RESTORATION & MAINTENANCE
WORKSHOP

Electrical Diagnosis

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Electrical Diagnosis Workshop

Our electrical workshop is brought to you in collaboration with Corvette Central and Corvette Enthusiast Magazine. Your instructor is Chris Petris Jr. of the Corvette Clinic in Sanford, Florida. The concept is to provide easy to understand electrical troubleshooting concerning all Corvette generations in laymen terms. We'll show you how to do this using inexpensive diagnostic tools and cure some common Corvette maladies. The first part will cover the general electrical system and then more specific problem solving as we wrap up the workbook.

We don't want to delve too deeply into all the theories concerning electrical power and how it works. We need to know a few basic electrical terms: Amps, Voltage and Ohms to begin our electrical system diagnosis. Amperage is a measurement of how much electrical volume is available while voltage measures the electrical pressure. Think of it like this. The battery is an amperage storehouse that has 12.6 volts of pressure to send the current out. Ohms are a measurement of electrical resistance, whether it's across a wire, cable or a component that uses resistance to operate. An example of a component that uses resistance would be a relay that uses tightly wound wire creating resistance to induce a magnetic field. There are a few other terms we need to cover. Let's go with voltage drop next, which occurs when resistance limits the amount of voltage available to a component. Voltage drop damages electrical motors (starters for example) because they can't run at the speed intended and consequently heat builds up, cooking the internals. Our next term is short circuit which is used for almost any electrical malady. Short circuits occur when a wire carrying current touches a ground circuit (negative). The ground circuit can be any wire or metallic object that is connected to the battery ground terminal. The short circuit causes blown fuses or intermittent blown fuses when the wiring is touching ground momentarily. Our last term is open circuit. This occurs when the circuit is open (how clever) usually from a cut wire; in most cases the fuse is not disturbed unless the cut side of the wire carrying current touches ground.

Safety

The most important thing to remember is batteries can explode. <u>#1 RULE- NO SPARKS/FIRE AROUND THE BATTERY!</u> We all do it when we install the cable and think, "hey look at all the neat sparks!" Sparking/arcing is inevitable when connecting the battery due to the many components that require memory today. <u>IF YOU SMELL SULFUR (ROTTEN EGGS) AROUND THE BATTERY, YOU ARE IN EXTREME DANGER OF BATTERY EXPLOSION IF ARCING OCCURS!</u> There is danger of severe burns from arcing wires, overheated wiring and components. Funny bone damage can result from the unintended jerking of your arm away from a sparking wire or cable!

Safety (continued)
Be very careful when checking Ohms. You can destroy your multi-meter easily if isn't fuse protected. If you leave the battery connected or circuit on and you check for continuity, it's possible that the ohmmeter will try to handle the circuit's load which will make your tester junk immediately.

Batteries
We all know the battery is where it all starts and in many cases where it doesn't. There have only been a few improvements from the first lead acid batteries that spew sulfuric acid vapors out of their removable fill caps. Later sealed top batteries have better control of the dangerous gases while the latest gel cells provide the most safety and control of internal components. We expect the battery which is the storehouse of the electrical system to provide enough energy to start engines on frigid mornings or when the engine is running at peak high temps. Cold engines drag at start-up due to thick oil, cold combustion chambers with their additional start-up fuel require hotter ignition spark to light the combustion fire. On top of that, batteries don't like to be cold or hot. 70-80 degrees makes for a happy battery.
Hot engines on the other hand require less fuel to start but the extreme combustion chamber heat causes more cylinder pressure couple that with advanced ignition timing and engine drag at start-up is inevitable. There are a few battery concerns with having the correct CCA (cold cranking amps) being very important. If the CCAs are too low besides the dreaded no start on an extremely cold morning or a hot restart after the local cruise, low battery amp output eventually damages other components. Starters and flywheels take the brunt of the punishment, starters from overheating while the flywheel teeth can be damaged when kick back occurs on a hot engine restart. Large cubic inch and high compression engines require more CCAs. The question is: do you save a few bucks on a borderline battery and pay for the other pieces later?

Arteries
The next critical concern: once we have the power from our correctly rated CCA battery available, will it get the required amperage to the starter and other high amperage load components? This is where the battery cables come in doing their job with little regard for their true importance. Battery cables are matched to the required amperage load of the starter and electrical system.
A good example of AMPS and the batteries potential power is this: let's say you were to use 16 gauge wire instead of the typical 2 gauge battery cable. The immediate result would be a melted wire in two pieces from the amperage load the starter requires. The light 16 gauge wire can't handle the amperage which creates resistance and extreme heat.

Arteries (continued)
Like extension cords at home, the longer the cord the larger the wire gauge requirement. The same holds true concerning battery cables. We also need to remember that large cubic inch/high compression engines require larger gauge cables than an L-48 engine. The correct selection of wire gauge for operating and controlling components is very important amperage loads are factored in to assure adequate electrical flow with minimal resistance.
Of course all heavy gauge wiring could be used to keep resistance to a minimum but overall vehicle weight is a factor which can add up quickly when wiring the typical vehicle. Since 1990, Corvette wire harnesses are using lighter gauge wiring than ever before due to the latest design low amperage draw component usage. The push to save fuel has auto manufacturers looking at vehicle weight so they have redesigned the amperage hungry components, allowing lighter harnesses controlling more components than ever before. 1997 Corvettes started a new era with modular controlled components and even lighter gauge wiring. In some cases, one wire does multiple functions. The modular computer controlled components use one heavy gauge wire supplying battery current and all the control wiring is light gauge, which also limits the amount of wire used. We've come a long way from the early Corvettes. Minimal accessories with high amperage draw heavy electrical components.
Wiring doesn't last forever. Under the hood it takes a beating from the heat and moisture. The interior wire harnesses fair better but they also succumb to heat after many years of electricity flowing over the wiring.

Fuses
Fuses or circuit breakers are used to prevent electrical fires and protect wiring. There have been a few changes over the years. Early Corvettes had fuses protecting the interior electrical components. If you accidentally shorted a major electrical artery under the hood, there was no stopping it until the battery was disconnected and the ensuing fire was extinguished.
1968 brought many new safety features to every vehicle including the wiring. Fuse links were installed in major current flow circuits to protect some of the underhood major electrical arteries from catastrophic damage and fires. This was a step in the right direction except the fuse links weren't at the source. They were down stream which would leave some sections of wire unprotected. Today fuse links protect all the major circuits at the source (as close to the battery as possible) to limit fires and major wire harness damage. Fuse links are short sections of wire that will melt when overloaded, possibly protecting the entire harness. The latest innovation is the maxi-fuse that replaces the fuse links. Now we simply replace the fuse. No wire harness repair is required.
Even our under dash fuse panels have morphed into sophisticated panels housing fuses, circuit breakers and relays. Early glass fuses worked okay, but cost was high and the fuses were difficult to remove and replace.

Fuses/Circuit Breakers (continued)
Today glass has been replaced with plastic everywhere. We rely on plastic ATO fuses in regular and mini sizes to protect our wiring and they've proven themselves to be reliable. The main thing to remember is that fuses are necessary to protect your car, first and foremost the wire harness. Using a jumper wire or higher amp rating fuse may keep a circuit going for a while but the wire harness can be damaged! I've heard many times, "we just put a 30 amp in place of the 15 amp fuse because the fuse only blows once in a while".
The problem with that is eventually the intermittent shorted circuit will become a full time shorted circuit and the wiring is not rated for the 30 amps or higher, causing damage from overheating.
Circuit breakers are used on high amperage circuit's wipers, defogger, power windows and power seats. Circuit breakers handle start-up load better than fuses and if necessary, trip out if the circuit is overloaded. The beauty of circuit breakers is their ability to cool off and reset so the circuit has power again. Like fuses, circuit breaker amp ratings should not be exceeded because they will keep applying the load until the component or wiring is severely damaged. Circuit breakers can be used in place of fuses as long as the amperage rating is not exceeded.

Components/Starters
All electrical components have one thing in common. They have resistance during operation or the fuse that supplies the circuit would be burned creating an open circuit. Motors require a high initial start-up shot of energy to get the shaft spinning then the electrical load tapers off. As heat builds, so does resistance. That's why the starters solenoid wire that comes from the ignition switch is typically 12-14 gauge wire. When the engine is cool, the solenoid requires fewer amps to do it's job of activating the starter. Delco starters require more energy to activate and rotate than the later NipponDenso gear reduction starters found on the 1988 and up Corvettes. Plus they take up less room for header equipped cars and oil pans with kick-outs. There's nothing wrong with a correctly built Delco starter. They're just heavier and use more energy.

Blowers/Cooling Fans
Blower and radiator cooling fan motors are another high amperage consumption electrical device. They work tirelessly but overtime as wear occurs they need more amps to start and run until they quit completely. Linear motors are used for A/C mode door placement in 1986 and up Corvettes, which are also very reliable. DC Electric motors are capable of variable speeds without damage from heat with the exception of starter motors. Blower motor fan speeds are regulated through resistors. More resistance equals slower speeds. Resistors are placed in the HVAC system to allow constant air flow across

Blowers/Cooling Fans (continued)

the resistor to dissipate the heat that builds. Radiator cooling fans weren't designed to run continuously and when they're running constantly their life is shortened. There's also more load on the entire electrical system, including the alternator.

Wiper Motors

Wiper motors, like blower motors, use resistance to control the rotation speed. Wiper delay systems use a rotating pin to actuate a set of contacts, informing the delay electronics that the wipers have made a full sweep. Each time the pin contacts the timer, it times out the selected sweep delay.

63-77 Corvette wiper motor speeds are controlled by grounds through the switch. 68-72 Corvettes are unique with their wiper motor override switch under the column to allow wiper blade service. 68 wiper motor speeds are controlled in the same manner as all the 63-77 motors, with the exception of the wiper motor ground circuit being controlled by the override switch under the column. 69-72 had a change in how the override was controlled. Current was cut to the wiper motors armature when the override switch was turned on or off. 68 Corvettes control the wiper door in conjunction with the wiper motor, using the wiper switch, opening and closing the grounds circuits as necessary. 69-72 Corvettes use a different approach, supplying current to the necessary wiper door components. This means you can only use a 68 GM service manual to diagnose the wiper and wiper door system on a 68.

78-82 Corvette wiper motors control the wiper, delay and wash through the switch while current is supplied to the wiper motor by a stand alone wiper delay module. 84 and up Corvettes have the control switch supply power to all electronics on the wiper motors exterior plastic cover controlling wiper speed, delay and washer functions.

Diagnosing 63-82 inoperable wiper motors is not too difficult. In most cases, wiper motors are replaced because of dirty contacts and old lubricants slowing the motor operation. We rarely replace the wiper motors because they're very tough and have an overheat protection device that opens the internal power circuits. A simple clean-up almost always fixes any issue. Disassembly is easy if care is taken to place the components in order during disassembly.

84-96 wiper motors are also tough and in most cases the black plastic cover that houses the electronics is the culprit when problems arise. The cover is prone to damage when valve covers or the engine is removed, for example.

Generator/Alternator

DC Generators and mechanical voltage regulators were used on the early Corvettes the tenacious charging system was simple to diagnose and repair when necessary. Generators usually came to life with a fresh set of brushes and a quick polarization you'd have to be in the business a while to know about polarization. Polarization you might say aimed the positive electrons in the right direction. Mechanical voltage regulators were very simple with a set of points that vibrate controlling the voltage output and a cutout switch to prevent battery drain.

Generator/Alternator (continued)
Although a crude way to regulate voltage by today's standards, it worked well with the meager generating output we required. Another drawback: dirty voltage control electronic regulators smooth out the alternators output, keeping the electronics happy. Alternators were another big stride in keeping up with the changing requirements of the electrical system. We were happy with 42 and 60 amp output alternator on small block non A/C Corvettes. Today, 105 amps is the norm to keep up with all the accessory loads. Whether you have a generator or alternator, it has two functions. Keep up with the entire electrical system load plus have enough voltage and amperage to recharge the battery from the initial start-up. Remember the battery is the energy storehouse. If the generator/alternator can't keep up with the electrical load, the battery will discharge slowly.
Here's something to remember. Alternators charge at lower voltage when high amperage is required in the system. An example would be after your Corvette has been idle in the garage for a while and the battery is close to dead but the engine still starts, the alternator will be pumping out the amps trying to keep up with the load so the volt gauge will show lower charging volts. Once the battery is close to full charge, the volt gauge reading will go up because fewer amps are required in the system.

Solenoids/Relays
Solenoids and relays are used all over your Corvette, whether you have an early or late car. Early cars only required a few. Later cars use them for many functions, including the emission system. Solenoids are wire wound devices that become magnetic when current is supplied. Relays are a combination of a solenoid and contact points. Relays are used to control high amperage circuits with low amperage circuits. Horns, for example, require high amperage to vibrate the sounding coils. Using a relay allows light gauge wiring to control the horn from the steering column. The alternative would be large gauge wiring routed all over the interior and many potentials for fire.
Another example of a solenoid is your A/C compressor clutch. Even though it's rotating, its creating a magnetic field, pulling the clutch plate onto the drive pulley.

Gauges
Ammeters were used in the early Corvettes informing you of the charging output. We mentioned earlier how a low battery would require high amps to charge to a fully charged state. An ammeter equipped Corvette would show a higher charge rate at start-up with the low battery. The voltmeter equipped Corvette on the other hand, would show less voltage output with the low battery because it would be charging more amps.

Gauges (continued)
The key point to remember is ammeters will show a greater charge rate at start up then taper off as the battery is charged, while the voltmeter will show less charge at start up and then increase as the battery reaches a fully charged state.
Also ammeters typically don't move as much as voltmeters when the batteries are fully charged. As the wiring ages, resistance builds, causing less meter fluctuations.
As far as knowing the true condition of the system, I'd go for the voltmeter. It will at least tell you if the alternator output is above 12.6 volts. As long as the alternator maintains at least 12.8 volts with a low battery, you'll get home.
Every once in awhile, we have a request to install an amp meter which we try to discourage because of the extreme load placed on the gauge. Amp meters must have the entire load of the electrical system fed through the gauge to know the true alternator output. In the early days an amp meter was okay to use because there weren't high electrical loads on the system.
We covered arteries or wiring earlier which can affect gauge accuracy. All engine monitoring gauges work off of resistance senders/sensors. Any added resistance skews the gauge reading. Temperature gauges will show a lower engine temp reading as wire resistance builds. Fuel gauges receive resistance readings from the fuel sender. 0 ohms would be an empty tank while 90 ohms would be full. If the wiring or connections for the fuel gauge or sender had higher than normal resistance, the gauge would always read higher than the actual fuel level. A shorted fuel gauge sender wire to ground would have the gauge reading empty all the time.
Oil pressure gauges have a different approach. The gauge goes to the high end when the sensor circuit is open or has high resistance. If you find the oil pressure gauge at 60-80 pounds all the time most likely the oil pressure sender or the wiring has an open circuit. A shorted to ground sender or sender wiring would show a 0 reading on the oil pressure gauge all the time.
Tachometers read voltage pulses from the distributor against the 12 volts supplied to the gauge. Open circuits in the white wire supplying the dash will keep the tach at 0 all the time. Grounded circuits will do the same, keeping the needle at 0 sometimes when the battery is low and a jump start is used to get you going the tach can become stuck at the redline. Usually after a few starts the needle will come to its senses and be back where it should be.
Electronic speedometers use a vehicle speed sensor to generate magnetic impulses to a buffer that cleans up the VSS signal for smooth operation. The clean VSS signal is sent to the processor that calculates speed and then displays it on the dash.
81-82 Corvettes have a hybrid VSS system using a hall-effect sensor mounted to the back of the speedometer head for VSS computer input with the mechanical driven speedometer.
84-89 Corvette dashes have the buffer and cruise control onboard the speedometer cluster assembly. 90-96 Corvettes have the buffer in the ECM/PCM (electronic control module/powertrain control module).

Shop Notes:

Early batteries were prone to leakage and gassing out the fill level caps, requiring constant cable/terminal maintenance. Keep an eye on the cable terminals and use acid neutralizing felt washers to keep the acid in check.

1968-1982 Corvettes are susceptible to battery cable damage when acid leaches into the cable from a leaking side post battery. We've found 1968-1982 Corvettes that wouldn't start with what appeared to be a dead battery (no lights on the dash) but then with a battery check, we found a fully charged battery. The battery had a leaking side post connection that over time damaged the battery ground cable. The sulfuric acid followed down the cable, corroding the connection of the cable to the terminal at the frame. That was a tough one as there was no visible problem, but with an ohm test we found the open circuit.

1953-1967 & 1984-1996 Corvettes can be damaged from acid leakage and should be checked annually for frame damage. There are more problems with frame damage than wiring concerns. A quick clean up and an application of baking soda/water will neutralize the acid. Apply a coat of chassis black and away you go.

1997-2007 Corvettes can be severely damaged from acid leakage. There are major harnesses and computers sitting below the battery. The worst case we've come across required one major harness replacement and other connector repairs. The tip off was the A/C wasn't coming out the vents correctly because the vacuum hose routed through the wire harness was damaged from the sulfuric acid.

The battery maintenance is simple. When spring rolls around, check the battery tray for corrosion or acid build-up. Replace it or clean as necessary and install a battery mat for added protection. Batteries live longer with activity. Long periods of inactivity cause sulfation of the plates. Applying a quick high amperage recharge can overheat the battery causing more damage.
The newest batteries require an immediate high voltage surge to get going, then the battery charge rate should be lowered. We typically start with the battery charger on high for the first 15 minutes then back it off to the medium setting for the next 4-5 hours. Delco says that a fully discharged battery may take up to 24 hours to fully recharge! Jump starting or using a battery charger can be dangerous if care isn't taken when the cables are installed. Always connect the positive cable of the vehicle to be jumped at the battery. Then connect the ground cable of the vehicle to be jumped up to the alternator or

Shop Notes(continued):

any bracket that will give a good ground to the system. This prevents sparks at the battery from ruining your day even more!

Whether you're using a set of jumper cables or a battery charger, wait and let the dead battery charge up for 10-15 minutes before attempting to start the car. Completely dead batteries can take much more time before they will be charged enough to start the car, especially when using inexpensive jumper battery cables. You also run the risk of damaging computer components when the voltage spikes from jump starting, so wait for a while and let the battery charge before making the start attempt.

The best battery maintenance tool on the market for your battery is the Battery Tender. The Battery Tender keeps the battery at optimum charge level without overheating the battery while monitoring ambient temperature.

Before condemning any electrical component or the battery, always check for good clean connections. If you have a hard start problem, it can be a simple as a loose cable connection. Be careful to lightly touch the cable terminal at first because they can become very hot. Then try moving the terminal. If it's loose and hot to the touch you've found a problem. A neat trick is using a temperature gun that you can point at the connections, slightly elevated temperatures are normal (10-30 degrees). Any more and there is a problem.

Diagnosing a no start can be very aggravating whether you have an early or late Corvette. We spoke earlier about how heat affected the starter adversely and it required more amperage to activate the solenoid. This applies to all Corvettes, 53-87. When the NipponDenso starter was introduced in 88, heat was not as much a factor.

To know for sure whether the starter, neutral safety switch, clutch safety switch, VATS (vehicle anti-theft system) or ignition switch is the problem, one simple test must be performed using a test light. Always check for 12 volts at the starters violet wire terminal. First the test light must have a bright light for the starter to engage. If the light is bright when attempting to crank the engine the starter is the culprit. At that point give it a nudge with a small ball peen hammer. A light tap on the case sometimes is all it takes to get a balky starter back on track. The fix is only temporary but in a pinch it can get you home. If you have no light or a weak light at the violet wire on the starter, there is a switch or wiring problem.

The safety switches would be the next place to check, then the VATS if equipped, for the open circuit. Here, a couple of hard lessons learned. Never discount the starter as being the problem even if it is rebuilt or freshly rebuilt. Don't blame the VATS immediately. Many times it has nothing to do with the problem. Neutral safety switches operate under extremely tough conditions. The heat in the console builds and you can have a hot no start condition.

Shop Notes(continued):

On 68-82 Corvettes, make sure the frame to engine ground cable is tight after starter replacement. If the starter is installed correctly, the rear brace has the frame to engine ground cable attached to it. Many times we find it loose.

Early Delco alternators have been extremely reliable. They have a few possible issues and for the most part work without any major problems for many years. When the brushes are worn excessively, we've found that the alternator may charge okay at idle, but as RPM increases the voltage/amperage output drops.
The internal voltage regulators can have seizures and have extreme voltage output. From time to time, you'll notice that the headlights are extraordinarily bright.

The real "problem child" alternator is the CS-130 used on the 86-91 Corvettes because of their lightweight design. The CS-130 bearings and components are susceptible to overheating and failure results. There is no easy way to disassemble them and make repairs unless you like using a saw and soldering iron in tight places.
The CS-130 alternators are adequate as long as they're not overworked. In the old days you jumpstarted a dead battery and by the time you got where you need to go the battery was back and everything was good. Try doing that with the CS-130 and you'll have a failed alternator from overheating. The damage may take a few weeks to show up but it will. The best policy is to charge the battery. If you find a dead battery, don't rely on it to bring the battery back to full charge.
1992-1996 are the good old Delco units that are very reliable and the same minor issues pertain to them that concern the earlier Delco units.

Poor connections in general elevate wire temperatures over time and this is usually apparent on high amp circuits like blower motors. The wiring becomes stiff and discolored. Wire insulation may not be considered important but it is very important to prevent corrosion from occurring and creating high resistance. It's a good idea to limit poking a wire with a test light as the tiny pin holes allow moisture in and corrosion starts. Dash gauges work on resistance readings from sensors. Poor connections and high resistance wiring can skew the readings.

Always look closely at all wire connectors for distortion from overheated terminals. A prime example is the 78-82 starter extension harness. Many times we'll find the connector melted and the terminals black from extreme heat.

84-85 Corvettes have a separate lead off the battery cable for the radiator cooling fan which is prone to overheating.
It's a good idea to check the battery cable auxiliary positive leads on all 84-92 Corvettes annually for acid damage. They supply power to the VATS and computer memory and other accessories.

Shop Notes(continued):

We've found a few loose cable connections on the 93-96 Corvettes at the maxi-fuse block near the battery that shut the entire power supply down. There have been a few fuse issues, always due to poor connections that we've found to date.

1966-1975 Corvettes use a barrel fuse holder for the A/C blower power lead. This is the fuse and fuse holder to check when high blower speed goes out. You can locate the fuse holder by following the red lead from the blower relay on the A/C evaporator case under the hood. We find the fuse holders melted from the poor connection and in most cases replace the fuse holder with a circuit breaker to alleviate the problem for good.

Corvettes that use glass fuses have a tendency to have corroded terminals, causing high resistance at the fuse panel. Brushing on some Brasso will eliminate the corrosion and restore a good connection.

1982 Corvettes can have an issue at the main fuse panel where the fuel pump fuse connects. We've found a few burned fuse panels that required bypassing the panel altogether. Also the 82 has a fuse holder in the battery compartment for the ECM and fuel pump. The fuse holder can become corroded and cause a no-start. The engine will crank over, but it won't start.

Blower motors on all Corvettes will eventually die from use. There a few warnings, they just don't come on one day. Keep in mind that the blower motor uses a separate power source for high blower which is a direct battery source. If you find the blower won't work on any speed, the blower motor is the most likely cause. Like the starter, the blower motors supply wire is violet in color. If the violet wire has power and the blower motor ground wire is good, the motor itself is most likely bad.

When a customer comes in and says that their blower motor and wipers aren't working on a 1969-1982 Corvette, the first question I ask is "was the starter replaced?" It's common to find the black ground wire for the engine harness to be connected to the starter's positive battery cable connection. This is an easy mistake to make. After all, the black ground wire's terminal is large enough to go on the positive cable terminal. To date we've not found any components are harmed from the inadvertent wire connection. Although not NCRS correct, I instruct our techs to install the ground wire on the bell housing bolts to minimize the possibility of error when the starter is replaced.

Radiator cooling fans will eventually die from usage and if you run yours all the time, the life span will be considerably shorter. The symptoms are the same. They just quit. No warning until you find the engine running hotter than normal at idle. 1984-1986 Corvettes

Shop Notes(continued):

have relay connection problems that are obvious from the distorted plastic electrical connector.

Wiper motor problems can be difficult to diagnose unless you understand the system. As we mentioned earlier, 63-82 wiper motors are controlled by grounding the wiper motor. Poor dash grounds will disable the wiper motor and can give you a noticeable jolt of current when you turn on the wipers on the 63-76 Corvettes. The wiper case itself must also be grounded for proper operation.

The 78-82 Corvette uses a resisted ground circuit to pulse the wipers. Before condemning the wiper delay module, use your ohm meter to test the connection. As the wiper motors park pin rotates, it touches the black plastic cover. The resulting contact closes the resisted ground circuit causing an ohm reading that should rise to 100.0 ohms at the point of contact. If you find an open circuit, the covers contacts are most likely worn or dirty, which in most cases can be cleaned.

84-94 wiper motors have been reliable unless they've been subjected to damage from engine repairs in the area. 84-89 Corvettes have the most wiper switch problems, at least in the south, due to rain ending up in the switch. Water leaks or leaving the window open during light rain can eventually soak the switch.

Window motors use reverse polarity to change direction, worn switches create resistance and slow motors in 68-82 Corvettes. 1984-1987 Corvettes with tape style regulators are painfully slow no matter how well they're lubricated. The only fix for the 84-87 is to replace the original tape style regulators with scissors style regulators.

78-82 Corvettes use reverse polarity switches for their power door locks. We find poor connections cause inoperative door locks in most cases. Later Corvettes have very few power door lock problems.

Solenoids are found in many areas on all year Corvettes (like the 84-96 deck lid release). Testing a solenoid is simple. They must have at least 20 ohms of resistance, any less and they're considered shorted. Use your Ohm meter to check for the minimum ohms. If they test open circuit, they're also bad.

If you have a voltmeter equipped Corvette, connecting a recently calibrated volt gauge to the battery will allow you to compare your Corvettes dash volt gauge to the calibrated volt gauge. This will give you an idea where your system voltage is at, keeping you well informed.

Shop Notes(continued):

Bulkhead connectors on the 63-67 Corvette are prone to open circuits causing the car to shut down completely. Usually you go over a noticeable bump and the car shuts off, pull over and all of a sudden it's back the engine starts up and away you go. When we hear a complaint like this, we go out under the hood and wiggle the bulkhead connector. Most of the time the engine dies. We reform the terminals, apply some grease and reconnect the connector. In most cases everything is okay. In extreme cases, the wire harness requires replacement.

If you have rear light harness issues (no power to the taillights), check the rear harness connector near the lower section of the driver side dash at the kick panel. Sometimes the connector can be found behind the kick panel. These connectors can become corroded, causing intermittent rear light and fuel gauge operation.

Brake light power comes from the brake light switch, then goes through the turn signal switch back to the rear of the car. If you find no power going to the taillights when the brake pedal is depressed, check the brake light switch for power first then check the white wire at the turn signal connector for power when the brakes are depressed. If you have power at the white wire and no lights chances are the turn signal switch is the problem.

In conclusion

The idea here was to give you basics of the electrical system and how to diagnose typical problems. Now it's your turn to try our info first hand. The first tool you need is the factory service manual, and then patience. The factory service manual explains the circuits and you should try to understand the how the circuit works before any testing takes place. When you're looking for peculiar problems, always look at the related circuits. Many times ground problems cause unexplained operation because the ungrounded component is using the other components ground.
When aftermarket electronic equipment is added, it's easy to stick the ground wire from the new toy under an existing ground which may make life very difficult in the long run. As ground circuits are stacked on top of one another, there is a possibility that another components ground circuit is an easier path to ground and who knows what will occur. The safe bet is to keep the stacking of grounds to a minimum and space the ground screws a few inches apart.
Another difficult problem to diagnose is shorted circuits, especially when they're intermittent. We go about it systematically, looking at the service manual, finding what components are involved then checking with the customer to see if any repair work was done in the immediate area. Try to remember if there was any movement of something, when the fuse blew, for example. All of the clues put together can save enormous amounts of time. Careful thinking can save a lot of needless work, which in most cases takes a lot of work to find that out.