

ALTERNATOR SYSTEM

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GENERAL SERVICE

The charging system is made up of an alternator, alternator regulator, battery, charge indicator light and the necessary wiring to connect the components.

Every vehicle has a Bosch alternator with non-adjustable integral electronic regulator.

The alternator that is used has an output of 85Amp with eight zener output diodes.

Always determine the cause of failure as well as making the repair.

1. Polarity and Connections. The alternator is used on the negative earth electrical systems only. Polarity cannot be reversed by 'Flashing' the field terminals as with the dynamo and any attempt will damage the alternator.

2. Refitting Vehicle Battery. The alternator rectifiers can be damaged if the battery connections are reversed. When refitting, place the positive + connector to the battery positive + terminal and then place the negative - connector to the battery negative -terminal.

3. Battery Charging. First disconnect the battery negative cable as this isolates the alternator from the battery and external charging equipment.

4. Battery Connections. Whilst the car is running the battery must not be disconnected as damage may occur to the rectifier and/or control box semi - conductor devices. It is inadvisable to break or make any other connections in the alternator circuit while the engine is running.

5. Alternator Main Output Cable

(a) Even when the engine is running, the cable connecting the alternator and the battery is 'live'. Damage will occur to the cable if care is not taken to earth the live cable if it should be removed.

(b) The alternator must never be run with main output cable disconnected either at the battery or the alternator end while the field remains energised or the rectifiers may be damaged.

6. Arc Welding. The damage that may occur to the semi - conductor devices during arc welding operations on a vehicle is very slight. It is a worthwhile precaution to isolate the control box and alternator by disconnecting their wiring connectors prior to carrying out any arc welding on the vehicles.

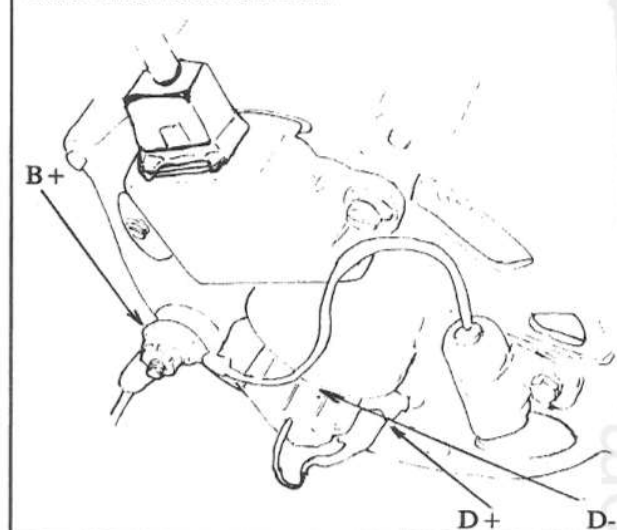
ALTERNATOR TEST

Before testing the Voltage Regulator make an alternator output test.

As the alternator output terminal is connected to the battery at all times, use care when connecting any test equipment to the alternator system.

Alternator Output Test - Off Engine

Bosch Alternator Terminals



A test bench must be used when the alternator output test is conducted off the vehicle. When the alternator is removed from the vehicle for this purpose always disconnect a battery cable as the alternator output connector is connected to the battery at all times.

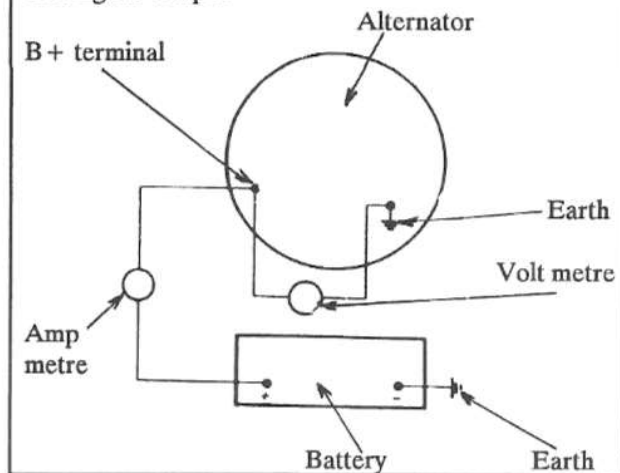
On Engine

A variable load such as a Carbon pile rheostat must be available to place across the battery.

A suitable substitute for a carbon pile is a switched lamp bank of 800 Watt capacity.

All output testing is to be made whilst the alternator is warm.

Testing for Output



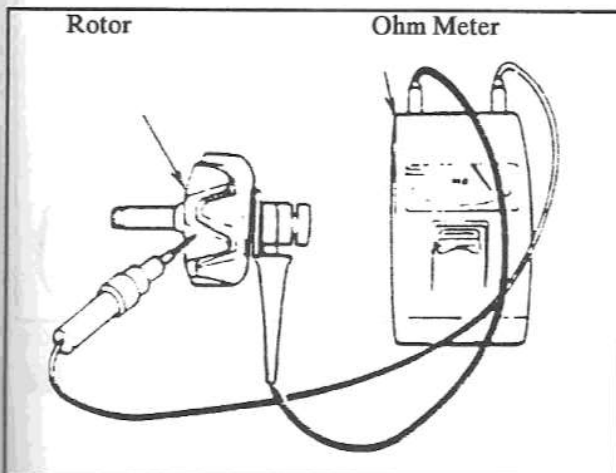
ALTERNATOR SYSTEMS

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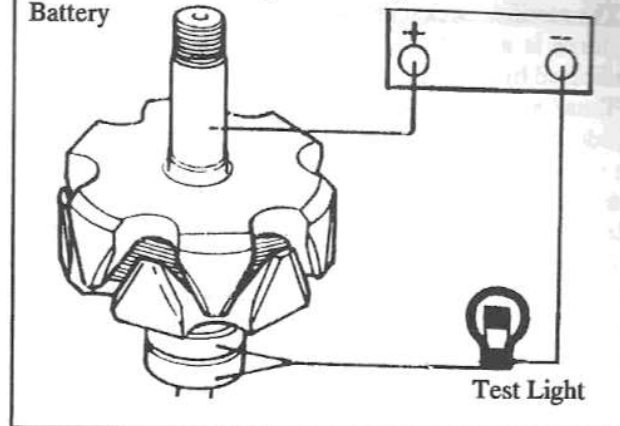
Run alternator on full load for 5 minutes prior to making tests.

When carrying out this test the regulator cannot be isolated from the circuit. The alternator must be removed from the engine for the testing of the regulator, if rated output is not achieved.

1. Make sure the engine is off. Detach the battery earth cable.
2. Remove the leads from the alternator main (B+).
3. Connect the positive lead of a moving coil 100 amp ammeter to the B+ terminal of the alternator and the - lead to the B+ terminal in the wiring harness.
4. Connect the positive lead of a good quality voltmeter to the alternator B+ terminal and the negative lead to the ground. Connect the battery earth cable.
5. Connect the carbon pile rheostat or the switched lamp bank to the battery terminals. (Ensure that the load control is in the off position). Connect a tachometer to the engine.
6. Start the engine and slowly increase engine speed to obtain 2500 rpm alternator speed.
7. Adjust the carbon pile or lamp bank until constant voltage of 14.0 is achieved.
8. The ammeter should now register the rated output. Reduce engine speed to idle rpm and remove the battery load.
- * Never remove the battery load while the engine is running at speed.
9. Switch off the engine and remove the battery earth cable.
10. Remove the test meters and replace the original wiring to the alternator.
11. Replace the battery earth cable. The alternator must be removed from the vehicle for further tests and repairs if the alternator fails to produce the rated output.

TESTING THE ROTOR

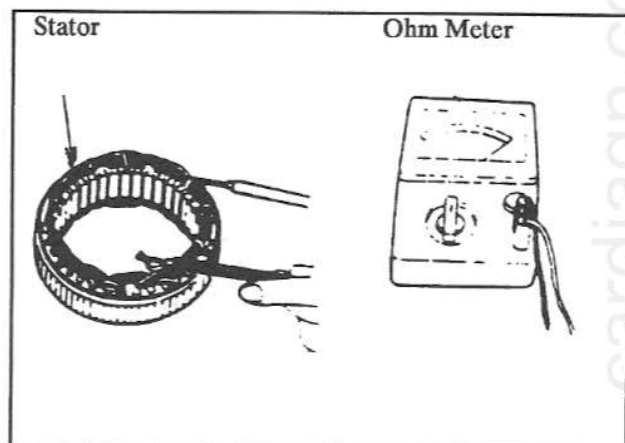
1. Test the rotor windings by connecting an ohmmeter between the slip rings. An open circuit is indicated if the reading is above specifications. Short circuited windings are indicated if the reading is below specifications.

Use a 12 Volt Battery & Test Light

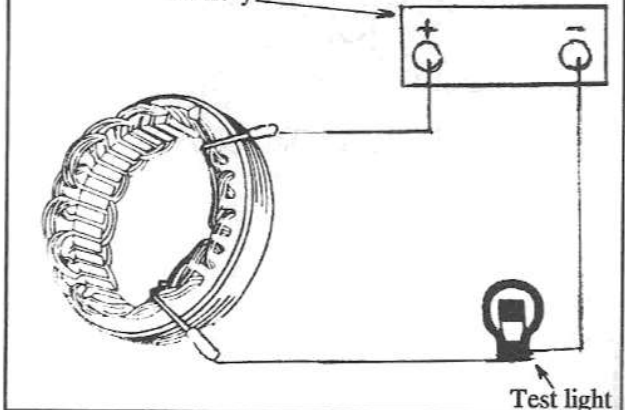
2. By using a 12V battery and test lamp test the rotor insulation. Place one prod on a slip ring, the other on the rotor shaft. The test lamp should not light.

TESTING THE STATOR

1. Test the stator windings by connecting an ohmmeter between the winding ends. The readings must be even on each phase. High readings mean an open circuit and low readings mean short circuit.



2. By using a 12V battery and test lamp test the stator insulation, between each winding end and the lamination pack. The test lamp should not light.

Use a 12 Volt Battery & Test Light

TESTING THE DIODES & RECTIFIER ASSEMBLY

The rectifier pack must be removed from the alternator if there is a fault in one or more of the diodes being indicated by the alternator output test.

There are two main possibilities which can destroy a diode during a service, they include, either a breakdown in resistance to current flow caused by high current flow and high temperature, or an open circuit in both directions almost always the consequence of excess voltage.

It is not necessary to disconnect the individual diodes for testing purposes, however it is essential that the stator leads be unsoldered from the rectifier pack.

For diode testing, a 12 volt battery with test probes and a 2 watt globe in series.

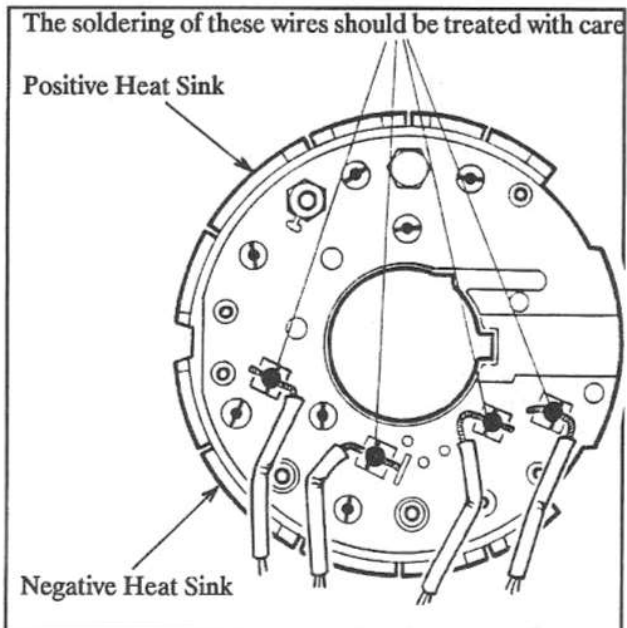
POWER DIODES

1. Apply one probe to the diode junction and the other probe to the appropriate heat sink.

2. Reverse the probes. The test lamp should light in one direction only. The diode is short circuited if the lamp lights in both directions. (If both diodes of one phase are short circuited all 8 diodes will show a short circuit when tested.) The diode is open circuited if the test lamp does not light in either direction.

HEAT SINKS

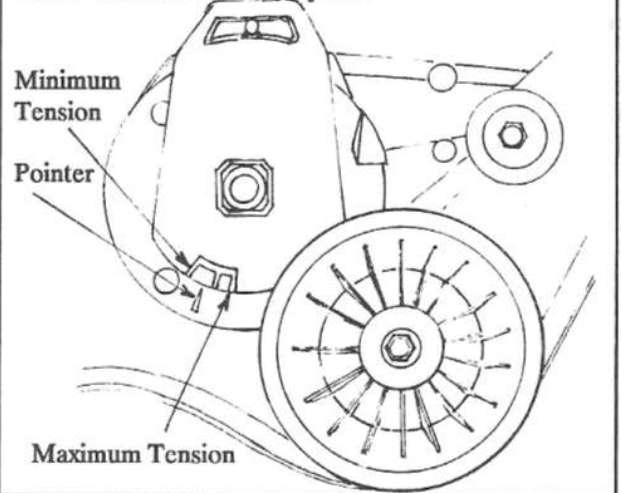
The negative heat sink is grounded to the alternator frame. The positive heat sink is insulated from the alternator frame and from the negative heat sink.



* The rectifier is not repairable and if found faulty in the foregoing tests it must be replaced.

V6

1. Loosen the locknut on the automatic adjusting idler pulley mounting stud and turning the stud, relieve the tension on the drive belt.

V6 Drive belt automatic adjuster

2. Adjust belt, turn the automatic adjuster idler pulley mounting stud to adjust tension.

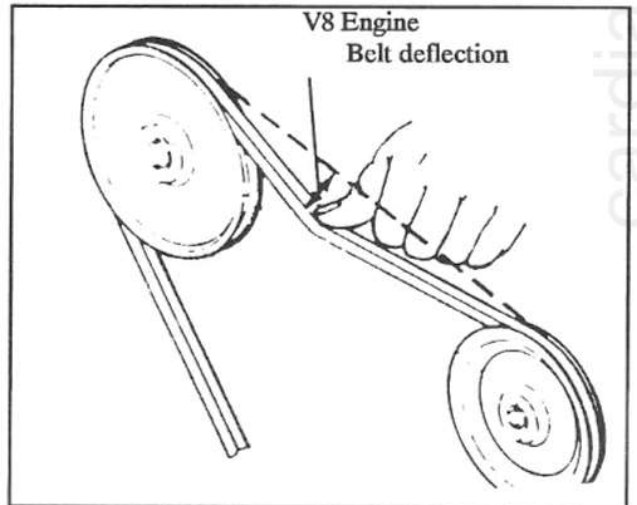
3. Check belt wear reference marks on tensioner. Install a new belt if tension is not within reference marks.

V8 - DRIVE BELT and ADJUST BELT TENSION

* Some belt squeal when the engine is started or stopped is normal and has no effect on durability of drive belt.

1. Loosen the adjusting arm bolt and the alternator mounting bolt.

2. By rotating the adjustment nut adjust the drive belt tension to achieve the specified belt deflection. New Belt deflection 8-9mm, used belt deflection 10-11mm.



*Note: A belt that has operated for 10 minutes or more is a used belt.

3. Tighten the adjusting bolt and mounting bolt.

CLEANING AND INSPECTION

1. The rotor, stator, and bearings must not be cleaned with solvent. Wipe these parts off with a clean cloth.

2. Rotate both the front and rear bearings and assess their condition by feeling for excessive play or roughness.

When checking for roughness load the bearings by hand pressure and rotate the outer race at least six turns in this manner. Look for excessive lubricant leakage. If any of these conditions exist replace the bearings.

3. Inspect the rotor assembly for damage to the pole surfaces due to contact with stationary components, scores or bruises on the slip ring; loose slip ring; damaged rotor leads; shaft thread damage, etc. Replace or repair this assembly as required.

4. Inspect the pulley and fan for excessive looseness on the rotor shaft. Inspect the fan for cracks and bent blades. Replace the fan if cracks are apparent.

5. Check both end heads for cracks, stripped threads (particularly on the mounting lugs), distortion, enlarged diode holes, etc. Replace defective end heads.

6. Check the stator windings for signs of overheating. Check that the stator leads are not fractures or broken off inside the sleeving. Re-solder any poor connections.

7. Check the regulator assembly for distortion and wear. Inspect brushes for wear and lead or spring breakage.

* Prior to assembling the alternator refer to the section for details of Insulating Washers and the position in which they are used. Failure to insulate the components properly can damage the alternator and regulator.

Maintenance

Remove

1. Disconnect the battery leads and remove the battery heat shield.

2. Disconnect the alternator wiring.

3. Loosen alternator adjusting lock bolt and rotate adjusting nut to relieve drive belt tension. Remove the drive belt, lock bolt and adjusting nut.

4. Remove alternator to mounting bracket attaching bolt and remove alternator.

Install

1. Place alternator to mounting bracket and install lower attaching bolt.

2. Install upper adjusting nut and lock bolt, drive belt and adjust as described in Tune-up Chapter. Torque attaching bolts to specification.

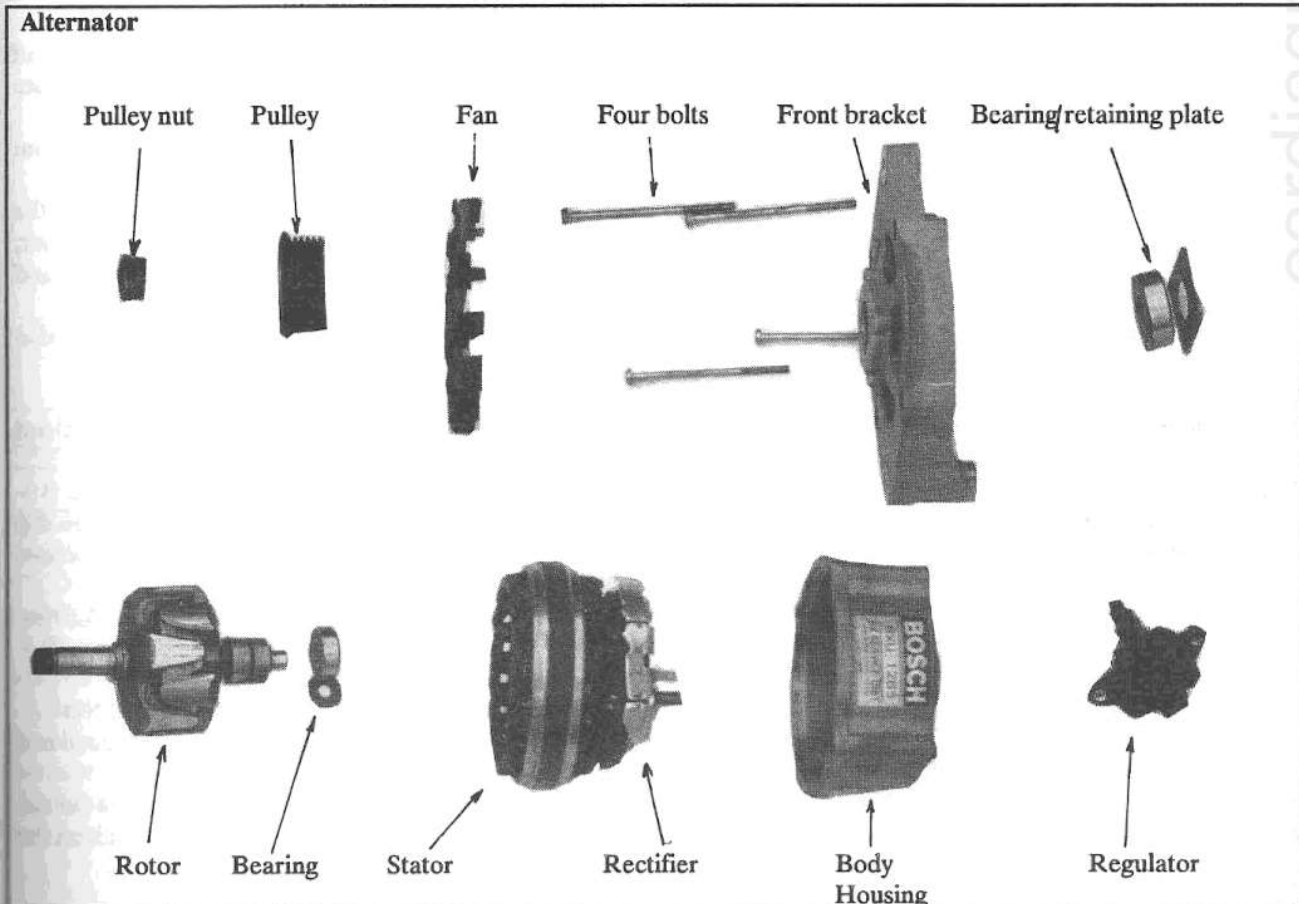
Alternator upper attaching nut specified torque: 35-45 Nm.

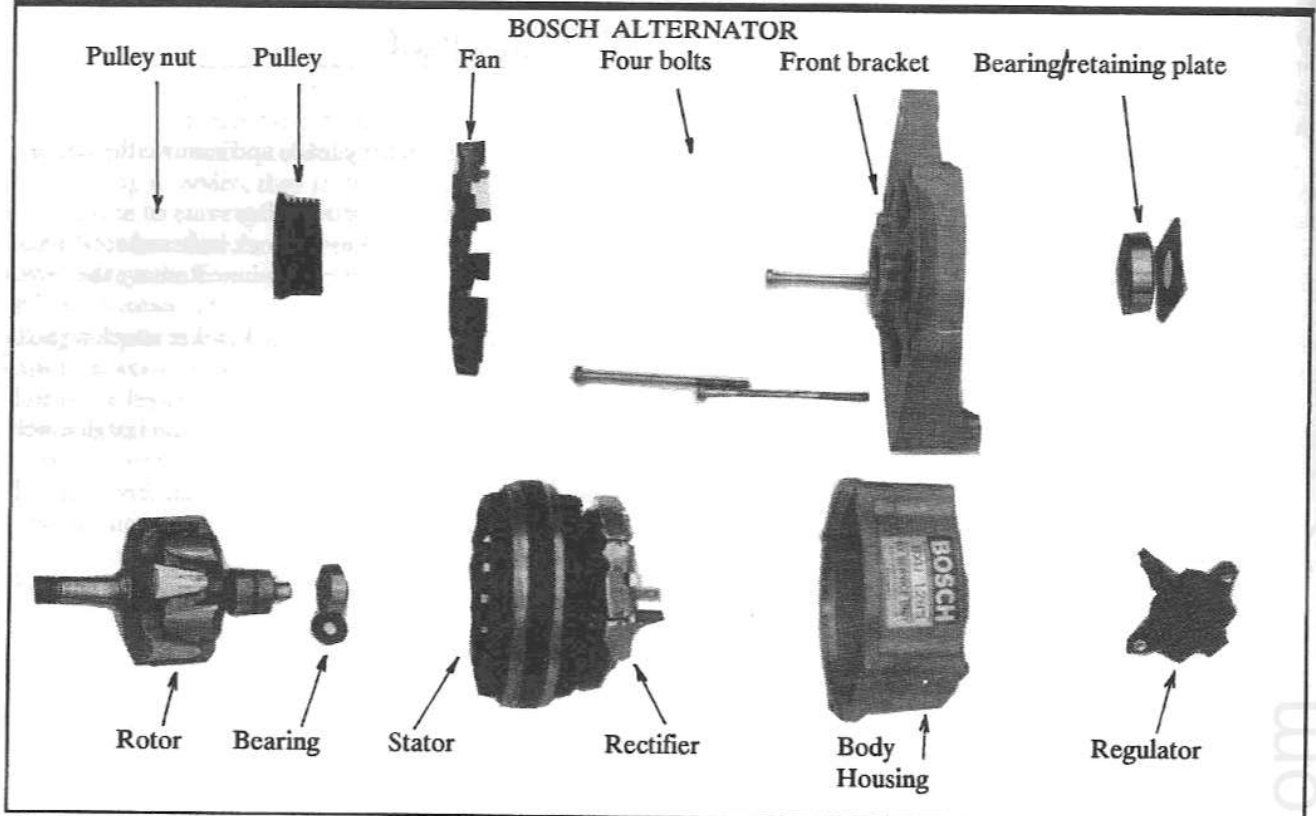
Alternator attaching bolt specified torque: 12-16 Nm.

3. Connect alternator wiring, refit battery heat shield and attach battery leads.

Dismantle

1. Using a scribe mark, mark both end housing and the stator.





2. By removing the 2 attaching screws, remove the brush holder and regulator and remove the 4 through bolts.

3. Separate the drive end head and rotor sub-assembly from the slip ring end head and stator sub-assembly. Do not lose the wave washer from the slip ring end head bearing recess.

4. Unsolder the stator leads from the rectifier assembly and remove the stator by using long nose pliers on the diode leads as heat sinks.

5. Disconnect the suppressor capacitor connector. Remove the three attaching screws and the nut from the B+ terminal post. Withdraw the rectifier assembly from the slip ring head.

6. Hold the head in a vice equipped with soft jaws to remove the rotor from the drive end head. Remove the pulley retaining nut, lock washer, flat washer and pulley sheaves. Remove the pulley spacer, fan reinforcing washer and fan.

7. Unscrew the 4 front bearing retaining plate screws to remove the drive end head. Take out the rotor shaft and bearing assembly.

8. Remove the retaining collar, bearing and retainer plate from the rotor shaft with a suitable puller.

9. Remove the bearing from the slip ring end of the rotor shaft with a suitable puller.

Assembly

1. Place the retaining plate on the rotor shaft, and push the rotor shaft through the bearing. (This should be a hand push fit.)

2. Place the retaining collar onto the rotor shaft with the shoulder toward the bearing and press the collar onto the shaft.

3. Position the drive end head, insert the rotor shaft and bearing assembly. Secure with the 4 retaining plate screws.

Bearing Retainer Plate Screws Torque Specification: 2.1-3.0 Nm.

4. Place the fan on the shaft with the blades toward the end head and follow it with the fan reinforcing washer, pulley spacer, pulley sheaves, flat washer, lock washer and nut.

5. Tighten the pulley nut by placing the rotor in a vice and gripping the rotor with soft jaws.

Drive Pulley Retaining Nut Torque: 54-68 Nm

6. Press the slip ring end bearing onto the shaft shielded side first.

7. Place an insulating washer and spacer on the B+ terminal post then position the rectifier pack in the slip ring end head. Install the rectifier pack attaching screws (3 locations) and tighten securely.

Rectifier Plate Screws Torque Specification: 1.0-2.5 Nm.

Place an insulating, flat and wave washer on the B+ terminal post. Fit and tighten the nut.

'B+' Terminal Nut Torque Specification: 5-12 Nm

8. Place the stator assembly on the slip ring end head and align the scribe marks.

9. Solder the stator leads to the diode junction on the rectifier pack by using a pair of pliers as a heat sink on the diode leads.

10. Place the wave washer in the slip ring end head bearing recess.

11. Position the rotor end head and rotor sub-assembly to the slip ring head and stator sub-assembly. Align the scribe marks and fit the through holes and tighten the through bolts evenly.

Through Bolt Torque Specification: 3.8-5.5 Nm.

12. Place the brush holder/regulator assembly to the end head, ensuring the rectifier plate contacts are correctly positioned. Fit and tighten the 2 attaching screws.

13. Ensure that the rotor easily turns freely by hand, install alternator on the vehicle and observe the operation.

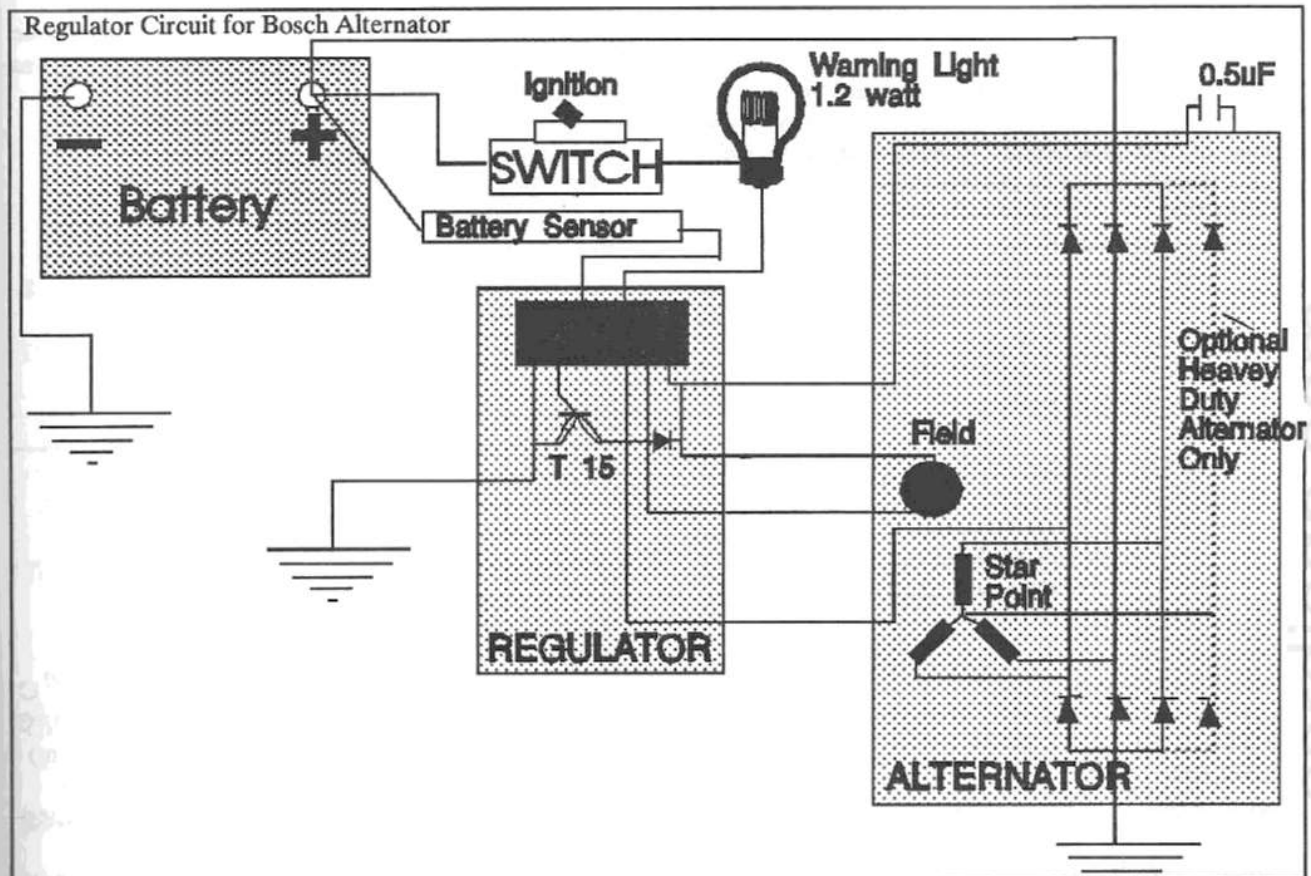
The electronic regulator is temperature compensated and a decrease in regulated voltage of 0.07V will occur for every 10 degrees celsius temperature rise.

Off Vehicle Test

Due to the voltage regulator having been removed from the alternator, use a test unit as shown in the diagram or a similar set up.

1. Connect the D- lead of the unit to the regulator base plate which is riveted to the regulator housing.

2. Connect the S lead to the brush rail which is situated furthest from the regulator base plate and connect B+ lead to 12 volt (+).



ALTERNATOR REGULATOR

VOLTAGE REGULATOR TEST

In Vehicle Test

* The diodes may be damaged if the alternator is not connected to the battery during testing.

1. Between the B+ terminal and the alternator terminal connect a voltmeter.

2. Increase the alternator speed to 6000 rpm. Set the load current to 5 rpm. Readjust the alternator speed if necessary.

3. Read the regulator output voltage within one minute and compare with specifications.

3. Connect the DF lead to the remaining brush rail. (Nearest to the base plate.)

4. Switch the test unit on. Rotate the potentiometer until the voltmeter reads 12V. At this stage the warning lamp should be fully on, however, if the lamp is not on then the regulator is faulty.

5. Slowly increase the voltage until the warning lamp goes out. Correct voltage regulator until the warning lamp goes out. Correct voltage regulator operation is indicated by the extinguishing of the warning lamp between the limits of 14.25-14.55. With voltage below this value the warning lamp is on. The regulator is faulty and must be replaced if the regulator does not switch within these limits.

Problem Solving

Testing the Charging System

The battery should be checked and the circuit inspected for faulty wiring or insulation, loose or corroded connections and poor ground circuits prior to any tests that are made on an alternator or regulator. Test the battery with a hydrometer. The battery should be placed on charge or on a fully charged battery temporarily installed for test purposes if the battery is not fully charged. To be sure that the alternator belt is tight enough to prevent slipping under load, check the belt tension. Prior to proceeding any unfavourable conditions that were noted should be corrected.

*** The ignition switch must be off and the negative battery cable disconnected from the battery before making any test connections. Damage to the system may occur if there is failure to observe these steps.**

PROBLEM

Alternator does not charge.

POSSIBLE CAUSE

Driving belt loose, Worn brushes or rings, Sticking brushes, Open field circuit, Open charge circuit, Open charging circuit, Open circuit in stator winding, Faulty diode rectifiers, Faulty regulator.

PROBLEM

Low or variable charging rate

POSSIBLE CAUSE

Driving belt loose, High resistance in charging circuit (check battery terminals), High resistance in earth return circuit, Open circuit in stator winding.

PROBLEM

Low output and battery

POSSIBLE CAUSE

High resistance in charging circuit, Faulty diode rectifier, Grounded stator winding.

PROBLEM

Overcharging

POSSIBLE CAUSE

Regulator not effectively earthed.

PROBLEM

Unsatisfactory warning light operation

POSSIBLE CAUSE

Faults in alternator and regulator operation.

OUTPUT TEST DIAGNOSIS

PROBLEM

Warning light normal at standstill, goes out at cut-in speed but then glows progressively brighter as speed increases.

POSSIBLE CAUSE

A positive output diode open-circuited. (May damage rotor winding and output stage, overheat brush boxes and blow warning light).

PROBLEM

Warning light out under all conditions.

POSSIBLE CAUSE

A positive output diode short circuited.

PROBLEM

Warning light normal at standstill, dims appreciably at cut-in and gets progressively dimmer at higher speeds.

POSSIBLE CAUSE

A negative output diode open-circuited.

PROBLEM

Warning light normal at standstill, dims slightly at cut-in and remains so throughout speed range.

POSSIBLE CAUSE

A negative output diode short-circuited. (The same symptoms would be apparent if one phase winding was shorted to earth).

PROBLEM

Warning light on under all conditions.

POSSIBLE CAUSE

Phase voltage sensing wire broken.

PROBLEM

Warning light out.

POSSIBLE CAUSE

Voltage regulator failure - voltage sense circuit.

SPECIFICATIONS

Earth polarity	Negative
Nominal voltage	12 V
Nominal output	85 Amps
Stator phases	3
Stator winding connections	Star
Number of poles	12
Resistance of rotor winding	2.47-2.73 Ohms @ 20 ⁰ C
Resistance of stator winding	0.070-0.077 Ohms @ 20 ⁰ C
Brush Length	4.0mm (minimum)
Voltage regulator setting	12mm (new)
Regulating Voltage:	14.25-14.55 Volts at 60000 alternator rpm and 5 amps. output.
Regulator type:	Integral Solid State Non Adjustable

Torque Wrench Spec's Nm

Through Bolt	4 - 5.5
Bearing Retainer Plate Screw	2 - 3
Drive Pulley Retaining Nut	55 - 70
Regulator and Brush Assembly Securing Screw	1.6-2.3
'B + ' Terminal Stud Nut	7.5 - 8.5
Rectifier Plate Retaining Screw	1.0 - 2.5
Capacitor Fixing Screw	3 - 4
Alternator	
Upper Mounting Bolt	25 - 35
Lower Mounting Bolt	12 - 16