of certain cleaning methods, hand cleaning which seems to be quite cheap and easy is actually most expansive process.

The cleaner equipment selected the method application used greatly influence the speed, thoroughness and economy of the cleaning operation. Most commonly used methods of cleaning operation. **Most commonly used methods of automobiles and its parts are steam cleaning, water pressure cleaning, solution cleaning and vapour bath cleaning**. To clean engine dirt, grease etc, spray method with compressed air used , for this purpose a kerosene spray under pressure is sprayed on engine.

For cleaning engine exhaust system. Take them apart and soak them kerosene oil overnight. A pack of kerosene soaked waste attached to along wire may be drawn through it cleaning the pipe and manifold.

Visual inspections

- After dismantling all the parts are inspect them carefully and replace the defective parts.
- All parts should be clean with kerosene and dry them with the compressed air.
- They cylinder walls may be inspected for scoring. The cylinder may require reboring or rehoning if scores are present
- To inspect piston for scores, remove the ring without braking them.
- Inspect the piston ring for damage or wear. If these are defective replace them.
- Inspect the conncting rod small end bearings. If these are scored or pitted. Service with rebbitting.
- Check the valve face and seat. If any part is defective service the valve face with the help of valve seat for correct seating of valves.

Minor and major tune up

Tune up includes testing the various components and necessary systems involved in engine operation. It also includes readjusting or replacing parts as required restoring engine performance. Therefore to retain peak performance and reliability. An engine tune up should be carried out every 12000 km or at the end of each 500 hours of off the road use.

RECONDITION METHODS OF ENGINE COMPONENTS

Degreasing plant

A layer of oil, grease and dirt gets coated to the engine parts with passage of time and usage, befor performing servicing of the engine, the unwanted layer should be removed. This can be done by hand cleaning or by means of certain cleaning methods.
The parts being brushed or scrubbed with stiff bristle brush to get rid of hard deposits. For the larger components is usual in small workshop to use a hot caustic soda bath or steam bath. The caustic soda should not be used for aluminum alloy since it has a masked chemical action paraffin or steam bath is recommended instead

Decarbonizing

Carbon is deposited in cylinder due to rich mixture supply, use of wrong grade oil, unnecessary idling, too much oil, unnecessary idling, too much oil, poor filled piston and piston rings.
There are in general three methods of decarbonizing or decoding

1. Scrapping method
2. Oxygen decarbonizing method
3. Chemical method of decarbonizing
4. Scrapping method

This is done usually by hand scraping with help of tools. To remove the carbon from the piston, separate the piston from the cylinder, now the carbon removing brushes may be fixed in the chuck of an electric portable drill, to clean valve guider. Valve stems etc, special wire brushers may also use.

Oxygen Decarbonizing Method

It is the process of removing carbon the inside of the cylinder and head of the piston without removing cylinder head by means of oxygen flame. The equipment consists of an oxygen tank fitted at an initial pressure of 156 kg/ cm^2 and an adjustable reducing valve for bring the pressure down to 0.7 to 1,4 kg / m^2

Chemical Method Of Decarbonizing

In this method decarbonizing is done by injecting a special chemical in liquid from to that cylinder head through spark plug hole. The engine should be in a warm condition so that the liquid can act more efficiently after keeping the engine stopped for 12 hours the carbon deposits will be loosened, while starting up the engine deposits will be out through exhaust pipe.

Reconditioning Of Cylinder

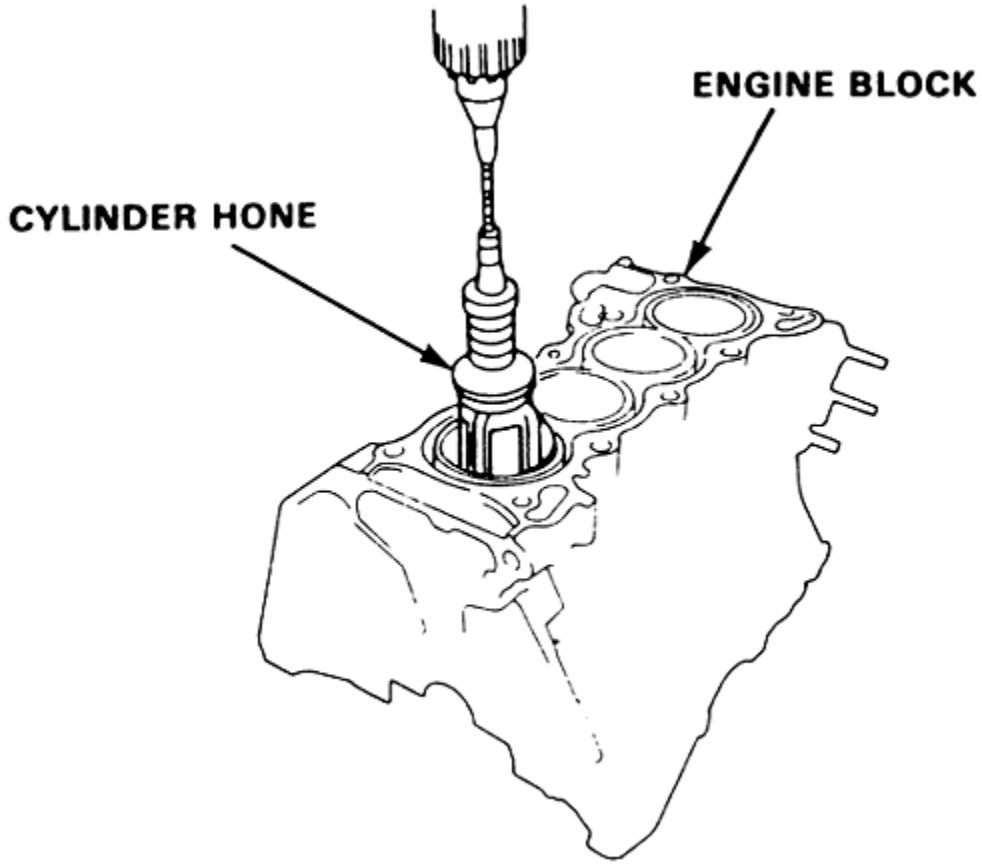
When the engine is operated for 40000 to 60000 kms, it will get maximum taper wear and ovality and taper, shop manual is consulted to find out whether reboring the cylinder is necessary or honing only will be sufficient

Generally the maximum permissible ovality is specified as 0.01 mm and the tapper as 0.25 mm, depending upon the wear of the cylinder bore next over. Size is selected so as to remove all ovality and taper. The oversizes generally specified are 0.01, 0.02, 0.03. 0.04, 0.06 inch. Corresponding oversize piston has also to be fitted in such a case.
Cylinder bores with less than 0.01 mm ovality need not be rebored. They can be rectified by honing only

CYLINDER REBORING METHOD

In recent practice the method worn cylinders with the being bar has become widely on account of its rapidity and precision. Reboring is done on special machines, it's shown in figure
In this machine uses a single point tool cuter which is set to the exact diameter required with special micrometer. The cutting edge is sharpened on are revolving disk, using a mixture of diamond dirt and oil. The cutter blade shaft is mounted inside a column which moves up and down of its housing in the fixed part of the fixed part of the machine for tool feeding purpose. The cutter is driven at low speed by an electric motor mounted on the machine.
The top surface of the cylinder block is thoroughly cleaned and the boring bar set at one of the cylinder bores. The bar is centered set to the desired depth of cut and the machine started. The cutter will bore progressively to the other end, and the machine stops when the boring complete. Aftere the job is complete again the cylinder must be washed thoroughly to remove all abrasive particles
Before starting reboring operation it is very important to preventive the entry of metal or abrasive practices in the oil galleries. It is a good practice to warp insulation tapes on crank pins to cover other parts as is possible.

CYLINDER HONING METHOD



Honing the cylinder walls is necessary after reboring, or to remove minor imperfections and glaze. A hone consists of four or six narrow, fine graded grinding stones mounted in cage around a spindle which is rotated by an electrical motor.

In the fixed machine shop type hone, the cylinder block is of the hone up and down the bore often effected automatically. Portable hones, designed to be driven by a heavy duty electric drill. Mounted on a stroking stand are also widely used, especially in conjection with a portable boring bar, in these cases the stroking action is effected manually.

Place the hone in the cylinder and expand the stones until the assembly can just be turned by hand and machine started. Home drive at drill speed while moving the hone up and down the entire length of the cylinder until the hone begins to run free. During this operation a liberal amount of kerosene. Or other suitable cutting fluid, should be used to keep the stones clean move the hone up and down slowly with the first cut rough stones, but more rapidly with first cut rough stones, the cylinder walls and repeat honing operation until the desired bore diameter is obtained. After the honing is completed, all abrasive particles must be removed from the engine parts. Hot water and soap is recommended to clean cylinder walls.

Cooling system-

The main purpose of cooling system is to keep the engine at its most efficient operating temperature at all speed and under all operating condition.

TYPES OF COOLING:-

1. Air cooling – Here there are metal fins on the heads and cylinder to dissipate heat from the engine. Even fans are used on some air – cooled engine to improve air circulation around the cylinder and heads.

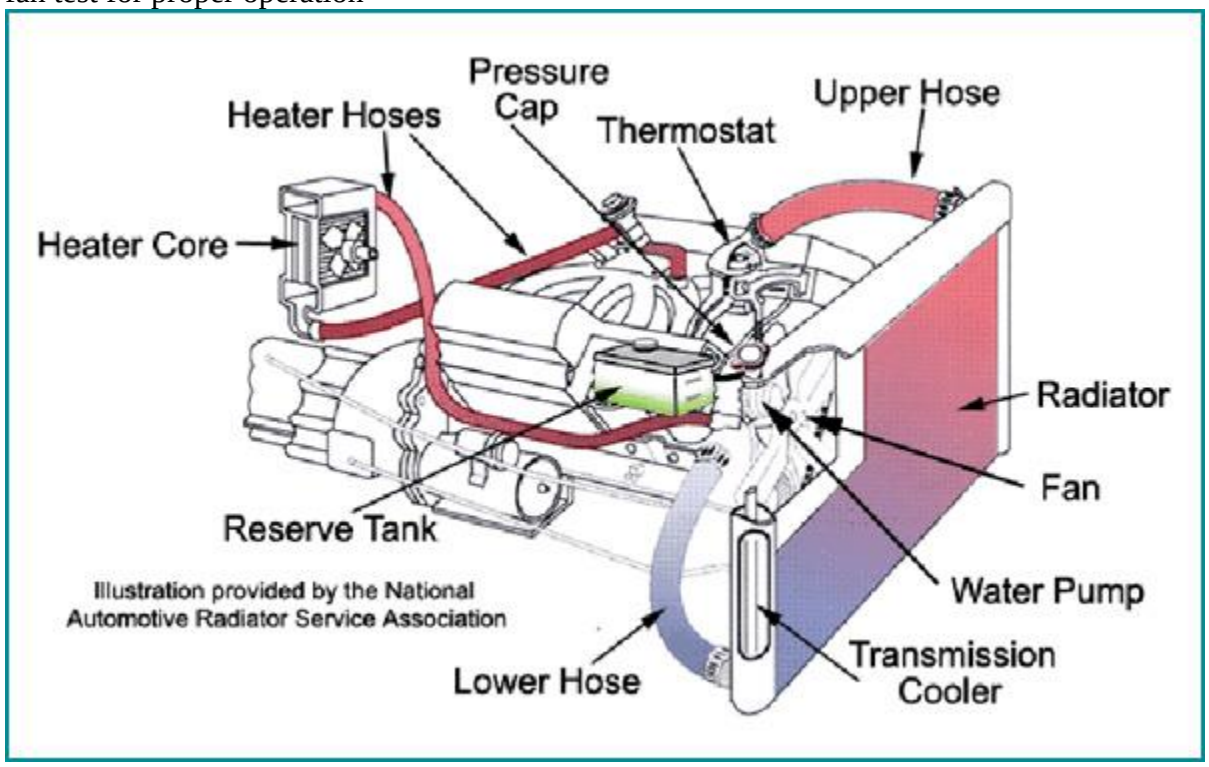
2. Liquid cooling – Here the liquid is circulated around the cylinder to observe from the cylinder walls. The liquid used is water, but even antifreeze solutions are used as coolant to prevent freezing is cooled weather.

COOLING SYSTEM

- Check the radiator for any damage and blocks
- Check the hoses that connect radiator and engine
- Check for any leakage
- Check the fan belt
- Use clean water in the radiation

COOLING SYSTEM AUTO MAINTENANCE

- a visual inspection of all cooling system components, including belts and hoses
- a radiator cap pressure test to check for the recommended system pressure level
- a thermostat check for proper opening and closing
- a pressure test to identify any external leaks to the cooling system parts; including the radiator, water pump, engine coolant passages, radiator and heater hoses and heater core
- an internal leak test to check for combustion gas leakage into the cooling system an engine cooling fan test for proper operation



- **Antifreeze/Coolant**
- The main function of the Cooling System is to carry heat away from the engine and maintain the desired operating temperature. This is accomplished by circulating antifreeze/coolant through the engine, where heat is generated, and carrying it to the radiator to be cooled.
- Modern automobiles operate in a wide variety of ambient temperatures, from well below freezing to well over 100 F. The fluid used to cool the engine must have a very low freezing point, a high boiling point, and it must have the ability to transfer heat.

  An adequate amount of an antifreeze/coolant and water mixture is necessary to reduce the possibility of engine overheating and freezing, and contain additives to prevent rust and corrosion

in the cooling system. Water is one of the most effective fluids for holding heat, but water freezes at too high a temperature to be used in automobile engines alone.

- The fluid used in most vehicles is a mixture of water and ethylene glycol, also known as "antifreeze" or "coolant". By adding antifreeze to water, the boiling and freezing points are improved significantly.
- The temperature of the coolant can sometimes reach 250 to 275 F (121 to 135 C). Even with antifreeze added, these temperatures would boil the coolant. To prevent this, the cooling system is pressurized, which further raises the boiling point of the coolant. Most systems have around 14 to 15 pounds per square inch (psi), which raises the boiling point approximately 45 F so the coolant can endure the high temperatures produced in the engine.
- **Coolant Hoses**
- The radiator hoses and heater hoses are easily inspected by opening the hood and looking. You want to be sure that the hoses have no cracking or splitting and that there is no bulging or swelling at the ends.
- If there are any signs of problems, the hose should be replaced with the correct part number for the year, make, model and engine of the vehicle. Never use a universal hose unless it is an emergency and a proper molded hose is not available. For either the radiator hoses or the heater hoses, make sure that you route the replacement hose in the same way that the original hose was running. Position the hose away from any obstruction that can possibly damage it and always use new hose clamps. After the cooling system is refilled with the proper coolant mixture, a pressure test should be performed to ensure that there are no leaks.
- **Belts**
- On older vehicles, the water pump is driven by either a V belt or serpentine belt on the front of the engine that is also responsible for driving the alternator, power steering pump and air conditioner compressor. These types of belts are easy to inspect and replace if they are worn. Check for dry cracking on the inside surface of the belt.
- On newer vehicles, the water pump is often driven by the timing belt. This belt usually has a specific life expectancy at which time it must be replaced to insure that it does not fail. Since the timing belt is inside the engine and will require partial engine disassembly to inspect, it is very important to replace the timing belt at the scheduled interval.

LUBRICATING SYSTEM SERVICING (AUTOMOBILE)

COMMON PROBLEMS

Higher Oil Consumption.

The main factors affecting oil consumption are engine speed and engine wear. engine temperature increases at high speed due to which the oil viscosity decreases. the low viscosity oil can pass at higher rate through piston rings into the combustion chamber where it is burned. high speed can cause ring shimmy or ring float. under this condition the oil control rings cannot function effectively. crankcase ventilation at higher speeds causes more air to pass through the crankcase due to which more oil is lost in the form of mist. at high speeds more oil is fed through the crankcase to the connecting rod journals. oil consumption increases with engine parts wear. worn bearings throw more oil on the cylinder walls. oil control rings do not perform perfectly on the worn cylinder wall and hence more oil is admitted into the combustion chamber where it burns and fouls spark plugs, valves, rings, and pistons. worn intake-valve

and exhaust-valve guides increase oil consumption. therefore worn parts are to be repaired or replaced accordingly to bring down the oil consumption to the recommended level.

Erratic Oil Pressure Indication.

if sometime light glows, or the gauge shows low pressure reading, then either there is less oil in the crankcase or the oil pickup is inconsistent. if light stays on all the time, or the pressure gauge constantly reads low, then the causes may be

(t) a weak relief-valve spring,

(ii) a defective sender unit or oil pressure indicator,

(hi) a worn oil pump,

(iv) obstructed or cracked or broken oil lines,

(u) insufficient or excessively thin oil, and/or

(vi) worn bearings, which pass more oil than the pump can deliver.

Excessive Oil Pressure Indication May Be Due To

(i) a clogged oil line,

(ii) excessively viscous oil, (hi) stuck relief valve, and/or

(iv) excessively strong valve spring.

SYSTEM MAINTENANCE

Checking Oil Level.

While checking the oil level, the vehicle should be on a level surface and the engine should be stopped. if the engine has just been shut off, then some time should be allowed for the oil to drain back into the oil pan. The appearance of oil should be noticed to check whether it is dirty, thin or thick. the oil is rubbed between the thumb and finger to check for dirt. if oil is dirty or thin it should be drained and clean oil should be filled. if oil level is less, oil should be added to the required level.

Changing Oil.

The oil additives become depleted as the vehicle is driven. The antioxidant additive is used up which may cause thick tar-like deposits in the engine. The corrosion and rust inhibitors become depleted, and corrosion begins to take place on the bearing surfaces. The oil in slowly contaminated with carbon. In some cases moisture gradually forms sludge in the oil.

Oil change intervals are based on the time or mileage, whichever occurs first. it is very important to change the oil at the manufacturers' recommended intervals to maintain engine internal cleanliness and long engine life. Older vehicles usually have shorter recommended oil change intervals. When the oil is changed it is very important to follow the manufacturers' recommended oil classification and viscosity rating. The engine should be at normal operating temperature before oil is drained from the crankcase. This helps for complete drainage of oil with contaminates. to change the engine oil, the vehicle is put on a lift. An oil drain pan is placed in position and the drain plug is removed from the oil pan. After oil is drained, the plug is installed and the vehicle is lowered. then oil is filled in the crankcase.

Servicing the Oil Filter.

As per the recommendation of the manufacturer the oil filter should be serviced or replaced regularly for long life of the engine. Normally oil filter is serviced with the first oil change and then after every other oil change. Some filters have replaceable elements, and with full-flow oil filters, which are commonly used, the filter element and container are replaced as a unit. a new filter should always start out with new oil.

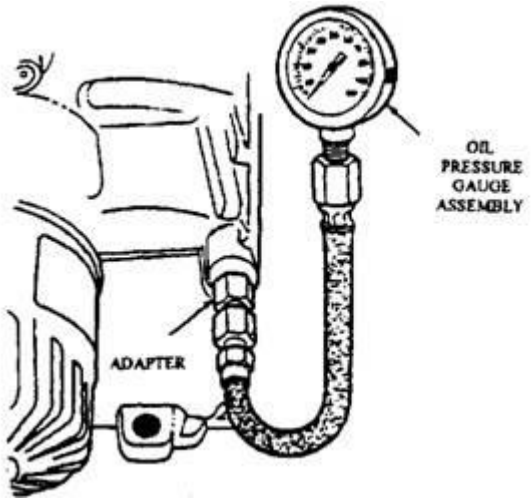
With the old filter off, the recess and sealing face of the filter bracket should be wiped with a clean shop towel. Then, the sealing gasket of the new filter should be coated with oil. The seal on the new oil filter should be lubricated with a small amount of clean engine oil before the filter is installed. When the new oil filter is installed, it should be tightened by rotating it about one half-turn after the seal makes contact with the mounting plate.

Servicing Oil Pump and Relief Valve.

Oil pumps require very little service in normal operation. If pump is badly worn, the pump is to be removed and disassembled. The pressure relief valve should be removed and checked to make sure that it is moving freely. Springs of different tension may be required to be installed to change the regulating pressure in the relief valve.

if the rotor or the pump housing is worn to the point where the end play exceeds specifications, one or the other must be replaced. The clearance between the inner and outer rotors, and that between the outer rotor and the pump housing should be measured and if the clearance exceeds the specification replacement of specific part or the total pump is necessary.

similar is the case with the gear-type pump. The oil pump pickup should be checked for a plugged screen and air leaks.



Servicing Oil Pressure Indicators.

If the oil indicator light does not come on when the ignition switch is turned on, the wire at the pressure switch should be removed and grounded. If the bulb does not come on, the bulb, fuse, or connecting wires have an open circuit. When the oil indicator bulb is illuminated with the pressure switch wire grounded, but does not come on with the wire connected to the switch, the pressure switch is defective. When the oil

indicator light is on with the engine running, the engine should be stopped and the oil level in the crankcase should be checked. If the crankcase oil level is correct, the oil pressure should be tested by removing the pressure switch and installing a pressure gauge in place of the switch, as shown in fig. If the oil pressure equals or exceeds the manufacturer's specifications, a defective oil pressure switch must be the cause of the illuminated oil light. a low oil pressure reading indicates a defect within the engine and the oil pump should be checked first.

MAINTENANCE AND FAULT DIAGNOSIS OF ENGINE MANAGEMENT SYSTEMS (AUTOMOBILE)

Maintenance and Fault Diagnosis of Engine Management Systems

Modern engine-control systems incorporate many sensors to communicate operational data to the ECU to control the engine effectively. Cables from these sensors and associated circuitry use many multi-pin connectors.

Connector Problems

Under ideal conditions the connectors used on automobiles normally perform satisfactorily but when they are exposed to an under-bonnet high temperature environment, to water, salt, oil and dirt, these are likely to develop problems. Although to minimize these problems, some form of flexible cover is provided to prevent the ingress of contaminates, but the possibility of even partial failure cannot be eliminated, especially after the connector has aged.

During routine maintenance, and when a fault is being diagnosed, attention should be given to the condition of the connectors, specifically the plugs located in exposed conditions. Security and assessment of the condition of the connectors plug requires two important routine checks. Where an intermittent fault is experienced, it is often impossible to locate a cable connector
fault by normal meter tests. In these cases the contact pins of all connectors in the circuit that have the problem, should be cleaned.

Some manufacturers recommend the actual method for cleaning the contact surfaces. These methods range from the use of an ink eraser for spraying the surfaces with a special cleaning fluid. Emery cloth should not be used, because it removes the contact surface and is likely to create a short-circuit due to the electrical conductivity of the emery dust.

Self-diagnosing Systems

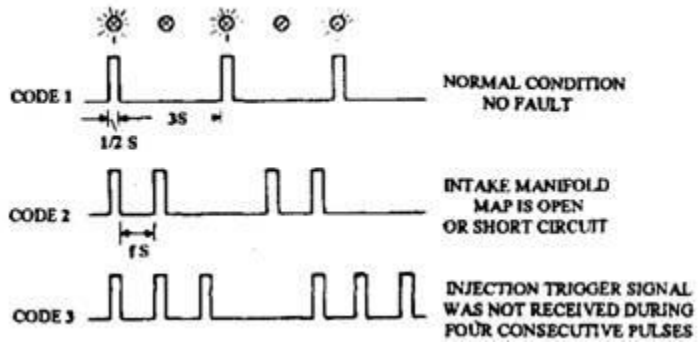
It is expected that in due course of time most management systems will incorporate their own fault-diagnosis circuit. Already these systems in use have a monitoring circuit, which either signals the driver when a fault occurs, or controls the system in such a way that the fault does not seriously damage the engine. In such a case the ECU resets the control system to enable the vehicle to 'limp home' and be driven to the garage for repair.

Some engine management computers incorporate a built-in self-diagnosing feature, which displays, when instructed by a diagnostician, the faulty area. Systems of more advanced design use a facility, which permits the transmission of information relating to a fault to a larger computer installed in the workshop.

Self-diagnosis by Light Signal.

The Toyota computer controlled system (TCCS) uses a coded light signal to indicate the cause of a malfunction in the system. When a fault develops, the ECU registers the sub-system in which the fault is present, into its memory. This information is stored in the memory even after the engine is switched-off. The possible faults are monitored by the system. Some of these faults are capable of producing an engine stall, so in such a case a warning light on the instrument panel indicates the driver to check engine. When the malfunction is corrected the warning light goes out, but the ECU still holds the information in its memory. This is specifically helpfull to the diagnostician when an intermittent fault recurs.

Access to the memory data is obtained by short-circuiting a test terminal. This causes the panel lamp to flash at a rate, which indicates a particular fault that can be identified by referring to the code shown in the repair manual. Figure 18.28 illustrates the lamp behavior for three examples and the fault associated with each one of them.



In addition to this memory feature, this computer also incorporates a fail-safe function that avoids an engine stall due to faulty operation of MAP, coolant temperature and intake air temperature sensors. Malfunctions in one or more of these areas cause the computer to make the following adjustments.

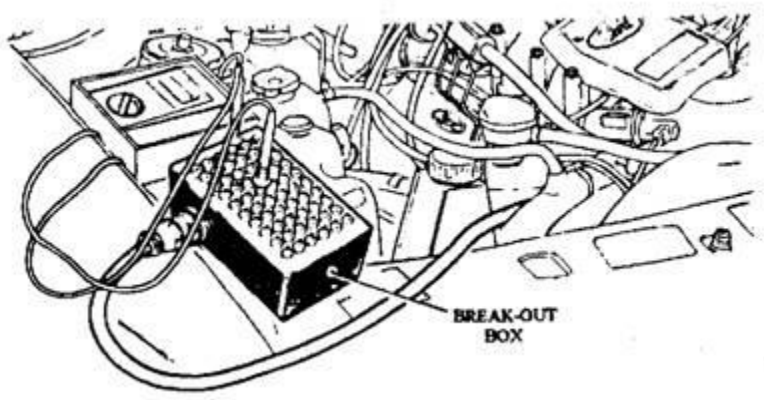
MAP : Sets the ignition timing to 10 degrees before TDC and maintains a constant injection duration.

Coolant temperature : Sets injection duration by assuming a temperature of 353 K.

Air temperature : Sets injection duration by assuming a temperature of 293 K.

Breakout Box Tests.

A breakout box provides a series of contact plug sockets that allows test meters to be connected into the various circuits to carryout fault diagnosis. A breakout box used on Ford vehicles is shown in Fig. This box has 60 sockets and a provision for the connection of these sockets to the multi-plug, which normally fits into the ECU.



Tests conducted with the aid of this box cover many sub-sections. The use of the box minimizes the problems of connecting test equipment to the wrong pin and making ineffective connections to the test meters.

Each socket is numbered, which simplifies the test procedure when used in conjunction with a fault-diagnosis chart. As with many other tests of electronic equipment, proper care must be taken when a multi-meter is used to measure resistance. This is because the current supplied by the meter can damage many of the components in an electronic control unit.

EMISSION CONTROL SYSTEM SERVICE

Objectives

- Determine the causes of various emission system problems
- Perform service on the emission control system
- Repair or replace defective emission control parts
- Diagnose emission problems using an exhaust gas analyzer

Inspecting Emission Control Systems

- Many states require periodic emission inspections
- Visual inspection
- Look at hoses and wires
- Check that all parts are in place
- Run engine and listen for air leaks
- Check condition and tension of the pump drive belt
- Inspect the air cleaner

Computer-Controlled Emission Service

- New cars have sophisticated emission systems
- Controlled by a computer, sensors, and actuators
- May have emission maintenance reminder lights

- Many ways of testing devices and resetting the light

Crankcase Ventilation System Service

- Crankcase system must be air tight
- Engine running and OCV valve installed
- Should be a vacuum at oil filter opening when Leak in the crankcase ventilation system
- Not always readily apparent
    - Testing PCV valve
        - Pull PCV valve from its grommet
        - With engine stopped, remove and shake valve
        - With engine running, cover valve end
        - Pull fresh air hose from air cleaner
    - Check the breather hose to the air cleaner
        - Kinks
        - Restriction

Evaporative Control System Service

- Fuel evaporation
    - Major cause of air pollution
- Evaporative emission controls
    - Installed on gasoline filler nozzles
    - Vehicles have their own on-board evaporative systems
    - Often neglected until driveability problem occurs

Evaporative System Maintenance

- Fresh air is drawn into the canister during purging
    - Some canisters have a replaceable filter
- Service interval is usually every two years
    - More often in dusty conditions
- Check condition of all system hoses
    - Use fuel hose or hose designed to be used with fuel vapours

Evaporative System Problem Diagnosis

- Leaking evaporative systems allow gasoline vapors to escape into the air
- Check liquid/vapor separator if there is liquid fuel in charcoal canister
- Loud rush of air entering the tank when cap is pulled indicates a venting problem
- EVAP systems on OBD II vehicles self-test for leaks

Air Injection System Service

- Visual inspection
  - Look for rusty check valves and air manifolds
  - Check condition of hoses mounted near exhaust parts
  - Inspect air pump drive belt
- Several problems in an air injection system
  - Exhaust noise under the hood
  - Backfiring on deceleration
  - Air pump noisy or frozen
  - Emission test failure

Catalytic Converter Service

- Common failure of OBD II vehicles
  - Overheating caused by a misfiring cylinder
- Plugged converter
  - Restricts engine exhaust flow
- Do not just replace the converter
  - Determine whether there is another problem

Converter Testing

- Cat must be heated: at least 600°F
  - Converter light off: converter begins to oxidize
  - Temperature is measured with a high-temperature pyrometer
  - Best test for a converter: emission analyser

Catalytic Converter Replacement

- Replacement converter
  - Often bolted on with new gaskets
  - Some require welding
  - Use an EPA-approved equivalent replacement
  - Installation of a used converter is illegal unless it has been tested and certified

TEXT / REFERENCE BOOKS

1. Ed May, “Automotive Mechanics”, Volume 1 and 2 , McGraw Hill Publications, 2003

2. Vehicle Service Manuals of reputed manufacturers

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SCHOOL OF MECHANICAL ENGINEERING

DEPARTMENT OF AUTOMOBILE ENGINEERING

SAU1307 VEHICLE MAINTENANCE AND RECONDITIONING

UNIT 3 TRANSMISSION AND DRIVELINE MAINTENANCE

UNIT III

TRANSMISSION AND DRIVELINE MAINTENANCE

DIFFERENTIAL TROUBLE DIAGNOSIS:

The first sign of differential trouble is usually noise.

1. HUMMING:

- A humming noise is often due to incorrect internal adjustment of drive pinion or the ring gear.
- Incorrect adjustment causes rapid tooth wear or even failure of differential.
- This humming noise will take on a growling noise as wear progresses.

2. NOISE OR ACCELERATION:

- Noise from differential is louder when the car is accelerating since there is heavy contact on the ends of the gear teeth.
- Noise is louder when the car is coasting since there is heavy toe contact and both these conditions must be corrected.

NOISE ON CURVES:

- If the noise is heard only when the car is going around a curve , the trouble is inside the differential case.
- Pinion gears tight on the pinion shaft, damaged gears or pinions, too much backlash between gears could be cause for this problem.
- When the car turns along a curve, the parts inside the differential case more relative to each other.

1. LIMITED-SLIP DIFFERENTIAL:
   - The limited slip differential requires a special type of lubricant. The wrong lubricant can cause clutch surfaces to grab. This may produce chattering noise during a turn.
   - The remedy is to drain the old lubricant and fill specified lubricant designed for limited-slip differential. In such cases wheel spin can also occur, even though

UNIVERSAL JOINT AND PROPELLER SHAFT MAINTENANCE:

- Universal joints and propeller shaft do not require maintenance in normal use.
- Some universal joints and pre-lubricated for life during original assembly. When wear (or) noise occurs, the universal joints have to be replaced. However,
- some manufacturers recommend lubricating the universal joints every time a chassis lubrication is performed.

- The drive shaft and universal joints are carefully balanced during original assembly. Always mark the position and alignment of the parts before dismantling. Then after reassembly and installation, they should be still in balance. A drive shaft can often be balanced by installation of two worm-type hose clamps

REMOVAL OF MANUAL TRANSMISSION:

- Raise the vehicle on a lift.
- Mark rear axle flange and drive shaft so that the drive shaft is reinstalled in the same manner.
- Drain the lubricants present in transmission unit.
- Disconnect the speedometer cable.
- Disconnect the wiring to the backup light.
- Disconnect the drive shaft.
- Support the engine with jack or engine support.
- Remove the bolts attaching the transmission support to the cross member. Then remove bolts attaching cross member to the body frame and remove the cross member.
- Remove the upper bolts attaching the transmission to the clutch housing and install guide pin in the hole.
- Remove the other transmission attaching bolts. Then slide the transmission until the clutch shaft comes clear of the clutch.

INSTALLATION OF GEAR BOX:

- Installation is the reverse of removal. Just before installation, shift the transmission in to each gear and turn the input shaft to check whether the transmission works or not.
- Place a small amount of lubricant on the spline of input shaft.
- Pre-align the spline on the input shaft and the friction disc hub by turning the input shafts so that the splines line up.
- Install guide pins and slide the transmission in to position.
- Turn the shaft if necessary to secure alignment of the shaft and hub splines.
- Then fix the bolts and tighten them along the guide pins.

CLUTCH TROUBLE SHOOTING CHARTS:

COMPLAINT	POSSIBLE CAUSES	CHECK(OR)CORRECTION
1. Clutch slips while engaged	□ Broken or weak pressure springs □ Broken engine mount □ Warped clutch disc □ Grease or oil on disk facing	□ Replace □ Replace □ Replace □ Replace facing or disk
2. Clutch chatters when engaged	□ Warped clutch disc □ Broken engine mount	□ Replace □ Replace

	□ Binding in clutch release linkage	□ Adjust and lubricate
3. Clutch noises	□ Misalignment of engine and transmission □ Friction disc hub loose on the clutch shaft □ Release lever not properly adjusted	□ Realign □ Replace worn parts □ Readjust(or)Replace the assembly
4. Clutch pedal pulsations	□ Engine and transmission not aligned □ Flywheel not seated on the crankshaft flange	□ Realign □ Seat properly
5. Friction disc facing wear	□ Driver rides clutch □ Excessive and incorrect use of clutch □ Crack in flywheel	□ Keep foot off clutch except when necessary □ Reduce use □ Replace
6. Clutch pedal stiff	□ Clutch linkage lacks lubricant □ Misaligned linkage plate □ Bent clutch pedal	□ Lubricate □ Realign □ Replace

MANUAL TRRANSMISSION TROUBLESHOOTING:

COMPLAINT	POSSIBLE CAUSES	CHECK(OR)CORRECTION
1. Hard shifting into gear	□ Gear shift linkage out of adjustment □ Gear shift lacks lubricants □ Excessive clutch free-pedal play	□ Adjust □ Lubricate □ Adjust
2. Transmission sticks in gear	□ Gear shift linkage out of adjustment □ Gear shift lacks lubrication □ Synchronizing unit stuck	□ Adjust □ Lubricate □ Replace damaged parts
3. No power through transmission	□ Clutch slipping	□ Adjust
	□ Gear broken □ Misalignment of transmission with engine	□ Replace □ Realign
4. Transmission noisy in neutral	□ Gears worn or teeth broken □ Bearings worn away □ Transmission misalignment with engine	□ Replace gears □ Replace and lubricate □ Realign
5. Transmission noisy in gear	□ Insufficient lubrication □ Gears loose on mainshaft	□ Properly lubricate with correct lube. □ Replace worn parts

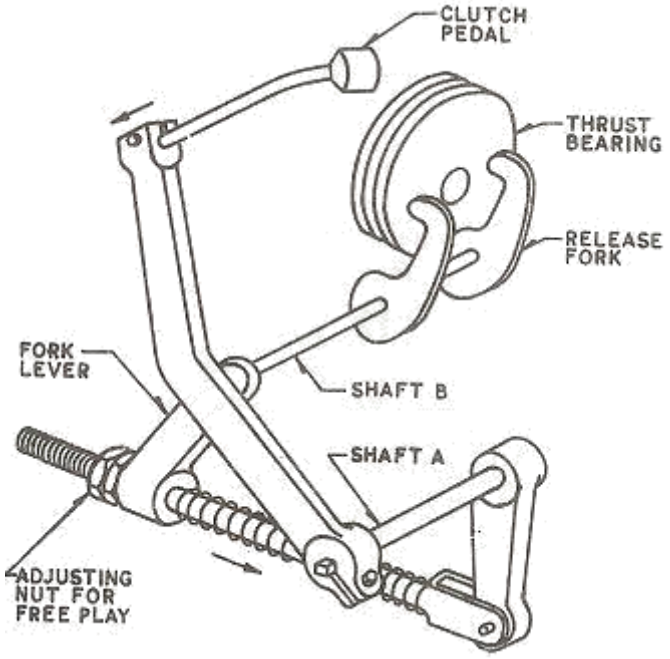
	□ Synchronisers worn	□ Replace worn parts
6. Gears clash while shifting	□ Synchronisers defective □ Incorrect lubricant □ Idle speed excessive □ Incorrect free-pedal play	□ Repair or replace □ Replace with correct lubricant □ Readjust □ Adjust
7. Transmission noisy in reverse	□ Reverse idler gear damaged □ Shift mechanism damaged	□ Replace □ Repair, replace, readjust defective parts
8. Oil leaks	□ Foaming due to incorrect lubrication □ Oil level too high □ Oil seals damaged □ Drain plug loose	□ Replace with correct lubricant □ Use proper amount, not more □ Replace □ Tighten the plug

Adjustment of pedal play

Clutch pedal play adjustment

Clutch pedal free play (2 to 4 mm) is adjusted from clutch release arm with clutch operating flexible cable coming from clutch pedal.

While fitting clutch release arm on the clutch release shaft, fix up the arm such that the punched mark on the clutch release is shifted towards the front side but one notch from the punched mark on the clutch release shaft, after tightening the arm fix up the cable and adjust clutch pedal free play through adjuster nut 1. It is not possible to get the desired play then adjust with adjuster nut 2.



Clutch Repairs and Inspection

1. Clutch facing and service limit
2. Loose holding down rivets
3. Check up the torque spring
4. Check for distortion or crack on clutch
5. Check for flat run out (<0.4 mm)
6. Check for lateral run out (<0.7 mm)

Brake pedal play adjustment

The free pedal play should be at least 12.7 mm or as recommended by the company. The procedure for brake pedal play adjustment is as follows

Raise the vehicle until the wheels are off the road.

- With a wrench loosen the locknut for the forward brake shoe and hold it.
- With another wrench turn the eccentric towards the front of the vehicle until brake shoe strike the drum.
- While turning the wheel with one hand, release the eccentric until the wheel turn freely.
- Hold the eccentric in position and fasten the locknut.
- Repeat this procedure to adjust the reverse shoe. But, turn the eccentric towards the back of the vehicle.
- Repeat this on all the four brakes.
- Check the fluid level in the master cylinder
- When the pedal goes down, close the vent screw.
- Again repeat the procedure until all the bubbles are removed.

DIFFERENTIAL SERVICE AND MAINTENANCE

Differentials in a properly operated vehicle seldom cause any maintenance problems. With the maintenance of the proper lubrication level and occasional changing of a seal or gasket, the assembly will normally last as long as the vehicle. The first hint of existing trouble is generally an unusual noise in the axle housing. what operating conditions the noise is most pronounced. Defective universal joints,
rough wheel bearings, or tire noises may be improperly diagnosed by an inexperienced mechanic as differential trouble. Some clue may be gained as to the cause of trouble by noting whether the noise is a growl, hum, or knock; whether it is heard when the vehicle is operating on a straight road, or on turns only; and whether the noise is most noticeable when the engine is driving the vehicle or when it is coasting with the vehicle driving the engine.

A humming noise in the differential generally means the ring gear or pinion needs an adjustment. An improperly adjusted ring gear or pinion prevents normal tooth contact between the gears and therefore produces rapid tooth wear. If the trouble is not corrected immediately, the humming noise will gradually take on a growling sound, and the ring and pinion will probably have to be replaced. It is very easy to mistake tire noise for differential noise. Tire noise will vary according to the type of pavement the vehicle is being operated on, while differential noise will not.

To confirm a doubt as to whether the noise is caused by tire or differential, drive the vehicle over various

pavement surfaces. If the noise is present in the differential only when the vehicle is rounding a comer, the trouble is likely to be in the differential case.

If the backlash (clearance) between the ring and pinion is too great, a clunking sound is produced by the gears. For example, when an automatic transmission is shifted into drive, the abrupt rotation of the drive shaft can bring the gears together with a loud thump. The ring and pinion gears can become worn, scored, out of adjustment, or damaged.

The problems can result from prolonged service, fatigue, and lack of lubricant. You need to inspect the differential to determine whether adjustment or part replacement is required. A differential identification (ID) number is provided to show the exact type of differential for ordering parts and looking up specifications. The number may be on a tag under one of the carrier or inspection cover bolts; it also may be stamped on the housing or carrier. Use the ID number to find the axle type, axle ratio, make of the unit, and other information located in the service manual.

Differential Lubricant Service

Many vehicle manufacturers recommend that the differential fluid be checked and replaced at specific intervals. To check the fluid level in a differential, remove the filler plug, which is located either in the front or rear of the assembly. The lubricant should be even with the fill hole when hot and slightly below the hole when cold. When the manufacturer recommends that the differential fluid be replaced, remove the drain plug located on the bottom of the differential housing. Some differentials require the removal of the inspection cover to drain the lubricant. With all the fluid drained, replace the drain plug or inspection cover and refill with the proper lubricant.

Always install the correct type of differential lubricant. Limited slip differentials often require a special type of lubricant for the friction clutches.

REAR AXLE SERVICE

Rear axle service is needed when an axle bearing is noisy, when an axle is broken, bent, or damaged, or when an axle seal is leaking. The rear axles must be removed to allow removal and repair of the differential assembly.

Axle Bearing Service

Worn or damaged bearings in the carrier or on the axles produce a constant whirring orhumming sound. When bad, these bearings make about the same sound whether accelerating, decelerating, or coasting. When diagnosing and repairing bearing failures, do the following:

• Check the general condition of all parts during disassembly, not just the most badly worn or damaged parts.

• Compare the failure to any added information in the service manual and your knowledge of the component’s operation.

• Determine the cause of the part failure. This helps in assuring that the problems do NOT reoccur.

• Perform all repairs following the manufacturer’s recommendations and specifications. When an axle bearing is faulty, it must be removed from the axle or housing carefully and a new one installed. The type of axle configuration determines how the bearing is to be removed and replaced. Always refer to the manufacturer's service manual for instructions for the removal and installation of the bearing. The procedures we will discuss are for a semi-floating axle with the bearing and collar pressed on. With the

axle removed from the vehicle, proceed as follows:

NOTE

Procedures for axle removal may be found in the service manual for the applicable vehicle.

- Carefully cut off the collar with a grinder and a sharp chisel.
- With the collar off, place the axle in a hydraulic press. The driving tool should be positioned so that it contacts the inner bearing race. Use the press to push the axle through the bearing.
- To install the new bearing, slide the bearing onto the axle. Make sure that the bearing is facing the right direction. Some bearings have a chamfered edge on the inner bearing race which must face the axle flange.
- Applying force on the inner bearing race, press the bearing into place by pressing the axle back through the bearing. Then press the collar or retaining ring onto the

Axle Seal Service

Rear axle lubricant leaks can occur at numerous spots, such as at the pinion gear seal, carrier or inspection cover gaskets, and two axle seals. The leak will show up as a darkened, oily, dirty area below the pinion gear or carrier, or on the inside of the wheel and brake assembly. Always make sure that a possible axle seal leak is not a brake fluid leak. Touch and smell the wet area to determine the type of leak.

Anytime the axle is removed for service, it is wise to install a new axle seal. This action ensures that the seal between the axle and axle seal is tight. The axle seal is normally force-fitted in the end of the axle housing. To remove a housing-mounted seal, use a slide hammer puller equipped with a hooknose. Place the hook on the metal part of the seal. With an outward jerk on the puller slide, pop out the seal. If a slide hammer puller is not available, a large screwdriver will also work.

CONSTANT VELOCITY JOINT SERVICE

Constant velocity joint service requires disassembly of the joint. Refer to the service manual for the vehicle when servicing a CV joint. The manual will give special detailed directions that are required depending on the type of joint.

Once the CV joint is disassembled, obtain a CV joint repair kit (usually includes new joint components, grease, boot, and bootstraps). When the joint is being assembled, refer back to the service manual for detailed directions.

Always use the recommended type of grease on a CV joint. The wrong type of grease will cause boot deterioration and joint failure. CV joint kits provide the correct type and amount of grease required.

After reassembling the CV joint, fit the boot over the joint. Make sure the boot ends fit into their grooves. Install the bootstraps. Do not over tighten the straps, as they may cut the boot or break.

UNIVERSAL JOINT SERVICE

The universal joints on many automotive vehicles are factory lubricated. However, construction equipment has universal joints that have lubrication fittings that should be lubricated at regular intervals.

Service to universal joints that are factory lubricated is limited to replacement when signs of excessive wear are present. The universal joints provided with lubrication fittings are lubricated only with a hand operated low-pressure grease gun. Use of a high-pressure grease gun will damage the seals, resulting in early failure of the universal joint.

Another area to be concerned with when servicing the universal joints is the slip yoke (joint). Slip yokes may be lubricated from the transmission or through a lubrication fitting.

A worn universal joint is the most common drive line problem, causing squeaking, grinding, clunking, or clicking sounds. The grease inside the joint can dry out. The roller bearings will wear small indentations in the cross. When the bearings try to roll over these dents, a loud metal-on-metal grinding or chirp sound can result. Quite often, a worn U-joint is discovered when the transmission is placed in reverse.

When the vehicle is backed up, the roller bearing is forced over the wear indentation against normal rotation. When this occurs, the rollers will catch on the sharp edges in the worn joint, causing even a louder sound. The universal joint may require removal and disassembly to enable you to check the condition of the join physically. Steps for the removal and disassembly of a U-joint are as follows:

1. Raise the vehicle and place it on jack stands.
2. Scribe the alignment marks on the differential yoke and universal joint so drive shaft balance is ensured upon reassembly.
3. Unbolt the rear joint from the differential. If used, also unbolt the center support bearing. Pry the shaft forward and lower the shaft slightly.
4. Wrap the tape around the caps to prevent them from falling off and spilling the roller bearings.
5. Slide the drive shaft out of the transmission. If the transmission lubricant begins to leak, install a plastic plug into the extension housing.
6. Before disassembling the universal joint, especially constant velocity joints, scribe mark each component. The marks will show you how to reassemble the joint.
7. Clamp the drive shaft yoke in a vise. Do **NOT** clamp the weaker center section of the drive shaft or it will bend. If used, remove the snap rings, using a screwdriver, snap-ring pliers, or needle nose pliers.
8. Use two sockets—one larger than the bearing cap and one smaller than the bearing cap. Place the smaller socket on the bearing cap of the universal joint. The larger socket is to be placed over the outside diameter of the bearing cap on the opposite side of the joint.
9. With both sockets and the universal inside the vise, slowly tighten the vise to force the bearing caps out of the yoke. Use the same procedure on the remaining bearing caps, as required.

Normally, a universal joint is replaced anytime it is disassembled. However, if the joint is relatively new, you can inspect, lubricate, and reassemble it. During the inspection, clean the roller bearings and other parts in solvent. Then check the cross and rollers for signs of wear. If you find the slightest sign of roughness or wear on any part, replace the U-joint.

Once you have cleaned, inspected, and found the U-joint to be in a serviceable condition, you must reassemble it. Steps for reassembling a U-joint are as follows:

1. Pack the roller bearings in high-temperature grease. A good method of keeping the bearing in place is to fill the bearing cap with grease.
2. Position the cross inside the yoke. Align your marks. Then fit the bearing caps into each end of the yoke.
3. Center the cross partially into each cap to keep the roller bearing from falling.
4. Place the assembly in a vise. Tighten the vise so that the bearing caps are forced into the yoke.
5. Press the caps fully into position by placing a small socket on one bearing cap.

Tighten the vise until the cap is pushed in far enough to install the snap ring. With one snap ring in place, use the socket to force the other cap into position. Install its snap ring.

6. Repeat this procedure on the other universal joint, if needed.

After assembly, check the action of the U-joint. Swing it back and forth into various positions. The joint should move freely, without binding.

Double check that all snap rings have been installed properly. Once the U-joint has been checked and is working properly, reinstall the drive shaft back into the vehicle as follows:

1. Wipe off the outside slip yoke and place a small amount of grease on the internal splines. Align the marks and slide the yoke into the rear of the transmission.
2. Push the slip yoke all the way into the extension housing and position the rear Ujoint at the differential.
3. Pull back on the drive shaft and center the rear universal properly. Check your rear alignment marks.
4. Install the U-bolts, bearing caps, or yoke bolts to secure the rear universal joint.
5. With the rear universal joint secured, lower the vehicle to the ground.
6. Test drives the vehicle for proper operation. Check for unusual noises, vibration, and other abnormalities.

REMOVAL AND INSTALLATION PROCEDURE OF PROPELLER SHAFT

Front Propeller Shaft

1. Raise and suitably support the vehicle.
2. Remove the front propeller shaft-to-front axle assembly bolts.

Tightening Torque 7.0 - 8.5 kg•m

• Make alignment marks on the front propeller shaft and front axle housing.

3. Remove the front propeller shaft-to-transfer case bolts.

Tightening Torque 8.1 - 8.9 kg•m

4. Remove the front propeller shaft.
5. Installation should follow the removal procedure in the reverse order.

Rear Propeller Shaft

1. Raise and suitably support the vehicle.
2. Remove the rear propeller shaft-to-rear axle assembly bolts.

Tightening Torque 7.0 - 8.5 kg•m

• Make alignment marks on the rear propeller shaft and rear axle housing.

3. Remove the rear propeller shaft-to-transfer case bolts.

Tightening Torque 8.1 - 8.9 kg•m

4. Remove the rear propeller shaft.
5. Installation should follow the removal procedure in the reverse order**.**

CLUTCH MAINTENANCE AND REPLACEMENT

The clutch acts as the transfer of energy between the engine and gearbox, undergoing significant stress each time a gear is selected, particularly whenever a gear is missed or the clutch is released too sharply.

As an active component the clutch of your vehicle will fail at some stage as the car ages, and is designed

to fail rather than cause more serious damage to other components in the drive system. Automatic vehicles do not use a clutch mechanism.

Possible Symptoms of clutch failure

- Engine revs increasing but little power
- Poor performance with increased fuel consumption
- Burning smell
- loss of drive
- Unable to engage gear while engine Running
- Possible Symptoms of dual mass fly wheel failure
- Car is "juddering" when setting off or changing gear
- Chattering sound when starting car

Loss of drive

If you are experiencing any of these symptoms, or generally poor performance then your clutch or dual mass flywheel may need attention and should be checked. If you leave a failing clutch too long before having it checked, this could cause further damage to the vehicle, including damaging the flywheel itself, which is a significantly more expensive repair procedure.

Clutch Replacement

The clutch assembly is made up of multiple components, depending on the make and model of your vehicle and together with the clutch plate there is often a "dual mass flywheel" in modern vehicles that can also fail.

Clutch components are large items tightly coupled with the engine and therefore time consuming to replace. A typical clutch replacement service can take anywhere from 3 to 6 hours (possibly more) depending on the vehicle model and specification. For this reason during any clutch related service all components including the dual mass flywheel would also be checked to ensure they are in good working order before reassembling the clutch casing.

TEXT / REFERENCE BOOKS

1. Ed May, “Automotive Mechanics”, Volume 1 and 2 , McGraw Hill Publications, 2003

2. Vehicle Service Manuals of reputed manufacturers

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DEPARTMENT OF AUTOMOBILE ENGINEERING

SAU1307 VEHICLE MAINTENANCE AND RECONDITIONING

UNIT 4 STEERING, BRAKE, SUSPENSION, WHEEL MAINTENANCE

UNIT IV

STEERING, BRAKE, SUSPENSION, WHEEL MAINTENANCE

HYDRAULIC BRAKE:

PRECAUTIONS:

- Always keep the brakes properly adjusted.
- Never allow the brake linings to wear down.
- Regularly inspect the fluid level in the reservoir and top up with brake fluid if necessary.
- Always exercise cleanliness when dealing with any part of hydraulic system.
- Never handle the internal hydraulic brake parts with greasy hands.
- Always use fresh brake fluid or alcohol for cleaning internal parts of the hydraulic system.
- One form of brake trouble that occurs frequently due to mineral oil contamination and it is usually caused by topping up the hydraulic system with superior fluids (or) cleaning cylinders with petrol during servicing.
- If the brake system has been contaminated, it is a dangerous condition and immediate attempt has to be made to flush off all the brake fluid from the system and then refill with appropriate fluid.

BLEEDING OF HYDRAULIC SYSTEM:

- The process of removing the brake fluid from the hydraulic pipe line and cylinder is known as bleeding. It is necessary whenever any part of the system is disconnected (or) fluid in the supply tank exceeds the limit.
- Whenever seats are worn out it is possible for air to enter into the wheel cylinder without any sign of leakage causing spongy pedal and it is the usual indication of air in the system.
- Never, under any circumstances use the fluid which has been bled from the system to top up the supply tank because it may be aerated, have too much moisture content (or) be contaminated.

BLEEDING PROCEDURE:

- Before starting to bleed, follow the essential steps:
- Before commencing bleeding at each bleed screw, remove the dust cover and clean thoroughly. If the master cylinder is fitted with bleeding screw, bleed the master cylinder first.
- Attach the bleed tube to wheel cylinder and then from the master cylinder to the glass jar containing brake fluid.
- Open the bleed screw to 3/4th of a turn sufficient to the brake fluid to flow freely. Depress the foot pedal slowly throughout full stroke of the pedal and allow it to return to its position slowly.
- There would be an interval of 3 to 4 seconds before making the next stroke.
- Repeat this action until the air bubbles seizes and then close the bleed screw immediately.
- While the pedal is thus held, securely tighten the bleed screw and remove the tube. Replace the dust cover on the bleed screw. Repeat the same procedure on all the wheel cylinders.
- After the bleeding operation, top up the master cylinder reservoir with appropriate brake fluid to a level of of 3/4th the reservoir and replace the filler cap.

BRAKE TESTERS:

- There are two types of brake testers, namely static and dynamic.
- Static tester has four tread plates and registering columns.

- To remove the tests, the car is driven on to the tread plates at specified speed and the brakes are applied hard.
- The stopping force at each wheel is registered on four columns. If the readings are too low, brake service is needed.
- The dynamic brake tester has rollers in the floor. The two wheels for which brakes are to be tested are placed on the rollers. If these are the drive wheels, the wheels are spun at specified speed by vehicle engine. For non- driving wheels, the rollers and wheels are spun by electric motor. Then the electric motor is switched off and the brakes are applied. The braking force at each wheel registers on meters and based on the readings, service is performed

BRAKE SERVICE:

- Any complaint of faulty braking action, immediate measures have to be taken.
- Brake service includes:
  - Addition of brake fluid
  - Bleeding the hydraulic system to remove air
  - Repair or replacement of master cylinder, wheel cylinders, etc.
  - Replacement of brake linings Refinishing of brake drums

Overhauling of power-brake units.

WHEEL ALIGNMENT:

SERVICING STEERING LINKAGES AND SUSPENSION:

- If any defects are found, the causes must be determined and corresponding corrections must be made before aligning the wheels.
- Servicing steering and suspension includes removal, replacement, adjustment of tie rods, removal and replacement of other linkage parts.
- All of these services, if needed must be performed before aligning the wheels.

WHEEL ALIGNMENT:

- There are many types of wheel aligners. Some are mechanical types that attach to the wheel spindles. Some have light beams that display the measurements on a screen in front of the car.
- When doing front wheel alignment, you should first check castor, camber, toe, turning radius, etc. These are not adjustable. If they are out of specification it means parts are damaged and must be replaced.
- Before you make alignment checks, the following pre-alignment inspections must be first made.
  - Check and correct tyre pressure.
- Check and adjust wheel bearings.
- Check and adjust wheel run out.
- Check ball joints, if they are too loose, replace them.
- Check wheel balance, correct if necessary.
- Check front suspension height.
- Check shock absorbers and replace them if they are defective.
- Check wheel tracking.

- This means whether rear wheels follow the front wheels. If the wheels are off the track, it usually means frame is bent and it should be straightened

WHEEL BALANCE:

- The wheel may be checked for balance on or off the car.
- This is done in either of two ways: static or dynamic.
- In static balancing, the wheel is taken off the car and put on a "bubble" balancer to detect any imbalance.
- A wheel that is out of balance is heavier in one section. This will cause the bubble in the centre of the balancer to move off the centre. To balance the wheel, weights are added to the wheel rim until the bubble returns to centre.
- In dynamic balancing, the wheel is spun either on (or) off the car. An electronic wheel balancer is used to balance a wheel on a car. Lack of balance shows up as a tendency for the wheel to move off the centre (or) out of line as it spins. If the wheel is out of balance, one or more weights are installed on the wheel rim.

ADJUSTING CAMBER AND CASTOR:

- By installing (or) removing shims.
- By turning a cam.
- By shifting inner shaft.
- By changing length of strut rod

ADJUSTING TOE:

After correcting camber and castor, toe is adjusted. Place the front wheels in straight-ahead position. Then check the positions of the spokes in the steering wheel. If they are not centered, they can be properly positioned when toe is set

TYRE MAINTENANCE:

The main purpose of tyres is that they have air-filled cushions that absorb most of the shocks caused by road irregularities and secondly they grip the road to provide good traction. Good traction enables the car to accelerate, brake, make turns without skidding. The main steps involved in tyre maintenance are: Always maintain the recommended tyre inflation pressure.

- Do not overload the vehicle beyond the capacity prescribed by manufacturer.
- Avoid frequent sudden acceleration followed by sudden braking.
- Do regular checks like wheel alignment, condition of brakes, springs, wheels, etc.
- Regularly inspect the tread condition very closely since it is equally important like other components.
- Retread the tyres promptly before they are completely defected.
- Replace the tyre before the tyre surface becomes smooth

CAUSES OF TYRE WEAR:

1. INFLATION PRESSURE:
    - Over inflation or under inflation will cause rapid tyre wear. Over inflation results in wear of the centre portion and under inflation results in wear of the shoulder.

2. TOE-IN OR TOE-OUT:
   - The excessive toe-in shows feathered edges on inside edges.
   - The excessive toe-out results in feathered edge wear on outside edges.
3. CAMBER:
   - Too much positive camber results in excessive wear on the outer shoulders of the tyres. Too much negative camber results in tyre wear of the inner shoulders
4. CASTOR:
   - Excessive castor causes the spotting wear of tyres. Unequal castor causes the wheel to pull to one side resulting in excessive and uneven wear.

TYRE FAILURE:

- The amount of wear a tyre gets depends upon its location of the car. For example on a car with rear wheel drive, the right tyre wears twice as much as the left tyre. This is because many roads are slightly crowned (higher in the centre) and also the right tyre is driving. The crown causes the car to lean out a little so that the right tyre carries more weight.
- To equalize the wear as much as possible tyres should be rotated any time, uneven wear is noticed as the distance specified by the manufacturer.
- One manufacturer recommends rotating radial tyres after 12000kms and then after every 24000kms. Bias tyres should be rotated every 12000kms.
- The amount of wear the tyre experiences depends upon its rotation on the car.
- On a car with rear wheel drive, the rear right tyre wears about twice as that of the rear left wheel.
- To equalize wear as much as possible, tyres should be rotated any time whenever eneven wear is noticed and at the distance specified by the manufacturer.

TYPES OF TYRE WEAR:

1. TOE-IN OR TOE-OUT WEAR:
   Excessive toe-in or toe-out on turns causes the tyre to be dragged sideways as it moves forward and this scraps off rubber.
   If both tyres show this type of wear, then toe is correct. But if only one tyre shows this type of wear, steering arm should have been bent.
2. CAMBER WEAR:
   If the wheel has excessive camber, the tire runs more on one shoulder than the other.
3. CORNERING WEAR:
   This is caused by taking curves at high speeds producing diagonal type of wear.
4. UNEVEN TIRE WEAR:
   It occurs due to various mechanical problems. These include misaligned wheels, over inflation of tyres, unbalanced wheels, etc.
5. HIGH-SPEED WEAR:
   Tyres wear more rapidly at high speed than at low speed. Tyres driven at 110-130km/hr will experience only half the life of tyres driven at 50-60km/hr

TYRE INSPECTION:

- The purpose of inspecting the tyres is to determine whether they are safe for further use. When an improper wear pattern is found, technician must know the cause for abnormal wear and should correct the problem.
- If the tyres are in good condition they can be rotated

- While inspecting a tyre, check for bulges in the side walls. A bulge is a danger signal. It can mean that plies are separated or broken and the tyre is likely to go flat. A tyre with bulge should be removed.
- To make complete tyre inspection, remove all the stones from the tread. This is to ensure that no tire damage is hidden by the stones.
- A quick way to check tread wear is with a Lincoln penny inserted in the tread grooves. Tread of atleast 0.79mm is needed.
- A tyre can look okay from outside but it may have internal damage. To completely inspect a tire it should be removed from the rim and then examine it closely, inside and out.

REMOVAL AND FITTING OF TYRE AND TUBE :

The procedure for the removal and fitting of tyre and tube is as below:

1) Loosen the wheel nuts of tyre to be removed.

2) Place the wedge before and after resting the three wheels to prevent vehicle from rolling.

3) Fix up jack and lift the vehicle to the extent that wheel is free from ground.

4) Remove the wheel after removing the wheel nuts.

5) Keep the wheel flat on ground and deflate it after removing valve with valve die.

6) Hammer the tyre at shoulder so that its bead is free from rim on both sides.

7) Press tyre lever between bead of tyre and rim flange.

8) Take another tyre lever; press it in the same way a little apart from the first lever.

9) Now press both levers down. By doing so some portion of tyre bead will come out of rim.

10) Pull out first lever and insert it again at some distance away from the second lever. Press it down.

11) Now go on changing the lever till tyre is out of the rim completely.

12) When one bead of tyre is out take out the tube after unscrewing valve body securing nut.

13) If tyre is to be completely replaced, proceed in the same way to remove the second bead.

14) In case, only tube is to be replaced, fix up the new tube.

15) Finally replace the tyre with caution using the levers and inflate it to correct pressure.

STEERING SYSTEM TROUBLE SHOOTING:

COMPLAINTS	POSSIBLE CAUSES	CHECK(OR) CORRECTION
1. Excessive play in steering system	□ Looseness in steering gear □ Looseness in linkage □ Loose wheel bearing	□ Readjust, replace worn parts □ Readjust, replace worn parts □ Readjust
2. Hard steering	□ Low tyre pressure	□ Inflate to correct tyre

	□ Friction in steering gear □ Friction in linkage	pressure □ Lubricate, readjust, replace worn parts □ Lubricate, readjust, replace worn parts
3. Car wander	□ Low or uneven tyre pressure □ Steering gear binding □ Linkage binding □ Incorrect wheel alignment	□ Inflate to correct tyre pressure □ Readjust, lubricate, replace worn parts □ Readjust, lubricate, replace worn parts □ Check alignment and readjust
4. Car pulls to one side during normal driving	□ Uneven tyre pressure □ Uneven castor or camber □ Wheel not tracking	□ Inflate to correct tyre pressure □ Check alignment, adjust □ Check tracking, replace defective parts
5. Car pulls to one side while braking	□ Brakes grab □ Uneven tyre pressure □ Uneven castor or camber	□ Readjust, replace brake lining □ Inflate to correct tyre pressure □ Check alignment, adjust
6. Front wheel shimmy at low pressure	□ Uneven tyre pressure □ Loose linkage □ Loose ball joints □ Dynamic imbalance	□ Inflate to correct tyre pressure □ Readjust, replace worn parts □ Replace worn parts □ Balance the wheels
7. Steering shakes	□ Uneven tyre pressure □ Looseness in linkage □ Looseness in steering gear □ Shock absorber defective	□ Inflate to correct tyre pressure □ Readjust, replace worn parts □ Readjust, replace worn parts □ Repair or replace
8. Tyres squeal on turns(skids)	□ Excessive speed on curves □ Uneven tyre pressure □ Front alignment incorrect □ Worn tyres	□ Take curves at slow speed □ Inflate to correct tyre pressure □ Check and adjust □ Replace tyres

SUSPENSION SYSTEM TROUBLE SHOOTING:

COMPLAINT	POSSIBLE CAUSES	CHECK(OR) CORRECTION
1. Hard or rough ride	□ Excessive tyre pressure □ Defective shock absorber □ Excessive friction in suspension spring	□ Readjust to correct pressure □ Repair (or) replace □ Lubricate, realign parts
2. Sway on turns	□ Loose stabilizer bar □ Sagging springs □ Castor incorrect	□ Tighten it □ Repair or replace □ Adjust
3. Spring breakage	□ Overloading □ Defective shock absorber	□ Avoid overloading □ Repair or replace

	□ Loose U-bolts	□ Keep bolts tight
4. Sagging springs	□ Broken leaf □ Spring weak □ Defective shock absorber	□ Replace □ Replace □ Repair or replace
5. noises	Could co me fro m any loose, worn(or) unlubricated part in the suspension(or) steering system	

DESCRIPTION:

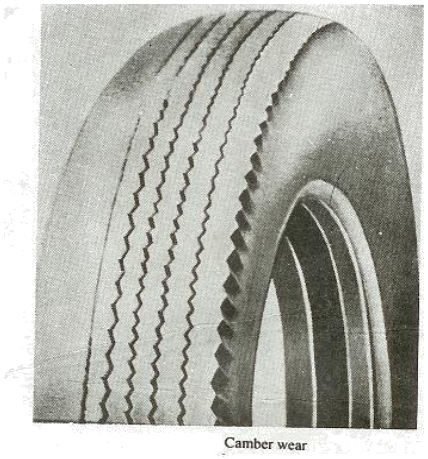
The wheel alignment refers to the positioning of the front wheels and steering mechanism that gives the vehicle directional stability, promotes case of steering and reduces tyre wear to a minimum. A vehicle is said to have directional stability or control if it can run straight down a road, enter and leave a turn easily and resist road shocks. The front wheel alignment depends upon the following terms – Camber, Caster, Kingpin inclination, toe- in and toe-out on turns. The front wheel geometry or steering geometry refers to the angular relationship between the front wheels, the front wheel attaching parts and the vehicle frame. All the above terms are included in the front wheel geometry. The various factors that affect the wheel alignment of the vehicles are given below

1. Factors pertaining to wheel
    a. Balance of wheels
    b. Inflation of tyres
    c. Brake adjustment
2. Steering Geometry
    a. Camber
    b. Caster
    c. Kingpin inclination
    d. Toe- in and Toe-out
3. Steering linkages
4. Suspension System

Camber

The angle between the centerline of the tyre and the vertical line when viewed from the front of the vehicle is known as camber. When the angle is turned outward, so that the wheels are farther apart at the top than at the bottom, the camber is positive. When the angle is inward, so that the wheels are closer together at the top than at the bottom, the camber is negative. Any amount of camber, positive or negative, tends to cause uneven or more tyre wear on one side that on the other side. Camber should not Exceed $2^{0.}$

Uneven wear due to incorrect castor.



Camber wear

Procedure

(i) Turn the wheel to 30^{υ} LHS
(ii) Adjust the sprit level such that the bubble occupies the center position.
(iii) Note the reading of the 60^{0} scale.
(iv) Turn the wheel to 30^{0} RHS and the above procedure is repeated and the value is noted.
(v) The difference between the two readings gives the camber angle.

Caster

The angle between the vertical line and the kingpin centerline in the plane of the wheel (when viewed from the side) is called the Caster angle. When the top of the king pin is backward, the caster angle is positive and when it is forward the caster angle is negative. The caster angle in modern vehicles range from 2 to 8 degrees.

Procedure

(i) Park the car on the turning table
(ii) Turn the wheel alignment gauge to 900.
(iii) Fix the wheel alignment gauge on the wheel.
(iv) Turn the wheel to 250 in RHS.

(v) Adjust the bubble to its original position

(vi) Note the reading on the 50-degree scale and the noted value will give the caster angle.

Kingpin inclination

The angle between the vertical line and center of the kingpin or steering axle, when viewed from the front of the vehicle is known as kingpin inclination or steering axle inclination. The kingpin inclination in combination with caster is used to provide directional stability in modern cars, by tending to return the wheels to the straight-ahead position after any turn. It also reduces steering effort particularly when the vehicle is stationary. It reduces tyre wear also. The kingpin inclination in modern vehicles range from 4 to 8 degrees.

Procedure

(i) Park the car on the turntable.

(ii) Fix the wheel alignment gauge on the wheels.

(iii) Turn the wheel to 300 RHS and adjust the spirit level such that the bubble occupies center position.

(iv) Note the value on the 600 scale and the value gives the kingpin inclination.

Toe- in and Toe-out

The front wheels are usually turned in slightly in front so that the distance between the front ends

(A) is slightly less than the difference between the back ends (B), when viewed from the top. The difference between these distances is called toe- in. The amount of toe- in usually 3 to 5 mm. The toe-in is provided to ensure parallel rolling of the front wheels, to stabilize steering and prevent side slipping and excessive tyre wear.

Toe-out is the difference in angle between the two front wheels and the car frame during turns. The steering system is designed to turn the inside wheel through a larger angle tha n the outside wheel when making a turn. The condition causes the wheels to toe-out on turns, due to difference in their turning angles. The toe-out is secured by providing the proper relationship between the steering knuckle, tie-rods and pitman arm.

Procedure

(i) The toe-out bar is positioned from the front of the vehicle such that the pointer touches the wheel and the distance between the wheels is found from the scale on the bar. Keep is as (A).

(ii) Similarly the distance between the front wheels on the rear side is noted. Keep it as (B).

(iii) From the readings we can find out toe- in or toe-out. If A > B, then it is toe-out and if B > A, then it is toe- in.

Toe-out on turns

(i) Park the car on the turn table.

(ii) Turn the wheel to extreme left.

(iii) The readings in both the turntable are noted. The difference in the reading will give the toe-out on left turn.

(iv) Similarly the values are calculated for the right turn.

Wheel Bearing Tightening and Adjustment

Hoist the vehicle and remove the rear wheel.

- Remove spindle cap by hammering at 3 or 4 locations.
- Remove the split pin, castle nut and washer.
- Check to ensure that the parking brake lever is not pulled up.
- Remove the back plate plug attached to the backside of brake plate, so as to increase clearance between brake shoe and brake drum.
- Remove the wheel bearings.
- Insert the new stud in drum hole after rotating the stud slowly to assure the serrations are aligned with these made by original bolt.

Ensure that all the nuts are tightened properly

BRAKE MAINTENANCE & REPAIR

Automobile braking systems are engineered to deliver precise movements to slow or stop your vehicle on demand. When you apply the brake pedal, the master cylinder generates pressure through hydraulic brake lines triggering brake pads or shoes to press against discs and/or drums that slow and stop your vehicle. The friction and heat generated wears down brake shoes, pads, calipers, rotors and other brake components.

Brake Rotor Maintenance and/or Replacement

Brake rotors and brake pads are the two most renowned items in your vehicle's braking system. The rotors are iron discs mounted to your wheel hubs which are gripped by brake pads or shoes encased in a caliper system. Slots or circular holes may be found on your brake pads or on the rotors themselves which are incorporated to circulate air to cool the brake system providing more effective braking while extending rotor longevity.

Disc Brake Repair

Most modern-day vehicles are equipped with disc brakes in both the front and rear. Disc brake systems are comprised of brake pads, calipers, rotors, and hydraulic components. Calipers squeeze brake pads against rotors to slow or bring the vehicle to a stop in disc brake assemblies. Ventilation holes or slots may be present on the rotors in order to help dissipate heat and cool the brake system. Although brake pads and rotors require the most maintenance, any portion of the disc brake assembly may need attention from time-to-time.

Drum Brake Repair

Certain vehicles are manufactured with rear drum brakes in place of rear disc brakes. Drum brake assemblies consist of brake drums, shoes, wheel cylinders, springs and self-adjusters. Brake shoes rest against the "drum" until the brakes are pressed sending brake fluid through the wheel cylinders against the brake shoes which squeeze against the drum and creates stopping power. Upon release of the brake pedal, the springs return the brake shoes back to their starting position. This self-adjusting system helps keep the brake shoes in position when the brakes are not applied. As the brake shoes wear, a self-adjuster compensates for the gap by moving the brake shoe closer to the brake drum.

Parking Brake Repair

A parking brake's sole function is to keep your vehicle stationary when parked, especially when parked on steeper grades. Parking brakes are typically synonymous with "emergency brakes" since their use can be for sudden stops to prevent accidents and operate mutually exclusive of the main braking system. A parking brake check should be part of any routine brake inspection.

SUSPENSION SYSTEM SERVICE

A suspension system undergoes tremendous abuse during normal vehicle operation. Bumps and potholes in the road surface cause constant movement, fatigue, and wear of the shock absorbers, or struts, ball joints, bushings, springs, and other components.

Suspension system problems usually show up as abnormal noises (pops, squeaks, and clunks), tire wear, steering wheel pull, or front end shimmy (side-to-side vibration). Suspension system wear can upset the operation of the steering system and change wheel alignment angles. Proper service and maintenance of these components greatly increase reliability and vehicle life.

Macpherson Strut Service

- Macpherson strut shock fails
  - Common repair procedures
    - Replace entire assembly
    - Install a strut cartridge
- Some struts are easily removed at the bottom by removing two bolts
  - Spring compressor is used to compress the coil spring
  - Some struts can be serviced with a shock cartridge
- Inspect the upper strut bearing
  - Inspect condition of upper strut bearing while strut is disassembled

- Install the coil spring
  - Install coil spring and tighten locknut
  - Be sure both ends of spring are correctly seated before removing compressor
- Reinstall in same position as before
  - Wheel alignment may be needed after strut replacement
  - Brakes will need to be bled if brake caliper was disconnected

Coil Spring Service

- Characteristics
  - Coil spring will rarely break unless it has been constantly overloaded or has a stress raiser
  - Incorrect ride height affects wheel alignment angles, camber, toe, SAI, and scrub radius
  - A vehicle that is too low cannot be aligned properly
- Adjusting spring height
  - Correct ride height must be restored prior to alignment
  - Coil springs must be replaced when they have sagged beyond specifications
- Coil spring replacement
  - Replaced in front or rear pairs
  - Replacement springs must be of the same kind
- Major considerations
  - During a coil spring replacement: only lower ball joint needs to be removed
  - Spring seats must be accurately aligned
  - Torsion bar adjusting bolt must be loosened before removing torsion bar
  - Leaf spring problems include broken leaves, spring sag, and differences in ride height

Leaf spring service

Leaf springs are likely to wear because they have several moving parts. They should be inspected at intervals specified by the car manufacturer, or at major service intervals - usually every 12,000 miles (20,000 km).

The standard leaf spring is made from several thin strips of sprung steel of different lengths and held together by clamps. It is subject to wear as the leaves rub against each other during suspension movement. To overcome this, a tapered-profile single leaf spring is fitted on some vehicles. Dirt particles between separate leaves accentuate wear and rust. The springs should be kept fairly clean in order to extend their useful life. The intervals at which this is done will be given in your car handbook. Modern leaf springs do not need lubricating with oil — which may damage any anti-friction material between leaves. Spray them instead with a silicone-based lubricant.

STEERING SYSTEM MAINTENANCE

Maintenance of the steering system consists of regular inspection, lubrication, and adjusting components to compensate for wear. When inspecting the steering system, you will need someone to assist you by turning the steering wheel back and forth through the free play while you check the steering linkage and connections. You will also be able to determine if the steering mechanism is securely fastened to the frame.

As light amount of free play may seem insignificant, but if allowed to remain, the free play will quickly increase, resulting in poor steering control after prolonged use, steering components can fail. t is important that the steering system be kept in good working condition for obvious safety reasons. It is your job to find and correct any system malfunctions quickly and properly

Steering Linkage Service

Any area containing a ball-and-socket joint is subjected to extreme movements and dirt. The combination of these two will cause the ball-and-socket joint to wear. When your inspection finds sworn steering linkage components, they must be replaced with new components. Two areas of concern are the idler arm and the tie-rod ends.

IDLER ARM SERVICE

A worn idler arm causes play in the steering wheel. The front wheels, mostly the right wheel, can turn without causing movement of the steering wheel. This is a very common wear point in the steering linkage and should be checked care fully. To check an idler arm for wear, grab the outer end of the arm (end opposite the frame) and force it up and down by hand. Note the amount of movement at

the end of the arm and compare it to the manufacturer's specifications. Typically, an idler arm should NOT move up and down more than 1/4 inch. The replacement of a worn idler arm is as follows: Separate the outer end of the arm from the center link. A ball joint fork or puller can be used to force the idler arms joint from the center link.

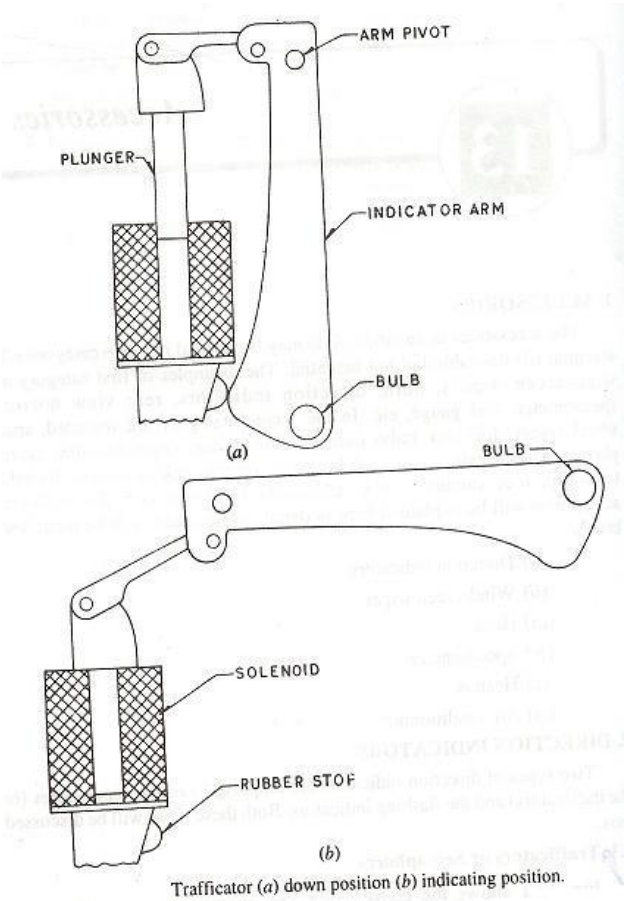
With the outer end removed from the center link, unbolt and remove the idler arm from the frame. Install the new idler arm in reverse order of removal. Make sure that all fasteners are torqued to manufacturer's specifications. Install a new cotter pin and bend it properly.

MANUAL STEERING SYSTEM SERVICE

Steering system service normally involves the adjusting or replacement of worn parts. Service is required when the worm shaft rotates back and forth without normal pitman arm shaft movement. This would indicate that there is play inside the gearbox. If excess clearance is not corrected after the adjustments, the steering gearbox must be replaced or rebuilt.

HORN SYSTEM

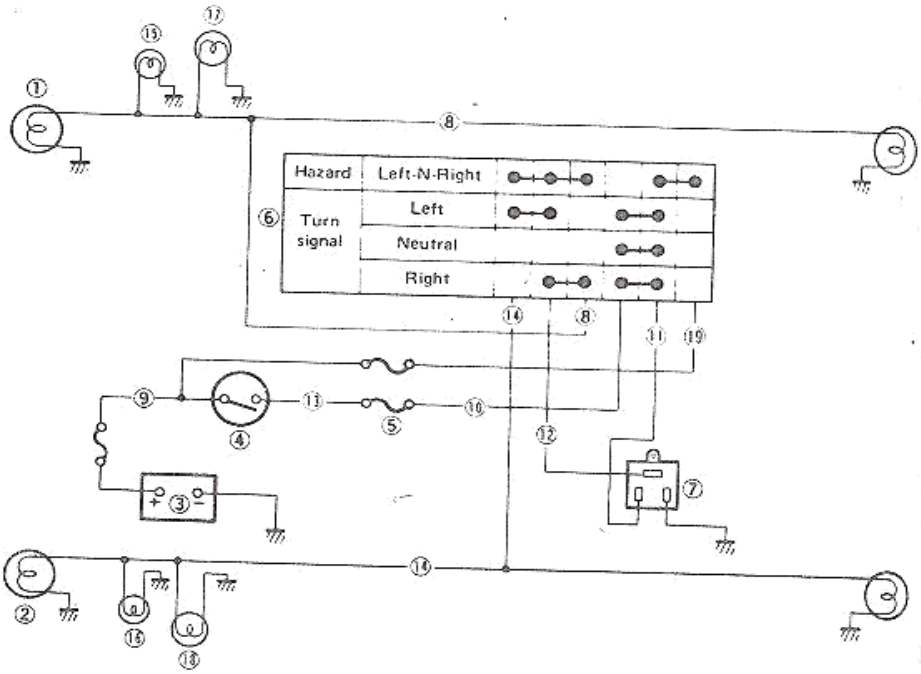
The electrically operated horn system consists of a diaphragm and an armature inside a field coil. The contacts are shown closed, which is the position when the horn switch is in the off position. When the driver pushes the horn switch the circuit is completed and the field coil produces an emf, which causes the armature along with it the diaphragm too move down, the contacts separate opening the electrical circuit. The field coil is then de energized and again the armature moves up on account of the force of a mechanical spring, which keeps it into the upper most position. This motion causes the diaphragm to vibrate in up and down motion causing the vibrations of air column below it. These vibrations of air column subsequently produce the horn sound, which depends upon the frequency of diaphragm. The horn system is used to alert the pass4ngers on the road or the other vehicles to move away.



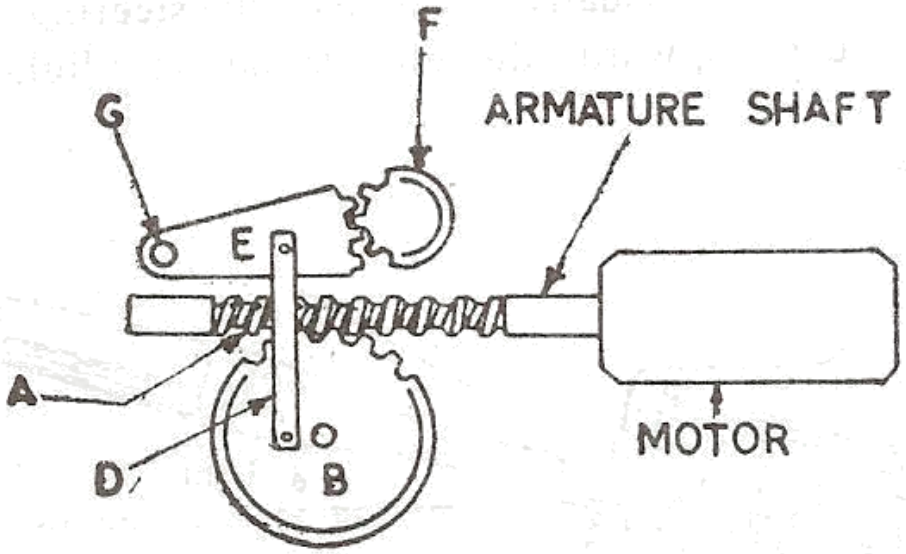
Trafficator (*a*) down position (*b*) indicating position.

TURN SIGNAL LIGHT AND HAZARD WARNING LIGHT

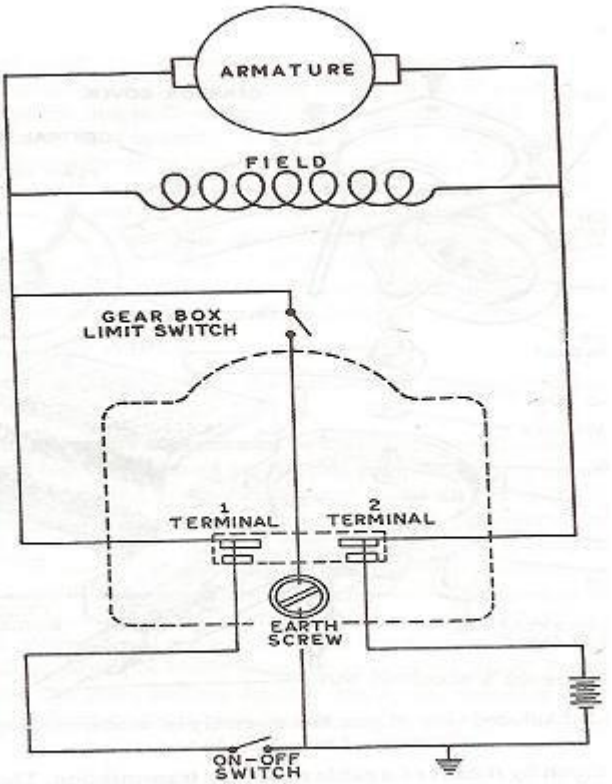
CIRCUIT DESCRIPTION



1. Right turn signal
2. Left turn signal
3. Battery
4. Main switch
5. Fuse
6. Turn signal and hazard warning switch
7. Turn signal and hazard warning relay
8. Green/Yellow
9. White/Yellow
10. Yellow
11. Yellow/Blue
12. Green
13. Black/Blue
14. Green/Red
15. Meter pilot light (Right)
16. Meter pilot light (Left)
17. Side turn signal (Right)
18. Side turn signal (Left)
19. White/Green



Windscreen wiper.



Circuit diagram for the Lucas windscreen wipe

Charging system

The function of the charging system in an automobile is to generate, regulate and supply the electrical energy for charging the battery. The charging system consists of a generator for converting mechanical energy from the engine to electrical energy, a regulator to control the amount of electrical energy so produced, a relay to regulate the flow of the charging current from the generator to the battery relevant to the state of the charge of the battery and an ammeter or indicating lamp to indicate whether the system is operating or not.

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SCHOOL OF MECHANICAL ENGINEERING

DEPARTMENT OF AUTOMOBILE ENGINEERING

SAU1307 VEHICLE MAINTENANCE AND RECONDITIONING

UNIT 5 AUTO ELECTRICAL AND AIR CONDITIONING MAINTENANCE

UNIT **V**

AUTO ELECTRICAL AND AIR CONDITIONING MAINTENANCE

BATTERIES:

TESTS CONDUCTED ON BATTERIES:

ROUTINE OR LABORATORY TEST:

- Hydraulic test – To measure specific gravity of electrolyte.
- High discharge test – To measure discharging current.
- Individual cell tests – Cell voltage can be measured.
- Cadmium test – Cell voltage can be measured.

1. SPECIFIC GRAVITY TEST (HYDORMETER TEST)
    - Specific gravity is the rate of density of given fluid to density of water.
    - Specific gravity test is performed to know the condition of the battery.

    There are two types of hydrometers.

➢ Ball type Hydrometer:

To use this hydrometer stick the rubber tube to the cell electrolyte, then squeeze and release the bulb. This draws electrolyte in to the glass tube, the no. Of balls that float indicates the batteries state of change. If all the balls float, then the battery is fully charged. If no balls float, then the battery is fully discharged.

➢ Float type hydrometer:

This has float with stem that sticks up above the electrolyte level in the tube. The float stem s marked to indicate the specific gravity of the electrolyte. The height of the stem above the electrolyte indicates batteries state of change.

2. CADMIUM TEST:
    - ➢ This test is performed to know the chemical condition of plates and it is performed when the battery is either on-charge or discharge.
    - ➢ A cadmium rod is enclosed in a perforated ebonite tube and is immersed in electrolyte. Then the rod is connected to the negative terminal of voltmeter and the positive terminal of voltmeter is connected alternatively to positive and negative terminals of the battery cell.
    - ➢ The voltmeter shows reading for both positive and negative terminals .The 2 readings are then added to obtain potential difference between the plates. The plate in good condition will show potential difference of above 0 for positive plate and below 0 for negative plates.

3. HIGH RATE DISCHARGE TEST:
    - This test determines actual capacity of the battery that converts chemical energy into electrical energy.
    - This test should be conducted only if specific gravity of the electrolyte is more than 1.215.
    - The prods of the tester are placed on the cell terminals and the voltmeter indicates the cell voltage. The duration the test is very small since high current of 100A – 200A flows across resistance.
    - For a 12V battery, if the cell is fully charged, the test should show a battery voltage not less than 10V and other cells should show the same reading.
    - Lower voltage readings indicate faulty cells or cell is not in proper position to hold full charge.
4. OPEN VOLT TEST:
    - To conduct this test, very accurate and sensitive voltmeter is required.
    - For a 2V cell, if a battery cell is in good condition and fully charged, it must have a open circuit voltage of 2.15V.
    - The batteries which have been just charged should not be tested since gases on the plates would cause high reading. These gases should be eliminated by subjecting the battery to high discharge for few moments and we have to measure the open circuit voltage.
    - If the voltage is 2.15V for 2V battery cell, then it indicates it is fully charged. Here 0.01 volt of open circuit voltage = 0.01 specific gravity of electrolyte. Therefore, voltage of the cell = specific gravity + 0.840.

INSTALLING THE BATTERY:

- Batteries should be fitted in easy accessible position.
- Battery connecting cables should be flexible ad sufficiently long to prevent strain on battery.

ELECTTROLYTE LEVEL:

- Check the level of the electrolyte periodically once in forth night or every 800 km.
- Add pure distilled water as necessary.
- Electrolyte level should be 1/4th above the top of separator.

TERMINAL CONNECTION:

- Clamp connections to the terminal post must fit well to avoid contact resistance.
- All the corrosion products should be removed.
- Terminals should be washed, dried and covered with vasoline.

VENT PLUG:

- Keep vent holes free from dust disposition.

BATTERY CHARGING:

- Batteries must be fully charged to have uniformity of the specific gravity readings and voltage of the cells.

TEMPERATURE OF THE ELECTROLYTE:

- The temperature of the electrolyte must not exceed 50°C during charging.
- Over charging, undercharging and over-discharging must be avoided.
- If the specific gravity of the electrolyte is 1.28, it indicates the battery is fully charged. If the specific gravity of the electrolyte is 1.125, it indicates that battery is fully discharged and it is corrected to 27°C.

MAINTENANCE OF STARTER MOTOR:

- Starter motor needs lubrication only during overhaul or it requires lubrication every 5000 miles or 300 hours of operation.

Trouble Shooting:

- Visual and electrical checks should be made.
- Check the battery voltage and specific gravity.
- Inspect the wiring for proper insulation.
- Make sure all ground connections are clear and tight.

There are 4 common symptoms that indicates defect in the starter systems.

- Starter springs freely.
- Engine cranks noisily.
- Engine cranks slowly.
- Engine does not crank.

Inspection and Repair:

The various parts line brushes , brush holder, armature and the field coils should be inspected and repaired.

MAINTENANCE OF GENERATORS:

- The maintenance of generator infact includes mainly its lubrication, brush wear inspection and adjustment of belt.

- Certain generators do not need lubrication as their bearings are pre-packed with grease whereas other models should be lubricated at the appropriate holes provided for this purpose after intervals of 10,000 Km.
- The brushes should be inspected after every 30,000km and should be replaced if their wear is found to be more than specified value.
- This inspection should be done on and off to see that there is enough tension.
- The sagging when present at the middle of the belt should be about 12mm.
- If the belt is too tight, it is liable to damage the water pump gland and generator bearings.
- On the other hand a very loose belt will not drive the generator efficiently and also ensure that generator pulley does not become oily as this will cause the belt to slip.

TESTING OF GENERATOR – REGULATOR SYSTEM:

- An accurate ammeter is connected in series in the battery circuit. The reading on the ammeter gives the charging rate.
- The state of the battery is tested with the hydrometer.
- From the above two observations any of the four conditions is found to exist.

a) Discharged battery and a high charging rate.

b) Charged battery and low charging rate.

c) Charged battery and high charging rate.

d) Discharged battery and a low charging rate.

Out of these (a) and (b) are the normal conditions and the remaining 2 conditions may be investigated to locate the source of the trouble.

c) →Investigation of charged battery and high charging rate:

- Run the generator at medium speed.
- Disconnect the F load at the regular terminals, thereby opening the generator field circuit. I
- f this causes the generator output to drop, it indicates that generator is alright and so took for the trouble in the regulator.

d) → Investigation of discharged battery and low charging rate: \

- The possible for this may be - Defective wiring or loose connection.
- If on inspection, the connections are found to be correct and this leads to good condition short cut the generator field circuit in the regulator.
- With the generator running at medium speed and the generator field circuit shorted.
- If the output increases, the fault lies in the regulator.
- If the output does’nt increase, it indicates a faulty generator.

GENERATOR FAULTS AND THEIR DIAGNOSIS;

1. No ouput:

a) Visual inspection:

- If the generator is not giving any output, the first step is to remove the cover band and have visual inspection.
- Check for sticking brushes , burnt commutator and loose connections.
- If everything looks alright, disconnect the generator leads and proceed with further tests with the help of test-lamp.

b) Ground test:

- Insert some paper or some other insulation between commentator and the grounded brush.
- Check for the ground with test lamp between generator brush and the frame.

c) Open field test:

- Place the test lamp between the armature and generator field terminal.
- If the lamp does'nt light, the field circuit is open.

d) Short field test:

- Connect a battery of the specified voltage and ammeter in series with the field circuit.
- If the current flow is higher than the specified value by the manufacturer, the field coils are shorted and replaced.

2. Low or unsteady output:

- The following are the causes for it.
- Generator drive belt may be loose and be slipping.
- Worn out brushes.
- Defective brush spring.
- Dirty or worn out commutators

3. Excessive output:

- In the externally grounded field type of generator, excessive output is caused because of internal grounding of the field circuit, which prevents excessive regulation.
- This may be tested by connecting the test lamp between 'F' terminal and the generator frame, with the 'F' leads disconnected and some insulation is placed between the commutator and field brush.
- If the test lamp lights the field is internally grounded.

4. Excessive noise: Excessive generator noise may be due to:

- Loose drive pulley.
- Worn out bearings.
- Worn out commutator.
- Improperly seated brushes.

ALTERNATOR MAINTENANCE:

An alternator in an AC generator producing alternating current instead of direct current.

- At regular intervals , inspect the terminals for corrosion and loose connection.

- Check for mounting bolts, nuts and belts.

- Adjust the belt tension according to the recommendation of manufacturer of engine.

- Check for noisy operation that may be due to worn out bearings.

On car test:

- Some tests can be made on charging system without disconnecting or removing any part from the car. Tests are for voltage and are made with a voltmeter.
- Begin with a charged battery and ignition off, clip meter probe to the positive terminal of the car battery, other to negative terminal. Read the voltage which will be about 12V. This is battery reference voltage.
- Now run the engine at fairly high speed with lights and all accessories off. Read the voltage on meter again and compare it to reference voltage.
- If the voltage has not changed, the alternator is probably defective. To test the alternator, if voltage is 2 or more volts higher the reference voltage, regulator is defective and should be replaced. If the voltage increase fall between 0 and 2V, then make the next test.
- Now run the engine at high speed with all the lights and accessories switched on. If the voltage increases by ½ volt or above reference voltage, then alternator and voltage regulator are ok. If the voltage s increased by less than ½ volt, then proceed with the test.
- Now run the engine off, then disconnect probe s of the voltmeter. Reclip one of the probes to the alternator terminal (BAT) and other probe to the ground. Restart the engine with lights and accessories on at high speed again. If the voltage does not increase more than ½ reference voltage, turn off the engine and check alternator for the defects. If the voltage increases by more than ½V then the regulator is defective.

- <u>ALTERNATOR TESTS:</u>
- 1) Rotor test:

Connection:	Reading:	Result:
Ohm meter from slip ring to shaft.	Very low.	Grounded.
110V test lamp from slip ring to	Lamp glows.	Grounded.

shaft.		
Ohm meter across slip rings.	Very high.	Open.
110V lamp across slip rings.	No light.	Open.

2) Stator test:

Connection:	Reading:	Result:
Ohm meter from load to frame.	Very low.	Grounded.
110V test lamp from load to frame.	Lamp glows.	Grounded.
Ohm meter across each pair of leads.	Very high.	Open.
110V lamp across each pair of leads.	No light.	Open.

3) Diode test:

Connection:	Reading:	Result:
Ohm meter across diode then reverse connections.	a) Both readings very low. b) Both readings very high.	Shorted. Open.
12V test lamp across diode and then reverse connections.	a) No light in both checks. b) Lamp lights in both checks.	Open. Shorted.

REGULATOR MAINTENANCE:

- Inspect for burning of various regulator contacts. The contacts are burnt due to excessive current caused by faulty connections.
- Even during normal operation, a small arc occurs during each time the regular contacts open and oxide formation takes place in the contacts and hence cleaning or replacement is required. If oxide formation is small, contacts must be cleaned and if there are large oxide deposits then the points may be.

IGNITION SERVICE:

CAUSES FOR IGNITION FAILURE:

1. Loss of energy in primary circuit: This may be due to:
   - Improper point setting
   - Discharged battery.
   - Defective generator.
   - Defective condenser.
   - Grounded primary circuit.
2. Loss of energy in secondary circuit: This may be due to:
   - Fouled plugs.

- Defective high tension winding.
- Defective connection in the high tension circuit.
- High tension leakage across coil head , rotor.

3. out of time:

   This may be due to:
   - Improper ignition timing.
   - Defective vaccum advance mechanism.
   - Defective centrifugal advance mechanism.
   - Worn distributor shaft.
   - Pre-ignition due to fouled plugs.

IGNITION TIME-UP:

- Test the battery and cables.
- Test the ignition coils and condenser.
- Test the distributor.
- Select the high tension wiring.
- Check the contact points.
- Check the spark plugs.

MAINTENANCE OF LIGHTING SYSTEM:

Adjusting Head light:

- It is necessary to focus the bulb before aiming.
- Adjustment of the bulb can be made by moving the bulb back and forth with respect to reflector.
- Aim the head lights such that it points correctly both horizontally as well as vertically.

Head light Aiming:

There are two aiming devices in use:

1. Screen.
2. Prism and reflector.

1. Screen test:

- A screen on which the head light pattern can be studied with the vehicle located 25 feet infront of the screen.
- Draw 3 lines A,B,C. Distance AB should be centre distance of headlights and distance C should be headlight centre height from the ground. Now switch on the light. The majority of light should fall on the lower portion of screen and if the light rays are not focussed properly, then it has to be adjusted.

2.Prism and reflectors:

- This does not require so much room. This method consists of series of prisms and reflectors that show an accurate miniature pattern of the head light beam and miniature screen.
- Adjusting screw and mounting bracket nuts must be turned or loosened to permit swinging of light up or down or from one side to others.

ELECTRIC HORN CIRCUIT:

HORN POSSIBLE CAUSES AND REMEDIES:

Producing weak signal:

- Check whether the voltage is less than 5.25V (11 volts mormally) and test fro battery.
- Use jumper lead to check relay as the cause for drop.

No sound:

- Check for open circuit.
- Remove shell and inspect contact points.

Worn out parts.

- Otherwise winding may be open, so replace it.

GAUGES:

ENGINE TEMPERATURE GAUGE:

- The engine temperature gauge is mounted on the intake manifold or at cylinder head.
- This type of fuel gauge checks the temperature of engine cooling system. It cautions the driver by indicating engine is over heated and this may lead to damage of engine parts, especially piston.
- In this figure, the operating current is supplied from battery through the ignition switch to both dash unit as well as engine unit.
- Throughout the operation of the gauge, the current flowing through the left coil is constant whereas the current flowing through the right coil changes depending on the water temperature.
- When the water is cold, the battery current flows to the earth through the left coil. This causes armature with pointer to move to left and indicating that it is cold.
- When is gets heated up, the resistance decreases and more amount of current flows to the right coil. This results in stronger magnetic field in the right coil. Hence the armature with the pointer indicates that it is hotter.

Testing:

Check the wire connection from ignition switch to the gauge for faults. During starting blue - light glows indicating cold condition.

At 125°F – Again blue light glows indicating cold condition. At 245°F – Red light glows indicating hot condition.

If the bulb does not light:

- Disconnect and check for bulb.
- Grounding of switching is checked.
- If necessary replace temperature switch.

FUEL GAUGE:

- This mainly consists of 2 units, dash unit and tank unit. These both are connected in series with suitable wire.
- When the ignition switch is switched on, the current flows from battery to both units.
- The tank consists of a float connected to the one end of hinged arm and other end is connected to sliding content.

- The sliding contact moves along resistance. The float moves up or down according to the fuel level in the tank.
- When the fuel level in the tank is empty then, the sliding contact moves to the left and thus more current flows to the left coil in the dash unit and only little pass through the right hand coil. The armature along with pointer moves to the left indicating the fuel level in the tank.
- Similarly when the fuel level in the tank is high, then the float moves up and the sliding contact moves to the right and thus more current flows to the right coil in the dash unit than the left coil. Now the right coil is magnetically stronger than the left coil. The armature with the pointer moves to the right indicating fuel level is high.

Testing :

- If the gauges are inaccurate, then calibrate it.
- If the voltage reading is steady, then change the regulator.
- If the resistance is around 8 to 12 ohms, float will be in upward position.
- If the resistance is around 60 to 80 ohms, float will be in downward position.

ELECTRIC FUEL PUMP:

TROUBLE SHOOTING:

1. INSUFFICIENT FUEL DELIVERY:

Causes:

- Clogged filter screen in the pump.
- Restriction in fuel line.
- Incorrect float lever, malfunctioning of inlet needle in carburetter.
- Vapour trapped in fuel.
- Air leak on inlet side of fuel pump.

Remedies:

- Clean or replace filter.
- Repair fuel line or remove restriction.
- Check the vapour lock.
- Tighten and clean all connection of the pump.
- Clean gas cap or tank vent.

2. PUMP NOT OPERATING:

Causes:

- Damaged wiring.
- Loss of ground.

Remedies:

- Inspect mountings and all the wirings.
- Clean frame on which pump is mounted.
- Replace fuse.

3.CARBURETTOR FLOODING:

Causes:

- Worn needle and seat assembly in carburettor.

- Too much pressure due to wrong model fuel pump.
- Air leak on inlet side of fuel pump.
- Increased pressure due to fuel pump.

Remedies:

- Replace the worn needle.
- Reduce the pressure.

Headlights, Trafficator lights and Parking lights

The requirements of headlights for automobile are that this should illuminate the road ahead at the reasonable distance with sufficient intensity.

The trafficator are shown in the diagram. A solenoid contains a plunger, which is further connected with the pivoted indicator arm. When the vehicle has to take a turn, the driver operates the trafficator switch. This energies the solenoid which pulls the plunger down so that the indicating arm is lifted up to the horizontal position. The direction of the vehicle about to turn is indicated by it.

Windscreen wiper

Windscreen wiper is operated by mea ns of a small motor. The motor drives the worm „A‟ which rotates the wheel „B‟, the sector „E‟ reciprocates about the fulcrum. This motion is then imparted to a similar sector „F‟ on the spindle on which it is mounted the wiper arm. Wiper blade is attached to the wiper arm by means of a spring lock. A rubber-wiping element is held in place in the wiper blade. When the motor rotates the wiper blade wipes off the glass.

Description :

Soldering

Soldering is the process of joining two or more pieces of metal by means of fusible alloy or metal called solder, applied in the molten state.

Soldering is basically of two types.

1. Soft soldering
2. Hard soldering

Soft soldering

It is used extensively in sheet metal work for joining parts that are not exposed to the action of high temperatures and are not subjected to exclusive loads and forced.

Hard soldering

- It employs solders which melt at high temperatures and are stronger than those used in

soft soldering.

- Silver soldering is hard soldering method and silver alloyed either tin uses a solder. The temperature of

- various hard solders varies from 600 to 900 degrees. The fluxes are mostly in the form of paste and are

- applied to joint with a brush before heating.

Denting

- The process of body repairing and refinishing is called denting. It mainly involves sheet metal works in

- which the damaged body panels and fenders are straightened or given profiles to make them look like the original item.

The need for denting of a vehicle arises when,

- The fenders, doors or panels are junked.
- Panels are twisted after collision.
- A series of ridges are seen on certain area.
- A damaged wrinkled panel is to be straightened.
- A protruding sheet metal is to be pressed back into position.
- The patches or scratches have come up and the original colour has faded.

The denting is also called as dinging process which involves number of processes such as bending, flattening, shearing, filling, painting, colour matching etc. These processes are performed with the help of modern tools are equipments most of which are described. Some tools are very common and essential for the denting and are generally referred as denting tools. These are fender-straightening hand tools, center punches, metal shears, pull rods, dolly blocks, dinging hammers et.

Window rising mechanism

Windows are provided in the upper part of the doors. They are used to admit natural light when closed and allow inflow of air when open. To provide additional passenger space without increasing the overall vehicle width, the window glasses are curved at passenger shoulder level. They are made of one-piece safety glass of bout 5 – 6 mm thickness. Like windshield glass they are also made of toughened (tempered) or laminated glass. The window can be raised or lowered by means of a window lever through mechanism. A rack and pinion mechanism is employed for

this purpose.

Door locking mechanism:

To open form outside

As soon as the push button is pressed, the catch is raised upwards and the slotted disc rotates and free from the U- fitting. When the catch is raised up, locking bar is also raised up with the catch. When the U-fitting is free from slotted disc, the door is opened.

To open from inside

To unlock the door from inside, the locking bar is raised initially and then inside opening lever is pulled up. If this inside opening lever is pulled up the catch is raised and the slotted disc rotated and fee from the U- fitting.

Door in closed position

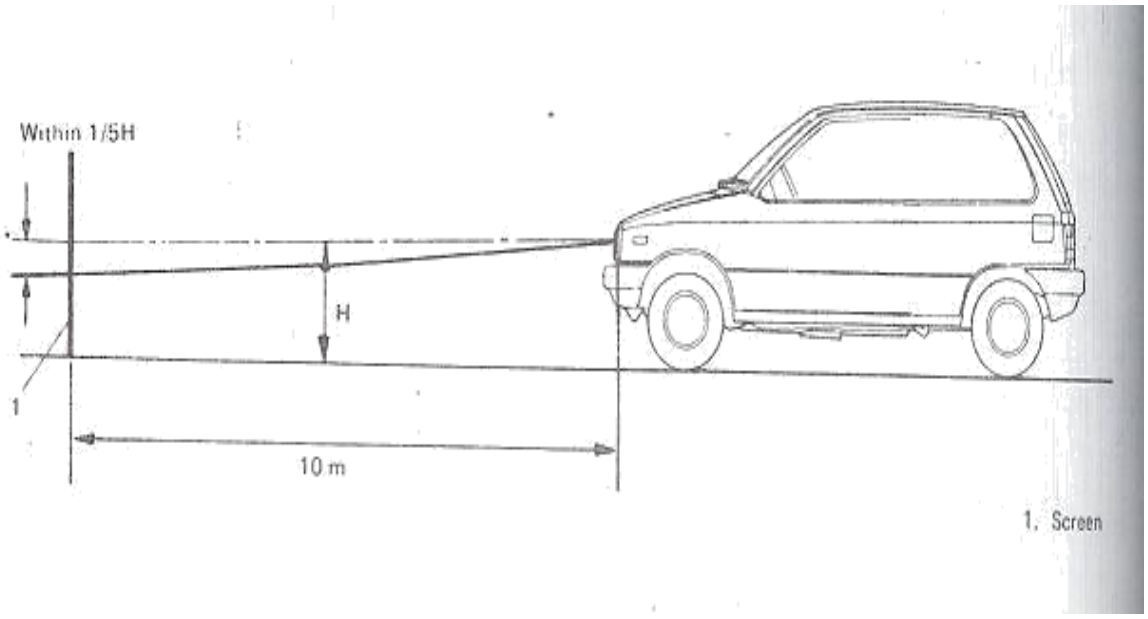
When the door is closed the slotted disc rotates and fastens into the V- fitting. During this operation the catch with locking bar is also selected into the slot. Once the slotted side fastens the V- fitting, the door is locked

Adjustment of head light beam :

The headlights of a vehicle have to be focused to ensure that light falls at proper angle on the road. To adjust these proceed as follows

Park the vehicle on level ground 25 feet away from a white wall. Draw three lines A, B and C. Distance AB should be center distance of headlights and distance C should be headlight center height from the ground. Now switch on the light. The majority of light rays should fall on circular area as shown. If one light ray goes up, down or sidewise, it should be adjusted through adjusting screws fixed in the headlamp body as shown

Finally replace the tyre with caution using the levers and inflate it to correct pressure



ROUTINE MAINTENANCE SCHEDULE -AIR CONDITIONING

3, 6, 9 monthly

- Inspect & clean air filter as per unit maintenance manual.
- Check unit heats & cools.
- Check unit for noise and vibration (both indoor and outdoor units).
- Check refrigerant pipe connection for signs of leakage.
- Remove rubbish & dust accumulation from outdoor coil fins.
- Check and clean indoor unit condensate tray and drain

12 monthly

- Carry out 3 monthly tasks.
- Check all electrical connections, controls and safety functions.
- Clean coil and straighten damaged fins on both the indoor and outdoor units.
- Check suction & discharge operating pressure.
- Check operation of de-ice controls, HP, LP safety controls & compressor contactor.

AIR CONDITIONING SERVICE COMPONENTS

1**. Compressor:**

An air conditioning compressor is a pump that moves the refrigerant thru the whole system. Some units have a two-speed compressor or two separate compressors on the same units. This feature allows the system to work on a low and high speed, low speed for mild temperature days and high speed for very hot or cool days.

2. Blower motor:

It's the motor that pushes the air flow from your air handler system thru your duct work and vents. Some AC systems have a multi-speed blower motor and others have a variable speed blower motor. The multi-speed motors have a low, medium and high setting which is set during the installation process. The variable-speed motor changes on its own from low to high speed - making the system work on a low profile and thus more efficient. Variable speed motors are great for humidity control.

3. Evaporator Coil:

The Evaporator coil is located in the air handler unit and is part of the system that removes the heat or cool from the conditioner space. While the compressor is moving refrigerant thru the Evaporator coil during the cool temperature setting, the hot air from the conditioner space gets stuck on the evaporator coil and is removed outside the area. The process is reversed when the HVAC system is running on heat mode.

4. Condenser Coil:

The Condenser Coil is located on the outdoor unit or heat pump system. When the refrigerant comes back from the evaporator coil it travels thru the condenser coil at hot temperatures, dissipating the heat from the conditioner space. The same process is true in the winter, only cold temperatures are dissipated in this way. That's why if you put your hand on top of the outdoor unit you will feel hot air coming out when the AC is on or cool air if system is running on heat mode.

5. Filtration:

Every air handler has a filtration system of some kind. These filters come in a variety of sizes and types. The most common is the standard 1" air filter, but other systems may use a 5" air filter, a media filter or an electronic filter. Each of these filtration methods requires some type of maintenance to be performed either monthly or every couple of months.

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