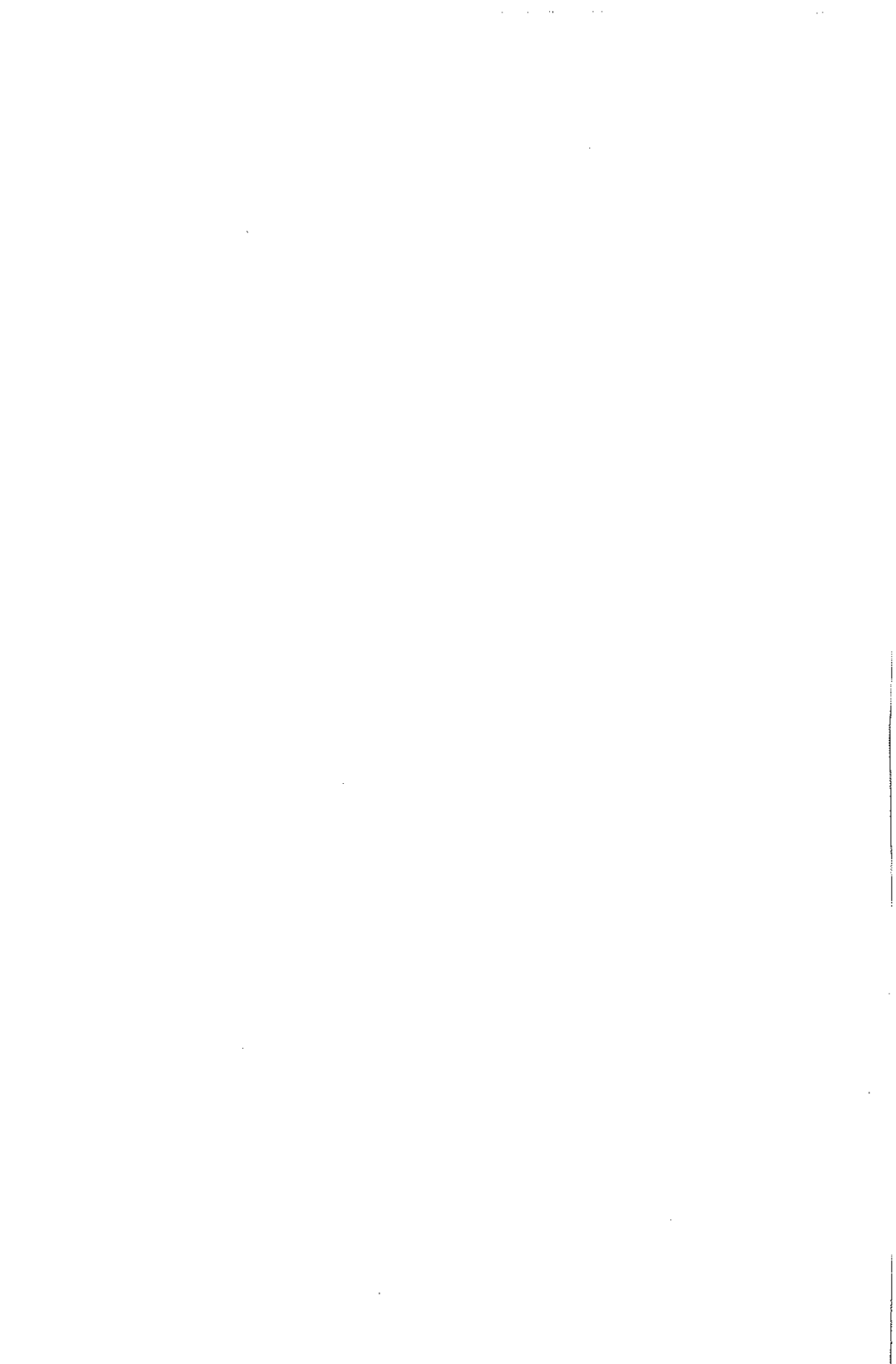


**2888**

**AMP  
PROBE**

**2-204101**



## **AMP PROBE DESCRIPTION, HOOKUP AND SPECIFICATIONS**

### **DESCRIPTION AND HOOKUP:**

The 2888 Amp Probe is designed for use with any digital or analog multimeter having standard .75 (3/4)" input jack spacing and a 1 to 2 Volt D.C. range. The unit plugs directly into the COM (-), and D.C. Volts/Ohms (+) input jacks on the multimeter. When using this amp probe with the KAL EQUIP 2882 Digital Analyzer, plug it into the auxiliary (AUX/COM) input side of the analyzer, and select the AUX or Alt Test switch positions (per the instructions in this manual) on the 2882. The display is read directly in amperes with 1 ampere resolution. Amp Probe output is 1 millivolt per ampere.

### **SPECIFICATIONS:**

**Amperes** - 0 - 1000, 1 ampere resolution

**Operating Temperature** - 32° F to 32° F.

**Selector Switch, and Power ON/Battery Condition Indicator** - The front panel LED (Light Emitting Diode) indicates that the probe is ON. Power to the probe is switched On and OFF via the front panel slide switch. The Amps position is used with all multimeters to display amps; the Alt Test position is used only with the KAL EQUIP 2882 to display alternator condition as instructed later in this manual. To preserve battery life, always turn the selector switch OFF when the unit is not in use. To maintain maximum accuracy from the probe, replace the internal nine (9) volt battery when the LED no longer illuminates.

**Zero Amps Control** - This control electrically zeros the digital display (or analog meter) of the display instrument when the Amps function is

selected. Zero the display before hooking the Amps Probe to the vehicle and making measurements.

### **AMPS PROBE CONNECTIONS**

Hook the Amps Probe around the wire(s) to be measured. Make sure that the probe closes completely. As indicated above, always zero the digital display before hooking the probe around a wire.

### **INTERNAL BATTERY REPLACEMENT**

The unit is powered by a standard nine (9) volt transistor radio battery. Extended service can be obtained by using an alkaline battery. To replace the internal battery, turn the unit OFF, slide the rear cover off the unit, remove the exhausted battery, replace it with a fresh one, and reinstall the rear cover.

### **ELECTRICAL SYSTEM - PRELIMINARY CHECKS**

**INTRODUCTION-** Before performing any electrical system tests, carefully read the following information. These checks will help you to identify the more common electrical system problems and will serve as a general guide for making electrical system tests.

#### **VEHICLE CHECKS**

**A. CONSULT THE VEHICLE MANUAL OF THE VEHICLE BEING TESTED FOR SPECIFIC VOLTAGE AND CURRENT SPECIFICATIONS AND TEST PROCEDURES.**

**B. Check the fan belt; adjust the tension to manufacturer's specifications.**

**C. Check the generator or alternator pulley and mounting bolts. They should be tight. Make sure that the charging and cranking system wiring and the battery**

cables are in good condition and that connections are clean and tight. Make sure that the battery is clean and that the liquid level in each cell is above the plates on vent cap style batteries or that the green "eye" is visible on maintenance free batteries.

**D.** Check the "CCA" (Cold Cranking Amps) rating of the vehicle battery, often listed on the battery. This number should equal or exceed the specification given by the manufacturer for the vehicle's engine. If the battery capacity is too small, a cold engine may crank slowly or not at all on very cold days. If specifications are not available, the following method may be used to determine battery capacity.

**8 CYLINDER ENGINES** The cubic inch displacement (CID - not liters) equals the cold cranking amp requirement. For example, a 350 cubic inch displacement engine equals a 350 CCA minimum. For cold climates, add 20% of the cubic inch displacement to the CCA. Therefore  $350 \times .2$  (20%) = 70.  $350 + 70 = 420$ . A 420 CCA or greater rated battery should be used.

**6 CYLINDER ENGINES** Calculate the cubic inch displacement per cylinder and multiply by 8. For example a 231 cubic inch displacement 6 cylinder engine = 38.5 cubic inch displacement per cylinder. Then,  $38.5 \times 8 = 308$  CCA minimum. For cold climates add 20% of the adjusted cubic inch displacement to the CCA. Therefore  $308 \times .2$  (20%) = 62.  $308 + 62 = 370$ . A 370 CCA battery or greater should be used.

**4 CYLINDER ENGINES** Multiply the cubic inch displacement of the engine by 2. For example a 151 cubic inch displacement 4 cylinder engine  $\times 2 = 302$  CCA. For cold climates add 20% to the CCA. Therefore  $302 \times .2$  (20%) = 60.  $302 + 60 = 362$ . A 362 CCA or greater rated battery should be used.

**E.** Check the alternator/generator output rating as listed on its color coded tag or stamped on the alternator/generator frame. For example, 60A or 100A indicates a

60 ampere or 100 ampere alternator/generator. This rating should equal or exceed the manufacturer's specification for the vehicle as equipped. An alternator/generator which is electrically too small for the vehicle cannot charge a battery when the vehicle is run under heavily electrically loaded conditions (lights, HI fan, air conditioning, etc.) The result could be a no CRANK/START condition after prolonged operation under heavy electrical load conditions.

**F.** Electrical specifications are generally given for an engine which is at normal operating temperature. If the engine is cold and will start operate the engine for at least 10 minutes before making any tests or until it is fully warm (upper radiator hose is hot). If the engine will not start, and the cranking system tests must be made on a cold engine, cranking voltage may be slightly lower and current draw slightly higher than specifications state.

## CRANKING SYSTEMS TESTS

**DESCRIPTION.** This system consists of the battery, the starter motor, the starter solenoid and/or relay, and associated wiring and connections. The following procedures check the operation of this system.

### CRANKING VOLTAGE, STARTER CURRENT DRAW and BATTERY CONDITION.

#### Preparation:

1. Perform the instructions listed under *ELECTRICAL SYSTEM-PRELIMINARY CHECKS*.
2. Disable the engine from starting as explained in your vehicle service manual.

#### Hookup Procedure:

1. See your multimeter manual for hookup procedures covering battery voltage measurement.
2. Slide the Selector Switch on the Amp

Probe to the AMPS position, and set the multimeter to measure amps.

3. Using the Zero Control, adjust the multimeter's display to read zero.

4. Clamp the Amps Probe around the battery cable. The Amps Probe may be clamped around either the positive (+) or negative (-) battery cable, whichever is easier to access. When clamped around the negative (-) battery cable, the arrow should point towards that battery terminal. It should point away from the positive (+) battery terminal when clamped around the positive (+) battery cable. (This will insure an upscale reading on analog meters.) When there are multiple wires connected to the battery terminal, make certain that they are all enclosed in the probe to assure accurate current measurement.

5. Set your multimeter to measure VOLTS.

### CAUTION

The Amps Probe measures a wide range of current (amperes). Large currents (such as those encountered in cranking) can offset the Amps Zero adjustment and possibly produce false results when measuring low current levels (such as those in battery charging). To avoid inaccurate readings:

1. When the vehicle is started or restarted, remove the Amps Probe from around the wires to which it is connected. Allow the Amps Probe to close. If necessary reset the Amps Zero adjustment to zero as explained in Step 3 above. Reinstall the Amps Probe and continue the test procedure.

2. When clamping the Amps Probe around the alternator/generator output wire(s) keep it as far from the alternator/generator as is physically possible.

### Test Procedure:

1. Crank the engine for 15 seconds.
2. Near the end of the cranking period switch the multimeter between Amps and Volts measurements and observe the cranking voltage, and starter current draw.

### Test Results:

1. Within specification
  - a. Voltage: 9.6 volts or greater at 70° F or higher (battery temperature).
  - B. Current Draw: Approximately 80 to 300 amperes.

### NOTE

The current draw on an engine is dependent on several factors, the number of cylinders, engine displacement (cubic inches or liters), temperature, and the engine's compression ratio. Consult your vehicle service manual for the cranking current of your specific engine.

If Test Results are within specification, re-enable the ignition system by reversing the disabling procedure.

### 2. Out of Specification

a. *Voltage high, current low and engine cranks slowly or not at all.*

1. Corroded connections in the cranking circuit (battery).

2. Loose connections in the cranking circuit.

3. Defective battery/starter cables.

4. Starter motor not tightly mounted to the engine.

5. Defective starter solenoid.

6. Defective starter motor.

b. *Voltage low, current high and engine cranks slowly or not at all.*

1. Tight engine

a. Low or no oil.

b. Newly rebuilt engine

c. Mechanical problem

2. Defective starter motor

*C. Voltage and current measure, normal at the beginning of the test but drop quickly during 15 seconds of cranking; voltage low current low.*

1. Undercharged or defective battery
  2. Battery too small for vehicle
  3. Defective starter motor
- d. Voltage and current low during 15 seconds of cranking.*
1. Undercharged or defective battery
  2. Battery too small for vehicle
  3. Defective starter motor

## CHARGING SYSTEM TESTS

It is the function of the charging system to keep the battery charged when the engine is running and to power the rest of the vehicle's electrical load requirement (ignition, lights, fan, etc.). If this system fails, the result will be a discharged, or possibly "dead" battery.

### CAUTION

To avoid damage to the charging system, observe the following precautions:

Do not reverse connection to the alternator.

Do not short across or ground any of the terminals in the charging circuit except as directed by the vehicle manufacturer's instructions.

NEVER operate the alternator with the output terminal disconnected.

## CHARGING SYSTEM VOLTAGE AND BATTERY CHARGING CURRENT TEST

### Hookup Procedure:

1. See your multimeter manual for hookup procedures covering battery voltage measurement.
2. Slide the Selector Switch on the Amp Probe to the AMPS position and set the multimeter to measure amps.
3. Using the Zero Control, adjust the

multimeter's display to read zero.

4. Clamp the Amps Probe around the battery cable. The Amps Probe may be clamped around either the positive (+) or negative (-) battery cable, whichever is easier to access. When clamped around the negative (-) battery cable, the arrow should point away from that battery terminal. It should point towards the positive (+) battery terminal when clamped around the positive (+) battery cable. (This will insure an upscale reading on analog meters.) When there are multiple wires connected to the battery terminal, make certain that they are all enclosed in the probe to assure accurate current measurement.

5. Set your multimeter to measure VOLTS.

### Test Procedure:

1. Operate the engine at curb idle. Switch the multimeter between Amps and Volts measurements. Observe the voltage and current indications. Under normal conditions the amperage reading will fall as the voltage reading rises.
2. When the voltage reading stabilizes, record this reading and the amperage reading. (If the battery has been discharged by cranking tests or for other reasons, this voltage reading will climb slowly and may take several minutes to stabilize. On a close to fully charged good battery, the stabilized reading occurs quickly.)
3. Set the engine to maintain fast idle, (1500 - 2000 RPM). Maintain fast idle through step 7.
4. After a few seconds record the voltage.
5. Fully load the electrical system; turn on the lights, HI fan, air conditioning etc.
6. Wait a minute or two and record the voltage.
7. Set the multimeter to measure amps and record the amperage reading.
8. Turn OFF all accessories, return the engine to curb idle and shut it OFF.

### Test Results:

## 1. Within Specification

a. The voltage reading should stabilize between 13.2 and 15.2 volts or as specified in your vehicle service manual. Voltage should not change more than about 0.5 volts when speed is changed from curb idle to fast idle. Voltage should not drop to less than about 13.0 volts at fast idle with all accessories on.

b. The amperage reading is a trickle charge of approximately 0-5 amperes.

## 2. Out of Specification

a. *Voltage high/Current high*

1. Voltage regulator defective.
2. Corroded, loose, or otherwise defective connections in the battery or charging circuits.
3. Incorrectly set voltage regulator (mechanical type).

b. *Voltage normal/Current high*  
Defective battery.

c. *Voltage low/Current low*

1. Corroded, loose, or otherwise defective connections in the battery or charging circuits.
2. Alternator drive belt slipping.
3. Voltage regulator defective.
4. Incorrectly set voltage regulator (mechanical type).

5. Defective alternator/generator

d. *Voltage low/Current "0" or below "0" (discharge, display reads negative).*

1. Voltage regulator defective.
2. Open field wire from the voltage regulator to the alternator/generator (external voltage regulator systems only).
3. Corroded or loose connections in the field circuit.
4. Defective alternator/generator.
5. Open voltage reference wire between battery and voltage regulator or integral (internal) regulator.

e. *Voltage low/Rises to normal at engine fast idle.*

1. Slipping alternator drive belt.
2. Corroded, loose or otherwise defective connections in the battery or charging circuits.
3. Defective alternator/generator

f. *Voltage normal/rises significantly more than 0.5 volts and out of the normal range at engine fast idle.*

Voltage regulator defective.

g. *Voltage drops below about 13.0/Current drops below "0" at a fast idle with accessories on, no other abnormal symptoms.*

1. Slipping alternator/generator belt.
2. Defective alternator/generator.
3. Alternator/generator too small (electrically) as equipped.
  - a. Previous replacement alternator/generator incorrectly sized.
  - b. After market accessories were added to vehicle (rear window defroster, air conditioning etc.) Alternator/generator is no longer adequate for vehicle.

## ALTERNATOR CONDITION TEST

### NOTE

The ALTERNATOR CONDITION TEST is designed to be used with the KAL EQUIP 2882 Digital Multimeter. It will not work with other multimeters.

The alternator in most vehicles is a three phase Alternating Current (AC) generator. The alternating current is "changed" to direct current (DC) to match the vehicle's electrical system. This is accomplished by diodes inside the alternator. The ALTERNATOR CONDITION TEST will check the operation of all three phase windings and the diodes of the alternator.

#### NOTE

Some alternators/generators are equipped with a diode trio in addition to the normal diodes used with the stator windings. This test may not detect a faulty diode trio. Although many defects will illuminate the vehicle instrument panel alternator/generator warning lamp, usually when the diode trio is defective, the warning lamp will glow dimly. This part is tested with an ohmmeter during off-the-vehicle bench testing. Consult your vehicle service manual for the proper test procedure.

#### NOTE

Some alternators/generators have a heavy ground wire between the alternator/generator and the vehicle or engine. Do not confuse this wire with the output wire(s).

#### Test Procedure:

1. Start the engine and set it to maintain a speed between 1500 and 2000 RPM.
2. Fully load the electrical system; turn on lights, HI fan, air conditioning, etc.
3. Observe the alternator test LED (Light Emitting Diode) on the 2882. If it is OFF, the alternator's stator windings and diodes are good. If it is ON or flickering the stator windings and/or diodes may be bad.

#### Hookup Procedure:

1. Connect the Amp Probe to the AUX input of the 2882 as explained at the beginning of this manual.
2. Slide the Selector Switch on the Amp Probe to the AMPS position and set the 2882 to the auxiliary position.
3. Using the Zero Control, adjust the 2882's display to read zero.
4. Turn the function selector on the 2882 to the alternator test (Alt Test) position, and slide the switch on the Amp Probe to the Alt Test position.
5. Clamp the Amps Probe around the heavy output wire(s) attached to the positive (+) output stud at the rear or side of the alternator with the arrow on the clamp pointing away from the alternator. Do not enclose wires from other parts of the wiring harness in the Amps Probe. They could affect the accuracy of the test results. Be sure the clamp closes completely.

#### NOTE

Some alternators will produce enough AC ripple to turn on the Alternator test LED even though the diodes and stator windings of the alternator are good. If charging system voltage level tests indicate a problem, or the vehicle battery goes dead repeatedly, it is advisable to perform the alternator output test outlined below.

4. Turn OFF all accessories.
5. Return the engine to curb idle and shut it OFF.

#### ALTERNATOR OUTPUT TEST

If you have not performed the Battery Charging test, the Alternator Condition Test and the *ELECTRICAL SYSTEM - PRELIMINARY CHECKS*: it is recommended that they be done

before this procedure. This test is necessary only if the vehicle has failed the above tests or if you suspect that the alternator output is not up to specification.

Read ALL directions for this test before beginning. Parts of this test must be done quickly and accurately to avoid possible damage to the system.

### CAUTION

The Alternator Output Test drives the alternator to full electrical output. This test is safe when properly performed. When the test is improperly performed, system voltages can reach potentially damaging levels to vehicle electrical components (headlamps, radios, onboard computers etc. It is strongly recommended that you consult your vehicle service manual and follow any precautions and procedures listed. If there is any conflict between this test procedure and the one in your vehicle service manual, follow the recommendations of the vehicle service manual. Be especially careful with high output alternators (greater than 60 amperes.)

### Hookup Procedure:

1. See your multimeter manual for hookup procedures covering battery voltage measurement.
2. Slide the Selector Switch on the Amp Probe to the AMPS position, and set the multimeter to measure amps.
3. Using the Zero Control, adjust the multimeter's display to read zero.
4. Clamp the Amps Probe around the heavy output wire(s) attached to the positive (+) output stud at the rear or side of the alternator with the arrow on the clamp pointing away from the alternator. Do not enclose wires from other parts of the wiring harness in the Amps Probe. They could affect the accuracy of the test results. Be sure the clamp closes completely.

### Test Procedure:

1. For this test the voltage regulator must be bypassed and the alternator "full fielded". Full fielding is defined as applying full electrical system voltage (13-15 volts) directly across the field winding (rotor) of the alternator. This causes the alternator to put out its maximum current (Amperes). Refer to your vehicle service manual for full fielding procedures.

### NOTE

The Delco Remy solid state (integral) charging system is full fielded after the engine is running. Go directly to Step 13.

- a. Disconnect the negative (-) battery cable.
  - b. Remove the connector at the voltage regulator (for full fielding at the regulator) or remove the field wire at the alternator (for full fielding at the alternator). When full fielding from the alternator, remove the field wire and using a jumper wire connect the field terminal at the alternator to either the "BAT" terminal or ground as indicated by your vehicle service manual.
  - c. When full fielding from the voltage regulator remove the connector from the regulator. Using a suitable jumper wire connect the terminals indicated together, at the removed connector or connect the field wire terminal from the removed connector to either the positive (+) battery post or ground as indicated by your vehicle service manual.
2. Double check your full fielding procedure for accuracy and connection security.
  3. Make sure all vehicle accessories are OFF.

### CAUTION

Switch the multimeter to volts to display electrical system voltage periodically during the procedure (Steps 4 - 10): Do not allow electrical system voltage to exceed 16 volts.

4. Reconnect the negative (-) battery terminal. Start the engine. Return to curb idle quickly.
5. Electrically load the vehicle quickly. Turn on the following accessories in the order listed:
  - a. Hi speed wipers
  - b. Hi speed fan
  - c. Air conditioning
  - d. Rear window defroster
  - e. Hi beam headlights
6. Set the fast idle to 1500-2500 RPM.
7. Set the multimeter and Amps Probe to amps and record the reading.
8. Return the engine to curb idle.
9. Turn OFF all accessories in the reverse order from which they were turned ON.
10. Shut OFF the engine.
11. Reverse the procedure used in Steps 1 and 2 to restore the charging system to normal regulated operation.
12. Proceed to test results.

#### *Delco Remy Integral Charging System Test Procedure:*

13. Make sure all vehicle accessories are OFF.
14. Start the engine
15. Set the fast idle to 1500-2500 RPM.
16. Electrically load the vehicle. Turn on the following accessories in the order listed:
  - a. Hi speed wipers
  - b. Hi speed fan
  - c. Air conditioning
  - d. Rear window defroster
  - e. Hi beam headlights
17. Function Switch (multimeter and Amps Probe) - AMPS

18. Insert a small, clean screwdriver about 3/4" (but not more than 1") straight into the D shaped hole at the rear of the alternator. The screwdriver must make contact between the small tab inside the D shaped hole and the alternator case. You may see a small spark when contact is made; this is normal.

19. When contact is made, quickly observe the amps reading, and remove the screwdriver

20. Turn OFF all accessories in the reverse order from which they were turned ON.

21. Shut OFF the engine.

22. Proceed to Test Results.

#### Test Results:

##### 1. Within Specification

Output current (amperes) is equal to alternator nameplate specification within the tolerance limits specified in the vehicle service manual.

##### 2. Out of specification

a. *Output current reads below specified limits.*

1. Shorted or open diodes in alternator.
2. Shorted or open windings in alternator.

### NOTE

The alternator must be removed from the vehicle for bench testing in accordance with the vehicle service manual.

b. *Output current reads above specified limits.*

Alternator nameplate marking incorrect.

### NOTE

An alternator that is above specified limits is not a cause for concern. The alternator is acceptable if it was designed for the vehicle in which it is installed and has passed all tests up to and including this one. Voltage regulator action will maintain proper system operating levels.

### REPLACEMENT PARTS

Part Number	Description
2-204101	Instruction Manual
400-1609	Battery Cover
20-109	9 volt alkaline battery

