

## R/R Alternator Brushes; Rev. by author, 12-07-2007

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Skill level required: Medium-low...but not a ham-fisted Beginner

Tools required:

- BMW standard on-bike tool kit
- 8 mm Spintite or modified nut driver (this is optional, only needed if you decide to remove the brush holder).
- Good sized soldering iron, such as 250 watt soldering gun; or 25 to 100 watts standard soldering iron, but with a large tip. Can be done with smaller iron, see text.

You will need some rosin core standard electronics type solder

- Long nose pliers or other device to act as help to avoid solder wicking (MAY not be necessary, see text)

Parts required:

- Brush set, 12-31-1-244-480 (one set = 2 each). Some older numbers for this set were 12-31-1-350-787; 12-31-1-243-004; 12-31-1-244-389
- Brush holder if you are not careful and break yours, 12-31-1-243-003
- Snail springs (two) (usually the old set is OK) 12-31-1-350-786 (snail spring replacement does not HAVE to be done. If they get just a bit weak, they can be coiled slightly tighter, by one turn. RARELY does a snail spring have very poor heat treatment, and have to be replaced, due to it having poor pressure when properly coiled). Snail springs can be mounted by more than one method, onto their metal tang....only one way is 100% proper, although all work adequately. A good look-see will show you how to do it.

**\*\*\*CAUTION!! BE SURE TO DISCONNECT THE BATTERY NEGATIVE LEADS FIRST!!** Only then is it safe to remove the front cover of the engine!

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Alternator brushes are usually worn to the "too short and intermittently contacting" point by AROUND 80,000 miles. YOUR mileage may vary. Wear depends on atmospheric dirt and how much or how long higher alternator output levels are used. When the brushes begin to fail to contact the rotor slip rings properly, you will usually have problems with the GEN lamp lighting and eventually no or intermittent charging. Quite often the problem begins showing up as a dim GEN lamp indication, or lowered charging voltage. Irregularities in run-out of the slip rings (the entire rotor wobbles very SLIGHTLY) cause intermittent brush contact and irregularities in charging. It is necessary that a considerable electrical current travel steadily through the rotor to ensure full output. When a brush's length is such that troubles begin, the brush is usually still more than long enough to work OK, if it was not for the circular snail spring that applies pressure against the brush. This spring can be mechanically prevented from pushing much on the brush; or, just barely contacting with very light pressure, if any; when the brush wear is enough to allow the snail spring to bottom-out on ITS slot in the brush holder.

\*\*\*There is more than one style of brush holder, they are all basically interchangeable, this is being mentioned in case you see slight differences. There is ..or WAS&hellip;two styles of brushes, also interchangeable, the difference being in how the stranded wire exits the brush. That is, the multi-stranded wire may come out of the END of the brush, or the SIDE of the brush. Some brush holders have grooves for the brush wire that comes from the brush side. If yours does, have the brush wire in that groove side during replacement!

On some brush holders the soldering point is easy to get to on both brushes, without removing the stator, but the rear (inner) brush and snail spring may be somewhat of a bear to get to without removing the stator. You will see what needs to be done by a quick look-see. Both brushes are in a single, somewhat breakable (especially when old) plastic holder. The outer (forward) brush is relatively easy to get to, not so the inner brush. Since the brushes MIGHT NOT wear evenly, checking just the outer brush for length and interference of the holder and SNAIL spring, is NOT adequate. Sometimes due to irregularities in brushes, snail spring pressure, dirt, etc., the inner brush MIGHT wear faster, so take the time to find out. I use a dentists mirror and flashlight or remove the stator assembly.

A new brush measures 16.5 mm (0.65 inch) from the center of the curved portion to the top, measured along the wide side. When worn approximately half way, the brushes are usually not working correctly, or, soon won't be. You can tell by looking at the snail spring, and see if it is BOTTOMING on the side slot of the HOLDER. If it is NOT bottoming, there should be brush life left IF the spring is OK and applying pressure. You do NOT need a lot of pressure. Rotating the snail spring adjusts the pressure, and the snail spring can be installed 2 or 3 ways at its very center, to the brush-holder spring tang.

The flexible stranded wire coming from the brush is soldered to the brush holder metal plate. You will need a soldering iron with a substantial size soldering tip to hold enough heat during the soldering. Large heavy duty soldering guns also work OK. NOTE that some folks simply snip the old brushes stranded wire, leaving enough room for them to SOLDER the old wire to the new brushes wire. That can work just fine, and you can use a much smaller soldering iron. No matter how done, be sure that you do not allow solder to 'wick' up the wires, which, if excessive, greatly stiffens the wires.

SO, when replacing the brushes you have choices:

Method #1: Cut the old wires off, leaving a bit of these wires attached at the soldered-to-the-plate point, for soldering to the new brush's wire. You have to be careful when soldering these wires as solder wicking can occur, making a considerable length of the wire stiff, not allowing proper brush movement... and a potential for breaking from vibration. A long nose pliers will help prevent solder wicking, but three hands are nice if you add the solder and soldering gun/iron; most folks will use some sort of alligator clip as a heat sink, or other device, such as hemostats. This procedure, attaching to a part of the old existing wire is really not the best but it IS OK.

Method #2: Remove the case/stator of the alternator. Some folks struggle with, and even break, the plastic holder, when trying to replace the brushes...especially the inner brush. This can be avoided and a neater job done, by removing the outer case/stator assembly. This is the preferred and frankly usually much easier method. You can now easily replace the brushes properly. This is the method described below. \*\*\*NOTE that you do NOT have to remove the rotor!! You do NOT have to unsolder any stator wires!!

1. Unplug all wires at the alternator. They are push on/pull off types. Take note of any that are not fitting tightly or are overheated; and, fix these problems before reassembly, by cleaning with a fine tipped tool of some sort and squeezing the female connector parts slightly.

2. NOTE where the brush holder and their respective wires connect to...you will be putting the alternator stator/cover and wires back in the same position upon reassembly. HOWEVER, of the THREE stator wires right next to each other, their order is unimportant. Do NOT mix up the two rotor wires. D- (as marked on the case) is ALWAYS BROWN. Remove the THREE long screws holding the alternator case to the timing chest.

3. Using a small piece of soft wood in one hand (NOT a metal screwdriver!!) and SUPPORTING the outer alternator/stator case with the other hand to keep it from dropping on the floor when it suddenly releases; CAREFULLY AND LIGHTLY pry, evenly all around, at the open areas along the REARward area of the stator metal, where it meets the engine. AVOID TOUCHING/PRYING THE STATOR WINDING WIRES!!!! Pry points ARE the timing chest metal to the alternator stator multi-layered metal stack. Typically prying a SMALL amount, relatively evenly, at the three opposing places along the circumference is all that is necessary. Try to remove the assembly straight out horizontally.

\*\*\*NOTE!...Avoid any damage to the brush holder or to the stator wiring. Absolutely NO nicks on the wiring is allowed!

\*\*\*NOTE!... Be careful, notice that the brushes might get hung up on the slip rings during removal, so go at this bit by bit, and lift the brush by pulling on its wire if a brush edge starts to catch on the rotor slip rings. It is HERE that folks get hamfisted and break the plastic brush holder.

4. With the case/stator/brush assembly in your hand and away from the engine, all will be self explanatory upon inspection.

5. For SOME holders, you need to remove the inside nuts to remove the holder for soldering, on other holders this is not necessary. The nuts holding the brush holder to the case are thin, and you may have to improvise a nut-driver. I use a SpinTite, with the end ground flat to avoid any internal taper. A thin socket, suitably also so ground, will also work fine. This is a great time to contemplate how you would remove the diode board outer nuts, if that was ever necessary; and, perhaps you will want some similar tool, or the same tool, modified as required, in your on-bike tool kit.

6. Replace the brushes. Reassemble everything. AVOID damaging the brush holder and avoid the brushes hanging up on the rotor slip rings, during re-assembly. DO NOT nick the stator metal laminations, nor the stator wires. If the stator part that fits into the motor is rusty or cruddy, clean the mating areas. Tighten the three long screws evenly, back and forth.

#### Hints:

When replacing the case/stator, be SURE it, and the engine mating surfaces are cleaned of all filth. Corrosion on the part of the stator that fits into the engine cavity can be cleaned with sandpaper. DO clean off any residues. DO NOT use steel wool. DO NOT nick or bend or scratch any metal of the stator laminations, avoid nicking its housing, or the stator/engine mounting area.

DO NOT get scratch marks across the stator laminations!!

To avoid breaking the brushes and brush holder during reinstallation, the brushes MUST be moved or lifted/moved away from the rotor slip rings as you install the case/stator. You do this one brush at a time, during refitting. DO NOT forget this!

It is altogether too easy to forget that one of the brushes (Df) is an electrically hot brush, and the other one (D-) is grounded. IF you have to remove the brush holder, do not fail to note the type and style of insulating washers (look at both sides of these washers), and where the washers are located, and how assembled!! Failure to reinstall the insulating washers at the proper places, in the proper order, with any washer ridges in proper direction/position, can result in NO charging! You would not be the first person to ground the DF brush by installing the brush holder wrongly. There are markings on the stator housing. The D- marking is the grounded brush, and the BROWN wire connects there. Df is the hot, INSULATED brush. You will probably find the Df brush wire to be blue/black.

Make a final inspection after assembling the long screws EVENLY, and do not overtighten. Attach all the wires, be sure that the grouping of three at the stator are very tight fitting. It makes no difference what order these three are

attached....some alternators have those as a three wires in one plug, some have individual wires.

If, for some reason, you are removing and replacing a ROTOR, be advised that use of ONLY a HARDENED tool should be used, DO NOT use a conventional fingered puller!!!!....use either the BMW special 1 piece removing bolt tool (it is hardened), or you can make one, as described on this website in an article "Alternator Rotor Puller" by Joe ('Cuda).

The rotor will 'pop off' very suddenly, so have one hand on it so it does not fall to the floor.

The TAPERS, male and female, of the crankshaft, and the rotor, must be CLEAN AND DRY,,,,no finger prints either...and do NOT use gasoline as the degreaser. Do NOT overtighten the rotor bolt when replacing it.

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