When it comes to the electrical system on a car, many people shake their heads in despair. Even experienced mechanics can shy away from electrical work for fear of the unknown. While some components do use computers and advanced circuitry, solving most electrical problems just is not rocket science.

Using simple tools and some common sense, it is possible to diagnose and solve nearly all electrical problems quickly and easily. Among these tools are a test light, a voltmeter and a good understanding of electrical basics and common problems. However, when you go out to tackle an electrical problem, remember that the generalizations in this article may not apply to your car – you will be wise to consult a service manual for its specific electrical information.

Golden Rules and the Basics

There are several golden rules for solving problems with automotive electrical systems. Corrosion is the biggest reason for failure. Wires do not fail. Grounds, connections and individual components fail regularly. And in most cases, it is far better to repair a faulty factory circuit than to rewire it.

Corrosion is electricity's biggest enemy. Battery terminals, fuse blocks, sensors, switches, connectors, and grounds are likely to fail because they are corroded. Cleaning or replacing these connectors will repair a great percentage of electrical problems.

With most cars, the body and frame serve as one of the 'wires' that feed each circuit. Usually, the car body and frame serve as the negative side of each circuit [the ground], and the positive side of the circuit is fed with a wire. If a device is not properly attached to the body or frame, or the attachment point is corroded, the circuit is compromised and will not function properly. The first thing to do when a circuit fails is to make sure it is grounded properly.

Individual wires do not fail. Insulation may crack or burn off, but the wire will still conduct electricity. The only time a wire will fail is if it is physically damaged, cut or broken. Damage can usually be detected by following along the wiring loom and looking for cuts. If the outside of the loom is not damaged, it is safe to assume the wires inside are not damaged, either. If you suspect a bad wire, read on – wires do not just go bad, but connections do.

Connections at the ends of wires fail regularly. Sometimes, they break or come loose. Other times, they corrode. Factory wiring harnesses usually do not hide connections

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under tape or other wrappings. When tracing a problem, follow the harness and verify that each connection is clean and functional.

Switches, sensors, light bulbs and microprocessors are all electrical components that are susceptible to failure. Components with moving parts, that generate or receive heat, or that are exposed to water or other corrosives are the most likely to fail.

In almost all cases, it is better to repair a factory circuit than to re-wire around it. Adding circuits for new accessories is one thing, but do not change the way one left the factory. Most factory electrical systems, including much-maligned Lucas systems, were carefully designed by trained engineers and work perfectly well until corrosion or component failure sets in. Shadetree mechanics who wire around factory circuits usually do so out of a lack of understanding. They often take short-cuts or make mistakes that can be dangerous [read as 'will burn up a car'].

TOOLS NEEDED

Given these common problems, a 12volt test light is an essential tool to diagnose and trace an electrical failure directly to its cause. A quality test light looks like an awl with a light bulb in the handle and a wire sticking out of the top. It should have a sharp point and an alligator clip at the end of an 50 to 100cm long wire. These lights are available for under $15, so every toolbox should have one.

Another helpful tool is a voltmeter. Voltmeters come in two flavours, digital and analogue. Each type has advantages and disadvantages, but either works well for diagnostics. Pick the type you prefer in the cost range you can afford.

Voltmeters are usually combined with other measurement features. One typical combination is the Volt/Ohm meter, which includes the ability to measure resistance of a circuit in ohms. The other typical combination is the engine diagnostic meter, which usually will measure dwell [for points ignitions], current [amps], and include a tachometer function. Volt/Ohm meters are available from under $30 to much more. Engine diagnostic meters are more expensive – plan to spend at least $80, and much more for a high-quality unit. If you have to buy just one meter, start with a cheap Volt/Ohm meter.

Get a few pieces of jumper wire with insulated alligator clips on the ends. It is a good idea to include an inline fuse in the jumper wire in case of mistakes or problems. A few wire brushes and a battery post cleaner should round out your electrical tools.

TROUBLESHOOTING BASICS

Before troubleshooting a circuit, check and clean the battery terminals and check all fuses. Make sure the battery is fully charged. If a fuse is burned out, do not just replace it and think the problem is solved. The circuit affected must be further tested to determine why the fuse burned out. More on that later.

After these preliminary checks, use the test light to test circuits as follows:

Check that the test light is working. Attach the alligator lead to a ground, and then touch the pointed end to the positive side of a circuit. The positive battery terminal or a terminal on the fuse box is good test points.

Test the positive lead at the device. Leaving the alligator lead attached to the same ground that was used to test the light, touch the pointed end of the light to the positive connection of the device that is not working. If the light glows, there is either a bad ground or bad device. If the light does not glow, trace the positive circuit that leads to the device using Step 4.

Test the ground at the device. Connect the alligator clip from the test light to the positive lead of the device, and then touch the pointed end of the test light to a bare metal portion of the device, to its ground strap, or to a bolt that attaches the device to the body or frame. Ensure that you touch the pointed end of the light to bare metal, as paint or other coatings will not conduct electricity. If the light glows, you have power to both sides of the circuit and most likely, the device has failed. If the light does not glow, clean or replace the bolts, nuts or ground strap to the device. A wire brush and/or sandpaper can be very effective for this.

Test the positive circuit that leads to the device. Ground the test light's alligator clip. Test the light again to ensure the quality of the ground. Working backward from the device, follow the positive wire to its switch, sensor or source of positive current. Test the circuit at each connection along the way [i.e., each terminal block or snap connector]. If the light glows at each connection after the switch, suspect the switch. If the light stops glowing at a connection, clean or replace the connector.

Test a switch, if applicable. To test a switch, check that there is positive power to the switch by touching the positive lead on the 'input' side of the switch. If the light does not glow, continue to trace the circuit back to the fuse box or battery. If the light glows, touch the positive lead on the 'output' side of the switch. [A manual may be helpful here to show the location of these leads.] Move the switch through its range and see if the light ever glows. If the light does not glow, or glows in the wrong switch position, replace the switch. Occasionally, a

switch can be repaired by spraying it with WD-40 or a similar lubricant/corrosion fighter. However, this is usually only a temporary fix.

Test a sensor, if applicable. To test a sensor, microprocessor or other black box, refer to a manual for testing instructions for that specific item. This is one area where equipment that is more sophisticated is often needed. Alternatively, replace the sensor or item with a known working item. The latter method is not usually practical, as new electrical parts are generally not returnable and few people keep working spares.

If these steps do not help solve the problem, keep in mind that it could be multiple problems. For example, a device may suffer from a bad ground and a loose connection along the positive side of the circuit. Two or more simultaneous problems are much harder to troubleshoot than a single problem. If you are still stuck, keep reading about common problems and solutions, or consider turning the problem over to an expert.

Common Problems. Common Solutions. Common Sense.

This set of problems and solutions is common to most cars, and dealing with them does not require a lot of specific electrical knowledge, just some common sense. Of course, these are very general and may not work for some specific makes and models. If these do not work, consult a manual or an expert.

Technical Talk

Dead Battery

Charge the battery for at least one hour. Check for clean connections at the battery terminals, starter and grounds. Use the starter to crank the engine over five or six times. Attach a voltmeter to the battery and watch its reading as someone cranks the engine several times. The voltage should stay at 12 volts when the engine is not cranking. If the voltage drops below eight or nine volts while cranking, or the engine will not crank any more, suspect the battery. If you suspect the battery, and it is not very old, charge it longer and test it again.

Slow Battery Drain

If the battery is draining overnight or over the course of a few days, some device is still turned on and draining it. To find the cause, disconnect the negative battery connection. Use your test light to jump the negative battery cable to the negative post on the battery. If the light glows, something is turned on. Disconnect fuses and/or circuits one by one until the light goes out.

Trace the circuit that was causing the light to glow to find which device is still on. Dome lights, trunk lights, alternators and non-factory accessory circuits are common causes of such drains. Usually, radio memories and dash clocks are not drains and will not make the light glow for this test.

Alternator Over or Undercharging

Attach a voltmeter to a good ground and a good positive lead. [Usually, the battery works best for this.] With the engine switched off, the battery voltage should read 12 volts. With the engine running, the voltage should read 13.5 to 14.5 volts.

Below 13.5 volts usually signals a non-working charging circuit. Check for a tight belt, and clean connections at the alternator and the battery. Also, make sure the engine is properly grounded.

Above 14.5 volts usually signals a bad voltage regulator. Either way, the solution is usually a new or rebuilt alternator.

Crank Starter, Everything Goes Dead

Sometimes everything will seem just fine until you crank the starter, then nothing will work, not even the dome light. Starting with the battery terminals, remove them and give them a good cleaning. Then clean the ground strap to the body and to the engine. Then clean the positive connection to the starter. One or more of these connections is corroded. The load of the starter causes arcing at the corroded connection, which weakens the connection. Since these connections are the main power connection for the whole car, they shut everything else down when they get too weak.

Sticking Heater, Accelerator, Clutch or Choke Cables

What does this have to do with electrical problems? Plenty. If the engine ground strap goes bad, the engine will seek another ground through these cables. Often, the car will run and start just fine. Over time, however, these cables will melt themselves to their housings. Replace the affected cables and clean or replace the engine ground strap.

Dim Headlight

Sometimes, one or both headlights will be dim. One of the headlights has a bad ground and is grounding itself through the other headlight. In doing so, the headlights change the wiring configuration from parallel to series. When wired in series, they each share half the voltage and glow dimly. Clean or replace the ground[s].

Brake Lights Turn off Taillights

This is a variation on the dim headlight problem. A bad ground is causing the brake lights to ground themselves through the taillight circuit and vice-versa. Clean up the grounds, and everything will work fine.

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Turn Signal Problems

When a bulb burns out, most turn signals will either flash quickly or not at all. Sometimes, they do so even though all bulbs appear to be working. Other times, they may flash, but very slowly. If both left and right circuits act the same, suspect the flasher unit or the switch. If only one side has a problem, corrosion is at work. The solution is to first check and clean all the grounds, which often requires removing lamp assemblies to clean the bolts and attachment points with a wire brush. Sometimes, the base of a bulb will corrode, and simply replacing the bulb will solve the problem. Other times, the bulb socket is corroded and should be cleaned.

Blown Fuse

Finding the cause of a blown fuse can be difficult. A component in the circuit is either dead-shorted to ground, or is causing too much load on the circuit. If something is dead-shorted, fuses will blow the instant they are replaced and the circuit is turned on.

Physically search the wiring in the circuit, and then disconnect components attached to the circuit one by one until you find the short. If something is generating too much load, the diagnosis is similar, but more difficult. Try to isolate any device on the circuit and see if its use blows the fuse. If you still do not find the problem, check a manual or consult an expert for testing each device and ensure each device is in spec.

Intermittent Problems

Intermittent problems are the hardest to solve. If you cannot get the problem to happen while you are looking for it, shake the car or the wiring harness and see if that causes it. Loose or corroded connections are common causes for intermittent problems and such shaking will often bring them about. If you still cannot solve it, call in an expert.

Wiring Additional Circuits

First and foremost, follow the accessory manufacturer's instructions. However, many instructions suggest wiring directly to the battery to ensure a good power supply. Avoid this if possible. First, see if there is an available accessory circuit in the factory wiring that can handle the necessary current. Many factory systems have extra accessory circuits and fuses built in for owners to expand. If you still want to wire directly to the battery, make sure you have a fusible link, fuse, or circuit breaker as close to the battery as possible. Also, avoid the self-resetting circuit breakers since they may reset before you know there is a problem. This article by Carl Heideman first appeared in Grassroots Motorsport magazine in January 2005.

Spare News

Some of our members may have heard of the efforts Richard Kennedy from Tasmania has gone to having 'D' series gearshift rubbers reproduced, see attached photo. These components part number DV856-124 are for the right hand drive models. Previously, only the left hand drive part DV856-123 has been available from Europe. Most right hand drive cars have a ragged rubber in this position unless the owners have, like me, adapted a left hand drive component that still does not fit properly but certainly looks better than most. The Club has purchased 50 of these parts for members and will sell them for $20 each: this is a much cheaper price than anywhere else they are offered [they can be found on the Aussie Frogs website]. Quantities will be limited and anyone wanting to purchase commercial quantities should call me and I will do my best to accommodate them. A special thanks to Richard for completing this task and I would like to welcome him to the Club as he is intending to join us, he is also restoring a 'D' Safari.

I am currently working with a drive line engineer in Bendigo to once again have CV joints fitted to Traction drive shafts. I hope this will be completed in time for the next magazine. Our previous supplier does not want to do them any more as the numbers were obviously insufficient. This time I have quite a few members interested in this modification, so give me a call if you want to be added to the list.

We recently purchased a job lot of ID parts. At the moment I am working on forming a list of parts with prices that I hope will be in the next magazine. The parts are as diverse lot – ranging from suspension units and height correctors to a roof seal and many other parts including steering components. Please note, these are all red fluid parts.

I have even spoken to our good friends at Arden Continental in Birmingham, England. They are still as confident as ever that one day we will see the hub caps that we ordered! At the moment they have some Big 6 hub caps at the platers for us and will send them all together when they return, I expect Hell may be frozen over by then, but at least they are still speaking to us.

Rob Little