Getting Your Wires Up To Scratch

- by Pete Snidal, Looner Tooner Extraordinaire

If you put a Halogen headlight on your Brit bike, you'll likely find that it needs a little help in the conductor department. You see, the original wiring is generally found to be overtaxed by the extra current requirement of the new light.

But there's hope. With a voltmeter, you can troubleshoot your wiring, and if you find any deficiencies, they can be corrected by a few simple additions of some heavier wire. To do this, we'll use a few facts:

- Halogen headlights draw more current than the original.
- Every conductor has SOME resistance
- Resistance creates a "voltage drop"
- The Voltage drops more as the current draw increases
- The voltage drop shows as a voltage across the resistance

Using this knowledge, you can troubleshoot your lighting circuit, and improve the loosey-goosey parts.

First, you'll need a voltmeter, preferably one with a 0 - 5V scale - the voltage drops will be a fraction of the total voltage, which will be ~12.5 with motor not running. We are going to connect the meter to various section of the high-beam circuit, looking for weak spots, which we will then correct.

Since we're going to be working with the headlight switched on, but the motor not running, we'll need to position the motor so the points are open. Turn on ignition, pull the decompressor lever, and move the kickstarter, watching the ammeter. When the ammeter shows a discharge, continue moving the motor around until the ammeter jumps back towards zero. The points are now open; this is where to leave the engine. NB: All voltage drop readings must be taken with the headlight ON!

Let's go. You'll need to find high beam, so turn on the ign/light switch, and put the dip switch to the high beam position - high beam draws the greatest current, and so will show the greatest voltage drops. Remove the headlight unit and rim from the housing, supporting it on the front mudguard. Ensure that the connecting wires are strong enough to prevent it falling and breaking. Turn on the meter, if necessary, and set it to the lowest full volt reading 0 - 5 or 0 - 2.5 or whatever you have. 0-15 will work in extreme cases.

Your voltmeter will be analog - meedle type - or digital - reads in numbers. Analog meters hate being connected backwards, digitals just read with a - in front of the number if they are. So in each of the following tests, turn on the lights or connect the meter momentarily while checking the meter, and if it "dips" down, reverse the meter connections before leaving the switch on for more than a fraction of a second. If your meter is digital, it will just show a "-" in front of the reading. No blame.

We'll be using the concept of *voltage drop* - when the current flow in a circuit passes through a resistance, some of the pressure, or voltage, is lost in the resistor. This voltage loss shows as an actual voltage between the in point and the out point of the resistance.

To demonstrate this, let's first check the ground section of the high beam circuit. Connect the + meter

lead directly to the + battery terminal. (Assuming + ground.) Connect the - lead of the meter to the ground terminal of the headlight unit - where it is connected to the chassis/headlight shell/casquette. Turn on the ign/light switch momentarily, looking for a reading on the meter. If it dips down, reverse the meter leads. Once it's going up, leave the lights on for 30 seconds or so and observe the reading, if any.

If there's a resistance between these points, it will show as a voltage. If you get a reading, you should "jump" the connection. Connect a length of #14 wire of the appropriate colour, (red for +, black for -) between the battery ground lead and the terminal to which the headlight ground is connected on the chassis. You can use pussy crimp-on ring connectors, but I always strip the wire, twist the strands, bend a loop, and tin it with a soldering iron - crimp connectors can form resistances, too. If you've made an improvement - drop in voltage reading - you'll want to pull your gas tank and add this wire permanently (and neatly.) (But hold on, there's another wire to come!)

OK. Time for the "hot" section. Let's just review the current path on this leg from battery to headlight terminal:

- 1. battery terminal to ammeter "bat" terminal - one terminal of the ammeter connects to the battery, the other to the system as a whole, so that all current flowing to or from the battery from or to the system registers on the ammeter. For the time being, unless the ammeter itself is contributing a voltage drop, it won't matter which terminal you test.

- 2. Ammeter "system" terminal to ign/light switch - some systems feed the light switch through an ignition switch, many have dispensed with the separate light switch, and just feed the light directly from the one "master" switch.

- 3. The ign/light switch itself - switches can offer serious resistances, and must be cleaned or replaced when this happens

- 4. The ign/light switch to the dip switch

- 5. The dip switch itself

- 6. The dip switch to the headlight connector

First, a gross overall reading of the entire ungrounded side of the circuit. Check as above between battery "hot" (- in + ground systems) and the headlight high beam terminal. - with the light on, of course. Be sure you connect to the correct headlight terminal - it'll be the only one which shows a voltage. if you get NO voltage between battery "hot" and any of the terminals, stop; your wiring can't be improved!

If you find a drop, you'll have to check each element of the circuit leg individually. First, the battery to ammeter wire. Still leaving the voltmeter lead on the battery, connect the other to one of the ammeter terminals and see if you have a drop. There should be virtually no difference between either ammeter terminal, but if jumping is necessary, you'll want to jump to the "bat" one, and not the "system" one.

Here's how to find the right one; temporarily remove the ground wire from the battery before you do this, to prevent sparks, blown fuses, lighting up wires, etc. if your wrench on the ammeter terminal shorts to ground.

Then disconnect the wires from one of the ammeter terminals. Test to see if you've got the "bat" terminal. Being careful to avoid letting any of the wires you've disconnected from the ammeter touch any metal, reconnect the battery ground temporarily, and run another jumper wire from the

ungrounded battery terminal to the wires you took from the ammeter terminal. If this lights the headlight, then you've disconnected the wrong ammeter terminal. If it doesn't, (assuming the headlight switch is still on) , you've got the "bat" terminal of the ammeter first time. If it did, disconnect the ground wire from the battery, reconnect the wires you've removed from the ammeter. The other terminal is the "bat" one.

Once you've found the "bat" terminal, with the battery ground again disconnected, run an appropriately-coloured #14 wire from the "hot" battery terminal to the ammeter "bat" terminal. Tighten up the connector and reconnect the battery ground. Check one last time for a voltage drop from battery to ammeter terminal - it should have disappeared with the addition of the #14 jumper. You'll want to install this permanently, under the tank, with the ground jumper if you've added one.

As you install jumpers, it isn't necessary to disconnect the original wiring - every little bit helps; your jump just adds to the conductivity.

Now, move the voltmeter lead from the battery up to the latest good point in the circuit - the ammeter terminal. With the other VM lead on the headlight High Beam terminal, check for a voltage drop. If you have one in this section (wire-switch-wire-dip switch-wire), and if it's significant, you have two choices. The first is to check each element as you by now know how to do, and to correct where possible by jumping wires, cleaning or replacing switches, etc., or you can make a Big Jump, here! You can introduce a Relay into the circuit, which will be energized by the headlight high beam wire, and when energized, will pass voltage directly from the ammeter system terminal to the headlight HB terminal, through #14 wire all the way.

The Ol' Bosch horn relay trick. Bosch make this lovely little horn relay - I'm not sure of part number or application. I bodged the starter circuit in my '64 Chev Impala with one a few years ago. Visiting friend, a radio tech, had one in his toolbox which he donated. Says they're used commonly in the trade, handle decent current, trigger on nothing, and are cheap and available all over the place. Mine's under 3 feet of snow right now, so hopefully someone will find the part no. and application for these little marvels and get back to us. It's about the size of 4 sugar cubes, black, and it says Bosch on it. 3 spade terminals. Other horn or light relays will work, but the instant I suggested I might try a relay to fix my funky starter circuit, my friend's eyes lit up and he said, "I've got just the one you need."

And he was even more right for this application. It's small, it's efficient, and it will handle the current for a halogen light with room to spare. There are other relays on the market that will do the job as well, but the Bosch is my personal favourite.

In any event, the relay will take care of the voltage drop situation in a number of ways. It will replace both switches with a high-current low resistance alternative. Here's how:

First, you have to figure out which of the three terminals is which. Two of them, when connected to the battery + and -, will make the thing "click." (Connecting wires to the wrong places can't hurt it, provided connections are momentary. If you get a spark, that's the wrong pair.)

When you find the two that click it, the third one should get "hot." - the terminal will light a tester bulb or show ~12V to ground.If not, reverse the connections. Now the third one will be hot when it clicks. So you have a ground tab, a "switched hot" tab, and an "energizer" tab. Make a note of which is which - they're numbered, and proceed to connect, using crimp-on spade connectors. (Purists may solder.) Connect the ground terminal to ground - the same ground as the jumper would be nice. Connect the "switched hot" terminal to the headlight high beam connector, removing the original wire from the dip switch. Crimp a spade connector to this wire, and snap it onto the remaining relay terminal, the "energizer" tab. Last connection: the "hot" terminal of the relay directly from the ammeter "system" terminal. Now, you've made a simpler, more direct current path from battery to

high beam, energized by the old high beam supply. The low beam, and all the other wiring, stays the way it was.

Your ground is jumped all the way to the light ground from the battery +, which will improve both lights, and all other elements of the electrical system.

If you've had to install the two jumpers mentioned above, you might as well jump the charging circuit as well - you can test for voltage drop, or just do it on faith. This will mean yet another short piece of #14 wire directly from the rectifier output to the ammeter "system" terminal.

Summary: What Have You Done?

You have "jumped" or bypassed the entire circuit that used to be a wire (probably too small for halogens) from your battery to through the ammeter to the ign/light switch to the dip switch to the headlight, with one skookum #14 short wire through the high-current relay to the high beam. You've improved the ground side of the circuit with the ground jumper to the headlight section. (Go ahead; do another #14 ground jumper between the battery and the rectifier for the Full Meal Deal!) And you've done it all with two or three pieces of wire and a little horn relay! (or a lot of switch cleaning and/or replacing, more wire, and no horn relay.)

This little bodge will help your whole system, and will definitely solve any resistance problems the addition of a halogen headlight will bring about. And it will give vent to your pent-up wishes to do some actual monkey-wrenching, if you find yourself fixating on dicking around with accessories, like solo seats, funky turn signals, etc. Some Real Tuning that will be beneficial!

You're welcome! Send One Dollar to: Pete Snidal, 6515 Sleepy Hollow Road, Grand Forks, BC Canada V0H 1H0. Tankyouvedymuch!