MODULE CONTENT

| Unit of Competency | **DIAGNOSE AND REPAIR CHARGING SYSTEM** |
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| Module Title | **DIAGNOSING AND REPAIRING CHARGING SYSTEM** |
| Module Descriptor | This unit covers the knowledge, skills and attitudes required to diagnose and repair charging system and its component |
| Nominal Duration | **hours** |
| Summary of the Learning Outcomes: | |
| Upon completion of this module the student must be able to: | |
| LO1. Prepare to diagnose and repair charging system | |
| LO2. Diagnose charging system | |
| LO3. Repair charging system | |
| LO4. Complete work processes | |

**LEARNING EXPERIENCES**

**LEARNING OUTCOMES NO. 2**

**DIAGNOSE CHARGING SYSTEM**

| **Learning Activities** | **Special Instructions** |
| --- | --- |
| Read Information Sheet 3.1-1 Diagnose charging system | If you have some problem with the content of the information sheet don’t hesitate to approach your Trainer.  If you feel that you are now knowledgeable on the content of the information sheet, you can now answer the self-check provided in the module. |
| Answer Self-Check 3.1-1 on Diagnose charging system | Try to answer the Self-check without looking at the Answer Key  Compare your answer to Answer Key 3.1-1 |
| Observe Trainer’s demonstration on Task Sheet 3.1-1 on Diagnose charging system | Listen carefully and attentively so that you may be able to perform a task correctly  Ask questions if are in doubt for clarification |
| Perform the Task Sheet 3.1-1 on Diagnose charging system | Remember the step-by-step procedure of the Diagnose charging system |
| Evaluate the performance using the Performance Criteria Checklist 3.1-1 | Repeat the task in case fail to meet the criteria |

**INFORMATION SHEET 1.1-1**

**DIAGNOSE CHARGING SYSTEM**

**Learning Objectives:**

After reading this **Information Sheet**, you must be able to:

1. Inspection of alternator components operation
2. Repair and replacement of alternator
3. Inspection and repair of charging system circuit

**CHARGING SYSTEM**

PRELMINARY CHECKS

The key to solving charging system problems is getting to the root of the trouble the first time. Once a customer drives away with the assurance that the problem is solved, another case of a dead battery is very costly—both in terms of a free service call and a damaged reputation. Add to this the many possible hours of labor trying to figure out why the initial repair failed, and the importance of a correct initial diagnosis becomes all too clear.

Safety Precautions

Disconnect the battery ground cable before removing any leads from the system. Do not reconnect the battery ground cable until all wiring connections have been made.

Avoid contact with the AC generator output terminal. This terminal is hot (has voltage present) at all times when the battery cables are connected.

The AC generator is not made to withstand a lot of force. Only the front housing is relatively strong. When adjusting belt tension, apply pressure only to the front housing to avoid damaging the stator and rectifier.

When installing a battery, be careful to observe the correct polarity. Reversing the cables destroys the diodes. Proper polarity must also be observed when connecting a booster battery, positive and negative to ground.

Keep the tester’s carbon pile off at all times, except during actual test procedures.

Make sure all hair, clothing, and jewelry are kept away from moving parts.

Inspection

In addition to observing the ammeter, voltmeter, or indicator light, there are some common warning signs of charging system trouble. For example, a low state of battery charge often signals a charging problem, as does a noisy AC generator.

Many charging system complaints stem from easily repairable problems that reveal themselves during a visual inspection of the system. Remember to always look for the simple solution before (Figure 19-32) performing more involved diagnostic procedures. Use the following inspection procedure when a problem is suspected.

PROCEDURE

Inspections

STEP 1 Before adjusting belt tension, check for proper pulley alignment, especially critical in serpentine belts.

STEP 2 Inspect the generator drive belt. Loose drive belts are a major source of charging problems. The correct procedure for inspecting, removing, replacing, and adjusting a drive belt I shown in Photo Sequence 15.

STEP 3 Inspect the battery. It might be necessary to charge the battery to restore it to a fully charged state. If the battery cannot be charged, it must be replaced. Also, make sure the posts and cable clamps are clean and tight, because a bad connection can cause reduced current flow.

STEP 4 Inspect all system wiring and connections. Many automotive electrical systems contain fusible links to protect against overloads. Fusible links can blow like a fuse without being noticed. Also, look for a short circuit, an open ground, or high resistance in any of the circuits that could cause a problem that would appear to be in the charging system.

STEP 5 Inspect the AC generator and regulator mountings for loose or missing bolts. Replace or tighten as needed. Remember that the circuit completes itself through the ground of the AC generator and regulators. Most AC generators and regulators complete their ground through their mountings. If the mountings are not clean and tight, a high resistance ground will result.

Figure 19-32 Start your diagnosis with an inspection of the generator and its drive belt and wires.

If the vehicle passes all preliminary visual checks, listen for noisy belts, bad hearings, or the whining sound of a bad diode. If no unusual sounds are heard, it is time to test the charging system.

GENERAL TESTING PROCEDURES

Diagnosing a charging system is a straightforward task. Test can be conducted with a VAT, current probe, DMM, or a lab scope. Charging system test for all cars are basically the same; however, it is very important to refer to the manufacturer’s specifications. Even the most accurate test results are no good if they are not matched against the correct specs.

Regulator Tests

Begin your diagnosis by determining if a no-charge problem is caused by the generator or the regulator. To do this, you must first determine if the system has an integral regulator, then whether it has a type-A or type-B field circuit. A type A has one brush connected to the battery terminal and the other brush grounded through the regulator. Type-B circuits have one brush directly grounded and the other connected to the regulator.

With this knowledge you can isolate the problem to the generator or regulator by bypassing the regulator or full-fielding the generator. To do this on a type A, ground the wire going from the brush to the regulator. On a type B, apply battery voltage to the wire going from the brush to the regulator. Turn the vehicle’s high beam headlights on and start the engine. If the charging system now has an output, the problem is the regulator. It is important that the lights be turned on. The drain on the electrical system protects the vehicle’s computers from excessive voltage and helps absorb any damaging voltage spikes. Because the computer systems are so sensitive to voltage, many manufacturers recommend that a full-field test not be done.

A poorly performing charging system is rarely caused by a faulty regulator; therefore, it is not necessary to check it. A bad regulator can cause excessively high voltage outputs.

Voltage Output Test

To check the charging system’s voltage output, begin by measuring the battery’s open circuit voltage. Connect the voltmeter across the battery and note the reading on the meter. Next, start the engine and run it at the suggested rpm for this test (usually 1,500 rpm). With no electrical load, the voltage reading should be about 2 volts higher than the open circuit voltage.

A reading of less than 13.0 volts immediately after starting the engine indicates a charging problem. No increase in voltage means the system is not producing voltage. A reading of 16 or more volts indicates overcharging. A faulty voltage regulator or control voltage circuit are the most likely causes of overcharging.

If the unloaded charging system voltage is within specifications, test the output under a load. To do this, increase engine rpm to about 2,000 rpm and turn on the headlights and other high-current accessories. Under these conditions, the output should be about 0.5 volt above battery open circuit voltage.

Current Output Test

Using a VAT is an easy way to check the amperage output of a charging system. With the tester connected to the system, the engine is run at a moderate speed and the carbon pile is adjusted to obtain maximum current output. This reading is compared against the rated output. Normally, reading that are more than 10 amperes out of specifications indicate a problem.

Field Current Check

Low generator output can be caused by worn brushes, which limit field current. To measure field current, place a current probe or the VAT’s inductive pickup over the field wire at the generator. Now load the charging system with the carbon pile to bring the generator to full output. Observe the ammeter reading on the tester. The procedure for measuring field current is different for generators with an integral regulator and those procedures vary with the model of generator, so follow the instructions given by the manufacturer.

Diode Checks

The output of a generator is highly dependent on the condition of the diodes. Not only for the diodes rectify AC voltage to DC, they also prevent AC voltage from being present in the output. Bad diodes are indicated by the presence of more than 0.5 AC volt in the output wire. To check this, set the DMM to measure AC volts. Then connect the black meter lead to a good ground and the red lead to the generator’s battery terminal.

Another check of the diodes while they are still in the generator is done with the engine off and with a low-amperage current probe. measure the current on the generator’s output wire. Any measurement greater than 0.5 milliamp indicates one or more diodes are leaking and the generator or diodes need to be replaced.

Oscilloscope Checks

AC generator output can also be checked using an oscilloscope. Figure 19-33 illustrates common AC generator voltage patterns for good and faulty generators. The correct pattern looks like the rounded top of a picket fence. A regular dip in the pattern indicates that one or more of the coil windings is grounded or open, or that a diode in the rectifier circuit of the diode trio circuit failed. One or more bad or leaking diodes the output of a generator.

Figure 19-33 AC generator oscilloscope patterns: (A) a good AC generator under full load, (B) a good AC generator under no load, (C) a shorted diode and/or stator winding under full load, and (D) an open diode in diode trio.

Circuit and Ground Resistance

These tests measure voltage drop within the system wiring. They help pinpoint corroded connections or loose or damaged wiring.

Circuit resistance is checked by connecting a voltmeter to the positive battery terminal and the output, or battery terminal of the AC generator. The positive lead of the meter should be connected to the AC generator output terminal and the negative lead to the positive battery terminal. To check the voltage drops across the ground circuit, connect the positive lead to the generator housing and the negative meter lead to the battery negative terminal. When measuring the voltage drop in these circuits, a sufficient amount of current must be flowing through the circuit. Therefore, turn on the headlights and other accessories to ensure that the AC generator is putting out at least 20 amps. If a voltage drop of more than 0.5 volts is measured in either circuit, there is a high resistance problem in that circuit.

AC GENERATOR SERVICE

When the cause of charging system failure is the AC generator, it should be removed and replaced or rebuilt. Whether it is rebuilt or replaced depends on the type of generator it is, the time and cost required to rebuild it, your shop’s policy, and your customer’s desires. Many late-model AC generators are not rebuilt. They are traded in as a core toward the purchase of a new or remanufactured unit. Just in case you do need to rebuild one, Photo Sequence 16 is given as an example of what it takes to do so. This procedure is for a specific type and model of generator. Make sure you follow the procedures given by the manufacturer for the generator you are working on.

To test the components of an AC generator it must be removed and disassembled.

A faulty AC generator can be the result of many different types of internal problems. Diodes (Figure 19-34), stator windings (Figure 19-35), and field circuits (Figure 19-36) may be open, shorted (Figure 19-37 and Figure 19-38), or improperly grounded. The brushes or slip rings can become worn. The rotor shaft can become bent and the pulley can work loose or bend out of proper alignment.

Figure 19-34 Using an ohmmeter to test a diode trio.

Figure 19-35 Testing a stator for opens.

Figure 19-36 Testing rotor for opens.

Figure 19-37 Testing a stator for a short to ground.

Figure 19-38 Testing a rotor for a short to ground.

Follow service manual procedures when removing and installing AC generator. Remember, improper connections to an AC generator can destroy it.

Follow service manual procedures for disassembling, inspecting, testing, and rebuilding AC generators.