GROUP

BATTERY AND CHARGING SYSTEM 14

(10000)

SECTION 14-00 Battery and Charging System—Service

VEHICLE APPLICATION

Taurus / Sable.

DESCRIPTION AND OPERATION

Charging System

The charging system consists of a generator (GEN) (10300), voltage regulator, charge indicator, storage battery, fuse links and associated wiring.

This section contains general information applicable to all charging systems and generators. For information on batteries, refer to Section 14-01. For information specific to the generator / charging system being tested or serviced, refer to the appropriate section in this group.

The generators used on these vehicles and their specific application follows:

IGR Generator With Internal Fan and Internal Regulator

This generator is used on Taurus vehicles equipped with the optional 3.0L / 3.2L SHO engine. Refer to Section 14-02B for testing and servicing of this system.

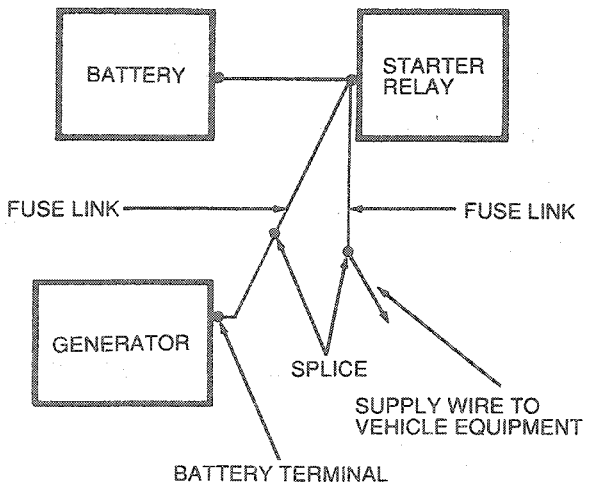
IGR Generator With Internal Fan and Rear Mounted Regulator

This generator is used on vehicles equipped with the 3.0L or 3.8L engine. Refer to Section 14-02A for testing and servicing of this system.

DESCRIPTION AND OPERATION (Continued)

Fuse Link

The fuse link is a short length of insulated wire integral with the engine compartment wiring harness. It is several wire gauges smaller than the circuit that it protects. The fuse link for the generator is a 12-gauge gray wire.



Service fuse links are brown, green or black depending on usage. All fuse links have a flag moulded on the wire or on the terminal insulator. Color identification of the flag or connector for the external voltage regulator system is brown 18-gauge wire or gray 12-gauge wire. The illustration shows a typical fuse link installation.

The fuse link is designed to burn out, thus protecting the generator and wiring when heavy reverse current flows, such as when a booster battery is connected incorrectly, or a short to ground occurs in the wiring harness.

A burned-out link may have bare wire ends protruding from the insulation, or bubbled insulation with illegible identification. If it is hard to determine if the link is burned out, perform a continuity test.

Refer to Diagnosis, for testing procedures for fuse links used in the charging system.

DIAGNOSIS

Preliminary Checks

Before performing charging or starting system tests on the vehicle, note the complaint such as: slow cranking, battery discharged or using an excessive amount of water, top of battery wet, generator warning lamp does not come on or never goes out. This information will aid in isolating the part of the system causing the symptom.

Next, visually inspect as follows:

1. Check the fuse link located between the power distribution box and the generator. Replace the fuse link if burned.
2. Make certain that the battery is OK; then turn on the headlamps or any other accessory. If the headlamps or accessory do not operate, the fuse link is probably burned out.
3. On some vehicles there are several fuse links. Use the same procedure as in Step 1 to test the fuse link that protects vehicle equipment.

To test the fuse link that protects the generator, make certain the battery is OK. Then check with a voltmeter for voltage at the BAT terminal of the generator. No voltage indicates that the fuse link is probably burned out.

4. Check battery posts and battery cable terminals for clean and tight connections. Remove the battery cables (if corroded), clean and install them securely.
5. Check for clean and tight wiring connections at the generator, voltage regulator and engine ground.
6. Check the generator belt tension. Refer to Section 03-05.

- When a relatively new battery is discharged, test for current drain. Refer to Section 14-01 for proper procedures. The following are some of the most common current drain problems:
  - — Glove compartment lamp stays on with the door closed
  - — Hood lamp stays on constantly
  - — License plate lamp or interior lamp stays on constantly
  - — Other electronic component malfunctions
- Check for secure ground connections at the engine and body. Also check for proper connections at the generator and voltage regulator.
- Check the testing equipment and instructions. If the equipment is malfunctioning or the instructions for use are incorrect, use the equipment on a vehicle you know to be operating properly.
- Only test the charging system with a fully charged, properly operating battery. Make sure cable connections are clean and secure.

DIAGNOSIS (Continued)

In order to check the charging system, the use of Rotunda Starting / Charging VAT-40 Tester 078-00005 or equivalent is suggested. Connect the tester to the battery positive and negative posts and also connect the current probe to the generator + output lead (to measure generator output). (When measuring generator output, the tester can also be connected to the battery positive or negative cable. In this case, all electrical accessories must be turned off and 10-15 amps added to the reading on the tester due to the engine operation). With the engine running at 2000 rpm, adjust the tester load bank to determine the output of the generator. The generator output should be near to, or exceed the generator rating (27°C (80°F) ambient). Checkout the charging system as indicated and service if required.

NOTE: Refer to the tester test procedure manual for complete directions on checking out the charging system.

Isolating the Concern

Battery and starting system concerns can be caused by poor charging system performance. It is also reasonable to suspect the charging system because of an overload in another area of the electrical system.

To avoid guesswork, it is necessary to isolate the battery, the charging system, and the electrical circuits to correctly identify the area where the difficulty lies. Check the battery first before performing any electrical system diagnosis. The battery must be in proper state of change and operation before the other areas of the electrical system can perform normally.

Battery Check

Check battery to see if it has the capacity and ability to accept and hold a charge. Refer to Section 14-01, Battery. If the battery is good, then the charging system should be checked to see that it performs its function of keeping the battery charged.

The battery capacity, specific gravity and cell comparison test (low-maintenance batteries only) will determine the ability of a battery to accept and hold a charge. If the battery cannot meet the specifications, replace it with a new fully charged battery before further diagnosis of other areas of the electrical system.

If the battery is found to meet the required specifications, it should be fully charged before proceeding with the diagnosis of other electrical system components.

Charging System Test

The Charging System Test should be performed before testing any of the individual charging system components. Its "road-map" type of layout should reduce confusion in determining "what to do next" and speed up diagnosis. The component tests will determine the type of component service to be performed.

Use Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent and a test lamp to test the system. Special care should be given when using the ohmmeter near "hot" circuits. The component to be checked should be disconnected from the circuit or the battery terminals should be disconnected.

CAUTION: Damage to the component could occur, if the circuit is allowed to remain intact.

Rotunda Charging / Starting Analyzer 059-00002 or equivalent is available for testing the charging system. Test instructions are provided with the analyzer.

NOTE: When checking generator output current with the Rotunda Analyzer at the battery cable, add 10 to 15 amps to the reading because of charge current removed for engine operation.

DIAGNOSIS (Continued)

CHARGING SYSTEM DIAGNOSIS

CONDITION	POSSIBLE SOURCE	ACTION
• Battery Does Not Stay Charged—Engine Starts OK	• Battery. • Loose or worn generator belt. • Damaged or worn wiring or cables. • Generator. • Voltage regulator. • Other vehicle electrical systems.	• Test battery, replace if necessary. • Adjust or replace belt. Refer to Section 03-05. • Service as required. Refer to Section 18-01. • Test and / or replace components as required. • Test, replace if necessary[1]. • Check other systems for current draw. Service as required[1].
• Generator Noisy	• Loose or worn generator belt. • Bent pulley flanges. • Generator.	• Adjust tension or replace belt. Refer to Section 03-05. • Replace pulley[1]. • Service or replace generator[1].
• Lamps and / or Fuses Burn Out Frequently	• Damaged or worn wiring. • Generator / voltage regulator. • Battery.	• Service as required. Refer to Section 18-01. • Test, service, replace if necessary[1]. • Test, replace if necessary[1].
• Charge Indicator Lamp Flickers After Engine Starts or Comes On While Vehicle Is Being Driven	• Loose or worn generator belt. • Generator. • Field circuit ground. • Voltage regulator. • Lamp circuit wiring and connector.	• Adjust tension or replace. Refer to Section 03-05. • Service or replace[1]. • Service or replace wiring. Refer to Section 18-01. • Test, replace if necessary[1]. • Service as required[1].
• Charge Indicator Lamp Flickers While Vehicle Is Being Driven	• Loose or worn generator belt. • Loose or improper wiring connections. • Generator. • Voltage regulator.	• Adjust tension or replace belt. Refer to Section 03-05. • Service as required. Refer to Section 18-01. • Service or replace[1]. • Test, replace if necessary[1].
• Charge Indicator Gauge Shows Discharge	• Loose or worn generator belt. • Damaged or worn wiring (battery to generator for ground or open). • Field circuit ground. • Generator. • Voltage regulator. • Charge indicator gauge wiring and connections. • Damaged or worn gauge. • Other vehicle electrical system malfunction.	• Adjust tension or replace belt. Refer to Section 03-05. • Service or replace wiring. Refer to Section 18-01. • Service or replace wiring. Refer to Section 18-01. • Service or replace[1]. • Test, replace if necessary[1]. • Service as required[1]. • Replace gauge. Refer to Group 13. • Service as required.

TJ2205K

ADJUSTMENTS

Belt Adjustment

Refer to Section 03-05 for generator belt tensioning procedure.

SPECIAL SERVICE TOOLS

ROTUNDA EQUIPMENT

Model	Description
007-00001	Digital Volt-Ohmmeter
059-00002	Charging / Starting Analyzer
078-00005	Starting / Charging Tester VAT-40

TJ4475A

1 Refer to the appropriate generator Section in this Group.

SECTION 14-01 Battery

VEHICLE APPLICATION

Taurus / Sable.

TESTING

Before attempting to test a battery, it is important to give it a thorough examination to determine if it has been damaged.

Tests are made on a battery to determine the state of charge and also its capacity or ability to crank an engine. The ultimate result of these tests is to show that the battery is good, needs recharging, or must be replaced.

WARNING: BATTERIES NORMALLY PRODUCE EXPLOSIVE GASES WHICH CAN CAUSE PERSONAL INJURY. THEREFORE, DO NOT ALLOW FLAMES, SPARKS OR LIGHTED SUBSTANCES TO COME NEAR THE BATTERY. WHEN CHARGING OR WORKING NEAR A BATTERY, ALWAYS SHIELD YOUR FACE AND PROTECT YOUR EYES. ALWAYS PROVIDE VENTILATION.

WHEN LIFTING A PLASTIC-CASED BATTERY, EXCESSIVE PRESSURE ON THE END WALLS COULD CAUSE ACID TO SPEW THROUGH THE VENT CAPS, RESULTING IN PERSONAL INJURY. LIFT WITH A BATTERY CARRIER OR WITH YOUR HANDS ON OPPOSITE CORNERS.

WARNING: KEEP OUT OF REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERY TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH SKIN OR EYES, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF 15 MINUTES AND GET PROMPT MEDICAL ATTENTION. IF ACID IS SWALLOWED, CALL A PHYSICIAN IMMEDIATELY.

Battery State of Charge

Maintenance-Free Batteries

Read the battery open circuit terminal voltage with a digital voltmeter such as Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, capable of reading 1 / 100 of a volt. If open circuit voltage of battery is below 12.4 volts and the battery has passed the capacity test, charge the battery.

Low-Maintenance Batteries

Use a hydrometer such as Rotunda Battery and Anti-Freeze Tester 021-00046 or equivalent to check the specific gravities of all cells.

In order to obtain an accurate specific gravity reading, it must be corrected to the standard temperature of 26°C (78°F). The correction factor of four points (0.004) is used for each 6°C (10°F) change in temperature. Four points (0.004) are added to the indicated reading for each 6°C (10°F) increment above 26°C (78°F) and four points (0.004) are subtracted for each 6°C (10°F) increment below 26°C (78°F).

If the difference between cells is 50 points (0.050) or more, the battery is not satisfactory for service and should be replaced.

If the difference between cells is less than 50 points (0.050) and one or more cells are less than 1.225, charge the battery for 20 minutes at 35 amps and conduct the capacity test. If the battery fails, replace the battery. If it passes, add water if necessary and charge the battery.

TESTING (Continued)

If the difference between cells is less than 50 points (0.050) and all cells are above 1.225, conduct the capacity test. If the battery fails, replace the battery. If it passes, return to service.

BATTERY TESTING PROCEDURE — TEST A

TEST STEP		RESULT ▶	ACTION TO TAKE
A1	VISUAL INSPECTION		
	• Remove negative cable, then positive cable. • Check for dirty or corroded connections. • Are connections OK?	No ▶ Yes ▶	CLEAN terminals and clamps. GO to A2. GO to A2.
A2	LOOSE BATTERY POST		
	• Check for loose battery posts. • Are posts OK?	No ▶ Yes ▶	REPLACE battery. GO to A3.
A3	CRACKED BATTERY COVER		
	• Remove holddowns and shields. • Check for broken / cracked case or cover. • Is cover OK?	No ▶ Yes ▶	REPLACE battery. GO to A4.
A4	BATTERY CAPACITY AND LOAD TEST		
	NOTE: Whenever possible, test and charge battery at or near room temperature. • Use a high rate discharge tester with a variable rate control or a fused rate tester with meter compensation for different battery electrical sizes. Follow instructions supplied with tester for the battery capacity test. • Recommended discharge rate at 27°C (80°F): one-half of the cold cranking amps.	Passed the minimum load voltage and OCV above 12.40 ▶ Passed the minimum load voltage and OCV below 12.40 ▶ Failed the minimum load voltage and OCV above 12.40 ▶ Failed the minimum load voltage and OCV below 12.40 ▶ ▶ ▶	Battery OK. Battery OK but needs charging. Battery worn out. REPLACE battery. CHARGE battery for 20 minutes at 35 amps. REPEAT Step A4 (load test). Passed the minimum load voltage. Battery OK but needs charging. Failed the minimum load voltage. REPLACE battery.

Cold Cranking Amps	Discharge Rate Amps
650	325
540	270

• Voltage readings at 15 seconds for good battery (Battery Capacity Test).

Approximate Battery Temperature	Minimum Load Voltage
27°C (80°F) and above	9.6
21°C (70°F)	9.6
16°C (60°F)	9.5
10°C (50°F)	9.4
4°C (40°F)	9.3
-1°C (30°F)	9.1
-7°C (20°F)	8.9
-12°C (10°F)	8.7
-18°C (0°F)	8.5

• Wait 2 minutes and check the Open Circuit Voltage (OCV).
• Measure OCV with a digital voltmeter capable of reading 1 / 100 volt.

TJ4553A

TESTING (Continued)

Battery Drain Test

With Clamp-On DC Ammeter

Test Procedure

1. Turn the ignition to the OFF position and make sure there are no electrical loads. After determining that the underhood lamp is turning off properly, disconnect the bulb.
2. Clamp the meter clip securely around positive or negative battery cable (all cables if two or more lead to post).

   NOTE: Do not start vehicle with clip on cable.

Test Conclusion

The current reading (current drain) should be less than 0.05 amp. If it exceeds 0.05 it indicates a constant current drain which could cause a discharged battery. Possible sources of current drain are vehicle lamps (underhood, glove compartment, luggage compartment, etc.) that do not shut off properly.

If the drain is not caused by a vehicle lamp, remove fuses from the fuse panel, one at a time, until the cause of the drain is located. If drain is still undetermined, remove fusible links one at a time at the power distribution box to find the problem circuit.

With Voltmeter

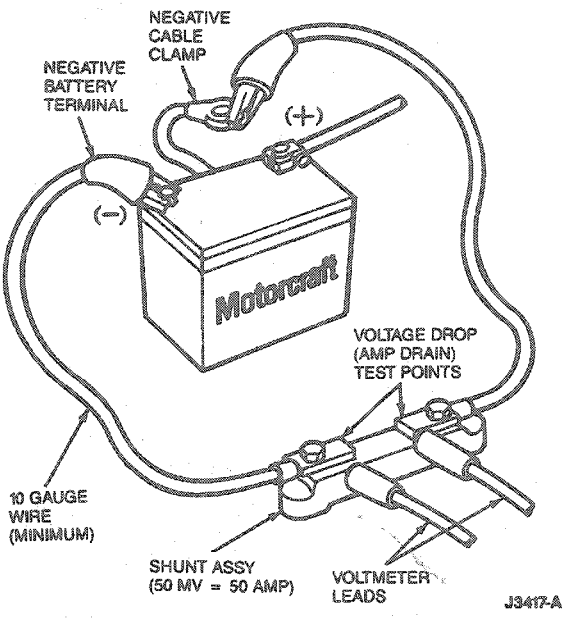
This test requires a digital volt-ohmmeter with an appropriate low voltage scale such as Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent. The meter must read within 0.01 millivolt. Also required is a shunt assembly similar to that shown in the illustration.

Test Procedure

1. Turn ignition switch to the OFF position and make sure there are no electrical loads. After determining the underhood lamp is turning off properly, disconnect the bulb.
2. Check battery voltage. If voltage is under 11.5 volts, charge the battery to above 11.5.
3. Disconnect negative battery cable.

   NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
4. Connect shunt assembly as shown.

   CAUTION: Do not crank the engine, it could destroy the shunt. Also do not use the shunt to measure starting currents.
5. Set volt-ohmmeter to 200 or 300 mv scale for an accurate reading (must be within 0.01 millivolt).
6. Connect meter leads to shunt as shown. With this size shunt (50 mv = 50 amps) and meter, a direct current drain measurement can be made.



Test Conclusion

The current reading (current drain) should be less than 0.05 amp. If the reading is between 0.2 and 0.9 a possible drain may be a vehicle lamp (glove compartment, underhood, luggage compartment, etc.) that does not turn off. If the problem is not a lamp, remove the fuses from the fuse panel one at a time until the cause of the drain is located. If drain is still undetermined, remove fuses one at a time at the power distribution box to find the problem circuit.

To Test Vehicles with Major Key-Off Loads such as Air Suspension or Load Leveling

Vehicles equipped with these features will have temporary current drains that may last up to 70 minutes after ignition is switched OFF. These drains can range from 0.1 to 20 amps if the compressor is cycling. This action can often mask a problem and must be considered when evaluating test results. To test for this kind of drain proceed as follows.

1. Repeat Steps 1 through 5 of the battery drain test.
2. Turn ignition to RUN for a moment and then OFF again.
3. Disconnect major key-off load circuits.
4. Make sure illuminated entry is off, if applicable.

Test Conclusion

The current reading (current drain) should be less than 0.05 amp. If it is higher, disconnect fuses and fusible links as in the previous test to locate the problem circuit.

If the drain is less than 0.05 amps, reconnect the major key-off load circuits, turn ignition to RUN and then OFF, and wait 70 minutes to make sure they shut off properly. If current drain is still greater than 0.05 amps after 70 minutes, disconnect each of the components one at a time until the cause of the current drain is located.

TESTING (Continued)

To Check for Electronic Drains Which Shut Off When the Battery Cable is Disconnected

1. Repeat Steps 1 through 5 of the Voltmeter Drain Test.
2. Without starting engine, turn ignition switch to the RUN position for a moment and then OFF. If applicable, wait one minute for the illuminated entry lamps to turn off.
3. Connect voltmeter and read voltage.

Test Conclusion

The current reading (current drain) should be less than 0.05 amp. If it exceeds 0.05 after a few minutes, and if this drain did not show in previous tests, the drain is most likely caused by a malfunctioning electronic component. As in previous tests, remove fuses in power distribution box one at a time to locate the problem circuit.

Battery Charging

Before recharging a discharged battery, inspect and service the following conditions, if they exist:

1. Loose generator belt.
2. Pinched or grounded generator / voltage regulator wiring harness.
3. Loose harness connections at the generator and / or voltage regulator.
4. Loose or corroded connections at battery and / or engine ground.
5. Excessive battery drain due to:
   a. Hood, luggage compartment, glove compartment and courtesy lamps remaining energized (damaged or misadjusted switch, glove compartment left open, etc).
   b. Luggage compartment solenoid continuously energized on vehicles equipped with keyless entry system.
   c. Inoperative autolamp module causing approximately 2 amp drain with ignition switch in the OFF position and autolamp off.

Maintenance-Free and Low-Maintenance Batteries

Cold batteries will not readily accept a charge. Therefore, batteries should be allowed to warm up to approximately 5°C (41°F) before charging. This may require four to eight hours at room temperature depending on the initial temperature and battery size.

A battery which has been completely discharged may be slow to accept a charge initially, and in some cases may not accept a charge at the normal charger setting. When batteries are in this condition, charging can be started by use of the dead battery switch on chargers so equipped.

Completely discharged batteries, which have been discharged for a prolonged period of time (over one month) or which have an open circuit voltage of less than two volts, may show no indication of accepting a charge even when the battery switch is used. The initial charge rate accepted by batteries in this condition is so low that the ammeter on some chargers will not show any indication of charge for up to 10 minutes.

To determine whether a battery is accepting a charge follow the charger manufacturer's instructions for use of dead battery switch. If dead battery switch is the spring-loaded type, it should be held in the ON position for up to three minutes.

After releasing dead battery switch and with charger still on, measure battery voltage. If it shows 12 volts or higher, the battery is accepting a charge and is capable of being recharged. However, it may require up to two hours of charging with batteries colder than 5°C (41°F) before the charge rate is high enough to show on the charger ammeter. It has been found that all non-damaged batteries can be charged by this procedure. If a battery cannot be charged by this procedure, it should be replaced.

Once it has been determined that the battery has begun to accept a charge, it can be charged to a serviceable state or a full state of charge by one of two methods:

- The **first method** is to use the AUTOMATIC setting on chargers so equipped. This setting maintains the charging rate within safe limits by adjusting voltage and current to prevent excessive gassing and spewing of electrolyte. Approximately two to four hours will be required to charge a completely discharged battery to a serviceable state. If a full state of charge is desired, the charge can be completed by a low current rate of 3-5 amps for several hours.
- The **second method** is to use the MANUAL or constant current setting on the charger. Initially set the charging rate for 30-40 amps and maintain this setting for approximately 30 minutes or as long as there is no excessive gassing and electrolyte spewing. If gassing results, the charge rate must be reduced to a level where gassing will stop. This is particularly true for maintenance-free batteries where excessive gassing will result in non-replaceable loss of electrolyte, thus shortening battery life.

The total charge required will vary with battery size and its initial state of charge. In general, to bring a discharged battery to a serviceable state of charge, current-time input should equal the battery amp-hour capacity. For example: a 45 AH battery will require 15 amps of charge for three hours, or 9 amps of charge for five hours. If a full state of charge is desired, the charge can be completed by a low constant current of 3 to 5 amps for several hours.

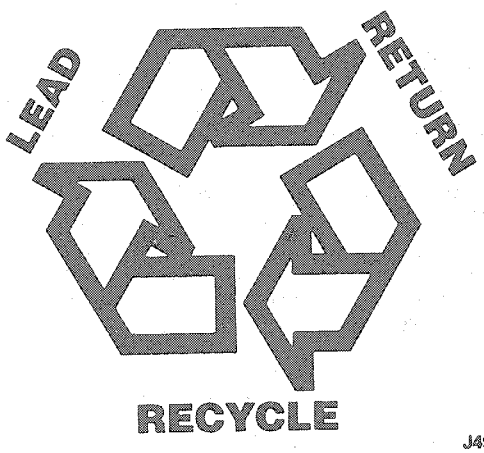
If the battery has failed, or is low in charge, it may be necessary to refer to Diagnosis, Section 14-00.

TESTING (Continued)

Jump Starting
Refer to Section 03-06.

REMOVAL AND INSTALLATION

Help Us Protect Our Environment
Ford Motor Company strongly recommends that lead-acid batteries be returned to an authorized recycling facility for disposal.



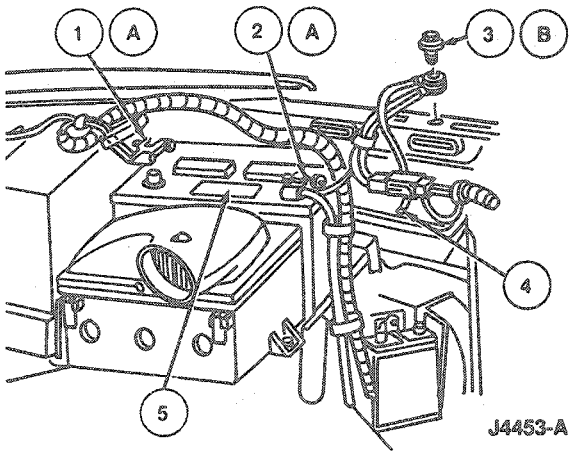
J4961-A

Removal

1. Remove battery cables from battery terminals (negative first).

3.0L EFI and 3.8L EFI

Battery

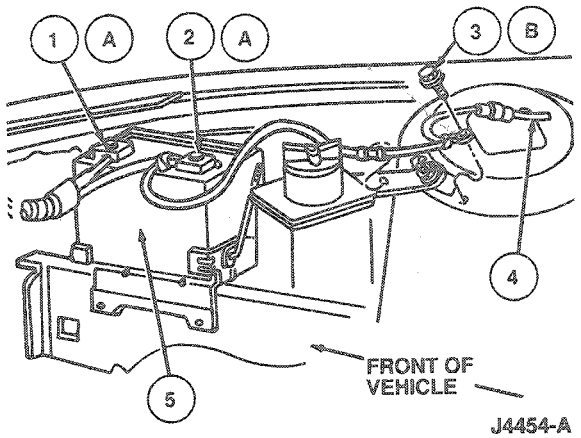


J4453-A

Item	Part Number	Description
1A	—	Positive Battery Terminal
2A	—	Negative Battery Terminal
3B	N803991-S39	Screw (3 Req'd)
4	2C054	Wiring Assy
5	10655	Battery
A		Tighten to 6-10 N·m (60-90 Lb-In)
B		Tighten to 3.4-4.8 N·m (31-42 Lb-In)

TJ4453A

3.0L/3.2L SHO



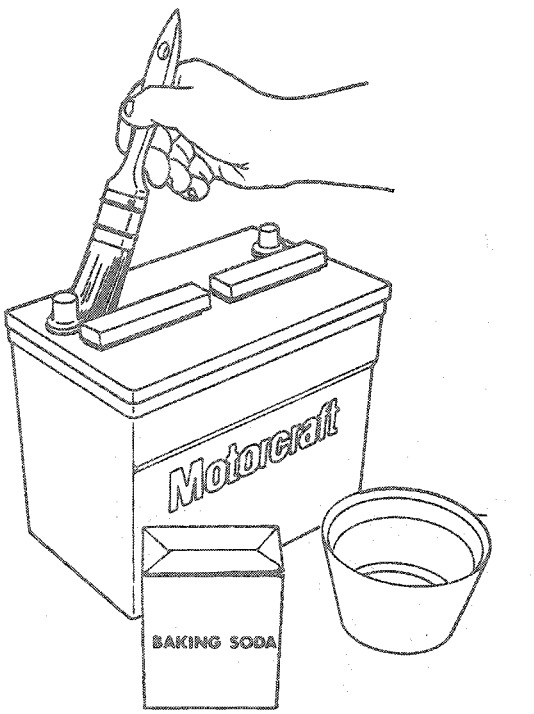
J4454-A

Item	Part Number	Description
1A	—	Positive Battery Terminal
2A	—	Negative Battery Terminal
3B	N803991-S3	Screw
4	12A581	Wiring Harness
5	10655	Battery
A		Tighten to 7.6-10.4 N·m (68-92 Lb-In)
B		Tighten to 3.4-4.8 N·m (31-42 Lb-In)

TJ4454A

REMOVAL AND INSTALLATION (Continued)

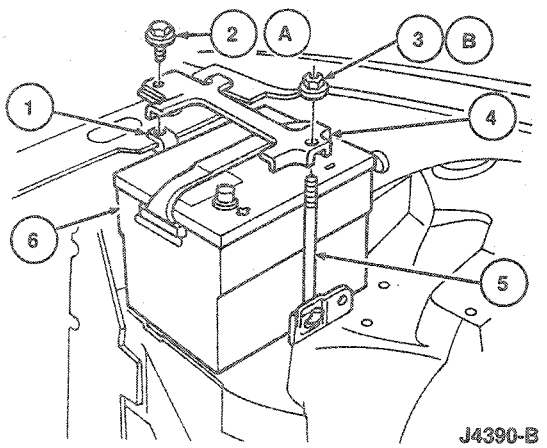
2. Clean cable terminals using an acid neutralizing solution and terminal cleaning brush.



J2847-A

3. Remove hold-down clamps.

Battery Hold Down



J4390-B

Item	Part Number	Description
1	N623333-S2	U-Nut
2A	N606690-S2	Bolt (1 Req'd)
3B	N801521-S2	Nut (1 Req'd)
4	10755	Bracket
5	10K700	J-Bolt

(Continued)

Item	Part Number	Description
6	10655	Battery Assy
A		Tighten to 7-10 N·m (62-88 Lb-In)
B		Tighten to 3-5 N·m (27-44 Lb-In)

4. Remove battery from vehicle.

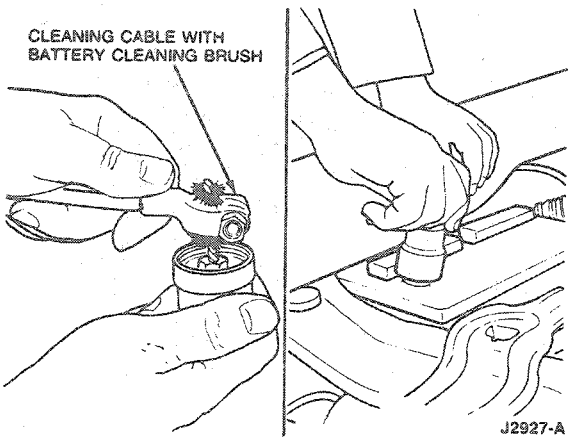
WARNING: BATTERIES NORMALLY PRODUCE EXPLOSIVE GASES WHICH CAN CAUSE PERSONAL INJURY. THEREFORE, DO NOT ALLOW FLAMES, SPARKS OR LIGHTED SUBSTANCES TO COME NEAR THE BATTERY. WHEN CHARGING OR WORKING NEAR A BATTERY, ALWAYS SHIELD YOUR FACE AND PROTECT YOUR EYES. ALWAYS PROVIDE VENTILATION.

WHEN LIFTING A PLASTIC-CASED BATTERY, EXCESSIVE PRESSURE ON THE END WALLS COULD CAUSE ACID TO SPEW THROUGH THE VENT CAPS, RESULTING IN PERSONAL INJURY. LIFT WITH A BATTERY CARRIER OR WITH YOUR HANDS ON OPPOSITE CORNERS.

5. Test battery and determine if it should be:
   - Placed back in service
   - Recharged before placing back in service
   - Replaced with a Motorcraft or equivalent battery

Installation

1. Clean cable terminals and hold-down with a wire brush. Replace all cables or parts that are worn or frayed.



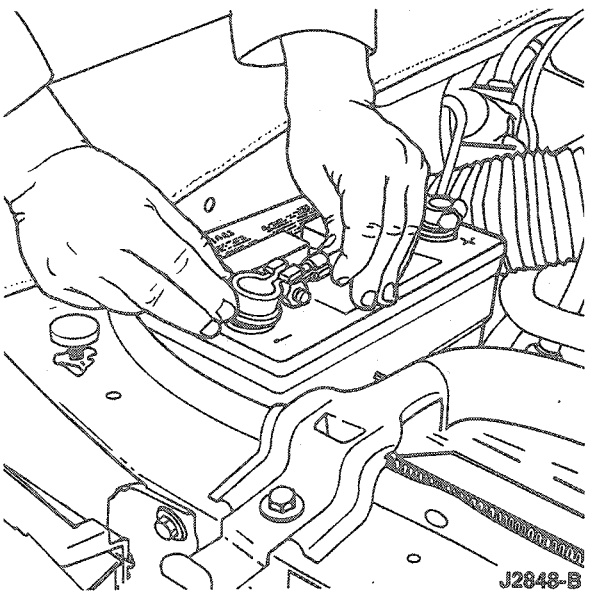
J2927-A

2. Clean battery tray with a wire brush and scraper.
3. Place battery in tray with positive and negative terminals in same position as previous battery. Assemble and tighten hold-down hardware so battery is secure. Do not over-tighten.

REMOVAL AND INSTALLATION (Continued)

4. Secure cables (positive first) to proper terminals. **Do not over-tighten.** Apply petroleum jelly to terminals.

   NOTE: When the battery is disconnected and reconnected, some abnormal driving symptoms may occur while the powertrain control module (PCM) relearns it adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.



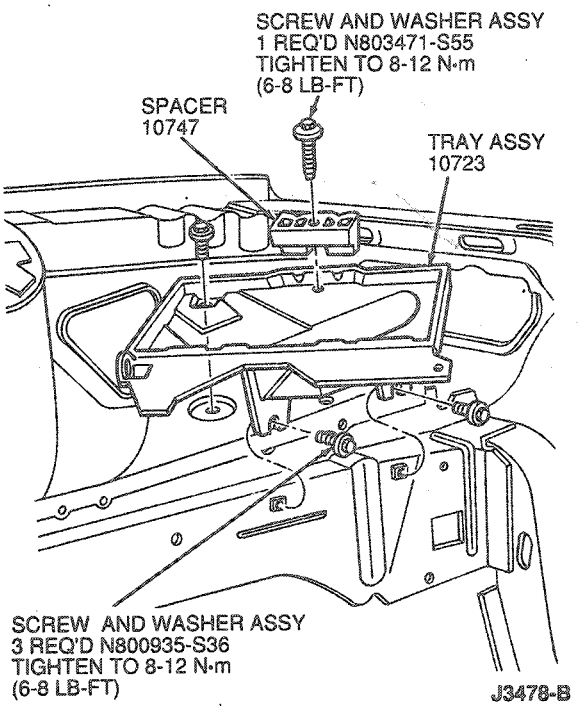
Battery Tray

Removal

1. Remove battery from vehicle as outlined.
2. Remove retaining bolts, screws and washers from battery tray.
3. Remove battery tray from vehicle.

Installation

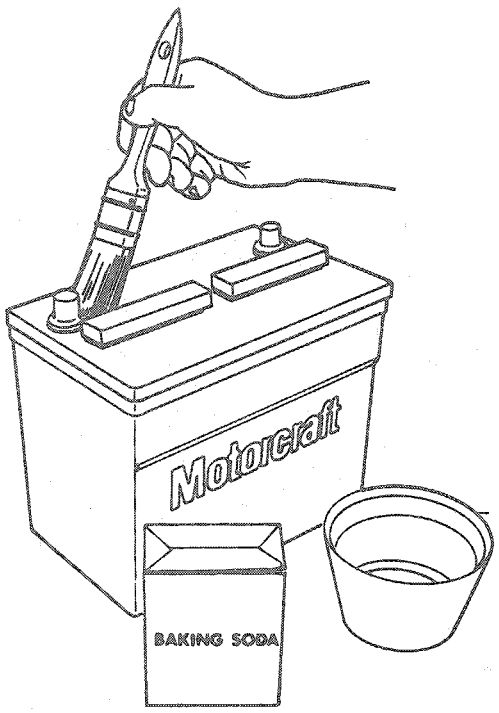
1. Position battery tray to inside fender in engine compartment.
2. Install retaining bolts and washers. Tighten each to 8-12 N·m (6-8 lb-ft).
3. Install battery in engine compartment as outlined.
4. Tighten hold-down bracket bolt to 7-10 N·m (6-7 lb-ft).



MAINTENANCE

Battery Cleaning

Keeping the battery top clean and dry reduces the need for service and extends battery life. Also, make certain the cable clamps are tightly fastened to the battery posts. If corrosion is found, disconnect the cables and clean clamps and posts with a wire brush. Neutralize the corrosion with a solution of baking soda and water. After installing cables, apply a small quantity of Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent to each battery post to help prevent corrosion.



J2847-A

CLEANING AND INSPECTION

Tools

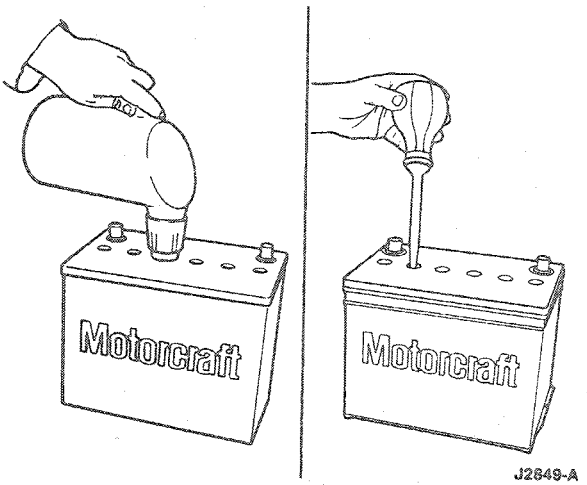
Anyone working with a battery needs the proper tools. Using the right tools will prevent damage to the battery, battery cables and hold-down bracketry.

Tools and equipment manufactured for servicing batteries have parts insulated to help prevent arcing should the tool be dropped or placed accidentally between a terminal and some other contact surface.

Battery Filling Devices

Batteries with Removable Vent Caps

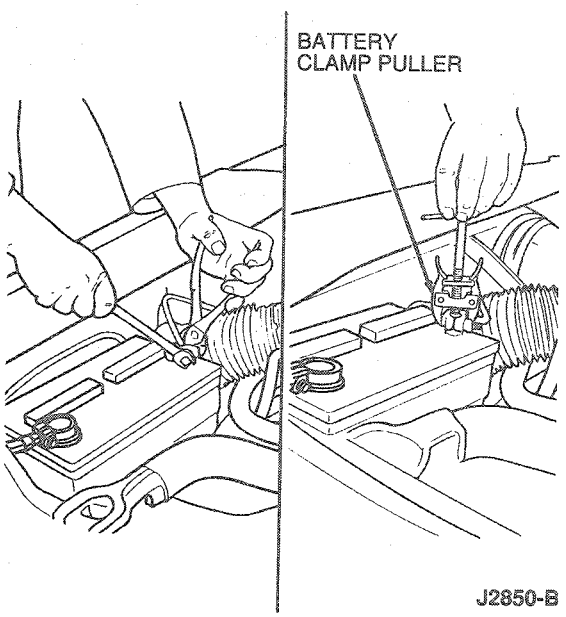
One of the most important on-vehicle services is to maintain the correct electrolyte level. Two devices are available for this purpose: a self-leveling filler which allows the battery to be filled to a predetermined level automatically, and a syringe-type filler.



J2849-A

Battery Pliers

Battery pliers have jaws specifically designed for gripping cable clamp bolts securely. Care should be taken when removing or replacing the cable clamp bolts so that the battery terminal is not subjected to any excessive lateral or twisting forces. Such forces could cause major damage to the internal components of the battery, and leakage at the terminals.



J2850-B

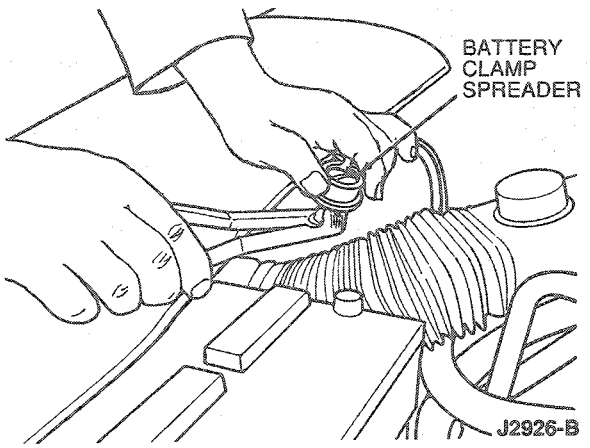
Battery Clamp Puller

Use a clamp puller to remove a cable clamp from the battery terminal. With the jaws gripping the underside of the cable clamp, pull the clamp up by means of pressure exerted against the top of the battery terminal. Proper use of this tool avoids the damaging lateral or twisting forces that result when using a pry bar or pliers.

CLEANING AND INSPECTION (Continued)

Battery Clamp Spreader

The spreader is used to expand the cable clamp after it has been removed from the terminal and the clamp bolt has been loosened. The cable clamp can then be easily placed in its correct position completely on the terminal.



Terminal Cleaning Brush

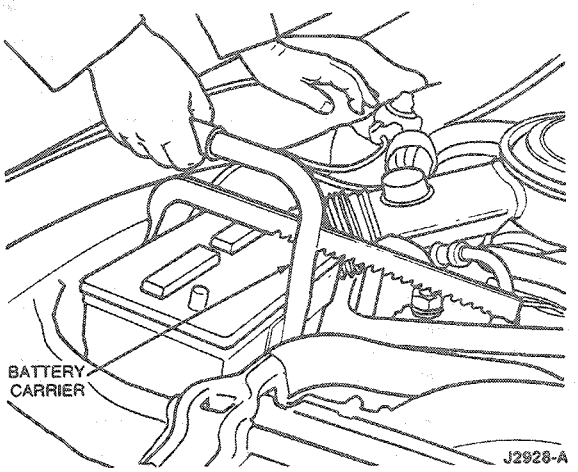
The terminal cleaning brush is designed with units to clean both the tapered battery terminal and the mating surface of the cable clamp. Refer to illustration under Battery Installation, Step 1.

Battery Carrier

Use a suitable battery carrier for lifting and transporting the battery. The illustration shows a clamp-type carrier used to grip the sidewalls of the container just below the lip of the cover. The carrier is used on the sidewalls, rather than the endwalls, since the sidewalls have additional strength from the inner cell partitions. This is particularly important with the plastic-cased battery which has endwalls that are flexible.

WARNING: BATTERIES NORMALLY PRODUCE EXPLOSIVE GASES WHICH CAN CAUSE PERSONAL INJURY. THEREFORE, DO NOT ALLOW FLAMES, SPARKS OR LIGHTED SUBSTANCES TO COME NEAR THE BATTERY. WHEN CHARGING OR WORKING NEAR A BATTERY, ALWAYS SHIELD YOUR FACE AND PROTECT YOUR EYES. ALWAYS PROVIDE VENTILATION.

WHEN LIFTING A PLASTIC-CASED BATTERY, EXCESSIVE PRESSURE ON THE END WALLS COULD CAUSE ACID TO SPEW THROUGH THE VENT CAPS, RESULTING IN PERSONAL INJURY. LIFT WITH A BATTERY CARRIER OR WITH YOUR HANDS ON OPPOSITE CORNERS.



Adding Water

Some batteries have removable vent caps and may occasionally require the addition of water. If the electrolyte level is below the level indicator in any cell, add enough pure water to bring the level up to the indicator. In batteries without a level indicator, maintain electrolyte level at 6.3 to 12.7mm (1/4 to 1/2 inch) above the plates. **Never add electrolyte ("battery acid") to the battery.** This could shorten the life of the battery.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	N·m	Lb-In
Battery Tray Retaining Bolts	8-12	6-8 (Lb-Ft)
Battery Tray Hold-Down Bracket Bolt	7-10	6-7 (Lb-Ft)
Battery Terminal Clamps (3.0L/3.8L EFI)	6-10	60-90
Screw	3.4-4.8	31-42
Battery Terminal Clamps (3.0L/3.2L SHO)	7.6-10.4	68-92

SPECIAL SERVICE TOOLS

ROTUNDA EQUIPMENT

Model	Description
007-00001	Digital Volt-Ohmmeter
021-00046	Battery and Anti-Freeze Tester

SECTION 14-02A Generator, Integral Rear Mount Regulator—Internal Fan Type

VEHICLE APPLICATION

Taurus / Sable Vehicles with 3.0L and 3.8L EFI Engines.

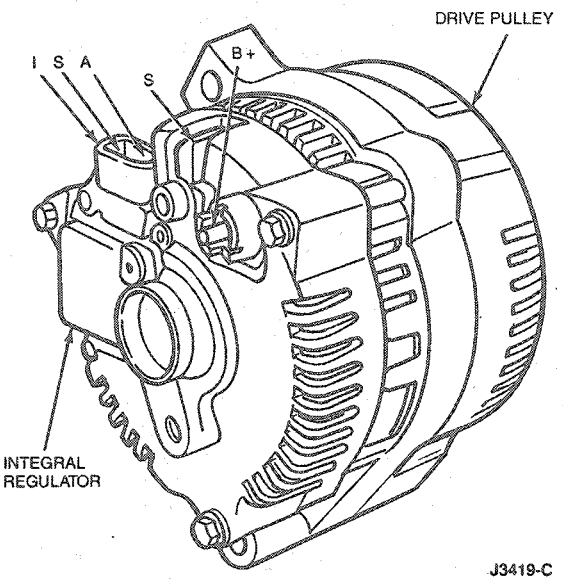
DESCRIPTION AND OPERATION

The electrical charging system is a negative ground system consisting of an integral generator / voltage regulator (IGR), charge indicator, storage battery, and the necessary wiring and cables. Refer to the Electrical and Vacuum Troubleshooting manual for schematics and locations of components and wiring.

With the ignition key in the RUN position, voltage is applied through the charge indicator lamp 'I' circuit to the voltage regulator. This turns the regulator on allowing current to flow from the battery sense 'A' circuit to the generator field coil. When the engine is started, the generator begins to generate alternating (AC) current which is converted to direct (DC) current by the rectifier assembly internal to the generator. This current is then supplied to the vehicle's electrical system through the output connector Battery Positive Voltage (B+) located on the rear of the generator.

Once the generator begins generating current, a voltage signal is taken from the generator stator and fed back to the regulator 'S' circuit, turning off the charge indicator.

With the system functioning normally, the generator output current is determined by the voltage at the 'A' circuit (battery sense voltage). The 'A' circuit voltage is compared to a set voltage internal to the regulator, and the regulator controls the generator field current to maintain proper generator output. The set voltage will vary with temperature and is typically higher in the winter than in the summer, allowing for better battery recharge in the winter and reducing the chance of overcharging the battery in the summer.



DESCRIPTION AND OPERATION (Continued)

Generator Circuit

Circuit Description

Battery Positive Voltage (B+) Output

The generator output is supplied through the Battery Positive Voltage (B+) output connection to the battery and electrical system.

'I' Circuit

The 'I' circuit, or ignition circuit, is used to turn on the voltage regulator. This circuit is powered up with the ignition key in the RUN position. This circuit is also used to turn the indicator on if there is a fault in the charging system operation or associated wiring circuits.

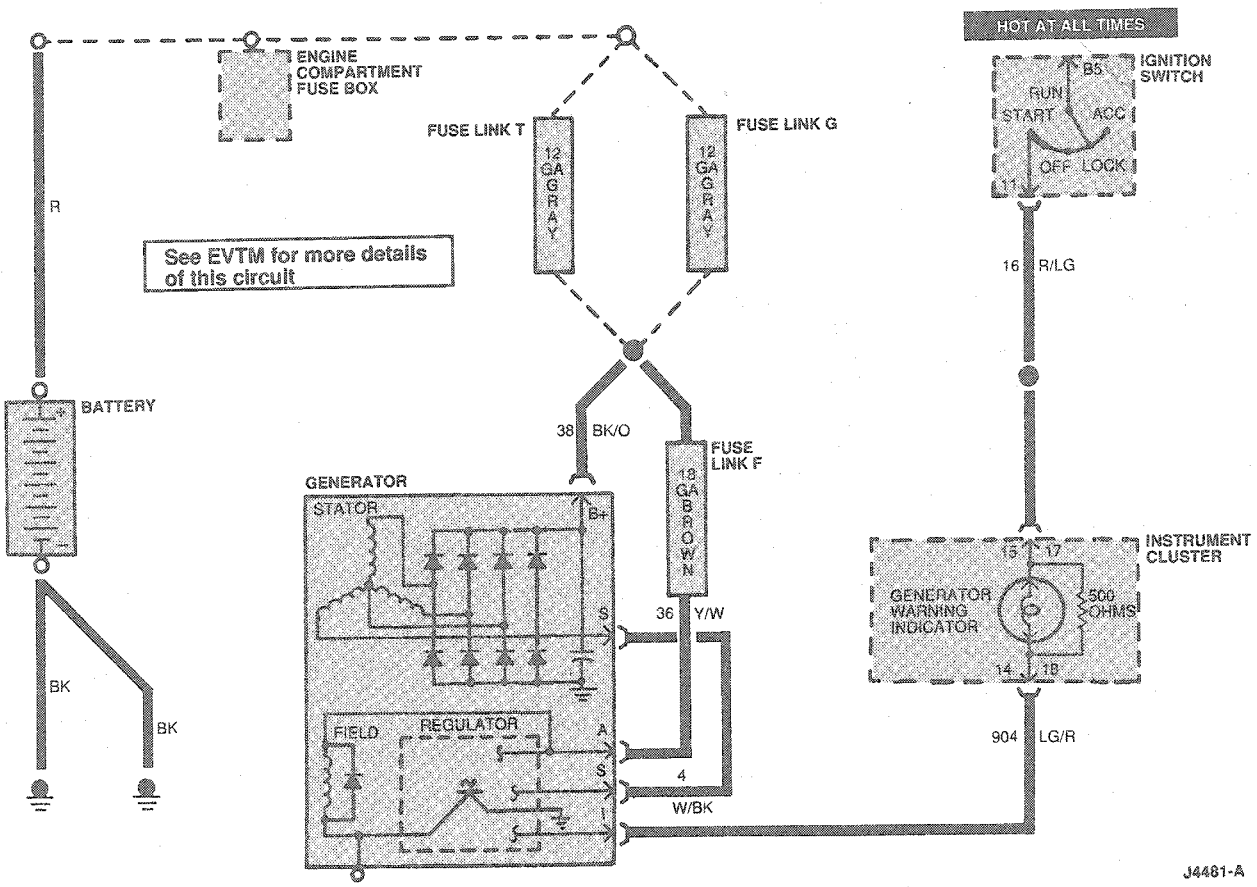
'A' Circuit

The 'A' circuit, or battery sense circuit, is used to sense the battery voltage. This voltage is used by the regulator to determine the generator output. This circuit is also used to supply power to the generator field coil. This circuit is connected back to the load distribution point and is a protected circuit.

'S' Circuit

The 'S' circuit, or stator circuit, is used to feedback a voltage signal from the generator to the regulator. This voltage, typically 1 / 2 battery voltage, is used by the regulator to turn off the indicator.

Generator Circuit



DIAGNOSIS AND TESTING

Before performing charging system tests on the vehicle, note conditions such as: slow cranking, discharged battery, generator / battery charge indicator stays on with engine running or generator / battery charge indicator does not light with ignition switch in RUN and engine not running. This information will aid in isolating the part of the system causing the symptom.

Visual Inspection

Preliminary checks to the charging system should be made regardless of the inoperable condition. These checks include:

1. Check battery posts and cable terminals for clean and tight connections. Clean the posts and the cables to ensure good electrical contact.

DIAGNOSIS AND TESTING (Continued)

2. Check for secure connections at the generator output, regulator, and engine ground connections. Also check the connection at the load distribution point.
3. Check the generator belt to ensure proper tension and no slip between the generator pulley and the belt.
4. Check the fuses / fuse links to the generator to ensure that they are not burned or damaged. This condition, resulting in an open circuit or high resistance, can cause erratic or intermittent charging system concerns.

Isolating the Concern

Battery, starting system and lamp system problems can be caused by poor charging system performance. It is also reasonable to suspect the charging system if an overload condition has occurred in another area of the electrical system.

To avoid guesswork, it is necessary to isolate battery, charging system, and electrical circuits to correctly identify the area where the difficulty lies. Check the battery first before beginning any electrical system diagnosis. The battery must be in proper state of charge and operation before the other areas of the electrical system can perform normally.

Battery Check

Check battery to see if it has the capacity and ability to accept and hold a charge. Refer to Section 14-01. If battery is OK, the charging system should then be checked to see that it performs its function of keeping the battery charged.

The battery capacity, specific gravity and cell comparison test (non-maintenance free batteries only) will determine the ability of a battery to accept and hold a charge. If the battery does not meet specification, replace it with a new, fully charged battery before further diagnosis of other areas of the electrical system.

If the battery meets required specifications, it should be fully charged before proceeding with the diagnosis of other electrical system components.

Charging System Check

The charging system test should be performed before testing any individual charging system components. The component tests will determine the type of component service required.

Test instruments used in the charging system test are a voltmeter (0-20- or 0-30-volt scale) and an ohmmeter.

WARNING: SPECIAL CARE SHOULD BE TAKEN WHEN USING THE OHMMETER NEAR "HOT" CIRCUITS. DISCONNECT THE COMPONENT TO BE CHECKED ON THE BATTERY CABLES TO PREVENT DAMAGE TO THE OHMMETER.

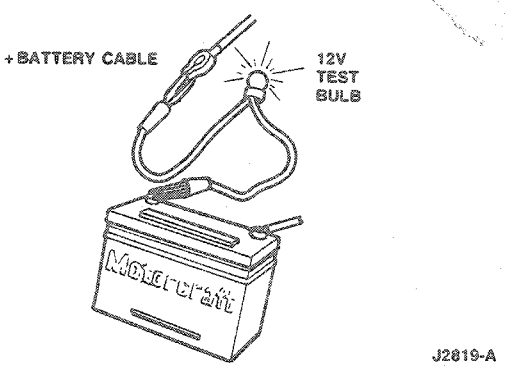
Battery Drain Test

Tools Required:

- Rotunda Digital Volt-Ohmmeter 007-00001

Check for current drains on the battery in excess of 100 milliamps with all the electrical accessories off and the vehicle at rest. Current drains can be tested one of three ways:

1. Connect a 12-volt test lamp in series with battery positive terminal. If lamp glows, then a drain exists.
2. Use an in-line ammeter between the battery positive or negative post and its respective cable.
3. Use a clamp-on current probe to the battery positive or negative cable. Make sure that the probe is properly calibrated to prevent false readings.



Typically, a drain of approximately one amp can be attributed to an underhood lamp, glove compartment lamp, or rear deck lid lamp staying on continually. Other component failures or wiring shorts may be located by selectively pulling fuses or disconnecting fuse links to pinpoint the location of the current drain. When the current drain is found, the test lamp will go out or the meter reading will fall to an allowable level. If the short is still not located, after checking all the fuses and fuse links, the drain may be due to the generator / regulator. Disconnect the generator output wire from the output stud and the regulator connector. If this eliminates the drain, check the charging system to locate the concern.

NOTE: A voltmeter is sometimes used for this test but it will react to a very small normal drain caused by "always-on" electronic systems such as starter interlock, anti-theft alarm, illuminated entry, etc, which cause no concern. The test lamp shows only drains which are large enough to cause a concern.

NOTE: For vehicles with electronic instrument cluster or message center, when the Message Center is initially powered up (after a battery disconnect), the Message Center "computer" may be energized for as long as one minute causing a 0.25 amp current draw before returning to the normal 0.010-0.012 amp current draw. Therefore, it is important to allow at least one minute to pass (after ammeter hookup) before observing any current measurements.

DIAGNOSIS AND TESTING (Continued)

Charging System Tests

Tools Required:

- Rotunda Starting and Charging System Tester (VAT-40) 078-00005

Generator Output Test

When performing charging system tests, turn off all lamps and electrical components. Place transmission in PARK and apply parking brake.

CAUTION: Do not make jumper wire connections except as directed. Making improper jumper connections may damage the regulator or fuse links.

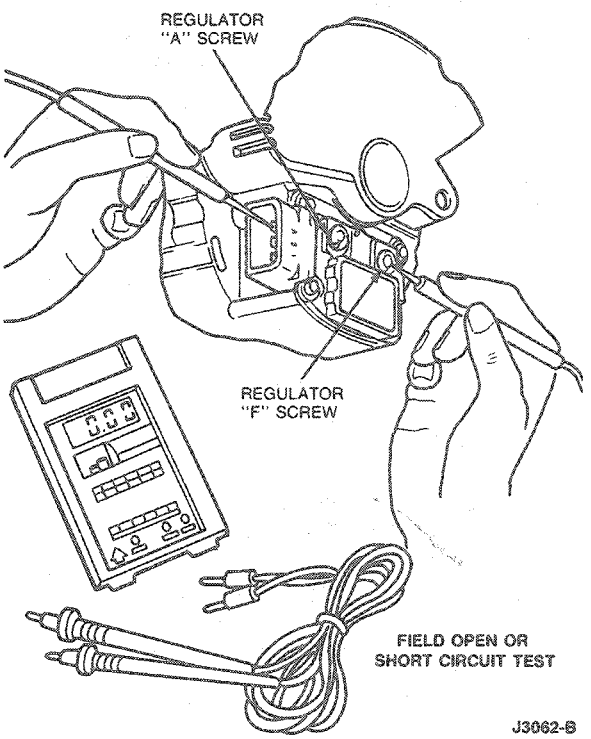
NOTE: Battery posts and cable clamps must be clean and tight to ensure accurate meter indications. Reference measurements to ground should be made to the battery negative post.

In order to check the charging system, the use of Rotunda Starting and Charging System Tester (VAT-40) 078-00005 or equivalent, is recommended.

1. Connect the positive and negative leads of the tester to battery.
2. Connect current probe to generator output lead (to measure generator output).
3. With the engine running at approximately 2000 rpm, set the load adjustment to determine generator output (with an ambient temperature of less than 27°C [80°F]).

   NOTE: When measuring generator output, the tester can be connected to the battery positive or negative cable. In this case all electrical accessories must be turned off and 10-15 amps must be added to the reading on the tester to compensate for engine operation.

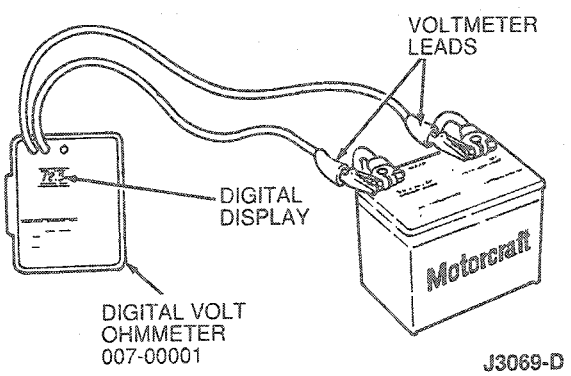
   NOTE: Refer to the tester procedure manual for complete directions on checking the charging system.



Base Voltage Test

NOTE: Prior to running this test, turn the headlamps on for 10-15 seconds to remove any surface charge from the battery. Then, wait until the voltage stabilizes prior to performing the base voltage test.

1. With ignition switch in OFF position and no electrical loads operating, measure voltage across the battery positive and negative posts.
2. Record battery voltage reading shown on voltmeter scale. This reading is called base voltage.



No-Load Test

1. Connect a tachometer to engine.

DIAGNOSIS AND TESTING (Continued)

2. Start engine and increase speed to approximately 1500 rpm. With no other electrical load (foot off brake pedal and doors closed), voltmeter pointer should move upward (increase) but not more than 3.0 volts above base voltage.

   NOTE: The reading should be taken when voltmeter pointer stops rising. It may take a few minutes to reach this point. If voltage increases to proper level, perform Load Test. If the pointer continues to rise, perform the Over Voltage Tests. If the voltage does not rise to proper level, perform Under Voltage Tests.

Load Test

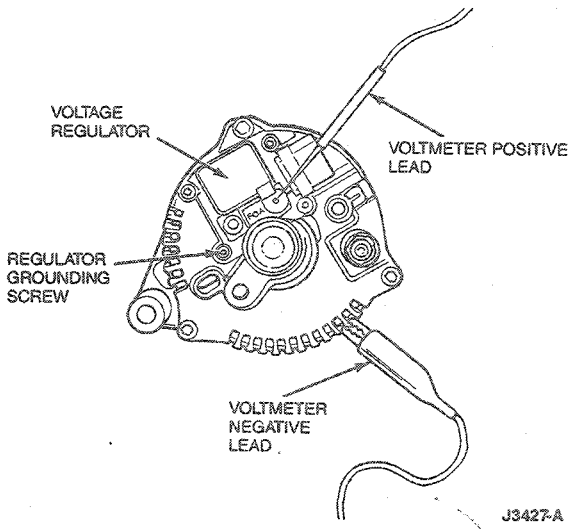
1. With engine running, turn heater / air conditioner blower motor on (high speed) and headlamps on high beam.
2. Increase engine speed to approximately 2000 rpm. Voltmeter should indicate a minimum of 0.5 volt above base voltage. If not, perform Under Voltage Tests.

   If above tests indicate proper voltage readings, charging system is operating normally. Proceed to the following tests if one or more of the readings is different than shown above and use a test lamp to check for battery drain.

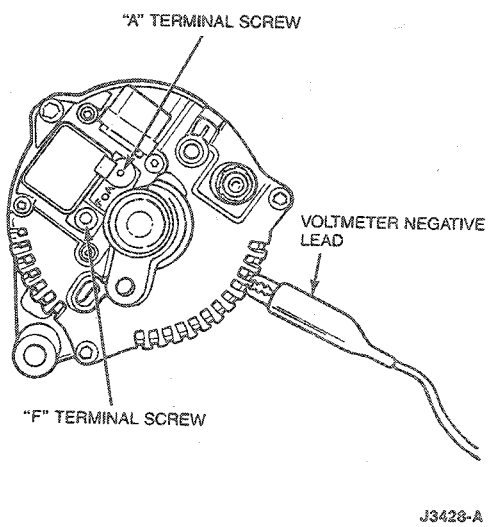
Over Voltage Tests

If voltmeter indicates more than 3.0 volts above base voltage in No-Load Test, follow these procedures:

1. With ignition switch in RUN position (engine not running), connect voltmeter negative lead to ground. Contact voltmeter positive lead first to generator output connection at load distribution point and then to regulator 'A' screw head.
2. If voltage difference between two locations is greater than 0.25 volt, service 'A' terminal wiring circuit to eliminate high resistance condition indicated by excessive voltage drop.
3. If over voltage condition still exists, check for loose regulator and generator grounding screws. Tighten loose regulator grounding screws to 1.7-2.8 N·m (16-24 lb-in).



4. If over voltage condition still exists, connect voltmeter negative lead to ground. With ignition switch in OFF position, contact voltmeter positive lead first to regulator 'A' screw head and then to regulator 'F' screw head. Different voltage readings at two screw heads indicate a malfunctioning regulator grounded brush lead or a grounded rotor coil. Replace regulator / brush holder or generator assembly.
5. If same voltage reading (battery voltage) is obtained at both screw heads in Step 4 then there is no short to ground through the generator field / brushes. Replace the regulator.

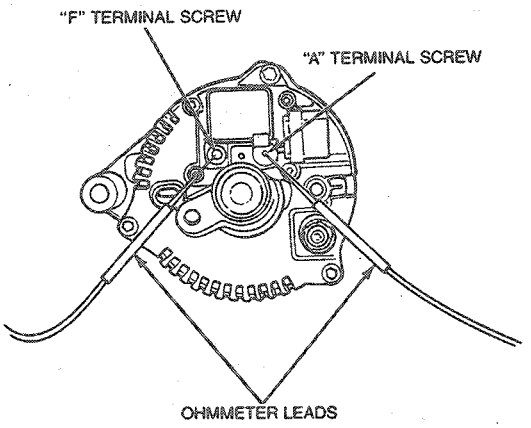


Under Voltage Tests

If voltmeter does not indicate more than 0.5 volt above base voltage, follow these procedures:

DIAGNOSIS AND TESTING (Continued)

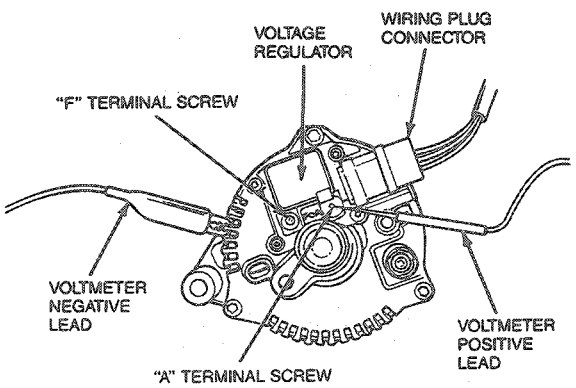
1. Disconnect wiring plug from regulator and connect an ohmmeter between regulator 'A' and 'F' terminal screws. The meter should indicate more than 2.4 ohms. If less than 2.4 ohms is indicated, check the generator for shorted rotor to field coil or shorted brushes. Replace the brush holder, if needed. Perform Load Test after servicing.



J3429-A

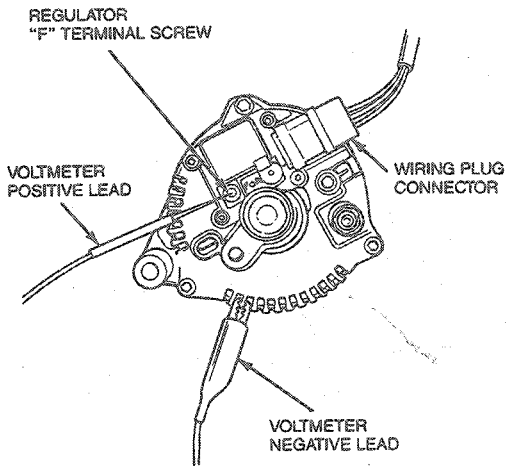
CAUTION: Do not replace the regulator if a shorted rotor coil or field circuit has been diagnosed. Regulator damage could result. Replace the generator assembly.

2. If above ohmmeter reading is greater than 2.4 ohms, connect regulator wiring plug and connect voltmeter negative lead to ground. Contact voltmeter positive lead to regulator 'A' terminal screw. The meter should indicate battery voltage. If there is no voltage, service the 'A' wiring circuit. Perform Load Test after servicing.



J3430-A

3. If voltmeter indicates battery voltage, connect voltmeter ground lead to ground. With the ignition switch in OFF position, contact voltmeter positive lead to regulator 'F' terminal screw. The meter should indicate battery voltage. If there is no voltage, replace generator assembly. Perform Load Test after servicing.

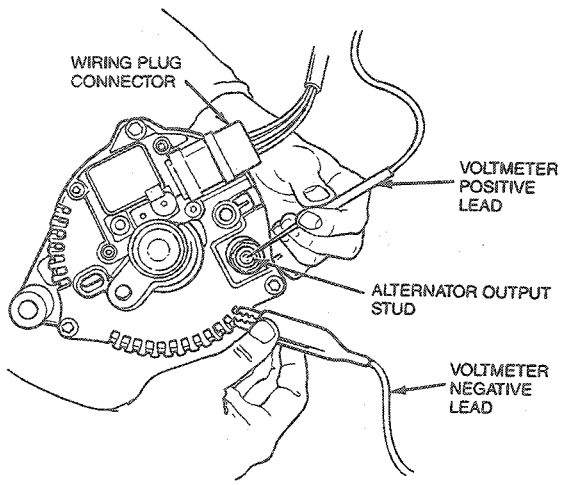


J3431-A

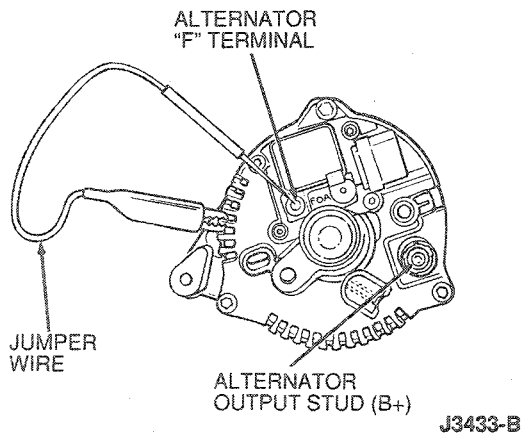
4. If voltmeter indicates battery voltage, connect voltmeter negative lead to ground. Turn ignition switch to RUN position (engine off) and contact voltmeter positive lead to regulator 'F' terminal screw. Refer to illustration under Step 3. The voltmeter should indicate 2 volts or less. If more than 2 volts is indicated, perform 'I' circuit tests and service 'I' circuit if needed. If 'I' circuit checks normal, replace regulator if needed and perform Load Test after servicing.

DIAGNOSIS AND TESTING (Continued)

5. If 2 volts or less is indicated, perform Load Test, but connect voltmeter positive to generator output stud. If voltage rises more than 0.5 volt above base voltage, service wiring from generator to load distribution point. Repeat Load Test, measuring voltage at battery cable clamps after servicing.



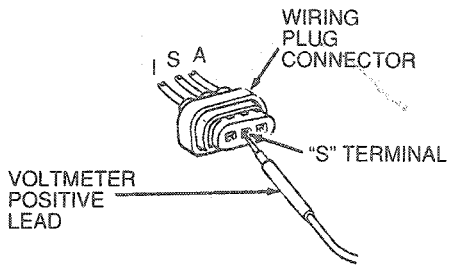
6. If voltage does not rise above 0.5 volt above base voltage, perform Load Test and measure voltage drop from the battery to the 'A' terminal of the regulator (with regulator connected). If the voltage drop exceeds 0.5 volt, service wiring from 'A' terminal to load distribution point.
7. If voltage drop does not exceed 0.5 volt, connect a jumper wire from the generator rear housing to regulator 'F' terminal. Repeat Load Test with voltmeter positive lead connected to the generator output stud. If voltage rises more than 0.5 volt, replace regulator.

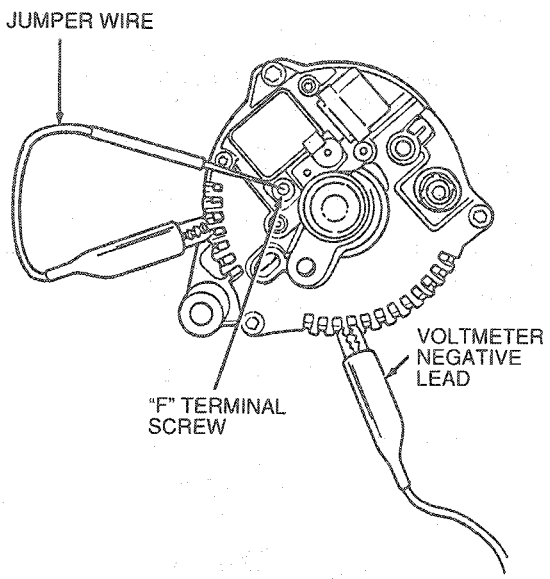


8. If voltage does not rise more than 0.5 volt, replace generator assembly.

Regulator S and / or I Circuit Test

1. Disconnect the wiring plug from the regulator. Connect a jumper wire from the regulator A terminal to the wiring plug A lead. Add a jumper wire from the regulator F screw to the generator rear housing.
2. With the engine idling and the voltmeter negative lead connected to ground, connect the voltmeter positive lead to the S terminal and then to the A terminal of the regulator wiring plug. The voltage at the S circuit should read approximately one-half that of the A circuit. If voltage readings are normal, remove the jumper wire. Replace the regulator and connect the wiring plug to the regulator. Repeat the Load Test after servicing.





3. If no voltage is present, remove the jumper wire and service the faulty wiring circuit or generator.
4. Connect the voltmeter positive lead to the positive battery terminal. Connect the wiring plug to the regulator. Repeat Load Test.

Fuse Link Continuity

1. Ensure first that battery is OK, then turn on headlamps or any accessory. If headlamps or an accessory do not operate, fuse link is probably burned out.

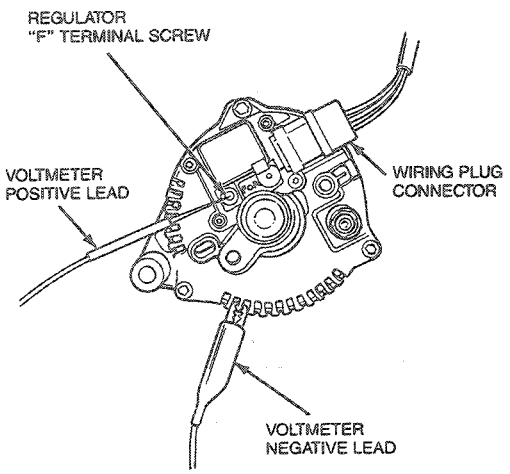
DIAGNOSIS AND TESTING (Continued)

2. On some vehicles there are several fuse links. Use same procedure as in Step 1 to test fuse link that protects vehicle equipment.
3. To test fuse link that protects generator, ensure that battery is OK, then check with a voltmeter for voltage at BAT terminal of generator and 'A' terminal of voltage regulator. No voltage indicates that fuse link is probably burned out. Refer to Section 18-01 for fuse link replacement procedures.

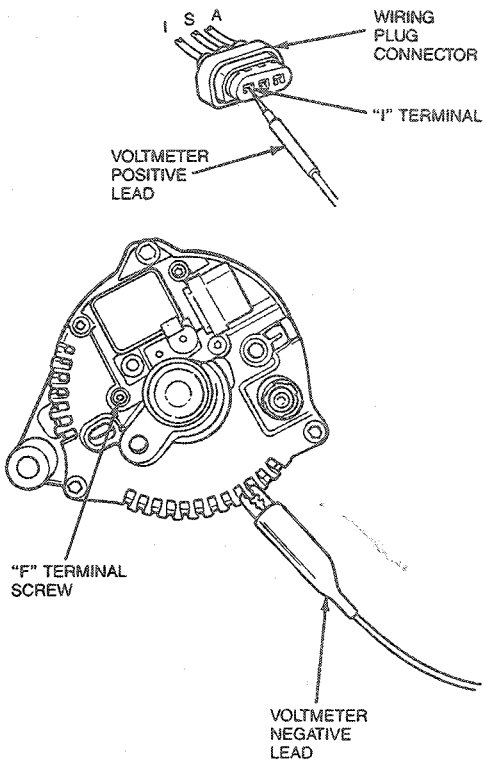
Field Circuit Drain

Connect the voltmeter negative lead to the generator rear housing for all of the following voltage readings:

1. With ignition switch turned to OFF position, contact voltmeter positive lead to regulator 'F' terminal screw. The meter should indicate battery voltage if system is operating normally. If less than battery voltage is indicated, proceed with Step 2 to find cause of current drain.
2. Measure voltage at 'I' terminal (ignition OFF). If voltage is indicated, service 'I' circuit from ignition switch to eliminate voltage source.
3. If no voltage was indicated in Step 2, contact voltmeter positive lead to wiring plug 'S' terminal. No voltage should be indicated. If no voltage is indicated, replace the regulator.
4. If voltage was indicated in Step 3, disconnect the one pin 'S' terminal connector. Again, contact voltmeter positive (+) lead to regulator wiring plug 'S' terminal. If voltage is indicated, service 'S' lead wiring to eliminate voltage source. If no short is found, replace generator assembly.



J3431-A



J3435-A

Diagnosis Charts

Continue through Diagnosis charts until service is completed. Then, test system again to see if service has corrected the condition.

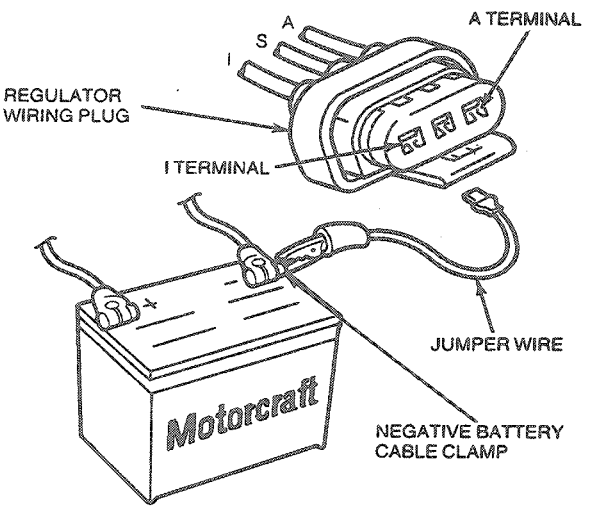
PINPOINT TEST A: CHARGE INDICATOR — DIAGNOSIS

TEST STEP		RESULT ▶	ACTION TO TAKE
A1	LAMP CHECK NO. 1		
	• Engine OFF. • Key in OFF position. • **Is charge indicator on?**	Yes ▶ No ▶	GO to **A4.** GO to **A2.**

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A: CHARGE INDICATOR — DIAGNOSIS (Continued)

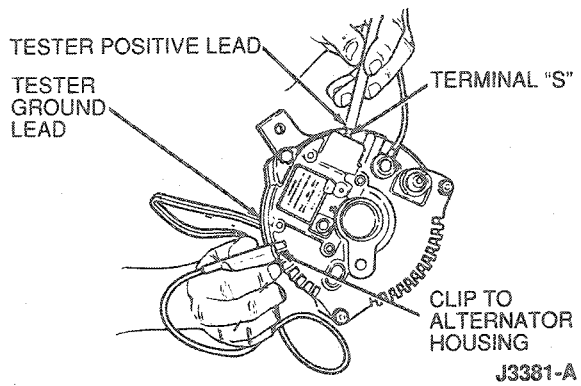
TEST STEP		RESULT	ACTION TO TAKE
A2	LAMP CHECK NO. 2		
	• Engine OFF. • Key in RUN position. • **Is charge indicator on?**	Yes ▶ No ▶	GO to A3. GO to A5.
A3	LAMP CHECK NO. 3		
	• Key in RUN position. • Engine running. • **Is charge indicator on?**	No ▶ Yes ▶	Lamp test complete. GO to A9.
A4	IMPROPER 'I' CIRCUIT WIRING		
	• Key in OFF position. • Check for voltage at 'I' circuit. • **Is voltage present?**	Yes ▶ No ▶	CHECK for voltage feed from always hot circuit to I circuit. CHECK for damaged or improper wiring to indicator lamp at instrument cluster.
A5	INOPERATIVE INDICATOR LAMP		
	• Key in ON position. • Engine OFF. • Disconnect regulator connector and ground 'I' terminal. • **Is charge indicator on?**	Yes ▶ No ▶	GO to A7. GO to A6.
A6	RESISTANCE / BULB TEST		
	• Check for voltage at 'I' terminal of regulator connector. • **Is voltage present?**	Yes ▶ No ▶	CHECK for burned out indicator lamp or high resistance in lamp circuit. CHECK for an open in 'I' circuit wiring.

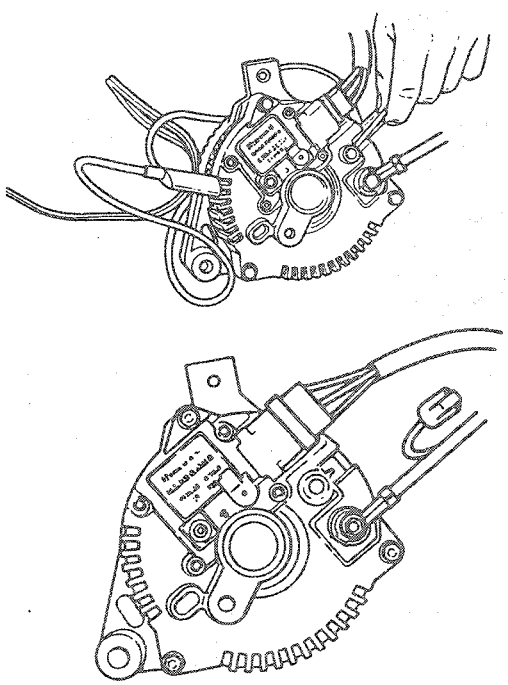


DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A: CHARGE INDICATOR — DIAGNOSIS (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A7	STATOR VOLTAGE FAULT		
	• Reconnect voltage regulator. • Engine OFF. • Check voltage 'S' terminal. • **Is voltage present?**	Yes ▶ No ▶	GO to A8. REPLACE regulator.
A8	PINPOINT STATOR VOLTAGE FAULT		
	• Disconnect 1-pin stator connector. • Key in ON position. • Engine OFF. • **Is charge indicator on?**	Yes ▶ No ▶	REPLACE generator assembly. REPLACE regulator.
A9	OPEN CIRCUIT CHECK		
	• Check voltage regulator, stator and Battery Positive Voltage (B+) output terminal connections for looseness or corrosion and service before checking voltage. • With key in ON position, engine off, check voltage at Battery Positive Voltage (B+) and 'A' terminal. • **Is battery voltage present?**	Yes ▶ No ▶	GO to A10. SERVICE wiring or fuse / fuse link for an open circuit between battery and generator or regulator.





DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A: CHARGE INDICATOR — DIAGNOSIS (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A10	VOLTAGE DROP TEST — 'A' TERMINAL		
	• Key in ON position. • Engine OFF. • Measure voltage between battery positive post and voltage regulator 'A' terminal. • **Is voltage difference more than 0.25 volt?**	Yes ▶	CHECK for high resistance in wiring between voltage regulator 'A' terminal and battery. SERVICE as required.
		No ▶	GO to A11.
A11	VOLTAGE DROP TEST — BATTERY POSITIVE VOLTAGE (B+) TERMINAL		
	• Key in ON position. • Engine running. • Blower on HIGH, headlamps ON. • Measure voltage between generator Battery Positive Voltage (B+) output terminal and battery positive terminal. • **Is difference less than 1.5 volts?**	Yes ▶	GO to A12.
		No ▶	CHECK for high resistance in wiring between generator Battery Positive Voltage (B+) output terminal and battery. SERVICE as required.
A12	'I' CIRCUIT CHECK		
	• Key in ON position. • Blower on HIGH. • Engine running. • Disconnect voltage regulator connector. • **Is charge indicator on?**	Yes ▶	SERVICE 'I' circuit for a short to ground.
		No ▶	GO to A13.
A13	'S' CIRCUIT CHECK		
	• Reconnect voltage regulator connector. • Engine running. • Measure voltage at 'S' circuit at generator and at regulator.	Voltage approximately 1/2 'A' circuit battery voltage at both locations ▶	GO to A14.
		Voltage approximately 1/2 'A' circuit battery voltage at generator but not at regulator ▶	SERVICE open in 'S' circuit wiring.
		No voltage at either location ▶	GO to A15.
A14	VOLTAGE OUTPUT CHECK		
	• Engine running at 2000 rpm. • Measure battery voltage. • **Is battery voltage above 16 volts?**	Yes ▶	CHECK generator for brush or rotor short to ground. CHECK regulator screws for tightness, or high resistance in 'A' circuit. If no concern found, REPLACE voltage regulator.
		No ▶	REPLACE voltage regulator.
A15	NO VOLTAGE CHECK		
	• Ground 'F' screw on voltage regulator. • Check for voltage at 'S' terminal. • **Is voltage approximately 1/2 battery voltage?**	Yes ▶	REPLACE regulator.
		No ▶	REPLACE generator assembly.

TJ3426D

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST B: CHARGING SYSTEM TEST — IAR GENERATOR

TEST STEP		RESULT	ACTION TO TAKE
B1	PRELIMINARY CHECKS		
	• Preliminary Checks: — Fuse link — Battery terminals and cable clamps — Wiring and ground connections to generator, regulator and engine — Generator belt tension • **Are components OK?**	Yes No	GO to **B2.** SERVICE and / or REPLACE as necessary. GO to **B2.**
B2	BASE VOLTAGE AND NO LOAD TEST		
	• Connect voltmeter to battery posts. Read battery voltage — this is base reading. • Start engine, run at 1500 rpm with no electrical load. Voltage should increase but not more than 3 volts. • **Does voltage increase more than 3 volts?**	No No increase Yes	GO to **B3.** GO to **B5.** GO to **B12.**
B3	LOAD TEST		
	• Increase engine speed to 2000 rpm. • Turn heater-A / C blower and headlamps on HIGH. • **Is voltage a minimum of 0.5 volt over base voltage?**	Yes No	GO to **B4.** GO to **B5.**
B4	BATTERY DRAIN TEST — KEY OFF		
	• Concern can still be battery drain. Turn OFF ignition, install test lamp in series with positive battery cable and check to isolate problem circuit. • **Is there a battery drain?**	Yes No	CHECK vehicle circuits for drain. REFER to Section 14-01.
B5	UNDER-VOLTAGE TEST		
	• Disconnect regulator. • Check resistance between regulator 'A' and 'F' terminals on regulator. • **Is resistance more than 2.4 ohms?**	Yes No	GO to **B6.** CHECK generator for shorted field circuit and REPLACE generator assembly if required. If generator is OK, REPLACE regulator. GO to **B2.**
B6	'A' TERMINAL VOLTAGE CHECK		
	• Reconnect regulator. • Measure 'A' terminal voltage. • **Is there battery voltage?**	Yes No	GO to **B7.** SERVICE 'A' circuit wiring.
B7	'F' TERMINAL VOLTAGE CHECK — IGNITION OFF		
	• Voltage regulator connected. • Key OFF. • Measure regulator 'F' terminal voltage with ignition off. • **Is there battery voltage?**	Yes No	GO to **B8.** REPLACE generator assembly. GO to **B2.**
B8	'F' TERMINAL VOLTAGE CHECK — IGNITION ON		
	• Turn ignition to RUN position (engine not running). • Measure regulator 'F' terminal voltage. • **Is voltage more than 1.5 volts?**	Yes No	GO to **B9.** GO to **B10.**
B9	'I' CIRCUIT TESTS		
	• Perform 'I' circuit tests. • **Is circuit OK?**	Yes No	REPLACE regulator. GO to **B2.** SERVICE 'I' circuit wiring. GO to **B2.**
B10	JUMPERED LOAD TEST		
	• Repeat Load Test measuring voltage to generator Battery Positive Voltage (B+) output terminal from battery negative clamp. • **Does voltage rise 0.5 volt or more?**	Yes No	SERVICE generator to starter relay wiring. GO to **B2.** GO to **B11.**

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST B: CHARGING SYSTEM TEST — IAR GENERATOR (Continued)

TEST STEP		RESULT	ACTION TO TAKE
B11	LOAD TEST REPEAT — 'F' TERMINAL		
	• Connect a jumper wire from generator rear housing to regulator 'F' terminal. • Repeat load test measuring voltage at Battery Positive Voltage (B+) output terminal. • **Does voltage rise 0.5 volt or more?**	Yes ▶ No ▶	REPLACE regulator. GO to B2. REPLACE generator assembly. GO to B2.
B12	OVER-VOLTAGE TEST		
	• Turn ignition to RUN position (engine not running). • Measure voltage at regulator 'A' terminal and starter solenoid. • **Is voltage difference 0.5 volt or less?**	Yes ▶ No ▶	GO to B13. SERVICE A circuit wiring. GO to B2.
B13	REGULATOR GROUND CHECK		
	• Check for loose regulator ground screws. • **Is ground OK?**	Yes ▶ No ▶	GO to B14. SERVICE ground screws. GO to B2.
B14	ENGINE GROUND CHECK		
	• Check for bad engine ground. • **Is ground OK?**	Yes ▶ No ▶	GO to B15. SERVICE engine ground. GO to B2.
B15	GENERATOR GROUND CHECK		
	• Check generator ground. • **Is ground OK?**	Yes ▶ No ▶	GO to B16. SERVICE generator ground. GO to B2.
B16	REPEAT NO LOAD TEST		
	• Start engine, run at 1500 rpm with no electrical load. • Voltage should increase but not more than 3 volts. • **Does voltage increase more than 3 volts?**	No ▶ Yes ▶	GO to B3. GO to B17.
B17	'A' AND 'F' VOLTAGE CHECKS		
	• Turn ignition OFF. • Measure voltage at regulator 'A' and 'F' terminals. • Terminal voltages should be the same as battery voltage. • **Is there battery voltage at both terminals?**	Yes ▶ No ▶	REPLACE regulator. GO to B2. REPLACE generator assembly. GO to B2.

TJ3058E

REMOVAL AND INSTALLATION

WARNING: BATTERIES NORMALLY PRODUCE EXPLOSIVE GASES WHICH CAN CAUSE PERSONAL INJURY. THEREFORE, DO NOT ALLOW FLAMES, SPARKS OR LIGHTED SUBSTANCES TO COME NEAR THE BATTERY. WHEN CHARGING OR WORKING NEAR A BATTERY, ALWAYS SHIELD YOUR FACE AND PROTECT YOUR EYES. ALWAYS PROVIDE VENTILATION.

WHEN LIFTING A PLASTIC-CASED BATTERY, EXCESSIVE PRESSURE ON THE END WALLS COULD CAUSE ACID TO SPEW THROUGH THE VENT CAPS, RESULTING IN PERSONAL INJURY. LIFT WITH A BATTERY CARRIER OR WITH YOUR HANDS ON OPPOSITE CORNERS.

WARNING: KEEP BATTERIES OUT OF REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERY TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH THE SKIN, EYES OR CLOTHING, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF FIFTEEN MINUTES. IF ACID IS SWALLOWED, DRINK LARGE QUANTITIES OF MILK OR WATER, FOLLOWED BY MILK OF MAGNESIA, A BEATEN EGG, OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.

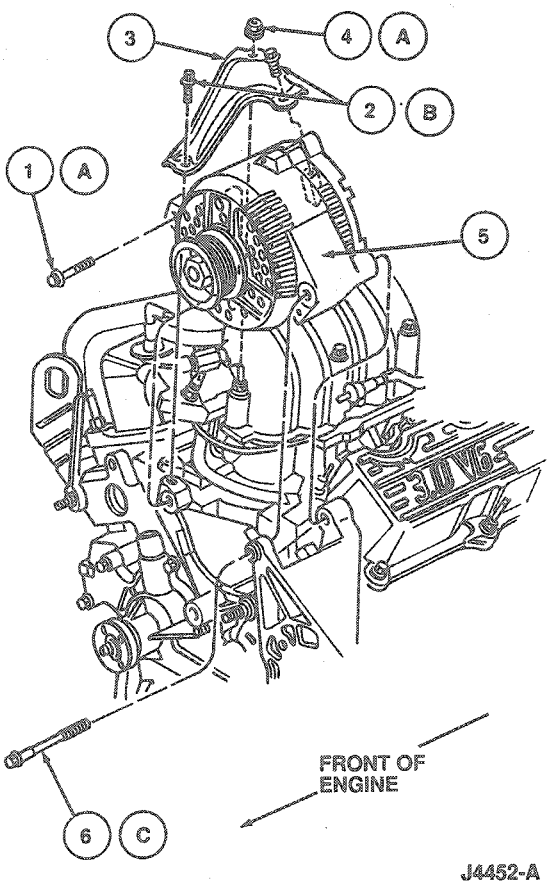
REMOVAL AND INSTALLATION (Continued)

Generator

Removal

1. Disconnect battery ground cable.
2. Disconnect the wire harness attachments to the integral generator / regulator assembly.
3. Loosen the generator pivot bolt. Remove the adjustment arm bolt from the generator.
4. Disengage the accessory drive belt from the generator pulley.
5. Remove the generator pivot bolt and generator / regulator assembly.

3.0L / 3.8L



J4452-A

Item	Part Number	Description
1A	N807274-S309B	Adjusting Arm Bolt
2B	N605892-S8	Bolt (2 Req'd)
3	10B315	Alternator Brace
4A	N621939-S53B	Nut and Washer
5	10300	Alternator
6C	N807241-S36B	Pivot Bolt
A		Tighten to 20-30 N·m (15-22 Lb-Ft)
B		Tighten to 8.5-11N·m (7-8 Lb-Ft)

(Continued)

Item	Part Number	Description
C		Tighten to 40-55 N·m (30-41 Lb-Ft)

TJ4452A

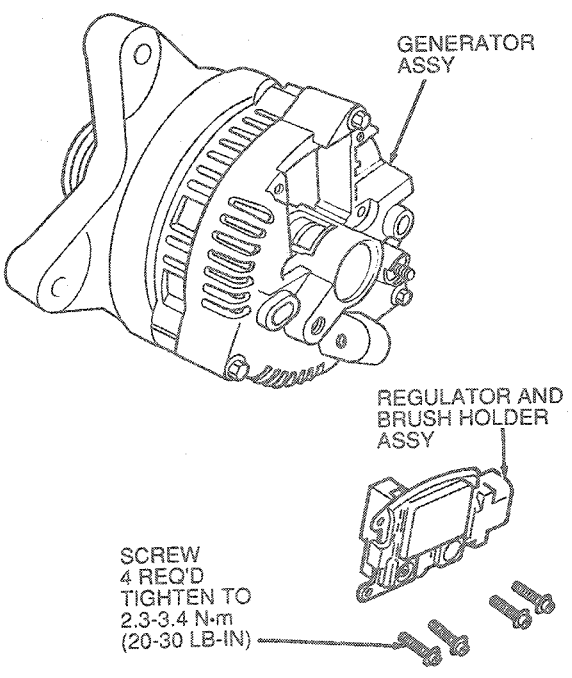
Installation

1. Position the integral generator / regulator assembly on the engine.
2. Install the generator pivot and adjustment arm bolts, but do not tighten the bolts until the belt is tensioned.
3. Install the accessory drive belt over the generator pulley.
4. Tighten the adjustment arm bolt to 20-30 N·m (15-22 lb-ft) and pivot bolt to 40-55 N·m (30-41 lb-ft).
5. Connect the wiring harness to the generator / regulator assembly.
6. Connect battery ground cable.

Regulator

Removal

1. Remove the four screws (T20 TORX®-type head) attaching the regulator to the generator rear housing. Remove the regulator, with brush holder attached, from the generator.

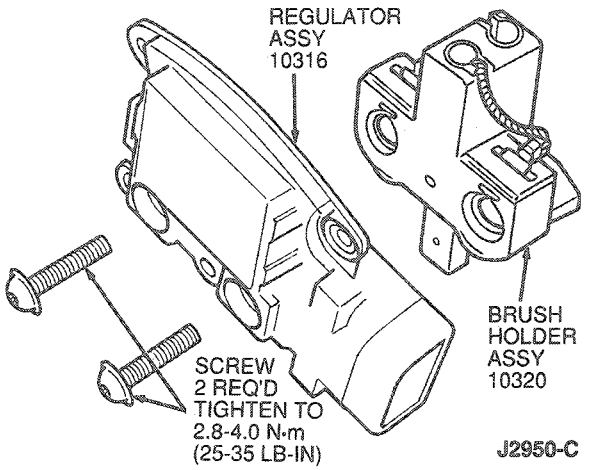


J4486-A

2. Hoid the regulator in one hand and pry off the cap covering the 'A' screw head with a screwdriver.

REMOVAL AND INSTALLATION (Continued)

3. Remove two screws (T20 TORX® type head) attaching the regulator to the brush holder. Separate the regulator from brush holder assembly.



Installation

1. Replace brush holder to regulator and install attaching screws.
2. Replace cap on the head of the 'A' terminal screw.
3. Depress the brushes into the holder and hold the brushes in position by inserting a standard size paper clip (or equivalent) through both the location hole in the regulator and through the holes in the brushes.
4. Install the regulator and brush holder assembly to the generator assembly with attaching screws.

   NOTE: Remove paper clip (or equivalent) from the regulator.

DISASSEMBLY AND ASSEMBLY

NOTE: The regulator, brush holder, fan and pulley are serviceable. If the generator assembly needs further service, it must be replaced as an assembly.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	N·m	Lb-Ft
Regulator Grounding Screws	1.76-2.8	16-24 (Lb-In)
Adjustment Arm Bolt	20-30	15-22
Pivot Bolt	40-55	30-41
Adjusting Brace Bolts	8.5-11	7-8
Generator Brace Nut	20-30	15-22

SPECIAL SERVICE TOOLS

ROTUNDA EQUIPMENT

Model	Description
007-00001	Digital Volt Ohmmeter
078-00005	Starting and Charging System Tester

SECTION 14-02B Generator, Integral Regulator — Internal Fan and Regulator Type

VEHICLE APPLICATION

Taurus with 3.0L, 3.2L Super High Output (SHO) Engine.

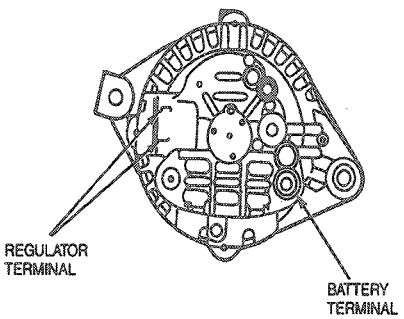
DESCRIPTION

Charging System

The electrical charging system is a negative ground system consisting of an integral generator / voltage regulator (IGR), charge indicator, storage battery and the necessary wiring and cables. Refer to the Electrical and Vacuum Troubleshooting manual for schematics and locations of components and wiring.

Generator

The integral generator / regulator (IGR) is belt-driven from the engine. Field current is supplied from the generators internally mounted voltage regulator, to the rotating field of the generator through two brushes and two slip rings.



J3437-A

OPERATION

With the ignition key in the RUN position, voltage is applied through the charge indicator 'I' circuit to the voltage regulator. This turns on the regulator and the indicator. When the engine is started, the generator begins to generate alternating (AC) current which is converted to direct (DC) current by the rectifier assembly internal to the generator. This current is then supplied to the vehicles electrical system through the generator Battery Positive Voltage (B+) connection located on the rear of the generator.

Once the generator begins generating current, a voltage signal is taken from the generator stator and fed back to the regulator warning circuit, turning off the charge indicator.

With the system functioning normally, the generator output current is determined by the voltage of the 'A' circuit (battery sense voltage). The 'A' circuit voltage is compared to a set voltage internal to the regulator, and the regulator controls the generator field current to maintain proper generator output. The set voltage will vary with temperature and is typically higher in the winter than in the summer, allowing for better battery recharge in the winter and reducing the chance of overcharging the battery in the summer.

Circuit Description

Battery Positive Voltage (B+) Output

The generator output is supplied through the Battery Positive Voltage (B+) output connection to the battery and electrical system.

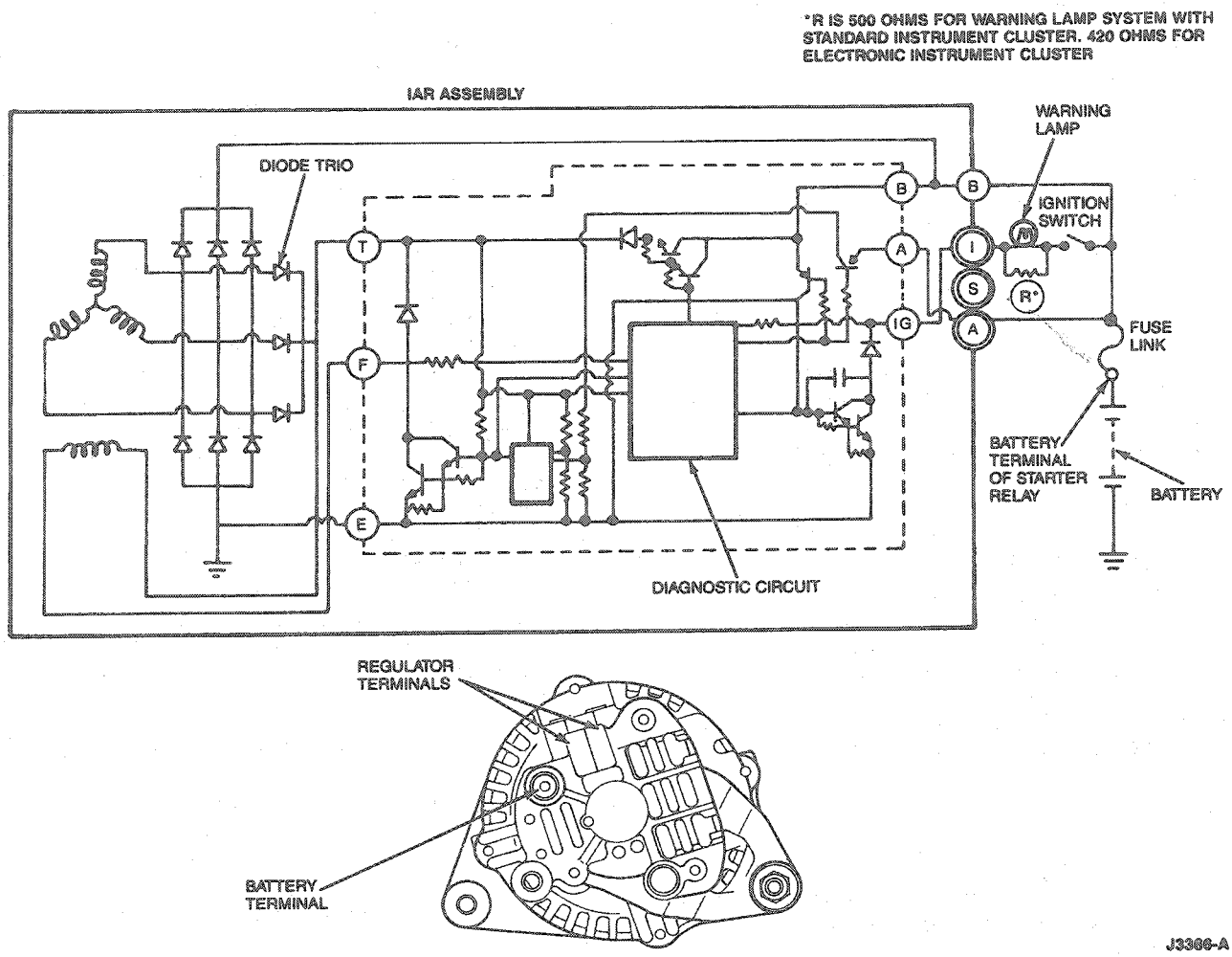
'I' Circuit

The 'I' circuit, or ignition circuit, is used to turn on the voltage regulator. This circuit is powered up with the ignition key in the RUN position. This circuit is also used to turn the indicator on if there is a fault in the charging system operation or associated wiring circuits.

OPERATION (Continued)

'A' Circuit

The 'A' circuit, or battery sense circuit, is used to sense the battery voltage. This voltage is used by the regulator to determine the generator output. This circuit is connected back to the load distribution point and is a protected circuit.



DIAGNOSIS AND TESTING

Certain tests outlined in this Section are illustrated in schematic and in pictorial form. A schematic drawing of the charging system is shown under Operation.

NOTE: The tests are divided into On-Vehicle and On-Bench test procedures. The On-Bench procedures follow the On-Vehicle tests in this Section.

A volt ohmmeter (0- to 20-volt scale), such as Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, jumper wire and a test lamp (12-volt) are the only tools required to perform on-vehicle tests of the complete charging system. Test meter calibration should be checked once a year and the date of calibration stamped on the meter face. It is recommended that this practice be followed by all technicians to maintain test meters at acceptable accuracy.

On-Vehicle Tests

Tools Required:

- Rotunda Digital Volt-Ohmmeter 007-00001

DIAGNOSIS AND TESTING (Continued)

Troubleshooting or diagnosis is required before actual service can be made in the electrical system. Even where an obvious condition makes replacement of a unit necessary, find out why the unit failed. When a condition is diagnosed correctly, unnecessary service is prevented, the time the vehicle is out of service will be decreased, and the condition will be properly corrected the first time.

Visual Inspection

Preliminary checks to the charging system should be made regardless of the fault condition. These checks include:

- Check battery posts and cable terminals for clean and tight connections. Clean the posts and the cables to ensure good electrical contact.
- Check for secure connections at the generator output, regulator and engine ground. Also check the connection at the load distribution point (starter relay).
- Check the generator belt to ensure proper tension and no slip between the generator pulley and the belt.
- Check the fuses / fuse links to the generator to ensure that they are not burned or damaged. This condition, resulting in an open circuit or high resistance, can cause erratic or intermittent charging system concerns.

Before performing charging system tests on the vehicle, note conditions such as: slow cranking, discharged battery, top of battery wet, generator / battery charge indicator stays on with engine running, generator / battery charge indicator does not illuminate with ignition switch in RUN and engine not running. This information will aid in isolating the part of the system causing the symptom.

Isolating the Concern

Battery, starting system, and lamp system concerns can be caused by poor charging system performance. It is also reasonable to suspect the charging system if an overload condition has occurred in another area of the electrical system.

To avoid guesswork, it is necessary to isolate battery, charging system, and electrical circuits to correctly identify the area where the difficulty lies. Check the battery first before beginning any electrical system diagnosis. The battery must be in proper state of charge and operation before the other areas of the electrical system can perform normally.

Battery Check

Check battery to see if it has the capacity and ability to accept and hold a charge. Refer to Section 14-01. If battery is OK, the charging system should then be checked to see that it performs its function of keeping the battery charged.

The battery capacity, specific gravity and cell comparison test (non-maintenance free batteries only), will determine the ability of a battery to accept and hold a charge. If the battery does not meet specification, replace it with a new, fully charged battery before further diagnosis of other areas of the electrical system.

If the battery meets required specifications, it should be fully charged before proceeding with the diagnosis of other electrical system components.

Constant Current Drain Test

Tools Required:

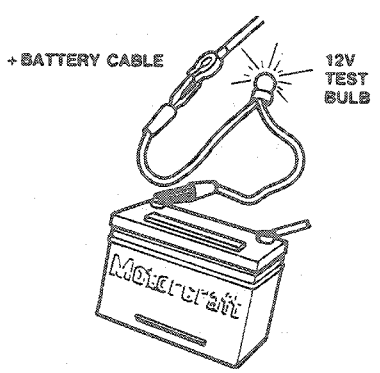
- Rotunda Dwell-Tach-Volts Ohm Tester 059-00010

NOTE: A voltmeter is sometimes used for this test but it will react to a very small normal drain caused by "always-on" electronic systems such as starter interlock, anti-theft alarm, illuminated entry, etc., which are so small they cause no concern. The test lamp shows only drains which are large enough to cause a concern.

NOTE: When the electronic instrument cluster is initially powered-up (after a battery disconnect), the "computer" may be energized for as long as one minute causing a 0.25 amp current draw before returning to the normal 0.010-0.012 amp current draw. Therefore, it is important to allow at least one minute to pass (after ammeter hookup) before observing any current measurements.

Check for current drains on the battery in excess of 50 milliamps with all the electrical accessories off and the vehicle in PARK. This test can be performed one of three ways:

- Use a clamp-on current probe to the battery positive or negative cable.
- Use an in-line ammeter between the battery positive or negative post and its respective cable.
- Use a 12-volt test lamp between the battery positive post and the positive cable. If the lamp illuminates, then there is a drain somewhere in the electrical system.



DIAGNOSIS AND TESTING (Continued)

Typically, a drain of approximately one amp can be attributed to an underhood lamp, glove compartment lamp, or rear deck lid lamp staying on continually. Other component failures or wiring shorts may be located by selectively pulling fuses or disconnecting fuse links to pinpoint the location of the current drain. When the current drain is found, the current will drop below 50 milliamps or the test lamp will go out. If the short is still not located, after checking all the fuses and fuse links, the drain may be due to the generator / regulator. Disconnect the generator output wire from the output stud and the regulator connector. If this eliminates the drain, check the charging system to locate the concern.

Charging System

Tools Required:

- Rotunda Starting and Charging Tester (VAT-40) 078-00005

In order to check the charging system, the use of Rotunda Starting and Charging Tester (VAT-40) 078-00005 or equivalent tester is suggested. Connect the tester to the battery positive and negative posts and also connect the current probe to the generator output lead (to measure generator output). (When measuring generator output, the tester can also be connected to the battery positive or negative cable. In this case, all electrical accessories must be turned off and 10-15 amps added to the reading on the tester due to the engine operation). With the engine running at 2000 rpm, adjust the tester load bank to determine the output of the generator. The generator output should be near to, or exceed the generator rating at 27°C (80°F). Checkout the charging system as indicated and service if required.

NOTE: Refer to the Rotunda VAT-40 test procedure manual for complete directions on checking out the charging system.

Indicator System

Normal Charge Indication

With this IGR system four conditions can cause the charge indicator to come on during vehicle operation:

1. No generator output: damaged generator or regulator.
2. Over-voltage condition: shorted generator rotor or regulator.
3. No connection at generator output terminal (B+).
4. No connection at battery voltage sensing terminal ('A' terminal).

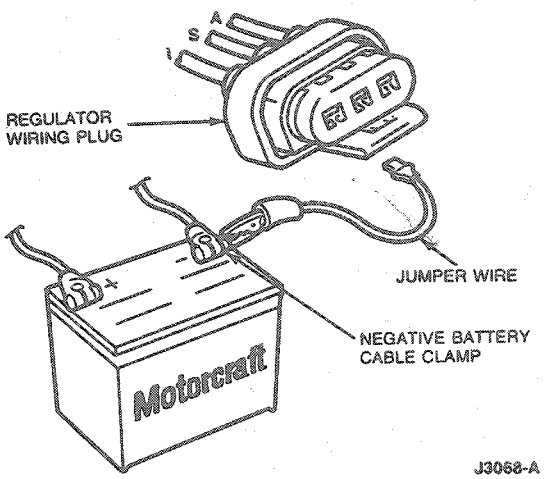
With ignition switch in the OFF position, charge indicator (generator or battery) is off.

With ignition switch in the RUN position (engine not running), charge indicator (generator or battery) is on.

With ignition switch in the RUN position (engine running), charge indicator (generator or battery) is off.

Indicator Testing

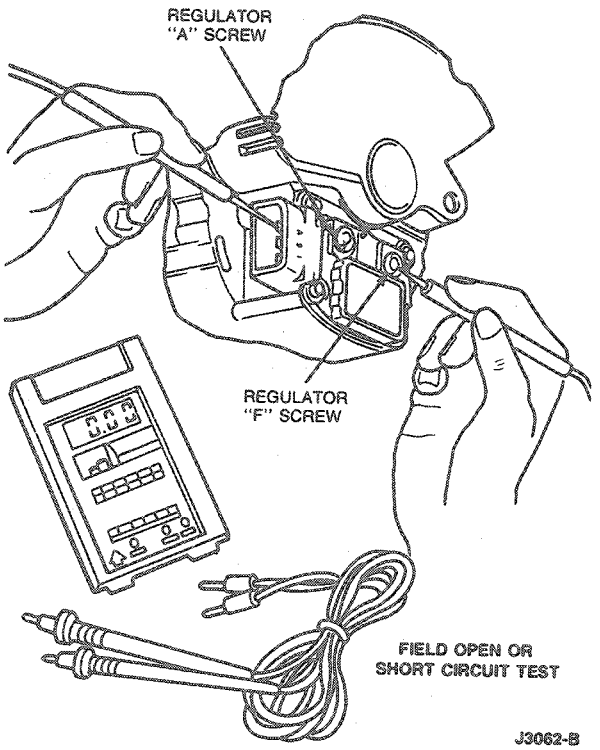
1. If charge indicator does not come on, disconnect wiring connector from regulator.
2. Connect a jumper wire from wiring connector 'I' terminal to battery negative (-) post cable clamp.



3. Turn ignition switch to RUN position with engine off. If indicator does not light, check for presence of lamp socket resistor. If resistor is present, check for contact of lamp socket leads to the flexible printed circuit. If good, check indicator for continuity and replace if burned out. If indicator checks good, perform Regulator 'I' Circuit Test.
4. If indicator does light, remove jumper wire and reconnect wiring plug to regulator. Connect voltmeter negative lead to battery negative post cable clamp and contact voltmeter position lead to regulator 'A' terminal. Battery voltage should be indicated. If battery voltage is not indicated, service 'A' circuit wiring.
5. If battery voltage is indicated, clean and tighten ground connections to engine, generator and regulator.

DIAGNOSIS AND TESTING (Continued)

6. Turn ignition to RUN position with engine off. If indicator still does not light, replace regulator.



Charging System Tests

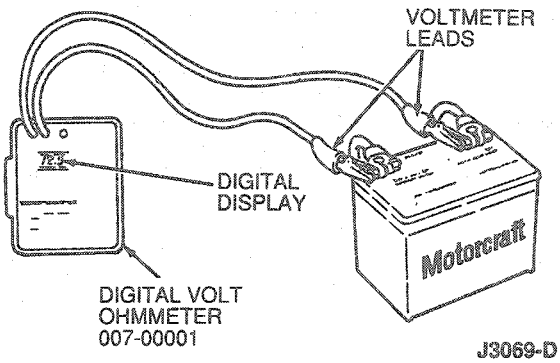
When performing charging system tests, turn OFF all lamps and electrical components. Place transmission in NEUTRAL and apply parking brake.

CAUTION: Do not make jumper wire connections except as directed. To do so may damage regulator.

NOTE: Battery posts and cable clamps must be clean and tight to ensure accurate meter indications.

Base Voltage Test

1. With ignition switch in OFF position and no electrical load, connect negative lead of voltmeter to negative battery cable clamp.
2. Connect positive lead of voltmeter to positive battery cable clamp.
3. Record battery voltage reading shown on voltmeter scale. This reading is called base voltage.



No-Load Test

1. Connect a tachometer to engine.
2. Start engine and increase speed to approximately 1500 rpm. With no other electrical load (foot off brake pedal and doors closed), voltmeter pointer should move upward (increase) but not more than 2.5 volts above base voltage.

   NOTE: The reading should be taken when voltmeter pointer stops rising. It may take a few minutes to reach this point. If voltage increases to proper level, perform Load Test. If the pointer continues to rise, perform the Over Voltage Tests. If the voltage does not rise to proper level, perform Under Voltage Tests.

Load Test

1. With engine running, turn heater / air conditioner blower motor on (high speed) and headlamps on high beam.
2. Increase engine speed to approximately 2000 rpm. Voltmeter should indicate a minimum of 0.5 volt above base voltage. If not, perform Under Voltage Tests.

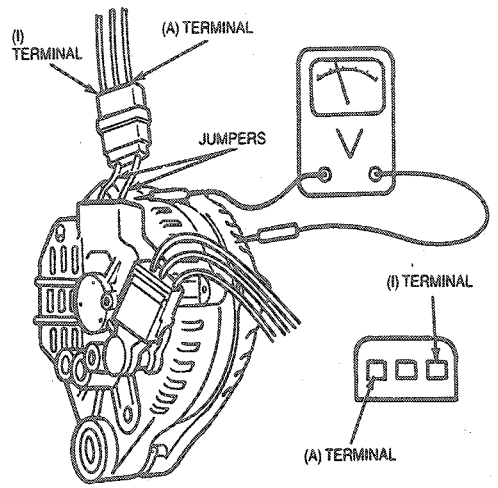
   If above tests indicate proper voltage readings, charging system is operating normally. Proceed to the following tests if one or more of the readings is different than shown above and use a test lamp to check for battery drain.

Over-Voltage Tests

If voltmeter indicates more than 2 volts above base battery voltage, disconnect regulator (ASI) harness connector and insert jumper wires for 'A' and 'I' circuits. With ignition switch in ON position and engine off, connect voltmeter negative lead to generator rear housing. Contact voltmeter positive lead first to generator output connection at starter solenoid and then to regulator harness connector 'A' pin. If voltage difference between the two locations is greater than 0.5 volts, service 'A' wiring circuit to eliminate high resistance condition indicated by excessive voltage drop. Perform Regulator 'A' or 'I' Circuit Test.

DIAGNOSIS AND TESTING (Continued)

If the same voltage reading (battery voltage), is obtained at both locations, replace regulator portion of generator assembly.



Under-Voltage Tests

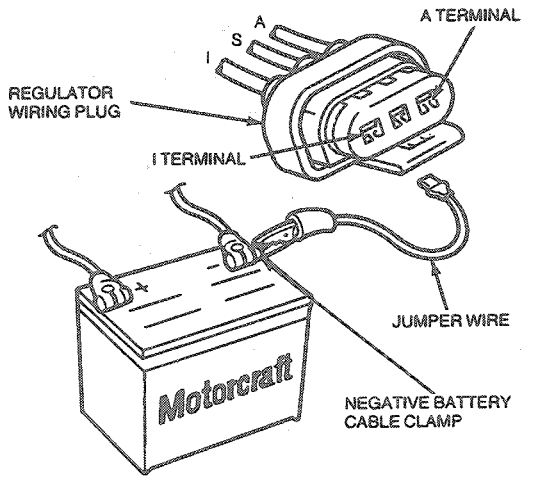
If voltmeter indicates less than 0.5 volt above base voltage, perform Regulator 'A' and/or 'I' Circuit Test.

NOTE: If under voltage condition still exists, replace integral generator assembly.

Regulator 'A' and/or 'I' Circuit Test

With ignition switch in the RUN position (engine not running), charge indicator (generator or battery) should be on.

1. Disconnect wiring connector from regulator and connect a jumper wire from wiring connector 'I' terminal to battery negative post cable clamp.



2. Turn ignition to RUN position with engine off. If indicator does not light, check indicator bulb for continuity and replace bulb if burned out. If bulb checks good, service open in 'I' circuit of vehicle and check for normal operation.
3. If indicator does light, remove jumper wire and connect voltmeter negative lead to battery negative post cable clamp and contact voltmeter positive lead to regulator wiring connector 'A' terminal. Battery voltage should be indicated. If battery voltage is not indicated, service 'A' circuit wiring.
4. If battery voltage is indicated, clean and tighten ground connections to engine and generator.
5. Turn ignition to RUN position with engine off. If indicator still does not light, replace complete generator assembly.

Fuse Link Continuity

1. Ensure first that battery is OK, then turn on headlamps or any accessory. If headlamps or an accessory do not operate, fuse link is probably burned out.
2. On some vehicles there are several fuse links. Use same procedure as in Step 1 to test fuse link that protects vehicle equipment.
3. To test fuse link that protects generator, ensure that battery is OK, then check with a voltmeter for voltage at Battery Positive Voltage (B+) terminal of generator and 'A' terminal of regulator. No voltage indicates that fuse link is probably burned out.

Charging System Check

The charging system test should be performed before testing any individual charging system components. The component tests will determine the type of component service required.

Test instruments used in the charging system test are a voltmeter (0-20- or 0-30-volt scale) and an ohmmeter.

WARNING: SPECIAL CARE SHOULD BE TAKEN WHEN USING THE OHMMETER NEAR "HOT" CIRCUITS. DISCONNECT THE COMPONENT TO BE CHECKED OR THE BATTERY CABLES TO PREVENT DAMAGE TO THE OHMMETER.

Continue through Diagnosis and Testing charts until service is completed. Then, test system again to see if service has corrected the condition.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A: CHARGING SYSTEM TEST—IAR GENERATOR

TEST STEP		RESULT	ACTION TO TAKE
A1	PRELIMINARY CHECKS		
	• Check the following: • Fuse link. • Battery terminals and cable clamps. • Wiring connections at generator, integral voltage regulator (IAR) and engine-to-body grounds. • Generator belt tension. • **Are components OK?**	Yes No	GO to **A2.** SERVICE and / or REPLACE as necessary. GO to **A2.**
A2	BASE VOLTAGE AND NO-LOAD TEST		
	• Connect voltmeter to battery posts. Record battery voltage (base voltage). • Start engine and run at 1500 rpm with no electrical load. Voltage should increase, but not more than 2 volts.	Increases, but not more than 2 volts No increase Increases more than 2 volts	GO to **A3.** GO to **A5.** GO to **A7.**
A3	LOAD TEST		
	• Increase engine speed to 2000 rpm. • Turn heater / A / C blower and headlamps on HIGH. • Voltage should read a minimum of 0.5 volt over base 'A' circuit voltage.	Increases 0.5 volt or more Increases 0.5 volt or more, but generator indicator stays on Increases less than 0.5 volt	GO to **A4.** GO to **A7.** GO to **A5.**
A4	BATTERY DRAIN TEST—KEY OFF		
	• Perform battery drain test. Refer to Section 14-01. • **Is there a battery drain?**	Yes No	CHECK other vehicle circuits for drain. REFER to Section 14-01.
A5	'I' CIRCUIT VOLTAGE TEST		
	• Disconnect regulator. • Turn ignition switch to RUN (engine off). • Measure voltage at 'I' terminal of IAR. Voltage should be same as battery voltage. • **Is there battery voltage?**	Yes No	GO to **A6.** SERVICE 'I' circuit for open or short to ground. GO to **A2.**
A6	'I' CIRCUIT CURRENT TEST		
	• Jumper 'I' terminal at IAR connector to battery negative post. • Turn ignition switch to RUN (engine off). • **Does charge indicator light?**	Yes No	GO to **A7.** SERVICE 'I' circuit (high resistance). GO to **A2.**
A7	'A' CIRCUIT TEST		
	• Disconnect IAR. • Connect voltmeter negative lead to battery negative post. • Connect voltage positive lead to 'A' terminal of IAR connector. • **Is voltage same as battery?**	Yes No	GO to **A8.** SERVICE 'A' circuit (open / high resistance). GO to **A2.**
A8	CHECK GENERATOR OUTPUT LEAD		
	• Stop engine. • Connect voltmeter positive lead to B+ terminal of generator. • Connect voltmeter negative lead to battery negative post. • **Is voltage same as battery?**	Yes No	SERVICE or REPLACE generator. GO to **A2.** SERVICE or REPLACE circuit from generator to battery. GO to **A2.**

TJ3334C

DIAGNOSIS AND TESTING (Continued)

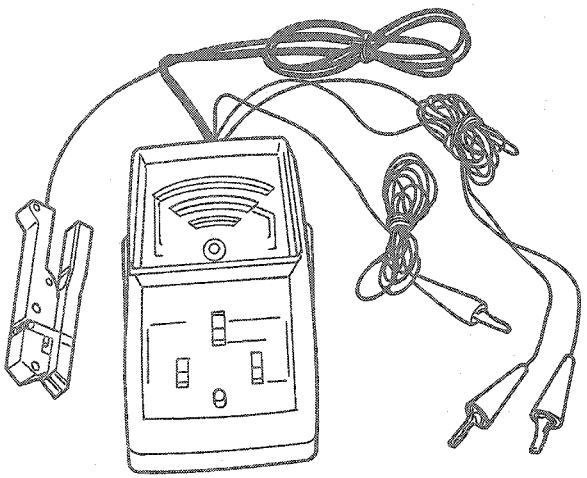
On-Bench Tests

Tools Required:

- Rotunda Dwell-Tach-Volts Ohms Tester 059-00010

If system diagnosis has isolated a concern in the integral generator / regulator assembly, remove it from vehicle for bench testing and service or replace. Refer to Removal and Installation.

The following tests are performed with an analog (needle-type) ohmmeter. Test values shown are referenced to Rotunda Dwell-Tach-Volts Ohms Tester 059-00010 or equivalent. THESE VALUES MAY BE DIFFERENT FOR OTHER OHMMETERS. If you do not have Rotunda Dwell-Tach-Volts Ohms Tester 059-00010 or equivalent, use known good parts to establish reference values for your own meter. These values can be written into the spaces provided in the meter reading charts for future reference.



DWELL-TACH-VOLTS
OHMS TESTER 059-00010

J2934-C

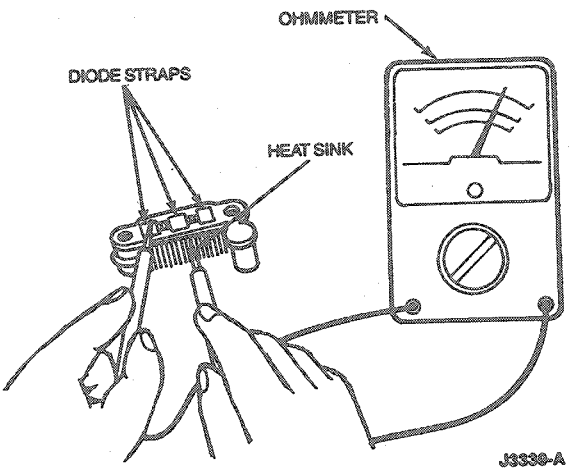
Rectifier Assembly Test

Remove the rectifier assembly from the generator. Place the ohmmeter, Rotunda Dwell-Tach-Volts Ohms Tester 059-00010 or equivalent, Multiply-By setting at 1 and calibrate the meter as directed.

CAUTION: Digital meters cannot be used to perform these tests.

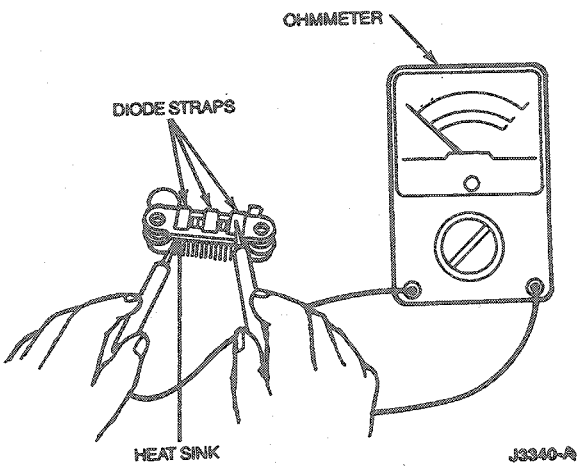
Rectifier

1. Positive Diode (non-grounded)—Check for continuity between the positive diode lead and the heat sink at the positive side, using an ohmmeter. There should be continuity only in the direction from the diode lead to the heat sink.



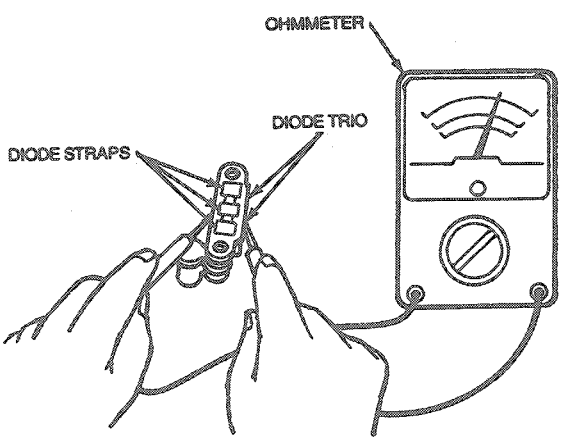
J3339-A

2. Negative Diode (grounded)—Check for continuity between the negative diode lead and the heat sink at the negative side, using an ohmmeter. There should be continuity only in the direction from the heat sink to the negative diode.



J3340-A

3. Diode Trio—Check for continuity using an ohmmeter. There should be continuity in one direction only.



J3341-A

DIAGNOSIS AND TESTING (Continued)

METER READING			
Set meter at Ohms x 1. Make readings in both probe directions to all three phase terminals.			
Resistance Measurement		Acceptable Reading	
Heat Sink	to Diode Lead	Model 059-00010	Reference For Another Meter
One probe direction to each diode		About 7.0 ohms	About ____ ohms
Other probe direction to each diode		∞	∞

CJ3342-A

4. If the meter readings are not as specified, replace the generator assembly.

Radio Suppression Capacitor Open or Short Test

NOTE: This is an open or short circuit test only and does not measure capacitance value. Actual capacitance value should be measured on a capacitance bridge at 1 kHz at a maximum voltage of 350 mV rms.

The radio noise suppression capacitor is built into the rectifier assembly and cannot be serviced by itself. To test the capacitor, place the ohmmeter, Multiply-By setting at 1000 and zero the meter. Text values shown in brackets [ ] __ are referenced to Rotunda Model 059-00010 and may be different if another tester is used.

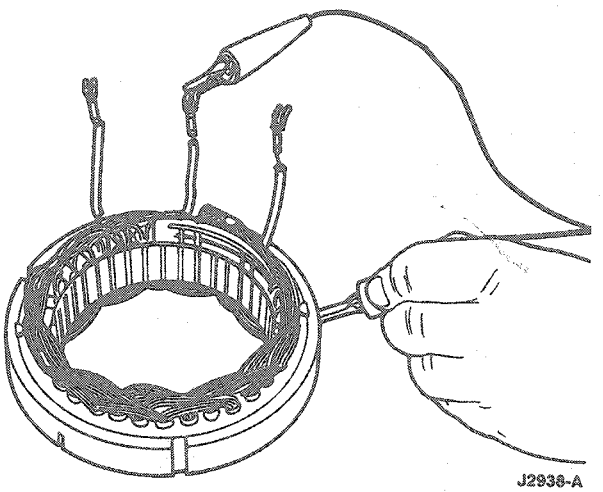
CAUTION: Digital meters cannot be used to perform this capacitor test. The rectifier assembly must be dry.

1. Contact one probe to the rectifier assembly B+ terminal and contact the other probe to the rectifier assembly ground. Reverse the probes and repeat the test. One position should give an infinite reading, indicating the reverse current direction through the diodes and the other position should give a reading of about [1000] __ ohms, indicating the forward current direction. The same reading in both directions indicates an inoperative rectifier assembly.
2. To check the capacitor, contact the probes to the rectifier assembly B+ terminal and ground in the forward current [1000] __ ohms reading direction. While observing the meter indicator needle, reverse the probes and again contact them to the rectifier assembly B+ terminal and ground. The indicator needle should jump slightly (indicating that the ohmmeter batteries are charging the capacitor) and then return to its original position (infinite reading). If the needle does not jump, the capacitor is open. Replace the generator assembly.

Stator Coil Grounded Test

These tests are made to determine if the stator coil is shorted to ground. Remove the stator from the generator and disconnect it from the rectifier assembly as outlined. Place the ohmmeter Multiply-By setting at 1000.

1. Connect the ohmmeter probes to one of the stator lead terminals and to the stator laminated core. Ensure that the probe makes a good electrical connection with the stator core. The meter should show an infinite reading (no needle movement).
2. If the meter does not indicate an infinite reading (needle moves), the stator winding is grounded to the core and the generator assembly must be replaced.



J2938-A

METER READING			
Set meter at Ohms x 1000. Make readings for all stator leads. DO NOT TOUCH LEADS WITH HANDS.			
Resistance Measurement		Acceptable Reading	
Stator Terminal	to Stator Core	Model 059-00010	Reference For Another Meter
All Stator lead combinations: Probe polarity optional		∞	∞

CJ2610-B

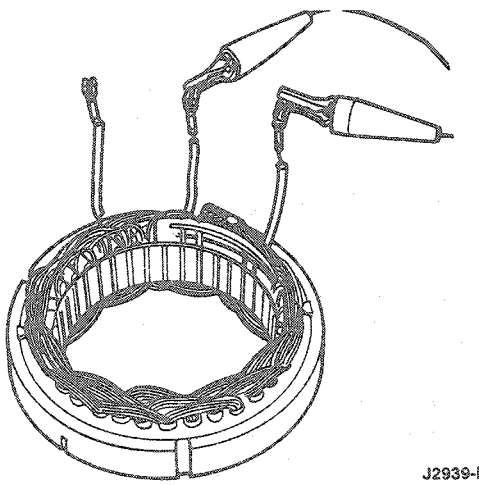
Stator Coil Open Test

This test determines if there is an open stator circuit. Disconnect the stator from the rectifier assembly. Place the ohmmeter Multiply-By setting at 1.

1. Connect one ohmmeter probe to a stator phase lead terminal and touch the other probe to another stator lead terminal. Check the meter reading.

DIAGNOSIS AND TESTING (Continued)

2. Repeat this test with the other two stator lead combinations. If no meter movement occurs (infinite resistance) on a lead paired with either of the other phase leads, that phase is open and the generator assembly must be replaced.



J2939-B

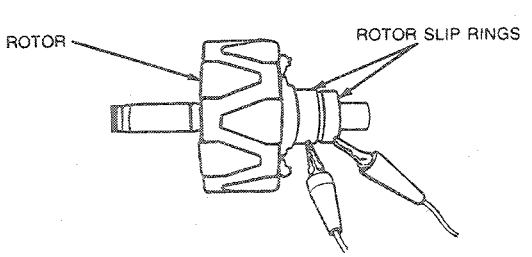
METER READING			
Set meter at Ohms x 1. Make readings for all stator lead combinations.			
Resistance Measurement		Acceptable Reading	
Stator Terminal	to Stator Terminal	Model 059-00010	Reference For Another Meter
All lead combinations; Probe polarity optional		Less than 0.5 ohms	Less than 0.5 ohms

CJ2811-B

Rotor Open or Short Test

Remove the rotor from the generator. Place the ohmmeter Multiply-By setting at 1 and calibrate the meter as directed.

1. Contact each ohmmeter probe to a rotor slip ring. The meter reading should be [2.0-3.9] __ohms.
2. A higher reading indicates a damaged slip ring, welded connection or a broken wire. A lower reading indicates a shorted wire or slip ring. Replace the generator assembly.

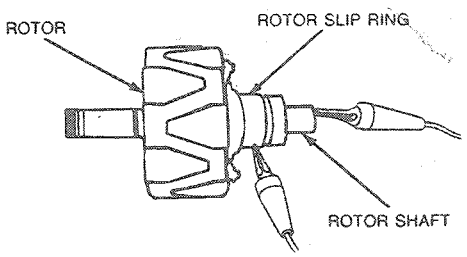


J2818-A

METER READING			
Set meter at Ohms x 1.			
Resistance Measurement		Acceptable Reading	
Slip Ring	to Slip Ring	Model 059-00010	Reference For Another Meter
Probe polarity optional		2.0 to 3.9 ohms	2.0 to 3.9 ohms

CJ2812-B

3. Contact one ohmmeter probe to a slip ring and the other probe to the rotor shaft. The meter reading should be infinite (no needle movement).
4. A reading other than infinite indicates the rotor coil is grounded to the shaft. Replace the generator assembly if the rotor is grounded.



J2817-A

METER READING			
Set meter at Ohms x 1.			
Resistance Measurement		Acceptable Reading	
Slip Ring	to Rotor Shaft	Model 059-00010	Reference For Another Meter
Either slip ring; Probe polarity optional		∞	∞

CJ2813-B

REMOVAL AND INSTALLATION

WARNING: BATTERIES NORMALLY PRODUCE EXPLOSIVE GASES WHICH CAN CAUSE PERSONAL INJURY. THEREFORE, DO NOT ALLOW FLAMES, SPARKS OR LIGHTED TOBACCO TO COME NEAR THE BATTERY. WHEN CHARGING OR WORKING NEAR A BATTERY, ALWAYS SHIELD YOUR FACE AND PROTECT YOUR EYES. ALWAYS PROVIDE VENTILATION.

REMOVAL AND INSTALLATION (Continued)

WHEN LIFTING A PLASTIC-CASED BATTERY, EXCESSIVE PRESSURE ON THE END WALLS COULD CAUSE ACID TO SPEW THROUGH THE VENT CAPS, RESULTING IN PERSONAL INJURY. LIFT WITH A BATTERY CARRIER OR WITH YOUR HANDS ON OPPOSITE CORNERS.

WARNING: KEEP BATTERIES OUT OF REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERY TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH THE SKIN OR EYES, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF FIFTEEN MINUTES. IF ACID IS SWALLOWED, DRINK LARGE QUANTITIES OF MILK OR WATER, FOLLOWED BY MILK OF MAGNESIA, A BEATEN EGG, OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.

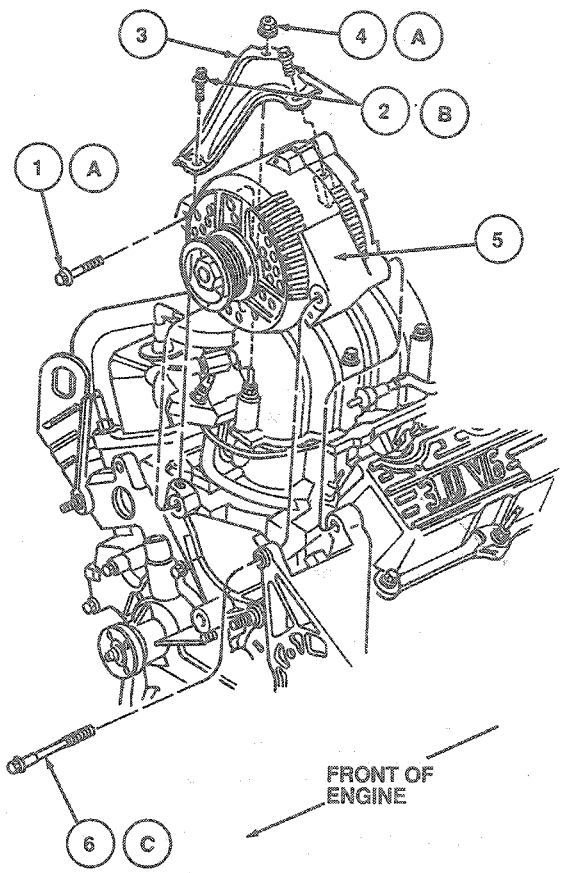
Generator

Tools Required:

- Belt Tension Gauge T63L-8620-A
- Generator Pulley Remover T65P-10300-B
- Rotunda Belt Tension Gauge 021-00019

Removal

1. Remove battery and battery tray. Refer to Section 14-01.
2. Disconnect electrical harness connector and output terminal wiring.
3. Loosen belt tensioner and remove generator belt from pulley.
4. Remove one mounting bolt at front of generator and two bolts at rear.
5. Remove generator from vehicle.



J4452-A

Item	Part Number	Description
1A	N807274-S309B	Adjusting Arm Bolt
2B	N605892-S8	Bolt (2 Req'd)
3	10B315	Alternator Brace
4A	N621939-S53B	Nut and Washer
5	10300	Alternator
6C	N807241-S36B	Pivot Bolt
A		Tighten to 20-30 N·m (15-22 Lb-Ft)
B		Tighten to 8.5-11N·m (7-8 Lb-Ft)
C		Tighten to 40-55 N·m (30-41 Lb-Ft)

TJ4452A

Installation

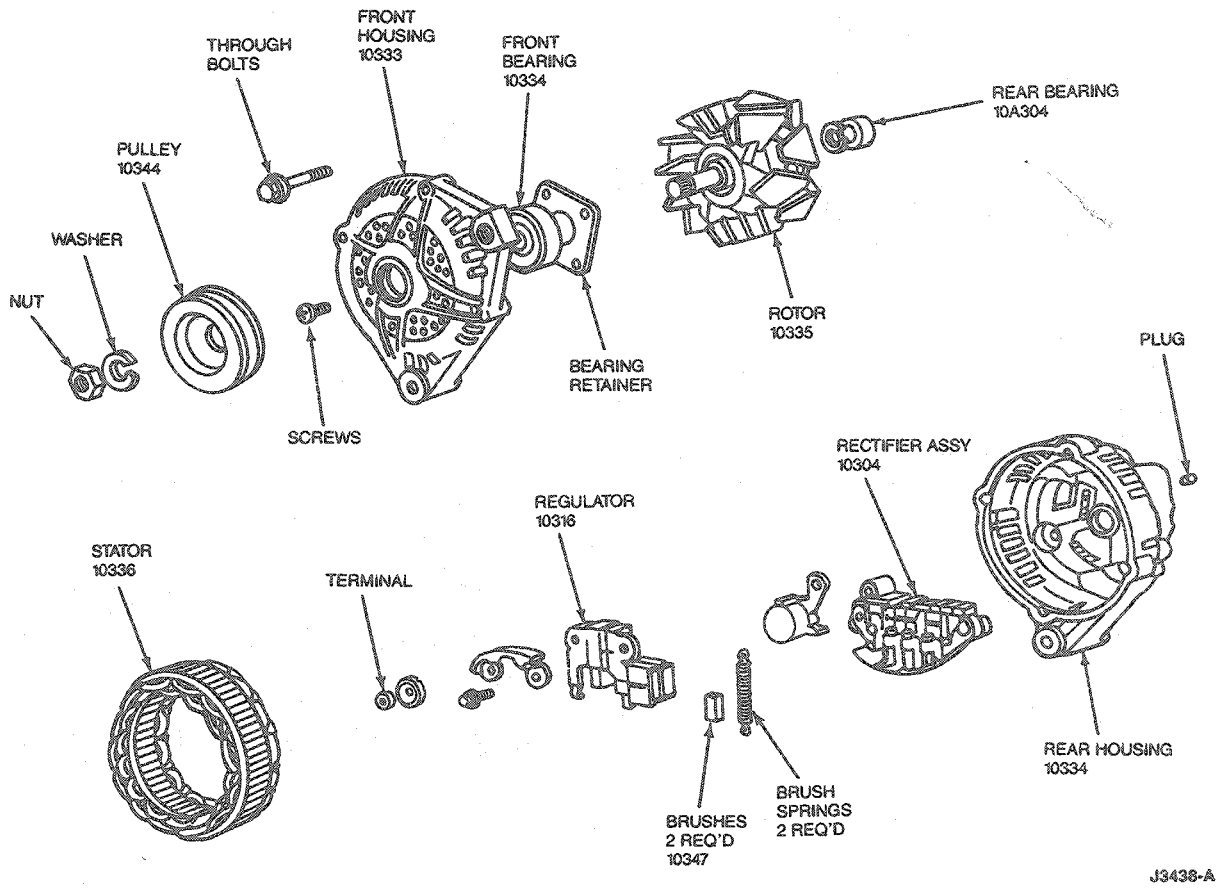
1. Position generator in vehicle and install three mounting bolts. Tighten front bolt to 48-72 N·m (36-53 lb-ft). Tighten rear bolts to 34-50 N·m (26-36 lb-ft).
2. Install generator belt and set belt tension to 658-854 N (148-191 lb) for a used belt, or to 978-1178 N (220-264 lb) for a new belt.
3. Connect output terminal wire and electrical harness connector.

REMOVAL AND INSTALLATION (Continued)

4. Install battery tray and battery. Refer to Section 14-01.

DISASSEMBLY AND ASSEMBLY

NOTE: All of the following Disassembly Steps may not be necessary to perform a particular test or service. Perform only those steps that apply. The following illustration is a disassembled view of the integral generator / regulator assembly.

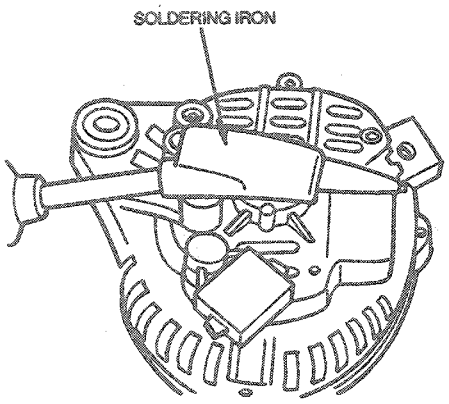


DISASSEMBLY AND ASSEMBLY (Continued)

Disassembly

1. Place a soldering iron (200W class) on the bearing box for three or four minutes to heat to about 50-60°C (122-144°F).

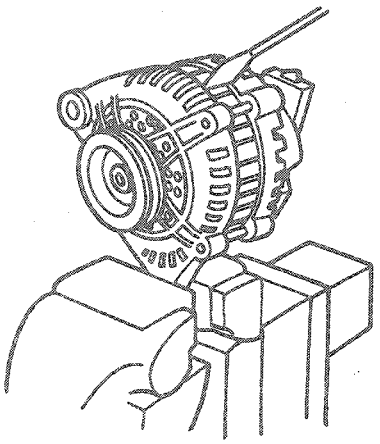
   NOTE: If the bearing box is not heated, the bearing may not be pulled out, because the rear bearing and rear bracket fit together very tightly.



J3343-A

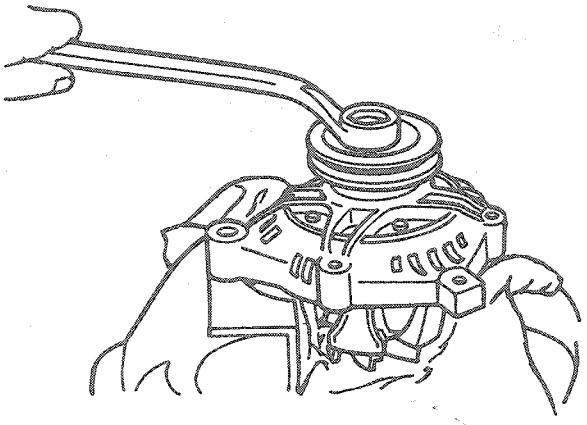
2. Remove the four bolts, and insert a flat-tip screwdriver between the stator core and front bracket and separate them.

   NOTE: Be careful not to force the screwdriver in too far, because the stator may be scratched.



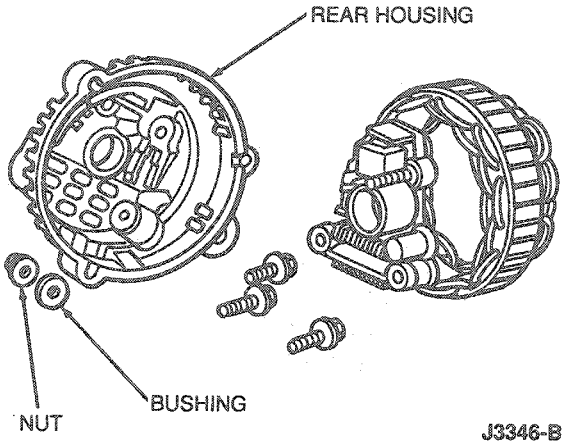
J3344-A

3. Remove the locknut, pulley, rotor and front bracket.



J3345-A

4. Remove the following rear bracket and stator parts:
   - The nut of the 'B+' terminal
   - Insulation bushing
   - Rectifier retaining screws
   - Brush holder retaining screw

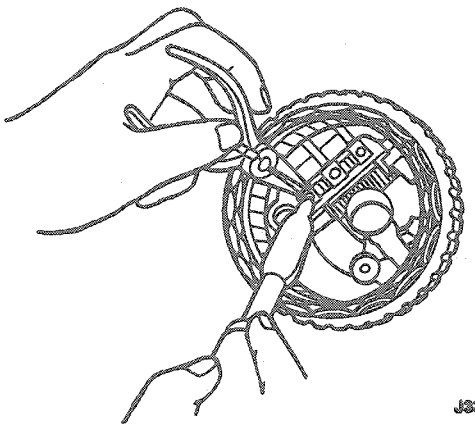


J3346-B

DISASSEMBLY AND ASSEMBLY (Continued)

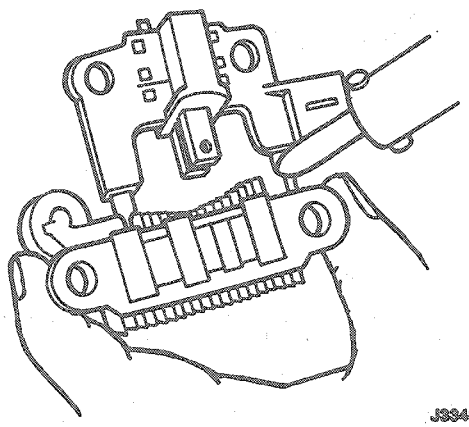
5. Use a soldering iron to remove the solder from the rectifier and the stator lead.

   CAUTION: Disconnect quickly, use the soldering iron no more than about five seconds, because the rectifier may become damaged if it is overheated.



J3347-A

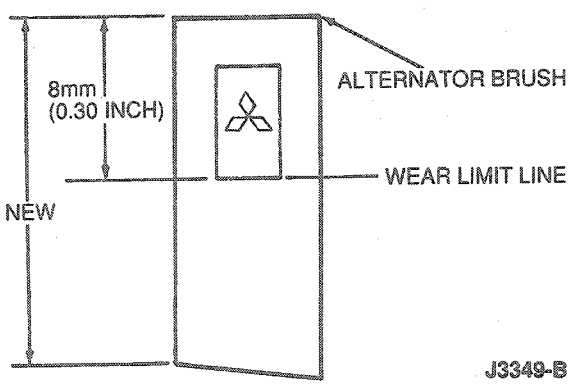
6. Use a soldering iron to remove the IC regulator from the rectifier.



J3348-A

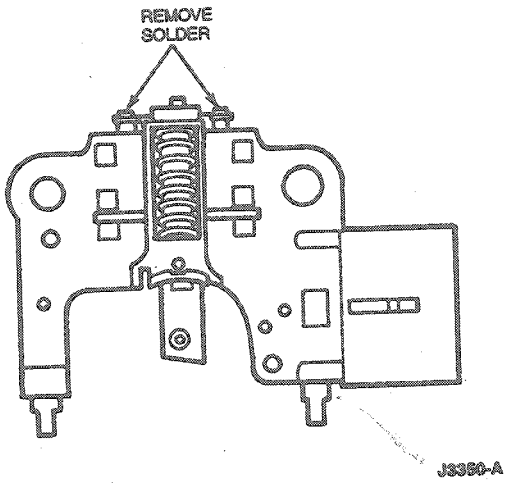
Brush Replacement

1. Replace the brushes if they are worn at or near the wear line as shown.



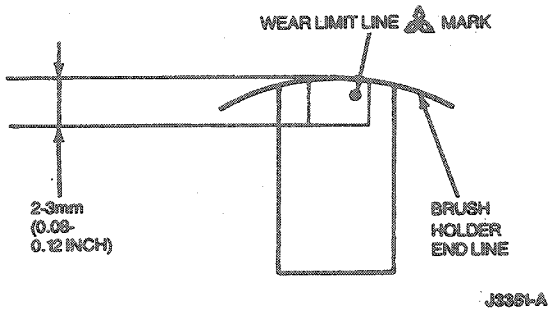
J3349-B

2. If it is necessary to replace the brushes, remove the solder from the brush pigtails at the points shown. Remove the brushes.



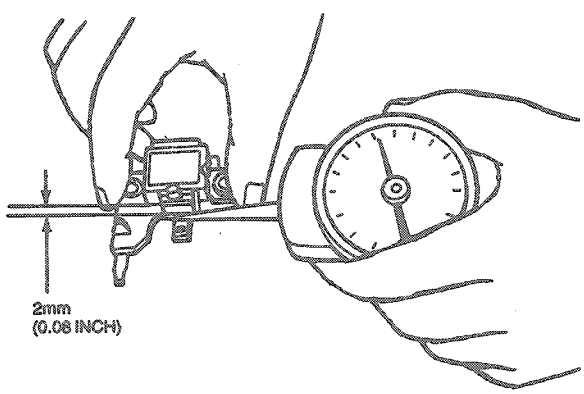
J3350-A

3. When soldering the brush, solder the pigtail so that the wear limit line of the brush projects 2 or 3mm (0.08-0.12 inch) out from the end of the brush holder.



J3351-A

4. Brush springs may be checked by using a spring pressure gauge to push the brush into the brush holder until the tip of the brush projects 2mm (0.080 inch). Read the force at this time. Replace the spring if the force is less than 2.0N (200g or 7.1 oz). For a new brush the force should be 3 to 4.4N (310-450g or 10.9-15.9 oz).



J3352-A

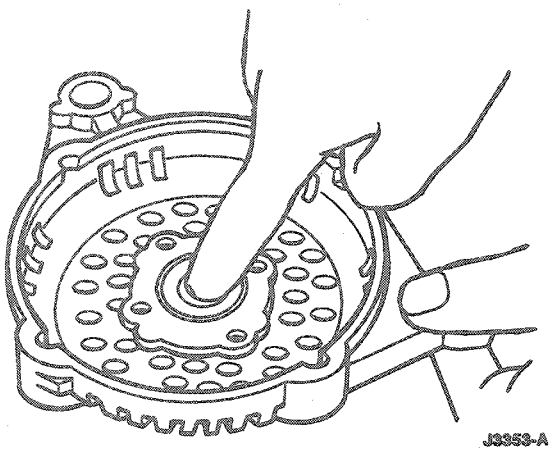
DISASSEMBLY AND ASSEMBLY (Continued)

Bearing Replacement

Tools Required:

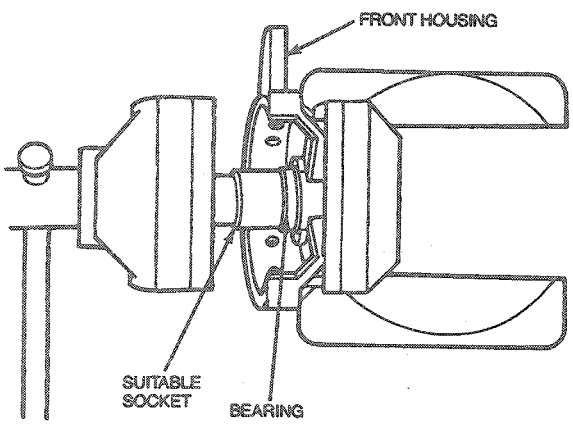
- Bearing Puller D80L-1002-L

1. Check front bearing for abnormal noise, looseness, binding or insufficient lubrication. Replace the bearing if there is any concern.



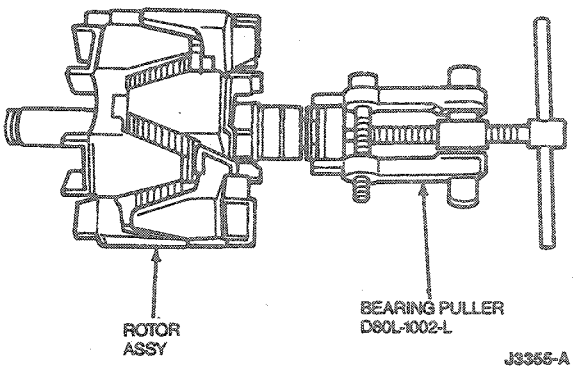
J3353-A

2. To replace the generator front bearing, use a socket or driver which fits the outer race of the generator front bearing, and carefully press a new bearing into the generator front housing using a press or vise.



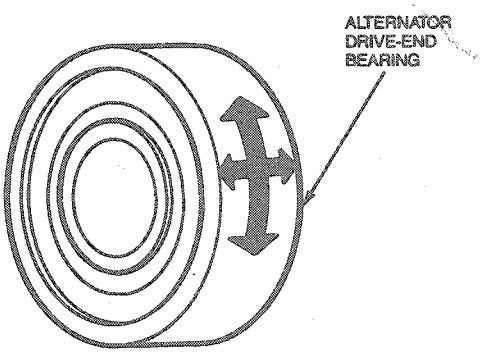
J3354-A

3. Check for rear bearing abnormal noise, looseness, binding, or insufficient lubrication. Replace the bearing if there is any concern.
4. To replace the generator rear bearing, first remove the old bearing from the rotor using two-jaw Bearing Puller D80L-1002-L or equivalent as shown.



J3355-A

5. Check the bearings for abnormal noise, looseness or insufficient lubrication. Replace as necessary.



J3356-A

Cleaning and Inspection

CAUTION: When rebuilding an integral generator, use only high-temperature bearings. Use of standard parts will result in generator failure.

1. Wipe the stator, rotor and front bearing with a clean cloth. Do not clean these parts with solvent.
2. Rotate the front bearing on the drive end of the rotor shaft. Check for any scraping noise, looseness or roughness. Look for excessive lubricant leakage. If any of these conditions exist, replace the bearing.
3. Inspect the rotor shaft rear bearing surface for roughness or severe chatter marks. Replace the rotor assembly if the shaft is not smooth.
4. Place the rear bearing on the end of the rotor shaft and rotate the bearing. Make the same check for noise, looseness and roughness as was made for the front bearing. Inspect the rollers and cage for damage. Replace the rear bearing if these conditions exist or if the lubricant is lost or contaminated.
5. Check all wire leads on both the rotor and stator assemblies for loose or broken connections. Check the windings for burned insulation. Replace parts that show signs of burned insulation.

DISASSEMBLY AND ASSEMBLY (Continued)

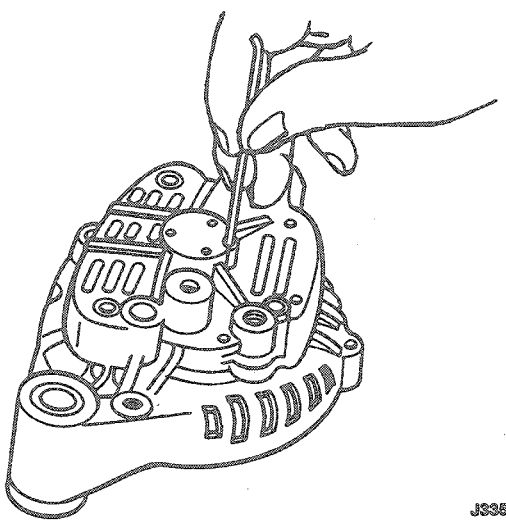
6. Check the pulley and fan for excessive looseness on the rotor shaft and for cracks or other damage. Replace any pulley or fan that is loose, cracked or bent out of shape.
7. Check both the front and rear housings for cracks, particularly in the webbed areas at the mounting ear. Replace a damaged or cracked housing.
8. Replace the brushes if they are at or are worn shorter than the wear limit line, 8mm (0.30 inch).

Assembly

Assembly is in the reverse order of disassembly. There is no lubrication required. Tighten generator assembly through bolts to 4.0-6.7 N·m (35-59 lb-in). Tighten generator pulley locknut to 82-135 N·m (60-100 lb-ft).

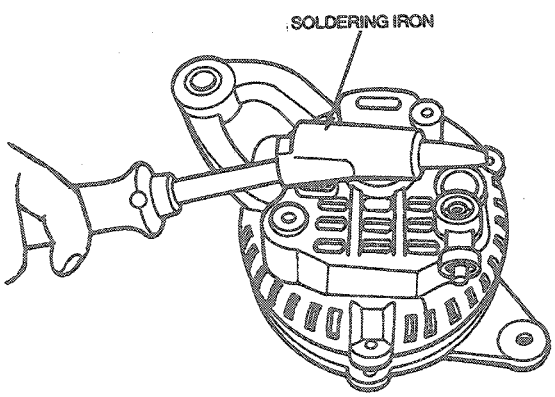
1. Before assembly, push the brush into the brush holder and pass a wire (2 mm, 40-50mm (0.08 inch, 1.6-2 inch)) through the hole shown to secure the brush in position.

   NOTE: Be sure to pull the wire out after the assembly is completed.



JS357-A

2. When the rear bearing is pressed into the rear bracket, heat the bracket before pressing it in.



JS358-A

3. After assembly is completed, rotate the pulley manually and check that the rotor turns easily.

ADJUSTMENTS

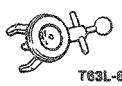
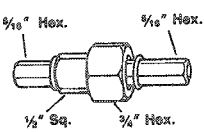
Refer to Section 03-05 for drive belt adjustments.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	N·m	Lb-Ft
Generator Front Mounting Bolts	48-72	36-53
Generator Rear Mounting Bolts	34-50	26-36

SPECIAL SERVICE TOOLS

Tool Number / Description	Illustration
T63L-8620-A Belt Tension Gauge	 T63L-8620-A
T65P-10300-B Generator Pulley Remover	 5/16" Hex. 5/16" Hex. 1/2" Sq. 3/4" Hex. T65P-10300-B

Tool Number	Description
D80L-1002-L	Bearing Puller

ROTUNDA EQUIPMENT

Model	Description
007-00001	Digital Volt Ohmmeter
021-00019	Belt Tension Gauge
059-00010	Dwell-Tach-Volts Ohms Tester
078-00005	Starting and Charging Tester (VAT-40)