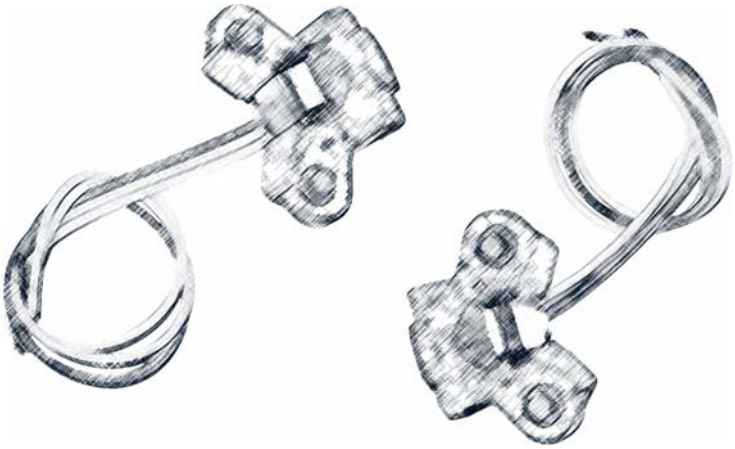
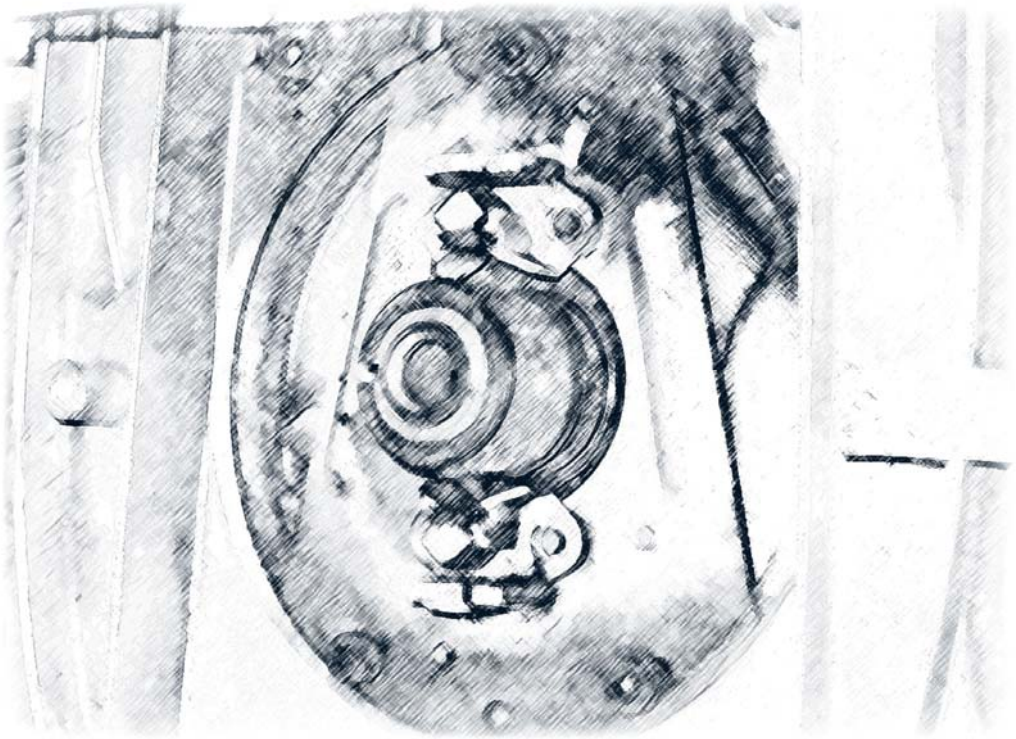


Diagnosing and Replacing the Oilhead Hall Effect Ignition Impulse Sending Unit



by ***Dana E. Hager***

Send comments/corrections to

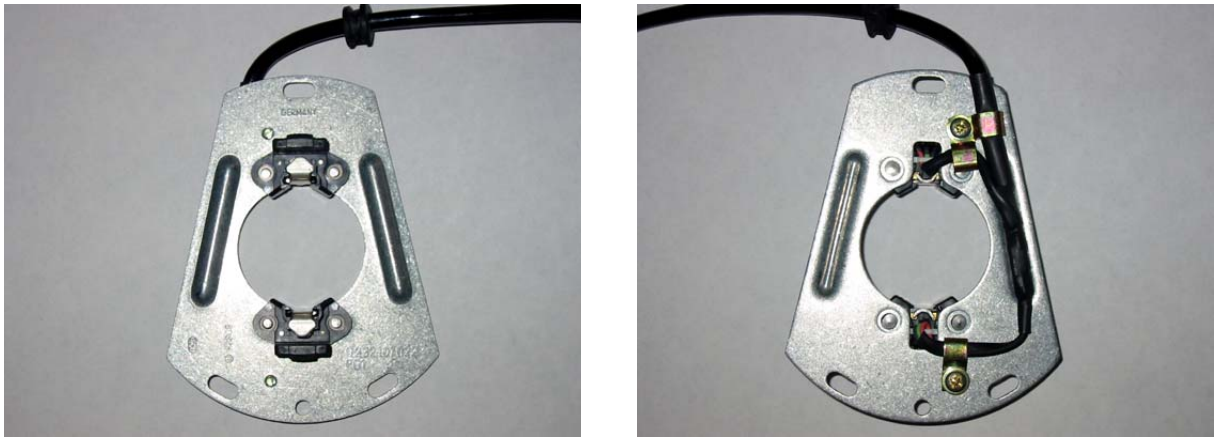
dehager@rcn.com

DRAFT Edition
8-26-2004

The author(s) have described how they made the parts/ tooling. The construction was based on their experience, knowledge, skills and available materials and tools. Our experience, knowledge and skills maybe and likely are different from any potential users of the information here. Users may not have the material and tools we had available. What was, or is, obvious to us and so not described, may not be apparent to potential users at all. Therefore, they/ we assume no liability for any damage or injury caused by any errors or omissions in this description. Please consult the OEM maintenance manual before doing any work. Use at your own risk.

Oilhead Hall Effect Ignition Impulse Sending Unit

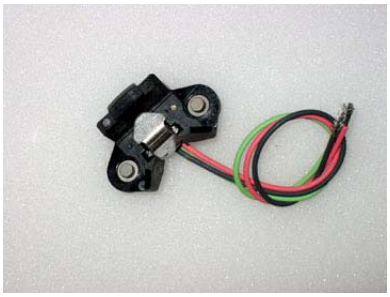
It was a dark and stormy night… That is usually how it starts out when someone asks why their bike quit and left them stranded on the side of the road. Oilheads and K models use a device called a Hall-Effect sensor to determine the position of the crankshaft for ignition timing. These electronic devices replaced points to provide better reliability but like all electronic devices they sometimes fail. One of the most difficult aspects of troubleshooting these devices is that the failure is usually intermittent and sometimes difficult to reproduce. There are two types of failures which plague our Oilheads, both of which are caused by the sensors and the wiring harness being constantly immersed in heat. First is failure of the device, which is uncommon but it does happen. Second, which is very common on older Oilheads, is failure of the wiring harness. It appears that BMW used the improper wire insulation for this application. The Hall effect sensor itself uses silicone insulated wire but the harness which BMW attached to the sensor was obviously not up to the task.



12 11 2 306 137 $278.39 USD Ignition Impulse Sending Unit

Hall Effect Sensors

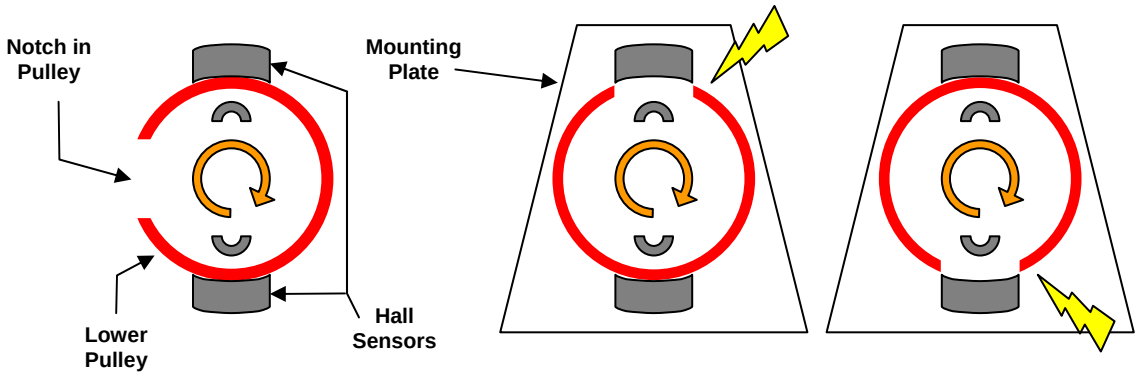
A Hall effect sensor detects the proximity of a magnetic field. The Hall effect principle was discovered in 1879 by Edward H. Hall at Johns Hopkins University. Today's devices combine the Hall sensor, voltage regulator, trigger circuit, amplifier and output transistor into one very small package. Lucky for us we can replace the Hall sensor with one obtained from an electronic parts supplier. This is a common industrial sensor and at the time of this writing they were available from Newark Electronics www.newarkinone.com for US$ 12.31 each.



Honeywell 2AV54

PN: 96F1986 Honeywell 2AV54 Hall-Effect Vane Sensor

On the front of the crankshaft there is a steel ring attached to the inside of the lower alternator belt pulley. The steel ring shunts the magnetic field produced by the hall sensor. When the notch in the ring passes through the Hall sensor it senses the magnetic field and sends a signal to the Motronic engine management computer indicating crankshaft position. The Motronic engine management computer takes care of adjusting timing advance, dwell, spark, fuel required and injection period.



Typical symptoms of failure include (*some or all symptoms may be present*):

- Difficulty starting.
- Sudden engine shutdown (*as if the kill switch was activated*).
- No spark.
- No fuel pressure (*listen for the fuel pump to operate*).
- Bouncing tachometer.
- The engine will usually restart and run after it cools down over night.

Check the following:

- RID (*Rider Information Display*) is on and working with ignition on.

- Side stand safety cutoff switch:
  - Engine will not turn over with side stand down & RID unit is off.
  - Engine will turn over with the side stand up & RID unit is on.

- Clutch safety cutoff switch:
  - Engine will not turn over with bike in gear and clutch out.
  - Engine will turn over with bike in gear and clutch in.

- Battery is charged and in good condition.

If you do not have all of the above conditions it may not be the Hall sensors. Check and replace the battery and safety cutoff switches if necessary before continuing any further.

Removing the Hall Effect Ignition Impulse Sending Unit

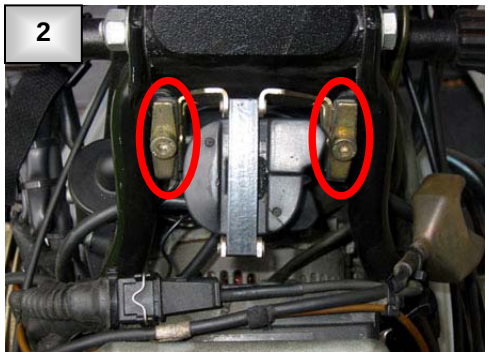
1. Remove fuel tank. *(You may be able to slide it to the rear without disconnecting any hoses.)*

2. Before proceeding any further, inspect the coil which is located above the alternator between the upper frame rails. Disconnect the harness and plug leads. Remove the two screws and pull the coil out from the frame. Pay close attention and look for any cracking, discoloration, bulging or acrid smell, all are indications of a bad coil. Use a multi-meter and measure the resistance of the primary and secondary coils.

Primary coil
Measure resistance between pins 15 and 1 - (~0.5Ω)

Secondary coil
Measure resistance between pins 4a and 4b - (~13kΩ)

2



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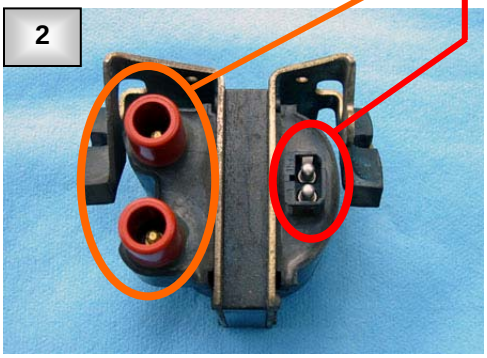


3. Unplug the Hall effect ignition unit connector which is located near the upper frame rails on the right side.

4. Remove front alternator belt cover.

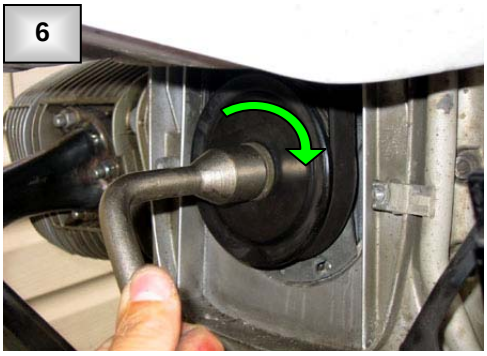
5. Remove the timing window cover, being careful not to push it into the clutch housing.

3

4

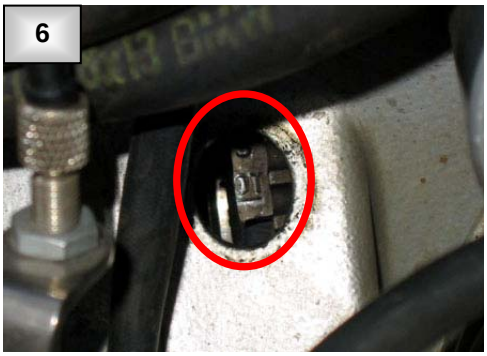
5

6. Using a 17mm wrench rotate the crankshaft clockwise *(while looking at it)* until you reach TDC as indicated by **OT** in the timing window. It is not important which cylinder is on the firing stroke.



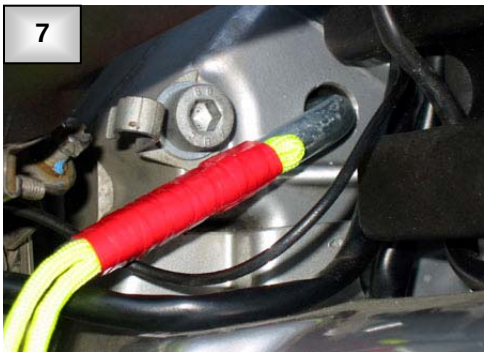
7. Lock the flywheel in place at TDC by using the access hole located on the left side of the clutch housing. You can use an 8mm bolt at least 100mm long or make a copy of the BMW tool PN: 90 88 6 112 650 for ~US $2. *(See the document: Oilhead TDC Locating Mandrel at http://users.rcn.com/dehager/)*

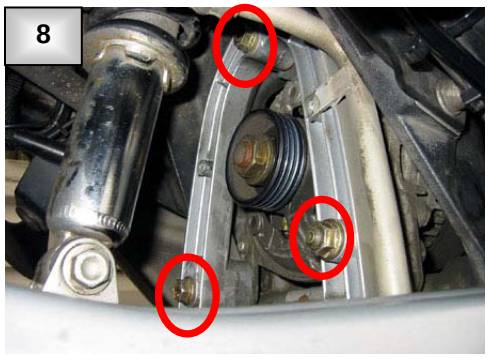
   Note: If you are doing repairs while broken down on the road the wheel lug bolt wrench is 17mm and will fit the pulley bolt. With the bike in gear and holding the rear foot brake you can break the bolt loose and then tighten it.



8. Loosen the alternator and remove the belt.

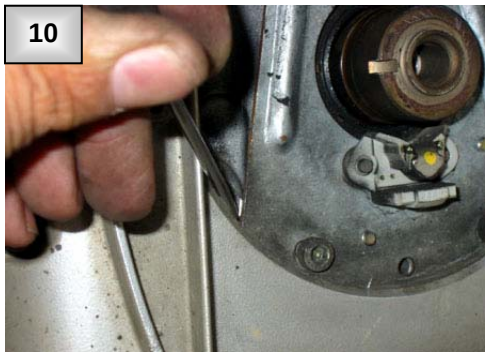
9. Remove lower pulley.

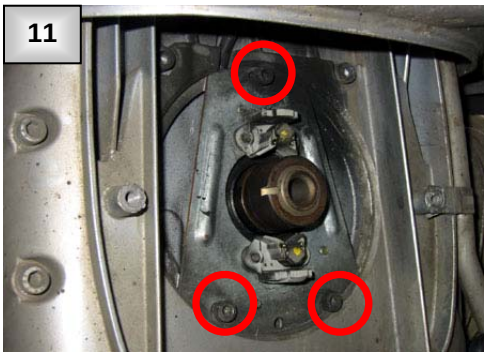


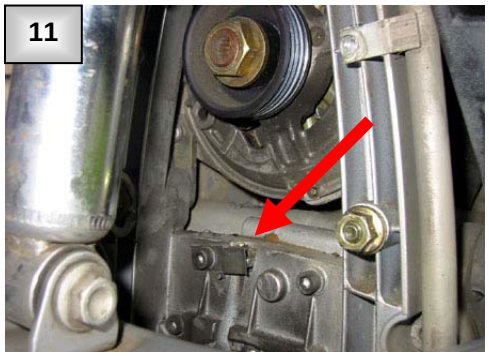


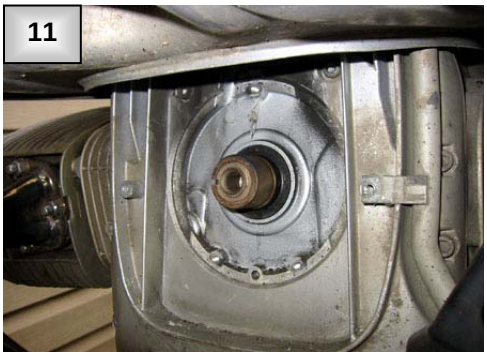
10. Scribe two marks to indicate where the plate is. This will assure that when you reassemble the parts you get the timing back to where it originally was.

11. Remove the Hall ignition timing unit. Slide the strain relief and harness from the clip holding it down. Raise the alternator and carefully pull the wiring harness and connector out from under the alternator.









Testing the Hall Effect Sensor

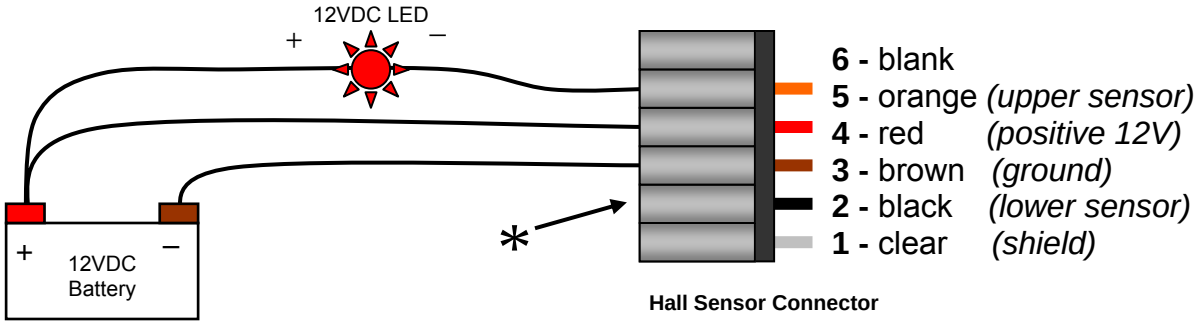
Instructions on how to build a test box for Hall sensors and setting engine timing can be found at: *(See the document: Oilhead Timing Test Box at http://users.rcn.com/dehager/)*

You will not be able to reproduce the heat and vibrations of the operating environment on the workbench and I ***do not*** recommend running an Oilhead and allowing it to idle for testing. Due to the low cost of the sensor, always replace the part when in doubt if you can not reproduce the failure.

You will need the following tools:

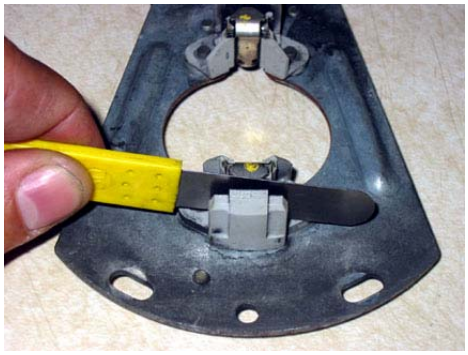
- Heat gun.
- Feeler gauge or knife blade.
- 12V battery or power supply.
- Clip leads.
- One 12VDC Light emitting diode. (RadioShack Catalog #: 276-270 $1.99 USD) *Only use a LED for testing the sensor, an incandescent lamp will draw too much current and could damage the sensor.*

Use the clip leads to hook up the upper Hall sensor as indicated in the diagram below. Make sure to observe the correct polarity when hooking up the LED. **** When ready to test the lower Hall sensor, remove the clip lead from pin 5 (orange) and connect to pin 2 (black).***



Hall Sensor Connector

Testing the Hall sensor is simple. With the battery connected the LED should be on. Passing a metal object through the sensor should cause the LED to turn off. If either of the above changes does not occur the Hall sensor is defective. If the sensor appears to be working the next step is to subject it to heating and cooling. With the sensor connected and the LED on, apply heat to the sensor. The 2AV54 Hall sensor is rated for -40°C to 150°C (302°F), so do not be afraid to get it warm. It may take a few minutes but if the sensor failed due to heat the LED will go out. As stated before, intermittent failures are difficult to diagnose. If you can not reproduce the failure it would be a good idea to inspect the harness and connectors.



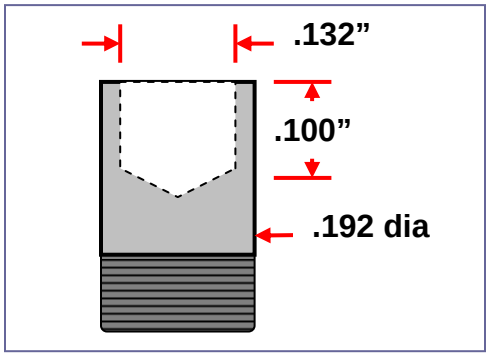
Making a Riveting Tool

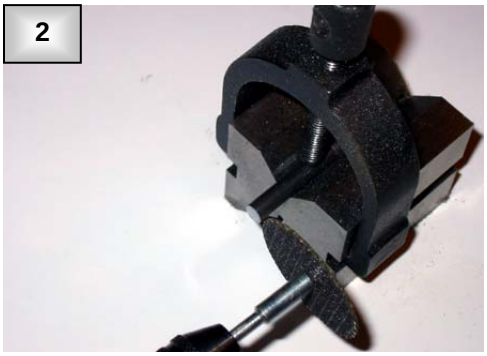
1. You will need a 5mm x 50mm bolt with a shank that is .192” in diameter.

2. Cut off the head of the bolt.

3. Carefully drill a .132” hole in the center .100” in depth.

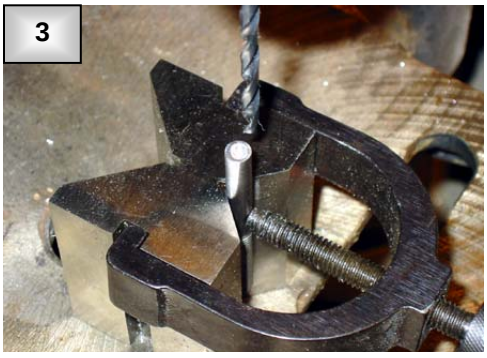
   A #30 (0.1285”) or a 1/8” (0.125”) will be close enough. You will need to work the bit in the hole by hand to clean it out enough to provide a loose fit.

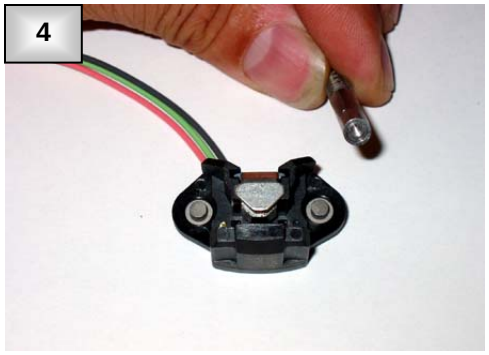


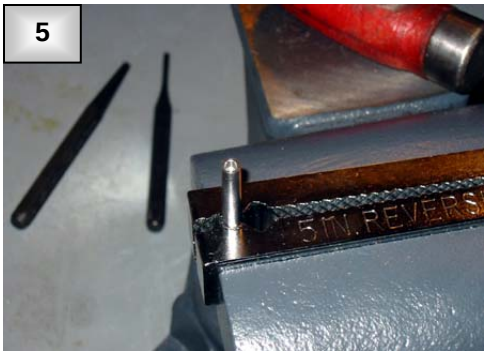


4. It is important that you have a loose fit. When you peen the sensors rivet you do not want it to get stuck in the riveting tool when the head starts to deform.

5. Clamp the rivet tool into a bench vice to use.



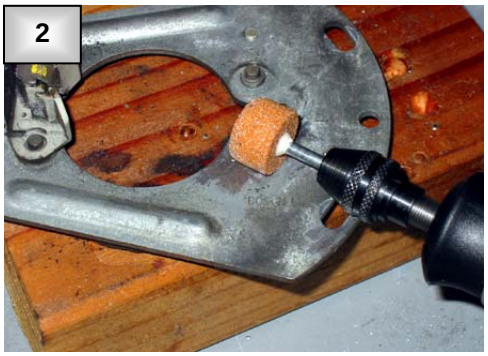


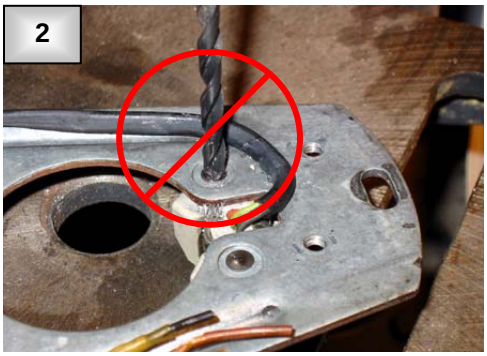


Removing and Replacing the Hall Effect Sensors

1. Cut the wires near the sensor and carefully break off the sensor without bending the sensor mounting plate. Remove any remaining plastic sensor pieces.

2. Using a Dremel or suitable grinding tool, grind the rivets from the front of the sensor mounting plate. Carefully grind the rivet flush with the mounting plate and use a center punch to knock the rivet out of the hole. I ***do not*** recommend drilling out the rivets. They appear to be hardened and the placement and size of the holes on the plate is critical. It is very easy to miss the center and make the hole too large.

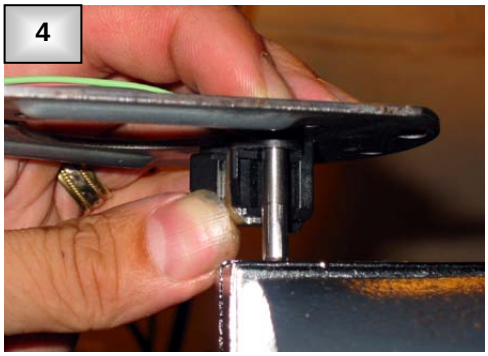




3. Clean up the mounting plate and rivet on the new sensors.

4. Keep the mounting plate and sensor perpendicular to the riveting tool. It is very easy to break the plastic sensor parts.

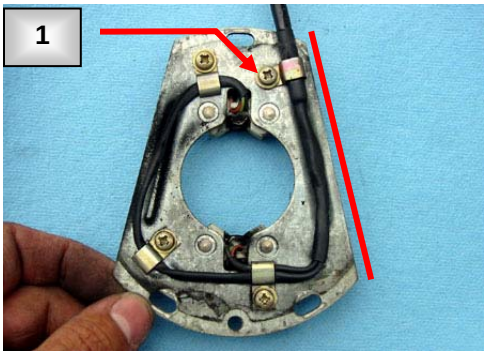
   The sensor must be firmly pressed against the mounting plate. Work carefully while you start to form the rivet and get the sensor seated.



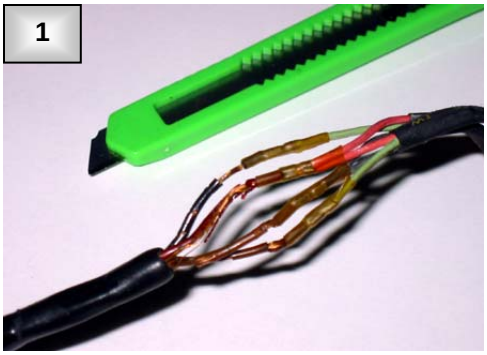
Inspecting and Repairing the Wiring Harness

The wiring harness on the ignition input sending unit is constantly subjected to heat from the engine and the exhaust headers. Early Oilhead ignition input sending units were manufactured with wire insulation that was not suitable for this type of environment. What may look like a good harness on the outside is usually deteriorated on the inside. The only way to inspect the condition of the insulation is to cut open the harness near the strain relief and pull back the shielding. Most ignition input sending units can be repaired with a little imagination and a few dollars in supplies.

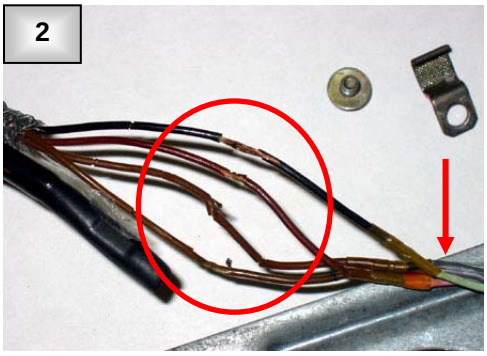
1. Remove the screw clamp from the base plate and carefully remove the heat shrink tubing from the wiring harness with a sharp razor knife. Do not cut into the individual wires.

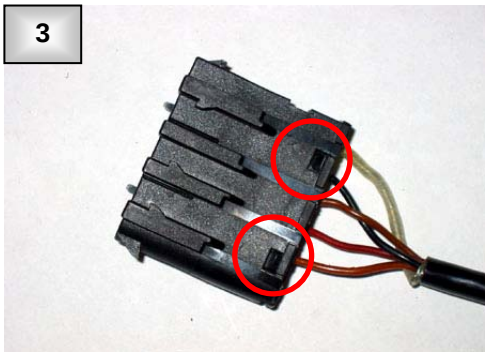


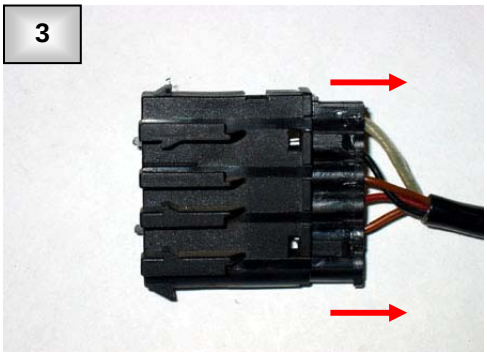
2. You will likely find deterioration of the wire insulation hidden inside the outer cover. This could easily cause a failure of the ignition system. If you were not able to make one of the Hall sensors fail this is likely the cause. With this much damage you will need to replace the inner wires. Make note of the difference in insulation materials between wire types. If you have not found any deterioration you should close the harness up and seal the outer cover with a self-fusing silicone rubber electrical tape to seal out moisture. Scotch® 70 Self-Fusing Silicone Rubber Electrical Tape sometimes called ”*Tommy Tape*” is available in most hardware stores and has temperature rating of 180°C/ 356°F.



3. Be careful old plastic can be brittle. Separate the harness down into its individual components, by disassembling the connector body with a small flat blade screw driver. Lift the outer body over the locking tabs and slide the inner part out over the wires.

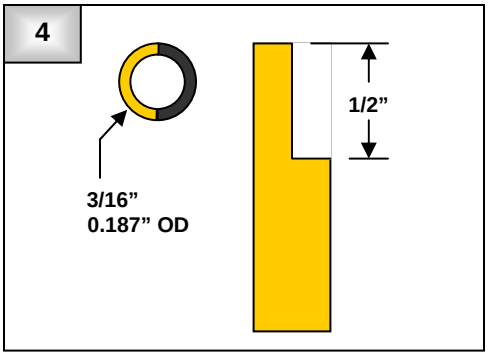




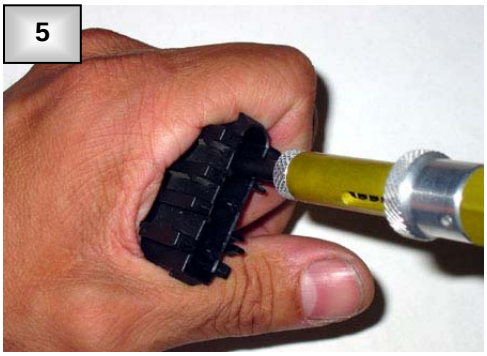


4. If you do not have the appropriate pin remover one can easily be fabricated for a few cents. Your local hardware store or hobby shop should have small brass tubing. Purchase a 12 inch piece of 3/16” (0.187” OD, 0.159” ID) brass tubing and file a 1/2” long flat halfway through the tubing on one end.

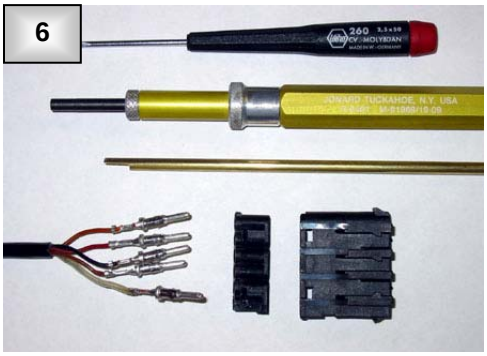
   K&S Engineering, Inc. http://www.ksmetals.com/



5. Do not damage the pins, you will be reusing them. Insert the pin remover from the front of the connector and push the pins out of the connector body. The object is to get the little fingers to lay flat against the pin body so it will slide out of the connector seat. You may need to rotate the brass tube around the pin and gently tug on the wire to get the pins to release.

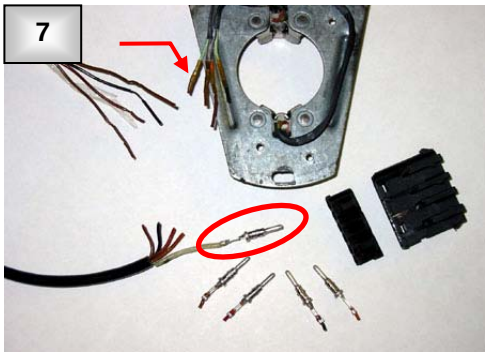


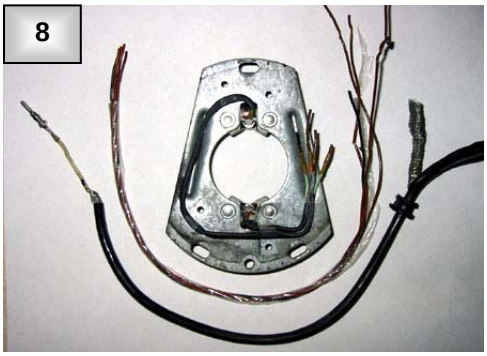
6. With all the pins pushed out you can finish separating the connector body.



7. Cut the pins from the black, brown, orange and red wires do not cut the pin from the shield wire. Cut the Hall effect sensor wires just above the splice.

8. Carefully pull the four wires from the harness leaving the shield in the outer covering.

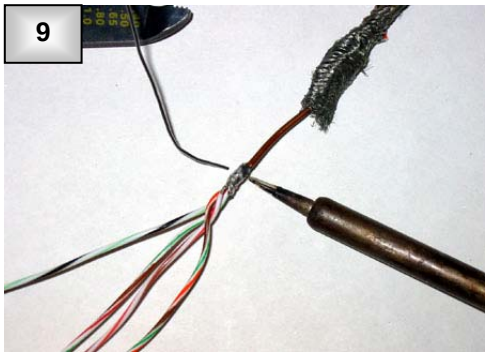


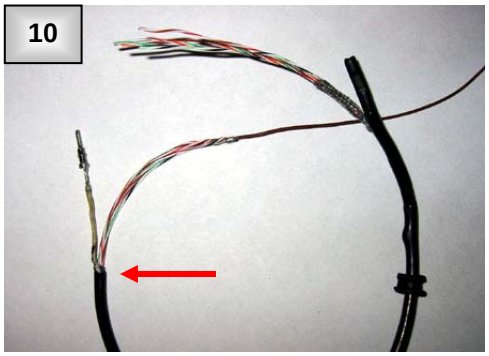


9. *Belden #83396 Non-Paired - High Temp Controls and Instrumentation Cable* is just what we need for this application but it is very expensive and only sold in 100' and 500' rolls. The harness is only 19 inches long so we will have to use some ingenuity to fabricate one.

   You will need seven feet of stranded, 22 AWG silicone rubber or TFE (Teflon) insulated wire *(four pieces of wire, 21 inches long).* Make sure what ever wire you decide to use has a temperature rating of at least 150°C (302°F). Unless you have wire or you know someone who works on industrial controls your best chances of locating wire would be a local airport avionics and maintenance shop or a amateur radio operator.

   Fish one of the old wires back through the old harness, you will use it to pull the new wires back through. On one end strip 1/2" of insulation off the old wire and the four new wires, twist and solder together Make sure you have a nice smooth solder joint so it does not get stuck while pulling it through the shielding.

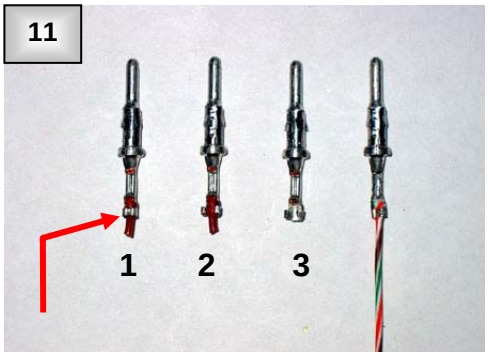


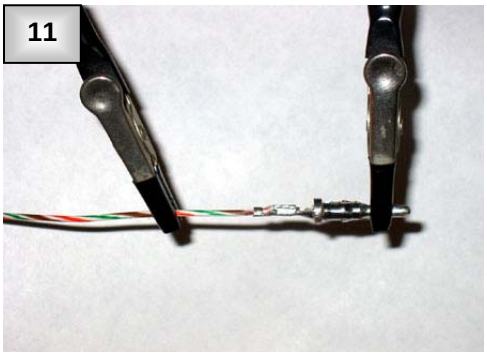


10. Carefully pull the four wires back through the harness. On the connector end of the harness add a 1/2" long piece of heat shrink tubing to seal the end.

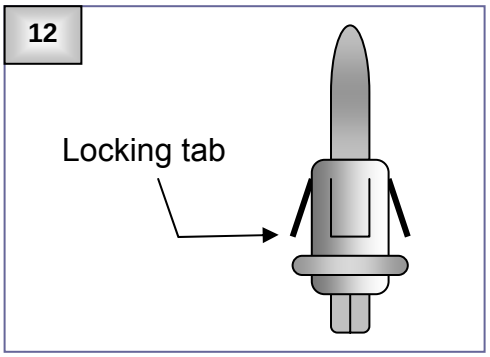
11. Prepare the pins for soldering onto the new harness wires.

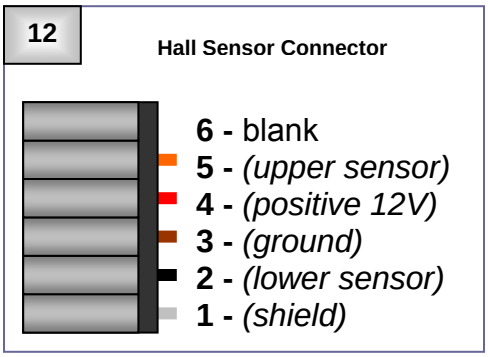
    - Carefully open the crimped strain relief.
    - Cut wire flush with the crimped wire area.
    - Tin the pin, wire and solder the pin.
    - Clean the solder joints with flux cleaner to prevent any corrosion.

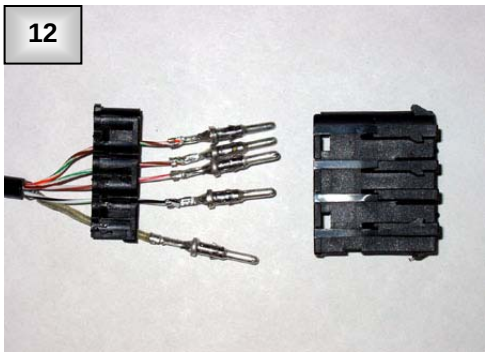


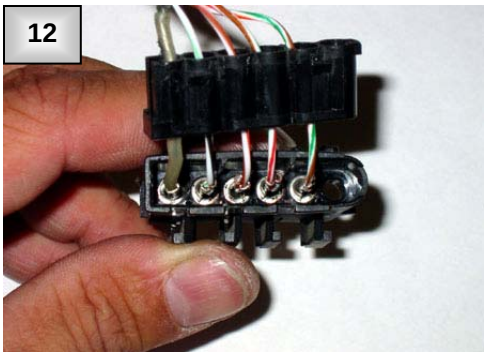


12. Make sure the locking tabs on the pins are bent out slightly and reassemble the connector. Use a small flat blade screw driver to seat and lock the pins into the holes. Give the wire a tug to make sure the pins are firmly seated and locked.

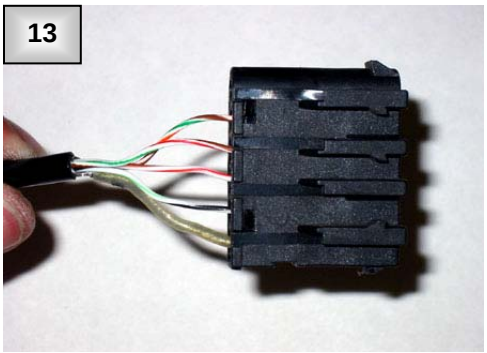


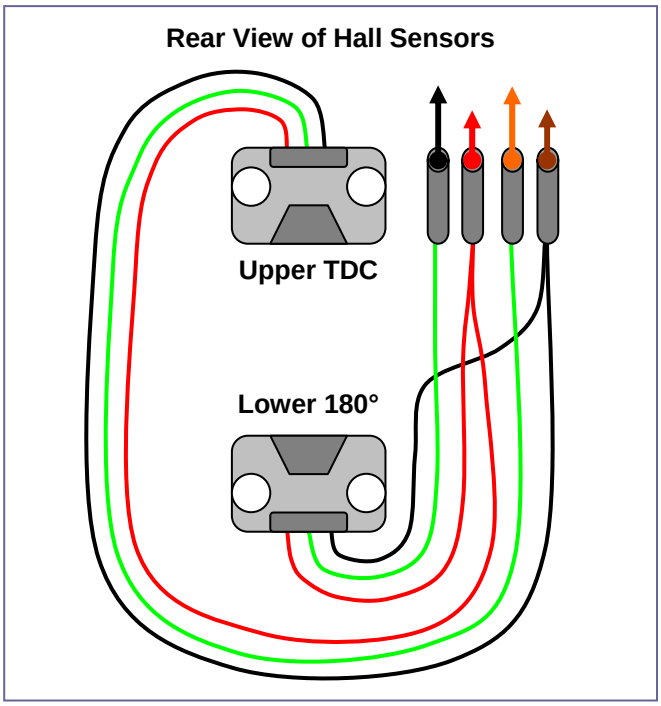


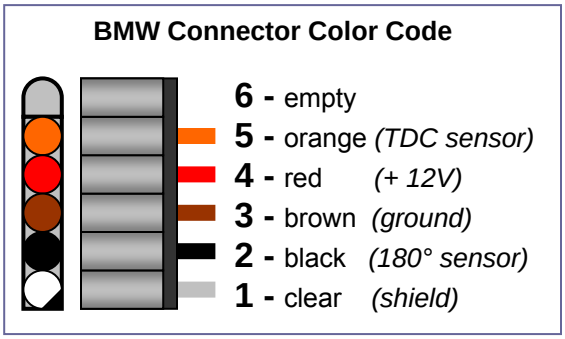


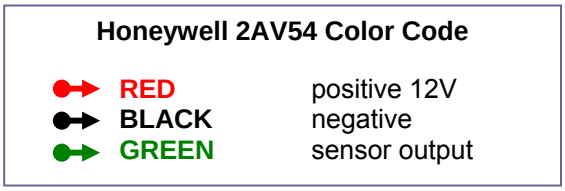


13. Complete the harness by soldering the wires to the sensors like the original. Use heat shrink to seal and insulate all connections. Install the harness clamps and test the sensors.







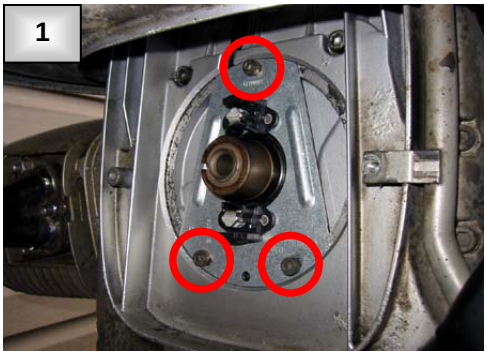


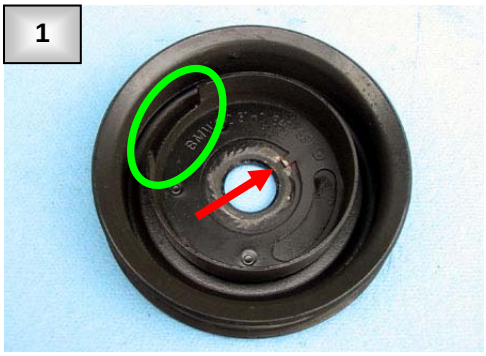
Installing the Hall Effect Unit and Setting Engine Timing

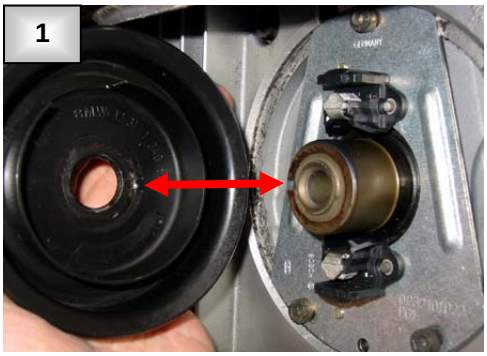
6. Install unit in reverse order of removal. Leave the three mounting screws loose on the Hall Effect unit mounting plate and do not plug in the connector to the bike wiring harness.

   The notch on the inside ring (*green circle*) of the pulley is what the sensors use to indicate crankshaft position and engine speed to the Motronic computer.

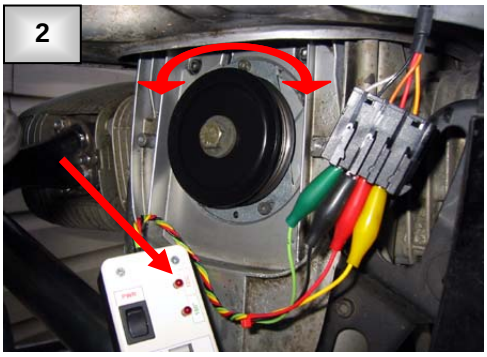
   When installing the lower pulley make sure you align the tab on the pulley (*red arrow*) with the notch on the crankshaft.







7. The timing is set by rotating the Hall unit mounting plate until the LED just goes out. When the timing is set tighten the three bolts to secure the Hall unit mounting plate.



8. Plug in the connector, remove the TDC locating mandrel and finish reassembling the bike.