Jim Hill's primer for

PREVENTIVE

MAINTENANCE

And RESTORATION TIPS

FOR YOUR ANTIQUE AUTOMOBILE

2010 EDITION

retail price: $5
+ p&h

INDEX to Preventive Maintenance

Introduction

First thing to note.... **This compilation is copyrighted**. But, far as you're concerned, all that means is that you can't copy it to sell it; I can. You may copy it for your own use because you need copies to use in your shop and to keep yearly records, and then you can keep the original in your office where it's safe from oil spills. And you can show it around to your buddies. 'Nuff said. Now, I have received a lot of help and suggestions on this primer, and I would like to share it around. Feel free to show it around for your buddies so they can see what guidance they need. And if you come across ideas or procedures that need changed or added to this, please forward it on to me so I can tell others. That's what the hobby is for.... It's as the Packard brothers, long ago, advised when they said...."**Ask the man who owns one";** my comment is now **"Ask the man who knows how."**

Technicalities aside, this little booklet comes to you with my **absolutely perfect guarantee**. I'll fully refund if at any time you feel this primer won't help you in your restoration project as much as it cost you, which is projected to be $5 if bought at shows, $5 + $1 s&h if bought through the mail. My guarantee: If you don't think this publication is worth what you paid, just let the me know of your dissatisfaction, and your complete investment will be refunded to you in US currency and you will also get a suggestion to pass on your copy to someone else (who has antique autos) at no cost to them; don't return it to me. I'll bet no one else makes you a guarantee like that. I got confidence in my experience.

Second. You need to keep records concerning what you did, when you did it, and what parts or supplies you put into the auto. This will be good reference for you when you need to check things and it will also give good proof of what you did to maintain your auto whenever it goes to a new home. Copy the records pages, then record on them everything you can, including brands of parts, part numbers, and sources, and store those sheets in a notebook. In addition, that info will help someone else get into their own project.

Third. Preventive maintenance doesn't cost you anything. It actually pays dividends. I discovered this on my first "new" car. When I sold it several years later, the motor was still "like new" and I actually got more for the car (that's above what I expected) than what all the maintenance cost me while I owned it. And preventive maintenance also reduces the possibility of a problem on-the-road. Consider what you would do if you had a brake or radiator problem stop you in Punkin Center, Colorado. There's virtually no service there and parts come out of Colorado Springs, 60 miles to the west. You'll sit there in a 2-horse town motel for 3 days (snack food in the local quick shop) until parts get back and get put on, to get you on your way. How much more will you save by doing the repairs at home **before** they are needed???? That's **before** the system "goes south" on you? The Kanter brothers have a motto: **"Do it once and do it right"**. That makes sense; make it your motto.

Fourth. During a restoration you will have opportunity to repair items, or you can just ignore them. It will be cheaper, at the moment, to ignore them or just patch them to get the car going. But a patched system may die the first time you get it out on the street/highway and you'll spend more to get the car towed back home than what the parts would have cost you in the beginning. You will find that the time and effort to dig back into the system to fix it, is time worth far more than those parts would have cost you the first time. Sure, you'll spend more than you had planned, but you will also know, while you are driving around, that certain systems won't die on you when you least expect it. "Smile, you **won't** be on Candid Camera."

Some of the suggestions here may seem like they are really "going out on a limb". They sure are. But in the long run, spending a dollar now will prevent you from having to spend ten dollars later on. I like those

odds, but then I'm not a gambler. And it's the inconvenience that costs you the most when it's out on the road.

Know also that I publish a little 8-page pamphlet on safety in the auto shop. It is available costing only the postage: two first class stamps. It's intended to give you something to think about before you get hurt on your project. E-mail for info about it.

 James Hill
1419 College Drive
Emporia, KS, 66801

E-mail to **jnrhill@att.net**

A RECORD OF REPAIRS, PARTS, SPECIFICATI ONS

Keep These Records.....

WHAT YOU DID on **YOUR CAR:** _____
(and the date of maintenance)

OIL: changed on _____ (date) _____(miles)

brand used _____ weight used_____

FILTER: changed on _____ (date) _____(miles)

filter used _____

where bought _____

BRAKE FLUID: changed on _____ type _____

ANTIFREEZE: changed on _____ (date) _____ (miles)

brand used _____ temp check _____ (degrees)

additives put in _____

flexible hoses replaced_____

brand_____ part number _____

BATTERY CHECK: topped up: _____ (date) _____(miles)

battery brand _____ model _____

new at _____ (date) _____(miles)

TIRE PRESSURES: RF _____ RR _____

LF_____ LR _____

L sidemount_____ R sidemount_____

Spare _____

BEARING IDENTITIES (brand & number)

Front wheel inner:_____ Front wheel outer :_____

Rear axle:_____

Transmission front:_____ Transmission rear:_____

Transmission center:_____ Overdrive rear:_____

Driveshaft front:_____ Driveshaft rear:_____

Differential (1) :_____ Differential (s) :_____

SEAL IDENTITIES (brand & number)

Front wheel:_____ Rear wheel:_____

Transmission front:_____ Transmission rear:_____

Overdrive rear:_____ Rear axle:_____

You now have a listing of what you need to check when you get your auto ready to drive. As you get the car ready to drive, check all the above levels and values to be sure everything is full or up-to-par. Don't think you can ignore anything in the spring just because you checked it last fall; **check it again!**

"Appliances"

Many cars used "appliances" made by other companies. For instance, many electrical parts were made by Autolite and by Delco. While they may have connecting surfaces that were unique, the actual pieces may have been a standard unit. In general, these may include distributors, generators, starters, alternators.

As an example, while a distributor for a Packard is unique to Packards, they include many internal parts that were used on a lot of other cars. Therefore, you can do your shopping for these internal or common parts at any swap meet. For example, points, condenser, rotor, distributor cap for my 1940 Autolite-Packard will be similar or same for many other cars that used Autolite in the same years. Likewise- a Delco system used in a Chevrolet may have also been used in many other cars fitted with Delco, including a Packard. You may not be able to find these parts "over the counter" but you have a wider shopping range at a swap meet. And controls (switches, voltage regulators, etc) are probably widely available and similar.

For many cars the starter and generator were of a unique shape or dimension, but it happens that they may have the same armature as many other cars. To find out what will fit or interchange, you need the "**Hollander's Interchange Manual**". This was a common-fit identifier used by "junk yards" 50 years ago. The company has reprinted some of them as books that cover certain years. Contact them at 14800 28th Ave N, in Plymouth, MN, 55447, 800-825-0644. These books are often available in your local library. If you are starting a project, you may find their books wonderfully valuable! Learn how to use them.

Sometimes appliances were not made for a specific car company but they turn out to be unique. For instance, water pumps and shock absorbers. You will probably end up having your original pieces rebuilt. Sorry, but that's about the only route you can go. Again, you may have to look through **Hemmings Motor News** to find the companies that rebuild these. In other words, some sources are handled by Helen Hunt- you need it, you'll go to Hell 'n hunt for them. Hey- nobody ever promised it would **all** be easy.

Now, here's one other far-out source to consider.... During WW-2 a lot of things were made for military vehicles and machines. And a lot of these parts may have ended up in some "army-surplus" stores. Hey, it's worth the bother to go doing some shopping- you never know what you might find. If you find something, buy a lifetime supply while you can. You an always swap 'em off at a later time. Old-car-men are suckers for a good deal.

Windshield wipers were often made by the Trico company. They've since sold out all the "old" parts to a company named Ficken (advertising in Hemmings). The vacuum wiper systems are rebuildable. Electrics may be a bit more difficult. You may be able to clean the old vacuum motor with solvent and make it work or have Mr Ficken do it.

Carburetors and fuel pumps are easily rebuilt. There is very little of the "body" really that wears out. You can buy rebuild kits and take it from there to clean and replace and adjust. A professional rebuild is expensive but you get back a piece that's like-new if that's important. More about this in the fuel section.

Brakes

The brakes of a car are as important as the motor. The motor gets you going and gets you there; the brakes stop you before you rely on a tree or another car to do it. 'Nuff said.

The parts of the brake units are often industry standardized but not all of them. But if they are standardized, you can find them if you have a friendly counter-man who will take the time to compare parts and look for "interchanges". If you can find brake shoes that will work, get rebuilt pieces. If you can't find rebuilt pieces, you can probably find a local repair shop that will reline your old brake shoes. As a last resort, shop through **Hemmings Motor News**.

The wheel cylinders are fairly standardized. It is actually cheaper to buy new cylinders than it is to have yours rebuilt or refurbished, so have your friendly counter-man try to find cylinders that are close enough to yours to work. I have found that if you can find modern cylinders that are close enough to work, but no more than 1/16th inch larger diameter; those will also work as long as you replace both fronts or both rears. For example, my '40 Packard uses 15/16" diameter cylinders in the rear end. I can replace both cylinders with 1 inch diameter and they will work fine. Cost is around $30 each.

There are probably three flexible brake hoses- one to each front wheel and one to the pair of rear wheels. During the initial rebuild, replace all three with new ones. You may have to go to 1 or 2 inches longer, but do what you need to. The metal brake lines around front-to-back of the car auto are **steel**. These are industry standardized tubing so replace all of them with new steel lines. Some people "push" stainless steel; **never** use copper!

The master cylinders are probably unique to your make or model of auto. You may need to have your master cylinder rebuilt if you can't find a new one at a swap meet. Several companies advertise in **Hemmings Motor News** that they do this rebuilding. They hone out the cylinder and then put in a new liner to the original dimension along with the proper rubber seal parts. Cost is around $75-100.

If you have no idea of the condition of your brakes, take apart the right front wheel assembly. See how things inside are. If they are clean and dry, you probably don't need to do anything or at most, replace the brake shoes and rubber brake cylinder seals while you are in there. If anything in the right front wheel needs work, do it while you are in there, and plan on doing the same work on the left front wheel except **only after** you complete the right side. And if both front wheels need work done, it is a sure thing that both the rear wheels need the same even if they don't give any indication of the need. Catch it before they catch you.

OK, and while you are into the wheels & brakes, you've got bearings & seals inside there. Most likely each front wheel has an inner bearing and an outer bearing and a seal that keeps wheel bearing grease from getting out into the brake parts. These bearings usually are not real expensive so you might as well go ahead and get enough for doing both sides. Four bearings for the two front wheels will probably cost you $60 to $80 and the seal will cost about $10-15. But once you replace things like this you know you'll probably never have to do it again and the car won't leave you setting out along the road in Punkin Center, Colorado. (Yes, it does exist- it is just 75 miles east of Pike's Peak which is visible off in the distance; and not much service in the little town.)

ELECTRICAL

As you make repairs and restoration efforts, you will find that electrical devices often don't work any more. They often quit working because something else in the system has quit. For instance, the purpose of a switch is to make or break an electric circuit; you pull the knob to turn on the lights and they don't come on. Lights work because electricity flows through them. No electricity, no lights. There are several reasons. When the wiring harness for your auto was made, it was probably made by crimping wire ends onto the wire bared at the end. That becomes metal touching metal. Good and easy. But with 50 years of aging, the copper wire corrodes and the wire ends corrode, and electricity can't get through the connection. So what to do?

You can first check with a volt meter whether electricity is getting to where it is supposed to go. But that doesn't tell whether there is **enough** electricity getting through, just whether some (and volt meters usually operate on millivolts and milliamps, not 6 or 12 volts and not 10 amps).

My next thought is to make a "jumper" wire of a sufficient length to go "from here to there", maybe 20 feet (the extra can be coiled up and stuck away somewhere until you are done with the diagnostics). Make it of the same gauge (size) as the original. Put on wire ends (open ends, not eyes) and solder them on using rosin core solder. You can use this wire to run between the pieces you suspect have a problem to tell, quickly, whether it is the wire or the other operating pieces. If the system works, it's the wire and you make a replacement wire, or you clean and put new wire ends onto the original wire. But this time, you **solder the end** onto the wire, not crimp it.

There are often several pieces in a circuit, so you may have to check several pieces: a switch, wires, operating unit, etc. While you are checking each unit of the circuit, my suggestion is to replace the steel screws with brass ones. You can keep originality by using nickel-plated brass. Better connections.

Sometimes your problem is a light bulb. I've found that during a restoration, never use the old ones- throw them away and **use all new ones**. Hey- they only cost a quarter to a dollar apiece, and it isn't worth that much to fiddle around with an old bulb. And, chances are, the new one will probably last forever anyway; you'll never have to replace it again.

If it's a light bulb that doesn't work the problem might be a dirty socket or dirty connection between the socket, the lamp fixture, and the frame. If you're doing a restoration, solder a wire onto the outside of the socket, and run that as a ground wire along with the other wires until you can find a good clean place to fasten that ground wire to the frame or body. I ran into this one time when, after a paint job, half the lights of the car worked. Paint is an insulator! I got caught!

Let me look at other electrical items. If your headlights "glow" instead of "shine", maybe it's because of poor electrical connections. It may also be because of wires too small to carry the necessary amount of electricity. Lights in the 1930s and 1940s usually operated on currents of 2 amps for small bulbs to 10 amps for a large one, including headlamps. Modern lights operating on the same voltage might need twice that amount of electricity. If you rewire your auto, make sure that the lights have wires large enough to give them enough electricity. An easy guess is to go to the next larger wire size. If the original wiring had #16 wire, when you replace it, use #14 (bigger size number is smaller diameter). If you don't know what I'm talking about here, talk to an electrician- he can explain it with examples of various wire sizes. As an

example, in your home, #14 wire will carry 15 amps; #12 wire will carry 25 amps, #10 wire will carry 30 amps. See the difference?

There is the old complaint that the 6 volt systems just don't work well, and they don't give enough power to make the starter spin the motor. But it's often the wire, and not the starter. An old battery cable may have poor conductivity- another reason to replace it with a new one with clean connections. It's hard to find a heavy enough battery cable but you can get one from a "farm & ranch supply" store. They will have cables of any size and any length. Use the largest cable you can get to fit and which you can handle. Never use a small cable the size of a pencil as it just won't carry enough electricity, even if you have a 12 volt system.

When you consider that the starter may pull hundreds of amps of electricity in order to get the power, a little restriction can easily reduce the motor's power. But now consider- some cars are built with the starter "grounding" to the engine, and engine to the transmission, and the transmission through the gears finally to the frame at the rear end because all the rest of the system is mounted on rubber blocks. All that power has to go through the drive system. Not good! My recommendation is to get or make a grounding strap to run from the engine directly over to the frame. Use good bolts at least 3/8 inch diameter, even as large as ½ inch. A good connection can be made directly from the frame of the starter (where it bolts onto the engine) going directly over to the car frame near it. Some people will say it's "overkill", but you could even put on **two** grounding straps between the engine and the frame. Give that poor old starter all the help you can.

What about the generator? The old ones have a lot of mechanical needs. If you are trying to stay "original", you're stuck using an old generator although you can get yours rebuilt. And you may get it rebuilt to a greater amperage capacity in case you have installed air conditioning which draws a lot of electricity. But if you're not serious about "original", you can get the modern alternator. They have a higher output or capacity and you can get them with a voltage control already built into them; just mount them to the motor and they are ready to put out the electricity. Only thing you've have to watch is that your battery or system "polarity" is the same as what the alternator is made for: positive or negative ground?

The polarity of the electrical system is partly controlled by the spark system. Yes, there is a polarity in the spark. The polarity can be switched by changing the wires bolting onto the coil- some coils are marked "+" and "-" and the signs correlate to the polarity of the battery; it also relates to other appliances on the car such as radios. You can switch the polarity of the car but it's not always easy; there's no need to, though.

If you plan to install appliances (sound, air, lights, etc) that require a significant amount of electricity, plan to connect their supply wire to the battery cable post on the starter or starter solenoid, if possible. Use a wire of a size large enough to carry the electricity required, and use wire ends that are soldered on; don't crimp them. At a convenient place, mount a holder for a fuse that will be only large enough to carry the amount of electricity needed by the appliance. Remember, some of those appliances will also need a ground wire run between good connections.

Older cars have switches for headlamps that were not very strong. Modern lamps may draw more amperage than the original dash switch can handle. Such lights may require installing a relay so you don't overload the dash switch. A simple relay to use is one that was originally intended for a horn- it requires about 1 amp to operate it but it will "switch" as much as 30 amps. That's a simple remedy for a situation where the original is not convenient to clean or replace.

Fuel System

The motor runs because it has three things: fuel, compression, and spark. Any time the motor won't run, you need to methodically check out each system to be sure each is functioning. In this section, I'm going to look at fuel because it is becoming an increasing problem when we use modern fuels in antique autos.

Let's start at the motor. The carburetor has three main parts- a tiny tank that receives gasoline from the pumping system and then stores it until it passes through a metering valve into the moving air. The little tank is an excellent place for heavy sediment to build up in the bottom to eventually plug up any further movement through the carburetor. The metering valves are a small enough opening that even a small amount of sediment can plug it up. Air is metered by a flapper valve right in the middle.

None of these parts presents much of a problem; the biggest problem is a valve that controls the amount of fuel into the carburetor. It is operated by a float in that tiny receiving tank. In old carburetors that valve is usually a brass cylinder with a point that seals against a brass body. The brass often corrodes enough that it doesn't seal any more. Your only choice is to replace this valve, a quick and easy replacement if you have another one. They are often similar between different car makes because many of the carburetors were an appliance supplied by an outside company such as Carter. And every kit has a new one for you.

That's about all there is. It all needs to be clean and gaskets must seal so that there is neither fuel leaking out or air leaking in. Carburetor repairs are easy to make with very simple tools required. Rebuild kits can be purchased to supply everything you replace, so you go shopping at the dealers who supply for your make of antique auto. While you are shopping, you can get a fuel filter that will screw directly into the carburetor to pick up very fine sediment (rust). It's good insurance.

The next part of the fuel system is the fuel pump. It appears simple but it really is more complex. An arm is activated, usually by the cam shaft. That arm pushes or pulls on a diaphragm which is the main pumper. The fuel passes through a set of one-way valves (one letting gas into the pump body, the other letting it out. Simple. The usual failure is in that diaphragm developing a leak after millions of flexes. Second are those valves which age and become scratched on the surfaces that seal. Third, there is a seal around the shaft that pulls that diaphragm. A rebuild kit supplies you with everything you need to replace everything that ages and quits working. Buy it from the dealers who supply for your make of antique auto (do not buy new OLD stock kits- they won't last). Repairs are easy to make with very simple tools (mostly a screw driver and a vice to hold the parts). The fuel pump may also have a second diaphragm system to develop vacuum for windshield wiper; I'm not going to touch on this because it does not affect the running of the motor.

I have one warning- The fuel pump usually connects directly to the side of the motor. If the seal leaks around the actuating shaft, it may leak oil out, letting it drip off the fuel pump. If the fuel diaphragm leaks, fuel may run into the oil pan. If you notice oil level increasing, you may need a repair on the pump, and soon! Fuel leaking into the oil dilutes it and causes it to lose lubrication capability- that's hazardous to your motor!

Between the fuel tank and the carburetor there will be two pieces of metal tubing, often 5/16 inch diameter, and one piece of flexible tubing. If they are not in perfect condition (look for rusty leaks, flex-kinks, flattened places in the metal), replace the tubes. You can get steel lines at your automotive store of the right diameter and about the right length, with fittings already formed on the ends (they're standard). Bend it to

fit. The fittings tighten with special box-end wrenches made for that purpose. Don't use open-end wrenches, they just don't work, believe me!

There is a flexible line, usually near the fuel pump. It is a major cause of blockage because the material of the flexible part ages and absorbs fuel and expands, choking off the line. If this line is old, just go ahead and replace it with a new one because the new one will last your lifetime.

The fuel tank has hidden problem you don't think of. It is usually steel which may be galvanized or tinned inside. It rusts. Rust plugs up the whole system clear up to the carburetor. If you don't know what is inside, take off the tank for a major cleaning. You will probably find small rust-out holes in the bottom. You will probably find lots of rust flakes and leaves and other crud inside. I don't mean to imply that you are not "capable", but I strongly suggest you take the tank to a business that repairs them for them to do the cleaning and repairs because you may be working with hazardous materials and flammable vapors. And they'll do it right! This is one time to spend your dollar.

That fuel tank probably has a level sensor: a float and a resistor unit, usually in the top, in the middle. That can be repaired if yours is rusted and not working right. It comes off with about 8 to10 simple screws or it twists 1/8th of a turn in its special socket. A part of the sensor assembly is usually the dip tube through which the gasoline draws out, usually 3/8 inch diameter. It goes clear down to the bottom of the tank. Here you can get creative. There is a special brass screen, a very fine mesh. Buy a piece that is about 6 inches square. Cut that into a 4x6 piece to bend into a 4 inch long cylinder. The remainder can be cut into two squares to close the top and bottom of that cylinder. Solder seal all joints of this piece and one of the ends was previously cut with a hole that will tightly slip over that dip tube. Slip this filter over the dip tube just before you install the sensor unit back into the tank. This will block any sediment (except for fine powder which will likely pass on through anyway). You'll never know whether this filter did you any good, but, believe me, it will prevent problems for you. Making it will cost you only two or three dollars and 30 minutes of fiddling. Cheap insurance to prevent fuel problems later on!

Let me get into another subject here- "vapor locking". This happens when the vacuum of the fuel pump causes the gasoline to boil or evaporate in the line. This happens when the fuel is too warm. You can't do anything about that. It happens because the fuel contains modern components that boil easily, and this is usually alcohol. Alcohol boils at about 160 degrees F; the hydrocarbon of the gasoline boils closer to 200 to 240 degree F. A significant difference. It is your bad luck that the lower boiling components also have better burning characteristics ("octane rating"). This is one reason why modern autos have their electric pumps in the tank- the whole modern fuel system is pressurized. The only thing you can do about this is don't buy "gasohol" or "E-10" or any gasoline that contains alcohol.

People have tried silly things like putting clothes pins on their gas lines. It doesn't work! It's a "placebo" effect- you just think it works because you did something. And frankly, there is no boiling between the fuel pump and the carburetor because that part of the line is under pressure; most of the boiling is in the line from the tank to the fuel pump. One thing that will work a little is to get some sort of insulation tube to slip over the gas line from the tank to the fuel pump to keep that line a little cooler. Some cars had a heat shield to protect the fuel pump from radiator heat. You can make and install one, and this might do some good.

OIL CHANGES

Changing your oil accomplishes two important things- first, it gets rid of old oil that carries dirt and grit and acids. Secondly, it gets rid of combustion materials that may get past the pistons into the oil system. This writer recommends that you do, as a minimum, a change of **both** oil and filter at least once a year. If you do not run your car during the winter, use that time of lay-away as a time to change the oil and filter.

This process involves more than just draining out the old oil and replacing. I recommend driving the auto at full highway speeds or freeway speeds for ½ hour or more to get the oil hot and freely circulated, and to get all particulates (dirt) stirred up. Plan that you will start the drain process within a few minutes of getting home and be ready to start as soon as you get home.

Jack up and block the car safely enough to get under it with a drain pan to catch the old oil, then remove the drain plug (almost always at the middle or the back of the motor) to start the oil draining out of it. You will let the draining go on until tomorrow so you can now use this extra time for other things you need to do. Go to the distributor cap and pull the middle wire to prevent the motor from being started at a wrong time.

While you're waiting for drainage, you can change the oil filter (if you have one). They are usually of either a screw-on type (modern) or a cartridge type (of the 40s & 50s). Remove the screw-on filter and set it to draining so it can be recycled and oil can be caught; or open up the cartridge canister to remove the filter element inside and set it to draining. Replace the screw-on filter and properly torque it down; the canister of the cartridge type should be wiped out (even rinsed out with solvent) and dried with a clean rag. You want that filter canister completely clean- no residue, and when it's clean, put in the new cartridge and properly close up the canister, torque down the top bolt.

Ok, now it's "tomorrow". Pull the oil catch pan from under the car so it can be emptied into a can or bucket to take it for recycling or proper disposal. Install the drain plug and properly tighten that. Go back to the oil filter and check that it **is** properly tightened. Pour into the motor filler tube enough new oil to bring the level up to the "full" mark on the dipstick, not beyond. Go back to the distributor cap, install the center wire, and start the motor and let it run at an idle speed watching the oil indicator (light or pressure dial). Within about 10 seconds the pressure should rise and hold. That's good.

Let the motor run for about a minute then turn it off. Check for any leaks around the oil filter and around the drain plug. Check again to be sure they are properly tightened (but **not too tight**). Go back to the filler tube and add just enough oil to bring up the level just to the "full" mark, not over. Don't over-fill the oil; if you didn't add all the oil from all the containers, keep that extra for adding to the motor at some later time, or you can use it in your lawn mower. It's always handy to carry one quart in a safe container in the trunk in case you need it.

In your records, record what filter you used (brand & part number) what oil you installed (brand and "weight"), the date and odometer reading, and keep this record in your files. Over a period of 10 years you may "spend a dollar" but I guarantee you'll get it back some day.

THE RADIATOR

The radiator is important because it is the system that gets rid of all the excess heat developed by the motor. Sometimes as much as ¾ of the energy of the gasoline combustion passes through the radiator. While the cooling system is supposed to be separated from the rest of the motor, any problems in the motor casting or head gasket may show up as oil in the water and coolant before it becomes a problem elsewhere. It may hint to you to make a repair before repair becomes serious. That is called "preventive maintenance" – do it now before it becomes serious.

First a simple check with a simple piece of equipment. **Get an antifreeze tester**. It measures the specific gravity of the coolant. That relates to the amount of antifreeze in the water. Know that antifreeze serves two purposes: in the winter it keeps the water from freezing (protection as low as -40°) and in the summer it raises the boiling temperature of the water mixture (as high as 240°). In modern autos the recommended mix is usually 50:50, half water and half glycol. Most antifreezes are ethylene glycol with a yellow-green dye to identify it as coolant. That's because ethylene glycol is poisonous- to people, to pets. This character means you will need to dispose of used coolant in such as way that it does not get into our environment. Shop around to where you can take the old coolant for proper disposal.

When you pull out a sample for testing, you can observe the color. If the yellow-green color is rather weak, that may be a hint that the mix is rather weak. In addition, if the color is a pink, it may signal that you have some other anti-freeze chemical such as propylene glycol; that's less poisonous. For which to use, my best recommendation is to talk with people in a radiator shop to see what they will recommend. Choice of coolants may also involve additives in the mix; if you don't know what you are doing, talk to several shops, and talk with other people of your antique hobby. Remember Packard's motto: **"Ask the man who owns one."** Or ask an old mechanic who knows what is happening in the world.

According to one experienced mechanic, age of the coolant is not necessarily a reason to consider replacing it. If the antifreeze is clean, clear, no "off" odors, it doesn't necessarily need changed just because of age; these modern materials last for quite a few years. However, that sample for testing may also carry with it rust particles or globules of oil. Any red powder or particulates will indicate to you that the inside of the motor is beginning to rust. Globules of oil indicate that oil from the crankcase is getting into the coolant somehow; it also means that antifreeze may be getting into the parts of the motor where it shouldn't be. If not clean, it is time to drain the old coolant and flush the motor and go looking for other problems such as a leaking head gasket.

You can do this flush or you can have it done. Flushing the motor simply requires draining out the old coolant, filling the motor with pure water and running it long enough to cause the water to circulate and rinse out the motor. (The heater should always be "on" to allow coolant to circulate through that part too.) Then you drain out the dirty water, refill it with clean water and do it again. And again, and again, until the water comes out completely clean. There are additives that can be put into the flush water to help carry stuff from inside the motor; if you don't know what, ask an old mechanic that you can trust and follow his directions. Of course, if you have the motor done by a commercial shop they should know what to do and what to put in. Well, they should.... But they don't always do it.

When no more crud comes out of the motor, completely empty it, then close all draining points. But stop! If your thermostat is not fairly recently new, find out what one to use to replace it, and how to replace it. Know that most thermostats have a little 1/16th inch hole which lets air and fluid circulate through it; if your recommended one does not have a hole, find out why. (Lack of a hole may cause improper cooling and circulation; I'm not going to discuss why here- your mechanic can.) While you are working with the radiator, check that the hoses are all correct. Are the fan belts properly tightened and in good condition? It is far easier to replace those things now than it is out of the road somewhere. Is the radiator cap proper? Pay attention to temperature indicators- working properly? Also look for leaks in the radiator, itself.

Anyway, **to fill:** pour in half of the volume of the system using pure antifreeze (your owners manual will tell you the volume of the coolant system- my Packard requires about 20 quarts of coolant having 10 quarts of antifreeze), and then mostly fill the system with water. Run the motor until it gets as hot as it will get and fluid circulates completely. Remember that some motors do not totally circulate and mix until they are run for a few minutes. Check the specific gravity or the temperature to which it protects and then add more water or more antifreeze to get it to the proper specs or until it gets full.

KEEP RECORDS

When you do a restoration on an automobile, you need to keep a complete set of records to show what all you did, when you did it, plus lots of other useful references. Some of this information will be for your own use some day, and some will be for the time when you sell the car. And yes, you will eventually sell it; no one keeps them forever. If you have room in your garage for a desk, set up one as your information center. If not there, set it up in your home. And you need a file cabinet with several drawers of storage capability. This project is a big effort and you need lots of capability, not just one drawer in a cabinet.

With the modern writing and photographic devices (the youngsters call them "computers") you can do all sorts of things and here is what I'm suggesting. First of all, you bought a good electronic camera? Well, if you didn't, now is the time to get one that has "zoom" and "wide angle", and a high resolution (described as about 10 meg). A capability that is probably necessary is an automatic time/date stamping on the photo; this is a proof of time. Last one I bought cost me about $150. I bought it because the older one got stepped on. The amount of memory in the device really isn't too important because the photos soon get transferred to a computer for storage. Your camera has a little memory chip with it (or you buy a bigger one) which gives you the capacity to take and store about 100 or more photos before it fills. You also get a program disk that has the program to use for all your photo storage and work on a computer with it. The whole works. And a neighborhood kid can show you exactly how to use it and will help you get everything done with the computer. In fact, slipping the kid a twenty every now and then will ensure that you get as much help and advice you will ever need. I'll come back to this idea a little later.

With the camera, you photograph everything you do, starting with the auto before you start taking it apart and of the parts fresh out of their shipping box. It really doesn't cost you anything to take even a hundred photos. Those store for future reference. You will use some of the photos to show you how to put it back together. Some of them will be proof that you actually did the restoration work. These photos store into the computer in "files" each of a specific section such as brakes, motor, transmission, etc; your helper can set it up.

The files for each section will also get written information of exactly what you did and how you did it. Include a complete identity of all new parts you install, part manufacturer and his part numbers, where you bought the parts, how much each part cost. Document **every**thing because you may have to use this information some day to find more of those parts. If there were installation instructions or guarantees with the parts, store those in a paper file. Keep **every**thing! Eventually your record of what you did can also hold copies of the best photos to show your work and accomplishments. The photos "copy" from your computer storage into the written record. If you are poor at typing and writing, you can write it out long-hand and then have that helper kid help with typing it in and copying the correct photos to the correct places. If the record keeping becomes much of a project, you may find it helpful to offer to buy this kid his own "antique car" and it may get him into the hobby too.

Look back into the "Introduction" section. There is a "blank" form that you may copy many times for keeping records of what you do at specific times. It can also be a template for keeping these records. The copyright gives you permission for such copying for your own use, so use it!

Anything that you do that is not "standard" should be documented. If you change specifications on anything, document it by recording what was the original and to what you changed it. Any machine work that changes sizes should be documented. For instance, if you have the brake drums machined, record the original size (if possible) and the size to which they are machined to. If you have the crankshaft ground to an undersize, record original and new size. If you put in different sizes of brake components, document it. You get the idea.

Paint colors and compositions change with aging. Paint colors change names over the years. Try to record the paint manufacturer, color, type of paint, and color mix that gets to your specific color and finish. If you have anything that represents the original color that you tried to match, that "chip" can be preserved inside wrapped-up aluminum foil because modern paint analysis allows a color to be duplicated. (**How** it is duplicated, I'm not saying, but it can be done; you're on your own here.)

Upholstery changes with aging and colors given to leather change even with individual manufacturers. Dye lots do not remain constant, so anything that will allow you to document a color will be useful, including keeping scraps of the original leather or cloth and of the material used in the new upholstery.

If you rewire the vehicle, record the company information about the commercially-available wire loom, or if you make your own wire set, record what each color at each place represents. The original wire loom did not have any identifier tags, only colors, so keep it as close to original as possible. Do not change the wire polarity (positive or negative "ground" or "earth") unless it will really makes a difference. Notice that the battery cables have different sizes of connector clamps for positive and negative; no changes there unless you change the battery polarity.

SPRINGS and SUSPENSION

Your car probably rides on four springs at the four corners, with shock absorbers or snubbers for increased stability. Without these modern features, it's like riding in a farm wagon- and all that bouncing would make your butt sore within a mile! The early designers saw this, and they built in a spring suspension very soon into the development of the automobile.

With long aging, the springs get tired and begin to sag. You can get coil springs of any size and spring capability. Ask around to the nearby shops that make new springs; many large cities have such suppliers or manufacturers nearby. Others advertise in **Hemmings Motor News**. They will ask you the physical size, the weight of the car and other dimensional points. Some cars have some coil springs and some leaf-springs. New-manufacture leaf springs are available too; go shopping. Installation is best done by the local spring company; this time leave it to the professionals.

Fastening pieces (like "U-bolts") are available, so use new ones; everywhere! Don't go getting cheap. Likewise spring shackles and all other hardware are available. Get them new!

Each front wheel usually rides on a vertical "king pin". This pin is the left-to-right pivot point, a heavy vertical pin, usually ¾ inch to 1½ inch diameter, 4 to 8 inches long. With aging and use, the pin and its bearings wear, allowing the wheel to wobble top-to-bottom. Jack up a front wheel and hold the wheel at top and bottom, try to wiggle the top and bottom. If it wiggles, you need to replace the pin and bearing assembly. Your proper repair set gives you two pins, two bearing inserts for each pin, two vertical thrust bearings, and numerous washers for adjustments. It will be best to have this replacement done by a mechanic experienced with this sort of work; I've done it on my own cars and each time I have to stop and figure out "what do I do and then what next"? Unless you're experienced, and have the proper tools, don't try to figure it out yourself; this time leave it to the professionals. By the way, the king pins need greased about each year, through a grease fitting usually on the side of the housing that holds the king pin.

Near the king pin there may be a horizontal support pin on each side. It's virtually the same as the king pin. Good guess is that if you need to replace the king pins, you need to replace these pins too. Grease them like the king pins.

The steering assembly couples to the front wheels through a piece called the tie-rod. The tie rod has "ends" that fasten between the tie rod and an arm that attached to the frame of the front wheel assembly. A rule of thumb is, "if you replace the king pins, replace the tie rod ends". A diagnostic trick is to jack up a front wheel and try to wiggle the front wheel side-to-side. If it wiggles you need tie-rod ends. They're not cheap, $25 to $50 each, but new ones will probably last the remaining life of the car. By the way, the tie rod ends need greased about each year, through a grease fitting usually on the bottom of the housing of each piece.

Each wheel usually has a shock absorber or a snubber. They usually cannot be rebuilt except by professionals. Inquire of advertisers in **Hemmings Motor News**. Sometimes you can find new tubular shock absorbers that will work, so inquire at a shop doing modern suspension work. A second type has a heavy arm that reaches out to hold the top of the wheel assembly. These are a part of the suspension as well as a part of the ride and have to be replaced as a pair although they are rebuildable. Again, inquire to rebuilders advertising in Hemmings. They're not cheap but they're necessary.

TIRES and WHEELS

Tires are some of the least-considered parts of an antique auto, and they may need the most attention to keep the car going. After all, you're not going anywhere if those tires are flat! Or… if you do, you won't have tires for very long. But there are other considerations too, so listen up.

First, if you buy new tires, consider buying at least two at a time if not a whole set of 4; you can only buy **one** if it's exactly like the others of the set. That means that if you have some extras left over that are still pretty good condition, those can go for spares. Replacing tires two at a time (L & R on either front or rear) means that you have equal steering capability and equal stopping capability. But there are a lot of other things you ought to consider beyond the actual cost of the tires.

Almost all the tires you put onto an antique car can be biased or biased-belted tires. Be sure that you do not mix biased tires with any other tires; it makes for strange or unsafe steering and stopping. Check your owners manual to see what sizes you can use, but remember the size your owners manual will mention may not be the size that is available to you now, so you will need advice of a tire dealer. This writer recommends going to a well-known vintage-tire dealer that you can trust. If you have the capability, I recommend actually driving to the shop of this well-known dealer to deal with him face-to-face because a personal contact will let you know each other better. You may drive 200 miles or more each way- but with modern roads you will have no problems. Unless your tires are huge and you have a very small modern automobile, you can remove the wheels from your antique and take the four whole wheel units with you; a pickup truck is awfully handy here. If there is no other possibility, drive your antique auto to the dealer's shop.

After you settle on the exact tires you will buy, don't go getting cheap- <u>don't put your old tubes back in</u>. Replace both tires **and** tubes with new ones because old tubes stretch to fit the tires they lived in, and if they have any creases or repairs, those repairs are more likely to fail and cost you the price of a new tire replacement. Call it good insurance. And even replace the valve stems if used. Preventive maintenance.

With this purchase being so significant to the health of your antique car, get the "whole shebang"! New tires, new tubes, balancing, **and** also get the road hazard warranty because if a tire goes flat while you are driving, you will mostly shred that tire before you can get stopped and you just bought a new one! I can speak from experience- a Packard Super-8 can be awfully harsh on a flat tire; been there, done that.

Next, pay attention to the actual replacement details. By going to a dealer serving antiques you know his workers are experienced at replacing tires and tubes; modern tire shops have kids working for them who have never even **seen** a tube unless it was at the swimming pool. Know that improper installation of the pieces may damage the tube, and if the dealer damages your tube, be sure that you have him replace the damaged tube with a new one (**don't** let the worker repair that damage!) Get an agreement to this fact before the replacement starts.

Have the dealer advise you on the pressures to use in the tires as the weight of the car may affect the pressure to be carried in tires. Even consider whether front and rear should have different pressures. If you don't have a good tire gauge, get one now and have the dealer confirm that the readings are correct. Start a service log at this point to keep track of pressures because you should be checking tire pressures every month or even more often, to know if there is a loss of pressure before it becomes apparent.

Get a pick to clean the tires. We used to call them "ice picks"... that was back when we could buy big blocks of ice! Use this pick to dig out **every** big and little piece of gravel. Look for nails and thorns while you are cleaning the tires as this may head off a flat by removing the nail before it can puncture the tube; if it has punctured the tube, you can get a repair done before the tire goes flat while driving. This writer knows one man in Dallas who insists that he will not have a tube repaired; he requires replacing the tube because he doesn't think the repair is all that permanent. **You** decide what is best for you. Remember- preventive maintenance means you make a repair before if causes a failure, because that failure gets much more expensive. (You can replace many punctured tubes for what you might pay for one on-road repair.)

Now, we also get into the question of putting modern tires on the old rims or wheels that were made for biased tires. We get into the question of how to be sure the rim is the proper physical condition or "finish" for the new tires. To be sure, you must be confident that that the metal of your wheels is strong enough that the metal won't break from stress; **ask the tire dealer** for his opinion. You should also know that the metal or paint surface may affect the life of the tire or the tube on it; again, **ask**.

We run into the question of radial tires on antiques. I have questioned local tire companies and no one knows of any expression of problem with putting a radial tire on a bias wheel. I, myself, have installed radial tires on the 16-inch rims of my 1940 Packard Super-8. It made a world of difference: the car drives beautifully, handles easily, smoother, straighter, and with much for stability than it did with the old biased tires. To me, this represents the tires being a safety device on the car, every bit as significant as the installation of those non-original turn signals that you're allowed. However, it is counter to the current judging rules of the Packard Club with no expression of justification other than "they aren't original". Well, whoopee! Neither are the turn signals and brake lights, which the club allows in the interest of safe operation. The driver is not "original", either, nor is the judge. So, if you're having the car judged, you must pay attention to club rules and it appears that this point is of your own decision, provided that radial tires are available in the size proper for your antique auto. You probably won't find radial tires for a Ford Model A or Model T. You can find radials that will fit almost any Packard made after 1934, and likewise any similar Cadillac, Buick, or Chrysler; many others. So you're on your own. I'm not going to recommend here; you should talk with the tire dealers yourself, then make your own decision. Consider the following thoughts from Mr Kelsey, a tire dealer.

Mr Kelsey of Kelsey Tires (in Missouri) writes about this topic:

Mr. Hill, although I am aware of articles being written by various individuals, I do not recall, perhaps incorrectly, any being authored by tire manufacturers or authoritative individuals. I have hands-on experience in retail store operations in our local community during the time period of the introduction of the radial tire to the American market in the early to mid seventies. Our store never encountered any rim flex problems with customer vehicles which were changed from bias to radial. The average age of the American vehicle fleet was 8.2 years, much the same as it is today. Thus millions of vehicles were changed over. When it came to a questionable wheel, the customer was always asked if they knew anything about the wheel or wheels in question, especially those coming from a salvage yard – possible fire damage etc, garage sales – especially if they were early alloy construction. I expect retailers today make the same observations and present the same questions – as they should.

Regards,
Kelsey

Jim Pepper is a repair advisor for the Studebaker Drivers Club. He wrote concerning this topic:

A Kelsey-Hayes engineer was involved in developing the first radial approved wheels in the early 70's. The SAE testing regimen written during that time frame was a result of that work. I have since learned a lot about material fatigue strength and fracture. Radial tires apply more bending or flexing force with every revolution. Steel has a spring rate and it flexes. If that flexing is below a critical stress level, the flexing can go on almost for ever with no detrimental effects. Increase the flex amount and the material strain increases. Under these conditions the material will fatigue and fracture at a predictable amount of cycles.

In early testing, Kelsey-Hayes discovered that the rolling wheel flex increased by a large amount with a radial tire. The radial approved wheel was designed to bring the stress and strain levels back to what the original wheels were with the narrow bias ply tires. Lug nuts pulling through the center are not a fatigue problem but simply an increased load/force induced failure. During a lateral slide more force is generated on the wheel center due to the better traction qualities of radial tires. They do not slide as easy. Again, the wheel center was designed to withstand these higher forces without allowing the nuts to pull through. At Lancaster we received a first hand account of wheels cracking after switching to radial tires.

The question is not if old wheels will crack under the stress of radial tires but when will they crack. I am convinced that they all will crack if driven like a vehicle used for daily transportation. Bob has a copy of a service bulletin Studebaker released when the company changed from the 4 ½" wide wheels to the 5" wheels due to tire aspect ratio changing. Wheel load was a consideration when that change occurred.

JWH's CONCLUSION: **You're going to have to decide what is best for you.**

TOOLS

It seems like every job will have its own special tools. If you don't know, ask someone who does his own mechanical work. But get only what you really need or what you will use. For instance, don't buy a motor lift if you won't be using it. It'll look impressive but who do you want to impress? It'll only take up room in your shop. And you don't need to buy a whole set of 1000 tools & pieces at the very beginning of a project. Don't try to get your tools at yard sales and auction sales- you won't get all the sizes you need and likely "you will pay too much for your whistle".

When you go shopping, look for "quality" and "guarantee", not cost. You can buy a cheap set of end wrenches that cover bolts from ¼ inch to 1 inch for about $15. Or you can go shopping and find the same set with a life-time guarantee for $25. What's the difference? When you put a strong pull on a stuck bolt, the cheap wrenches may bend or expand and then you need another one, but you can't buy just **one**- you'll probably need to buy a whole 'nother **set**. The good ones won't bend, so you won't need another.

Years ago, a friend was working on a Caterpillar tractor and he broke a biiiiig socket. He took it back to Sears and they gave him another one (free- that was their guarantee.) They didn't ask about the fact that he had a 6 foot long pipe on the wrench to break things loose. He took it home and did the same thing again. The second time the salesman commented that maybe the bolt was a little too tight, but they gave him the replacement, again. No cost. The third time, he cut the bolt before he applied the wrench and it came apart easily. Big rusted bolts are sometimes tough to get apart. Guarantees last forever.

It used to be that only certain brands of tools were really good quality. MAC and SK tools were good and only sold to "professionals", but that may have been a sales technique; I don't know. Along the way, Sears began to offer good quality with a lifetime guarantee: "you break it, we replace it", free, forever; and Sears stores are available almost everywhere. Now, I believe Wal-Mart makes the same guarantee. And their tools I've seen appear to be good quality Stanley tools. I've even seen Sears replace the plastic box that some of their tools came in. Don't buy out of a truck that comes around to parking lots unless you want cheap- that's what you pay and that's what you get.

In some cases, you may wish to compare the tools and how you'll use them. If you need a drill for occasional use (not hard every-day use), you may find the Black & Decker electric tools will last well enough. I have one of their ¼ inch electric drills that I've run for over 30 years and it's still working; I think I paid $20 for it then. I could have bought an expensive one for $50. Would I have saved anything? I really doubt it. And another thought- would I buy the same drill now, that came from China? Not on your life! If you plan to use these tools every day for professional jobs, I'm not making any recommendations. For this, talk to the person who does it for a living.

The operating power for tools can be either electricity or compressed air. Electricity is cheaper and more accessible, but it is the more dangerous. Electric tools do not require a compressor operating at the same time. If your floor is moist and a good "ground", electricity could lead to a shock or a spark (dangerous around flammable vapors). Electric tools are often less controllable than air, although some of them have a controllable trigger mechanism, even reversibility.

Air tools are a complement to the "guns" for spraying paints and all are controllable according to the pressure in the air line and that's controllable. You will probably need an air compressor to supply air for tires and for blowing dirt and dust out of your work, for operating a solvent/air spray for cleaning parts. The disadvantage is that you need to "pipe" the compressed air to convenient places around the shop and air hoses are heavy and stiff, uneasy to move around to your work. I will recommend that, if you pipe air around your shop, also put one of two air outlets outside the shop for uses where you want the dust and solvent vapors outside. With all this, my recommendation is to talk with old mechanics who have used everything and see what they would recommend, and then go with what you feel more comfortable using. You have lots of choices for the size of capacity of the compressor and for the storage tank. Again, get some advice. Ask the man who uses one.

Hand grinders are convenient, often necessary. Some of them are related to a drill in that the main shaft comes right out the front end and there it holds the grinding wheel (or buffing wheel). Another design has the motor shaft at a right angle to the wheel. For some reason, it's called a "right angle grinder"; clever those Americans! Again, my recommendation is to talk with old mechanics who have used everything and see what they would recommend. They might even let you experiment with their tools to let you see how they handle.

If you have a flat and smooth concrete floor in your garage so that you can scoot around under the work, you need a device to lie on, called a "creeper", and seats that will scoot around on wheels, and yet be safe to sit on. If you don't have a smooth cement floor, you need soft and insulating ground covers such as foam plastic sheets or thick blankets. Remember your "creature comforts".

Keep in mind, if you're going to be under the work, it **must** be supported safely; not on jacks, not on "axle stands". I strongly recommend using **wood beams**. I would suggest using 12-18 inch lengths cut from 4x4, 6x6, and 8x8 posts. A few pieces of 1x6 and 2x6 of the same length may be useful. (You may be able to get such scrap from a lumber yard or from a building contractor.) Do NOT use cement blocks or bricks- those will damage the metal that they contact and they may also shatter with too much weight applied. Metal handles should be screwed onto the pieces of wood for easy handling.

You need jacks to lift your work. Easiest and strongest are hydraulic jacks. There are the little "bottles" that sit vertically under the frame of the car. There is a hydraulic jack that is sort of a scissor but it lies very low to the ground or floor. Either of these can be bought having a capability of 2-3 tons, even more. I really do not like bumper jacks because they have a tendency to bend the bumper or its attachment bars. They are not stable; they slip. With any jacks, it is convenient to have squares of ¼ inch aluminum sheet (alternate: steel) to put on the ground or floor under the jack; stability. How big? Oh, minimum 6 inches square; on dirt, up to 12 inches square. Now go **read chapter 12** pertaining to **safety**. Your body is more important than the auto's body; protect yourself. If it hurts, you're doing something wrong.

TRANSMISSION and DIFFERENTIAL

Most people ignore the transmission and the differential (the "rear end"). Those are full of grease and they seldom need much care but if they ever do, it will be a difficult repair and an expensive one. Consider what can be done here.

The automatic transmission has a fluid level indicator. Once or twice a year, check the level of the fluid. You will probably never need to replace any, but if you do, follow instructions of your owners manual.

Standard transmissions often have a drain plug on the bottom and a filler plug on the side somewhere. If you don't know where and how to check the lubricant, ask someone who knows your car; don't rely on a "grease monkey" at your service station- they don't know old cars. Likewise, the differential probably has two such plugs also. You'll probably never need to replace the grease in either, but it is good to check them every year or so. And that about takes care of it, but there is more. An overdrive unit may have its own set of drain and check plugs but the lubricant often is indirectly connected to the transmission. Check it.

A car that has set for years waiting for you to come along and take care of it, might have leaked the grease out of either unit. I will suggest that, during a restoration, you should drain all units mentioned here and refill them with new lubricant or fluid. But, going further, you may find it a good idea to consider draining and washing out these units if you don't go for a complete disassembly and rebuild. A complete wash-out is a minimum. For this, put the rear end of the car onto wood blocks that have the car stable and the rear wheels completely off the ground. Remove the drain plug of the unit and allow as much grease to drain out as will, until tomorrow. When you come back tomorrow, replace the drain plug then pour into the unit about ½ to 1 gallon of solvent such as petroleum-based paint thinner or kerosene, then install the filling plug. Start the motor, put it into gear and let the motor pull the system at idle for about 10 minutes then turn it off and come back tomorrow. (If no motor, you can turn a rear wheel several times and repeat this once every hour until you get tired of doing it.)

Now it's tomorrow. Take out the drain plug and allow everything to drain out. Put the drain plug back in and put in another quantity of solvent, and repeat (maybe twice). You want to wash out everything that will wash out. The last time, allow the unit to drain overnight, then fill it with the proper lubricant to the proper level.

Let me comment here about bearings. Most transmissions and differentials run on ball or roller bearings. With age, these begin to rust and with rusting they will whine or hum until they eventually fail. If you have the time to dismantle a unit, simply plan to **replace all bearing sets**. They aren't expensive and they are usually industry-standard pieces. Your parts house won't have them but in your city there is probably an industrial bearing supply house; mine is named "Industrial Bearing & Transmission", "IBT". On every bearing piece there is a number. Take those bearing numbers to the counter man and ask for those numbers; he won't care what they fit as he doesn't have that information anyway. He may have them on hand or he may be able to have them tomorrow. Transmission bearings can probably be bought for $75-100 for all the bearings. Other old-car bearing houses also have them, but likely for $150-200, for the same bearings Get the idea?

DOs and DONTs

These following thoughts are based upon what others have told me. Of course I've never done anything dangerous, myself. And I've never done anything stupid, myself. But in this short life, we will never live long enough to learn everything from our own mistakes, so we've got to be smart enough to learn from others. The thoughts are not necessarily arranged in any particular order even though I've tried to do so.

You might ask whether my garage has everything I mention here.... No it doesn't. If it did, there would be room for two bicycles and the project car would set out in the driveway. These thoughts are presented for you to consider in light of your own safety, space, finances, and needs. Here goes!

Sharp tools are supposed to be sharp. Chisels, for example, cut through metal much better when they are sharp. Surprisingly, you are **less** apt to cut yourself with a sharp tool than you are if the tool is old and dull. There is no safe way to handle a sharp tool- you can either pull it toward you or push away from you. Neither way is safe. But if you need it, you need it!

Pull on **wrenches**, don't push them. When you pull, you can stop pulling more easily than you can stop the inertia of your body if you are pushing. If you can't pull hard enough, try using a handle extender, a "cheater" (inexperienced people call then "pipes") if you can get it into the space.

Hammers slip off what they hit if the faces are smooth; new ones are usually smooth. One suggestion is to grind the face of a hammer to flat, with the scratches (grooves) going <u>across</u> the face (not up & down). The flat face is less apt to deflect from what you hit. Hammers hit hard are more likely to slip off the chisel than if you tap it controllably. It is never safe to hold the chisel when someone else is swinging the hammer.

Air impact tools are the best thing to work with to get a lot of torque on a bolt, and the impact will break a rusted bolt loose. Sure, they cost money, but you don't have to work nearly as hard. And with a little experience you can learn how to set them to give you the amount of torque (work) you want to expend. Air wrenches require more equipment to run them (an air compressor) but air is more controllable and safer than electric.

A complete **tap & die set** is valuable because you will use them to clean up threads that are not new. Get the best you can, usually called "high speed" quality; don't buy "cheap", don't buy "Chinese". Learn how to use them by getting instruction from an old machinist.

Good tools don't cost.... They save you. If a tool bends or gets dull, you can't improve it, so you must replace it. Bent tools often slip off the work or round off corners of bolts, etc. Get the right tools- for example a basic open-end wrench is no substitute for the wrench made especially for tubing fittings. Metric tools don't substitute for inch tools and vice-versa. If you lose tools, get proper replacements. You use more of certain tool sizes so have duplicates (3/8, 7/16, 1/2, 9/16, 3/4 inch sizes, for instance). You need duplicates of handles for those sockets. You need extra extension pieces.

Jacks are also known as "widow-makers". A car supported on a jack (either mechanical or hydraulic) can either slip or fall down, and that allows the car to come down, crushing whatever is underneath it. If you insist on working under a car supported by just a jack, be sure you have enough life insurance to leave your wife a rich widow so she can advertise: "rich Cadillac widow desires good looking and young mechanic to complete the jobs her husband didn't." Got the idea?

You can best support a car by using pieces of **wood beam** laid horizontally; not vertically. I would suggest using 12-18 inch length pieces of 4x4, 6x6, and 8x8 square posts. A few pieces of 1x6 and 2x6 of the same length may be useful. Metal handles can be screwed onto the pieces of wood for easy handling. Do NOT use cement blocks or bricks- those will damage the metal that they contact and they may also shatter with too much weight applied. There are metal axle stands. I do **not** recommend them; even strong ones. They slip on floors, they slip from under frames and axles. They bend under heavy weights. I like the wood beams mentioned above.

Modern shops have a lot of hazardous materials around them. Talk with an experienced mechanic about **face masks and respirators** (vapor absorbers). There definitely are things you shouldn't be breathing and there are jobs that produce dust that you shouldn't be breathing. Don't depend on our government and OSHA to protect you- you need to find out what is dangerous and how to protect yourself.

You may use a lot of **solvents for cleaning**. You can get them at a hardware store as petroleum-based paint solvent (or "naphtha"); they're also "paint reducers". A more expensive substitute is charcoal starter. If your city has a "hazardous household materials" disposal, you may also be able to go there to pick up things for use, often at no cost. And you probably can dispose of your old used fluids there too; inquire there about disposal.

Flammable solvents give off vapors that will ignite. Ask a fireman what is the meaning or definition of "flash point" and find out how that relates to your shop safety. If you must use flammable solvents, use them outside your shop where the vapors do not build up in an enclosed or occupied enclosure. Can you spell "explosion"? Do you know what is an "explosion"? (You don't want to know first-hand.)

A good place to locate an **electrical outlet** is overhead. Either fasten it to a rafter or let the electric line drop down to above your standing area. Locate the outlet at a height that you can stand flat-footed and reach the outlet for plug or unplug. Next convenient location will be along the wall at about 3-4 feet above the floor. You should never install more outlets than what you will need.... but you'll never know how many you will need, so install as many as you can. Unused ones don't cost you anything to have there.

An electrical contractor can advise you on your **electrical service** and you may find that several circuits of 15 amps minimum/30 amps maximum will give you safe electricity. (Special loads like air compressor or welder require their own circuit.) You may want to be able to turn off service at night or when you don't need it. The power box should be easily accessible in case of emergency to "kill the service" instantly.

A **voltage controller** is handy around the shop. One brand is "**Variac**"; it's also known as an "auto-transformer". It controls the power (voltage) into whatever you are operating. For example, when honing brake cylinders, you can use a large drill but run it slowly so as to control the speed of the tool. You can vary the power into a battery charger so that you can charge a 6 volt battery with a 12 volt charger.... Well, some of the time. Many fans and motors can be somewhat controlled by one. Just a thought.

An **electric heater** around a shop is a bad idea. Any sort of fuel-powered heater also gives a hot area that can easily ignite flammable vapors. If you must heat your shop use either an overhead heater built for that job or use the heater to warm the area and then turn it off before you start work.

Cooling fans make the shop a lot more comfortable. On a hot day, a little moving air helps. A fan also blows away fumes or vapors so they don't build up around you. Here is a piece that can be controlled by the autotransformer so that it runs at the speed you want and not what it wants. Don't blow up a storm.

Drip pans can be made from baking pans or aluminum sheet pans that are used for serving buffet portions of meat. **Drain pans** can be made from deeper cake pans although you may use heavier plastic pans. Buy your wife some new ones and take her old ones that she really wanted to get rid of anyway.

Parts pans can be made from plastic dishes that held "TV dinners". Many of these are rectangular or oval, about 4x6 inches. The best ones are in the Lean Cuisine dinners. You need 30 of them along with tape and marking pens for identification.

If you have water service in your shop, keep a **garden hose** connected at all times so you have a simple "fire hose" just in case. It might be handy to have a filled sprinkler can nearby also. Every shop should have a good fire extinguisher available; I'd recommend at minimum, "5-pound ABC" but I'd also recommend asking for a visit by the friendly folks down at the **Fire Department**. If you're really serious about safety, ask them to come and have a good look-around to give you their recommendations.

Jewelry is dangerous around the shop. All metallic jewelry (rings & bracelets) conduct electricity.... Electricity is the same as energy. I've heard of people touching a ring between a battery cable and the frame and burning off a finger. Jewelry also gets caught on things and it jerks or pulls the hand into something moving. It just ain't worth it! She doesn't need proof you're still married to her.

A good **solid work surface** (work bench) is valuable. They are hard to find, unless....you can go to an auction of office furniture. Metal office desks are often heavy and strong and of the right height for a work table. A metal office desk will sometimes sell at auction for $20 and when you try to load it, you'll think it weighs a ton. And it will be one of the best shop benches you could ever find because you can work on the top and you've got 2-5 drawers in which you can store tools and supplies.

I've never owned or used a **mechanic's stethoscope**. But Dave LaChance of Hemmings Motor News talks it up as a fine diagnostic tool to find out where that little "noise" is originating. Noises may develop in one part and then travel through metal to "sound off" from somewhere else. He suggests it can find bearing noise, metal rubbing, gases leaking, idler pulleys scraping, pistons slapping, flowing water gurgling, and so forth. Makes sense. I'd suggest talking with a professional mechanic to see what all it can do for your $20 investment.

You need a **cream hand cleaner**. You can buy it at the automotive stores and they also sell a wall-mounted dispenser. I've found a suitable substitute is "vitamin E cream" in a 1 pint plastic bottle with dispenser already built in. It will help dissolve greases and tars from your hands and then it almost wipes away with a paper towel. Get it at Wal-mart or K-mart for a couple dollars per bottle.

As you accumulate cars, you start to notice that all the **keys** seems to **look alike**. Sure they do, because a lot of them were made by Briggs & Stratton. Some people keep a lot of key rings with identifications on each ring. And when the id tag comes off, you're in trouble, deeeep trouble! I like to stamp the keys with ¼ inch stamping dies. I stamp each key to show a year and letters to tell the model. For instance, my 1940 Packard has 40 **IG** and 40 **TR** (**ig**nition and **tr**unk), my 39 LaSalle has 39 **LAI** and 39 **LAT** (for **ig**nition and **tr**unk). The 60 Lark has 60**LI** and 60**LT** for **Lark ig**nition and **Lark tr**unk. You can decide how you want to be imaginative. You can do the same with your house and garage keys: **1107F, 1107B, 1107G** become keys for **f**ront, **b**asement, **g**arage for the house at #1107. Once you start labeling keys, you simply can't mix up them up, even if they are all mixed into the same storage box.

A **good grinder** helps you smooth or control the shape of an object. Some people prefer a grinder wheel on a motor shaft; some prefer a sanding belt-type grinder. You need to get experienced with both types to know which fits your needs. Remember that a grinder will even remove very hard steel; think of what it will do to soft skin on fingers and knuckles. They also extend your vocabulary.

A digital **volt meter** (sometimes called a "VOM") also measures resistance, and is handy for checking voltages and resistances. It will show when there is a break in a wire, a poor connection, low or high resistance, etc. A little help from a teacher at the high school or technical school will show you what all you can test with it. The cheap ones are as low as $15 and you really don't need to spend much more, but get one with a range of 1-1000 volts or more, resistance up to 100,000 ohms.

Baling wire is very handy around the shop. No kidding! A strong steel wire can be used a lot of places. You also need a smaller steel wire for fastening things that don't need held as strongly. Come to think of it, you also need ropes and cords; I've found that nylon straps work great. Buy 100 feet of various sizes.

A general supply of **nuts, bolts, washers** is valuable. If you dismantle something that has good like-new fasteners, save them; throw them in a bucket. I have three buckets- one for steel, one for brass, one for stainless steel. When you go looking in a bucket, remember that "if you find one, there is another." "If you find three, there are four". When you buy nuts, bolts, washers, **buy more** than you need and put the extras into your buckets. I promise you, you'll use them some day and it's handy having that supply right there in your shop instead of running to the store every time.

When you consider where to **pour something** remember, "you dump it, you drink it". Oils, antifreezes, solvents, anything like that- they should be disposed of safely and properly, not on the ground. Inquire where such can be left for proper disposal. Ask your city government, ask at Wal-Mart, ask service stations, ask the businesses that change these oils and other fluids.

When **you drain out good-looking fluids** such as oil, antifreeze, brake fluid, hydraulic fluid, you can be cheap and keep them for reuse.... but you really won't save anything because they usually carry contamination (such as grit) that you don't want in your final work. You can be penny-wise and dollar-foolish; you can save $2 on used oil and lose a $100 dollar crankshaft. Collect and properly dispose of them.

A lot of repair parts can be found in a "**tractor store**" or "**farm store**" near you. Mine is Bluestem Farm & Ranch Supply and they claim "If we don't have it, it's probably not around". Find an old clerk in that store and ask him for what you need. You'll be surprised at what a 1950s or 60s tractor uses that may also fit your vintage auto.

A **complete record** of what you do is truly valuable for many years to come. You got that digital camera to take pictures. Completely document where you start, what you do to take it apart, and what you do to put it back together again. Get a "memory stick" or "zip drive" for your computer and store the pictures on that along with the computer memory. No computer?- borrow a friend's for the transfer.

Safety is an important part of your shop work. Get some instruction on how to handle small problems and keep a good supply of Bandaids and other bandage materials, antiseptic cream, some popsicle sticks and medical tape. It is also useful to keep a small supply of aspirin or Tylenol, and even a few Darvon tablets (that's heavy duty industrial-strength pain medication) just in case of a serious misfortune. If you do not have a regular phone in the shop, try to keep a mobile phone handy "just in case". Know how to use it.

Your shop needs lots of **storage space**. I built strong shelves along two walls of my garage that will hold many boxes "of". These shelves will also hold many plastic containers of parts. You can get these containers with lids at most home-supply stores. You can also store parts in the zip-lock type bags but those tend to cover over each other to where you lose track of what is in them. Start with a general storage area to hold these containers, then move them to their own item-area as you fill them with specific parts, labeled with both a name and a locator number. Store these identities in a record book so you will know where to find them. You need boxes on these shelves. Get regular-sized boxes such as boxes that typing paper comes in. The heavier the box, the longer it will last. It should also have hand holes for lifting.

Looking more at these shelves- it seems silly to express it this way, but you will use high shelves for light and bulky items such as upholstery or insulation materials. Keep a stable step ladder to reach the top shelves. As you use the ladder, don't over-extend your reach because a fall can ruin your whole day. Use a ladder with rubber feet that will not slip on the floor. Also, you will put heavy items at the low levels. Make wood supports for holding heavy items like transmissions off the floor. Big containers of solvents can go on the floor. Never place anything higher than to what you can comfortably lift up or down because there is work in that lifting and they can also fall back down to the floor and break. Finally, arrange lighting fixtures to supply enough visibility to all these shelves. Flashlights won't do the job, but keep them around.

Floor covers are handy. Sometime you're at a sale of picnic supplies, look for a 2 to 3 foot wide roll of paper to roll out on the floor under the car. This will show where the drips & drops are coming from. A cloth cover can be laid over the paper to catch those drips of greater volume. Use it to cover the workbench if you need a clean surface there. Use it to cover parts that need protected from the atmosphere in your shop (think: "paint overspray and dust"). Another material that will serve the same purpose is an old bed sheet- look for them at home auctions and yard sales. Something about these covers to remember- don't reuse them if they pick up much dirt, dust, drips- you'll contaminate what you try to cover. Fender covers will help protect your fenders and flat panels. They're just good insurance.

Wiping rags are really useful. You'll use a lot of them. Go to a home auction to buy sheets, pillow cases, towels. Check what the Salvation Army thrift store has for sheets & blankets. So what if they're nice.... Your auto is nicer. After you use them ONCE, you can just throw them into the trash and wave goodbye.

SAFETY

This chapter is looking at many of the UNSAFE situations involved with automotive work. I do not claim to "have all the bases covered" here, but some of the thoughts here should catch you attention. After all, the main reason you're working on this project is to complete the restoration of your automobile. And if you have a serious accident, if you have a fatal accident, you won't get it done! Some of the thoughts here are also covered in other chapters but it's worth repeating them and putting them all together.

First of all, as I've said before, jacks are widow-makers. **Jacks are made for lifting**, not holding or supporting. They fall over, they collapse, they catch fingers or hands or legs. If you have to lift your auto, you probably will use a jack but just remember- while it's up, don't get under that car! If you have to work on the car, be sure you are outside the perimeter of the car, not under it, **not under any part of it** unless it is supported. Once you lift the car, you can put supports under it. Again, I strongly recommend heavy and strong wood blocks. You can best support a car by using square **wood beam** pieces. I suggest using 12 to18 inch length pieces of 4x4, 6x6, and 8x8 square post pieces. A few pieces of 1x6 and 2x6 of the same length may be useful. Metal handles can be screwed onto the pieces of wood for easy handling. Do NOT use cement blocks or bricks- those will damage the metal that they contact and they may also shatter with too much weight applied.

There is a type of automotive support called an axle stand. It has four legs and an extendable shaft in the middle. You've seen then. Unless you have heavy and big strong ones, don't use them- they can fall to a side and allow the car to fall on whatever, whoever is under it. And if you use them, be sure they are either setting on a cement floor or on a large strong metal plate as a platform.

Most of the cars sold in the time period we are involved with used bumper jacks. These have a tendency to fall or slip to the side and if you're on the side the car falls to, you'll get caught. The worst thing about these jacks is that they scratch the fine chrome of the bumper but that's not a safety point. I will suggest that you keep the original bumper jack only as an ornament. Put it in the trunk only if you want to show that you've got the original. Get a low-lying hydraulic jack for lifting the car. Use that for the lift and then immediately put wood blocks under the car to support it safely. Hydraulic jacks tend to sink into the ground if you're not parked on cement or pavement. Get a piece of ¼-inch aluminum sheet of dimensions at least ½ foot wide and 1½ feet long. Lay that on the ground and then put the jack onto that. Remember, however, that the jack will still have a possibility of scooting across that metal sheet; but it won't sink into the ground.

All the tools you use have safety hazards. When using a tool that has a handle you pull or push on, always try to use it by pulling. When you pull, you have more control, and if something slips, you have more ability to stop pulling than you will if you are pushing. Pay attention to what is around the handle of the tool so that if it moves suddenly, you hands or arms will not hit something hard or sharp.

Tools that have sharp edges or points have those for a specific purpose. Remember that if such a point or edge is to cut metal, it will also cut skin. Such a point or edge needs to be sharp so that you don't have to hit or move it with a lot of force because the greater the force, the more likely it is to bounce off its target.

Drill bits have sharp edges so they will actually cut into metal. The duller they are, the harder you must push to make them cut into the target metal. And the harder you push, the more likely they are to slip off and hit your hand. Keep them sharp.

A good grinder helps you smooth or control the shape of an object. Some people prefer a grinder wheel on a motor shaft; some prefer a sanding belt-type grinder. You need to get experienced with both types to know which fits your needs. Remember that a grinder will even remove very hard steel; think of what it will do to soft skin on fingers and knuckles. It will also help your vocabulary.

Every mechanic has a hammer. Probably several. Richard Lentinello of Hemmings Motor News says "One of the most important tools that every old car guy must own a generous selection of, is the hammer. The hammer is one of those tools that you just can't work without." And when you are swinging a hammer that weighs 2 or 3 pounds, the slightest miss can lead to mashed fingers and hands. I've seen it and some of those smashes can be terribly disabling (a wife of a mechanic friend was laid up for a year with a broken hand). You need to have hammers for the right job and know how to swing them without missing. There is one thing about hammers you may not have noticed- most of them are ground with the face somewhat rounded and smoothed. And old mechanic experienced in percussive maintenance once showed me how the rounded face will cause the hammer to glance off its target. He suggested to me that you should grind the face of a hammer flat, and grind it that the scratches should cross the face side-to-side so that the hammer won't slide across its target. That makes sense to me. I will leave you with the suggestion to consider grinding your hammers; it works for me.

Manufacturers always seem to give you the warning that the head of a hammer can shatter and throw shrapnel. I've never seen it but that's not the point. I will also leave you with the suggestion that when you are using a hammer for a hard hit, you probably should be wearing a safety goggle. It's insurance. You never need insurance until the event actually happens and by then, it is too late. 'Nuf said?

Most of the solvents you use in the shop have a medical hazard associated with them. Even something as innocuous as "alcohol" is hazardous. Most solvents breathed into your lungs will be absorbed into the blood and they will act similar to an anesthetic and depress your capability to work safely. These include hydrocarbons (petroleum solvents), ethers, alcohols, and good scotch. Not only do they affect your brain, they can also affect your liver and kidneys and continued destruction of those tissues can lead to medical problems. As a trained chemist, I can assure you that it's best that if you are using anything you can smell, you should have a well-ventilated shop to exhaust those vapors. Many paints have components and solvents that actually react with your body tissues causing severe damage. These paints include the "polyurethane" types and those may require a breathing apparatus that will actually absorb the vapor from the air you breathe.

Safety as an important part of your shop work includes first aid. Get some instruction on how to handle small problems and injuries. Keep a good supply of Bandaids and other bandage materials, antiseptic cream, some popsicle sticks and medical tape. It is also useful to keep a small supply of aspirin or Tylenol, and even a few Darvon tablets (that's a heavy-duty industrial-strength pain medication) just in case of a serious misfortune. If you do not have a regular phone in the shop, try to keep a mobile phone handy "just in case". Know how to use it. Keep a posting of phone numbers of medical service for your shop personnel and for yourself. Post the phone numbers for emergency service, fire service, mechanical services so that anyone around can make the call even if they are not a part of your regular shop help.

Jewelry is dangerous around the shop. All metallic jewelry (rings & bracelets) conduct electricity. I've heard of people touching a ring between a battery cable and the frame and burning off a finger. Jewelry also gets caught on things and it jerks or pulls the hand into something moving. It just ain't worth it! She doesn't need proof you're still married. When I worked in a chemical lab, I never wore jewelry because it could also catch corrosive chemicals and conduct them to skin to cause a serious chemical "burn". Spilled corrosives need to be cleaned from the skin where it spreads and damages. If you have a hand washing sink, keep good mild soap at the sink for washing. Keep a dispenser of baking soda (sodium bicarbonate) to neutralize acids. If you don't have a washing sink, keep a good mild hand cream for scrubbing spills. You can buy a good hand cream at the automotive stores and they also sell a wall-mounted dispenser. I've found a suitable substitute is a "vitamin-E lotion" in a 1 pint plastic bottle with dispenser already built in. It will help dissolve greases and tars from your hands and then it almost wipes away with a paper towel. Get it at Wal-mart or K-mart for a couple dollars per bottle.

If your shop has water service, keep a water hose with a spray nozzle at the "ready-on" setting. If a spray is needed, it will instantly come to life. If you do not have water service, keep a 2 or 3 gallon sprinkler bucket filled with water. Put a little baking soda in that water as an acid neutralizer.

In a similar need, you should have fire extinguishers around the shop. I think most people suggest the type designated 5 or 10 pound ABC-type. Those are supposed to work on all fires. I'd also recommend asking for a visit by the friendly folks down at the **Fire Department**. If you're really serious about safety, ask them to come and have a good look-around to give you their recommendations. Alternatively, keep a verrry larrrrge insurance policy on liability and contents.

Any time you do significant work on the electrical system, it will be safest to disconnect the battery so that everything is "dead" and safe because a "short" can burn out important switches and circuits. Disconnect at the battery**: first unbolt the ground cable at the battery.** Yes, first! After that, you can disconnect the "hot cable" or any other wires; not the other way around. After disconnecting, you can clean the cable ends with a wire brush or with a round file or emery paper. Likewise, clean the battery posts. After all are cleaned, you can connect the hot cable and tighten it. Then at any later time, **connect the ground cable last**. Get it right- **d**isconnect **g**round cable **f**irst; **c**onnect **g**round **l**ast; make and past a label: **"DGF-CGL"** means **"disconnect ground first; connect ground last".**

Finally- this writer also publishes a little 8-pager on **automotive shop safety**. It has a very modest cost: 2 postage stamps. It is my effort to encourage and explain safety around the automotive shop. It is **not copyrighted** and users are encouraged to copy it and spread it around for groups to discuss safety in the shop. Write me at: James Hill, 1419 College Drive, Emporia, Kansas, 66801

If you get involved with rear brake repairs, you will be getting into the same parts and locations as differential repairs. At this time, pay especial attention to the rear axle bearings and seals. Just like in the transmission, if you're "in there" already, replace those bearings anyway. By doing that, you'll probably never have to replace them again and in the same way, when you're out on the road, you'll know you don't have to worry about those bearings. You can spend $25 a wheel now or you can spend $100 and two days of waiting out on the road some time. It's your call....

One more piece. The drive shaft probably has bearings at the front and at the rear. They get greased with a grease gun (a pressure lubricator), the same as used on other suspension fittings. If bearings are old, figure on replacing them. There are two types, one is an "X" type that is fairly industry standardized and easy to replace. The other is a large "cup" type that is hard to replace. But it still needs the care. You may have to take the shaft to a shop to have this one replaced if you can find the replacement. If you don't do it, you will be left out somewhere when the whole unit comes apart while driving, and you may have to replace more than the bearings. Read this at-home job as $, and the on-road job as $$$$.

SCAM WARNING SCAM WARNING

In the past years there have been continual warnings published in Hemmings Motor News and other publications to the hobby about scams going on. You should know, fully, whats-a-haps.

In some cases, people have offered for sale parts that they do not have. They take your money and simply never send them. If your purchase is small (a hundred dollars or so), you have almost no possibility of getting anything back. A larger purchase might get a weak effort by local police (yours or theirs). In some cases the parts are much lower quality than what is advertised [advertised: "NOS", delivered "poor" to only "good"]. Again, you probably won't get much help getting your money back. My suggestion is to try to find someone you know who is near to the purchase location, to have them actually look at the parts and confirm what it is you're buying. Be cautious about buying from someone you've never heard of. In addition, a car-club membership is little insurance; anyone with felonious intent can easily join a hobby group. But it gives you a group within which you may be able to find helpers or people who know the sellers.

Sometimes good to high quality cars are being offered for sale and again either the quality is lower or the vehicle is never delivered. The higher the investment the more you need an investigation service to check out and appraise the merchandise and the sale. On high value purchases, you might also consider using an "escrow service" through a bank where the money is held until both seller and buyer release it. Talk to your bank. It'll cost you a little but you may save a lot! If at all possible, go see the car yourself before you complete the sale! But know that the seller might not be willing to accept your check.

A third scam is where someone will purchase something you have for sale, often with almost no inquiry of what it is or its condition, and offer your price. Eventually you receive a bank check, even "certified", often a large amount more than what you are to get, with request that you cash the check and send your own check for the difference to a third party. Know that such a check should be considered "no good" until it finally clears the issuing bank and some such checks are frauds. While you may not have sent the parts yet, if you send your refund check, the receiver gets it and cashes it, and you might be out a large amount of your own money because when that first bank check comes back to your bank as "bouncy-bouncy", you don't get paid. Work with your banker here and be sure that your bank can **confirm that the check has cleared** before you release the parts or send any refunds. Don't be in any hurry to complete the purchase; a legit buyer should understand and be willing to work with you. Be concerned about people "in a hurry".

It's getting to where you just don't know whom you can trust. Sure, some of the big dealers may charge more than a small one-time advertiser, but you can be more sure you'll get the parts and the parts will probably be right. (Although, long in the past I had dealings with two big dealers in the east, one of whom never shipped and the other shipped poor merchandise. No names will be told, though, because one died over 15 years ago and the other is in a different business now.)

In the past I have bought and sold a lot of parts and some cars through national advertising and never had any significant problems. But now, things are getting more questionable. I think now I'd be afraid to buy or sell a car or expensive part to the public; I don't know what I would do! Be careful. Know who your are dealing with and what you are buying. If it's valuable, "cash" is safest if you can arrange it in person.

Know that Hemmings Motor News keeps a service for **consumer problems**. She is **Mary Brott at HMN, POBox 256, Bennington, VT, 05201**, with e-mail at **mbrott@hemmings.com**. Phone **800-227-4373**.