

Saga of Hall sensors of BMW R1100

My saga of Hall sensors (Nth story but perhaps THE issue)

Like many, I had my history of problems with the Hall sensors.
(the boxer R 1100 series is the laughing stock of the members of the motor club of my company, it's almost always the one who is stranded on rides, with big smile of the bikers on Italian or Japanese)

After several failures around 130000 km in summer, it let me ride again after "some time", I finally got into the problem, breakdowns recurring too often.

The first time, because I actually struggled a few times, I changed the sensors for the Chinese sensors, widely cited in the forums : CYHME56.

These sensors are attractive for :

- their prices
- speed of delivery from Germany
- comparable characteristics, because the requirement is finally tolerant (12V hold, drain a few milliamps when they switch; they work at 24V, 40mA)
- react to the passage of soft iron vane in the air gap (the magnetic field is produced by the sensor itself, so no worries on that side)
- withstand the temperature and are guaranteed to operate at 175 ° C and the output wires are made of silicon, withstanding the 380 ° C of my soldering iron

I kept the bulk of the cable between sensor and connector and I soldered the sensors wires just at the end of the old cable.

Hurray, it works!

But for a short time, about two weeks.

Well, I told myself that I had screwed up something, and I check again the sensors, they are good! I change them anyway just in case ...

A week later, failure in heavy rain, but the bike started again after only half an hour wait.

Two weeks later, total failure under heavy rain, an hour away from home!

Pityful repatriation of the BMW, but seemed to run after a night, I just lost confidence.

Now I NEED to understand the problem, and not change systematically sensors, and if possible, not at BMW price. I had to drive a Suzuki GSX400 thirty years old, it worked faithfully while troubleshooting the problem.

I finally made the connection between rain and failure that occurs half an hour or an hour later.

BINGO!

I finally found the root cause of the problems (I think so, subsequently confirmed)

At BMW, a zealous employee of the purchasing department must have received a good annual bonus after saving a few pennies to the company (he may be the same which has shortened the bar cables or let randomly place the rilsan fixing, and won another award for a new reduction in reliability?) Whoever designed the gearboxes that run less than 100Mm (yes, mégameters! 1Mm=1000km) is rather a subcontractor unless it has been given instruction. In short, the bike of our cops is not a model of reliability.

Yet these same sensors are used on other bikes and cars without problems.

Try to think and observe:

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the wires of Chen Yang or Honeywell sensors are made of silicone and withstand very high temperatures. The sensors are also pretty high temperature resistant. These wires are connected to a cable to link to the connector, cable is sheathed. The sheath has a beautiful appearance, that finally hides what is happening inside!

Doing it right the first time, I kept all the wires of sensors with "Duck Tape" (the wide tape gray or black to fix anything)

O surprise, this tape has been damaged, as melted: So it's hot on board !

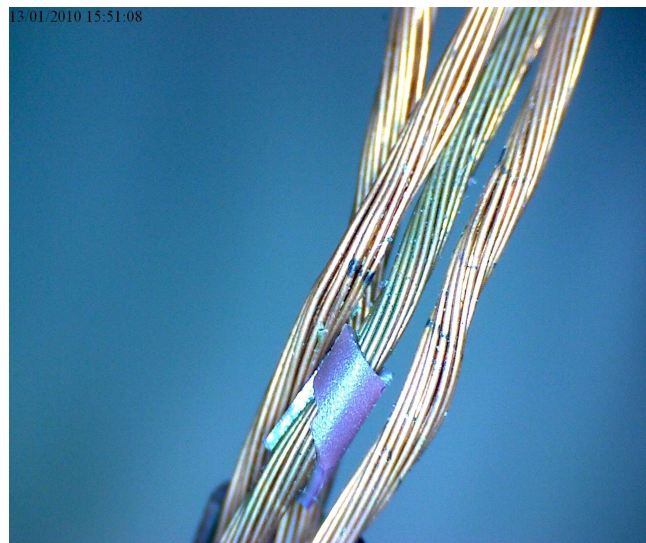
we see black deposits while the plate was cleaned during the repair



After all, it's not so bad since the wire is very resistant to higher temperatures.

Yes, but the beautiful vertical cable, how is it inside ?

Horror!



The plastic of the wire (probably PVC which withstands 70 ° C) is cracked and the scales falls from the wire as soon as we move the cable.

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There are black marks on the wire, which seem to follow the scales: probably dust, sludge and metal particles. But the cell holder plate is in an environment of deposits, see picture of the plate.

I understand the mechanism of failure like this :

- a zealous employee at BMW created a business of tens of thousands of sensors plates to change (he deserves his premium) he may have also invented the too short cables on the bar (or the random positioning of rilsan cable fixation) on the same R1100, another common failure.
- There is a return pipe of hot oil in the corner, placed differently from other BMW models.
- hot oil is much hotter than the water of the cooling system of K series or cars. The belt is suffering a bit, but it is less time exposed to the hot pipe: it rotates and is cooled by air, it suffers only when engine is stopped hot, and is NOT made of PVC.
- PVC changes with age, and very differently depending on the climate of the place (local temperature and humidity).
- at each change of temperature, the air contained in the cable expands and retracts: an effect of heat pump. An aggravating factor is the wire floating in a (beautiful) sheath, which leaves room for a significant volume of air, aggravating the problem.
- each cooling, air enters the cable draining dust and metal particles from close environment, forming a sludge between the scales of PVC, we see these deposits on the picture of the underside of the plate.
- this sludge ends up being conductive and pollutes the electrical signal from the sensor.
- this phenomenon is sensitive to temperature, humidity, perhaps even to the altitude, and requires "some time" to trigger or disappear! It looks very close to all my troubles.

When I changed the Hall sensors only, the failure still occurred, preferably during very wet weather. A feature of this failure is the return to normal operation after "some time", sometimes after several hours. Change. The change of cable linking the sensors to the connector, makes the final repair (>50Mm in my case).

This is why I reject the alternative hypothesis, less poetic: the short circuit between denuded wires. I think the scales stay almost in place until the sheath is open, the cable and the fault would have little tendency to get back to work, symptoms often found on the Web, and it does not explain the sensitivity to moisture. The computer, if well designed (which is the case of vital automotive electronics: computer, ABS and ESP, the rest is very often manufactured cheaply) is foolproof, and +12 V sensor supply must withstand a short to the ground, the sensor output in an open collector, by nature resistant to short circuits to ground. Only the short-circuit to the +12 V, without series resistance, is destructive, at least for the sensors. The current has to be limited to 40mA max. Whatever the fine mechanism is (sludge or short circuit), it is definitely a problem of wire insulating.

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Conclusions

The cause of the problems is the bad choice of the wire by BMW, inadequate to the conditions of use, and of aging.

It is not necessary to change the sensors themselves because they are always good (but must be measured without BMW cable) their change implies a probable decrease of reliability: piercing the rivet alloy harder than the support plate , manufacture a riveting tool with quality steel (Internet advocate certain recommendations to bolts, may softer than the rivet!), riveting is not so obvious to anyone.

I put the wire from a computer cable and stamped 115 ° C, it is not in that garbage of BMW PVC, **AND** does not flake off over time, **AND** withstands much better the temperature. I lazily preferred this solution, rather than changing the passage of the oil pipe.

For more than 50,000 km without change the sensors again, no more problem before, during or after rain, heat or cold, it also becomes totally insensitive to high pressure watering (Kärcher) wich was the panic of the Beemers, **so it was indeed the cause.**

I URGES CHANGE of CABLE (CABLE and NATURE of , NO MORE GENUINE BMW CABLE !) BETWEEN THE SENSOR AND THE CONNECTOR, but the sensors may remain (they last the length of the machine on the BMW K series and on cars)

The failure may occur on motorcycles from very different age.

Some people were also advised to change the ignition coils, completely useless here, except for the pockets of sellers, the coils are filled with epoxy, which has little tendency to spoil.

Pull-up resistors, sometimes recommended on the internet may not be necessary, they could help to ride until the cable change, making the circuit less sensitive to pollution, it will be valid for "some time" . Assuming a current drain by the computer of 10 mA max, the resistance shall not be less than 500 ohms, 1 kilo ohms for each resistor, is OK.