UNIT 4 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 beinspected 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 voltageregulator 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

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" airfilter, 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

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. Sometools 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