Auto Repair Tips

Here are some useful tips that I have learned around the shop in no particular order.

1. **How many times have you just had to take a look at a problem under the hood knowing full well that you wouldn't get that good shirt you are wearing full of grease and road dirt. Normally just about the time you have closed the hood and come in for dinner your wife notices a large spot of grease in your sleeve. What now? Dinner smells too good to wait but you need to do something right away. I have learned that good old DL or Go-Jo hand cleaner works wonders on these problems. Back up the dirty spot with a piece of clean paper towel and rub in some hand cleaner - use your fingernail to scrape the grease spot and press the grime thorough the cloth and into the paper towel. Change the towel to a clean spot and repeat the process until all of the grease has been dissolved and pushed thorough the shirt sleeve and in to the paper towel. A quick rinse with warm water will remove any emulsified grease and you can pat it dry enough to get back to the dinner table before the steaks are cold!**

2. **After a major repair job in the garage I normally have a lot of grease and oil spots on the cement floor. A putty knife will scrape up the majority of the garbage but if you want the floor to look really clean try this. Get a cup of kerosene and a large coffee can full of speedy dry. Dump the kerosene on the spot and brush it in with a stiff bristle brush. Now spread the speedy dry down on the kerosene and let it sit for an hour or so. When you brush it up you will find the brightest spot on the garage floor where there once was a grungy greasy dirty looking spot. I used to use gasoline for the job but it is highly flammable compared to kerosene and kerosene works just as well as the gas did.**

3. **Want to keep peace in the family and not have your wife scream at you for tracking in all that dirt and grease from the garage? I mean like you do have to run down to the cellar occasionally for a tool that isn't in the garage and you don't want to remove those boots just to dash across the carpet to get to the cellar door and of course you don't want to run outside and into the cellar through the back door! If you have a medical supply place nearby stop in and buy those paper booties that they use in the operating rooms to cover their shoes. If not, get a box of baggies, not the zip lock type, and slip one over each boot as you enter the house. You can secure it with a large rubber band. They will protect the carpet from your dirty boots. Be careful going down the cellar stairs because the polyethylene is a bit slipperier than you might expect. When you are ready to go back out into the grunge just slip them off and leave them next to the garage door for the next trip. The paper booties really do work better and have a less slippery surface which makes them a safer choice. Either way you are much better off than if you had gotten grease on that family room carpet since a broom across the behind hurts a lot more than you may think!!**

Rusted hardware responds to only one factor - heat, heat and more heat!!

I wrote this in reply to a request from a reader as to how to remove busted off rusty exhaust manifold bolts and when I sent the mailnote it bounced! So I will post the reply here for anyone else in the same predicament.

First of all, get heat! Oxy acetylene heat, not bernzo heat. Don't touch another bolt or nut until you heat it red hot and let it cool a bit - it's the only way! I call my torch the universal (both metric and English) gas wrench cuz I use it for removing rusted bolts more than welding or cutting.

If there is any bolt or stud sticking out try welding a nut to the part that is sticking out. The heat from the welding operation should also loosen up the frozen component. I use a wire welder and have even removed those keyed wheel lug nuts when my son lost the "key", by welding a nut onto the end of the lug!!

If that fails, or you can't get to a welder, then drill an "easy out" sized hole up the middle of the shaft. Use a "center drill" to start the hole for the highest accuracy. Try the easy out route.

If that fails and you haven't broken the easy out (ugh) then drill out the broken component with a drill as close to the tap drill size. "Easy outs" usually only work on bolts which are not severely rusted in and I

have not been too successful using them. I normally run a starting tap into the hole and try to cut the old bolt out using the tap.

If all else fails, then you can resort to the heli-coil route. Just continue increasing the drill size until you reach the size of the heli-coil insert.

In the future, NEVER try to remove a severely rusted bolt or nut until you have applied serious heat to it. If you don't already have one, make an oxy-acetylene torch your next "wrench" purchase - it's better than vice-grips!!

My friend Otto called me one Saturday with a strange sound to his voice. Now Otto isn't one to ask trivial questions and he has been mucking around with cars and trucks and farm vehicles for as long as I have known him. He has a repair shop that would put any professional shop to shame and has enough mechanical savvy to work his way out of any problem. But this one was different. He has the sister truck to mine and had it "stored" for a few months while he drove his "winter car". He had tried to put it on the road the previous weekend but was unable to get it running. I knew I was in for a long day but when Otto calls I know it is going to be an interesting day so I put on my Saturday best and headed for Otto's house.

The hood was open and there were wires and testers all over the fenders. He had disconnected the major connectors and was standing there with a blank look on his face, a volt meter in his hand and the service manual open to a schematic laying on the front seat.

"Soooo, where'e the keg?" I quipped. "It's inside - go get yerself a mug - yer gunna need it! This one has me baffled!"

We stood there mulling over the problem - it would crank, but wouldn't start. Otto had determined that there was no spark by holding a plug wire near the manifold bolt and cranking it over. It should have zapped a fat spark every time. He had also cracked the fuel rail fitting and found that there was no fuel pressure. He then determined that the fuel pump in either of the dual tanks was not making any noise whatsoever - it should hum for about five seconds each time you turn the key on. He had clipped a voltmeter onto the negative terminal of the battery and had tested all the connectors associated with the fuel pump and its relay and the ignition system. He had also determined that the fuel pump relay was clicking!! He had disconnected the connector at the fuel pump and determined that there was even voltage at the fuel pump connector! Must be a bad pump - but both pumps failed to run. How could both fuel pumps fail simultaneously?? Not a chance. He had also determined that there was 12 volts at the coil terminal. So why didn't it start??

Otto had done everything right. He had the service manual for the truck, he had traced the wires by their color codes and had determined that the only possibility was a bad fuel pump in both tanks - not a likely situation. He had resisted the temptation to yank the tank and check out the pump on the bench but had decided to call me instead. A good move as it turned out. He had determined that there was voltage at the coil, but no spark!! A failed coil along with two failed fuel pumps??? Nahhhhhh.

I decided to take the time to repeat Otto's diagnostic procedures and took the voltmeter lead and started back-probing the connectors. Same thing as Otto had found. There was voltage everywhere! But I discovered one thing that Otto had missed. Remember I said that he measured a good solid 12 volts at the fuel pump connector? With it disconnected?? Well I was a bit lazy and when I crawled under the truck with a voltmeter lead in my hand I decided to poke thru the wire at the connector rather than disconnecting it. Otto turned on the key and I measured three volts! Not the 12 volts Otto had measured! Now it doesn't take a rocket scientist to figure out that a 12 volt fuel pump can't run on 3 volts!! I yanked the connector and measured it again - 12 volts!!

Well according to a good friend of mine, Oscar Ohm, his law states that the voltage is proportional to the resistance (E=IR) and the practical application of this engineering wisdom told me that there was a resistance in the supply wire that was far greater than the resistance of the fuel pump! What that meant was that the wire or a connector was bad. Who ever heard of a bad wire? So we started yanking more connectors looking for corrosion somewhere - firewall connector, ignition switch harness - everything was clean.

Back to the bad wire theory. I took the needle probe of the voltmeter and started piercing the insulation of a fat wire which started at the battery and went into the main harness that fed the ignition switch. Might as well start at the beginning, I figured. The voltage at the battery was 12 volts (under fuel pump load) and I moved along the wire six inches at a time. After a foot or three I found a spot on the wire where the probe entered the insulation very easily and went clean thru the wire and into my index finger!! Ouch!! Thinking that I had just slipped with the needle-probe I tried again. I was virtually standing on my head leaning over the fender and reaching down near the steering column so I couldn't see what I was doing very well but one thing was certain. I had found a SOFT SPOT in the wire. We pulled the tie-downs that held the harness in place and stretched the harness over the fender where we could see it better. I took my trusty MacIver knife (Swiss Army) out of its sheath and started slicing. What I found amazed us. There was a six inch length of wire that was no longer wire. There was nothing inside the insulation but copper oxide! Green powder that nature had made out of copper, salt and electricity! This was the main wire that supplied 12 volts to the ignition switch. It was "hot" all the time and must have been nicked so that the insulation was missing near the frame (which is connected to the negative side of the battery). That, along with Rochester salt as an electrolyte had caused an electrolysis reaction inside the wire (24 hours a day) and had done its dirty work where no one could see it.

SNIP - CRIMP - CRIMP - Five minutes later I had spliced a six inch piece of 12 gauge wire into the supply wire. Thirty seconds later we had the harness plugged in again and ten seconds later the Ford truck started and ran like it had a new life!!

The whole job had taken about four hours - the total cost of the parts to fix it was about fifty cents. We both agreed that if Otto had taken this truck to a dealer or other "replacement therapy" repair shop he would have paid for a pair of fuel pumps, a new coil, a distributor, a relay and a new harness, all to the tune of about eight hundred dollars. There is a lesson here - DIAGNOSIS, DIAGNOSIS, DIAGNOSIS. Then replacement!

Here is the procedure for isolating which one (or more) cylinders are causing a "misfire" or rough idle in any standard ignition driven system (not diesel).

The first thing we have to do is to find out why is is misfiring - not necessarily ignition related, but it could be. Do a compression test so we can rule out bad stuff. Write down the compression readings for all the cylinders. If one (or more) is more than 15% lower that the highest, then there is a problem with either the valves or the piston/rings. I won't go into the procedures to isolate that problem here.

Assuming it turns out OK, then we do a "power test" by grounding out one spark plug wire at a time while it's idling. Use a small thin screwdriver or something else that you can slip under the boot that covers the spark plug. Attach a grounding wire to the screwdriver and clip the other end onto a metal part of the engine. With the engine idling, slip the screwdriver under the spark plug boot to short out that plug and stop it from firing, and note the drop in RPM - do it for all 8. One of them (or more) will not affect the idle condition as much as the rest. That one will be the offending cylinder. Next, find a spark plug wire which is the same length as the offending cylinder but caused a significant drop in RPM, and swap wires. See if the problem follows the wire or stays with the cylinder. If it goes with the wire then it's time to replace the wire set. No sense in just replacing the bad one - do 'em all. If the problem stays with the cylinder then start looking for a fuel problem with that cylinder. Look for a vacuum leak around the

intake manifold for that area of the engine. Check all the vacuum hoses for cracks and leaks. If it is a fuel injected system (Port Fuel Injection) then pull the injector and see if it is functioning. If it isn't squirting a fine mist then check the signal to the injector using a special injector tester. Repair or replace as necessary.

Finally, if nothing else appears to be wrong try swapping the spark plugs form one cylinder to another and see if the problem follows the spark plug. If it does then replace all the plugs. Note the condition of the failed plug and from which cylinder it originated. This may be an indication of other engine problems like oil burning in that cylinder

I have a 1985 Ford F-150 pick up truck that has been reliable through all of the abuse I have been able to hand out. I only use the truck occasionally and at times it sits too long without running but it never has failed to start no matter how long I leave it idle. Well, a few weeks ago I thought I had finally killed it. The wife and I were out for a ride to the pumpkin patch and on the way home the truck died. Fortunately, I was close to home. I walked home, got some tools and went back for my truck. I knew I wasn't out of gas because I have dual tanks and I was using the front tank which was full. Anyway, I pour a little gas down the throat of the carb and the old truck fires up and runs as usual. I drive it home and as I pull into the driveway it dies again.

Now the saga begins. I check the ignition and get the obligatory shot in the arm from the spark plug wire so I realize everything is OK there. I spray carb cleaner in the carb and the truck runs for a moment. It runs every time I use an external fuel source. So, I figure it can't be getting any gas. The fuel filter seems OK but I poke a hole through it just to be sure. Still won't start. I figure the next step is the fuel pump but it's Sunday and the stores are closed so I knock off for the day.

Monday - After work I pick up a new fuel pump and that evening I install it. Still won't start. For the next four days I try various things like taking apart the carburetor, reinstalling the fuel pump, rechecking the ignition, checking the fuel lines, etc. etc.. Still won't start.

On Saturday I try to buy I rebuilt carburetor but I have a California truck in New Jersey. No smog problem in New Jersey, I guess, because I can not get the carb anywhere. So, I buy the carburetor rebuild kit and clean and rebuild the carburetor. On Sunday I reinstalled the carb and the truck STILL WON'T START. Over the next several days I continue to do various things again and again and the truck does not respond to any treatment. I'm beginning to think that the gas in the tank may be bad because I let the truck sit too long this time but I have doubts so I decide it must be the Engine Control Module. You know, the little electronic brain that controls all of the ignition, fuel, and emission systems on California vehicles. I decide it's worth a shot and I call the Ford dealer to order the part. Problem. The part is $215.

On Thursday I decide that shot gunning with a $215 part is not a good idea so I have the truck towed to the local Ford dealer for repair. Within an hour the guy calls me and tells me that they put fuel (4 gallons) in the rear tank and the truck runs. Not good, but it runs. I tell him that he needs to run the truck on the front tank because that is the tank I was using when I had all the trouble. (Now I am beginning to believe in bad gas and not the Brussel Sprouts kind). I tell him to go ahead and tune up the truck as long as he has it there.

The next day I pick up the truck and the mechanic tells me that the gas in the front tank is fine. He told me that it appeared as if the fuel lines were air bound because it took a long time to get gas through the fuel pump. I ask how that could happen and he says it probably happened when I replaced the fuel pump. My mind is at ease. the fuel pump went bad and in the process of replacing it I got air in the fuel lines. Makes sense but I am still a little suspicious.

That afternoon, and evening, I drive the truck all over town and I realize that I must have really needed a tune up because I am getting great gas mileage. The gas gauge (front tank) hasn't moved at all. Man, am

I happy. Not for long. I take the wife shopping and in the shopping mall parking lot the truck stops running again and it will not start. NOW I HAVE THE ANSWER!!!!! The valve that selects fuel tanks is stuck on the rear fuel tank. The gauge switches but the valve doesn't. I was actually out of gas all this time. I call AAA, put gas in the rear tank and off we go. I am considering leaving things as they are because I get great gas mileage on the front tank but on second thought tomorrow I will resolve the fuel tank valve situation. Too Soon Old, Too Late Smart

My wife recently called me from a neighborhood store and explained that the Taurus had quit at the red light and she finally got it started just enough to pull in to a small store lot and get out of the way of traffic. I quickly headed out in the truck with my tool kit and found her distraught and upset about the car. After trying to start and also having no luck, I opened the hood and checked all the things you would normally look at. I found nothing wrong and tried to start the car again and lo and behold it started ok.

I drove the car home and let my wife follow in the truck and had no problems on the way home. I immediately started troubleshooting at home in better surroundings and still could find no problems to cause the no start. I replaced the fuel filter and checked the gas for water etc. and the car still performed ok.

Several weeks later I was checking the same items under the hood and when I closed the hood the car would not start. After checking for spark (weak) and looking for fuel pressure, I found the connector that provided power to the fuel injectors not snapped in. This had been the problem all along and after snapping the connector in and assuring the tabs were locked, the car started fine and I have had no further problems. What seemed like a serous problem and possible intermittent condition was repaired by making more than a cursory check.

RUNNING COMPRESSION TEST

This is a summary of the responses to a question about a "Dynamic Compression Test" sent out via the i-ATN e-mail list and posted on Compuserve's "For Techs Only" forum. It seemed to ring a bell with the most techs as a "running compression test," so I will use that name here. Call it what you will, this test is an accurate if slightly esoteric and time-consuming test of cylinder breathing. It is in fact recommended by Detroit Diesel instead of a traditional static compression test, it is included as part of Delmar's ATTP program, and several instructors use it as part of their state emission training programs.

HOW TO PERFORM A RUNNING COMPRESSION TEST

1. Start with a normal ("static") compression test. To eliminate rings, valves, holes in pistons, that sort of things. A normal cylinder balance test is also helpful (so you know which, if any, cylinder is presenting a problem). Engine should be warm.

2. Put all spark plugs but one back in. Ground that plug wire to prevent module damage. Disconnect that injector on a port fuel system.

3. Put your compression tester into the empty hole. The test can be done without a Shrader valve, but most people recommended leaving the valve in the gauge and "burping" the gauge every 5-6 "puffs".

4. Start the engine and take a reading. Write it down

5. Now goose the throttle for a "snap acceleration" reading. Reading should rise. Write it down NOTE: Don't use the gas pedal for this snap acceleration. The idea is to manually open then close throttle as fast as possible while without speeding up the engine. This forces the engine to take a "gulp" of air.

6. Now write down your readings for at least the bad cylinder (if there is a single bad cylinder) and maybe 2-3 good ones. Make a chart like this: CYL STATIC COMPR IDLE -RUNNING COMPR - SNAP Cyl 1 150 75 125 Cyl 2 175 80 130 Cyl 3 160 75 120 Cyl 4 160 80 125

7. ANALYSIS: Running compression at idle should be 50-75 psi (about half cranking compression). Snap throttle compression should be about 80% of cranking compression.

EXAMPLE 1 - RESTRICTED INTAKE CYL STATIC COMPR IDLE -RUNNING COMPR - SNAP Cyl 1 150 75 80 If Snap reading is low (much less than 80% cranking compression), look for restricted intake air- severely carboned intake valve, worn lobe on cam, rocker problem, "shutters" mispositioned in the runners. (Toyota, Vortec etc. with variable runner length) Comparing measurements between cylinders is important.

EXAMPLE 2 - RESTRICTED EXHAUST CYL STATIC COMPR IDLE -RUNNING COMPR - SNAP Cyl 1 150 75 180 If snap measurements are significantly higher than 80% of cranking measurements, look for restricted exhaust on that cylinder-such as worn exhaust cam lobe, or collapsed lifter. Or, if they are all high, look for a clogged cat converter.

Low Compression?

WHAT IS GOING ON?

When you do a normal compression test, you are checking cylinder sealing, not cylinder breathing. When you check engine vacuum at the manifold, you are looking at the breathing of the entire engine, by checking vacuum at a common (plenum) source. You aren't testing a specific cylinder. This test looks at the breathing of an individual cylinder.

Say the engine is running at 18 inches vacuum. Atmospheric pressure is about 30 inches, so the difference (30 inches - 18 inches = 12 inches) is what the engine is sucking in. 12 inches mercury is equivalent to about 6 psi absolute air pressure. Compressed at an 8 to 1 ratio, you should get 6 x 8 = 48 psi pressure if all the air makes it into the cylinder and then gets pushed out. So your idle reading on running compression is about 50 psi.

When you snap the throttle, the manifold vacuum drops, so the absolute air pressure going into the cylinder increases.

In fact, you can do running compression tests at various constant manifold vacuum readings (by brake-torqueing the engine momentarily), and the running compression should roughly correspond to the manifold vacuum. For example, at 10 inches vacuum, engine should be breathing in about 10 psi air pressure, so you should see a running compression reading of about 80 psi (at 8 to 1 compression ratio).

If one cylinder reads low running compression compared to the rest it means that the air didn't make it in. If one cylinder reads high, the air didn't make it out (and the next pulse of air raised the pressure).

First thing you will need is a spark plug adapter for your air compressor. You might be able to find one at an auto parts store but most of the desk jockies there will look at you as if you had lobsters coming out of your ears. So build one yourself. Take an old spark plug that came from the car and beat it with a hammer till the porcelain is crumbled and can be removed. Careful not to damage the threads. Now get an air chuck fitting that will fit your air system. Screw it into the end of the plug where the porcelain was and braze it in place - it has to be a good airtight seal. You can epoxy it in place if you don't have a torch.

Now screw it into the plug hole of the cylinder that has low compression. Hand crank the engine over until you feel air pushing out of the fitting. That will mean that you are coming up on the compression stroke and both valves will be closed. Now lock the crankshaft in place using a socket on a breaker bar

placed on the crankshaft damper pulley. Wedge the handle tightly into the frame somewhere - make sure it is locked in place in tightly else it will spin around during the next step and whack you in the head!!

Now put your air hose onto the fitting and slowly begin to increase the pressure on the cylinder.

As soon as you hear air leaking somewhere stop increasing the flow. Use a length of heater hose to listen to the hole where you add oil. This is normally on top of one of the valve covers. If you hear air leaking there then you have either badly leaking rings or a cracked or hole in the piston.

Listen at the tailpipe. If you hear hissing in there then you have a leaking exhaust valve.

Listen at the throttle body intake. If you hear hissing there then you have a leaking intake valve.

If you hear hissing at all three places they sell then car as fast as you can!!

YOU SUSPECT THAT THE TIMING GEARS ARE WORN AND THE CHAIN IS STRETCHED BUT YOU AREN'T SURE. HERE IS A SIMPLE WAY TO CHECK FOR A LOOSE CHAIN WITHOUT REMOVING THE TIMING GEAR HOUSING. IT'S A REAL TIME SAVER!!

There is a very simple check for a loose timing chain due to a broken tensioner, worn gears, or a stretched chain. Pull the distributor cap and observe the rotor position. Take a breaker bar and a appropriate socket and put it on the crankshaft damper pulley. If you have a degree wheel put it on the damper pulley else you can just chalk mark the timing mark position at the appropriate time.

Now - slowly turn the crankshaft pulley in a clockwise direction. Watch the distributor and observe that the rotor is moving. Stop turning. Now - mark the damper pulley position with the chalk or observe the degree wheel. Very carefully turn the crankshaft in the other direction and VERY carefully observe the rotor in the distributor. The instant it begins to move STOP turning and mark the crankshaft position again. Measure the number of degrees of rotation of the crankshaft. If there is a lot of slop in the chain then you will have moved the crankshaft ten or fifteen degrees (or more) before taking the slop out of the chain after the reversal before the camshaft began to turn. Get the picture?? If all is well and there is no slack in the timing chain then you will see about three to five degrees of "reverse motion" before the distributor begins to turn.

If you are not sure how many degrees it turned during the procedure there is a simple way to calculate that based on the spacing between the chalk marks. Take a string and wrap it around the crankshaft damper where you made the chalk marks to measure the circumference of the damper. Let's say it was 18 inches. If there is one inch between the chalk marks then divide 1 by 18 and multiply the result by 360 (the number of degrees in a circle). In this case the answer is 20 degrees and it is time to replace the gears!!!

If the valve timing is off then the engine will run poorly. There are many reasons for that but one main one is that the compression will be low on all cylinders. If the chain slop is not excessive it is still possible that you have jumped a tooth especially if it is a rubber timing belt.

To check the valve/crank timing just pull the valve cover and observe the valves for the #1 cylinder. Pull the spark plugs, hand crank the engine over with a finger covering the spark plug hole for #1, and wait until it starts up on the compression stroke. Make sure you are rotating the engine in the same direction

that the starter motor turns it. You will feel the pressure escaping past your finger. That means that the piston is on the way up towards top dead center (TDC). Now, watch the timing mark on the crankshaft damper pulley and continue rotating the engine until the timing mark is at TDC. Both valves must be completely closed at this time. There should be no doubt of it. You can watch the valve action as they close and make certain that they are closed. If either one is even slightly open you have a problem. A compression test will also reveal timing problems. From the above description it should be obvious that the compression on all cylinders will be low if a valve is still open at TDC. So all cylinders will show low compression values.

I've had a lot of these in recent months. The complaint is that nothing in the car works. No horn, no lights, no starter. The battery and cables have been replaced and still no juice!! Here's a basic test you can do with a simple multimeter (e.g. Radio Shack $15.00)

Put the multimeter across the battery terminals. 12 volts?? No, then charge the battery and re-test. 12 volts? No=junk the battery and get a new one.

If you get 12 volts at the battery terminals then leave the + lead on the + battery terminal and move the - (neg) lead to the engine block - find a good clean metal surface on the engine and see if there is a 12 volt reading. No=bad ground cable from battery to the engine.

If yes then put the - lead back on the battery and move the + lead down to the next available measurement point, normally the fat lug on the starter motor solenoid. 12 volts?? No=bad battery cable or terminal.

If yes, then move the + lead to the BAT terminal on the alternator. 12 volts? No=burned out fusible link or broken wire .

Yes then move the + lead to the + terminal of the main fuse block in the car. 12 volts?? No=burned fusible or broken wire going to the fuse block.

The basic idea here is to start at the source of energy, the battery, and then move further and further away from the battery (assuming it is good) until you no longer get a 12 volt reading. Then look for burned wires, burned out fusible links and broken connectors. It's not rocket science but it does require an orderly process to isolate the problem

Ever had the problem of trying to loosen the bolt that holds on the crankshaft damper pulley? The crank just turns over and you can't stop it. Try this:

Here's a trick that always worked for me. Pick a cylinder, any cylinder. Remove the spark plug and crank it over counterclockwise until that piston is starting on its way up on the compression stroke (just make sure both valves are closed). Fill that cylinder with good clean motor oil and put the spark plug back in. The piston can't compress the oil and it won't leak out since the valves are closed - the crank is now locked. It's called a hydraulic lock. Now loosen your bolt.

I have also heard of doing a similar thing only instead of using oil you stuff a length of nylon rope into the spark plug hole - a foot or so will do. You don't have to worry which stroke the piston is on. Make sure you leave a sufficient mount of rope sticking out so you can remove it later on. Rope is just about as incompressible as oil and is a lot easier to clean up afterwards.

Electrical Short

Ever have an electrical short that was so bad that it blew fuses instantly? here's a way to diagnose that short circuit without emptying your wallet buying fuses.

I have a great idea on finding short circuit problems. some shorts may not only be in wiring, but in components. when a fuse blows it is because the load is bypassed and moved to the fuse.

Take a old headlight and two headlight electrical connectors and put a set of alligator clips on one connector (for round glass fuses) and a set of spade connectors on the other plug(for newer blade style fuses.)

Place the wired headlight across the blown fuse and it will glow at full brightness. start disconnecting components on that circuit until the light either dims or goes out. when it does, it will tell you whether the component or wire is bad. it is the best system i have ever used and wanted to share it. remember, this works on cars, boats, or whatever.

A reader describes what can happen when a loose connection causes a high resistance which in turn generates sufficient heat to melt the plastic on a fuse.

My wife's 89 Celica GT had a problem with the brake lights not working. The first thing I did was to check the fuse. I found the plastic on the blade type fuse to be melted but the fuse itself was not blown. Went to Toyota dealer after I could not solve the problem myself [I am an aircraft mechanic but I try to stay away from cars as I don't always have the patience or the manuals]. The Toyota de aler couldn't find anything wrong since the lights started to work after the mechanic played with the fuse. So $80 later I took the car home and found that all it was was the fuse was loose in the fuse holder. The fuse had gotten so hot that it melted the fuse holder and the plastic on the fuse without blowing the fuse. The burned fuse holder caused a high resistance in the brake light circuit not allowing the lights to work. To bad there $80 mechanic couldn't find this out. I bent the blades out on the fus e and everything works great.

Here's a real timesaver from a Ford Shop mechanic who evidently knows what he is talking about!!

I just thought I would drop you a line to help your readers. If you have the unworthy task of replacing an in tank pump on a ford truck use this trick. Instead of dropping the tank raise the bed. If you loosen all 3 or 4 bolts on the left frame rail, and remove the ones on the right you can jack up the bed on the passenger side far enough to get access to both front and rear tank pumps. I work at a Ford dealership and we figured out this trick a long time ago.

The small Ford truck is even easier as the bolts are accessible from inside the bed. You can also remove all the bolts and then with the help of a friend you can slide the bed back and set it on the rear wheels. Just remember to unhook the tail light wire harness near the rear bumper for the small truck. And if you have a wrap around bumper on the full size truck, place a shop towel or rag folded up between the bumper and the bed to avoid scratching the paint finish on the drivers side.

One final Editor's note. The pick-up truck bed is quite heavy and you don't want it falling on you when you crawl between the bed and the frame so make sure you use good strong blocks to support the bed and don't count on the hydraulic jack to carry the weight when you are working on it!! Safety is the primary consideration here!

1989 Mustang's starting problem finally yields to this reader's

analysis work

This is about my 89 mustang with the no start problem during extreme temperature changes. I actually found out what the problem was the day after I sent you the message.

I hauled my voltage tester out and tested the relay. There was always voltage coming from the battery, but when the car would not start there was no voltage across the other side of the relay. I traced the wiring diagram in my chilton and noticed a fuel pump inertia switch in line with my relay. Chilton didn't tell me where it was located though.

So I ran down to my local library and looked through a Mitchell's manual. It described exactly where it was. In my trunk behind the trim wall up against the back of my tail lights on the driver's side. It even told me how to test it. Check for 5 ohms or less resistance across the contacts. Any more and they said to reset it or replace it.

Well, mine gave me about 1000 ohms of resistance(and this was while the car was starting). Since I got the bad reading and since this thing is bolted to a metal wall then it seemed to me like moisture could very well be a problem. I've been taking it out every night since then and keeping it in my house and putting it back in in the morning and haven't had the problem since. I'll get around to buying one soon.

These things are only available from a dealer. Although since I know how to test it now I can probably get a good one from a junk yard. You'd be surprised at the number of parts store people that just didn't know what one of these things was. I had a guy from NAPA that kept insisting that I was saying the wrong thing and he kept offering every part under the sun except what I wanted.

Just in case you're not familiar with the inertia switch(I know you probably are but I'll explain it anyway, just in case you post this), the fuel pump inertia switch is like a little breaker that pops whenever your car experiences a hard collission or rolls over and it shuts the fuel pump off (hence my starting problem) to prevent any fires and also shutting the engine off in the process. Don't know how much one of these little buggers costs yet but it looks just unique enough to be expensive.

Hopefully this will be a help to someone else.

Low compression in one or more cylinders can be caused by many possible failure modes. Here's a diagnostic procedure to isolate the culprit.

Could be caused by: 1. Cracked head. 2. Blown piston 3. Cracked Block 4. Blown head gasket 5. Broken valve component - spring, cracked seat, bent valve, bad lifter

Make an air fitting out of an old sparkplug with the guts removed. Remove the valve cover for that head. Check for a hung up valve by removing the rocker arms for both valves and observing the height of the valves - should be equal.

Insert the air fitting in the spark plug hole and add compressed air - the piston will be forced to the BDC position so watch your hands as the crank rotates.

Now listen for a loud hissing from one of the following: 1. Crank case 2. Intake manifold 3. Exhaust pipe 4. External cylinder head/block interface

Wherever the hissing is coming from will tell you where the compression is going.

Fogging of the inside of the windows is caused by moisture - duh!! Well it may sound simple but the question is "Where is the moisture coming from and why isn't it leaving the inside of the car??"

One source of moisture is a leak in the heater core. Check for dampness in the rugs where your feet rest - mainly on the passenger side front.

Second, moisture is brought in with snow from your feet (in cold climates naturally) and remains in the carpets.

Third, moisture is brought in with your body. Every breath you take pumps moisture into the inside of the car. Perspiration, even in the winter, will bring moisture in the car with you. Four people in a standard car will fog up the windows in a few minutes - if and only if you don't remove the moisture from the car!!

That is the key - removing any moisture from the inside of the car no matter how it got in there in the first place. Normally, the ventilation system of your car is capable of removing the moisture IF you have it turned on, and IF you have it set for FRESH AIR, not set in the recirculating air mode. 99% of all car ventilation systems have the capability of turning the system off and/or recirculating the inside air as well as bringing in fresh air from the outside.

If you have it set for recirculating then the moisture stays inside the car and condenses on the inside of the windows once the relative humidity get high enough. Sometimes this is not the operators fault, but rather a faulty control cable or vacuum control for the baffle that switches between recirculating and fresh.

Make certain that the system is on fresh. To test this, close all the windows, turn the fan onto the highest setting and then open one window about a half an inch. Standing outside the car you will feel a strong wind blowing out the window - if you don't feel it then it is not bringing in fresh air - it is recirculating the inside air!! If you have it set on the fresh position then something is broken.

All modern cars have vents in the doors which act to allow air to exit the car even if the windows are closed. These vents can get clogged up with dust and debris so make sure they are clean to ensure that air can leave the car with all that moisture it contains.

Turning the fan to the highest position and cracking open a window will allow a lot more flow of the moist air from the interior of the car. On vehicles with "wing windows", open them an inch or so and the moisture will leave even faster. If you don't like the rushing noise of a window open next to you then crack open a rear window - an added benefit is that your mother-in-law won't be able to hear you and your spouse talking about her!!

Intermittent Wipers

It was a dark and stormy night . . . . actually it was. I had been experiencing some problems with the intermittent wipers on my '88 F 150 the past week and that night was no exception. Sometimes they would work and sometimes they wouldn't - you know, intermittent. I pulled into the Wegmans store and ran in to get milk and bread - it was raining pretty hard and the wipers had been functioning OK on high speed. I came out and jumped in the truck, started it up, dropped it into gear and released the parking brake. As I released the parking brake with its normal resounding thump the wipers stopped dead. I did mention that it had been raining heavily, didn't I? Well that's a lousy combination - no wipers and a downpour. I sat there pondering what my next move should be when lo and behold the wipers came on

again. I took that as a sign from above and hurried home. Once safely in the driveway I dared turn the wipers off and tried them again. No go!!

The next day was Saturday and it had stopped raining - so I didn't need to fix the wipers - no rain, no wipers. That sounded simple but I knew better so I hurried down to my favorite place, the Rundell Library in Rochester. The woman at the desk knew me from the many trips I had made there in the past and she asked me, "the Buick or the Ford?". Ford, I replied.

I trucked on home and spent the next half hour in the upstairs reading room and learned all I could about the wipers on the Ford. There was a wiper switch and a potentiometer in the dash and a separate module tucked waaaaay up under the dash that contained the intermittent wiper circuit. It probably would have taken me at least an hour to dig into the harness mess under the hood and under the dash to find the module but the manual clearly depicted where it was. Right above the parking brake release lever.

After removing the module and disassembling it I looked at it under a microscope. It took about two minutes of looking and then I found it. The relay that powers the wiper motor was soldered to a small circuit board. Under about 50 power magnification I could see a fine crack all around the solder joint for the relay contact. The solder had fractured in a complete circle around the contact and was giving new meaning to the word intermittent.

A quick reheat and some fresh solder and it was looking as good as new. I re-soldered all the other connections on the board and reassembled the unit. As I remounted a bracket to the module I noticed some writing in white letters on the cover - "Do Not Drop" That sounded a bit weird, but then I realized why it was there. The relay was not bolted to the little 2X2 inch circuit board - it was held there by the solder on the lugs. The same solder that had failed!! Dropping the assembly or subjecting to any other severe shock would result in the relay breaking away from the circuit board!

Then I realized why the unit had failed - Ford in its wisdom had mounted the module directly onto the frame brace that supports the parking brake assembly. Remember earlier when I mentioned that the wipers had stopped when I released the parking brake? Well over the years that shock of the parking brake hammering against the bracket had taken its toll - the solder joint failed. I guess they should have written the letters "DO NOT DROP" in larger type so that the design engineers could have seen them.

When I reassembled the unit I did not mount it back on that bracket. It now floats in space hanging from a harness with a tie-wrap suspending it gently in air. My guess is that the same failure occurs and at a higher frequency with all stick shift F-150s since those with automatic transmissions probably use "Park" instead of the parking brake.

So if you have a Ford F150, and one day your wipers quit on you, you will know how to fix them and remember, you read it here on Mister Fixit's page.

Seems to be that as the weather gets colder I get more and more requests for heater diagnostics, so here it is.

The heat in all automobiles today is supplied by the hot coolant circulating through the engine. A small amount of that hot coolant is diverted into a small hose that goes into the firewall and then into a small heat exchanger that looks like a miniature radiator. Cold air from the outside, or recirculated air from the inside, is directed either completely or partially through that "heater core", as the industry calls it.

In some vehicles the hot coolant flow is modulated by a valve which is controlled by the user via a sliding lever on the heater control panel labeled "hot" on one end and "cold" on the other. This method is not used by all automobile manufacturers. Others modify the percentage of incoming air that flows through the heater core, bypassing the core to reduce the temperature. This is done by a moveable baffle that is controlled by the "hot - cold" lever.

So, it's cold and you fire it up and slide the control to "hot" and cold air blows out. Now what??

First thing to do is to make sure that the coolant temperature is up to operating temperature, about 190 degrees F. That is controlled by the engine thermostat. A quick check by feeling the radiator hoses would tell you if it is hot. Using a thermometer taped to the upper hose of the radiator will tell you exactly where you are. If it isn't hot enough, change the thermostat. While you are in the vicinity of the radiator, make sure the coolant level is correct. A low coolant level will reduce the flow to the heater core.

Next, find the two hoses that go into the firewall. Feel them. Are they hot? If not, check for a control device in one of the lines. It may have a vacuum hose attached or a pull cable hooked onto a lever. Work the control inside the car and see if there is any response. If there is a vacuum line on it, pull it off and see if there is vacuum there. If not find the vacuum source and fix it. The problem is normally just a hose pulled off a small fitting. When in doubt, remove the device and replace it with a piece of pipe. Then see if the hoses get hot. If they do, replace or repair the control.

Another reason for the hoses to not be hot is that the heater core is plugged. Remove both hoses and flush the core with a garden hose. Careful because the garden hose can supply up to 100 PSI which can rupture a heater core. Just supply sufficient water to flush out any junk in the core. If the core is plugged too solidly, replace it.

Next, assuming the hoses are hot enough check to see if there is an inside control of the air flow across the core. This is not always easy, however you can get under the dash and move the "hot - cold" control lever and see what moves. A lot of times it is simply a broken or disconnected control cable. Also check to see if there are vacuum hoses on the heater control. If there are, then check under the hood for a ball the size of a softball. It is the vacuum accumulator, a small tank which is used to supply constant vacuum to the heater controls. Look for disconnected or cracked hoses in the vicinity of the accumulator and repair as needed.

One final note, if you have heat most of the time but it disappears when you are going up a long hill you probably have a vacuum controlled system. Going up hill normally reduces engine vacuum. If there is a vacuum leak in the engine, or the engine is old and tired, then the vacuum will be reduced to the point where the controls will go back to the default condition of "off". Check engine vacuum to see if that is your problem and repair where necessary.

If there is no air flowing when you turn on the blower then you have the task of checking the electrical system of the blower. Check for a fuse first. Then using a voltmeter, follow the wires from the fuse block to the heater switch, and then on to the blower motor. If there is voltage all the way to the motor then check the ground wire from the motor. If it's good then the blower motor is bad.

Sometimes your blower motor will only work on high speed. In that case here is a paragraph or two about what may be wrong.

Heater blower motors come in two or three varieties. Older models had several windings inside for the various fan speeds. It was expensive and is no longer used in most modern cars. Newer blowers have only one winding and therefore only one wire going into the motor (plus, of course, a ground wire). The speed is controlled via a series of resistors which are switched in as needed to lower the fan speed. These resistors are wire coils and get very hot. Therefore, they are normally mounted inside the heater plenum

chamber where air from the blower flows over them to keep them from burning up. Sometimes the burn up anyway.

The blower switch in 80% of today's cars have different positions which control the flow of current to different resistors thus changing the speed of the blower. Therefore you have two places to look - a faulty switch or a faulty resistor bank. Since the blower runs on high it should not be a problem.

If you have a system similar to the one in my Buick Park Ave. then you are in for big money since the blower speed is controlled by a solid state device which pulses the current on and off in a square wave sequence varying the duty cycle to vary the speed. Big bucks and expensive diagnostic equipment there (oscilloscope).

Now we all know why it is called an IDIOT LIGHT!

I came across something that all GM owners should know about. One of my neighbors came over to seek my advice on a baffling problem he was having with his GM (I think it was a Chev) and its charging system. He was having dead battery problems (sort of like Don was in another story) and had taken his alternator off to replace it. Fortunately he had taken it to "Wheels" the former National Auto store, and they had tested it on an alternator testing machine. There was nothing wrong with it. This neighbor, I'll call him Artie, had the foresight to do some diagnostics ahead of time and determined that there was no output (14.5 volts) at battery or at the alternator stud, so a logical conclusion was that the problem was in the alternator - it has a built in voltage regulator so logic prevailed. Replace the alternator and solve the dead battery problem, right? Nope.

I walked over to see what I could see. We had the service manual open to the circuit describing the charging system. I traced the wires and determined which one was the field and which was the bat and which one was ground. Then I noticed something strange. I thought it was a typo - the wire from the 12 volt source to the field winding went through the idiot light filament, that's right, the bulb is in series with the field supply. Alternators don't have a true field supply like the old generators had with external voltage regulators which regulated the output by switching the field winding on and off. But they do need something to start the system working. Once the system is putting out its current the system becomes sort of self sustaining.

I took a short length of wire and connected it to the field terminal while the engine was running. Suddenly, the voltmeter across the battery went to 14.5 volts! I took the wire off the terminal and sure enough the system continued to charge at 14.5 volts. Fixed, right?? Nope.

Artie shut the engine down and restarted it again - nothing - jump the field, 14.5 volts.

I asked Artie if the idiot light was on while it was running and not putting anything out. Nope. He shut it down again and we tried it all over again, only this time I sat in the driver's seat and Artie did the jumper thing. Same results, only I did notice something strange. "Just where is the "alt" idiot light on the dash panel Artie? I didn't see one - just an engine light and an oil pressure light."

There was no idiot light for the charging system! I took a flashlight and held it at an angle to the dash panel. There, not visible under normal lighting conditions, was a place for the "bat" light. Yet it did NOT light when the switch was turned to the "ON" position. Then it hit me like a ton of poop! Remember I thought that the circuit diagram was in error - that the idiot light was shown to be in series with the field terminal on the alternator?? Well, that was not a typo! The bulb in the dash panel is part of the charging circuit. It is REQUIRED to be functional to supply the initial field voltage to get the alternator started doing its thing. IF THE BULB IS BURNED OUT THE SYSTEM WILL NOT CHARGE!!

It took us another half an hour to get to where the bulb should be but it became obvious that it was going to take a LOT more than a half hour to replace the bulb. It looked like part of the instrument cluster was going to come out before we got to the bulb. Plan "B" went into effect. I found the wire under the hood that supplies the idiot light and wired in a small socket and a bulb under the hood. I connected the other end of the wire to the field terminal and started it up. Voila! Charged just like new. I taped the bulb and socket to a handy vacuum hose and closed the hood. To this day that GM product is still riding around with a bulb taped to the vacuum line under the hood. I would love to see the face on the mechanic who discovers that bulb and wonders what the heck it is doing there!!

ALTERNATORS

If you have been around cars for a while you might have heard the term generator. Well, those were the old days and the good old generator is history. What a generator did for the old cars, an alternator now does. You see, a car has and electrical system that carries power to such essential things as headlights, the ignition coils, engine cooling fans and other non-essential things as the radio (my son would argue that one), air conditioning fans (my wife would argue that one), and all of those other things upon which we have become accustomed to depend. All of that power has to come from somewhere!! A lot of people might think that power comes from the battery, and that is true to some extent. But the real answer is that the power to run all of those electrical things comes from Saudi Arabia! Huh? Saudi Arabia? Well, maybe Dallas, or Oklahoma. But the point is that the source for all of that energy is the gas tank. Yep. And the link from the gas tank to the battery is that mysterious thing called the alternator. It takes mechanical power from the crankshaft, transmits it via a "fan" belt, (it used to run the cooling fan as well) or serpentine belt as it is called in most of the newer vintage cars, and turns the alternator. So, the main function of the alternator is to convert power from the gasoline engine that drives you along the road, to electrical energy to keep the battery in tip-top condition.

So, what happens when an alternator goes bad? Well, at first, nothing. That is because the battery has some reserve power in it, enough to keep the engine running for quite some time, many many miles in fact. So a bad alternator doesn't necessarily mean a tow truck should be called right away. As long as energy is conserved elsewhere, like turning off the blower motor, the rear window de-fogger, the stereo and the headlights (if possible), you could make it for some distance on just the battery reserve alone.

One major problem which will finally occur as the battery loses its charge is that there will not be sufficient voltage to keep the engine running well. Many years ago I was in California and saw a car coming down the street with its catalytic converter glowing white hot and flames coming from beneath the car. What had happened is the alternator quit, the battery ran down, the engine was not firing on all eight cylinders and the unburned fuel was being burned in the catalytic converter! It had been long overdue for the driver to call a tow truck!

So, how do you know when your alternator is going bad? Most of the time the alternator fails in stages. A little techie talk here. The alternator gets its name from the fact that it generates alternating current (AC). The old generators I mentioned before generated direct current (DC). Well the battery can't use alternating current so the alternator output is fed into what are called diodes, which convert the AC into DC. The alternator has a unique feature in that it is able to generate a relatively high voltage while the engine is at idle. The old generators needed to be running at a fast pace before they got up to 13 or 14 volts. The alternator can do this since it is really three alternators in one body. Each of the three sections of the alternator generates its voltage out of phase with the other two sections. Since the complete cycle (one revolution) of the alternator is 360 degrees, each phase is shifted by 120 degrees from the next phase. So in one revolution of the alternator it puts out three separate voltages.

OK, back to the failure mode. Each of the three phases has its own windings in the alternator and each of the windings has its own pair of diodes. Each of these windings and/or diodes can fail, one set at a time. If

this happens the alternator can still charge the battery, but only with a limited current, approximately 2/3 of its original capacity if one system fails. If two systems fail, then it puts out only 1/3 of its rated capacity. What that means to you is that you can go a long time on a limping alternator. Chances are if you don't need headlights or air conditioning or other high current using accessories, you would never know that the alternator was in the process of failing! The time you will find out is when it is 10 below zero and you wear down the battery by cranking the starter, then put the fan on high for heat, and then drive in the dark.

So, how can you tell if the alternator is failing without taking it apart and doing some measuring inside the alternator? It's really pretty simple. You will need a simple voltmeter. You can get one at Radio Shack for under ten dollars. Here's what you do - start the car, make sure all the accessories are off and rev up the motor to a fast idle. Set the Voltmeter to the DC scale (not AC or Ohms). Measure the voltage across the battery terminals - red lead of the voltmeter on the positive terminal, black on the negative (ground in most cars). The voltage should, and probably will, read around 14 volts. If it reads less than 12 volts you may indeed have a failed alternator and you can skip the next step. Next, turn on the heater, the rear window de-fogger, the radio, the headlights and anything else that draws power. Now rev up the motor and watch the voltmeter. It should still be reading around 14 volts. If it reads lower than 13 volts the chances are that your alternator is not up to snuff.

One last failure mode is of course noise. The rotor inside the alternator rotates on bearings, normally very high precision needle bearings, and these can fail. When they do you will hear a loud grinding noise associated with the alternator. To isolate the noise take a length of tubing, heater hose will do fine, put one end to your ear and move the other around in the vicinity of the alternator. The noise will be much louder when you point it at the alternator if that is the culprit. Other possibilities are the water pump and the power steering pump which are also driven by the engine belt. To further isolate the noise disconnect the drive belt and spin the alternator by hand. If you hear a rumble or grinding noise then the bearings are shot. If you don't hear a noise the problem may still be in the alternator since the bearing might be quiet without the loading of the drive belt tension. Check for side play in the pulley. If you are pretty certain the noise came from the alternator it is a relatively simple task to take it apart and visually inspect the bearings, else swap it in for a rebuilt. Your auto supply store will normally bench test the alternator free of charge and can tell you at that time if the bearings are noisy.

Before you go running down to the parts store for a new alternator make sure to check the connections at the battery terminals and *also check to see that the voltage is the same at the alternator terminal (the big fat one with the heavy wire attached)* {also, read the article, dead battery}. Check to make sure the belts are tight and not slipping. Replace them if they are cracked or shiny on the side that faces the alternator pulley.

One final thing to check - the field voltage. In order for the alternator to generate electricity it must be supplied with a field voltage. If you know which wire is the one that supplies the field (normally labeled 'F') then simply check with a voltmeter to see if there is 12 volts at the field. Another check is to use a hacksaw blade or a lightweight screwdriver , anything magnetic, and hold it near the side of the alternator with the ignition switch turned in the on position. If there is a field voltage present then the metal will be attracted magnetically to the side of the alternator, not very strongly, but you will feel it pull the metal to the side of the alternator.

So, what are you going to ask the mechanic when he tells you that you need a new alternator?

1. Did you perform a load test on the alternator? If you did, what were the voltage readings? Were they all below specification?? (mechanics will use a load testing machine instead of turning on all the accessories.)

2. Did you check to see if the belts were old and cracked or possibly slipping?

3. Did you measure the voltage at the alternator connector or at the battery? Were the readings the same at both places or is there a voltage drop somewhere in the system. You can tell him the "Dead Battery" story if you want to.

4. Finally, did you check the price on a rebuilt as well as a new alternator? (rebuilt alternators are just as good as new if they are done correctly and usually cost about 1/3 as much)

Now that you know all about alternators you can feel confident that you can discuss the failure modes with a mechanic and not get shafted. It is also fun to watch the faces of a mechanic when you ask questions like those above. He will soon figure out that you know more about the electrical system of your car than how to turn the lights on!

For yet another description and a different perspective on the charging system go here.

1989 Ford Ranger Pickup Truck 6 Cy, Fuel Injected Manual Transmission

Problem

1. The Charging System would sometimes cut out, and even when it was "working" I noticed that the Alternator Gauge would gradually read lower, and lower, over a period of a few months, and turning on Lights would drop it even lower.

2. I took the Truck to the Shop, several times, as things got worse, and each time their Tester said the Electrical System was "OK".

3. Finally, the Charging System stopped working altogether.

4. I took the Truck to the Shop again, and this time they said the Alternator was bad, and installed a Rebuilt Alternator.

5. I parked the Truck, while I went on a 2 day trip, and when I got back the Battery was dead.

6. I measured the Current, with a Multimeter, with the Engine and all Electrical Devices off, and found a 2.5 Amp continuous drain on the Battery.

7. I traced the source of the current drain, by pulling Connectors, Fuses, etc., and found that if I pulled one of the two Connectors on the Alternator, the current drain went away.

8. I took the Truck back to the Shop, they checked it again, and said their Tester said the Electrical System was "OK", it's not a problem with the Alternator they had installed, and that it's an Electrical System problem, and I need to take the Truck to an Automotive Electrical Shop.

9. I went on the Net, found Bob Hewitt's very excellent Automotive Web Site, and sent him an Email explaining the problem, and asking him if the Alternator could be bad, but the Shop's "Tester" say it's good.

10: Bob sent me a very detailed reply, explaining that it certainly could, if the Connector that I had pulled was the Battery (BAT) Connector. Bob further explained that one of the Diodes inside the Alternator could be shorted, causing the drain on the Battery, but the Alternator would still put out 12 Volts, and therefor pass the Voltage Output Test, however it could not put out full Current, and would

fail the Current Load Test, IF the Shop actually ran that Test. Bob also gave me instructions on measuring the Resistance at the Alternator Connector to determine if the Alternator had this problem.

11. "Armed" with this information, I went back to the Shop, and although it took making a CAD Drawing, on the Computer, showing the Parts, Wiring, and Connections involved, along with a detailed Written Explanation, plus talking to 6 people, including the Shop Manager, over a period of about 5 days, to finally convince the Shop that this problem could exist, they finally agreed to replace the Alternator again (as they said that they had no way to really Test for this problem, in the existing Alternator).

12. The final solution: YES - it WAS the Rebuilt Alternator, and when they replaced the Alternator again, the problem went away - full output Voltage and Current - and no more Battery drain.

My Comments and Observations - and things to watch out for.

1. It's obvious that the Original Alternator was going bad over a period of time, but the Shop's Tester said it was OK, and it's obvious that the 1st Rebuilt Alternator was also bad, but the Shop's Tester said it was also OK. This tells me that, in all these cases, the Shop was running only the Voltage Output Test, and was not running the Current Load Test - watch out for this, when a Shop tells you that their "Tester" says the Electrical System is OK, but you are still having problems.

2. As to the 1st Rebuilt Alternator, the Shop Manager told me that the Technician who installed it, had changed the positions of the Connectors on the Alternator, from Side Mounted to Rear Mounted (he called it something like "Clocking the Connectors" - I didn't get the exact word), and that this could have also caused the problem. On the 2nd Rebuilt Alternator (the one that worked), they did not do this. So another thing to watch out for.

3. Make sure you're well prepared with all the necessary "firepower", i.e., the info and knowledge (like you get from Bob Hewitt) before going back to the Shop to try to convince them that they didn't do the work correctly. In my case, had I not had this "firepower" to confront them with, the situation would have been horrible. Shop #1 wouldn't have installed another Alternator, and I would have gone to an Auto Electric Shop (Shop #2), just to have them tell me that Shop #1 had put in a bad Alternator, then there would be the dispute between Shop #1 and Shop #2 as to who was "right", and I probably would never have gotten back the $$$ I had paid to Shop #2 to tell me that Shop #1 was really responsible.

4. It is apparent that some of the Automotive Technicians know how to run a Tester, take the Readings, and perform whatever Service Work is recommended according to what the Readings say, but they accept whatever the Tester says as "Absolute Truth", and they really don't understand what the Tester is really testing for, or what the Readings really mean, or how to interpret any Variations in the Readings (and change the Tests accordingly), or what could be wrong with the Part they are replacing. So, if you are continually having problems, don't necessarily accept the first thing, the first Tech tells you as "Gospel", and don't be afraid to talk to as many people at the Shop as necessary, including the Manager, or his Manager, etc., until you find someone who really understands what is going on, as to the problem you are having.

Here is a note from a reader who found out about broken connectors and diagnostics the hard way.

Bob:

Thank you for taking the time to construct your web page. I was baffled with an electrical problem in a 1972 Oldsmobile Cutlass that I inherited eight months ago. Thanks to two of your articles in particular and the site in general, with assistance from another site ... "automotive information center" ... I was able to find and fix the problem. I gave the car to my son who is in his last year of pharmacy school in Baltimore, MD. All belts were replaced as was the alternator and battery just after I received the car. A month or so ago he mentioned the alternator light was coming on. The belt had broken. He sanded the pulley and replaced the belt so the new alternator was back in operation. Jeff did not mention the numerous times the light came back on since because the car was still running and the problem was intermittent. Unfortunately, the battery was discharged several times because of this and the fact that 1972 cars did not have warning bells when the lights were on with the ignition off as the newer ones do. One does become accustomed to relying on those bells. In the last week or so, the light stayed on constantly but was not driven very much as he walked to class and work at the local hospital.

Two weeks ago was my birthday ... of several years ... and the family convened from our various locations at Brick, NJ for the weekend. The light was on the entire trip from Baltimore to Brick, NJ and the car died right in front of Grandma's House at midnight. The next day I looked at the system and noticed that if I disconnected the wires coming off the diodes the light would go off. I thought that was good since there was no connection then to the light. When I pushed on the "field" wire the light also went out. When I let go, the light came back on. I did not have a volt meter at my mother-in-law's house nor did I have access to your web page. But, Jeff and I found a starter-n-alternator shop open on Saturday that checked us out. After tightening the hot wire nut he pronounced the problem fixed. But the light was still on by the time we drove back to Grandma's. To let you have some idea how desperate we were, I took Jeff's battery and put it into Steve's 1990 Baretta to charge it up for the trip home. It worked but reset Steve's computer so his car did not run as well as before the switch ... but that was an easier solution.

Jeff limped back to Baltimore in the rain without using his windshield wipers to conserve energy. Rain-X really does a fantastic job of allowing you to see without wipers in an emergency. Frustrated, Jeff replaced the battery with a more powerful one, replaced the voltage regulator and the condenser attached to it all to no avail. The light still was on and he was $100.00 lighter in the pocket book. We talked and he drove the 60 miles to my house one afternoon. My volt meter showed a constant 12 volts across the battery and the hot connection on the alternator and the light was still on. I tried to replace the diode trio but the style of this alternator was such that it did not use the black box diodes but ones that were pressed into the housing of the alternator. So I bought a new alternator. This one did have the proper pulley so the old rusty pulley was not going to wear down the belt any more. Perhaps a blessing in disguise ... but a $53.00 blessing none the less. With the new alternator installed ... the light still shone brightly. What a surprise! That's when I found your web site and spent the next several hours reading about alternators and the electrical system of cars. The problem I had was getting to your page took several hours in it self. Believe me, you are now book marked.

I was still intrigued by the fact that I could make the light go off by pushing in on the "field" wire. At last ... in desperation ... I brought out my Sears engine analyzer that I purchased when bought a, then new, 1971 Pontiac Lemans ... when a Lemans was a car ... and replaced the D-cell battery that had been in for about 15 years. To my surprise the ohms check worked. I tested the two wires coming from the alternator to the voltage regulator. The first showed 0 ohms while the "field" wire showed infinite ohms. Why did I not believe my instincts when I saw the light go off in NJ when I pushed the wire in. I was obviously making the broken wire make connection when I pushed in and it lost connection when I let go.

Since no one will sell me a connector that plugs into the back of a 1972 Olds alternator with out the complete wiring harness ... if they had a harness ... and I did not want to rummage though the salvage yards, I bought two insulated female connectors, sized for 22-18 gage wire and removed the old plug, half of which was useless. The light went out immediately. More to the point, the voltage across the hot wire of the alternator was now 14.5 volts. I took the precaution to wrap electrical tape around each connector

and then around the pair to replicate the discarded plug. I labeled the driver-passenger side of the new "plug" so as not to connect it backwards in the future.

Conclusion, when dealing with old wires, believe your instincts, especially when you are at your mother-in-law's without your tools. After spending over $200.00 and taking the advice of some respected mechanics, the problem was solved for about $0.50.

Thanks for your help in allowing me to believe in my ability to diagnose car problems again.

JUMP-STARTING YOUR BATTERY THE SAFE WAY

I am writing this section at the request of one of my readers who wondered why there was nowhere on the web that she could read about jump-starting a car with a dead battery. As with any procedure involving opening the hood of a car there are several precautions you should take to avoid injury - I mention them as we go along so read the article completely. If you are unsure or feel as if the procedure is too dangerous or complicated, by all means get someone who is knowledgable to help you so as to prevent injury to yourself and damage to your car. I assume no responsibility for damage or injury you cause while following these procedures! So here is the safe and simple way to do it:

Before we get started you should understand that there are many reasons for a battery to go dead. If you know that you have left your lights on and you are reasonably sure that your battery and charging system are in pretty good shape you can just jump-start your car and be pretty sure that it will recover from the temporary problem you have encountered. If, on the other hand you know that your battery is pretty old (three or four years, typically) and/or you have experienced multiple dead batteries with no obvious reason, you need to perform some diagnostics to find the problem. This article deals with the simple and safe steps to get you started and on your way.

You will need a few essentials before attempting this task. First, you will need a good set of jumper cables. Good cables have multiple stranded copper wire, about four gauge. It usually says it on the box. The "alligator clips" should be copper as well and the junction of the wire and the clips should be secure. Soldered connections are best but a really good crimp will suffice. When you buy jumper cables go for the extra buck and get them longer than your car so that you could possibly get a jump-start from someone parked behind you.

You will also need a willing participant to offer their car (and battery) from which you can jump-start your car. It helps if you open your hood and stand there with the jumpers in your hand with a sad, forlorn look on your face. It doesn't matter if the "volunteer's" car is smaller than yours. I have jumped my own car using a John Deere garden tractor.

Third, and don't take tis lightly, you need some form of protection for your eyes. Safety glasses with side shields would be perfect but the chances of you having them readily available are next to nil. I think that all jumper cables should come with safety glasses as a requirement, but that's just my personal opinion. Use sun glasses or your normal reading glasses or whatever you have available - you will see why as we continue.

Once you have made arrangements with a volunteer get the cars as close as necessary to comfortably connect them together with the cables. Open both hoods and locate the batteries. If it is dark get a flashlight so that you can make a definite identification of the battery terminals. The identification of the polarity of the terminals is critical - don't guess else you can do SERIOUS damage to yourself and/or the car's electrical system. Batteries all have one characteristic in common. They all have one positive and one negative terminal. This is where the car's internal cables connect to the battery. On older cars you may find that the terminals are on top of the battery, however most newer cars have their terminals on

the side of the battery, making them nearly impossible to see, much more difficult to clamp an alligator clip in place.

OK, so you have the hoods open and good lighting available. What now. Look for one or both of the following identification marks near each of the terminals; find either a plus (+) sign or a minus (-) sign. Or, look for a red or black marking on the battery cables or terminations. Red is positive and black is negative. This is a universally common standard in the automotive industry.

A note here about one of the dangers concerning what you are about to do. Batteries are charged by the alternator on your engine. When they are charged they internally generate both hydrogen and oxygen gas from the electrolysis of the water - remember your high school chemistry class, H2O? Well, if you make a spark in the vicinity of the battery there is a pretty good chance that you will ignite this highly combustible mixture with a resulting explosion and very rapid distribution of battery acid!!! Bad Stuff!! Also be aware that even if you do connect the batteries together correctly there is a slight chance that one of the batteries could explode due to an internal short circuit in either battery. Never place your head directly over the batteries during these procedures!!

So, what's next? We've need to connect the good and bad batteries together - positive to positive and negative to negative terminals. But there is a hitch. You see when batteries are charged they generate both hydrogen and oxygen gasses internally. The combination is highly explosive, so we don't want to risk touching off an explosion by making sparks in the vicinity of the batteries. The secret is to make the connection between the cars somewhere else besides the batteries.

Virtually every car made today has its negative terminal connected to the engine. The positive battery cable is connected to a terminal on the starter solenoid. So, when we connect the batteries we first connect the red jumper cable to the positive terminal of both batteries. Be extremely careful that you don't accidently connect the positive cable to the battery and then let the alligator clip hit some nearby metal - it will make a large spark and may cause an explosion. Then we connect the black jumper cable to the negative terminal on the good battery. Next, find a heavy bracket or other metal part of the engine block on the other car and connect the black cable to it. This will probably cause a spark but if there is a spark it isn't close to the battery so there is no danger of an explosion.

With the batteries connected we now start the good car's engine. Make sure that the jumper cables are not interfering with the fan belts or the serpentine belts and pulleys - dress them neatly over the fender of both cars and be careful of not tripping over them especially in the dark. I usually leave the batteries connected with the engine running for a few minutes to charge the dead battery. Now start the car with the dead battery. If it doesn't start right away make certain that the jumper cable connections are tight and that the jumper's alligator clips are on clean, rust free surfaces. Wiggle the clips and try it again. Long jumper cables, especially the cheaper ones, can't carry the 300 amps or more required to jump-start a car so letting the good engine run at a fast idle for five or more minutes will charge the dead battery and take some of the load from the jumper cables when you try to start the car with the dead battery.

Once the car has started run it at fast idle for a few minutes. Assuming that its charging system is up to snuff, this will charge the battery sufficiently to restart the car after the next step. To make sure that you aren't injured I recommend that you now turn off both engines so that you can safely remove the cables without getting tangled in the moving parts like fan blades and belts. Remove the cables in the reverse order that you used to hook them up, taking the ground cable clamp from the engine metal first. After removing the cables immediately re-start the car. If you feel comfortable removing the cables with the engine running have a care about loose clothing and fingers and keep the cables away from moving parts.

Next step is to close the hoods, profusely thank the volunteer who helped you and go home.

If the battery had been run down completely or if the weather is below freezing it is a good idea to charge the battery overnight. If you don't have a battery charger you can purchase one at an auto supply store for around twenty five bucks. Connect it using the color codes discussed previously. Most chargers can be left connected indefinitely since they are voltage regulated and won't overcharge your battery.

Dead Battery? Maybe so. Read on.

You get into the family buggy and try to start it. It cranks over but sounds like it is cranking slowly. After a few seconds of cranking it still turns over, but slowly. Before you go out and buy a new battery, read this. Maybe you will eventually buy a new battery, but you will have diagnosed the problem and will not be wasting your hard earned cash..

The things we are going to check out here are a bad battery, corroded cables or a bad starter motor. A bad battery will be detected by a low voltage at the battery terminals (not the cables) while cranking. Corroded cable connections will be detected by low voltage at the cable ends. A bad starter motor will draw a high current and the battery cables will get warm to the touch.

You have to get inside the ends of these new fangled side terminal battery cable ends to make sure they are free of corrosion. Just brushing them with a wire brush is not sufficient!! Believe me!! Remove the battery cables from the battery and clean them thoroughly by dipping the ends in a paper cup full of water with two tablespoons of bicarbonate of soda mixed in. Brush the battery terminals and cable ends with a wire brush and keep dipping them in the cup until all the green corrosion is gone. Rinse the cable ends with clean water and reassemble them, positive first.

If you want to do a little bit of diagnostics either before or after cleaning the cables (assuming that cleaning them didn't fix the problem) then do the following. The first thing you have to do is to make sure that the battery is fully charged. Put a charger on it for at least three hours. Now, get yourself a voltmeter and start measuring voltages. First across the battery terminals. Should be a good solid 12 volts from your battery, 14.5 if you have the jumpers connected to a running car. A battery that is three or four years old will probably cause you problems, either now or some night when it's 20 below zero!! Replace it!

Now try to start it. While it's cranking measure the voltages across the battery terminals. It should be somewhere around 12 volts or just below. If it is much lower than that, say 10 volts, then the battery is bad and should be replaced. If it is around 12 volts then leave the negative voltmeter lead on the battery and probe the starter. The voltage there should be 12 volts or so, not much lower. If it still hasn't started and the battery runs down again then feel the cables to the starter - are they hot? If so then the starter motor may be shot and is drawing too much current. If you can get a clamp-on ammeter then use it to measure the current draw of the starter motor. 300 amps is typical - 400 means that the armature is dragging on the stator and drawing too much current.

I suspect that I have blown head gasket but I'm not sure. How can I be certain before I pull the heads??

Every standard piston/crankshaft car made today has an engine block and a cylinder head which bolts on top. Between these elements is the infamous head gasket. The function of the head gasket is to seal both the compression of the cylinders and the coolant which flows between the block and the head.

Sometimes the compression from the pistons blows a "hole" in the gasket allowing the compression to leak into the cooling system and coolant to leak back into the cylinder. There are a few symptoms of a

blown head gasket. The first one is loss of coolant. Coolant can be lost from the leak in the gasket into the cylinder. From there it can go past the piston rings and into the crankcase or it can be forced out of the exhaust system by the action of the piston coming up on the exhaust stroke.

If the coolant enters the crankcase it mixes with engine oil. Of course oil and water don't mix very well but the presence of ethylene glycol (anti freeze) and the agitation caused by the crankshaft and other moving parts can whip the mixture of coolant and oil into a milkshake.

If the coolant is forced out of the exhaust system it is usually heated by the hot exhaust manifold and the rest of the exhaust system. This results in a sweet smelling steam emanating from the tailpipe. The steam is rather persistent, that is it will hover in the air and not dissipate like the normal steam that comes from the combustion process.

Testing an automobile engine for a blown head gasket is pretty straightforward. The first check is to see if there are combustion gasses getting into the cooling system. Take a sample of the coolant and go to the local radiator shop and request that they analyze the coolant for the presence of hydrocarbons. If they are present then it is most likely that you have a blown head gasket.

Another check is to look at the oil of a warmed up engine. The antifreeze in the oil will whip it up into a frothy brown mixture that looks like a milk shake. If it looks like chocolate mousse then you probably have a blown head gasket.

Another check is to fill the cooling system to the brim and remove the radiator cap. Do this when the engine is cool. Start the engine and race it. If there is a compression leak and the gasses are going into the cooling jacket then the gasses will displace the coolant. Since the cap is off the coolant will be pushed out of the radiator. You probably have a blown head gasket.

OK, so we are pretty sure there is a blown head gasket and if we have a straight cylinder engine then there is only one head to remove, but what if it is a V-8 or V-6? How can you isolate the cylinder that is leaking? Remove all the spark plugs. Get a cooling system pressure tester and pressurize the cooling system to specification, normally about 20 PSI. Leave the system pressurized for a few hours. Now lay down some clean paper towel along the cylinder heads where the spark plugs were. Crank the engine over for a few seconds. Since the spark plugs are not in place any antifreeze that leaked into the cylinder will be blown out onto the clean paper towel. Examine the paper towel for the telltale signs of antifreeze and you will be able to tell which is the guilty cylinder.

You can also look at the condition of the spark plugs. Any spark plug that looks different from the rest should be suspect. Of course if you can see antifreeze on a plug then you know that is the bad guy. If the plug looks cleaner than the rest or has a white powder on it then suspect that one.

Most blown head gaskets will require a new gasket be installed. There are very few which will be fixed by addition of a cooling system sealer - you can try it, but be prepared to spring for the big bucks and have the gasket replaced.

Here's a tale from a reader who knows about automotive electrical circuits and quickly figured out what was wrong - perhaps his quick thinking can save you from problems in the future.

Reading problems with unusual fixes reminded me of a Corvair I had many moons ago. (This car had a manual choke.) One morning after I turned the key to start it, I happened to look back and noticed smoke coming out of the engine compartment. (Remember, this was rear engine car.) I quickly shut off the car, lifted the hood, but found nothing. When I started it again, the same problem. Smoke. Looking

and poking around, I happened to touch the choke cable, and it was hot. Now, this threw me for a loop. There not supposed to be any electrical current going through the cable, this is strictly a mechanical thing. I started the car again, and observe the choke cable getting hotter and hotter. Then the light clicked on in my head. I quickly checked the block to body ground strap, and sure enough, it was broken off. The juice was going through the choke cable, and since it presented high resistance, it heated up. Since then I always try to look for the simplest most obvious problem first before I get into heavy duty diagnostics.

Editor's note: There are no car on the market today which have a manual choke cable but there are many other paths to ground that can cause headaches if the main engine ground strap is corroded or broken - its a good thing to check out first when you have flaky electrical problems.

Alternator Problems

Last year in mid October my Datsun 100A's alternator broke down. It stopped charging the battery.

After I was left on the road a couple of times I checked the battery, which naturally was almost dried out. I refilled it, charged it with a home charger and tried again. Finally I was forced to admit that there's something wrong with the charging system of my car, so I took it to the local mechanic for repairs.

The mechanic took out the alternator, measured the voltage and said there was something wrong with the charging field i.e. the alternator was broken unfixable. He then went to the parts shop and brought back a new alternator, which in fact was not an original 100A alternator. The new alternator had an internal voltage regulator opposed to the external on the original hookup. The mechanic fitted the new alternator and left the old voltage regulator intact! At first he even connected the lamp wire to the wrong lead, so that the charge indicator would flash whenever I used my turn signal! I went back to the shop to get it fixed, and for three months the whole system worked like new.

Then one afternoon I was just about to back up from our school parking lot when I noticed that the charge indicator lit while the motor was running. Wisely enough I opened the hood and checked the alternator. It was so loose I could wiggle it with my bare hands. I drove immediately to the repair shop and had the mechanic take a look at it. At first he suspected it had just loosened from shaking, but when he pulled the alternator out, he was pretty shocked. One of the alternator attachment wings had just broken! And if that's not weird enough, he then had the wing REWELDED back onto the alternator! The alternator had a 12 month guarantee, and he goes and rewelds it!

I noticed after the charge indicator had lit, that my turn signal wasn't working and my fuel meter was showing empty. The mechanic refitted the broken alternator back, put a new fuse and checked the system. It was charging 14.1 volts as it should, but when I backed up out of the shop the charge indicator lit again! The mechanic's response to this? "The voltage regulator is probably broken, but the guarantee doesn't cover for it. The alternator still charges, so drive off!" Can you believe this guy?

Well I couldn't so I drove up to the parts shop where the alternator had been bought from. The owner there immediately said that the alternator would be replaced due to the material defect. So I picked up another alternator and drove back home. The next day I and my neighbor started working on the alternator problem. We pulled the old one out and fitted the new one. At this point I noticed the same flasher fuse had blown again, so I fitted a new one. The alternator seems to be working fine now, it charges 14.1 volts and the turn signal works. My neighbor goes back home and I go for a test drive. I

back up from our yard and BOOM! The fuse is out and the charge indicator is lit again! God was I pissed at that moment!

You might already know what is blowing the fuse, but I didn't realize it at first, so read on. The next day I call my neighbor (who used to own my 100A earlier) and say that it's not working and it blows the fuse. At this time I realized that the alternator won't charge if the fuse is blown, but what the hell is blowing the fuse? The next Monday my neighbor brings me the electric schematic of the 100A and I start checking it out. A-ha! The voltage regulator is in fact a simple relay which goes off when a certain voltage is reached! That must be it! I tried taking the old voltage regulator off, but then the alternator wouldn't charge. I put a piece of tape in the relay to prevent it from connecting. No cheese. The fuse would blow anyway.

Finally I remove the whole voltage regulator and rewire the connections. The fuse still blows. At this point I was just about ready to sell my car to anyone who would pay more than $100 for it. BUT THEN one afternoon when I was leaving school the fuse blew again but for some reason, god knows why, I suddenly realized just what the hell was wrong with it! Thinking back to what we had done to my car in the beginning of the week. The fuse blew on Friday, and on Tuesday we had FIXED THE BACK UP GEAR! The back up had been unfunctional for a couple of months due to problems in the gear shifting. Now that the back up was working, the back up light shorted out the fuse! This I discovered from the schematic. The same 12V goes to the alternator, the turn signal relay and the back up light switch! BINGO! And when the back up lights connect the 12V to the ground, the fuse blows and the alternator stops charging. Why? Because the remote power is supplied to the alternator via the charge indicator, which's other lead just happens to be connected to the fuse that is blowing!

While being in ecstasy (not the drug) from figuring it all out, there was the final phase. Finding out which part of the system is shorting out. The known fact is that whenever there is something wrong with your car and you start searching for the fault, it never occurs. This was the case this time, too. But in a flash of heavenly enlightenment, pure luck or whatever you want to call it I managed to isolate the problem unknowingly. We checked the back up bulbs and they looked horrible. I took the right hand bulb out for comparison. The bulb was rusted inside and had some shit on it. I left it lying on my desk for a few days. Needless to say, the problem disappeared after removing the bulb. Then I checked if the bulb was OK, so I hooked it up on my 2A voltage source. The bulb is 10W so it should consume 1.2A but when I try it, it shorts out my voltage source!

After measuring its resistance it seems to be 10 times too small! So instead of 1.2 amperes a total of 24A is taken when back up lights are lit! That is a BIT over the 15 amperes the fuse can stand. I replaced the bulbs and the problem was fixed.

Now you are asking why the alternator broke down the first time the fuse was blown? When the alternator is revolving at 1500 RPM and charging 14.1V and suddenly you remove the remote power it technically tries to spin itself off from the attachment. That combined with incorrect installation of the alternator can lead to the failure described. The thing where the alternator is attached to is about 4 inches wide and the alternator attachment wings are about 4.1 inches apart. If you don't apply washers between the wings and the holster, one of the wings is to bend and finally crack under pressure. Don't worry, I'm not going to use the same mechanic for repairs again.

So what is the moral to this story? NEVER ever look for the most logical answer to your car problems. The problem can lie just about anywhere as in this case. Murphy's law is in effect even in car electric systems

Here's a story from a reader whose Lincoln wouldn't start.

About six weeks ago, my 100,000+ mile 1980 Lincoln Continental Mark VI 4- door was in the shop for repairs. Seems that it had a few problems that added up to a no-start situation. To make a long story short, my ace mechanic, Don, replaced a fuel injector (damn Ford throttle body system), the ignition coil, and a few other parts. I also had to invest in a complete exhaust system, so I ended up putting a few bucks into my old sled. But its part of the family, so it was worth it. My resurrected Mark VI ran just fine after the repairs...for about three days. Let me digress a bit. Both prior to and after the repairs, my fuel pump was functioning in a loud manner, almost like it was cutting in and out, so I thought that it was failing. The third morning that I had the Mark back, I went to start it and it just wouldn't go! Needless to say, I was quite frustrated. Don came out to the house, but couldn't get it to run either, so he towed it in to his shop. After going through the entire fuel system, it seemed that the fuel pump had failed. But Don, knowing that I was crazy over the whole situation, had a hunch that paid off. He crawled into the trunk, (the trunk???) and presto, the problem was diagnosed! It seems that the fuel cutoff inertia switch, a safety related item, had failed, thus disabling the fuel pump. The problem was corrected on the spot and my pride and joy was back on the road!

Here's a story from a reader about a problem with hard starting and fuel tank woes on Ford F250s.

Okay, here's the story. There is a recall kit for several years of F-250 trucks (including 93) which consists of two in-line check valves and a new fuel pressure regulator. The valves go in the supply line from the fuel pumps to the tanks and prevent fuel from flowing into the tanks from the supply lines. This kit was issued by Ford to prevent two problems: fuel flowing from one tank into the other through the supply lines, and long cranking times due to fuel running back into the tanks after the vehicle was shut off.

The pressure regulator was included as good practice. In my case, I had the two valves and the pressure regulator installed. Sure enough, the long cranking time stopped, but I still had fuel going from one tank to the other. Yes, I verified that fuel was flowing from one tank to the other. The final solution was to replace one of the fuel pumps (only one because Ford wants ~$250 for the things and if that WASN'T the problem, I wasn't out $500). Voila! I replaced the front tank fuel pump, and fuel would still flow from the rear to the front, but NOT from the front to the rear. I will replace the rear pump in a couple of weeks, and the problem will go away completely. The problem seems to be that the fuel pumps were going bad, and not putting out enough pressure to open the return valves in their own tanks, but putting out enough pressure to flow through the return valve in the OTHER tank.

Let me explain. In one of Ford's "better ideas", some turkey decided that each fuel pump should have its return line flow through the pump assembly through a valve. Okay. Not how I would have done it, but okay. However, to make the valve open only when that pump was activated, a minimum amount of pressure must be maintained in order to open the valve sufficiently so that fuel can return ONLY through that valve. The problem is that when that minimum amount of pressure is not available, fuel will flow through the *other* tank's return valve, which is what was happening to me. I suppose it's another way to indicate that a fuel pump is going bad, but it seems like a simple pressure sensor would be better. And cheaper. Anyway, that's what it was. Runs great now. I highly recommend anyone who has one of these trucks and is experiencing the long start-up time to get the valves placed in the lines. It solves the problem immediately

HOW TO SIPHON GASOLINE (OR ANY OTHER FLUID) WITHOUT GETTING A MOUTHFUL

It never fails. Time to cut the grass, storm is moving in and you don't have enough gas in the can to fill the lawn mower. Ah haaaaa, a simple solution, I'll just steal a gallon from the wife's car. She'll never notice it's missing.

Get a length of tubing - stick it in the tank - bring the can over near you and start sucking. Ptoooooie! Yuck, damn that gas tastes awful!

<u>Cut to the chase . . . .</u>

How many times has that happened to you? Well here' the scoop on how to siphon any liquid from any container without even getting close to getting a mouthful.

First, let's talk a bit about liquid and levels and gravity. You might have heard the saying that a liquid always seeks its own level. What that means is if you put a gallon of water in a pail you will expect it to be at the same level all over the surface of the pail. Even if you insert a baffle in the pail to split it into two halves of a pail you would expect that some of the water would seep around or under the baffle and come to the same level on both sides of the baffle.

Now it's time to expand your thinking. Let's take a pail and make provisions to attach a hose to the bottom of the pail on a nipple. Make sure the free end of the hose is not lower than the top of the pail and fill the pail half full of water. No water runs out of the end of the hose because the open end of the hose is higher than the water level. However, if you move the end of the hose lower than the water surface in the pail, water will flow out then. This is true even if the hose is twenty feet long and the end is in another room! The water has a continuous uninterrupted path from the pail through the nipple through the hose into the other room. Ok, we all agree?

Now the secret in the last paragraph is a "continuous uninterrupted path". Let's see what that means. Take another bucket and a five foot length of clear plastic hose. I want to use clear hose so we can see whether or not there is any air in the hose. Fill large glass container, like a bowl, with water. Take the hose to the sink and carefully fill the hose completely with water. You can do this by letting the hose droop into a "U" shape and by holding the ends of the hose at the same level while filling the hose from the faucet. Got the picture? OK, now carefully bring the hose to the table with the glass container of water on it. Put one thumb on each end of the hose, submerge one end of the hose completely under the surface of the water and remove that thumb. Make sure you have no air in the hose (that's why it is clear plastic). Now carefully let the hose droop over the side of the table, keeping your finger on the other end of the hose.

If you now bring the end of the hose with your thumb on it to a point higher than the top of the glass container and release it you will see see something amazing. Because the water has a "continuous uninterrupted" path from the inside of the pail and over the edge of the pail through the hose, the water in the hose will seek its own level! If you put the hose near the glass bowl and sight through the hose and into the glass bowl you will see that the water level in the hose is precisely the same level as that in the glass pot! It ain't magic. It ain't rocket science. It's nature!!

On with the siphon demonstration. Now comes the fun. Get another container and put it on the floor near the table. Slowly lower the open end of the hose until the end of it is just at the level of the water in the glass container. Now lower it one more inch and make sure the container on the floor is underneath. Water freely flows out of the open of the hose. How long will it flow? Until the level in the glass container drops one inch! The water has once again sought its own level. And you have just seen a siphon in action! That's all there is to it.

So let's see how we can apply this to starting a siphon - without getting a mouthful of water (or gas). The secret is to somehow get one end of the hose well below the level of the liquid in the tank from which we wish to transfer the fluid. So take the hose, empty it by just lifting the end way up in the air and let the water run back into the glass container. Now stand on a chair so that you are well above the table and the glass container. Stick one end of the hose in the glass container well below the surface of the water. Now, carefully suck on the other end of the hose and watch the water level rise in the hose. Keep sucking until the water is about a foot from your mouth. While still maintaining suction, carefully bend over so that the hose can droop over the end of the glass container and form a loop which droops down to the table top. Slowly release the suction and watch the water level drop. How far will it drop? Until it reaches the level of the water inside the bucket. But since you have a loop of hose drooped over the edge of the container there is still water in the hose, right? Now lower the free end of the hose to the floor and stick it in the container on the floor. Water will flow out of the end of the hose and continue until the container on the table is empty, assuming that the hose goes to the bottom of the container. That is a siphon. You started it without getting any fluid in your mouth.

So, here's how you apply the principles we just learned to siphoning gas from a tank and into a container so that you can get the lawn cut and stop fooling around with glass containers and tables and water!

First, make sure you have a sufficient length of hose. That usually means six feet or so. I use 3/8 inch clear Tygon tubing so I can see what's happening. Push the hose into the gas tank until it is below the surface of the gas in the tank. If your wife is any thing like mine, that means you have to push a few feet into the tank! Make sure the end is under the surface by blowing into the hose and listening for a bubbling noise in the tank.

Now, from what we learned before, make a long loop of hose such that it goes clear down to the ground and comes back up to a point well above the fuel level in the tank. If you have to stand on a chair to get sufficiently above the gas level, do it! Now suck! Watch as the gas comes up into the hose and starts to flow down the loop towards the ground. It will then start to fill the hose until the gas in the hose reaches the level of the gas in the tank. If you keep the free end of the hose high enough nothing will ever come out. if your stick the free end into a can and lower the free end and the can towards the ground you will see gas flowing into the can. When you feel that you have enough gas in the can to fill the lawn mower simply raise the hose and the can above the level of the gas in the tank and the gas will stop flowing. If you leave the hose in the can, submerged below the surface, gas will start to flow back into the gas tank of the car!

When you are finished, just lift the free end of the hose way up high and let the hose empty back into the car tank, yank it out of the tank and go cut the grass!

Mustang Fuel Problem

Hi Bob, here is a story you may enjoy that happened here in Delaware. My daughter has a 87 Mustang that would not start or run. I tried everything I could, with no luck, so I called the Ford dealer here in town to ask a real mechanic. He told me, "oh yea, the fuel pumps are bad in that year of Mustang. They burn out all the time. Being an Electric fuel pump located in the fuel tank I found this just a little hard to believe. So I called a dealer north of here and asked them. Service put me on hold, for a while, then came back and told me that it sounds like need to put gas in the car! Good call if I was blind, def and dumb! At this point I thought maybe I should do more troubleshooting on my own. I put the car up on stands in the garage. After I crawled under the fuel tank I had my daughter turn on the ignition switch so I could listen for the pump to kick in. No sound at all! I thought I have found the problem, after checking the fuse, it checked good (I even ohm checked it to make sure it was as good as it looked), so now I am ready to go to Pep Boys and try to get the right part.

The counter man told me they didn't have the pump, but did I check the relay? Relay?? Why NO, where is it located? With a big grin he opened his parts book and said he didn't know it isn't in the book, but he was pretty sure it had one. He said it should be somewhere under the dash or "maybe" under the hood on the firewall. Hey it made sense to me so here I am off back home to the garage to find this beast and check it out.

I crawled all over the inside of dash with a drop light, flashlight and mirror. Not quite sure what it looked like. I found nothing under the hood either. I went back down to Ford's. I got a new Relay. They couldn't tell me where it was located in the car but, I figured with the part in hand I will match it up with the bad one, simple but effective! To make this short for you, I could not find this jewel anyplace on this Mustang! I called a Ford dealer south of here to talk to their top man in the garage about the location of this. He couldn't talk on the phone because he was to busy.

OK this is starting to get out of hand. I got into my car and drove down to the Ford dealer south of here to talk to this guru in person. After getting there the man at the counter told me clue where it is and he knew it wasn't on any of the Micro-fish. Then he said he would go ask Jim in the back, he might know. I am standing thinking how did this guy memorize all the Micro-Fish and be so sure it wasn't in there somewhere. This man in his 70's came out from in back and asked me what kind of problems was I having. So I started with day one through, and here I am standing before you. After Jim stopped laughing he told me the reason why I didn't find it under the hood or inside the dash was very simple. Ford put the Relay, (get this) under the drivers side bucket seat. I thanked him and started to leave. Jim yelled to me that next time I called down there to be sure and ask for HIM or no one will get him for the phone!

After getting home I reached under the drivers seat and felt some wires. I was surprised! I removed the nuts that hold the seat down so I could see the exact location for this relay. After I got the seat laying back I seen the relay right where Jim said it would be. Chanced it, herd the pump start when I turned the key and the car ran great! Thanks to Jim. In summary: if you need to change the FUEL RELAY in a 1987 Mustang, you will find it under the drivers bucket seat! I am sure if I would have had the Ford dealer come and fix the car I would have paid for a new fuel pump, labor and hard telling what else. Plus a fuel pump relay! If you think this story is fitting for your web page feel free to include it. I get a chuckle when I think of all the events in those two days. I really do enjoy your web page. Thanks! Vic

Sometimes when you turn the key off the engine keeps running - sometimes for a long time - sometimes backwards? What causes this phenomenon? How can I prevent it?

The most common cause of that is the failure of the anti dieseling mechanism, sometimes an "anti dieseling solenoid", found on most late model carbureted cars. What is happening is that the throttle is remaining partially open when the engine is shut down, which gives the hot engine sufficient fuel to run without a spark from the spark plugs. Most hot engines have sufficient carbon build-up that remains glowing red hot and acts as an igniter for the fuel. The solution is to make sure that the throttle closes completely when you turn off the ignition switch. Check the throttle stop and make sure that the fast idle on the choke or the "bottom stop" isn't what is stopping the throttle from closing. It must be the anti-dieseling mechanism and that mechanism must be functional.

Some motors (Olds for example in 85) used an actual servo motor for this function. The motor drives a worm gear which advances or retracts the idle speed control rod depending on what the computer tells it to do. When it is in the "closed throttle" position and the key is killed it retracts completely to allow the throttle plate to close completely thus preventing the "dieseling" that so many cars are experiencing.

Idling problems -

If you have a fuel injected car and you are experiencing stalling, hunting or fast idle problems one thing you need to check is the idle control system. These systems vary from car to car but there are basically two types. The first uses a small idle speed control servo motor which is driven by the computer. When the throttle is released and the rpms begin to drop this small motor moves a portion of the throttle linkage (gas pedal linkage) to advance the throttle so that the engine doesn't stall - sort of like you depressing the gas very slightly. As the engine rpm approaches the idle speed the computer measures the rpm and moves this small motor to adjust the speed to a set value stored in the computer's memory. If this motor fails to respond to the computer then the engine will either stall or race. If the motor responds slowly then the engine will hunt for the correct idle speed and will alternately race and approach stalling speed. Check the operation of the motor to see if it is moving the linkage.

The second type of control is the idle air control valve. Its job is to control the idle speed of the engine by allowing a small amount of air to get around a closed throttle plate. The system is similar in that the computer is the controlling factor however here the computer sends signals to a small motor that moves a pintle valve which allows air to get into the engine and thus increase the idle speed. This system gets gunked up and causes the pintle valve to stick in one place or to move slowly. The effect is the same as above, the engine stays at one rpm or it stalls when you let your foot off the gas. Remove the idle control system and soak it in a good strong carburetor cleaner to clean the gunk from the pintle shaft.

One other type of IAC system moves a pintle valve by means of engine vacuum. There is a vacuum diaphragm instead of the small motor which moves a pintle valve. Sometimes the vacuum diaphragm fails and sometimes the vacuum passages get clogged up. Remove the valve and check it out.

CRC5-56 isn't just for nuts.

It had rained for most of the day, one of those constant downpours that we see frequently during the spring season here in the northeast. Water had overfilled most of the storm sewers, and flooded underpasses were common in the area. I was driving home in the 64 Chevelle convertible, my wife's dowry, and had been accustomed to having problems in wet weather. It seems that the ignition coil had a hairline crack down the high voltage tower and wet weather played havoc with the 30K volts at the coil wire.

I had pulled up to a traffic light and was the first in line. I saw a similar Chevelle pulled up to the light facing me. The hood was open and the driver was standing there scratching his head. As I waited for the light to turn green he leaned in and tried to crank it over again. I heard the engine cranking but that was all. It was still raining and I knew that he had just come through a deep underpass which I was certain was filled with rainwater. I knew precisely what was wrong - his engine had been drenched with water.

Remember I said I had experienced the same problems? Well, I also had the cure. It was a can of CRC5-56 that lived under the seat on the passenger side. I reached under the seat and grabbed the spray can. When the light turned green I crossed the intersection, pulled over in the center of the road adjacent to the dead Chevelle, stepped out and quickly sprayed his high voltage system with the magic juice.

"Step in and try it now" I knew exactly what would happen. It started like it was brand new. I jumped back into my car, tossed the CRC under the seat and started down the road. The guy yelled after me as I drove away, "Heyyyyy, what is that stuff?????"

I yelled out the window as I drove down the street, "It's CRC5-56 . . . . . you can get it at your local automotive store!"

I felt like the lone ranger riding off into the sunset. No, I didn't yell out Hi, Ho Silver . . . Awaaaaay!"

So what makes this CRC stuff work its magic? Well, to quote a line from "Fried Green Tomatoes", the secret is in the sauce. CRC5-56 is a petrochemical. It's main use is to loosen rusted bolts and it does that quite well. But as a "penetrating" liquid it also has the amazing property of getting down into microscopic cracks and displacing moisture. The dielectric properties of the CRC5-56 are such that it prevents any leakage of current down the high voltage tower on the coil. It doesn't coat the surface like some sprays which then trap moisture inside the hairline cracks. It just pushes the water out of the way and prevents the short circuiting that kills a lot of wet engines.

I get a lot of these type questions. "Whenever it is raining my car runs miserably. Hard starting, misfiring, no power etc. I take the car to the shop on a nice dry day and they can find nothing wrong with it, but they charge me for the diagnosis and it still isn't fixed!" Here is the answer I recently gave to Kim, one of my readers.

Kim, Run don't walk to your pantry and get an empty spray bottle. Fill it with water. Run out to your car when the sun is shining and it's dry and hot out. Open the hood. Start the car. Now be careful here cuz I don't want you coming out of this with a few nubs where there once were fingers - stay away from belts and pulleys - watch out for hot parts like the exhaust manifold.

Set your spray bottle on STUN (we want a fine and directed spray, not a deluge here) and point it at the first spark plug you find. STUN!! Listen - - - did it start to misfire? Yes? Then that is the culprit. Replace the plug or wire or both. No? Then STUN the next plug - keep on until you find the bad guy. If no bad guys are found then direct the spray at the HV tower of the coil - STUN! Stall? Yes, replace the coil,. No? On to the distributor cap. STUN! About here you will have run out of HV things to STUN - If that did it then replace the distributor cap. If not then message me back with details and we'll take it from there. These shops have no imagination. If it isn't raining, make it rain? Duuuh!!!

Distributor

The process to install a distributor is as follows: Crank the engine over until the number one piston is coming up on the compression stroke. You can remove all the spark plugs and crank it over with your finger in the #1 spark plug hole and wait until you feel the compression start to build up. Both valves will be closed.

Next, watch for the timing mark to come to TDC. Stop the cranking there. Now set the distributor so that the rotor is pointing at the #1 position on the distributor, ie. where the #1 spark plug wire would be when the cap was in place.

Insert the distributor into place and make sure the gear is engaged. Then push it into place. The distributor gear is a bevel gear which means that the distributor shaft will rotate when you push it into place. You need to watch to see how much it turns and then compensate by backing off the position on initial insertion so that it is perfectly lined up when it is fully seated.

The oil pump shaft may be driven by the bottom of the distributor. If it is then it may be difficult to get the distributor to line up with the hex shaft in the oil pump at the same time you have the gears lined up. When you are absolutely sure you have it ready to go in and have the gears engaged, just rotate the engine a slight bit until the oil pump shaft lines up and it will go in easily.

Recheck the position by going thru the cranking process described above and make sure that the rotor points to the #1 position on the cap when the crankshaft is lined up on TDC on the compression stroke.

Remember, the crankshaft is lined up on TDC twice as the distributor turns around, once on TDC when the piston is coming up on the exhaust stroke and once when it is coming up on the compression stroke!! Don't get the two positions confused. Make sure you are on TDC

Headlights are turned on!! Why??

I just had an experience this morning with Ford trying to nail down a problem that has been hassling at least four of my customers with late 80s Ford F-150s. Occasionally, when turning on the headlights or using the flashers the engine stumbles for an instant - this has been bugging me for a year or more and I even stopped by the local Ford shop last spring to ask if the service manager knew anything about the symptom. No clue, was the answer.

I was poking through the TSBs on my vehicle and came across the following:

272. 881616 AUG 88 An Engine Stumble/Miss When Headlamps On/Off

WOW!!! The actual problem I was trying to solve was listed there in terms even I could understand!!! Next problem was to find out what the service bulletin said! A call to the local Ford dealership yielded a dead end, even with the actual TSB number in hand. I was given a "Hot Line" number to call 1-800-392-3673 where I was connected to a very polite but highly un-knowledgable young woman who didn't even know what a TSB was. After 15 minutes of working with her on the phone it was determined that she could not help me either, and I was given an address to which I could write to get the information I needed - maybe. That was her only call escallation procedure! She wouldn't even connect me to her supervisor!!

Not wanting to look for an envelope and a stamp and feeling that there must be a better way than snail mail I started calling other Ford dealerships. On the third try I hit gold!! The service manager actually read the TSB to me in its entirety - "connect a ground strap from the headlight surround sheet metal to a good engine ground, preferably directly to the battery ground strap" He even gave me a Ford part number for the recommended strap assembly!!

From what he told me I concluded that there must be a ground loop generated thorough the sheet metal surrounding the headlights and directional flashers. I used a piece of 10 gauge wire with a fast-on ring terminal on each end instead of the Ford part and installed it today. So far, after a dozen attempts to make it stumble with the high beams it hasn't done it yet!

Cold weather = cold air = more dense air = =less fuel/air mix = lean mixture = rough engine.

Normally the colder air doesn't bother performance if the mixture were correct in the first place. Whenever I hear about a car that performed normally in warm weather, but is acting up as the weather turns colder, I always suspect a vacuum leak which is causing an even leaner mixture. There are many possible sources of vacuum leaks such as loose or cracked vacuum hoses or possibly a loose carburetor, where it bolts onto the intake manifold. Failed seals around an injector can also cause a severe vacuum leak - especially to one cylinder. In addition I look for a sticky EGR Valve - I remove the vacuum hose on the EGR and drive it for a while to see if the symptoms go away. An absolute check of the EGR Valve is to remove it completely and block the hole in the intake manifold with a metal plate with a gasket between. A visual inspetion of the EGR can determine if it is closed when removed. I also check for a

sticking or faulty PCV valve. If that is open at low speeds or at idle it can play havoc with performance - again, a lean mixture. Basically, check anything that is connected to the intake manifold that uses vacuum from the engine for any reason.

Other possible causes for poor cold weather performance are the diverter valve, a faulty thermostat which causes the engine to operate unheated and sends "cold" information to the computer, a faulty coolant temperature sensor which sends erroneous "hot" information to the computer and a faulty heat riser valve in cars that have them. A heat riser valve is the device that causes hot exhaust gas to be circulated under the intake manifold to improve the vaporization of fuel, especially in cold weather conditions.

Radiator

I get a lot of questions as to why the engine is running hot - way above the normal range on the temperature gauge. Here are a few things to check out.

First, make sure it IS really running hot. It may be a failed temperature sending unit. Check the coolant temperature with an accurate temperature measuring device.

If it really is running hot check the thermostat. Remove it and put it in a pot of water on the stove. Heat the water while monitoring the temperature. The thermostat should open at the temperature stamped on it, normally 190 degrees F.

Next, are you losing coolant at all? I mean an internal leak as in blown head gasket. Have the coolant tested to see if there are combustion by-products in it which would indicate that combustion gasses are getting past the head gasket.

Next, check the cooling fins on the radiator to ensure that they are firmly attached to the cooling tubes. Salt from the highway will corrode the solder and break the bond between the fins and tubes thus preventing sufficient heat transfer from the coolant to the atmosphere.

Do you have electric fans? Are they turning on while idling in traffic? If not then find the problem and resolve it.

Of course if you are losing coolant from a leaking radiator or hose or possibly from the heater core, fix it!!

Anti-freeze contains a lot of chemicals that do more than protect your cooling system from freezing. Most good brand name anti freeze products contains anti-corrosive chemicals which are especially important to engines that contain aluminum parts. Therefore it is a good idea to flush out the coolant each season or at least every other season and replace the anti freeze to gain the protection from the new fluid.

Most engines have drain plugs on the block so that you can ensure that you drain all of the old coolant. these plugs are usually very hard to get to as they are hidden behind the exhaust system and other components on the engine. As a result most people don't drain the block. If you want to make sure you get all the old stuff out you can flush the system with cold water, then run the engine until the thermostat opens (feel the top hose and run until it gets hot) and then shut it off and drain it again. If you do this a few times you will basically remove all the old coolant by a dilution process.

Now comes the rub. You have pure water remaining in the heater core and the block so how much anti freeze should you add to ensure that you get the correct mixture (50-50) ? Look in your owner's manual and find out the capacity of your cooling system. For example let's assume your system holds 8 quarts.

The simple answer to the question is just add 4 quarts of anti freeze and then top it off with water. But what happens if you can't fit 4 quarts in the system due to the amount left in the block and heater core??

Here's the trick. On the last draining, drain the coolant into a drain pail and measure the amount of liquid you were able to remove. Let's assume you could only get out five quarts - that means there are three quarts of pure water left in the cooling system. In order to ensure that you have a 50-50 mixture of coolant you need to add an equal amount of anti freeze so just add 3 quarts of anti freeze to the system. Now you have 6 quarts of 50-50 mixture in the system. In order to make up the difference just add 2 quarts of 50-50 mix (one quart of water and one quart of anti freeze) to the cooling system and it will be topped off with the correct mixture of anti freeze and water.

I also get a lot of questions as to just what to do with the old coolant that is drained from the system. I called the local conservation office and got a recommendation from them. Check the local laws in your community. Call 800-424-9346 to find out the latest recommendations from the EPA as to how to dispose of antifreeze. Our local conservation office told me to dilute the antifreeze solution with water at a ratio of 10 to 1 and dump the coolant down the sanitary sewer drain. It seems that the bacterial in the sewer effluent will break down the anti freeze into components that can be handled by the local disposal plant and will not harm the environment. DON'T DUMP IN DOWN THE STORM SEWERS. IT IS TOXIC IN ITS ORIGINAL FORM AND WILL KILL ANY ANIMAL THAT DRINKS IT! It also stands to reason that you shouldn't leave it standing around in open containers since a dog or cat might drink it - if it does it will die within a day unless it is treated by a veterinarian!

I had a failure of a GM Olds 88 cross-flow radiator--some of the top tubes pulled out of the tank on one end--so I took it to the radiator shop, naturally. The owner mentioned that he was glad GM made that model, because it surely carried him through some lean times, what with running with air in the tubes. I got to thinking about that after I had another failure, and here's what I figured out:

The cooling system gets air into it and creates a temperature difference between the top tubes with the air, and the bottom tubes with coolant in them. This in turn makes an expansion difference which eventually pulls the tubes out of their solder joints. NOW..."Where does the air come from", you ask. The coolant-recovery tank is there to eliminate that problem, right???. OH, but it IS supposed to!

GM, in all its corporate eagerness to cut to the lowest cost on everything, makes (or outsources from Timbuktu or Elbonia) the coolant-recovery tank with a blow-mold with its halves which almost line up. (If they lined up and were properly maintained, it would cost more to assure quality.) The result is a small ridge on the inlet line where the tube to the radiator clamps on. This ridge allows air to be drawn in.

Since you read the owner's manual, you dutifully fill the tank with 50/50 mix and the level stays where you left it. Or, and you won't notice this, it overflows--but while you're driving. What happens is the coolant heats up and expands into the tank, as it should. When it cools down, though, instead of slowly pulling coolant back into the radiator, it pulls air by the little ridge under the hose clamp, because that route has slightly less resistance to air flow than pulling coolant the few inches from out of the tank.

So your tank level remains constant (or, as most diligent operators only note, it has coolant in it...), while the radiator has increasing air in it. The result is eventually that described above: tube pullout and a trip to the garage or to the dealer, where they will cheerfully sell you a new radiator, installed, for many hundreds of $$$, when the problem is original design.

I have never seen a maintenance alert on this. In most cases it won't happen until the warranty is expired, so manufacturer attention to the problem is, let's say, spotty...

Hope this helps some of you out there! I'll send some more of these insights as I get time...

For now, let's curse side-post batteries (Delco in particular) for their sorry little green/red window and impossibility for jump-starting, and for acid leaks by the terminals where they pass through the plastic--corroding and doing weird things to operation.

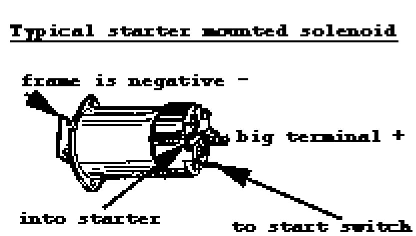
CHECKING OUT A STARTER MOTOR AND SOLENOID

Starter motor problems usually are indicated by the following symptom: Turn the key to the START position and you hear a loud click, or sometimes you hear nothing. The headlights are bright and don't dim when you turn the key to START, and everything else electrical seems to work fine. It could be a bad starter neutral switch or a bad key switch but about 99% of the time it's a bad starter or starter solenoid. Here is the procedure for checking out a starter motor and its solenoid.

Problems in a starter motor normally involve a "bad spot" on the commutator, the electrical section of the armature that contacts the brushes. They get dirty and worn down. The brushes sometimes wear out but not normally. Open circuits can occur in the armature or in stator windings. You could fix these problems but the normal procedure is to replace the starter with a rebuilt. If the starter motor armature just happens to stop on a "bad spot" the circuit is open and the starter won't turn. Sometimes you can "rock" the engine by hand (be careful - make sure the ignition switch is off) or in a standard transmission car you can put it in gear and "rock" the car by pushing it forward or backward a few inches - this can move the starter motor off the "bad spot" and get you on your way, but it's a crap shoot as to when it will happen again. Sometimes rapping the starter with a hammer can make temporary contact where the contact was flaky, but you can do more harm to the starter than good if ya hit it too hard!!

You can diagnose the starter by measuring the current draw. You can purchase a small "clamp on" ammeter that you simply lay on the cable to the starter - ya don't have to disconnect anything. Crank it and watch the little needle tell you what the current is. If there is a high current draw then you know that the starter is at fault. There is one main reason for a starter to fail when it is hot - worn bearings, especially in the tailshaft. The heat generated in the starter by the engine and the exhaust pipes (sometimes) causes the armature to expand. If the bearings are worn then the armature drags (actually contacts) on the stator causing a short circuit and a high friction drag. Sometimes just replacing the bearings can fix the problem.

When checking out a starter motor it is a good idea to remove it from the car and lock it firmly in a vice. If you don't hold it down securely, like in the jaws of a vice, and it turns out to be good, it will twist rather violently when it spins and possibly fall off the bench onto your big toe - could really ruin your weekend. You can do the following test with the starter in the car but it makes it a bit more difficult and there is a chance of shorting out the test jumper cables to ground.



Referring to the above diagram, the "big terminal" on the starter solenoid is where the battery + cable goes. There are one or two smaller terminals on the solenoid, one going to the "start" position on the ign switch.

On a bench test, the negative battery jumper cable goes to the vice that is holding the starter by the frame. The Positive goes to the "big terminal" on the solenoid. Jump from the big terminal to one of the smaller ones with a jumper wire or a screwdriver blade to actuate the solenoid. It should click and the starter should whirrrrr. If it does, don't get carried away and let it spin freely for a long time - it's not good to run a starter with no load for extended periods of time, especially an old and tired one.

If it doesn't spin, look for another "big" wire going into the starter. On GMs you can usually see it at the other end of the solenoid - it goes into the body of the starter. I'm not sure about other makes and models. Look around. Carefully touch the + jumper cable to it and the starter should immediately whirrrr and you should get a good sized spark - that is normal - the starter is a heavy current eater.

If you get no whir from that test then the starter motor is fried inside. You can take it apart and see if it is fixable (new brushes, a clean-up of the commutator and possibly new windings, but at that point I would suggest a rebuilt starter/solenoid assy.

If the starter did whir on the last test then you can remove the solenoid and either rebuild it or replace it, the later being a good idea. The new starter will come with a new or rebuilt Bendix drive which is probably next in line for failure.

When going for a new starter make sure to bring the old one along with you. First, you can match it up to make sure the computer picked the right one for your vehicle and second, they charge a "core charge" for the old one - they want it back to be rebuilt and sold again. Just to make sure you got a good one you should bench test the new starter - it wouldn't be the first time a bad rebuilt was shipped.

Transmission

My son has a 93' Explorer with 75,000 miles. His transmission (auto) recently began sticking in 1st gear when first started in the morning(cold). Once the vehicle is driven 2-3 miles the transmission will start shifting to 2nd, 3rd and 4th. Several transmission shops recommending rebuilding the transmission at costs from $1,500 to $2,000. My son being an engineer reasoned that a sticking problem did not require a complete overhaul, so he drove it for six months until he could come to visit us in Houston. I went with him again to several shops and we got the same story, need an overhaul.

Our last visit was to a Ford dealer parts dept. for a factory manual, with hopes for information on transmission troubleshooting. While talking to the parts men I ask if they heard of the problem. I was told to see the service manager. He said that if the transmission fluid got dirty the close tolerance fit of the speed governor would cause sticking and cause the problem. The service manager printed a drawing and showed us how to fix the problem.

The governor is inside the tail shaft housing which can be removed without taking out the transmission. The governor is just a weight which is attached to a hydraulic piston which when pulled out by centrifugal force causes hydraulic control fluid pressure to be diverted to cause shifting from 1st to 2nd gear. A light spring pushed the weight/piston back when speed is reduced to allow downshift to 1st.

When we pulled the tail shaft housing we removed the weight/piston assembly and found them stuck in the aluminum housing. Once removed, cleaned and polished the assembly moved very smoothly. We change the output shaft seal (slight leakage), transmission filter, gasket and fluid. THE TRANSMISSION WORKED PERFECTLY !!! The transmission fluid was over due about 15,000 miles for a change. I believe the timing is 30,000 miles. My son learned the lesson of necessary maintenance.

I just wanted to submit a story so that others can maybe avoid the expensive problem I had. I have a 92 Mazda Navaho, which is exactly the same mechanically as a 2-dr Ford Explorer.

I have a 5 speed manual transmission. I have since found out (the hard way) that there is a serious problem with this transmission. Apparently, the shifter plugs on the top of the tranny tend to dry out and leak. It is a slow leak, but since it is at the top, it does not leak unless the truck is moving. I changed the transmission oil at 25 and 50 thousand miles, the fluid level was not low. To make a long story short, After 50,000 miles the transmission oil all leaked out on the highway, leaving little or no sign on my driveway. I think you see where this is going.

I unknowingly ran the transmission dry and killed it. I replaced the transmission with the latest model. I hope that the problem is solved, but I will now keep an eagle's eye on the fluid level. The mechanic I talked to said that this is a common problem with this tranny, but Mazda (or Ford) has not said a word about it. No recall, no nothing.

If you have this year and model, get under your truck and check the fluid level in the tranny. Check the rear seal, if it looks like it is weeping, most likely, your shifter plugs are hosed and the oil is finding its way around to the rear seal and soaking it. Replace the plugs immediately and maybe you can avoid my problem.

Good Luck.