AC Dodd is a mechanical engineer and A-series engine guru. With an engineering background in the defence industry, his 'it must work first time, every time' approach has earned him a reputation for building engines and gearboxes that really deliver the goods.

Words and photos: AC Dodd

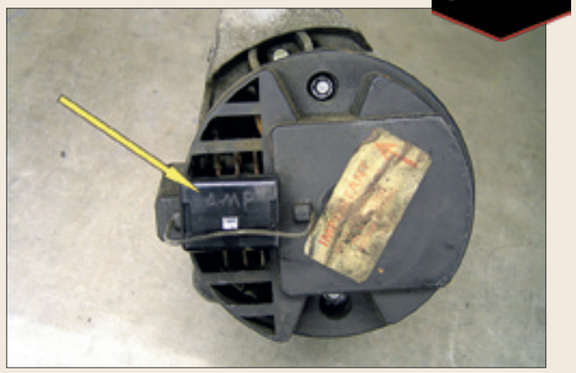
Rebuild your Lucas alternator: test procedures

The purpose of this article is to supplement the alternator rebuild article published in *MiniWorld* June 2010 issue. References were made in the article to tests that needed to be performed on certain parts of the alternator. Here you will find these simple test procedures and others that can be used to determine the serviceability of a unit and its components. You will also find the information on how to identify your unit.

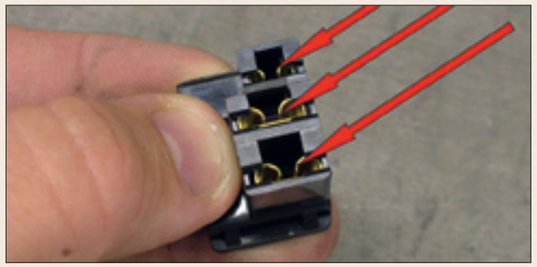
So let's start with the most important question - does it actually need a rebuild?

01 Believe it or not, it is very simple to test your vehicle's charging system. All you need is a simple digital multimeter such as the budget Draper unit shown here. There are only a few simple tests needed to determine if an alternator is serviceable or not. First though, we need to carry out a few checks:
1. Check the fan belt is not worn; does it fill the v-groove of the alternator pulley? The thinner it gets, the lower it will run in the pulley and the less grip there will be to drive the unit. Bottom line is, if you are not sure, fit a new belt to ensure the maximum grip.
2. Ensure that the fan belt is correctly tightened. (i.e. 1/2-inch/12mm max. movement of the belt along its longest length)
3. Ensure that a good, healthy, fully-charged battery is fitted. Failure to do this will ensure that the test results are inconclusive.

02 With the multimeter configured to read DC volts, measure the terminal voltage of the battery to be used for the test. The open circuit voltage (ie no load on the battery) needs to be at least 12.5 volts for the test to continue. If it's low, check that all loads are off. If it is still low, recharge the battery or replace with a known good unit. With the ignition switched on, check that the ignition no-charge light is on (red dash lamp). If it does not come on this could indicate a fault in the vehicle wiring, the alternator or even a blown warning lamp bulb.

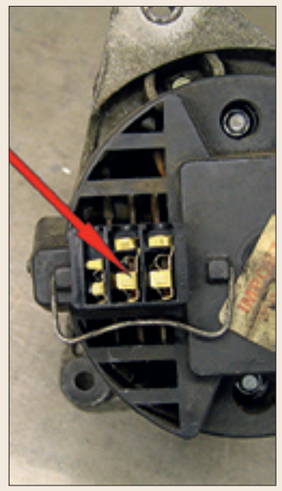


03 Locate the multiplug connector on the rear of the alternator. Remove the plug from the rear of alternator. There should be a clip that holds the plug in place. This will need to be removed first (the plug wiring is not shown in this image).

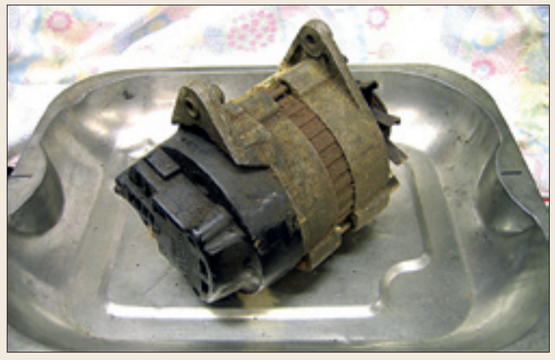


04 Using your multimeter, again configured to read DC volts, connect the black lead to a good earth and test each terminal in turn with the test probe. You should see battery volts on each of the larger connections. You may only have one large terminal connected to the wiring loom, in this case you should only have power on the one large terminal instead of both. You should only have voltage on the smaller terminal when the ignition is switched on. If you do not get the results shown here then you will very likely have a wiring fault which will need further investigation. The smaller terminal is the earth line for the warning light bulb. Connect this to earth with the ignition switched on to check the circuit. It should illuminate if the circuit checks out. WARNING: Do not connect the large terminals to earth as each is connected directly to the battery and a fire is the likely result!

05 No load test - switch off ALL electrical loads for this test. With the plug reconnected, but the plug cover removed, measure the voltage at the larger terminals with the engine running. It is helpful to have an assistant run the engine for this test. Run the engine at 3000rpm for 20 seconds and check the voltage produced at the alternator. Again, connect the black test lead to a good earth and use the red to connect to one of the larger terminals. I would advise making the connections before you start the engine, as having your hands in close proximity to the ignition HT cables is very dangerous, especially if you have a heart condition! Use a small cable with a small crocodile clip at each end to extend the connection for the test. You should have a maximum of 14.45 volts (consider 14.2 volts to be a minimum). Repeat this test but this time measure the voltage at the battery terminals. The figures should be very close if not the same.

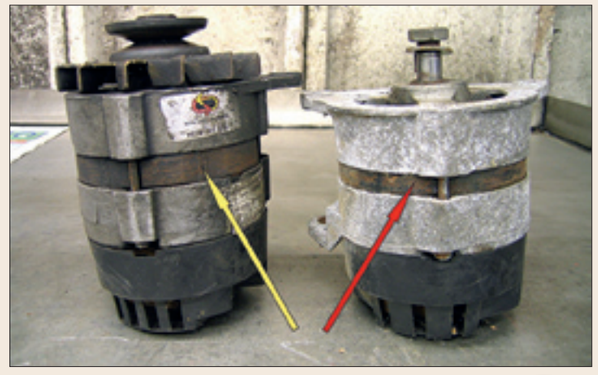


06 Load test, switch on headlights, heated rear screen if fitted, heater, and fog lamp if fitted. Use the same procedure as in the no load test except this time the voltage range is 13.9 to 14.1 volts at the alternator, and you should be getting about 13.7 volts at the battery. If you have less than 13.6 volts at the battery, this indicates excess resistance in the charging circuit and this needs to be investigated. This needs to be rectified and the test run again to see the outcome. If the voltages measured at the alternator during these tests are outside those stated then we need to strip and repair/overhaul the alternator.



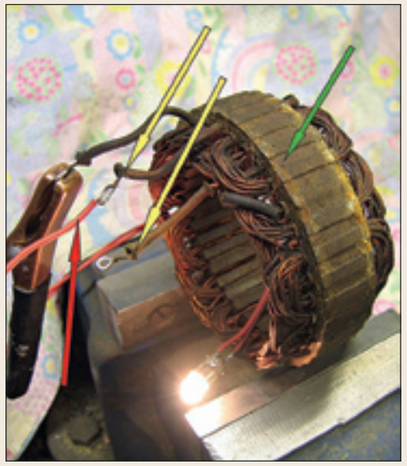
07 With the unit removed from the car, the process of identifying and stripdown can begin. This particular unit is a Lucas 17 ACR. How did we know? This unit has a wide stator. Wide stator ACRs were either 36-amp 17 ACRs or the larger 43-amp 18ACR.

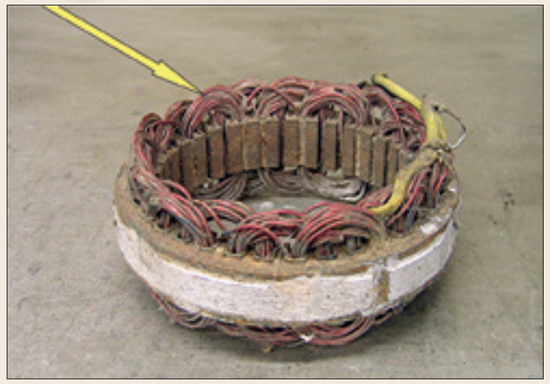
08 Here I have shown the external visible difference between the wide and narrow stator ACRs.The narrow stator ACRs are the 28-amp 15ACR and the larger 34-amp 16ACR as fitted to many a standard pre-'82/post '73-ish Minis. To further determine exactly which output you have, read on.



09 For the next steps we need to use a 12-volt power supply and a 4-watt bulb. Here is the simple test lamp I made to perform the tests for this article. For a power supply you can use a simple basic (non automated) car battery charger.

10 The Stator test: Here we are going to check the continuity of the windings and check for any short circuits. Set up the circuit as shown above. Connect one side of the test bulb to the positive of the battery charger. Connect the other (negative) charger lead as shown to one of the stator windings. With the remaining wire from the test lamp (red arrow), touch it to the other two winding take-offs (yellow arrows). If there is continuity the bulb will light as shown. Finally, check the insulation. Move this wire to the outer of the stator (green arrow), touch this to a clean area. The bulb should not be on. If the bulb illuminates now it would indicate a short in the windings through to earth, which would mean this stator is defective and it would need to be replaced. A better test can be performed using a 110-volt AC supply and a suitable bulb. However, for the DIY'er this is dangerous. Using such high voltages without a safety interlocked test rig is liable to end in you being electrocuted! Stick to the safe low voltage set-up unless you have access to the proper test equipment.

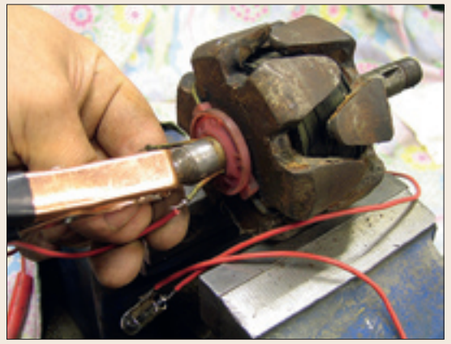




11 While we are looking at stators, here is the narrow band stator with red windings. This indicates that this stator is for the 16ACR 34-amp unit. The 15ACR stator would have orange/gold coloured windings...

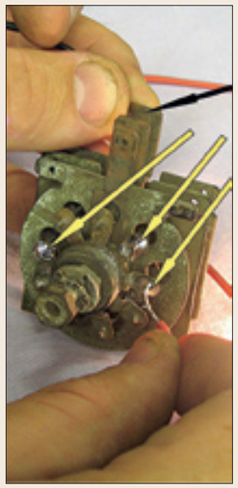
12 ... Whereas the larger stator in our unit, with orange windings, indicates it is a 17ACR 36-amp unit. A wide stator and red windings would indicate it is the 18ACR 43-amp unit.

13 Rotor Test: The rotor winding is tested by passing a current through it. The field winding should have around 3 to 4 ohms of electrical resistance. By applying a 9- to 12-volt supply (from a battery charger) across the rotor winding we should get a current of 3 to 4 amps using ohms law. (V=IR, where V is the voltage, I is the current in Amps and R is the resistance in Ohms). If you get a similar current at a full 12 volts, this is a good sign that the rotor winding is intact. The other thing you will notice while you do this test is that the rotor will become magnetic and it will want to stick to ferrous objects - just like the vice in this example. If no current flows the coil cannot energise and induce the magnetic field, i.e. the rotor is dead.

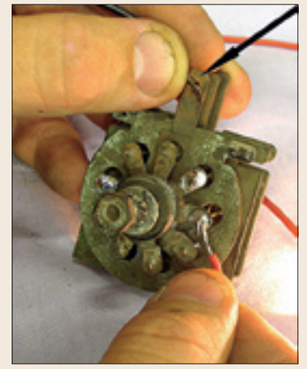


14 A final test is to check the insulation in the same way we tested the stator. Connect the 12-volt supply through the bulb as before and test to see if current can flow from the rotor winding to the frame or shaft. If you make the connection and the bulb lights, the rotor is dead.

15 Rectifier Test: Test No. 1. In this alternator I am using a new unit. However, to know how to test, read on. There are nine diodes to check. Here I am starting with the main output diodes on the positive output of the rectifier. Connect your test lamp as before, then connect to the rectifier as shown. Attach the remaining wire from the bulb to either of the larger spade terminals (black arrow). Connect the other charger lead to each of the rectifier stator connections in turn (yellow arrows). These stator connections are used in all these rectifier checks. The test is simple - you are checking that current flows in one direction only, since that is what a diode does. Swap over the connections and test at the same points. If the bulb lights on all three points in one direction and not at all in the other direction, all is well. If it does not illuminate at all, the diodes are dead, as is, if it illuminates in both directions.



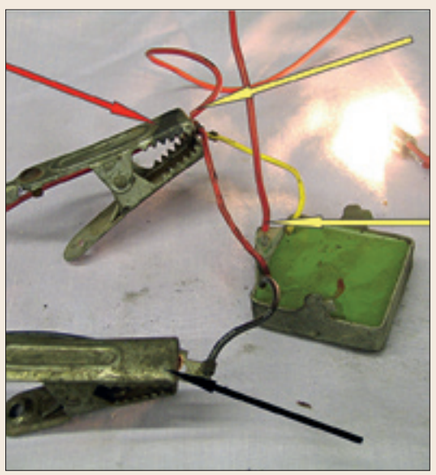
16 Test No.2. The same as before, however to test the negative side of the main output diodes, the connections are made at the stud as shown by the black arrow. Test as before.



17 Test No.3. The final rectifier test is to check the field output diodes. These are the smallest diodes in the rectifier. Again, the same test as the other two, but this time the connection is made to the smaller of the spade terminals.

18 Regulator test: For this part only we need a bit more kit. Don't worry if this looks like something from a science-fiction film - this is my under bench mounted variable power supply, actually three in one unit, but all you need is a basic bench power supply that has a variable DC voltage output - 0 to 20 volts and up to 1 amp is all that is required. This is the sort of thing that can be bought cheaply off the internet, but it needs to be a smoothed output or you will ruin the regulator during this test.

19 The regulator shown is a three-wire model. With the power supply switched on and turned to the lowest setting, connect the wires as shown. The red and black arrows designate the positive and negative wires from the power supply. Connect the test lamp as indicated by the yellow arrows. You may also want to connect your digital multimeter. Use this to read the output voltage from the power supply if your unit does not have an accurate one fitted. Turn the voltage up to 14 volts. The lamp should illuminate dimly at first, then get brighter as the voltage rises. If all is well, continue to up the voltage slowly until around 14.5 volts, when the bulb should extinguish. If it does, this indicates the regulator is functioning correctly. If the bulb is still on at 15 volts and higher, the regulator is faulty. Also, if the bulb does not illuminate at all, the regulator is also faulty and a replacement is the only option. If you have a more common two-wire regulator, use the same wire colours/positions as above when connecting up, omitting the third wire.



20 Final circuit check: With your Digital Multimeter set to the diode test facility, connect one lead (it does not matter which one) to the rectifier earth nut or the main body of the alternator, and the other to the small rectifier terminal, as shown. You should get a reading. Reverse the connections. You should also get a reading, although different. This indicates that there is a circuit present through the regulator and rotor/brushes. This unit should work when fitted. Job done!

WWW.MINIWORLD.CO.UK